Boffa Miskell

Waihi North Project

Terrestrial Ecology Values and Effects of the WUG

Prepared for OceanaGold (NZ) Ltd

WAI-985-000-REP-LC-0007. Rev 0

20 February 2025

This document has been produced for New Zealand consenting purposes only. Information contained herein must not be relied on for investment purposes.

TOITŪ CARBON ZERO ISO 14064-1 ORGANISATION

Boffa Miskell is proudly a Toitū carbonzero® consultancy

Document Quality Assurance

<table>
<tr><td colspan="3">Bibliographic reference for citation:
Boffa Miskell Limited 2025. Waihi North Project: Terrestrial Ecology Values and Effects of the WUG. Report prepared by Boffa Miskell Limited for OceanaGold (NZ) Ltd.</td></tr>
<tr><td>Prepared by:</td><td>Katherine Muchna
Senior Ecologist - Principal
Boffa Miskell Limited</td><td></td></tr>
<tr><td>Reviewed by:</td><td>Sarah Flynn
Senior Ecologist - Principal
Boffa Miskell Limited</td><td></td></tr>
<tr><td>Status: Final draft</td><td>Revision / version: 3</td><td>Issue date: 20 February 2025</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Template revision: 20230505 0000

File ref: WAI-985-000-LC-0007

Boffa Miskell 2024 - Waihi North Project - Terrestrial Ecology Values and Effects of the WUG_FINAL.docx

Cover photograph: Willows Road Farm, 2021

Executive Summary

The Waihi North Project (WNP) comprises several components to expand the Waihi operation including a new open pit (Gladstone Open Pit) and one new underground mine, Wharekirauponga (WUG). This report provides an ecological assessment of the terrestrial components associated with the WUG only.

The Project Site for the WUG includes two discrete areas, Willows Road Farm where the portal and supporting surface infrastructure will be located, and Coromandel Forest Park where exploration drill sites, pump sites, and ventilation raises will be located.

Willows Road Farm

The primary effect associated with Willows Road Farm activities is the loss of low value vegetation (0.25 ha) and potential fauna habitats that vegetation provides within the project footprint. As part of the integrated mitigation package, OceanaGold New Zealand Ltd (OGNZL) proposes to revegetate approximately 0.56 ha of the available onsite riparian areas for ecological and landscape mitigation purposes. The remaining effects (construction noise and discharges to air) will be minimised through engineering design and site management processes. The level of effects with mitigation and management measures on Willows Road Farm range from Low to Very Low.

Coromandel Forest Park

The primary effect of the Project within Coromandel Forest Park is the temporary loss of vegetation / habitat (0.66 ha) at the proposed exploration drill, pump test and vent raise sites and impacts on fauna that occupy those areas. These effects will be minimised by staged fauna salvage and translocation to a prepared, intensively pest controlled release site and remediation of the cleared sites (post-drilling / mining). The temporary loss of vegetation area will also be offset by replanting and facilitating the natural regeneration of an approximately 27 ha area on the north east ridge and entire forest boundary at Willows Road Farm.

Additional potential ecological effects associated with WUG include disturbance to fauna from artificial lighting, drilling and helicopter noise; continuous noise emissions from the vent raises; and the potential to introduce kauri dieback disease into the forest environment during works. These effects are localised, temporary and immediately reversible upon completion of works.

Activities in exploration drill, pump test and vent raise sites occupy a very small area within the context of the forest and we consider that the majority of these effects can be minimised to a low level of effect using a combination of avoidance measures; careful remediation; engineering and design solutions; site management and timing; and testing, cleaning and surveillance practices to prevent kauri dieback introduction and spread.

There is an anticipated low (but uncertain) risk for this project to generate residual adverse effects on Archey's and Hochstetter's frogs from water vapour and air discharges from the vent raises and the surface expression of blast vibrations. The primary compensation measure to address these potential residual effects is wide scale intensive pest control over an area of 633 ha, including 314 ha exposed to vibration levels greater than 2mm/s and 318 ha immediately adjacent. Compensation in the form of research funding is proposed to enable the investigative work within the WUG and wider

Wharekirauponga Animal Pest Management Area to assess efficacy of pest control regimes for frog recovery.

Within the wider WNP we have adopted an integrated effects management strategy that has sought to provide consistency and cohesion between ecological mitigation and landscape mitigation planting, so that the revegetation proposed for both forms of mitigation is similar in composition and structure, and in the same key locations, provides linkages between these locations, and connects vegetation and freshwater environments, which will benefit biodiversity throughout the proposed project footprint whilst also providing benefit from a landscape and visual perspective.

In line with the intention of OGNZL, we have sought a net gain in biodiversity and ecological value through the application of the effects management hierarchy and a demonstration of enhanced connectivity is part of this net gain.

In our assessment, the effects of the Project on terrestrial ecological values are minimised to the extent possible through design and management processes; and offset / compensation is provided where appropriate.

CONTENTS

Appendices

Figures

GLOSSARY

The table below sets out the defined terms and acronyms used in this document.

Term	Meaning
Canopy	Tallest layer of the forest
CFP	Coromandel Forest Park
Collection Pond	A pond for the purpose of gathering and retaining run-off water until it is in a state suitable for discharging to the surrounding environment. This may include settlement, treatment, and interception/removal of hydrocarbons
Cryptic species	Species camouflaged and adapted for concealment in their habitat
Construction works	Activities undertaken to construct the Project
DOC	NZ Department of Conservation
Earthworks	Excavation and/or placement of cleanfill to change the contour or level of a site or part of a site (HDC)
Ecological District (ED)	A particular geographical region that has a characteristic landscape and range of biological communities
Edge effects	Changes in population or community structure that occur at the boundary between two different habitats
FAR	Fresh air raise providing fresh air to the mine ventilation system
GOP	Gladstone Open Pit
GOP TSF	Gladstone Open Pit converted to a tailings storage facility following the end of mining
HDC	Hauraki District Council
HDP	Hauraki District Plan (2019)
LENZ	Land Environments of New Zealand
LINZ	The Government Land Information Service of New Zealand
LoM, LoMP	Life of Mine Plan, Plan for the Life of the Mine

Term	Meaning
Mitigation package	A collective term used in this report that includes all aspects of the ‘mitigation hierarchy’
MUG	OGNZL’s existing Martha Underground Mine
NAF	Non-Acid Forming: Rock that does not contain elements which may oxidise (weather) to form water soluble compounds capable of forming an acid
NRS	Northern Rock Stack
OBDA	Overburden Disposal Area
OGNZL	Oceana Gold (New Zealand) Limited
PAF	Potentially Acid Forming: Rock that contains elements which may oxidise (weather) to form water soluble compounds capable of forming an acid.
Plant Access Tunnel	A decline connecting the OGNZL Waihi processing plant area with the dual tunnels commencing at ventilation shaft 1 on Willows Road Farm largely for the transportation of ore and rock to and from the WUG mine.
Paper road	HDC legal road reserve: a legally-recognised road that is undeveloped or partly formed, but provides public access to a particular area or feature. The paper road for the WNP refers to a corridor that ranges in size from approximately 15 m – 150 m wide within Coromandel Forest Park that is owned by the local authority (HDC).
PAMP	Pest Animal Management Plan
Processing Plant	The plant and associated infrastructure required to extract the gold and silver from the ore
Project area	The area within the proposed project footprint, and immediate surrounds to the extent Project works extend beyond this footprint.
RAR	Return air raise exhausting ventilation air from the mine.
RECCE	RECCE plot methodology is the collection of vegetation data within a 20 x 20 m plot (Hurst & Allen, 2007).

Term	Meaning
Significant Natural Area (SNA)	Areas of significant terrestrial indigenous vegetation or significant habitats of indigenous fauna located either on land or in freshwater environments identified in District Plans. SNAs are assessed using the criteria for determining significant indigenous vegetation and significant habitats of indigenous fauna contained in the Waikato Regional Policy Statement, and nationally recognised criteria. The sites are identified on the planning maps and are listed in the schedule at the end of Section 6.2 as Significant Natural Areas.
Site	A habitat assemblage within the Project area identified and assessed by the Project team.
Terrestrial	Land-based (i.e. terrestrial vegetation, terrestrial fauna).
Torpor	Decreased physiological activity in an animal, usually by a reduced body temperature and metabolic rate.
Vent Raise 1	A ventilation shaft located on the Willows Road Farm. Located close to Department of Conservation land on the western boundary of the property.
Vent Raises 2-5	Ventilation shafts located within the Department of Conservation controlled Coromandel Forest Park.
WAA	Wildlife Act Authority
Willows Access Tunnel	A decline connecting the WUG Surface Facilities Area with the dual tunnels commencing at Vent Raise 1.
Willows Portal	The access portal to the decline tunnel from the WUG surface facilities, located at the end of Willows Road, Waihi.
Willows Road Farm	A farm property of 197 hectares located at the end of Willows Road, Waihi, on which surface infrastructure and a portal will be constructed in support of the Wharekirauponga Underground mine
WRC	Waikato Regional Council
WRPS	Waikato Regional Policy Statement
WNP	Waihi North Project
WTP	Water Treatment Plant

Term	Meaning
WUG	Wharekirauponga Underground Mine component of the WNP
WUG Portal	The entry/exit to the ore handling tunnel at the Waihi Processing Plant
Willows SFA	Surface Facilities Area located on farmland at the end of Willows Road to service the new Wharekirauponga Underground Mine

1.0 Introduction

1.1 Background

Oceana Gold New Zealand Limited (OGNZL) has engaged Boffa Miskell Limited (BML) to prepare an Assessment of Ecological Effects for the Wharekirauponga Underground Mine (WUG) elements of the proposed Waihi North Project (WNP, the Project).

The current Waihi life of mine plan (LoMP) is to complete production by the end of 2030. Study work conducted between 2016 and 2020 identified opportunities to expand the Waihi operation with one new open pit and a new underground development beneath Wharekirauponga, within Coromandel Forest Park. The WNP will integrate these new developments with OGNZL's existing mines and existing and consented mining infrastructure.

The WNP comprises several elements, including:

- a new underground mine and associated facilities (Wharekirauponga Underground Mine or WUG);
- a new open pit (Gladstone Open Pit, GOP);
- a new tailings storage facility (TSF3);
- a new rock stack (the Northern Rock Stack, NRS).

BML has worked with OGNZL and the consultant team to avoid, where practicable, and minimise impacts on the ecological values throughout the project design.

1.2 Approach

The assessment of ecological effects undertaken for the WNP project is presented in three separate reports:

- This report covers the terrestrial ecology assessments for the WUG component of the WNP, including works within Coromandel Forest Park and Willows Road Farm (refer Figure 1).
- The freshwater ecology assessment for the whole of the WNP is presented in Boffa Miskell (2025a).
- Terrestrial ecological values and effects of the development of GOP and associated components of the Project (TSF3, NRS, and Processing Plant) are presented in Bioresearches (2025a).

All the above reports use Environment Institute of Australia and New Zealand (EIANZ) impact assessment guidelines (Roper-Lindsay et al., 2018) as a framework to assess ecological values and significance, and the magnitude of the project's adverse effects on the site's ecological values.

The WNP takes an overall 'Nature Positive' approach to impact management whereby all potential impacts on biodiversity are mitigated / compensated / offset (as appropriate) to a level that a Net Gain is the expected outcome. Criteria for assessing ecological significance include those contained in the Waikato Regional Policy Statement (WRPS) (Waikato Regional Council, 2018).

1.3 Report Structure

This report is set out as follows:

Section 1	presents an overview of the project and our assessment approach.
Section 2	describes the ecological context, project location and detailed project description.
Section 3	provides an overview of relevant statutory matters.
Section 4	describes ecological survey and assessment methods, including effects assessment methodology.
Section 5	describes the ecological values of the Project Site and surrounding area and their significance with reference to the WRPS.
Section 6	describes and evaluates potential ecological effects.
Section 7	describes the integrated landscape and ecological approach
Section 8	outlines proposed approach to manage ecological effects.
Section 9	provides a summary and conclusion.

2.0 WNP Project Location and Description

2.1 Ecological Context

The Project is situated within the Waihi Ecological District (**Waihi ED**), in Wharekirauponga Forest which forms part of Coromandel Forest Park administered by the Department of Conservation, and on adjacent farmland northward of Waihi township.

The largely forested northern half of Hauraki Ecological District encompasses the southern portion of the Coromandel Ranges, and its landforms are derived from volcanic rocks overlying Jurassic siltstone, sandstone and conglomerate, with long ridges, steep and broken hillslopes and deeply incised streams.

The bioclimatic zone is lowland to submontane ((Kessels & Associates, 2010) and the climate is typically mild, humid and wet with c. 20°C average temperatures through the warmest month (February) and c. 10°C through the coolest (July). The area periodically experiences both summer droughts and episodes of very high rainfall. Average annual rainfall is between 1400 and 2800 mm depending on elevation, mainly during winter, while localised, heavy falls can occur at any time of year.

Pollen records from sites in the central and southern Coromandel Ranges indicate pre-human forest were likely to have comprised mixed podocarp-hardwood forest similar to that which dominates the Coromandel Ranges today, likely with emergent rimu and northern rata above a canopy containing kauri, podocarps and mixed broadleaved trees (e.g., maire, rewarewa, pukatea, puka and nikau). These forests appear to have existed for at least a millenium (c. 1800-800 yr BP) without major changes (Byrami et al., 2002).

Polynesian forest clearance around 800-700 BP likely occurred as localised, discrete fires, with evidence of subsequent succession through shrub associations to old-growth forest comparable to the original assemblage (Byrami et al 2002).

In contrast, European-era pollen records indicate European occupation coincided with sudden and extensive loss of forest cover, which aligns with kauri logging operations of the late 19th and early 20th centuries. Much of the land on more moderate terrain and altitude was subsequently converted to pastoral farmland, such that lowland alluvial podocarp forest is reduced to small remnant examples, while swamp forest remnants containing swamp maire are present but rare (Kessels & Associates, 2010). The more challenging terrain of the central Coromandel Ranges has largely reverted to indigenous forest cover.

Modern forest assemblages comprise variations of warm climate conifer-broadleaved forests, with species dominance principally determined on the basis of disturbance history, drainage and altitude (Singers and Rogers, 2014). Remnant areas of mature secondary kauri-podocarp-broadleaved forest are interspersed among early- to mid- successional assemblages including kanuka, kamahi and towai- dominant forest and shrubland with emergent pole-sized podocarps, rewarewa and other broadleaved trees. The dominance of pioneer forest species makes these communities resilient to disturbance as gaps are quickly recolonised with native plants.

Forest within Waihi ED broadly conforms with the WF11 forest ecosystem unit (kauri, podocarp, broadleaved forest) described in Singers and Rogers (2014), though extensive kauri logging has altered the forest succession in some areas to resemble the WF13 ecosystem unit (tawa, kohekohe, rewarewa, hīnau, podocarp forest) that more characteristically occurs beyond the southern distributional limit of kauri. Weedy exotic plants are generally uncommon within the interior of forested areas, though plants associated with historic attempts at agricultural conversion (broom, gorse, pampas, pastoral grasses) persist in open sites and on forest margins, while wilding pines are present among some areas of more recent manuka – kanuka scrub, in fairly local patches where seed sources (single trees or small plantations) are present.

The land surrounding the existing Waihi mine operations is typically low-lying with some rolling hills and small ridges. Excluding the Martha Pit, most of the area is in rural production (grazed pasture with some areas of plantation pine), with patches of native vegetation and low-density rural dwellings. Weed infestations are more frequent and varied around settlements, primarily originating from ornamental 'garden escapes', and these have encroached into the margins of Coromandel Forest Park in places.

As a voluntary initiative (not part of any regulatory or land purchase requirements), OGNZL (and the former Waihi Gold) undertook approximately 35.31 ha of revegetation across the existing Waihi mine site and surrounding areas between 1995-2016 (Figure 4), with 455,400 plants planted. Of these plants, 206,541 were identified as 'riparian' plantings, 14,379 were identified as 'swamp', and 41,805 plants as 'gully' plantings.

The location of these plantings includes TB1 Stream and a number of associated wetlands, Eastern Stream, and the lower reaches of the Ruahorehore Stream and tributaries (Figure 4). These plantings have improved the ecological value and function of these watercourses and wetlands.

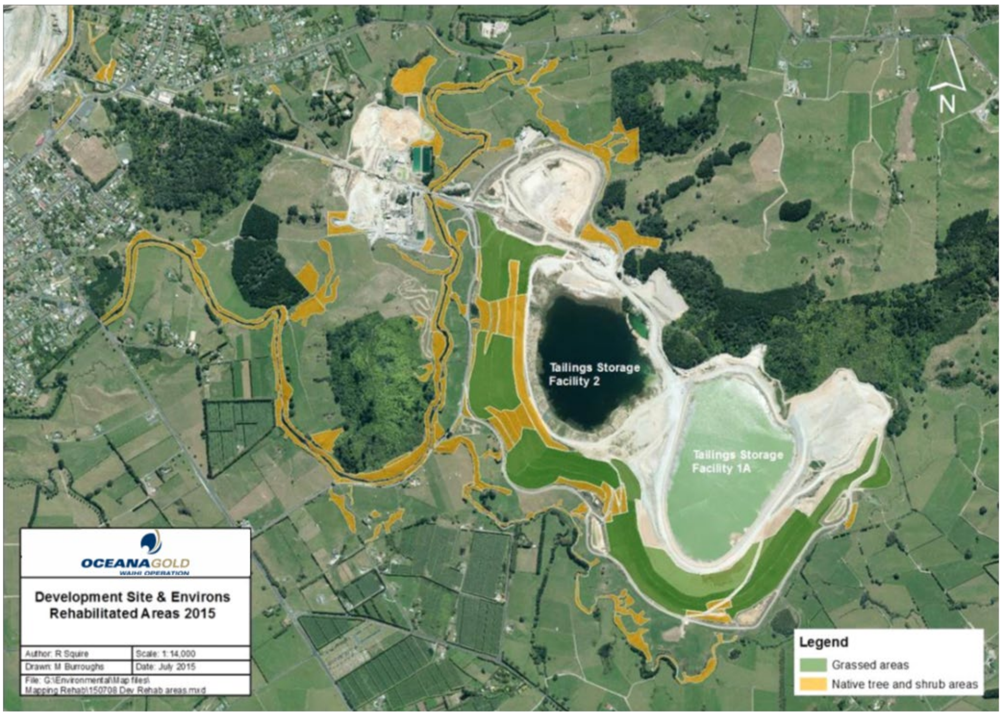


Figure 1: Revegetation plantings around Waihi town.

2.2 Project Location

OceanaGold's Waihi operations are located within the Waihi township, near the east coast of the North Island of New Zealand. Operations currently consist of the Martha Open Pit and the Correnso, Slevin, Favona, Trio and Martha Underground mines.

The proposed footprint of the surface works for the WNP is set across seven areas of works (Figure 2), including within Coromandel Forest Park and adjacent rural land in the Hauraki District, with access from State Highway 25 (SH25).

The land surrounding the current mining operations (mainly zoned Martha Mineral Zone) is predominantly pastoral farmland, with the exception of the Martha Pit which is surrounded by residential, low-density residential and town centre areas. Proposed surface works not located within the existing Martha Mineral Zone are largely located within the Rural Zone (refer to the Hauraki District Plan).

The WUG is located under the Coromandel Forest Park, within the Mataura, Ramarama, Waiharakeke and Wharekirauponga catchments. The WUG is located south of Otahu Ecological Area and is a typical example of Coromandel forest gazetted as reserve in 1976 for conservation and research.

The Willows Portal entrance and Willows Surface Facilities Area (Willows SFA) are located at Willows Road Farm, a property encompassing 197 ha of rolling to steep pastoral land approximately 5 kilometres north of the Waihi township (refer Figure 2).

The Project Area is accessed from SH25 at the foothills of the Coromandel Ranges.

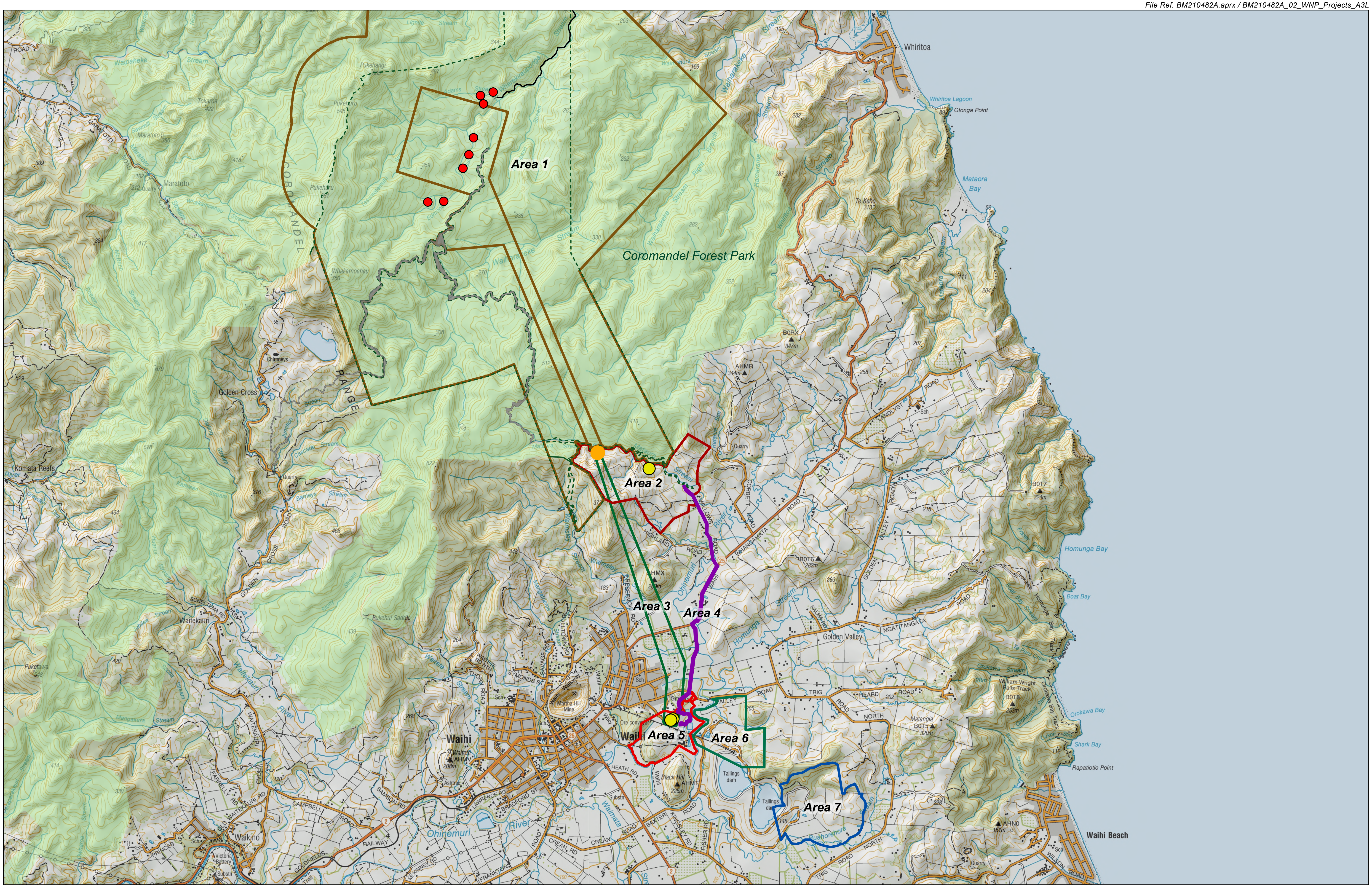
2.3 WNP Project Description

The WNP provides for two mining operations, sufficient surplus rock storage and tailings disposal areas and sets appropriate closure criteria. Establishment of a new Surface Facilities Area near the Willows Road portal will be required to support the tunnelling and subsequent mining at Wharekirauponga. A new portal for ore delivery and rock return will be constructed close to the existing Processing Plant for servicing the Wharekirauponga Underground mine via a tunnel extension from the Willows Road vent raise 1 site (underground). Details of the Project are provided in the Assessment of Environmental Effects (Mitchell Daysh 2025).

As set out above, the WNP comprises several components (Figure 2):

- A new underground mine, Wharekirauponga, located approximately 11km north-west of the existing Processing Plant and under DOC-managed land (Coromandel Forest Park). Site infrastructure supporting the mine will be located on OGNZL owned farmland located at the end of Willows Road (Figure 2). The underground mine would exhibit only minimal surface features, including exploration drill sites and fenced vent raises (Figure 3);
- The mining of a new open pit near the existing Processing Plant, centred over Gladstone Hill, the Gladstone Open Pit (GOP). This pit will be converted to a tailings storage facility on completion of mining;
- A new tailings storage facility to the east of existing TSF1A, called TSF3;
- a new rock stack, the Northern Rock Stack (NRS) at the Northern Stockpile area adjacent to the existing TSF2; and
- Changes to the layout of the existing Processing Plant to enable ore processing up to 2.25 million tonnes per annum (MTPA), up from 1.25 MTPA currently.

File Ref: BM210482A.aprx / BM210482A_02_WNP_Projects_A3L



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that they arise from inaccurate information provided by the Client or any external source.

0 1 Km

1:60,000 @ A3

DRAFT

Data Sources: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Vent Raise 1
- Tunnel Portal
- Indicative Drill Site Locations
- Wharekirauponga Walk
- Area 1: Wharekirauponga Underground Mine
- Area 2: Willows Road Farm
- Area 3: WKP Underground Access Tunnel
- Area 4: Services Trench Corridor
- Area 5: Gladstone Open Pit
- Area 6: Northern Rock Stack
- Area 7: Tailings Storage Facility 3
- Coromandel Forest Park
- Paper Road
- Access Arrangement Area

WAIHI NORTH

WNP Projects

Date: 18 February 2025 | Revision: 4

Plan prepared for Oceana Gold by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: HCo | Checked: KMu

Figure 2

2.4 WUG Project Activities

2.4.1 Overview and Staging

Activities associated with the WUG will be staged to align with the required work programme:

Stage One: Activities required to:

- Establish / drill the Willows Access Tunnel decline;
- Establish / install infrastructure associated with the Willows Access Tunnel, including the Willows Portal, and the Willows SFA;
- Upgrade the existing Water Treatment Plant (**WTP**), and renew the discharge permit for the WTP to cover the term of the WNP; and
- Support WUG mine resource investigation and exploration progression in Coromandel Forest Park.

Stage Two: Activities associated with the wider mining and production activities of the WNP; and

Stage Three: Two-years of mine remediation and closure activities.

2.4.2 Coromandel Forest Park

The primary project elements associated with the Coromandel Forest Park land will be located underground and comprise a dual decline tunnel and the mine.

Above ground elements located in conservation estate include exploration drill sites, and geotechnical drill sites to confirm tunnel alignment and/or location of vent raises. New and existing drill sites may be subsequently used for camps / messing facilities and helipads to service the drilling and mining operation. Exploration, geotechnical and vent raise sites may be located in the existing Access Arrangement area, or outside of it above the dual access decline. The total clearance area of the sites detailed below comprises 0.66 ha.

Exploration Drill Sites

Four additional drill sites at Stage One, and four additional drill sites at Stage Two for exploration drilling located within the AA Area (Figure 3). The drill sites would be sized the same as existing operations at a maximum disturbed area of 150 m^2 per site. Indicative locations for these drill sites are shown in Figure 3. The WNP proposes to reuse exploration drill sites as follows:

- Ability to use two drill sites as a helipad (four in total);
- Ability to have an additional four camps located on any drill site (six in total);
- Ability to install piezometers either in standpipes or grouted from any new exploration holes;
- Ability to conduct packer testing within any hole.

OceanaGold proposes to have a maximum of 6 operational exploration drill rigs at any one time. Water will be supplied by two additional proposed pump sites at a maximum of 600 m^3 per day.

Maximum number of operational sites proposed: 8

Maximum site extent / clearance area: 150 m^2 per site

Hydrogeological Drill Sites

Short term pumping tests are required to reduce uncertainty associated with hydrogeological modelling. To facilitate and conduct such a test requires the establishment of up to four large pumping test / vent sites ("pump test sites").

These sites will be located at either existing cleared pads or new sites within the Area 1 (Figure 2). All efforts will be made to use existing sites if they are deemed to be appropriate (which ensure any clearance requirements are reduced as far as practicable).

Sites will not be wooden platforms but instead levelled concrete pads which enable a raise bore rig and the ability to drill a larger diameter hole. Earthworks and retaining walls will be required to establish the flat pads. The total area for each pad would be 900 m^2 maximum (with the concrete pad size being 12x12 m, however the larger 900m^2 is required to accommodate potential steep gradients). All efforts will be made to reduce total clearance area as far as practicable. These large pumping test sites will ultimately become the vent raise sites.

As for exploration drill sites, OceanaGold proposes to conduct pumping tests, packer testing and install piezometers within holes drilled on hydrogeological drill sites.

Maximum number of sites proposed: 4

Maximum site extent / clearance area: 900 m^2 per site

Hydrogeological Piezometer Sites

Four sites are proposed for the purpose of drilling additional piezometer holes (also "pump test sites") to assist with pumping test investigation and/or other hydrogeological testing or baseline data collection. These sites will have a maximum disturbed area of 150 m^2 per site.

Maximum number of sites proposed: 4

Maximum site extent / clearance area: 150 m^2 per site

Geotechnical Drill Sites for Investigation

Up to four geotechnical drill sites are proposed for resource investigation purposes. These sites will have a maximum disturbed area of 150 m^2 per site.

Maximum number of sites proposed: 4

Maximum site extent / clearance area: 150 m^2 per site

Geotechnical Drill Sites for Tunnel Alignment

Four geotechnical drill sites are proposed within the tunnel corridor area contained within Area 1 of the WNP. These are in addition to the eight exploration drill sites. Geotechnical drill sites will have a maximum disturbed area of 150 m^2 per site. A water supply pump site will be located at the closest stream site for each of the geotechnical drill sites.

OceanaGold proposes to conduct packer testing and install VWPs or standpipe piezometers within holes drilled on geotechnical drill sites. OceanaGold further proposes to reuse one of the drill sites as a camp, and one drill site as a helipad.

Maximum number of sites proposed: 4

Maximum site extent / clearance area: 150 m^2 per site

<u>Geotechnical Drill Sites for Vent Raises</u>

To assist with locating / determining vent raise sites, OceanaGold proposes to undertake geotechnical investigations comprising:

- Man-portable rig drill investigations at up to 50 sites to determine suitable locations for vertical ventilation shafts[1].
- Four additional geotechnical drill sites at the preferred vertical ventilation shaft sites. These sites are the same locations as the four large pumping test sites (hydrogeological drill sites, described above).

OceanaGold proposes to install instrumentation such as extensometers or piezometers within holes for hydrogeological and geotechnical monitoring and testing.

Geotechnical considerations may require additional reinforcement of the vent raise collar, but the surface footprint will be limited to 30 x 30 m. Vent raises will be constructed at different stages of the mine life in response to resource extensions and mining schedules, and vent raises may be converted between intake and return (or vice-versa). Once operating, steam plumes may be visible from return air raise (RAR) discharges under certain climatic conditions (typically during winter and in periods of higher relative humidity). Once mining is complete surface infrastructure will be removed, and vent raise areas will rehabilitated.

Maximum number of man portable rig sites proposed: 50

Maximum site extent / clearance area: Minimal clearance (i.e. canopy trimming) and moving groundcover / leaf litter to accommodate the small drill rig.

Maximum number of vent raise sites proposed: 4

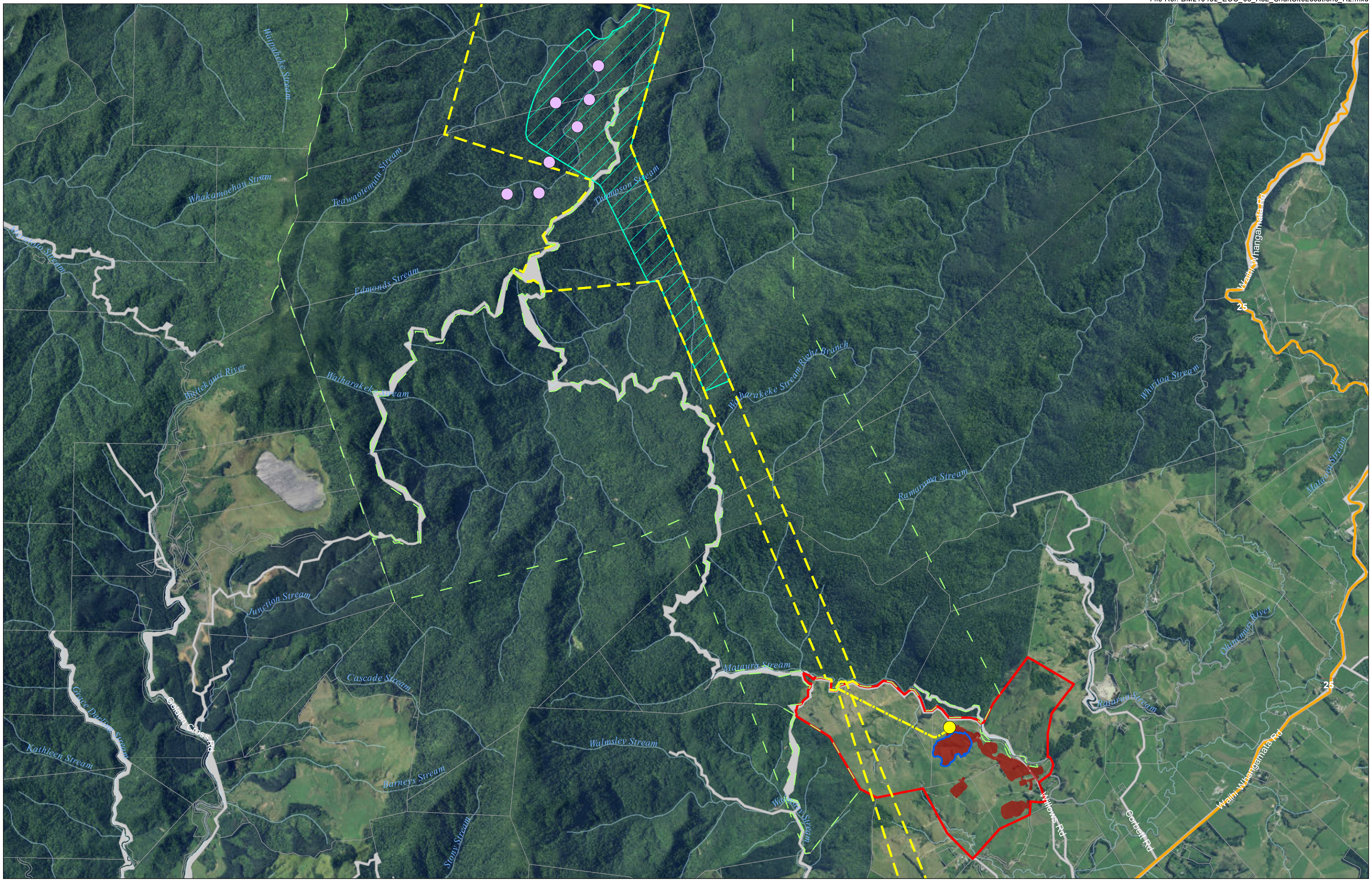
Maximum site extent / clearance area: no additional clearance. Vent raises will be located on sites previously cleared for hydrogeological drilling.

<u>Water Management</u>

Incidental, minor quantities of water emanating from the ground and/or from normal tunnelling operations will be drained to sumps within the tunnel. Suitable water will be diverted for recycling underground for mine equipment and surface dust suppression. The balance of water will be pumped to the Waihi Processing Plant for treatment and discharge. Where significant quantities of water are encountered in tunnelling, the ground in the immediate vicinity will be shotcreted and/or grouted to provide an effective seal to prevent any significant and/or sustained drainage of local groundwater. Current hydrogeological data from the tunnel route is limited, however geology of the area is well understood. It is predicted that the dewatering volume will increase incrementally as the tunnel is developed until completion.

Prior to commencement of the first stoping operation, baseline data collection will occur and drilling and grouting will be undertaken if required in the upper development drives to ensure no water is lost from surface water bodies when mine dewatering commences. Current data, modelling and expert analysis indicates that the surface water is in contact with the vein system but only at shallow depths and not highly interconnected. Hence grouting is expected to be highly effective in preventing surface water loss through mining and dewatering. Where necessary, grouting will continue well ahead of mining throughout the mine life. Mining at shallower depths will be limited and monitored to ensure no risk of surface water drainage. Ongoing work is underway to understand the groundwater system to design appropriate measures to avoid effects on surface water bodies.

[1] Man portable rig investigations do not require tree clearance, but will require clearance of groundcovers, wood debris and forest duff which provide habitat for native species over an area of 32 m^2 each.



Boffa Miskell

www.boffamiskell.co.nz

0 — 1 km

1:30,000 @ A3

Data Sources:
Waterways and Roads sourced from LNZ data service
Proposed Infrastructure sourced from Oceana Gold
LIDAR sourced from WRC
Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Potential drill / vent sites
- Tunnel Portal
- Willows Rock Stack
- Project Area
- Willows Road Site
- Access Arrangement Area
- Proposed Tunnel Envelope (Underground)
- Proposed Hydrogeological and Vent Sites
- Wharekirauponga Walk
- Road Parcels
- Cadastre

WAIHI NORTH PROJECT

Willows Road Farm and Coromandel Forest Park Locations and Features

Date: 19 February 2025 | Revision: 3

Plan prepared for Oceana Gold by Boffa Miskell Limited

Project Manager: katherine.muchna@boffamiskell.co.nz | Drawn: HCo | Checked: KMu

Figure 3

2.4.3 Willows Road Farm

Surface infrastructure will include workshops, administrative buildings and materials / chemicals storage areas, private roads, a helipad, an explosives magazine, sumps / ponds for general surface water and mine water collection, carparking, a tunnel portal and ventilation raise, a rock storage pad (approximately 6 ha), topsoil stockpiles (2 – 3 ha) and holding ponds (Figure 4). This above ground infrastructure is referred to as the Willows Surface Facilities Area (Willows SFA).

The surface infrastructure footprint comprises approximately 20.83 ha of farmland (approximately 10.6 % of total farmland within the Willows Road Farm site). Once mining is complete, all surface infrastructure will be removed, and footprint areas will be rehabilitated with stored topsoil. The land will be returned to arable farming land.

Rock Stack

The design of the Willows waste rock stack incorporates dish drains around the stockpile that separate catchment water from rock stack contact water. The rock stack is located over the Tributary 2 channel (Figure 4). Catchment water will be diverted around the rock stack and discharged into the lower natural reaches of the tributary to maintain flows. After exhausting the rock from the rock stack, Tributary 2 will be rehabilitated and returned largely to its original configuration, with improved riparian areas and stock exclusion fencing to protect the waterway. The rock stack footprint area is 6.06 ha.

Topsoil Stockpile

Topsoil derived from the project will be stored alongside but upslope of a small gully within Willows Road Farm. The storage area is well away from any permanent or intermittent streams. The topsoil will remain covered (grassed) until such a time as it is required for rehabilitation. The location of the topsoil upslope and away from existing watercourses is not expected to result in any impacts to streams or wetlands.

Helipad

A new helipad will be established on Willows Road Farm (indicative location provided in Figure 4). Increasing from the current two helipads (at the Baxter Road process plant and Golden Cross sites) to three will provide operational efficiency for OceanaGold as well as limiting the increase in potential noise effects on residents associated with the proposed increase in helicopter activity from up to 100 flight hours per month to no more than 200 flight hours per month. The third site also provides an alternative should activities at one of the other sites need to be reduced, e.g. due to any instability at the Golden Cross site or adverse community effects from use of the Process Plant or Willows Road sites.

Tunnels

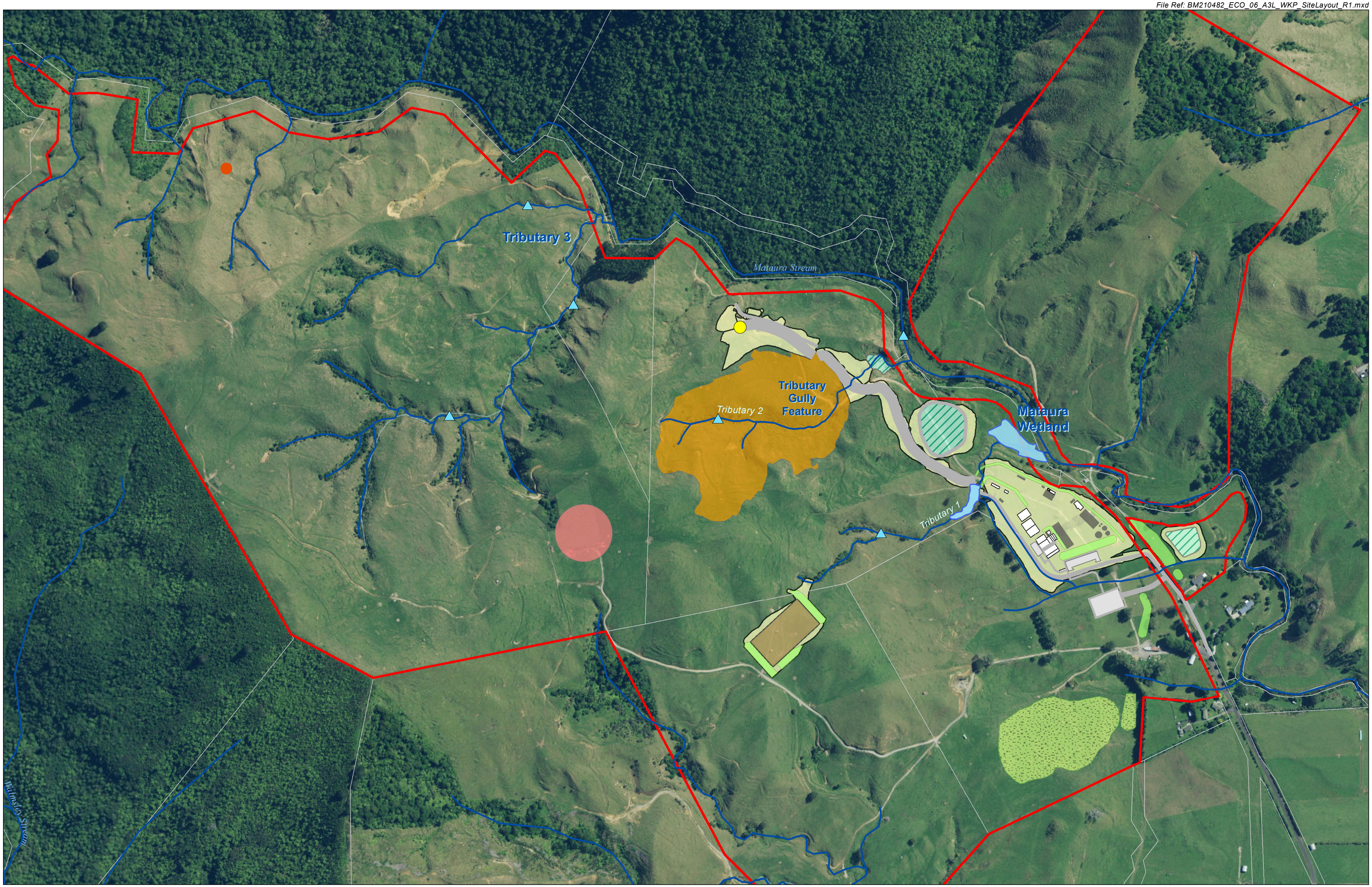
The Willows Access Tunnel, the Dual Access Tunnel and the Wharekirauponga Access Tunnel will be constructed by drill and blast. The impacts of drilling and blasting and their associated dust, noise and vibrations for the Dual Access Tunnel and Willows Access Tunnel are assessed in this report. Tunnelling speed will be approximately 10 metres per day.

The Wharekirauponga Access Tunnel is a single decline tunnel that connects the Dual Access Tunnels to the Processing Plant in Waihi and is not addressed in this report.

Wastewater

Human wastewater from the operations at Willows Road Farm will be treated on site by a package sewage treatment plant (STP). Discharge water from the STP will be directed into a seepage field on the site. The seepage field will be located remotely from the Mataura Stream and its tributaries.

File Ref: BM210482_ECO_06_A3L_WKP_SiteLayout_R1.mxd



Boffa Miskell

www.boffamiskell.co.nz

0 200 m

1:6,000 @ A3

Data Sources:
Waterways and Roads sourced from LNZ data service
Proposed Infrastructure sourced from Oceana Gold

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Tunnel Portal
- Indicative Shaft
- Freshwater Sampling Site
- Wetland
- Willows Road Site
- Cadastre
- Access Road\Path
- Building Footprint
- Parking
- Bund
- Hard landscape
- Magazine Footprint
- Retention / Collection Ponds
- Willows Rock Stack
- Topsoil Stockpile
- Earthworks
- Helipad envelope (100m)

WAIHI NORTH PROJECT

Proposed Willows Road Site Layout

Date: 26 September 2024 | Revision: 1

Plan prepared for Oceana Gold by Boffa Miskell Limited

Project Manager: katherine.muchna@boffamiskell.co.nz | Drawn: HCo | Checked: KMc

Figure 4

3.0 Definitions, Assessment Criteria and Statutory Obligations

3.1 Introduction

In this section we comment on the relevant statutory definitions to be applied to ecological features of the WNP and appraise the criteria to be applied in assessing significant indigenous vegetation and/or habitats of indigenous fauna. We emphasise that this section is not a statutory assessment. In this section we make reference to:

- The National Policy Statement on Indigenous Biodiversity (NPS-IB)
- WRC RPS
- HDC District Plan
- Wildlife Act (1953) and RMA obligations

3.2 National Policy Statement on Indigenous Biodiversity (NPS-IB)

NPS-IB operative provisions for new use or development that affects indigenous biodiversity are separated into activities within or affecting SNAs. Clause 3.10 of the NPS-IB contains specific requirements relating to indigenous biodiversity within and outside of Significant Natural Areas (SNAs). Specifically, Clause 3.10(2) states that each of the following adverse effects on an SNA must be avoided, except as provided in clause 3.11:

a) loss of ecosystem representation and extent:

b) disruption to sequences, mosaics, or ecosystem function:

c) fragmentation of SNAs or the loss of buffers or connections within an SNA:

d) a reduction in the function of the SNA as a buffer or connection to other important habitats or ecosystems:

e) a reduction in the population size or occupancy of Threatened or At Risk (declining) species that use an SNA for any part of their life cycle.

Any adverse effects on an SNA of a new subdivision, use, or development that are not referred to in subclause (2), or that occur as a result of the exceptions in clause 3.11, must be managed by applying the effects management hierarchy.

Clause 3.11 identifies situations where the NPS-IB specifies that Clause 3.10(2) does not apply, and any adverse effects on an SNA of a new subdivision, use or development must be managed in accordance with clause 3.10(3) and (4).

One such exception is where development is for the purposes of mineral extraction *"that provides significant national public benefit that could not otherwise be achieved using resources within New Zealand"*. This exception requires that there is a functional need or operational need for the development to be in that particular location; and there are no practicable alternative locations for it.

The effects of proposed activities on the ecological features within the proposed project footprint, including both within and outside of SNAs, have been documented and evaluated using the EIANZ impact assessment framework, and managed using the effects management hierarchy. Details of how the information requirements of the NPS-IB (Section 3.24 of that document) are documented in this report.

3.3 Waikato Regional Policy Statement

The Waikato Regional Policy Statement (WRPS) specifies criteria for where regional and district plans require an assessment of significant indigenous vegetation and significant habitats of indigenous fauna as part of Method 11.2.1.

The significance of vegetation and habitat within the proposed project footprint was evaluated using WRPS criteria. Vegetation or habitat is deemed significant if one or more of the criteria are met.

3.4 Hauraki District Plan

The WUG is located below predominantly rimu-tawa forest in Coromandel Forest Park. This land is also classified as SNA T13 P152 (HDP 2019), a large SNA which adjoins the property at Willows Road.

Point 7(h) in Section 6.2.1 of the District Plan also states that if an area of indigenous habitat that is not listed as an SNA due to a lower ecological ranking, it can still be environmentally important and therefore adverse effects on it should be avoided, remedied or mitigated as appropriate.

3.5 Wildlife Act and RMA Obligations with Respect to Fauna Protections

Native animals including bats, birds, lizards, frogs and some invertebrate species are ‘absolutely protected’ under the Wildlife Act (1953, s63 (1) (c)), and their habitats are protected by the Resource Management Act (1991) and administered by the DOC and local authorities (WRC and Hauraki District Council, HDC), respectively.

A Wildlife Act Authority (WAA permit) is required to handle, catch, release or kill native wildlife including lizards, birds, bats and frogs. WAA permits typically include conditions that need to be met to ensure the safety of wildlife. These conditions may include limiting who may undertake the activity (e.g. experienced persons only), a maximum number of animals that can disturbed and the timing and quantity of surveys. A WAA will be sought for the WUG to allow for the survey, handling and relocation of native frogs and lizards within Coromandel Forest Park exploration drill, pump and vent raise sites. A separate WAA will be sought for the survey and handling of native lizards at Willows Road Farm and other WNP project areas.

4.0 Description of Methods

4.1 Wharekirauponga Ecological Data

Vegetation and fauna surveys were undertaken every year from 2017– 2021 as a condition of OceanaGold’s access arrangement with the Department of Conservation, which required ecological assessments of all potential new exploration drill sites / camp sites / pump sites (BML 2017, 2018, 2019a, 2021a).

In 2021, vegetation and limited fauna surveys were undertaken to inform potential vent raise locations under a previous iteration of the WNP project description. These sites were located on the paper road, and hereafter noted as ‘Paper Road sites’. While the proposed vent sites may not be located on the paper roads, the assessments previously undertaken on these sites remain of relevance as they expand the areas surveyed to incorporate the forest south east of the exploration drill sites. Survey details and locations of Paper Road sites are provided in Appendix 2. No additional site-specific ecological surveys have been undertaken to inform the WNP Fast Track application, but we note that data collected previously is highly relevant and informs this assessment.

Broad-scale baseline ecological surveys were also carried out in 2019 and 2020 to further inform potential exploration in the Wharekirauponga catchment area (BML 2019b, 2022a). A summary of survey effort and ecological data collected during these surveys is provided in Appendix 1.

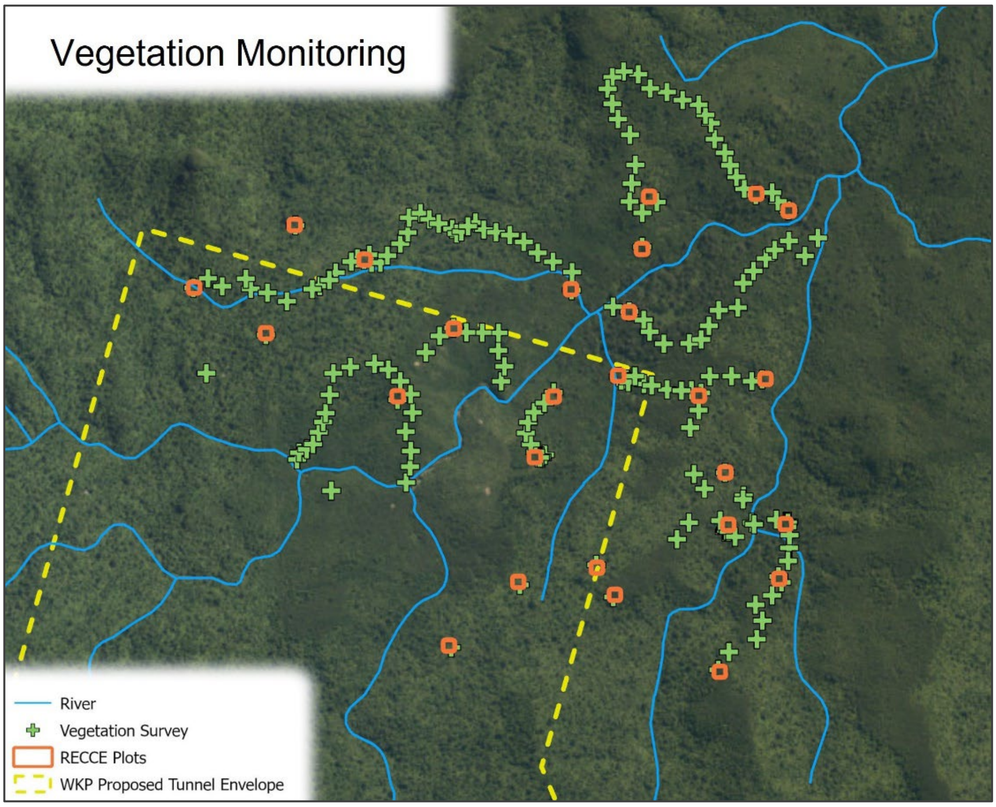
Broadly, repeated ecological surveys of terrestrial and aquatic communities have been undertaken within an approximately 2 km^2 area in the Wharekirauponga catchment (Figure 5)[2]. The study area for these surveys encompasses the Access Arrangement area; and includes all active exploration drill sites for which data is referenced throughout this report (Figure 5).

The surveys were carried out using standardised, replicable methods that provide baseline ecological data for pre-selected sites. These methods allow for the inventory to be repeated over time to assess change to the vegetation, some fauna species, and freshwater ecological communities in this area.

Surveys were designed to enable integration with existing data where possible. Specific assessments of the following habitats, communities and populations included:

- Vegetation (RECCE plots and incidental observations of ‘Threatened’ and ‘At Risk’ species, and orchids, transect vegetation surveys)
- Birds
- Lizards
- Archey’s and Hochstetter’s frogs
- Bats
- Paua slugs

[2] The vegetation and fauna surveys were undertaken within an area of approximately 2 km^2 that included the catchments of Adams Stream, Thompsons Stream, Teawaotemutu Stream, Edmonds Stream and the upper reaches of Wharekirauponga Stream. Freshwater surveys were undertaken at two sites on the Teawaotemutu Stream and two sites on the Wharekirauponga Stream, downstream of the public walking track.



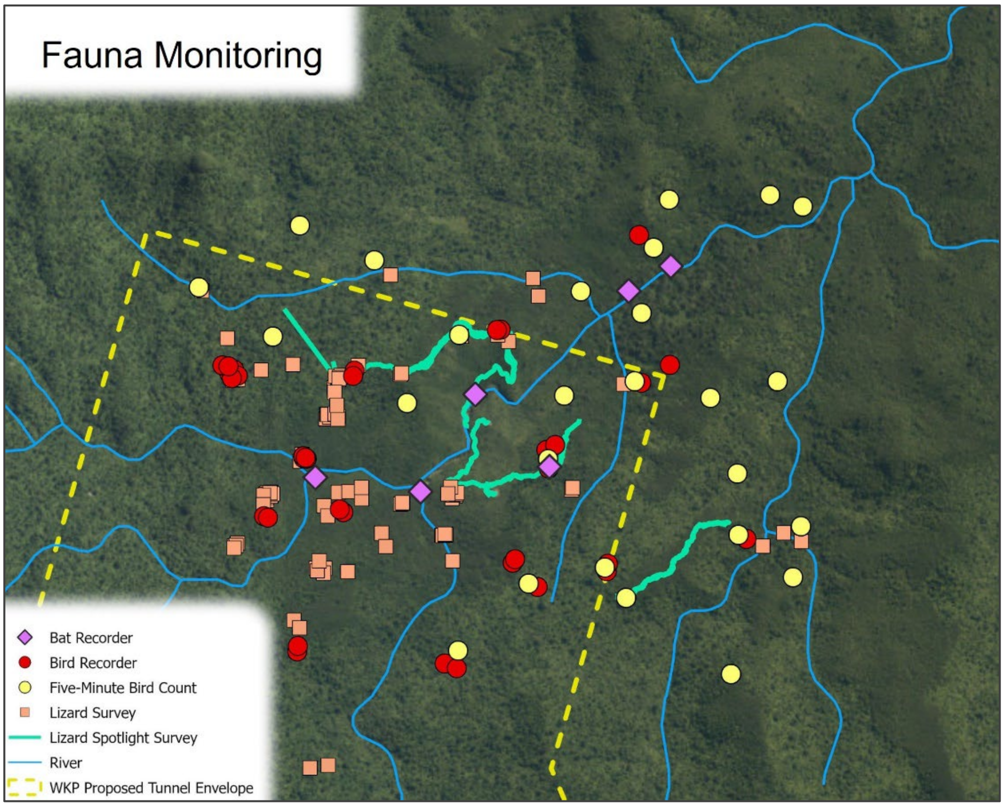


Figure 5: Baseline ecological survey study area, a 2 km^2 area within the Wharekirauponga catchment. This figure indicates broad-scale vegetation mapping and RECCE survey locations (top); and fauna monitoring locations (bottom).

4.2 Vegetation

4.2.1 Desktop Analysis

Desktop review of available literature on vegetation to inform this assessment included aerial imagery; the SNA report (Waihi ED, (Kessels & Associates, 2010)), Land Environments New Zealand (LENZ) Threatened Environment Classification maps and botanical lists (where available); and collation of existing catchment-specific information from previous surveys (BML 2019, 2022a).

4.2.2 Vegetation Surveys

Wharekirauponga Catchment

Vegetation surveys were completed at 26 sites within the Wharekirauponga biodiversity survey area in 2019 and 2020. An additional eight ordination transects of 20 plots each were also surveyed in 2020.

Paper Road Sites

Detailed vegetation assessments within the paper road provide a robust description of the vegetation communities and enables evaluation of the ecological quality of each of the paper road sites. Vegetation descriptions are provided in Appendix 2.

Reconnaissance plot surveys (RECCE plots) were carried out at 14 sites within the paper road in Coromandel Forest Park from March 2021 to May 2021. The purpose of sampling 20 x 20 m RECCE plots was to identify in more detail habitat and plant communities present within these sites, including species composition, species diversity and vegetation structure.

We note that, due to the recent incursion of myrtle rust *(Austropuccinia psidii*) into New Zealand, all Myrtaceae species which were previously been classified as 'Not Threatened' have been elevated to 'Threatened - Nationally Vulnerable' or 'At Risk – Declining'. Myrtle rust is a fungal disease that severely attacks plants in the myrtle family which includes mānuka, kānuka and rātā. Most new classifications of Myrtaceae as Nationally Vulnerable are a precautionary measure due to the unknown impact of myrtle rust on native species. De Lange et al (2018) notes that the classifications for mānuka, kānuka and common *Metrosideros* species are Designated (i.e. these abundant and widespread species do not meet standard threat status criteria).

Kauri (*Agathis australis*) has also been recently classified as 'Threatened- Nationally Vulnerable' due to the increased spread of kauri dieback (*Phytophthora agathidicida, PA*) by human and pig (*Sus scrofa*) movements (Krull et al., 2013).

Kauri and Myrtaceae species are commonly encountered throughout the Coromandel Ranges, hence we did not document individual observations of these taxa, but rather looked for evidence of disease when these species were encountered. While we have not documented numbers of kauri observed during surveys in this document, we note that OGNZL has an existing kauri dieback monitoring programme in Wharekirauponga that includes mapping and health assessment of kauri.

Willows Road Farm

Vegetation surveys comprised site walkovers and rapid plant community assessments at Willows Road Farm. The farm property was assessed over a total of 5 days in July and November 2020, January 2021 and November 2021. Vegetation and habitats on the boundary of Coromandel Forest Park were assessed in May 2022. Stands of vegetation were typically fragmented and smaller than the 20 x 20 m minimum size requirement for a RECCE plot[3].

4.3 Terrestrial Invertebrates

4.3.1 Desktop Analysis

The desktop assessment for terrestrial macroinvertebrates included a literature review including iNaturalist records from the Coromandel area, and data contained in the Coromandel-Thames SNA report (Waihi ED, (Kessels & Associates, 2010)).

4.3.2 Habitat Assessments and Surveys

In general, habitat complexity and condition has been used in this evaluation as a proxy indicator of invertebrate biodiversity, due to the limitations of rapid biodiversity assessment and analysis methods for terrestrial invertebrate communities (Ward & Larivière, 2004). A further consideration for this site is that some invertebrate sampling methods may endanger other forest species (for example, pitfall traps are a hazard to native frogs and lizards).

Field surveys of invertebrates were limited to observations of conspicuous and easily recognisable invertebrate taxa. Particular focus was given to mapping and documenting observations of paua slug, as this is a relatively immobile species that is typically confined to intact forest habitats due to its sensitivity to drought, and its vulnerability to predation in the absence of suitable refuges such as dense vegetation or litter microsites. Therefore, paua slug is used here as a surrogate indicator of high value forest invertebrate habitat. Attention was also given to recording incidental observations of any native invertebrates typical of forest habitats, Threatened or At Risk invertebrate species and conspicuous terrestrial macroinvertebrates, including peripatus / Ngaokeoke (*Peripatoides* spp), wētā, collected during surveys in the Wharekirauponga catchment.

Search effort for these ‘indicator taxa’ was focused in areas of indigenous vegetation cover and undertaken during other fauna surveys (particularly during systematic searches for herpetofauna) including within the vent raise areas in Coromandel Forest Park, on the margin of Coromandel Forest Park adjacent to Willows Road Farm, and in stands of native vegetation within the Willows Road Farm property.

4.4 Native Frogs

4.4.1 Literature Review

A review of the biology and ecology of Archey’s frog *(Leiopelma archeyi)* and Hochstetter’s frog (*Leiopelma hochstetteri)* is presented in Bioresearches (2025b). Lloyd (2025a) provides a detailed summary of Archey’s frog records compiled to date, the known distribution of the

[3] RECCE plot methodology is the collection of vegetation data within a 20 x 20 m plot. Within each plot, the cover-abundance of all species present is assessed in six standard height tiers (>25 m tall, 12-25 m, 5-12 m, 2-5 m, 30 cm-2 m, <30 cm). Six cover-abundance classes are used (< 1%, 1– 5%, 6–25%, 26–50%, 51–75%, 76–100%). A detailed description of the method is provided in Hurst & Allen (2007).

species, and draws some inferences about habitat suitability for Archey's frog on the basis of recent observations and analysis of distribution patterns in relation to environmental factors. Both these documents were prepared as part of the ecological assessment for the application.

4.4.2 Habitat Assessments and Surveys

Extensive native frog surveys have been undertaken within the Wharekirauponga catchment from 2017-2024 as part of baseline studies for the WUG mine project (121 sites, including potential exploration drill sites, pump sites, vent sites and helipad sites) (BML 2018, 2019a, 2019b, 2021b, 2021c, 2022a, Appendix 1). Similarly, Hochstetter's frog (*L. hochstetteri*) surveys have been undertaken in suitable habitats in the Wharekirauponga catchment (BML 2019b, 2021c, Lloyd 2025a) and those records are reviewed in Section 5.1.2.

Archey's frog surveys comprise systematic searching of all available habitats within a 20 x 20 m plot to assess frog presence. Experienced observers scan vegetation, ground cover and other potential habitats for emerged frogs and carefully lift potential refuge materials to search underneath. Frog handling is kept to a minimum to avoid stress, and all handlers follow 'Frog Hygiene Protocols' (DOC, undated).

Native frogs are small, nocturnal and visually and behaviourally cryptic. Archey's and Hochstetter's frogs are terrestrial and semiaquatic, respectively. The principal field method for inventory and monitoring surveys of native frogs is systematic searches at night for emerged frogs, or searches during the day for non-emergent frogs in refugia (Lettink and Monks, 2016). Frogs are more reliably active from September – April in weather conditions that are warm and moist – e.g. after rain when the vegetation and ground is still moist and temperatures are a minimum 12°C. As such, the survey window for native frogs is typically small in a given year. Observer experience and undertaking surveys over multiple nights of suitable weather is very important in assessing frog presence. Archey's frogs have no free-living tadpole stage, and development occurs entirely within the egg capsule. Eggs are laid in spring (November–December), in dark, damp sites such as under logs and rocks. Male frogs brood the eggs for a period of 6–9 weeks by sitting high over the eggs with body raised, and hence are likely to be more cryptic during this time. We note that most frog surveys within Wharekirauponga to date were undertaken outside of this brooding season.

Potentially affected streams within the project footprint were assessed for prospective Hochstetter's frog habitat and searched using systematic search methods (Hare, 2012). These surveys are described in Lloyd (2025a).

Native frog transect surveys and habitat assessments were carried out on the boundary of Coromandel Forest Park (outside of the Project Area) over two nights in May 2022.

Native frog surveys were undertaken within 11 paper road sites in Coromandel Forest Park between March and May 2021 (Appendix 2). Seasonal and weather constraints to animal activity prevented a comprehensive ecological survey in five of the sites during the survey interval, and we note that repeated surveys are required to have any degree of certainty that frogs may be absent from a site.

Archey's and Hochstetter's frog habitat assessments were carried out within the Project Area at Willows Road Farm. Native frog surveys were carried out in suitable frog habitat at Willows Road Farm, including within stands of native vegetation outside of the Project Area.

4.5 Native Lizards

4.5.1 Desktop Analysis

The Bioweb Herpetofauna database (administered by DOC) was analysed for records within 10 km of the Project Area to determine which native species are present in the wider area. The distance of closest record from the Wharekirauponga catchment, the date range of records, and the numbers of records for each species are summarised in Section 5.1.3.

4.5.2 Habitat Assessments and Surveys

Lizard survey methods are strongly weather dependent, and surveys are to be carried out in fine weather when lizards are most likely to be active. Lizard surveys can be conducted from September – April (inclusive), when ambient night temperature is at least 12ºC, with little or no wind. Manual searches during the day are conducted in fine, warm weather, avoiding temperature extremes.

Survey methods include repeated manual searches for terrestrial skinks and nocturnal (spotlight) searches for arboreal geckos. Manual searching involves looking for emerged lizards and checking retreat sites (e.g. under wood debris, in tree cavities) for inactive lizards and lizard sign (Lettink & Monks 2016). Care is taken to restore refuges as they are found to avoid altering the refuge microclimate.

Nocturnal surveys are carried out after dusk primarily to detect arboreal geckos. This method requires experienced observers to scan vegetation: branches, trunks, crevices, loose bark and other potential refuges for lizard eye-shine or distinctive body shape. Lizards are captured where possible, identified to species, photographed, measured, sexed and released.

Lizard survey methods currently available have poor detection rates as a consequence of typically low population densities, species' cryptic colouration, difficulty in surveying preferred habitats and behaviour / activity patterns. As such, even an intensive lizard survey will not detect all individuals in the population or necessarily encounter all species present[4]. Inherent poor detectability is a constraint understanding the distribution or true population status of many species.

The records of lizard surveys, and search effort for surveys carried out at Wharekirauponga form part of the dataset for this assessment (BML 2019b, 2022a). These included 15 biodiversity survey sites where visual and manual searches were carried out and four transects where nocturnal spotlight surveys were carried out, as well as incidental observations during other survey work (Appendix 1). Ten previously consented exploration drill sites have been surveyed for lizards prior to vegetation clearance.

Habitat assessments for native lizards were undertaken within the Willows Road Farm property, on the boundary of the Willows Road Farm property and Coromandel Forest Park, and in Coromandel Forest Park.

4.6 Bats

4.6.1 Desktop Analysis

Bat survey records (pers. comm. M Pryde - DOC) were reviewed for the Willows Road Farm site and surrounding area. Bat observations described in the Coromandel-Thames SNA report (Waihi ED, Kessels & Associates 2010), and Bioresearches ecological assessments from the Waihi area (Bioresearches 2025a) were also reviewed.

4.6.2 Habitat Assessments and Surveys

Bat surveys were undertaken at least annually in the Wharekirauponga catchment as part of previously consented exploration drill site clearance (ten sites) and during baseline ecological

[4] The specific limitations associated with survey methods are described in Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna (Hare 2012; Lettink and Monks 2016).

surveys (BML 2018, 2019a, 2019b, 2021, 2022a). No bats were detected during any of these prior surveys.

The project footprint and wider Willows Road Farm property were assessed for potential roosts and other favourable habitat features for bats.

4.7 Birds

4.7.1 Desktop Analysis

New Zealand Bird Atlas records were reviewed for grid AG76 and AH77 (NZ Bird Atlas, accessed 26 April 2022). Bird records described in the Coromandel-Thames SNA report (Waihi ED; Kessels & Associates 2010) and plot data from the national biodiversity monitoring programme were accessed and the details for the nearest site (Site CU46) (DOC, 2017) were reviewed.

4.7.2 Habitat Assessment and Surveys

Baseline avifauna surveys of the Wharekirauponga Catchment using five-minute bird counts (5MBCs – 26 sites) and acoustic recording devices (ARDs – 14 sites) were carried out in January – February 2019 and repeated at the same sites in November – December 2020 (BML 2019b, 2022; summarised in Appendix 1). Habitat surveyed was representative of that in the vicinity of potential vent raise sites in Coromandel Forest Park.

A total of 14 ARDs (Version B.2) were deployed at pre-determined sites (Figure 6). An initial deployment of 12 ARDs were programmed to record daily from 7:00 pm until 12:00 am and then from 5:30 am to 7:30am. These 12 ARDs were in place for 11 consecutive days and nights (29 January to 8 February, 2019). Night time monitoring enabled nocturnal species to be identified whilst the early morning and evening monitoring captured the dawn chorus and crepuscular activity.

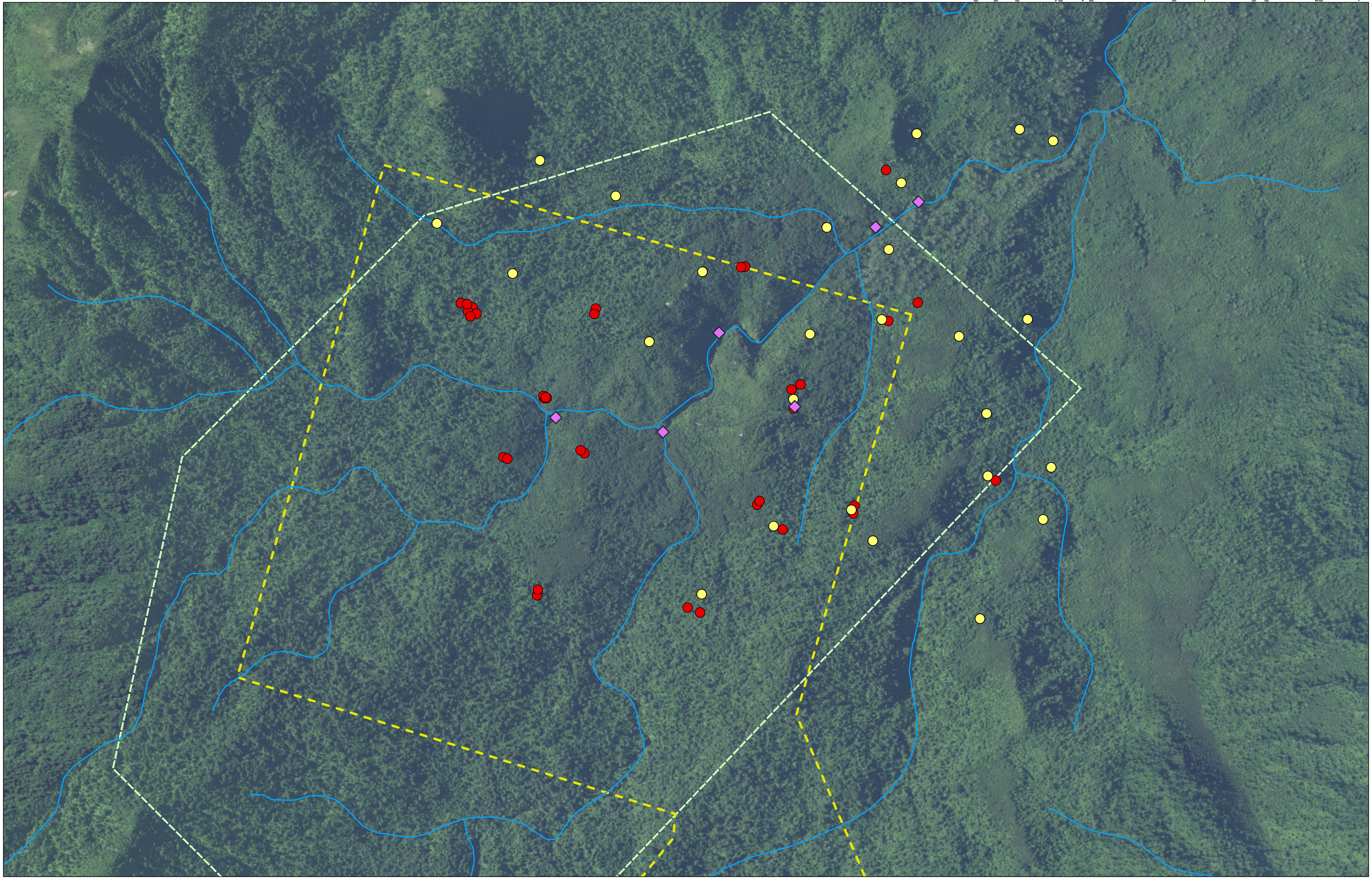
One recorder malfunctioned and did not record any data and was excluded from the analysis. Loud cicada calls occurred throughout the monitoring period during all of the daytime and early evening recording periods and likely impacted the potential range of ARDs for detecting species. Acoustic files were analysed using the software package RavenLite (Version 2.0). All species with calls visible in the sonogram were recorded and the location and species of all detected birds were recorded.

A further two ARDs were deployed in response to a reported kiwi sighting made by OceanaGold contractors within the Wharekirauponga catchment. These two ARDs were programmed to record nightly from 7:00 pm until 12:00 am. Both ARDs recorded for 48 consecutive nights (23 April to 16 June, 2019). The first recorder was deployed at the location of an unconfirmed kiwi sighting and the other on a nearby ridge to optimize detection of any kiwi calls in the valley below. Due to the large dataset obtained from 48 consecutive nights, the first 25 nights of acoustic files were analysed and then following this the acoustic files from every third night was analysed. Acoustic files were analysed using the software package RavenLite (Version 2.0) to identify any kiwi calls visible in the sonogram.

Incidental observations of other bird species of interest were also made when field teams were undertaking other monitoring or moving around the site.

Bird surveys (5MBC) and habitat assessments were carried out in four representative locations in and adjacent to bush remnants within Willows Road Farm on 19 November 2021.

File Ref: U:\2019\BM19887_KMu_WKP_biodiversity_surveys_2019-20\GIS\BM19887_AGOL.aprx BM19887_07_BirdMonitoring_A3L 1:07 pm



Boffa Miskell

www.boffamiskell.co.nz

0 300 m

1:10,000 @ A3

Data Sources: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Bat Recorder
- Five-Minute Bird Count
- Bird Recorder
- WKP Proposed Tunnel Envelope
- Access Arrangement Area
- River

WAIHI NORTH

Bird and Bat Monitoring Locations from Biodiversity Surveys

Date: 03 October 2024 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Katherine.Muchna@boffamiskell.co.nz | Drawn: HCo | Checked: KMu

Figure 6

4.8 Pest Animals

4.8.1 History of Control

Previous pest control in the Wharekirauponga / Otahu area has predominantly consisted of aerial 1080 applications approximately every three years, with the last operation on 7 November 2021. Rat tracking indices before the aerial application were 71% TTI, and dropped to 4% TTI on 22 December 2021 following the application (Department of Conservation, 2021c, 2021b). There is localised control for rats and stoats with Goodnature and DOC200 traps around camps and drill sites, carried out by OceanaGold.

4.8.2 Pest Animal Monitoring

An assessment of current pest animal densities was conducted using a combination of methods including tracking tunnels, chew cards and lured camera traps deployed across the proposed Wharekirauponga Animal Pest Management Area (WAPMA), both inside and outside of the vibration footprint (Figure 8, BML 2025b). The aim of this monitoring is to determine presence/ absence, and obtain a coarse indication of relative abundance, of rats, mice, possums, mustelids, hedgehogs, cats, and ungulates across the site.

4.9 Ecological Evaluation Methods

4.9.1 EIANZ Guidelines

Ecological Values

Environment Institute of Australia and New Zealand (EIANZ) impact assessment guidelines (Roper-Lindsay et al., 2018) provide a method for assigning value to ecological elements found within a Project Site, determined by the species, communities, habitats and ecosystems occurring there. Ecological features can be considered at a range of spatial and organisation scales (e.g. species, ecosystems, land environments). To ensure consistent and comprehensive evaluation, Roper-Lindsay et al. (2018) group prospective ecological attributes of a site into four over-arching 'matters', these being **representativeness, rarity/ distinctiveness, diversity and pattern,** and **ecological context**, with a set of criteria to enable evaluation of specific attributes pertaining to each matter.

The site's value for each matter, and its overall ecological value is then ranked on a scale of Negligible to Very High based on the extent to which criteria (and sub-factors for criteria) are met.

Magnitude and Level of Effect

The ecological effects of the project have primarily been assessed at a local scale using the Project Areas shown in Figure 2. The level or severity of adverse effects on an ecological feature or process is determined by the nature and magnitude of the effect (Table 1), in combination with the ecological value of the site or feature (Table 2) (Roper-Lindsay et al., 2018). Assessment of the level of adverse effect excludes consideration of specific mitigation measures (i.e. it is a 'raw', unmitigated, assessment), but does consider whether the effect could be potentially mitigated or remedied.

In general, a negligible or low effect is sufficiently minor that mitigation is not necessary because the ecosystem / assemblage will recover without intervention. Avoidance or mitigation is usually required for moderate, high, or very high levels of effect.

Table 1: EIANZ criteria for describing magnitude of effect (Roper-Lindsay et al., 2018). Magnitude of effect in this table is considered without mitigation.

Magnitude	Description
Very high	• Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will fundamentally change and may be lost from the site altogether; and/or • Loss of a very high proportion of the known population or range of the element/feature
High	• Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; and/or • Loss of a high proportion of the known population or range of the element/feature
Moderate	• Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; and/or • Loss of a moderate proportion of the known population or range of the element/feature
Low	• Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; and/or • Having a minor effect on the known population or range of the element/feature
Negligible	• Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; and/or • Having negligible effect on the known population or range of the element/feature

Table 2: EIANZ criteria for level of ecological effect (Roper-Lindsay et al., 2018).

		Ecological Value				
Magnitude		**Very High**	**High**	**Moderate**	**Low**	**Negligible**
	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	Very High	High	Moderate	Very Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

4.9.2 Integrated Effects Management Approach

The WNP has applied the effects management hierarchy throughout planning and development of the proposal to minimise adverse effects, as specified in NPS-IB Preliminary Provision 1.6. In this context, “effects management hierarchy” means an approach to managing the adverse effects of an activity on indigenous biodiversity that requires that:

a) *adverse effects are avoided where practicable; then*

b) *where adverse effects cannot be avoided, they are minimised where practicable; then*

c) *where adverse effects cannot be minimised, they are remedied where practicable; then*

d) *where more than minor residual adverse effects cannot be avoided, minimised, or remedied, biodiversity offsetting is provided where possible; then*

e) *where biodiversity offsetting of more than minor residual adverse effects is not possible, biodiversity compensation is provided; then*

f) *if biodiversity compensation is not appropriate, the activity itself is avoided.*

All activities were reviewed at intervals throughout the Project design, and where potential adverse ecological effects were identified, opportunities to avoid, or minimise (e.g., reduce the extent or duration of) the identified effects were explored.

The resulting Project design includes some unavoidable ecological effects (including potential effects), and the proposed mitigation for these effects (to reduce their severity) is set out in this report. A package of measures to balance residual ecological effects (including potential effects) that may remain after mitigation is proposed in order to achieve an overall net biodiversity benefit.

We have adopted an integrated effects management strategy, so that while components of planting for the purpose of landscape mitigation are not ‘counted’ as ecological mitigation (or vice versa), in most cases the ecological mitigation and the landscape mitigation planting take a similar form and are in the same key locations, or locations link to one another. This approach provides a more continuous connection of vegetation and freshwater environments, which will maximise biodiversity benefits throughout the proposed project footprint and enhance the ecological connectivity across the landscape. In line with the intention of OGNZL, we have sought a net gain in biodiversity and ecological value in applying the effects management hierarchy and a demonstration of enhanced connectivity is part of this net gain.

5.0 Ecological Features and Values

5.1 Wharekirauponga Underground Mine

5.1.1 Vegetation and Flora

Wharekirauponga Catchment

The SNA report for Waihi ED describes lowland vegetation in this area as predominantly tawa forest with emergent northern rata, rimu, totara, miro, pukatea and kauri (Kessels & Associates, 2010).

Analysis of RECCE plot data using the principal component analysis (PCA) ordination and unweighted pair group method with arithmetic mean (UPGMA) clustering algorithms identified three broad vegetation types within the Wharekirauponga catchment, including:

- Kauri forest;
- Mixed secondary broadleaved forest;
- Kanuka scrub.

The kauri forest assemblage forms a well defined group in the analysis, while the analysis also indicated a relationship between the kauri forest and a sub-group of kanuka scrub vegetation types (kānuka dominated ridgelines), the inference being that this component of the scrubland is essentially an early-successional phase of kauri forest.

The broadleaved forest and kānuka scrub vegetation types were much less distinct than kauri forest, largely because they encompass a complex mosaic of overlapping environmental gradients, disturbance patterns and age classes. While the species assemblages in secondary broadleaved forest had greater overall species richness than kauri or scrubland types, numerous species were found as single individuals or in low numbers (differentiating the plots in the analysis) while the main canopy dominants were fairly consistent.

Summary descriptions of identified vegetation types are as follows:

- **Kauri Forest**

  Kauri forest is found mainly on ridgelines and knolls on the sides of valleys. Kauri dominates the top canopy, often comprising groups of young kauri (rickers) growing closely together, with many of the trees over 25 m tall. Tanekaha, and to a lesser extent toatoa, are interspersed sporadically throughout canopy and subcanopy tiers. Rimu and rewarewa are also present in moderate densities along with towai and *Pseudopanax discolor*. Toro and tāwari are occasionally present.

  Kauri grass, *Gahnia xanthocarpa* and towai are the most abundant sub-canopy species. Seedlings and saplings of canopy species are represented in the sub-canopy along with abundant broadleaved species such as kanono, pigeonwood, rewarewa, mapou, *Pseudopanax discolor*, toro and mingimingi. Miro was present in the sub-canopy as seedlings and juvenile plants. Kiokio was the most abundant fern, and silver fern was also common. Mosses and ferns were underrepresented, which is typical of kauri forest (Wyse et al., 2014).

While distinct areas of kauri forest are generally small and confined to ridgelines, early successional components of this forest type were present throughout the broadleaved forest and scrubland vegetation types. Historically, kauri stands would have been a common vegetation type, but historic logging and land clearance has depleted and fragmented kauri forest within the Wharekirauponga catchment.

- **Mixed Secondary Broadleaved Forest**

  Broadleaved secondary forest is the principal vegetation type in the Wharekirauponga catchment. The canopy structure is patchy, with numerous tall emergent trees interspersed throughout a relatively low stature (<5 m tall) subcanopy.

  Rewarewa, tanekaha and pukatea are the most abundant canopy species, while tawa is locally co-dominant in places. Ponga and nikau are ubiquitous in the subcanopy, and mahoe is also common. Miro, tanekaha, tōtara, hinau, rimu, tanekaha, toatoa and kauri are occasionally present in low abundances. Ponga, māmāku, pigeonwood, wheki, hangehange, makamaka, lancewood, mapou and kanono are frequently present in subcanopy layer and/ or understorey tiers, along with epiphytic orchids, ferns and lianes such as supplejack and kiekie.

  Ferns are a dominant plant group throughout broadleaved forest, and are a common ground cover, along with kamu (*Carex uncinata*) and bush rice grass.

  A local area of swamp forest was identified as a component of the secondary broadleaved forest type. These forested wetlands are situated on hillside terraces, with a tall canopy of pukatea with spreading buttress roots, and in dense thickets of kiekie and supplejack in the understorey.

- **Kanuka Scrub**

  Kānuka scrub typically has a top canopy layer approximately 5 m tall, comprising kanuka and pole-sized rewarewa, tanekaha and towai, in varying proportions. Rimu and mahoe occur frequently in the scrub canopy but are not abundant. Mapou, kauri, ponga, rimu, pigeonwood, mingimingi, mahoe, Pseudopanax discolor, supplejack, towai and karamu, hangehange, kiokio are also common, while miro, nikau, kauri grass, toro, lancewood, kumeraho, morelotia, bushy clubmoss, makamaka, Gahnia xanthocarpa, kiekie, wheki, akapuka, kānuka, kamu and toropapa are often present. Tree ferns are more common on the lower slopes and hillsides.

  In the lower, easterly part of the valley, wilding pines are present amongst the scrubland. The vegetation is more heavily dominated by tree ferns in and around the pines. It appears that the pine area has been more recently disturbed than the other parts of the scrubland vegetation type, enabling pines to establish.

Vegetation communities identified are consistent with early to mid-successional stages of the WF11 and WF13 ecosystem units typical of Coromandel Forest Park. LENZ[5] classification indicates that this habitat type is not rare, with > 30% left and > 20% protected.

The New Zealand Plant Conservation Network database (accessed 2019) records 54 orchid taxa from the Thames-Coromandel District, of which 16 are Threatened or At Risk. However, orchids are frequently only identifiable when they are flowering.

Typical orchid types and genera that are likely to be encountered within the Wharekirauponga catchment include:

[5] Land Environments New Zealand Category IV

- Greenhood orchids: *Pterostylis*
- Sun orchids: *Thelymitra*
- Spider orchids: *Corybas*
- Bird orchids: *Chiloglottis*
- Finger orchids: *Caladenia*
- Perching orchids: *Earina, Drymoanthus, Dendrobium, Bulbophyllum*
- Gnat orchids: *Acianthus, Cyrtosylis, Townsonia*

Orchid surveys were undertaken in October and November 2020 to identify flowering orchids to species level and rank their abundance. Biodiversity plots established in 2019 were surveyed, and additional orchid data was captured from the ordination plots carried out in 2020.

During surveys in 2020, thirty-four species of orchid were found across seven different orchid types (gnat, perching, finger, bird, sun, spider and greenhood orchids). Plots within kauri forest had the greatest overall orchid diversity (number of types) and species richness. All orchid types listed above were found within the kauri forest vegetation classification. Four orchid types were observed within broadleaved forest, and five in kānuka scrub.

Two *Pittosporum virgatum* (Threatened – Nationally Vulnerable) were observed within the RECCE plots in Wharekirauponga. King fern (*Ptisana salicina*, At Risk- Declining) was incidentally observed within the wider Wharekirauponga catchment.

Dactylanthus taylorii (Te Pua a Reinga or wood rose) is the only fully parasitic flowering plant endemic to New Zealand. It lives underground as a forest root parasite and forms a tuber up to 40 cm in diameter on the root of a host tree or shrub, while the root itself forms into an ornate "rose". *Dactylanthus* is known to parasitise about 30 species of native trees and shrubs including mahoe, lemonwood, lancewood, kohuhu, wineberry, broadleaf, fivefinger, pate and karamu. Dactylanthus occurs in widely scattered sites, and prefers damp but well drained places, and is often found growing at the head of small streams. In late summer to autumn, each plant produces inflorescences filled with nectar which grow just above the forest floor. Short-tailed bats *(Mystacina tuberculata)* are the only confirmed native pollinator. Mice and introduced ship and Norway rats have been shown to pollinate the flowers, though rats often browse and destroy flowers rather than pollinating them. Possums and pigs are also strongly attracted to *Dactylanthus* flowers and destroy them through browsing.

While not detected during any ecological surveys in Wharekirauponga Catchment, the potential presence of this species is considered important as it has a threat status of 'Nationally Vulnerable', principally as a result of browsing pressure and destruction of populations by "wood rose" collectors. There are no formal records of *Dactylanthus taylorii* in Coromandel Ecological Region, however the distribution of *Dactylanthus taylorii* remains uncertain because this plant is only visible above ground during its fairly brief flowering period.

5.1.2 Native Frogs

Wharekirauponga Catchment

Hochstetter's and Archey's frog have been recorded throughout the wider Coromandel Forest Park. Records of frogs within 10 km of the Project Site are provided in Table 3 (see also Figure

7). At present, both Hochstetter's and Archey's frogs are classified as "At Risk – Declining" (Burns et al 2018).

Table 3: Native frog records within 10 km of the Project Area (Boffa Miskell / OceanaGold records).

Species	Threat classification	Habitat	Number of records
Archey's frog (*Leiopelma archeyi*)	At Risk - Declining	Lowland broadleaved podocarp forest	>1000
Hochstetter's frog (*L. hochstetteri*)	At Risk - Declining	Stream margins in forested low light environments	>100

[1]Burns et al., 2018

Hochstetter's frogs were observed during targeted surveys in the Wharekirauponga catchment (BML 2019b, 2022)) and numerous small, stony-bottomed tributaries in the catchment provide high quality habitat for Hochstetter's frog.

Quantitative Archey's frog surveys undertaken at 121 potential exploration drill sites and vent sites within the Wharekirauponga catchment established that Archey's frogs are common throughout the Project Site, but are less prevalent in vegetation types associated with drier, more well drained soils (BML 2018, 2019a, 2021a). Vegetation successional stage does not appear to influence frog abundance; we found similar frog abundance in mature secondary forest compared to early successional vegetation dominated by grasses. Archey's frogs occupy a wide range of forest types provided there is sufficient groundcover and refuge habitat available.

Lloyd (2025a) produced a range of density estimates of the Archey's frog population size within in the vibration footprint of the proposed mine, using available data from sample plots surveyed within Wharekirauponga catchment, and applying a variety of constraints to the analysis. He concluded that the likely total Archey's frog population size within the vibration footprint ranges between 48,888 – 152,774 individuals.

Archey's frogs have been surveyed more intensively within the Wharekirauponga catchment than anywhere else throughout their range (Lloyd 2025a, Figure 7), and the numerous records in Wharekirauponga compared to surrounding forest areas in Coromandel Forest Park reflects survey effort rather than a representation of actual frog abundance between these areas (Figure 7). Relative to other well studied populations, Archey's frogs are widely, but not densely[6] distributed throughout the Wharekirauponga catchment. Plot and transect surveys undertaken in 2021 – 2024 over the northern, southern and central Coromandel Peninsula, including sites with historic records and new sites within suitable habitat are described in Lloyd (2025a). Lloyd (2025a) concludes that forest within the vibration footprint of the proposed mine offers relatively lower quality habitat for Archey's frogs because it is at low altitudes (90–330 m a.s.l.) and has a high proportion of regenerating forest (rather than undisturbed forest). The estimated mean number of Archey's frogs per 100 m^2 plot in the vibration footprint was 9.3 compared to estimates of 80 and 90 frogs per 100 m^2 plot in undisturbed mid and high-altitude forest on Tapu Ridge and Whareorino (Lloyd 2025a and references therein). Based on the density estimates of

[6] Archey's frogs can reach densities of up to 4.8 frogs per m^2 (480 frogs per $100m^2$) in the Coromandel (Bell 1997) and emerged frogs were detected in densities of up to 77 frogs per 100 m^2 in Whareorino (Daglish 2010). Close searching of $400m^2$ plots surveyed in Wharekirauponga (2018 – 2022) yielded an average of ~3.08 frogs per plot (Lloyd 2023), while Hotham (2019) estimated a mean of 9.3 frogs per 100 m^2 based on capture-recapture surveys.

Lloyd (2025a) the frog population in the footprint is likely to be less than 0.61% of the Coromandel's Archey's frog population.

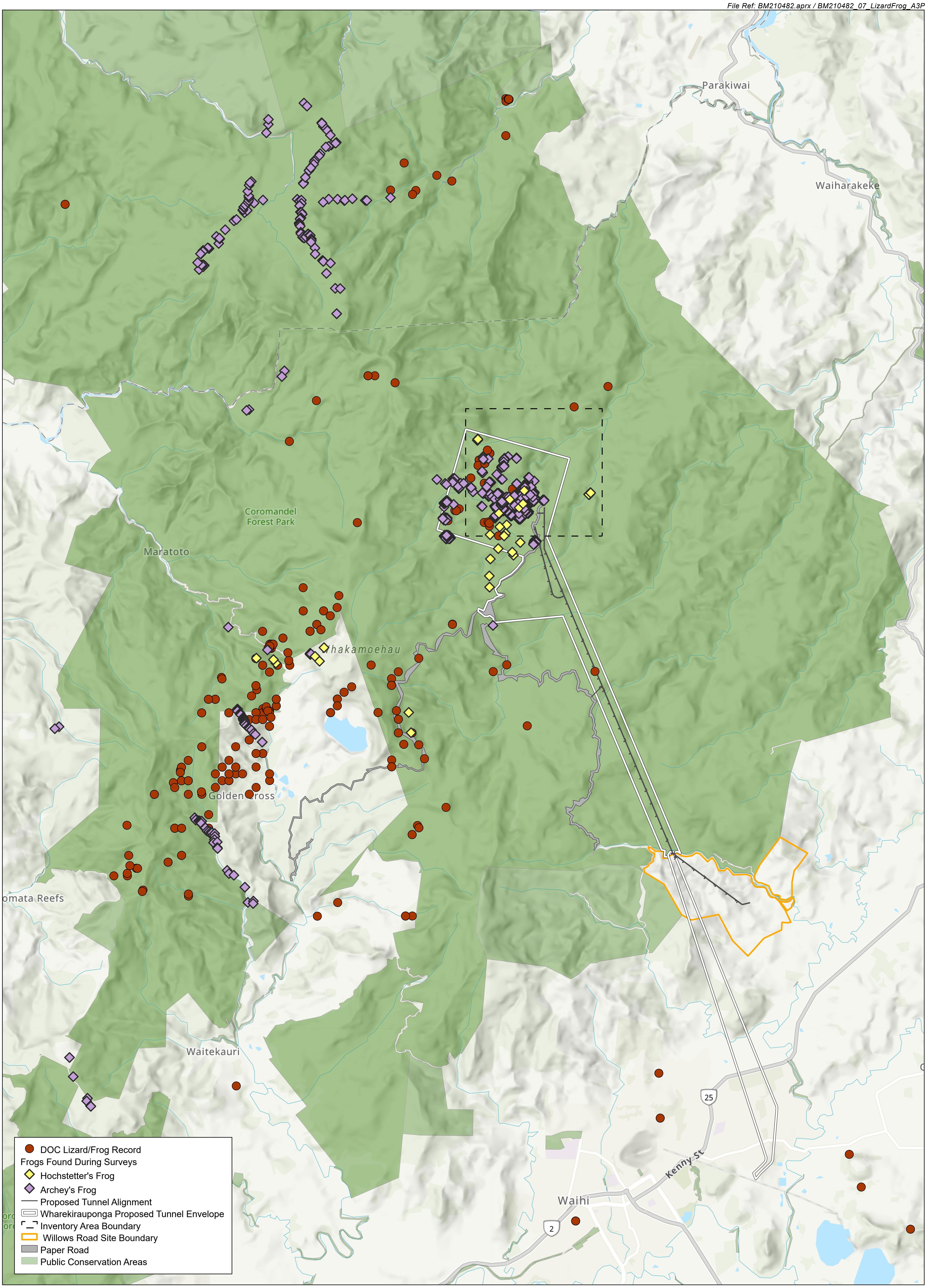
There is a reasonable likelihood that Archey's frogs are present in poorly surveyed areas elsewhere across their predicted[7] range, although they may be patchily distributed. Surveys undertaken for OceanaGold during the period 2018– 2024 were focussed on the area south of Tapu–Coroglen Road, with most of the surveys in the southern region, some in the middle region (mostly south of Tapu–Coroglen Road), and none in Moehau. Previously, the highest densities of sightings are in undisturbed forests at mid and high altitude >400 m a.sl (Lloyd 2025a).

Paper Road Sites

Archey's frog surveys were carried out at 11 paper road sites in Coromandel Forest Park (details provided in Appendix 2). Vegetation at these sites comprised mature secondary forest with deep leaf litter, tree ferns with abundant fallen fern fronds and low growing grasses and sedges. Frogs were present at 7 out of 11 sites surveyed.

Hochstetter's frog surveys were undertaken in Edmonds catchment in 2022-2023. Survey findings are described in Lloyd (2025a) and Bioresearches (2025b).

[7] Lloyd (2025a) provides hypothesised distribution ranges of three distinct Archey's frog populations in Coromandel based on locations of Archey's frog sightings and habitat preferences (including altitude and extent of LCDB vegetation types). A combined area of the three distribution ranges is 51,800 ha.



Boffa Miskell

www.boffamiskell.co.nz

0 2 km

1:50,000 @ A3

Data Sources: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Classic Basemap Server - Eagle Technology, Land Information New Zealand, Boffa Miskell, Bioresearchers

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

WAIHI NORTH PROJECT

Lizard and Frog Records in the Southern Coromandel Area

Date: 13 February 2025 | Revision: 1

Plan prepared by Boffa Miskell Limited

Project Manager: katherine.muchna@boffamiskell.co.nz | Drawn: HCo | Checked: KMu

Figure 7

5.1.3 Native Lizards

Wharekirauponga Catchment

A desktop assessment was carried out for lizard observations recorded within a 10 km radius of the potential vent raise sites. Existing lizard records for this area are very limited, likely due to lack of survey effort, cryptic species behaviour and the lack of effective search techniques for the habitat (Figure 8).

Native lizards recorded within 10 km of the area include two ground dwelling skink species and one arboreal gecko. Seven species of native lizard have been recorded on the Coromandel Peninsula including the Threatened – Nationally Vulnerable Toropuku gecko (Northern striped gecko *Toropuku inexpectatus*) (Hitchmough et al 2020). Native lizard records from similar habitats (i.e. excluding coastal species) across the Coromandel Peninsula are summarised in Table 4.

Baseline ecological surveys using a range of methods at Wharekirauponga have detected a single forest gecko (BML, 2021b). Nine observations[8] of elegant geckos have been recorded in Wharekirauponga (Boffa Miskell, Liam Ireland pers. comm, Ben Barr pers. comm.[9]). Low population densities and/or cryptic behaviour of native geckos and skinks may have influenced their detectability during previous surveys. Notwithstanding, their presence throughout the catchment is considered likely.

During baseline ecological surveys, extensive areas of high-quality habitat were identified for lizards throughout the survey area. However, there was a notable presence of invasive predators including extensive pig rooting, and frequent observations of mice, rats and wasps, and all of these species have been attributed to declines in native lizard populations across the country (Hare, et al. 2016).

Table 4: Native lizard records from the Coromandel Peninsula and species' habitat preferences.

Species	Threat classification (Hitchmough et al., 2021)	Habitat	Distance of closest[1] record Project Area	Date of record(s)	Number of records
Elegant gecko (*Naultinus elegans*)	At Risk - Declining	Open scrubland habitats	In Wharekirauponga	2020	6
Pacific gecko (*Dactylocnemis pacificus*)	At Risk – Relict	Coastal, lowland, forested habitats included (if available).	15 km 80 km	1972 2005	2
Forest gecko (*Mokopirirakau granulatus*)	At Risk - Declining	Forest, scrubland	In Wharekirauponga	2020	1

[8] Some of these observations may be of the same individual.

[9] Liam Ireland carried out research in Wharekirauponga in 2020, Ben Barr carried out lizard surveys in Wharekirauponga in 2022 and 2023.

Northern striped gecko (*Toropuku inexpectatus*)	Threatened – Nationally Vulnerable	Dense forest, kiekie, or scrubland	80 km	1997	1
Copper skink (*Oligosoma aeneum*)	At Risk - Declining	Coastal, lowland forested	**<5 km** 70 km	1998 2007	7
Ornate skink (*O. ornatum*)	At Risk - Declining	Forests, scrublands and grassland habitats.	95 km	1932	1
Moko skink (*O. moco*)	At Risk – Relict	Coastal, lowland	**<10 km**	2012	11

Note: [1] Where the closest record is more than 20 years old, the closest record within the last 20 years is also included (if available).

5.1.4 Native Bats

New Zealand has two endemic species of bat (pekapeka), the long-tailed (*Chalinolobus tuberculatus*) classified as Threatened – Nationally Critical and short-tailed (*Mystacina tuberculata*) classified as Threatened – Nationally Vulnerable (O' Donnell et al 2023). The DOC Bat Database (accessed March 2022) has no recent or historic records[10] for short-tailed bats in the Coromandel Ecological Region.

Previous records suggest that long-tailed bats were once widespread across the Coromandel Peninsula (Kessels & Associates, 2010). Historical records of bats from the saddle between Marototo and Grace Darling catchments, in forest close to and above the Waitekauri River; and on the western side of the Waitekauri River near its confluence with Union Stream have been reported (Garrick Assoc. & DSIR, 1987 Wildlife of Golden Cross. Golden Cross Mining Project. Technical Report Series). Long-tailed bats are recorded as present within the Waihi ED (Kessels & Associates, 2010), and the DOC Bat Database (accessed March 2022) shows numerous recent (2018 – 2020) detections around the northern extent of the Kaimai Ranges (c 25 km from the Project Area). Long-tailed bats were also recently detected around the proposed Gladstone pit (October 2024, Bioresearches 2025b) and around Maratoto track, approximately 4.5 km southeast of Wharekirauponga (November 2024, BML, unpublished data). Long-tailed bats can range over large areas (in the order of 10,000 ha) and move long distances between roost sites and it is possible they may use habitats within the wider area for roosting or feeding, or may return to Wharekirauponga in time.

The cause of the apparent decline in the long-tailed bat population on the Coromandel Peninsula is unknown, but the general population decline across New Zealand is attributed to predation and competition from introduced mammals and wasps as well as habitat loss, degradation and fragmentation (O'Donnell, 2002). Pest animal density within the Wharekirauponga catchment area is very high, and this may partially explain the absence of bats there (see Section 5.1.7).

Old growth forest, which contains abundant cavity-bearing trees required by both native bat species for communal roosting, is uncommon in the Wharekirauponga catchment. However, long-tailed bats are highly adaptive and make use of a variety of human-modified habitats

[10] A single pass, annotated "Thames Valley" and dated 1900, is included in the database but is considered an unreliable record.

across the country, including utilisation of pines and other exotic trees with suitable features for roosting. Adult male and non-breeding female long-tailed bats also roost alone as they move widely through the landscape and are less selective in their choice of solitary roosts. Hence, trees greater than 15 cm diameter, treeferns, and sheltered features with holes or crevices are all regarded as potential solitary roosts.

Bat surveys have previously been carried out at specific sites as part of the Wharekirauponga exploration drill surveys and baseline ecological surveys (BML 2018, 2019a, 2019b, 2021a). A total of 15 sites throughout the Wharekirauponga area have been surveyed for 220 nights. No bats have been detected in the Wharekirauponga catchment during any of these surveys.

The wider Coromandel Forest Park offers high quality habitat for bats, containing abundant suitable roost trees (native or exotic trees measuring greater than 15 cm DBH that have roosting habitat features, including hollows, cavities, knot holes, splits, cracks and peeling/flaking bark) and protected flyways (e.g., stream corridors).

5.1.5 Native Birds

New Zealand Bird Atlas records for grids AG76 and AH77 (encompassing the Willows Road property and part of the Wharekirauponga catchment area) comprises 8.79 and 15.83 person hours of survey respectively. These surveys recorded 41 bird species (excluding coastal species which are not relevant to this assessment), most of which were recorded in primarily rural areas. Twenty one of the 41 species listed were native, and all but two (kākā, At Risk - Recovering and Australasian coot, Naturally Uncommon) are classified as Not Threatened. The bird survey data recorded in the NZ Bird Atlas reflects a low survey effort and bias towards rural / urban areas and does not present a representative summary of the forest avifauna assemblage.

Bird species recorded in the SNA report for Waihi ED included korimako / NZ bellbird, tūī and kererū, all of which were described as being “common”. Kākā and North Island brown kiwi (Kessels & Associates, 2010) were described as ‘occasional’, and potentially persisting in low numbers in Waihi ED, respectively.

Twenty-four bird species were recorded during baseline surveys (16 native, 8 exotic), including common forest birds such as miromiro / tomtit, riroriro / Grey warbler, ruru / morepork, kererū, tūi and korimako / NZ bellbird (Figure 6, Table 5). Kākā were also heard incidentally throughout the site although not captured during formal surveys or on acoustic recorders.

Table 5: Bird species recorded in Coromandel Forest Park (Coromandel Forest Park) during baseline biodiversity surveys in January – February 2019 and November – December 2020, at Willows Road Farm in 2021 and species recorded in the NZ Bird Atlas (grids AG76 and AH77, accessed 27 April 2022). Green shading indicates that a species was recorded. Red shading highlights species of conservation concern.

Common name	Species	Threat Classification (Robertson et al., 2021)	Recorded in Coromandel Forest Park (2019)	Recorded in Coromandel Forest Park (2020)	Recorded at Willows Road Farm (2021)	Recorded in NZ Bird Atlas
Pīwakawaka / New Zealand fantail	*Rhipidura fuliginosa*	Not Threatened				
Kāhu / Australasian harrier	*Circus approximans*	Not Threatened				
Korimako / Bellbird	*Anthornis melanura*	Not Threatened				
Riroriro / Grey warbler	*Gerygone igata*	Not Threatened				
Keruru / NZ pigeon	*Hemiphaga novaeseelandiae*	Not Threatened				
Kotare / Kingfisher	*Todiramphus sanctus*	Not Threatened				
Tauhou / Silvereye	*Zosterops lateralis*	Not Threatened				
Miromiro /Tomtit	*Petroica macrocephala*	Not Threatened				
Tūī	*Prosthemadera novaeseelandiae*	Not Threatened				
Warou /Welcome swallow	*Hirundo neoxena*	Not Threatened				
Pōpokotea / Whitehead	*Mohoua albicilla*	Not Threatened				
Kākāriki/ Yellow-crowned parakeet	*Cyanoramphus auriceps*	Declining				
Pūtangitangi / Paradise shelduck	*Tadorna variegata*	Not Threatened				
Ruru / Morepork	*Ninox novaeseelandiae*	Not Threatened				
Dunnock	*Prunella modularis*	Introduced				
Kākā	*Nestor meridionalis*	Recovering				
Pīpīwharauroa / Shining cuckoo	*Chrysococcyx lucidus*	Not Threatened				
Eurasian Blackbird	*Turdus merula*	Introduced				
Chaffinch	*Fringilla coelebs*	Introduced				
Eastern Rosella	*Platycercus eximius*	Introduced				
House sparrow	*Passer domesticus*	Introduced				
Australian Magpie	*Gymnorhina tibicen*	Introduced				
Redpoll	*Carduelis flammea*	Introduced				
Song thrush	*Turdus philomelos*	Introduced				
Mallard Duck	*Anas platyrhynchos*	Introduced				

Spotted Dove	*Anas platyrhynchos*	Introduced				
Pukeko	*Porphyrio melanotus*	Not Threatened				
Common myna	*Acridotheres tristis*	Introduced				
White-faced heron	*Egretta novaehollandiae*	Not Threatened				
Mallard & Pacific black duck hybrid	*Anas platyrhynchos/ Anas superciliosa*	Introduced				
European goldfinch	*Carduelis carduelis*	Introduced				
Yellowhammer	*Emberiza citrinella*	Introduced				
Ring-necked Pheasant	*Phasianus colchicus*	Introduced				
Spur-winged plover	*Vanellus miles*	Not Threatened				
European Greenfinch	*Carduelis chloris*	Introduced				
Common starling	*Sturnus vulgaris*	Introduced				
California Quail	*Callipepla californica*	Introduced				
Wild turkey	*Meleagris gallopavo*	Introduced				
Eurasian skylark	*Alauda arvensis*	Introduced				
Australian coot	*Fulica atra*	Naturally Uncommon				
Greylag goose	*Anser anser*	Introduced				
New Zealand scaup	*Aythya novaeseelandiae*	Not Threatened				
Rock pigeon	*Columba livia*	Introduced				
Peafowl	*Pavo cristatus*	Introduced				
Canada goose	*Branta canadensis*	Introduced				
Muscovy duck	*Cairina moschata*	Introduced				

Most birds recorded are considered locally abundant in Coromandel Forest Park, and within Waihi ED (Kessels & Associates, 2010). Species of note observed during 2019 and 2020 surveys include the whitehead / pōpokatea[11], yellow-crowned kākāriki and kākā. These species are classified as At Risk or Conservation Dependent (Robertson et al., 2021), primarily due to their susceptibility to introduced mammalian predators. Their presence is likely a result of the pest control (including aerial 1080 applications, most recently in 2021) undertaken by DOC in the wider conservation estate.

Species regarded as potentially present within the wider Coromandel Forest Park that were absent from our surveys include North Island brown kiwi[12] (which has not been recorded in the area for decades) and koekoeā / long-tailed cuckoo, a migratory species that breeds in New Zealand forests over spring and summer. Koekoeā / long-tailed cuckoo is a "brood parasite" that relies on other birds to raise their young, and in the North Island parasitises nests of pōpokatea / whitehead. Koekoeā / long-tailed cuckoo are listed as Nationally Vulnerable (Robertson et al., 2021), with their decline likely connected to the decline in range and abundance of their host species.

5.1.6 Native Invertebrates

Kessels & Associates (2010) notes two invertebrate taxa of conservation interest within the Waihi ED, these being paua slug (*Schizoglossa worthyae, S. novoseelandica novoseelandica*) and a flightless stag beetle (possibly Te Aroha stag beetle - *Geodorcus auriculatus* sp.).

The distribution of *G. auriculatus* is not well known (Sparse according to Leschen et al. (2012)), but is recorded from forest near Golden Cross (Kessels & Associates, 2010), and scattered observations have been recorded on iNaturalist in forested areas in the wider Waihi ED. Large, flightless invertebrates such as this beetle are vulnerable to habitat destruction and predation by invasive mammals such as rats and pigs (Leschen et al., 2012). No large stag beetles were observed during field surveys, though nocturnal searches are not optimal for finding beetles.

Paua slugs are a nocturnal, carnivorous slug that have been recorded in the Wharekirauponga area (Appendix 2). Twenty-two paua slugs were observed within the Wharekirauponga catchment during nocturnal surveys, with a greater frequency of observations in areas with higher search effort. Two paua slug shells were also noted. Paua slugs were found to be sparsely distributed and did not emerge reliably on consecutive nights. One of the paua slug species that may be present, S*. worthyae*, is listed as Nationally Vulnerable, and S. novoseelandica is Not Threatened (Walker et al. 2022).

Peripatus / Ngaokeoke (Not Threatened; Trewick et al., 2018) is another nocturnal invertebrate generally found only where forest cover is largely intact, with abundant leaf litter and woody debris and minimal disturbance or stock intrusion. Ngaokeoke were observed within the Wharekirauponga catchment (BML, 2019, 2021; likely *Perpatoides sympatrica* and *P. aurorbis).* Auckland tree wētā (*Hemideina thoracica*) and species of cave wētā (*Pachyrhamma spp*) (both classified as Not Threatened (Trewick et al., 2014) were observed frequently during surveys in Wharekirauponga (BML 2018, 2019).

Where indigenous forest cover is largely continuous and intact, with well-developed vegetation tiers, abundant leaf litter and minimal disturbance (e.g., due to stock intrusion etc), we consider that the invertebrate community is likely to contain a characteristic suite of native forest taxa. This assumption is borne out by our observations of forest interior species such as wētā, paua slugs and peripatus in forested sites.

[11] In the 2021 threat classification series, North Island brown kiwi and whitehead / pōpokatea were moved out of the 'At Risk' category to 'Not Threatened' but with the qualifier of 'Conservation Dependent'

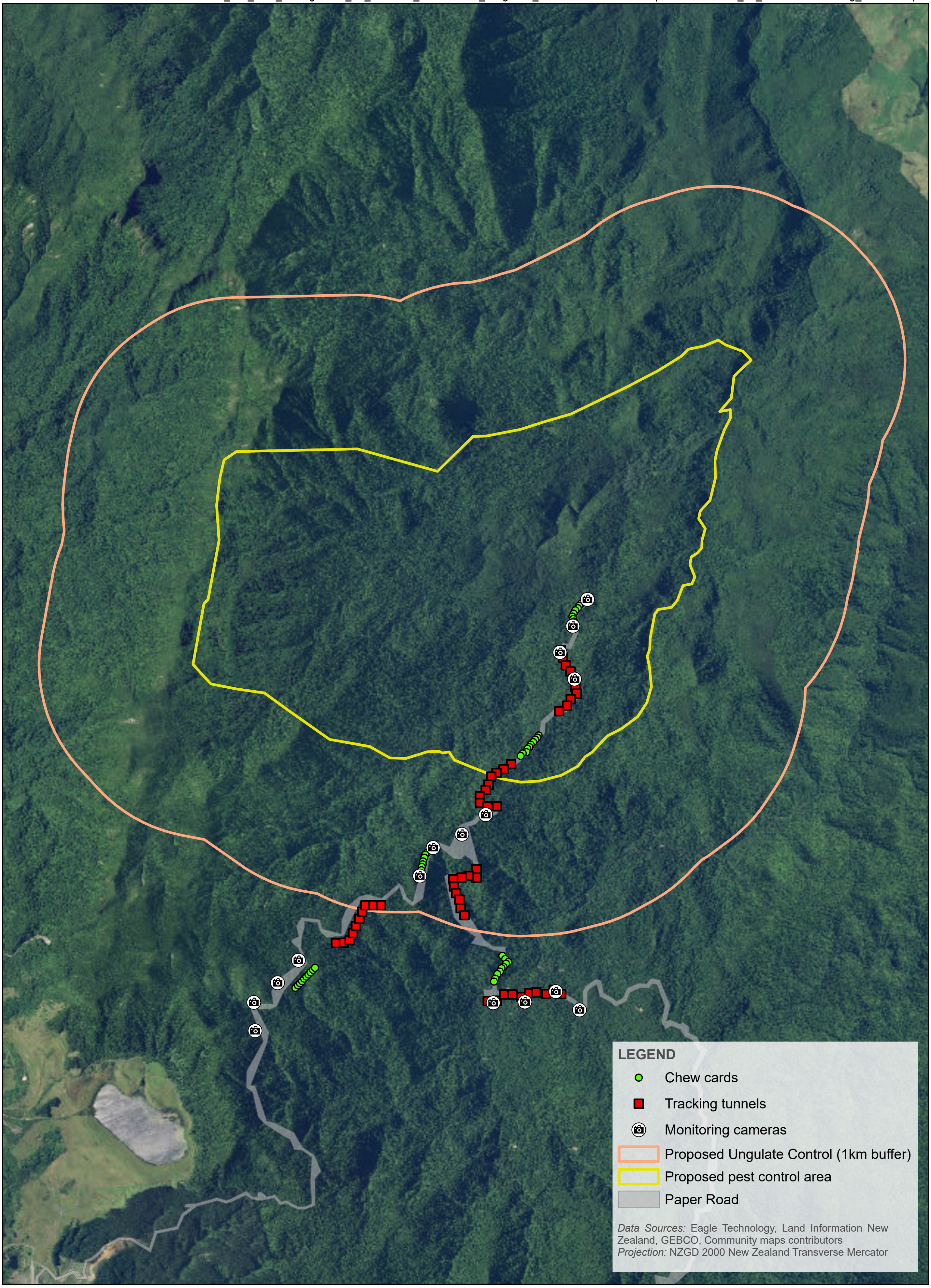
[12] Specific surveys for North Island brown kiwi were carried out in Wharekirauponga 2019, but they were not detected.

5.1.7 Predators and Pest Animals

Baseline monitoring conducted to date has shown very high pest densities within and around Wharekirauponga. Baseline pest monitoring locations are shown in Figure 8. During the winter and spring monitors in 2024, pest densities across the area were consistently high, despite the expected reduction in pests in winter due to colder temperatures (BML, 2025b). Findings include:

- Results of rat monitoring show 'very high' rat population densities. Rats are known as important predators of native frogs, lizards and birds.
- Mouse densities were 'moderate - high', possibly slightly lower than rats due to outcompeting by rats over lures provided during monitoring, as well as colder temperatures. Mice are thought to predate juvenile native frogs.
- Possum activity was 'moderate-high. Possums browse native vegetation and prey upon nesting birds.
- Stoats were observed in moderate-high densities, despite their seasonal behaviour meaning they are usually tracked at low densities in winter (peak stoat activity is during late spring and summer and numbers are greatly reduced during colder months). It was possible to identify multiple individual stoats from camera images. Stoats are a key predator of native lizards, birds and frogs.
- Feral cats were detected on camera and may be a key predator of native frogs and other species.
- Pigs were detected in moderate numbers at trail cameras, despite not being a target species for the lures and survey tools used. Pig sign (i.e. root rutting, churned up soil), was also noted in the field consistently across the site. This likely indicates that pig numbers are high. Pigs have been documented directly predating native frogs and other native species as well as damaging the forest floor, and thus impacting forest successional processes.

Overall, the monitoring shows very high pest densities in Wharekirauponga.



Boffa Miskell

www.boffamiskell.co.nz

SOUTHERN COROMANDEL PEST MONITORING

Baseline Pest Monitoring Locations

Date: 13 February 2025 | Revision: 0

Plan prepared for OceanaGold by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: LMa

Figure 8

5.1.8 Summary of Ecological Values

In accordance with the EIANZ method (Roper-Lindsay et al., 2018) of assigning value to ecological features, the WUG Project Area has been evaluated through a process of describing and assessing the value of a range of component attributes (grouped into four broad "matters"). Scores for each matter are then summarised as a holistic judgement of overall ecological value.

Both the overall judgement and the detailed analysis are important for subsequent assessment of ecological significance and level of effects, as adverse effects on all component attributes that have moderate or greater ecological values must be addressed.

The ecological values associated with the WUG Site are set out in Table 6.

Table 6: Ecological values within the WUG Site.

Matters	Attributes
Representativeness	Very High Vegetation community structure and composition is characteristic of mid-elevation native forests in the Coromandel[13]. All vegetation tiers are present, although regeneration is impacted by pig rooting and browse in places. Exotic species are rarely encountered. The avifauna assemblage recorded during baseline ecological surveys is representative of forest habitats in Waihi ED.
Rarity / distinctiveness	Very High Both Archey's and Hochstetter's frogs at classified as 'At Risk – Declining', although Archey's frogs have a more restricted range nationally. The Coromandel population of Archey's frogs is one of three populations in NZ[14]. *Pittosporum virgatum,* kauri (both Threatened – Nationally Vulnerable) and king fern (At risk – Declining) recorded at Wharekirauponga. Site is near southern distributional limit for *Pittosporum virgatum.* *Pittosporum virgatum* and kauri (both Threatened – Nationally Vulnerable) and king fern (At risk – Declining) were recorded at Wharekirauponga. Native lizards recorded from the Coromandel include one threatened species and five 'At Risk' species. Surveys at Wharekirauponga have recorded forest gecko and elegant gecko (both classified as "At Risk – Declining'). Pōpokotea (Not Threatened but with a patchy distribution), yellow crowned kākāriki (At Risk - Declining), and kākā (At Risk - Recovering) were recorded in Wharekirauponga. Pōpokotea is of note as the brood host of long-tailed cuckoo (not recorded during surveys but known to inhabit Coromandel Forest Park), which is classified as Threatened - Nationally Vulnerable.

[13] Rimu-tawa forest within the Coromandel Ranges and Hapuakohe Ranges is the largest vegetation unit within the District. Secondary growth kanuka forest and logged kauri and tawa forest are also well represented, with much of this forest type being present along the eastern flanks of the Hapuakohe Range and in the northeastern hill country forests north and south of Waihi (Proposed Hauraki District Plan, Section 6.2 (November 2012)).

[14] Archey's frogs occur naturally in the Coromandel and Whareorino Forest. A population of Archey's frogs was translocated to Pureora Forest in 2006 (Bishop et al., 2013).

Diversity and pattern	Very High Vegetation communities in Coromandel Forest Park are highly diverse, supporting natural successional and altitudinal patterns. The Project Area has habitat value for both Archey's and, to a lesser extent, Hochstetter's frogs. Both species are known to be present in surrounding catchments and the Coromandel Ranges forest environments more generally. Hochstetter's frogs are more likely to be associated with stream margins and small tributaries. Wharekirauponga and the Project Area are close to the known range limit for Archey's frogs in southern Coromandel (although data is patchy). Coromandel Forest Park is one of two areas where Archey's and Hochstetter's frogs are sympatric[15]. Archey's frogs and Hochstetter's frogs do not occupy the same habitats, and their distributions within Coromandel Forest Park follow natural patterns. The terrestrial invertebrate community includes a variety of taxa indicative of complex and intact forest interior habitat. Habitat for bats, native lizards and avifauna within Wharekirauponga and the Project Area is high quality, though vertebrate pests cause visible degradation in places and are likely to reduce the availability of safe sites. Habitat for bats is abundant within Coromandel Forest Park, but there have been no confirmed records of bats in Wharekirauponga in 20 years, despite 228 nights of survey in Wharekirauponga between 2017-2021 (Appendix 1)
Ecological context	Very High The Project Area where the proposed vent raises will be located are within a largely intact forested corridor within the lower Coromandel Peninsula that supports a diverse range of flora and fauna in all life stages. Habitats within Coromandel Forest Park provide secure long-term habitat for native flora and fauna. The park is large (approx. 72,000 ha), provides continuous habitat for dispersal, and connectivity for wide ranging species (e.g. kākā).
Overall ecological value	**Very High**

5.2 Willows Road Farm

5.2.1 Vegetation Description

Native forest and scrub vegetation present within the Project Area on the Willows Road Farm property mainly comprises narrow riparian remnants confined to steep tributary sides, and some isolated trees in pasture (vegetation survey areas 6 & 7 shown in Figure 9, assessed as a representative sample of better-quality riparian vegetation within the property). Riparian areas are all currently unfenced and are heavily grazed (Figure 9, Figure 10, Figure 15).

Mānuka forms a fragmented canopy interspersed with emergent tawa, kohekohe and nikau, above an understorey of kawakawa, karamu, māhoe, wineberry and several fern species. These riparian remnants lack a ground tier and regeneration of indigenous species is sparse or absent due to stock grazing and trampling. Riparian vegetation supplies shading and organic input functions to the incised tributaries, but little terrestrial habitat value for native fauna.

[15] Archey's frog and Hochstetter's frog are also both present in Whareorino Forest (Bishop et al., 2013).

Figure 9: Riparian vegetation within vegetation survey areas 6 and 7.

The footprint within which the rock stack is proposed overlies Tributary 2, and is typical of the surrounding Willows Road Farm site, comprising sparse woody vegetation, with only occasional native species (e.g. māhoe, mānuka, wheki and ponga) (Figure 10, Figure 15). The Tributary 2 stream channel is steep with evidence of erosion, and pasture grasses are present within the channel itself. Native scrub becomes denser further upstream as the stream and tributaries become more incised. Māhoe and makomako are common shrubs, with ferns in the understory. Vegetation quality was assessed as poor with many dead trees observed.

Figure 10: Riparian vegetation along Tributary 2 within the footprint of the proposed Willows Rock Stack at Willows Road Farm, Waihi. Downstream view (left), upstream view (right).

Larger indigenous forest fragments are present within Willows Road Farm outside of the Project Area, including on the northern boundary and eastern land parcel (vegetation survey areas 1, 2, 3, and 5 in Figure 11, Figure 15).

Vegetation on the boundary with Coromandel Forest Park (vegetation survey areas 1 & 2; refer Figure 11, Figure 15) includes mature forest remnants with patchy undergrowth near the proposed Vent Raise 1 site, and areas of secondary scrub dominated by mahoe, with common karamu, pōnga, lancewood and pigeonwood. Kahili ginger (an invasive environmental weed) dominates the understorey, and pampas is also locally common. Vegetation survey area 1 is partially fenced, and mānuka, bracken and kiokio ferns grow along the fence margins, interspersed with rank pasture grass. A large rewarewa and a rimu are present next to the river. Several hillside seepages are evident, and margins of streams and hillside seepages are dominated by ferns, including ponga, whekī, mamaku and gully tree fern.

Pig disturbance (rooting) was evident throughout scrub and forest remnants on the margins of Coromandel Forest Park, but the feature nevertheless contains a fairly representative composition and species assemblage, largely as a result of stock exclusion.

Figure 11: Secondary scrub on northern boundary of Willows Road Farm (vegetation survey area 1). Coromandel Forest Park visible in the background.

A stand of secondary forest and scrub covers 5.3 ha of moderate to steep hillslopes on the northeastern boundary of Willows Road Farm (vegetation survey area 3, Figure 15). This feature is the largest patch of native vegetation within the property. Mature secondary forest species (tawa, rewarewa and kohekohe) dominate the canopy, with a sub-canopy of mahoe, tree ferns and epiphytes growing on the trunks of larger host trees. The bush remnant is unfenced, and understory and ground floor are sparse due to heavy stock grazing (Figure 12).

Figure 12: Forest remnant in survey area 3. Note unfenced margins and absence of ground cover vegetation.

A small, isolated bush remnant in a stream gully is present on the eastern side of the property (vegetation survey area 5, Figure 13, Figure 15). Mature mahoe trees grow intermittently along the streambank, with occasional pigeonwood and pukatea interspersed throughout. Pasture grass forms a sparse ground cover beneath mature trees and directly alongside the stream. There is no recruitment (younger trees or seedlings) due to stock grazing and damage, although plentiful seeds were observed on the forest floor.

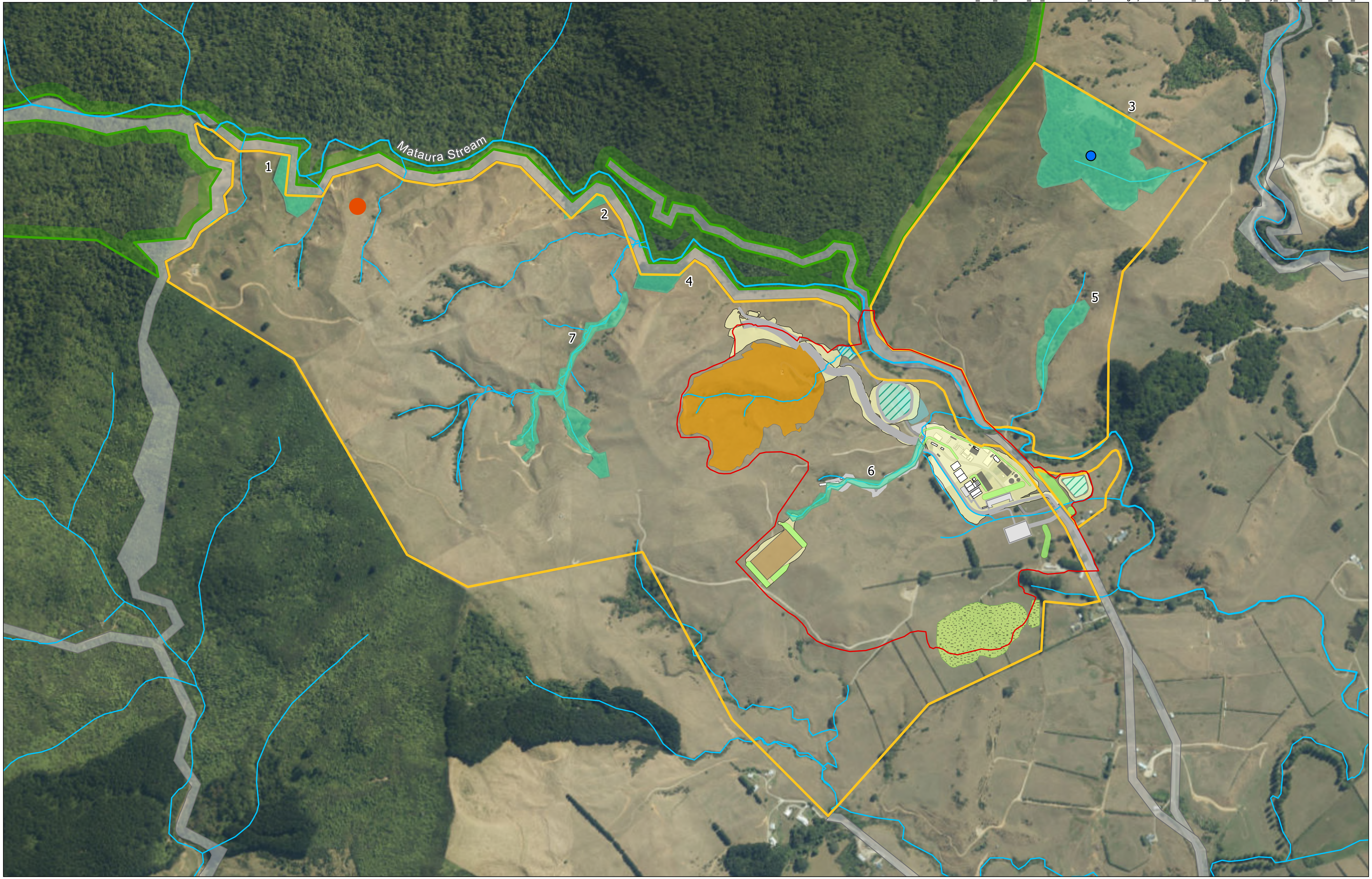
The head of the stream contains a seepage from a spring within a larger area of continuous canopy cover. Pukatea dominates the canopy, along with hinau, titoki, nikau, mahoe, kohekohe, pigeonwood and pōnga. The sub-canopy is devoid of vegetation, other than epiphytes (perching lily, hounds tooth fern and bamboo orchid) on the lower branches of the upper canopy. No understorey or ground cover vegetation is present other than local patches of *Icarus filiforme* fern.

Figure 13: Bush margins and interior of survey area 5.

A mature pine plantation with a native understorey of mapou, mahoe, kawakawa and karamu is present on a steep, east facing, hillside on the northern boundary of Willows Road Farm adjacent to Coromandel Forest Park (vegetation survey area 4; Figure 14, Figure 15). Pampas is abundant on steep banks alongside an access track through the stand.

Figure 14: Mature pines above broadleaved scrub understorey adjoining Coromandel Forest Park (survey area 4).

File Ref: BM200729_Eco_Services_for_OceanaGold_Consenting.aprx / BM200729_15_Vegetation_Survey_Areas_Willows_Road_A3L



Boffa Miskell

www.boffamiskell.co.nz

0 200 m

1:8,000 @ A3

Data Sources: Classic Basemap Server - Deprecated Basemap - Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

Projection: NZGD 2000 New Zealand Transverse Mercator

- Hochstetter's frog
- Indicative shaft
- Vegetation Survey Areas
- Stream
- Farm Property
- Coromandel Forest Park
- Project Area
- Bund
- Hard landscape
- Magazine Footprint
- Retention / Collection Ponds
- Willows Rock Stack
- Topsoil Stockpile
- Access Road\Path
- Building Footprint
- Parking
- Earthworks

ECOLOGICAL SERVICES FOR OCEANAGOLD CONSENTING

Vegetation Survey Areas at Willows Road Farm

Date: 18 February 2025 | Revision: 4

Plan prepared by Boffa Miskell Limited

Project Manager: Katherine.Muchna@boffamiskell.co.nz | Drawn: HCo | Checked: KMu

Figure 15

5.2.2 Native Frogs

Habitat within the Willows Road Farm property was assessed as generally unsuitable for Archey's frogs, being typically small bush patches with minimal understorey, ground cover or leaf litter due to stock damage.

Forest patches in survey area 1 (on the boundary of Coromandel Forest Park and survey area 5 (outside of the proposed works footprint)) (Figure 15) provided more complex ground layer habitat in places but were assessed as being too dry for Archey's frogs due to edge effects and/or a lack of intact forest understorey to maintain a forest interior microclimate. No native frogs were encountered during surveys conducted over 2 nights in May 2022 on the boundary of Coromandel Forest Park and Willows Road Farm. Rats and possums were observed during surveys.

Four potentially affected streams within the project footprint were assessed for possible Hochstetter's frog habitat and searched using systematic search methods (Hare 2012)[16]. Habitat within these streams was assessed as unsuitable for Hochstetter's frogs due to the high level of disturbance and lack of protected long-term refuges for frogs. Hochstetter's frogs favour small streams and tributaries as well as damp forest areas with abundant damp crevices.

A juvenile Hochstetter's frog was recorded in a small stream fed from a freshwater spring near the centre of vegetation survey area 3 (outside of the proposed works footprint, Figure 15), indicating recruitment has occurred in the area.

5.2.3 Native Lizards

Willows Road Farm is heavily impacted from stock access and grazing with few habitats and refuges for native lizards. It is possible that some lizard species suited to grassland habitats (e.g. copper skink) may be present within the farm property in ungrazed areas, although these were assessed as small and isolated at the time of survey and we consider it unlikely lizards are present. Nevertheless, precautionary surveillance and salvage measures will be incorporated into construction management in order to minimise the mortality risk to native lizards.

Vegetation within Willows Road Farm was assessed as low quality habitat for native lizards, due to the relatively poor condition of vegetation remnants, limited refuge availability and prevalence of vertebrate predators. Larger, more intact remnants containing mature trees (survey area 3 and possibly survey area 5) may potentially harbour relict populations of arboreal lizards, however the long term viability of such functionally isolated populations is poor in the absence of habitat restoration or management.

5.2.4 Native Bats

The majority of habitat within the farm property is pasture or scrub and is not suitable for bats, which generally favour mature trees and linear features such as forest margins and vegetated riparian corridors.

The stand of mature pine trees on the northern property boundary offers potential bat roosting habitat. The Mataura River and forest margin also provide a flight corridor that bats may utilise. These potential habitats are all outside of the Project footprint. Long-tailed bats were also

[16] Hochstetter's frog survey dates within the from property include Impact sites 1 and 2 (20-22 July 2020 and 21 January 2021, respectively), and within Vegetation Areas 1-7 (11 November 2020).

recently detected around Gladstone pit (October 2024) (Bioresearches 2025b) and it is possible they may use the wider site intermittently, although there are higher quality habitats in the surrounding area.

5.2.5 Native Birds

Bird surveys (single 5MBCs) were conducted at four sites on Willows Road Farm in November – December 2020, for the purposes of describing the characteristic avifauna assemblage of the site. Species recorded included common native species of forest, scrubland and human-modified landscapes i.e. tūī, pīwakawaka, tauhou, riroriro, kotare, pīpīwharauroa, welcome swallow and several exotic species that inhabit the fringes of native forest (blackbird, chaffinch), along with species more typical of rural and suburban environments (e.g. greenfinch, yellowhammer, magpie, myna, etc) (refer Table 5). Pīwakawaka (fantail) and other unidentified bird nests were observed within scrub on the margin of Coromandel Forest Park (vegetation survey area 1, Figure 15).

5.2.6 Native Invertebrates

Habitat within the Willows Road Farm property was assessed as relatively poor for native terrestrial forest invertebrates due to fragmentation and stock damage. Much of the vegetation cover lacked understorey or ground cover tiers, leaf litter was sparse or shallow, and soil was frequently compacted.

5.2.7 Summary of Ecological Values

Willows Road Farm ecological features have been evaluated using the EIANZ with respect to component attributes of each of four "matters", as per the EIANZ method (Roper-Lindsay et al. 2018). Scores for each matter are then summarised as a holistic judgement of overall ecological value. Note that ecological features on the property that are not impacted by the works are described but excluded from the assessment of attribute values.

The ecological values associated with the WUG Site are set out in Table 7.

Table 7**:** Ecological values of vegetation communities within the Willows Road Farm Area.

Attribute	Willows Road farm
Representativeness	<u>Very Low</u> Within the project footprint, pasture grassland and exotic species dominate. Native vegetation is confined to scattered patches of scrub in gully systems. Native vegetation communities elsewhere within the farm property mainly comprise small, degraded riparian fragments. Vegetation on the boundary of Coromandel Forest Park and remnants in the northeastern arm of the property are somewhat more intact, though still impacted by stock and weeds.
Rarity / distinctiveness	<u>Very Low</u> No Threatened or At Risk flora, fauna or communities were observed in the terrestrial habitats within the Project footprint.

	Common native and introduced species were recorded during surveys. Rare and distinctive bird species are unlikely in this habitat based on local bird atlas records. A stand of swamp maire is present in a wetland outside the project footprint (refer Boffa Miskell 2022a). A single Hochstetter's frog was recorded in the headwaters of a stream in vegetation survey area 3 (outside of the Project footprint).
Diversity and pattern	<u>Low</u> Vegetation communities on the farm property are of low diversity, consisting of a mix of native and exotic species commonly found in rural / agricultural environments. Habitat within the project footprint (and wider farm property) is largely unsuitable for native frogs with the exception of streams and flow paths in vegetation survey area 3 (outside of the Project footprint). Habitat within the project footprint (and wider farm property) is largely unsuitable for native lizards although potential habitat for grassland species (e.g. copper skink) is present in ungrazed areas. Habitat quality within the project footprint (and wider farm property) is poor for terrestrial invertebrates characteristic of forest ecosystems. Stands of intact native vegetation that provide higher quality lizard habitat are outside of the Project Area where vegetation clearance will occur. Potential bat habitat within the farm property is present but limited in quality and extent, and assessed as unlikely to be occupied by bats. Potential roost habitats are all outside of the Project footprint, though the final location of Vent Raise 1 may be in the vicinity of mature trees in vegetation survey area 1.
Ecological context	<u>Very Low</u> The project footprint does not contain ecological features of any 'provenance' value, or contribute to any network of terrestrial ecological features. Outside of the Project footprint, patchy native vegetation provides a modest amount of habitat for common flora and avifauna but is unlikely to form an important corridor or linkage for any species. Vegetation on the boundary with Coromandel Forest Park is of value as a buffer to the extensive forested reserve, though weed infestations present are likely to provide a propagule source for further encroachment into the park.
Overall ecological value	**Low**

5.3 Indigenous Biodiversity Significance

The Wharekirauponga catchment in Coromandel Forest Park meets the following WRPS criteria for indigenous biodiversity significance:

1. Wharekirauponga catchment is within Coromandel Forest Park, which is protected for conservation purposes.
3. The Catchment contains habitat for indigenous species that are classed as threatened or at risk (two tree species observed in surveys are classified as ‘Threatened – Nationally Vulnerable’; and at least two frog, two gecko, two bird and one fern species classified as ‘At Risk’), or at the limit of their natural range (Archey’s frogs and *Pittosporum virgatum*).
7. It is an area of indigenous vegetation or naturally occurring habitat that is large relative to other examples in the Waikato region of similar habitat types, and which contains all or almost all indigenous species typical of that habitat type.
9. It is an area of indigenous vegetation or habitat that is a healthy and representative example of its type because:
    - its structure, composition, and ecological processes are largely intact; and
    - if protected from the adverse effects of plant and animal pests and of adjacent land and water use (e.g. stock, discharges, erosion, sediment disturbance), it can maintain its ecological sustainability over time.
10. It is an area of indigenous vegetation or habitat that forms part of an ecological sequence, that is either not common in the Waikato region or an ecological district, or is an exceptional, representative example of its type.
11. It is an area of indigenous vegetation or habitat for indigenous species (which habitat is either naturally occurring or has been established as a mitigation measure) that forms, either on its own or in combination with other similar areas, an ecological buffer, linkage or corridor and which is necessary to protect any site identified as significant under criteria 1-10 from external adverse effects.

Terrestrial biodiversity values in the WUG works footprint outside of Coromandel Forest Park (i.e. Willows Road Farm) do not meet any WRPS significance criteria.

6.0 Actual and Potential Ecological Effects

6.1 Proposed Works and Associated Effects

The potential adverse ecological effects of the WUG are associated with exploration, construction and operational activities. These are grouped into three stages to facilitate the approvals process.

The key stages of the WNP would comprise:

<u>Stage One</u>: Willows Access Tunnel decline, infrastructure associated with the Willows Access Tunnel at Willows Road Farm, upgrades to the existing WTP, and Wharekirauponga resource investigation and exploration progression through surface drilling and hydrogeological pump testing;

Stage Two: Wider mining development and production associated activities including drilling and blasting to access and recover the resource (localised around the orebody) and associated sustained air discharges and noise and vibration effects; and

Stage Three: Remediation / Closure Activities.

The assessment of potential ecological effects is described in detail in Sections 6.2 – 6.5 and includes:

- An overview of possible fauna responses to indirect impacts (noise, vibration and light) based on available literature.
- Potential effects associated with works around Willows Road Farm.
- Localised potential effects in Coromandel Forest Park associated with exploration drilling and operation of vent raises.
- Potential long-term or widespread effects in Coromandel Forest Park - these potential effects are typically more uncertain, long-term (if realised) and / or widespread (beyond specific drill site or vent raise areas).

A brief statement of the management response for each effect is provided following the effect description.

A summary of the potential ecological effects is provided in Section 6.6.

6.2 Literature Review of Potential Fauna Responses to Non-Lethal Disturbance and Stressors

6.2.1 Overview

This section provides an overview of potential fauna responses to changes to the natural environment that may result from the WNP. This section does not evaluate the likelihood of occurrence, or the severity of the potential effect for this project. These are assessed in Sections 6.3-6.6 with specific reference to the activities of the WNP, and ecological communities in Willows Road Farm and Coromandel Forest Park.

Fauna responses to non-lethal stressors (for this assessment, these are noise, vibration and light (specifically artificial light at night, ALAN)) may include prolonged physiological stress and energy expenditure that may compromise the health of individuals, avoidance behaviours, altered behaviour (e.g. change in volume or pitch of bird calls, reduced emergence) and reduced / failed reproduction. The ability to move away from these stressors varies between individuals, species, and factors like mobility, habitat requirements, exposure to predators, reproductive state and dormancy / torpor (if applicable).

The section below briefly describes potential behavioural responses by fauna groups to key stressors arising from the proposed surface exploration drilling and underground mining operation. We note that fauna responses to some of these environmental effects are understudied, particularly in the New Zealand situation, and our assessment reflects the available literature. Further, fauna responses to the combined influence of these stressors are largely unstudied and may result in unexpected patterns of behaviour (Willems, 2022). It is likely that given species-specific variation in responses to these stressors, that at a community level, the combined effect will be that less tolerant species are excluded from the most impacted areas of forest.

With respect to noise and light impacts associated with surface drilling activities, we note exploration drilling is underway at three drill rigs. As such, there is an existing modified noise[17] and light environment around those rigs. Responses of fauna to this modified environment have not been studied, but several authors have noted the difficulties in drawing robust, ecologically valid conclusions about the impacts of environmental stressors in dynamic natural environments.

6.2.2 Terrestrial Invertebrates

Noise

Terrestrial invertebrates are a large and diverse group and are generally poorly studied with respect to responses to stimuli. Many invertebrate species have a proven ability to hear and use sound to communicate and to understand their environment. Noise may be disruptive for invertebrates that communicate by sound by interfering with their perception of natural sounds (masking). Depending on the acoustic characteristics (i.e. volume, frequency, impulsiveness / constancy) of the noise, the individual may demonstrate behavioural and/or physiological responses. Behavioural responses of invertebrates may include aversion (if the individual is mobile), or adaptation to compensate for increased background noise. Many invertebrates communicate at frequencies below 10 kHz but may be sensitive to frequencies up to 100 kHz (Morley et. al 2014, and references therein).

The effects of noise on invertebrate species in New Zealand is understudied, although there is likely to be highly species-specific responses. For example, New Zealand tree wētā (*Hemideina* spp.) readily communicates by stridulation[18] that produces a low frequency chirping sound. These sounds are important in social behaviour, for both aggressive and mating interactions (Ewers and Cowley, 2005). In contrast, ground wētā (*Hemiandrus* spp.) primarily communicate using vibration signals as they lack tympanal hearing organs. Both ground wētā and tree wētā are common in Coromandel Forest Park.

Vibration

As with noise, vibration effects on native invertebrates are not well understood, but it follows that species that rely on vibration signals for communication or as an environmental stimulus are probably more sensitive to human-induced vibration. For example, ground wētā (*Hemiandrus* spp.) primarily communicate using vibration signals. Ground wētā burrow in soil and mate on leaf litter which also transmits signal vibrations. Males also use vibrational signals to defend their burrows and territory. Vibrations produced are sexually dimorphic (Hill, 2001; Gwynne, 2004). Tree wētā have a suite of tibial organs which allow them to sense both substrate vibrations and air borne sound (Strauß et al., 2017). Tree wētā produce vibrations on mānuka trees as a method to locate mates (Hill, 2001). Both ground wētā and tree wētā are common in Coromandel Forest Park.

Light

The potential effects of ALAN on insects (reviewed in Owens and Lewis, 2018) may include:

- temporal disorientation (desychronisation from typical activity patterns),

[17] For the purposes of this assessment, when referring to 'noise' associated with exploration drill rigs, this includes noise from the drill machinery itself, nearby pumps and generators.

[18] Vibration produced by rubbing two parts of the body together. In the case of wētā, sounds is produced by rubbing a scraper on the hind legs against a file on the side of the body. Giant wētā also communicate by stridulation, but their known range does not include the Coromandel.)

- spatial disorientation (disrupting orientation cues such as the moon and stars),
- attraction to lights (positively phototaxic species, particularly moths and aquatic insects),
- desensitization to lights (temporary or permanent damage to photoreceptors), or
- reduced recognition (individuals may be less responsive to intra-or interspecies signals).

Invertebrate vision is highly varied and the severity of impact depends on the degree of overlap between the spectral sensitivity of the insect in question and spectral emission and intensity of the particular light source (Gaston et al.,2015, Spoelstra et al, 2023).

Insects attracted to light sources may become trapped in a "light sink" whereby they expend large amounts of energy and are unable to forage, attract mates, or reproduce (i.e. a fatal attraction to lighting (Dugdale, 1994)). Other invertebrate species, such as orb-web spiders may exploit artificially lit areas to catch dazzled prey.

In the New Zealand context, large-scale disruption to pollination activity by moths and other nocturnal insects may have a community-level effect where seed production is reduced and flower, fruit and seed availability for fauna is also reduced. Further, anecdotal observations of activity around streetlights indicates that phototaxic invertebrates are preyed on by ruru / morepork and bats (Simcock et. al., 2022).

6.2.3 Native Frogs

Noise

Archey's frogs do not have inner ear structures and their sensitivity to airborne sounds is limited. Leiopelmatid frogs do not appear to communicate primarily by vocalisation so the noise associated with the surface exploration drilling, and the construction and operation of the vent raises, is expected to have minimal impact on their behaviour or communication.

Archey's frogs are nocturnal, and noise generated during their active period is more likely elicit a response. Construction of the vent raises, and helicopter activity will be limited to daylight hours, outside of their typical active period. Noise associated with active drill sites and the fan when vents are operational would be continuous. Taking a conservative approach, Archey's frogs' response to noise disturbance may include freezing while out of a refuge, resulting in heightened predation risk; or reluctance to emerge from a refuge resulting in inability to find prey / mates. Modelling indicates that operational noise associated with the vent raises will be similar to ambient noise levels, but the noise associated with exploration drilling is much louder than ambient noise levels in close proximity to the drill site. Archey's frogs have been observed near active drill sites (i.e. less than 20 m away, K Muchna, personal observation), but that is not clear evidence there is no impact from noise or other disturbance from exploration drilling.

Vibration

Archey's and Hochstetter's frogs are sit and wait predators that remain stationary for long periods. They may be sensitive to vibration if they use it to detect prey, or if vibrations from natural sources act as behavioural cues (e.g. rainfall vibration as a cue to emerge) although this is unknown. Bioresearches (2025b) has assessed the potential effects of mine blast vibrations from the WNP on native frogs. This assessment includes a review of the biology of Archey's frog, a review of literature and observational data regarding perception of vibrations and an assessment of potential responses to vibrations. In summary, Archey's frogs are thought to potentially be sensitive to vibrations during the breeding cycle (particularly the egg-brooding phase), but there is evidence from a range of sources to suggest that they can tolerate a low level of vibration disturbance, including during brooding. In particular, the persistence of Archey's (and Hochstetter's) frogs in the vicinity of Golden Cross mine, where Archey's frogs were subject to blast vibrations of at least 2 mm/s, and Hochstetter's frogs experienced blast vibrations of up to 6-10 mm/s, indicates that frogs did not disperse or perish despite experiencing mining-associated blasts similar to those expected from the WUG. Bioresearches concluded that the Golden Cross data does not provide evidence of a vibration threshold (both in terms of vibration acceleration and duration) above which an ecologically meaningful response might be expected.

Light

Native frogs are nocturnal, visual foragers and the introduction of ALAN may result in a similar response to those observed in other species (see invertebrate responses, above), including temporal or spatial disorientation; and behaviour changes including reduced emergence / foraging activity, freezing and avoidance as observed in other frog species (described in Buchanan, 1993). Potential indirect effects from these physiological and behavioural changes may include reduced body mass and increased / altered hormone levels (Secondi et. al. 2021). We also note the increased risk of predation by nocturnal predators such as rats and ruru/ morepork in brightly lit areas. The response of leiopelmatid frogs to artificial light has not been studied, but given their propensity to 'freeze' in response to threats, we expect that native frogs would avoid brightly-lit areas.

6.2.4 Native Lizards

Noise

Vocalising is not the primary means of communication for most New Zealand lizard species, although several do produce clicks and squeaks / barks and chirps in distress and as social calls (Hare et al., 2016), often accompanying postural displays. *Naultinus* (green) geckos are known to vocalise conspicuously, but not continuously. Both skinks and geckos have well developed hearing that enables them to respond to predator movement and noise.

The potential response of lizards to noise may range from increased 'freeze' behaviour to avoidance behaviour (i.e. moving away temporarily or permanently). Lizards are likely to acclimatise to continuous, steady noise as from the operational vent raise but it may mask (or be perceived by lizards to mask) predator movements. It is possible lizards may modify their behaviour during vent raise construction because of increased human presence and disturbance, rather than construction noise *per se*. Noise associated with exploration drilling is at a frequency and volume that it could mask interspecific communication and predator activity around active drill sites which would likely elicit an aversion response from *Naultinus* geckos and possibly other lizard species (if present).

Vibration

Substrate-borne vibrations and their relevance to lizards is understudied, although lizards are sensitive to vibrations which may, at least locally or very locally, act as cues or stimuli for predator and prey detection, and changes in their environment. Some older studies have shown the use of vibrations in chameleons on plants to communicate between opposite sexes (Barnett et al., 1999). The sandfish lizard (*Scincus scincus*) has also been shown to detect vibrations from its prey on the surface when being buried under sand up to 15 cm deep (Hetherington, 1989). It remains unknown if New Zealand lizards use similar cues.

For lizards within Coromandel Forest Park, infrequent blast vibrations may cause them to be startled, potentially resulting in freezing behaviour when they are in the open (emerged), or increased reluctance to emerge. These behaviours may increase predation risk or reduce fitness (as a result of stress), respectively. The blast vibrations are expected to be of short duration (approximately 10-12 seconds each during the production phase) and occur 3-4 times per day.

Light

New Zealand lizards exhibit a range of activity patterns throughout the day and night, including diurnal (day active), nocturnal (night active), crepuscular (active at dawn and dusk) and cathermeral (irregularly active) activity periods (Hare, et. al. 2016). As such, changes to the photoperiod and/or temporal cues may disrupt activity patterns resulting in indirect behavioural and physiological responses. For the purposes of this assessment, we consider the two species recorded in Wharekirauponga, *Naultinus elegans* (elegant gecko), and *Mokopirirakau granulatus* (forest gecko). Elegant geckos are diurnal, although easily observed on trees at night; and forest geckos are classified as cathemeral.

Lizards in New Zealand are both predators (of invertebrates and smaller lizards), and prey (of rodents, mustelids and larger mammalian species). As such, there may be a trade-off whereby brightly lit areas may have a higher density of invertebrate prey, but lizards are more visible to predators. Or, that increased light may also improve the detection of predators, and on balance, is beneficial (Nordberg and Schwarzkopf, 2022).

Anecdotal observations suggest that native lizards may be able to adapt to some level of artificial lighting as they are observed in urban settings and along road margins.

6.2.5 Bats

Noise

Bat populations (if present) within Coromandel Forest Park may respond to a localised increased noise environment with avoidance if the noise is within a frequency that they can perceive. Previous studies on road traffic impacts on long-tailed bats showed that bat activity declines rapidly as traffic rates increase at night (Smith et al 2017). The extent of these impacts at a population level was not explored. Similarly, a study using bat detector units to assess long-tailed bat activity near New Zealand highways showed a negative relationship between bat activity and night-time traffic volume adjacent to the highway, whereas bat activity recorded on distant bat detector units had no discernible relationship with night-time traffic volume (Borkin et al., 2019). The importance of specific factors (e.g. noise, lighting, odour, etc) associated with the highway that may have produced the response was not assessed.

Long-tailed bat calls have a peak amplitude at or around 40 kHz, and short-tailed bats call between 25-30 kHz and 50-60 kHz. These call frequencies are outside of the sound frequencies recorded by Marshall Day (2025a and b) from their measurement of noise environment within Wharekirauponga.

Vibration

Vibration effects on bats are poorly studied internationally and in New Zealand. Bats are highly mobile and would be able to relocate in the event that vibrations were distressing. We further consider that vibrations will be barely perceptible in an arboreal roost.

Light

Several observational and experimental studies of long-tailed bats indicate that bat activity decreases in response to streetlights or brighter illumination, suggesting that bats may avoid brightly lit areas (reviewed in Cieraad and Farnworth, 2023).

In an experimental study, bats emerged approximately 2 hours later on lit nights in comparison to unlit nights[19], suggesting artificial lighting may also impact circadian cycles and natural emergence cues. Both of these responses may effectively reduce foraging duration and extent of foraging habitat available. However, anecdotal observations of long-tailed bats feeding around streetlights in urban areas suggest a potential attraction to light, or habituation to light and learned behaviour of greater feeding opportunities.

The net impacts on fitness of these competing responses is not well understood, but it is likely that naïve individuals would likely avoid localised brightly lit areas if suitable habitat was available nearby.

6.2.6 Native Birds

Noise

New Zealand forest bird species are highly vocal and highly mobile and may display aversion behaviours if the noise associated with exploration, helicopter activity or ventilation fans is disruptive. However, international studies indicate that birds do soon habituate to regular disturbance, particularly continuous, steady noise (Harbrow et al., 2011).

The types of behaviours that birds may display to compensate for elevated background noise levels includes avoidance of particularly loud areas; changing the strength, nature, and frequency of calls; and foraging birds increasing vigilance in response to the perceived reduction in awareness of predators. Birds may also compensate for the masking effects of anthropogenic or natural noise sources by selecting perches where the impacts are less severe (e.g. higher in a canopy, on a ridge) (Harbrow et al., 2011)

Key physiological and population-level effects may include:

- **Reduction in fitness,** because of stress associated with elevated vigilance in response to the perceived reduction in awareness of predators;
- **Impacts on breeding success,** from reduced ability to detect courtship song and engage in normal courtship singing, and inability of parents to hear begging chicks;
- **Masking social calls,** like calls to protect territories, keeping in touch with mates and alerting other conspecifics to danger or food resources.

Vibration

New Zealand forest bird species are highly mobile, and species recorded in Wharekirauponga catchment all nest in trees. Birds are most sensitive during the nesting season (from laying to fledging), but it is expected that vibrations will be barely perceptible in an arboreal nest. Natural disturbance (e.g. high winds) is more likely to impact nesting success.

[19] Recent experimental research showed that bat activity (defined as the number of ultrasonic calls captured by recording devices) started approximately two hours later and was reduced overall on nights when 4000 K lights were on, compared to unlit nights (Schamhart et al. 2023).

Light

Consistent with other taxonomic groups, bird responses to artificial light are specific to the species and the type of light (wavelength and intensity). Birds may change their vocalisation, orientation (particularly migratory birds) and foraging behaviours in response to ALAN. Different types of lighting may favour particular species, thus changing bird community dynamics by altering species richness, relative abundance and community composition in an urban environment (McNaughton et al. 2021).

Cieraad and Farnworth (2023) provide a synopsis of New Zealand studies of the impact of night lighting on various taxonomic groups. ALAN has been shown to alter the timing of behaviours by delaying the onset of tūī dawn chorus after changing from high pressure sodium lighting to LEDs. It is possible that changes to activity patterns following exposure to ALAN are more widespread in New Zealand, but that this is not well studied.

As noted above, anecdotal observations indicate that street lighting attracts native nocturnal insectivores such as New Zealand bats and ruru / morepork, increasing their foraging success (Simcock et. al. 2022).

6.3 Willows Road Farm

6.3.1 Approach

The ecological values of the Willows Road Farm are low, with negligible vegetation values and low fauna values. The potential ecological effects associated with construction and operation of the tunnel and surface infrastructure are well-understood. Engineering interventions (e.g. noise bunds) have been incorporated into the design where appropriate to reduce potential effects on neighbours and fauna outside of the immediate area. This section describes the potential ecological effects of the WNP on the Willows Road Farm site (including the southeastern extent of Coromandel Forest Park, where appropriate). These potential effects include those associated with vegetation / habitat clearance; construction noise; and air discharges.

6.3.2 Effects Associated with Vegetation and Potential Habitat Clearance

The proposed construction footprint for the Surface Facilities Area on the Willows Road Farm property is a combined area of 18 ha within the 197 ha farm property, comprising:

- Buildings (including office, crib room and change house; first aid room and gatehouse, small service workshop, wash down bay, and stores building);
- Lay down area for storage of tunnelling consumables such as poly pipe, vent bag and rock bolts / mesh;
- Topsoil stockpiles;
- A rock stack;
- Storage ponds for general surface water collection / settling and mine water collection;
- A package sewage treatment plant with septic tank and soak away area;
- Tunnel recycled water storage and air supply

- Private road connection to Willows Road and site connecting roads;
- Helipad; car parks; and explosives magazines;
- Hazardous substances holdings to store diesel, oils, greases, coolants, limestone etc;
- Ventilation fan located just outside the mine portal mounted on top of a sea container or similar (until such time as the first ventilation raise is constructed);
- Ventilation raise located immediately south of the DOC boundary;
- A high voltage (HV) substation including HV and Low Voltage (LV) switch rooms and transformers; and

Throughout the project development phase, the design and layout of the surface infrastructure was developed to avoid native vegetation areas where possible. Approximately 0.25 ha of mixed native / exotic vegetation will be removed in the footprint of the rock stack and portal entrance. Most of the footprint is within existing pasture or modified riparian margin with **Low** or **Very Low** ecological value.

The magnitude of effect of vegetation and potential terrestrial habitat clearance within the farm property is assessed as **Negligible**, i.e. in terms of native vegetation the local change, and catchment change, will be largely indiscernible and have minimal effects upon the availability of habitat or resource for local terrestrial fauna. The ecological value of the vegetation is **Low** and therefore the level of effect of vegetation clearance is assessed as **Very Low.**

Effects management

Effects management for vegetation loss / potential habitat clearance associated with construction includes:

- Vegetation clearance protocols will include surveys to minimise impacts on active bird nests, bat roosts and lizards present within the clearance area. These protocols are described in Section 7.0 and will be described in site-specific management plans.
- Revegetation and fencing of riparian areas is described in the Freshwater and Wetland Ecological Assessment (BML, 2025a).
- Revegetation and remediation of the rock stack area once the rock has been reused / removed at or before mine closure.

6.3.3 Fauna Effects Associated with Construction Noise

Construction noise generating components of the WUG on Willows Road Farm include earthworks and general construction and roadworks for site establishment; construction of the initial tunnel drive including blasting for portal formation; construction and operation of a vent raise; and operation of a temporary external ventilation fan. Noise generated during the construction period will be higher than during operations, and this period is considered below because the effects (if any) would be expected to be higher.

Calculated noise levels at different stages of the project are detailed in the Assessment of Noise Effects (Marshall Day 2025a). Near to the works area[20], calculated noise level during construction ranged from 40 – 50 dB $L_{Aeq\ (15\ min)}$ during the day and from 33 – 38 dB $L_{Aeq\ (15\ min)}$ for night works. Mapped noise contours indicate that daytime noise levels of up to 50 dB L_{Aeq} (15 min) may extend into the south eastern edge of Coromandel Forest Park in some modelled scenarios, this compares to measured ambient noise of 46 dB $L_{Aeq\ (15\ min)}$ in Coromandel Forest Park[21]. As such, construction noise will be approximately ambient for species occupying habitat within the south eastern edge of Coromandel Forest Park.

Modelled night operations are not expected to exceed 40 dB $L_{Aeq\ (15\ min)}$ at night, compared to measured ambient noise of 30 dB $L_{Aeq\ (15\ min)}$ in Coromandel Forest Park. Construction noise will be greatest during site establishment and initial tunnel drive phases (approximately 1 year) but will reduce once the tunnel is established and the work moves underground.

The modelled noise levels described above include the recommended mitigation of noise barriers (bunds) and installing the external ventilation fan in an insulated shipping container to achieve acceptable noise levels.

Modelled noise contours within Willows Road Farm show that noise effects largely avoid the areas with the highest ecological values on the site (i.e. the native bush fragments in the north west and north east of the property). Vegetation within the Project Area that will be exposed to higher noise levels includes narrow riparian margins with Low ecological value for fauna habitat (Section 5.0).

Modelled noise contours that extend into Coromandel Forest Park (50 dB $L_{Aeq\ (15\ min)}$ during the day and 35 dB $L_{Aeq\ (15\ min)}$ at night) are comparable to measured ambient noise levels (41 dB $L_{Aeq\ (15\ min)}$ during the day and 38 dB $L_{Aeq\ (15\ min)}$ at night)[22]. Any potential effects on fauna are most likely frequency[23] and amplitude[24] dependent, and species specific[25]. The predicted noise levels of 40 – 45 dB $L_{Aeq\ (15\ min)}$ are consistent with moderate rainfall levels (i.e. ~50 dBL). At the predicted levels, the noise profile would likely dissipate rapidly across the environmental landscape (i.e. the primary impact area would be very localised) (see noise contour mapping in Marshall Day, 2025a).

Given the small the zone of influence (i.e. Willows Road Farm and the southeastern boundary of Coromandel Forest Park) for increased noise within an extensive high-quality habitat area within Coromandel Forest Park, and the small, expected change in ambient noise we consider that the magnitude of effect of noise is **Negligible.** The ecological value of fauna within the noise affected area on Willows Road Farm is **Low.** Therefore, the level of effect of construction noise is assessed as **Very Low**.

---

[20] i.e. Receivers R33, R34 and R35 in Figure 19 of the Noise Assessment

[21] Ambient noise levels in the existing environment were recorded continuously between 16 and 30 July 2020. Further details provided in Marshall Day (2021). Maximum ambient noise levels (L_{Amax}) of 72 dB (day) and 69 dB(night) were recorded in Coromandel Forest Park during the noise survey period. These noise levels were attributed to natural sources such as wind or birds.

[22] Although note that the decibel scale is logarithmic, not linear.

[23] The frequency of a sound wave is perceived as its pitch or tone.

[24] Amplitude is the height of the sound wave from peak to valley. Amplitude determines the loudness or intensity of the sound.

[25] Factors that may impact an animals' response to noise include the threat-response characteristics of the species (e.g. 'freeze' behaviour), previous exposure of the individual, life cycle stage and habitat features (Harbrow et al., 2011).

Effects management

The project design includes recommended mitigation of noise barriers (bunds) and installing the external ventilation fan in an insulated shipping container to reduce overall noise levels.

6.3.4 Effects of Discharges to Air on Fauna

Key features of the WUG infrastructure on Willows Road Farm that may affect air quality on the farm property and / or adjoining Coromandel Forest Park include earthworks and general construction for site establishment (approximately 1 year duration); construction of the tunnel drive including blasting for portal formation (approximately 3.5 years duration); and discharges from the tunnel ventilation raise (ongoing). There will be no crushing or rock processing on the site. Details of activities and predicted air discharges are provided in the Assessment of Effects of Discharges to Air report ('Air Discharge Assessment (WUG and Willows)', BECA, 2025).

Potential discharges to air from the WUG include dust from surface sources; products of combustion from surface and underground vehicles[26]; dust from excavation discharged from the portal and ventilation raise; contaminants from underground blasting discharged from the portal and Willow Road Farm vent raise (as the tunnel progresses)[27]; and rehabilitation of surface areas after tunnel development. Blasting emissions will be infrequent and of short duration (during the tunnel drive, it is expected that blasting will comprise two blast events per day, with each event lasting for about 10 seconds) and emissions are expected to disperse rapidly.

The results of air quality monitoring at Waihi Mine were used to assess the likely effects of emissions of key contaminants (deposited dust, TSP, $PM_{2.5}$ and PM_{10} and silica) of the WUG. The Air Discharge Assessment concludes that there is a short-term moderate to high risk of dust, from the construction of the noise bund and storage of topsoil, adversely affecting the nearest houses along Willows Road to the east / southeast of the site. The risk of dust generated from other site activities, such as constructing the rock stack, blasting and tunnelling, adversely affecting residences (and thus, fauna and habitats) in the proximity of the project is low (BECA, 2025).

The Willows Road Farm vent raise will be constructed close to the northern boundary of the property, adjacent to Coromandel Forest Park. The Air Discharge Assessment found that there may be some short-term localised disturbance and minor dust deposition during construction that will quickly wash off during subsequent rainfall. Any ongoing effects on native vegetation from dust at the raises during tunnelling will likely be minor.

As such, we consider that the magnitude of effects of construction-related discharges to air on fauna and fauna habitats is **Negligible**. The ecological value of fauna and fauna habitats within Willows Road farm is **Low**. We further consider that habitats in the boundary of Coromandel Forest Park are likely lower value than in interior forest habitats due to weed infestation and edge effects[28]. Although we note that ecological values of Coromandel Forest Park (including its

[26] Such as particulate matter ($PM_{10,}$ $PM_{2.5,}$), nitrogen oxides (NOx) and carbon monoxide (CO)

[27] Blasting generates emissions of particulates (CO, NOx and small quantities of SO2), as well as dust from the shattering of rock. Blasting will occur using ammonium nitrate explosives (at any time in accordance with all relevant safety procedures).

[28] Edge effects are a feature of ecological communities at the boundary of two habitat types, in this case, forest and farmland. This southern boundary of Coromandel Forest Park is subject to higher sunlight and wind penetration

margins) are assessed as **Very High**, however, the level of effect of discharges to air is assessed as **Very Low – Low**, as no substantive changes to species populations or habitats are anticipated. Vent shaft discharges to air from mining within Coromandel Forest Park are assessed in Section 6.4.4.

Effects management
Site management to minimise dust includes water spray trucks and reseeding the topsoil stockpile.

6.3.5 Lighting effects Willows SFA

Willows Road Farm exists in open pasture farmland with a backdrop of forested conservation land. Existing lighting is limited to lighting associated with the farm buildings only, as there is no roadway lighting on Willows Road or State Highway 25 in this area. Potential lighting installations for the WNP are described and assessed in the Assessment of Environmental Effects: Lighting report (Lighting Assessment, Pedersen Read, 2025).

Findings are provided briefly below in the context of how lighting may impact native fauna. We reiterate that the effect of light on wildlife is variable and is a function of the animal's sensitivity and response to light, and the cues it uses during orientation, dispersal, foraging, migration and for particular behaviours. Most wildlife appear to respond to high-intensity short-wavelength light, point sources of light, skyglow and directional light (DCCEEW 2023).

The impact of artificial lighting on the night-time environment is defined in AS/NZS 4282:2023[29] as spill light, glare, and sky glow:

- **Spill Light:** "Light emitted by a lighting installation that falls outside the boundaries of the property for which the lighting installation is designed".
- **Glare:** "Condition of vision in which there is discomfort or a reduction in ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrasts in the field of vision".
- **Sky Glow**: "brightening of the night sky that results from the reflection of radiation (visible and non-visible), scattered from the constituents of the atmosphere (gas molecules, aerosols and particulate matter), in the direction of observation".

Artificial lighting to support the Willows Road SFA includes lighting during the SFA construction, tunnel construction, production and closure stages.

Spill Light

The Lighting Assessment indicates that spill lighting will typically be able to be contained to comply with Haruaki District Plan requirements, other than in very localised places for safety / security reasons (street lights, entry gates). Localised spill light may attract invertebrates and

resulting in lower humidity, soil moisture and encouraging growth of opportunistic species (e.g. weeds) that are less common in the forest interior.

[29] Australian and New Zealand Standard AS/NZS 4282: 2023, "Control of the obtrusive effects of outdoor lighting".

their predators (ruru / morepork and bats, if present) but is unlikely to impact a wider suite of species as it will be located around the built up SFA.

Glare

After dark activities associated with the WUG rock stack which require the use of mobile lighting plant have the potential to produce glare effects when the stack's height exceeds the height of the surrounding hillsides. Additional sources of glare include lighting associated with vehicles and task lighting. Glare effects are assessed from the perspective of residents and it is unclear if there would be any effects on fauna. The Lighting Assessment notes that lighting designed to minimise adverse effects should result in minimal, if any, direct glare effects.

Sky Glow

All lighting units facing above the horizontal have the potential to contribute to sky glow. At Willows Road SFA, from viewing locations towards the backdrop of the unilluminated farmland and Coromandel Forest Park, this effect would be more than minor with no mitigation employed.

The area for the Willows SFA, mine portal and rock stack is sparsely illuminated at present. Above-ground construction activities requiring artificial lighting would result in an increase in both glare and sky-glow from locations with a view of the area. Mobile lighting plant has the most potential to create these effects.

Sky glow likely has the largest areal extent of the lighting impacts described here. As such, sky glow would likely result in the most pronounced avoidance behaviours, and is also most likely to impact orientation, dispersal, foraging, migrating and natural behavioural cues for species sensitive to it.

The magnitude of effect of lighting impacts at Willows Road SFA is assessed as **Low.** The ecological value of the fauna is **Low** and therefore the level of effect of artificial lighting is assessed as **Low.** The Lighting Assessment finds that if appropriate management combined with careful lighting control is undertaken, then the potential effects are expected to be minor given their temporary nature. Night-time activities in sensitive locations will be minimised, as most construction activity will occur during day shift operations.

Effects management

Effects management for lighting effects includes careful mobile lighting plant selection, location, and luminaire orientation and aiming (i.e., into the site); careful timing of activities in sensitive areas; and lighting controls for permanent lighting.

Lighting shall be designed and installed using the best practice principles in the National Light Pollution Guidelines for Wildlife – particularly with respect to using luminaires with reduced blue wavelengths and using luminaires with a lighting distribution which is asymmetrical in the vertical plane such that the light emitting surface is horizontal to the ground.

Mitigation measures are detailed in the Lighting Assessment.

6.4 Coromandel Forest Park: Potential Localised Effects

6.4.1 Approach

This section describes those potential effects that have a known (small) zone of influence relative to the wider forest. The potential effects described below include:

- vegetation clearance required for exploration drill sites, pumps and vent raises and the consequent habitat loss,
- noise associated with exploration drill operation,
- noise associated with helicopter support for exploration activities;
- lighting effects associated with drill rig operation and campsites;
- water and air discharges from the vent raises; and
- continuous noise from the vent raises for the duration of mining.

6.4.2 Effects Associated with Exploration Drill Site, Pump Test , Vent Raise Clearance and Temporary Habitat Loss

This section assesses the effects of the vegetation clearance for exploration drill sites, geotechnical drill sites, pump sites and vent raises. New and existing drill sites will be subsequently used for camps / messing facilities and helipads to service the drilling and mining operation, and will not require further vegetation clearance.

Exploration drill sites, geotechnical drill sites and pump test sites will be operational for a variable period (average 2 years, but range of 1 – 7 years), and vent raise sites will be operational for the duration of mining (estimated to be 10 years). The temporary loss of vegetation cover and fauna habitat within the footprint of these sites is assessed below. The proposed remediation of these sites is described in Section 8.4 and OGNZL (2025), and the offset for this habitat loss is described in Section 8.5.2.

Removal of intact native forest is one of the primary ecological impacts of the Project. The combined vegetation clearance area across multiple sites (see Section 2.4.2) will not exceed 0.66 ha combined. For context, Coromandel Forest Park encompasses approximately 72,000 ha of similar forest communities and habitats, and localised disturbances at a similar scale to each individual cleared area[30] occur periodically in the forest environment as a result of slips, tree falls, and human activity associated with recreational access etc. The clearance area may be smaller still if not all sites are required, following successful exploration drilling.

The location of the drill, pump test and vent sites will be determined using a multi criteria site selection process with the objective of minimising ecological and recreational impacts at sites where the ore body can be successfully reached and investigated from a variety of points, and which meet associated engineering and geotechnical requirements. The assessment criteria are provided in Appendix 2 and described in the AEE (Mitchell Daysh, 2025).

As noted above, old sites will be re-used as camp facilities and possibly helipads once drilling is complete. This reduces the quantity of vegetation clearance and would likely minimise impacts

[30] For drill and pump test sites (150 m^2), not vent raise sites which may be up to 300 m^2.

on fauna as they may be less likely to occupy a disturbed site. Approximately two sites will be cleared per year.

Vegetation Communities

It is likely that clearance of small areas of forest will cause temporary (albeit prolonged) changes to the forest structure and species composition in the immediate environs due to "edge effect" factors, including increased light (photosynthetically active radiation, due to the removal of canopy species) and changes to temperature, air movement within the surrounding forest. However, the extent of clearance is small and the sites are likely to be readily colonised by native species. Low stature, early successional vegetation (e.g. sedges and kiekie) have been observed in old drill sites and were found to be occupied by Archey's frogs (Hotham 2019). Remediation of the site would include returning woody material and fern stumps to the footprint area, and management of weeds (Section 8.4 and BML 2025f).

The magnitude of effect of delayed forest regeneration is small in the context of the surrounding area and is assessed as **Low**. The ecological value of the vegetation communities is **Very High**. The level of effect of vegetation clearance is **Moderate**, but temporary.

Fauna Communities and Habitat

The intent of the site selection criteria is to minimise impacts on native fauna by selecting sites with poorer quality habitat from the range of sites available. Given that the distribution of native frogs (Archey's frogs), native lizards and birds, and notable invertebrate fauna is patchy but widespread throughout the forest, it is likely that native species will be impacted by habitat clearance. Fauna salvage and translocation prior to and during site clearance will be a key part of the proposed measures to minimise effects on fauna. There is a risk of mortality and elevated stress, as well as unforeseen outcomes during fauna translocations. These risks will be managed as thoroughly as possible using methods described in the Ecology and Landscape Management Plan (specifically the WUG Ecological Management Plan *in* OceanaGold, 2025). Post-translocation survival rates will be monitored as described the Ecological Management Plan. Habitat elements (e.g. rotting logs) will be moved with fauna to the translocation site, or will be moved outside of the clearance footprint to be retained for site remediation (Section 8.4 and BML 2025f).

The temporary loss of habitat and impacts on fauna species (invertebrates, lizards, frogs and birds) in the drill, pump and vent raise footprints is very small in area. The magnitude of effect is **Very high**. The ecological value of the potential fauna communities is **Very High** while the level of effect is **Very High.**

Effects management

Proposed management actions to mitigate and offset clearance of native forest, fauna habitat and impacts on native fauna include the following:

- Revegetation of a total of 21 ha on the northeast ridge of Willows Road Farm (Vegetation Area 3) is proposed to offset the loss of 0.66 ha of indigenous forest vegetation and habitat within Coromandel Forest Park. The proposed revegetation will connect an existing remnant bush fragment (with resident Hochstetter's frogs) to Coromandel Forest Park. Both the remnant forest and the revegetated area will be fenced to exclude stock and pigs, and will be subject to pest control (rodents, possums and mustelids). In addition to providing a direct replacement for the loss of forest extent, the proposed offset will restore forest interior habitat to the forest remnant, improve connectivity of forest patches on the periphery of the park, buffer and extend the forest margin, and improve the viability of threatened species populations known to be present in these areas. We consider that these benefits balance the loss of several small patches of mature, interior secondary forest vegetation and habitat in the short to medium term, and provide a positive and substantial 'net gain' overall.
- Buffer planting along the existing forest edge at the Willows Road Farm property (5.5 ha in total) to address the creation of new (interior) forest edges resulting from clearance of drill and pump sites.
- Remediation of vent raise areas will be undertaken in a staged way following completion of drilling activities (for drill and pump sites) or mine closure (for vent raise sites) (Boffa Miskell 2025f).
- Impacts on fauna will be minimised by site selection processes, and carefully implemented fauna salvage prior to and during site clearance. Fauna will be translocated to an intensively pest-controlled, prepared site with materials collected from the impact site. Fauna salvage will follow the principles outlined in the IUCN guidelines for reintroductions and other conservation translocations (IUCN 2013) and described in the WUG Ecology and Landscape Management Plan (OceanaGold, 2025).

6.4.3 Effects of Exploration Drill, Pump Test and Helicopter Operational Noise on Fauna

Noise associated with the operation of the exploration drills, pumps tests and supporting helicopter activity is described in the Forest Noise Survey and Bird Count Results report ('Forest Noise Survey') (Marshall Day, 2025). The study focussed on collecting data to assess the potential masking effect of exploration drill, pump and helicopter noise on forest birds[31]. This analysis was used to inform our assessment.

[31] Forest birds were selected as a study group because their vocal ranges are well studied and they can be reliably surveyed. We consider that other fauna groups may be more or less affected by noise based on their specific characteristics, but that birds are a broadly representative group.

Any potential effects on fauna are frequency[32] and amplitude[33] dependent, and species specific[34]. Also, distance from the source of the noise and ambient noise levels can alter how a noise is perceived by an individual. Of relevance to this assessment is how the noise generated by exploration drill and pump operation alters the forest noise environment relative to forest sites that experience little anthropogenic noise (a proxy for 'baseline' conditions).

Noise Level measurement

The study collected acoustic data at a total of 16 locations[35] within the Wharekirauponga area. These locations were selected to include quiet forest areas, areas with various levels of anthropogenic noise, and areas near existing (active) drills, pumps and helicopter flight paths / helipads.

Measured average daytime noise levels (i.e., perceived as "loudness") comprised:

- Quiet forest sites (including those close to streams) ranged from **30 – 61 dB L_{Aeq}**
- Forest sites with audible drill / pump noise ranged from **40 – 55 dB L_{Aeq}**
- Pump noise was **76 dB L_{Aeq}**
- Drill noise was **82 dB L_{Aeq}**
- Camp generator noise was **74 dB L_{Aeq}**
- Helicopter take-off noise was **87 dB L_{Aeq}**

Bird Vocalisation Frequency

The recordings were also used to analyse the number of bird vocalisations at each site using a machine learning algorithm to detect pre-selected native bird species. The species of interest were chosen based on the survey data from the site[36] and included 10 species[37].

Bird vocalisations were classified into two groups, <u>wide</u> frequency range vocalisations (four species) and <u>high</u> frequency range vocalisations (6 species):

- Birds with <u>wide</u> frequency range vocalisations (i.e., 500 Hz – 10 kHz), include tūī, ruru / morepork, korimako / NZ bellbird and kākā. The assessment found that there was a high overlap with the measured anthropogenic noise and the wide frequency range in which these species vocalise. As such, potential impacts (i.e. masking) are greater for these species.
- Birds with <u>high</u> frequency range vocalisations (i.e., 2 kHz – 10 kHz) include pīwakawaka / fantail, tauhou / silvereye, miromiro / tomtit, riroriro / grey warbler, pōpokatea / whitehead and yellow-crowned kakariki. The assessment found that there was less overlap with anthropogenic noise for these species.

---

[32] The frequency of a sound wave is perceived as its pitch or tone. Measured in Hz or kHz.

[33] Amplitude is the height of the sound wave from peak to valley. Amplitude determines the loudness or intensity of the sound and is measured in decibels (dB). The scale is logarithmic.

[34] Factors that may impact an animals' response to noise include the threat-response characteristics of the species (e.g. 'freeze' behaviour), previous exposure of the individual, life cycle stage and habitat features (Harbrow et al., 2011).

[35] 14 locations had short term recordings (1-5 minutes), and 4 locations had long term recordings (1-2 weeks).

[36] Detailed in Section 5.1.5.

[37] Species assessed are: tūī, ruru / morepork, korimako / bellbird, kākā, pīwakwaka / fantail, tauhou / silvereye, miromiro / tomtit, riroriro / grey warbler, pōpokatea / whitehead, yellow crowned kakariki.

- There were significantly less bird vocalisation detections in forest areas near the active sites compared with quieter locations[38]. The greatest reduction in detections was for the ruru / morepork, which is expected because its hoot is the lowest frequency vocalisation of the bird species assessed and can be easily masked by anthropogenic noise (Table 8).
- Bird vocalisation detections follow a clear trend where the percentage decrease in detections (i.e. fewer detections compared to the remote site) is highest at the noisiest sites and lowest at the quiet site, WL1.
- This trend holds for all species except miromiro / tomtits. There were significantly more detections of miromiro / tomtits in the area with high anthropogenic noise (Table 8). The reason for this is unclear, but both male and female are territorial during the breeding season (when the recordings were made), suggesting that they perceive anthropogenic noise as a threat and respond to it vigorously; or that they are less sensitive to anthropogenic noise and preferentially occupy the noisier parts of the forest when other species do not (or are at least less vocal).

Table 8: Bird vocalisation detections, based on data provided by Marshall Day (2025). Data is adjusted to average / day to allow for comparison between sites with different recording durations. The % increase or decrease is calculated for each species compared to site NMT1 (remote forest location) as a control

	NMT1	NMT2	WL2	WL1
	Remote forest location (average/day)	**Noisiest forest area (average/day)**	**Moderate noise area (average/day)**	**Quiet location next to southern helipad (average/day)**
Wide frequency range vocalisations (500 Hz – 10 kHz)				
Tūī	134	23 (-83%)	82 (-39%)	95 (-30%)
Ruru / Morepork	244	0 (-100%)	1 (-99%)	91 (-62%)
Korimako / Bellbird	423	14 (-97%)	44 (-90%)	112 (-74%)
High frequency vocalisations (2 – 10 kHz)				
Pīwakawaka / Fantail	848	15 (-98%)	118 (-86%)	407 (-52%)
Tauhou / Silvereye	494	3 (-99%)	90 (-82%)	145 (-71%)
Miromiro / Tomtit	12.5	103 (+721%)	171 (+1268%)	46 (+267%)
Riorio / Grey Warbler	305	10 (-97%)	91 (-70%)	138 (-55%)
Common Chaffinch	108	8 (-93%)	3 (-98%)	85 (-21%)

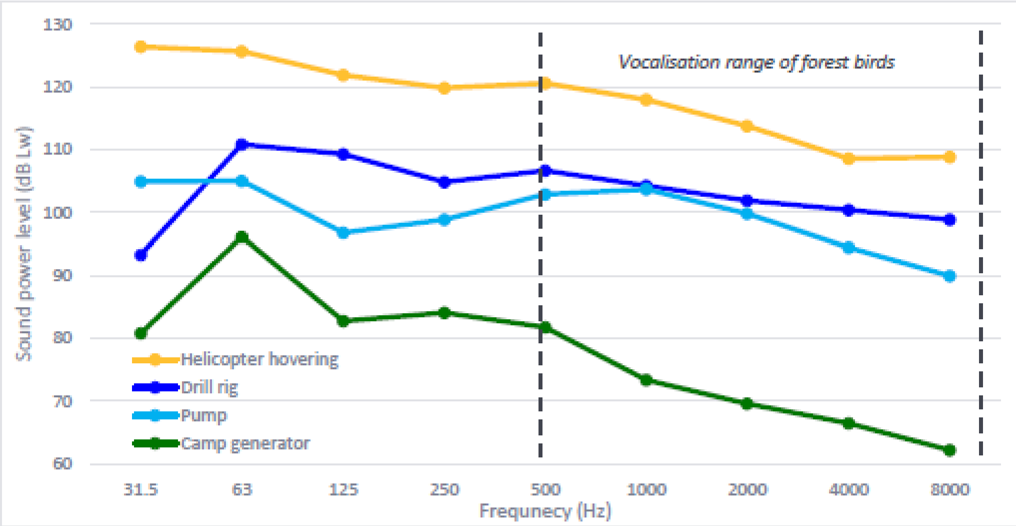
Measured noise levels and frequencies are expressed in Figure 3 of the Forest Noise Survey report, reproduced below. This figure indicates that helicopter take-off noise is significantly louder than other anthropogenic noise types (although we note that it is of short duration); and

[38] We note that using there are limitations to using this method as a proxy for bird presence / activity because it is not possible to separate whether bird vocalisations are not detected because they are masked by the noise, or because the birds are absent.

drill and pump noise are similarly loud in close proximity to the machinery (drill, pump and generator noise will be continuous, day and night).

All anthropogenic noise sources overlap with forest bird vocalisation frequencies and could mask bird vocalisations. This is illustrated by the spectrograms provided in the Forest Noise Study report (Figures 4 – 15 therein).

Figure 3: Calculated sound power level spectra from equipment measurements



Deviation from ambient noise levels

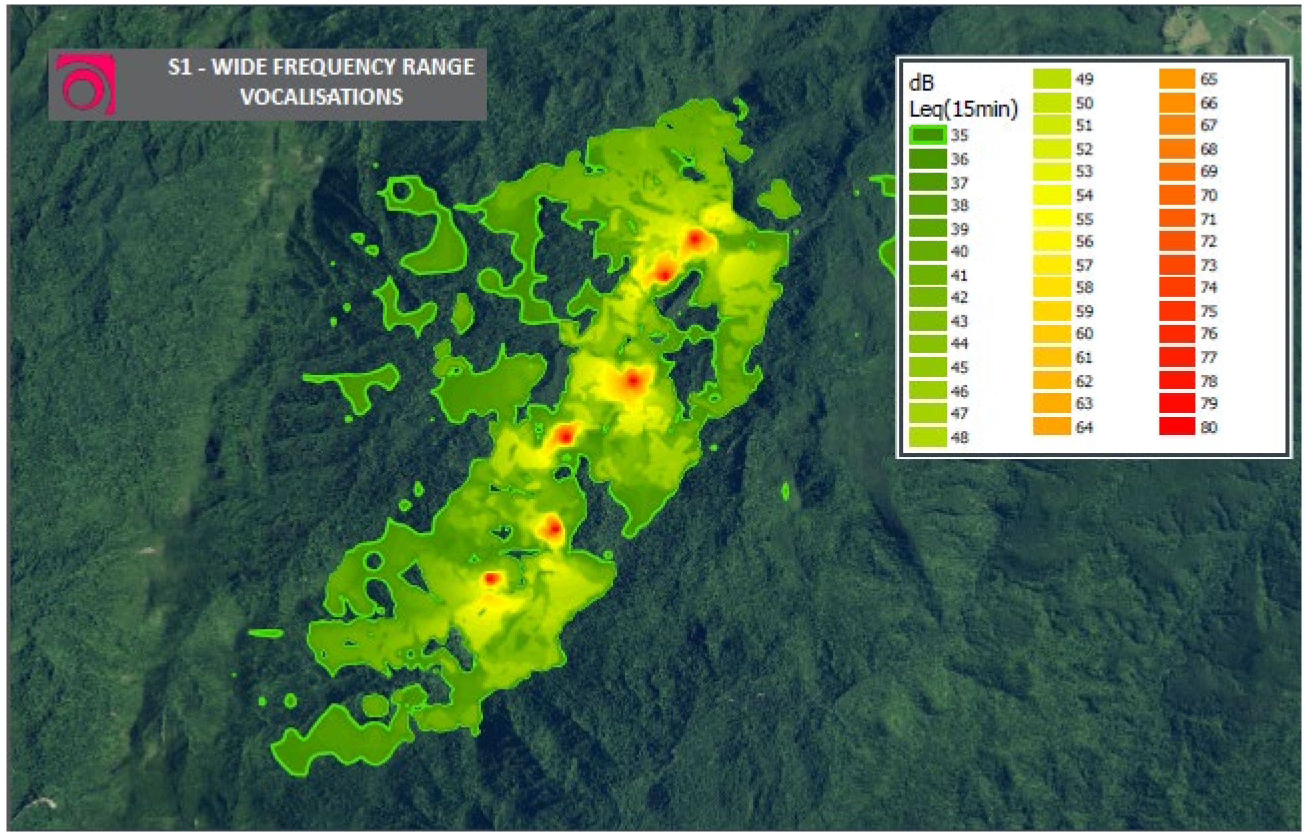
Marshall Day determined the ambient noise level measurements in a remote forest location to be **35 dB** $L_{50\ (500\ Hz – 8\ kHz)}$ in the <u>wide</u> frequency range and **31 dB** $L_{50\ (2 – 8\ kHz)}$ in the <u>high</u> frequency range. The L_{50} levels represent the sound that is in the forest for more than 50% of the time, which excludes intermittent sources such as helicopter pass-bys, birdsong and most wind/rain.

Further noise modelling tested three scenarios for drill site placement to assess the extent of potential masking in both the <u>wide</u> frequency and <u>high</u> frequency vocalisation groups. This analysis provides an indication of the extent of area affected (i.e. potential vocalisation masking zone) by different drill placements. Marshall Day also modelled the area impacted by helicopter hovering noise for both the <u>wide</u> frequency and <u>high</u> frequency vocalisation groups. This data is provided in Table 8, and Figure 17, and findings include:

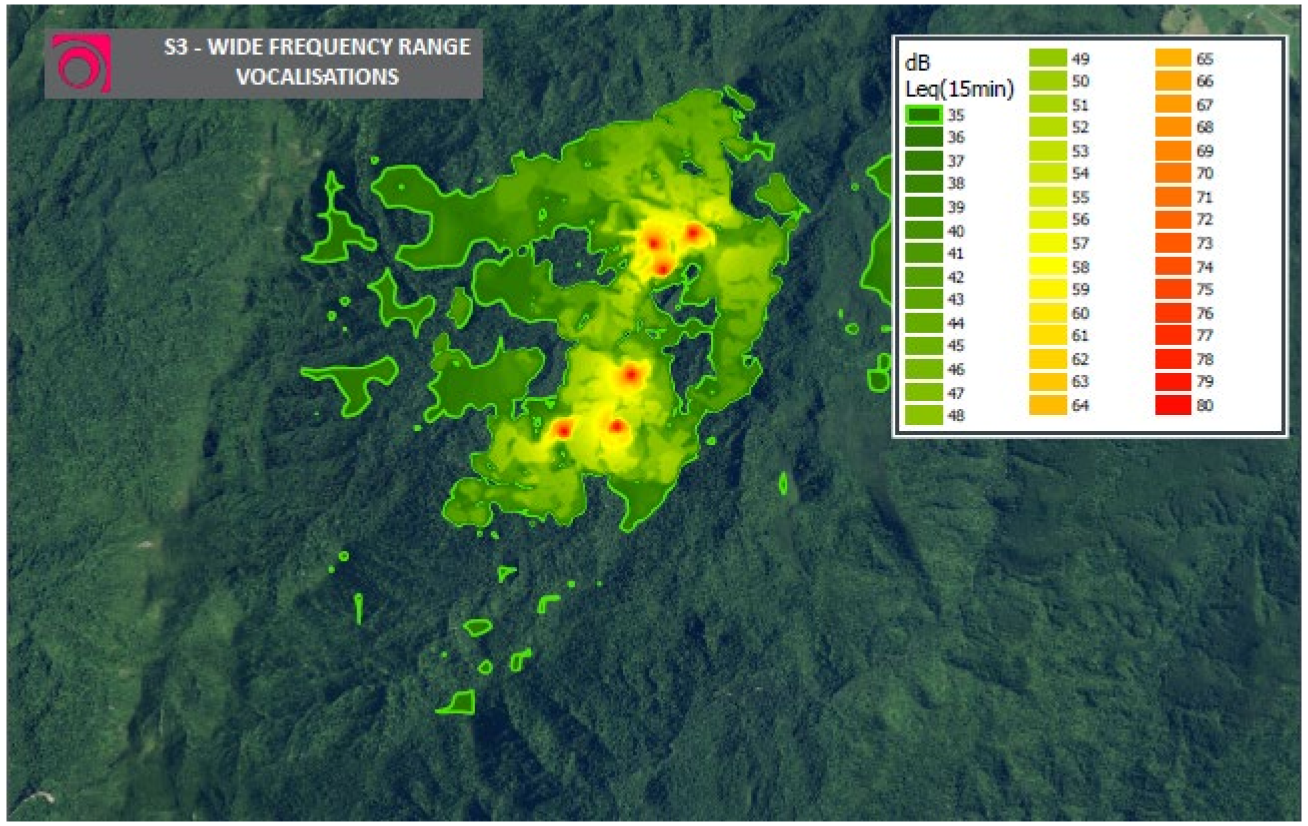
- The potential masking area is smallest with a compact arrangement for both <u>wide</u> frequency and <u>high</u> frequency vocalisation groups.
- Because high frequency sounds are more readily absorbed by the environment, scenarios modelling the <u>high</u> frequency vocalisation group are much smaller than the equivalent <u>wide</u> frequency vocalisation group.
- The addition of two hovering helicopters to the model greatly increases the extent of the potential masking area. We note that helicopter hovering time is likely to be in the order of minutes in any single event.

Table 9: Summary of potential masking areas, where noise levels are higher than ambient (measured as 35 dB $L_{50 \, (500 \, Hz – 8 \, kHz)}$ and 31 dB $L_{50 \, (2 – 8 \, kHz)}$. from each scenario) (table sourced from Marshall Day, 2025).

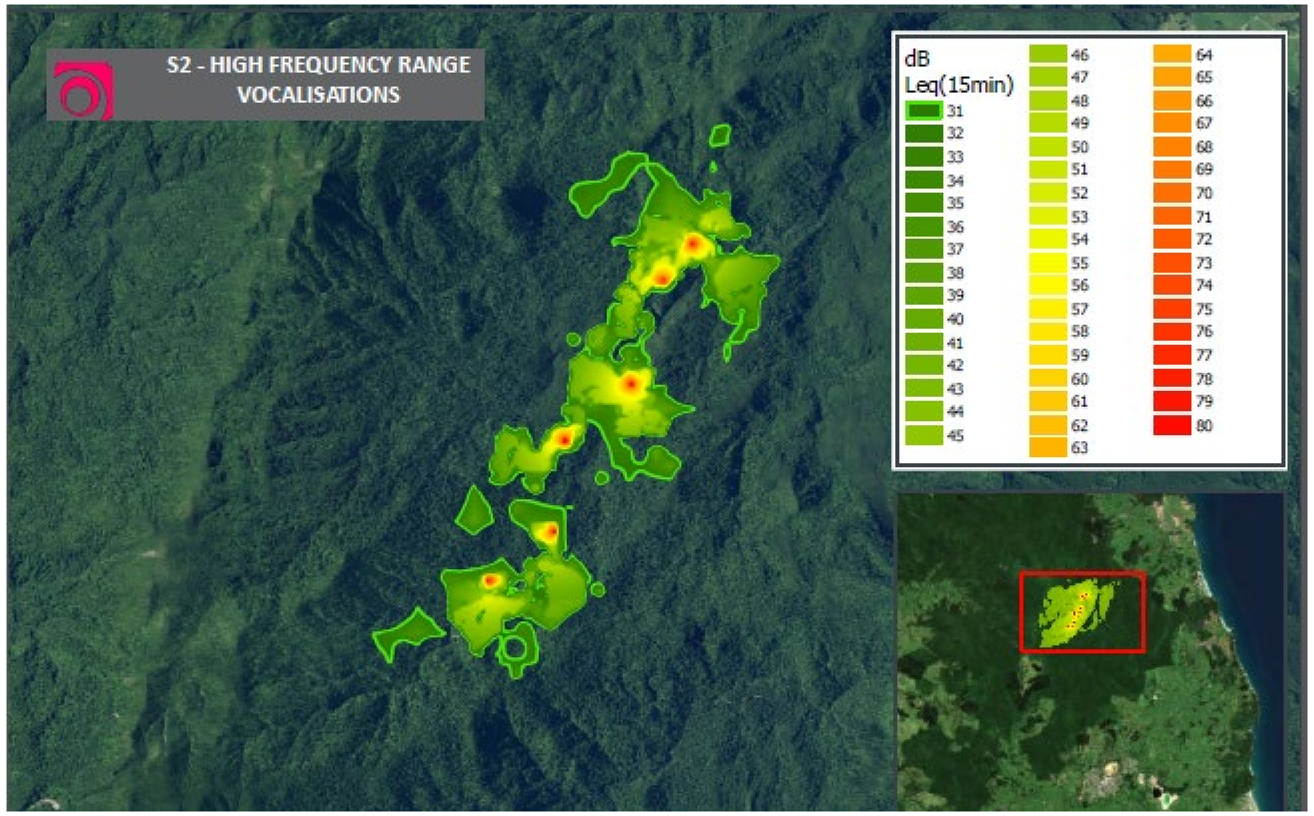
Scenario	Operation Description	Vocalisation group	Potential masking area
S1	Continuous noise from 6 drill rigs spread out arrangement	Wide frequency range	400 ha
S2	Continuous noise from 6 drill rigs spread out arrangement	High frequency range	140 ha
S3	Continuous noise from 6 drill rigs compact arrangement (north sites)	Wide frequency range	340 ha
S4	Continuous noise from 6 drill rigs compact arrangement (north sites)	High frequency range	130 ha
S5	Continuous noise from 6 drill rigs compact arrangement (south sites)	Wide frequency range	330 ha
S6	Continuous noise from 6 drill rigs compact arrangement (south sites)	High frequency range	130 ha
S7	Short term noise from 2 helicopters hovering with drill rigs	Wide frequency range	1440 ha
S8	Short term noise from 2 helicopters hovering with drill rigs	High frequency range	460 ha



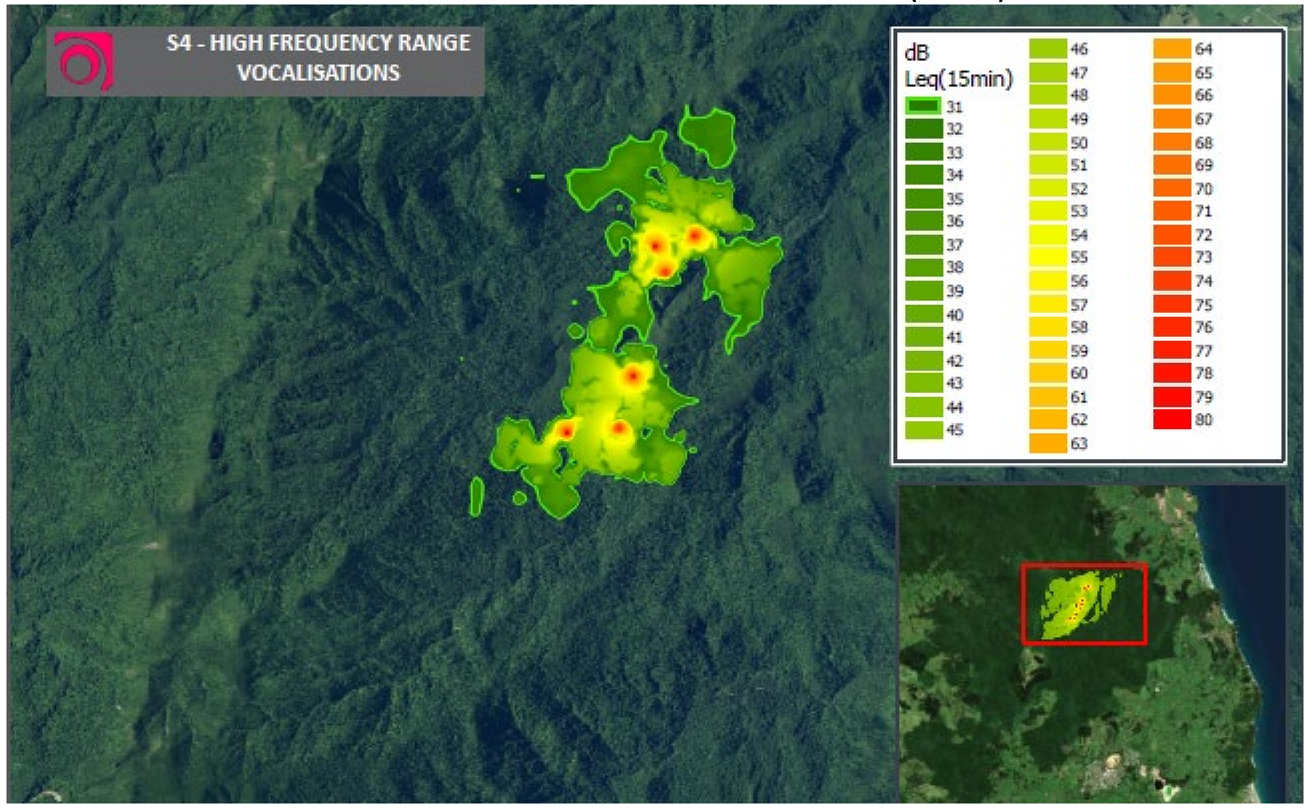
SCENARIO 1: CONTINUOUS NOISE FROM 6 DRILL RIGS SPREAD OUT ARRANGEMENT



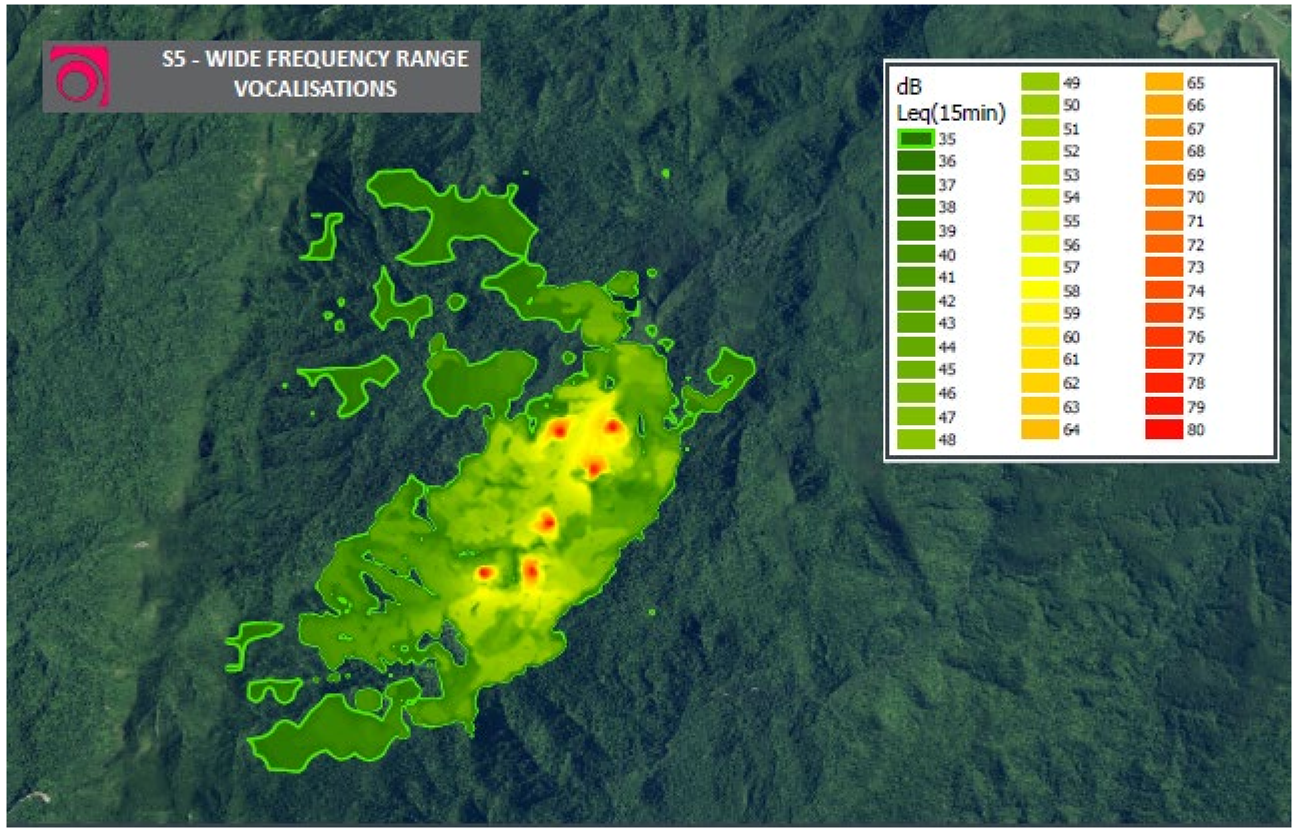
SCENARIO 3: CONTINUOUS NOISE FROM 6 DRILL RIGS COMPACT ARRANGEMENT (NORTH)



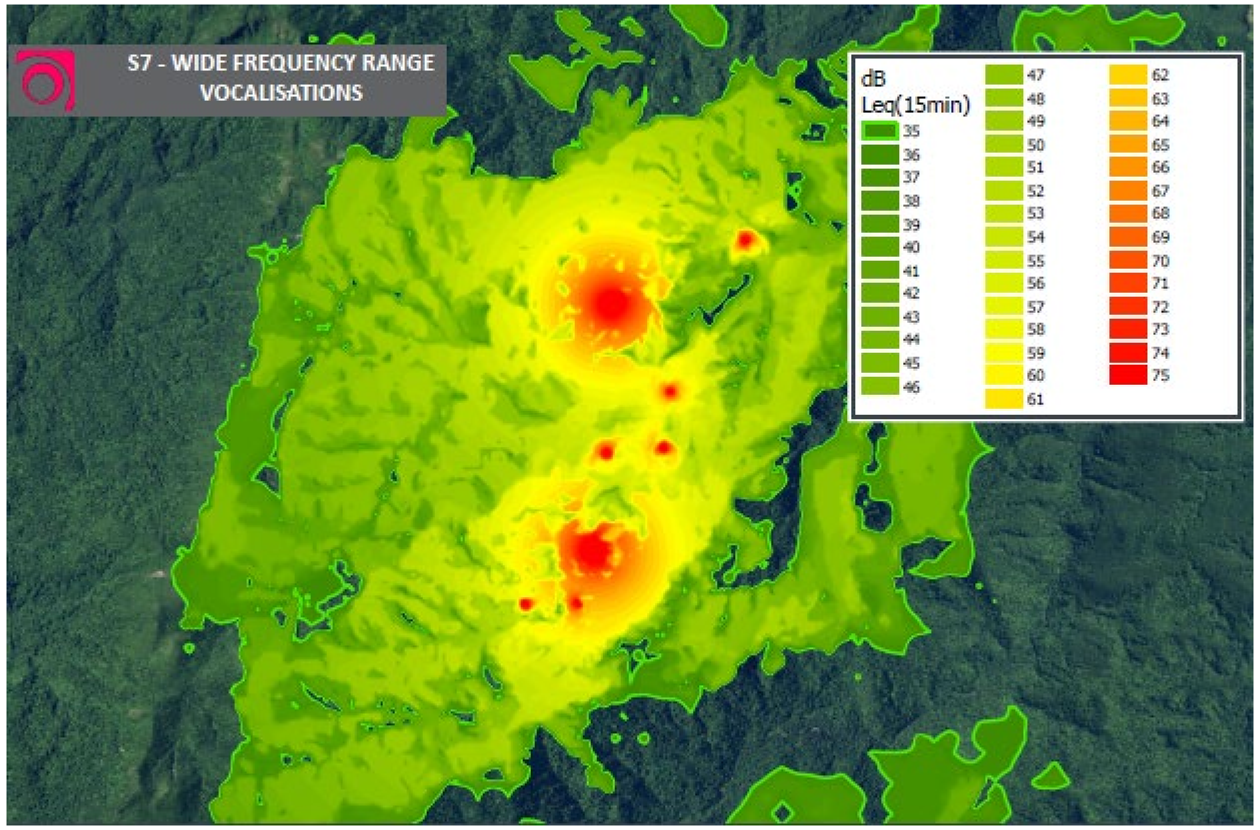
SCENARIO 2: CONTINUOUS NOISE FROM 6 DRILL RIGS SPREAD OUT ARRANGEMENT



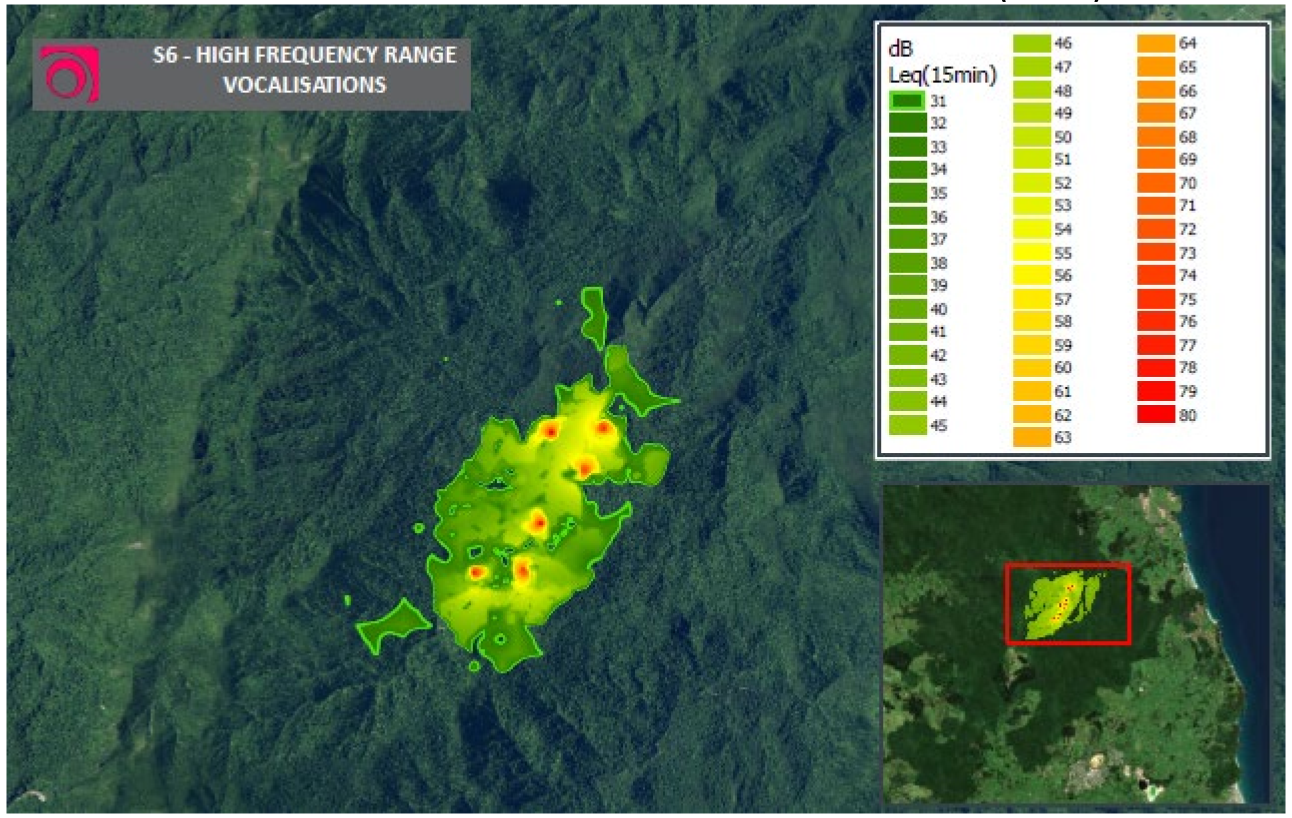
SCENARIO 4: CONTINUOUS NOISE FROM 6 DRILL RIGS COMPACT ARRANGEMENT (NORTH)



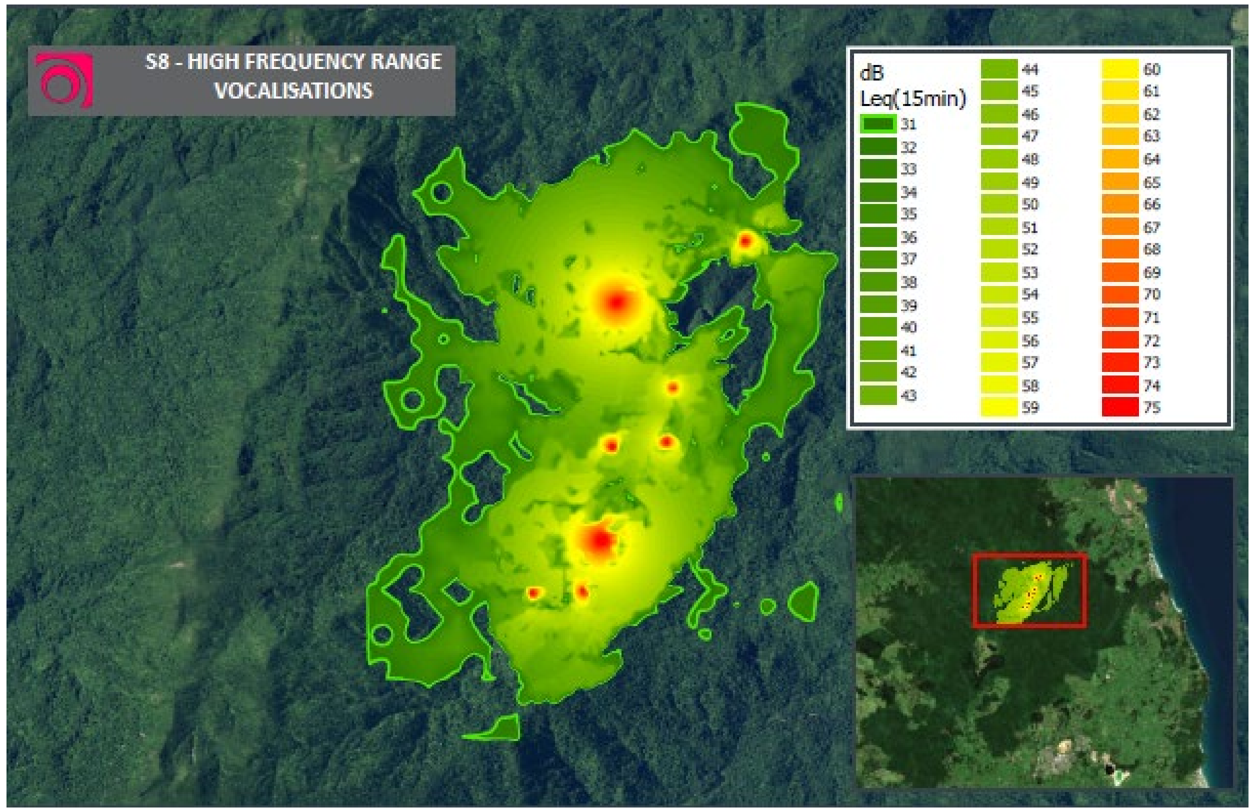
SCENARIO 5: CONTINUOUS NOISE FROM 6 DRILL RIGS COMPACT ARRANGEMENT (SOUTH)



SCENARIO 7: SHORT TERM NOISE FROM 6 DRILL RIGS SPREAD OUT AND 2 HELICOPTERS HOVERING



SCENARIO 5: CONTINUOUS NOISE FROM 6 DRILL RIGS COMPACT ARRANGEMENT (SOUTH)



SCENARIO 8: SHORT TERM NOISE FROM 6 DRILL RIGS SPREAD OUT AND 2 HELICOPTERS HOVERING

Figure 16: Noise modelling scenarios (provided by Marshall Day, 2025c). The extent of the potential masking effects zone is shown by the light green border and the noise sources are in the red areas. The colour gradient Illustrates that the vocalisation masking increases closer to the noise source.

Other ambient noise sources

Natural noise sources in the forest include rivers and waterfalls, high winds, heavy rainfall, and thunderstorms. These natural noise sources produce noise in the same frequency range as the drilling activities and can also mask bird vocalisations. As such, animals within the forest are adapted to episodically high noise levels, but not continuous high noise levels.

Summary

Stage 1 of the WNP will generate additional anthropogenic noise within the forest environment as a result of exploration drill, pump test and helicopter activity. It is likely that in close proximity to machinery and helicopter activity / helipads, fauna would be more impacted. The noise contours in Figure 17, and potential masking areas in Table 8, are the largest extent that we consider that may have impacts on fauna. These areas range from 130 ha in the compact arrangement to 400 ha in the spread out arrangement.

It is important to note that deviation from ambient noise levels does not mean that masking or behavioural responses from any or all fauna are certain, but there is less "acoustic space" for animals to communicate or hear dangers within their environment. Indeed, the Forest Noise survey indicates that for most bird species sampled, there is a negative correlation between noise level and bird vocalisation. However, miriomirio / tomtit are most vocal (or more numerous) in noisier parts of the forest.

As described in Section 6.2, fauna responses to elevated noise may include behavioural and/or physiological responses such as aversion (if the individual is mobile); reduced emergence / activity; adaptation to compensate for increased background noise; elevated stress / reduction in fitness; and impacts on breeding success.

For all fauna groups we consider that there will be a localised **High** level of effect in the vicinity of the drill rigs / and pumps over an area of less than 400 ha[39] at any one time. Given the variability between species and fauna groups to how they perceive and respond to noise, we broadly expect that sensitive species will be most impacted and will exhibit avoidance or reduced emergence / activity behaviour for the duration of drilling activity.

Because helicopter activity is episodic and very short term, we consider that it contributes to the noise environment but does not change it significantly because helicopters will be most active within an already noisy forest area.

The magnitude of level of effect is assessed as **High** given the localised nature of the impacted area within the context of the wider forest, and the temporary (i.e. reversible and short-term) nature of the impact. The post-development character of the forest (with respect to noise) will not be altered as a result of the WNP.

[39] This being the maximum area of continuous noise above 35 dB L50 (500 Hz – 8 kHz) and 31 dB L50 (2 – 8 kHz).

<u>Effects management</u>

No specific noise management is proposed to address the effect of exploration drilling and pump noise on fauna. Noise effects will be more severe near individual drill sites, although the extent of disturbance may be reduced by operating drill sites in close proximity to each other where possible.

The impacts of helicopter noise will be managed by limiting the number of support flights per week to no more than 200 flights per month.

6.4.4 Effects of Lighting on Fauna at Exploration Drill Sites, Camp Sites and Pump Test Sites

Artificial lighting will be required to illuminate work and camp sites during and outside daylight hours in Coromandel Forest Park. There is no artificial lighting in these areas except for those associated with existing and proposed facilities. As such, fauna within Coromandel Forest Park are naïve to artificial lighting and would be expected to respond more strongly than those in urban / peri-urban environments (where many of the study sites in scientific literature are located, e.g. McNaughton, 2019, Simcock et. al, 2022).

Artificial lighting may be associated with exploration drill, camp, pump test, man-portable rig, geotechnical drill, pumping test, and vent shaft sites (during construction). Potential lighting installations for the WNP are described and assessed in the Assessment of Environmental Effects: Lighting report (Lighting Assessment, Pedersen Read, 2025).

Definitions of key terms and concepts are provided in Section 6.3.6.

Spill Light

The Lighting Assessment concludes that there is likely to be localised light spill from work and camp sites into the surrounding forest, exceeding Hauraki District Plan limits of 8.0 lux spill. Given that vegetation clearance is minimised to the extent possible, there is minimal open space between the site boundary and the forest edge. Any fauna occupying forest edge habitats may be exposed to elevated light levels from spill light. The Lighting Assessment notes that light intensity reduces with the square of the distance from the light source, and effects will be localised. Edge vegetation will also impede light spill further into the forest to some degree, depending on height, leaf cover etc.

The Lighting Assessment recommends that lighting in CFP should be designed and installed in accordance with the National Light Pollution Guidelines for Wildlife (DCCEEW 2023). In particular, luminaires with reduced or filtered blue, violet and ultraviolet wavelengths would be used. This combined with careful aiming of luminaires into the site will minimise spill light effects.

Localised spill light may attract invertebrates and their predators (ruru / morepork, geckos and bats, if present). Other taxa groups, including native frogs, invertebrates, and native birds may experience disruption to orientation, foraging and environmental cues for particular behaviours (e.g., emergence). The level of this effect depends on the animal’s sensitivity to artificial light and how close they are to the light source.

Glare Effects

Lighting associated with sites in the conservation estate could produce glare effects when exterior luminaires need to be aimed above the horizontal to provide operational and safety lighting for work areas. Whilst luminaires would be aimed into each site, the relatively small site sizes would mean that both discomfort and disabling glare effects could occur[40] in the area surrounding the site.

Glare effects could be visible for hundreds of meters if the light sources are directly visible and sufficiently bright. Direct screening by foliage and topography will restrict visibility distance and is likely to limit (in addition to engineering controls described below) the extent of glare effects associated with this project.

Sky Glow

All lighting units facing above the horizontal have the potential to contribute to sky glow. In CFP, particularly at elevated sites with the backdrop of the unilluminated conservation estate, this effect would be more than minor with no mitigation employed.

Within CFP, mine related sites will contribute 100 % of sky glow around each site. The extent of the effects of skyglow on birds and bats is likely to depend on the lightings' proximity to foraging and nesting sites, changes in location of prey (insects being attracted to lights), and commuting corridors. Because mobile nocturnal species are adapted to low light environments, they are likely to be most affected. The amount of skyglow (and its impacts) will also be affected by the spectral distribution of the lighting sources.

Coromandel Forest Park provides important habitat for native species to undertake biologically important activities such as foraging, breeding, roosting or dispersal. However, in this assessment, we also consider the localised nature of the lighting effect, the shielding provided by surrounding vegetation, and the short duration of the effect at any on particular site (in the order of 1- 7 years, in effect, temporary). The effects of artificial lighting are immediately reversible once the drill rig / camp site / pump is removed.

The magnitude of effect of lighting impacts in CFP, if effects are minimised to the extent possible using controls described below, are **Low - Moderate**. The ecological value of the fauna is **Very High** and therefore the level of effect of artificial lighting is assessed as **Moderate.**

[40] Disability glare impairs the visibility of objects without necessarily causing discomfort. Discomfort glare causes discomfort without necessarily impairing the visibility of objects.

Effects management

Effects management for lighting effects includes careful mobile lighting plant selection, location, and luminaire orientation and aiming (i.e., into the site); careful timing of activities in sensitive areas; and lighting controls for permanent lighting (e.g., shades for camp windows).

Lighting should be designed and installed using the best practice principles in the National Light Pollution Guidelines for Wildlife – particularly with respect to using luminaires with reduced blue wavelengths and using luminaires with a lighting distribution which was asymmetrical in the vertical plane such that the light emitting surface could be horizontal to the ground.

The best practice principles in the National Light Pollution Guidelines for Wildlife include:

1. Start with natural darkness and only add light for specific purposes.
2. Use adaptive light controls to manage light timing, intensity and colour.
3. Light only the object or area intended – keep lights close to the ground, directed, and shielded to avoid light spill.
4. Use the lowest intensity lighting appropriate for the task.
5. Use non-reflective, dark-coloured surfaces.
6. Use lights with reduced or filtered blue, violet and ultraviolet wavelengths.

6.4.5 Water and Air Discharges from Ventilation Raise

An Assessment of Mine Vent Air Quality was undertaken by Tonkin & Taylor specifically to inform potential effects on native frogs (Tonkin & Taylor 2022). The nature of emissions from the tunnel are expected to be similar to those from the existing Martha underground mine. The main discharges to air from the vents will be particulate matter and products of combustion (i.e. oxides of nitrogen (NOx)) [41] from exhaust of mining equipment and trucks, as well as blasting events (Tonkin & Taylor 2025) [42]. The ventilation air will meet or exceed workplace exposure standards for these air quality parameters. We note that vehicle emissions will be effectively continuous, but particulate matter associated with blasting will be intermittent and of very short duration.

Underground emissions will be discharged to air via the ventilation shafts as a point source discharge rather than a diffuse source. The vent stacks will be 8 m tall and have a diameter of 5.5 m and exhaust temperature is expected to be between 20 - 21ºC. Emissions from the ventilation raises will be visible as a plume of water vapour in cool, calm conditions.

Dispersion modelling was undertaken to predict ambient contaminant concentrations around likely vent locations (Figure 17). These concentrations were then compared to measured contaminant concentrations on metalled public roads to infer conditions that native frogs (Archey's frogs) may experience (and persist with) at sites elsewhere in the Coromandel where

[41] Such as particulate matter ($PM_{10,}$ $PM_{2.5,}$), nitrogen oxides (NOx) and carbon monoxide (CO)

[42] Blasting generates emissions of particulates (CO, NOx and small quantities of SO2), as well as dust from the shattering of rock. Blasting will occur using ammonium nitrate explosives (at any time in accordance with all relevant safety procedures).

they are recorded near unpaved roads[43]. This method allows for an assessment of native frogs' potential tolerance to particulates and nitrogen oxide (acknowledging the paucity of data for this assessment, particularly the tolerance of forest-dwelling frogs to elevated contaminant concentrations).

Dispersion modelling methodology and parameters used, and results are described in Tonkin & Taylor (2021). The maximum ground level concentration of particulate matter (PM_{10}) due to the vent discharges was modelled as 2 µg/m^3 in the area between two vents. Predicted maximum 1-hour and 24-hour average NO_x concentrations are approximately 11 µg/m^3 and 6 µg/m^3 respectively. The findings of the Assessment of Mine Vent Air Quality with respect to native frogs includes:

- Predicted cumulative concentrations of PM_{10} in the vicinity of the vent raises will be lower than measured concentrations adjacent to an unpaved road in Northland (based on weekend traffic volumes).
- Based on similarity in traffic levels, PM_{10} concentrations are likely to be similar in areas adjacent to an unpaved public road in the Coromandel (north of the WUG) where baseline ecological assessments of Hochstetter's frog habitat have been undertaken. Therefore, it can be inferred that Hochstetter's frogs at this Coromandel location are exposed to greater levels of PM_{10} than anticipated in the vicinity of the proposed vents.

The potential effect of air discharges to fauna habitats within Coromandel Forest Park includes particulates settling on vegetation (habitats) and animals themselves. Native frogs are particularly susceptible to the effects of surface contamination because of their porous skin, but the change to air quality in the area surrounding the vent raise is expected to be very low.

Frogs are vulnerable to absorbing emissions through their skin and may be sensitive to the discharges from vent raises. The implications of long-term emissions of the type and quantity expected from the vent raises is unknown. While we consider that the level of effect will be **Low**, there is a lack of literature to inform this assessment. As such, we consider there is a **low likelihood of a residual effect on frogs**.

We have also considered the potential effects of air discharges on *Dactylanthus taylorii.* Because *Dactylanthus* has no above-ground foliage, its health depends primarily on the health of the host plant. *Dactylanthus* has no root structures of its own other than the parts which penetrate the host plant's root system, therefore the extent of its distribution in the soil profile is constrained by the host plant's root system.

We do not anticipate that the vent discharge will adversely affect the health or growth of prospective *Dactylanthus* host trees in the vicinity, therefore any populations of *Dactylanthus* that might be present are similarly unlikely to be affected.

We consider that the magnitude of effects of discharges to air on fauna and *Dactylanthus* is **Low** and the ecological value of fauna and *Dactylanthus* within Coromandel Forest Park are **Very High**. Therefore, the level of effect of discharges to air is assessed as **Low,** with a low likelihood of a residual effect on frogs and *Dactylanthus*.

[43] A total of eight Archey's frogs were recorded during a survey along Tapu-Coroglen Road in April 2022. The road is unpaved and vegetation was observed as dusty, despite rain during the day. Frogs were recorded between 1.60 and 2.65 m from the road edge. This finding suggests that Archey's frogs can persist with some level of dust deposition on habitat surfaces.

6.4.6 Continuous Noise from Ventilation Raise Effects on Fauna

Noise associated with the construction and operation of the ventilation raises is described in the Noise Assessment (Marshall Day, 2025). Noise modelling for the construction phase (pad construction, drilling and vent shaft construction including helicopter support) indicates that there will likely be high noise levels (up to 70 dB) around the construction site, but that these drop off quickly in the surrounding forest.

The source of noise from the operating ventilation raises are the fans located at the base of the raise within the underground mine. Predictions of fan noise were found to be only above ambient noise levels (around 40 – 45 dB $L_{Aeq\ (15\ min)}$)[44] in very close proximity to the vent raise at the orebody. We understand that the calculated sound power levels were based on measurements of sound from existing underground mine vent shaft at Union Hill, adjusted for location, changes in duty and vent raise geometry. We rely on the Marshall Day Noise Assessment (2025) in our discussion below.

Natural noise sources in the forest include high winds, swaying trees, heavy rainfall, and thunderstorms, and as such, animals within the forest are adapted to episodically high noise levels. However, noise from the fans would be continuous and as a worst-case scenario could result in heightened stress, avoidance behaviours, reduced/failed reproductivity for fauna species, and masking vocal communications and other sounds of interest (e.g. predator noise). The ability to move away from these stressors varies between species and factors like mobility, habitat requirements, exposure to predators and reproductive state may impact their ability to move. Literature examining the impact of human-induced noise on New Zealand fauna is very limited, and where available, is described in Section 6.2.

Any potential effects on fauna are most likely frequency and amplitude dependent, and species specific. The predicted noise levels of 40 – 45 dB $L_{Aeq\ (15\ min)}$ are consistent with moderate rainfall levels (i.e. ~50 dBL). At the predicted levels, the noise profile would likely dissipate rapidly across the environmental landscape (i.e. the primary impact area would be very localised).

Invertebrates

The magnitude of effect of noise generated by ventilation fans on invertebrates within the Project site and surrounding area is **Low**. This assessment takes into account that the change from baseline noise levels is potentially a minor increase in a small area around the vent shaft. Although many species communicate by sound, they are likely to have a behavioural response to either avoid or compensate for increased, continuous, background noise.

Frogs

The magnitude of effect of noise associated with ventilation fans on frogs within the Project site and surrounding area is **Negligible** given the low sensitivity of frogs to noise, and the small change expected to the existing noise environment.

Lizards

The magnitude of effect of noise associated with ventilation fans on lizards is **Low** given the capability of lizards to move away from disturbance. As noted in Section 6.2.4 and 6.4.3 lizards may acclimatise to continuous noise such as generator noise.

[44] Ambient noise levels measured as 35 dB $L_{50\ (500\ Hz\ –\ 8\ kHz)}$, see Section 6.4.3 for discussion.

Bats

The magnitude of effect of noise associated with ventilation fans on bats is **Negligible** given the capability of bats to avoid a localised unsuitable noise environment.

Birds

The magnitude of effect of noise associated with ventilation fans on birds is **Negligible** given the ability of birds to avoid a localised unsuitable noise environment. Although birds communicate by sound, they are likely to have a behavioural response to either avoid, or adapt to/ compensate for, an increase in continuous background noise.

Effects management

No specific noise management is proposed to address the effect of ventilation fan noise on fauna. We understand that best practise noise reduction designs are in place to reduce noise associated with vents, including location of the fans themselves at the bottom of the shaft, rather than near the top. The area surrounding the vent shaft will be surrounded by a wildlife exclusion fence to prevent animals occupying the area immediately next to the vent where any noise impact would be most severe.

6.5 Coromandel Forest Park: Potential Long-term Effects

6.5.1 Approach

This section describes potential effects associated with the WNP where there is a high level of uncertainty about the effect itself and/or the likelihood of the effect being realised, for instance:

- Responses of fauna (or specific animal groups) to the activity where there is insufficient literature / information to make a clear assessment of risk to fauna.
- Where the potential effect is very high, and over a large scale, but the risk of that effect occurring is very low because of management interventions (i.e. spread of kauri dieback, dewatering).

6.5.2 Episodic Vibration from Underground Blasting Effects on Fauna

For this Project, it is expected that underground blasting may generate perceptible (to humans) levels of vibration on the surface. Vibration modelling carried out by Heilig & Partners (2025) indicates that blasting associated with the development of the Access Decline (i.e. the tunnel required to access the orebody originating in Willows Road Farm, Years 1-4) will not produce vibration levels above 1 mm/s north of Willows Road Farm (i.e. under Coromandel Forest Park).

As such, the key period for potential impacts from blasting vibration is during the mining operation (Years 5 – 14) under the Wharekirauponga area of Coromandel Forest Park. Variable mining methods have been proposed as a method of minimising vibration related impacts on the surface and potential disturbance to fauna within Coromandel Forest Park. Blast designs were modelled using different explosive weights and packing options based on location.

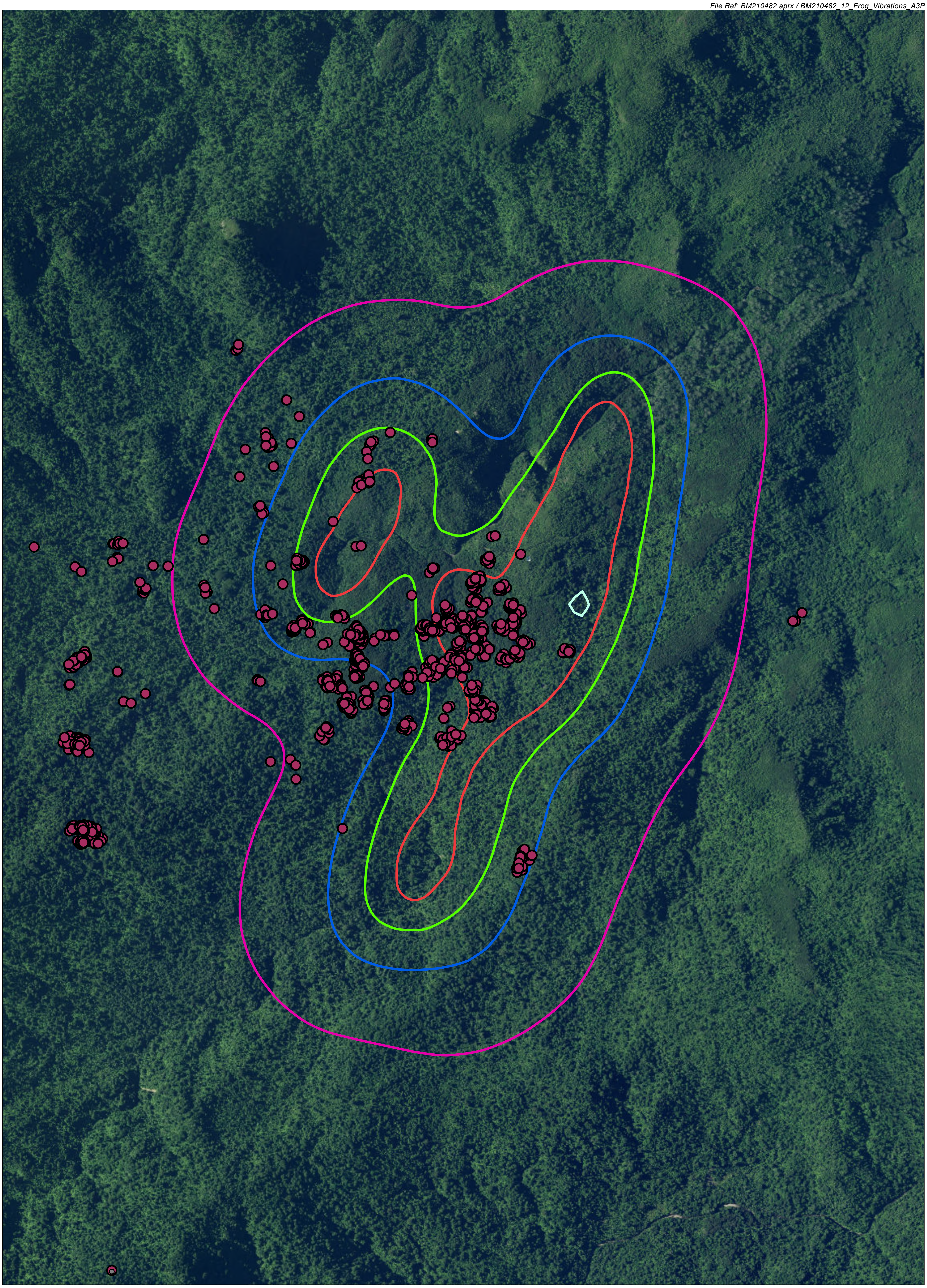
To aid in interpreting the vibration modelling, Heilig & Partners have generated a series of vibration contours to demonstrate what level of vibration will be experienced on the surface (Figure 18). The contours indicate the average level of vibration that could be expected across the whole area taking all blasts into consideration (i.e. not all of the area within each contour will experience blast vibrations at that level each time there is a blast). Histograms are also provided, indicating the expected number of blast events per year over the full range of predicated vibration.

Key vibration parameters include:

- Amplitude varies with distance from the blast and with size of explosive weight.
- Frequency of vibration refers to the number of cycles per second. For the WUG, frequency varies with distance from the blast, but frequencies between 30 -60 Hz are expected.
- Duration and frequency of occurrence blasts that generate a level of vibration above 2 mm /sec can comprise up to 78 % of the total blasts; however total number of such events would be around 3-4 events per day, each of around 10-12 seconds in duration, with a total time of such events around 30-50 seconds per day.

This analysis was used to inform our assessment. We consider that vibrations are likely to be felt more strongly by ground-dwelling species, particularly those that burrow into root crevices and refuges like Archey's frogs (and to a lesser extent, Hochstetter's frogs[45]), invertebrates and lizards. Measurable vibrations may be expressed on the surface over an area of approximately 314 ha. Vibration greater than >2 mm/s (above which there is a low, but unknown likelihood of impacts on native frogs) will be experienced at some time during the life of the mine, as it is currently designed, over an area of 314 ha.

[45] Hochstetter's frogs in Wharekirauponga have only been recorded around stream margins, although it is possible that they are present in the forest itself in the same areas as Archey's frogs. Therefore, our assessment of the level of effect on Archey's frogs also applies to Hochstetter's frogs.



Boffa Miskell

www.boffamiskell.co.nz

0 200 m

1:10,000 @ A3

Data Sources: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

Expected Vibration Contour
- 2 mm/s
- 4 mm/s
- 6 mm/s
- 8 mm/s
- 10 mm/s

Archeys Frog Record

WAIHI NORTH PROJECT

Wharekirauponga Vibration Contours

Date: 13 February 2025 | Revision: 1

Plan prepared by Boffa Miskell Limited

Project Manager: Katherine.Muchna@boffamiskell.co.nz | Drawn: HCo | Checked: KMu

Figure 17

Invertebrates

The potential response of invertebrates to vibrations is described in Section 6.2.2. The magnitude of effect of vibrations generated by blasting on invertebrates within the Project Site and surrounding area is **Low.** This assessment takes into account the short duration and infrequency of the blasts and that invertebrates (e.g. ground wētā) are active for many hours at a time and are typically resilient to non-lethal disturbance.

Frogs

The potential response of native frogs to blast vibrations is briefly outlined in Section 6.2.3 and thoroughly reviewed in Bioresearches 2025b. Intermittent blast vibrations greater than 2 mm/s are predicted to occur over ~314 ha of the Wharekirauponga area.

Bioresearches (2025b) assessed that both Archey's and Hochstetter's frogs can tolerate some level of disturbance, and also can tolerate blast or other ground vibrations[46]. However, there is no evidence of a vibration threshold above which an ecologically meaningful response could be expected. An upper limit of 15 mm/s is proposed as a management trigger to provide sufficient protection for native frogs.

For this reason, we consider that the vibration associated with blasting will have a **Low, but uncertain** magnitude of effect on frogs in Coromandel Forest Park. Frogs have a **High** ecological value and will experience a **Low, but uncertain** level of effect. We consider that there may be a potential residual effect of vibrations on frogs, which will be monitored as part of a large scale monitoring programme (Section 8.5.8).

Lizards

The potential response of native lizards to blast vibrations is outlined in Section 6.2.4. The magnitude of effect of blast vibrations on lizards is **Low.** This assessment takes into account the short duration and infrequency of the blasts and the apparent very low density of lizards in the Project Area (i.e. the number of lizards likely to be affected is low).

Bats

Vibration effects on bats are poorly studied, internationally and in New Zealand. Bats are highly mobile, and we consider that vibrations will be barely perceptible in an arboreal nest.

The magnitude of effect of blast vibrations on bats is **Negligible** given the apparent low density (if not absence) of bats within in the Project site.

Birds

New Zealand forest bird species are highly mobile, and for species recorded in Wharekirauponga catchment previously, all nest in trees. Birds are most sensitive during the nesting season (from laying to fledging), but it is expected that vibrations will be barely perceptible in an arboreal nest. Natural disturbance (e.g. high winds) is more likely to impact nesting success. Hence, the magnitude of effect of blast vibrations on birds is assessed as **Negligible**.

[46] Between 2–10 mm/s tolerated by Hochstetter's frog and 2 mm/s, maybe up to 4 mm/s, tolerated by Archey's frog (Bioresearches 2025b).

<u>Effects management</u>

Proposed management actions for vibration impacts includes:

- Variable mining methods to minimise vibration related impacts on the surface and potential disturbance to fauna within the Coromandel Forest Park.
- Biodiversity Offset initiatives to benefit Archey's frogs (and other fauna groups) where uncertain but potential residual risks have been identified (see Section 8.5.3).

6.5.3 Spread of Kauri Dieback Disease

Phytophthora agathidicida (PA) is the pathogen regarded as a primary causal agent of dieback disease in otherwise healthy kauri, while other *Phytophthora* species may also have a role in the expression and severity of disease symptoms. Kauri dieback infects trees through their roots, and spreads primarily through the movement of contaminated soil and water, as well as by root-to-root contact between trees (Bradshaw et al., 2020).

No PA has not been recorded in vicinity of the Wharekirauponga catchments to date. The magnitude of effect of introducing / spreading kauri dieback disease in the Wharekirauponga catchment would be **Very High** and the ecological value of kauri within the catchment is **Very High.**

OGNZL has an established Kauri Dieback Management Plan for working within the Wharekirauponga catchments to minimise both the introduction of PA spores and to reduce potential spread from one site to another. This plan is consistent with the Biosecurity (National PA Pest Management Plan) Order (2022) and addresses the ten National PA Pest Management Plan (NPMP) rules set out in the Order. This plan is also consistent with guidance documents provided by Waikato Regional Council and Tiakina Kauri (Kauri Protection) Management Agency.

In the absence of any PA detections, the primary focus of management is on strict inspection and hygiene procedures to ensure no soil is imported to the site on gear or machinery. All personnel and machinery are typically flown to and from the site, although personnel may walk in / out if conditions are not suitable for flying and the track is open. While PA has not been recorded in the vicinity, we note that survey effort to detect the disease within the Wharekirauponga catchments and surrounds is low, and there may be a significant lag between infection and trees showing symptoms. Therefore, the Coromandel Forest Park Kauri Dieback Management Plan (Coromandel Forest Park KDP) developed for WUG also includes protocols for containment of PA infection that may be present and undetected (OGNZL, 2025).

Mature kauri trees, seedlings and saplings may be present in the vicinity of the proposed footprint and along walking tracks between the exploration drill sites, helipad, camp sites and vent raise sites. The root systems of trees have the potential to harbour kauri dieback disease, and movement of machinery, equipment and people between sites during construction and drill site operation is a key pathway for the spread of kauri dieback.

Recent surveillance work has found that PA can occur in soil away from the rhizosphere (root zone) of kauri (Biosense, 2020), though the frequency of detection is much higher near to kauri trees. This is likely to be because the pathogen primarily reproduces within the rhizosphere of kauri, and therefore concentrations of propagules are much greater there.

The likelihood of *Phytophthora* invasion increases with the number of viable spores that are introduced into the habitat. Key factors are the total volume of contaminated material that is moved and the density of *Phytophthora* propagules in this material (Swiecki & Bernhardt, 2016). *Phytophthora* distribution in soil is typically non-uniform because these pathogens are normally associated with host roots (Swiecki & Bernhardt, 2016).

Current management practice operates on the basis that PA may be present but undetected within the Project Site, and assumes that the greatest risk is in close proximity to kauri where the pathogen load is likely to be high. The likelihood of contacting and spreading PA in the course of works is minimised through avoidance of all kauri, or application of stringent hygiene protocols in the vicinity of kauri where trees are not avoidable.

Current management includes avoiding movement and soil disturbance in areas within three times the radius of the canopy dripline of any kauri tree; regular cleaning stations on established routes (i.e. between drill site, helipad and camp); mapping kauri on walking tracks and monitoring their health; equipping staff with boot / gear cleaning materials; and training staff and contractors in surveillance. Pressurised bootwash facilities are being installed at drill and camp sites and the potential to upgrade tracks in muddy areas is being evaluated.

Current monitoring entails survey and mapping of all kauri trees in the vicinity of all access tracks and work sites, and canopy health assessments of kauri trees to identify any potential symptom of kauri dieback. Kauri tree health assessments are repeated annually to assess any changes in health status.

Although the risk of introducing kauri dieback disease to Wharekirauponga is always present, it is not specific to the activities associated with the WNP. Both animals and recreational users of the forest may also contribute to the spread of the disease. We consider that the proposed surveillance protocols for kauri dieback infection (described in the Coromandel Forest Park KDMP) will allow for early detection of the presence of the disease within the forest.

Effects management

None of the sites proposed for vegetation clearance or soil disturbance contain any kauri, however survey and pest control work will require movement of people through forest areas that contain kauri.

We note that reliable PCR-based methods for detecting PA and other *Phytophthora* pathogens associated with kauri dieback have recently been developed (Winkworth et al 2020; Biosense, 2020) that makes surveillance for PA in soil and watercourses feasible and practical as a component of kauri dieback management.

Proposed management actions for kauri dieback within future work areas includes:

- Preparation of a site / activity specific kauri dieback plan (Coromandel Forest Park KDMP) that describes identification of kauri contamination zones, avoidance measures, personnel / equipment cleaning procedures and kauri health monitoring methods;
- Development and implementation of a PCR-based disease surveillance programme for PA in soil and water samples to inform the risk assessment associated with work activities within the site footprint and the wider catchment prior to operations.
- Training all staff and contractors on kauri dieback hygiene protocols.

We note that these hygiene protocols have been successfully applied at Wharekirauponga and trees showing any signs of kauri dieback have been assessed quickly (kauri dieback has not been confirmed in any of the symptomatic trees). Effective disease risk management relies on an ongoing, high level of compliance with kauri dieback protocols and a high level of efficacy for those protocols. Surveillance methods using PCR (polymerase chain reaction methodology to amplify specific DNA segments) will give a high degree of certainty that management protocols are effective.

6.5.4 Dewatering Effects on Vegetation and Fauna

The potential of the WUG to reduce surface water volumes and moisture content in soils and streams (dewatering) was identified as a potential impact on vegetation communities and fauna habitats. WWLA (2025) assessed the potential impacts of the WUG dewatering on groundwater, stream baseflow and other surface water within Wharekirauponga using multiple project-specific models and geological and hydrogeological data. We understand from that assessment that deep mine dewatering will have limited effects at the surface due to the vertical separation of the deep groundwater and the geological conditions / low connectivity between surface waters and groundwaters. With respect to impacts on the forest environments in Wharekirauponga, we understand from the WWLA assessment that soil moisture content is predominantly rainfall derived and it is unlikely that vegetation will be affected by groundwater changes.

The risk of potential dewatering on Hochstetter’s frogs was assessed by Bioresearches (2025b), who found that there was unlikely to be a measurable effect on frog populations. Modelled reductions in stream flow and wetted width were assessed as unlikely to impact Hochstetter’s frog habitat extent or quality in lower stream catchments, and would not impact higher stream catchments (where most of the Hochstetter’s frog population occurs). Archey’s frogs are a completely terrestrial species and their forest habitat will be maintained by the shallow groundwater which is recharged by percolating rainfall (WWLA, 2025).

We rely on the WWLA summary report to inform our assessment of **No Effect** on terrestrial ecosystems or specific taxonomic groups from any dewatering that may result from the WNP.

6.6 Level of Effects on Terrestrial Vegetation, Habitats and Species

The level of effect on native species and communities is set out in Sections 6.3 – 6.5 and summarised in Table 8 and includes the effects management described throughout those sections.

It is not possible to precisely determine the effect of each residual activity, or the interaction between these effects, but in all cases, the 'zone of influence'[47] where potential effects may be experienced, is small relative to a species' distribution and none of the effects described threaten a species' persistence or abundance at a catchment scale.

All of the identified effects are of short duration (the period of exploration works, or operational works (mining)), and are reversible on completion of mining. The primary mechanism to reduce the level of effect is to avoid and minimise the impact on the ecological parameters considered through design and management (Table 8).

[47] That is: The 'zone of influence' (ZOI) refers to all land, water bodies and receiving environments that could be potentially impacted by the project. It includes the Project Site and any environments beyond the Project Site where 'indirect effects' such as discharges may extend (sometimes called the Study Area).((Roper-Lindsay et al., 2018)

Table 10: Summary of the level of effect for terrestrial vegetation, habitats, and species. Level of effect is provided with the management / avoidance / offset measures described in Sections 6.3 – 6.5.

	Effect	Feature	Ecological value	Magnitude of effect	Level of effect without Management	Level of effect with management
Willows Road Farm	Vegetation clearance, habitat loss	Willows Road Farm vegetation and habitats	Low	Negligible	Low	Very Low
		Willows Road Farm fauna	Low	Negligible	Low	Very Low
	Construction noise	Willows Road Farm fauna	Low	Negligible	Low	Very Low
	Discharges to Air	Willows Road Farm fauna	Low	Negligible	Low	Very Low
		Coromandel Forest Park near Willows Road Farm	Low - Very High	Negligible	Low	Very Low - Low
	Vegetation clearance, habitat loss for trench	Trench footprint vegetation and habitats	Negligible	Negligible	Very Low	Very Low
	Lighting effects	Fauna communities	Low	Low	Low	Low
Coromandel Forest Park – Localised effects	Vegetation and habitat loss for duration of mining	Vegetation	Very High (new sites) Low (reused sites)	Low	Moderate	Very Low
		Fauna habitats	Very High	Negligible	Very High	Very Low
		Fauna communities	Very High	Very High	Very High	Low-Moderate
	Episodic noise from drill and pump site operation, and helicopter activity	Fauna populations	Very High	High	Very High	Very High

	Effect	Feature	Ecological value	Magnitude of effect	Level of effect without Management	Level of effect with management
	Continuous Noise from Ventilation Raise	Invertebrate populations	Very High	Low	Low	Low
		Frog populations	Very High	Negligible	Low	Low
		Lizard populations	High	Low	Low	Low
		Bat populations	Uncertain	Negligible	Very Low	Very Low
		Bird populations	Very High	Low	Low	Low
	Discharges to Air from Ventilation Raise	Fauna communities	High	Low	Low	Low
	Lighting effects	Fauna communities	Very High	Low-Moderate	Moderate-High	Moderate
Coromandel Forest Park – Long-term Effects	Episodic Vibration from Underground Blasting	Invertebrate populations	Very High	Low	Uncertain (likely Low)	Very Low
		Frog populations	Very High	Low	Uncertain	Low
		Lizard populations	High	Low	Uncertain (likely Low)	Very Low
		Bat populations	Uncertain	Negligible	Low	Very Low
		Bird populations	Very High	Negligible	Low	Very Low
	Spread of kauri dieback disease	Kauri trees	Very High	Very High	Very High	Very Low
	Dewatering	Vegetation communities	Very High	Nil	Nil	Nil
		Fauna communities	Very High	Nil	Nil	Nil

7.0 Integrated Landscape and Ecological Response

The proposed mitigation for the Project has been developed as an integrated package of complementary measures that encompasses all landscape and ecological management initiatives and enhancements, with the intention that this coordinated effort achieves more than simply the ‘sum of its respective components’, and is consistent with the effects management hierarchy specified in the NPS-IB.

A summary of ecological enhancement initiatives is presented in the Ecology and Landscape Management Plan (OGNZL, 2025), including details of all the assumptions and ratios used to derive the total mitigation package with the intention of an overall Net Gain. In particular, landscape and ecological mitigation and offset responses are combined to create a corridor of vegetation that connects to the Coromandel Forest Park, which will improve the biodiversity value of both existing natural features and vegetation established to address landscape and visual effects.

The integrated mitigation plan will provide:

- Ecological and landscape connectivity across and within the Waihi North Project.
- Extensive restoration planting and open areas across the Waihi North Project.
- Extensive riparian planting along the waterways, to complement the riparian enhancements already carried out by OGNZL (and its predecessors).
- Providing recreational opportunities where safe to do so.
- Creation of new wetlands, and enhancement of existing wetland areas.
- Enhanced habitat for elements of native fauna such as frogs, birds, eels, koura, Cran’s bullies and for wetland birds.
- Greater ecological connectivity across the landscape for both resident and transient fauna.
- Enhanced viability of Coromandel Forest Park edge vegetation and habitats through buffer planting adjacent to Willows Road Farm.
- Extensive pest animal control to benefit native fauna and habitats.

We note that while all of the above initiatives will provide some ecological benefit, only initiatives that specifically address ecological effects are considered in the evaluation of proposed effect management measures in Section 8.0

8.0 Proposed Ecological Management

8.1 Effects Management Measures

We have assessed each of the effects under the effects management hierarchy as set out in Section 4.9.1. Overall, the effects of the WUG can be avoided, minimised, remedied and any significant residual effects can be compensated for. By implementing the recommended management measures for each of the potential impacts, described in their respective sections and summarised below, the level of effect can be reduced to **Very Low** or **Low** and the potential residual effects are compensated for (Table 11).

Supporting documents relating to Effects Management include:

- WUG Ecological Management Plan (within the ELMP (OGNZL 2025))
- Coromandel Forest Park Kauri Dieback Management Plan (Coromandel Forest Park KDMP (within the ELMP (OGNZL 2025))
- Wharekirauponga Pest Animal Management Plan (Boffa Miskell, 2025b)
- WUG Vegetation Remediation Plan (within the ELMP (OGNZL 2025))
- OGNZL Wharekirauponga frogs: Potential adverse ecological effects memo (RMA Ecology, 2025)
- Proposed consent conditions (Part E of the AEE, (Mitchell Daysh, 2025)).

For clarity, we have briefly defined elements of the effects management hierarchy consistent with the definitions provided in EIANZ (Roper-Lindsay et al., 2018). These terms are used in Table 10.

8.2 Avoid

As previously described in Sections 6.3 – 6.5, key measures to avoid or minimise ecological effects include:

- For clearance areas in CFP:
    - Avoid large tree specimens where possible and minimise ground disturbance and damage to vegetation, no trees with a DBH > 50 cm will be felled at exploration drill sites / pump sites, and no more than 4 trees with a DBH between 50 - 100 cm may be felled at the four large hydrogeological drill sites (and later vent sites);
    - Avoid native bat roost trees where possible and ensure potential bat roosts are not occupied, in accordance with Department of Conservation protocols (2024 or subsequent updates) to minimise risks to bat roosts; and
    - Avoid felling active native bird nests in clearance area, chicks should be fledged or the nest failed before felling.
    - Transfer of logs and potential habitat for stag beetles, peripatus and paua slug during site clearance to outside of the clearance footprint.

- Avoiding the spread of kauri dieback disease by following stringent hygiene and surveillance procedures.
- Tree felling protocols to be implemented to avoid removal of active bat roosts and bird nests (i.e. roosts and nests must be vacated before felling) in all circumstances where habitat is removed at Willows Road Farm and CFP[48].

8.3 Mitigate / Minimise

The following mitigation measures are proposed to reduce the severity of adverse ecological effects. Flowcharts detailing these processes are provided in Appendix 3, and site selection criteria are provided in Appendix 4. Mitigation measures include the following:

- Use site selection criteria to identify sites with the lowest habitat value (as a proxy for fauna values) from a range geotechnically suitable options.
- Pre-clearance fauna and habitat salvage over two days / nights (in suitable conditions from March - May) prior to tree felling. Any lizards, frogs, and notable invertebrates present will be captured and translocated to a prepared, intensively pest-controlled release site following the protocols described in the WUG Ecological Management Plan (Boffa Miskell 2025e) and illustrated with the flowcharts provided in Appendix 3.
- Transplant unoccupied nurse logs, ponga, Astelia, kiekie and seedlings of hardy species to be replanted on the forest edge. Leaves and wood debris to be stockpiled outside of the fenced project footprint. These will be returned to the cleared footprint once drilling is complete (Appendix 3).
- Project and engineering actions to reduce the impact of noise and air discharges at Willows Road Farm. These include noise barriers (bunds), installing the external ventilation fan in an insulated shipping container to reduce noise levels, water spray trucks and reseeding the topsoil stockpile to reduce dust.
- Project and engineering actions to minimise potential impacts on fauna and habitats within Coromandel Forest Park, including use of a small helicopter to reduce noise effects; the vent fan being fitted to base of shaft to reduce noise experienced at the surface; vent design to increase particulate dispersion and gaseous emission; fencing and a clearance buffer around vent shafts to prevent animal access.
- Supervise vegetation clearance on Willows Road Farm to ensure fauna are not harmed, relocate lizards / notable invertebrates following the procedures in the WUG Ecological Management Plan.
- Supervise vent site clearance and relocate frogs, lizards, invertebrates and habitat elements found within the clearance footprint during vegetation clearance[49].

[48] A series of sub-management plans will be prepared to guide fauna management prior to and during vegetation clearance at Willows Road Farm, including a Bat Management Plan, Avifauna Management Plan, Lizard Management Plan. The objectives of these plans are detailed in proposed conditions; Part E of the AEE, (Mitchell Daysh, 2022).

[49] For the avoidance of doubt, prior to vegetation clearance, vent sites must have had no recorded frogs and to have been fenced to exclude frogs and other fauna within 5 days of the final frog survey. In the event that a frog / frogs were not detected during surveys, but were detected during clearance, they would be relocated out of the fenced area following the protocols described in the proposed consent conditions (Part E of the AEE, (Mitchell Daysh, 2022)).

- Intensive pest control within 633 ha of the WUG surface footprint to deliver benefits specifically for Archey's frogs but with wider benefits for fauna and vegetation (refer to Pest Animal Management Plan for details).
- Kauri dieback management protocols and surveillance, as described in the Coromandel Forest Park KDMP.
- Rehabilitation of the Willows Road Farm and Coromandel Forest Park Project Areas at the conclusion of mining.

8.4 Remedy

The following remediation measures are proposed:

- Revegetation of the Willows Road rock stack area once the rock stack is exhausted / on mine closure. Mining infrastructure on the farm will be removed when no longer required and the farm property will be returned to pastoral farming.
- Remove drilling platform / campsite at cleared sites within CFP and return stockpiled materials to the cleared footprint following the protocols outline in the WUG Vegetation Remediation Plan (Boffa Miskell 2025f) (Appendix 3).
- Remove surface infrastructure at vent raises, restore vent raise footprint and undertake weed control / surveillance around vent raise sites over a period of two years. Rather than replanting within CFP, natural revegetation will be facilitated through weed and pest control to promote a more robust and complex vegetation community.

8.5 Biodiversity Compensation

8.5.1 Definition and Background

Biodiversity compensation includes measures taken to counterbalance any residual adverse impacts after implementation of the effects management hierarchy[50]. As previously noted in Sections 6.4.2 and 6.5.2, biodiversity compensation measures proposed for this project include:

- Enhancement planting to account for temporary loss of vegetation within the footprint of drill rigs, pumps and vent raises. This action is proposed to occur outside, but immediately adjacent to, the Project Area.
- Pest control to address uncertain but potential residual effects on Archey's frogs (resulting from blast vibration), Hochstetter's frogs, native lizards, native birds, native bats and native invertebrates from the potential residual effects of vent shaft discharges, habitat clearance, light and noise impacts. This compensation comprises intensive pest control within a potential vibration - impacted area (314 ha), and an adjacent area of high-quality frog habitat (319 ha) outside of the potentially impacted area (Sections 8.5.4 and 8.5.5).

[50] We note that Maseyk et al., (2018) define biodiversity offsets as "A measurable conservation outcome resulting from actions designed to compensate for residual, adverse biodiversity effects arising from activities after appropriate avoidance, remediation, and mitigation measures have been applied. The goal of a biodiversity offset is to achieve no-net-loss, and preferably a net-gain, of indigenous biodiversity values". For consistency with our assessment method, we have used the EIANZ definition.

- Research funding to assess efficacy of pest control to benefit frog populations; and ongoing Archey's frog distribution and abundance studies across the Coromandel Peninsula (Section 8.5.6).

These actions are proposed to occur outside, but immediately adjacent to, the project footprint. The compensation proposal provided here is consistent with the Principles of Biodiversity Compensation and in the NPS-IB. These principles and how they have been addressed are provided below:

1) **Adherence to the effects management hierarchy:** The actions described below address potential residual effects after steps to avoid, minimise/ mitigate and remedy those effects have been exhausted (Sections 8.2 to 8.4).
2) **When biodiversity compensation is not appropriate:** We consider that:
    - Enhancement planting on land adjacent to Coromandel Forest Park will secure biodiversity gains that appropriately balance the temporary loss of vegetation in the drill, pump and vent site footprints.
    - Biodiversity compensation (in the form of pest control and research funding) is appropriate because although the potential residual effects on native fauna from vibration, noise, lighting and temporary habitat loss are uncertain, we do not consider that they are significantly adverse or irreversible. We anticipate that positive effects of pest control on the fauna populations will be detectable within 5-10 years of commencing pest control. This time period takes into account the slow population level response of native frogs to management, as demonstrated in the Whareorino population. We further consider that habitat improvements resulting from pig, deer and possum control will be significant.
3) **Scale of biodiversity compensation:** We consider that the scale of the biodiversity compensation package is large relative to the scale and impact of the project on ecological values and will result in a net gain for biodiversity:
    - Enhancement planting will provide a net gain in like-for-like indigenous vegetation cover (by area) at maturity. We anticipate that the structure and quality of indigenous vegetation will be equivalent to forest edge habitats, not interior forest habitats. However, enhancement planting will buffer the existing forest edge.
    - Comprehensive predator control in the impact area and adjacent area (comprising the same fauna and vegetation values) is expected to deliver a measurable net gain in native frog population size. We expect suppression of mammalian pests will also deliver additional benefits to other fauna species and the vegetation community from the suppression of mammalian pests.
4) **Additionality:** The anticipated biodiversity gains as a result of the compensation package will exceed gains (if any) that would be achieved in the absence of the compensation measures.
5) **Leakage:** The proposed biodiversity compensation does not result in harm to other indigenous biodiversity.
6) **Long-term outcomes:** Enhancement planting will be legally protected, and as such provides a benefit in perpetuity. The duration of the pest control and monitoring will extend two years (minimum) beyond the cessation of works.

7) **Landscape context:** The biodiversity compensation package described here is within the impact area and immediately adjacent to it.

8) **Time lags:** Time lags will be minimised by commencing enhancement planting within the first 5 years of the project, and predator control before commencement.

9) **Science and mātauranga Māori**: The proposed biodiversity compensation package is evidence based and there are opportunities to incorporate cultural practices and cultural principles into the monitoring framework.

10) **Tāngata whenua and stakeholder participation:** We understand that stakeholder engagement has been undertaken and a Cultural Impact Assessment is being prepared.

11) **Transparency:** the biodiversity compensation package is described in this document, as well as Dr Ussher's assessment (RMA Ecology, 2025). Additional details of the pest control component are provided in the wide-scale pest animal management plan (WPAMP, Boffa Miskell 2025b).

We note that the biodiversity compensation principles of 'trading up' and 'financial contributions' are not applicable to this project.

8.5.2 Enhancement Planting: Vegetation and Habitat Loss Associated with Drill Sites, Pump Test Sites and Vent Raises

As described in Section 6.4.2, revegetation of a total of 21 ha on the north east ridge of Willows Road Farm will connect an existing remnant bush fragment (Vegetation Area 3) occupied by Hochstetter's frog to Coromandel Forest Park (Figure 20). This area will be fenced to exclude stock and pigs and subject to pest control (rodents, possums and mustelids), and provided legal protection in perpetuity[51].

While the potential habitat created by this initiative is not a 'like for like' replacement of the vegetation and habitat communities of the interior Coromandel Forest Park that will be cleared as part of the WUG, replanting this area will connect an indigenous forest fragment with established fauna values with Coromandel Forest Park, effectively expanding the Park's extent. Replanting this area will also buffer the existing forest edge, thus creating more forest interior habitat with established vegetation that will improve the viability and habitat quality of both the forest fragment and Coromandel Forest Park.

The extent of revegetation was determined on the basis that this is the area required to reconnect Vegetation Area 3 with Coromandel Forest Park.

Pest control will begin once fencing is complete.

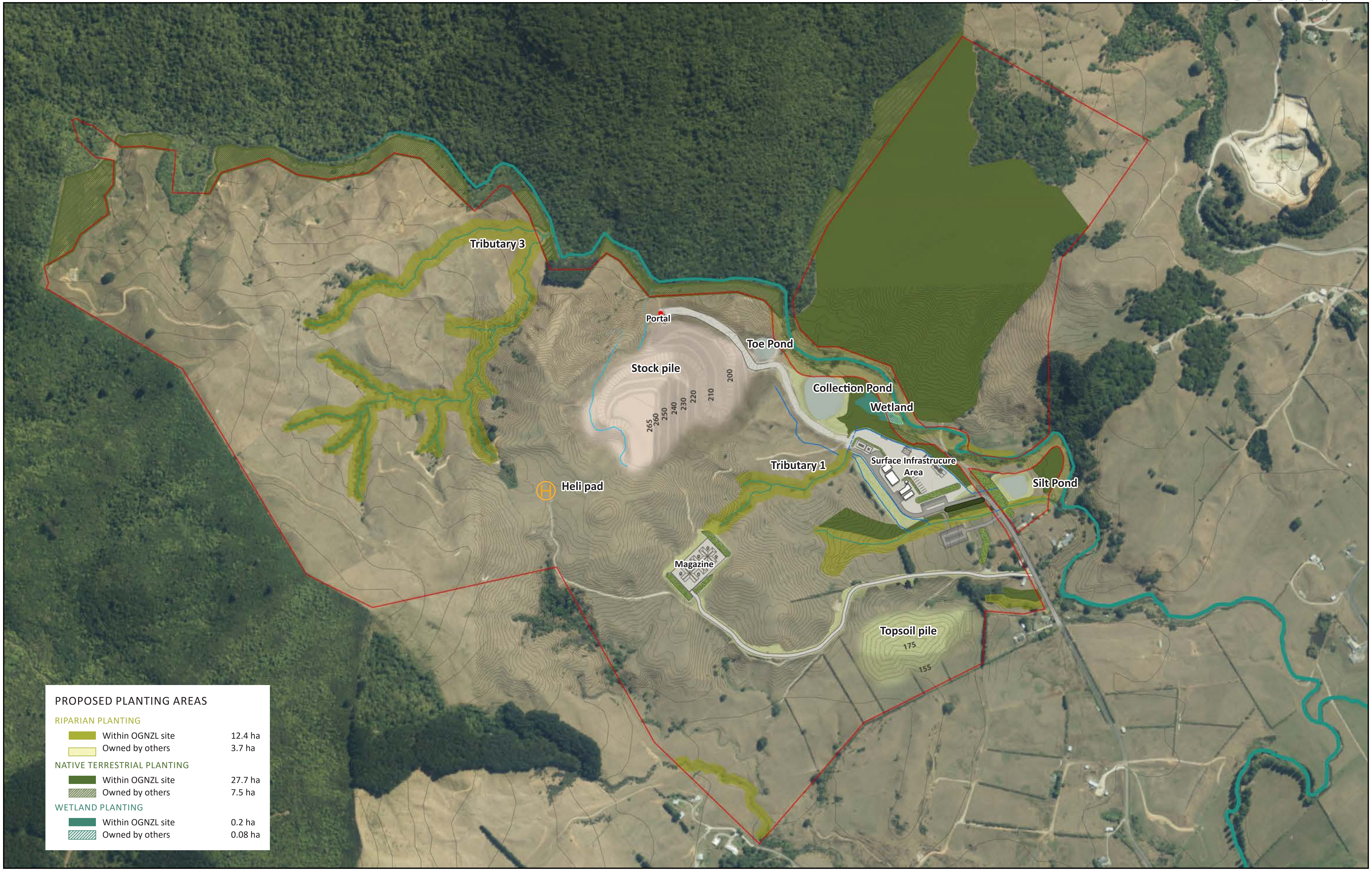
8.5.3 Buffer Planting of Forest Edge

Additional planting is proposed along the boundary with the Coromandel Forest Park (land administered by DOC). This planting is proposed to address the impacts of vegetation clearance within the forest that creates temporary interior forest edges. Buffer planting is aimed at minimising edge effects and providing a buffer between the Forest Park and adjacent

[51] Proposed conditions are provided in Part E of the AEE, (Mitchell Daysh, 2022). Replanting will commence when vegetation clearance begins and will be staged to replant a minimum of 2.5 ha / year,

farmland, and will provide additional habitat for indigenous flora and fauna. The buffer area was identified as an opportunity to restore the original extent of the Coromandel Forest Park as part of the WNP. The planting will comprise low-density planting of suitable native species to allow natural regeneration of species from the Forest Park. Weed control will be included in the management of this area. The forest buffer planting area amounts to some 5.5 ha of additional planting. These areas will be fenced to exclude livestock and will be subject to pest and weed management.

We further recommend that fencing indigenous forest areas that border Coromandel Forest Park include pig-proof fencing to promote forest regeneration and protect fauna values. We recommend that planting and weed management in this area commences within five years of the start of the project. Delays in planting may result from the high number of plants required for revegetation for other parts of the WNP and the ability to eco-source and grow the plants locally.



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that they arise from inaccurate information provided by the Client or any external source.

NORTH

0 250m

1:7,500 @ A3

LEGEND

- Willows Rd site
- Existing fences
- Existing streams
- Collection steam
- Culverts
- Proposed shelter belt
- Hydroseeded grass
- Bund

WAIHI NORTH

Proposed Integrated Mitigation - WUG Surface Facilities Area

Date: 18 February 2025 | Revision: 5

Plan prepared for Oceana Gold by Boffa Miskell Limited

Project Manager: rhys.girvan@boffamiskell.co.nz | Drawn: EFa | Checked: RGi

Figure 18

8.5.4 Pest Control to Address Uncertain Residual Effects on Archey's and Hochstetter's Frogs

This assessment identifies that due to uncertain vibration effects, there could be residual adverse impacts on Archey's and Hochstetter's frogs within the Wharekirauponga Project Area after avoidance and mitigation measures have been applied. While we consider that direct mortality is an unlikely outcome, there is uncertainty about the likelihood and level of indirect effects on native frogs (for example, whether intermittent vibrations could cause changes in behaviour that might suppress breeding or emergence behaviour). For this reason, we have taken a conservative approach to requirements for management intervention in order to ensure that native frog populations within Wharekirauponga will be maintained or enhanced.

Our primary recommendation is the implementation of a large scale pest animal management plan (WPAMP, Boffa Miskell 2025b) to benefit native frogs and other fauna within and beyond the 314 ha surface area exposed to vibration levels >2 mm /sec vibration levels (above which impacts on native frogs are uncertain).

The WPAMP programme is divided into two different areas, including the potential vibration - impacted area (314 ha), and an adjacent area of high-quality frog habitat (319 ha) outside of the potentially impacted area. This combined 633 ha area (Wharekirauponga Animal Pest Management Area, WAPMA) will undergo an intensive pest control regime designed to supress rats and mice as predators of native frogs and reverse the habitat destruction caused by pigs (Figure 21). Control of goats, feral cats, possums, wasps and mustelids is also proposed as part of the WPAMP.

The scale of the WPAMP is such that the benefits of undertaking intensive pest control will be more than sufficient to balance any potential effects on reproduction, recruitment or mortality rates that may occur under the most pessimistic scenario of adverse effects on Archey's frogs (RMA Ecology, 2025).

The pest control programme is expected to benefit the resident frog population as well as providing benefits by the habitat enhancement that comes from pest control (especially from pig removal). Extensive pest control will have benefits for other native species, including lizards, birds and invertebrates in addition to Archey's and Hochstetter's frogs (Byrom et al., 2016; Monks et al., 2014; Watts et al., 2020). Integrated large scale pest control as proposed here is expected to result in population recovery of forest bird species (i.e. increased abundance, improved nesting success and potentially increased species richness). Lizard species are also expected to benefit from the proposed pest control, but as the size of lizard populations is apparently low, may take longer to recover. Wide-scale pest management in the areas proposed has the additional benefit that they buffer each other, reducing the pest incursion rate and providing a large, continuous protected area, delivering further substantial benefits to indigenous biodiversity.

With effective pest control in place, the WPAMP anticipates that a level of population enhancement of Archey's frogs could be expected of between 2.3 and 4 times the current population over a period of 3-4 years (based on population gains observed elsewhere following pest control, detailed in Boffa Miskell (2025b). As such, we consider that wide-scale, comprehensive pest animal control is an appropriate biodiversity compensation for the potential residual effects associated with WUG.

A programme for monitoring the response of the Archey's frog population to potential vibration impacts and pest control will be developed in advance of project commencement (Section 8.5.6).

8.5.5 Pest control to Address Effects of Environmental Stressors on Fauna

The pest control proposed is considered to be more than sufficient to address the potential impacts of environmental stressors resulting from the surface exploration drilling and pump testing (e.g. elevated noise and light levels) and the temporary loss of habitat. Pest animal densities in Wharekirauponga are very high and are likely to have a significant impact on the forest ecology. We anticipate the removal of predators and subsequent forest regeneration will increase the carrying capacity of the surrounding forest. The rationale below is adapted from the WPAMP and is provided to demonstrate the wider ecological benefits of pest animal management.

Introduced mammalian pests have an extensive, damaging impact on New Zealand's flora and fauna. Reducing these impacts via pest control is known to result in substantial benefits for native biodiversity. For example, possum, rat and ungulate control has been proven to directly benefit native NZ vegetation by increasing foliage and fruit production, and by reducing tree mortality (Byrom et al., 2016; Wilson et al., 2003). Possums are opportunistic feeders, but particularly seek out tall canopy trees and will systematically strip individual trees of vegetation, after which the tree often cannot survive. This changes the composition of the forest over time and every level of the ecosystem is impacted.

Native bird abundance has also been proven to significantly increase following pest population suppression to low densities, both on offshore islands and on the mainland (MacLeod et al., 2015; Saunders & Norton, 2001; Spurr & Anderson, 2004). Integrated pest management regimes (similar to that recommended here) have been effective at mitigating the impacts of predation by introduced mammals at a landscape scale, including for even the most vulnerable species (O'Donnell & Hoare, 2012).

Pest control can also help to restore functionality of ecosystem services. At Maungataurari Sanctuary Mountain, Iles & Kelly (2014) demonstrated the restoration of pollination services to kotukutuku resulting from higher abundance of pollinating birds. Compared to sites with no pest mammal management, there was higher bird visitation to kotukutuku flowers, and higher pollen loads on female and hermaphrodite flowers.

There is a growing body of evidence that some of the benefits of pest control can spill over into the surrounding landscape, sometimes referred to as a 'halo effect' (Glen, Pech, et al., 2013). For example, the abundance of tūī increased in the largely unmanaged area surrounding Maungatautari Sanctuary Mountain over a nine-year period following pest eradication (Fitzgerald et al., 2019), and forest bird species, including kākā, have recolonised many of Wellington's urban forests since the establishment of Zealandia (Recio et al., 2016). These spillover benefits have also been observed for vegetation, for example, Tanentzap & Lloyd (2017) found that saplings of bird-dispersed fleshy-fruited tree species were higher inside and up to 500 m outside of Orokonui Ecosanctuary (near Dunedin) eight years after the mammal eradication than in comparable unfenced sites. Halo effects have also been observed at unfenced sites with predator control; at Ark in the Park elevated abundances of several native taxa (including broadleaved trees and weta) were observed up to 600 m beyond the edge of control infrastructure (Nathan et al., 2013).

Furthermore, a recent report by Forest and Bird (Hackwell & Robinson, 2021) estimated that the equivalent of nearly 15% of New Zealand's 2018 net greenhouse gas emissions per year — 8.4 million tonnes of CO_2 — could be locked into native ecosystem carbon sinks if feral browsing animals were controlled to the lowest possible levels, although the timeframe to achieve these benefits may be long (Allen et al., 2023).

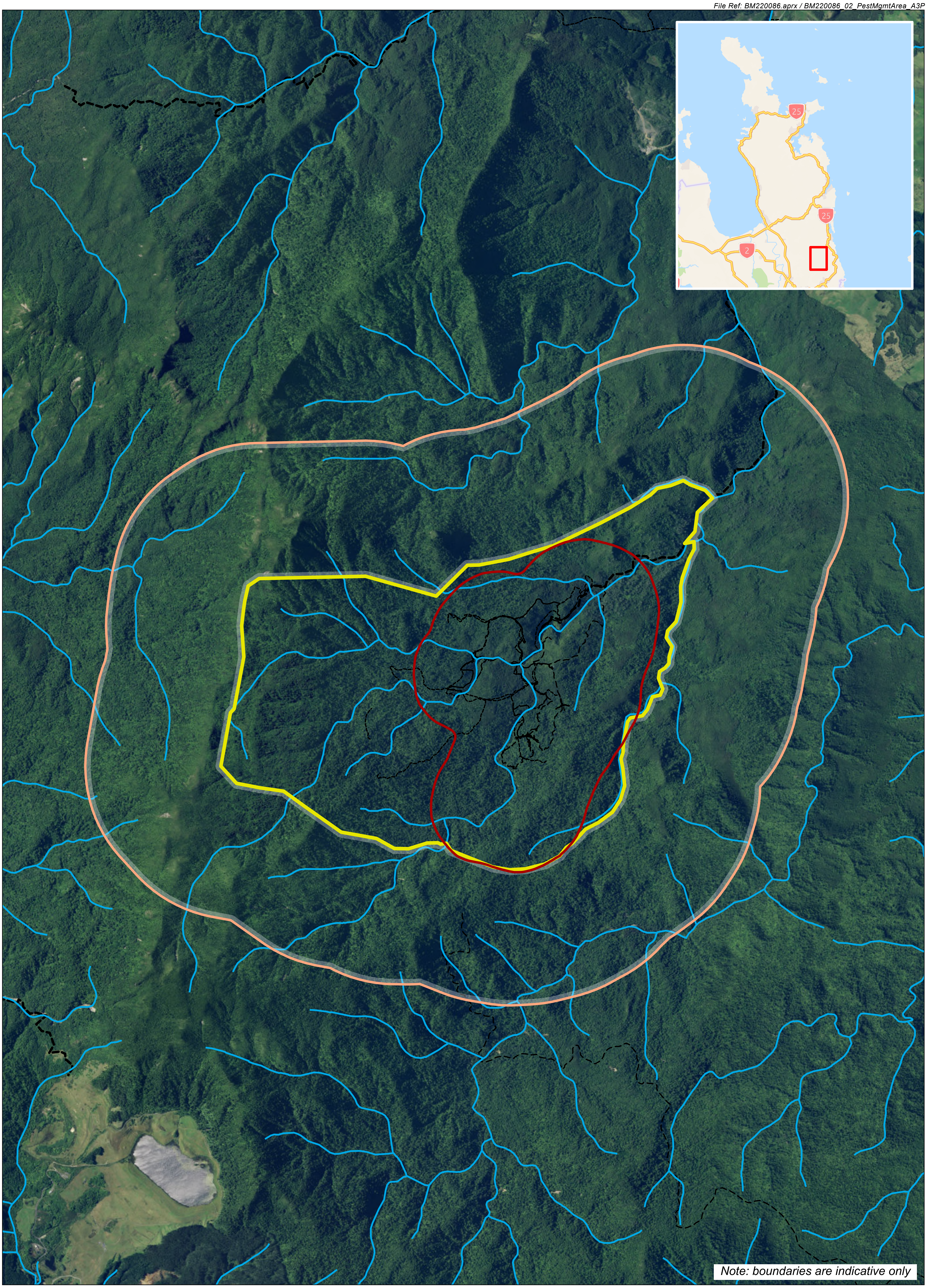
The methods needed to suppress pests sufficiently to achieve positive biodiversity outcomes are now well understood and widely used. Effective pest control is therefore expected to have an immediate benefit on native fauna, including decreasing predation pressure on populations of birds, lizards and invertebrates, increasing reproductive success due to lower instances of nest predation, and decreasing the impact of browse on native flora, thus increasing availability of food resources and plant survival. As the success of pest control and resulting biodiversity gains are readily obtained, measurable and can be tracked over the long-term, undertaking pest control as a form of mitigation is becoming more commonplace around New Zealand.

8.5.6 Research Funding

Compensation is proposed in the form of financial support for researchers to undertake investigative work within the WUG and wider Wharekirauponga Animal Pest Management Area to assess efficacy of pest control regimes for frog recovery. The proposed research budget is $25,000.00 at establishment and $25,000.00 per year for the duration of stoping.

Ongoing Archey’s frog surveys within the Coromandel Peninsula are also proposed to better understand the distribution, abundance and habitat preferences of Archey’s frogs.

File Ref: BM220086.aprx / BM220086_02_PestMgmtArea_A3P



Boffa Miskell

www.boffamiskell.co.nz

0 500 m

1:25,000 @ A3

Data Sources: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND
- Tracks
- River/Stream
- Proposed pest control area
- Ungulate Control (1km buffer)
- Area potentially subject to vibrations

PEST MANAGEMENT

Wharekirauponga Pest Management Area

Date: 13 February 2025 | Revision: 3

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBl

Figure 19

8.5.7 Biodiversity Compensation Model (BCM) and Biodiversity Offset Accounting Model (BOAM)

OceanaGold is committed to undertake biodiversity offset / compensation modelling based on the technical detail contained in this report (and others). A BOAM model was also completed to address the effects of vegetation clearance described in Section 6.4.2. The details of biodiversity components, attributes and net present biodiversity outputs are provided in Appendix 5.

BCM and BOAM models were prepared by RMA Ecology to address residual ecological effects on native frogs. This will be provided in a separate document (RMA Ecology 2025).

8.5.8 Biodiversity and Frog Monitoring Programme

Outcome monitoring is required to assess the efficacy of the pest control programme to compensate for potential impacts of the WUG on fauna species. For this project, there is uncertainty over the level of response by frogs (in particular, and fauna species generally) to mining activities and how they might respond to the proposed pest management. Lloyd (2025c) describes a monitoring programme for Archey's and Hochstetter's frogs (also described in RMA Ecology, 2025). The levels of treatment comparisons that will be included are:

1. Within the >2 mm/ second vibration zone (314 ha footprint) where frogs are also subject to intensive pest animal control;
2. In an adjoining area (the 318 ha offset area) where frogs are not subject to mine-related vibration, but are subject to intensive pest animal control; and
3. In an area to the west of the WUG intensive pest animal control area, where fauna is not subject to vibration or additional pest animal control as a result of this project.

Three sites therefore allow the comparison of potential effects or benefits of vibration and pest animal control compared to a baseline of the existing level of pests and pest control applied to the southern Coromandel Peninsula.is provided in brief below and adapted for a wider biodiversity monitoring programme.

Native Frogs

The monitoring site design, approach and sampling method is laid out in Lloyd 2025b, with a summary from that report provided below:

To ensure conclusions from monitoring are robust, the monitoring programme will be undertaken using a Before-After-Control-Impact (BACI) design. To separate effects from mining activities and pest control, monitoring will be undertaken in three area: two treatment areas and a non-treatment area. Characteristics of the treatment and non-treatment areas for each species will be as similar as possible. Monitoring will begin before the effects of mining and pest control begin and continue throughout the mine's life.

Archey's frog populations will be monitored using the standard capture-recapture method for monitoring Archey's frog populations, but with 30 x 30 m plots instead of 10 x 10 m plots to improve the quality of population estimates.

Hochstetter's frog populations will be monitored using replicate searches for frogs in their daytime refuges along 20 m long stream transects. General Linear Mixed Effect Models will be used to compare frog counts on transects in different areas and different surveys. N-mixture *modelling will be used to estimate frog abundance on transects. To achieve acceptable statistical power and robust abundance estimates, there will be 45 transects in each of the three treatment and non-treatment areas and 6 replicate searches of each transect during annual surveys. Fewer transects or replicates will reduce the likelihood of correctly identifying 100% increases (or 50% decreases) in frog abundance between surveys to unacceptably low likelihood levels (< 80%).*

We recognise that effective response monitoring of Archey's frogs is difficult and may require a long time period to evaluate population level changes resulting from pest control or vibrations (which are temporary and localised).

OGNZL's intention is to start pest animal control around 2 years ahead of the WUG mine works commencing. That will provide an opportunity to collect baseline information on frog populations within each of the treatment comparison areas prior to any potential adverse effects from mining being expressed on these populations.

Biodiversity Monitoring

A biodiversity monitoring programme will be developed based on existing baseline data and methodologies (see Section 4.1) to assess the ecological benefit of pest management on vegetation and fauna species in the three treatment areas over time.

8.6 Summary of Effects Management

The proposed management measures for each of the potential impacts, described in their respective sections, is summarised in Table 11.

Table 11: Summary of effects management associated with the WUG at Willows Road Farm and Coromandel Forest Park (not including compensation measures).

Location	Potential Effect	Impact management
Willows Road Farm	Vegetation habitat / clearance, primarily in the rock stack footprint (2,500 m^2)	Vegetation clearance protocols to ensure there are no active bird nests and lizards present Revegetation and remediation of rock stack area at mine closure Riparian planting is described in the Freshwater and Wetland Ecological Assessment. Fence riparian margin to protect vegetation to be retained. The proposed area of revegetation of riparian margin is 5.7 ha m^2.
	Construction noise effects on fauna	Installation of noise barriers (bunds) and installing the external ventilation fan in an insulated shipping container to reduce overall noise levels
	Discharges to air	Project design and construction best practise
Coromandel Forest Park	Vegetation and habitat loss (0.66 ha)	Site selection processes to avoid high quality habitats from a range of options. Fauna and habitat salvage within the footprint of all clearance areas. Translocation of salvaged animals to an intensively pest-controlled, prepared release site.

		Remediation following mine closure including removing drill platforms, vent shafts and exclusion fences, weed control, returning wood debris and fern stumps to cleared area. Replanting and facilitating natural regeneration (enhancement planting) of a 21 ha area on the northeast ridge of Willows Road Farm and buffer planting on the edge of Coromandel Forest Park 5.5 ha.
	Exploration drill and pump noise, helicopter noise	Operate exploration drills in close proximity to each other to reduce extent of noise footprint where possible. Limiting the number of flights.
	Effects of lighting on fauna	Careful mobile lighting plant selection, location, and luminaire orientation and aiming (i.e., into the site); careful timing of activities in sensitive areas; and lighting controls for permanent lighting (e.g., shades for camp windows). Lighting should be designed and installed using the best practice principles, particularly use of luminaires with reduced blue wavelengths and using luminaires with a lighting distribution that is asymmetrical in the vertical plane such that the light emitting surface is horizontal to the ground.
	Continuous Noise from Ventilation Fan	Vent designed to fit fan to base of shafts to minimise noise experienced at the surface.
	Water and Air Discharge from Ventilation Raise Effects on Fauna	Vent designed to include good design practice to increase dispersion of particulate and gaseous emissions. Buffer and fencing around vent shafts to prevent fauna access. Dampen exposed underground surfaces. Pest management to compensate for potential loss of Archey's frogs.
	Vibration from underground blasting	Variable mining methods to minimise vibration related impacts on the surface and potential disturbance to fauna above the WUG. Compensation pest animal control over an area of 633 ha to benefit Archey's frogs (and other fauna groups) where potential residual risks have been identified (see Section 8.5.4)
	Spread of Kauri Dieback Disease	Baseline disease testing in waterways and soil to assess presence of PA prior to works. Biosecurity hygiene procedures. These procedures are be described in the Coromandel Forest Park Kauri Dieback Management Plan (Coromandel Forest Park KDMP).

9.0 Summary and Conclusion

The WUG Project Area comprises two distinct sites, Willows Road Farm and the Wharekirauponga Catchment in Coromandel Forest Park, along with the underground tunnel that connects the two, and a service trench corridor that extends through rural land. The Project Area is entirely contained within the Waihi Ecological District.

The primary effect associated with Willows Road Farm activities is the loss of low value vegetation and potential fauna habitats within the project footprint. As part of the integrated mitigation strategy, OGNZL propose to revegetate approximately 0.56 ha of the available riparian areas for ecological and landscape mitigation purposes, including to compensate for effects of vegetation removal (described in the Freshwater Ecological Assessment). The remaining effects (construction noise and discharges to air) will be minimised through engineering design and site management processes. The level of effects with management on Willows Road Farm range from Low to Very Low.

Coromandel Forest Park comprises approximately 72,000 ha of continuous native forest. Surface works within the Wharekirauponga catchment (within Coromandel Forest Park) are limited to up to eight sites requiring a maximum clearance area of 12 x 12 m each for exploration drill and pump sites and four sites up to 30 x 30 m for each of the four vent raise sites (i.e. 0.66 ha in total). Site selection processes and pre-clearance fauna and habitat salvage will minimise effects on lizards, frogs, and notable invertebrates present. Fauna will be translocated to a prepared, intensively pest-controlled release site.

The primary effect of the Project within Coromandel Forest Park is loss of habitat (short – medium term, but not permanent) and associated change in vegetation community when the site is remediated (at the completion of drilling for drill sites, or close of mining for vent sites). These effects will be compensated for by enhancement planting of a total of 21 ha on the northeast ridge of Willows Road Farm to connect Coromandel Forest Park with a forest fragment on Willows Road Farm. Further replanting of approximately 5.5 ha on the boundary of Coromandel Forest Park and Willows Road Farm is also proposed in response to vegetation clearance within the forest that creates an interior forest edge.

Activities around exploration and geotechnical drill rigs, pump test and vent raise sites occupy a small area within the context of the forest and we consider that these effects can be minimised to a low or very low level of effect using a combination of engineering and design solutions (i.e. to maximise emission dispersion, and locating the fan at the base of the raise to reduce noise); careful fauna salvage and translocation, site management and timing (i.e. avoiding vent raise construction during nesting or active periods for fauna, minimising helicopter activity and using a small helicopter model); and using established hygiene and biosecurity control practices (i.e. testing, cleaning and surveillance practices to prevent kauri dieback introduction and spread).

There is a low (but uncertain) risk for this project to generate residual adverse effects on Archey’s frogs within the 314 ha area exposed to vibrations greater than 2mm/s. As such, the project team have developed a biodiversity compensation package that includes research and wide scale intensive pest animal control over an area of 633 ha including the area exposed to surface vibrations and an adjacent area assessed as having high quality frog habitat. Intensive pest control will also compensate the potential impacts of environmental stressors resulting from the surface exploration drilling and pump testing (e.g. elevated noise and light levels) and the temporary loss of habitat whereby the carrying capacity of the surrounding forest will be increased by the removal of predators and subsequent forest regeneration.

We consider pest animal control will provide tangible additional benefits to Archey's frogs and other fauna including increased survivorship, reproductive success, and improved habitat condition through the removal of feral pigs, rodents, goats, feral cats, possums, wasps and mustelids over the duration of the mine's life. A biodiversity compensation model and long-term outcome monitoring programme will be developed to assess the efficacy of the pest animal management programme.

We consider that the management actions proposed are acceptable and will minimise ecological effects arising from the WUG, while biodiversity compensation components and additional ecological benefit elements will deliver a substantial and measurable biodiversity benefit to the Wharekirauponga area and Willows Road Farm area.

The overall effects management for the WNP is conceived as a wholly integrated mitigation 'package' that encompasses all aspects of remedy, mitigation and offset proposed for landscape and ecological enhancements. The intent of the package is that it is integrated to achieve an outcome that is greater than the sum of its respective 'mitigation and offset components'. Such integrative concepts, including connectivity in the landscape and migration pathways, are difficult to capture and quantify within existing biodiversity mitigation concepts and offset models and are addressed throughout other ecological reports associated with the WNP.

10.0 References

Allen, K., Bellingham, P. J., Richardson, S. J., Allen, R. B., Burrows, L. E., Carswell, F. E., Husheer, S. W., St. John, M. G., & Peltzer, D. A. (2023). Long-term exclusion of invasive ungulates alters tree recruitment and functional traits but not total forest carbon. Ecological Applications, 33, e2836.

Barnett, K. E., Cocroft, R. B., & Fleishman, L. J. (1999). Possible Communication by Substrate Vibration in a Chameleon. Copeia, 1999(1), 225–228. https://doi.org/10.2307/1447408

BECA Limited (2025) Wharekirauponga Underground Mine – Air Discharge Assessment. Prepared for Oceana Gold (New Zealand) Ltd.

Bell, B.D. (1997): Demographic profiles of terrestrial Leiopelma (Anura: Leiopelmatidae) on Maud Island and in Coromandel: growth, home-range, longevity, population trends, survivorship and translocation. New Zealand Journal of Zoology 24: 323–324.

Bioresearches (2025a). Terrestrial Ecological Impact Assessment, Waihi Area.

Bioresearches (2025b). Proposed Wharekirauponga Underground Mine – Native Frog Effects Assessment. Prepared for OceanaGold New Zealand Limited. pp 69

Biosense 2022: Kauri dieback disease surveillance of Watercare's proposed replacement water treatment plant site at Waima Catchment. Prepared for Watercare Services Limited

Boffa Miskell Limited (2018). *WKP Fauna Surveys: Survey Findings (February-May 2017)*. Report prepared by Boffa Miskell Limited for OceanaGold.

Boffa Miskell Limited (2018). *WKP Fauna Surveys: Survey Findings (October 2017-March 2018)*. Report prepared by Boffa Miskell Limited for OceanaGold.

Boffa Miskell Limited (2019a). *WKP Fauna Surveys: Survey Findings (October 2018 – April 2019)*. Report prepared by Boffa Miskell Limited for OceanaGold

Boffa Miskell Limited (2019b). *WKP Biodiversity Monitoring: 2019 Baseline Assessments*. Report prepared by Boffa Miskell Limited for OceanaGold.

Boffa Miskell Limited (2021). *WKP Fauna Surveys: Survey Findings (October 2020 – June 2021)*. Report prepared by Boffa Miskell Limited for OceanaGold.

Boffa Miskell Limited (2022a). Wharekirauponga Biodiversity Monitoring: 2020 Baseline Assessments. Report prepared by Boffa Miskell Limited for OceanaGold.

Boffa Miskell Limited (2025a). Waihi North Project: Freshwater Ecological Assessment. Report prepared by Boffa Miskell Limited for Oceana Gold (NZ) Ltd. OceanaGold Document reference: WAI-985-000-REP-LC-0007 Rev C.1

Boffa Miskell Limited (2025b). Pest Animal Management Plan: Wharekirauponga Compensation Package. Report prepared by Boffa Miskell Limited for OceanaGold (NZ) Ltd.

Boffa Miskell Limited (2025). WUG Kauri Dieback Management Plan. Report prepared by Boffa Miskell Limited for OceanaGold (NZ) Ltd. (*in OGNZL 2025*)

Boffa Miskell Limited (2025). WUG Ecological Management Plan. Report prepared by Boffa Miskell Limited for OceanaGold (NZ) Ltd. (*in OGNZL 2025*)

Boffa Miskell Limited (2025). Vegetation Rehabilitation Plan. Report prepared by Boffa Miskell Limited for OceanaGold (NZ) Ltd. (*in OGNZL 2025*)

Borkin, K. M., Smith, D. H., Shaw, W. B., & McQueen, J. C. (2019). More traffic, less bat activity: the relationship between overnight traffic volumes and Chalinolobus tuberculatus activity along New Zealand highways. Acta Chiropterologica, 21(2), 321-329.

Burns, R.J.; Bell, B.D.; Haigh, A.; Bishop, P.; Easton, L.; Wren, S.; Germano, J.; Hitchmough, R.A.; Rolfe, J.R.; Makan T. (2018). Conservation status of New Zealand amphibians, 2017. New Zealand Threat Classification Series 25. 7 p.

Bradshaw, R. E., Bellgard, S. E., Black, A., Burns, B. R., Gerth, M. L., McDougal, R. L., Waipara, N.W., Weir, B.S., Williams, N.M. and Winkworth, R.C. & Horner, I. J. (2020). Phytophthora agathidicida: research progress, cultural perspectives and knowledge gaps in the control and management of kauri dieback in New Zealand. *Plant Pathology*, *69*(1), 3-16.

Byrami, M., Ogden, J., Horrocks, M., Deng, Y., Shane, P. and Palmer, J., (2002). A palynological study of Polynesian and European effects on vegetation in Coromandel, New Zealand, showing the variability between four records from a single swamp. *Journal of the Royal Society of New Zealand*, *32*(3), pp.507-531.

Buchanan, B. W. (1993). Effects of enhanced lighting on the behaviour of nocturnal frogs. Animal behaviour, 45(5), 893-899.

Byrom, A.E., Innes, J., Binney, R.N. (2016). A review of biodiversity outcomes from possum-focused pest control in New Zealand. Wildlife Research 43: 228-253.

Cieraad, E., & Farnworth, B. (2023). Lighting trends reveal state of the dark sky cloak: light at night and its ecological impacts in Aotearoa New Zealand. *New Zealand Journal of Ecology*, *47*(1).

Daglish, L.A. (2010): MAO 2009–2010 frog monitoring report. Maniapoto Area, Waikato Conservancy, Department of Conservation, Te Kuiti (unpublished). 4 p.

Dawson, D. G., & Bull, P. C. (1975). Counting birds in New Zealand forests. Notornis, 22(2), 101–109.

DCCEEW (2023) National light pollution guidelines for wildlife. Department of Climate Change, Energy, the Environment and Water, Canberra, May. CC BY 4.0.

de Lange, P. J., Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion, P. D., Perrie, L. R., Beadel, S. M., Ford, K. A., Breitwieser, I., Schönberger, I., Hindmarsh-Walls, P. B., Heenan, P.

B., & Ladley, K. (2018). Conservation status of New Zealand indigenous vascular plants, 2017 (New Zealand Threat Classification Series No. 22). Department of Conservation.

DOC (undated) Frog hygiene protocols.

Dugdale JS (1994). Hepialidae (Insecta: Lepidoptera). Fauna of New Zealand 30: 1–194.

Ewers, R. M., & Cowley, G. (2005). The role of sound production in determining dominance in agonistic interactions between male tree wetas (Hemideina crassidens, Orthoptera: Anostostomatidae).

Fitzgerald, N., Innes, J., & Mason, N. W. H. (2019). Pest mammal eradication leads to landscape-scale spillover of tūī (Prosthemadera novaeseelandiae) from a New Zealand mainland biodiversity sanctuary. Notornis, 66(4), 181–191.

Flo Solutions (2022). Wharekirauponga Underground Project: Updated Conceptual Model – EG Vein. 26 April 2022.

Gaston, K. J., Visser, M. E., & Hölker, F. (2015). The biological impacts of artificial light at night: The research challenge. Philosophical Transactions of the Royal Society of London. Series B, 370, 20140133.

Glen, A. S., Pech, R. P., & Byrom, A. E. (2013). Connectivity and invasive species management: Towards an integrated landscape approach. Biological Invasions, 15, 2127–2138.

GWS Limited (2022). Wharekirauponga Deposit. Assessment of Dewatering Effects. WAI-985-000-REP-LC-0030. 6 June 2022.

Gwynne, D. T. (2004). Reproductive behavior of ground weta (Orthoptera: Anostostomatidae): drumming behavior, nuptial feeding, post-copulatory guarding and maternal care. *Journal of the Kansas Entomological Society*, *77*(4), 414-428.

Hackwell, K., & Robinson, M. (2021). Native habitat carbon in crisis: It’s time to protect our Natural Ecosystem Carbon Sinks. Forest & Bird.

Harbrow, M.A., Cessford, G.R., Kazmierow, B.J. (2011) The impact of noise on recreationists and wildlife in New Zealand’s natural areas. A literature review. Science for Conservation 314. Department of Conservation.

Hare, K. M. (2012). Systematic searches (Inventory and Monitoring Toolbox: Herpetofauna DOCDM-725787). Department of Conservation.

Hare, K. M., Chapple, D. G., Towns, D. R. and van Winkel, D. (2016) The Ecology of New Zealand’s Lizards in D.G. Chapple (ed.), New Zealand Lizards

Helig (2025). Blasting and Vibration Assessment. Report prepared for OceanaGold.

Hetherington, T. E. (1989). Use of vibratory cues for detection of insect prey by the sandswimming lizard Scincus scincus. *Animal Behaviour*, *37*, 290-297.

Hill, P. S. (2001). Vibration and animal communication: a review. *American Zoologist*, *41*(5), 1135-1142.

Hitchmough, R.A., Barr, B. Knox,C., Lettink, M., Monks, J. M., Patterson, G.B., Reardon, J.T., van Winkel, D., Rolfe, J. & Michel. P. (2021). Conservation status of New Zealand reptiles, New Zealand Threat Classification Series 35. Department of Conservation, Wellington. 15 p.

Hitchmough, R. A., Barr, B., Lettink, M., Monks, J. M., Reardon, J., Tocher, M. D., van Winkel, D., & Rolfe, J. R. (2016). Conservation status of New Zealand reptiles, 2015 (New Zealand Threat Classification Series No. 17). Department of Conservation.

Hitchmough, R.A.; Nielsen S.V.; Bauer, A.M. (2020). Earning your stripes: a second species of striped gecko in the NewZealand gecko genus Toropuku (Gekkota: Diplodactylidae). Zootaxa 4890(4): 578–588.

Hotham, E, R. (2019). Abundance and microhabitat use of *Leiopelma archeyi* in relation to land-use : a thesis presented in partial fulfilment of the requirements for the degree of Masters of Science at Massey University, Palmerston North, New Zealand

Hurst, J. M., & Allen, R. B. (2007). A permanent plot method for monitoring indigenous forests: Field protocols. Landcare Research.

Kessels & Associates. (2010). Significant Natural Areas of the Thames-Coromandel District: Terrestrial and wetland (Environment Waikato Technical Report No. 2010/36; p. 120). Prepared by Kessels & Associates for Environment Waikato.

Krull, C. R., Waipara, N. W., Choquenot, D., Burns, B. R., Gormley, A. M., & Stanley, M. C. (2013). Absence of evidence is not evidence of absence: Feral pigs as vectors of soil-borne pathogens. Austral Ecology.

La Cock, G.D.; Holzapfel, S.; King, D.; Singers, N. (2005). Dactylanthus taylorii recovery plan, 2004–14 threatened species recovery plan 56

Leschen, R. A. B., Marris, J. W. M., Emberson, R. M., Nunn, J., Hitchmough, R. A., & Stringer, I. A. N. (2012). The conservation status of New Zealand Coleoptera. New Zealand Entomologist, 35(2), 91–98.

Lettink, M., & Monks, J. M. (2016). Survey and monitoring methods for New Zealand lizards. Journal of the Royal Society of New Zealand, 46(1), 16–28.

Lloyd, B. (2025a). Estimating the proportion of the Coromandel's Archey's frog population in the area affected by vibrations from the proposed Wharekirauponga Mine. Report prepared for OceanaGold.

Lloyd, B. (2025b). Analyses of the Results of Surveys for Hochstetter's Frogs Undertaken in 2024 to Assess the Impacts of Stream Flow Reductions Associated with the Wharekirauponga Underground Mine. Report prepared for OceanaGold.

Lloyd, B. (2025c). A programme to monitor the effects on Archey's frogs of vibrations from underground blasting and pest control. Report prepared for OceanaGold.

Marshall Day (2025a) Assessment of Noise Effects. Report prepared for OceanaGold New Zealand.

Maseyk, F. J. F., Ussher, G. T., Kessels, G., Christensen, M., & Brown, M. (2018). Biodiversity offsetting under the Resource Management Act: A guidance document. Prepared for the Biodiversity Working Group on behalf of the BioManagers Group.

McNaughton, E.J. 2019. Spatial distribution of urban artificial light at night and the ecological impacts of a streetlight retrofit. PhD thesis. University of Auckland.

McNaughton, E. J., Beggs, J. R., Gaston, K. J., Jones, D. N., & Stanley, M. C. (2021). Retrofitting streetlights with LEDs has limited impacts on urban wildlife. *Biological Conservation*, *254*, 108944.

Mitchell Daysh Limited (2025). Waihi North Project – Resource Consent Applications and Assessment of Environmental Effects. February 2025.

Morley, E. L., Jones, G., & Radford, A. N. (2014). The importance of invertebrates when considering the impacts of anthropogenic noise. *Proceedings of the Royal Society B: Biological Sciences*, *281*(1776), 20132683.

Monks, J.M., Monks, A., Towns, D.R. (2014). Corelated recovery of five lizard populations following eradication of invasive mammals. Biological Invasions 16: 167-175.

Nathan, E., Glen, A., & Stanley, M. (2013). The spatial extent of pest management outcomes at Ark in the Park, Waitakere Ranges Regional Park. Prepared for Ark in the Park and Auckland

Nordberg, E.J. and Schwartzkopft, L. 2022. Afraid of the dark? The influence of natural and artificial light at night on the behavioural activity of a nocturnal gecko. Frontiers in Ecology and Evolution. Volume 10 Article 821335.Council. https://arkinthepark.org.nz/wp-content/uploads/Thesis-Research-Summary.pdf

O’Donnell, C. F. J. (2002). Timing of breeding, productivity and survival of long-tailed bats Chalinolobus tuberculatus (Chiroptera: Vespertilionidae) in cold-temperate rainforest in New Zealand. Journal of Zoology, 257(3), 311–323.

O’Donnell, C. F. J., & Hoare, J. M. (2012). Quantifying the benefits of long-term integrated pest control for forest bird populations in a New Zealand temperate rainforest. New Zealand Journal of Ecology, 36, 131–140.

O'Donnell, C. F., Borkin, K., Christie, J. E., Davidson-Watts, I., Dennis, G., Pryde, M. A., & Michel, P. (2023). Conservation status of bats in Aotearoa New Zealand, 2022. Department of Conservation, Te Papa Atawhai.

OGNZL (2025) Ecological and Landscape Management Plan. Various authors.

Owens, A.C.S. and Lewis, S.M. 2018. The impact of artificial light at night on nocturnal insects: A review and synthesis. Ecology and Evolution 8:11337–11358.

Pedersen Read (2025) Assessment of Environmental Effects: Lighting.

Recio, M. R., Payne, K., & Seddon, P. J. (2016). Emblematic forest dwellers reintroduced into cities: Resource selection by translocated juvenile kaka. Current Zoology, 62(1), 15–22.

RMA Ecology (2025). OGNZL Wharekirauponga Mine: Assessment of Effects on Native Frogs.

RMA Ecology (2025).OGNZL Wharekirauponga Mine: Overall Summary of Ecology Matters.

Robertson, H.A., Baird, K.A., Elliott, G.P., Hitchmough, R.A., McArthur, N.J., Makan, T., Miskelly, C.M., O'Donnell, C.J., Sagar, P.M., Scofield, R.P., Taylor G.A., and Miche, P. (2021). Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation, Wellington. 43 p.

Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). Ecological impact assessment (EcIA). EIANZ guidelines for use in New Zealand: Terrestrial and freshwater ecosystems (2nd ed.). Environment Institute of Australia and New Zealand.

Saunders, A., & Norton, D. A. (2001). Ecological restoration at mainland islands in New Zealand. Biological Conservation, 99(1), 109–119.

Sedgeley, J. (n.d.). Roost occupancy and indices of bat activity: Automatic bat detectors (Inventory and Monitoring Toolbox: Bats DOCDM-590899). Department of Conservation.

Secondi, J., Mondy, N., Gippet, J. M. W., Touzot, M., Gardette, V., Guillard, L., Legagne, T. (2021) Artificial light at night alters activity, body mass, and corticosterone level in a tropical anuran. Behavioral Ecology 32(5), 932–940.

Simcock, R., Innes, J., Samarasinghe, O., Lambie, S., Peterson, P., Glen, A., & Faville, N. (2022). *Road edge-effects on ecosystems: A review of international and New Zealand literature, an assessment method for New Zealand roads, and recommended actions* (Waka Kotahi NZ Transport Agency research report 692). Singers, N.J. and Rogers, G.M. (2014). A classification of New Zealand's terrestrial ecosystems. Publishing Team, Department of Conservation.

Singers, N. J., & Rogers, G. M. (2014). A classification of New Zealand's terrestrial ecosystems.

Smith-Dodsworth, J. (2009). Webb Creek, Kauaeranga Valley, Coromandel Forest Park. Auckland Botanical Society Journal, 64, 49–54.

Smith, D., Borkin, K., Jones, C., Lindberg, S., Davies, F., & Eccles, G. (2017). *Effects of land transport activities on New Zealand's endemic bat populations: Reviews of ecological and regulatory literature* (NZ Transport Agency research report 623). https://www.nzta.govt.nz/assets/resources/research/reports/623/623-effects-of-land-transport-activities-on-NZs-endemic-bat-populations.pdf

Spoelstra K, Teurlincx S, Courbois M, Hopkins ZM, Visser ME, Jones TM, Hopkins GR. 2023 Long-term exposure to experimental light affects the ground-dwelling invertebrate community, independent of light spectra. Phil. Trans. R. Soc. B 378: 20220364.

Strauß, J., Lomas, K., & Field, L. H. (2017). The complex tibial organ of the New Zealand ground weta: sensory adaptations for vibrational signal detection. *Scientific Reports*, *7*(1), 2031.

Swiecki, T. J., Bernhardt, E. A., Aram, K., Rizzo, D. M., Kasuga, T., & Bui, M. (2016). Phytophthora ramorum causes cryptic bole cankers in canyon live oak. *Plant Health Progress*, *17*(1), 20-26.

Tanentzap, A. J., & Lloyd, K. M. (2017). Fencing in nature? Predator exclusion restores habitat for native fauna and leads biodiversity to spill over into the wider landscape. Biological Conservation, 214, 119–126.

Tonkin + Taylor Ltd. (2025). Technical Review of Air Quality Assessments.

Trewick, S., Johns, P. M., Hitchmough, R. A., Rolfe, J. R., & Stringer, I. (2016). The conservation status of New Zealand Orthoptera, 2014 (New Zealand Threat Classification Series No. 16). Department of Conservation.

Trewick, S., Hitchmough, R., Rolfe, J.R. and Stringer, I.A. (2018). Conservation Status of New Zealand Onychophora (" peripatus" Or Velvet Worm), 2018. Publishing Team, Department of Conservation.

van Winkel, D., Baling, M., & Hitchmough, R. A. (2018). Reptiles and amphibians of New Zealand: A field guide. Auckland University Press.

Ward, D. F., & Larivière, M. C. (2004). Terrestrial invertebrate surveys and rapid biodiversity assessment in New Zealand: lessons from Australia. *New Zealand Journal of Ecology*, 151-159.

Watts, C., Innes, J., Cave, V., Thornburrow, D., Thorpe, S. (2020). Beetle and wētā community responses to mammal eradication on Maungatautari, Waikato, New Zealand. New Zealand Journal of Zoology, 47:4, 272-290.

Waikato Regional Council. (2016). The Waikato regional policy statement: Te Tauākī Kaupapa here ā-Rohe. Waikato Regional Council.

Willems, J.S., Phillips, J.N and Francis, C.D. 2022. Artificial light at night and anthropogenic noise alter the foraging activity and structure of vertebrate communities. Science of the Total Environment (805) 150223.

Wilson, D. J., Lee, W. G., Webster, R. A., & Allen, R. B. (2003). Effects of possums and rats on seedling establishment at two forest sites in New Zealand. New Zealand Journal of Ecology, 27(2), 147–155.

Winkworth, R. C., Nelson, B. C., Bellgard, S. E., Probst, C. M., McLenachan, P. A., & Lockhart, P. J. (2020). A LAMP at the end of the tunnel: A rapid, field deployable assay for the kauri dieback pathogen, Phytophthora agathidicida. *PloS one*, *15*(1), e0224007.

WWLA (2025) Assessment of Groundwater Effects – Wharekirauponga Deposit. Prepared for OceanaGold Limited.

Appendix 1: Wharekirauponga Survey Effort and Summary of Findings

Date	Survey activity
October 2016 – May 2017	13 sites investigated for potential drill sites, camp sites and pump sites
October 2017 – May 2018	50 sites investigated for potential drill sites, helipads, or pump sites
October 2018 – May 2019	32 sites investigated for potential drill sites, helipads, or pump sites Jan – Feb 2019 baseline biodiversity surveys carried out over 4 weeks
October 2019 – May 2020	Nil
October 2020 – May 2021	11 sites investigated for potential drill sites, Oct-Nov 2020: biodiversity surveys carried out over 3 weeks 15 sites investigated for potential vent sites
October 2021 – May 2022	4 sites investigated for potential vent sites 1 site finalised for drill site

Summary by Year

October 2016 – May 2017 activity

Drill / Pump / Helipad site surveys

13 sites investigated for potential drill sites, helipads, or pump sites. 63 Archey's frogs recorded. No lizards or bats detected.

October 2017 – May 2018 activity

Drill / Pump / Helipad site surveys

50 sites investigated for potential drill sites, helipads, or pump sites. 349 frogs found. No lizards observed. No bats detected.

October 2018 – May 2019 activity

Drill / Pump / Helipad site surveys

32 sites investigated for potential drill sites, helipads, or pump sites. 193 Archey's frogs recorded. No lizards observed. No bats detected.

Baseline biodiversity surveys 2019

Baseline biodiversity surveys conducted over 4 weeks in January and February 2019. Surveys included:

- Freshwater ecological surveys at four different sites including 2 sites on the Wharekirauponga Stream and 2 sites on the Teawaotemutu Stream
- Frog surveys – 7 Hochstetter's frogs in 5 streams, 6 Archey's frogs
- Bat surveys- 72 nights or recording using 6 ABMs set out from 14th February 2019 for 12 nights,
- Bird surveys – 26 x 5MBCs and 11 sites with ARDs recorders. 12 native and 5 exotic bird species recorded.

- Lizard surveys – 26 sites assessed for suitable lizard habitat, of these 8 were searched visually and manually. A further 7 sites deemed to have low-medium habitat suitability were also searched. Additionally, tracks between suitable survey plots were also searched (spotlight surveys). No lizards were observed.
- Vegetation RECCE plots - 26 plots over broad vegetation types
- Manual invertebrate surveys carried out during detailed plot surveys.

October 2020 – May 2021

Drill site surveys

11 sites investigated for potential drill sites, 29 Archey's frogs recorded. No lizard or 'Threatened' / 'At Risk' invertebrate species recorded.

Vent site surveys

15 sites investigated for potential vent sites, 21 Archey's frogs recorded. No lizard or 'Threatened' / 'At Risk' invertebrate species recorded.

Baseline biodiversity surveys 2020

Baseline biodiversity surveys conducted over 3 weeks in October and November 2020. Surveys included:

- Frog surveys: 9 Hochstetter's frogs, one Archey's frog
- Bird surveys – 26 x 5MBCs, 11 sites with ARDs recorders
- Lizard surveys –poor weather conditions. Spotlight surveys at 3 sites, and opportunistically.
- Vegetation RECCE plots - 26 plots over broad vegetation types. An additional eight ordination transects of 20 plots each were also surveyed in 2020.
- Manual invertebrate surveys carried out during detailed plot surveys.

October 2021 - May 2022

Vent site surveys

4 sites investigated for potential vent sites, 3 Archey's frogs recorded. No lizard or 'Threatened' / 'At Risk' invertebrate species recorded.

1 site finalised for drill site. No lizards or frogs recorded in 3 nights of survey.

Summary by fauna group

Bat surveys summary

2016-17: ABMs installed for a minimum of 13 nights at 6 sites – no bat activity

2017- 2018: bat survey effort: 2 weeks of ABM surveys in 2 sites. 0 detected.

2018- 2019: 6 ABMs set out from 14th February 2019 for 12 nights. 0 detected.

2020- 2021: Bats not surveyed in biodiversity surveys.

2021- 2022: 1 site (drill 8) had 3 ABMs in place for two weeks prior to felling. No bats recorded.

Invertebrate survey summary

2016-17: no threatened / at risk invertebrates recorded at 12 sites. Paua slug observed at 1 site

2017- 2018: Manual searching for paua slug during Archey's frog searches. 0 reported.

2018- 2019: Manual searching for paua slug during Archey's frog searches. 0 reported.

2020- 2021: Manual searching for paua slug during Archey's frog searches. 0 reported.

2021- 2022: Manual searching for paua slug during Archey's frog searches. 0 reported.

Lizard survey summary

2016-17: day and night surveys for lizards across 8 sites

2017-2018: Both day and night systematic searches. 5 survey hours, 0 lizards detected.

2018- 2019: see biodiversity report summary above. 0 detected

2020- 2021: No lizards recorded in proposed drill sites, biodiversity surveys – spotlighting over 3 nights. 1 forest gecko reported. Manual surveys carried out at 15 sites.

2021- 2022: No lizards recorded in proposed drill sites or vent sites.

Frog survey summary:

2016-2017: 63 Archey's frogs in 137.5 survey hours

2017-2018: 349 frogs in 173.25 survey hours

2018- 2019: 193 frogs found in 398.65 survey hours

2020- 2021: 29 frogs found in 154.14 survey hours

2021- 2022: 3 frogs found in 29.58 survey hours

Bird survey summary

2017- 2018: Not surveyed

2018- 2019: 17 species recorded, 12 native species.

2020- 2021: 20 bird species were recorded, 14 native species.

2021- 2022: Not surveyed

Appendix 2: Vegetation Descriptions for Willows Road Farm and Paper Road Survey Sites

Coromandel Forest Park: Potential Vent Sites Within the Paper Road

Site 1

Nikau dominates the canopy, interspersed with tree ferns. Pigeonwood and hangehange form a sparse understory. The western corner of the site contains a grouping of ponga that contributes to increased leaf litter in this area. Leaf litter depth throughout the remainder of the site is shallow due to the plant species present. Supplejack dominates the eastern side of the site and is an abundant plant in the mid-tier. There were no large tree species (>40 cm DBH) or species suitable for bat roosts. 'Threatened / At Risk' plant species were not present within the survey area.

Other survey information: Site 1 was surveyed for Archey's frogs over three nights in 2021 (Table 1). Weather conditions were favourable for frog emergence (>13 C° and >80% relative humidity), with vegetation, leaf litter and soil recorded as 'Moist-Wet' during surveys (Cree 1989) (**Table**). Four of the five frogs recorded were in the western corner of the site utilising ponga as a habitat resource. No 'Threatened / At Risk' invertebrate species were identified during frog surveys.

Table 1: Survey details from Archey's frog searches at Site 1

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
30/03/2021	13	19.05	95.55	3
11/04/2021	5.5	17.2	98.95	0
12/04/2021	15	19.5	97	2

Suitability for vent site: The vegetation and physiography of Site 1 is suitable for a vent site as the area is relatively flat and there were no **'Threatened / At Risk' plant species or** large tree species (>40 cm DBH). The site overall is assessed as **unsuitable** due to the number of frogs found.

Site 2

Bordering Site 1, Site 2 is also dominated by nikau and tree ferns. No tree species exceed >40 cm DBH and no trees were suitable for bat roosting. Site 2 has more diversity in the undergrowth and mid-layers, with hangehange, pigeonwood, kanono and mahoe present. Seedlings of these forest species, and additionally rewarewa, are sparsely location on the forest floor. Kiekie, tank lily and supplejack are the most abundant epiphytic species in the site – these species are associated with

Archey's frog abundance. The leaf litter was patchy in depth throughout the site. 'Threatened / At Risk' plant species were **not present within the survey area**.

Other survey information: Site 2 was surveyed for Archey's frogs over three nights in 2021 (Table 2). Weather conditions were favourable for frog emergence (>13 C° and >80% relative humidity), with vegetation, leaf litter and soil recorded as 'Moist-Wet' during two survey nights (Cree 1989) (Table). Leaf litter and soil were moist, but vegetation was dry on the 11 April. Three frogs were located, two on epiphytes and one in the leaf litter. No 'Threatened / At Risk' invertebrate species were identified during frog surveys.

Table 2: Survey details from Archey's frog searches at Site 2

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
30/03/2021	11	18.55	93	2
11/04/2021	8	17.55	98.05	0
14/04/2021	5.25	13.25	98.4	1

Suitability for vent site: The vegetation and physiography of Site 2 is suitable for a vent site as the area is relatively flat and has no threatened flora. The site overall is assessed as **unsuitable** due to the location of Archey's frogs found, making this site impractical.

Site 3

Site 3 sits within a steep gully. Nikau and tree ferns are the prominent plant species, with no mature forest species exceeding >40 cm DBH. The leaf litter is thicker under the tree ferns, with fallen logs also providing suitable frog habitat. Rewarewa, kanono, pigeonwood and hangehange seedlings and saplings are patchily present. Kiekie and supplejack are abundant in places. Vegetation is not suitable for roosting bats and no 'Threatened / At Risk' flora species were identified.

Other survey information: Two nights of Archey’s frog surveys were completed at Site 3 (Table 3). Weather conditions were ideal for frog emergence (>13 C° and >80% relative humidity), with no individuals found. No additional surveys were completed at this site due to the topography causing difficulty for platform building.

Table 3: Survey details from Archey’s frog searches at Site 3

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
31/03/2021	3	18	95.6	0
31/03/2021	3	16.3	98.2	0

Suitability for vent site: The topography of the site is **unsuitable** for a drill platform.

Site 4

Site 4 is located on the border of Site 3 and just outside the paper road. The site is dominated by nikau, with an upper canopy of <12 m. The ground has a thin layer of leaf litter and was heavily pig rooted during frog surveys. The occasional seedling and sapling of hangehange, mapou, rewarewa, and kanono can be found. A large tōwai (<40 cm DBH) is located just outside the site. Vegetation within the site is not suitable frog, bat, or lizard habitat. No ‘Threatened / At Risk’ plant species were identified.

Other survey information: One survey was completed for Archey’s frogs during suitable weather conditions (>13 C° and >80% relative humidity) (Table 4). No ‘Threatened / At Risk’ invertebrate species were identified during frog surveys.

Table 4: Survey details from Archey's frog searches at Site 4.

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
31/03/2021	6	16.5	96	0

Suitability for vent site: The vegetation, presence of pig rooting (i.e., high natural disturbance), and lack of habitat associated with fauna is **potentially suitable** for a vent site. The site location outside the paper road deems the site of low priority for further survey at present.

Site 5

An emergent tawa tree dominates the centre of the site (25 m tall). The canopy is dominated by ponga and nikau. Rewarewa, mahoe and mapou are also present. Grouped together in the top corner of Site 5 are other large tawa. The depth of the leaf litter is substantial from the rewarewa and tree ferns. The site is well-drained due to sloping landform. Epiphytes are present on trees. The forest floor has limited seedlings and saplings. Some young wheki and *Blechnum fraseri* are present. The vegetation is suitable habitat for Archey's frogs, but less so for lizard and bat species.

Other survey information: Site 5 was surveyed for Archey's frogs over two nights in 2021 (Table 5). Temperature was cool (<13 C°) for the first survey night, with relative humidity at 100%. The second survey night had conditions more suitable for frog emergence (Table). Vegetation, leaf litter and soil were recorded as 'Moist-Wet' during the first survey night and leaf litter and soil were moist, but vegetation was dry on the second night (Cree 1989). Two frogs were located within the site. No 'Threatened / At Risk' invertebrate species were identified.

Table 5: Survey details from Archey's frog searches at Site 5.

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
15/04/2021	4.5	10.6	100	0
21/04/2021	6.5	15.2	100	2

Suitability for vent site: Site 5 avoided 'Threatened / At Risk' plant species, but large tawa trees were present within the site. Additional survey nights are needed to determine frog abundance. Specific surveys for bats, lizards and invertebrate species will need to occur when weather conditions are appropriate. The site is not within 100 m of an identified wetland. Site 5 is **potentially suitable** as a future shaft site.

<u>Site 6</u>

Site 6 has one large pukatea located in the centre of the site (>40 cm DBH). Puka is found growing up the pukatea, and tank lily is also present. The remainder of the site is mainly tree ferns and nikau, with one mid-sized rewarewa. Undergrowth is sparse with little regrowth. Tree ferns contribute to the leaf litter, but overall, the litter is thin. The site is concave and well-draining.

<u>Other survey information:</u> No frogs or 'Threatened / At Risk' invertebrate species were found during surveys (Table 6). Leaf litter and soil were recorded as 'Moist' during surveys, and vegetation as 'Dry-Moist' for two surveys nights. The site has not been surveyed for other native fauna species.

Table 6: Survey details from Archey's frog searches at Site 6.

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
14/04/2021	4.75	11.45	97.7	0
20/04/2021	5.25	15.1	97.7	0
21/04/2021	4.45	15.4	100	0

<u>Suitability for vent site:</u> The steepness of the site would make it difficult to build a platform on and the presence of the pukatea tree is in an unfavourable location (centre of site) and would require removal. No Archey's frogs were found. Site 6 was assessed as **<u>unsuitable</u>**.

<u>Site 7</u>

An emergent tawa is in the centre of the site (>40 DBH). Smaller pukatea and tawa (44 DBH) are also present within the site. Nikau are present throughout, with tree ferns scattered in-between. The undergrowth is sparse. Leaf litter is of deep throughout Site 7, and in particular under tree ferns. No 'Threatened / At Risk' plant species were observed in the site.

Other survey information: Two surveys for Archey's frogs were completed in favourable survey conditions (>13 C° and >80% relative humidity) (Table 7). The vegetation, leaf litter and soil were recorded as 'Moist-Wet' during surveys (Cree 1989). Three out of the four frogs were found in the leaf litter.

Table 7: Survey details from Archey's frog searches at Site 7.

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
13/04/2021	4.5	14.4	100	1
20/04/2021	7.25	16.3	95.1	3

Suitability for vent site: The site is **unsuitable** as a vent shaft option because of the size/maturity of the vegetation (>40 cm DBH) and the presence of native frogs.

Site 8

The canopy in Site 8 is dominated by nikau and tree ferns. Supplejack is a prominent plant species in the undergrowth and mid-layer. The undergrowth is well shaded by tawa, mapou, rewarewa, kanono, pigeonwood and miro saplings. A large miro is in one corner but can be avoided during clearance. Lots of leaf litter and dead rotten logs. Plenty of epiphytes, including kiekie and tank lily. 'Threatened / At Risk' plant species were avoided during site selection. The vegetation is considered to be not suitable for bat roosting.

Other survey information: Site 8 has suitable habitat features for Archey's frogs. The site was surveyed for Archey's frogs over three nights in suitable survey conditions (>13 C° and >80% relative humidity) (Table 8). Vegetation, leaf litter and soil were recorded during surveys as 'Wet-moist' (Cree

1989). No frogs were found in Site 8. One lizard survey was completed when conditions were too dry for frog surveys. No lizards were observed. Additional lizard, bird and bat surveys will need to be completed before vegetation clearance. No ‘Threatened / At Risk’ invertebrate species were observed during frog surveys.

Table 8: Survey details from Archey’s frog searches at Site 8.

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
21/04/2021	5	14.4	100	0
12/05/2021	6	16.3	95.1	0
12/05/2021	7.25	14	100	0
26/04/2021 Lizard survey	1.5	10.8	91	0

Suitability for vent site: Site 8 is **potentially suitable** as a vent site. The physiography is appropriate for a platform and there will be minimal removal of mature vegetation. The vegetation is suitable frog habitat, but no frogs were found over three survey nights in suitable climatic conditions. ‘Threatened / At Risk’ plant species were avoided during site selection and the site is not within 100 m of an identified wetland. Additional lizard, bird and bat surveys will need to be completed before vegetation clearance.

Site 9

Large miro with abundant epiphytes dominates the centre of the site. The site is on a slight hillside of a small gully and is dominated by nikau and tree ferns; the undergrowth is mainly open with few seedlings. A few old stumps with mosses and kiekie growing upon them are present in the site. Vegetation is relatively diverse, with rewarewa, pigeonwood, mapou, hangehange, kanono, and mahoe present. Old pig rooting is evident and there are numerous patches of bare soil. ‘Threatened / At Risk’ plant species were not present, and the site is not known to be within 100 m of a wetland.

Other survey information: One Archey’s frog was found during surveys (Table 9). This frog was located on the edge of the site. Survey conditions were optimal for frog emergence during surveys, with vegetation, leaf litter and soil recorded as ‘Moist’ (Cree 1989). No ‘Threatened / At Risk’ invertebrate species were observed during frog surveys. Before vegetation clearance, lizard, bat and bird surveys will need to be completed.

Table 9: Survey details from Archey’s frog searches at Site 9.

Date	Survey Effort (hrs)	Average Temperature (C°)	Average Relative Humidity (RH) %	Number of frogs found
11/05/2021	7.25	16.4	89.2	0
12/05/2021	6.5	12.25	100	0
15/05/2021	6	14.1	95.5	1

Suitability for vent site: Site 9 is **potentially suitable** for a vent site. In terms of vegetation there is a high species count, but occupancy is low. The large miro in the centre requires consideration and would ideally be avoided. The leaf litter is minimal due to pig rooting, and although suitable frog habitat is present, only one frog was found. The site is not within 100 m of an identified wetland. Before vegetation clearance, native fauna surveys will need to be carried out to determine the presence of bats, birds and lizards.

Site 10

Other survey information: One Archey’s frog was found during surveys (Table 10). Survey conditions were optimal for frog emergence during surveys, with vegetation, leaf litter and soil recorded as

‘Moist’ (Cree 1989). No ‘Threatened / At Risk’ invertebrate species were observed during frog surveys. Before vegetation clearance, lizard, bat and bird surveys will need to be completed.

Table 10: Survey details from Archey’s frog searches at Site 10.

Date	**Survey Effort (hrs)**	**Average Temperature (C°)**	**Average Relative Humidity (RH) %**	**Number of frogs found**
20/04/2021	2.75	17.5	96.2	0
21/04/2021	2.75	17.6	99.5	0
22/04/2021	2.33	11.8	94.0	1

Site 11

Other survey information: Two Archey’s frog was found during surveys (Table 11). Survey conditions were optimal for frog emergence during surveys, with vegetation, leaf litter and soil recorded as ‘Moist’ (Cree 1989). No ‘Threatened / At Risk’ invertebrate species were observed during frog surveys. Before vegetation clearance, lizard, bat and bird surveys will need to be completed.

Table 11: Survey details from Archey’s frog searches at Site 11.

Date	**Survey Effort (hrs)**	**Average Temperature (C°)**	**Average Relative Humidity (RH) %**	**Number of frogs found**
20/04/2021	3.00	17.5	96.2	0
21/04/2021	4.00	17.6	99.5	2
22/04/2021	2.33	11.8	94.0	0

Site 12

Site 12 is softly sloping with no larger tree species present. The site is dominated by tree ferns with hinau scattered throughout. Young nikau are also present. The ground layer is sparse. Leaf litter is deep in places, particularly under tree ferns. Pig rooting is evident. ‘Threatened / At Risk’ plant species were avoided and proximity to a wetland was considered during site selection.

Other survey information: No fauna surveys have been completed due to seasonal constraints.

Suitability for vent site: In terms of vegetation and physiography, the site is potentially suitable for a vent shaft. Further **surveys are required** to fully assess suitability. These will be completed when conditions are suitable for detection / emergence.

Site 13

Site 13 runs along a ridge. The site itself is slightly sloping with emergent tawa with a canopy of rewarewa, pigeonwood and tawa. Nikau and tree ferns scattered throughout site. Kiekie and crown fern are present on the forest floor. Overall, leaf litter is not very deep but around tree ferns and rewarewa it is deeper. Pig rooting is evident in the site. 'Threatened / At Risk' plant species were avoided during site selection.

Other survey information: No fauna surveys have been completed due to seasonal constraints.

Suitability for vent site: The slight slope seems to be manageable for building a drill platform. There are a few mature tree species within the site, and it has yet to be determined if Archey's frogs or other fauna are present. Further **surveys are required** to fully assess suitability. These will be completed when conditions are suitable for detection / emergence.

Site 14

Site 14 is dominated by tree ferns, and in particular wheki. Rata epiphytes, tank lily and kiekie were observed on many of the trees and ferns. Hangehange saplings and seedlings are in high abundance. The leaf litter is of deep and there are piles of dead fern fronds. 'Threatened / At Risk' plant species were avoided and proximity to a wetland was considered during site selection.

Other survey information: No fauna surveys have been completed due to seasonality. The site is numerous in tree ferns and kiekie, species that are associated with frog abundance.

Suitability for vent site: In terms of vegetation and physiography, the site is suitable for a vent shaft. Further **surveys are required** to fully assess suitability. These will be completed when conditions are suitable for detection / emergence.

Site 15

The canopy at Site 15 is tōwai and rewarewa (both approx.15 m tall). The lower forest levels are dominated by tree ferns, some reaching heights of 10-12 m. Tank lily and kiekie epiphytes are in abundance and supplejack is prevalent on one side of the site. Seedlings of rewarewa, tōwai, kanono, and nikau are present on forest floor. The forest floor is also covered with dead fern fronds. 'Threatened / At Risk' plant species were avoided during site selection. The site is along a ridge and is well-draining.

Other survey information: No fauna surveys have been completed due to seasonal constraints. The site has abundant tree ferns and kiekie, species that are associated with frog abundance.

Suitability for vent site: The site has maturing vegetation of significant height. Habitat associated with Archey's frogs is abundant. Further **surveys are required** to fully assess suitability. These will be completed when conditions are suitable for detection / emergence.

Site 16

Large tawa is present in the middle of the site. Mapou, hangehange, pigeonwood and tanekaha seedlings and saplings are present throughout the site. Leaf litter is deep, with tawa leaves dominating. The site could be used as a buffer for Site 11 and Site 12 because of the mature tawa clustered in the centre of Site 16.

Other survey information: No fauna surveys have been completed due to seasonal constraints. The site has abundant tree ferns and kiekie, species that are associated with frog abundance.

Suitability for vent site: The site has maturing vegetation of significant height. Habitat associated with Archey's frogs is abundant. Further **surveys are required** to fully assess suitability. These will be completed when conditions are suitable for detection / emergence.

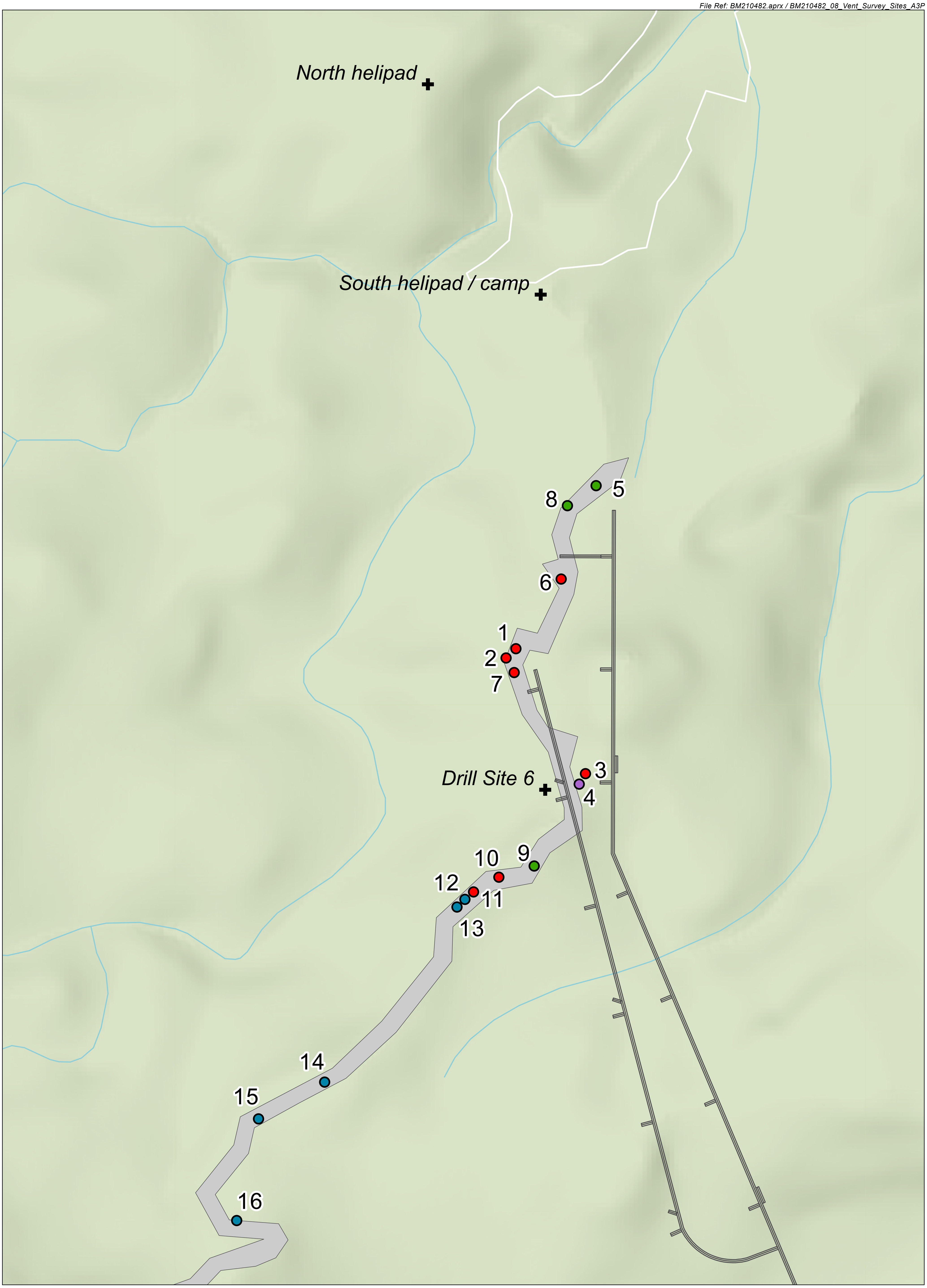
Other survey information: No fauna surveys have been completed due to seasonality. Cluster of large tawa in centre of site. Further **surveys are required** to fully assess suitability. These will be completed when conditions are suitable for detection / emergence.

Suitability for vent site: Site 16 is not suitable as a vent shaft site due to the large tawa trees. The site is located between Sites 11 and 12 and is suitable as a buffer for these two sites depending if, and where, frogs are found in Sites 11 and 12.

Reference

Cree A. (1989). Relationship between environmental conditions and nocturnal activity of the terrestrial frog, *Leiopelma archeyi*. *Journal of Herpetology, 23(1), 61-68*

File Ref: BM210482.aprx / BM210482_08_Vent_Survey_Sites_A3P



Boffa Miskell

www.boffamiskell.co.nz

0 100 m

1:6,000 @ A3

Data Sources: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

Suitability
- No frog surveys
- Outside paper road
- Potential
- Unsuitable

- Proposed Tunnel Alignment
- Paper Road

WAIHI NORTH PROJECT

Potential Vent Raise Sites Surveyed in Wharekirauponga

Date: 24 May 2022 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Katherine.Muchna@boffamiskell.co.nz | Drawn: HCo | Checked: KMu

Appendix 3: Summary Ecological Management Procedures

SITE CLEARANCE PROTOCOLS

SITE CLEARANCE AND REMEDIATION

1. LOCATE DRILL SITE

- Use site selection criteria to find lowest ecological value site
- 1 MONTH PRIOR TO CLEARANCE

2. PRE-CLEARANCE SALVAGE

- Fence clearance site
- Fauna salvage over 2 nights; remove habitat materials with each animal
- Transplant unoccupied nurse logs, punga, Astelia, kiekie and seedlings of hardy species replant on forest edge
- MARCH - MAY IN SUITABLE WEATHER

3. FOREST FLOOR CLEARANCE

- Careful removal of all ground layer materials to capture animals
- Stockpile leaves and wood debris outside work footprint on raised mat / wood debris
- PRIOR TO FELLING, MARCH - MAY

4. TREE FELLING

- Check trees prior to and after felling to salvage fauna
- Fell large trees only if necessary, bend/ squash smaller specimens
- Place smaller branches outside site in small piles to provide refugia in surrounding forest and buffer forest floor
- Canopies will be placed in surrounding forest to break down
- Selective cut / coppice branches of fast growing species to promote growth on edge for screening

5. CONSTRUCTION

- Build platform
- Non-slip grating to be used for frequently used pathways

6. SITE CLOSURE (DRILLING)

- Remove fence
- Re-spread stockpiled duff, branches etc
- Return nurse logs (if<6mo), leave if longer
- Move / transplant fallen epiphytes and local seedlings
- Leave new edge intact - don't shift previously moved ponga etc.

FAUNA SALVAGE PROTOCOLS

FAUNA SALVAGE AND TRANSLOCATION

1. LOCATE DRILL SITE

Use site selection criteria to find lowest ecological value site

Prepare release site:
- Fencing
- Pest monitor

1 MONTH PRIOR TO CLEARANCE

2. PRE-CLEARANCE SALVAGE

Fence clearance site

Fauna salvage over 2 nights; remove habitat materials with each animal

Translocate fauna + habitat to release site each night (PHOTO ID, MEASURE, WEIGH)

Salvage additional ponga logs as oviposition sites

MARCH - MAY IN SUITABLE WEATHER

3. FOREST FLOOR CLEARANCE

Careful removal of ground layer materials to capture animals

Translocate animals at night (PHOTO ID, MEASURE, WEIGH)

Stockpile leaves and wood debris outside work footprint on raised mat

PRIOR TO FELLING, MARCH - MAY

4. TREE FELLING

Check trees prior to and after felling to salvage area

Fell large trees only if necessary, bend/ squash smaller specimens

Place smaller branches outside site in small piles to provide refugia in surrounding forest and buffer forest floor

Canopies will be placed in surrounding forest to break down

5. RELEASE SITE MONITORING

As per release site monitoring plan

Will be assessed against pest monitoring

PEN REMOVAL TBC

Appendix 4: Site Selection Criteria

SITE SELECTION PROTOCOL FOR THE LOCATION OF DRILL SITES AND PUMPING TEST / VENTILATION SHAFT SITES

OVERVIEW

This document outlines the protocol which will be used by OceanaGold New Zealand Limited ("**the Consent Holder**") to select the location of up to eight exploration drill sites, twelve investigative drill sites and up to four pumping test / ventilation shaft sites at the proposed Wharekirauponga Underground Mine ("**WUG**"), located within the Coromandel Forest Park as part of the Waihi North Project ("**WNP**"). For avoidance of doubt, this protocol does not apply to portable drill rig locations.

This protocol follows a cascading management approach whereby:

> A short list of suitable drill sites will be selected based on the Consent Holder's technical requirements; and

> A short list of suitable ventilation shaft sites will be selected based on the Consent Holder's technical requirements.

Shortlisted sites will then be subject to a multicriteria assessment ("**MCA**"), which will evaluate each potential site against ecological, freshwater, landscape, heritage and recreational criteria. The final eight investigative drilling and four ventilation shaft sites will be selected based on the outcomes of the MCA. This protocol will ensure that selected sites meet the Consent Holder's technical requirements, whilst minimising adverse effects on the environment.

SHORT-LIST SITE IDENTIFICATION–

The Consent Holder shall create a short list of options for drill and ventilation sites which meet engineering and geotechnical requirements.

The Consent Holder shall assess each of the shortlisted sites against the MCA (set out below) to inform the final site selection.

Note: all sites must meet engineering and geotechnical requirements in order to fulfil their intended function. For ventilation sites in particular, it is recognised that engineering and geotechnical requirements may result in a low number of potential options.

MULTICRITERIA ASSESSMENT

The following assessment shall be used for drill sites and ventilation shafts.

Once the Consent Holder has established a shortlist of drill sites and/or ventilation shaft sites, it shall convene a team of appropriately qualified and experienced experts to undertake the MCA evaluation for each site.

The MCA will guide the Consent Holder's selection of up to eight exploration drill sites, twelve investigative drill sites and up to four ventilation shaft sites at locations which best achieve the outcomes set out below.

Multicriteria Assessment Outcomes

Terrestrial Fauna

> The loss of 'At Risk' or 'Threatened' herpetofauna is avoided;

> The loss of 'At Risk' or 'Threatened' terrestrial invertebrates is avoided;

> The removal of trees where bats are actively roosting is avoided; and

> The removal of trees in which birds[1] are actively nesting is avoided.

Terrestrial Flora

> The loss of 'At Risk' or 'Threatened' flora is avoided;

> The loss of mature trees (trees that are greater than 50 cm in diameter at breast height (1.4 m above ground level)) is minimised where practicable; and

> Preference is given to sites where trees can be trimmed or tied back in such a way as to minimise felling.

Freshwater Values

> Sites selected are located as far from surface waterbodies (including natural inland wetlands) as is reasonably practicable; and

> The loss of riparian vegetation within 20 m of a waterway is minimised where practicable.

Landscape and Visual Amenity Values

> Sites selected can be visually contained, including any consequent plume from ventilation shafts, and assimilated into the environment so that they are reasonably difficult to see.

[1] Any reference to birds means birds protected under the Wildlife Act 1953

> Once work has been completed, selected sites can be successfully rehabilitated to ensure that long term landscape and visual effects are avoided.

Heritage and Cultural Values

> Disturbance to, or interference with listed or known heritage features and / or sites is avoided.

> Archaeological features and features of particular significance to iwi are avoided.

The Consent Holder must engage a suitably qualified and experienced archaeologist to assess if there are any known archaeological or other historic heritage features, or a likelihood of unidentified archaeological or other historic heritage features within 500m of the shortlisted investigative drill sites and **ventilation** shaft sites.

Recreation Values

> Sites selected are located as far away as is practicable from the Te Wharekiraauponga Track.

Multicriteria Assessment Tool

A red / amber / green ("**RAG**") MCA tool will be utilised to guide decision-making. The assessment tool has three rankings, based on the level of adverse effect anticipated for each criterion, noting that the grading is relative to the other effects, not absolute:

Lower effects	Moderate effects	Higher effects

The criteria for assessing each value set is set out in **Table 1**.

Table 1: MCA Assessment Tool.

Criteria	Lower effects	Moderate effects	Higher effects
Terrestrial Fauna			
Habitat value for native frogs	<20 % cover of kiekie and / or fern species	≥20 %, ≤50% cover of kiekie and / or fern species	>50 % cover of kiekie and / or fern species
‘At Risk’ and / or ‘Threatened’ terrestrial invertebrates	No ‘At Risk’ and / or ‘Threatened’ terrestrial invertebrates are found on site.	‘At Risk’ and / or ‘Threatened’ terrestrial invertebrates are found on site, but can be salvaged and moved to suitable habitat at least 50m away from the drilling and / or ventilation shaft site (as assessed by a suitably qualified entomologist).	At Risk’ and / or ‘Threatened’ terrestrial invertebrates are found on site, and cannot be salvaged and moved to suitable habitat at least 50m away from the drilling and / or ventilation shaft site (as assessed by a suitably qualified and experienced ecologist).
Bat roosts	No trees with bat roost characteristics identified on site (as assessed by suitably qualified zoologist).	Trees with bat roost characteristics identified on site, but no bats are found to be currently roosting in the tree (as assessed by a suitably qualified ecologist).	Trees with bat roost characteristics identified on site, with signs that bats are currently roosting in the tree (as assessed by a suitably qualified ecologist).
Nesting birds	No active bird nests detected on site (as assessed suitably qualified ecologist).	-	Active bird nests detected on site (as assessed by a suitably qualified ecologist).
Indigenous Terrestrial Flora			
‘At Risk’ and / or ‘Threatened’ flora NB This does not include kauri and Myrtaceae species (classified as ‘Threatened - Nationally Vulnerable’ or ‘At Risk – Declining’ in response to disease risk.)	No ‘At Risk’ and / or ‘Threatened’ flora identified is on site (as assessed by suitably qualified botanist).	‘At Risk’ and / or ‘Threatened’ flora identified is on site, but can be readily translocated to a suitable alternative site containing similar light, soil and vegetation community characteristics (as determined by a suitably qualified botanist), or retained on site by bending back without cutting.	‘At Risk’ and/ or ‘Threatened’ flora identified on site, and cannot be readily translocated to a suitable alternative site containing similar light, soil and vegetation community characteristics (as determined by a suitably qualified botanist), or retained on site by bending back without cutting.
Removal of mature trees	No removal of trees greater than 50 cm in diameter at breast height is required.	Removal of <=4 trees greater than 50 cm in diameter at breast height is required.	Removal of >4 trees greater than 50 cm in diameter at breast height required.
Freshwater			
Proximity to rivers and streams	Site is more than 100m from nearest river or stream.	Site is between 50-100m from nearest river or stream.	Site is less than 50m from nearest river or stream.
Proximity to wetland	Site is more than 100 m from nearest wetland.	Site is between 10 - 100 m from a wetland.	Site is within or within 10 m of a wetland.[2]
Riparian vegetation	No riparian vegetation removal required.	Minimal riparian vegetation removal is required.	More than minimal riparian vegetation removal is required.

[2] NB: Resource Consent will be required under the NES-Freshwater for any earthworks or land disturbance within, or within a 10 m setback from, a natural inland wetland, or outside a 10 m, but within a 100 m, setback from a natural inland wetland results, or is likely to result, in the complete or partial drainage of all or part of the wetland

Landscape and Visual Amenity			
Visibility	Site cannot be seen from any formal walking track or viewpoints beyond the Coromandel Forest Park.	Site can partially be seen from any formal walking track or viewpoints beyond the Coromandel Forest Park.	Site can be clearly seen from any formal walking track or viewpoint beyond the Coromandel Forest Park.
Heritage			
Heritage features/Cultural	No heritage or cultural features and / or sites are identified within 500m of the site.	Heritage/cultural features and / or sites are identified within 500m of site, but outside the proposed site footprint.	Heritage/cultural features and / or sites are identified with the proposed site footprint.
Recreation			
Proximity to recreational tracks	Site is at least 750 m from nearest formal walking track.	Site is between 400 -750 m from nearest formal walking track.	Site is within 400 m of nearest formal walking track.
Proximity to *Waikato Conservation Management Strategy* recreation remote zones	Site is more than 500 m outside of a recreation remote zone.	Site is within 500 m of a recreation remote zone.	Site is within a recreation remote zone.

Multicriteria Assessment Process

The Consent Holder shall assess each site using the following process:

1. **Score Sites:** Each drill site and ventilation shaft option shall be evaluated against each MCA criterion set out in **Table 1**. Each site shall be given an RAG rating for each criterion.
2. **Evaluate Red Ratings:** Where a site option is assessed as red (having a high level of effect) for any criterion, the Consent Holder shall engage a suitably qualified expert to determine if the effect is of such magnitude as to constitute a 'fatal flaw' (i.e., a critical issue that would make the site unsuitable for selection, based on an environmental value or values). If the suitably qualified expert considers the site option unsuitable, it shall be disqualified. If the suitably qualified expert does not deem the effect to be a fatal flaw, the site shall remain in contention.
3. **Compare Sites:** After assigning RAG ratings, the Consent Holder shall compare the sites. Generally, sites with more green ratings and fewer amber or red ratings are more favourable.
4. **Site Selection:** The Consent Holder shall select those sites with the best overall balance of green and amber ratings, ensuring no fatal flaws are present.

REPORTING

The Consent Holder shall report the outcome of the MCA as follows:

- For drill sites, the results of the assessment shall be documented in a Drill Site Siting Report, which shall be submitted to the Hauraki District Council, Waikato Regional Council and Department of Conservation, at least 20 days prior to vegetation clearance commencing at any of the selected sites; and
- For ventilation shaft sites, the results of the assessment shall be documented in a Ventilation Shaft Siting Report, which shall be submitted to the Hauraki District Council, Waikato Regional Council and Department of Conservation, at least 20 days prior to the commencement of vegetation clearance or work required to construct the ventilation shafts.

Appendix 5: BOAM Calculation Details

Biodiversity Offsets Accounting Model for New Zealand (2015) The Catalyst Group. Version date: 26 March 2015.

IMPACT MODEL

	BIODIVERSITY TYPE
1	Lowland broadleaved forest

	This section captures which elements of biodiversity, and over what area, will be impacted by the proposal					This section is where the change in measure of each Biodiversity Attribute due to the proposed Impact is quantified, and Attribute Biodiversity Value calculated. Inputs are derived from direct measures, existing data or models where available, or expert estimated predictions			
	Biodiversity Component		Biodiversity Attribute	Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
1.1	Drill / vent footprint	1.1a	Vegetation	% cover	0.7	100	80	0	-0.56
		1.1b	Frog pop'n resilience	adult frogs / ha	0.7	900	286	0	-0.22
		1.1c	Stand Structure	basal area / ha	0.7	88	18	0	-0.14
		1.1d	Biodiversity	number of taxa	0.7	100	75	0	-0.53

Notes: Biodiversity component 1.1 is for the vegetation clearance associated with drill and vent sites (0.66 ha). Drill sites will be rehabilitated progressively, but activity at any one site will range from 1-7 years, with an average of 2 years. Attribute values are described below using data from Wharekirauponga data where available.

1.1a: Vegetation cover is provided here as canopy cover – around 75 % is typical in Wharekirauponga. The benchmark is 100 % (i.e., full canopy).

1.1b: Average number of frogs in Wharekirauponga = **286 adult frogs/ ha** (RMA Ecology) c.f. benchmark is **900 / ha** (RMA Ecology).

1.1c: Average basal area (measured in Wharekirauponga forest sites) = 18 m^2/ ha excludes ferns, and excluded one site that was predominantly fern (73 % fern spp). Benchmark site = 88 m^2/ha. From Christopher H. Lusk (2002) Basal area in a New Zealand podocarp broadleaved forest: Are coniferous and angiosperm components independent? *New Zealand Journal of Botany*, 40:1, 143-147

1.1d: The biodiversity attribute of 'biodiversity' reflects that vegetation, and fauna will be removed from the drill and vent sites for the duration of drilling and mining, respectively. We assume 100 % occupancy / cover in a benchmark forest, and 75 % occupancy / cover in Wharekirauponga (reduced because of known pest animal activity). Large fauna including lizards, frogs and At Risk invertebrates will be captured and translocated, and ground covers, logs and ferns will be retained for site rehabilitation. As such, the 'measurement after impact' of 0 does not capture how these species / individuals will be retained, albeit in a different location.

	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
1.2	New edge in forest	1.2a	Native forest microhabitat	Extent	1.22	100	100	50	-0.61

Notes: Biodiversity component 1.2 is the embedded forest edge created by clearance of interior forest (i.e. the edge around each drill / vent site). Denyer (2000) found that in embedded forest (in her study, where native forest edges were buffered by plantation forest), edge effects such as elevated radiation and air temperature were reduced (i.e. close to interior forest measurements) beyond a 5-10 m buffer zone.

1.2a: The area of impact is measured as a 10 m zone around all clearance areas. This includes 4 x vent sites, 8 x exploration drill sites, 4 x hydrogeological piezometer sites, 4 x geotechnical drill sites, 4 x geotechnical drill sites for tunnel alignment. The measurement after impact is only a minor change from the existing environment.

	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
1.3	Man-portable (no felling)	1.3a	Frog habitat	Forest duff and vegetation	0.16	100	80	0	-0.13
		1.3b	Native frog population resilience	Adult frogs / ha	0.16	900	286	0	-0.05

Notes: Biodiversity component 1.3 is the ground disturbance associated with man-portable drill sites. The area calculation is 50 sites x 32 m^2 = 1,600 m^2 = 0.16 ha. The impact is very short term in the order of days at any one site. Drills will be placed on bed logs to avoid damage to the forest floor.

1.3a: Forest duff and vegetation cover is the measurement unit used as a proxy for potential impacts on frog habitat. Prior to impact, the measure is assessed as 80 % cover (noting that man portable drills will, by necessity be located in forest clearings). The benchmark is 100 % cover of forest duff and vegetation.

1.3b: Average number of frogs in Wharekirauponga = **286 adult frogs/ ha** (RMA Ecology) c.f. benchmark is **900 / ha** (RMA Ecology).

OFFSET MODEL

BIODIVERSITY TYPE	DISCOUNT RATE
Lowland broadleaved forest	0.3

This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			End Point	This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute					
Biodiversity Component	**Biodiversity Attribute**		**Measurement Unit**	**Benchmark**	**Proposed Offset Actions**	**Offset area (ha)**	**Confidence in Offset Actions**		**Measure prior to Offset**	**Measure after Offset**	**Time till endpoint (years)**	**Biodiversity Value at Offset Site**	**Biodiversity Value at Impact Site**	**Attribute Net Present Biodiversity Value**
Drill / vent footprint	**1.1a**	Vegetation	% cover	100	Rehabilitation	0.7	Very confident >90%	Finite end point	0	80	20	0.00	-0.53	**-0.52**
	1.1b	Frog popn resilience	adult frogs / ha	900	Animal pest control	632	Very confident >90%	Finite end point	286	658	10	18.10	-0.22	17.87
	1.1c	Stand Structure	basal area / ha	88	Revegetation	21	Very confident >90%	Finite end point	0	25	20	0.03	-0.14	**-0.11**
	1.1d	Biodiversity	number of taxa	100	Animal pest control	632	Very confident >90%	Finite end point	75	85	5	16.26	-0.53	15.73

This is the average Net Present Biodiversity Value for the Biodiversity Component
Component Net Present Biodiversity Value
8.23

Notes:

1.1a: Vegetation cover at sites following the Vegetation Remediation Plan is estimated at 80 % cover (i.e., rehabilitated to pre-clearance cover) after 20 years. The negative net present biodiversity value for this attribute is due to the time lag associated with revegetation expressed through the discount rate (0.3).

1.1b: As part of the WNP, intensive predator and pest animal control will be undertaken over 632 ha of forest in Coromandel Forest Park. Existing frog density is 286 frogs / ha (RMA Ecology), assuming a 2.3 x increase in population density (c.f. Pest Animal Management Plan, Boffa Miskell 2025) as a result of pest control for the duration of mining (i.e. at least 10 years of pest control), there would be 658 frogs /ha.

1.1c: The proposed offset action for vegetation clearance for drill and vent sites is revegetation of 21 ha of farmland at Willows Road farm. Because the land is currently grazed pasture, the vegetation stand will take longer to develop into mature forest. However, we estimate that at 20 years, a basal area of 25 m^2/ha is achievable. The negative net present biodiversity value for this attribute is due to the time lag associated with revegetation expressed through the discount rate (0.3). This measurement does not capture the benefits of effectively extending the forest park and buffering the edge habitat on the southeastern edge.

1.1d: The proposed offset action to address the removal of vegetation and fauna from the drill and vent sites is pest animal control over 632 ha in Wharekirauponga. We consider that after 5 years, 85 % occupancy / cover could be achieved because of a reduction in predation and browsing pressure and consequent increase in habitat carrying capacity, species diversity and vegetation complexity.

This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L	This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute					
Biodiversity Component	**Biodiversity Attribute**		**Measurement Unit**	**Benchmark**	**Proposed Offset Actions**	**Offset area (ha)**	**Confidence in Offset Actions**		**Measure prior to Offset**	**Measure after Offset**	**Time till endpoint (years)**	**Biodiversity Value at Offset Site**	**Biodiversity Value at Impact Site**	**Attribute Net Present Biodiversity Value**
New edge in forest	**1.2a**	Native forest microhabitat	Extent	100	Buffering CFP @ Willows (revegetation)	6.58	Very confident >90%	Finite end point	0	100	5	1.69	-0.61	1.08

This is the average Net Present Biodiversity Value for the Biodiversity Component
Component Net Present Biodiversity Value
1.08

Notes:

1.2a: The proposed offset action for the loss of interior forest microhabitats is planting the Coromandel Forest Park forest edge at Willows Road Farm. This planting is estimated at 20 m wide for the length of the forest boundary (3.29 km), comprising 6.58 ha of planting. The planting will include fast growing native species that will begin the buffer the forest edge within 5 years.

This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L	This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute					
Biodiversity Component	**Biodiversity Attribute**		**Measurement Unit**	**Benchmark**	**Proposed Offset Actions**	**Offset area (ha)**	**Confidence in Offset Actions**		**Measure prior to Offset**	**Measure after Offset**	**Time till endpoint (years)**	**Biodiversity Value at Offset Site**	**Biodiversity Value at Impact Site**	**Attribute Net Present Biodiversity Value**
Man-portable (no felling)	**1.3a**	Frog habitat	Forest duff and vegetation	100	Remediation	0.16	Very confident >90%	Finite end point	0	100	1	0.12	-0.13	**-0.01**
	1.3b	Native frog population resilience	Adult frogs / ha	900	Remediation	0.16	Very confident >90%	Finite end point	0	286	2	0.03	-0.05	**-0.02**

This is the average Net Present Biodiversity Value for the Biodiversity Component
Component Net Present Biodiversity Value
-0.02

Notes:

1.3a: Ground clearance for man-portable drilling will be remediated by replacing all material moved out of the way as soon as the drilling is complete (within days). The negative net present biodiversity value for this attribute is due to the time lag associated with revegetation expressed through the discount rate (0.3), and that the minimum time period for the impact was 1 year.

1.3b: This attribute assumes a return to pre-impact conditions within 2 years (i.e. 1 breeding season). It also assumes no additional benefit from pest control. The negative net present biodiversity value for this attribute is due to the time lag associated with revegetation expressed through the discount rate (0.3).

Over the three biodiversity components assessed, there is a NET POSITIVE biodiversity value following the offset actions.

Together. Shaping Better Places.

Boffa Miskell is a leading New Zealand environmental consultancy with nine offices throughout Aotearoa. We work with a wide range of local, international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, Te Hīhiri (cultural advisory), engagement, transport advisory, climate change, graphics, and mapping. Over the past five decades we have built a reputation for creativity, professionalism, innovation, and excellence by understanding each project's interconnections with the wider environmental, social, cultural, and economic context.

www.boffamiskell.co.nz

Whangarei	**Auckland**	**Hamilton**	**Tauranga**	**Wellington**	**Nelson**	**Christchurch**	**Queenstown**	**Dunedin**
09 358 2526	09 358 2526	07 960 0006	07 571 5511	04 385 9315	03 548 8551	03 366 8891	03 441 1670	03 470 0460