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MP4 Fast-track, Macraes

Lizard Management & Monitoring Plan

for: OceanaGold New Zealand Limited

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Cover Illustration: Southern grass skink (*Oligosoma chionochloescens*), Macraes, Otago.

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Executive summary

This Lizard Management and Monitoring Plan (LMMP) has been prepared for the Macraes Phase 4 (MP4) Project to manage the effects of project activities on lizards and to satisfy the requirements of a Wildlife Act Authority. The Plan outlines the procedures, management measures, monitoring requirements, and reporting framework that will be implemented to minimise adverse effects on lizards during construction and operation of the Project.

The MP4 Project area supports widespread and locally abundant indigenous lizard populations characteristic of the Macraes Ecological District. Three indigenous lizard species have been confirmed within areas affected by the Project:

- McCann's skink (*Oligosoma maccanni*) – 'Not Threatened';
- Southern grass skink (*Oligosoma chionochloescens*) – 'At Risk – Declining'; and
- Kōrero gecko (*Woodworthia* "Otago/Southland large") – 'At Risk – Declining'.

Suitable lizard habitat is widespread throughout the Project area and includes schist rock outcrops, tussock grassland, shrubland, riparian gullies, and wetland margins. Rock outcrops, tussock grassland, and shrubland represent the highest-value habitats and support the greatest abundance and diversity of lizards. Population modelling indicates that the MP4 impact areas support approximately 155,500 lizards. When existing consented areas requiring Wildlife Act Authority management are included, the total population requiring management is estimated at approximately 278,768 individuals.

Project activities have the potential to adversely affect lizards through habitat loss, habitat modification, disturbance, displacement, injury, and mortality. Direct effects may arise during vegetation clearance, earthworks, road construction, reservoir development, and mining activities. Indirect effects may result from noise, vibration, dust deposition, edge effects, and the spread of invasive species, which may reduce habitat quality in surrounding areas.

To minimise adverse effects on lizards, a comprehensive suite of management measures will be implemented. These measures include pre-clearance surveys, staged vegetation clearance, lizard salvage and relocation, habitat enhancement, habitat protection, and mammalian predator control. The salvage programme is designed to maximise the number of lizards captured and relocated from impact areas while minimising injury and mortality. Suitable receptor sites will be identified and prepared to support the successful establishment of relocated lizards.

Recognising the limitations of salvage and relocation programmes, the Plan adopts a precautionary approach and acknowledges that complete recovery of all lizards cannot be guaranteed. The programme therefore focuses on applying best-practice management techniques, ensuring appropriate resourcing, and implementing adaptive management where necessary.

Despite the implementation of avoidance, minimisation, remediation, salvage, and relocation measures, some residual adverse effects are expected to remain due to permanent habitat loss and unavoidable mortality of some individuals within the Project footprint. To address these residual

effects, the Project includes broader biodiversity compensation measures centred on the Murphys Ecological Enhancement Area and surrounding lands. These measures include establishment of a mammal exclusion/ predator-proof fence, landscape-scale predator control, habitat restoration and enhancement, stock exclusion, long-term habitat protection, and ecological monitoring.

Implementation of this LMMP will be overseen by suitably qualified and experienced herpetologists and ecological practitioners. Monitoring, reporting, and adaptive management will be undertaken throughout the life of the Project to ensure management objectives are achieved and to support the long-term persistence of indigenous lizard populations within the Macraes landscape.

Overall, the LMMP provides a framework for managing lizards affected by the MP4 Project and is intended to minimise adverse effects, support the survival of affected populations, and contribute to positive long-term outcomes for indigenous lizards within the wider Macraes Ecological District.

1 Introduction

The Macraes Phase Four (MP4) Project requires management of indigenous lizards under the Wildlife Act 1953 (Wildlife Act), because the proposed mining activities have been assessed as having potential adverse effects on protected lizards and their habitats. This Lizard Management and Monitoring Plan (LMMP) has been prepared to support the application for Wildlife Act approvals associated with the MP4 Project under the Fast-track Approvals Act 2024 (FTAA).

Lizards are a significant component of New Zealand's terrestrial fauna, represented by 148 endemic taxa[1], more than 85% of which are classified as 'Threatened' or 'At Risk' of extinction under the New Zealand Threat Classification System (Townsend *et al*. 2008; Rolfe *et al.* 2022; Hitchmough *et al.* 2026). All native lizards are legally protected under the Wildlife Act (and subsequent amendments), and significant habitats[2] of indigenous fauna, including lizards, are protected under the Resource Management Act 1991 (RMA). In Otago, the Otago Regional Policy Statement 2021 (ORPS 2021) gives effect to the RMA through objectives and policies aimed at protecting, maintaining, and enhancing biodiversity values. These statutory obligations require the management of native lizards wherever they, or their habitats, are threatened by land disturbance or development.

1.1 LMMP structure

The MP4 Project comprises several project components, some for which resource consent is being sought under the FTAA framework, and others for which existing consents are already held but WA considerations remain (e.g., WA Authorities covering the capture, handling, and relocation of lizards). Whereas other documents supporting this application outline the effects on lizards and address effects on lizards within areas requiring consent, this LMMP addresses the management of all lizards under the WA across the full MP4 Project footprint, encompassing both unconsented areas and areas for which consent is being sought. Figure 2.1 provides an overview of the structure of MP4 Fast-track Project as it relates to lizard management and this LMMP.

2 Purpose and scope of the LMMP

The purpose of this LMMP is to describe the methods and management measures that will be implemented to avoid, minimise, and mitigate, as far as practicable, adverse effects on native lizards arising from the MP4 Project. In doing so, it addresses the requirements of Schedule 7 of the FTAA, including the requirement to describe "the methods to be used to safely, efficiently, and humanely catch, hold, or kill the animals and identify relevant animal ethics processes."

Unlike the ecological assessment documents, which evaluate the effects of the project components requiring resource consent under the FTAA, this LMMP applies across the entire MP4 Project footprint. It therefore provides a single, integrated framework for the management of all indigenous lizards potentially affected by the MP4 Project, covering both new project components requiring resource

[1] The term “taxa” is used instead of “species” because many New Zealand lizards, including some present within the project area, have not been formally described to species level.

[2] The term ‘significant’ is not defined by the RMA but for the purpose of this assessment, “significant habitats” is interpreted as habitat that provides all the necessary needs for persistence of lizard populations in an environment (i.e., food, shelter, areas for reproduction). It is weighted more heavily towards habitats for ‘Threatened’ or ‘At Risk’ species.

consent under the FTAA and existing consented areas where Wildlife Act Authority (WAA) obligations remain, including Camp Creek, Coal Creek, and other previously consented works.

Accordingly, this LMMP addresses two key components of lizard effects management:

1) mitigation of effects through lizard salvage, relocation, and habitat management across MP4 impact areas, including existing consented areas that require WAA management (e.g., Camp Creek and Coal Creek); and
2) monitoring and adaptive management to assess the effectiveness of mitigation measures and demonstrate the delivery of net positive outcomes for lizards affected by the MP4 impact areas subject to the current consent application.

The objectives of this LMMP are to:

- avoid, minimise and mitigate adverse effects on indigenous lizards arising from the MP4 Project, as far as practicable;
- provide clear procedures for the salvage, handling, temporary holding, and relocation of indigenous lizards from affected areas;
- ensure all lizard management activities comply with Wildlife Act approvals and other statutory requirements;
- provide for habitat enhancement and management measures to improve the long-term success of relocated populations;
- establish monitoring programmes to assess the effectiveness of mitigation measures;
- implement adaptive management where monitoring indicates changes are required; and
- contribute to demonstrating the positive biodiversity outcomes associated with the MP4 compensation programme.

This LMMP does not detail the biodiversity compensation measures proposed to address residual adverse effects, such as the approximately 252 ha Murphys Ecological Enhancement Area (MEEA) predator exclusion fence and the restoration of approximately 265 ha of habitat at Mt Highlay Station. Those measures are described in the Residual Effects Analysis Report: Terrestrial Ecology (E13; Bioresearches 2026l; Table 2.1). However, the monitoring programme set out in this LMMP will contribute to evaluating the effectiveness of both the mitigation measures described here and the compensation measures described in the E13 report.

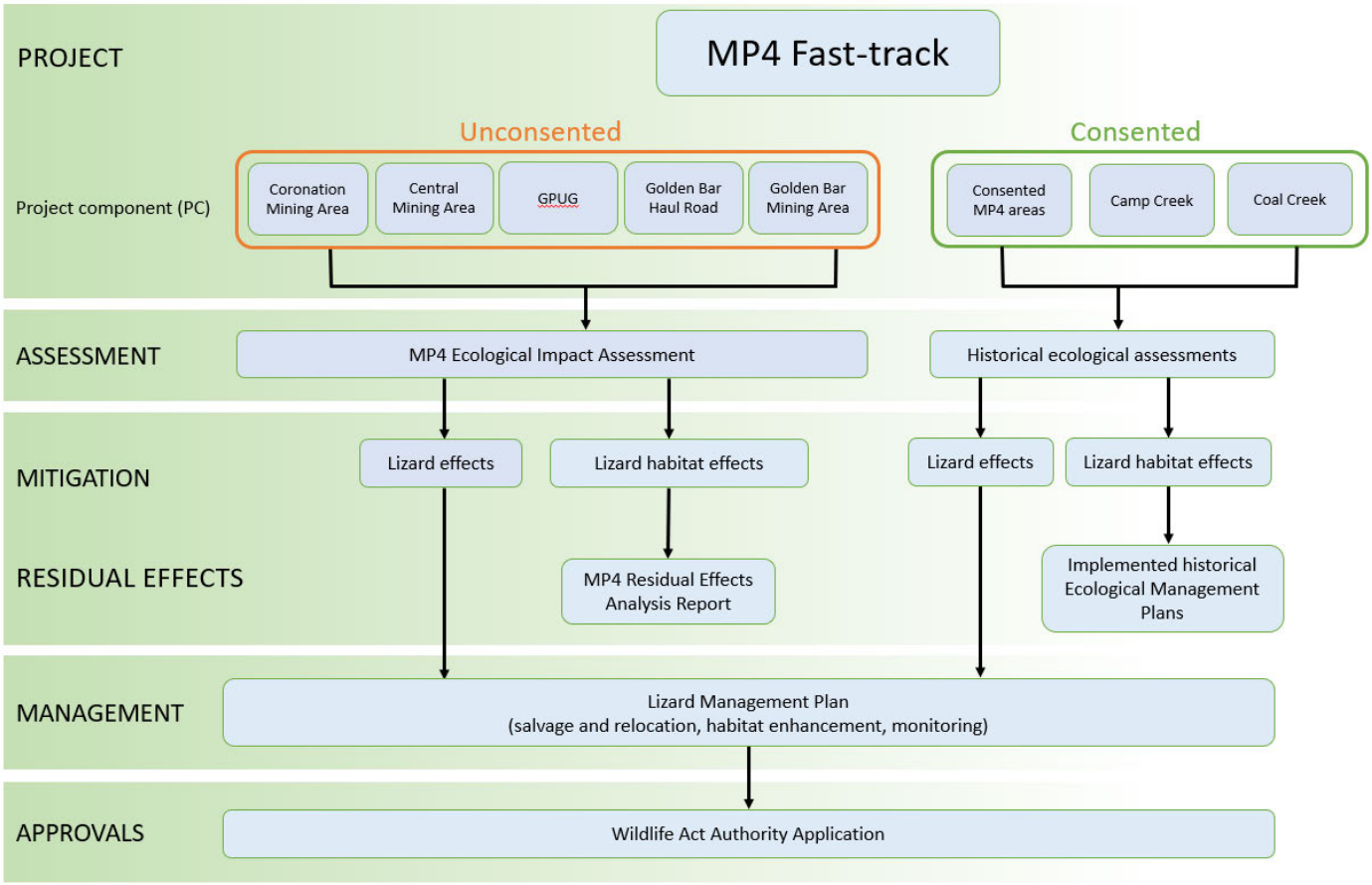


Figure 2.1. Structure of MP4 Fast-track Project as it relates to lizard management. Note: Central Mining Area includes Frasers West French Drain (FWFD).

2.1 Consistent and informed approach

This LMMP has been prepared in accordance with Department of Conservation (DOC) best-practice guidance for New Zealand herpetofauna, including guidance for preparing lizard management plans, for lizard salvage and transfer, and current guidance for developers, consultants, and DOC staff (Department of Conservation 2018; 2023a; 2023b). It generally adheres to the 'Department of Conservation guidance and key principles for lizard salvage and transfer in New Zealand' (Lizard Technical Advisory Group 2019), though some elements have been adapted based on the expert opinion of the Project herpetologist.

Development of this LMMP has also drawn on lessons learned from recent lizard salvage projects at Macraes Mine, including Deepdell North III (LizardExpertNZ 2021), Coronation North Stage 5 (CN5; Bioresearches 202e), and Continuity Consents Project Stage 2 (CCP2; Bioresearches 2026f). Key learnings include the difficulty of estimating lizard abundance across different habitat types, the resourcing required for effective salvage, the capacity of relocation sites, and the constraints of delivering salvage operations within the short South Island lizard season (October to April, inclusive). These lessons have informed the practices set out in this LMMP.

Table 2.1. Ecology documents prepared for the proposed Macraes Phase 4 Project. Current document highlighted.

Document #	Document name	Aspects covered	Author
E1	Terrestrial and Wetland Ecology Summary		Bioresearches (2026a)
Ecological Assessments			
E2	Assessment of Vegetation and Wetland Values	Terrestrial vegetation and wetlands	Whirika (2026)
E3	Assessment of Invertebrate Values		Bioresearches (2026b)
E4	Assessment of Lizard Values		Bioresearches (2026c)
E5	Assessment of Avifauna Values		Bioresearches (2026d)
E6	Assessment of Bat Values		Bioresearches (2026e)
E7	Ecological Impact Assessment	Terrestrial and wetland ecosystems and fauna	Bioresearches (2026f)
Ecological Management			
E8	Vegetation and TAR Flora Management Plan	Indigenous vegetation and threatened plants (wetland and terrestrial)	Bioresearches (2026g)
E9	Wetland Management Plan	Wetlands and TAR wetland plants	Bioresearches (2026h)
E10	Invertebrate Management & Monitoring Plan		Bioresearches (2026i)
E11	Lizard Management & Monitoring Plan		Bioresearches (2026j)
E12	Avifauna Management & Monitoring Plan		Bioresearches (2026k)
Residual Effects Analysis and Management			
E13	Residual Effects Analysis: Terrestrial Ecology	Residual effects analyses for vegetation and fauna	Bioresearches (2026l)
E14	Residual Effects Analysis: Wetlands	Residual effects analyses for wetlands	Bioresearches (2026m)
E15	Residual Effects Terrestrial Restoration Plan	Compensation planting and vegetation restoration	Bioresearches (2026n)
E16	Residual Effects Wetland Management Plan	Planting and restoration for wetlands	Bioresearches (2026o)
E17	Ecological Impact Assessment: Pest-proof Fence Construction	Terrestrial and wetland ecosystems and fauna	Bioresearches (2026p)
E18	Pest Control and Elimination Plan	Animal pest management	Alliance Ecology (2026)

2.2 Responsibilities and competencies

The roles and responsibilities for implementation of the LMMP are as follows:

- OGNZL holds overall accountability. The Macraes environmental team and nominated project manager are responsible for implementing and complying with the LMMP, and with any conditions attached to a WAA or resource consent issued to OGNZL.
- The project herpetologist (Dylan van Winkel; Appendix A) takes the technical lead and is suitably qualified and experienced in lizard handling, including salvage and relocation operations. The project herpetologist liaises with the other roles through OGNZL's project manager.
- Supporting ecologists and/or sub-contractors contributing to the LMMP protocols required before, during, and after mine development will be suitably experienced in lizard surveys and handling and will act under the supervision of the lead project herpetologist.

2.3 Mana whenua and stakeholder engagement

OGNZL is committed to engaging with Rūnaka in parallel with the processing of this application, and a Process Agreement is in place to support this engagement. Although the MP4 Project WAA application is new, its project components are a subset of the previous MP4 application and are similar to recent projects such as CN5 and CCP2, which OGNZL consulted with Rūnaka on during 2023–2025. Given this history of engagement, it is reasonable to expect continued collaboration, including comments and suggestions on this LMMP.

OGNZL recognises the importance of mana whenua engagement in all aspects of managing kārara/ mokomoko as part of the MP4 Project (e.g., LMMP refinement, capture, relocation, and monitoring) and is actively pursuing further engagement with mana whenua directly.

2.4 Sequencing of activities and proposed work dates

The project is not being progressed in stages. Rather, all activities that comprise the MP4 project are included in this substantive application. Those activities are anticipated to occur across a period of 13 years, with OGNZL proposing to commence the MP4 project as soon as the necessary approvals are obtained.

The activities described herein are expected to be generally sequenced as follows:

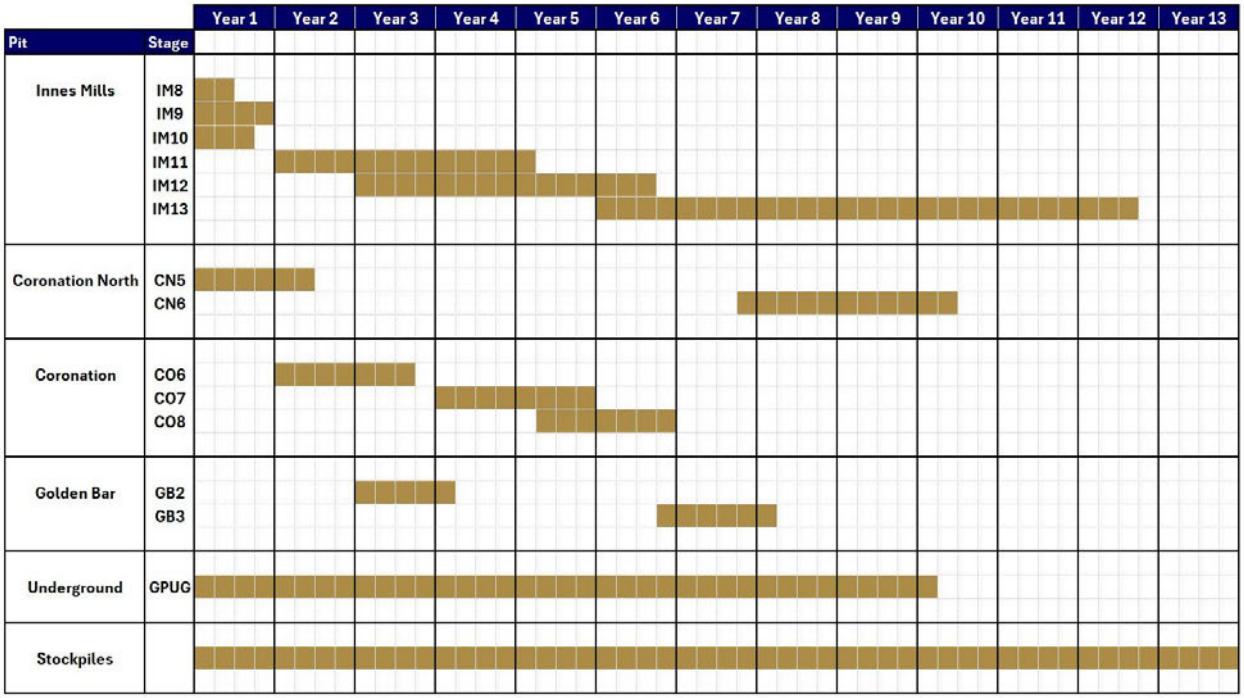
- The continuation of Innes Mills Pit mining from Year 1 to Year 12;
- The continuation of Coronation Pit mining from Year 2 to Year 6;
- Relocation of tailings from Southern Pit TSF and MTI from Year 2 to Year 12 to facilitate mining of Innes Mills Stage 13 (IM13);
- The continuation of Golden Bar Pit mining mostly in Year 3 and in Year 7;
- The continuation of GPUG mining from Year1 to Year 10;
- The continuation of Coronation North mining from Year 1 to Year 2 and then from Year 7 to Year 10;
- Associated replenishment of stockpiles throughout the MP4 mine life; and

- Full site rehabilitation to commence in Year 11 and be completed by approximately end of Year 13.

Mine planning is fluid at complex multi-pit operations such as the Macraes Operation. Precise timing of activities depends on a range of factors and operational requirements may facilitate changes to the sequencing of some activities.

Table 2.2 shows the anticipated sequencing of the proposed MP4 activities across the life of the project.

Table 2.2. Anticipated sequencing of MP4 activities



3 Summary of the MP4 lizard values and effects assessment

This section provides a brief summary of the lizard values and effects associated with MP4, to recap the reader ahead of the remainder of this Lizard Management and Monitoring Plan. It should not be relied upon as the values and effects assessment in its own right. Comprehensive detail on lizard values, potential effects, and residual effects is provided in the Assessment of Lizard Values (Bioresearches 2026c), the Ecological Impact Assessment (Bioresearches 2026f), and the Residual Effects Analysis: Terrestrial Ecology (Bioresearches 2026l), respectively, and readers should refer to these documents for the full assessment.

3.1.1 Lizard values

The MP4 Project area supports widespread and locally abundant indigenous lizard populations characteristic of the Macraes Ecological District (Macraes ED). Three species have been confirmed within areas affected by the Project (Figure 3.1):

- McCann's skink (*Oligosoma maccanni*) – 'Not Threatened';
- Southern grass skink (*Oligosoma chionochloescens*) – 'At Risk–Declining'; and
- Kōrero gecko (*Woodworthia* "Otago/Southland large") – 'At Risk–Declining'.

Suitable lizard habitat is widespread throughout the Project area and includes schist rock outcrops, tussock grassland, shrubland, riparian gullies, and wetland margins. Rock outcrops, tussock grassland, and shrubland represent the highest-value habitats and support the greatest abundance and diversity of lizards.

Several existing consented areas associated with the MP4 Project also support indigenous lizard populations. In particular, the Camp Creek and Coal Creek reservoir areas contain extensive areas of high-quality habitat and support high lizard values. Although these areas are already consented, they remain subject to Wildlife Act Authority (WAA) requirements. No populations of the 'Threatened' grand skink (*Oligosoma grande*) or Otago skink (*Oligosoma otagense*) were identified within areas proposed for direct disturbance. However, a remnant Otago skink population occurs within the wider Murphys Creek catchment outside the Project footprint.

Population modelling indicates that the MP4 Project impact areas support approximately 155,500 lizards. When existing consented areas requiring WAA management are included, including Camp Creek and Coal Creek, the total lizard population requiring management is estimated at approximately 278,768 individuals, comprising 116,986 McCann's skinks, 148,560 southern grass skinks, and 13,222 kōrero geckos.

The presence of indigenous lizard habitat and populations of 'At Risk–Declining' species resulted in all MP4 Project areas meeting ecological significance criteria under the National Policy Statement for Indigenous Biodiversity (NPS-IB), the Otago Regional Policy Statement (ORPS), and the Waitaki District Plan.

3.1.2 Effects on Lizards

The MP4 Project will result in direct and indirect adverse effects on lizards through the loss, modification, degradation, and fragmentation of habitat associated with vegetation clearance, earthworks, road construction, reservoir development, and mining activities. For areas requiring resource consent to clear lizard habitat, approximately 238 ha of suitable lizard habitat will be directly affected, with indirect effects potentially extending across a further approximately 180 ha of adjacent habitat (Table 3.1). In addition, areas that hold existing resource consents for mining activities but require consideration under the WA include approximately 173.3 ha of habitat supporting lizard populations that will need to be managed under this LMMP. Overall, the total area of land covered by the LMMP is approximately 412 ha of direct impact and approximately 180 ha of indirect impact (Table 3.1).

Direct effects include habitat loss, disturbance, displacement, and the injury or mortality of lizards during construction and operational activities. Indirect effects may arise from noise, vibration, dust deposition, edge effects, and the spread of invasive species, which may reduce habitat quality in areas surrounding the Project footprint.

To minimise adverse effects, the effects management hierarchy of avoidance, minimisation, and remediation has been applied, and a range of management measures will be implemented, including pre-clearance surveys, staged vegetation clearance, lizard salvage and relocation, habitat enhancement, habitat protection, and mammalian predator control (Bioresearches 2026f). These measures are intended to provide a protective benefit to affected lizards and support the persistence of local populations.

3.1.3 Residual Effects

Despite the implementation of avoidance, minimisation (salvage and relocation), and remediation measures, residual adverse effects on lizards are expected to remain due to the permanent loss of habitat and the unavoidable mortality of some individuals within the Project footprint. The Ecological Impact Assessment concluded that residual effects are **Moderate** for McCann's skink and **Very high** for southern grass skink and kōrero gecko. These levels of residual effect reflect the precautionary and conservative nature of the assessment, rather than an expectation of population-level decline or loss of species viability. These ratings are driven primarily by the large absolute number of individuals and extent of habitat affected when impacts are aggregated across all Project components, despite these impacts representing less than 10% of the estimated populations and less than 20% of available habitat on OGNZL landholdings for these species. Notwithstanding, the residual effects are considered long-term and irreversible within impacted areas and therefore, require biodiversity compensation measures.

To address residual effects, the Project proposes a broader biodiversity compensation package centred on the Murphys Ecological Enhancement Area (MEEA) and surrounding land. These measures are described in detail within the Residual Effects Analysis Report: Terrestrial Ecology (Bioresearches 2026l). Key measures include the establishment of a mammal exclusion fence, landscape-scale predator control, habitat restoration and enhancement, stock exclusion, and long-term ecological

monitoring. Together, these measures are intended to achieve a net positive outcome for indigenous lizards at the landscape scale.

In addition to providing benefits for the species directly affected by MP4, the mammal exclusion fence will also protect a remnant population of the 'Threatened' Otago skink occurring within the MEEA fence, delivering significant conservation benefits for this species.

Overall, while the MP4 Project will result in unavoidable adverse effects on indigenous lizards, the affected species remain widespread within the Macraes ED. The combination of mitigation, compensation, and long-term management measures is expected to maintain the viability of local populations and deliver enduring biodiversity benefits beyond the Project footprint.

McCann's skink (*Oligosoma maccanni*)
Conservation status: 'Not Threatened'
Common and abundant.
Occupies broad range of vegetation communities and habitat types, including exotic grassland. It is commoner in some areas such as rocky sites.

Southern grass skink (*Oligosoma chionochloescens*)
Conservation status: 'At Risk – Declining'
Common and abundant.
Occupies a broad range of vegetation communities and habitat types but prefers damper areas and grassland. Can be found in association with rock but not typically.

Kōrero gecko (*Woodworthia* "Otago/ Southland large")
Conservation status: At Risk – Declining'
Common and abundant.
Largely restricted to rocky habitats such as rock tors, rock outcrops, rock accumulations.

Figure 3.1. General information on lizard species occurring in the MP4 Project impact areas.

Table 3.1. MP4 Project Areas, showing the extent of the Project Component footprint, the extent of suitable lizard habitat Directly and Indirectly impacted by the project for both areas that are Unconsented (those requiring consent under MP4 Fast Track) and Consented (those with existing resource consents).

			Directly affected lizard habitat			Indirectly affected lizard habitat	
Project component (PC)	Acronym	PC footprint (ha)	Impact area	20 m buffer (impact assumed) (ha)	Total impact (Impact + 20 m buffer) (ha)	Surrounding 80 m buffer area (ha)	Total project area (Impact footprint + 20 m buffer + 80 m buffer) (ha)
Unconsented areas							
Coronation Mining Area	Coronation	79.1	73.7	9.3	83.1	37.9	121.1
Golden Point Underground	GPUG	172	0[A]	0	0	0	0
Central Mining Area	Central	107.1	41.3	8.6	49.9	23.6	73.5
Frasers West French Drain	FWFD	5.5	5.5	0[B]	5.5	0	5.5
Golden Bar Haul Road	GB HR	9.3	5.5	20.9	26.4	86.8	113.2
Golden Bar Mining Area	GB	66.8	62.7	11.1	73.8	32.4	106.3
Sub total		**439.8**	**188.7**	**49.9**	**238.7**	**180.6**	**419**
Consented areas							
Back Road Waste Rock Stack	BRWRS	172.0	0[C]	0	0	0	0
Camp Creek	Camp Creek	14.4	14.4	0	14.4	0	14.4
Coal Creek	Coal Creek	14.9	14.9	0	14.9	0	14.9
Other consented areas	Other consented areas	144	144	0	144	0	144
Sub total		**345.3**	**173.3**	**0**	**173.3**	**0**	**173.3**
Total		**785.1**	**362**	**49.9**	**412**	**180.6**	**592.3**

[A] GPUG underground mining activity is not expected to lead to measurable adverse impacts on lizards at the surface.
[B] The 20 m surrounding precautionary buffer has not been applied to FWFD because the footprint already encompasses a 20 m-wide footprint, with surplus to allow the construction of the 0.6 m base width drain as well as benches or batters to facilitate safe excavation.
[C] Not constructed under MP4.

4 Lizard salvage and relocation protocols

A lizard salvage and relocation programme will take reasonable steps to avoid, minimise, and mitigate adverse effects on native lizards. A dedicated salvage and relocation programme aims to reduce injury or mortality to individuals as far as practicable prior to, during, and after impacts occur. Following impact, lizard relocation management and monitoring will ensure the highest possible likelihood of lizard establishment and relocation success, as well as habitat protection and enhancement (e.g., mammalian predator control) measures to provide long-term protective benefits for both affected lizard populations and those populations resident at relocation and management sites.

The salvage and relocation programme will primarily target the three species of lizards known to occur in the MP4 impact footprint (McCann's skink, southern grass skink, and kōrero gecko) but will precautionarily include any other lizard species encountered (e.g., herbfield skink, Otago green skink). It is not considered likely that 'Threatened' Otago skinks nor grand skinks are present in the MP4 Project impact area given the absence of observations during surveys and absence of suitable habitat for these species (Bioresearches 2026c; E4).

The salvage will utilise a variety of industry standard and proven lizard capture techniques (e.g., ACOs, pitfall traps, Gee's minnow traps, and systematic searches). These techniques are relatively indiscriminate in terms of their ability to detect and capture a range of lizard species. This means there will be opportunities to salvage all other lizard species that may potentially occur but have not previously been recorded in the impact areas (e.g., herbfield skink).

4.1 Project staging and timing of salvage operation

The MP4 Project comprises several project components that will be delivered in stages over approximately 10 years, with project commencement scheduled for 2027. For each stage of mine development, associated lizard management activities will be carried out in the months immediately prior to development or mining in that area.

Vegetation stripping and lizard salvage will only occur within the recognised South Island lizard salvage season (October to April, inclusive). Because lizard activity is influenced by environmental conditions such as ambient air temperature and humidity, salvage and relocation will be undertaken only when conditions are suitable—that is, when lizards are active enough both to be captured and to move and settle successfully at the release site. Based on experience from previous salvage seasons, suitable conditions are defined as temperatures ≥ 10°C and the absence of rainfall.

4.2 Demarcation of the works footprint

Salvage effort will be invested across all suitable lizard habitats identified within the MP4 Project area that will be directly impacted by mining activities. This includes areas MP4 impact areas that are the subject of the current consent application and existing consented areas requiring WAA management (e.g., Camp Creek, Coal Creek, other areas) (Figure 4.1). Outside of the designated impact footprints, lies adjacent land that will not be directly affected by mining, but may experience indirect effects (i.e., land within the 80 m surrounding buffer). These areas will not be subject to lizard salvage activities.

Prior to any vegetation clearance or land disturbance, lizard salvage areas will be clearly demarcated to ensure everyone involved clearly understands the works extents and that works do not encroach into peripheral habitat areas.

An interactive GIS application, showing the works footprint boundary, aerial imagery, and other relevant overlays will be carried in the field by the project herpetologist to assist with orientation and boundary recognition.

4.3 Relocation site selection

The relocation site selection process involved a combination of predefined criteria, reviews of aerial imagery, and deductive reasoning to determine the most appropriate recipient site for salvaged lizards.

To assist with site selection, a set of eight site selection criteria were established. The criteria were based on consideration of the key principles for lizard salvage and transfer guidelines (Lizard Technical Advisory Group 2019) and other factors considered critical to provide the best prospects for lizard survival and persistence. The criteria included:

1. The site(s) must be ecologically appropriate and have long-term security (e.g., ecological covenants);
2. The habitat at the site(s) must be suitable for the salvaged species;
3. The site(s) must provide protection from predators;
4. The site(s) must be protected from future human disturbance;
5. The distance between the receiving site(s) and the original population (i.e., capture site) should be minimised as far as practicable;
6. The site must not compromise future potential mining opportunities (i.e., the site must not occur on land that could be designated for mining);
7. The site must not compromise any other mitigation activities required as part of the residual effects management package for MP4; and
8. The views of mana whenua must be included in the site selection process.

With these criteria in mind, aerial imagery was reviewed to scope potential sites on OGNZL landholdings and within the wider landscape. Further consideration was given to size, topography, and variety of lizards habitat present at the site. Site information was tabulated, and the suitability of each site assessed against the list of site selection criteria (Table 4.1). The relocation site that satisfied the greatest number of criteria and was selected.

Kāti Huirapa ki te Puketeraki on behalf of Te Runanga o Otakou and Te Runanga o Moeraki are being provided with a copy of this LMMP upon lodgement of the WAA application. Therefore, their views on lizard relocation, site selection, and post-release management have not yet been considered. OGNZL

has however, engaged with mana whenua in relation to the expected lizard management to take place and the general relocation site, and will continue to engage throughout the application process.

Eight potential lizard relocation sites, including Highlay Creek Ecology Covenant, Deepdell Station Ecology Covenant, Highlay Hill Covenant, Cranky Jims Creek Ecology Covenant, Cranky Jims Wetland Open Space Covenant, Island Block Covenant, Mt Highlay Station, and the proposed MEEA and Murphys Link were considered (Figure 4.1).

A detailed assessment of the suitability of each of these potential lizard relocation sites is presented in (Table 4.1).

The outcome of the assessment revealed that Murphys Link, comprising 395 ha of tussock and shrubland protection and enhancement, presented the most suitable and preferred relocation site for all lizards salvaged as part of MP4. Seven of the eight site selection criteria were met, with the eighth criterion—views of mana whenua—still under consultation. All other sites were assessed as less suitable or inappropriate, due to poor habitat quality, land access constraints, or conflicts with existing lizard management and research projects.

While the relocation of lizards into the MEEA predator-exclusion fence was considered, this could not occur because it would confound the compensation monitoring: it would become impossible to distinguish population changes caused by the compensation actions (e.g., predator elimination, habitat protection) from changes caused by the relocation itself.

Compensation monitoring will compare lizard densities over time against a baseline to determine whether the compensation is achieving its intended outcome (e.g., a doubling of lizard population size over a five-year period). If additional lizards are introduced at the start of, or partway through, this monitoring period, any subsequent increase in numbers could reflect either genuine improvement in survival and recruitment due to the compensation measures working, or simply the fact that more lizards were physically added to the population.

Because these two effects are indistinguishable in the data, the monitoring results would no longer provide a reliable measure of whether the compensation itself is delivering the intended conservation gain. This would undermine the ability to report accurately on compensation performance and could overstate the compensation's success if increases are driven by translocated individuals rather than by improved in-situ survival and reproduction.

Instead, salvaged lizards will be released outside the MEEA fence, into Murphys Link (395 ha). This area will be stock-excluded and protected through covenanting to maintain and enhance indigenous tussock grassland and shrubland habitats and will be subject to intensive mammalian predator control to assist the establishment and persistence of both relocated and resident lizards. In addition to providing habitat for relocated individuals, the area will strengthen ecological connectivity between the MEEA predator-exclusion fence to the east and the Redbank Covenant to the west. The Redbank Covenant supports a diverse lizard community, including all species recorded within the MP4 Project area, as well as a population of the 'Threatened' grand skink (M. Tocher, unpubl. data). Collectively, the MEEA (including the predator-exclusion fence, 1 km surrounding buffer, and Murphys Link) will

form an important habitat corridor, promoting population connectivity, dispersal, and long-term resilience of lizard populations across the wider landscape.

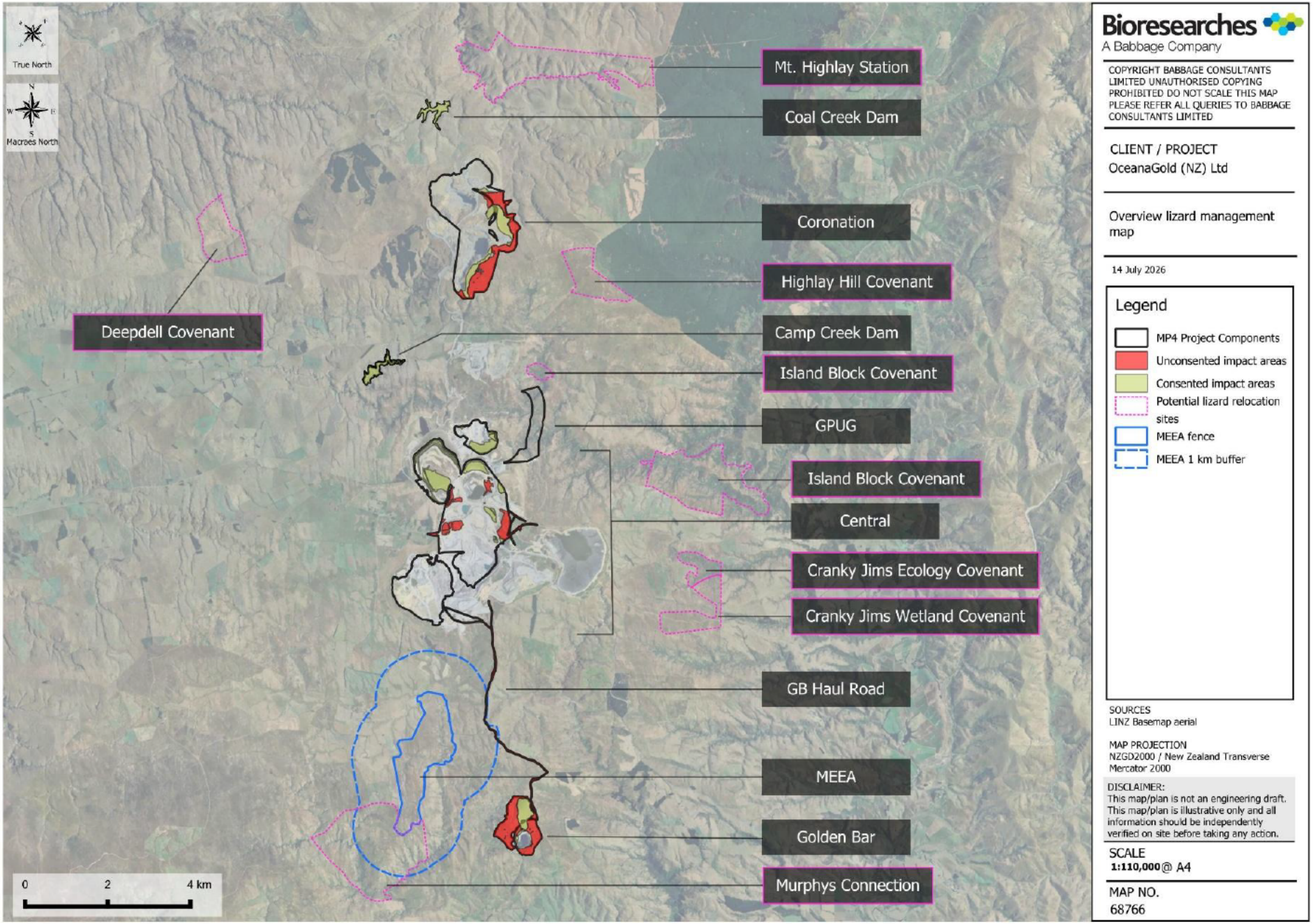


Figure 4.1. Aerial image showing the location of the impact (direct loss) footprints and potential lizard relocation sites (covenants) that were considered as part of this LMMP.

Table 4.1. Assessment of potential lizard relocation sites within OGNZL landholdings and wider surrounding landscape. Criteria definitions: 1. The site(s) must be ecologically appropriate and have long-term security; 2.The habitat at the site(s) must be suitable for the salvaged species; 3. The site(s) must provide protection from predators; 4. The site(s) must be protected from future human disturbance; 5. The distance between the receiving site(s) and the original population (i.e., capture site) should be minimised as far as practicable (receiving site preferably located on OGNZL landholdings); 6. The site must not compromise future potential mining opportunities (i.e., the site must not occur on land that could be designated for mining); and 7. The views of mana whenua must be included in the site selection process. TBD = to be determined.

Site name	Areal extent	Land status	Distance from centre of project area	Brief description	Criteria							
					1	2	3	4	5	6		7
Murphys Link	395 ha	OGNZL landholdings but proposed covenant and ecological enhancement area	9 km	Murphys Link forms part of the MEEA, which is being established as part of the MP4 Project and will encompass more than 1,500 ha of protected and actively managed habitat. The MEEA incorporates a range of management interventions aimed at enhancing ecological values and improving outcomes for indigenous biodiversity, including lizards. A 252 ha mammal exclusion fence will be constructed, and all mammalian predators within the fenced area will be eliminated. As the fence area forms part of the compensation package for addressing residual effects on lizards under MP4, it is not proposed as a recipient site for lizard relocations. Outside the predator-exclusion fence, approximately 1,100 ha of land currently supporting all three lizard species affected by the MP4 Project will be subject to landscape-scale mammalian pest control (Alliance Ecology 2026). While parts of this area will remain under agricultural management and therefore, provide only limited lizard habitat, the Murphys Link (395 ha) will be stock-excluded and protected through covenanting to maintain and enhance indigenous tussock grassland and shrubland habitats. The name reflects the areas direct ecological Links between the MEEA predator-exclusion fence and Redbank Covenant to the west. This area is considered suitable for lizard relocation, particularly if intensive pest control is implemented within relocation sites. In addition to	✓	✓	✓	✓	✓	✓	✓	TBD

				providing habitat for relocated individuals, the area will strengthen ecological connectivity between the predator-proof fenced area to the east and the Redbank Covenant to the west. The Redbank Covenant supports a diverse lizard community, including all species recorded within the MP4 Project area as well as populations of the 'Threatened' grand skink (M. Tocher, unpubl. data). Collectively, these protected areas will create an important habitat corridor that promotes population connectivity, dispersal, and long-term resilience of lizard populations across the wider landscape. Mana whenua are generally supportive of the MEEA concept; however, consultation regarding the proposed lizard relocation programme remains ongoing.								
Mt Highlay Station	350 ha	OGNZL landholdings	10.7 km	Mt Highlay Station is a large property located north of Coronation. The property was recently acquired by OGNZL for its plantation forestry values, with afforestation completed in 2023. The net stocked forest area is approximately 265 ha and comprises Douglas fir (*Pseudotsuga menziesii*), radiata pine (*Pinus radiata*), and hybrid pine (*P. radiata* × *P. attenuata*). The plantation was established predominantly on degraded exotic grassland, although some indigenous tussock regeneration is occurring. The site also contains numerous schist rock outcrops and more densely vegetated gullies that provide habitat for indigenous lizards. Three indigenous lizard species—McCann's skink, southern grass skink, and kōrero gecko—are known to occur on the property. While the plantation trees are currently young (approximately 0.5 m in height) and suitable lizard habitat remains widespread, the habitat values of the site are expected to decline as the forest matures. Increasing canopy cover will progressively shade rock outcrops and suppress understory vegetation, reducing habitat suitability for lizards.	x	x	x	x	✓	✓	x	TBD

				As part of the MP4 compensation package, Mt Highlay Station is proposed as an averted-loss site, whereby the plantation forest will be removed before it reaches maturity, preventing the long-term loss and degradation of lizard habitat. Because the site forms part of the compensation package, lizard relocation to the property is not proposed. Introducing additional lizards would confound monitoring of natural population trajectories and compromise the ability to quantify the conservation gains attributable to the averted-loss action. Accordingly, despite supporting suitable habitat, Mt Highlay Station is not considered an appropriate recipient site for relocated lizards.								
Island Block Covenant	291 ha	DOC covenant	5.2 km	A deeply incised gully system along the margins of Deepdell Creek. The area supports an abundance of mixed native and exotic shrubland, extensive areas of tussock and grassland, and an abundance of rocky outcrops and tors. The covenant is the site for other OGNZL Macraes lizard mitigation projects, including the CCP IM8 leaky fence research project and the CN5/ CCP2 lizard salvage-relocation and established research project. Over 8,600 lizards have been relocated to this covenant over the past three seasons, and there in ongoing predator control and lizard monitoring as part of two established lizard research projects. Despite the substantial size of the covenant, it is not considered appropriate to accommodate for any more lizards to be relocated to this site. Furthermore, relocations would compromise the integrity of the ongoing research projects. For these reasons, this site is not considered appropriate for a relocation site. Mana whenua supported the selection of this site for the previous lizard relocations but have not been consulted about further releases as part of	x	x	✓	✓	✓	✓	✓	✓

				MP4 because the site has been ruled out as a potential option by the project herpetologist prior to any consultation occurring.								
Deepdell Station Ecology Covenant	110 ha	QEII covenant	6 km	The Deepdell Station Ecological Covenant comprises an area of indigenous tussock grassland dissected by gullies that support a diverse range of native vegetation. The site contains numerous schist tors, bluffs, and rocky habitats that provide high-quality habitat for indigenous lizards. Lizard surveys and monitoring have confirmed the presence of five species: McCann's skink, southern grass skink, herbfield skink, Otago green skink, and kōrero gecko. With the exception of herbfield skink and Otago green skink, these species are known to occur in relatively high abundance (Ecogecko 2013a, c). Parts of the covenant have previously been used as mitigation sites for OGNZL consents and have been subject to lizard monitoring, research, and mammalian predator control programmes. Although predator control was undertaken historically, it may no longer be actively implemented. The site also remains subject to livestock grazing. OGNZL no longer owns the Deepdell Station Ecological Covenant, which is now vested with QEII National Trust. As a result, OGNZL has limited ability to implement or maintain management actions such as predator control, grazing management, habitat enhancement, or long-term monitoring. Consequently, despite its high lizard values, the site is not considered suitable as a recipient site for lizard relocations.	✓	x	x	x	x	✓	✓	TBD
Highlay Creek Ecology Covenant	16.9 ha	QEII covenant	4.2 km	A deep gully system dominated by indigenous scrub and tussocks on the ridges. Rocky outcrops, tors, slabs, and boulders are present in abundance in some areas.	x	x	x	✓	✓	✓	✓	TBD

				Habitat for lizards is limited at this site due to the abundance of dense shrubland covering most of the site and the limited open sunny habitat on the ridges. Lizard surveys and monitoring have been undertaken in Highlay Creek Ecology Covenant, which have identified the presence of three species (McCann's skink, **southern grass** skink, and kōrero gecko); all species occurred at low to moderate abundance (Ecogecko 2013a, c). While resident lizards occupy the site, it is estimated that less than 50% of the site comprises highly suitable tussock and rocky habitats for lizards. Mammalian predator control is not currently operational. Pest monitoring has revealed the presence of mice and mustelids. Pig sign (rooting) has also been recorded in the covenant. In addition, residual trap catch monitoring for possums was carried out in November 2024 (High Country Contracting 2024), and possum control carried out from January 2025.								
Highlay Hill Covenant	82 ha	DOC covenant	3.5 km	A higher elevation (550–820 m a.s.l.) site predominantly covered by tussock grassland, with interspersed shrubland and wetlands, and supporting a basalt rock cone. Limited information is available on the diversity and abundance of lizards at the site. The Highlay Hill Covenant Management Plan (Ahikā Consulting 2020) confirms the presence of three species of lizards (McCann's skink, **southern grass** skink, and kōrero gecko) and Knox *et al*. (2015) recorded the same three species in similar habitat and at similar elevations (~680 m a.s.l.) south of the Highlay Hill Covenant. Schist rock tor habitats appear to be absent from the covenant, which may have implications with respect to habitat suitability for kōrero geckos. Highlay Hill does support large basalt rock formations and talus slopes near	x	x	x	✓	✓	✓	✓	TBD

				the summit and on the northwestern facing slope but there is limited information on lizard occupancy within these rocky areas. The covenant is surrounded by a stock-proof fence, but mammalian predator control is not currently operational (possum monitoring is currently in place). In addition, a long-term lizard monitoring programme has recently been established at the site. To avoid compromising the integrity of the ongoing research project, this site is not considered appropriate for a relocation site.								
Cranky Jims Creek Ecology Covenant	47 ha	Covenant	10.4 km	Cranky Jims Creek Ecology Covenant supports an area of high value native bush, scrub and bracken, tussocks, and grassland. There is a considerable amount of steep rock bluffs lining the gullies, with some rock tors on the plateau. Lizard surveys and monitoring undertaken in Cranky Jims Creek Ecology Covenant identified the presence of three species (McCann's skink, **southern grass** skink, and kōrero gecko) but all species occurred at very low abundance (Ecogecko 2013a, c). The low lizard abundance was attributed to the structure of the rock at Cranky Jims not providing an abundance of suitable crevices or thin rock plates for lizards to refuge and the extensive forest cover having a cooling effect on the surrounding rock, shading out potential lizard habitat (Ecogecko 2013a, c). Kōrero geckos (N = 843) were relocated into Cranky Jims Creek Ecology Covenant as part of the Deepdell North III project. Lizard monitoring was established on-site in February 2023, but no monitoring results are currently available.	x	x	x	✓	✓	✓	✓	TBD
Cranky Jims Wetland Open Space Covenant	49 ha	Covenant	11 km	Cranky Jims Wetland Open Space Covenant is an area of open tussock and grassland, supporting sparse rock tors. The site was established specifically to protect wetland habitats.	x	x	x	✓	✓	✓	✓	TBD

				No lizard surveys or monitoring have been carried out at the site. However, it is assumed that three species of common lizard (McCann's, southern grass, and kōrero gecko) are present. Numbers of kōrero geckos will be low due to the limited number of complex rock outcrops available. Mammalian predator control is not currently operational.								

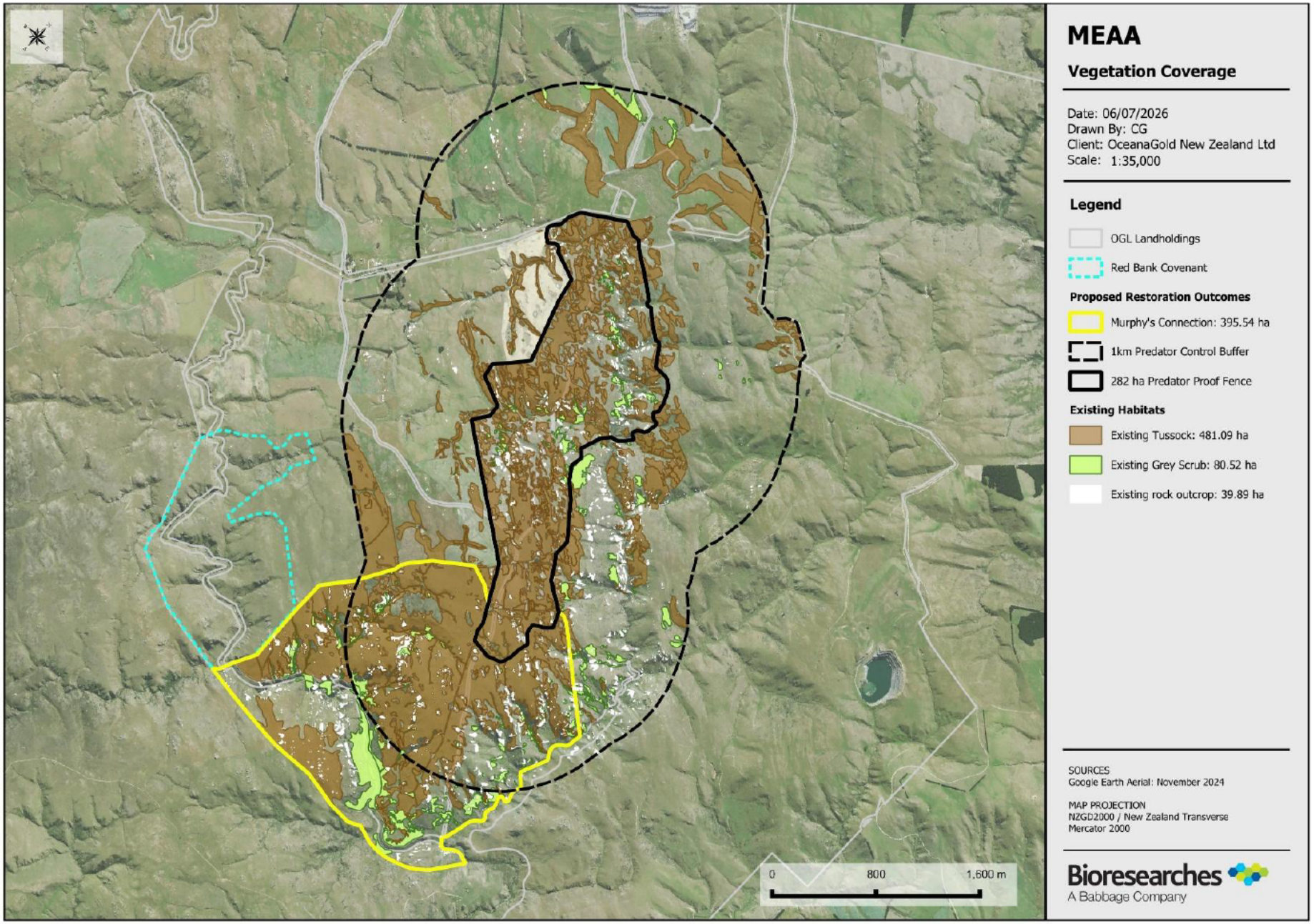


Figure 4.2. Murphys Link—the preferred relocation site for lizards salvaged as part of MP4—showing the extent of tussock and dry shrubland habitat. Uncoloured areas represent short exotic grassland.

4.4 Salvage programme strategy and parameters

Large-scale lizard salvage programmes present a range of challenges, including substantial resource requirements, the management of potentially large numbers of animals, and the identification of suitable recipient sites. Despite these challenges, the MP4 salvage programme has been developed using the best available information from baseline surveys and previous salvage operations at Macraes. The overarching strategy is to apply best efforts to capture and relocate as many lizards as practicable from areas subject to disturbance during each salvage season.

Recognising differences in conservation status, salvage efforts will prioritise 'At Risk' species, namely southern grass skinks and kōrero geckos, while 'Not Threatened' McCann's skinks will be captured opportunistically. However, the capture methods employed are largely non-selective, and recent salvage operations (e.g., CN5 and CCP2) have demonstrated that substantial numbers of McCann's skinks are likely to be captured alongside the target 'At Risk' species.

A possible Otago green skink observation was made at Camp Creek, necessitating dedicated efforts to detect and capture this species should it occur within the area. Although the observation was made outside the proposed impact footprint, targeted searches will be undertaken within the footprint, particularly in habitats considered suitable for Otago green skinks, such as damp gullies, seepages, and areas with abundant rock cover. These habitats overlap with those targeted for other lizard species and will therefore be incorporated into the broader salvage programme.

Population estimates have been developed for each MP4 Project area to assist with planning and resource allocation. These estimates are based on extrapolating species-specific density estimates derived from baseline monitoring across suitable habitat (Bioresearches 2026c). Previous salvage operations have demonstrated that population estimates are subject to uncertainty and may underestimate true abundance to an unknown degree. Nevertheless, in the absence of more robust information, they provide the best available basis for scaling salvage effort and allocating resources.

The salvage programme has been designed to incorporate lessons learned from previous operations and may be refined following consultation with the Department of Conservation and mana whenua. Adaptive management will be applied throughout implementation of the LMMP to continually improve capture, handling, and relocation outcomes.

4.4.1 Lizard population size

The estimated lizard population within areas subject to salvage is approximately 278,768 individuals, comprising 116,986 McCann's skinks, 148,560 southern grass skinks, and 13,222 kōrero geckos (Table 4.2).

These estimates are higher than those reported in the MP4 Lizard Values and Effects Assessments (155,574 lizards) because they include additional consented areas requiring management under Wildlife Act Authority (WAA) conditions, including Camp Creek and Coal Creek.

Population estimates were derived by extrapolating species-specific density estimates from baseline monitoring across the extent of suitable habitat within each impact area. For Camp Creek and Coal Creek,

kōrero gecko densities were increased to reflect the higher habitat quality and greater abundance of rock outcrops relative to other Project areas. Accordingly, a density of 150 geckos/ha, rather than 25 geckos/ha, was applied in these locations.

While this approach is subject to uncertainty and may overestimate populations in some areas and underestimate them in others, it is considered the most reliable method currently available. Alternative approaches can generate implausible results. For example, applying the lizard densities recorded during the CCP2 salvage operation (approximately 1,900 lizards/ ha) across the 412 ha of suitable habitat within the MP4 Project salvage area would produce an estimate exceeding 7.8 million lizards, including clearly unrealistic population estimates for areas supporting marginal to good quality habitat.

These estimates should therefore be regarded as indicative rather than definitive. Their primary purpose is to inform the scale of salvage operations and resource allocation across the Project areas, rather than to establish a numbers-based stopping rule for salvage activities.

Table 4.2. Lizard population estimates, by species, for each MP4 Project Area requiring lizard management.

	Coronation	Central	FWFD	GB HR	Golden Bar	Consented areas	Camp Creek	Coal Creek	Total
Lizard habitat extent (ha)	**83.1**	**49.9**	**5.5**	**26.4**	**73.9**	**144.4**	**14.4**	**14.9**	**412.4**
Species									
McCann's skink	22,452	12,434	1,474	6,728	18,909	36,977	10,711	7,301	**116,986**
Southern grass skink	30,277	18,107	2,134	9,834	27,461	54,129	3,192	3,426	**148,560**
Kōrero gecko	2,050	1,213	0	656	1,835	3,609	2,056	1,803	**13,222**
Total	**54,779**	**31,754**	**3,608**	**17,219**	**48,204**	**94,715**	**15,960**	**12,529**	**278,768**

• reflects lack of suitable habitat for kōrero gecko in FWFD area.

4.4.2 Lizard recovery rates

The lizard salvage programme aims to provide a protective benefit to lizards by ensuring all reasonable steps are taken to minimise injury and mortality during vegetation clearance, and to maximise the survival and persistence of affected individuals and populations. The programme will therefore seek to capture and relocate as many lizards as practicable from impact areas, within the constraints of available resources, suitable environmental conditions, and the defined lizard salvage season.

Complete recovery of lizards cannot be guaranteed. Factors such as the cryptic nature of lizards, their ability to evade capture, risks associated with vegetation clearance methods, and periods of unsuitable weather can reduce detectability and prevent some individuals from being salvaged. Consequently, some lizards are expected to remain within impact areas despite the application of best efforts.

The recovery strategy draws on lessons learned from recent large-scale, resource-intensive salvage operations at Macraes, CN5, and CCP2. These programmes were heavily resourced and used population-depletion approaches (e.g., Leslie-type methods) to assess reductions in lizard abundance over time; however, these methods proved unreliable for determining when a satisfactory level of population reduction had been achieved (van Winkel 2025; Scarrott 2026). Accordingly, the MP4 salvage programme will not rely on depletion modelling to set stopping rules, although catch-per-unit-effort (CPUE) and cumulative capture data will continue to be recorded and reviewed to inform future practice.

Instead, key performance metrics from these previous operations have been applied to the MP4 salvage areas to determine the resourcing needed to deliver a transparent, well-resourced salvage effort. Table 4.3 shows how these parameters translate into the salvage effort planned for Years 1–7 of the Project.

It must also be acknowledged that the salvage areas and number of lizards recovered will vary from year to year, according to the sequencing of mining activities (see section 2.4 of this report); a high proportion, potentially up to 50% of the total expected salvage number, is likely to be relocated in Year 1.

Table 4.3. Lizard salvage metrics from the CN5 (2025/6) and CCP2 (2026) salvage operations, and the resulting parameters proposed for MP4 lizard salvage.

Metric	2025/2026 salvage data	Proposed MP4 effort
Salvage area (ha)	14.9	412
Lizard catch rate (lizards/person hr)	1.1–2.2	≥ 1.5
Duration (days)	42–73	40–60 days **per salvage area**
Person effort (person hrs/ ha)*	123–191	120–180 **per salvage area**
Total lizard catch (no. lizards)	8,511	57,600–86,500

* excludes hours dedicated to pitfall and Gee's Minnow trap inspections.

Accordingly, the following parameters will govern lizard recovery:

- McCann's skink, southern grass skink, and kōrero gecko will be targeted for capture and relocation.
- Priority will be given to the recovery of 'At Risk' species (southern grass skink and kōrero gecko); however, 'Not Threatened' McCann's skinks will also be salvaged from all impact areas;
- Any other indigenous lizard species incidentally encountered (e.g., herbfield skink or Otago green skink) will also be salvaged (see section 3.4.4 *Management of incidentally detected 'rare' species*);
- In the highly unlikely event that a 'Threatened' species, such as Otago skink or grand skink, is discovered, additional dedicated salvage efforts will be initiated and will continue until the project herpetologist is satisfied that all reasonable efforts have been made to recover all affected individuals of the 'Threatened' species.
- Salvage will be undertaken during the DOC recommended South Island lizard salvage period of 1 October to 30 April.
- Salvage effort will be applied across all safe and accessible parts of the impact footprint. Areas deemed unsafe by suitably qualified technical specialists will be excluded from salvage activities.
- Salvage will only be undertaken under suitable weather conditions. Unsuitable conditions include:
    - daytime maximum temperatures below 10°C;
    - moderate or heavy rainfall, or persistent drizzle;
    - strong or persistent winds that reduce detectability or create health and safety risks; and
    - heavy frosts, which may restrict morning salvage activities.
- Salvage effort will be invested in all affected mining areas identified as supporting lizard habitat.
- Salvage effort per mining area will range from 40–60 salvage days per season and 120–180 person-hours per hectare, scaled to habitat quality. This level of effort will be fully invested before any decision is made to cease salvage operations.
- Where best efforts have been applied, no additional compensation will be provided for lizards remaining within impact areas. This reflects the conclusions of the Ecological Impact Assessment (Bioresearches 2026f), which found that salvage and relocation do not materially reduce the magnitude of effects, and that residual effects are addressed through the separate compensation package developed for the MP4 Project.

The salvage programme should be read alongside the broader compensation package developed for the MP4 Project (Bioresearches 2026l), which remains the primary mechanism for achieving positive outcomes for lizards. Salvage is intended to provide an additional protective benefit by recovering as many individuals as practicable, but it is not a substitute for that compensation package.

4.4.3 Relocation site carrying capacity and 'stocking density'

Ensuring that a relocation site has sufficient carrying capacity to support both resident and relocated lizards is critical to the success of any relocation programme. Carrying capacity is influenced by the size of the site, the abundance of suitable habitat, the size of the resident lizard population, and the habitat and pest management measures implemented at the site.

The proposed 395 ha relocation area within the Murphys Link supports extensive areas of high-quality lizard habitat and is known to support the same three lizard species affected by the MP4 Project. Applying

the same population estimation methods used elsewhere in this LMMP indicates that the site currently supports an estimated resident population of approximately 259,120 lizards.

If all lizards estimated to occur within the MP4 impact areas (i.e., 278,768 individuals) were successfully salvaged and relocated to the Murphys Link, this would result in an artificial increase in the resident population of approximately 107% and raise the density of lizards within the relocation site to 1,361 lizards/ ha. Considering the habitat enhancement at the relocation site, this density should be acceptable and is within the range of densities reported in similar habitats in the wider Otago area (see Appendix B). However, it is unlikely that all individual lizards will be able to be salvaged considering the limitations outlined in section 3.4.2 above. More realistically, an estimate of 57,600–86,500 lizards will be practicably salvaged and relocated, ultimately resulting in an artificial uplift of 22–33% in the population, resulting in densities ranging between 802–875 lizards/ ha. However, in practice, salvage and relocations will occur progressively over at least six seasons over the life of the MP4 Project rather than as a single release event. With an estimated 8,000 to 45,000 lizards released in any one season, the increase in lizard numbers at the relocation site is expected to occur gradually over time, though some years may see marked influxes.

Importantly, the current carrying capacity of the Murphys Link reflects existing site conditions, including livestock grazing and the absence of intensive mammalian predator control. The proposed management regime will remove or substantially reduce these constraints through stock exclusion, habitat protection and enhancement, and ongoing predator control (Alliance Ecology 2026). These measures are expected to improve habitat quality, increase survival and recruitment, and raise the site's carrying capacity over time. Studies from dryland Otago ecosystems have demonstrated that effective mammalian predator control can lead to increases in skink abundance, including in areas outside predator exclusion fences, and particularly where pest control is occurring adjacent to such fences (Reardon *et al*. 2012; Norbury *et al.* 2022).

Accordingly, the Murphys Link relocation site is expected to have sufficient capacity to accommodate salvaged lizards from the MP4 Project while continuing to support population growth and improved conservation outcomes over the longer term.

4.4.4 Management of incidentally detected ‘rare’ species

In the unlikely event that 'rare' lizard species such as herbfield skink, Otago green skink, Otago skink, and/ or grand skink are found during salvage and relocation, dedicated recovery effort will be directed toward these species and their potential habitat to ensure all individuals are salvaged. This will involve redirecting personnel to habitat surrounding the detection location, as well as any other habitat identified within the impact footprint where these species could occur.

Lizard trapping and capture methods will follow those outlined in Section 3.5 below; however, only highly experienced lizard handlers will be deployed to capture and handle 'rare' species, to minimise the risk of injury or harm during salvage.

All recovered 'rare' lizards will be relocated to suitable, unoccupied habitat within the MEEA predator-exclusion fence. This is an intentional deviation from the standard approach for all other lizards, which will be relocated outside the fence into Murphys Link, for two reasons: 1) predator exclusion offers the

best possible chance of survival for large-bodied and 'rare' lizards, and 2) known populations of at least Otago skink already exist within the MEEA predator-exclusion fence alignment.

Relocating other lizard species (McCann's skink, Southern grass skink, and kōrero gecko) into the fence has the potential to interfere with the ability to report accurately on compensation performance. This is not the case for the rarer, large-bodied species because they do not form part of the species monitored for compensation performance, and any individuals captured during monitoring can simply be excluded from the results. Accordingly, relocating them into the fence poses no perceived risk to monitoring outcomes.

4.4.5 Pre-salvage inductions and training

All personnel involved in the salvage and relocation operation will be required to attend a pre-salvage induction, delivered by the Project herpetologist, before any capture work begins. The induction will cover identification of all lizard species anticipated within the impact footprint, including the key features that distinguish 'rare' large-bodied species (Otago skink, Otago green skink, grand skink) from more common species such as McCann's skink, Southern grass skink, and kōrero gecko. Particular emphasis will be placed on species that could be confused in the field, so that any detection of a 'rare' species reliably triggers the dedicated recovery response described above. The induction will also cover safe capture and handling techniques, including minimising handling time and restraint stress, and recognising signs of heat stress, injury, or tail-autotomy risk, so that all personnel are equipped to capture and handle lizards without causing harm.

The induction will include a practical demonstration of all trapping methods to be used during salvage (e.g. pitfall traps, funnel traps, and artificial cover objects), covering correct installation, checking frequency, and servicing to maintain lizard welfare. Personnel will be shown how each trap type functions, common failures (e.g. flooding, overheating, or predator access), and the checks required at each visit to confirm traps are operating correctly and that any captured lizards are removed promptly. Correct procedures for processing captured lizards, including safe removal from traps, temporary holding where required, and release or transfer to relocation sites, will also be demonstrated, with an emphasis on minimising holding time and handling stress. Any welfare incidents, including injury or mortality, will be recorded and reported in line with the project's monitoring and reporting requirements.

Recognising the cultural significance of native lizards as taonga species, the induction will also cover the cultural protocols to be observed throughout the salvage operation, developed in consultation with mana whenua. This will include guidance on the appropriate handling and treatment of lizards during capture, transport, and release, and the specific steps to be followed in the event of an unavoidable lizard death, including notification requirements, appropriate storage and burial, and any karakia or other cultural practices to be observed. All personnel will be made aware that lizard deaths carry cultural as well as ecological significance, and will be expected to treat all individuals, living or deceased, with appropriate care and respect throughout the operation.

4.5 Lizard trapping and capture

A variety of reliable, tried, and proven live trapping and capture techniques will be employed to increase the probability of lizard capture, and these are considered to constitute ‘reasonable steps’ under section

53B (4) of the WA 1953. Techniques will include, but may not be limited to, pitfall traps (covered by an *Onduline* artificial cover object [ACO]), layered *Onduline* ACOs, Gee's Minnow traps, and diurnal systematic (hand) searches. Learnings from the CCP IM8, CN5, and CCP2 lizard salvages demonstrated the success of these methods as lizard capture techniques.

4.5.1 Lizard capture methods

4.5.1.1 Experienced personnel

The involvement of dedicated and experienced personnel is critical to the success of the lizard salvage programme. Previous salvage operations at Macraes have consistently demonstrated that experienced field staff significantly improve both the efficiency and effectiveness of lizard detection and capture. Experienced personnel are better able to identify suitable habitat, recognise lizard behaviour, and apply search and capture techniques effectively, resulting in higher capture rates. They also play an important mentoring and training role for less experienced staff, helping to build capability within the salvage team and improve overall capture success. Consequently, salvage operations will be led by experienced herpetologists and field personnel with demonstrated expertise in lizard survey, handling, and relocation techniques.

4.5.1.2 Pitfall traps

Pitfall trapping is a standard and effective technique for capturing terrestrial lizards in New Zealand (Hare 2012a). Pitfall trapping will involve the installation of four litre plastic pails, dug into the ground with the top of the bucket flush with ground level, and covered with an *Onduline* ACO lid wider than the aperture of the pail (Figure 4.3Figure 4.4). A small amount of soil and leaf litter is placed in the bottom of the traps to provide cover for captured lizards, and traps will be activated by adding a lure (e.g., soft fruit or Natural Confectionery Co Juicy Bursts Strawberry & Raspberry lures).

Arrays of pitfall traps will be installed throughout the impact areas; their specific locations to be determined by the project herpetologist based on habitat and topography and trap densities to be at least 20 traps/ ha. The locations of all pitfall traps would be recorded on a GPS and traps would be inspected at least every 24 hours (likely twice per day) for the duration of the pre-works salvage operation.

All pitfall traps used as this part of the operation will be installed in the field at least two weeks prior to the commencement of the lizard salvage. A longer 'settling time' is not considered necessary because the pitfall traps will be baited and will immediately attract lizards.

4.5.1.3 Gee's Minnow traps (funnel traps)

Gee's Minnow traps or funnel traps are small fish traps that typically consist of two funnel-shaped entrances at either end of a mesh cylinder. Funnel traps are a passive sampling method because they rely on lizards to willingly encounter and enter the trap. They can be used to capture lizards in a wide range of habitats because they can be positioned on or above ground, can be nestled among dense vegetation, and can easily be relocated without disturbing the soil (Hare 2012b).

Arrays of funnel traps will be installed throughout the impact area to compliment the pitfall traps. The specific locations to be determined by the project herpetologist and trap densities to be at least 20 traps/ ha. Each funnel trap would be half-filled with vegetation matter and baited with a lure (e.g., soft fruit or

protein-based lure). The locations of all funnel traps would be recorded on a GPS and traps would be inspected at least every 24 hours (likely twice per day) for the duration of the pre-works salvage operation.

4.5.1.4 Artificial cover objects (ACOs)

Artificial cover objects (ACOs) are a standard (best practice) tool for detecting, surveying, capturing, and monitoring lizards in New Zealand (Lettink & Cree 2007; Wilson *et al.* 2007; Lettink *et al.* 2011; Lettink 2012; Lettink & Hare 2016).

The ACOs used will constitute single- or double-layered, 400 mm x 475 mm corrugated *Onduline* sheets. *Onduline* is a bituminous corrugated roofing material that has heat retention properties, providing refuge and thermoregulatory benefits for lizards (Figure 4.3).

ACOs require a period of settlement following installation to allow any scent to equalise, and lizards to find and become familiar with the devices (Lettink 2012). Accordingly, ACOs would be installed in the field at least one month prior to being inspected for lizards. ACOs will then be repeatedly inspected, and all lizards found beneath captured. To assist in the capture of lizards, a portable plastic or metal shroud will be used to enclose the ACOS and prevent lizards from escaping during inspections.

Lizard use of ACOs is dependent on environmental factors such as proximity to dense, complex vegetation and weather conditions, as well as disturbance frequencies (Lettink *et al*. 2011). These factors will be taken into consideration during the placement and inspections of ACOs, to increase lizard detection probability.

Arrays of ACOs will be installed throughout the impact area; the specific locations to be determined by the project herpetologist and densities to be approximately 20–60 ACOs/ ha. The locations of all ACO would be recorded on a GPS and ACOs would be inspected at least every 24 hours (likely twice per day) for the duration of the pre-works salvage operation.

4.5.1.5 Systematic searches

Systematic searches are a commonly used method for herpetofauna surveys (Hare 2012c) and are frequently used during salvage operations to find and capture lizards. Diurnal systematic searches will be carried out across all impact areas.

Diurnal visual and hand searches will be carried out by the lizard salvage team who will move through the landscape searching for active sun-basking lizards and searching habitat features (e.g., lifting rocks and debris and searching crevices) to reveal refuging lizards (Figure 4.3). Accessible areas of dense vegetation such as fern clumps or vegetation overhanging rocky outcrops will be physically searched for lizards by lifting, moving aside, or removing foliage. Salvage effort per mining area will range between 120–180 person-hours per hectare over a period of 40–60 salvage days per season. In addition to systematic searches, opportunistic searches[3] will be carried during all salvage activities in the impact areas.

If deemed necessary, nighttime systematic searches will be undertaken to focus capture efforts on nocturnal kōrero geckos on rock outcrops. This method has not been trialled during previous lizard

[3] Opportunistic searches are considered 'non-dedicated searches' that will be undertaken while walking between sites or during other activities in the impact area. Effort associated with opportunistic searches will not necessarily be recorded/ quantified.

salvages at Macraes. Human health and safety will govern whether this method is used during the MP4 salvage operation.

4.5.2 Lizard management

4.5.2.1 Lizard capture, handling, and storage

Lizards will be captured and handled under the supervision of the project herpetologist.

A sheltered, temporary lizard processing station will be established near the salvage site, and all lizards captured during the salvage will initially be transferred to the station for temporary holding. Information on the lizards such as species, age class, sex, and capture method (e.g., pitfall trap, hand capture) will be recorded at the station, before lizards are placed into ventilated plastic storage bins (e.g., Sterilite Box 51L), furnished with vegetation and a water dish, until the dedicated 'lizard transfer' team can transport them to the relocation site. No more than 50 lizards will be placed into each storage bin.

The relocation programme does not include provisions for longer term (> 24 hr) captive holding of lizards. The reasons being that captivity can lead to stress, injury or mortality, and captive holding is resource intensive, which can divert resources away from other activities. Instead, lizards will be transferred and released daily, by a dedicated 'lizard transfer' team. Under exceptional circumstances when weather conditions are deemed too unsuitable for lizards to be released (temperatures low enough to compromise lizard activity and movement, e.g., < 10°C) lizards may be held in containment boxes for up to 24 hrs before release.

4.5.2.2 Inadvertent lizard injury or death

Killing of wildlife is not directly intended but is an unavoidable and foreseeable consequence. The following steps will be implemented when an injured or deceased lizard(s) is found during the salvage:

- The project herpetologist will record, for each species, the number of injured and deceased lizards encountered throughout the salvage and will report these figures to DOC at the conclusion of the salvage operation.
- Any injured 'Not Threatened' and 'At Risk' lizard assessed as having severe life-threatening injuries, will immediately be humanely euthanised. The DOC will need to agree to the method of euthanasia prior to commencement of the salvage operation.
- Any injury or death of a 'Threatened' lizard species will be reported to DOC within 24 hours (preferably immediately) of the observation.
- All injured 'Threatened' species will be taken to a suitably qualified veterinarian as soon as possible, or if deemed appropriate by DOC, sent to the Dunedin Wildlife Hospital for treatment and care. Injured lizards will be kept in an appropriate portable enclosure (a well-ventilated plastic container with substrate) under the direction of the project herpetologist to ensure the animal is handled appropriately until the lizard can be assessed and treated by a veterinarian.
- Any 'Threatened' lizard assessed by a veterinarian as uninjured, or otherwise in suitable condition for release, will be transported to the relocation site in the portable enclosure and released.

- If any lizard is injured or killed, appropriate measures will be developed and undertaken to minimise further injuries or deaths as the salvage progresses. Measures include but are not limited to adjusting the salvage strategy, ensuring additional support personnel are present to assist with the salvage, and conversing with or replacing machine operators.
- All deceased lizards will be retained and stored in the freezer. The bodies will be passed to mana whenua for ceremonial burial at a location of their choice.

4.5.3 Data recording

During all parts of the salvage, environmental and lizard catch data will be accurately recorded, and will include:

- Standard weather variables such as temperature, cloud cover, wind speed and direction, humidity, rainfall, etc.
- The number of lizards for each species caught using each salvage technique;
- The effort employed per day (e.g., number of trap nights or systematic search effort);
- The number of missed individuals and number of individuals found dead or injured.

4.6 Habitat degradation and lizard capture

Site preparation for mining activities involves the stripping of vegetation and topsoil and removal of unstable rocky areas to create a uniform and structurally stable surface for excavation or deposition of waste rock. It is during this pre-mining process that the project herpetologist and salvage team will work directly with machine operator(s) to progressively dismantle habitat features and clear vegetation to facilitate the capture of lizards.

Lizard salvage undertaken during vegetation clearance and habitat dismantling does not necessarily represent a distinct, sequential phase following pre-works management. Habitat simplification, including the staged removal of complex vegetation, may be implemented at any stage of the salvage process to improve lizard detectability and capture success.

The timing, location, and extent of machine-assisted vegetation clearance and habitat dismantling will be determined at the discretion of the Project Herpetologist, based on observed site conditions and salvage outcomes. Dedicated capture efforts using live traps and intensive hand-searching will continue to be undertaken during vegetation stripping and progressive habitat degradation.

4.6.1 Physical vegetation and habitat removal methodology

Effective lizard recovery during vegetation and habitat removal requires close coordination between the project herpetologist, salvage team, and machine operators. Prior to commencing works, the project herpetologist and machine operators will review and agree on the vegetation clearance methodology, communication protocols, and operational procedures to maximise lizard capture success while maintaining appropriate health and safety standards.

In areas supporting dense vegetation or rock outcrops clearance will be undertaken progressively using an excavator fitted with a toothed bucket, root-rake, or grapple attachment under the direction of the project herpetologist and/or salvage team. Lizards will either be captured by hand as vegetation is removed or captured immediately following vegetation stripping. Any pitfall or Gee's Minnow funnel traps and ACOs will remain operational during vegetation stripping and may continue to capture lizards displaced by the advancing clearance front. Lizards will be removed from traps and from beneath ACOs regularly, and the traps and ACOs themselves will be removed ahead of the clearance front as they are encountered.

Where rocky habitats, debris, or other features cannot be searched safely by hand, a dedicated excavator will be used to carefully lift, separate, or dismantle habitat features to expose lizards for capture. Wherever practicable, a grapple attachment will be used to enable precise handling of rocks and other materials while minimising crushing, scraping, or shearing forces that could injure lizards. In some situations, a toothed bucket may be required to move or roll larger habitat features (Figure 4.4).

Vegetation clearance and salvage activities will generally progress from the interior of the impact area (i.e., closest to existing mining infrastructure) toward the outer boundary adjoining unaffected habitat. This approach may encourage some lizards to move away from disturbance and disperse naturally into adjacent habitat beyond the impact footprint.

Where practicable, complex habitat features such as large tussock clumps will be carefully removed and relocated to nearby unaffected habitat. Relocated vegetation will be placed adjacent to similar habitat to provide opportunities for any undetected lizards to disperse naturally. This precautionary measure is intended to maximise lizard protection and reduce the likelihood of individuals being inadvertently harmed during vegetation clearance.

4.6.1.1 Camp and Coal Creek reservoirs

The Camp and Coal Creek reservoir footprints present a unique lizard management challenge because impacts will occur progressively during dam construction and the subsequent inundation of the valleys. Accordingly, lizard salvage activities will be undertaken both prior to and during dam construction, as well as during the gradual filling of the reservoirs as water levels rise.

Lizard salvage methods described elsewhere in this LMMP will be implemented throughout the reservoir footprints. Prior to inundation, salvage effort will focus on the valley floors, where vegetation clearance is proposed to reduce the amount of vegetative material entering the reservoirs. Where vegetation is not scheduled for removal but is identified by the project herpetologist as providing complex lizard habitat, additional habitat dismantling and destructive search techniques may be employed to maximise lizard recovery. This approach will also apply to rock outcrops and other rocky habitats within the reservoir footprints. Although many of these features will remain in place during dam construction, they will ultimately be inundated and therefore, represent permanent habitat loss. Furthermore, destructive searches are often necessary to effectively recover cryptic species, particularly kōrero geckos, which are frequently difficult to detect and capture using conventional survey methods alone.

Given the extended period over which the reservoirs are expected to fill (approximately 2–3 years), lizard salvage will be undertaken in a staged manner. Effort will initially focus on lower-elevation areas that will be inundated first, before progressively moving upslope as water levels rise. This approach ensures that

areas facing the most immediate risk of inundation are prioritised, while allowing salvage effort to remain aligned with the timing of habitat loss. Monitoring of reservoir filling and inundation levels will be used to inform the timing and location of salvage activities throughout this period.

Figure 4.3. Lizard capture techniques to be used during salvage operations. Upper left and right: *Onduline* Artificial Cover Objects (ACOs); central left, right, and lower left: pitfall traps; lower left: crevice searches ("winkling").

Figure 4.4. Lizard capture techniques to be used during salvage operations continued. Upper left, right, lower left, right: machine-assisted dismantling of a rock outcrops under supervision of herpetologists.

5 Lizard relocation management

Lizard relocation management is concerned with the management of lizards at the relocation site, delivery of habitat enhancement measures (e.g., mammalian predator control), and lizard monitoring to validate anticipated mitigation outcomes.

5.1 Lizards release strategy

A direct wild-to-wild release of lizards is proposed for MP4. Lizards will be 'hard released' (*versus* penned) into habitats suitable for each species (e.g., kōrero released into rocky habitats, southern grass skink released into damper grassland/ tussock habitats). Lizards salvaged as groups (e.g., kōrero gecko communities or family groups) will be released together into the same area to preserve group structure. Relocated lizards will be dispersed evenly across the 280 ha release site to reduce the risk of 'overstocking' specific areas of the recipient site.

Lizards will not be marked because no post-relocation monitoring is proposed, except for the monitoring associated with rock pile construction (see section 4.5.1). Relocated kōrero geckos that are to be released into the constructed rock piles will be photographed for subsequent identification during monitoring. Photographs will include a mixture of dorsal, lateral, and ventral images to characterise the individual for subsequent re-identification if recaptured.

5.2 Contingency relocation site

The proposed Murphys Link relocation site comprises approximately 395 ha of high-quality lizard habitat and is considered capable of accommodating all lizards salvaged from the MP4 Project areas. The site supports existing populations of the target species, contains extensive suitable habitat, and benefits from planned management actions, including stock exclusion, habitat protection, and mammalian predator control, which are expected to increase carrying capacity over time.

In addition, the relocation site is connected to larger areas of protected habitat with high lizard values, providing opportunities for natural dispersal and population expansion. Given the size, habitat quality, anticipated population response to management, and landscape connectivity of the site, it is considered to have sufficient capacity to receive all relocated lizards. Accordingly, no additional contingency or "spillover" relocation site is proposed.

5.3 Relocation site management

5.3.1 Protection fencing and habitat management

To protect and enhance habitat values within the lizard release area, the site will be fenced to exclude livestock and feral pigs. Grazing and rooting by these animals can degrade lizard habitat through the removal of indigenous vegetation, trampling of refuge sites, soil disturbance, and reduced habitat complexity. Excluding stock and pigs will allow tussock grassland, shrubland, and associated ground cover to recover and develop naturally, improving habitat quality for resident and relocated lizards.

Details of the proposed fencing and vegetation protection measures are outlined in the Residual Effects Terrestrial Restoration Plan (Bioresearches 2026n) and Pest Management Plan (Alliance Ecology 2026).

5.3.2 Mammalian predator control

Mammalian predators, including rodents, mustelids, hedgehogs, possums, and cats, pose a significant threat to indigenous lizards through direct predation and, in some cases, competition for food resources. Predator control is, therefore, a key component of lizard conservation and is particularly important at relocation sites, where reducing predation pressure can improve survival, recruitment, and long-term population persistence.

An intensive mammalian predator control programme will be established within the Murphys Link lizard relocation area to provide ongoing benefits for both resident and relocated lizard populations by suppressing exotic mammals. The programme will target a range of pest mammal species (rodents, mustelids, possums, hedgehogs, feral cats, rabbits, ungulates) using network of traps and bait stations deployed on a 100 m × 100 m grid. Additional control devices will be strategically placed along habitat corridors and site boundaries to minimise reinvasion by highly mobile predators such as mustelids and feral cats.

Predator control will be maintained for a minimum period of ten years to align with 7–8 years of lizard relocations and two years following the last relocation, with regular monitoring undertaken to assess programme effectiveness and measure changes in pest abundance. In addition to anticipated benefits for

lizards, the programme is expected to provide broader ecological gains through reduced predation pressure on other indigenous fauna and improved ecosystem condition.

The predator control programme will be implemented in accordance with the Pest Management Plan prepared by Alliance Ecology (2026), which incorporates industry best-practice methodologies for pest mammal management. Prior to implementation, the programme will be reviewed by OGNZL, the project herpetologist, mana whenua, and the Department of Conservation to ensure it is appropriately designed to achieve meaningful conservation outcomes for lizards. Programme performance and monitoring results will be reviewed annually, and an adaptive management approach will be applied where necessary to ensure predator populations are maintained at levels that support lizard population recovery and persistence.

5.4 Rock pile construction

The artificial construction of refugia using rocks, aggregate, or rubble has been successfully used to create supplementary habitat for reptiles internationally, including in Australia and the United Kingdom (Showler *et al.* 2005; Croak *et al*. 2010, 2013). More recently, similar approaches have been trialled in New Zealand (Lennon 2019; Herbert 2020; Rufaut 2020; Lennon *et al*. 2021; Herbert *et al*. 2023). Research has demonstrated that rock habitats provide important refuges for indigenous lizards by offering shelter from predators, suitable thermoregulatory environments, and protection from environmental extremes (Towns 1996; Lennon 2019; Herbert 2020). The network of interstitial spaces created within rock piles can exclude larger mammalian predators while providing secure microhabitats for lizards to forage, bask, shelter, and breed (Vitt *et al.* 1998; Santos *et al.* 2008; Lennon 2019). Consequently, the creation of supplementary rock habitat has the potential to increase habitat availability and, ultimately, support higher local lizard abundance.

A summary of recent New Zealand rock habitat creation projects that have informed the recommendations presented in this LMMP is provided in Appendix D.

At Macraes, rock habitat creation has previously been undertaken at Golden Bar Road, Camp Creek, the Deepdell South rehabilitation site, and Coronation North (Figure 5.1). A range of designs, including rock trenches, artificial tors, and rock piles, have been trialled to replicate habitat used by indigenous lizard species on OGNZL landholdings. While this technique is still largely experimental and monitoring results from these projects are either not available or still emerging, the early findings from the Coronation North research programme suggest that constructed rock habitats are readily occupied by lizards (Herbert *et al.* 2023).

Accordingly, while acknowledging the experimental nature of constructed rock stacks, the recommendations presented below are based on the best available published information, observations from past Macraes restoration projects, and the professional judgement of the author (D. van Winkel).

5.4.1 Quantum of rock

The MP4 Project will affect 64 rock outcrops, comprising 47 outcrops within the impact footprint and a further 17 within the 20 m buffer (rock outcrops in the 20 m are unlikely to be directly affected but assumed to be lost). Collectively, these features occupy approximately 0.26 ha of rock habitat.

To compensate for the loss of rock habitat, replacement habitat will be created within the Murphys Link relocation site at a ratio of approximately 1.2:1 based on rock surface area. This will involve the construction of 62 rock piles, each measuring approximately 10 m long × 5 m wide × 1.5 m high (50 m² footprint area; 75 m³ volume).

Constructed rock piles are intended to replicate the key ecological functions provided by natural rock outcrops, including opportunities for thermoregulation, refuge from predators, and access to food resources (Vitt *et al.* 1998; Santos *et al*. 2008). To maximise habitat value, rock piles will be designed to incorporate a range of rock sizes and configurations, creating diverse thermal environments and a variety of interstitial space sizes. This structural complexity is expected to provide suitable refuges for different lizard species, life stages, and breeding requirements (Lennon 2023).

The habitat value of the rock piles will be further enhanced through the establishment of indigenous vegetation around and between structures. In particular, divaricating shrubs such as *Muehlenbeckia* and *Coprosma* species are expected to increase habitat complexity, provide shelter and foraging opportunities, and improve the overall suitability of the constructed habitat for lizards (Herbert 2020).

5.4.2 Rock pile design specifications

The following methods are recommended for the construction of 62 rock piles in Murphys Link.

5.4.2.1 Rock selection

- A variety of rock sizes and shapes will be used, including large schist base rocks (500–1,500 mm), boulders (300–500 mm), and smaller waste rocks/ cobbles (70–300 mm). Rock will be sourced from a combination of rock outcrops removed from the MP4 impact areas and suitable rock type (schist) and suitably graded rock sourced from other areas of the mine operation.
- Schist rock slabs to be stacked with 10–30 mm openings facing north.

5.4.2.2 Location and orientation

- Rock piles will be created in sunny areas with well-draining soil.
- Rock piles will be orientated to the face north to capitalise on maximum sunshine hours.

5.4.2.3 Stack structure

- At each rock pile location, rocks will be placed on top of existing exotic grasses in areas avoiding native vegetation such as tussock or shrubs. Existing exotic vegetation will not be stripped back to soil. This is because as grasses decay, they leave small interstitial spaces beneath the rocks, available to become occupied by lizards and their invertebrate prey. The Project herpetologist will advise on the appropriate location of each pile and ensure no lizard habitat is affected by the rock pile construction.
- The layout of each pile will be broadly linear (Figure 5.2).
- Rocks will be stacked either in a gradient with larger schist base rocks placed at the south end and progressively smaller grade rocks placed towards the north, or as mixed size grades, creating more of a rock jumble. It is important to ensure there are plenty of gaps and crevices, to provide refuge

spots and thermoregulatory gradients for lizards. Ultimately allowing lizards to choose the most appropriate rock and crevice sizes to use.

- The placement of the rocks does not need to be precise and can be carefully achieved using a machine (excavator). Where available, schist rock slabs will be stacked on top of the large schist rocks using machinery, with 10–30 mm openings between slabs. The openings of the schist slabs should face north.
- Topsoil will be placed over smaller discrete areas of each rock pile to accommodate plantings and fragment the exposed rocky surfaces (Figure 5.2). Topsoil will not be placed over the entire rock pile.
- Rock stacks located on sloping ground will have an earth berm installed on south side of the stacks. The purpose of the earth berm is to 'insulate' the rock pile, effectively artificially recreating shoulder rock outcrops (Rufaut 2020).
- Finally, the small topsoil piles (and earth berm if present) will be planted with native plants (Figure 5.2).

5.4.2.4 Vegetation

- Native vegetation will be planted around the perimeter of the rock stacks to provide additional cover and food sources for lizards. Planting also assists with integrating the stacks into the natural surrounding environment.
- A variety of low growing divaricating vines will be planted to ensure the rock piles do not get shaded out as the plants mature. Plant species will include but not be limited to vines (*Muehlenbeckia complexa; M. australis; Rubus schimelioides* var. *subpauperatus*), shrubs (*Discaria toumatou*; *Coprosma crassifolia*; *Carmichaelia petriei*), and tussock grasses (*Chionochloa rigida; Poa colensoi*; *Festuca novae-zelandiae*).

It is acknowledged that the constructed rock stacks will favour saxicolous (rock loving) lizards such as *Woodworthia* "Otago/ Southland large" and *O. maccanni*, over *O. chionochloescens*, which prefers damper grassland environments. However, the plantings surrounding the rock stacks, especially the planting around the toe of the piles will offer suitable habitat for this species once established.

Figure 5.1. Examples of rock tors, rock stacks, and other rock features favoured by Macraes lizard species. Upper left: natural Otago rock tor; upper centre: created rock stack at Deepdell South, Macraes; upper right: stacked schist rock slabs; lower left: created rock tor at Camp Creek, Macraes; lower centre: created rock pile at Coronation, Macraes; and lower right: cobble sized rocks (70-300 mm) in pile.

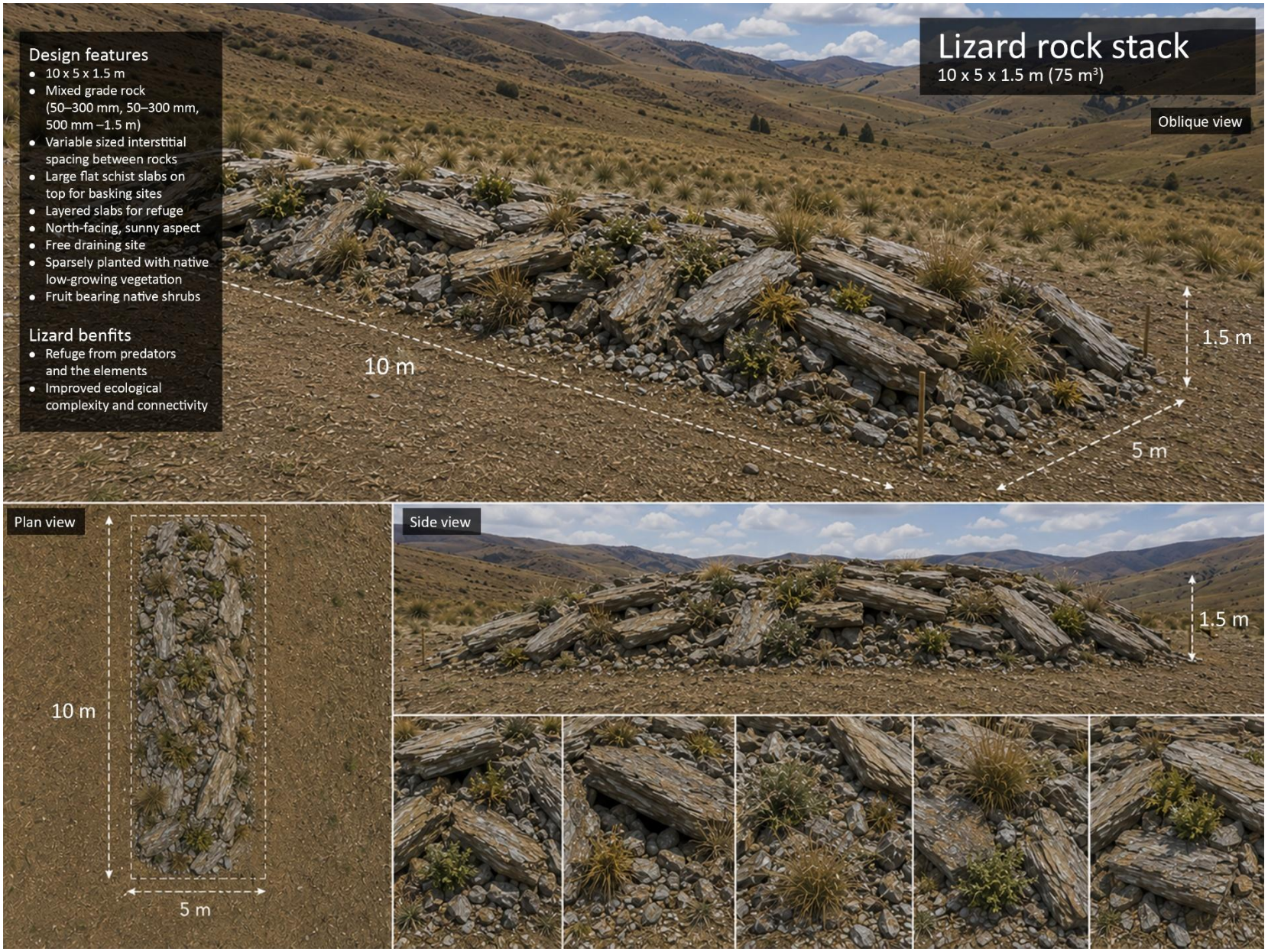


Figure 5.2. Concept design for constructed rock stacks to be installed in Murphys Link.

5.5 Lizard monitoring

Lizard monitoring will be undertaken to evaluate the effectiveness of both mitigation and residual effects management measures implemented under the MP4 Project. These comprise two distinct monitoring programmes, each with separate objectives.

1. **Constructed rock pile monitoring** – to assess the success of the rock piles and associated habitat enhancement measures established within Murphys Link to replace rock habitat lost from the MP4 impact footprint. Monitoring will focus on the condition and development of the constructed habitat, including vegetation establishment and survival, as well as the occupancy and use of the rock piles by lizards over time.

2. **Net positive outcome monitoring** – to assess the response of lizard populations within the mammalian predator exclusion fence in the MEEA and demonstrate achievement of the Project's net positive outcome objectives. Specifically, monitoring will seek to determine whether lizard densities increase by at least twofold relative to baseline conditions following predator exclusion and associated habitat management. The Otago skink population enclosed within the fence will also be monitored to demonstrate the additional benefits outlined in the Residual Effects Analysis Report: Terrestrial Ecology (document E14; Bioresearches 2026l).

Together, these monitoring programmes will provide information on the effectiveness of habitat replacement, predator management, and broader conservation measures implemented as part of the MP4 Project.

5.5.1 Constructed rock pile monitoring

5.5.1.1 Lizard monitoring devices

Sixty-two rock piles will be constructed within the tussock grassland and shrubland enhancement areas of Murphys Link as part of the MP4 Project. The rock piles and their immediate surroundings will be monitored for five years following construction to assess: (1) the timing of lizard occupancy, (2) the diversity of lizard species utilising the structures, and (3) temporal trends in lizard abundance.

Because the rock piles are newly created habitat features, the baseline condition is assumed to be zero occupancy. Any lizards detected within or immediately adjacent to the rock piles following construction will, therefore, represent colonisation of the habitat and evidence of successful uptake by lizards.

The monitoring methodology is based on that used by Herbert *et al.* (2023), with refinements informed by the findings of that study and the author's experience undertaking lizard monitoring on OGNZL landholdings over the past five years. This approach provides a robust and repeatable method for assessing the effectiveness of the constructed habitats.

Sixteen (approximately 25%) of the 62 rock piles will be selected for monitoring. Each monitored rock pile will contain four pitfall traps: two installed within the rock pile itself and two positioned around its perimeter, representing a total of 64 pitfall traps across the rock stack monitoring. programme. Traps will

be installed immediately following construction and their locations recorded using GPS to ensure consistent long-term monitoring.

Pitfall traps will consist of 300 mm lengths of 200 mm diameter PVC culvert pipe fitted with a permanently attached base cap (Figure 5.3). Drainage holes will be drilled into the base and lower sides of each trap to prevent water accumulation. Traps will be installed so that the opening is flush with, or slightly below, the surrounding ground or rock surface. A removable cap will be fitted to the top of each trap between sampling sessions and painted a bright colour to facilitate relocation during monitoring.

This PVC design has been selected in preference to traditional 4 L plastic pitfall buckets because it is more durable in rocky environments and less susceptible to deformation from overlying rocks. Previous lizard salvages and monitoring projects at Macraes have demonstrated that lizards escape from standard 4L plastic buckets (Bioresearches 2026r), and thus the new design, deeper PVC pitfall traps will substantially reduce this risk of escape and improve capture rates.

Pitfall traps will remain permanently installed but will be sealed between sampling sessions. This approach prevents the traps from functioning as artificial refuges and influencing lizard distribution or abundance around the monitoring sites. Traps filled with rocks or vegetation between sampling sessions can become occupied by resident lizards, potentially introducing bias into long-term abundance monitoring. Permanently installed, sealed traps also reduce disturbance associated with repeated trap installation and minimise neophobic responses by lizards, thereby improving detection rates when monitoring is undertaken (Hare 2012a).

Figure 5.3. PVC pitfall trap, designed to provide a more robust, long-lasting, and lizard escape-proof trap for monitoring constructed rock stacks.

5.5.1.2 Lizard sampling

Sampling will be undertaken annually, with the first monitoring session occurring during the first summer season following rock pile construction.

Each monitoring session will extend over seven days. On the first day, pitfall traps will be opened by removing the lids, clearing any accumulated debris, retaining a small amount of soil and fine rock material in the base, and baiting each trap with an appropriate attractant (e.g., canned pears or other sweet lure). Traps will then be checked daily for six consecutive days. If unsuitable weather conditions occur during a sampling session (e.g., daytime maximum temperatures below 10°C or periods of heavy rainfall), traps will be temporarily closed and reopened once conditions become suitable. The monitoring session will then continue until the full six trap-checking days have been completed.

In addition to pitfall trapping, all lizards observed on, within, or immediately adjacent to each monitored rock pile during trap inspections will be recorded. These observations will provide supplementary information on species presence, habitat use, and relative abundance.

Captured lizards will be identified to species, measured (snout–vent length and vent–tail length), sexed where possible, and temporarily marked using a non-toxic, xylene-free paint pen. Marks will be applied in unique combinations and locations each day to generate short-term capture-mark-recapture histories within individual sampling sessions. Following processing, lizards will be released within 0.5 m of their capture location.

Environmental variables likely to influence lizard detectability and activity, including air temperature, relative humidity, cloud cover, wind conditions, and habitat characteristics, will also be recorded during each sampling session. These data will be used as covariates during analysis to account for variation in lizard activity and detection probability among surveys.

5.5.1.3 Data analyses

Abundance within monitored rock piles will be estimated using models designed for repeated counts of imperfectly detected animals. Annual abundance estimates for each species will primarily be generated using closed-population N-mixture models (Royle 2004), which account for imperfect detection while estimating true abundance. Where sufficient data are available, open-population extensions of the N-mixture framework (e.g., Dail & Madsen 2011) may be used to assess population trends across years by incorporating recruitment, survival, and population change. Alternatively, annual abundance estimates derived from separate closed-population models may be compared through time to evaluate trends in occupancy and abundance.

Environmental covariates known to influence lizard activity and detectability, such as temperature, relative humidity, wind speed, cloud cover, and habitat characteristics, will be incorporated into modelling where appropriate to account for variation in detection probability among surveys.

Capture-mark-recapture (CMR) analyses will also be undertaken using within-session capture histories to generate independent estimates of abundance and to validate the assumptions and outputs of the N-mixture models. These data will be particularly useful for assessing whether annual sampling periods meet the assumption of population closure.

All statistical analyses will be undertaken by suitably qualified biostatisticians, with interpretation of results provided jointly by the biostatistician and project herpetologist.

5.5.1.4 Rock pile condition and plant survival monitoring

Constructed rock piles and associated planted vegetation will be monitored annually to assess their condition, development, and suitability as lizard habitat. Monitoring will evaluate the structural integrity and stability of the rock piles, evidence of erosion or disturbance, and the establishment, survival, and health of planted vegetation. These measures will provide an indication of habitat development, including the availability of refuge, shelter, and foraging resources for lizards. Monitoring results will be used to identify any maintenance requirements and inform adaptive management to ensure the long-term effectiveness of the habitat enhancement measures and their continued suitability for lizard occupancy.

5.5.2 Monitoring the benefits of predator exclusion within the MEEA fence

Introduced mammalian predators, particularly rodents, hedgehogs, mustelids, and cats, are widely recognised as a primary driver of lizard population declines in New Zealand. Although quantitative assessments of lizard population responses to predator removal remain relatively limited, available studies consistently demonstrate positive responses following predator control, particularly within mammal exclusion fences where predator populations are reduced to near-zero levels (Reardon *et al.* 2012; Romijn 2013; Norbury *et al.* 2022).

As part of the MP4 Project compensation package, a 252 ha mammal exclusion fence will be established within the MEEA and all mammalian predators eradicated from within the fenced area. This is expected to result in increased lizard survival, recruitment, and population growth through the removal of predation pressure and improved breeding success. The fenced area supports all three lizard species affected by the MP4 Project and is therefore, anticipated to provide substantial conservation benefits for these species. In addition, the fence will provide conservation benefits for a remnant population of 'Threatened' Otago skinks that will be enclosure within the predator-exclusion fence.

The MEEA fence will be constructed within 5 years of consent being issued, and it is estimated to take 18 months to 2 years to construct the fence. Pest eradication in the MEEA fence will be completed during the first winter after fence construction is completed, and maintenance of the fence will be funded by OGNZL until 2050. Post-2050 the MEEA—as well as Cranky Jims link and Mt Highlay compensation areas—will be transferred to a special purpose trust which will be funded by a closure capitalisation fund set up by OGNZL. At this stage the parties to the trust and its governance have not been confirmed.

5.5.2.1 Lizard population monitoring

Results from the Biodiversity Offset Accounting Model (BOAM) indicate that achieving a two-fold increase in skink density within the fenced area over a five-year period would deliver net positive outcomes for lizards and provide appropriate compensation for residual effects associated with the MP4 Project (see Residual Effects Analysis: Terrestrial Ecology report; Bioresearches 2026l). Although the BOAM assessment is based on skinks, it is anticipated that kōrero geckos and any other lizard species occurring within the fenced area will also benefit from predator exclusion and associated habitat management. This assumption is based on documented positive lizard population responses (including geckos) to pest

elimination within predator-exclusion fences (Turner and Norbury 2023; Trustees of the Central Otago Ecological Trust 2026).

To evaluate whether the compensation objectives are being achieved, baseline estimates of lizard abundance and density will be established prior to predator eradication, followed by ongoing monitoring to quantify population responses over time. Monitoring results will be considered alongside predator monitoring (see Alliance Ecology 2026) to assess the effectiveness of predator exclusion and determine whether the anticipated ecological benefits are being realised.

The following sections describe the monitoring methods that will be used to quantify lizard population responses both within and outside the MEEA fence and assess progress towards achieving the Project's net positive outcome objectives.

5.5.2.1.1 Monitoring design

Lizard abundance and density within and outside the MEEA fence will be estimated using a combination of N-mixture modelling and capture-mark-recapture (CMR) analyses. These approaches account for imperfect detection and provide robust estimates of population size and density through repeated sampling. Monitoring will be undertaken using a landscape-scale pitfall trapping programme designed to generate both repeated-count and CMR data.

Monitoring areas will include the 1) interior of the MEEA predator-exclusion fence (predator elimination), 2) an area outside the fence but within Murphys Link (higher intensity predator suppression and lizard relocation), and 3) an area outside the fence but within the 1 km MEEA buffer (lower intensity predator suppression) (Table 5.1) (see Alliance Ecology 2026 for predator control targets for each monitoring area). Paired monitoring within and outside the MEEA fence is important to understand relative changes in lizard density and population size over time.

Sampling locations will be selected using a stratified random design to ensure representative coverage of the major habitat types occurring within and outside the fenced area. To locate sampling locations, a 20 m × 20 m grid will be overlaid on aerial imagery, and grid cells will be randomly selected within each monitoring area to reflect sampling locations. The 20 x 20 m grid size was selected because it exceeds the estimated home range size of the target skink species (approximately 20 m^2; Patterson 1985), thereby reducing the likelihood of individual lizards being recorded at multiple sampling sites and helping to maintain spatial independence among sampling locations. Table 5.1 shows the number of sampling locations established for each of the monitoring areas. At each sampling location, clusters of three pitfall traps—each fitted with an *Onduline* ACO cover—spaced 5 m apart will be established. Each cluster will represent the sampling unit. Clusters of pitfall traps raise within-cluster recapture rates and improve the precision of each site's abundance estimate. The current design is expected to deliver > 90% statistical power[4] for determining expected measurable changes in lizard abundance at the sites (e.g., a 2-fold increase in lizard numbers within 5 years inside the MEEA fence).

[4] Assuming limited zero-inflation (i.e., nil captures remain are low and under approximately 10% in the per-year data). If zero inflation occurs (more zero values than standard probability distributions expect), the monitoring programme will be reviewed and adjusted (e.g., more monitoring sites added) to ensure adequate statistical power to detect trends in lizard abundance over subsequent years' monitoring.

Table 5.1. Lizard monitoring design for inside and outside the MEEA fence.

Monitoring location	No. of sampling locations	No. of pitfall traps
Inside the MEEA predator-exclusion fence	20	60
Inside Murphys Link (outside the fence)	15	45
Inside the 1 km MEEA buffer (outside the fence and outside Murphys Link)	15	45
Total	50	150

During monitoring sessions, traps will be activated on Day 1 by removing any accumulated debris, retaining a small amount of soil and fine rock material in the base, and baiting with a suitable lure (e.g., canned pear or other sweet attractant). Traps will then be checked daily for nine consecutive days thereafter. If unsuitable weather conditions occur during a sampling session (e.g., daytime maximum temperatures below 10°C or periods of heavy rainfall), traps will be temporarily closed and reopened once conditions improve, with monitoring continuing until the full nine trap-checking days have been completed.

Captured lizards will be identified, measured, sexed where possible, temporarily marked, and released at their point of capture to generate capture histories for CMR analyses. Environmental variables that may influence lizard activity and detectability, including temperature, relative humidity, cloud cover, wind conditions, and habitat characteristics, will also be recorded during each sampling session and incorporated into statistical analyses where appropriate.

5.5.2.1.2 Baseline monitoring

Baseline monitoring will be undertaken following construction of the MEEA fence but prior to commencement of predator eradication. For areas outside the MEEA fence, baseline monitoring will be carried out prior to implementation of predator control measures or lizard relocations. This monitoring will establish estimates of lizard abundance and density both within the proposed fenced area and in adjacent unfenced areas.

These data will provide the reference condition against which future population responses will be assessed. Estimates from within the fenced area will establish the baseline population densities from which increases associated with predator exclusion can be measured. Monitoring sites outside the fence will serve as reference areas, enabling comparison of population trajectories inside and outside the predator-free environment and helping to distinguish treatment effects from broader environmental variation.

5.5.2.1.3 Annual monitoring

Following fence construction and predator eradication, monitoring will be undertaken annually to quantify changes in lizard abundance and density within and outside the fenced area. Surveys will be conducted at approximately the same time each year, likely during late summer (February–March), to minimise seasonal variation in lizard activity and maximise comparability among years.

Monitoring inside and outside the fence will be undertaken concurrently wherever practicable to ensure that survey conditions are comparable and to reduce potential bias arising from temporal differences in weather, habitat conditions, or lizard activity. The resulting data will be used to estimate annual

abundance and density, assess population trends through time, and evaluate progress towards achieving the Project's net positive outcome objective of a two-fold increase in skink density within the MEEA fence. Annual monitoring will continue for a minimum of five years—the timeframe within which the two-fold increase in lizards is expected to occur—but will continue until the desired objective has been demonstrated.

5.5.2.1.4 Data analyses

Annual density estimates for each lizard species inside and outside the MEEA fence will be generated using models designed for repeated counts of imperfectly detected animals. Closed-population N-mixture models (Royle 2004) will be used to estimate abundance and density during individual monitoring years, while population trends through time will be assessed using open-population extensions of the N-mixture framework (Dail & Madsen 2011), where data permit. If an open-population approach is not appropriate, annual density estimates derived from separate closed-population models will be compared to evaluate temporal trends and population responses to predator exclusion.

Environmental covariates that may influence lizard activity or detectability, such as temperature, relative humidity, cloud cover, wind conditions, and habitat characteristics, will be incorporated into the modelling where appropriate. This will help account for variation in detection probability among surveys and improve the accuracy of abundance and density estimates.

Capture-mark-recapture (CMR) analyses will also be undertaken using capture history data collected during each monitoring session. These analyses will provide independent estimates of abundance and density for comparison with N-mixture model outputs and will assist in assessing whether the assumption of population closure is reasonable during individual annual sampling periods.

Further details of the proposed data modelling and statistical analyses are provided in Appendix C. All analyses will be undertaken by suitably qualified biostatisticians, with interpretation of results provided jointly by the biostatistician and project herpetologist.

5.5.2.2 Otago skink monitoring

Although not necessary to demonstrate net positive outcomes for the MP4 Project, monitoring of the Otago skink population within the MEEA fence will be undertaken to quantify the additional gains expected as a result of the predator-exclusion fence for this 'Threatened' species.

Monitoring will use one or more of the following recognised methods for monitoring Otago skinks:

a) Standardised rock-scanning along designated monitoring transects (as per Roughton 2005).

b) Multi-session, non-invasive photo–resight methodology, accounting for variable detection probabilities and resight heterogeneity (as per Reardon *et al*. 2012).

c) eDNA pipes, consisting of pear-baited alkathene pipes equipped with Dacron filters for eDNA capture, can effectively monitor occupancy and dispersal (as per Reeves *et al.* 2025).

Lizards will not be captured, handled, or marked as part of the monitoring as the methods do not require this.

Monitoring will be undertaken annually, during periods of suitable weather conditions. Environmental variables that may influence lizard activity and detectability, including temperature, relative humidity, cloud cover, wind conditions, and habitat characteristics, will also be recorded during each sampling session and incorporated into statistical analyses where appropriate.

Statistical analyses will be undertaken in accordance with methods associated with each of the respective monitoring method, depending on which method(s) is used. Analyses will be undertaken in consultation with suitably qualified biostatisticians, with interpretation of results provided jointly by the biostatistician and project herpetologist.

5.5.3 Monitoring the benefits of pine removal for lizard populations at Mt Highlay Station

An averted loss approach, aimed at securing existing lizard habitats under threat from afforestation, is proposed for the Mt Highlay Station site. In 2023, approximately 265 ha of land was planted in pine trees with trees currently reaching around 1 m in exposed areas and up to 1.2–1.4 m in more sheltered locations with favourable soils (Forbes 2025). Preliminary surveys of the site have confirmed the presence of three lizard species—McCann's skink, southern grass skink, and kōrero gecko—as well as extensive areas of suitable lizard habitat (e.g., extensive grassland and numerous large schist rock outcrops).

Under the current land management regime, the plantation is expected to develop into a closed-canopy forest over a 16–25 year period, significantly reducing the number of lizards beneath the dense canopy, as has been previously demonstrated (Ahika 2021). To avert this loss, all planted trees will be removed and the area protected in perpetuity, allowing existing lizard populations and their habitats to persist over time, with an assumption that lizard population size and habitat extent will remain static over a 25 year period[5].

[5] This represents a conservative assumption, as it does not account for potential increases in lizard abundance over time associated with the natural regeneration of dryland vegetation, which is expected to enhance habitat complexity and suitability for lizards.

5.5.3.1.1 Monitoring design

Monitoring these outcomes will involve an initial baseline survey to describe the existing state of the lizard population and habitat availability across the 265 ha area, followed by repeated 5-yearly monitoring over a period of 25 years to describe any changes in lizard populations and habitat extent and suitability.

The baseline survey and monitoring design will follow the methods described for the lizard population monitoring within and outside the MEEA fence (see section 4.5.2), involving 15 sampling locations, each with a cluster of three pitfall traps (i.e., total of 45 pitfall traps) designed to generate both repeated-count and CMR data. In addition, kōrero gecko occupancy and relative abundance will be monitored using double layer *Onduline* ACOs placed on or adjacent to rock outcrops and repeatedly inspected over each monitoring session.

5.5.3.1.1 Data analyses

Density estimates for each lizard species will be generated using models designed for repeated counts of imperfectly detected animals. Closed-population N-mixture models (Royle 2004) will be used to estimate abundance and density, while population trends through time will be assessed using open-population extensions of the N-mixture framework (Dail & Madsen 2011), where data permit. If an open-population approach is not appropriate, annual density estimates derived from separate closed-population models will be compared to evaluate temporal trends.

Environmental covariates that may influence lizard activity or detectability, such as temperature, relative humidity, cloud cover, wind conditions, and habitat characteristics, will be incorporated into the modelling where appropriate. This will help account for variation in detection probability among surveys and improve the accuracy of abundance and density estimates.

Capture-mark-recapture (CMR) analyses will also be undertaken using capture history data collected during each monitoring session. These analyses will provide independent estimates of abundance and density for comparison with N-mixture model outputs and will assist in assessing whether the assumption of population closure is reasonable during individual annual sampling periods.

Further details of the proposed statistical analyses are provided in Appendix C. All analyses will be undertaken by suitably qualified biostatisticians, with interpretation of results provided jointly by the biostatistician and project herpetologist.

5.5.4 Adaptive management

Monitoring results will be used to evaluate the effectiveness of the compensation measures in achieving their intended outcomes for lizards. An adaptive management approach will be applied to ensure that management actions can be refined where monitoring indicates objectives are not being achieved.

5.5.4.1 Constructed rock piles

Lizard monitoring and habitat condition data will be reviewed following each annual monitoring event and assessed against the monitoring objectives, namely: 1) the timing of lizard occupancy, 2) the diversity of lizard species utilising the rock piles, and 3) temporal trends in lizard abundance.

If monitoring indicates that the rock piles are not functioning as intended, OGNZL will investigate potential causes and consider appropriate remedial actions. Should lizard occupancy not be detected within monitored rock piles by Yr 3, OGNZL will consult with the DOC regarding potential improvements to rock pile design, configuration, placement, vegetation enhancement, or other habitat management measures aimed at increasing suitability for lizards.

5.5.4.2 Monitoring lizard population response inside the MEEA fence

An adaptive management framework will also be applied to the predator exclusion fence and associated lizard enhancement area. Results from lizard monitoring undertaken under this LMMP will be considered alongside predator monitoring data collected by Alliance Ecology (2026) to evaluate whether predator exclusion is delivering the anticipated benefits for lizard populations.

If monitoring does not demonstrate a positive lizard population response within three years of predator eradication, the underlying causes will be investigated and management actions reviewed. Consideration will be given to predator monitoring results, habitat condition, vegetation management, and other factors that may be limiting population growth or recruitment.

Potential management responses may include modifications to predator control programmes, additional habitat enhancement, supplementary lizard releases, changes to vegetation management, or other measures identified through consultation with DOC, mana whenua, the project herpetologist, and other relevant experts. This adaptive management process will ensure that management actions can be refined over time to maximise conservation outcomes and support achievement of the Project's net positive lizard objectives.

5.5.4.3 4.5.3 Monitoring the benefits of pine removal for lizard populations at Mt Highlay Station

If monitoring demonstrates a decline in lizard parameters (density or population size) after at the Yr 5 monitoring, or any of the 5-yearly monitoring events thereafter, the underlying causes will be investigated and management actions reviewed. Consideration will be given to the potential impacts of mammalian predators—noting that predator-control for lizards will not be implemented at Mt Highlay—, habitat quality, and any other factors that may be causing population declines.

Potential management responses may include habitat management measures (e.g., weed control), potentially targeted predator control, or other measures identified through consultation with DOC, mana whenua, the project herpetologist, and other relevant experts. This adaptive management process will

ensure that the stated objectives associated with lizard populations and habitat quality at the Mt Highlay Station site are achieved.

5.6 Reporting

5.6.1 Salvage findings reports

Following completion of the lizard salvage, a report detailing the results of the operation will be prepared and copies provided to OGNZL, DOC, Council, mana whenua, and other relevant stakeholders. The results reported will include but not be limited to salvage conditions, numbers salvaged for each species, population demographics, and the number of injured or deceased lizards. Recognising that lizard salvages will be staged over several years, a lizard salvage report will be prepared following each salvage event, within three months of salvage completion.

5.6.2 Annual monitoring reports

Reporting for the various lizard monitoring programmes, including constructed rock piles, lizard population monitoring inside and outside the MEEA fence, and Otago skink monitoring, will be provided annually for a minimum of five years.

Reporting for the Mt Highlay Station lizard monitoring programme will be provided after Year 1 (as a baseline monitoring report), and thereafter on a five-yearly basis through to Year 25. This schedule aligns with the timeframe and expected outcomes set out in the lizard compensation model, namely that existing lizard populations and habitat extent will be maintained over the 25-year assessment period, rather than declining to zero under a plantation scenario.

All reports will be provided to OGNZL, DOC, Council, mana whenua, and other relevant stakeholders within three months of completion of the respective monitoring programme.

5.6.3 Wildlife Act Authority compliance reporting

All reporting requirements outlined in the project specific Wildlife Act Authority[6] will be adhered to. All records of lizard records will also be compiled, summarised, and submitted to DOC's national data repository for herpetofauna records (BIOWEB Amphibian and Reptile Distribution Scheme [ARDS] Herpetofauna database) annually.

As a minimum, compliance reports will include the following information:

- DOC Wildlife Act Authority number and Project name and location;
- A summary of the species, numbers and age/ sex classes of lizard captured;
- Summary of salvage methods and efforts; and
- Locations of lizards captured and specific relocation sites.

[6] At the time of writing, a project specific Wildlife Act Authority is yet to be granted by the Department of Conservation.

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Applicability and Limitations

Restrictions of Intended Purpose

This report has been prepared solely for the benefit of OceanaGold New Zealand Limited as our client with respect to the brief.

Babbage/ Bioresearches acknowledges that this report will be relied on by a Panel appointed under the Fast Track Approvals Act 2024 and these disclaimers do not prevent that reliance.

Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgements are to be relied on, they should be independently verified with appropriate legal advice.

Maps and Images

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Babbage Consultants Limited.

Reliability of Investigation

Babbage/ Bioresearches has performed the services for this project in accordance with the standard agreement for consulting services and current professional standards for environmental site assessment. No guarantees are either expressed or implied.

Appendix A

Dylan van Winkel Curriculum Vitae

Appendix B

Densities of lizards reported in the literature

Density estimates (no. of lizards/ hectare) for Otago lizard species present or likely to be present in the MP4 Project Area. Density estimates available in the literature and those recorded from historical lizard management projects at the Macraes mine are presented. Information on sampled sites and habitats is also provided for context.

	Densities (lizards/ ha) available in the literature									Densities (lizards/ ha) recorded from activities on OGNZL Macraes landholdings				
Reference	Patterson (1984)	Patterson (1985)	Dixon (2004)	Clark (2006)	Jones (2013)	Bell *et al.* (2013)	Knox *et al.* (2013)	Knox *et al.* (2013)	Wilson *et al.* 2017	Macraes Baseline survey (N-mixture models) [A]	Deepdell North III salvage Tocher (2021)	IM8 lizard salvage (van Winkel 2024)	CN5 lizard salvage (van Winkel 2026)	CCP2 lizard salvage (van Winkel unpub. data)
Habitat & site information	Tussock; Rock & Pillar Range	Tussock; Rock & Pillar Range	Tall tussock; Macraes	Ridges & gullies; Alistair's Gully control site, ~29 ha	Tall tussock, Macraes	Deepdell QEII covenant, 110 ha	Tussock, rank grass, rock tors; FNWRS salvage, 5.24 ha	Tussock, rank grass, rock tors; FSWRS salvage, 4.91 ha	Tussock, Macraes Flat (non-pest control vs predator-proof fence)	Tussock, rank grass, rock tors	Tussock, rank grass, rock tors; MPIII Deepdell North III salvage, 109 ha	Rank grassland, Macraes 0.11 ha	Tussock, rock outcrops, Macraes 11 ha [B]	Tussock, rank grass, Macraes 2.38 ha
Species														
Southern grass skink	-	769[C]	572–2,250 [C]	2–35 [D]	683–777	1–8	3	13	1,900–4,000 [E]	24–637	2.9	778 [D]	368	1,077
McCann's skink	423				~300	-	11	0		91–1,328	- [F]		1,047	812
Herbfield skink	-			-	-	-	-	-		0	0	0	0	0
Kōrero gecko	-	-	-	-	-	3–9	0.2	7		8–22	11.6	0	~25-60	0

[A] Only N-mixture modelling results presented due to inaccuracies related to low detection probabilities in CMR modelling data.

[B] Estimates have been inflated to account for incomplete salvage (Hamlin 2025).

[C] Figure includes tussock, McCann's, and cryptic (herbfield) skink combined.

[D] Figures include tussock and McCann's skink combined.

[E] The upper estimate (4,000/ ha) reflects lizard densities within the predator-proof fence.

[F] McCann's skinks were not salvaged; hence no density estimate is available.

Appendix C Detail on the lizard density estimation methods used to measure lizard response.

Modelled lizard response

A landscape scale lizard pitfall trapping and release programme involving repeated count and capture-mark-recapture data collection will be employed to describe lizard repsonse to management. Specifically, statistical methods including N-mixture modelling and Capture-Mark-Recapture analyses will be used to estimate densities of lizards over time within the MEEA fence area.

To provide confidence in data collection approach and analytical methods, the study design was reviewed and validated by an experienced biometrician from *Proteus*, an ecological statistical consulting company based in Mosgiel, New Zealand.

N-mixture modelling (Repeated counts)

N-mixture models (Royle 2004) are a type of statistical model used primarily in ecology to estimate the abundance of a species in each area while accounting for imperfect detection. These provide estimates of how many individuals of a species are present, even though not all individuals may be detected during a survey. The model uses repeated count data (i.e., number of skinks captured each day) from each trap location to estimate the expected number of skinks in the vicinity of each trap (i.e., 'per trap' metric) (MacKenzie & Bratt 2024). This estimate does not necessarily equate to an estimate of the unique number of individuals in the vicinity of a trap during the entire trapping session, but rather a measure of relative (cf. actual) abundance. It also estimates a detection probability, which is the probability of detecting an individual during a survey. Detection probability is informed by the variability in the nightly counts at each trap, relative to the maximum count over all nights at the trap (noting that the total number of individuals may be greater than the maximum counted) (MacKenzie & Bratt 2024).

Capture-mark-recapture (CMR)

Capture-mark-recapture (CMR) is a popular and powerful method in ecology used to estimate population size, survival rates, and other demographic parameters of animal populations. It involves capturing, marking, and releasing animals, then recapturing them later to gather data on the proportion of marked individuals in the population. Mark-recapture methods utilise the information in the frequency of capture of individuals to estimate the probability of capture, and hence the number of individuals that were in the population but never captured during the trapping session. A closed-population model (Huggins-type) will be used (i.e., assuming no births, deaths, immigration, or emigration during the study period), which is considered a valid approach considering the relatively short nine-day consecutive trapping period.

Estimates of abundance from the CMR will represent an estimate of the unique number of individuals in the vicinity of all traps during the sampling session (cf. N-mixture models are at the scale of a single trap) (MacKenzie & Bratt 2024).

Skink density estimates from modelled data

The data collected will be modelled by a qualified biostatistician to generate estimates of skink relative abundance and detection probabilities. Relative skink abundance values from the N-mixture modelling

and CMR analyses will be converted to density estimates (skinks/ ha). Since the two approaches describe slightly different abundance metrics (i.e., N-mixture models provide a “per trap” abundance metric whereas CMR provides an estimate of the unique number of individuals in the vicinity of all traps during the sampling session), different calculations are required to estimate population densities for each of the approaches.

A key consideration common to both approaches was the exposure of skinks within each population to the pitfall trapping technique, specifically the size of the area around each trap that is effectively being sampled for skinks (MacKenzie & Bratt 2024). To inform the effective trapping area, average home range sizes for McCann’s and tussock skinks ($\overline{x}$ = 20.6 m^2 as reported by Patterson 1984, 1985) will be applied to the areas surrounding each trap, allowing density estimates for each representative area of the landscape and for each modelling approach to be calculated.

Appendix D

Summary of the New Zealand experimental rock pile construction projects

- Lennon (2019) and Lennon *et al*. (2021) reported on the use of constructed rock piles as a lizard mitigation measure at a roading development site near Wellington. They modelled three-dimensional interstitial spaces within rock piles of varying rock sizes and used the model results to design rock piles that provided the highest inferred protection of skinks from predatory mice. The studies generally advocated for rock piles that provide a diversity and complexity of gaps, which can encourage diversity of invertebrates (a food source) by providing variable habitat. These studies recommended the use of larger rocks (20–40 mm) for smaller sized skinks (e.g., *Oligosoma polychroma*), as this grade provided the lowest proportion of small gaps and therefore, was more likely to be the most accessible to skinks, retaining a reasonable proportion of optimal[7] spaces (41%). Lizards were reported to occupy to rock piles, albeit at relatively low numbers, and the study could not determine whether habitat enhancement increased population size or viability of existing lizards at the rock pile sites.
- Herbert (2020) conducted a before-after-control-impact (BACI) habitat enhancement experiment on lizard communities on the mammal-invaded Miramar Peninsula, Wellington. The tested the influence of supplementary native planting and provision of gravel piles against pre-enhancement monitoring and control sites and showed that the enhancement measures did not significantly affect site use, body condition, or evidence of reproduction in the lizards being monitored (three species). She concluded that while adding gravel and native vegetation (especially divaricating shrubs and vines) may offer a suitable strategy for creating habitat for some species of native lizards, without intensive mammal control or eradication, habitat enhancement alone is not expected to markedly benefit, nor restore, lizard communities.
- Rufaut (2020) undertook research into optimal construction designs of rock outcrops (rock tors) for native lizards at Camp Creek, Macraes. They initially identified which natural outcrops supported regular use by lizards and then sought to define a key set of features that characterise high-use outcrops. This geo-ecological information was used to design and construct several rock stacks representing a 'familiar form' to colonising lizard species (Figure 1.2). To my knowledge, monitoring of these rock stacks for lizards has not been carried out but a recent inspection of the stacks by the author (D. van Winkel) revealed that the stacks have been taken up by at least two species of lizard including McCann's skink (*O. maccanni*) and kōrero gecko (*Woodworthia* "Otago/ Southland large"; van Winkel pers. obs. February 2023).
- Herbert *et al*. (2023) reported on three species of local Otago lizards (McCann's skink, *O. maccanni*; tussock skink, *Oligosoma chionochloescens* [reported as *Oligosoma* aff. *polychroma* Clade 5], and kōrero gecko, *W.* "Otago/ Southland large") taking up residence in ten 375 m^3 (25 m L × 5 m W × 3 m H) constructed rock piles adjacent to the Stage 5 area of the Coronation Project over a period of 2.4 years (Figure 1.1). These rock piles were created using locally excavated Haast schist rock ranging in size from 2–50 cm, and one rock pile was comprised of a mixture of soil and schist rock. Native plant seeds were scattered over the rock piles approximately 1.5 years after the rock pile creation. The study reported an increase (≥10%) in the estimated abundance of McCann's skink over time, with neonates (newborn skinks) also being observed using the rock piles.

[7] optimal refers to optimal size of gaps for skink access.

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