Tekapo Power Scheme re-consenting, Tekapo

Herpetofauna Effects Assessment

Report prepared for

Genesis Energy Ltd

Prepared by

RMA Ecology Ltd

Report number and date

Job 2004

December 2023

BETTER ECOLOGICAL OUTCOMES

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Project No. 2004

Version date: December 2023

Version status: Issued ver2

Citation:

RMA Ecology Ltd. December 2023. Tekapo Power Scheme reconsenting, Tekapo: herpetofauna effects assessment. Report prepared for Genesis Energy Ltd, Auckland. 36 pages + Appendices.

Revisions

Revision	Date	Description
Ver 4	3 Feb 2023	Update significance assessment with RPS criteria as per ECan feedback
Issued	23 Feb 2023	Remove draft watermark, PDF and issue as final
Issued ver 2	02 Dec 2023	Incorporated changes arising from Council s92

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BETTER ECOLOGICAL OUTCOMES

EXCUTIVE SUMMARY

Genesis is currently undertaking a programme of re-consenting for its Tekapo Power Scheme ('TekPS') in the Waitaki Catchment of the Mackenzie District of the South Island.

Genesis is applying for resource consents relating to the ongoing damming, diverting, taking and use of water associated with the TekPS. It is not applying for consent to operate structures or to undertake activities that relate to land use or maintenance.

As part of the re-consenting process, RMA Ecology Ltd has undertaken an assessment of the reptile and amphibian values (together, 'herpetofauna') of the TekPS and an assessment of the potential effects of the continued operation of the scheme.

The TekPS comprises two hydro-electric power stations (Tekapo A and Tekapo B), and a 25.5 kilometre long Tekapo Canal. Water in Lake Tekapo/ Takapō can bypass Tekapo A Power Station by being released down the upper Tekapo/ Takapō River, through Lake George Scott and then 45 kilometres long Tekapo/ Takapō River.

Our survey focussed on the land areas within the existing TekPS footprint (for canal areas), within 200 m of the Tekapo/ Takapō River, and 50 m of the Lake Tekapo/ Takapō and Lake Pūkaki margins.

Our survey did not include areas distant from these focal points – such as escarpment systems with excellent quality talus, scree and shrubland environments – simply because the TekPS will have no influence on them.

The sampling design focussed search effort across good quality local examples of habitat, and also across multiple examples that were spatially separated – in order to provide an accurate representation of habitat quality, species present, relative abundance and habitat association across the TekPS scheme.

Survey methods included slow walk transects for basking skinks, binocular search, and visual search of suitable shrubland habitat for jewelled gecko, manual search of rocks, woody debris and vegetation accumulations for skinks and geckos, and where deep pebble banks were present, intensive searches for basking (binocular search), sign (scat), and individuals of large bodied skinks. All habitat searching and animal handling was undertaken in accordance with Wildlife Act Authority 91677-FAU.

Twenty (20) individual sites were assessed, covering lakeside, canal, and Tekapo/ Takapō River margins. Together these sites covered an area of around 40 ha which was searched for lizards to detect presence. A total of 200 lizards were recorded from within the sites.

In summary, our findings were:

- Three species of native lizard were recorded – McCann's skink, Southern Alps gecko and Canterbury grass skink.
- Southern Alps gecko and McCann's skink were found across most sites; relative abundance differed between sites but was generally inversely related to the level of past disturbance of the site.
- At the Tekapo/ Takapō River margin sites, Southern Alps gecko and McCann's skink occupied all habitat areas including river bank, terrace, riser, pebble, and boulder-bank areas.

Populations of these species along the margins of the Tekapo/ Takapō River and its associated dry channels, floodplain areas and historic terraces would likely number in the 1,000s per kilometre of river.

- Canterbury grass skink was found at one site - along the riparian margins of a minimally disturbed section of the Mary Burn Stream near a culvert section of the Tekapo Canal.
- No other lizard species were recorded; jewelled gecko, scree skink, long-toed skink or Mackenzie Basin skink were not found within the study locations, although for all of those species habitat quality within the survey areas was poor and generally lacked key habitat aspects with which these species are usually associated.
- No exotic lizards or frogs were recorded.

Adverse effects may potentially occur due to the ongoing operation of the TekPS as associated with the water permits being sought relate to river flows. This assumes that the operating regime for lake levels and recreational release flows in the upper Tekapo/ Takapō River continue as are currently allowed for (as Genesis is seeking in its applications).

Mortality of Southern Alps gecko may result if releases of flows into the upper Tekapo/ Takapō River result in swiftly rising waters that inundate lizards that have moved into vacant river bed habitat. This contrasts with the lake margin areas, where periodic inundation would be a more gradual process, and would presumably allow animals to retreat to higher ground.

There are two additional potential adverse effects that may result from the operation of the TekPS scheme. Both relate to the canal structure, rather than the operating regime for lake levels and recreational release flows, and therefore are not considered further in this assessment.

1. Maintenance works: Mortality, injury, or loss of fitness (health) from the removal of vegetation along canal embankments and infilling or land rehabilitation works for erosion features that have resulted in lizard habitat and colonisation by lizards (as was recorded in many places within canal batter/ embankment survey sites).

2. Population fragmentation: If Canterbury grass skink populations along streams bisected by the Tekapo Canal have suffered population fragmentation (as is likely) and if these population effects are ongoing – such as through a lack of gene flow – the presence of the canal could contribute to a progressive decline of Canterbury grass populations associated with the canal streams. Over time that could potentially lead to localised loss of population fitness or loss of stream populations if gene flow at the level potentially affected is important for these populations.

Southern Alps gecko and McCann's skink are listed as 'At Risk – Declining' and 'Not Threatened' (respectively) in the DOC threat classification. The population of both species are locally very large. Any potential loss of Southern Alps gecko and McCann's skink through operations of the TekPS scheme, as would be undertaken under the range of consents being applied for (water permits only), would constitute a very small portion of the overall populations in the local area.

The dry river bed areas within which Southern Alps gecko were found meet the significance criteria of the Canterbury RPS (based only on species rarity), and therefore management of this habitat requires no net loss of lizard values.

The level of potential effects in terms of loss of ecology values is assessed as 'Very low'. This 'Very low' level of ecological effect is equivalent to 'no more than minor' when considered in the context of potential effects on the environment under the RMA. Where the level of effects is anticipated to be 'Very low', the EIANZ guidelines recommend that normal design, construction and operational care should be exercised to minimise adverse effects.

Overall, the level of new effects arising from the consents sought by Genesis will be nil, although the continuation of its current activities (as sought under these consents) may cause effects on lizard populations. Under the existing environment, the activities proposed by Genesis will not have cause any effects on lizard populations beyond that already caused under its exiting suite of operating consents.

Therefore, no mitigation or offset is required under the RMA or the Canterbury RPS.

Where positive environmental outcomes are supported by Genesis as part of its operating and environmental principles, offset or compensation for losses to native lizard populations should be encouraged. Project River Recovery is the key programme that can potentially result in beneficial outcomes for native lizards, through its focus on weed control and nesting bird protection across very large areas of the upper Waitaki Basin.

Project River Recovery is a Department of Conservation programme established in 1990 that aims to protect or restore rivers and wetland ecosystems in the upper Waitaki Basin.

The trapping programme for Project River Recovery includes extensive broad-scale trapping of introduced mammalian predators of native lizards (as part of protection work for braided river birds) in the Tasman Valley and the upper Ohau River. Given the known impacts of introduced animals on native lizard populations – particularly feral cats and mustelids in dryland environments, the benefits of sustained pest control are anticipated to be great.

The likely benefits of the work undertaken by Project River Recovery for controlling lizard predators over a large scale, and the potential conservation benefits on Threatened as well as less rare lizard species in those areas, is likely to provide a conservation benefit that greatly exceeds the very minor level of adverse effects that may be caused by the re-consenting of the TekPS scheme on native lizards.

CONTENTS

1.0 Introduction

1.1 Background

The Tekapo Power Scheme ('TekPS') forms part of the Combined Waitaki Power Scheme, which is a large-scale hydro-generation scheme in the Waitaki Catchment of the Mackenzie District of the South Island.

The Tekapo Power Scheme has been owned and operated by Genesis Energy Ltd ('Genesis') since 2011. Resource consents for the water permits for TekPS expire in April 2025, and Genesis is currently undertaking a programme of re-consenting, of which this herpetofauna effects assessment forms a part.

As part of that re-consenting process, Genesis has engaged RMA Ecology Ltd to undertake an assessment of the reptile and amphibian values (together, 'herpetofauna') of the TekPS and an assessment of the potential effects of the continued operation of the scheme[1].

1.2 Tekapo Power Scheme

The TekPS comprises several parts over a large geospatial area. The following description (abridged) of the TekPS has been provided by Genesis.

A schematic of the TekPS is provided in Figure 1.

In summary:

> The TekPS comprises two hydro-electric power stations, referred to as 'Tekapo A' (capacity 30 MW) and 'Tekapo B' (capacity 160 MW). Water for electricity generation is stored in Lake Tekapo / Takapō by virtue of control gates where the lake discharges into the Tekapo / Takapō River and is then released into the Tekapo Canal from where it is diverted through the two power stations, before discharging into Lake Pūkaki.
>
> Lake Tekapo/ Takapō is the sole source of water for the TekPS. The lake is dammed by the Lake Tekapo Control Structure ('Gate 16') at the head of the Tekapo / Takapō River. Lake Tekapo/ Takapō has a normal operating range from 702.1 metres above sea level ('masl') to 710.9 masl; however, the minimum and maximum operating levels vary throughout the year.
>
> Tekapo A Power Station is situated on the southern foreshore of Lake Tekapo / Takapō. The intake structure for Tekapo A Power Station draws water for the power station and passes it through a six metre diameter, 1.4 kilometre long tunnel. This intake structure is located in the bed of Lake Tekapo/ Takapō to the west of Lake Tekapo/ Takapō township. Construction of the Tekapo A Power Station began in 1938 and was commissioned in 1951.
>
> Outflows from Tekapo A Power Station enter the 25.5 kilometre long Tekapo Canal, which was constructed in 1970. The Tekapo Canal passes over a number of natural waterways which are accommodated by culverts under the canal, including Forks Stream, Irishman Creek and Mary Burn

[1] This report has been prepared in accordance with our letter of engagement with Genesis dated 5 February 2020.

Stream. Water in the canal flows into a head pond before entering the penstocks and Tekapo B Power Station at Lake Pūkaki.

Water in Lake Tekapo/ Takapō can bypass Tekapo A Power Station by being released through Gate 16. When the control gates are open, water flows down the upper Tekapo/ Takapō River approximately 3.5 kilometres downstream of Gate 16 where it is impounded by a concrete weir to create Lake George Scott. Water can then be released into the Tekapo Canal via a gate in the control structure that impounds Lake George Scott or continues to the Tekapo/ Takapō River.

The Tekapo/ Takapō River is approximately 55 kilometres long and is augmented by spring fed flows and tributaries such as Fork Stream, and the Grays and Mary Burn rivers. The Tekapo/ Takapō River converges with the Pūkaki River before discharging into the Haldon Arm of Lake Benmore.

Prior to the commissioning of the TekPS, the natural (uncontrolled) lake level fluctuation was approximately 2.6 m, with lake levels varying between 704.4 and 707 masl under the influence of the natural inflows and outflow from the lake.

Under normal conditions the Tekapo/Takapō River channel has no or very little flow from the Lake Tekapo/Takapō outlet until it converges with Fork Stream, approximately 7 km downstream of the Lake Tekapo/Takapō outlet. The 3 km reach of the Tekapo/Takapō River between Lake George Scott and the confluence with Fork Stream does have some minor groundwater inflow which results in some ponding and minor surface flow along this reach of the Tekapo/Takapō River.

Genesis is applying for resource consents relating to the ongoing damming, diverting, taking and use of water associated with the TekPS. It is not applying for consent to operate structures or to undertake activities that relate to land use or maintenance. This report identifies potential effects across the scheme operation – including those related to land use and maintenance, however we understand that only those effects relating to water need be considered in terms of the consents sought for this application.

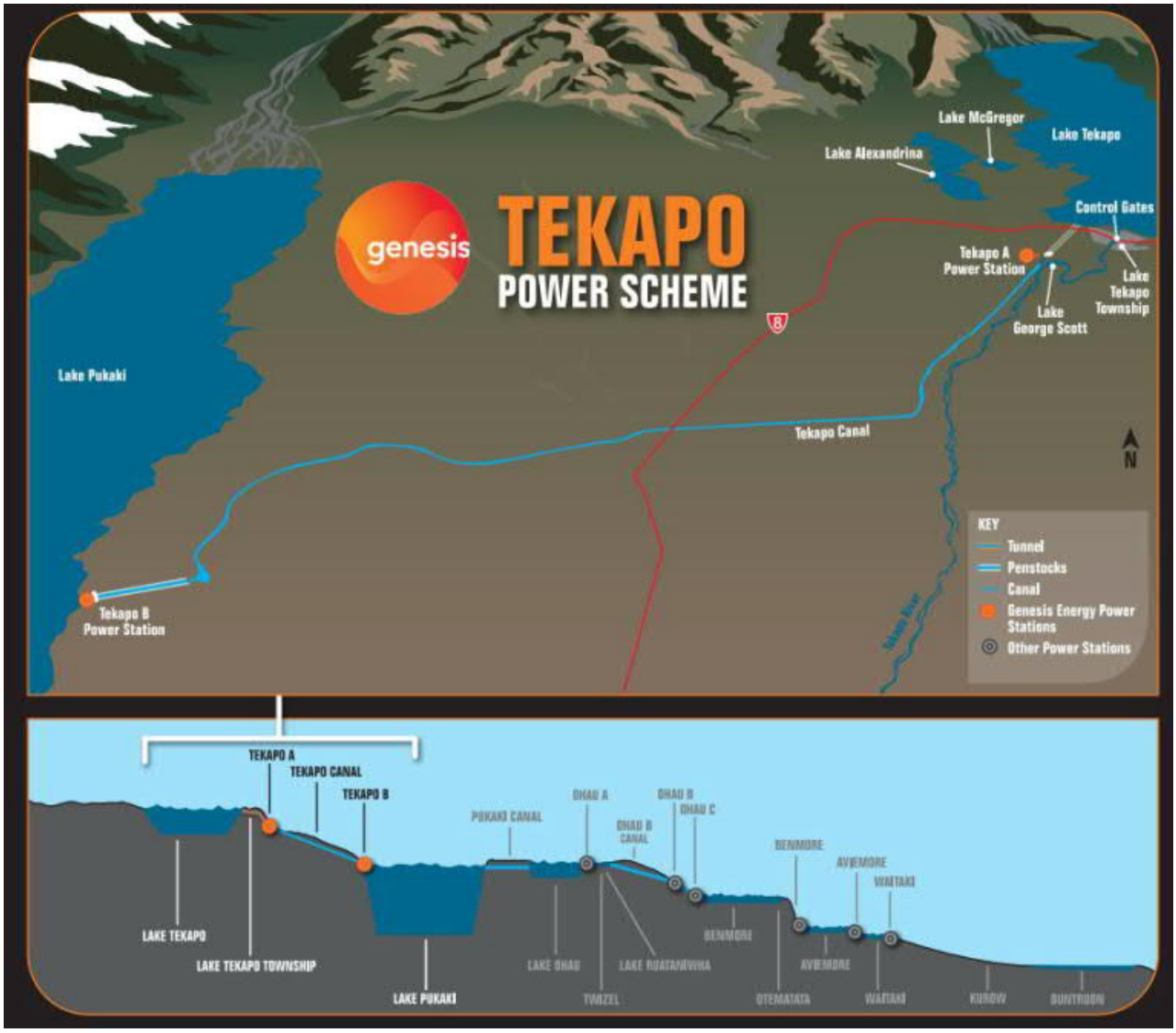

Figure 1. Tekapo Power Scheme Overview Diagram.

1.3 Project River Recovery

Genesis' existing resource consents were granted in 1990 under the Water and Soil Conservation Act 1967. These are deemed resource consents under the Resource Management Act 1991 ('RMA'). The resource consents are complemented by a series of mitigation agreements negotiated between Genesis' predecessor organisations and various stakeholders, and which Genesis is now a signatory to.

One of the agreements is Project River Recovery ('PRR'), which is a Department of Conservation ('DOC') programme established in 1990 that aims to protect or restore rivers and wetland ecosystems in the upper Waitaki Basin. Project River Recovery is funded by Meridian Energy Ltd and Genesis under an agreement between DOC, Meridian and Genesis.

The objective of PRR is to maintain indigenous biodiversity and protect and restore terrestrial and aquatic river and wetland habitat and the ecological communities therein. The project aims are outlined in the PRR Strategic Plan (the latest of which is available for the period 2012 – 2019; Rebergen & Woolmore 2015), and the outputs are summarised in annual reports. The annual reports detail the areas controlled for weeds, the results of animal pest trapping and control programmes, and the outcomes for key wildlife species that are part of ongoing monitoring and management programmes.

Part of the purpose of this report is to provide a summary of the likely benefits of the PRR funding and management programme for the conservation of native lizards in the upper Waitaki Basin.

1.4 Existing environment

The construction of the TekPS required extensive earthworks across a broad area of the Tekapo/ Takapō River Basin. Construction of canal embankments, diversion and culverting of streams, disturbance to riparian margins, changes braided river flows and deltas, removal or covering over of terrace and riser river environments, and quarrying for construction materials would have all been necessary for the development of the scheme.

As is detailed further in this report, native lizards would have occupied most, if not all, of the areas subject to the scheme construction – including lake shoreline, riparian and braided river margins, riser and terrace floodplain systems, inland outwash plains, boulder-field and shrubland communities, and escarpment, valley side, ridge, and scree areas.

While it is impossible to quantify, the construction of the scheme would likely have resulted in a substantial loss of individuals, populations, and habitat of native lizards within localised areas. Ongoing losses over the decades (beyond immediate construction effects) of genetic variability and loss of population resilience are likely from fragmentation of populations; for example, by the Tekapo Canal bisecting the landscape and stream margins.

We understand that the impacts that have occurred during the construction and operation of the TekPS over the past 40 – 70 years comprise part of the 'existing environment'; that is, any effects assessment should be based on an assessment with the current operation of the TekPS as the baseline. An explanation of 'existing environment' is contained within the project overall Assessment of Environmental Effects report.

When applied to this assessment of herpetofauna, this means that the description of the existing environment should necessarily be restricted to those areas where the TekPS may continue to have, or through re-consenting, may result in potential adverse effects on native herpetofauna.

As Genesis is not proposing to change current operating conditions in the reconsenting of the TekPS, it is not necessary to consider the potential level of adverse effects that would have resulted from the construction of the scheme, nor from other potential hypothetical operational scenarios of the scheme. This assessment does not and cannot (given the lack of historic information) consider the original impacts of the scheme on herpetofauna communities.

Rather, it focuses on the existing herpetofauna community and considers those aspects of the ongoing operation of the TekPS that have the potential for ongoing effects on it.

We also acknowledge that climate change is a significant issue that exacerbates the current rate of biodiversity loss - therefore climate change will have a fundamental negative effect on biodiversity.

1.5 Scope of work

The scope of this investigation includes an assessment of the current herpetofauna values within the TekPS area, the potential effects of the current TekPS operation on herpetofauna, and an assessment of the significance of potential adverse effects and the need for compensatory actions to provide for such effects.

In addition, an evaluation is made of the potential benefits to herpetofauna arising from the existing compensatory programmes undertaken as part of the PRR, in the context of the value of the PRR programme for addressing potential adverse effects on herpetofauna of the re-consenting of the TekPS.

2.0 Herpetofauna of the Tekapo Area

The TekPS is located in the northern part of the Mackenzie Basin, an area generally described by the Mackenzie Ecological Region. Through geological history and climatic isolation, the Mackenzie Basin has developed unusual plants and animals adapted to the often stony and infertile soils and local climatic extremes of drought, frost, heat, and wind. Human occupation (Māori, then European) has brought about widespread change to the vegetation through land clearance and conversion to exotic pasture grasses (McGlone 2004), such that many indigenous species and communities supported in the Basin are very much reduced compared to their original extent and abundance (Walker et al. 2003; de Lange et al. 2009).

The Mackenzie Basin has a disproportionate density and area of naturally rare ecosystems (otherwise known as 'historically rare' ecosystems) compared to most other places in New Zealand. These ecosystems often support highly specialised and diverse plant and animal communities and are characterised by relatively high proportions of either endemic or nationally threatened or rare species (Williams et al. 2007). Six of the 72 historically rare ecosystems identified throughout New Zealand are present in the Mackenzie Basin area, and include moraines, inland outwash surfaces, inland sand dunes, braided rivers, ephemeral wetlands, and tarns. The presence of many of these features within or in the vicinity of the TekPS is important, as it provides an indication of the potential diversity of habitats for herpetofauna within and surrounding the investigation area.

Herpetofauna in the Mackenzie Basin is restricted to lizards (skinks and geckos) and exotic frogs. The only exotic frog recorded from the wider Tekapo area is the whistling frog (Litoria ewingii), with the closest record approximately 25 km to the east of Tekapo A Power Station.

For the purposes of this effects assessment, we therefore refer simply to the lizard fauna of the TekPS, rather than herpetofauna. While the exotic whistling frog (and exotic southern bell frog Litoria raniformis) were not deliberately included in the surveys for this assessment, we were alert to the potential presence of these species, and would have noted them in our records had they been found. Although not known from this part of New Zealand, we were also alert to the possible presence of the introduced plague skink (Lampropholis delicata) and our survey included methods that would have detected them had they been present and abundant.

The National Reptile and Amphibian Database ('Herpetofauna database') records seven species of lizards in the vicinity (ca. 5 km) of the TekPS (Table 1). Of these, all are known to have habitat preferences that include Makenzie Basin floor/ lake edge/ riser and terrace system environments such as those found within the area occupied by the TekPS. There are no records in the Herpetofauna database of lizards along the Tekapo Canal system, and few records within the Tekapo / Takapō River braided river system (riparian margins, riser or terraces) – almost all records are from surveys previously undertaken along the river scarp (ca. 1 km inland) and from inland outwash plains and moraine areas, where the focus has most likely been on detecting large-bodied or rare lizard species.

The characteristics of each of the species listed in Table 1 is described in Table 2.

Records from the Herpetofauna database in proximity to the TekPS are shown in Figure 2. Additional recent records from a survey (undertaken by Ryder Environmental Ltd, 2018) of the Simons Pass Dryland Reserve at the confluence of the Pūkaki and Tekapo / Takapō Rivers (and which therefore are relevant to this assessment) are not yet in the Herpetofauna database. The results of that survey include new records for scree skink (Oligosoma waimatense*)* and Mackenzie Basin skink (Oligosoma prasinum*)* within pebble flats/ scree/ talus and outwash plains (respectively). We have used that information in our assessment.

Table 1. Herpetofauna recorded in the vicinity of the TekPS. Threat classifications from Hitchmough et al. 2021.

Species	Common name	NZ threat classification	Potential presence within TekPS vicinity
Oligosoma maccanni	McCann's skink	Not threatened	Certain
Oligosoma aff. polychroma Clade 4	Canterbury grass skink[1]	At Risk - declining	Likely
Oligosoma waimatense	Scree skink	Threatened – Nationally Vulnerable	Possible
Oligosoma longipes	Long-toed skink	Threatened – Nationally Vulnerable	Unlikely
Oligosoma prasinum	Mackenzie Basin skink	Threatened – Nationally Vulnerable	Possible
Naultinus gemmeus	Jewelled gecko	At Risk - declining	Unlikely
Woodworthia sp. 'Southern Alps'	Southern Alps gecko	At Risk - declining	Certain

[1] We understand that *recent genetic results have found Mackenzie Basin grass skinks to be clade 5 southern grass skinks, despite their speckled appearance. We have requested confirmation form DOC on this matter as we understand that he results of this work are as yet unpublished. Until we received confirmation, this report will refer to grass skinks as Canterbury grass skink Clade 4.*

Table 2. Habit and habitat of lizards that may reside within or in the vicinity of the TekPS.

Species	Habit	Habitat associations
McCann's skink	Medium-sized day-active skink, avid sun-basker & highly active	Ubiquitous throughout a broad range of degraded and unmodified environments, including open rocklands, pebble-fields, grasslands, modified environments, grazed grasslands with occasional tussock shrubs
Canterbury grass skink	Medium-sized day-active skink, avid sun-basker & highly active	In Mackenzie Basin typically found in damper/ wetter places than McCann's skink – such as river/ stream/wetland margins where there is sufficiently deep pebble/ boulder/ rank low vegetation
Scree skink	Large-bodied day-active skink, avid sub-basker, but easily disturbed/ shy	Pebble/ scree/ talus banks including examples that are shallow (not deep) and within degraded grassland areas without canopy cover
Long-toed skink	Medium-sized day-active skink, avid sun-basker & highly active	Dry open grassland or sparse shrubland within river terraces, talus slopes and scree
Mackenzie Basin skink	Large-bodied day-active skink, sub-basker, but extremely easily disturbed/ very shy	Typically, deep pebble/ scree/ talus banks, usually with some form of open shrubland (native or exotic) providing shaded edges/ cover and dappled sunlit- areas

Jewelled gecko	Medium-sized, day-active gecko, sun-basker & best detected early morning before full heat of the day	Typically, dense shrubland or forest areas dominated by native vegetation
Southern Alps gecko	Medium-sized, nocturnal gecko, resting during day	Daytime resting areas include rock crevices, under stones/ pebble banks, logs, typically ubiquitous throughout a broad range of degraded and unmodified environments

3.0 Assessment methods

3.1 Survey approach

The TekPS extends across a large area and across a diverse suite of potential lizard habitats.

These include:

- Natural environments such as lake shoreline, boulder banks and degraded grassland margins of Lakes Pūkaki and Tekapo/ Takapō;
- Riverbed, eroding river banks, riser and terrace systems, pebble banks and shallow talus associated with the margins of Tekapo/ Takapō River; and
- Batters, erosion runnels, culverted stream margins, earthwork dumps, and degraded or sparsely vegetated grasslands associated with the extensive construction areas for the Tekapo Canal, watercourse crossings and power stations.

Because Genesis does not intend changing the existing operational parameters of the TekPS, our assessment has focussed on areas close to the current operation – that is, to the canal system, power stations, lake margins and Tekapo/ Takapō River. Our survey did not include areas distant from these focal points – such as escarpment systems with excellent quality talus, scree and shrubland environments – simply because the TekPS will have no influence on them.

Therefore, typically, our survey focussed on the land areas within the existing TekPS footprint (for canal areas), within 200 m of the Tekapo/ Takapō River, and 50 m of the lake margins. For the lakes and Tekapo/ Takapō River this is the equivalent of survey within 'inland' margin areas that have not been impacted by the previous changes to water levels during the operation of the TekPS (i.e. it includes habitat that is obviously stable, regenerating and not within the current operating water level range for the scheme), as well as habitat closer to areas of water that may be subject to changes in water flows, erosion susceptibility and dynamic habitat change.

This sampling approach, although focussed spatially, covered approximately 40 ha of the several thousand hectares of potential lizard habitat available across the broader TekPS environs. The sampling design focussed search effort across good quality local examples of habitat, and also across multiple examples that were spatially separated – in order to provide an accurate representation of habitat quality, species present, relative abundance and habitat association across the TekPS scheme.

The sampling approach is summarised in Table 3 and sites are illustrated in Figure 2. Representative photos of site types listed in Table 3 are illustrated in Plates 1-4.

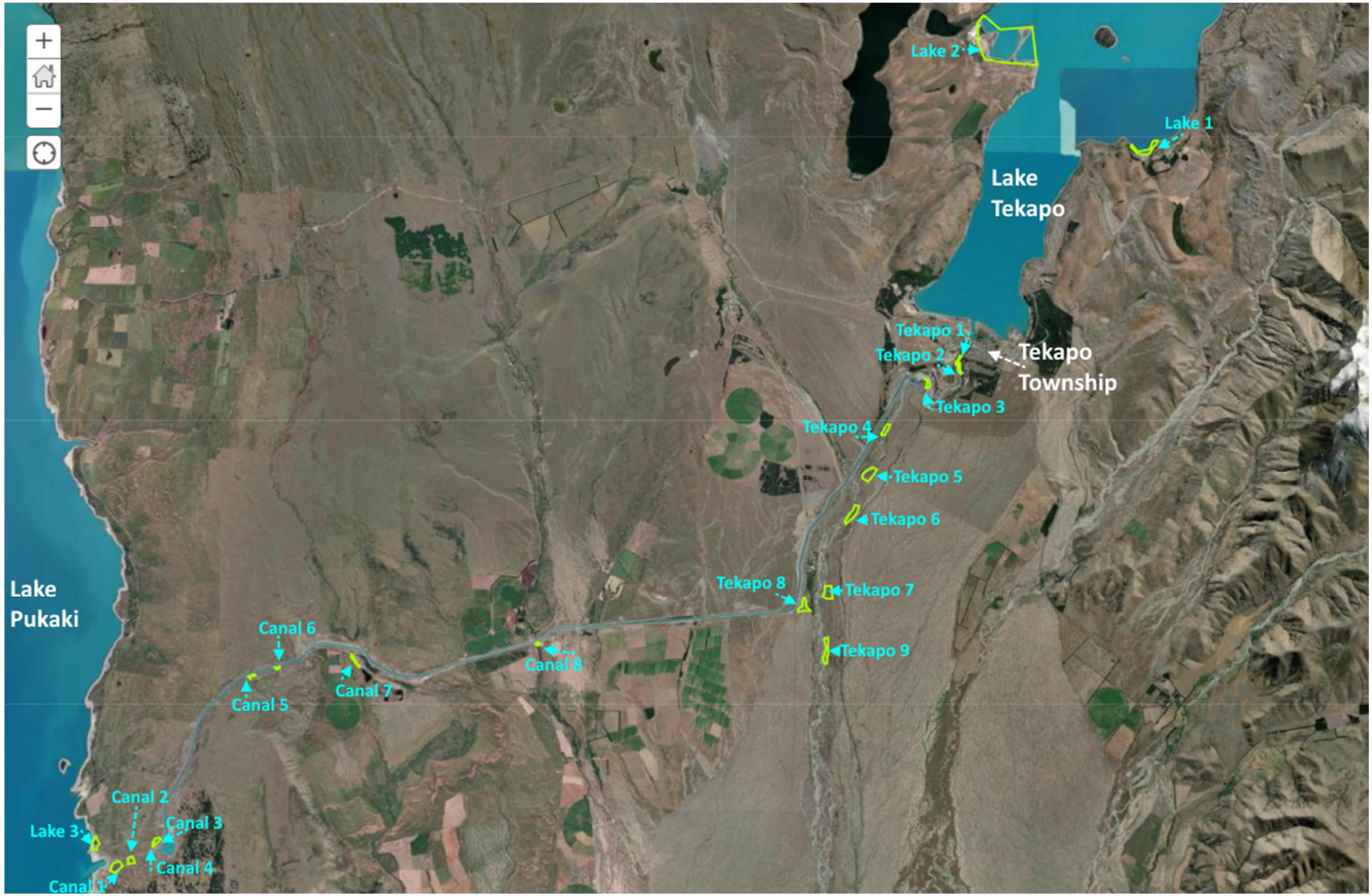

Figure 2. Location of survey areas for lizard assessment (Lake sites 1-3, Canal sites 1-8, Tekapo/ Takapō River sites 1-9). Green polygons represent search boundaries.

Table 3. Characteristics of the survey sites.

Site(s)	Environment type	Area (ha)	Level of modification	Potential habitats for lizards	Availability of habitat
Lake 1, 2 & 3	Lake margins	Lake 1: 6.1 ha Lake 2: 45 ha Lake 3: 2.6 ha	Moderate/Low – natural landform & boulder/ rock areas, with exotic grassland and shrubland	Boulder piles, pebble banks, driftwood and vegetation accumulations, eroded bank margins, littoral low vegetation	Moderate
Tekapo 1	Upper Tekapo River margin	0.7 ha	Moderate – pine forest toe slope scree & river margin	Scree piles, pine logs, river stone on margins, all under established pine cover	Low
Tekapo 2	Upper Tekapo River margin	1.1 ha	Moderate – riparian floodplain flats, grazed exotic grassland, partial pine tree cover	River stone piles, logs, debris packs	Low
Tekapo 3	Lake George Scott margin	1.2 ha	High – extensively earthworked and shaped margins and flats, sparse grass	Spoil piles, boulder dumps, eroded pebble banks	Low
Tekapo 4, 5, 6, 7, & 9	Tekapo River margin	Tekapo 4: 2.4 ha Tekapo 5: 6.8 ha Tekapo 6: 5.6 ha Tekapo 7: 6.2 ha Tekapo 9: 4.6 ha	Low – natural river margin with mixed grassland/ shrubland vegetation	Diverse – eroded river banks, primary and secondary terraces, extensive pebble banks, low-growing woody vegetation	High
Tekapo 8	Tekapo River margin	4.3 ha	Moderate - partially earthworked	Hill-slope and toe, historic river floodplain – boulder piles, shallow pebble piles	Moderate
Canal 1 & 2	Tekapo B Penstock slopes	Canal 1: 5.1 ha Canal 2: 2.6 ha	Moderate – partially earthworked	Hill-slope, eroded watercourse, sparse exotic grassland with sparse exotic woody shrubland	Low
Canal 3, 4, 5, 6, & 8	Canal embankment (Canal 8 is Irishman Creek crossing)	Canal 3: 1.8 ha Canal 4: 0.35 ha Canal 5: 0.7 ha Canal 6: 0.6 ha Canal 8: 0.5 ha	Very high – constructed environment	Constructed batters with eroded runnels, very sparse exotic grassland and occasional self-seeded native vegetation (low-growing).	Low
Canal 7	River margin (Mary Burn River)	1.5 ha	Low – natural river course and margins	Eroded, deep pebble banks, rank exotic grass margins	High

Plate 1. Lakeside margin search areas. Lake Pūkaki foreshore (top left; Lake site 3), Lake Tekapo west foreshore matagouri/ briar rose shrubland and rock banks (top right, bottom left; Lake site 2), Lake Tekapo east foreshore with single banks and low-growing briar rose and coprosma (bottom right; Lake site 1).

Plate 2. Canal areas least modified showing earthworked landforms with natural slopes supporting exotic grassland, sparse exotic woody vegetation and occasional rock stacks, boulders or erosion watercourse channels (Canal sites 1 & 2 upper left and right, bottom left), and Mary Burn River downstream of the culvert beneath the canal (Canal site 7; bottom right) with natural margins and eroded pebble banks.

Plate 3. Canal batters/ embankments with sparse grassland with exposed rock rubble and occasional erosion runnels (top left; Canal site 5; and right; Canal site 4). Margins of the upper Tekapo/ Takapō River showing shallow rock banks at pine forest toe slope (bottom left; Tekapo site 1), and well-compacted river margin (bottom right; Tekapo site 2).

Plate 4. Tekapo/ Takapō River sites showing dry Tekapo/ Takapō River bed upstream of Forks junction (top left; Tekapo site 4), river bank downstream of Fork Stream junction with flow in the Tekapo/ Takapō River (top right; Tekapo site 6), first terrace with river stone bank and sparse native and exotic vegetation over (bottom left; Tekapo site 6) and first riser showing extensive pebble banks with sparse vegetation (bottom right; Tekapo Site 6).

Plate 5. Indicators of lizards used to score presence at a site; Live animals (top left Southern Alps gecko, bottom left McCann's skink), skin slough (top right Southern Alps gecko), and faeces (bottom right; white dots).

3.2 Methodology

Sites were searched by day. No nocturnal searching was undertaken, as there was no need to obtain abundance index information for Southern Alps gecko when they were active at night.

For each site, the following methods were applied:

1. Slow walk transects along the length of the site (if at lake or river areas) or through systematic search (if within canal sites) to detect basking skinks using a combination of visual observation and binoculars (Steiner Observer 10x40 medium distance focus);
2. Binocular search and visual search of suitable shrubland habitat for jewelled gecko. Suitable habitat was sparse in most sites.
3. Manual search of rocks, woody debris and vegetation accumulations for skinks and geckos. Where habitat was sparse (e.g. canal sites) almost all habitat was searched through. For sites where habitat was abundant (e.g. Tekapo/ Takapō River sites) several transects through the site were walked and spot searches were carried out approximately every 50 m
4. Where deep pebble banks were present, intensive searches were carried out for basking (binocular search), sign (scat), and individuals of large bodied skinks.

At any given spot that was searched, when a positive identification was obtained for a lizard, the search ceased and the effort moved on to the next habitat (nearby in sparse areas, or 50 m in abundant habitat areas). Some habitats yielded multiple geckos or geckos and skinks under one piece of habitat (rock or log).

The allocation of search effort between sites is recorded in Table 4 (see results section) relative to habitat availability, which together give an estimate of relative search coverage of potential habitat in each site.

Time spent searching at each site was recorded (included time spent handling or photographing animals). In most cases, animals were handled only to obtain positive identification. Handling to obtain morphometric information or photographs was not undertaken in most instances; rather time was spent covering a greater distance for survey, rather than collecting in-depth information for each animal caught. Equipment was carried to each site so that, if large-bodied lizards (ie. scree or Mackenzie Basin skinks) were caught, they could be appropriately weighed, measured, sexed, identified and photographed.

Indicators of lizard presence used were (see Plate 5):

1. Scat – from smaller skinks and Southern Alps geckos under rocks and within rock piles, compared to much larger scats (typically 3-4 x larger) deposited by large-bodied skinks on the surface of basking platforms.
2. Slough – of Southern Alps geckos under refuges.
3. Individuals - as caught to make positive identifications or caught in order to safely release back into refuges once replaced.

In order to ensure that our technique was effective in detecting large-bodied skinks, we surveyed a local site where Mackenzie Basin skink had recently (2019) been recorded (a gully in the Sawdon Flats area near survey site Tekapo site 9). Over 1 hour on a fine morning we observed three Mackenzie Basin skinks basking within a 100 m section of deep talus rockfield (Plate 6), as well as

approximately 25 McCann's skinks over that same period in the same location. Therefore, we are confident that our survey method for the 20 survey sites was sound for detecting basking/ active large-bodied skinks, as well as small-bodied skinks.

Within sites surveyed, individuals were identified using species characteristics (colour, pattern, lamellae and scale counts) as per Gill and Whitaker (1996) and van Winkel et al. (2019), as well as the author's experience with working with these lizard species in Otago, Canterbury and the Mackenzie Basin.

Habitat disturbed was carefully replaced. Animals handled were carefully replaced in secure repaired habitat or adjacent secure habitat.

All habitat searching and animal handling was undertaken in accordance with Wildlife Act Authority 91677-FAU.

Records of all lizards seen and/or caught have been lodged with the Herpetofauna database through the Amphibian and Reptile Database Scheme (ARDS) (Appendix A).

Plate 6. Deep talus boulder banks with coprosma and matagouri shrub cover where Mackenzie Basin skink were observed (outside of the TekPS lizard survey area).

3.3 Assessment of significance

An assessment of ecological significance was carried out against Canterbury Regional Policy Statement (CRPS) 9.3.1 (see below).

This was applied only in regard to lizard values, not other values relating to any other aspects of ecology.

An assessment of the potential scale and importance of effects on the canal, river and lake margins is also provided, using both the RPS significance criteria and the EIANZ assessment framework.

The EIANZ assessment framework assesses significance of effects using a matrix approach as described by the Environment Institute of Australia and New Zealand (EIANZ). The EIANZ matrix approach, and the guidelines within which it is included, has been developed as a guide for ecologists undertaking effects assessments under the RMA (EIANZ, 2018). The EIANZ guidelines and the impact assessment matrix in particular, provides a robust, concise and consistent approach to effects assessment, whilst ensuring that individual expert evaluation and opinion is preserved.

The guidelines have been updated since they were originally released in 2015. We have applied the 2nd Edition version (released in May 2018) which provides updates to parts of the values, magnitude, and level of effect analysis.

Canterbury Regional Policy Statement 9.3.1 Protecting significant natural areas

1. Significance, with respect to ecosystems and indigenous biodiversity, will be determined by assessing areas and habitats against the following matters:

a. Representativeness

b. Rarity or distinctive features

c. Diversity and pattern

d. Ecological context

The assessment of each matter will be made using the criteria listed in Appendix 3.

2. Areas or habitats are considered to be significant if they meet one or more of the criteria in Appendix 3.

3. Areas identified as significant will be protected to ensure no net loss of indigenous biodiversity or indigenous biodiversity values as a result of land use activities.

4.0 Results

4.1 Survey weather conditions

Lizard activity is closely linked to weather conditions. It is generally accepted that survey for day-active lizards in dryland areas is more effective during spring and autumn, rather than peak summer. Temperatures in summer in the Mackenzie Basin can often exceed 30^0 Celsius. The Department of Conservation uses a temperature range of 12^0 – 18^0 Celsius (sometimes 12^0 – 20^0) as a guide for recommending timing for lizard surveys, although this can differ between species. For example, successive years' catches of Lakes skink (Oligosoma aff. chloronoton 'West Otago') and McCann's skink in the upper Waitaki Basin as part of PRR recorded a considerable increase in catches over several years, and noted that may be as a result of successively higher temperatures during each year's survey period, rather than a benefit from pest control work (Welch et al. 2019).

For this survey we have followed the usual recommendation from DOC and assumed that fine, warm temperatures are preferable for the detection of basking and active lizards. Most of the temperatures during our survey period were warm and fine (Table 4).

Table 4. Climatic conditions during the survey. Source NIWA CliFlo National Database; Tekapo Station.

Date	Wind	Temp range; degrees C (9am – 5pm)	Rainfall
2 Nov 2020	slight	12.2/ 17.3	nil
3 Nov 2020	slight	8.1/ 15.9	nil
4 Nov 2020	slight	16.7/ 23.1	nil
5 Nov 2020	slight	16.7/ 23.2	nil
6 Nov 2020	slight	10.3/ 15.5	nil

4.2 Site survey effort

Survey effort for each site is described in Table 5. Generally, an average of around 60 minutes was spent searching viable habitat at the Canal sites, and around 90 minutes at the more complex/ habitat-rich Tekapo/ Takapō River and Lake edge sites.

Where sites were relatively small and where habitat was limited, most of the site was systematically searched. Where habitat was abundant and the site was large, several transects through representative sections of the site were thoroughly searched – amounting in most cases to a small portion of the overall site.

Table 5. Survey effort across sites and lizard detections. Proportion of site searched indicates proportion walked over, observed, searched but does not imply that all lizards were caught within that area (it is certain that only a small fraction were detected, even in the areas searched).

Site(s)	Area (ha)	Availability of habitat	Time spent searching (mins)	Proportion of site searched (%)	Lizard detections
Lake 1	Lake 1: 6.1 ha	Moderate	90	75 %	7 x Southern Alps gecko; 1 x McCann's skink
Lake 2	Lake 2: 45 ha	Low	130	25 %	13 x Southern Alps gecko; 2 x McCann's skink
Lake 3	Lake 3: 2.6 ha	Moderate	90	50 %	1 x Southern Alps gecko; 3 x McCann's skink
Tekapo 1	Tekapo 1: 0.7 ha	Low	45	100 %	5 x Southern Alps gecko
Tekapo 2	Tekapo 2: 1.1 ha	Low	30	50 %	2 x Southern Alps gecko; 2 x McCann's skink
Tekapo 3	Tekapo 3: 1.2 ha	Low	45	50 %	1 x Southern Alps gecko; 7 x McCann's skink
Tekapo 4	Tekapo 4: 2.4 ha	High	90	50 %	7 x Southern Alps gecko; 6 x McCann's skink
Tekapo 5	Tekapo 5: 6.8 ha	High	90	20 %	15 x Southern Alps gecko; 7 x McCann's skink
Tekapo 6	Tekapo 6: 5.6 ha	High	90	20 %	14 x Southern Alps gecko; 6 x McCann's skink
Tekapo 7	Tekapo 7: 6.2 ha	High	50	20 %	9 x Southern Alps gecko; 4 x McCann's skink
Tekapo 8	Tekapo 8: 4.3 ha	Moderate	70	50 %	17 x Southern Alps gecko; 2 x McCann's skink
Tekapo 9	Tekapo 9: 4.6 ha	High	70	25 %	15 x Southern Alps gecko; 3 x McCann's skink
Canal 1	Canal 1: 5.1 ha	Low	100	50 %	13 x Southern Alps gecko; 2 x McCann's skink
Canal 2	Canal 2: 2.6 ha	Low	70	75 %	1 x Southern Alps gecko; 2 x McCann's skink
Canal 3	Canal 3: 1.8 ha	Low	45	75 %	3 x McCann's skink
Canal 4	Canal 4: 0.35 ha	Low	30	75 %	1 x McCann's skink
Canal 5	Canal 5: 0.7 ha	Low	70	90 %	7 x Southern Alps gecko; 7 x McCann's skink
Canal 6	Canal 6: 0.6 ha	Low	50	90 %	2 x Southern Alps gecko; 9 x McCann's skink
Canal 7	Canal 7: 1.5 ha	High	90	90 %	3 x grass skink, 1 x McCann's skink
Canal 8	Canal 8: 0.5 ha	Low	20	100 %	nil

Plate 7. Lizard habitat along canal embankments and batters; loose rocks (top left), self-seeded tussocks (top right), self-seeded native woody vegetation (matagouri; bottom left), and erosion runnels with multi-layered rocks and longer grass (bottom right).

4.3 Survey results

Summary of results:

- 20 individual sites were assessed, covering lakeside, canal, and Tekapo/ Takapō River margins. Together these sites covered an estimated 40 ha which was searched for lizards to detect presence (based on the percentage searched of each site). A total of 200 lizards were recorded from within the sites; however, this reflects only the numbers recorded from targeted spot-searching and is certain to be a considerable underestimate of the actual numbers present in the areas searched.
- Three species of native lizard were recorded – McCann's skink, Southern Alps gecko and Canterbury grass skink (Plate 8).
- Southern Alps gecko and McCann's skink were found across most sites; relative abundance differed between sites but was generally inversely related to the level of past disturbance of the site.
- At the Tekapo/ Takapō River margin sites, Southern Alps gecko and McCann's skink occupied all habitat areas including river bank, terrace, riser, pebble, and boulder-bank areas. Populations of these species along the margins of the Tekapo/ Takapō River and its associated dry channels, floodplain areas and historic terraces would likely number in the 1,000s per kilometre of river.
- Canterbury grass skink was found at one site - along the riparian margins of a minimally disturbed section of the Mary Burn Stream near a culvert section of the Tekapo Canal.

Plate 8. Skink that keyed out as a Canterbury grass skink; one of five seen (but only one caught) among riparian boulder habitat at Canal site 7 (margins of the Mary Burn Stream).

- No other lizard species were recorded; jewelled gecko, scree skink, long-toed skink or Mackenzie Basin skink were not found within the study locations, although for all of those species habitat quality within the survey areas was poor and generally lacked key habitat aspects with which these species are usually associated.
- No exotic lizards or frogs were recorded.

In relation to the TekPS infrastructure and assets:

- Southern Alps gecko and McCann's skink were found along shorelines of Lake Tekapo/ Takapō (and were also found along the shoreline of Lake Pūkaki, although the water level of this lake is not influenced by Genesis) and, with individuals of Southern Alps gecko found up to 20 m closer to the lake water line than McCann's skink and within areas devoid of vegetation (i.e. suggestive of individuals occupying areas periodically inundated by lake water levels). A review of past aerial images for Lake Tekapo/ Takapō shows that some areas where Southern Alps gecko were recorded have been previously inundated as part of the normal change in water levels of the lake. Of the 21 Southern Alps geckos found along both lakeside shorelines, three (3) were found below vegetated shorelines within rock areas that most probably are inundated as lake levels rise. No McCann's skinks were found in similar lake bed locations.
- Southern Alps gecko and McCann's skink were found within all canal survey sites except one, with relatively abundant populations along batter slopes and toes of canal embankments. This was especially so where tussock and short dense woody vegetation had established along embankments slopes and within erosion runnels on batters where rocks were undermined, had accumulated, or where longer, denser grasses and woody vegetation had established (see Plate 7).
- Southern Alps gecko were found at the edge of the bed of the Tekapo/ Takapō River where no flow was present (Tekapo/ Takapō River sites 4 and 5 before the confluence with Fork Stream). Of the 70 Southern Alps geckos recorded along Tekapo/ Takapō River margin sites (sites 1-8, being in close proximity to the river edge), nine (9) were recorded in river stone areas devoid of vegetation and which appeared to be river bed that is occasionally inundated. No McCann's skinks were found in similar river bed locations.

Maps of lizard records for each survey site are provided in Appendix B.

Overall:

- Native lizards are common throughout the TekPS scheme areas.
- The most abundant species are Southern Alps gecko and McCann's skink – classified as At Risk – Declining and Not-Threatened species respectively - and both of which are very widely distributed in the local area and region. Populations of both species in the vicinity (ca. 200 m) of the TekPS, lake margins and Tekapo/ Takapō River are certain to be very large and are likely to number in at least the 1,000s in the immediate vicinity of the TekPS area.
- Southern Alps gecko appears to be a ready coloniser of new environments such as dry river bed of lakes and the dewatered section of the upper Tekapo/ Takapō River. Both Southern Alps gecko and McCann's skink are capable of colonising constructed habitats such as canal embankments and batter areas, even if habitat is sparse and of (apparent) low quality.

- The Canterbury grass skink was recorded from within only one of the survey sites, and its known habitat distribution within this part of the Mackenzie Basin suggests that it is only likely to be found around stream margins and damper habitats.
- No other lizard species were recorded.

Southern Alps gecko and McCann's skink are known widely from the local area, although most records (from the Herpetofauna database) are from the escarpment, set well back from the Tekapo/ Takapō River, and from inland sites. The results from this survey provide continuity of distribution for these species across habitats along the Tekapo/ Takapō River and lake margins near to Tekapo/ Takapō Township and Tekapo B Power Station, as well as along the constructed Tekapo Canal. The significance of these records could be best described as of 'local interest' only. The results add to the knowledge that both species are widely-distributed and show great plasticity in their use of natural, degraded and novel habitats.

The Canterbury grass skink is very abundant in parts of its range in eastern and central Canterbury, but is far less frequently encountered in the Mackenzie Basin, at the western extent of its distribution. There are far fewer records of the species in the Herpetofauna database – which may reflect the focus of surveys on dry-land large-bodied skinks, but may also reflect the more limited distribution of the species to damper, more humid environments in the Tekapo (and Mackenzie Basin) area. Whatever the reason, the records from this survey add another population of this At-Risk listed species to its known distribution in the local area.

5.0 Tekapo Power Scheme Effects Assessment

5.1 Context

The effects of scheme construction activities – habitat removal and population loss – occurred many decades ago, and while acknowledging that construction activities may have affected lizard populations, albeit to an unknown, and unquantifiable extent, they are not addressed further in this report. Pressures on native lizards due to the introduction and spread of introduced mammalian predators, and potential changes to habitats from the introduction and spread of exotic plants have occurred independent of the operation of the TekPS.

Adverse effects that may potentially occur due to the ongoing operation of the TekPS as associated with the water permits being sought, relate to river flows. This assumes that the operating regime for lake levels and recreational release flows in the upper Tekapo/ Takapō River continue as are currently allowed for (as Genesis is seeking in its applications). In addition, while not strictly associated with the water permits (and have their own separate consents or are permitted activities), vegetation maintenance within the scheme, including mowing or weed control along the canal, has the potential to adversely affect native lizards. It is however noted that native lizards have been found, and obviously can live within, such managed environments.

1. River flows: Mortality of Southern Alps gecko if releases of flows into the upper Tekapo/ Takapō River result in swiftly rising waters that inundate lizards that have moved into vacant river bed margin habitat (ie. not the banks or historic vegetated river terraces). This contrasts with the lake margin areas, where periodic inundation would be a more gradual process, and would presumably allow animals to retreat to higher ground.

There are two additional potential adverse effects that may result from the operation of the TekPS scheme. Both relate to the canal structure, rather than the operating regime for lake levels and recreational release flows, and therefore are not considered further in this assessment.

3. Maintenance works: Mortality, injury or loss of fitness (health) from the removal of vegetation along canal embankments and infilling or land rehabilitation works for erosion features that have resulted in lizard habitat and colonisation by lizards (as was recorded in many places within canal batter/ embankment survey sites). Removal of self-established woody vegetation may be via herbicide spraying or manual removal – either way, it will result in the loss of habitat and potential injury to lizards using these areas.

4. Population fragmentation: If Canterbury grass skink populations along streams bisected by the Tekapo Canal have suffered population fragmentation (as is likely) and if these population effects are ongoing – such as through a lack of gene flow – the presence of the canal could contribute to a progressive decline of Canterbury grass populations associated with the canal streams. Over time that could potentially lead to localised loss of population fitness or loss of stream populations if gene flow at the level potentially affected is important for these populations. The severity and significance of this is unknown and potential effect considered here is speculative.

5.2 Significance of effects - RPS

Potential adverse effects may occur in regard to river flows on the upper Tekapo/ Takapō River. Potential adverse effects on lizards along the canal system are not considered with regard to an assessment under the RMA 1991 as canal maintenance works are authorised under the existing consents held by Genesis and do not relate to the operating regime for lake levels and recreational release flows which are the focus of this effects assessment. In addition, the likelihood of potential adverse effects occurring on lizards due to rise in lake levels is considered to be very low, as lizards are likely to move to higher ground as water levels gradually increase.

Therefore, the only aspect considered under this significance assessment is the river bed margin of the upper Tekapo/ Takapō River (i.e. that part that is between the river banks and the normal flow channel of the river) as that is all that is potentially affected under the renewal of resources being sought by Genesis. We note that these changes to the river flows relating to recreational release flows is a continuation of an existing activity and is considered part of the existing environment i.e. it is not a new activity against which an assessment of effects of a new activity is being applied for.

In terms of significance of the upper Tekapo/ Takapō River margins as habitat for Southern Aps gecko, an assessment is provided in Table 6. The assessment concludes that the river margins do meet the criteria for qualifying habitat as ecologically significant under the RPS criteria (based only the presence of Southern Alps gecko (as an At Risk- Declining lizard species) using this habitat.

Table 6. Assessment of level of ecological effects using the EIANZ matrix method for the upper Tekapo/ Takapō River bed margin with respect to Southern Alps gecko. Explanation of terms used in the RPS is provided by Appendix 3 of the RPS and the accompanying publication by Wildlands (2013).

Criterion & Description	Assessment against potential effects on lizards
1. Representativeness Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district.	The boulder/ rock habitat is not vegetated and constitutes habitat that is used at a very low level of occupancy by Southern Alps gecko compared to adjoining river terraces where Southern Alps gecko are abundant. It is not core or typical habitat for this species. This criterion is NOT MET.
2. Representativeness Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	The area of boulder/ rock habitat within the river bed and which may be affected by recreational flow is a small portion of the Tekapo/ Takapō River and a considerably smaller portion of similar river bed when considered across the ecological district. This criterion is NOT MET.
3. Rarity/ Distinctiveness Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, or ecological district, or freshwater environment.	Southern Alps gecko is very widely distributed in the ecological district and region. While local density is likely to have been reduced by land change and introduced predators, the extent of its distribution is extensive and covers most of the ecological district. This criterion is NOT MET.
4. Rarity/ Distinctiveness	Southern Alps gecko is classified as At Risk -Declining. This criterion is MET.

Indigenous vegetation or habitat of indigenous fauna that support an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.	
5. Rarity/ Distinctiveness The site contains indigenous vegetation or an indigenous species as its distribution limit within Canterbury or nationally.	The habitat contains no vegetation. The site is not at a distributable limit for Southern Alps gecko. This criterion is NOT MET.
6. Rarity/ Distinctiveness Indigenous vegetation or an association of indigenous species that is distinctive, or restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combination of factors.	There is no vegetation within the site. This criterion is NOT MET.
7. Diversity and Pattern Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.	In terms of lizard communities, the dry river bed is only used by Southern Alps geckos (it does not support a high diversity of lizard species) and does not support changes to lizard species community that reflect diverse natural features or diverse gradients. This criterion is NOT MET.
8. Ecological Context Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.	The river bed habitat is marginal habitat for Southern Alps gecko and does not provide a connection of linkage to other more important habitat. This criterion is NOT MET.
9. Ecological Context A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.	The site is not a wetland. This criterion is NOT MET.
10. Ecological Context Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges form predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.	Based on the frequency of captures inferred density of geckos within the site compared to the adjoining river terraces and margins, the dry river bed areas do not constitute key habitat or important refuges places for this species at a population level. At an individual animal level, the rocky nature of the river bed areas provides refuges from predators (as does every other instance of habitat in which animals live). This criterion is NOT MET.

The level of effect of the potential loss of lizards due to river flows is very low as few individuals relative to the overall local population will be affected. The RPS requires that any habitat that qualifies as ecologically significant will be protected to ensure that no net loss of indigenous biodiversity or indigenous biodiversity values results due to land use activities.

5.3 Level of effect – EIANZ assessment

The three key inputs into an assessment of the level of ecological effects under the EIANZ assessment framework is provided by:

- An assessment of the values of the ecological components potentially affected (Tables 5 and 6 of the EIANZ guidance; see Appendix C);
- An assessment of the magnitude of the effects on those values (based on criteria listed in Table 8 of the EIANZ guidance; measured in the context of the local Ecological District); and
- The application of a matrix (Table 10 of the EIANZ guidance) which indicates the potential level of effect based on the ecological value of the site or species assessed and the magnitude of effect.

The level of effect resulting from the matrix analysis can range from 'net-gain' through to 'very high' depending on the various inputs.

Level of effect can then be used as a guide to the extent and nature of the ecological management response required, as outlined in the EIANZ Guidance as follows:

- Project effects in the 'Very High adverse' category are unlikely to be acceptable on ecological grounds alone (even with offset or compensation proposals). Activities having very high adverse effects should be avoided. Where very high adverse effects cannot be avoided (and where policy allows), ecological offsetting or compensation with a net biodiversity gain would be appropriate.
- Project effects in the 'High adverse' or 'Moderate adverse' category represent a level of effect that should be managed through avoidance, design, or offset or compensation actions. Wherever adverse effects cannot be avoided, no net loss of biodiversity values would be appropriate.
- Project effects in the 'Low adverse' and 'Very Low adverse' categories should not normally be of ecological concern, although normal design, construction and operational care should be exercised to minimise adverse effects. If effects are assessed taking impact management developed during project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure Low or Very Low-level effects.
- Project effects in the 'Very Low adverse' category can generally be considered to be classed as 'no more than minor' effects.

The following location-specific factors have been included in the analysis for this study:

- Southern Alps gecko and McCann's skink are listed as 'At Risk – Declining' and 'Not Threatened' (respectively) in the DOC threat classification. The population of both species are locally very large; and
- Potential loss of Southern Alps gecko and McCann's skink through operations of the TekPS scheme as would be undertaken under the range of consents being applied for (water permits only), would constitute a very small portion of the overall populations in the local area.

The EIANZ effects matrix approach is applied in Table 7.

Table 7. Assessment of level of ecological effects using the EIANZ matrix method.

Factor	Value of resource[a]	Magnitude of effect[b]	Level of effect[c]
Loss of Southern Alps gecko due to river flows	High	Negligible	Very Low
Loss of McCann's skinks due to river flows	Low	Negligible	Very Low

[a] EIANZ matrix tables 5 and 6.

[b] EIANZ matrix table 8; measured in the context of the catchment (wetlands/ streams) or District (terrestrial values).

[c] EIANZ matrix table10.

The level of potential effects in terms of loss of ecology values is assessed as 'Very low'.

Using EIANZ this 'Very low' level of ecological effect is equivalent to 'no more than minor' when considered in the context of potential effects on the environment.

Where the level of effects is anticipated to be 'Very low', the EIANZ guidelines recommend that normal design, construction and operational care should be exercised to minimise adverse effects.

In relation to vegetation maintenance activities within the scheme, including mowing and/or weed control along the canal, while not associated with the water permits being sought, I suggest that Genesis consider the potential presence of lizards within appropriate habitats as identified in this report when undertaking such activities.

5.4 Effects Management

The renewal of resource consents for the operation of the TekPS will result in the continuation of potential adverse effects on native lizards – although the level of effect is considered to be very low. There will be no change to the existing baseline of the level of adverse effect resulting on the receiving environment. This is relevant, as the existing environment therefore incorporates the existing level of impacts on native lizards – including possible death or injury due to recreational flushing flows on the river.

The level of effect that is therefore considered under the RPS with respect to the dry river bed margins as being of ecological significance, the effect of granting the consents applied for will be no new level of effect. Therefore, the level of effect relative to the existing environment with respect to native lizards will be nil.

There is therefore no effects management response required, as there will be no loss of biodiversity or loss of biodiversity values on the dry river margins. For the EIANZ assessment, the low level of adverse effect is reduced to no effect once the existing baseline is taken into consideration.

While the loss of native lizards to the extent anticipated may not trigger specific requirements under the RMA, the loss of any native lizard to the TekPS may trigger the need for a Wildlife Act Authority from DOC to relocate or kill Absolutely Protected Species under the Wildlife Act. This is generally required where activities may affect native lizards (all of which are protected under the Wildlife Act). We acknowledge that relocation of lizards is unlikely to be practicably feasible.

5.5 PRR

Where positive environmental outcomes are supported by Genesis as part of its operating and environmental principles, offset or compensation for losses to native lizard populations should be encouraged.

Project River Recovery is the key programme that can potentially result in beneficial outcomes for native lizards, through its focus on weed control and nesting bird protection across very large areas of the upper Waitaki Basin.

In recent years of PRR, a focus on whole-of-ecosystem protection has included a broader work on pest animal management, and, since 2016, has included annual monitoring of a population of Lakes skink (Oligosoma aff. chloronoton 'West Otago'; Threatened: Nationally Vulnerable) in order to better assess if there are benefits of pest animal control on a broader suite of native species.

From the most recent three years of annual reports that we have reviewed (2016-2018; Welch et al. 2017, 2018, 2019) there is an emerging trend of increasing catches of Lakes skinks within a core area of animal pest control, although as the authors point out, this improvement in lizard catches could also be due to ambient air temperatures during each successive survey.

The trapping programme for PRR includes extensive broad-scale trapping of introduced mammalian predators of native lizards (as part of protection work for braided river birds) in the Tasman Valley (18 years of operation) and the upper Ohau River (13 years of operation). Given the known impacts of introduced animals on native lizard populations – particularly feral cats and mustelids in dryland environments (e.g. Middlemiss 1995[2]), the benefits of sustained pest control are anticipated to be great.

The likely benefits of the work undertaken by PRR for controlling lizard predators over a large scale, and the potential conservation benefits on Threatened as well as less rare lizard species in those areas, is likely to provide a conservation benefit that greatly exceeds the very low level of adverse effects that may be caused by the re-consenting of the TekPS scheme on native lizards.

[2] See also popular articles such as a recent record (May 2020) of a feral cat caught at Kaitorete Spit, Christchurch with 17 native lizards in its stomach (https://www.stuff.co.nz/environment/121645434/feral-cat-found-with-17-dead-native-lizards-in-its-stomach), or the regurgitated remains of 28 native lizards from a cat's meal found in central Otago in May 2021 https://www.stuff.co.nz/environment/126460978/calls-for-tighter-cat-controls-after-cat-devours-28-native-lizards).

6.0 References

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Report prepared by:

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Graham Ussher

Principal Ecologist

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Appendix A

ARDS card

ARDS CARD

NEW ZEALAND AMPHIBIAN/REPTILE DISTRIBUTION SCHEME
Herpetofauna Administrator, Department of Conservation, P.O. Box 644, Napier.

Bioweb-Herpetofauna Card No:

Observer: GT (Initials) Ussher (Surname)

Date: 2-6 Nov 2020

Alt (m) 710m

Locality Name: Tekapo, Tekapo

Address: Tekapo River Tekapo

Easting Northing

GPS Series

Map No. Easting Northing

Affiliation: RMA Ecology Ltd

Area Office: Conservancy: Ecol. District: Tekapo

Species name	No.	Time	Habitat	Weather
Oligosoma maccanni	66	9am-5pm	10, D, F	1+2, 2, 1+2
Oligosoma aff. polychroma Clade 4	3	9am-5pm	10, D, F	1+2, 2, 1+2
Woodworthia sp. 'Southern Alps'	131	9am-5pm	10, D, F	1+2, 2, 1+2

Voucher specimen(s) No Specify:
Photograph(s) No
Extra notes on reverse side Yes

Notes:
Found during survey of Tekapo Power Scheme along Tekapo Canal, Tekapo/ Takapō River margins and Lake Pūkaki

Identified by: Graham Ussher
Authority used: GTU and Gill & Whitaker/ van Winkel et al.

Weather

Light
1 Fine/Sunny
2 Part Cloudy
3 Overcast
4 Showers
5 Rain
6 Night
7 0-½ Moonlit
8 ½-1 Moonlit

Temperature
1 Hot
2 Warm
3 Moderate
4 Cool
5 Cold

Wind
1 Calm
2 Light breeze
3 Mod breeze
4 Gusty
5 Strong winds

Major Habitat Types
1 Beech Forest
2 Podocarp forest
3 Broadleaf forest
4 Exotic forest
5 Scrub
6 Sub-alpine
7 Alpine
8 Undeveloped tussock land
9 Developed farmland
10 River terrace
11 Fresh water
12 Wet land
13 Coastal
14 Scree
15 Bare rocks
16 Beach
17 Urban
18
19
20

Micro habitats
A Foliage
B Trunk
C Branches
D Under stones
E Under wood
F Open ground
G Crevices
H

See attached table for individual lizard location coordinates: coordinate system (WGS_1984_Web_Mercator_Auxiliary_Sphere)

OBJECTID	label - species	x	y
1	McCann's skink x 3	170.2086656	-44.11829893
2	Southern Alps gecko	170.2086329	-44.11853329
3	Southern Alps gecko	170.2166554	-44.12402079
4	Southern Alps gecko x2	170.2170284	-44.12401926
5	Southern Alps gecko x2	170.2174797	-44.12362881
6	Southern Alps gecko	170.2170948	-44.12294104
7	Southern Alps gecko x3	170.2154895	-44.12292126
8	Southern Alps gecko	170.2153416	-44.12379461
9	Southern Alps gecko	170.2212074	-44.12277487
10	McCann's skink	170.2208037	-44.12233641
11	McCann's skink	170.2207857	-44.1220034
12	McCann's skink	170.2270788	-44.11857235
13	McCann's skink x2	170.2282953	-44.11837026
14	McCann's skink	170.2280774	-44.11857935
15	McCann's skink	170.2276492	-44.11883127
16	Southern Alps gecko x2	170.2567381	-44.08144664
17	Southern Alps gecko x4	170.2569393	-44.08159867

ARDS card Tekapo Nov2020

OBJECTID	label - species	x	y
18	McCann's skink	170.2571993	-44.0815621
19	McCann's skink	170.2570631	-44.08186208
20	Southern Alps gecko	170.2570271	-44.0817561
21	McCann's skink	170.2583894	-44.08119983
22	McCann's skink	170.2580179	-44.08119438
23	McCann's skink	170.2580798	-44.08113504
24	McCann's skink x2	170.2580463	-44.08110859
25	Southern Alps gecko	170.2581504	-44.08106974
26	McCann's skink	170.265898	-44.07943272
27	McCann's skink x2	170.26558	-44.0795141
28	McCann's skink	170.2656079	-44.0796377
29	McCann's skink	170.2657148	-44.07959788
30	Southern Alps gecko	170.2664543	-44.07943992
31	McCann's skink	170.2664393	-44.07939726
32	McCann's skink	170.2664531	-44.07937375
33	McCann's skink	170.2658033	-44.07970995
34	McCann's skink	170.2656695	-44.07973363
35	Southern Alps gecko	170.2653633	-44.07989041
36	McCann's skink	170.2904658	-44.07897535
37	Grass skink	170.2904149	-44.07889996
38	Grass skink	170.2906078	-44.0790294
39	Grass skink	170.2907594	-44.0790736
40	Southern Alps gecko	170.4282909	-44.06690768
41	Southern Alps gecko	170.4281934	-44.06673887
42	Southern Alps gecko x2	170.4282727	-44.06658167
43	Southern Alps gecko	170.4282122	-44.06551775
44	McCann's skink	170.4282987	-44.06522992
45	McCann's skink	170.4290203	-44.06433557
46	Southern Alps gecko x2	170.4287153	-44.06488052
47	Southern Alps gecko x2	170.4289828	-44.0652305
48	Southern Alps gecko x3	170.4288976	-44.06545267
49	Southern Alps gecko x 2	170.4292366	-44.06620441
50	Southern Alps gecko x 3	170.4294619	-44.06654747
53	Southern Alps gecko	170.435262	-44.07850693
54	Southern Alps gecko	170.4353963	-44.0782999
55	Southern Alps gecko	170.4355087	-44.07753606
56	Southern Alps gecko	170.4355175	-44.07736259
57	McCann's skink	170.4356265	-44.07721851
58	Southern Alps gecko	170.4356421	-44.0771178
59	McCann's skink	170.4349055	-44.07734223
60	Southern Alps gecko	170.4349116	-44.07736591
61	Southern Alps gecko	170.4348758	-44.07740362
62	McCann's skink	170.4347839	-44.07746787
63	Southern Alps gecko	170.4348368	-44.077245
64	Southern Alps gecko	170.4350408	-44.07696592
65	Southern Alps gecko	170.4350789	-44.0769111
66	Southern Alps gecko	170.4353728	-44.07616771
67	Southern Alps gecko	170.4354935	-44.07486537
68	Southern Alps gecko	170.4357517	-44.07422483

ARDS card Tekapo Nov2020

OBJECTID	label - species	x	y
69	Southern Alps gecko	170.4349832	-44.07317055
70	Southern Alps gecko	170.4348042	-44.07332827
71	Southern Alps gecko	170.4372608	-44.06405008
73	Southern Alps gecko	170.4361186	-44.0639759
74	Southern Alps gecko	170.4354845	-44.06391987
75	Southern Alps gecko	170.4347226	-44.06360395
76	Southern Alps gecko	170.4347076	-44.06344809
77	Southern Alps gecko	170.4348195	-44.06329684
78	Southern Alps gecko	170.4351296	-44.06307774
79	Southern Alps gecko	170.435399	-44.06231817
80	McCann's skink	170.435499	-44.06179562
81	McCann's skink x2	170.4356451	-44.06143895
82	McCann's skink	170.4358738	-44.06168236
83	Southern Alps gecko	170.4367221	-44.06203767
84	Southern Alps gecko	170.4418739	-44.04733914
85	Southern Alps gecko	170.4418472	-44.04731578
86	Southern Alps gecko x3	170.4416844	-44.04716968
87	Southern Alps gecko	170.4416353	-44.04711138
88	Southern Alps gecko	170.4418701	-44.04684555
89	McCann's skink	170.4422557	-44.04641837
90	Southern Alps gecko	170.4425241	-44.04626335
91	McCann's skink	170.442602	-44.04591751
92	McCann's skink	170.4430736	-44.04526095
93	McCann's skink	170.4447406	-44.04363583
94	Southern Alps gecko x2	170.4448255	-44.04382203
95	Southern Alps gecko	170.4446345	-44.04458043
96	McCann's skink	170.444313	-44.0451799
97	Southern Alps gecko	170.4443442	-44.04512802
98	Southern Alps gecko	170.4438392	-44.04575247
99	Southern Alps gecko	170.4436517	-44.04604667
100	McCann's skink	170.443138	-44.04639364
101	McCann's skink	170.4492209	-44.03627958
102	Southern Alps gecko	170.4491262	-44.03621734
103	Southern Alps gecko	170.4482796	-44.03575428
104	McCann's skink	170.448262	-44.03576592
105	Southern Alps gecko	170.4485554	-44.03552646
106	Southern Alps gecko	170.4491589	-44.03535614
107	Southern Alps gecko	170.4492916	-44.03534273
108	Southern Alps gecko	170.4500707	-44.03507652
109	Southern Alps gecko	170.4499824	-44.03500092
110	Southern Alps gecko	170.4497142	-44.03510779
111	Southern Alps gecko	170.448358	-44.03565504
112	Southern Alps gecko	170.4480527	-44.03580357
113	McCann's skink	170.4478967	-44.03600733
114	Southern Alps gecko	170.4473786	-44.03651699
115	Southern Alps gecko	170.447247	-44.03664809
116	McCann's skink	170.446911	-44.03702481
117	McCann's skink	170.4467706	-44.03732057
118	Southern Alps gecko	170.4468517	-44.03730967

ARDS card Tekapo Nov2020

OBJECTID	label - species	x	y
119	McCann's skink	170.4476787	-44.03736315
120	Southern Alps gecko	170.4479841	-44.03734286
121	Southern Alps gecko	170.4493918	-44.0370306
122	McCann's skink	170.4503478	-44.03635296
123	Southern Alps gecko	170.4540965	-44.02732196
124	Southern Alps gecko	170.4536694	-44.0275504
125	McCann's skink	170.453604	-44.02753159
126	McCann's skink	170.4536481	-44.02742049
127	Southern Alps gecko	170.4543467	-44.02649538
128	Southern Alps gecko	170.4551081	-44.02582638
129	Southern Alps gecko	170.4547559	-44.02545766
130	Southern Alps gecko	170.454672	-44.02544701
131	Southern Alps gecko	170.4541852	-44.02597625
132	McCann's skink	170.4536127	-44.0264831
133	McCann's skink	170.4535514	-44.02661881
134	McCann's skink	170.4533422	-44.02677571
135	McCann's skink	170.4529467	-44.02753625
136	McCann's skink	170.4670687	-44.01575665
137	McCann's skink	170.467115	-44.01580954
138	McCann's skink	170.4672189	-44.01587635
139	McCann's skink	170.4672485	-44.01590349
140	McCann's skink	170.4673992	-44.01657632
141	McCann's skink	170.4671751	-44.01676131
142	Southern Alps gecko	170.4666417	-44.01704764
143	McCann's skink	170.4668049	-44.01629167
144	Southern Alps gecko	170.4761047	-44.01127037
145	Southern Alps gecko	170.4758656	-44.01194859
146	Southern Alps gecko	170.4761275	-44.01149331
147	Southern Alps gecko	170.4761277	-44.01143193
148	Southern Alps gecko	170.4769186	-44.01014807
149	Southern Alps gecko	170.4773676	-44.0138916
150	Southern Alps gecko	170.4772139	-44.01397772
151	McCann’s skink	170.4767227	-44.01343914
152	McCann’s skink	170.4768534	-44.0116082
153	Southern Alps gecko	170.4831332	-43.93526775
154	Southern Alps gecko	170.4863865	-43.93910604
155	Southern Alps gecko	170.4867222	-43.93903567
156	McCann's skink	170.4875895	-43.93833318
157	Southern Alps gecko	170.4868873	-43.94398992
158	Southern Alps gecko	170.4873075	-43.94393388
159	Southern Alps gecko	170.4870466	-43.94394591
160	Southern Alps gecko	170.4916083	-43.94468021
161	Southern Alps gecko	170.4930802	-43.94368721
162	Southern Alps gecko	170.4963645	-43.93831223
163	Southern Alps gecko	170.4966767	-43.9377677
164	Southern Alps gecko	170.4973475	-43.93735208
165	Southern Alps gecko	170.4979424	-43.93847685
166	McCann's skink	170.4978176	-43.93856609
167	Southern Alps gecko	170.4968499	-43.93901057

ARDS card Tekapo Nov2020

OBJECTID	label - species	x	y
168	Southern Alps gecko	170.5352441	-43.96481032
169	Southern Alps gecko	170.5367071	-43.96294455
170	Southern Alps gecko	170.536721	-43.96255475
171	Southern Alps gecko	170.5369459	-43.96229403
172	Southern Alps gecko	170.5323581	-43.96478609
173	Southern Alps gecko	170.5309538	-43.9639368
174	McCann's skink	170.5305979	-43.96368382
175	Southern Alps gecko	170.5302405	-43.96343273
176	Southern Alps gecko x 2	170.2160909	-44.12430349
177	McCann's skink	170.2164611	-44.12421878
178	McCann's skink	170.2168505	-44.12407476
179	Southern Alps gecko	170.2166547	-44.12414638
180	Mackenzie Basin skink x 3 observed	170.4430382	-44.07760963

Appendix B

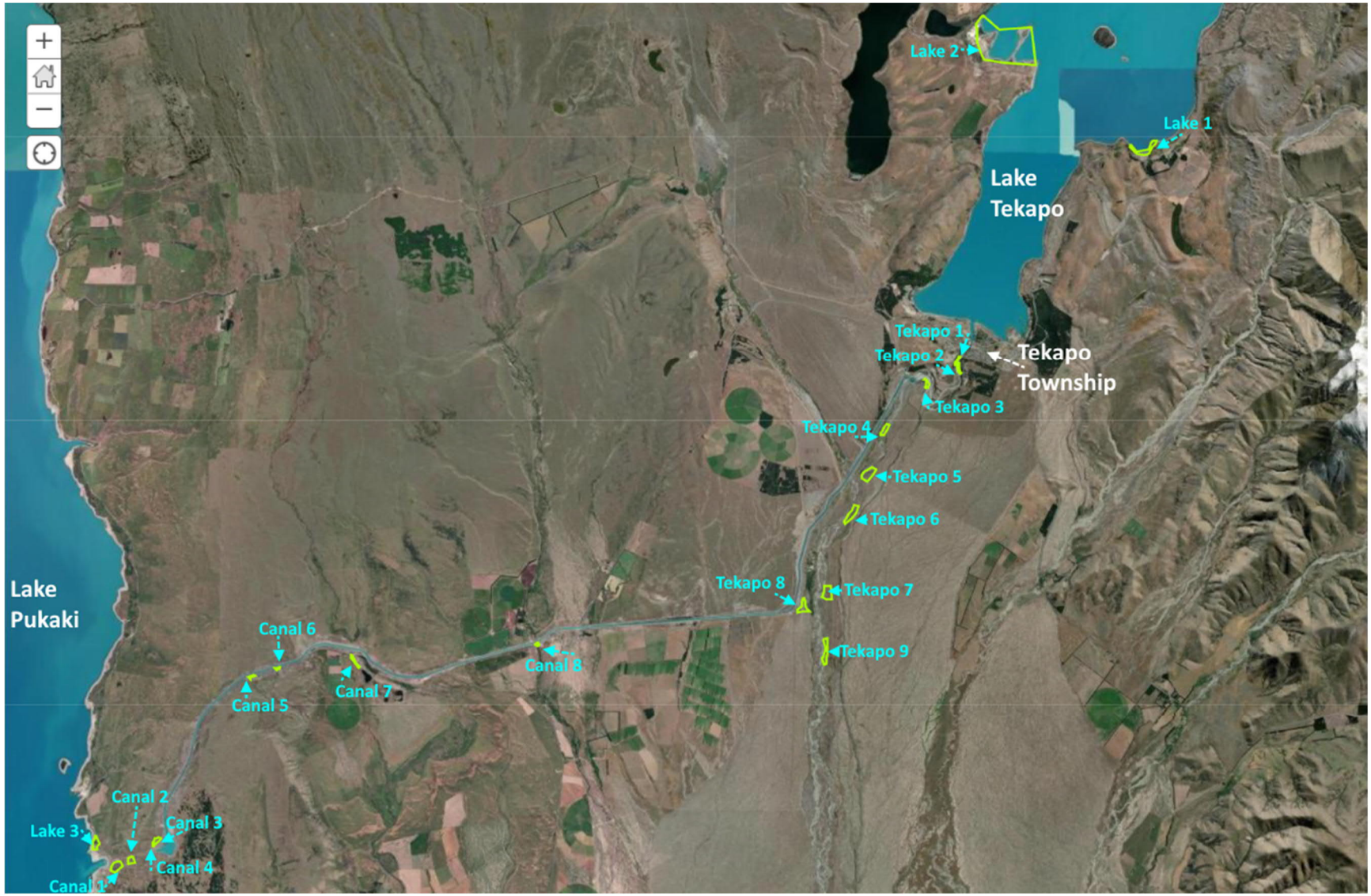
Site maps for survey locations and lizards recorded.

Red points represent lizard records noted in this survey.

Yellow points are records of lizards from the national Herpetofauna database.

Green line boundaries represent approximate survey site boundary.

Site map


Lake 2
Lake 1
Lake
Tekapo
Tekapo 1
Tekapo 2
Tekapo
Township
Tekapo 3
Tekapo 4
Tekapo 5
Tekapo 6
Tekapo 8
Tekapo 7
Tekapo 9
Lake
Pukaki
Canal 6
Canal 8
Canal 7
Canal 5
Canal 2
Canal 3
Lake 3
Canal 4
Canal 1

Lake 1


Southern Alps gecko
Southern Alps gecko
Lake 1
Southern Alps gecko
McCann's skink
Southern Alps gecko
Southern Alps gecko
Southern Alps gecko
100m

Lake 2


southern Alps gecko
Southern Alps gecko
Lake 2
Southern Alps gecko
Southern Alps gecko
Southern Alps gecko
McCann's skink
McCann's skink
Southern Alps gecko
Southern Alps gecko
Southern Alps gecko
Southern Alps gecko
Southern Alps gecko

Lake 3

Canal 1


Southern Alps gecko x3
Southern Alps gecko
Southern Alps gecko x2
Southern Alps gecko
Canal 1
Southern Alps gecko x2
McCann's skink
Southern Alps gecko
McCann's skink
Southern Alps gecko x 2
0
20
40m

Canal 2


McCann's skink
McCann's skink
Canal 2
Southern Alps gecko
0
20
40m

Canal 3 and 4


Canal 3
McCann's skink x2
McCann's skink
McCann's skink
Canal 4
0
20
40m

Canal 5


Southern Alps gecko
McCann's skink x2
McCann's skink
McCann's skink
McCann's skink
Canal 5
Southern Alps gecko x2
McCann's skink
Southern Alps gecko x4
Southern Alps gecko
McCann's skink
0
10
20m

Canal 6

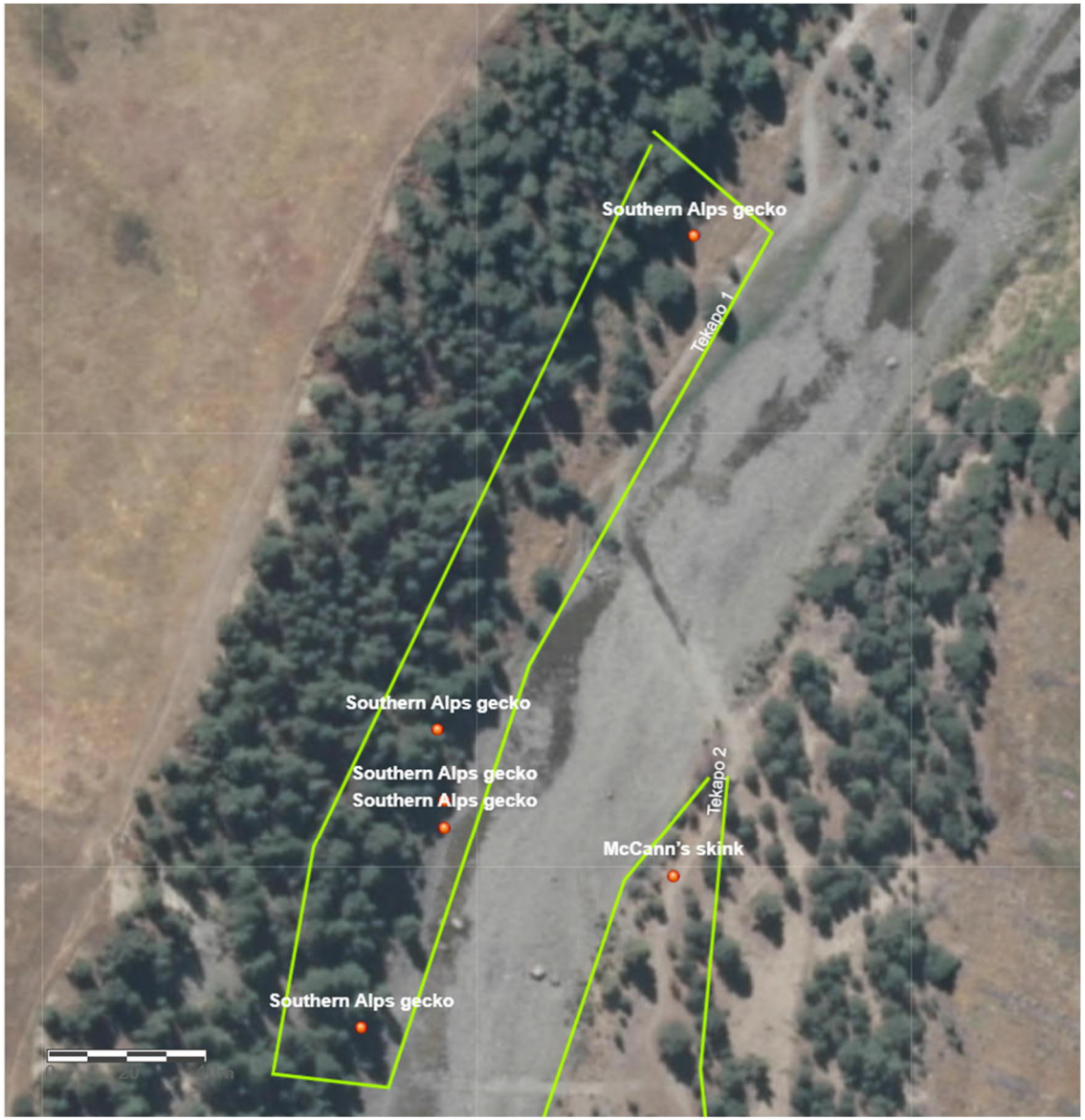

McCann's skink
McCann's skink
McCann's skink
Southern Alps gecko
McCann's skink x2
McCann's skink
McCann's skink
McCann's skink
McCann's skink
Canal 6
Southern Alps gecko
0
5
10m

Canal 7


Grass skink
McCann's skink
Grass skink
Grass skink
Canal 7
0
20
40m

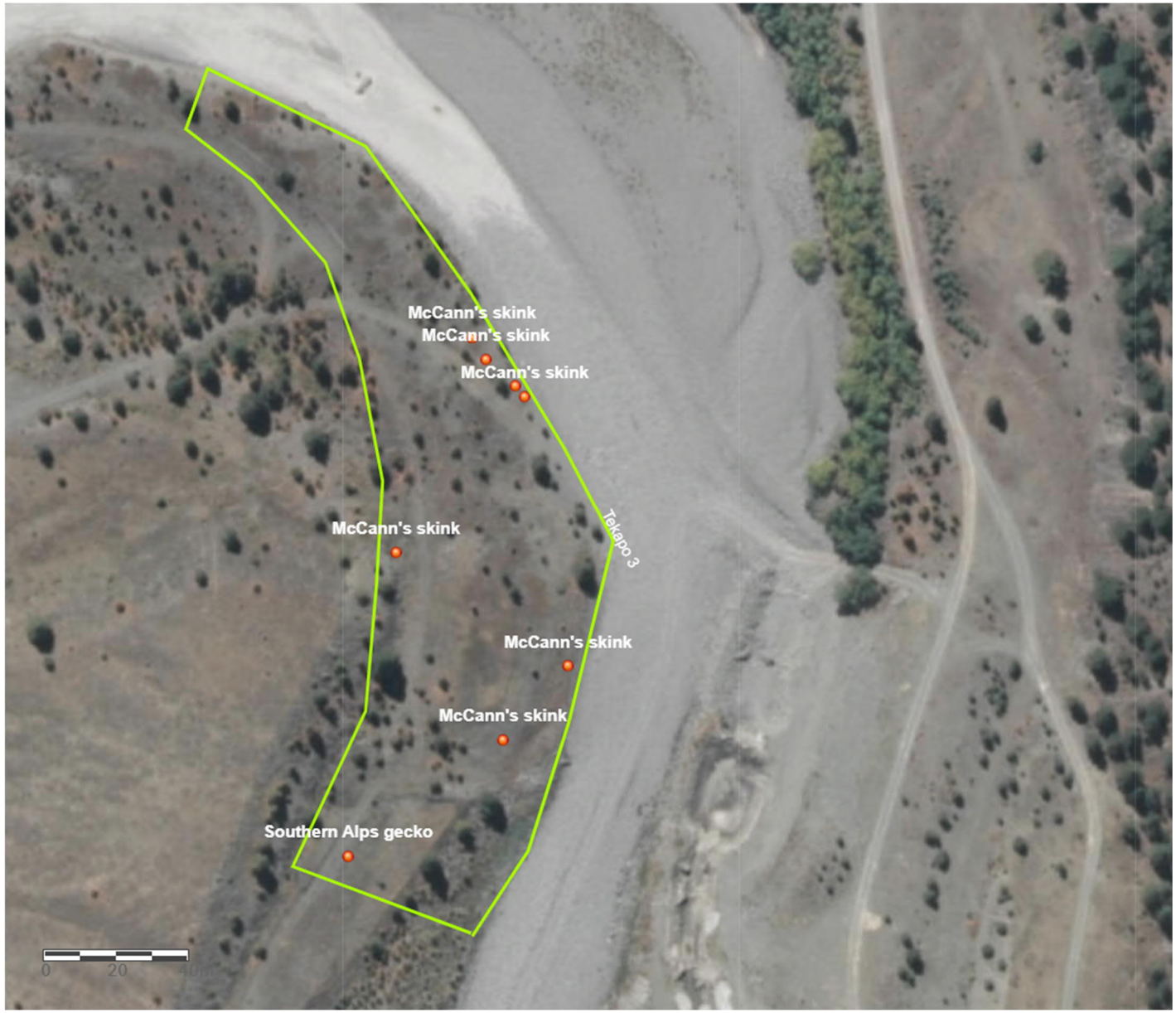
Canal 8

Tekapo/ Takapō River 1 (and top part of site 2)



Tekapo/ Takapō River 2 (and southern part of site 1)

Tekapo/ Takapō River 3



Tekapo/ Takapō River 4

Tekapo/ Takapō River 5

Tekapo/ Takapō River 6

Tekapo/ Takapō River 7

Tekapo/ Takapō River 8

Tekapo/ Takapō River 9

Appendix C

EIANZ tables for assessing level of ecological effect.

Table 5 Factors to consider in assigning value to terrestrial species for EcIA

Determining factors	
Nationally Threatened species, found in the ZOI either permanently or seasonally	Very High
Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

Table 6. Scoring for sites or areas combining values for four matters in Table 4.

Value	Description
Very High	Area rates High for 3 or all of the four assessment matters listed in **Table 4**. Likely to be nationally important and recognised as such.
High	Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or Area rates High for 1 of the assessment maters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder.

Table 8. **Criteria for describing magnitude of effect** (Adapted from Regini (2000) and Boffa Miskell (2011))

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

Table 10. **Criteria for describing level of effects** (Adapted from Regini (2000) and Boffa Miskell (2011))

Ecological Value ▸ Magnitude ▾	Very high	High	Moderate	Low	Negligible
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very Low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain