Appendix J

Ecological Impact Assessment
(NZ Ecology) and Vegetation Report
(Opus)

Ecological Impact Assessment

McPherson Quarry

Prepared for McPherson Resources Ltd

15 October 2019

Report Number 1708203-001 V5

ECOLOGY NEW ZEALAND

Document Sign-Off

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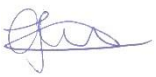
	Connor Whiteley Senior Ecologist Ecology New Zealand Limited	
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1. INTRODUCTION

This report[1], prepared by Ecology New Zealand Limited (ENZL) for McPherson Resources Ltd ('the client'), presents the results of an Ecological Impact Assessment (EIA) undertaken at McPherson Quarry, 47 McPherson Road, Pokeno, Waikato ('the site')[2]. It provides an assessment of the current terrestrial fauna and aquatic values found within 'Stages 1, 2 & 3' of the proposed quarry expansion and overburden storage areas at the site.

1.1. Background[3]

McPherson Resources Limited proposes to expand its operation at the McPherson's Quarry to extract aggregate from a greater area to meet the increasing demand within the district. The quarry is operating with existing use rights and will require a resource consent to continue future operations and to provide storage areas for overburden removed from the quarry site. Most of the quarry expansion footprint and overburden storage areas impact upon vegetation of negligible value (pasture and gorse). However, the expansion footprint also impacts upon relatively small areas of regenerating native forest located within the boundary of a Significant Natural Feature (SNF), being a Significant Natural Area (SNA) identified in the Operative Waikato District Plan. Therefore, an assessment of the effects of future quarrying operations on ecological values is considered necessary to support resource consent application.

1.2. Purpose and Scope

This report is intended to be read as supplementary information to the *McPherson Quarry Vegetation Assessment Report prepared by WSP-Opus, 2018*. The purpose of this report is to evaluate the current terrestrial fauna and aquatic values within the site, which have yet to be assessed in detail.

The scope of this report comprises the following:

- A description of the terrestrial fauna and aquatic values;
- An assessment of effects on terrestrial fauna and aquatic values; and
- Recommendations to avoid, remedy, mitigate or offset adverse ecological effects.

1.3. Site Location, Description and Ecological Context

McPherson Quarry is located at 47 McPherson Road (Property 3480373) on the eastern border of the Manukau Ecological District of the Auckland Ecological Region. The quarry is located at the south-western most extent of a near contiguous, native forest linkage between the quarry and the Hunua Ranges of the Auckland Region. At present, the majority of the existing vegetation onsite is comprised of pasture grass and gorse-dominated scrub. However, the quarry does bisect two large tracts of native forest located to the east and west of the site, which have been classified as Significant Natural Areas (SNAs) by the Waikato District Council (Figure 1).

[1] This report is subject to the Report Limitations provided in Appendix A.
[2] Defined as the proposed excavation areas (Stages 1,2,3 and overburden area)
[3] Background information as detailed within Bridge, D., Turner, J., and Yungnickel M. (2018). McPherson Quarry Vegetation Assessment. Expansion Stages 1 to 3. WSPOpus.

Legend

- Stage 1
- Stage 2
- Stage 3
- Overburden Storage Area
- SNA (Waikato District Council 2019)
- Indigenous Vegetation Avoidance

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N

0 50 100 150 200 250 m

1:4,000 @ A3

Projection: NZGD2000/NZTM2000 Sources: Map data-Waikato District Council 2019;Stage 1-3 footprints based on plans by Mansergh Graham Landscape Architects, dated October 2019.Overburden footprint-based on communications with Kinetic Environmental Ltd, dated 25-07-2019

Mcpherson Quarry, Mangatawhiri

Site Map and SNA Overlay

Date: 15 October 2019 | Revision : 2

Plan prepared for McPherson Resources Limited by Ecology New Zealand Limited
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2. METHODOLOGY

2.1. Terrestrial Assessment

Site investigations were carried out by ENZL ecologists on 16 January 2019, 28 February 2019 and 1 March 2019. Terrestrial habitat assessments were undertaken to investigate the potential presence of a range of terrestrial fauna including indigenous avifauna (birds), chiropteran fauna (bats) and herpetofauna (reptiles and amphibians). Specific onsite surveys for indigenous fauna populations are described in detail below. In addition, a desktop review of relevant fauna databases allowed a full analysis of potential fauna values onsite. The fauna databases that were consulted include the DOC herpetofauna and bat distribution databases and Auckland Council's herpetofauna database.

Site plans provided by Mansergh graham Landscape Architects, October 2019 (Appendix B) were used to determine the extent of the vegetation clearance and degree of ecological impact as a result of the project.

2.1.1. Avifauna

- A record of all bird species encountered (heard and/or seen) across the site, and within the immediate vicinity of the site, was documented during each site visit.
- Call playbacks targeting wetland bird species[4] were undertaken across the most suitable pond edge habitat in the Stage 3 area (Appendix C).

2.1.2. Chiropteran fauna

- A bio-acoustic survey for native bats was conducted using four AR-4 model Automatic Bat Monitors (ABMs), which were set from January 16th to February 8th 2019. These were set during favourable summer bat conditions with average low temperatures of 15°C[5]. Placement of the ABMs targeted potential bat roost trees (DBH >80cm) and linear commuting and foraging areas across the site (Appendix C).

2.1.3. Herpetofauna

Herpetofauna surveys included manual habitat searches, deployment of Artificial Cover Objects (ACOs), and nocturnal surveys. All surveys were conducted under Department of Conservation Authorisation Number: 52042-FAU.

Potential lizard habitats were surveyed using methods outlined by Whitaker (1994)[6] by two ecologists under the supervision of an experienced and permitted herpetologist. The lizard survey was aimed at surveying the habitats with the greatest potential to support the diversity of species known from the local area. As potential frog habitat was identified adjacent to the site, nocturnal spotlighting was likewise conducted targeting Hochstetter's frog (*Leiopelma hochstetteri*).

[4] Fernbird, Australasian bittern, Marsh crake, Spotless crake, and Banded rail.
[5] Metservice historical data from Jan 27th-Febuary 7th 2019.
[6] Whitaker, T. 1994.Survey methods for lizards. Ecological Management (2): 8-16.

- Manual habitat searches were carried out to establish the presence of terrestrial lizards across the site. This method involved systematically searching through potential microhabitats on site, including clumps of vegetation, under logs, and large rocks.
- A total of 45 ACOs were installed across the site (Appendix C). The monitoring devices were established with a focus on edge habitat, where skinks were likely to be attracted to the warmth and refuge of the ACOs. The ACOs were left for six weeks to allow establishment before being checked over two separate occasions.
- Six person-hours of nocturnal spotlighting occurred over two nights during suitable weather conditions (no precipitation, low windspeed, temperature ~18-19°C). This method involves scanning potential habitat for lizards and frogs, using high-powered head torches and binoculars. Where appropriate, manual searches were undertaken in microhabitats (e.g. terrestrial fern skirts and, loose bark, and aquatic/riparian flat rocks, cracks, and crevices) during spotlighting. These surveys primarily focused on arboreal lizard habitat along bush edges, composed primarily of kānuka (*Kunzea robusta)* scrub, and potential native frog habitat within the hard-bottom stream to the east of the site.

2.2. Freshwater Assessment

2.2.1. Watercourse Assessment

A team of two freshwater ecologists assessed the sites watercourses and waterbodies between 16 - 17 January 2019. All watercourses to be impacted both directly and indirectly were photographed and classified as either permanent, intermittent or ephemeral. Classification guidelines were derived from Auckland Unitary Plan definitions; as they provided definitive criteria to classify stream types, in the absence of Waikato District Plan definitions. Watercourse physical parameters were assessed based on four key ecological function groups:

- Hydraulic functions (processes associated with water storage, conveyance, flood flow retention and sediment transport);
- Biogeochemical functions (processes associated with the processing of minerals, particulates and water chemistry);
- Habitat provision functions (the type, amount and quality of habitat for flora and fauna); and
- Native biodiversity functions (the occurrence of diverse populations of indigenous native plants and animals).

2.2.2. Waterbody and Wetland Assessment

The assessment of wetlands and waterbodies on site examined key physical parameters including, but not limited to: hydrological connectivity, thermal regulation, vegetation composition of both aquatic and marginal vegetation. This methodology was used in the absence of any official guidelines for assessing ponds or wetlands in New Zealand.

2.2.3. Fish

Fish sampling protocols were based on New Zealand Freshwater Fish Sampling Protocols[7] where possible. In order to sample the fish population, passive sampling methods were used including the placement of both fyke nets and Gee Minnow traps throughout the site's watercourses and waterbodies. A total of eight gee minnow traps and two fyke nets were placed throughout the site – one fyke net and one gee minnow trap each in Ponds 1 and 2, two gee minnow traps in Tributary 1 and four gee minnow traps in Stream 1. This level of effort was designed as a presence/absence survey rather than for the purposes of population estimation.

Nocturnal spotlighting was also undertaken through stream reaches within proximity to potential herpetofauna habitat. This involved visual scanning of stream reaches for active fish at night, using torches.

Electric fishing was not possible in the impact stream identified as Tributary 1, due to shallow water depths and excessive macrophyte growth. Electric fishing was considered outside the scope of this assessment in Stream 1. Pond 1 and Pond 2 were considered inappropriate for electric fishing due to their size and depth.

Sediment treatment ponds, including those identified as North pond and south pond were not sampled for fish presence due to their functional role as primary sediment treatment facilities and the absence of critical habitat features required to sustain indigenous fish populations.

2.2.4. Aquatic Macroinvertebrates

Macroinvertebrates were sampled from instream habitats to obtain semi-quantitative data in accordance with the Ministry for the Environment's current "Protocols for Sampling Macroinvertebrates in Wadeable Streams". Sampling was undertaken from a representative reach of both Stream 1 and Tributary 1 using C1 protocols for hard-bottom streams. Sampling was also undertaken from both Pond 1 and Pond 2 using C2 protocols (soft-bottomed, semi-quantitative). The samples were preserved in isopropyl alcohol and sent to Environment Impact Assessments Ltd who processed samples using a total count method to the lowest practical taxonomic level. Several biotic indices were used to calculate, Macroinvertebrate Community Index (MCI) and MCI adjusted for soft-bottomed systems (SBMCI) scores including total number of taxa and Ephemeroptera-Plecoptera-Trichoptera (EPT). EPT is an index of mayflies, stoneflies and caddisflies which are generally sensitive to organic or nutrient enrichment, and a high percentage indicates good stream health; insects in the genera *Oxyethira* and *Paroxyethira* were excluded as these taxa are not sensitive and can proliferate in degraded habitats. The MCI is based on the average sensitivity score for individual taxa recorded within a sample. MCI scores of >120 are indicative of excellent habitat quality, 100 - 119 are indicative of good habitat quality, 80 – 99 are indicative of fair habitat quality and < 80 are indicative of poor habitat quality[8].

[7] Joy, M., David, B., and Lake, M. (2013). *New Zealand Freshwater Fish Sampling Protocols – Part 1 Wadeable Rivers and Streams*. Massey University.
[8] Stark JD, Maxted JR 2007. *A user guide for the Macroinvertebrate Community Index*. Prepared for the Ministry for the Environment. Cawthron Report No.1166. 58 p.

3. ECOLOGICAL ASSESSMENT

3.1. Terrestrial Ecological Values

3.1.1. Avifauna

A total of 13 bird species were documented during the assessment (Table 1). Of these species, six were identified as native and the remaining seven were exotic. Notable species recorded onsite and adjacent to the site included a shag species and a pair of New Zealand dabchick (*Poliocephalus rufopectus*), respectively; both species have a threat status of At Risk.

Most of the site was assessed as low-quality habitat for birds; however, the bush blocks provided high quality habitat, which also provide an ecological stepping stone to the Hunua Ranges to the east, and Mt. William Reserve to the west.

Table 1: Bird species recorded during ENZL field assessment and their threat status

Common Name	Latin Name	Threat status
Dabchick	*Poliocephalus rufopectus*	At Risk – Recovering
Black / Little Black Shag	*Phalacrocorax carbo novaehollandiae / P. sulcirostris*	At Risk - Naturally Uncommon
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened
Morepork	*Ninox novaeseelandiae*	Not Threatened
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened
Swamp harrier	*Circus approximans*	Not Threatened
Tūī	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened
Welcome Swallow	*Hirundo neoxena neoxena*	Not Threatened
Grey teal	*Anas gracilis*	Not Threatened
Australian Magpie	*Gymnorhina tibicen*	Introduced and Naturalised
California Quail	*Callipepla californica*	Introduced and Naturalised
Common Pheasant	*Phasianus colchicus*	Introduced and Naturalised
Myna	*Acridotheres tristis*	Introduced and Naturalised
Yellowhammer	*Emberiza citrinella*	Introduced and Naturalised
Skylark	*Alauda arvensis*	Introduced and Naturalised
Peafowl	*Pavo cristatus*	Introduced and Naturalised

3.1.2. Chiropteran fauna

A single possible long-tailed bat (*Chalinolobus tuberculatus*, Threatened – Nationally Critical[9]) pass was detected on one of the ABMs during the three-week monitoring period (Figure 2). A review of the Department of Conservation's bat distribution database verified the presence of long-tailed bats approximately 12km east of the site in the Hunua Ranges, and 15km north of the site. Recent (October 2019) bat monitoring by ENZL indicated bat activity at a site in Pokeno, approximately 5km southwest of the site.

Potential bat roosting habitat was noted in the form of scattered large senescing pine trees (*Pinus* spp.), kahikatea (*Dacrycarpus dacrydiodes*), rimu (*Dacrydium cupressinum*) and totara (*Podocarpus totara*), all with diameters at breast height measured at greater than 80cm and

[9] O'Donnell, C.F.J.; Borkin, K.M.; Christie, J.E.; Lloyd, B.; Parsons, S.; Hitchmough, R.A. 2018: Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Department of Conservation, Wellington. 4 p.

containing potential roosting features (Plate 1). Foraging sites were observed along linear bush edges and across small ponds within the site. Potential bat flightpaths were also noted along the site perimeter, haul roads and streams.

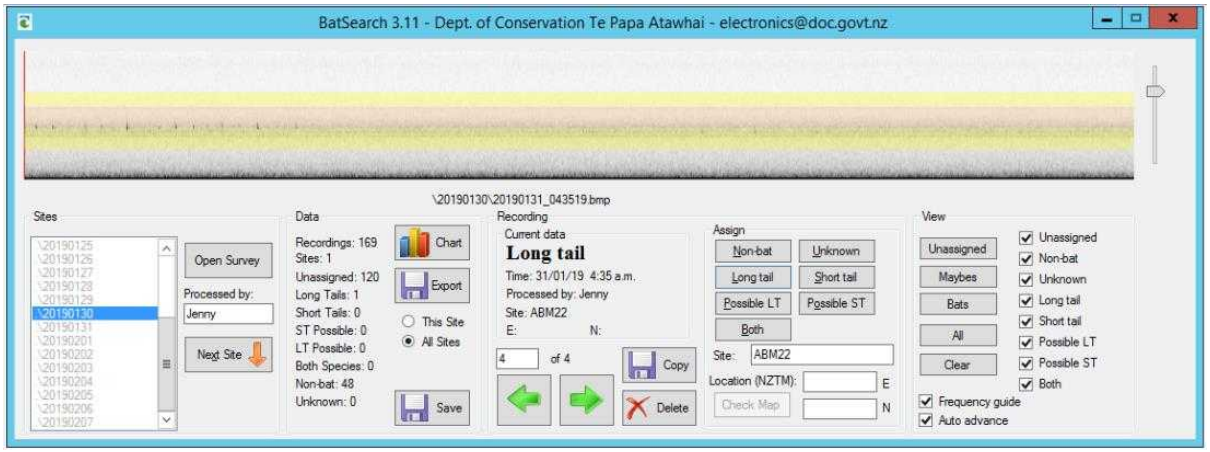


Figure 2 Bio-acoustic profile of possible long-tailed bat pass.

Plate 1 Scattered specimen trees representing bat roosting habitat.

3.1.3. Herpetofauna

Arboreal lizard habitat on-site appeared to be suitable within the kānuka-dominant bush block (Plate 2); however, the majority of the site presented low-quality habitat through pasture grasses. Ground-dwelling skink habitat was assessed as moderate quality due to the sparse leaf litter layer within the bush fragments, and lack of logs and other preferred habitat features within the ground layer. Grazed pasture grasses across the site provided a homogenous novel habitat for ground-dwelling skinks; however, a lack of logs or debris features was noted.

Lizard records are limited in this area with the closest record being a copper skink (*Oligosoma aeneum*) 12km from the site[10]; additionally, there are records of elegant gecko (*Naultinus elegans*) 15km in bush fragments to the north and 17km northeast within the Hunua Ranges[11]. Based on the habitat on-site and the contiguity with native bush, the herpetofauna species that may be present are outlined in Table 2 below. Six hours of nocturnal spotlighting, 90 ACO checks and manual habitat searches did not indicate the presence of any native species, with only one plague skink (*Lampropholis delicata, Introduced and Naturalised*) observed under an ACO. Though the species detailed in Table 2 may still be present on-site, it is considered that they may not be at high enough population numbers to allow detectability.

Plate 2 Kānuka-dominant bush block on eastern boundary of site.

Overall, Hochstetter's frog (*Leiopelma hochstetteri*) habitat within the proposed quarry footprint was considered low quality. This was primarily due to the little to no shading provision

[10] Department of Conservation Database, 2013.
[11] Auckland Council Fauna Database, 2018.

across streams and unfettered stock access into stream areas. Though they are sometimes detected on the edges of areas with high shading and water quality, the likelihood of their presence decreases with increasing distance from high quality habitat. The stream reach within the bush block directly east of the Stage 1 area, and outside of impact areas, presented moderate – high frog habitat (Plate 3). Manual searches and spotlighting did not indicate the presence of frogs. A significant population of Hochstetter's frog is known from within the Hunua Ranges to the northeast, with the closest record being 17km from the site.

Plate 3 High-quality potential frog habitat in a stream directly east of the site.

Table 2 Summary of herpetofauna found within 25km of the site.

Common Name	Latin Name	Threat status[12]
Auckland green gecko	*Naultinus elegans*	At Risk-Declining
Copper skink	*Oligosoma aeneum*	Not Threatened
Forest gecko	*Mokopiriakau granulatus*	At Risk-Declining
Green and Gold Bell Frog	*Ranoidea aurea*	Introduced and Naturalised
Hochstetter's frog	*Leiopelma hochstetteri*	At-Risk-Declining
Ornate skink	*Oligosoma ornatum*	At Risk-Declining

[12] Hitchmough, R.; Barr, B.; Lettink, M.; Monks, J.; Reardon, J.; Tocher, M.; van Winkel, D.; Rolfe, J. 2016: Conservation status of New Zealand reptiles, 2015. New Zealand Threat Classification Series 17. Department of Conservation, Wellington. 14 p

Common Name	Latin Name	Threat status[12]
Pacific gecko	*Dactylocnemis pacificus*	At Risk-Relict
Plague skink	*Lampropholis delicata*	Introduced and Naturalised
Southern Bell Frog	*Ranoidea raniformis*	Introduced and Naturalised

3.1.4. Pest Animals

Pest animals observed onsite included both hedgehogs (*Erinaceus europaeus occidentalis*) and mice (*Mus musculus*). Given the habitat and rural landscape setting of the site, additional pest animal species that are likely present on-site include possum (*Trichosurus vulpecula*), rats (*Rattus* spp.), mustelids and occasional feral goats (*Capra hircus*) and pigs (*Sus scrofa*).

3.2. Freshwater Ecology

3.2.1. Watercourse Assessment

All watercourses to be impacted both directly and indirectly within the site were assessed; a section of the "Waipunga Stream" (named as Waipunga Stream within the Opus report but referred to here as Stream 1) was also assessed, which is noted as the downstream receiving environment. A single tributary was found to be located within the south-western portion of the site and is referred to as Tributary 1 for the purposes of this report.

Stream 1

Stream 1 was identified as a section of the Waipunga stream, a tributary of the Mangatawhiri River, which in turn flowed into the Waikato River around 8km to the south-west of the site. It is expected to be directly and indirectly impacted by expansion of the McPherson Quarry, as the receiving environment for the watercourses within the site.

Stream 1 presented as a permanent, hard-bottomed stream (Plate 4) which formed the southern border of the site, meandering for approximately 1km in a generally north-west to south-east direction. Based on NZ Topomaps, the stream was classified as a third order stream (at least) with a relatively large catchment. Most of the upper catchment tributaries appeared to flow through native bush. The assessment was focused on the lowland portion of Stream 1 where there was the potential for impacts from the proposed quarry expansion.

Stream 1 had well-defined banks, steeply incised in places and ranging from c. 0.3m to several metres in height with channel widths varying between c. 3m and 6m. Evidence of scouring from flood flows was noted in places with bank undercuts and slumpage present. While this process of bank erosion was considered natural, the rate of erosion was likely occurring faster than expected due to the absence of complex riparian vegetation. Stock had direct access to the water in most places (Plate 5) including two fords for vehicle crossings where sheep were seen crossing the stream. Riparian vegetation in the assessed section was patchy and consisted predominantly of grazed and rank grass and exotic species such as hawthorn (*Crataegus monogyna*), gum trees (*Eucalyptus* sp.), Darwin's barberry (*Berberis darwinii*), gorse (*Ulex europaeus*), and kānuka (*Kunzea robusta*). At the eastern end of the site, a fallen gum tree was accumulating debris and organic foam, as well as facilitating notable scouring of the true right bank (TRB).

Stream 1 exhibited a high variation in hydrology with pool-riffle-run sequences present throughout and cascades present where the stream flowed off the hillside through the bush.

Channel morphology was also varied with a meandering channel, undercut banks and noticeable variations in depth throughout. Instream habitat provision was high with fine gravels and sand ranging up to large cobbles and (in the upper reaches at the bottom of the hill) boulders. Woody debris was present in places. No macrophytes were present within the channel; however, there was substantial growth of filamentous green algae which appeared to increase as the stream flowed east across the site. This algal growth was noticeably higher on stones that were subject to low shade, aside from the upstream extent of the assessed section where there was very little shade but little algal growth. Water clarity was measured as 78cm using a water clarity tube.

Three tributaries were noted flowing into Stream 1 along the assessed reach within the site – two from the TRB flowing from a neighbouring property, and one on the true left bank (TLB) through a culvert which was the impact stream. The two tributaries on the TRB were not assessed as they were not expected to be impacted by the proposed activities.

Considering the moderate level of shading throughout the reach, the diverse instream habitat range, stock access, sparse riparian vegetation and lack of significant instream anthropogenic modification, the ecological function of Stream 1 was considered high.

Plate 4 Stream 1 classified as a permanent, hard-bottomed stream

Plate 5 Stream 1 channel morphology within the pasture area with unfettered stock access.

Tributary 1

Tributary 1 was classified as a permanent stream which appeared to flow out of the native bush below Pond 2. The stream appeared as two or three small channels before flowing through a wetland area then forming one single channel. This channel then flowed for approximately 380m in a south-easterly direction before its confluence with Stream 1 via a culvert.

Tributary 1 exhibited both hard and soft-bottomed characteristics – displaying soft-bottomed characteristics where flow was slowed and sediment was deposited (especially in the ~10m upstream from the culvert) and reverting to hard-bottomed characteristics in areas of more rapid flow. Substrate, therefore, varied from silt/mud to gravel and small to medium cobbles. Macrophytes were abundant within the channel and were comprised mainly of water pepper (*Persicaria hydropiper*), watercress (*Nasturtium microphyllum*) and *Juncus* sp (Plate 6). Riparian vegetation consisted predominantly of rank pasture grass with a narrow margin of *Juncus* sp. and thistles.

Shading varied from low to high and was provided mainly by the vegetation within the channel. Stock access was unimpeded along the length of the stream. Streambed morphology showed little variation with only slow runs and small pools present along the reach. Channel morphology exhibited some variation with narrow meanders present in some places. There was also evidence of some in-flow from Pond E as marked on the concept designs by WSP-Opus (3/9/18, project number 3-39019.00).

Considering the degree of shading, the variation within instream habitat, the direct stock access and the poor-quality riparian vegetation, this reach of Tributary 1 was considered to have low ecological value.

Plate 6 Photo of macroinvertebrate sampling being undertaken within Tributary 1. Grazing of rushes by stock is clear from the photo.

Outfall Drain

This artificial channel was included within WRC's online mapping system as a watercourse; however, the channel present at the time of assessment was artificially managed, with steep sides, no meandering and piles of clay on top of the banks from excavation (Plate 7). It was almost impossible to tell whether this was originally a natural stream, due to length of time the quarry has been established. Given the nature of the channel, it is expected that this channel was likely constructed around the time of the North and South Ponds.

This drain was soft-bottomed (clay) with virtually no variation in channel morphology but some variation in streambed morphology, with runs and riffles present due to collapsed clay clumps. Watercress, *Juncus* sp. and curly pondweed (*Potamogeton crispus*) were present within the channel. Water depth was fairly uniform at around 0.2m and although the water still retained some of the lime-green cloudy appearance as seen in the ponds, the clarity was 42cm using a clarity tube. Shading was relatively poor, as it was mostly provided by the steep banks. Direct stock access was possible along the length of the channel with pugging of the banks evident, and it flowed for approximately 80m before exiting the site into the neighbouring property. The confluence with Stream 1 was not visible from the site.

Plate 7 Photo of outfall drain showing the clearly defined and excavated channel.

3.2.2. Waterbody Assessment

Five ponds were assessed and are referred to as north pond, south pond (as labelled on the concept plan by Opus, 3/9/2018 sheet C21), Pond 1, Pond 2 and Pond 3 (Appendix D).

North pond & South pond

The north pond and the south pond were sediment treatment ponds located at the south-eastern corner of the quarry. These ponds were included in the assessment due to being in the region of a watercourse marked on Waikato Regional Council's online mapping system.

The north pond was relatively narrow (approximately 3m wide at the northern end and approximately 10m wide at the downstream end) and around 40m in length. The pond was lime green in colour at the time of assessment, presumed to be as a result of treatment with a flocculant to aid in sediment removal. There was a small amount of shading provided by a single gum tree at the northern end, but otherwise, very little shading was present. Riparian vegetation was dominated by rank grass with a few juncus plants. There was very little macrophyte growth within the pond (Plate 8), leaving it mainly open water. The flocculant treatment has likely resulted in reduced macrophyte growth by creating a potentially unfavourable pH level.

The south pond was fed by water from the north pond flowing through a concrete culvert. Water flowing out of the culvert flowed into an area of waterlogged rank grass, then into a

more open area, around a separation barrier (comprising dirt, cabbage trees and pampas) and finally into an area of lime green open water. Both ponds had mosquitofish (*Gambusia affinis*) present with the south pond also having a brown teal (*Anas chlorotis*) and a single domesticated mallard (*Anas platyrhynchos domesticus*) present.

A second culvert was noted entering the south pond at the north-western edge, but no flow was visible at time of assessment. A small amount of shading was provided by the rank grass at the northern end and a row of manuka at the southern end. Given the minimal shading across both ponds and the relatively shallow depth, it is expected that thermoregulation of both ponds would be poor.

Given the artificial nature of both these waterbodies, the lack of shading, highly turbid water, continual sediment treatments and lack of any diverse habitat features, it is expected the ponds are in a state of poor ecological function. As such, ecological value for both ponds were considered to be low.

Plate 8 Photo of North Pond clearly showing the lack of any macrophyte growth.

Pond 1

Pond 1 was located above the current quarry extent and appeared to have virtually no connectivity either above or below it at the time of assessment. It presented as a relatively narrow pond varying between approximately 6-25m in width with an approximate area of 1,800m^2. The pond consisted of predominantly open water, with some marginal vegetation including bamboo spike sedge (*Eleocharis sphacelata*) and several juncus species. At the

northern extent of the pond, there was a manuka scrubland all of which was dead or dying, along with a few patches of gorse. There was very little if any shading resulting in poor thermoregulation of the pond. Maximum depth was not attainable, but it was well over 1m within 3m of the pond margin. It is highly unlikely that the pond would reach sufficient depth to establish a thermocline; ensuring that there is a constant mixing within the ponds water column.

There were no macrophytes present and only a small amount of algal growth. The pond was visibly artificial in nature - likely created for recreational use. The physical features and lack of connectivity meant that it presented marginal aquatic habitat. The lack of notable connectivity to the wider catchment, indicated it is unlikely that there will be significant migration of fish species into the pond, although eels may enter the pond by overland migration.

Pond 2

Pond 2 was significantly larger than Pond 1 having a length of roughly 130m and covering an area of approximately 6,500m^2 (Plate 9). A large maimai on stilts was present on the eastern bank for duck shooting. Pond 2 was also noted to be artificial, likely formed by damming of the headwaters of a watercourse historically. However, given the length of time this pond has been established it is impossible to determine the historical characteristics of the watercourse. Unlike Pond 1, there is connectivity to the wider catchment, a culvert was noted at the southern end discharging into the native bush below. It is expected that this discharge forms part of the source of Tributary 1. At the time of the assessment, there was no flow visible leaving the pond.

Pond 2 was divided into two distinct sections. The south section was characterised as a larger open water area with small areas of marginal rushes and macrophyte growth (curly pondweed). The northern section of the pond was significantly narrower with shading provided by the surrounding mānuka and raupō (*Typha orientalis*). Algal growth appeared to be low, indicating that the pond was unlikely to be in a state of eutrophication - this was further supported with visibility of 0.5 m.

The pond was noted to be relatively deep, with the client indicating depths were greater than 3m. Like Pond 1, the water column in this pond was likely to be well mixed throughout the summer. Filtration activity provided by the riparian vegetation was considered poor with the pond mainly surrounded by pasture grasses with patchy gorse. There was direct stock access, however there were no stock present at the time of assessment and based on the current state of the pasture, it appeared not to have been grazed for an extended period.

Plate 9 Pond 2 from the southern bank.

Pond 3

Pond 3 was the smallest of the three ponds (only 800 m^2) and was located immediately north of the active quarry. The southern edge of the pond was lined by bare earth, due to the current quarry traffic using this as an access way. There was a significant amount of bare earth on the margins of the pond. The pond presented a lime-green colouration similar to the North and South Ponds. The vegetation around the margin was limited to a few rush species and rank grass.

Pond Overview

The three ponds within the proposed quarry area presented very similar characteristics. Given the artificial nature of the ponds and their relative isolation, the ecological function of the ponds was expected to be low. Overall the ecological value of the ponds was considered low.

Wetlands

There were two highly degraded wetlands identified along Tributary 1. The upper wetland (Wetland 1) occurred around the confluence of several intermittent and permanent streams before they merged into Tributary 1. The lower wetland (Wetland 2) occurred just up from a culvert that drained Tributary 1 into Stream 1. Both wetlands were classified as riverine marshes. This classification could change should stock access be restricted and the wetlands allowed to recover.

The wetlands were significantly degraded due to stock having direct access to them. Scattered clumps of rushes (*Juncus* sp.) were the only wetland adapted vegetation within the area. The classification of these areas as wetlands occurred due to the high-water content within the surface soil and the presence of surface water when pressure was applied to the soils indicating the likelihood of hydric soils beneath the vegetation. At the time of assessment these riverine marshes were providing lower ecological function in terms of filtration, water retention and habitat diversity which could be recovered with stock exclusion and restoration works. Overall the ecological value of these wetlands was considered to be low.

3.2.3. Fish

A total of six native species and one pest species were documented on site. Overall, 13 individual fish were captured, which included common bully (*Gobiomorphus cotidianus*), inanga (*Galaxias maculatus*), shortfin eel (*Anguilla australis*) and a single longfin eel (*Anguilla dieffenbachia*) with banded kōkopu (*Galaxias fasciatus*) and kōura (*Panaphrops planifrons*) being observed during spotlighting. The eels were all found within the two ponds at the top of the site, whilst the bullies and īnanga were within Stream 1. Banded kōkopu where noted in a tributary east of the existing quarry, outside of the main channel, but directly connected to Stream 1 and are therefore assumed to be present within Stream 1. No native fish were found within Tributary 1 (the impact stream); however, it is highly likely that this tributary functions as a potential migratory pathway for native species, given the presence of eels within Pond 2 which is identified as a headwater feature. While the common bully and shortfin eel are listed as not threatened, the longfin eel and īnanga are listed as 'At Risk – Declining' under the New Zealand threat classification system[13]. Details of fish caught across the site are outlined in Table 3 below.

A wider catchment search of the New Zealand Freshwater Fish Database (NZFFD) revealed the presence of 13 native species (Table 4) within the Mangatawhiri River. This search revealed a relatively diverse native freshwater fish population within the wider catchment. While survey efforts only revealed five native species within the impact site, the potential presence of these remaining native species cannot be ruled out especially from the lower reaches of the site.

Table 3: Fish caught on site (Appendix D shows trap locations).

Site	Species	Common name	Number	Size Range
Stream 1 – Gee 2	*Gobiomorphus cotidianus*	Common bully	1	50mm
Stream 1 – Gees 3 & 4	*Gobiomorphus cotidianus*	Common bully	4	50-65mm
	Galaxias maculatus	Inanga	3	80mm
Tributary 1 - Gees	Nothing caught			
Pond 1 - fyke net	*Anguilla australis*	Shortfin eel	1	600mm
Pond 2 - fyke net	*Anguilla australis*	Shortfin eel	3	320-500mm
	Anguilla dieffenbachii	Longfin eel	1	600mm

[13] Goodman, J.M.; Dun, N.R; Ravenscroft, P.J; Allibone, R.M; Boubee, J.A.T.; David, B.O.; Griffiths, M.; Ling, N.; Hitchmough, R.A.; Rolfe, J.R. (2013) *Conservation status of New Zealand freshwater fish.* New Zealand Threat Classification Series 7

Table 4: Fish species found within the wider Mangatawhiri River catchment based on NZFFD

Species	Common Name	Caught on site	Native/non-native	National Threat Status
Anguilla australis	Shortfin eel	Yes	Native	Not Threatened
Anguilla dieffenbachii	Longfin eel	Yes	Native	At Risk- Declining
Cheimarrichthys fosteri	Torrentfish	No	Native	At Risk- Declining
Galaxias fasiculatus	Banded kōkopu	Yes	Native	Not Threatened
Galaxias brevipinnis	Kōaro	No	Native	At Risk- Declining
Galaxias maculatus	īnanga	Yes	Native	At Risk- Declining
Galaxias postvectis	Shortjaw kōkopu	No	Native	Threatened - Nationally Vulnerable
Geotria australis	Lamprey	No	Native	Threatened - Nationally Vulnerable
Gobiomorphus basalis	Crans Bully	No	Native	Not Threatened
Gobiomorphus cotidianus	Common bully	Yes	Native	Not Threatened
Mugil cephalus	Grey mullet	No	Native	Not Threatened
Neochanna diversus	Black mudfish	No	Native	At Risk- Declining
Retropinna retropinna	Common smelt	No	Native	Not Threatened
Ameiurus nebulosus	Catfish	No	Non-native	Naturalised Introduced
Carassius auratus	Goldfish	No	Non-native	Naturalised Introduced
Cyprinus carpio	Koi carp	No	Non-native	Naturalised Introduced
Salmo trutta	Brown Trout	No	Non-native	Naturalised Introduced
Scardinius erythrophthalmus	Rudd	No	Non-native	Naturalised Introduced

3.2.4. Aquatic Macroinvertebrates

Macroinvertebrate samples were taken from Pond 1, Pond 2, Tributary 1 and Stream 1. Results varied as was expected due to on-site observations and habitat availability. The highest MCI score was recorded for the main channel (Stream 1) with a score of 103.48 indicating "good" habitat quality. This stream also recorded an EPT score of 10 with almost half of the macroinvertebrates found being of the EPT group.

The remaining three sites were all sampled using a soft-bottomed methodology and as such the MCI score corrected for soft-bottomed systems (SBMCI) was used. This score accounts for the fact the certain macroinvertebrates have higher tolerances for poorer habitat conditions in soft-bottomed streams and as such their rating is lower. The impact reach, Tributary 1, had an SBMCI score of 86, indicating "fair" habitat quality whilst both ponds had much lower scores (63.5 and 47.43) indicating "poor" habitat quality which was expected for artificial pond systems within agricultural settings.

Table 5: Results of macroinvertebrate sampling at four sites, McPherson Quarry

Parameter	Pond 1	Pond 2	Tributary 1	Stream 1
Number of Taxa	12	7	17	23
EPT Value	0	0	3	10
Number of Individuals	12	7	17	23
% EPT Taxa	0.00	0.00	17.65	43.48
Sum of recorded scores	49.00	30.00	71.00	119.00
MCI Value	81.67	85.71	83.53	103.48
Sum of abundance load	49.00	30.00	71.00	119.00
QMCI Value	4.08	4.29	4.18	5.17
SBMCI Value	63.50	47.43	86.00	n/a

4. ASSESSMENT OF ECOLOGICAL EFFECTS

4.1. Terrestrial

4.1.1. Avoidance and Mapping Revisions

Following the previous version of this report (1708203-001.V3), the area of SNA in the southwest corner of Stage 1 and the area of SNA on the western boundary of Stage 3 have now been prioritised for avoidance. This has subsequently seen a reduction of 8,485m^2 in the proposed area of indigenous vegetation clearance associated with this project. Of this additional area to be avoided, 4,725m^2 is mapped as protected SNA.

Mapping updates have also led to the reduction of previously assessed vegetation clearance. An area of approximately 1040m^2 of indigenous vegetation located north of Wetland 1 was previously assessed as an area proposed to be impacted. This has been reviewed and is now confirmed to be outside of the overburden storage area.

Taking heed of the above information, a total of approximately 2.45ha of indigenous vegetation is now proposed to be impacted onsite. Of this, approximately 2.18 ha is within the SNA layer.

4.1.2. Assessment of Values (EIANZ)

The following assessment focuses primarily on fauna values and does not incorporate the vegetative/botanical quality of onsite vegetation. Vegetation quality is addressed within the McPherson Quarry Vegetation Assessment Report prepared by WSP-Opus, 2018.

The majority of the proposed quarry expansion area is comprised of pasture grasses and gorse-dominated scrub providing low quality habitat for native fauna (Appendix F). Table 6 evaluates the ecological value of native fauna within the habitat types presented across the site. The kānuka-dominant forest block on the east of the site provided the highest valued habitat for native herpetofauna within areas proposed for impact. This habitat was specifically suitable for arboreal geckos, although none were observed during nocturnal spotlighting efforts. This habitat type also provides high value habitat for native avifauna, specifically because it is part of a large tract of contiguous bush to the east and west. Kānuka-dominant forest ecosystems are identified as Least Concern[14].

While the kānuka-dominant forest does not provide high-quality roosting habitat for native bats; large specimen trees scattered throughout proposed development areas Stage 2 and 3 are expected to provide adequate roosting habitat for long-tailed bats. However, with only one possible bat pass detected within the Stage 1 area, the site is not likely a key area for long-tailed bats. The timing of the bioacoustics survey period was within the peak of the long-tailed bat breeding season. This provides evidence that the site may not provide key maternal roosting habitat for this species during the survey period.

[14] Singers, N.; Osborne, B.; Lovegrove, T.; Jamieson, A.; Boow, J.; Sawyer, J.; Hill, K.; Andrews, J.; Hill, S.; Webb, C. (2017) Indigenous terrestrial and wetland ecosystems of Auckland. Auckland Council

Table 6 Summary of habitat types and their values identified onsite.

Habitat Type	Area	Habitat Value	Comments
Existing quarry	11.67 ha	Negligible	Provides no habitat
Kānuka-dominant forest	2.45 ha	High	Provides high-quality habitat for herpetofauna and avifauna within the SNA but limited quality within the other scattered areas.
Specimen trees (DBH>80cm)	0.45 ha	Moderate	Provides moderate-high quality habitat for bats.
Gorse-dominated scrub	5.92 ha	Low	Provides low-quality habitat for native bats, birds and herpetofauna
Waterbodies	0.79 ha	Moderate	Provides novel habitat for waterfowl and shag species
Pasture	28.55 ha	Low	Provides little habitat for native bats, birds and herpetofauna

4.1.3. Assessment of values (Regional Criteria)

Based on the Waikato Regional Council criteria for determining significance of indigenous biodiversity, the site is classed as significant (Appendix E). This is due to the designated SNA, which provides an interface between the Hunua Ranges and Mt William Walkway and the presence of At Risk and Threatened species onsite. However, the areas that meet the criteria for classification as significant are a small percentage of the overall proposed expansion area, and the At Risk and Threatened fauna species observed were in low numbers.

4.1.4. Magnitude of Effects

Out of the three proposed development areas, Stage 1 had the most notable area of fauna habitat to be removed as part of the future quarry expansion. This is primarily attributed to the proposed clearance of an SNA bush block, which accounts for the majority of the 2.45 ha of indigenous vegetation proposed to be removed. The kānuka-dominant SNA bush block is adjacent to a large tract of existing forest (bisected by a haul road), leading to the Hunua Ranges in the northeast. Based on the fauna surveys described in Section 3.1, this bush block did not contain notable populations of herpetofauna, bats or threatened bird species.

In its entirety, the site is largely composed of low-quality habitat for avifauna, chiropteran fauna and herpetofauna. The majority of terrestrial fauna impacts are localised to a single bush block within Stage 1. Therefore, the magnitude of effects for the site is assessed as low (Table 7).

Table 7 Summary of magnitude of effects.

Habitat Type	Magnitude of Effect	Comments
Existing quarry	Negligible	Nil
Kānuka-dominant forest	Low	Loss of indigenous vegetation comprising of 5% of the site, and also 5% of contiguous SNA vegetation to the east.
Specimen trees (DBH>80cm)	Very High	Potential impacts on long-tailed bats, which are Threatened-Critically Endangered.

Habitat Type	Magnitude of Effect	Comments
Gorse-dominant scrub	Low	No lizards were found during extensive surveys, the loss of this low-quality habitat will have a low effect on fauna.

4.1.5. Overall Pre-Mitigation Level of Effects Rating

The table below provides an overall level of effects rating. The ecological values are based on Table 6. The magnitude of effect ratings are derived from Table 7. The potential impacts were assessed as having a low magnitude of effect on all three fauna groups considered in the habitat assessments; therefore, 'low' has been used as the average magnitude of effect below in Table 8. Impacts which are assessed as low should not normally be of concern or require mitigation; however, they have been considered during the design phase.

Although impacts are considered low, the protection of native species under the Wildlife Act 1953 require consideration. For this reason, consideration is still required to address uncertainty of species presence and management where they are expected present. This is further detailed in Section 5 of this report.

Table 8 Overall level of effects rating (EIANZ, 2018).

Habitat Type	Ecological Value	Magnitude of Effect	Level of Effect
Existing quarry	Negligible	Negligible	Negligible
Kānuka-dominant forest	High	Low	Low
Specimen trees (DBH>80cm)	Moderate	Very High	High
Gorse-dominant scrub	Low	Low	Very low

4.2. Freshwater

The proposed quarry expansion will result in the loss of Ponds 1, 2 and 3, the reclamation of part of Tributary 1 and the discharge of water from four sediment retention ponds into Stream 1. Given the difference in type and magnitude of effects at each location, each of these water bodies will be considered separately in order to assess the effects of the proposed activities.

4.2.1. Ponds

The proposed quarry expansion will result in the loss of 9,900 m^2 of poor quality, artificial, aquatic habitat. Whilst there is intermittent connectivity between Pond 2 and downstream environments, the connectivity between Ponds 1 and 3 and their downstream environment appears to be negligible due to the presence of the quarry. As such the removal of these ponds is unlikely to have an effect on their downstream environments. The primary effects of the proposed quarry expansion will be potential injury to or death of fish species, the loss of poor aquatic habitat and the loss of habitat and food sources for bird and insect species.

Assessment using EIANZ guidelines

Longfin eels (At Risk – Declining) were recorded within Pond 2 and while not recorded within Pond 1 or Pond 3, they cannot be excluded given the presence of shortfin eels in these ponds. Therefore, for the purposes of this assessment longfins have been assumed to be present in all three ponds. Furthermore dabchick (At Risk – Declining) have been noted using pond habitat within the site.

The pond habitat on site is not a unique or a threatened habitat type. The ponds have small catchment areas and are artificial in nature, providing poor quality aquatic habitat. Species diversity within these habitats was low as evidenced by on-site observations, fish surveys and macroinvertebrate surveys. The ponds are not contiguous with high-quality terrestrial ecosystems and the minimal riparian vegetation was also considered to be poor quality.

Magnitude and Level of Effects

The pre-mitigation magnitude of effect associated with the loss of pond habitat during quarry expansion is considered **moderate**. This magnitude has been reached due to the following:

- Whilst this is a total and permanent loss of habitat, these ponds are completely artificial in nature and as such provide limited ecological value compared to a natural system; and
- Given the location of the site within an agricultural environment, it is likely that there are numerous artificial ponds in the wider catchment and as such the proportional loss of this habitat type on a catchment scale is likely to be small.

With the ecological value considered **low** and magnitude of effect considered **moderate**, the overall level of effects under EIANZ guidelines prior to mitigation is considered **low**.

4.2.2. Tributary 1

The proposed quarry expansion would see the reclamation of Tributary 1 from immediately below Wetland 1 to immediately above Wetland 2 - approximately 311m in length. The channels within the wetland areas would be left in place to naturally revert to wetland ecosystems. The reclamation of this length of stream would remove all instream habitat within the impact reach and reduce migration pathways. This work also has the potential to cause death of or injury to native fish (although none were found during surveys and habitat availability is minimal).

Assessment using EIANZ guidelines

The impact reach of Tributary 1 presents a degraded system offering minimal aquatic habitat. It did not contain any threatened species at the time of assessment; however, it is a migratory corridor for an At-Risk species (longfin eel). The MCI score was indicative of poor water quality, which would fit with its location in an agricultural setting with essentially no riparian vegetation and direct stock access. It does have connectivity to both upstream and downstream water bodies but does not provide a contiguous riparian corridor. It is not representative of any unique or threatened ecosystems and exhibits a low level of diversity or ecological complexity. The ecological value of the impact reach within Tributary 1 was considered low.

Magnitude and Level of Effects

The magnitude of effect associated with the reclamation of this length of stream is considered high in the context of the complete and permanent loss of part of a degraded but natural stream system. This length of stream represents approximately 7% of all stream lengths within the site (based on Waikato Maps online mapping, 'river' layer). This loss is expected to cause minimal effect to the wider Mangatawhiri River catchment.

With the ecological value considered low and magnitude considered high, the pre-mitigation level of effects under EIANZ guidelines is considered low.

4.2.3. Stream 1

Stream 1 will be the receiving environment for any stormwater runoff and associated sediment related to the construction of a new overburden storage area and additional cleared land due to the quarry expansion. Therefore, the direct impact will be the potential increase in peak flow due to the reduction in vegetation absorption and a potential increase in sediment or contaminants entering the waterway during rain events. Potential positive effects may include a reduction in nutrient input by converting what is currently stock-grazed land in the greater riparian zone, into the overburden storage area on the true left of the stream.

Assessment using EIANZ guidelines

Stream 1 is typical of a hard-bottomed stream flowing out of a steep, forested catchment. It is a third order stream and has a large catchment size, providing habitat for a variety of fish and invertebrates year-round. Although it has been degraded by riparian zone alteration and nutrient inputs, it still supports At-Risk inanga, as well as multiple macroinvertebrate species that inhabit only high-quality water bodies. It is a tributary of the Mangatawhiri River, which flows into the Waikato River, and as such is subject to the requirements of the Vision and Strategy for the Waikato River. The ecological value of Stream 1 is considered to be high.

Magnitude and Level of Effects

If stormwater flowing off the site were to enter the stream system directly, there would be a substantial increase in sedimentation creating a notable change from the current baseline conditions. This would lead to an increase in nutrient levels, smothering of habitat for aquatic fauna, reduction of light filtration through the water column, potential overgrowth of macrophytes and impacts on the health of aquatic fauna by smothering of their gills. This sediment would also flow down through the catchment to eventually drain into the Waikato River thereby going against the Vision and Strategy for the Waikato River.

There would also be a potential increase in peak flow entering Stream 1 due to the removal of riparian vegetation. This would lead to more rapid changes in water levels due to a lack of infiltration of water into the ground and potentially more severe flooding events and bank erosion. The effect would be considered permanent given the projected lifespan of the quarry. Considering all of this, the unmitigated magnitude of effects would be considered high.

With a high ecological value and a high magnitude of effect, the unmitigated level of effect on Stream 1 would be very high, thereby requiring mitigation under EIANZ assessment guidelines. In addition, mitigation would be required due to the following:

- The presence of longfin eels and inanga within the Stream 1 catchment resulting in the habitat being considered significant under Waikato Regional Policy Statement Ecological Assessment Section 11A; and
- Stream 1 being a tributary of the Mangatawhiri River which flows into the Waikato River, and as such is subject to the requirements of the Vision and Strategy for the Waikato River.

4.2.4. Overall Pre-Mitigation Level of Effects Rating

Table 9 below provides an overall pre-mitigation level of effects rating. The ecological values are based on Section 3 and the magnitude of effects is derived from Section 4.2.

Table 9 Overall level of effects rating (EIANZ, 2018).

Habitat Type	Ecological Value	Magnitude of Effect	Level of Effect
Ponds	Low	Moderate	Low
Tributary 1	Low	High	Low
Stream 1	High	High	Very High

5. MANAGEMENT OF EFFECTS

5.1. Terrestrial

Though the overall level of effects for terrestrial fauna has been assessed as low, consideration for appropriate fauna management is recommended as native birds, bats and lizards are protected under the Wildlife Act 1953.

To effectively manage the potential direct injury/mortality threats to native birds and their eggs, mitigation is recommended by means of seasonal constraints for vegetation clearance activities across the higher quality SNA bush block in Stage 1. The removal of native woody trees and large shrubs should be undertaken outside of the peak bird breeding season (November to January inclusive). If this isn't possible, then those areas should be checked by an appropriately qualified ecologist for nesting birds immediately prior to vegetation removal and, if detected, vegetation removal should be put on hold until the area is deemed by an appropriately qualified ecologist to be clear of native nesting birds and fledglings.

Overall, potential habitat for native lizards was limited across the proposed footprint. As described in Section 3.1.3 of this report, the kānuka-dominant areas hold the greatest potential for providing habitat for native lizards. Although no native lizards were found during surveying efforts, it is recommended that prior to any works within the kānuka-dominant areas, an appropriately qualified and experienced herpetologist should resurvey these areas over a minimum of two nights of nocturnal spotlighting and checking previously artificial cover objects (terrestrial and arboreal) at least three times. This proposed effort will increase the confidence that can be placed in presence/absence results. If native lizards are found to be present, then a project- specific Lizard Management Plan should be prepared and implemented for the kānuka-dominant forest areas.

Although only one potential bat pass was observed over the surveying period, the site provided potential roosting and foraging habitat for bats. Based on the proximity of confirmed bat records relatively close by, and the relatively large home range of long-tailed bats, it is appropriate to undertake further acoustic surveys prior to the commencement of vegetation clearance during stage 2 and 3 respectively. If bats are found to be present, appropriate pre-clearance checks will be required on trees that contain suitable roosting features.

A planted corridor north of the site is recommended in the Effects Management section of the vegetation assessment written by WSP-Opus. The re-establishment of an ecological corridor between the eastern and western forest areas adjacent to the site could provide necessary compensation for the loss of this vegetation, and provide additional benefits to native fauna.

To ensure the ecological quality of restoration areas, it is recommended that pest animal control is undertaken. At a minimum, this should be undertaken across the northern corridor, and southern riparian areas. Details to undertake these works should be incorporated into a pest management plan for the site.

5.2. Freshwater

Pond Reclamation

The proposed extension of the quarry will see the total loss of 9,900 m^2 of low ecological value artificial ponds that under Waikato Regional Council criteria are classed as significant due to the presence of At-Risk species. While the overall pre-mitigation level of effect is low under EIANZ assessment guidelines, the presence of longfin eels and dabchicks utilising these ponds triggers habitat significance under the Waikato Regional Policy Statement Ecological Assessment Section 11A. Therefore, these effects require some form of ecological offsetting.

To offset the loss of habitat provision, it is recommended that raupō and rushland wetlands with open water areas be established within the site. Given that the level of effect is below that requiring mitigation/offset under EIANZ guidelines (as well as considering the artificial nature of the ponds and the expectation that the new wetland will provide a habitat with greater ecological function than the current ponds), the proposed area ratio is 1:0.5 to ensure that any ecological effect will be offset. In other words, for every square metre of pond reclaimed, 0.5m^2 of wetland should be established and be protected in perpetuity.

It is envisioned that these wetlands will be created by restoring and extending the existing two wetlands in the lowland area of the site, resulting in a total wetland area of approximately 4900m^2. Tributary 1 would be directed into Wetland 1 and water would flow through this area before discharging into Stream 1. Wetland 2 would be fed by groundwater and by the outflow from the new proposed sediment pond adjacent to it. In addition to the newly created habitat for both terrestrial and aquatic fauna, the wetlands would provide additional filtration and flood mitigation services. Wetland 2 in particular will deliver further ecosystem services by providing polishing treatment to water discharged from the proposed sediment pond nearby. This type of wetland creation/enhancement will also aid in meeting iwi suggestions/requirements as indicated within the cultural assessment, by Ngāti Tamaoho Ngāti Te Ata, 2019.

The new areas of wetland would be created prior to further expansion of the quarry (and hence prior to infilling of the ponds) and as such there would be time for the wetlands to become established and create additional habitat for native fauna species. This form of pre-impact offsetting allows for a fully establish habitat to be present at the time of habitat removal, as opposed to the standard approach which results in a time delay before the offset achieves ecological functionality/peek habitat provision.

If the above recommended compensation is carried out correctly, it is considered that the post-mitigation magnitude of effect will be negligible and may result in an increase in ecological functionality and habitat provision.

Tributary 1 Reclamation

The proposed reclamation of Tributary 1 will result in the loss of approximately 311m of instream habitat, and will include the whole length of channel between Wetlands 1 and 2. While the level of effect is low under EIANZ assessment guidelines, the presence of longfin eel throughout the site's catchment results in the habitat being considered significant under Waikato Regional Policy Statement Ecological Assessment Section 11A. Therefore, these effects require some form of mitigation. In addition to the Waikato Regional Policy Statement Ecological Assessment

Section 11A, Tributary 1 is a tributary of the Mangatawhiri River which flows into the Waikato River, and as such is subject to the requirements of the Vision and Strategy for the Waikato River.

To offset the loss of these functions it is recommended that riparian restoration along Stream 1 be undertaken. The main sources of degradation for Stream 1 are attributable to the lack of riparian vegetation and the direct stock access. It is recommended that on both sides of Stream 1 a 7.5m margin be planted, a fence put in place to prevent stock access and a covenant be applied to protect the vegetation in perpetuity. Although it is acknowledged that this is not 'like-for-like' mitigation, it is considered that restoration of this large stream would deliver substantially more ecological benefit for the wider Mangatawhiri River system than finding and restoring a small length of degraded tributary elsewhere. It is considered that restoring the entire length of Stream 1 on site (approximately 930m in length or 13950m^2 of stream area) should be sufficient to ensure that all ecological effects associated with the reclamation of 311m or 311m^2 of Tributary 1 are offset.

The ecological improvements to be gained by restoring this length of Stream 1 will include:

- Creation of a riparian corridor extending down from the current area of native bush to the west;
- Bank stabilisation;
- Reduced peak flow rates during periods of heavy rainfall;
- Increased filtration activity to reduce sediment and nutrients entering the stream;
- Increased shading of Stream 1, thereby improving temperature regulation, improving dissolved oxygen levels and reducing overgrowth of periphyton;
- Increased organic debris input, providing food and habitat for macroinvertebrates (and thereby indirectly increasing food sources for native fish species); and
- Increased biodiversity by improving the interaction between the terrestrial and aquatic environments and providing habitat for terrestrial fauna species.

The current potential area for restoration of Stream 1 has been indicated within Appendix D. A detailed site-specific planting plan should be created for this area.

The water that would previously have flowed through Tributary 1 into Stream 1 would be captured by the proposed restoration and extension of Wetland 1, which would extend up to the edge of Stream 1 but remain "offline". An outflow point would be created from Wetland 1 to allow it to flow into Stream 1 thereby maintaining connectivity with the upstream environment of Tributary 1 (Appendix G).

Taking into account this proposed mitigation, the post-mitigation magnitude of effect for the reclamation of this reach of Tributary 1 is considered negligible.

Sediment Output

Vegetation removal and earthworks associated with the project have the potential to generate sediment which, if unmitigated, may enter the catchment's freshwater ecosystems and cause significant ecological effects downstream. The implementation of stringent erosion and sediment control measures should be adequate to avoid adverse effects on the catchment's freshwater ecological values. It is recommended that a project specific sediment and erosion control plan be prepared by a suitably qualified and experienced professional.

As part of this sediment and erosion control, four sediment retention ponds are already proposed within the current designs. Stormwater flowing off the site will be captured by the sediment retention ponds and treated as it moves through these ponds prior to discharge. The magnitude of effect of the discharge of treated stormwater can only be estimated and depends on correct management and maintenance of the overburden storage areas and the treatment ponds. The overburden storage area should be managed to direct all stormwater runoff into one of the four sediment retention ponds and these ponds then treated with a suitable flocculant as appropriate.

If this sediment and erosion control is carried out correctly then the water entering Stream 1 should be similar quality to that currently within Stream 1. For the purposes of this report, it is assumed that this will be done correctly and therefore the magnitude of effect is considered to be low. The timeframe is still considered to be permanent as the proposed expansion stages of the quarry will continue for several decades.

Fish Management

Native fish are present within the ponds and potentially present within Tributary 1. Removal of the ponds and reclamation of Tributary 1 have the potential to cause injury to or death of native fish. Avoidance of reclamation or instream works within the channels flowing through the wetland areas will remove the risk of injury to or death of native fish in these reaches.

To minimise the risk to native fish it is recommended that prior to any works within the site's aquatic environment an appropriately qualified and experienced freshwater ecologist should prepare and implement a project-specific Fish Management Plan (FMP). Any fish found within the areas to be reclaimed should be relocated to a suitable release site identified within the FMP.

If fish management is carried out correctly then the effects on native fish should be minimal (i.e. the risk should be substantially reduced and if any fish are injured or killed it will only be a tiny proportion of the population compared to the unmitigated situation). As such, the post-mitigation magnitude of effects for the areas to be reclaimed is considered low.

6. POST-MITIGATION LEVEL OF EFFECTS

6.1. Terrestrial

Though mitigation has not been triggered under the EIANZ assessment for terrestrial fauna, management has been recommended to ensure potential direct injury/death impacts which may occur during the vegetation clearance phase of the project are addressed.

Table 10 Overall post-mitigation level of effects, Fauna

Habitat Type	Ecological Value	Magnitude of Effect	Level of Effect
Existing quarry	Negligible	Negligible	Negligible
Kānuka-dominant forest	High	Low	Low
Specimen	Moderate	Low	Low

trees (DBH>80cm)			
Gorse-dominant scrub	Low	Low	Very low

6.2. Freshwater

By implementing the management recommendations outlined in section 5.2, the magnitude of effects for all three freshwater systems becomes low or negligible. Under EIANZ guidelines low is: "*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 negligible "*Very slight change from the existing baseline condition. Change barely distinguishable, approximating to a 'no change situation' AND/OR having a negligible effect on the known population or range of the element/feature*". As a result of this the overall level of effects for the ponds and for Tributary 1 becomes very low and for Stream 1, becomes low. As such, it is considered that the ecological impacts will have been suitably addressed and no further mitigation is required.

Table 11 Overall post-mitigation level of effects, Freshwater

Habitat Type	Ecological Value	Magnitude of Effect	Level of Effect
Ponds	Low	Negligible	**Very Low**
Tributary 1	Low	Negligible	**Very Low**
Stream 1	High	Low	**Low**

6.3. Recommendations:

The following ecological management is recommended to ensure that any foreseeable ecological effects associated with the works are adequately managed and mitigated:

- **Lizard Management –** As detailed above, additional lizard surveys should be undertaken prior to clearance of the kānuka-dominant forest within the site. This will involve 2 nights of spotlighting and 3 checks of artificial cover objects within the Stage 1 bush block. If lizards are found to be present, a lizard management plan should be prepared by a Department of Conservation-recognised herpetologist and implemented across the high-valued habitat to ensure native lizards are relocated into retained vegetation of equal or greater quality on-site. Lizard management should be undertaken before and during vegetation removal by an appropriately qualified and experienced ecologist.

- **Bat Management –** Additional acoustic bat monitoring surveys should be undertaken before the commencement of clearance at Stage 2 and 3 respectively. If bat activity is detected, then bat management will be recommended at the discrepancy of a competent bat ecologist. This may require the preparation and implementation of a bat management plan.

- **Bird Management** – Vegetation removal should take place outside of the peak bird breeding season (October to January inclusive). If vegetation clearance cannot be achieved outside of these dates, then those areas should be checked by an

appropriately qualified ecologist for nesting birds immediately prior to vegetation removal. If active nests are detected, vegetation removal should be put on hold until the area is deemed to be clear of nesting birds by an appropriately qualified ecologist.

- A site-specific Ecological Management Plan (EMP) should be prepared for the site which aims to mitigate and manage foreseeable ecological impacts associated with the removal of protected habitat and enhance retained areas of indigenous biodiversity. This EMP should be approved by Waikato Regional Council for implementation and cover the following:
  - **Planting Plan** – This plan should be prepared by a suitably qualified and experienced ecologist and outline the planting to take place within 7.5m on either side of the bank along an identified area of Stream 1, and also for the corridor north of the site proposed by WSP-Opus[15]. Details should include plant species and size, site preparation, timing of planting and maintenance for five years from the time of planting. It is envisaged that natural regeneration will complement this planting.
  - **Pest Animal Management Plan**-– This plan will detail appropriate pest animal control across the newly planted corridor and existing bush edges for the lifetime of the quarry. This plan shall specify control measures, methods, timings and placements of traps/bait stations.
  - **Fish Management Plan** (FMP)- This should be produced by an appropriately qualified and experienced freshwater ecologist and should detail fish salvage and exclusion methodologies. The FMP should be implemented before any work on the site's aquatic environments is undertaken.
  - **Wetland creation/enhancement and planting plan –** This plan should detail concept designs for Wetlands 1 and 2, planting plans for these areas and suggested timelines to align the development of the wetlands with the reclamation of the reach of Tributary 1. Planting details should include plant species and size, site preparation, timing of planting and maintenance for five years from the time of planting.
- **Sediment and Erosion Control Plan**: Appropriate erosion, sediment and containment controls should be installed prior to the commencement of the proposed quarry extensions to reduce the risk of any sediment and/or containments entering the wider Mangatawhiri River catchment. This should be guided by a plan prepared by a suitably experienced professional.
- All revegetated areas should be prioritised for covenanting in order to provide protection in perpetuity.

[15] Bridge, D., Turner, J., and Yungnickel M. (2018). McPherson Quarry Vegetation Assessment. Expansion Stages 1 to 3. WSPOpus.

7. CONCLUSION

This report addresses the actual and potential impacts of proposed quarry extension at McPherson Quarry. The ecological effects were in general assessed as low under the EIANZ assessment guidelines, with the exception of the reclamation of a single watercourse. As a result, recommendations to manage these effects have been made due to the local and regional ecological significance of various ecological features on the site. Recommendations for various ecological considerations have been detailed in order to guide the appropriate management of potential adverse effects.

The preparation and implementation of a tailored ecological management plan based on the findings of this report will ensure the project adequately addresses all significant impacts to ensure they are managed to a low or negligible standard.

APPENDIX A

Report Limitations

This Report/Document has been provided by Ecology New Zealand Limited (ENZL) subject to the following limitations:

i) This Report/Document has been prepared for the particular purpose outlined in ENZL's proposal and no responsibility is accepted for the use of this Report/Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of ENZL's services are as described in ENZL's proposal and are subject to restrictions and limitations. ENZL did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report/Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by ENZL in regards to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry ENZL was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Report/Document. Accordingly, if information in addition to that contained in this report is sought, additional studies and actions may be required.

iv) The passage of time affects the information and assessment provided in this Report/Document. ENZL's opinions are based upon information that existed at the time of the production of the Report/Document. The Services provided allowed ENZL to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments, designs and advice made in this Report/Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Report/Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by ENZL for incomplete or inaccurate data supplied by others.

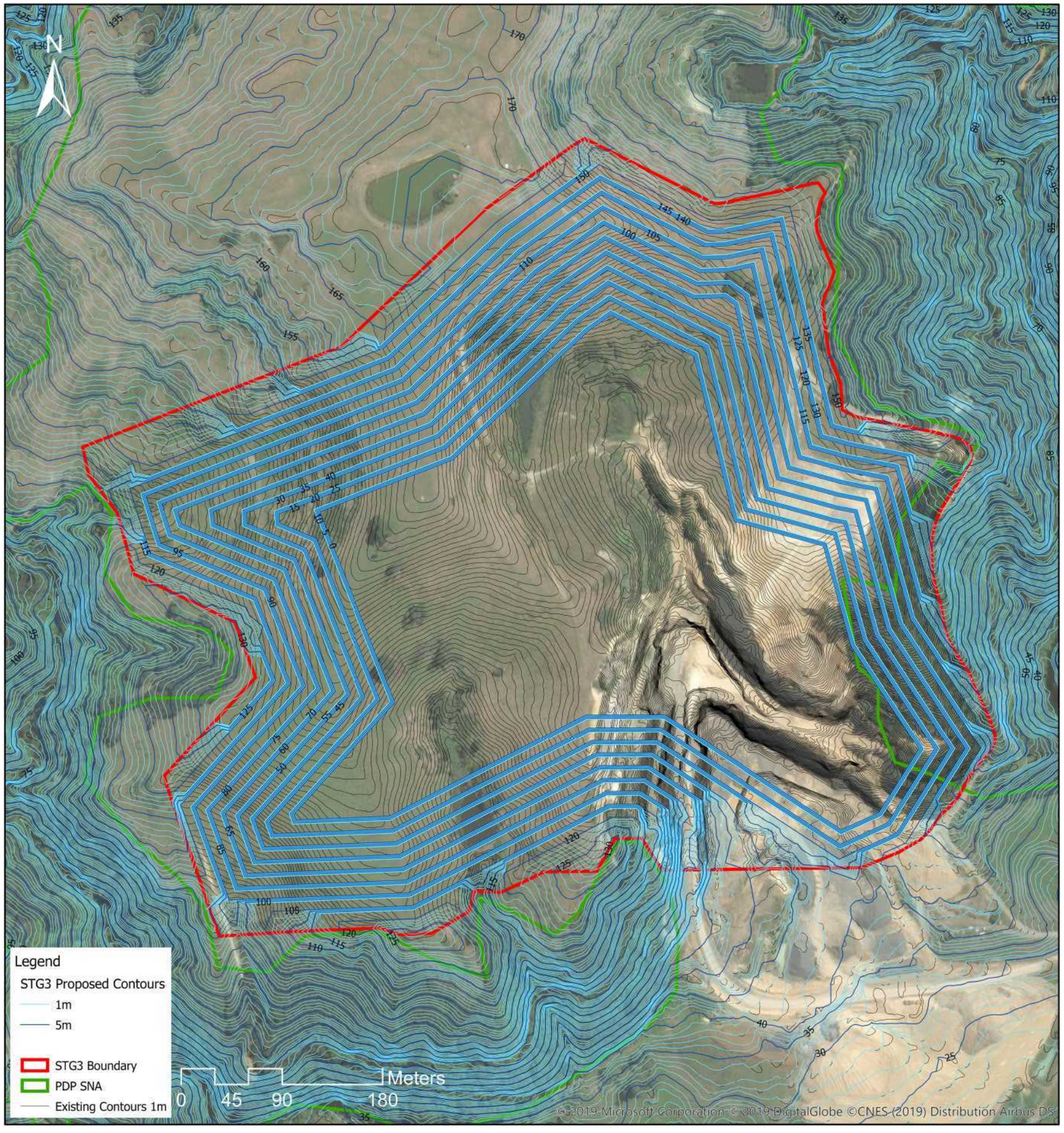
vii) The Client acknowledges that ENZL may have retained sub-consultants affiliated with ENZL to provide Services for the benefit of ENZL. ENZL will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from ENZL and not ENZL's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against ENZL's affiliated companies, and their employees, officers and directors.

viii) This Report/Document is provided for sole use by the Client and is confidential to it. No responsibility whatsoever for the contents of this Report/Document will be accepted to any person other than the Client. Any use which a third party makes of this Report/Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. ENZL accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Report/Document.

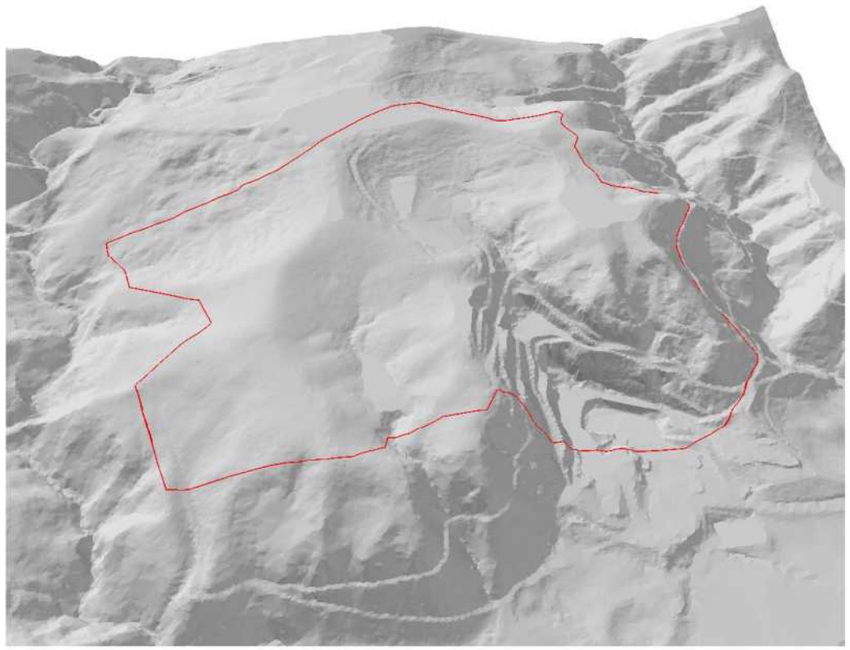
ix) Where lengths or other measurements have not been provided by a surveyor, ENZL has used basic GIS mapping and measurement systems to estimate these numbers. These should not be taken as surveyor-level accuracy for the purposes of decision making.

Appendix B

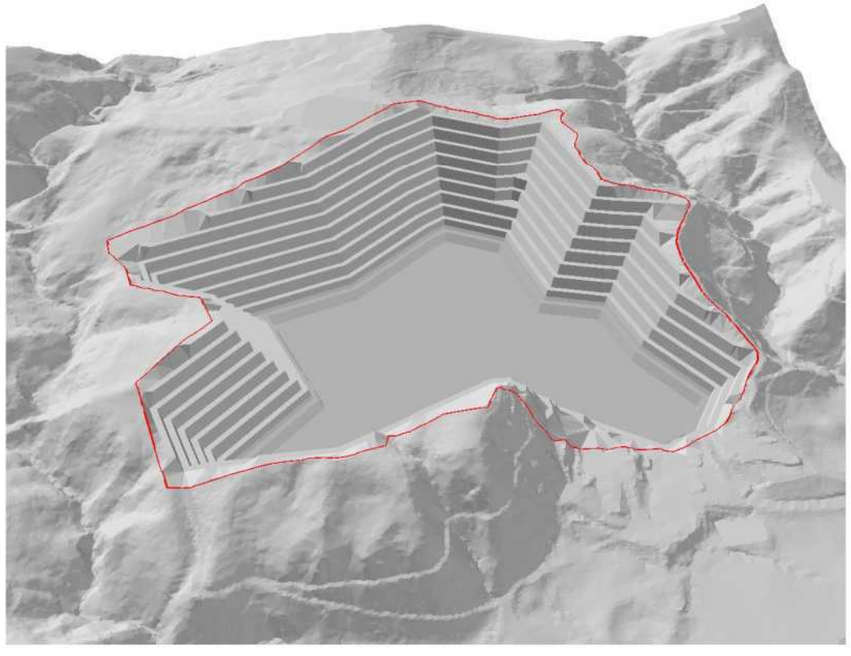
Site plans



Stage 3 Proposed Contours | Plan View | Scale 1:4,000



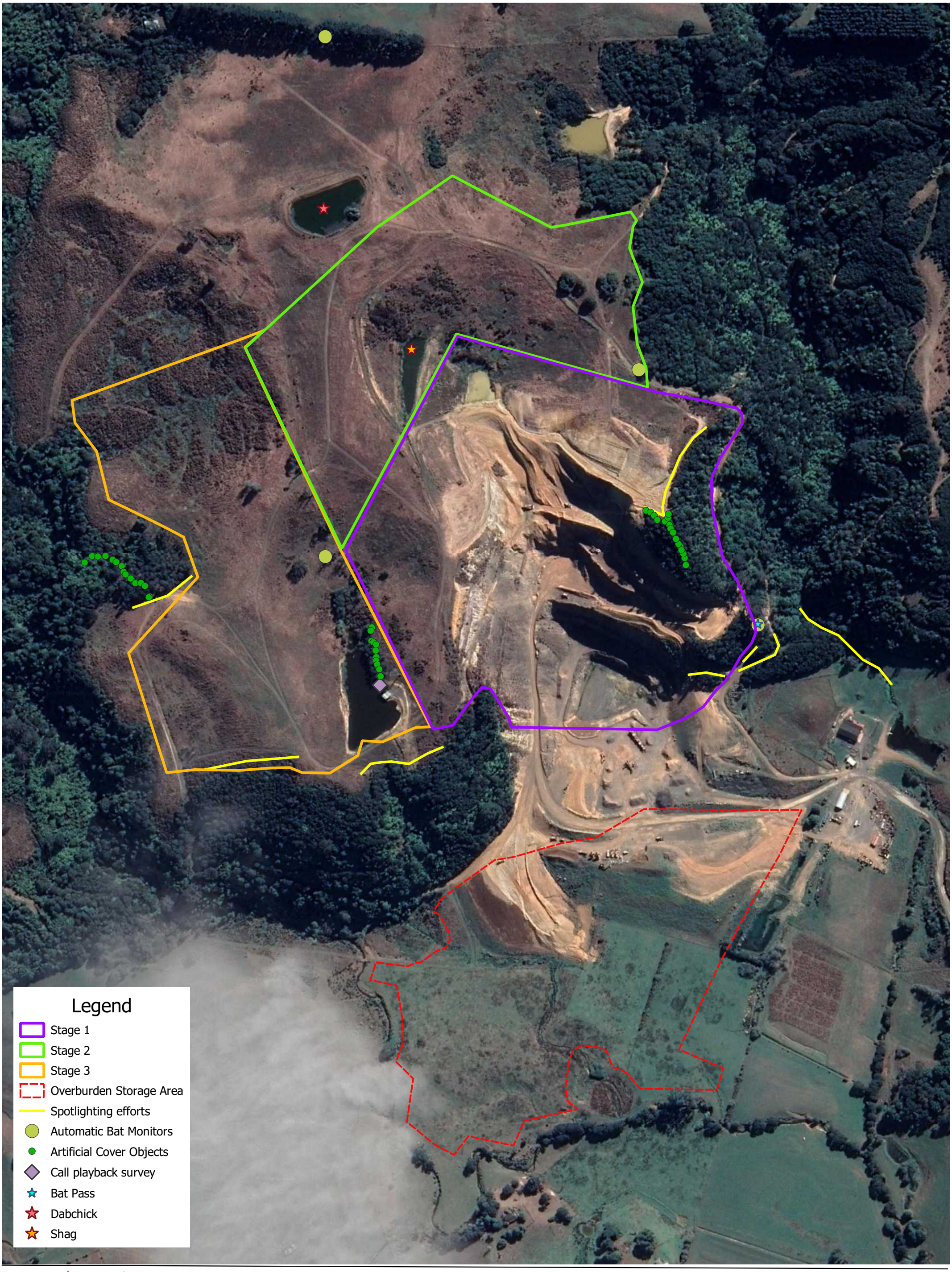
Existing Topography | 3D Perspective



Stage 3 Proposed Contours | 3D Perspective

Appendix C

Terrestrial Surveying Efforts



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Projection: NZGD2000/NZTM2000 Sources: Map data-Waikato District Council 2019;Stage 1-3 footprints based on plans by Mansergh Graham Landscape Architects, dated October 2019.Overburden footprint-based on communications with Kinetic Environmental Ltd, dated 25-07-2019

Mcpherson Quarry, Mangatawhiri

Terrestrial Surveying Efforts

Date: 15 October 2019 | Revision : 2

Plan prepared for McPherson Resources Limited by Ecology New Zealand Limited
Author: stephanie.angove-emery@ecologynz.nz |

Appendix D

Freshwater features and surveying efforts

Pond 1
Pond 3
Pond 2
North Pond
South Pond
Stream 1
Tributary 1

Legend

Stage 1
Stage 2
Stage 3
Overburden storage area

Watercourses

Drainage Channel
Intermittent Stream
Permanent Stream
Ephemeral Stream

Waterbodies

Sedimentation Ponds
Ponds
Wetlands

Surveying Traps

Fyke
Gee Minow

ECOLOGY NEW ZEALAND

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0 100 200 300 m

1:4,000 @ A3

Projection: NZGD 2000/NZTM 2000
Sources: Map data ©2019 Google, Map data-Waikato District Council 2019;Stage 1-3 footprints based on plans by Mansergh Graham Landscape Architects, dated October 2019.Overburden footprint-based on communications with Kinetic Environmental Ltd, dated 25-07-2019

McPherson Quarry
Aquatic Features and Surveying Effort

Date:15 October 2019 | Revision : 3

Plan prepared for McPherson Resources Limited by Ecology New Zealand Limited
Author: stephanie.angove-emery@ecologynz.nz

Appendix E

Regional Policy Statement Ecological Assessment Section 11A

Previously assessed site			Does criteria apply
1.	*It is indigenous vegetation or habitat for indigenous fauna that is currently, or is recommended to be, set aside by statute or covenant or by the Nature Heritage Fund, or Ngā Whenua Rāhui committees, or the Queen Elizabeth the Second National Trust Board of Directors, specifically for the protection of biodiversity, and meets at least one of criteria 3-11.*	A small portion of the vegetation onsite is classed as a Significant Natural Area by the Waikato Regional Council.	Yes
Ecological values			
2	*In the Coastal Marine Area, it is indigenous vegetation or habitat for indigenous fauna that has reduced in extent or degraded due to historic or present anthropogenic activity to a level where the **ecological sustainability** of the ecosystem is threatened.*	Not applicable	No
3.	*It is vegetation or habitat that is currently habitat for indigenous species or associations of indigenous species that are:* • *classed as threatened or at risk, or* • ***endemic** to the Waikato region, or* o *at the limit of their natural range.*	Threatened (long-tailed bat) and At Risk (shag, long fin eel and inanga) species were noted onsite.	Yes
4.	*It is indigenous vegetation, habitat or ecosystem type that is under-represented (20% or less of its known or likely original extent remaining) in an Ecological District, or Ecological Region, or nationally.*	The impacted site	No
5.	*It is indigenous vegetation or habitat that is, and prior to human settlement was, nationally uncommon such as geothermal, chenier plain, or karst ecosystems, hydrothermal vents or cold seeps.*	Not applicable	No

6.	*It is wetland habitat for indigenous plant communities and/or indigenous fauna communities (excluding exotic rush/pasture communities) that has not been created and subsequently maintained for or in connection with:* • *waste treatment;* • *wastewater renovation;* • *hydroelectric power lakes (excluding Lake Taupō);* • *water storage for irrigation; or* • *water supply storage;* *unless in those instances they meet the criteria in Whaley et al. (1995).*	The wetlands areas are degraded and only contain exotic and pastural species, as such do not fall within this criteria.	No
7.	*It is an area of indigenous vegetation or naturally occurring habitat that is large relative to other examples in the Waikato region of similar habitat types, and which contains all or almost all indigenous species typical of that habitat type. Note this criterion is not intended to select the largest example only in the Waikato region of any habitat type.*	The indigenous vegetation within the site composes a small percentage of the vegetation overall.	No
8.	*It is aquatic habitat (excluding artificial water bodies, except for those created for the maintenance and enhancement of biodiversity or as mitigation as part of a consented activity) that is within a stream, river, lake, groundwater system, wetland, intertidal mudflat or estuary, or any other part of the coastal marine area and their margins, that is critical to the self-sustainability of an indigenous species within a catchment of the Waikato region, or within the coastal marine area. In this context "critical" means essential for a specific component of the life cycle and includes breeding and spawning grounds, juvenile nursery areas, important feeding areas and migratory and dispersal pathways of an indigenous species. This includes areas that maintain connectivity between habitats.*	Yes, the stream reaches provide habitat and migratory and dispersal pathways of indigenous species.	Yes
9.	*It is an area of indigenous vegetation or habitat that is a healthy and*	The two small bush blocks that are in the site have slightly degraded	No

	representative example of its type because: • *its structure, composition, and ecological processes are largely intact; and* • *if protected from the adverse effects of plant and animal pests and of adjacent land and water use (e.g. **stock**, discharges, erosion, sediment disturbance), can maintain its ecological sustainability over time.*	understories and pest plant impacts.	
10.	*It is an area of indigenous vegetation or habitat that forms part of an **ecological sequence**, that is either not common in the Waikato region or an ecological district, or is an exceptional, representative example of its type.*	The majority of the vegetation onsite is composed of pasture grasses and gorse.	No
Role in protecting ecologically significant area			
11.	*It is an area of indigenous vegetation or habitat for indigenous species (which habitat is either naturally occurring or has been established as a mitigation measure) that forms, either on its own or in combination with other similar areas, an ecological buffer, linkage or corridor and which is necessary to protect any site identified as significant under criteria 1-10 from external adverse effects.*	The bush blocks on the eastern and western boundaries of the site are part of an ecological corridor running from the Hunua Ranges.	Yes

Appendix F

Terrestrial habitat features (all unmarked areas classified as grazed pasture)

Legend

- Stage 1
- Stage 2
- Stage 3
- Overburden Storage Area
- Kanuka-dominant forest
- Current quarry extent
- Specimen trees (DBH> 80cm)
- Gorse-dominant scrub
- Waterbodies

ECOLOGY NEW ZEALAND

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Projection: NZGD2000/NZTM2000 Sources: Map data-Waikato District Council 2019;Stage 1-3 footprints based on plans by Mansergh Graham Landscape Architects, dated October 2019.Overburden footprint-based on communications with Kinetic Environmental Ltd, dated 25-07-2019

Mcpherson Quarry, Mangatawhiri

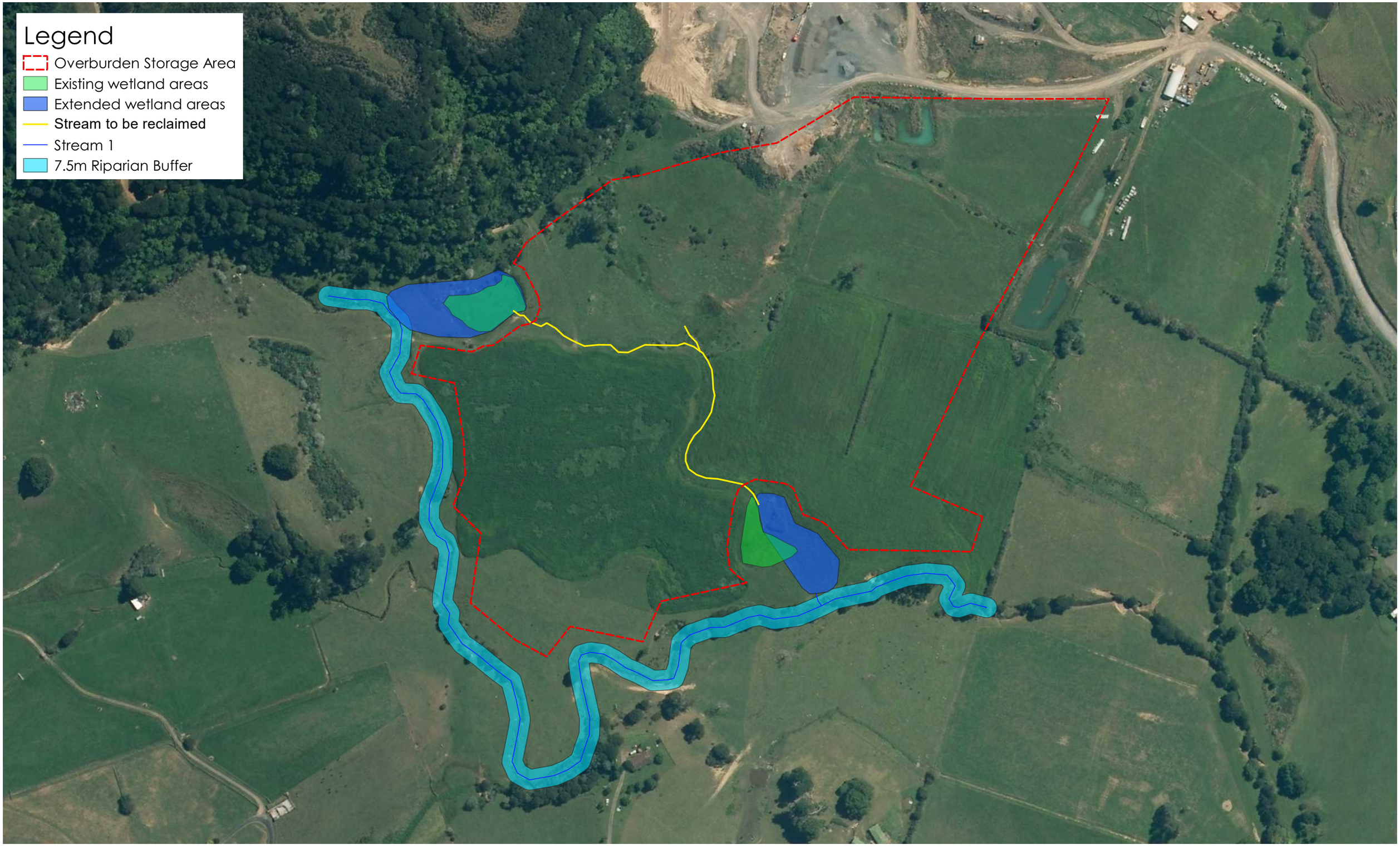
Terrestrial Habitat Features

Date: 15 October 2019 | Revision : 2

Plan prepared for McPherson Resources Limited by Ecology New Zealand Limited
Author: stephanie.angove-emery@ecologynz.nz |

Appendix G

Proposed Freshwater Impact Sites and Mitigation



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Projection: NZGD2000/NZM2000
Sources: Map data ©2019 Google; Overburden storage area footprint based on communications with Kinetic Environmental Consulting Ltd.

McPherson Quarry

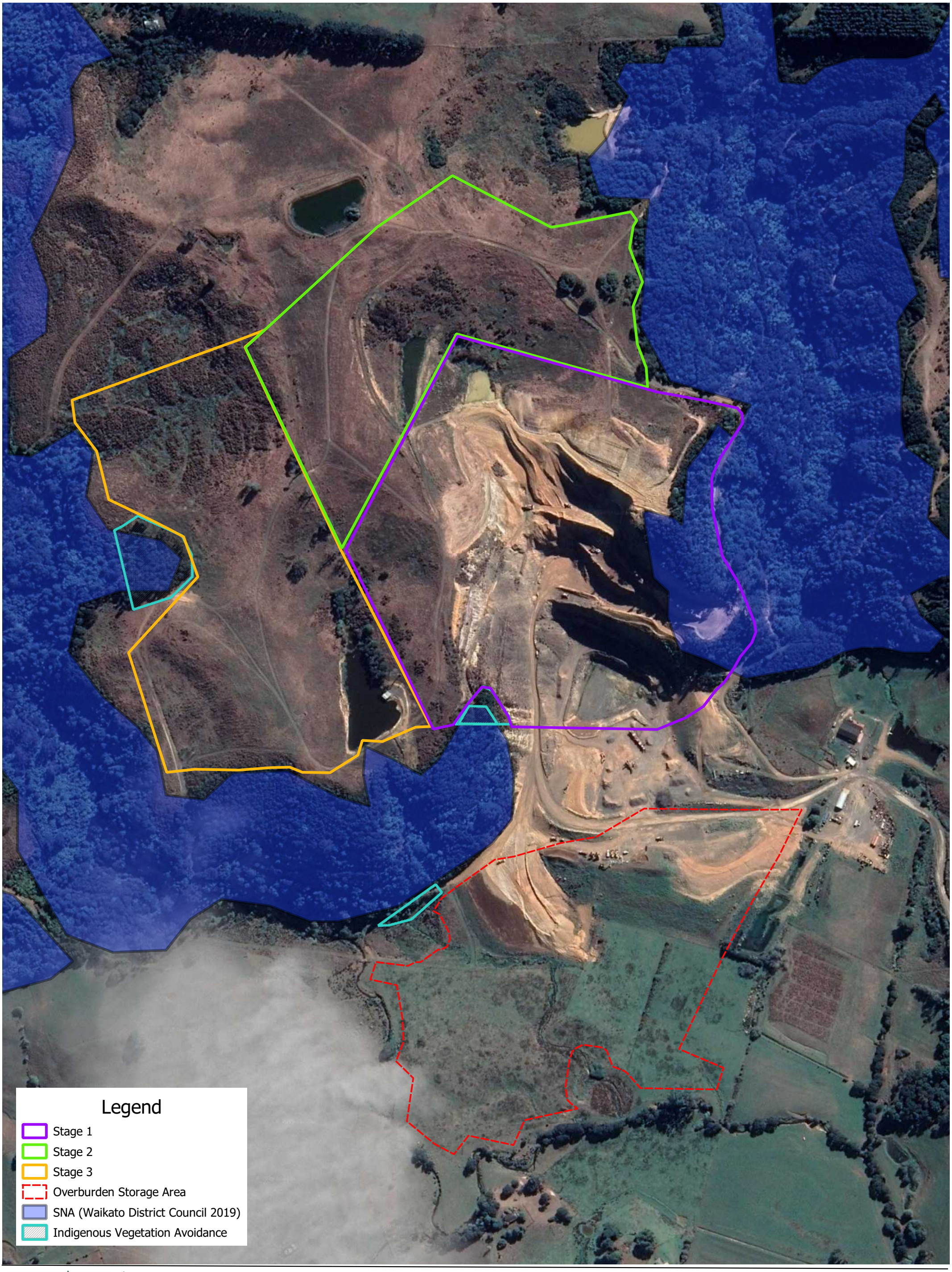
Freshwater Restoration Map

Date: 15 Oct 2019 | Revision : 2

Plan prepared for McPherson Resources Limited
Author: Stephanie A | Checked: C.Croft

Appendix H

Avoidance Measures



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Projection: NZGD2000/NZTM2000 Sources: Map data-Waikato District Council 2019;Stage 1-3 footprints based on plans by Mansergh Graham Landscape Architects, dated October 2019.Overburden footprint-based on communications with Kinetic Environmental Ltd, dated 25-07-2019

Mcpherson Quarry, Mangatawhiri

Avoidance measures with SNA Overlay

Date: 15 October 2019 | Revision : 2

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Author: stephanie.angove-emery@ecologynz.nz |