Before the Hearing Commissioners
appointed by the Grey District Council and
West Coast Regional Council

Under	the Resource Management Act 1991
In the matter of	Resource consent applications by TiGa Minerals and Metals Ltd to establish and operate a mineral sands mine on State Highway 6, Barrytown (RC-2023-0046; LUN3154/23)

Statement of evidence of Gary Neil Bramley

19 January 2024

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Qualifications and experience

1 My full name is Gary Neil Bramley.

2 I am currently employed as an ecologist at Ecological Solutions Limited. Ecological Solutions Limited is a specialist ecological consulting firm with offices in Northland, Auckland, Tauranga and Hawkes Bay. I have held that position since April 2022. At Ecological Solutions I am a shareholder and Director and I lead a team of seven terrestrial ecologists.

3 My previous work experience includes working as an independent consulting ecologist, working as an ecologist for Reconnecting Northland (a landscape scale conservation project in Northland), working as a tutor in Biology at Waikato Polytechnic, and as a lecturer in Biology at the University of Waikato. I have worked as a consultant ecologist since 2000, initially for NZ Environmental Limited and then Mitchell Partnerships Limited (now Mitchell Daysh). Between January 2016 and March 2022, I operated my own business (The Ecology Company) and then in April 2022 my business and Freshwater Solutions Limited merged to become Ecological Solutions Limited.

4 Since 2000 the majority of my relevant work experience has been to undertake or contribute to a large number of ecological investigations, significance assessments and assessments of the ecological effects of developments on urban, peri-urban, coastal, forest, wetland, gumland, farmland and subalpine areas throughout New Zealand. I have mainly worked throughout Northland, Auckland, Waikato, the West Coast of the South Island and the Waitaki, MacKenzie and Queenstown Lakes districts. I have been involved in a variety of development projects in New Zealand, including several plan changes, large-scale subdivisions, retirement villages, infrastructure projects (roading, electricity generation, a monorail), irrigation projects and mining and quarrying projects. I have carried out assessments of the effects of such schemes on terrestrial and aquatic ecology and have developed, contributed to or managed the implementation riparian and terrestrial restoration projects (ranging in size from a few square metres to 900ha) and pest management projects (ranging in size from a few hectares to more than 19,000ha) in both urban and rural settings. I have developed biodiversity offsets for some of the proposals I have been involved with.

5 I have published or contributed to eleven peer reviewed papers and more than 300 unpublished reports prepared for a variety of clients. My peer reviewed publications have related to the behaviour, ecology and management of avifauna, and rodents and the use of novel crops to promote invertebrate biodiversity on farms. I have been responsible for the preparation of Assessment of Environmental Effects ('AEE') documentation, management plans and Department of Conservation concession and wildlife permit applications among other matters. I have prepared

and presented evidence to Council, Environment Court and Environmental Protection Agency hearings and acted as an expert peer reviewer for councils, the Environmental Protection Agency and the Ministry of Business, Innovation and Employment. In 2004 I was awarded an "Old Blue" Conservation Award by the Royal Forest and Bird Protection Society followed in 2006 by a Northland Biodiversity Enhancement Group award for contribution to the conservation of Northland's natural heritage. In 2018 I was awarded life membership of the Puketi Forest Trust, a charitable trust which I helped establish in 2003 to restore Puketītī Forest in Northland. I am a member of the New Zealand Ecological Society, the Ornithological Society of New Zealand, the New Zealand Plant Conservation Network and the Environment Institute of Australia and New Zealand. In July 2017 I completed the "Making Good Decisions" programme and am a certified resource consent hearings commissioner.

6 I have provided ecological advice to a range of mining projects and proposed mining projects over the course of my career, including the following:

(a) Bathurst Resources Limited and related party coal mines at Stockton, Denniston, Maramarua, Canterbury and Southland (in most cases my involvement extends back as far as when these mines were owned and operated by Solid Energy);

(b) Strongman Mine near Greymouth and Giles Creek Mine near Reefton;

(c) Stevenson Group proposed coal mine at Te Kuha, near Westport;

(d) Francis Mining Group coal mines at Reefton, Roa and Lyell;

(e) Oceana Gold Corporation underground gold mine at Waihi;

(f) Westco Lagan alluvial gold mine at Ruatapu;

(g) Westland Minerals Limited sand mines at Cape Foulwind and Manunui.

I have prepared management plans for many of those sites and am actively involved in ongoing monitoring and compliance work and providing ongoing ecological advice at some of them. I have also visited a number of other mines to assess rehabilitation outcomes including Oceana Gold Corporation's mine at Reefton, Puke Coal (near Huntly) and the access road to Pike River Mine near Greymouth.

Involvement in the Project

7 My role in relation to TiGa Minerals and Metals Limited's (**TiGa**) application to establish and operate a mineral sand mine at 3261 Coast Road, SH6 Barrytown (**Application and Application Site**) has been to provide advice in relation to

terrestrial ecological matters and prepare the draft Avian Management Plan and Wetland Construction and Riparian Planting Plan. The latest versions of these documents are attached to my evidence as **Appendix 1** and **Appendix 2** respectively.

8 My assessment is based upon the proposal description attached to the evidence of Ms Katherine McKenzie as Appendix 1.

9 In preparing this statement of evidence I have considered the following documents:

(a) the AEE accompanying the Application;

(b) submissions relevant to my area of expertise;

(c) the assessment of hydrological effects prepared by Kōmanawa Solutions Limited;

(d) the statement of evidence of hydrology by Mr Jens Rekker;

(e) the Water Management, Monitoring and Mitigation Plan prepared by Kōmanawa Solutions Limited;

(f) the statement of evidence in relation to erosion and sediment control of Mr Graeme Ridley;

(g) the erosion and sediment control plan prepared by Ridley Dunphy Environmental Limited;

(h) the Dust Management Plan prepared by Mr John Berry;

(i) the evidence relating to landscape prepared by Ms Naomi Crawford;

(j) the landscape assessment and accompanying Graphic Supplement prepared by Glasson Huxtable Landscaping;

(k) the statement of evidence on noise prepared by Mr Jon Farren;

(l) the Noise Management Plan prepared by Marshall Day Acoustics;

(m) the statement of evidence relating to transport by Mr Nick Fuller;

(n) The statement of evidence on coastal processes by Mr Gary Teear;

(o) the statement of evidence on aquatic ecology by Mr Mark Roper;

(p) planning provisions relevant to my area of expertise;

(q) section 42A reports from Grey District and West Coast Regional Councils;

(r) the ecological peer review by Mr Mike Harding commissioned by Grey District Council;

(s) the draft proposed conditions prepared by Ms Mckenzie.

10 Ecological Solutions Limited was engaged in early 2022 by TiGa Minerals and Metals to undertake the baseline terrestrial and aquatic surveys necessary to inform this resource consent application and contribute to the mine planning, particularly in relation to avoidance of adverse effects on the ecological values of the areas adjoining the Application Site. Ecological Solutions Limited prepared an assessment of environmental effects of the proposed activities ('the AEE') and provided recommendations to mitigate and/or remedy effects which could not be avoided (where that approach is appropriate). I then had the AEE externally peer reviewed by Dr Graham Ussher (RMA Ecology) and Dr Leigh Bull (BlueGreen Ecology). Dr Ussher has a PhD in Conservation Management from the University of Auckland (2000) and has 25 years of experience in consulting. Dr Ussher's publications pertain to reptiles, biodiversity offsetting and ecological impact assessment. In particular he has been a co-author on a number of biodiversity offsetting guidance documents, including the document prepared by Local Government NZ entitled 'Biodiversity offsetting under the Resource Management Act (September 2018)'. He is also a coauthor of the Environment Institute of Australia and New Zealand ecological impact assessment guidelines (2018), which I refer to later in my evidence. Dr Leigh Bull has a PhD in Ecology and Biodiversity (Victoria University of Wellington) with 17 years' experience working as a consultant ecologist. She was until recently a partner at Boffa Miskell and is a Certified Environmental Practitioner Ecology Specialist with the Environment Institute of Australia and New Zealand and an Independent Hearings Commissioner. Dr Bull's scientific peer-reviewed publications pertain to coastal and oceanic avifauna, invasive species and lizards.

11 Mr Patrick Stewart (SoundCounts) has undertaken seasonal bird counts at the site under my direction and this data has informed the AEE. Mr Stewart is a field ecologist who has undertaken field surveys for a variety of birds over the last 20 years including seabirds, waders, waterbirds and forest and alpine birds, as well as long tailed bats in both islands. His work has included large scale surveys covering tens of thousands of hectares using acoustic recording devices.

12 I have visited the site in July 2021, April and December 2022, and January and December 2023 and January 2024. Other members of my team have visited the site on other occasions.

13 I have also engaged with Ms I Perkins (West Coast Penguin Trust), Dr Susan Waugh (who submitted in a private capacity, but is a seabird expert) and Ms Kate Simister (Department of Conservation) in relation to this proposal.

Code of Conduct for Expert Witnesses

14 While this is not a hearing before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

15 I have prepared evidence in relation to:

(a) Describing the existing ecological context and terrestrial ecological values at the site.

(b) the key findings of my assessment of effects;

(c) the relevant planning framework as it applies to ecological matters;

(d) matters raised by submitters to the Application;

(e) matters raised in the West Coast Regional Council's ('WCRC') and Grey District Council's ('GDC') staff reports (reports issued under s42A of the RMA);

(f) questions of clarification from the Chair of the Hearings Panel; and

(g) proposed conditions of consent.

Executive Summary

16 The site is located on farmland that has been 'humped and hollowed' situated between Collins Creek, Deverys Creek, State Highway 6 and the coast at the Barrytown flats, approximately 36km north of Greymouth. The ecological values within the site to be mined are negligible - low[1]. Immediately adjoining the site to be mined, ecological values are limited to small areas of riparian vegetation, the aquatic ecological values of Canoe Creek and Collins Creek and the values

[1] Areas with a score of 'low 'are ranked low or very low for the majority of assessment matters (representativeness, rarity and distrinctiveness, diversity and pattern and ecological context) and moderate for one. Low value areas can be thought of as being of limited ecological value other than as local habitat for tolerant native species.
Areas with a score of 'negligible' are ranked very low for three matters and moderate,low or very low for the remainder. Areas of negligible value are dominated by exotic species.

associated with the adjoining coastal lagoons and another pond referred to here as Rusty Pond. The lagoons and pond have high ecological values, particularly with respect to birds. The site is also located approximately 3.6km south of the only known tāiko/Westland petrel colony, which has very high ecological values as it is the only known breeding colony.

17 With respect to effects on hydrology extending beyond the site and affecting wetlands nearby, the proposal has been informed by detailed and ongoing hydrological studies intended to assist in formulating management actions to avoid effects on wetlands and other habitats adjoining the site. The approach adopted is to return treated mine water to ground and surface locations so as to maintain pre-mining median groundwater levels. Water would be returned via, in order of preference, infiltration trenches, reinjection wells and surface discharge. Water could also be discharged to an infiltration basin near Canoe Creek if required to manage the site water balance. Frequent and comprehensive monitoring of groundwater levels at the site perimeter would inform assessments of potential non-compliance, and management would be adjusted as necessary to maintain groundwater levels and avoid effects beyond the site.

18 In relation to bird values, I am of the opinion that any adverse effects on threatened and at risk bird species using the lagoons, pond and surrounding vegetation, or making use of the pasture and bare soil within the mining area, can be managed so that they are either avoided, or are very low[2]. Effects on tāiko can also be avoided. I have updated the Avian Management Plan in response to submissions and consultation with the named in Paragraph 13. This plan prescribes management to achieve the goals set out in Condition 18 and is expected to result in avoidance of adverse effects on threatened and at risk species in the CMA and avoidance of significant adverse effects and management to minimise other effects elsewhere. This management includes not mining or trucking at night, physical separation between the important habitats and the works, timing of works to avoid the breeding season, planting to act as a buffer and monitoring to inform ongoing management (such as the location of setbacks). For the tāiko/petrels in particular, not mining or trucking at night eliminates the risk of birds leaving the breeding colony located to the north of the Application Site becoming disoriented and being grounded in response to artificial lighting.

19 In my opinion the proposal meets the relevant directive policies of the National Policy Statements (i.e., the New Zealand Coastal Policy Statement (2010), the National Policy Statement for Freshwater Management (2020) and the National

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[2] Within the EIANZ framework a ‘very low’ level of effects is equivalent to a “not more than minor” level of effects in an RMA sense.

Policy Statement for Indigenous Biodiversity (2023). It also meets the policies of the regional and local planning instruments.

20 I conclude that from an ecological effects perspective, the mine is well located and the level of effects can either be avoided or managed to a low or very low level. This is equivalent to no effects (avoidance), less than minor (very low) or minor (low) effects in the RMA context.

The Application

21 Tiga proposes to mine ilmenite, garnet and other minerals over an area of land approximately 63ha (covered by Mining Permit MP 60785) within a larger (c. 115ha) property currently owned by Nikau Deer Farm Ltd. The proposal involves undertaking sequential strip mining and rehabilitation of the site in a south north direction with mined strips being approximately 100m wide and 300m long. The mine pit area will be 3ha, with 0.5ha of stripping occurring ahead of the mine pit and 0.5ha of active rehabilitation occurring behind the mine pit. The processing plant area will be 3.5ha in area including the mine access road and all settling pond infrastructure. The total disturbed area of the mine is approximately 6.5ha in area, however a total disturbed area of 8ha is proposed, which takes into account rehabilitated sites and provides for locations where the vegetation is slow to grow and considers these as still "disturbed". The maximum mining depth will be 9m. Mine life is expected to be 5 – 7 years, but consents are sought for 12 years.

22 The mine would be set back from State Highway 6 and the property at 3261 Coast Road. I had also recommended and Tiga have accepted, a setback of 20m from Collins Creek, the property boundaries and the coastal lagoon. The area south and west of Collins Creek is also excluded from the mining area to avoid Collins Creek.

23 As set out in Paragraph 82 of Ms Crawford's evidence, planting is proposed at various locations to screen the mine from viewers outside the property, to provide additional habitat for indigenous fauna and as enrichment for existing vegetated (riparian and wetland) areas. Planting between the lagoon and the mine will also assist in mitigating noise and disturbance effects on birds using the lagoon. Following mining, water treatment ponds 3 and 4, located near the existing lagoons and Rusty Pond would be retained as wetland areas and planted to provide wildlife habitat.

Ecological Context

24 The Application Site is located north of Canoe Creek and west of State Highway 6 on the Barrytown flats approximately 36km north of Greymouth. Vegetation throughout the area to be mined comprises farm pasture growing on land which has been farmed for decades, and has previously been 'humped and hollowed' to

improve drainage. Indigenous vegetation is limited to riparian areas which cattle cannot access, i.e., the true left of part of Collins Creek and the true right of part of the drain at the northern boundary of the property, as well as three isolated kahikatea (*Dacrycarpus dacrydioides*) trees (one of which has epiphytic species including broadleaf (*Griselinia littoralis*) and kowharawhara (*Astelia solandri*)). There are also planted areas of native species which cattle cannot access near the two feed pads on the property. There are occasional sedges (mainly rautahi, *Carex geminata*) and harakeke/flaxes (*Phormium tenax*) which have persisted near drains, although these have been heavily grazed.

25 My assessment has included review of available literature relating to the Application Site and surrounds (including Mr Mark Hansen's report for the previous proposal at this site, the ecology section of an unpublished report prepared by Murray-North for an earlier (1991), larger, proposal[3] and an SNA report prepared by Boffa Miskell for Grey District Council[4]) as well as that relating to the Punakaiki Ecological District generally, combined with the use of appropriate databases (avifauna, herpetofauna, Land Environments of New Zealand, Threatened Environments Classification and the Land Cover Database), reference to publicly available information and field surveys of the site and surrounding areas.

26 The Application Site is located within the Punakaiki Ecological District ('Punakaiki ED' or 'the ED'), most of which remains in indigenous forest except for extensive pākihi (heath/shrubland) in logged areas of the Tiropahi Valley, the strip of coastal flats near Barrytown and some lower valley flats and coastal gullies which are either farmed or have been modified by coal or gold mining (McEwen, 1987[5]).

27 The Barrytown flats extend approximately from Seventeen Mile Bluff in the south to Razorback Point in the north and are comprised of a complex sequence of old dune ridges and alluvial deposits, which originally would have been entirely covered in lowland (coastal) forest and wetland. Nearly all of the Barrytown flats have been modified by forest clearance and drainage for timber harvesting, mining, and farming, although remnants of wetland and forest remain.

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[3] Murray-North Limited. 1991. Environmental Impact Assessment – Westland Ilmenite Limited. Barrytown mineral sands. West Coast. Report MR3188. Unpublished report prepared for Westland Ilmenite Limited.

[4] Boffa Miskell 2006 Grey District Significant Natural Area Assessment PUN-W034. Unpublished report prepared by Boffa Miskell for Grey District Council. 11 pages + appendices.

[5] McEwen, W.M. 1987. Ecological Regions and Districts of New Zealand. Third revised edition in four 1:500 000 Maps. New Zealand Biological Resources Centre, Department of Conservation, Wellington.

28 Boffa Miskell undertook the task of identifying SNAs within the Grey District on behalf of GDC in 2006/2007. These mapped areas have been incorporated into the Draft Proposed Te Tai o Poutini District Plan[6] ('the TTPP'). To the north and west, the Application Site is bordered by an area identified by Boffa Miskell as Barrytown Flats, Canoe Creek Lagoon (Site PUN-W034).

29 Site PUN-W034 as defined by Boffa Miskell originally covered 40ha, including the area immediately around the lagoon to the west of the proposed mine site and two other wetlands to the north, including the one which I understand is known locally as "Rusty Pond". The extent of the Punakaiki ED and the proposed Significant Natural Areas ('SNAs') mapped by the GDC are shown in Figure 1 (**Attachment A** to this evidence). I note that these SNA areas have been included in the proposed TTPP and have not been confirmed yet. The 2006 Boffa Miskell report describing the SNA nearest the site also forms part of **Attachment A**.

30 Since approximately 2010, there has been a concerted effort to rehabilitate sand plain forest on the 80ha former Rio Tinto property at the northern end of the Barrytown flats (adjoining Nikau Scenic Reserve and known as Te Ara Tāiko Nature Reserve) with the aim of restoring an ecological connection (or corridor) between the coast and habitats inland. Te Ara Tāiko (the pathway of the tāiko or the route of the tāiko) is located east of the tāiko colony and was given to protect that ecological corridor from the Paparoa Ranges to the sea[7]. The location of the tāiko colony in relation to the Application Site is shown in Figure 1 within **Attachment B** to this evidence.

31 Site PUN-W034 is described in Schedule 4 of the TTPP as "Punakaiki Lagoon and Coastal Wetland sequence. A lagoon and series of small lakes bordered by flax wetlands and coastal forest. Significant vegetation and ecosystem sequence". Despite this description I note that the ecosystem sequence is discontinuous as shown in Figures 2 and 3 (**Attachment B** to this evidence).

32 My understanding is that the lagoons are natural and the ponded areas were created as a result of mining activities there between 1932 and 1948, but I note that this is disputed by the submitters. These waterbodies have been referred to as historic mining ponds within Mineral Reports with little other information provided.

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6 The TTPP is a combined District Plan for the Buller, Grey and Westland Districts.

7 S. H. Rhodes, K. Lorenzon, J. L. Hahner, M. H. Bowie, S. Boyer, N. Dickinson, C. Smith and D. Sharp (2013). Punakaiki coastal restoration project: A partnership for closure and restoration of a mineral sands project site in New Zealand. In A.B. Fourie & M. Tibbett (Eds.), Proceedings of the Eighth International Conference on Mine Closure. Australian Centre for Geomechanics, Cornwall (pp. 447-451).

33 The History House in Greymouth provided the Geological Map and survey map which I have included as Figures 4 and 5 respectively in **Attachment B** to this evidence. These maps indicate that the pond on the Langridge Property to the north is the McKay and Whites Blow up Claim. I understand that a blow-up claim is another name for an Elevator which produce gold by gold bearing material being sluiced into a hole and bucket elevators bringing material to the surface for processing, and that elevators were common on the West Coast at that time. It appears water for the McKay and Whites Elevator/Blow up claim was sourced from Canoe Creek where a large water race was built to supply water to the numerous sluice claims on the hills east of the highway and piped down to the Blow-up claim. Both the geology map (Figure 3) and the survey map from 1907 (Figure 4) show the location of the pipeline.

34 As described by Murray – North Limited[3], at the Barrytown flats the flow of creeks crossing the flats is often impeded at the coast by the action of a net northward longshore drift which has the effect that creeks tend to be displaced parallel to the coast with many of the creek mouths being closed to the sea for protracted periods. The result is various backshore ponds, ribbon lakes and swamps. Murray – North go on to state "in this active coastal environment …. few of the backshore water bodies can be regarded as permanent". Although the lagoons near the Application Site are the largest, there are several similar impounded areas scattered along the Barrytown flats inland of Pakiroa/Barrytown Beach.

35 Other proposed SNAs in the vicinity include PUN-W033, PUN-043, PUN-044, PUN-049, PUN-123 and PUN-124. The locations of these areas in relation to the Site are shown in Figures 2 and 3 (**Attachment B** of this evidence). These areas are described as follows in Schedule Four of the TTPP:

(a) PUN-W033. Flax dominated wetland and some coastal forest that extends from Nikau Scenic Reserve to the northern tip of Barrytown Flats. The wetland supports a brown mudfish population which are nationally threatened[8].

(b) PUN–044. Lowland forest and wetland adjoining Maher Swamp with adjacent coastal hill forest. Mix of kahikatea forest with northern rata and sparse rimu in places, but also extensive areas of flax and sedgeland. Provides an ecological corridor between the Maher Swamp and the forested land to the east of the road.

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[8] Note that brown mudfish (*Neochanna apoda*) are considered 'At Risk (Declining)' rather than "Threatened" in the New Zealand Threat Classification System (Dunn et al. 2018).

(c) PUN–049. Lowland kahikatea forest with some wetland character and scrub on the fringes. Provides a connecting stepping stone between the coast and the forested ranges.

(d) PUN-123. Large area of broadleaved and rimu forest with occasional northern rata and hard beech. Serves as an ecological corridor between Paparoa National Park and Maher Swamp.

(e) PUN–124. Coastal forest dominated by broadleaves and rimu with occasional nikau. This is an important breeding site for the Westland petrel.

I note that PUN-043 appears to have been omitted from the descriptions in Schedule 4, but is mapped in Map 39. I have visited PUN-043 and the vegetation comprises coastal forest which is still grazed.

36 The Application Site has been substantially modified for farming and other land uses and currently contains no habitats comprising predominantly indigenous vegetation.

37 McEwen (1987[5]) considered that there was a very high diversity of vegetation types throughout the Punakaiki ED according to the variety of drainage and fertility presented by an equally high diversity of landforms. She also considered the ED unusual in the variety and quality of the indigenous forests that remain.

38 Murray-North (1991[3]) prepared an environmental impact assessment to inform an application for mining across the majority of the Barrytown flats. They describe the circa 1990 landscape as "reflect(ing) a landform which has been, and continues to be, subject to relatively rapid natural change in response to coastal (e.g., changing sea level) and geological (the flats lie within an area of uplift) processes. In more recent time further change has resulted from the influence of man's activities…. At the present time the southern part of the coastline continues to erode at a relatively rapid rate (up to 3.5m per year has been estimated)". Murray-North included a helpful diagrammatic representation of changes to the vegetation on the Barrytown Flats over the 20th Century which I have included as Figure 6 of **Attachment B** to this evidence. Murray – North identified eleven habitats of "particular biological significance" along the Barrytown flats. Listed from Razorback Point south these habitats were:

(a) Razorback Swamp;

(b) Coastal vegetation from Razorback Swamp to Canoe Creek Lagoons;

(c) Nikau Scenic Reserve;

(d) Waiwhero Scenic Reserve;

(e) Maher Swamp;

(f) Sand ridge forest remnant (inland from Maher Swamp);

(g) Canoe Creek Lagoon;

(h) Canoe Creek Bush (Langridge's Reserve);

(i) Barrytown kahikatea stand (Noble's Bush);

(j) Weir's Bush; and [9]

(k) Southern pond complex.

These historic observations combined with information from the Land Environments of New Zealand[10] and the Threatened Environments Classification, indicate that the Punakaiki ED is relatively intact with respect to species, habitats and ecological functioning, although the Barrytown flats are atypical of the wider ED.

Vegetation

39 Vegetation surveys at the Application Site were undertaken on the 5th and 6th July 2021. Vegetation across the majority of the site comprised high producing exotic pasture. Indigenous vegetation was limited to riparian areas along creeks and drains and nearest the lagoon and pond, plantings near livestock feed pads, and three isolated kahikatea trees in a paddock. There were occasional native plant species present in the proposed infiltration basin near Canoe Creek, but that vegetation was dominated by blackberry (*Rubus fruticosus* agg.) and gorse (*Ulex europaeus*).

40 The riparian vegetation adjoining Collins Creek and the pasture, weeds and occasional indigenous vegetation in the Canoe Creek infiltration basin were assigned an ecological value score of 'low'. Species present are common and widespread, they do not provide high quality habitat for birds and lizards and they are not representative of an indigenous community. The planted flaxland near the feed pad and the isolated kahikatea were assigned an ecological value score of 'negligible' due to their small spatial extent, isolation and damage by livestock. Rushland and flaxland were present around Rusty Pond and Canoe Creek lagoon,

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[9] Low value areas can be thought of as being of limited ecological value other than as local habitat for tolerant native species (see footnote 1) .

[10] The area to be mined contains mostly Land Environments M1.1a and O1.4a with smaller amounts of O1.3a. More than 30% of these level 4 environments remains in indigenous vegetation.

providing habitat for birds and buffering open water and coastal areas from the effects of land use activities. This vegetation was assigned an ecological value score of 'moderate'[11] based on vegetation values alone.

Birds

41 Onley (1980[12]) carried out 117 bird counts in five different low altitude forest types in the Punakaiki ED including Karst forest, Coastal forest, Old Tertiary forest, Limestone talus forest and cutover forest. The forests were all located below 170m asl. Coastal forest was dominated by kāmahi (*Pterophylla racemosa*) with emergent rimu (*Dacrydium cupressinum*) and conspicuous northern rātā (*Metrosideros robusta*) and hīnau (*Elaeocarpus dentatus*). The average number of native birds per count recorded in Coastal forests was 10. Coastal forest had the lowest number of species overall (9), with Old Tertiary forest having 10 native species and Karst forest having 13.

42 A search of the eBird[13] database undertaken on 20 February 2023 for records within 10km of the mouth of Collins Creek revealed 1,276 records comprising 72 taxa including seabirds, coastal birds and land birds. A number of the bird species recorded are of conservation concern, including rōroa (great spotted kiwi, *Apteryx maxima*), mātātā (South Island fernbird, *Poodytes punctatus punctatus*) and tāiko (Westland petrel, *Procellaria westlandica*). The birds recorded in the eBird database and their conservation status are shown in Table 1 in **Attachment C** to this evidence.

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11 'Moderate' value areas are conisdered important habitats at the Ecological District level. They rate either high for one matter, moderate and low for the remainder, or moderate for two matters and low or very low for the remainder..

12 Onley, D.J. 1980. Bird counts in lowland forests in the Western Paparoas. Notornis 27:335-

13 EBird.org is a free, open-source database maintained by the Cornell Lab of Ornithology which stores observations, photos and recordings of birds from anywhere in the world. Anyone with a user account can enter an observation in the eBird database electronically, but any unusual observations, such as rare species or unusually high numbers of birds, are automatically flagged and reviewed by knowledgeable local volunteers before being made publicly available. Some historical data have been added. Users include amateur ornithologists and professional researchers. Users can request data relating to species or locations and this is typically used for research, management and conservation purposes. This format has been adopted by Birds New Zealand for collection of data to inform the development of the third New Zealand Bird Atlas (2019 – 2024), superseding the more manual methods used in the previous two atlases (1969 – 1979 and 1999 – 2004).

43 This search of the eBird data base was updated in December 2023 and extended to include records within the Punakaiki ED. This search resulted in 19,129 records, including 110 taxonomic groups.

44 My team have carried out seasonal bird surveys at the site between April 2022 and January 2024 using a combination of five-minute bird counts and digital acoustic recorders at the locations shown in Figure 7 (**Attachment C** to this evidence).

45 Acoustic recorders were set to record for 12 hours each day between 1930hrs and 0730hrs at each of the 15 locations shown in Figure 7 (**Attachment C**). This will have captured the dawn chorus, as well as any early evening and nocturnal calls and, during summer, early morning calls. Recorders were set for between 8 days (April 2022) and 14 days (October 2023) during the seasonal surveys. In total 53 days of recording has been obtained at each of the 15 locations to date (424 12-hour days in total). One five-minute bird count ('5-MBC') was also undertaken at 14 of these locations during the site visits. In total 375 minutes (6.25 hours) of 5-MBC have been collected to date.

46 Species detected were generally exotic or common native species and the avifauna community generally reflects the highly modified state of the rural environment at the site. However, fourteen species of conservation concern[14] were recorded during these surveys, including the birds listed in Table 2 of **Attachment C** to this evidence

47 In addition to the species listed in Table 2 of **Attachment C**, a bird that may have been a crake (most likely a marsh crake (*Zapornia pusilla*, At Risk (Declining)) was recorded at Barrytown on 15 September 2022 and again on 18 October 2023. Both Mr Stewart and I are familiar with crake calls and we conferred about this record, but the recording is atypical and we cannot be completely certain what it is. The 2023 call included a more complete call sequence and provided a more positive identification. Our best guess is a marsh crake. This addition would conservatively bring the number of species of conservation concern using habitats near the site to 15. The habitats adjoining the site are 'high[15]' value for birds.

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[14] In this evidence I have used the term 'species of conservation concern' which means species which are regarded as 'Threatened' or 'At Risk' in the latest Department of Conservation conservation status update. 'Species of conservation interest' are species which are not Threatened or At Risk but have other ecological characteristics which make them regionally or locally important such as a disjunct distribution, regional rarity and the like.

[15] High value habitats are regionally important. The area rates either high for two of the assessment matters, moderate and Low for the remainder, or high for one of the assessment maters and moderate for the remainder.

48 None of these species are likely to rely on the pasture habitat within the site, but several may visit for feeding or loafing. The locations of the birds of conservation concern detected during the surveys are shown in Figure 8 (**Attachment C** to this evidence).

49 We have not been granted access to land adjoining the site, but since October 2023 we have also been undertaking similar surveys at a site north of Burke Road. The location of the 14 monitoring points where 5MBCs have been undertaken at the Burke Road site is shown in Figure 9 (**Attachment C** to this evidence). Acoustic recorders have been set at five of those locations. This has resulted in 70 minutes of 5MBCs and 15 days of recording at 5 locations (only 43 effective days) to date. To date 24 species of bird have been recorded there. Four species of conservation concern have been recorded at that site, including South Island pied oystercatcher, variable oystercatcher, red-billed and/or black-billed gull and black shag. All four of these species have also been recorded at the Application Site.

50 Given my experience with acoustic recorders elsewhere, the acoustic recorder surveys should have detected Australasian bittern (*Botaurus poiciloptilus*) and other secretive or cryptic birds if they were calling. Bitterns call more frequently between September and November (O'Donnell & Williams 2015[16]), so the October survey in particular should have detected them if they were present. Bittern calls can also often be detected from a long distance (hundreds of metres, depending on local conditions). Background noise was an issue for the recorders closest to the coast throughout the acoustic surveys (the sound of waves breaking on the shore), so the detection distance would have been reduced and sounds may have been masked, but Mr Stewart (who collected the data) and I are confident that no bittern have been recorded in any of the surveys to date.

51 O'Donnell and Williams (2015) concluded that if booming bitterns are present at a site, it is reasonable to expect them to be detected in 1–3 nights of listening during the peak calling period. If listening outside the peak period, which is mid-September to mid-November as described above, when booming call rates are less frequent, they considered it may be prudent to survey for more nights if birds have not been detected after the third night.

52 Our seasonal surveys used acoustic recording devices for eight days or more and included two surveys during the potential bittern breeding season (December 2022 and October 2023). The 5MBCs used a trained observer familiar with bittern calls,

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[16] O'Donnell, C.F.J.; Williams, E.M. 2015: Protocols for the inventory and monitoring of populations of the endangered Australasian bittern (*Botaurus poiciloptilus*) in New Zealand. Department of Conservation Technical Series 38. Department of Conservation, Wellington. 40 pp.

although the 5MBCs were not undertaken at the optimum time of the day. The acoustic recorders were operating during peak bittern calling which is approximately 1.5 hours before dawn and at dusk (O'Donnell and Williams 2015). Bittern call occasionally at other times of the year (i.e. outside the breeding season) and throughout the day and night. I consider that the amount of search effort expended is reasonable to have detected bittern if they were resident within 30 – 50m of the recorder. This suggests to me that if bitterns are using the habitats adjoining the site, they are not preferentially choosing the areas nearest the farmland. On that basis noise and activity from mining at the site would be less likely to affect them.

53 Similarly, the birds of conservation concern present near the Application Site identified in Table 2 of **Attachment C** are concentrated in habitats near, rather than within, the Application Site. Of the species recorded, several would visit the farmland on occasion, and gulls, oystercatchers and terns may feed there if conditions are suitable.

Lizards

54 A search for herpetofauna records within 5km of the site using the Department of Conservation Bioweb database was undertaken on 17 February 2023. This revealed two southern bell frog (*Litoria raniformis*) records and one brown tree frog (*Litoria ewingii*) record and one record of an unidentified skink. A lizard survey was not undertaken at this site due to the regular grazing and therefore lack of suitable lizard habitat within the area to be mined. Given the highly modified nature of the vegetation at the site and the lack of suitable lizard habitat within the area to be mined, the presence of lizards is highly unlikely.

Wetlands

55 Any original wetlands within the Application Site have been reclaimed by farming practices, including most recently 'humping and hollowing'. Therefore, no natural inland wetlands as defined by the National Policy Statement for Freshwater (2020) ('NPS-FM') were located within the Application Site itself during site visits.

56 The modifications to the landform have resulted in a near complete loss of wetland ecosystem types from the area. The ecosystem services provided by wetland systems including flow attenuation and water quality improvement have also been lost.

57 I have not accessed the wetland areas located within 100m of the proposed mining area immediately to the north and south of the site. However, when viewed from the application site, to the north these areas include *Juncus* rushland, kahikatea swamp forest and flaxland with common mikimiki (*Coprosma propinqua*). To the south the potential wetland area includes herbaceous wetland species and exotic

grasses which may or may not be indicative of a natural inland wetland, despite still being grazed.

58 I note that in the previous hearing in relation to this site Mr Richard Nichol provided an assessment of wetlands that he had identified on the Langridge property to the north near the boundary with the Application Site. Mr Nichol also concluded that based on his observations, it is highly likely that there are other wetland areas on the Langridge property to the north and I agree. I also consider it is likely that there are wetlands on the Langridge property to the south. As stated above, I have not had access to those areas, but have relied on the evidence of Mr Nichol for the previous hearing in relation to the values of those wetlands to the north. The version of Mr Nichol's wetland report I have does not have the data sheets attached, I am therefore reliant on Mr Nichol's conclusions with respect to the application of the relevant tests.

59 Mr Nichol undertook four plots at the Langridge property (Sites 206, 207, 211 and 214) and concluded that two sites met the vegetation tests for natural inland wetlands (Sites 206 and 207) and two did not (Sites 211 and 214). The location of these sites is shown in Figure 10 (**Attachment D** to this evidence). Sites 211 and 214 met one of the vegetation tests to be considered a wetland (the prevalence index test), but did not pass either the rapid or dominance vegetation test or have hydrological indicators present. On that basis Mr Nichol concluded that these two plots were not wetlands. Unfortunately, Mr Nichol did not report on the assessment of soils for the plots, because confirmation of whether the soils are hydric (develop in the absence of oxygen or not) is useful in determining whether a plot which passes one but no more of the three vegetation tests is a wetland (or has been drained) or not as set out in the Ministry for the Environment guidelines provided as Figure 11 (**Attachment C** to this evidence).

60 Mr Nichol considered that the formation and maintenance of the drainage channel on the Coates' property, which I have called the Northern Drain, has lowered the water table such that surface water rarely accumulates at the two plots which he determined were not wetlands. Mr Nichol considered that sites further from the boundary were likely to once again fulfil wetland criteria.

61 Without a physical inspection of Plots 211 and 214 (including soils), I cannot rule out that they may also be wetlands. I have assumed from the outset that wetlands did occur immediately adjacent to the site to both the north and south and the project has been designed to avoid adverse effects on those wetlands in accordance with the National Policy Statement for Freshwater (2020).

62 In his evidence to the earlier hearing, Mr Nichol considered that the northern drain on the Application Site appears to have influenced wetland hydrology in some areas on the Langridge property to the north. He also considered that additional

or increased drainage on the application site near the boundary would likely increase the extent of drainage, or partial drainage, of parts of the wetland areas on that property.

63 Without inspecting the wetlands, I cannot speculate whether the existing Northern Drain has affected wetland values there, but I agree with Mr Nichol that altered water levels on the Applicant Site could result in changes to the wetlands nearby. Because of the requirement of the National Policy Statement for Freshwater Management 2020 and accompanying National Environmental Standard to avoid adverse effects on both the extent and values of natural inland wetlands, this matter has been top of mind since the project inception and considerable attention has been paid to understanding the local hydrology and how to avoid effects on wetlands beyond the boundary. I discuss this matter further in Paragraphs 76 – 100 below.

64 In order to understand what potential adverse effects could be on these wetlands as a worst-case scenario (i.e., in the event that the proposed groundwater management fails at every level), and in the absence of being able to investigate the adjoining wetlands directly, I explored areas of farmland on the Coates property to the north as well as Maher Swamp, the Te Ara Taiko reserve and Nikau Scenic Reserve in order to identify what species were likely to occur in any wetlands in close proximity to the site and therefore what effects on the adjoining wetlands could be.

65 The vegetation at Maher Swamp, and the vegetation within the adjoining wetlands reported by Mr Nichol, comprised common species such as flax, mikimiki (*Coprosma propinqua*), rautahi (*Carex geminata*), pukio (*Carex virgata*), tī kouka (*Cordyline australis*), *Machaerina rubiginosa* and the like. Examples of that vegetation are shown in Figures 12 – 14 of **Attachment D**. This accords with the descriptions of Murray-North (1991[3]), Gardner (1992[17]) and Johnson (1992[18]). Indeed, Gardner described Maher Swamp as having "a relatively limited number of species with a history of disturbance" and considered it might be easy to rehabilitate were it adversely affected by mining. The history of disturbance refers to flax cutting, grazing and burning undertaken there historically, but not recently.

66 To summarise, the ecological values of the site are currently very limited. The values have been adversely affected by previous land uses which have resulted in

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[17] Gardner, R.O. 1992. Whitebait to White Paint: Maher Swamp on the Barrytown lowland (North Westland) its history and prospect. Auckland Botanical Society Journal 47(2): 40 – 45.

[18] Johnson, P.N. 1992. Maher Swamp botany and conservation assessment. Unpublished report prepared by Manaaki Whenua – Landcare Research, Dunedin. 41 pp.

the removal of wetlands and the removal of almost all of the indigenous vegetation. There are no recognised sites of ecological significance within the site, but it does adjoin an SNA identified in the TTPP. The coastal lagoons, Rusty Pond and surrounding vegetation provide important habitat for bird species, including species of conservation concern, making them of high value and regionally important.

67 There are also wetlands adjoining the site to the north and perhaps to the south. I have not been able to investigate these wetlands. In my view, and based on my experience, my observations at nearby sites and the findings of others which I have access to, it is reasonable to conclude that the vegetation most likely comprises common and relatively hardy species similar to that present at Maher Swamp and other wetland areas nearby.

68 Notwithstanding this conclusion, I have considered the potential for threatened and at risk flora to be present in these wetlands. Given the ongoing grazing of the areas to the south, the likelihood of threatened and at risk species being present is low. Grazing pressure is less intense to the north. Given this area's location near natural biogeographic boundaries it is possible that some plants of conservation interest, and/or threatened or at risk species are present, particularly at the northern site.

69 With respect to species of conservation interest, Gardner (1992) reported the presence of swamp millet (*Isachne globosa*) which has only rarely been recorded in the South Island. In terms of Threatened or At Risk plants detected during previous surveys at wetlands nearby the stout water milfoil (*Myriophyllum robustum,* At Risk (Declining)) which grows in shallow slow moving water – lakes, slow flowing streams, dune ponds, and muddy or seasonally flooded ground and water brome (*Amphibromus fluitans*, Threatened (Nationally vulnerable)) have both been recorded in or near Maher Swamp. Water brome grows in moderately fertile, seasonally dry wetlands or along the edges of shallow lakes and lagoons and is only known from Maher Swamp and Lake Tekapo in the South Island[19]. No plants of conservation interest or threatened or at risk plants were recorded in the SNA report by Boffa Miskell (2006).

70 The descriptions of habitat provided by Mr Nichol and others, as well as my observations from beyond the boundary, do not suggest that suitable habitat is available for either *M. robustum* or *A*. *fluitans* in the adjoining wetland to the north. In the absence of being able to confirm the vegetation present, I have recommended a precautionary approach that seeks to avoid effects beyond the boundary and Tiga have accepted this.

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[19] New Zealand Plant Conservation Network accessed 14 January 2024.

Assessment of effects

71 I assessed the ecological effects of the proposed mineral sand mine in accordance with the methods outlined in the second edition of the Ecological Impact Assessment ('EcIA') guidelines produced by the Environment Institute of Australia and New Zealand[20]. Briefly this method relies on assigning values to species and habitats within the subject site and the surrounding 'zone of influence' according to a range of factors, including conservation status and others, and then requires consideration of the magnitude of effect (ranging from positive (net gain) to very high (total loss)) and deriving an overall level of effect ranging from very high to net gain. I note that Mr Harding does not support this approach and I discuss this matter further in Paragraphs 191 – 195 below.

72 The EcIA recommend assessment of effects at a range of scales, including the Ecological District, although there are exceptions. For the species affected by this proposal, I have considered effects at the scale of the Barrytown flats and the Punakaiki Ecological District. Because tāiko have only one breeding colony the appropriate scale of assessment for that species is nationally.

73 Although the SNA classification of PUN-W034 has not been confirmed, I have also considered the effects on the SNA against the relevant policies of the NPS-IB. The NZCPS and the NPS-FM also have policies requiring avoidance of effects and I have considered these in reaching the conclusions I have set out here.

74 Mining is proposed to proceed from west to east (from the coast towards SH 6) and from south to north. Initially the pasture vegetation and overburden would be removed. From that point, the mining works would be below the existing ground level. The works would include dewatering and extraction of the mineral resource followed by deposition of tailings, overburden and topsoil, contouring of the final land form and then establishment of pasture. Generally, an area of up to 8ha would be "operational" at any one time.

75 Mining would also require dewatering of the mine pit which would create inflow from surrounding groundwater. This drawdown could extend beyond the site and affect the hydrology of wetlands immediately outside the site.

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[20] Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. 2018. Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition. Published by Environmental Institute of Australia and New Zealand, Melbourne. 133 pp.

Hydrology

76 The need to lower water levels in the sand extraction pit travelling along the mine path causes a temporary depression in the surrounding water table and changes groundwater patterns, including the flow relationships between the water table and surrounding water bodies as discussed in the evidence of Mr Rekker.

77 Hydrogeological investigations by Mr Zeb Etheridge, Mr Rekker and others using site-specific groundwater level surveys and monitoring, aquifer testing, groundwater sampling for analysis, and intensive drilling investigations have characterised the groundwater systems and have demonstrated that the coastal flats' sediments host an unconfined and progressively semi-confined groundwater system with mixed clay, silt, sand, and fine gravel deposits. The permeability of the various strata varies as described in the evidence of Mr Rekker.

78 In Paragraph 68 of his evidence, Mr Rekker describes that recent drilling and groundwater properties testing have confirmed that Collins Creek and the Northern Drain are both perched and separated from flowing groundwater by clay-rich overburden, between 4 metres and 14 metres thick. Other parts of the surface water network were also considered to be hydrologically isolated by similar clay-rich overburden.

79 In Paragraph 95 of his evidence, Mr Rekker identifies five types of potential effect on the ground and surface water at the site.

80 Water management at the site is proposed to address these effects including maintaining surface flows and groundwater levels and inputs using a combination of augmentation of Collins Creek and/or the Northern Drain (i.e, surface discharge), discharge to the Canoe Creek Infiltration Basin, discharge to infiltration trenches to bolster shallow groundwater levels, and sub-surface injection via injection wells to bolster medium depth and deeper groundwater levels.

81 The order of preference for using treated mine water would be infiltration into groundwater, then injection into groundwater, followed by direct surface augmentation (i.e., surface discharges to affected water courses) so as to prevent the exacerbation of lowered groundwater level inducing flow depletion. Given the hydraulic isolation of the streams, this last method is not expected to be required. Detailed monitoring to inform adaptive management would be undertaken as set out in the evidence of Mr Rekker. Mr Rekker is of the opinion that with these methods of mitigation, surrounding water bodies would be subject to only negligible flow depletion. In particular, because of the location of the coastal lagoon and because only a small amount of water is lost from the site overall (with the heavy mineral concentrate) adverse effects on the water level in the lagoon are not expected. I have relied on these conclusions in my assessment.

82 If Mr Rekker is wrong and changes in the hydrology of the area do occur as a result of mining and result in depressed water levels in the adjoining wetlands or the coastal lagoon, this could be expected to affect the vegetation and birds and other species using those adjoining habitats. Changes to hydrology could also affect surrounding areas for varying distances from the site depending on the degree and extent of hydrological change amongst other factors. If it were to occur, a drop in ground water levels beyond the site could lead to drying out of the surrounding areas. This could reduce the suitability of the habitats for wetland species and could promote invasion by weeds and dryland species.

83 Given that the species present in the wetlands nearby are both common and relatively hardy, and that there is more than one option available to maintain groundwater levels (both shallow and deep) and that the proposed management approaches can have effects ranging from immediate to long-term as described by Mr Rekker, I have concluded that effective monitoring of groundwater levels combined with a reliable feedback loop to ensure groundwater management is adapted if necessary, will be critically important in avoiding effects beyond the site boundary.

84 This monitoring is provided for in the Water Management, Monitoring and Mitigation Plan ('WMMMP') required by Condition 26 and the specific monitoring required by Condition 26.2 (groundwater). I have worked with Mr Rekker and Mr Etheridge to inform the WMMMP, including in relation to response timeframes required to avoid adverse effects on vegetation and habitats.

85 The relevant goals of the WMMMP with respect to avoiding adverse effects on wetlands adjoining the site due to dewatering relate to maintaining the groundwater levels on the application site. This would result in maintaining the springs on the Langridge property to the south, maintaining water levels in the Langridge property to the north, maintaining water levels in Rusty Pond and maintaining inputs to Canoe Creek Lagoon. I note that the available data shows that in general the water levels in Canoe Creek Lagoon vary very little, but are punctuated by larger step changes and then a new equilibrium. In my opinion achieving these goals would be sufficient to protect wetland values beyond the Application Site.

86 Baseline groundwater monitoring to confirm the pre-mining median groundwater level at the site perimeter began in May 2022. Groundwater levels are logged at hourly intervals. When operations commence, the groundwater levels will be logged at a minimum of six hourly intervals and discharges to the infiltration system will be monitored daily.

87 As described in Section 6.3.3 of the WMMMP, groundwater recharge locations and rates will be adjusted based on monitoring data from the site perimeter piezometers. For example, if the monitoring data show groundwater levels starting

to fall below the action trigger thresholds, additional recharge will be supplied to that stretch of the site boundary. Targeted recharge wells will be installed if the infiltration trench is unable to recharge sufficient water to the groundwater system to maintain groundwater levels within the target range at specific locations.

88 Section 7.4 of the WMMMP sets out that the median groundwater levels (i.e., the action trigger thresholds) will be derived from data recorded in boundary monitoring piezometers PZ1 - PZ12 and PZ18 - PZ19 for at least 12 months prior to commencement of mining below the water table. Section 7.5 of the WMMMP explains that two action thresholds are defined for boundary monitoring piezometers PZ1 - PZ7, PZ09, PZ10 - PZ12, PZ18 and PZ19: a 7-day rolling average and a 30-day rolling average. The former comprises an operational management trigger, the latter comprises a mitigation action threshold.

89 If the 7-day rolling average groundwater level in any of the boundary monitoring piezometers falls below the pre-mining median, water would be discharged to the appropriate sections of infiltration trench/infiltration wells to recharge the aquifer where groundwater level has declined.

90 Following discharge to ground, groundwater levels will be reviewed over the subsequent 48 hours and adjustments made to the rate of recharge until the pre-mining median groundwater level is restored (within the constraints of the pit pumping rate).

91 If the 30-day rolling average groundwater level in any of the above boundary monitoring piezometers falls below the pre-mining median the management response is escalated and remedial actions must restore groundwater levels within 20 working days. Thus, the maximum period depressed groundwater levels would occur is approximately 60 days (30 days to detection and 20 working days to remedy).

92 The effects of lowered ground water for approximately 60 days (two months) would vary, depending partly on when the lowering occurs. If it occurs during or immediately following a wet period, any effects would likely be less than if it occurs during or immediately following a prolonged dry period. In any event, the species present in the adjoining wetlands are generally tolerant of a wide range of groundwater conditions and I would not expect plant death or dieback to be either widespread or substantial, even if the two months of lowered ground water coincided with a prolonged dry period and the plants were already stressed when groundwater levels dropped further.

93 Table 2 of the Hydrology AEE report indicates that the maximum duration of a dry spell during the period 1981 to 2010 was 39 - 40 days. If a prolonged dry period were to occur and coincide with lowered ground water, the maximum period of lowered water levels would be in the order of 100 days (slightly less than 4 months).

I would expect most specimens of robust species like harakeke and tī kouka to survive three – four months of lowered water levels. Given the frequent monitoring proposed, the reasonable threshold limits applied, the variety of management actions that can be deployed and the ability to respond at a range of scales from immediate to long-term, I remain of the opinion that adverse effects on wetlands beyond the site can be avoided. As I discuss in more detail in Paragraph 216(f) below, I would expect a change in the median groundwater level of up to 20cm to have a low chance of causing significant adverse effects provided that the seasonal fluctuations remain the same. Beyond 20cm the risk of effects would be increased.

94 I consider that one element that could be improved with respect to the management and monitoring response to depressed groundwater levels is monitoring of the wetland vegetation itself. The applicant proposes to monitor water levels at the perimeter and that should be sufficient to detect changes that might cause effects beyond the boundary, however should permission be granted to access adjoining land, I recommend that monitoring of this vegetation in the wetlands beyond the Application Site boundary would be helpful to confirm that effects have been avoided.

95 I note that no longer term reductions in water level in the lagoons or Rusty Pond are anticipated because water "lost" further up the catchment will still report to the lagoon area via groundwater infiltration and discharge. If a reduction in wetted area were to occur (i.e., in the absence of dewatering being returned to the local hydrological system) it would reduce the amount of habitat for fish species which might live in the lagoon (e.g., banded kokopu, *Galaxias fasciatus*) and reduce the foraging area available for birds. In the short term that could be a positive effect (concentrating fish in a smaller area), but in the medium to longer term, a reduction in fish at the local scale would likely be a high to very high level of adverse effect for fish eating birds. This type of effect may have occurred in the past due to natural coastal processes. The monitoring and management proposed in the WMMMP is designed to prevent a reduction in wetted area in the lagoon and maintain habitats for fish and birds. In my view the monitoring proposed would be effective and sufficient to detect changes and respond pre-emptively.

96 Vegetation and habitats surrounding the lagoon could also be sensitive to reduced water levels as described above. The two change events that I have already observed at the coastal lagoon (September 2021 and August 2023) have been rapid increases in water from relatively large rain events leading to a 'blow out' of the sand bar and subsequent reduction in water level and reorganisation of the lagoon area. This has resulted in the loss of the existing vegetation, which has generally been replaced with a higher proportion of bare sand and a different type of vegetation community with more rushes and fewer herbs and macrophytes, at least initially. Turf, herbs, and other species gradually returned over time to the areas near the water's edge.

97 If the reductions in water levels were short (days to a few weeks), and water levels returned to a similar level to that prior to the drop, I would expect the vegetation to be maintained. It is most likely that the turf and other species would remain, although there may be localised dieback of more sensitive or more strongly hydrophytic species (such as any *Myriophyllum* species) if the lowered levels lasted for weeks. If the decline was short enough, this dieback might be completely or partially reversible. For prolonged and/or repeated declines, in my view the most likely vegetation response would be that the native species would decline in vigour and extent and exotic and other dryland species would invade and come to dominate, replacing the wetland habitat with a weedier, lower value habitat as I have described above. The proposed monitoring would be sufficient to detect water level declines quickly and allow management to prevent this occurring.

98 The majority of the vegetation surrounding the lagoon comprises harakeke (New Zealand flax) on the landward side. Flax is a relatively hardy, fast growing and long-lived plant which tolerates a range of water regimes well. In fact, it is so robust it is regarded as an invasive weed on the Juan Fernandez Islands near Chile, on Molokai Island in Hawai'i and in Tasmania and Victoria (Australia).

99 Coastal environments are harsh for plants, in part because of salt laden winds. Flax is one species which tolerates coastal conditions very well. I consider that if temporary reductions (up to four months duration) in water level were to occur at the lagoon and surrounds, then harakeke is sufficiently robust to persist and vegetation change of the type I have described would be extremely unlikely. Raupō is also common in the lagoons, is similarly robust and also has rhizomes which would persist and regrow following drier periods.

100 I am of the view that the effects of the proposal are not at a level where they would require offsetting or compensation. However, I am mindful that the much of the natural habitats formerly present at the Barrytown flats have either been removed or substantially modified. I am also aware that wetlands as an ecosystem type a have been substantially reduced in extent, are a national priority for protection and are home to a wide variety of species of conservation concern and conservation interest. I am also of the opinion that habitat restoration is made easier when you build on existing values. For these reasons I recommended that water treatment wetlands 3 and 4 be located near the existing wetlands to provide additional buffering for the surrounding habitats during mining and then that they be retained and converted to useful wildlife habitat post-mining. The retention of water treatment ponds 3 and 4 after the completion of mining will add around 1.9ha to the amount of wetland habitat available in the area for wetland species, including birds, in the medium – long term. Since retention of these ponds is not required for ongoing water treatment and they can likely be rehabilitated to a standard at least comparable to the surrounding vegetation and open water areas which we know have high bird values, I consider this to be a positive effect of the proposal.

101 Whilst I do not consider this proposal to be an offset, I have been asked to review the National Policy Statements for Freshwater Management and Indigenous Biodiversity which both include principles of offsetting (in Appendices 6 and 7 respectively) for addressing more than minor residual effects and consider whether the proposal is consistent with these principles. The principles are not exactly the same in the two documents, but are congruent. The principles are: adherence to the effects management hierarchy, limits to offsetting, must achieve no net loss, must be additional and avoid leakage, must provide long term outcomes, include a landscape context, avoid time delays, be transparent and apply science and mātauranga Māori and involve tangata whenua and stakeholders. With respect to the last two and the principle of transparency, I do not consider that the proposal has applied mātauranga Māori or involved tangata whenua or stakeholders or been transparent yet, but it still could if that were required. This would require engagement with tangata whenua and others with the specifics of the proposal to construct and restore the wetland and would likely result in some changes to it to meet these principles. In relation to the other matters, I do not consider the proposal breaches the limits to offsetting, the effects management hierarchy has been applied, there will be a net gain in wetland habitat and no net loss of wildlife or flora, the proposal is additional and would not transfer effects elsewhere or destroy indigenous biodiversity in its creation (it is currently an area of exotic pasture). Time delays will have been minimised by planting part of the area before mining commences. I consider that long term outcomes could be achieved without covenanting the new wetland because it would be protected by local and national planning instruments. As well as the increase in extent of habitat, the new wetland area would also buffer the existing lagoon and the SNA from future farming activities. Despite not being proposed as an offset, the proposed wetland restoration would achieve a net gain in biodiversity and would be a positive outcome of the project that would not occur with status quo management of the site.

Birds

102 Species using the existing pasture for feeding, loafing or nesting (which could include gulls, banded dotterel, pied stilt, oystercatchers, white-faced herons, paradise shelducks, New Zealand pipit and the like) might be affected by the removal of a small proportion of habitat for at least the length of time it takes to replace the vegetation, and perhaps longer depending on their tolerance to disturbance and the proximity of the mining activities. All of these species are relatively hardy to human activities and would be unlikely to be affected to even a minor degree. Adverse effects could also include direct mortality from vehicles or machinery within the Application Site, but the low speed limit proposed (15km/h) substantially reduces this possibility.

103 Disturbance due to mining could include noise, vibration, lighting, traffic and machinery movements and an increase in human activity and dust. These effects could extend beyond the area being mined for some distance into the high value habitats for birds adjoining the Application Site or along State Highway 6. The level of these effects would depend on the individual sensitivities of the species affected. I discuss each of these effects in more detail below

104 I note that dotterels and pipit in particular might nest in pasture habitat or disturbed soil. Other species (such as gulls and oystercatchers) use it for feeding and loafing. My experience elsewhere is that usually any nests in pasture are destroyed/trampled by cattle as they rotationally graze around a site (c.f. more extensive grazing where nest damage is less common). Furthermore, once earthworks commence, the number of birds visiting the area increases sharply as gulls, oystercatchers, stilts, dotterels and the like identify a foraging opportunity and search the newly bare soil for invertebrate prey and/or expand into the site to build nests there. If these species did come to occupy the mining area they could be adversely affected by mining, particularly if they were breeding.

Noise

105 With respect to noise and vibration, no blasting is proposed at the mine, but there will be noise and vibration due to heavy machinery movements and the processing of the raw product. I note that the mining proposal includes a 20m setback from the coastal lagoons and the SNA and that the processing plant is located as far as it can simultaneously be from the SNA and the coastal lagoon, which will reduce noise effects from that source at those locations.

106 The effects of noise on wildlife can take several forms depending upon the loudness, character and duration of the noise as well as the sensitivity and habits of the species and the individual affected.

107 Nearest an activity where loud noise levels occur there is potential for noise exposure to cause permanent or temporary physiological hearing damage. The sound levels at this site are not loud enough to cause this type of damage. Further away, or when the sound is quieter, masking can occur, which is when the sound source is loud enough, and in the same time and frequency window, that it disguises other sounds that are biologically important to the affected individual(s) e.g., sounds from predators, prey, or other members of the same species. When it can be distinguished from the ambient soundscape, sound also has the potential to elicit behavioural responses such as leaving a site or changes in foraging behaviour. Behavioural responses are often context-specific, that is animals may behave differently according to the time of year (e.g. during breeding versus outside the breeding season) or other cues. Regular disturbance can lead to physiological and/or energetic consequences for wildlife. A heightened state of

alertness can lead to increased heart rates and cortisol levels leading to acute or chronic effects. Chronic stress can include a reduced immune response, making an animal more susceptible to disease, parasitism or predation. When energy is expended, such as during a disturbance event, less energy is available for other activities, including maintenance. For these reasons, individual disturbance events can lead to population-level consequences.

108 Species responses will vary for a range of physiological and ecological reasons. For example, some species and individuals will be more sensitive or alert to sounds as cues than others. Site attached (territorial) species may be more adversely affected by noise than mobile species because of their reluctance to move. Responses will also vary over time and degree of exposure (some species and individuals will acclimatise over time, either quickly or slowly, whilst others will not).

109 I note that there are no recognised limits for noise effects on native species in New Zealand, and little research to address this issue, although one recent study has indicated that levels of 80dB for short periods during the day associated with pile drilling did not appear to affect the productivity or behaviour of kororā at Waiheke Island[21]. Similarly, there are no recognised setback distances, although 20m, 30m and 50m have been commonly adopted in resource consent processes I am familiar with. In this instance relevant matters when determining the setback include the existing natural buffers, the location of the majority of the activity below existing ground level, the proposal to time the works nearest the high value habitats to the period outside the breeding season and the planting proposed to mitigate visual effects making activities less obvious.

110 I have reviewed the noise contours produced by Mr Farren. Modelling of activities in Panel 10, which is the panel nearest the SNA, results in a noise level of 60dB being achieved approximately 120m from the edge of the mining area. At night there would be no mining and noise due to mining would be reduced to only that able to be heard from the processing area (approximately 1km from Rusty Pond and around 700m from the lagoon at the closest point). Given the distances involved, and the ambient surf noise, any noise from the processing plant is unlikely to reach birds in these areas, even at night.

111 The closest mining activity to the lagoon on the western part of the site and the SNA to the north is expected to generate noise levels in the order of 60dB for the period when mining occurs there. The project description sets out that mining within each panel is expected to take 4 – 6 months. Panel 10 (nearest the SNA) is

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[21] Lawrence et al. 2023. Effect of Piling on Little Blue Penguins. Pages 1 – 23 in: The Effects of Noise on Aquatic Life edited by A.N. Popper et al. Published by Springer Nature Switzerland.

the smallest panel (approximately 1.9ha) and would be expected to be at the shorter end of this time frame. Mining there would occur outside the breeding season as required by Condition 18.8 and the proposed Avian Management Plan.

112 The coast can be a relatively noisy area at times, due to natural events such as storms, waves breaking or strong winds. Mr Farren anticipates existing surf noise levels within approximately 200m of the high-water mark will be in the order of 55 - 65dB depending on the surf activity. Thus, the mining noise would be below the existing surf noise levels most of the time. Measurements show this surf noise reduces in level gradually across the site to a minimum of approximately 45dB along the site boundary with SH6. Mr Farren has advised that the surf noise contains a broad range of frequencies and as a result is good at 'masking' other sounds. Mining tends to be mostly low frequency sound and is effectively masked by surf noise. For example, at the Westland Minerals sand mine at Nine Mile (near Westport) mining activity is not particularly noticeable where surf noise dominates (J. Farren pers. comm. 21 December 2023). That has also been my experience at that site. Having said that, birds at this location have probably only rarely been subjected to human disturbance, particularly in the form of ongoing (continuous) noise, and I would expect them to be relatively sensitive to novel sounds, at least initially.

113 For the species which occupy the coastal lagoons and SNA area adjoining the site, high pitched calls will tend to penetrate, and be audible above, the character of the noise generated by both the surf and the mining. For lower frequency calls masking may be an issue, although any masking would be mostly due to the surf activity rather than mining alone.

114 Secretive species that either are or may be present outside the site, and which could be affected by noise, include Australasian bittern, Pacific reef heron, kōtuku, fernbird and marsh crake. Of these species only fernbird and perhaps marsh crake have been confirmed as residents, although the others, with the exception of bitterns, have visited the site.

115 Although no Australasian bittern have been detected at the site by our surveys, there is one previous record in the eBird database nearby and the habitat present within the SNA area and Rusty Pond is suitable for bitterns, although in my opinion, not ideal. There are thought to be fewer than 900 bitterns nationally and they are relatively cryptic. Bittern make low frequency 'booms', particularly during the breeding season, which could be masked by background noise at the site. Sonogram from the Eurasian bittern (a close relative to the Australasian bittern), indicates that the maximum volume of a bittern's "boom" is around 40dB. Existing ambient noise at this site exceeds 40dB and as described above, surf noise is known to mask a wide range of frequencies. This also indicates to me that the site is not ideal bittern breeding habitat.

116 Given the context outlined in Paragraphs 105 – 111 above, I expect that some shy or secretive species living closest to the mining area might seek to avoid this level of noise, at least initially. Our surveys indicate that shy species such as Pacific reef heron and kōtuku are only occasional visitors to the site rather than residents. These visiting birds would likely visit similar habitats further form mining during operations instead, at least initially. Some individuals of these species might seek to avoid the area in the medium – longer term as well. This displacement to other habitats would only affect a small number of birds and would likely only be an issue whilst the mine noises are audible from their habitats, which I estimate would be intermittently (outside the breeding season) as mining moves through the sites nearest the important habitats and across a period of 4 – 6 months at most, even in Panel 10 (which is the closest to the affected habitats) based on the currently proposed mining rates.

117 More robust species, such as gulls, mallards, pūkeko and the like might well seek to avoid the noise and disturbance initially, but I would expect over time (days to weeks) they would become accustomed to it and cease to be affected by it.

118 Given these natural behaviours, I have recommended that the area closest to the lagoons and pond be mined outside the breeding season (when birds present would be more site attached than usual (i.e., less likely to move) and effects would be more pronounced because they would affect any eggs or nestlings as well as adults. Given that the mine life is several years, I would expect that this approach would lead to those resident birds using the area outside of the breeding season having time to adapt to the noise as it approaches and recedes with the mining progress, and that non-site attached species or individuals which would not or could not behaviourally adapt might relocate to suitable habitats nearby (Maher Swamp and other coastal lagoon areas further north for example) and would have time to do so before breeding commences. Given the proposed pace of mining, by the following breeding season, the active mining area would have moved further east, and perhaps north, and be less audible from the coastal area, particularly the lagoon where many birds are concentrated. I have recommended, and Tiga has accepted, a 100m setback from activities during the breeding season which reduces to the 20m normal mining setback at other times of the year.

119 I expect habitat displacement to affect only a very small subset of the bird species present, and only a small number of individuals as well. Furthermore, it would most likely be temporary in nature since birds generally exhibit very plastic behaviours in response to regular and predictable human disturbances and mining is transitory in each panel. I consider that the unmitigated level of effects of noise generally will be at worst moderate (i.e., for highly sensitive and threatened species living closest to the mining area and unable to move). Mitigation in the form of spatial separation, seasonal avoidance and planting to reduce visual cues, combined with the location

of the mining activities below the existing ground level, is expected to reduce the level of these effects to low[22].

120 Noise will be managed at the site in accordance with the Noise Management Plan required by Conditions 17.1 – 17.6. Effective implementation of the minimisation and mitigation actions outlined in the Avifauna Management Plan and the Noise Management Plan required by the proposed conditions of consent are expected to avoid any effects due to noise on avifauna using the habitats outside the site. I consider that these conditions will address effects on birds due to noise.

121 Noting the lack of data with respect to defining appropriate setbacks to address the effect of noise on birds, I have adopted a very conservative setback (100m) during the breeding season and included provisions for monitoring noise at the coastal margin in the Avian Management Plan to assist in confirming that effects have been avoided. As I have described in Paragraph 109, this is very conservative relative to other projects I am familiar with. It also aligns with the 100m setback recommended by Mr Harding. I am confident that this setback is adequate to avoid effects on breeding birds and therefore lasting or significant adverse effects on resident species.

Lighting

122 Lights can disorient night-flying birds, particularly seabirds and migratory birds, causing them to land (or crash land). Lights from towns, fishing boats at sea, oil rigs and the like all have similar disorienting effects. The brightness of light is also known to affect species' vision and behaviour (e.g., 'possum in the headlights'). Lighting also affects other nocturnal species and can disrupt food webs by, for example, concentrating insects such as moths around lights, which in turn attracts their predators.

123 If they are not injured or killed by crash landing, grounded seabirds are vulnerable to land-based hazards such as predation, collisions, and starvation. Harm to wildlife can be mitigated by controlling the intensity, direction, and duration of outdoor lighting[23] and I have recommended methods to be applied intended to achieve a reduction in effects on sensitive wildlife.

124 In addition to my recommendations, Tiga has now offered to mine and truck only during daylight hours. Therefore, there would only be very limited fixed lighting

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[22] Equivalent to a minor effect in RMA terms.

[23] Longcore, T., Rodríguez, A., Witherington, B., Penniman, J. F., Herf, L., & Herf, M. (2018). Rapid assessment of lamp spectrum to quantify ecological effects of light at night. Journal of Experimental Zoology Part A: Ecological and Integrative Physiology 329:8-9.

within the area to be mined as required for health and safety reasons. This may include lighting near the pit pump to allow for the pump circuit to be checked at night if required for example. This light would be located below the natural ground level, would only be activated in the event it was required and would be designed to avoid effects on wildlife as per the requirements of the consent conditions.

125 Fixed external lights on the Processing Plant would be similarly limited to those necessary for health and safety reasons and the building has been designed without windows or other light sources on the western (coastal) side. Some fixed external lighting will be necessary to allow for safe access to toilets, office and crib rooms. These lights will be managed as required by the lighting management plan. This lighting would be necessary to enable processing operations at night to ensure health and safety. Given that mining and trucking would only occur during the day, and the other conditions imposed with respect to lighting to protect wildlife, I am confident that the consent conditions will avoid effects due to lighting on seabirds.

126 Trucking only during daylight[24] means that there would not be lighting effects from machinery and vehicles operating at night at the load out area, driving around the site or driving to and along the highway after leaving the site. Some shift changes would occur at night and Tiga proposes a minivan(s) to take workers to the site. Shift numbers and times are indicatively 18 staff from 07:00 to 17:00 and 12 staff from 14:00 to 22:00 and 19 staff from 06:00 to 18:00 plus 8 staff from 18:00 to 06:00. Thus, up to around 20 staff could be leaving the site at change of shift and depending on the time of the year, some of those shift changes would occur at night. The provision of minivan(s) reduces the number of light vehicle movements associated with these shift changes from around 20 (assuming each person travels to the site independently) to a much lower number depending on how many people use the transport provided or carpool. These light vehicle and other movements relating to shift changeovers or infrequent maintenance requirements on the site would be subject to the management requirements set out in the Avian Management Plan, the Lighting Management Plan and the Traffic Management Plan including speed limits, a requirement to dip headlights and a requirement to report all near misses with wildlife. These are expected to reduce effects and the monitoring of vehicle strike and near miss incidents is expected to inform operations at the site so that if such events occur, the risk of future instances can be reduced.

127 In relation to traffic and machinery movements and an increase in human activity (as well as noise), for the majority of the mine life, those activities will be located at some distance from the important habitats which adjoin the site because mining

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[24] Daylight hours are defined as the period between 30 minutes before sunrise and 30 minutes after sunset.

will be sequential across the site, rather than occupying the whole area continuously. The 100m separation between the mining and the habitats during the main breeding season (August to December inclusive) will assist in reducing the potential effects of traffic and machinery movements and other human activities too.

128 At the worst (for the most sensitive species during the breeding season), I expect the level of unmitigated effects on birds due to traffic and machinery movements and increased activity to be low[25]. Similar mitigations to those recommended for effects due to noise are proposed (spatial separation, location of the processing plant away from the coastal lagoon, seasonal avoidance of mining nearest the lagoon, bunding and planting to act as a screen, noting also that some of the movements will be below the present ground level). Given these mitigations I expect the level of effects due to increased activity and vehicle and machinery movements to be very low (i.e., less than minor).

Dust

129 With respect to dust, dust generated from the gravel roads and excavation activities in the mine, and from the processing plant, could unless controlled, settle on surrounding vegetation and soils. The effects of dust are expected to be greatest on vegetation, partly because animals can actively respond to it either by moving to avoid it or by bathing/preening to remove it.

130 The effects of dust on vegetation can be physical, for example by blocking stomata (pores through which gases are exchanged), shading or abrading leaves or increasing drought stress, or chemical, affecting either the leaf surface or the soil. Dust settling on leaves, can if sufficiently thick, affect productivity by reducing the amount of photosynthetically active radiation at the leaf surface, by reducing the temperature of the leaves or by blocking the stomata. If prolonged, these effects could lead to changes in plant health and ultimately species composition over time. I have not observed any such adverse effects at other opencast mines I have visited.

131 As set out in Paragraph 72 of Mr Rekker's evidence, the rainfall at Barrytown is relatively high and as I have described above and as set out Table 2 of the hydrology AEE, prolonged rainless periods are uncommon. Dust is most easily managed through road watering trucks if required.

132 The mine life at Barrytown is expected to be short (12 years, more likely 5 – 7). I note that Mr Ridley has concluded that effects of dust can be managed. In my opinion, given the low ecological value of the majority of the vegetation, the

[25] Equivalent to minor in the RMA context.

comparatively small size of the mining area and roading, the relatively high and consistent local rainfall and the ability to manage dust generated by the mining activities as set out in the Dust Management Plan required by Condition 27 (in the event that dust suppression is required), I expect that dust generated by the proposal will not have adverse effects on vegetation. I am also of the opinion that the conditions are sufficient to protect vegetation and habitats at and surrounding the Application Site.

Avian Management Plan

133 I have recommended that effects on birds, be managed via an Avian Management Plan. This has been incorporated as a requirement of Condition 18. I have had input into the development of Condition 18 and am satisfied that it covers the necessary matters. The AMP includes a significant monitoring component in order to assist in mine planning and ensure that birds are protected from the mining activities. I have provided the latest version of the draft Avian Management Plan as **Appendix 2** to my evidence.

134 The Draft Avian Management Plan covers matters such as timing of works, monitoring of habitats and species, protection of nesting birds or species that are directly in the path of operations, decision making and consultation about management interventions. The draft plan submitted with the application has been independently reviewed by Dr Leigh Bull and her suggestions for improvement have been incorporated into the updated version of the plan. I have also received helpful comments from Inger Perkins (West Coast Penguin Trust) in relation to kororā in particular, and these have also been incorporated into the attached version. The latest version also includes changes made as a result of the applicant's offer to only mine and transport during daylight.

Tāiko

135 The northern boundary of the Application Site is approximately 3.6km south of the only known tāiko (Westland petrel) colony which is located between Punakaiki River and Waiwhero Creek as shown in Figure 1 (**Attachment B**).

136 Tāiko have a conservation threat status of "at risk (naturally uncommon)" with the qualifiers "one location" and "stable" (referring to the population). Naturally uncommon species are those which number <20,000 mature individuals (unless they occupy an area of <1000km^2) and have a distribution confined to a specific geographical area or which occur within naturally small and widely scattered populations, where this distribution is not the result of human disturbance. The total population of taiko is estimated to be 13,800 – 17,600 individuals or around

6,200 breeding pairs[26]. This is an increase of approximately 30 – 50% in the decade since the previous estimate of 7,900 – 13,700 individuals or around 4,000 breeding pairs[27]. Productivity is estimated to be around 50-60% on average, but is reduced in the presence of nest predators[28] or as a result of storm events (see below). Productivity has been relatively high in recent years (around 70%)[29]. I have relied on these population estimates in my assessment of effects.

137 Tāiko are winter breeders. Eggs are laid in May and hatch in July. Land based threats include landslides and storm events, the impact of goats, dogs, feral pigs and other mammals on breeding habitat and mortality due to disorientation caused by artificial lighting. In 2014 Tropical Cyclone Ita is thought to have significantly affected the tāiko breeding colony (prior to breeding commencing), but the effect of that event on the population remains unknown. Tāiko are nocturnal on land, leaving their colony at dawn to feed out at sea and returning at dusk.

138 Immature petrels leave the colony at fledging and do not return until first breeding, typically between the ages of five and ten (most commonly around seven years of age). They are most vulnerable within the several days after they commence that first flight to sea.

139 Most grounded petrels have been collected between November and January (118 of 131 birds collected, 90%, Wilson 2016[30]) with a peak in the first half of December. An average of 14 birds per year were collected as grounded birds over the period 2005 – 2015 (Wilson 2016).

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26 Waugh, S.M, Barbraud, C., Delord, K., Simister, K.L.J., Baker, G.B., Hedley, G.K., Wilson, K.-J. & Rands, D.R.D. 2020. Trends in density, abundance, and response to storm damage for Westland Petrels *Procellaria westlandica*, 2007–2019. Marine Ornithology 48: 273–281.

27 Waugh, S.M.; Bartle J.A. 2013. Westland petrel. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

28 Waugh, S.M., Barbraud, C., Adams, L., Freeman, A.N.D., Wilson, K.-J., Wood, G., Landers, T.J. & Baker, G.B. 2015a. Modeling the demography and population dynamics of a subtropical seabird, and the influence of environmental factors. The Condor 117; 147-164.

29 Simister, K.J., Bose, S., Fischer, J. and Taylor, G.. 2023. Progress report on Westland Petrel projects (POP2021-08) and (POP2022-07) investigating burrow occupancy, foraging behaviour and at-sea Movement. Unpublished report available at https://www.westcoastpenguintrust.org.nz/wp-content/uploads/2023/08/2023-08-CSP-Westland-Petrel-draft-progress-report.pdf

30 Wilson, K.J. 2016. A review of the biology and ecology and an evaluation of threats to the Westland petrel *Procellaria westlandica*. Unpublished report prepared for the West Coast Penguin Trust. 46pp

140 Grounded birds are assumed to have been disoriented and have been collected from a wide geographical area including as far north as Westport, as far south and inland as Lake Kaniere (inland and south of Hokitika). Not all groundings are fatal and the potential exists for rehabilitating any birds collected alive after grounding.

141 Of 141 tāiko discovered after a grounding between 2005 and 2015 where the location was known, 91 (64.5%) were collected in the Punakaiki area, 22 (15.6%) in and around Greymouth and Stillwater, 23 (16%) from the Westport area and 5 (3.5%) from the Hokitika area or Lake Kaniere (Wilson 2016[31]). Thus, the proposed mine is clearly in close proximity to essential core habitat for tāiko.

142 Adult birds leaving to forage at sea or returning appear to be less affected by lighting, but some adults are still disoriented by lights.

143 Mining will not occur outside daylight hours (as per Condition 12). Lighting at the mining area and processing plant will be controlled by Condition 16 (particularly 16.2) and vehicle lighting on site by the provisions of the draft AMP. Any encounters of mine vehicles with wildlife will also be recorded.

144 Within the mining area fixed lighting may be required, which could include lighting around the pump to allow for the pump circuit to be checked during the night. This lighting would be managed to protect wildlife, including only being used when required as per Condition 16.2 and the Draft Avian Management Plan, which also proposes monitoring of tāiko to confirm that effects are avoided.

145 At the processing plant, no windows or other openings are proposed on the western (coastal) face of the building and the plant is surrounded by planted bunds to the north and east. As I have described in Paragraphs 124 and 125, external lighting would be required for health and safety reasons to enable processing operations (particularly during winter). This lighting will be managed and tāiko groundings monitored to confirm effects have been avoided.

146 Trucking would only occur during daylight hours (Condition 12) and this is expected to avoid adverse effects of truck movements on tāiko.

147 The data reported by Wilson (2016) cover the period 2005 – 2015. The loss of 141 juvenile birds from a population of say 10,000 individuals corresponds to 1.4% of the population or 5.4% of the average 2,600 chicks produced per year. If the population were 15,000 birds (as the more recent estimate suggests), 141 birds equates to slightly less than 1% (0.94%) of the population or around 4.1% of the average 3,400 chicks produced per year. Note that these numbers are an

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[31] Note it is not clear why Wilson records 131 groundings in Table 5 (relating to month of grounding) and 141 in Table 6 (relating to location).

underestimate (or a minimum estimate), because not every bird which is grounded will be found.

148 Waugh and Wilson (2017[32]) when considering the effects of lighting generally on the population concluded that the effects were 'low'. I consider that the effects of lighting generally on tāiko are avoided with the current proposal. In particular the approach of only mining and trucking during daylight is appropriately precautionary.

149 I consider that I have been conservative in assessing the risk to tāiko, but given the location of the proposed mine in proximity to the only known colony, I recognise that there is a real risk of adverse effects. Furthermore, given the very restricted distribution of tāiko, every effort should be made to avoid and/or mitigate that risk and that is why the Avian Management Plan still provides for monitoring and reporting of tāiko groundings at the site to confirm effects have been avoided as expected and allow formulation of a response if a bird (alive or dead) is detected.

150 As well as the actions set out in the Draft Avian Management Plan there are other more general management actions proposed to avoid or mitigate adverse effects on resident fauna. In no particular order these include:

(a) Physical separation from the activities. This is provided for in the proposal to provide a 20m separation from the boundaries of the site for any earthworks and the decision to relocate the processing plant and fix it (so it is not moved around the site) some distance from the area with highest habitat values (the coast, Rusty Pond, the lagoons and associated vegetation). At some locations, such as along the coast, some or all of this area would be planted with native species to provide a screening/buffering function. This would also provide a small amount of additional habitat for species using the area.

(b) Modifications to the type, direction and spill of lighting for activities undertaken at night. The effect of different light spectra has not been specifically tested with tāiko, but generally lamps with orange, yellow and yellow-green tones typically affect wildlife less than those with white or blue tones (Longcore et al 2018). In relation to this proposal, I have recommended that the internal lights in the processing plant be yellow – orange and directed downwards, that there be no windows on the western aspect and also that the eastern and northern sides of the processing plant be bunded (to reduce light spill from the internal lights). I have further recommended that the outside lights (necessary for health and safety) be

[32] Waugh, S.M., and Wilson, K-J., (2017) Threats and threat status of the Westland petrel *Procellaria westlandica.* Marine Ornithology 45:195-203.

directed downwards and use yellow – orange light rather than white or blue. Adaptive light controls such as timers, dimmers and motion sensors to manage light timing, intensity and colour will also be utilised.

(c) As required by Condition 16.2, all lighting on site will adhere to the Australian Government's National Light Pollution Guidelines for Wildlife, January 2020 (or subsequent revision), which recommends initiatives such as downward-pointing lights, shields to avoid light spill, and using lights in the yellow-orange spectrum. Additional conditions require a detailed lighting plan to be submitted, and audited by a suitably qualified professional, to confirm compliance with Condition 16.2. this will ensure that any necessary lighting is designed in accordance with best practice principles for wildlife protection. I note that the same principles have been applied at the Westland Mineral Sands' 9 Mile sand mining site (south of Westport). The list of coastal birds potentially affected at Nine Mile included kororā, tōrea, tōrea tai, fairy prion (*Pachyptila turtur*), tāiko and sooty shearwater (*Puffinus griseus*). Although the Westland Minerals site is not as closely located to the tāiko colony as this proposal, it is located near fairy prion and sooty shearwater colonies at Wall Island (approximately 120m from Cape Foulwiind and 6.5km from the mine). No grounded birds have been detected at Westland Mineral Sands' site, although I also note that petrel groundings near Westport are historically much less than petrel groundings near Punakaiki[33] and therefore effects on tāiko there would be expected to be less anyway.

(d) Creation of an additional wetland area at the end of mine life. I have recommended that wetland restoration form part of the rehabilitation of the site. The proposed wetland is not a necessary consequence of the mining, nor do I consider it necessary to offset or compensate for adverse effects. Rather, recognising that the Barrytown flats once included much more wetland habitat, that the adjoining habitats are regionally important for birds, including threatened and at risk species, that a large amount of wetland habitat has been lost on the West Coast, including to humping and hollowing, and also that whilst the location of Wetlands 3 and 4 assists in buffering parts of the adjoining habitats, it is most likely that some birds will come to occupy them during mining, I have recommended, and the applicant and the landowner have both accepted, the creation of additional wetland area as a specific ecological response to increase the amount of habitat in the area (albeit by a relatively small amount) and connect the surrounding habitats into a mosaic of wetland types. Increasing the ecological connectivity is important for poorly mobile species or very secretive species which will not cross open country. The wetland area will also provide other ecological

[33] Only 16% of tāiko groundings discovered are from the Westport area as set out in Paragraph 141.

functions such as intercepting runoff and channel seepage from the site and helping to remove dissolved iron, suspended sediments and agricultural runoff from water before it reaches the lagoon. The provision of the 1.9ha wetland area is a positive effect of the project. I expect the wetland area to develop in ecological complexity and value over time and to produce a positive ecological outcome in the medium – longer term. The proposal is to plant the area between the existing wetland and up to the mine disturbance boundary (near ponds 3 and 4) in the second half of 2025. This area would not be disturbed again. Following mining and after the creation of the island and any additional disturbance required to achieve the parameters outlined in the draft WCRMP, additional wetland planting would revegetate the disturbed area as described in the indicative staging plan provided in Annexure 3 of the Landscape Mitigation Planting Plans prepared by Glasson Huxtable which is attached to the evidence of Ms Crawford. With respect to the ongoing protection of the wetland area, my understanding is that resource consent would be required for any vegetation removal/earthworks within 100m of a wetland (which this area would be), and that this would be sufficient to protect the constructed wetland and planting.

(e) Planting the constructed wetlands (0.75ha), coastal planting (0.3ha) and riparian planting along Collins Creek (0.75ha) and the Northern Drain (0.17ha) will include 16,398 native plants covering a total area of approximately 1.97ha as described by Ms Crawford. This excludes planting for the purposes of landscape mitigation, which is also proposed as discussed in the evidence of Ms Crawford. This brings the total amount of native planting at the site to 25,841 plants across 4.0ha. All mitigation planting areas will be subject to livestock exclusion fencing, and pest plant and animal control. I consider that fencing and planting the riparian areas with appropriate native species will improve the long-term health of Collins Creek and be consistent with the National Policy Statement for Freshwater Management (NPS-FM) directives which took effect 3 September 2020 relating to improvements of degraded streams. If the area is adequately fenced (whilst retaining crossings), this will be a lasting benefit once the land returns to agricultural use. As well as benefitting stream health, this recommendation also builds on the existing terrestrial ecological values of the site (all associated with stream edges) and improves ecological connectivity between the coastal hills and the coast itself in a minor way. The majority of this vegetation would remain after mining concludes at the site with the only vegetation to be removed being that located on the bund around the processing plant.

Relevant Planning Framework

151 When contributing to the design of this project and assessing the effects, I have considered the national policy statements for coastal areas (2010), freshwater management (2020), and indigenous biodiversity (2023) and assessed the effects against these policies in the first instance. For the purposes of my assessment relating to the SNA, and effects on that SNA, I note that I am referring to the area proposed in the TTPP and shown in Figure 15 of **Attachment D** to my evidence. Figure 15 also shows my best estimate of the location of the Coastal Marine Area ('the CMA'). The Regional Coastal Plan for the West Coast ('the Regional Coastal Plan') does not include maps showing the entire CMA boundary. Instead, Table 1.1.2 of Schedule 1 provides cross river reference points. The location of the CMA boundary between these points remains unknown. These points are the only detail given in the Regional Coastal Plan, so I have drawn the line to connect them in Figure 15. I accept that this might not represent the true CMA boundary. As shown in Figure 16 of **Attachment D**, this line bisects Deverys Lagoon, meaning that the largest part would be within the CMA and a smaller part (and all of Rusty Pond) would be considered inland. From an ecological perspective, my view is that the sensible interpretation is that Devery's Lagoon is a coastal wetland and the CMA applies to all of it and the immediately adjoining vegetation. Figure 17 of **Attachment D** to this evidence shows the wetlands in relation to the Application Site as well as the indicative location of the CMA boundary and a 100m setback from the wetland areas and the SNA. Given the location of the CMA boundary and my opinion that the lagoons should be included within the CMA, rather than bisected by it, the natural inland wetlands would include those to the north and south of the site. The wetland vegetation surrounding Collins Creek and Deverys Creek Lagoon are therefore also coastal in my view, whilst Rusty Pond is inland with the CMA boundary sensibly falling somewhere between Deverys lagoon and Rusty Pond. On the basis of Figure 17 of **Attachment D**, Panel 9 is within 100m of potential natural inland wetlands to the south, Parts of Panels 3 – 8 are within 100m of the coastal wetland (Collins Creek Lagoon, which is part of the larger Canoe Creek Lagoon) and Panels 7, 8 and 10 are within 100m of the natural inland wetland to the north. This wetland surrounds Rusty Pond, which I understand was constructed as I have set out in Paragraph 33.

Nonetheless, I have taken a precautionary approach and treated Rusty Pond as a natural inland wetland in my assessment.

National Policy Statement for Freshwater Management ('NPS-FM')

152 The NPS-FM came into effect on 3 September 2020. I have assessed the proposal against the NPS-FM policies in relation to wetlands here. An assessment of the proposal against the NPS-FM policies in relation to aquatic ecology is set out in the evidence of Mr Roper.

153 The NPS-FM sets out 15 policies. The most relevant to this proposal from an ecological perspective relate to the health of the wetland habitats and are listed below:

Policy 3: Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.

Policy 5: Freshwater is managed through a National Objectives Framework to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and wellbeing of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.

Policy 6: There is no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted.

Policy 9: The habitats of indigenous freshwater species are protected.

I discuss each of these policies in more detail below.

154 In relation to Policy 3, the potential effects on the receiving wetlands to the north, south and west of the Application Site have been considered and the proposal has been designed to avoid adverse effects.

155 With respect to Policy 5, the health and wellbeing of the natural inland wetlands will be maintained via the effective implementation of the WMMMP, the goal of which is to maintain water levels in waterbodies outside the site.

156 In relation to Policy 6, no direct wetland removal is proposed and wetland values would be maintained via active water management during mining. There would be no loss of wetland values or extent. Because of the proposal to reinstate c. 1.9ha of wetland around Treatment Ponds 3 and 4 there would be a small increase in wetland extent overall. The wetland values of this area would be as set out in the draft WCRMP and over time would likely be equivalent to those found at Rusty Pond.

157 With regard to Policy 9, the freshwater species using the natural inland wetlands (Rusty Pond and surrounding vegetation to the east and the potential wetland to the south) include plants and birds, but vary according to location. The highest value and diversity of bird species is associated with Rusty Pond and the wetland forest identified by Mr Nichol and the lowest value areas are grazed pasture wetlands. This proposal does not include protection of those wetland species in the sense of legal protection, but it does include protection in the sense of maintenance (of hydrology levels, of species occupancy and use). The pest control proposed at the Application Site set out in the draft AMP (traps around the

perimeter and more specific/localised trapping in the event that monitoring locates existing nests) will also contribute to physical protection of species in adjoining areas in a limited/minor way. I have reached a view that the proposal is consistent with the NPS-FM.

National Policy Statement for Indigenous Biodiversity ('NPS-IB')

158 The NPS-IB came into effect on 7 July 2023. The objective of the NPS-IB is to maintain indigenous biodiversity across Aotearoa New Zealand so that there is at least no overall loss in indigenous biodiversity. The NPS-IB sets out 17 Policies, of which eight are ecological matters relevant to the proposal (Policies 3, 4, 6 - 8 and 13 - 15).

159 Policy 3 relates to adopting a precautionary approach when considering adverse effects on indigenous biodiversity. For this project the relevant indigenous biodiversity is the plants, birds and other indigenous species present in the areas adjoining the Application Site.

160 With respect to vegetation, as I have set out above, in my view dewatering poses the biggest risk. To manage water and effects on wetlands within 100m of the site, extensive hydrological testing has been undertaken to understand and predict the groundwater movements and responses. Frequent monitoring of ground and surface water levels at the site perimeter is proposed combined with a suite of options for flow augmentation as required. This is expected to maintain the natural pre-mining median water level and hydrological function of the surrounding wetlands, therefore maintaining their extent, ecological values and floral biodiversity. In my view maintaining the pre-mining median water level is precautionary. This water management will be assisted by the naturally high rainfall at Barrytown and the semi-confined nature of some parts of the aquifer due to the poorly porous clays (aquitards) underlying parts of the site. By seeking to avoid effects on wetland extent and values beyond the boundary, I consider that the proposal is consistent with this policy.

161 In relation to birds, a precautionary approach has been adopted for effects on birds in the form of spatial separation (20m setbacks outside the breeding season 100m during the breeding season) between mining activities and the key bird habitats (wetlands to the north and the coastal lagoon), avoiding mining in areas closest to important bird habitats during the breeding season and by choosing to mine and transport from the site only during daylight. The monitoring set out in the AMP to detect birds in in advance of mining and provide for management response adds another level of caution to the effects management in my view.

162 In my view, the inclusion of ecological matters in a broad sweep of the conditions including Condition 6 requiring the suite of management plans, Condition 7 which limits the mining extent and requires 20m setback from the streams, coastal

lagoons and wetlands, Condition 9 which requires the site to be rehabilitated promptly (including in the event that mining pauses for some reason) and that Collins Creek, the northern boundary drain, surrounding wetlands and the coastal lagoon be protected from the effects of erosion and sediment mobilisation, Condition 12 which restricts mining to daylight hours, Condition 15 which restricts trucking to daylight hours and requires all near misses with wildlife to be reported, Condition 16 which requires a Lighting Management Plan and requires lighting to be designed to protect wildlife, Condition 17 which requires a Noise Management Plan, Condition 18 requiring the draft Avian Management Plan and setting out what should be included therein to achieve the purpose of avoiding effects on any threatened or at-risk indigenous bird species, Condition 19 which requires the wetland construction and restoration and riparian planting to be in accordance with the Wetland Construction and Riparian Planting Plan, Condition 23 which requires the Erosion and Sediment Control Plan, Condition 24 which requires the WMMMP to maintain groundwater levels and protect wetland extent and values beyond the site, Condition 26 which requires the monitoring to inform whether the groundwater level at the site perimeter is being maintained at the target, level Condition 27 which requires the Dust Management Plan, Condition 29 which sets the outcomes of the WMMMP (i.e., to maintain ground water levels in wetlands and streams) together with the information, objectives and management actions in the draft management plans I have reviewed are suitable to demonstrate the application of Policy 3 of the NPS-IB for the project.

163 Policy 4 relates to managing indigenous biodiversity to promote resilience to the effects of climate change. I consider the revegetation of the constructed wetland, sections of Collins Creek and the Northern Drain, and visual screening areas with indigenous species to be consistent with this policy. I consider that an increase in the extent and integrity of indigenous communities is expected to improve ecological resilience, including to climate change.

164 Policy 6 is to identify significant indigenous vegetation and significant habitats of indigenous fauna as SNAs using a consistent approach. The TTPP process is currently ongoing, however The SNA (PUN-W034), which includes part of the coastal lagoons adjoining the site, was identified by Boffa Miskell on behalf of Grey District Council (GDC) in 2006 using the significance criteria of representativeness, rarity and distinctiveness and ecological context. These criteria are consistent with the NPS-IB criteria.

165 Policy 7 is to protect SNAs (which have been identified/mapped as such) by avoiding or managing adverse effects from new subdivision, use and development. Although SNA PUN-W034 is not yet confirmed, potential adverse effects on the SNA from hydrological changes and potential effects on wildlife due to noise, lighting, dust, human disturbance and vehicles, have been addressed in the ecological effects assessment report and discussed in my evidence above. As

shown in Figure 16 of **Attachment D**, the majority of the SNA, with the exception of the area closest to Rusty Pond, is buffered from the in pit activities in Panel 10 by the water treatment ponds and the adjoining vegetation (existing and proposed). The parts of the SNA in close proximity to the mined area are limited to the immediate margins of Rusty Pond and the open water itself. At Rusty Pond effects would be mitigated as described above, with mining activities in Panel 10 only occurring outside the breeding season, and mining being undertaken below ground and at least 20m from the Northern Drain. In practice this separation is likely to be even more because the thin strip of vegetation between Rusty Pond and the Application Site is quite open and I would not expect secretive species to be nesting there, because of that openness. The same may be true of the narrow strip of vegetation to the north of Rusty Pond, but I have not seen it. For secretive species, the best habitats are those between Rusty Pond and the lagoon and those located south east of Rusty Pond because they are larger, more intact and more buffered from farm activities and activities on Pakiroa Beach. In my view the effects on the coastal lagoon parts of the SNA will be further reduced because they are further away from the mining areas than Rusty Pond.

166 Monitoring to date has shown that the lagoon environment is relatively stable over the short term with occasional step change 'events' (related to both rainfall and geological processes) over the medium and longer term which create substantial change. Given these characteristics, the presence of the aquitard layers which affect groundwater movement, the location of the lagoon at the "bottom" of the site (i.e., where all the water will ultimately report), the commitment to maintain the pre-mining median water levels and the variety of methods by which to do so, I expect water levels will be maintained and adverse effects on vegetation in the SNA due to hydrological changes will be avoided. Enhancement of the SNA buffer through restoration planting at the edge of Pond 4 to be undertaken early in the proposal, as well as the pest and weed management in the adjoining wetland habitat is proposed, which is consistent with Policy 7.

167 Policy 8 recognises the importance of maintaining indigenous biodiversity outside SNAs. Indigenous biodiversity is limited at the Application Site, however there are areas adjoining the site, but outside the SNA, which are of high ecological value including Collins Creek lagoon, the coastal margin and the vegetation between Rusty Pond and the lagoon portion of the SNA. Coastal restoration and screening planting, setback between the mining area and the southern part of the coastal lagoon, spatial and temporal staging of mining and weed and pest control would all assist in maintaining, and in some cases, improving biodiversity outside the SNA. Within the site, the proposed riparian planting, as well as retention and restoration of Ponds 3 and 4 is expected to improve the biodiversity within the site from a low base and also contribute to better ecological connection between the coast and inland. As shown in Figure 16 and it can be seen in Figure 17 of **Attachment D**, the proposed wetland would be located so as to connect the Rusty Pond part of

the SNA to the southern coastal lagoon part and better connect that habitat with the southern lagoon outside the SNA. This will maintain and improve an area directly outside the SNA and contribute to buffering it from future activities on the Application Site as I have described above.

168 Policy 13 is to promote and provide for the restoration of indigenous biodiversity, and Policy 14 similarly is to promote increased indigenous vegetation cover in both urban and non-urban environments. As outlined in the draft WCRMP attached to my evidence, riparian habitat of Collins Creek and the Northern Drain will be planted to restore ecological values, and wetland habitat will be created and planted with indigenous vegetation to increase the overall botanical values of the site. Planting along the coastal margin will also increase the extent of indigenous vegetation and therefore, in the longer term, biodiversity. In my opinion, the restoration proposed at the site addresses Policies 13 and 14.

169 Specific effects to be avoided within an SNA include:

(a) loss of ecosystem representation and extent;

(b) disruption to sequences, mosaics, or ecosystem function;

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

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

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

In relation to (a), the proposal to maintain groundwater levels will ensure that ecosystem representation and extent is maintained. The restoration of Treatment Ponds 3 and 4 will increase the extent. With regard to (b) there will be no disruption to vegetation sequences or mosaics because the mining is located within pasture. Considering (c), the fragmentation of the coastal vegetation will be reduced by the proposal to restore wetland habitat at Ponds 3 and 4. With respect to (d), the buffering and connection of the SNA will be (slightly) improved by the proposed planting and management. In relation to (e), the proposed management of the site ensure that the threatened and at risk species using the SNA (and the adjoining habitats) are maintained in the area and monitoring will confirm no reduction in occupancy.

170 Policy 15 is to identify and manage areas outside SNAs that support specified highly mobile fauna to maintain their populations across their natural range, and improve information and awareness of highly mobile fauna. Ten species confirmed as using the site are identified as ‘specified highly mobile fauna’ in terms of the

NPS-IB including black shag (At Risk (relict)), black-billed gull (At Risk (declining)), Caspian tern (Threatened (nationally vulnerable)), grey duck (Threatened (nationally vulnerable)), red-billed gull (At Risk (declining)), South Island pied oystercatcher (At Risk (declining)), white fronted tern (At Risk (declining)), Pacific reef heron (Threatened (nationally endangered)), variable oystercatcher (At Risk (recovering)) and South Island fernbird (At Risk (declining)) as shown in Table 2 of **Attachment C** to this evidence. In addition, four other species which might use either the pasture, coastal lagoon or flaxland area outside the SNA, but have not been confirmed as present include banded dotterel (At Risk (declining)), New Zealand pipit (At Risk (declining)), marsh crake (At Risk (declining) and Australasian bittern (Threatened (nationally critical)). With the exception of pipit, these species are not likely to rely on pasture habitats, but may use them for feeding and loafing. Pipit would use the pasture for feeding and breeding, but would not use the coastal lagoon area, except as occasional visitors. Grey duck would occupy open water for feeding and may nest in surrounding habitats. Bittern, marsh crake and fernbirds would occupy the dense flaxland and rushland vegetation outside the SNA and may breed there, but would be unlikely to venture into the farmland. Caspian tern and variable oystercatcher may breed on the beach and would feed in the coastal lagoon and perhaps in the pasture. The remaining highly mobile species (gulls, terns, shags) would use the coastal lagoon area outside the SNA and the pasture areas for feeding and/or loafing but would be unlikely to breed there. The small mining area (relative to the larger site) and the proposal to sequentially mine and rehabilitate the site as mining proceeds both mean that bird species will not be excluded from the pasture for feeding or loafing during mining. The presence of these species and the potential to be adversely affected by mining activities has informed the proposed management actions outlined in the Avian Management Plan. For example, in the first instance pipits or dotterel attempting to nest in an area about to be mined would be encouraged to settle elsewhere. Any nesting birds would be detected via the fortnightly monitoring and then their nests protected until either the chicks fledge or the nest is abandoned. For species using the coastal lagoon or the dense vegetation outside the SNA, effects during the breeding season will be avoided by employing 100m separation during that time. The monitoring proposed in the AMP will improve information in relation to these species and how they use the site and inform site management. This type of management has been used at sites elsewhere where I have worked including large coastal subdivisions and the Westland Minerals Site and has been effective at protecting birds there. I believe the proposal is consistent with Policy 15 of the NPS-IB.

New Zealand Coastal Policy Statement 2010 ('NZCPS')

171 Policy 11 of the NZCPS relates to indigenous biological diversity (biodiversity) and Policy 11(a) is to avoid adverse effects on indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists and/or

taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened. The birds which engage this policy are those shown in Table 2 of **Attachment C** to this evidence as well as those listed in Paragraph 114 above.

172 I am of the opinion that by setting the processing plant back from the coastal environment, only mining and trucking during daylight, managing the lighting colour and potential for spill (including location of windows, bunding and planting), maintaining 100m physical separation from the key habitats during the breeding season, managing the effects on the affected species and avoiding hydrological effects on the wetland vegetation, the applicant will be able to avoid adverse effects on these species in the coastal environment, avoid or manage effects within the SNA and manage effects outside the SNA such that effects are transitory and are either minor or less than minor.

173 Policy 11(a) also relates to indigenous ecosystems and vegetation types, none of which apply to the area to be mined. Effects on the indigenous ecosystems and vegetation adjoining the site would be avoided via physical separation and ongoing monitoring allowing management responses to be updated as required and management as set out in the draft WMMMP.

174 Policy 11(b) is to avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on habitats in the coastal environment that are important during the vulnerable life stages of indigenous species and indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification including lagoons and coastal wetlands such as those found outside the Application Site. As I have discussed elsewhere in my evidence, I consider that effects on those habitats would be principally brought about by changes to hydrology, which as outlined in the evidence of Mr Rekker are either not anticipated or can be managed so as to maintain the status quo.

Grey District Plan

175 Section 5 of the Grey District Plan relates to significant indigenous vegetation and significant habitats of indigenous fauna. As discussed in Paragraph 24, I have concluded that there are no sites of significant indigenous vegetation within the site and adverse effects on the adjoining SNA can be avoided. As described above, I have recommended, and Tiga and the landowner have agreed, to retain Treatment Ponds 3 and 4 as wetlands at the site at the completion of mining, which I expect will in time come to contribute to the significant habitats of indigenous fauna locally (i.e., enhancing the areas of indigenous vegetation and habitats, which is consistent with Objective 5.3.1).

176 Policy 5.4.3 is to avoid, remedy or mitigate adverse effects on the ecological integrity, functioning and habitat values of areas of significant indigenous

vegetation and habitats of indigenous fauna. As I have discussed elsewhere in my evidence any potential effects have been avoided by relocating elements of the mine infrastructure, imposing a setback from the coastal area, mining and trucking during daylight hours, managing lighting and native planting. The planting before and after mining and the post-mining wetland restoration post-mining in particular will contribute positively to the habitat values and ecological integrity at the site. I consider that the proposal is consistent with Policy 5.4.3.

177 Policy 5.4.4 is to reduce the effect that pests, including new pests, can have on areas of significant indigenous vegetation and habitats of fauna. I do not consider that the proposal will increase the effects of pests around the site and this policy is not relevant. I note that the draft Avian Management Plan provides for pest control around the perimeter of the Application Site and more targeted pest control if nesting birds are detected within the mining area.

West Coast Regional Land and Water Plan ('WCRLWP') 2021

178 There are no scheduled wetlands within or near the Application Site, the nearest being Maher Swamp. Policy 3.3.1 of the WCRLWP is when managing any activity involving water to give priority to avoiding, in preference to remedying or mitigating adverse effects on the habitats of threatened species identified in Schedule 7A. None of the habitats identified in Schedule 7A are located within the proposed mining area. Nonetheless, I consider that the proposal will avoid adverse effects on threatened and at risk species using habitats nearby.

West Coast Regional Policy Statement (2020) ('WCRPS')

179 Section 7 of the WCRPS relates to Ecosystems and Indigenous Biological Diversity. Section 7 includes objectives to identify in regional and district plans, and through the resource consent process, areas of significant indigenous vegetation and significant habitats of indigenous fauna in a regionally consistent manner (Objective 7.1), to protect significant indigenous vegetation and significant habitats of indigenous fauna (Objective 7.2), to provide for sustainable subdivision, use and development to enable people and communities to maintain or enhance their economic, social, and cultural wellbeing in areas of significant indigenous vegetation and significant habitats of indigenous fauna (Objective 7.3) and to maintain the region's terrestrial and freshwater indigenous biodiversity (Objective 7.4). As I have described in Paragraphs 29 – 31, the site adjoins Site PUN-W034 identified as significant by Boffa Miskell, and now (with modified boundaries) incorporated into the TTPP. The area to be mined is set back at least 20m from the proposed SNA as shown in Figure 16 in **Attachment D** to this evidence, and the SNA would not be affected by the proposal. Furthermore, I have recommended additional planting and creation of a wetland to assist in connecting the habitats

and buffering them from future farming activities post mining. I consider that the proposal is consistent with objectives 7.1-7.4.

180 Those objectives are supported by policies 7.2, 7.3, 7.7 and 7.8. Policy 7.2 is that activities shall be designed and undertaken in a way that does not cause:

a) The prevention of an indigenous species or communities ability to persist within their natural range;

b) A change in the Threatened Environment Classification to category 2 or below;

c) Further measurable reduction in the proportion of indigenous cover on those land environments in Categories 1 or 2 of the TEC at the Ecological District Level; or

d) A reasonably measurable reduction in the local population of threatened taxa.

I have concluded that the overall effects of the proposal are low[34]. Given that the vegetation at the site is not indigenous, policies 7.2b and 7.2c do not apply. I have set out above why I consider that the proposal will not reduce or prevent indigenous species or communities from persisting and the management actions required to avoid a reduction in the local population of the threatened taxa. I consider that the proposal complies with Policy 7.2.

181 Policy 7.3 is that provided Policy 7.2 is met, when managing adverse effects of activities on indigenous biological diversity within SNAs, that a mitigation hierarchy be applied (i.e. in order of application, avoidance, remediation, mitigation, offsetting and compensation). The proposal is not located within an SNA, but it could still affect values within the adjoining SNA if appropriate site management is not employed. Since I became involved in the project the mitigation hierarchy has been applied, including by altering the mine boundaries to avoid effects on the SNA and streams, by locating the infrastructure away from the SNA and important habitats, by mining and trucking during daylight only and by maintaining pre-mining median water levels. Remediation proposed includes planting to restore habitats, and mitigations include the application of the WMMMP and the Avian Management Plan, particularly with respect to the effects of lighting and noise. Given that the overall level of effects on the SNA is very low[35] and there are no significant residual adverse effects, application of offsetting or compensation is not required. I also

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[34] Equivalent to minor effects, i.e., Adverse effects that are noticeable but that will not cause any significant adverse impacts

[35] Equivalent to less than minor effects.

note that Tiga have accepted my recommendation to restore 1.9ha of wetland at the site which will assist in buffering the SNA during mining and improve ecological connection once mining is completed.

182 Policy 7.6 relates to allowing activities within the SNA provided values of the SNA are maintained and isn't relevant here.

183 Policy 7.7 is to provide for use or development within land areas or water bodies containing indigenous biological diversity that do not meet any of the significance criteria in Appendix 1 or 2 by:

(a) Allowing activities with no more than minor effects;

(b) Avoiding, remedying or mitigating more than minor adverse effects;

(c) Where there are significant residual adverse effects, considering any proposal for biodiversity offsetting or compensation.

In accordance with the EIANZ guidelines, a 'very low' level of effects is considered to equate to effects which are no more than minor. I have described in my evidence how the effects will be avoided, remedied and/or mitigated so that the overall result is a very low level of effects, so the proposal is consistent with Policy 7.7.

163 Policy 7.8 is to maintain indigenous biodiversity, ecosystems and habitats in the region by:

(a) Recognising that it is more efficient to maintain rather than restore biodiversity;

(b) Encouraging restoration or enhancement of indigenous biodiversity and or habitats where practicable;

(c) Advocating for a co-ordinated and integrated approach to reducing the threat status of indigenous biodiversity.

I consider that Policy 7.8 is particularly relevant to this proposal because the site to be mined currently has almost no indigenous biodiversity, and effects beyond the boundary can be avoided or managed so as to be very low. On that basis it represents a good location for a mine. I have also recommended restoration of riparian habitats and construction of wetland habitat on the margin of existing habitat (including the Rusty Pond part of the SNA) to enhance local indigenous biodiversity. I am of the opinion the proposal is consistent with Policy 7.8.

180 Section 9 relates to the coastal environment and seeks to give effect to the NZCPS. Policy 9.1 is to protect indigenous biological diversity in the coastal environment from inappropriate subdivision, use and development by:

(a) Identifying in regional and district plans areas of significant indigenous biological diversity, recognising the matters set out in Policies 11, 13 and 15 of the NZCPS;

(b) Avoiding adverse effects on significant indigenous biological diversity, and

(c) Avoiding significant adverse effects and avoiding, remedying or mitigating other adverse effects on indigenous biological diversity.

As set out above, the Application Site is not within a previously identified SNA, but adjoins PUN-W034. Paragraphs 164 – 166 and 170 above set out the measures proposed to avoid adverse effects on the SNA and the adjoining high value habitats and my conclusions with respect to this matter.

181 Section 9 also considers coastal hazards which are addressed in the evidence of Mr Teear.

Matters raised by submitters

182 I have read the submissions which raise matters relating to the ecology of the site, in particular the effects on avifauna and their habitats. A number of submitters raise similar concerns and I have grouped them by topic, rather than by submitter, here.

(a) Changes to hydrology leading to adverse effects on wetland habitats and fauna using them.

(b) Potential effects on tāiko.

(c) Potential effects on kororā.

(d) Potential effects on other birds.

The concerns raised are addressed in more detail.

Effects on Hydrology

183. A number of submitters have raised the potential changes to hydrology as a result of the proposed mining activity. As I have discussed in Paragraphs 76 to 100 above, Kōmanawa Solutions Limited (2023) has proposed a suite of water management actions to avoid changes to hydrology such that wetland vegetation and fauna would not be adversely affected. Frequent and comprehensive ground and surface water monitoring will inform water management at the site and appropriate trigger values will ensure water levels will be maintained at median pre-mining levels. This is expected to maintain ground and surface water levels and therefore wetland vegetation adjoining the lagoons and other wetland vegetation near the site. I regard the risk of adverse effects as low, mainly due

to the indigenous species present being tolerant of water level changes, the frequent water level monitoring proposed, the suite of water management tools available and the high local rainfall.

184. If for some reason this approach is not successful, the option remains to cease mining and flood the pit which I understand would restore groundwater levels very quickly.

Effects on tāiko/Westland petrel

185. Tiga has offered to mine and truck from the site during daylight only. This will avoid the potential for adverse effects on tāiko due to mining and trucking at night. Lighting management at the processing plant is proposed to protect tāiko from adverse effects arising from lighting there. The Avifauna Management Plan (**Appendix 2**) includes provision for monitoring of taīko, including the effects of vehicle movements, as a precautionary measure and to confirm effects management is working.

Effects on kororā/little blue penguin

186 A number of submitters are concerned that the potential impacts on kororā has not been sufficiently evaluated or mitigated. During surveys of the site no kororā burrows or potential burrows have been detected within the mining area, but it is recognised that kororā are present in low numbers in the Pakiroa/Barrytown beach area as described in Section 2.3.3 of the Avian Management Plan. No burrows or potential burrows have been detected in the habitats adjoining the Application Site either, but the searches there have not been as intensive as the vegetation would require to detect them. There are two main risks to kororā, including mining separating them from their burrow on the inland side of the mine and kororā being killed on the roads by mine-related vehicles. Section 3.4 of the draft Avian Management Plan provides for maintaining existing access ways, replacement of any directly affected burrows with two artificial burrows/nest boxes within the vegetated coastal foreshore habitat associated with any identified accessways and development of a specific mitigation plan where coastal erosion occurs. Annual monitoring of access tracks is proposed to inform the location of kōrora and confirm that effects have been avoided.

Matters raised by WCRC Staff Report

187. In paragraph 129, Dr Durand refers to Mr Harding's ecological peer review in relation to the status of the existing environment and the manner that this was assessed in the application and agrees with Mr Harding's conclusion. There are three matters raised (items a), b) and e) in paragraph 129) where I disagree with Mr Harding as follows:

i. The site sits within "a landscape of largely undeveloped land: indigenous vegetation and wetlands to the north; extensive forest on the Paparoa Range to the east; Canoe Creek and the Langridge Scenic Reserve to the south; and, Canoe Creek Lagoon and the beach/sea to the west." (paragraph 31 of the peer review).
ii. There is no indication that the ecological values of adjacent areas - or the wider Barrytown Flats coastal-plain ecosystem - were surveyed during the preparation of the AEE." (paragraph 32 of the peer review)
iii. Assessment of the potential adverse effects of the activity on terrestrial ecology is constrained by the lack of information in the EEA on indigenous biodiversity values on adjacent properties. It is further constrained by our limited understanding of ecological processes in the wider Barrytown Flats coastal-plain ecosystem." (paragraph 43 of the peer review).

188. In relation to the first matter, as I have described in Paragraphs 26 and 27 above, the undeveloped land in the Punakaiki Ecological District is mostly situated outside the Barrytown flats. I agree that there are remaining natural areas within the Barrytown flats, but as shown in Figure 6 of **Attachment A** to my evidence, the natural habitats on Barrytown flats have been substantially altered over time by both natural and human induced processes. The result is a substantially modified environment.

189. In relation to the second matter, I have set out in Paragraphs 25 – 39 of my evidence the information in relation to the Barrytown flats coastal plain ecosystem which have informed the assessment.

190. In relation to the third matter, I agree that the lack of information on adjoining properties is a constraint, however I consider that by assuming there are wetlands at the boundary and therefore requiring that effects on wetland extent and values must be avoided in accordance with the NPS-FM, this constraint has been addressed in a precautionary manner. I disagree that the existing environment has not been well characterised given the level of ecological survey effort I have described in my evidence, the aquatic surveys described by Mr Roper and the level of hydrological investigation described by Mr Rekker.

191. In paragraph 176, Dr Durand considers that the ecological effects of a pit wall collapse have not been considered. Mr Wyllie has advised that the risk of a pit wall collapse is extremely low, and that the open pit is expected to be stable for the proposed configuration. In Paragraph 45 of his evidence, Mr Wyllie considers that the ground displacement at 20m from the pit edge would be c. 0.25m. Given

the proposed 20m setback from streams and the coast, a pit wall collapse would not affect these features unless it occurred during the start-up phase. Mr Wyllie goes on to say (in Paragraph 51) that from a risk perspective, the likelihood of occurrence at the time of exposure of the boundary cut is rare with a low risk of damage and could be addressed by reinstatement.

Matters raised by GDC Staff Report

192. Ecological matters are discussed in Paragraphs 222 – 251 (pages 51 – 61) of the S42A report from the GDC. Mr Geddes' opinion is based on a peer review from Mr Harding and he concludes that potential adverse effects on ecology are of concern and that ideally, the applicant would provide more information about the potential adverse effects on these matters. Mr Harding has three broad areas of concern, the assessment methodology, the potential effects at the site and the potential effects on habitats adjoining the site. Specifically, these concerns include

    a. The Assessment Methodology. Mr Harding's opinion is that the EIANZ methodology used is not endorsed by DoC, MfE or the Ecological Society of NZ and suppresses project impacts and is therefore problematic.

    b. Ecological values ascribed to some vegetation/habitats at the site are too low and not fully understood.

    c. Potential effects at the site as described in the ecological assessment are too low.

    d. The duration of the avifauna survey (1 year) cannot be relied upon to conclude that species will not be present during the 12-year mining period.

    e. The importance of the site's habitats for mobile/migratory bird species and fauna (e.g., Lepidoptera) is unclear.

    f. The avifauna management plan will likely mitigate, but not necessarily avoid adverse effects on avifauna.

    g. A 20m separation between mining activities and fauna habitat will likely be insufficient. A wider buffer (100m) should be provided to reduce this risk.

    h. Mining activity may cause the displacement of Australasian bittern from what is regarded as the best habitat in the ecological district, and that the loss of one individual would affect the bittern population. The risk to Bittern could be mitigated by providing a buffer of 100m (instead on 20m) between the lagoon margin and mining operations.

    i. The limited period of data collection (1 year) and the possibility that other – discreet or cryptic species, may be occasionally present, mean that it is not

possible to be certain that all adverse effects on avifauna utilising habitats directly adjacent to the site will be avoided.

j. It is difficult to determine whether the avifauna management plan would avoid or only mitigate adverse effects on tāiko. In the absence of certainty, it would be prudent to at least restrict mine operations to daylight hours between November and January (inclusive), to reduce the risk of artificial light disorienting tāiko.

k. The submitters state the Royal spoonbill (at risk and naturally uncommon) and kotuku/white heron (threatened/nationally critical) use the Canoe Creek Lagoon habitat. That latter was observed during the site visit. Disturbance of these species by mining activities would be an effect; it is less clear whether the magnitude of any adverse effects on the species (instead of on individuals) would be more than minor.

l. A significant potential adverse effect of the mine operation is mortality of kororā/little blue penguin (at risk/declining) caused by mine traffic on the Coast Road. There is insufficient data in the application to determine this effect. Information from submitters indicates that this effect may be high. To help avoid adverse effects on kororā, it would be prudent to restrict mine traffic on the Coast Road to hours of daylight outside the dawn and dusk periods for the July to December period.

m. It is not clear that the Canoe Creek Lagoon and its margins have been surveyed comprehensively for species of conservation concern.

n. The assessment of ecological effects is optimistic to assume a survey of vegetation on the property adjoining to the north is not necessary because the proposal will not affect biodiversity. This is inconsistent with the NZCPS's precautionary approach.

o. The possible effects of altered hydrology on adjacent wetlands could not be assessed without better information on the character and composition of the plant communities at those wetlands. If there is any mining-induced alteration to hydrology (especially water levels) at adjacent wetlands, there remains a risk that there will be adverse effects on indigenous biodiversity.

p. A possible adverse effect on adjacent vegetation and habitats is collapse of the pit wall, particularly if the injection wells fail. This could cause significant adverse effects on adjacent vegetation/habitat through erosion and dewatering of the Canoe Creek Lagoon and other wetlands. The EEA provides insufficient information to assess this effect as there is no habitat survey of adjoining sites.

q. The open-freshwater, wetland, and beach habitats of the Barrytown Flats represent the only extensive habitats of these types along a long – and otherwise steep and rocky – coastline. The significance of these habitats – even if used only occasionally – may be greater than suggested by their size and condition.

r. The occurrence risk, and possible effects from natural hazards, does not appear to have been adequately addressed in the application.

s. The risk of storm events leading to inundation of the mine, and consequent erosion and/or dewatering of adjacent areas does not appear to have been adequately addressed in the application.

Each of these matters is considered in more detail below. I note that Mr Harding has completed his assessment based on the AEE and ecological and hydrological studies have been ongoing since the application lodgment in April 2023.

193. In relation to the EIANZ methodology, I am aware that Mr Harding disagrees with the EIANZ approach. The EIANZ guidelines are the only systematic and transparent process for assessing ecological effects of which I am aware. Each level of effect is also clearly explained in plain English, which is another advantage for decision makers and other non-ecologists. To my knowledge none of DOC, MfE or the Ecological Society of New Zealand have been asked to ratify the approach, nor would I expect them to do so routinely, since it is a uniquely RMA approach which is not the core business of any of those bodies. I also note that the first edition of the method (published in 2015) was prepared by a group of experienced ecologists over about a two-year period. The second edition (2018) was prepared based on feedback from ecologists working in the field using the earlier version. Thus, the method has been subject to a degree of limited peer review from people familiar with the resource management environment. The method has been accepted in Environment Court proceedings and other resource consent hearings, although I agree that the acceptance is not universal. The EIANZ methodology does not suppress impacts. It does the opposite. The methodology requires that the user clearly describes the potential impacts that may be created, demands transparency around how potential effects have been avoided or mitigated prior to accepting an impact for management under this framework, and clearly communicates the scale and context of residual effects and best practice for how these should be addressed. The EIANZ approach is a framework that assists an ecologist as part of their decision-making, and in my opinion is helpful in making explicit the reasoning which informs your opinion and in cross referencing the level of effect within the framework with the level of effect in the RMA context. Ultimately, it is up to the expert to form an opinion and convey that to the decision maker.

194. Rather than saying 'the methodology used is not endorsed by DoC, MfE or the Ecological Society of NZ and suppresses project impacts and is therefore problematic', it would be more correct to say 'To date the EIANZ methodology used has not been challenged in its use by DoC, MfE, or the Ecological Society of New Zealand and has been accepted by the Environment Court'. In my view it clearly communicates project impacts and is therefore helpful to discussions of context, scale, appropriateness and management of potential impacts on biodiversity when parties engage with it openly and consider what it means. I consider its use to be appropriate and this was supported by the external peer reviewers engaged by the applicant as part of its internal review of evidence.

195. Mr Harding considers that the ecological values ascribed to some vegetation/habitats at the site are too low and not fully understood. In response, I note that the ecological values are an assessment of the **relative** (my emphasis) importance of the ecological components of the environment and a value assessment must be undertaken in order to make informed judgements with regard to avoidance or alternatives. An assessment of values is not the same as an assessment of significance. When assigning ecological value, unless prescribed otherwise by the relevant planning policy, the EIANZ approach considers four attributes that contribute to ecological value, including representativeness, rarity/distinctiveness, diversity and pattern, and ecological context. These terms are given wider meaning for EcIA than they might have in traditional conservation assessment (for example under RMA s6(c)). The EIANZ framework is consistent with, but different from (as noted above), the NPS-IB framework for assessing significance.

196. The vegetation and habitats within the site to be removed comprise grazed pasture, individual mature trees and limited indigenous vegetation which has been planted (mostly harakeke, New Zealand flax, *Phormium tenax* of unknown provenance) they would not score highly for any of the four attributes which contribute to ecological value (they are not representative of indigenous communities, they do not contain rare or distinctive indigenous elements, they do not include a diversity of native species nor have a natural ecological pattern and contribute little to local ecological function since they are located within an ecological district which is largely intact with respect to vegetation and fauna.

197. In relation to item 9.4(iii) above, Mr Harding considers that the potential effects at the site as described in the ecological assessment are too low. Given the low ecological value of the vegetation and habitats within the site, the temporary nature of the vegetation removal before rehabilitation to pasture occurs, the small area disturbed at any one time (only approximately 1/8th of the 63ha mining area which is less than half the 115ha site) and the proposed planting of approximately 4ha of ecosourced indigenous vegetation along the coast, in riparian areas and to mitigate visual effects, nearly all of which would remain post-mining, I do not see how

effects on those values could be anything but low or very low, noting that within the EIANZ framework, very low level effects can generally be considered to be classed as 'not more than minor' effects.

198. In relation to the duration of the avifauna surveys, Mr Harding considers that one year of data cannot be relied upon to conclude that species will not be present during the 12-year mining period. I agree and for that reason I have also used eBird records for the ecological district, which date back decades, albeit with patchy coverage. In addition, seasonal bird surveys at the site are ongoing and will continue for the life of mining and slightly beyond as set out in the Avifauna Management Plan required by Condition 18. The mine plan is such that mining near the coastal lagoon and important habitats to the north (Panels 4 – 8 and 10) would not take place immediately. Plant construction and detailed design is expected to take at least six months, following by pre-mining establishment works which are expected to take six months. On that basis it would be at least 18 months to two years following the granting of any consents before mining starts and then longer before it reaches Panel 4, which would give time for at least twelve more surveys (three more years) to inform any necessary amendments to the Avian Management Plan if new species were detected before mining occurs in the vicinity of the lagoon. Given the likely delay between this hearing, consents being granted and any appeals being heard, there would likely be more than twelve surveys undertaken. To date we have undertaken five seasonal surveys with both observers and acoustic recorders and have more than 53 12-hour days of continuous recording with 15 recorders and more than 3 hours of diurnal observer counts from the site (as well as casual observations spread over more than a year). These surveys will continue until post-mining. On that basis, and based on my experience at other sites, I would expect we have a good understanding of the birds which are resident at the site, but it is likely that occasional visitors will continue to be detected over time. Occasional visitors would not be reliant on the site for habitat. The monitoring described in the draft Avian Management Plan is, in my view, sufficiently precautionary to address birds which arrive unexpectedly at the site.

199. Mr Harding considers that the importance of the site's habitats for mobile/migratory bird species and fauna (e.g., Lepidoptera (moths and butterflies) is unclear. I disagree. With respect to bird fauna, mobile and migratory species may use the area for foraging and loafing, but they are unlikely to be dependent upon it and there is similar farmland to the north and south of the site, and elsewhere on the site away from mining, which they could use if mining deterred them from settling there. Since the vegetation is dominated by exotic species and almost a monoculture, with little species or structural diversity, it is unlikely to provide habitat for a diverse or unusual native invertebrate fauna and even if it did, the removal of up to 8ha at a time (leaving more than 100ha intact), followed by revegetation with similar species, is unlikely to pose a significant constraint for mobile fauna.

200. With respect to item 9.4(vi) above, Mr Harding is of the opinion that the avifauna management plan will likely mitigate, but not necessarily avoid adverse effects on avifauna. Since the version submitted with the application the Avian Management Plan provided as **Appendix 2** to this evidence has been updated in response to submissions and as a result of consultation with a number of the submitters. This includes mining and trucking only during daylight hours so as to avoid effects due to lighting on tāiko and other seabirds as well as additional protections for kororā and other birds including fernbirds and marsh crake at the site. Condition 18 provides for ongoing bird monitoring and also requires the Avian Management Plan to be updated in response to that monitoring in order to ensure that up to date information is included and adverse effects on birds are avoided.

201. Mr Harding is of the opinion that a 20m separation between mining activities and fauna habitat will likely be insufficient and considers a wider buffer (100m) should be provided to reduce this risk. The Avian Management Plan which accompanied the application proposed a 95m setback during the breeding season and I have increased that to 100m in the latest version. As I have discussed in Paragraph 109 above, there is almost no research in New Zealand that looks at disturbance distances for wildlife, effects vary with individual and species and over time and furthermore can vary from undetectable (but still adverse) physiological effects to easily observed behavioural effects (such as avoidance). I am not aware of any research that says a minimum of 100m is required, but I note that 20m from active nests is commonly used in other resource consents I am familiar with and this seems to be supported, at least for kororā, by the study I have cited[21], however I note that kororā are not a particularly shy or cryptic species. In my opinion, and based on my experience elsewhere, effects due to activity, noise and lighting on birds at this site will be mitigated by the comparatively high levels of background noise, the additional planting between the coastal lagoons and the mining, the location of the mining below ground, limiting the hours of mining, effective lighting management and the predictability of the activities (no blasting or percussive noises) as well as the physical separation from the works, particularly during the breeding season when the separation distance is 100m as Mr Harding suggests is appropriate. Monitoring is also proposed to confirm this approach avoids effects on species occupancy.

202. In relation to item 9.4(viii) above, Mr Harding considers that mining activity may cause the displacement of Australasian bittern from what is regarded as the best habitat in the ecological district, and that the loss of one individual would affect the bittern population. He also considers that the risk to bittern could be mitigated by providing a buffer of 100m (instead on 20m) between the lagoon margin and mining operations. I disagree that the adjoining habitat is the best habitat in the ecological district. In my experience, bittern tend to prefer raupō wetlands, rather than flaxlands. The coastal lagoon does not include suitably dense habitat for bittern, at least on the coastal side. The vegetation on the landward side and surrounding

the adjoining Rusty Pond area is dominated by flax, and whilst it does include raupō, it is not what I would consider to be a raupō reedland. Maher Swamp, approximately 1.3km north of the site and still within the Punakaiki Ecological District, is much more what I would consider to be ideal bittern habitat, being dominated by dense raupō, and also quieter. Examples of the vegetation at Maher Swamp are shown in Figures 12 - 14 of **Attachment D** to this evidence. I consider Maher Swamp to be the best bittern habitat I have seen in the Punakaiki ED. As I have described, Maher Swamp is a Schedule 1 wetland in the RLWP. Maher Swamp would remain unaffected by this proposal.

203. Bitterns often occupy a number of small wetlands in flying distance of each other and move between them for feeding, sometimes covering large distances. As I have set out in Paragraphs 44 and 45 above, despite undertaking 53 days of recording at 15 locations and visiting the site multiple times, no bittern have been detected in the adjoining habitats. There is only one bittern record in the eBird database records for the Punakaiki ED. Based on my experience at other sites, I would expect to have detected bittern given this much survey effort. I cannot rule out bittern visiting these habitats occasionally, but based on the data obtained, and the type of habitats present, I do not consider bittern would permanently reside there. Mr Harding goes on to state that the loss of one individual would affect the bittern population. It is fanciful to suggest that the proposed mine would kill any bittern. The activities on the site adjoining their habitat may cause bittern to move, but as I have already stated, I do not consider that the habitat is ideal for bittern and it is unlikely they would reside there all year anyway.

204. In relation to items 9.2(ix) and 9.2(xi), Mr Harding also raises the possibility that other – discreet or cryptic bird species may occasionally be present. This is certainly a possibility, and to date Pacific reef heron have been seen there on one occasion and Mr Geddes notes seeing a white heron. Our surveys have detected spoonbill and possibly marsh crake. The fact that these species might visit the site does not necessarily mean that it is significant for them, or that they are dependent on it. The ongoing avifauna monitoring is designed to detect new species at the site and the AMP can be updated as necessary if new species establish there. The submitters suggest that the Royal spoonbill and kōtuku/white heron use the Canoe Creek Lagoon habitat. Kōtuku in particular are likely to be visitors. They are only known to breed at Waitangiroto River, just north of Okarito Lagoon, where there are approximately 50 pairs[36]. Kōtuku are known to visit a variety of wetland sites, but would be unlikely to be present at Barrytown for much of the year because they would be breeding. Disturbance of these mobile species which are not breeding

[36] Adams, R. 2013 [updated 2023]. Kōtuku | white heron. In Miskelly, C.M. (ed.) New Zealand Birds Online. www.nzbirdsonline.org.nz

at the site by mining activities would be a transient effect on individuals, rather than a population level effect.

205. With respect to item 9.4(x) above, Mr Harding remains uncertain whether the avifauna management plan would avoid or only mitigate adverse effects on tāiko. Tiga has offered to restrict mining and trucking to daylight hours and this will avoid the risk of artificial light from either mining or trucking activities disorienting tāiko and lights at the processing plant will be managed to protect wildlife. Thes management actions are expected to avoid adverse effects on tāiko

206. Mr Harding considers that a significant potential adverse effect of the mine operation is mortality of kororā/little blue penguin (at risk/declining) caused by mine traffic on the Coast Road and suggests that to help avoid adverse effects on kororā, it would be prudent to restrict mine traffic on the Coast Road to hours of daylight outside the dawn and dusk periods for the July to December period. Given that Tiga now propose only daylight trucking, this potential effect will be avoided.

207. Mr Harding considers that the Canoe Creek Lagoon and its margins may not have been surveyed comprehensively for species of conservation concern. The lagoon and its margins have been surveyed three times (in July 2021, May 2023 and December 2023). As I have described in Paragraph 96 above, during the period I have been visiting the Application Site there have been two substantial changes to the coastal lagoon which have removed most of the vegetation. Photographs showing the area before and after these events are provided as Figures 17 – 20 in **Attachment D** to this evidence. Following the August 2023 event, the much of the vegetation was removed as described in Paragraph 96. It is possible that plant species of conservation concern occur there which have not been detected. Given the proposal to maintain pre-mining water levels, the lagoon is outside the zone of influence and any vegetation there would not be affected by mining activity.

208. Mr Harding considers that the assessment of ecological effects is optimistic to assume a survey of vegetation on the property adjoining to the north is not necessary because the proposal will not affect biodiversity. On the contrary, we have not been allowed access to these areas to make an assessment, so we have always assumed that effects beyond the boundary must be avoided. The hydrologists have advised that ground and surface water levels can be maintained beyond the site boundaries using the water management methods proposed. In the event that that is not the case, I investigated the character and composition of the plant communities at wetlands and other areas that I could access to the north of the site. As I have described above beginning at Paragraph 58, I have also used Mr Nichol's assessment of the wetlands immediately to the North of the site and the Boffa Miskell SNA report to inform the assessment because both related to these areas I could not access. Vegetation in the wetlands I investigated is consistent with Mr Nichol's description of the adjoining wetlands, the SNA report

and the historic descriptions by the other authors I have referred to throughout my evidence. Provided that the wetlands to the north include similar vegetation, and there is nothing to suggest that they don't, I consider that if there were any mining-induced changes to water levels there, the vegetation is such that it could withstand these fluctuations for the extent of time required for remediation to occur. If the effects could not be remedied as set out in the conditions, the applicant would be in breach of their consents and the consenting authority could issue an abatement notice. My understanding of the nature of effects is that ceasing operation and filling/rehabilitating the pit void would allow a return to natural water levels relatively quickly, so any unforeseen effects would be temporary and able to be remedied without permanent post-mining effects. This places a very strong onus on the applicant to achieve pre-mining median water levels with only a very low risk of permanent ecological harm.

209. Mr Harding also considers the possibility of adverse effects on adjacent vegetation and habitats due to erosion and dewatering following collapse of the pit wall, particularly if the injection wells fail. Firstly, I would note that infiltration trenches are proposed as well as injection wells to return water to ground. Surface water discharges (to Collins Creek and the Northern Drain) and discharges to the Canoe Creek infiltration basin are also proposed, but my understanding is that these would not contribute significantly to groundwater because of their hydraulic disconnection. Mr Wyllie has advised that the pit wall collapsing would only pose a threat to adjacent vegetation and habitats as I have described in Paragraph 191 above and that it could be addressed via reinstatement. Pit opening represents only a very small proportion of the time that the mine is operating. For the majority of the mine life, the pit would be separated from these habitats by much more than 20m, it would not be directly adjacent to them. On that basis any erosion event would need to be significant to adversely affect vegetation.

210. In my view, the risk of dewatering poses a more real threat to adjoining vegetation and habitats and this risk has been top of mind during mine planning. In addition to the ongoing ecological surveys, ongoing hydrological investigations have continued since lodgement. More recent work has confirmed that the potential for inflow to the pit and consequential dewatering is less than originally envisaged at the start of the project, and even when the AEE was prepared. The evidence of Mr Rekker sets out the existing hydrology at the site and discusses the effects of removing groundwater from the pit. He concludes that this could result in groundwater drawdown beyond the site. Mr Rekker also describes (in Paragraphs 34 and 35) the mean annual rainfall (in the order of 2.7m per year) and the mean annual calculated evapotranspiration for coastal flats from Greymouth to Westport, which generally ranges between 700mm and 850mm, well below total annual precipitation. This excess rainfall over evapotranspiration results in groundwater recharge (in the order of 1.7m per year). This figure is important because this water would be available to recharge wetlands from precipitation if the local groundwater

level dropped. When considering the unmitigated effects of mining near Maher Swamp and possible wetland restoration for an earlier proposal, Jackson (1994[37]) considered the high rainfall at Maher Swamp would be expected to mitigate effects and the same is true at the Application Site in my view.

211. As Mr Rekker describes in Paragraph 95, the need to lower water levels in the sand extraction pit travelling along the mine path causes a temporary depression in the water table and changes groundwater patterns, including the flow relationships between the water table and surrounding water bodies. The potential unmitigated effects arising from that change could affect surface water drainage, flows and levels and affect groundwater levels. Changes to groundwater levels could affect surface vegetation (particularly in wetlands which are groundwater fed). In Paragraph 29 of his evidence, Mr Rekker states that on average these changes are around 30L/s depending on depth of the pit, permeability of the substrate and proximity of nearby water bodies.

212. As Mr Rekker describes (in Paragraph 117), the mitigating effect of infiltration or injection structures is to partially return groundwater to the groundwater system in a manner and at quantities that would raise local groundwater levels and diminish surface water body depletion via the groundwater system. I have not considered surface water body depletion effects on ecological values further here, although that is discussed in the evidence of Mr Roper. The purpose of the infiltration trenches is to raise shallow groundwater levels in lower permeability superficial sediments. Mr Rekker considers that infiltration trenches have immediate and medium-term impact. The purpose of injection wells is to raise groundwater levels in a radial pattern around each well, while a line of injection wells can provide a curtain of mounded groundwater level or pressure. Mr Rekker is of the opinion that injection wells have medium to long-term impact. My understanding is that the location of both can be moved as required (e.g. if they become less effective due to blocking) and also that there are other measures that can be taken to enhance acceptance rates and extend the recharge distance. I also understand that the initial scale trials undertaken in September 2023 were effective in reintroducing water to the aquifer.

213. Turning to the potential ecological effects on adjacent wetlands due to dewatering, those effects would vary according to a range of factors including (but not limited to) the hydraulic connection, the plant species present, the current conditions at the time the dewatering occurs, the time of the year, the depth and the duration of the drawdown and the distance from the site. I have considered these matters in Paragraphs 82 – 93 above and concluded that effects would be minor.

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[37] Jackson, R.J., 1994. Hydrological management of three wetlands. Conservation Advisory Science Notes No. 89, Department of Conservation, Wellington. 5p.

214. I generally agree with Mr Harding's opinion that the open-freshwater, wetland, and beach habitats of the Barrytown Flats represent the only extensive habitats of these types along a long, and otherwise steep and rocky, coastline and that the significance of these habitats, even if used only occasionally, may be greater than suggested by their size and condition. However, I am of the opinion that this significance has been give due consideration in the mine planning process and that appropriate steps have been taken to avoid adverse effects where required and to remedy and mitigate adverse effects where that is appropriate.

215. In relation to the final two matters raised by Mr Harding, the occurrence risk, and possible effects from natural hazards and the risk of storm events leading to inundation of the mine, and consequent erosion and/or dewatering of adjacent areas, the risk of these matters is addressed in the evidence of Mr Wylie and Mr Teear. Murray-North[1] have described the dynamism of the Barrytown flats and having visited the site several times I can confirm the location, extent and depth of the lagoons and the nature of the surrounding vegetation have been substantially different at times. These natural changes will continue and will occur whether mining does or not occur and can be addressed to some extent via replanting and other works depending on the nature and magnitude of the change.

Proposed consent conditions

216. Proposed consent conditions 16.0 (Lighting), 17.0 (Noise), 18.0 (Avian Management) and 19.0 (Visual Screening and Planting) relate specifically to ecological mitigation at the site. As I have identified in Paragraph 162 above, there is a wide range of conditions with ecological implications. I have read the proposed consent conditions in full and believe they are sufficient to address ecological effects at the site.

Questions of clarification from the Chair of the Hearings Panel

217. This section responds to Minute No.6 'Further Housekeeping and Matters and Observations Arising from Pre-Hearing Reading by the Chairperson', dated 10th January 2024. In particular, points 9 and 10 On 10th January 2024, the Chair of the Hearing Panel issued Minute no. 6 in which he raised some matters for clarification and asked that these be addressed in the applicant's evidence. The matters raised relating to terrestrial ecology were:

    a. Matters 5 and 6 noted that the Site plan (ATT F – Amended Site Plan) does not identify Canoe Creek, Collins Creek and the Northern Drain or delineate and identify the Canoe Creek Lagoon and Rusty Lagoon or Pond 4 (at least by name). To address these matters, Mr Roper has prepared the map attached as Figure 1 in **Attachment A** to his evidence.

b. Item 7(a) requests a copy of the Boffa Miskell SNA report for Canoe Creek Lagoon. This is provided as **Attachment A** to my evidence.

c. Item 7(b) asks whether there is any disagreement amongst ecologists about the importance of the values of the coastal lagoon. I have not discussed this matter with Mr Harding, but I can confirm the lagoon is high value (regionally important) in my opinion.

d. Item 7(c) states that it may be useful to have spatially identified the ecologically significant turf vegetation and a description of its habitat context and parameters for ecological function. Noting that the relevant species appear to be vegetation, which was mostly indigenous and included species such as *Myriophyllum triphyllum*, *Potamogeton suboblongus*, *Centella unifilora*, bachelor's button (*Cotula coronopifolia*) and *Lobelia anceps*. The extent of this turf vegetation in particular, is probably affected to a high degree by the dynamic nature of the lagoon and the regular (daily, seasonal) changes in the water level; per Ecological Response Memorandum 12 June 2023. As I have described above, and shown in Figures 17 – 20 in Attachment D, the vegetation surrounding the lagoon has changed recently due to natural disturbance and the turf vegetation has yet to return to most of its former extent. With regard to its habitat context, turf vegetation develops where fluctuations in water levels, which occur naturally both seasonally and annually to varying degrees, lead to zonation of the water's edge vegetation, with the most aquatic vegetation at the base (usually fully submerged, *Myriophyllum* and the like) and an upslope sequence of zones having decreasing flood-tolerance usually merging to rushland, reedland, forest or tussock grassland up slope depending on local conditions. Turf is typically rich in species including native genera such as *Myriophyllum*, *Crassula*, *Lobelia*, *Eleocharis*, *Carex*, *Sellieria*, *Epilobium*, *Isolepis*, *Viola*, *Hydrocotyle*, *Leptinella*, *Gonocarpus*, *Lilaeopsis*, *Gnaphalium*, *Galium*, *Gunnera*, *Limosella*, *Euphrasia* and and *Centella* as well as naturalised species present to varying degrees (Johnson and Brooke 1989, Wilson 2000). The more predictable and regular the changes to the water levels, and the longer they have been that way, the more species-rich the turf vegetation is likely to be. The turf described in the SNA report had a moderate species diversity, but not especially high, which indicates it had likely developed over some years since the last disturbance event. That natural successional process has now been restarted by recent events.

e. Item 7(d) The Water Management Plan and Kōmanawa report (consistent with the ECIA) aim for a low impact in the relevant Boffa Miskell (presumably EIANZ) effect band for level variation, but the conditions aim to maintain the median. Are these materials well-aligned? As described by Mr Rekker in his response to this question, the available water level data for the lagoon

shows, perhaps unsurprisingly, that the water levels are relatively constant over the monitoring period (the maximum and minimum values being approximately 40cm different). I consider that a pre-mining median value is appropriate because it is effectively the "minimum" value that will be achieved because rainfall events of varying amounts will continue to contribute to the lagoon due to runoff from the unmined parts of the catchment and contribute to higher water levels when these events occur. This approach provides for more natural variation than adopting a higher value (such as, in this case, the mean) which would lead to higher than normal water levels overall and therefore less variation, particularly less time with lower water levels of the natural range.

f. Item 8(b) states "Based on v1 of the Offered Conditions, management of the water level of the Canoe Creek Lagoon is based on a median level, yet the ecological evidence describes the natural condition as being dynamic and having fluctuating water levels. What are the implications of using a median value for managing such a dynamic ecosystem?

   As discussed by Mr Rekker in his response to the same question, Canoe Creek Lagoon is dynamic (particularly over medium – longer term time scales), but normally fluctuates within a small range (over shorter terms). In other words there are periods of relative stasis, interspersed with bigger step changes which may result in a new equilibrium. Discussion with Mr Rekker has indicated these small/short term variations are probably correlated with catchment high rainfalls, creek flows and consequent increases in lagoon water storage, with the larger events (such as the one which occurred in August 2023) coinciding with unusually big rainfall events and/or king tides and the like. My advice with respect to maintaining the median level was based on maintaining the short-term stasis within reasonably similar levels and was partly based on Beca (2008[38]) who defined the potential risk of ecological change associated with changes in median water levels in wetlands as follows:

      1. Low - <0.2 m change in median water level and patterns of water level seasonality (summer vs. winter levels) remain unchanged from the natural state.

[38] Beca. 2008. Draft guidelines for the selection of methods to determine ecological flows and water levels. Report prepared by Beca Infrastructure Limited for Ministry for the Environment. Published by the Ministry for the Environment, Wellington. March 2008. 120pp. + appendices.

2. Medium - > 0.2 m and < 0.3 m change to median water level and patterns of water level seasonality show a reverse from the natural state (summer relative to winter).

3. High - >0.3 m change to median water level; and, patterns of water level seasonality show a reverse from the natural state (summer relative to winter).

The proposal to maintain pre-mining median water levels is intended to achieve no change in the median water level and patterns of water level seasonality.

g. Item 11(a) asks whether the restoration measures to be captured in an evaluation under RMA, s 104(1(ab)? If so, are these benefits adequately identified, characterised, and quantified in the ECIA? These benefits are not proffered for the purpose of offsetting or compensating as I don't consider offsets are required. However, if they were to be considered I have discussed this matter in Paragraph 101 above in relation to the principles of offsetting set out in the NPS-IB and NPS-FM. In my view the benefits have been adequately characterised and consist of an increase in wetland extent of 1.9ha, which includes an increase in the amount of open water, providing a range of water depths, including a small island, which is important for nesting wildlife and better connecting the existing wetland habitats whilst providing additional buffering to the SNA. All of these are positive ecological outcomes in my view.

h. Item 12 relates to taiko and seeks a clear picture of the spatial extent of the tāiko breeding colony and it's relationship to the Application Site. This is provided as Figure 1 of **Attachment B** to this evidence. Item 12 also asks for the evidence establishing causation or correlation between lighting and disorientation of birds (generally or for a specific age cohort) and its incidence. This matter was explored specifically for tāiko, but further evidence has not been included due to the proffered condition to avoid mining and trucking outside daylight hours. Any tāiko can be susceptible to grounding, but young birds leaving the nest for the first time are thought to be particularly vulnerable. Young birds leave the nest between November and January.

i. Item 13 relates to the provisions in the Avian Management Plan for management of tāiko. In my view, given that the applicant has offered to mine and truck from the site only during daylight hours the potential risk to tāiko is avoided. As I have stated in Paragraph 185, monitoring of tāiko has been retained in the Avian Management Plan as a precaution to ensure that

the Lighting Management at the site is working as intended and effects have been avoided.

j. Item 16 asks two questions:

   i. What conditions implement (the relevant experts) requirements or support their conclusions?

   ii. How does the expert understand the conditions will work to meet those requirements.

I have dealt with this matter in Paragraphs 162 and 216 above. In general terms Ms McKenzie and I have revisited the conditions given the concerns raised, with a view to improving their certainty of outcome. I consider the conditions will provide certainty as to outcome by including clear objectives/goals, setting realistic management triggers requiring achievable and effective actions, providing conservative 'bottom lines' and ensuring that sufficient monitoring is required to demonstrate compliance.

Conclusion

168 The ecological values of the Application Site are very low to negligible, which can be thought of as ranging from predominantly exotic species through to providing habitat for tolerant (usually common) native species, although few native species are present within the site itself. Ecologically high value sites are present outside the area to be mined. These habitats are regionally significant, or in the case of the tāiko colony, nationally significant. The level of adverse effects on ecological values due to noise, disturbance, lighting and changes to hydrology beyond the Application Site boundary once the necessary mitigation and management actions have been deployed effectively is minor or less than minor. In my view the proposal is consistent with the national policy direction provided in the New Zealand Coastal Policy Statement and the National Policy Statements for Freshwater Management and Indigenous Biodiversity.

Dr Gary Neil Bramley

Dated this 15 day of January 2024

Significant Natural Areas Programme

Punakaiki Ecological District **PUN - W034**

Grey District Council

Boffa Miskell

Grey District
Significant Natural Area assessment

Punakaiki Ecological District

PUN-W034

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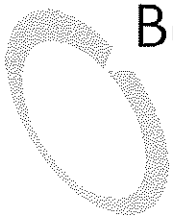
Report prepared for the **Grey District Council** by



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1. Introduction

This report presents the findings of a visit to a site that was identified as a possibly Significant Natural Area (PUN-W034) on the Barrytown Flats.

As part of their Resource Management Act 1991 (RMA) obligations, the Grey District Council must provide for the protection of Significant Natural Areas (SNAs). The Council has already undertaken an initial study (stage one) to determine which sites are most likely to be considered as significant. This report constitutes part of the follow up study (stage two) that seeks to determine the actual ecological values present at specific sites. In order to do this, several criteria are applied to each site in order to make the assessment of ecological significance as objective as possible.

The full process and the criteria used to determine significance are explained in detail in the following section.

1.1. The process

The Significant Natural Areas (SNA) process was initiated by the Grey District Council to fulfil their obligations outlined in Part II Section 6(c) of the Resource Management Act (RMA) 1991. This section provides that:

"In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna."

In the first instance, this Grey District Council has recognised that their obligation requires that areas of significant indigenous vegetation and significant habitats of indigenous fauna within the District be identified. This requires the classification of native vegetation or habitats of native fauna into either significant or not significant categories and is achieved by applying significance criteria. Land administered by the Department of Conservation is typically exempt from this classification because such areas are already formally protected. For the Grey District SNA process, the significance criteria used are as follows:

- Representativeness – a measure of how modified an ecosystem (sometimes described as forest types) is when compared to its pre-human extent. This is assessed at different nested spatial scales including local (ecological districts), regional (ecological regions) and national. Ecosystems are considered under-represented if they have been reduced to less than 20 % of their former cover. The use of multiple spatial scales means that an ecosystem could be under-represented at a local scale and adequately-represented at a national scale, or vice versa. In any event, ecosystems are termed as under-represented overall if they are under-represented at any scale. This criterion is used to ensure that the full range of ecosystem types is protected within a geographic area. Clearly, the ecosystems most impacted by humans (i.e. cleared, disturbed, fragmented etc) are the most in need for protection as they are often threatened with local elimination. An

important feature if this criterion is that representativeness values are not static and will change over time. As such, currently adequately-represented ecosystems may in time become under-represented or, alternatively, under-represented ecosystem types may become adequately-represented following restoration or natural regeneration. This means that representativeness analysis must be undertaken at regular intervals to allow the protection of ecosystem types that have fallen below the 20% threshold.

- Rarity and distinctiveness – an assessment of whether threatened species or distinct species and distinct species assemblages occur at a site. Distinct species can be those at their known geographical limit or an assemblage of species that are common nationally but rare locally. This criterion is used to ensure that locally occurring threatened species or distinct species and assemblages are not adversely affected by habitat destruction or direct removal.

- Ecological context – a measure of how important an area is to the wider landscape in terms of providing connectivity between otherwise unconnected large areas of native vegetation, buffering of important native vegetation or aquatic habitats and providing critical habitat for native species that use the wider landscape. These features are often most important for species with low dispersal ability or an aversion to crossing large open areas, but also relate to sites that have seasonally important food sources for species with high dispersal ability. This criterion is used to ensure that areas of habitat or food sources for native species that are critical to the maintenance of native species in the wider landscape are retained. It also ensures the protection of areas of native vegetation that buffer more important areas from disturbance.

The process undertaken to identify SNAs consists of two stages. The first stage involved the analysis of ecological patterns of the wider area (using Geographic Information Systems and spatial databases[1]) to identify the most highly modified ecosystem types and the areas most likely to provide important ecological service to the wider area. In addition, ecologists with extensive field knowledge of the West Coast were consulted to identify sites containing threatened species or distinct species assemblages. Investigation of the location, size and shape of forest areas using the land cover database version two (LCDB2) and aerial photographs assisted the identification of the most important sites with respect to ecological context.

Once these analyses had been performed, site inspections carried out from public roads (at no time was private land crossed) and from the air (fixed wing aircraft) were undertaken to help verify the values of sites identified from the remotely performed analysis and also to identify sites that the analyses had missed. Sites were excluded and different sites were included as a result of these observations.

Following the analyses and the quick site inspections, a list of 'possibly' Significant Natural Areas was constructed and was submitted to the Grey District Council in the form of a report with simple descriptions and location maps for each listed site.

This report is a component of the second stage of the SNA process and involves the on-site assessment of ecological values (i.e. a site visit) and a more critical application of the significance criteria to the listed 'possible' SNAs. The site assessments seek to characterise the ecological patterns of the site, while considering the effects of past land uses. Due to the limited time available, the

[1] See Appendix two for a more detailed account of the analysis approach.

assessments are focused on vegetation and do not involve concerted searches or surveys for native fauna. However, the role of sites in providing habitat for native fauna is considered in terms of connectivity issues and the presence of major food species and nesting trees. Searches for threatened species are made for species known to exist in the Grey District, but searches are generally restricted to the habitats that these species are known to occur in.

This stage provides landowners with an opportunity to raise concerns and to help establish an adequate balance between farm operation and biodiversity management. Landowner's knowledge of their land and the wider landscape is an invaluable resource and they are encouraged to give their perspective on the major patterns and importance of biodiversity in the region. Ultimately, the classification of the significance of the site is made on pure ecological grounds and is necessarily rigid in this respect. However, boundary locations are often, but not always, more flexible and the delineation of these boundaries will be achieved with input from landowners. For example, this provides an opportunity for farmers to retain key stock movement routes and to make fencing more efficient and robust (fencing is strongly encouraged to protect or enhance ecological values, but is not a requirement).

This report deals specifically with the 'possibly' significant site listed as PUN-W034. This site will be described in context with the local setting and in finer detail and will have the significance criteria re-applied in a more rigorous fashion than was done in stage one.

2. The site and its setting

The site is located on the Barrytown Flats within the Punakaiki Ecological District. Within this general area the places that have experienced the greatest degree of forest clearance are the fertile low surfaces of the river terraces, the coastal plains and some of the post-glacial outwash terraces. This pattern of modification is consistent throughout the West Coast; most of this forest clearance was initially for the purposes of timber harvesting or mining, but clearing or draining for conversion to farmland often followed. The vegetation types that formerly occupied these surfaces were matai/totara-dominated associations on the most fertile, well drained surfaces, kahikatea and fertile wetland associations on the poorly drained surfaces and mixed forests of the coastal plains. In many places the remaining native vegetation on these surfaces is highly modified; often it has been logged, is fragmented and has experienced some stock damage due to its proximity to farmland. These fragmentation effects have caused disruptions in the ecological functioning of forest fragments, with increased weed abundance, more frequent disturbance[2] and some species loss.

2.2. Site description

This moderate sized (c. 40 ha) site occurs to the south of Burke Road and to the north of Canoe Creek (Figure 1). The site occurs within the Barrytown Flats, which are formed of a complex sequence of old dune ridges and outwash deposits from the surrounding streams. Consequently, the soils of the area tend to comprise relatively

[2] Disturbance includes, amongst other things, physical damage from climatic exposure and also damage from pests and diseases.

infertile sand derived soils of the old dune ridges, more fertile silt derived soils of the better-drained inter-dune depressions and moderately fertile mixed peat and silt derived soils of the most poorly drained inter-dune depressions. However, this sequence of soils has been altered by past activities such as mining, logging and drainage.

The site is comprised of an old lagoon of Canoe Creek that has been modified by 20th century gold sluicing operations. The two-part lagoon was probably smaller in extent prior to sluicing operations, with the sluicing cutting into the dune ridge that backed onto the lagoon in the east. This has created a series of bays and banks on the eastern shore of the southern of the two main lagoon areas. The northern lagoon area has generally gentle slopes leading into the water, but the vestiges of an old dune are present in the northernmost shore, which creates a steeper edge. In general the lagoons do not appear to be very deep, although some moderately deep areas occur in the southernmost lagoon area.

Another open area of water occurs to the immediate east of the northern lagoon area, but this appears to be completely man-made.

Deverys and Collins Creeks run into the lagoon from the north and south, respectively, and Canoe Creek occasionally flows through from behind the beach during flood events. The two creeks that permanently flow into the lagoon are deep and slow moving where they enter the lagoon (Photo 1). The banks of Deverys Creek are particularly unstable and are actively eroding through mass slumping. During high tides and stormy conditions the sea breaches the lagoon and leads to saltwater intrusions.

To the west the lagoon is impounded behind the beach. This shoreline tends to be relatively sparsely vegetated, but common species include oioi, giant umbrella sedge, shore bindweed and *Muehlenbeckia axillaris*. Areas with silt tend to support dense flax and raupo.

On other shores the vegetation cover varies considerably. In the areas least accessible to stock (either too wet and boggy or protected by banks or gorse shrubland) are tall and dense stands of raupo (Photo 2). Flax often forms the dominant cover to the landward side of these raupo stands. Swamp kiokio is sometimes present amongst the flax. This is the primary vegetation type fringing the man-made pond, with flax dominant and raupo occurring in patches.

Elsewhere the upper edges of the lagoon support often dense patches of oioi, *Carex sinclarii* and soft rush*, with *Juncus canadensis**, lotus*, *Carex virgata, Isolepis prolifer** and Yorkshire fog* spread throughout. The grazed areas behind the raupo stands tend to support rough exotic pasture species, such as creeping bent and Yorkshire fog, but also moderate abundant are swamp kiokio, *Carex gaudichaudiana,* giant umbrella sedge and oioi. Saltmarsh ribbonwood and cabbage tree are also scattered throughout these areas.

Mixed gorse* and native shrub occur to the north and east of the lagoon, but are less extensive in the south. This vegetation is usually associated with the raised dunes or the steep banks of the southern bays. The most common species present are gorse* (most abundant), mahoe, mikimiki, bracken, pohuehue, wheki and blackberry.

The water levels within the lagoon appear to vary considerably and consequently a broad band of turf vegetation occurs in the more gently sloping areas. This community is relatively diverse and is dominated by native species (Photo 3). These

include *Myriophyllum triphyllum, Galium palustre, Potamogeton suboblongus, Centella uniflora, Pratia perpusilla,* bachelors button, spiked sedge, *Crassula helmsii, Glossostigma elatinoides, Lilaeopsis novae-zeelandiae, Limosella lineata, Lobelia anceps,* silverweed and *Hydrocotyle novae-zeelandiae.*

Cattle have access to most of the site and have significantly altered most of the plant communities present through trampling, browsing and introduction of weed species. Grazing has been particularly heavy on the landward edge of the main raupo patches and has lead to a collapse of raupo stands in places.

A few small patches of crack willow* are present in the northeastern areas and these are likely to spread in the future. However, periodic saltwater incursions may slow its spread.

Birds

Native birds observed during the field visit include fantail, fernbird, pukeko, paradise shelduck, pied stilt, white-faced heron, kotuku, western weka, little shag and black shag. One of the landowners commented that Australasian bittern, royal spoonbill and Canada geese* have been sighted here. Other native birds likely to occur are shoveler, grey warbler, tui, bellbird, grey duck, and possibly marsh crake.

In general the site contains a wide diversity of bird habitat types, from shallow edges for wading birds, deeper vegetated edges for waterfowl, moderately deep open water for shags, dense reed beds for bittern and perhaps crake, and dense shrubland for fernbird and other passerines.

Fish

Although no fish surveys were conducted during the site visit, past surveys conducted within the site have indicated that brown trout*, long finned eel, short finned eel, giant kokopu and common bully are common (Bioresearches, 1986). Numerous brown trout* were caught in the open lagoon and the giant kokopu were restricted to the man-made pond to the east of the lagoon.

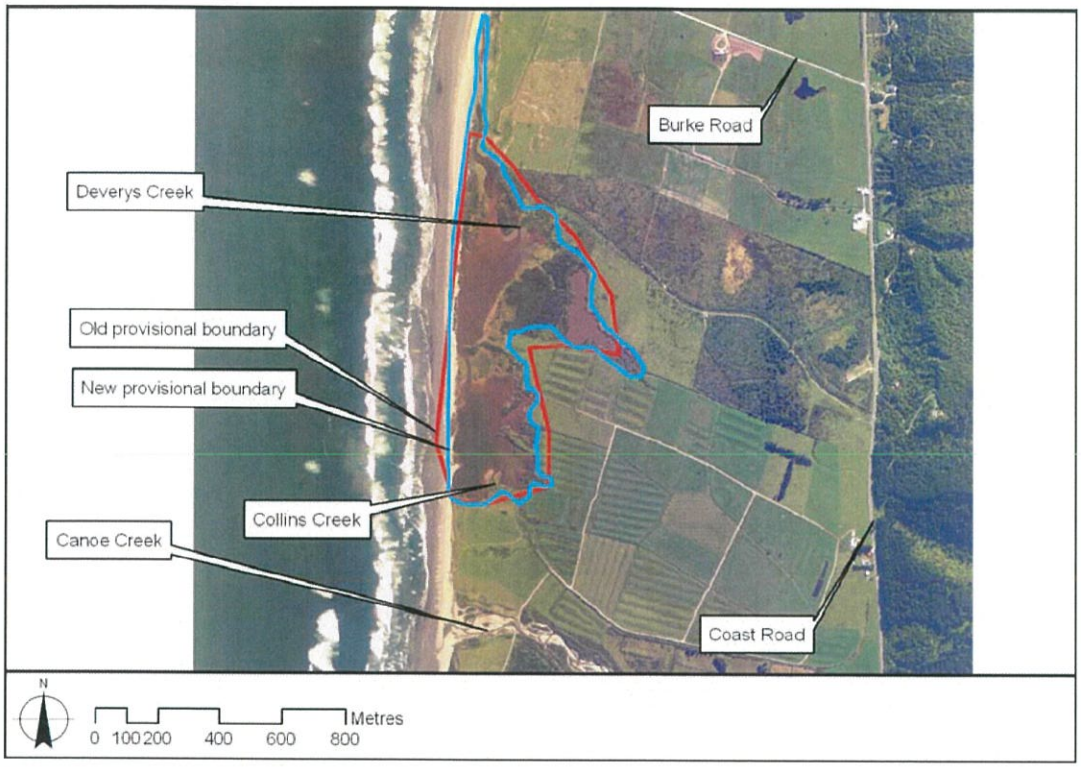

Figure 1. Site location

Photo 1. Deverys Creek is deep, slow moving and sinuous where it enters the lagoon. The riparian areas tend to be dominated by exotic species.

Photo 2. Dense stands of raupo are backed by flax and sedges, and then blackberry* and gorse*.

Photo 3. The fringes of the lagoon support a diverse turf community.

2.2.1. Summary of ecological patterns

In general the lagoon supports a relatively high diversity of vegetation types from submerged aquatic, marginal turfland, tall sedgeland, tall raupo and flax and dense shrubland. Although the site has experienced considerable modification in the past, it still retains a high abundance of well-developed native wetland vegetation and supports many native birds and fish.

2.3. Significance criteria application

2.3.1. Representativeness

The majority of the Barrytown Flats have been cleared for agriculture or mining and very little remains of the coastal forests and wetlands that were previously abundant. The Barrytown Flats are unique within the Punakaiki Ecological District in that they are the only major area of flat coastal land that would have formerly supported a mosaic of forest and wetlands. Although fertile wetlands of the Punakaiki Ecological District and the wider area have been largely cleared and should be considered as under-represented, the brackish coastal wetlands have been less affected by land clearance and drainage because they do not usually yield productive farmland. There is little to suggest that coastal lagoons have been highly modified or cleared within the Punankaiki Ecological District or wider area and, consequently, they should not be considered as under-represented.

2.3.2. Rarity and distinctiveness

Several bird species present within the site are included with the New Zealand threatened species lists (Hitchmough 2002). These include western weka and Australasian bittern. Western weka is listed as serious decline and bittern are listed as nationally endangered.

Generally weka are widespread and abundant in the Grey District and are probably more influenced by predation (and perhaps disease) than they are by habitat loss. There is nothing to suggest that the site is important for the ongoing persistence of this species within the local or wider area and, as such, the presence of this species will not be used to determine significance.

Australasian bittern is much less abundant and widespread, but this species occurs throughout the country in a variety of generally fertile wetlands, often in association with open water. These species will forage in a variety of habitats, but will tend to breed only in areas with dense reeds. Given the abundance of raupo and suitable foraging habitat on the edges of the lagoon the site provides very good bittern habitat for both feeding and breeding. This appears to be the best habitat for this species in the Punakaiki Ecological District and appears to be the most suitable bittern habitat for at least a 70 km stretch of the coastline.

No threatened species of plant were observed during the site visit, but it is possible that *Amphibromus fluitans* (a small wetland grass) may occur, as it has been recorded from the nearby Maher Swamp and is known to occur in the shallow

margins of wetlands and other water bodies. This species is listed as nationally threatened and the Maher Swamp record is apparently the only one for the West Coast. A more thorough search for this species may be warranted on the site, but for the purposes of this assessment it will be assumed that this species does not occur on the site.

Giant kokopu and long finned eel are the only threatened species of fish that occur within the site. These species are listed as gradual decline, but are abundant in some areas of the West Coast. Long finned eel are typically widespread and occupy a range of habitats from lowland coastal streams and wetlands to upland rivers and lakes and the site is unlikely to provide important habitat for them. In contrast, giant kokopu are typically restricted to lowland streams and wetlands not far from the coast, although they are known to occur in the Lake Brunner area. Given the restricted nature of giant kokopu populations and their presence in modified lowland landscapes, the man-made pond within site is likely to provide important habitat for this species as it is moderately large, is fringed by dense over-hanging vegetation and is protected from brown trout* by a densely vegetated outlet stream.

No species or communities that occur within the site can be considered as distinctive within the Punakaiki Ecological District or the wider area.

Given that the site may to provide important habitat for bittern feeding and breeding and also provides good habitat for giant kokopu, it should be considered as significant in terms of the rarity and distinctiveness criterion.

2.3.3. Ecological context

Moderately large lagoons with dense native riparian vegetation are very uncommon within the Punakaiki Ecological District, largely for natural landform reasons, and the site comprises one of the few examples of such lagoons for a long stretch of coastline (at least 70 km). As such, the site is likely to form an important breeding and feeding area for many species of wetland birds that travel along the West Coast. As such, the site should be considered as significant in this respect.

2.3.4. Summary of significance

Given the assessment of the above criteria, the site should be regarded as significant in terms of Section 6(c) of the Resource Management Act 1991; the site supports threatened species and provides significant ecological service to the wider area.

2.4. Boundary issues

The boundary should encapsulate all areas within the site that form a relatively contiguous area of wetland and shrubland. However, it is acknowledged that large areas of gorse are included and this may not be deemed appropriate given that it is not a native species dominated cover in all areas. Final boundary designations will need to be determined in consultation with the landowner and other stakeholders.

2.5. *Management*

Given that the site is classified as significant, it should be managed to maintain its ecological values. Particular focus should be placed on the values that determine the site's significance. As such, vegetation clearance should be seen as contrary to protection of the site.

2.5.1. Stock

Stock have had full access to the site in the past and have had considerable impact on the lagoon margins. The site would benefit from stock exclusion, which could be achieved by fencing.

2.5.2. Pest control

Pest control would be of great benefit to the site, with focus placed on the control of possums*, stoats* and ferrets*. Currently these species preferentially browse palatable native species, altering species composition, and also prey on native birds and their eggs and chicks.

2.5.3. Weeds

Although numerous weeds occur on site, most of them are not considered as problematic. However, crack willow* is a known problem weed in wetland environments and has the potential to dominate the site if not controlled. This species does not spread by seed so a combination of manual and herbicide control of the small population will be very effective at removing it from the site. Some surveillance and control may be beneficial to prevent new weeds becoming established on site and may be especially useful if stock are removed from the area, as they may have been suppressing potentially problematic weeds.

2.5.4. Vegetation modification

In general, vegetation clearance should be seen as inconsistent with the purpose of the site. However, the Council may deem it appropriate to grant consent for activities that may involve some vegetation clearance. Any such activity should involve mitigation that is sufficient to compensate for the loss of specific values relating to the site's significance.

2.5.5. Restoration

The site is somewhat fragmented by areas of rough grassland and weedy wet areas, largely created by stock browsing and trampling. Targeted restoration activities aimed at reducing this fragmentation and improving the continuity of the native vegetation around the entire periphery of the lagoon would be very beneficial.

2.5.6. Drainage

Given the low relative level of the lagoon (when compared to sea level) it is likely to be resilient to drainage activities. However, activities such as artificial opening to the sea or diversion of feeder streams could be detrimental to the long-term ecological functioning of the lagoon and should be avoided.

3. Conclusions

The lagoon area, while heavily influenced by past mining activities retains a diverse array of native vegetation types that are uncommon elsewhere in the Punakaiki Ecological District, such as dense patches of raupo and marginal turf vegetation. This in turn supports a diverse array of bird species, including the threatened Australasian bittern, which typically depends on dense raupo for breeding. Also

present are several species of fish including the threatened giant kokopu. The man-made pond within the site provides good habitat for this species, while the densely vegetated outlet prevents predatory brown trout* from reaching the pond.

The lagoon should be regarded as significant in terms of providing important habitat for threatened species and an important coastal feeding and breeding area for wetland birds on a stretch of coastline that has few examples of similar habitats.

Ecological values could be improved with targeted restoration of the lagoon margins, especially in the south, predator control and exclusion of stock from the area.

4. References

Bioresearches. 1986. Barrytown Flat – baseline biological survey 1985-86. Unpublished report prepared for Grampian Mining Company.

Hitchmough, R. 2002. New Zealand Threat Classification System lists 2002. Threatened Species Occasional Publication 23. Department of Conservation, Wellington.

Appendix one

Scientific and common names of species mentioned in text.

Woody species	
Aristotelia serrata	wineberry
Coprosma propinqua	mikimiki
Cordyline australis	Cabbage tree
Dacrycarpus dacrydioides	Kahikatea
Melicytus ramiflorus	Mahoe
Muehlenbeckia australis	pohuehue
Muehlenbeckia axillaris	
*Rubus fruticosus**	Blackberry*
Plagianthus divaricatus	Saltmarsh ribbonwood
Podocarpus totara	totara
Prumnopitys taxifolia	Matai
*Salix fragilis**	Crack willow*
*Ulex europaeus**	Gorse*
Ferns	
Blechnum minus	Swamp kiokio
Pteridium esculentum	bracken fern
Herbaceous species	
Apodasmia similis	Oioi
Calystegia soldanella	Shore bindweed
Carex gaudichaudiana	
Carex sinclairii	
Carex virgata	
Centella uniflora	
Cotula coronopifolia	bachelors button
Crassula helmsii	
Cyperus ustulatus	Giant umbrella sedge
Eleocharis acuta	Spiked sedge
Galium palustre	
Glossostigma elatinoides	
Hydrocotyle novae-zelandiae	
*Isolepis prolifer**	
*Juncus canadensis**	Canadian rush*
*Juncus effusus**	soft rush*
Lilaeopsis novae-zeelandiae	
Limosella lineata	
Lobelia anceps	
*Lotus pedunculatus**	lotus*
Myriophyllum triphyllum	
Phormium tenax	flax
Potamogeton suboblongus	
Potentilla anserinoides	silverweed
Pratia perpusilla	
Typha orientalis	raupo
Uncinia ferruginea	

Birds

Anas rhynchotis	Shoveler
Anas superciliosa superciliosa	Grey duck
Anthornis melanura melanura	bellbird
Ardea novaehollandiae	White faced heron
Botaurus poiciloptilus	Australasian bittern
Bowdleria punctata punctata	fernbird
Chrysococcyx lucidus lucidus	Shining cuckoo
Egretta alba modesta	Kotuku
Gallirallus australis australis	weka
Gerygone igata	Grey warbler
Hemiphaga novaeseelandiae	kereru
Himantopus himantopus leucocephalus	Pied stilt
Petroica macrocephala macrocephala	South Island tomtit
Phalacrocorax carbo novaehollandiae	Black shag
Phalacrocorax melanoleucos brevirostris	Little shag
Porphyrio melanotus	Pukeko
Porzana pusilla affinis	Marsh crake
Prosthemadera novaeseelandiae novaeseelandiae	tui
Rhipidura fuliginosa fuliginosa	fantail
Tadorna variegata	Paradise shelduck

Fish

Anguilla dieffenbachii	Long finned eel
Galaxias argenteus	Giant kokopu
Galaxias fasciatus	Banded kokopu
Galaxias maculatus	Inanga
Gobiomorphus cotidianus	Common bully
*Salmo trutta**	Brown trout*

Mammals

*Mustela erminea**	Stoat*
*Mustela furo**	Ferret*
Rattus spp.*	Rat*
*Trichosurus vulpecula**	Possum*

Appendix two

As a basis for assessing the natural values of the Grey District, and hence to determine the location of possible SNAs in terms of RMA Section 6(c), an analysis of the past and present distribution of native ecosystems within the area was undertaken to:

(1) Identify how much of the district still retains a predominantly native cover, and where this is located;
(2) Compare the current extent of native cover to past extent in order to evaluate the level of representation of ecosystem types.
(3) Identify areas of native cover on private land that represent under-represented ecosystems.

For the study area the following spatial information was obtained:
1. LENZ classification of ecosystem types (level 4 classification).
2. LCDB classification of current vegetation cover (version 2).
3. Extent of public conservation lands (land tenure).
4. Ecological District boundaries.

Traditional approaches to assessing representativeness (and hence identifying under-represented ecosystem types) have involved detailed field surveys and subsequent analyses of ecological patterns on and off public conservation land. However, use of LENZ and LCDB2 provides a much quicker method to obtain similar information. LENZ provides a classification of areas of New Zealand with similar ecosystem character. Land environments are modelled from information on climate (e.g. radiation, temperature and rainfall deficit) landform (slope) and soil (e.g. drainage, fertility and parent material). The LENZ classification is given at four different levels that correspond to different spatial scales of its intended use. The range is from level I with 20 different land environments (best used at the 1:2-5,000,000 map scale) to level IV with 500 land environments (best used at the 1:50,000 map scale). The 15 environmental variables used to define the land environments were chosen because of their known correlations with distributions of the most common native tree species. Because of this the LENZ provides a map of potential ecosystem types for an area irrespective of current land use. The code used to name land environments (LE) is hierarchical so that each land environment can be related to the group to which it belongs. For example, the O1.4a LE (level IV) belongs to the O1.4 LE group (level III), which belongs to the O1 LE group (level II), which in turn belongs to the O LE group. The differences between individual LEs within a group become subtler with increasing level. For example, the difference between the O1 and O2 LEs is much greater than the difference between the O1.4a and O1.4b LEs in terms of the 15 climate, landform and soil attributes that define them.

This significance assessment exercise used land environments to provide a map of potential ecosystem cover at level IV (it is assumed that all areas, except wetland and alpine, were forested in pre-human times) and then intersected this in a Geographic Information System (GIS) with the LCDB2. The LCDB2 two is based on high-resolution satellite images of New Zealand taken over the 2001-2002 summer. These images have been classified into 43 land cover types that depict the current land cover (eg, native forest, plantation forest, and pasture). By using the LCDB information, the land environments can be analysed to determine how much of each land environment (ie, potential ecosystem type) still retains native vegetation (eg, native forest as opposed to pasture or plantation forest) and from this to identify

which land environments have been most impacted by human activities. Information on land tenure can then be used to determine how much of the remaining area of each land environment that carries native vegetation occurs on different land tenures (eg, public conservation land versus private land) to show what is already protected through conservation legislation.

The spatial relationships between land LENZ, LCDB2 and tenure data were analysed in ArcGIS 8 using the Spatial Analyst extension to determine the following:

1. The extent of each ecosystem type (from LENZ) within the study area by ecological district (ED) and overall.
2. The proportion of each ecosystem type that still supports native vegetation by ecological district and overall.
3. The proportion of each ecosystem type with native vegetation that is within public conservation lands by ecological district and overall.

The LCDB2 classes of 'alpine grass/herbfield' (15), 'herbaceous freshwater vegetation' (45), 'herbaceous saline vegetation' (46), 'flaxland' (47), 'fernland' (50), 'manuka and or kanuka' (52), 'broadleaved indigenous hardwoods' (54), 'sub alpine shrubland' (55), 'grey scrub' (57) and 'indigenous forest' (69) were used to define the area of predominantly native vegetation cover. All other classes were taken to represent modified areas (e.g., pasture and plantation forest). Some of these classes, such as coastal sand and gravel, could be taken as native cover, but LENZ represents these areas as 'null' because they do not contain soil and inclusion of such areas would create a discrepancy in the analysis. LCDB2, land tenure and ecological districts were all converted to raster format to simplify calculations and to avoid errors associated with analysis of very large vector data sets.

Limitations associated with using LENZ

LENZ provides a useful tool for describing the past or potential ecosystem types present within a region at four scales. It does this by combining ecosystem drivers (climate, landform and soil) in a spatially explicit manner. However, it must be recognised that LENZ is limited by the quality of its inputs, especially so at its finest scale (level IV).

At LENZ level IV the boundaries between land environments are largely driven by the underlying soil type distributions. In the case of the West Coast, these soil type distributions used in the LENZ classification were very coarse-scale, except for the soils of the Inangahua Valley. As such, there are errors in the actual allocation of sites to specific LENZ types. In some places, terraces of markedly different age and fertility are assigned to the same land environment, yet they supported markedly different vegetation types. Conversely, many examples were observed in the field of different land environments supporting the same vegetation type, especially in areas dominated by beech.

This highlights the importance of using LENZ as a *guide* not as a determinant. LENZ is best applied to categorise a large amount of information and to provide guidelines for those ecosystem types that are under-represented in the region. Once these types are identified, LENZ can indicate where they are likely to reside but its spatial and classification accuracy needs to be questioned at finer scales.

Assessment of wetlands

Wetlands can be viewed as separate subsystems within more generalised ecosystems and, as such, present a special case for representative analysis. Whereas a more general ecosystem can have its historical extent well approximated

by LENZ, wetlands suffer from a more simplified approximation; LENZ can indicate the land environments within which wetlands occur, but it cannot indicate their extent within said environments.

Soils provide a basis for the estimation of historical wetland extent, as their appearance and chemistry reflect hydrology (gleying and cemented pans), fertility (cation status) and past vegetative cover (organic material). All of these factors have implications for past and present wetland occurrence and character. For the purposes of this study, the historical extent of wetlands within ecological districts on the West Coast was estimated using soil data (NZLRI), wetland cover (LCDB2) and land tenure in an approach outlined as follows:

Historical wetland occupancy levels on different soil types were estimated by calculating the proportion of area covered by wetlands, as defined by LCDB2 (includes 'herbaceous freshwater vegetation' [45], 'herbaceous saline vegetation' [46], 'flaxland' [47] and cover classes with wetland character), on soil types within public conservation land (PCL)[3] of the entire West Coast Region. These occupancy levels were then extrapolated to the entire study area to obtain an estimate of historical wetland extent on all land described in the NZLRI. Presently occurring wetland area within different soil types were then compared to estimates of past extent in order to obtain an estimate of representativeness, given as a percentage.

The limitations of this analysis are largely attributable to the types of soils within PCL and the accuracy of the underlying soil data, yet other anomalies occurred that were independent of the soil data limitations.

The most common soils in PCL are infertile ones, as most of the recent soils have been cleared for farming purposes (Wardle, 1991). As such, it is likely that the modelling of the extent of wetlands on infertile soils is much more robust than the modelling of those on low alluvial surfaces and coastal plains, which are typically pastoral landscapes.

Furthermore, the soil information used for the wetlands representativeness analysis is very general; it does not account for fine-scale variation in parent material and slope, and does not always represent coastal areas accurately (DSIR, 1968). The accuracy of this information is likely to be poorest in forested and inaccessible areas. This limitation probably resulted in wetlands being ascribed to incorrect soil types in analysis in some cases. However, provided soil units are relatively consistent throughout the region, this error is unlikely to adversely affect estimates of wetland extent.

A special limitation concerns the soils on which saltmarsh wetlands occur. The NZLRI often excludes soils in estuarine areas, which weakens the implications of analysis for these wetland types. However, it is unlikely that such soils have been highly modified, as their high salinity makes them difficult to covert for farming purposes (DSIR, 1968).

Independent of the limitations of the soil data, these analyses presented one major anomaly for interpretation; many wetlands occurring on private land were more extensive than predicted by estimates of historical extent. This can be primarily explained by the creation or expansion of wetlands by logging on some types of soil.

---

[3] It is acknowledged that PCL includes areas that have been modified in the past, yet as a general rule PCL provides a good approximation of historical land cover.

In part, this relates to the fact that wetland edges are difficult to delineate, as hydrological properties may change gradually across wetland/forest boundaries. When forest is cleared near a wetland the boundaries (as identified by LCDB2[4]) of the wetland can expand outward, effectively increasing the wetland area. In other cases forest may exist on soils with high water tables and the removal of forest in these situations can lead to a raised water table and establishment of wetland vegetation. Essentially, these problems occur because LCDB2 cannot effectively differentiate between wet forest and dry forest. A better representation of the distribution of wet forest (effectively wetland) would improve the estimation of the extent of true wetland change by reduction the error component attributable to "induced" wetlands.

When all of these examples are considered together it is apparent that the most dominant effect is the "inducement" or expansion of wetlands following logging or clearing of forest or scrub. There is a general tendency for this analysis to underestimate the level of wetland removal because this 'inducement' of wetland often does not create wetland; it simply converts forested or woody wetland into wetland dominated by herbaceous species.

It is recognised that soil data used in this analysis is a source of weakness, yet more accurate soil information was not available in a spatially explicit format. Analysis using land environments (LENZ) would have suffered from the same problems as it uses the NZLRI soil data.

Given the limitations of this method for assessing wetland representativeness, a conservative threshold of 50% was set to define wetland representativeness for this study. This is supported by several arguments:

- There is uncertainty surrounding the estimation of past wetland extent, especially for wetlands that occur on recent soils.
- LCDB2 may misclassify wetlands and does not always accurately portray their true extent.
- The use of NZLRI soil data excludes many areas that contain saltmarsh wetland.
- Wetlands are one of the most nationally threatened ecosystem types, with an estimated 10% remaining.
- Threatened species information lacks detail and completeness, which may lead to the exclusion of important habitats of threatened species through the lack of information at a site.

This conservative approach led to a large number of possibly significant wetlands being identified, given the criteria specified. However, subsequent surveys and analysis will refine the list of wetlands as new information regarding threatened species, hydrology, and sustainability is obtained.

References

DSIR, 1968. Soil Bureau Bulletin 27. General survey of the soils of South Island, New Zealand. New Zealand Department of Scientific and Industrial Research, Wellington.

Wardle, P. 1991. Vegetation of New Zealand. Cambridge University Press, Cambridge.

[4] It should be noted that the minimum mapping unit for LCDB2 is one hectare.

Road Reserve

Legal Riverbed (LINZ)

Confirmed SNA Boundary

QEII Covenant

WCRC Wetlands

8/7/14

BRAMLEY – ATTACHMENT B (BACKGROUND FIGURES)

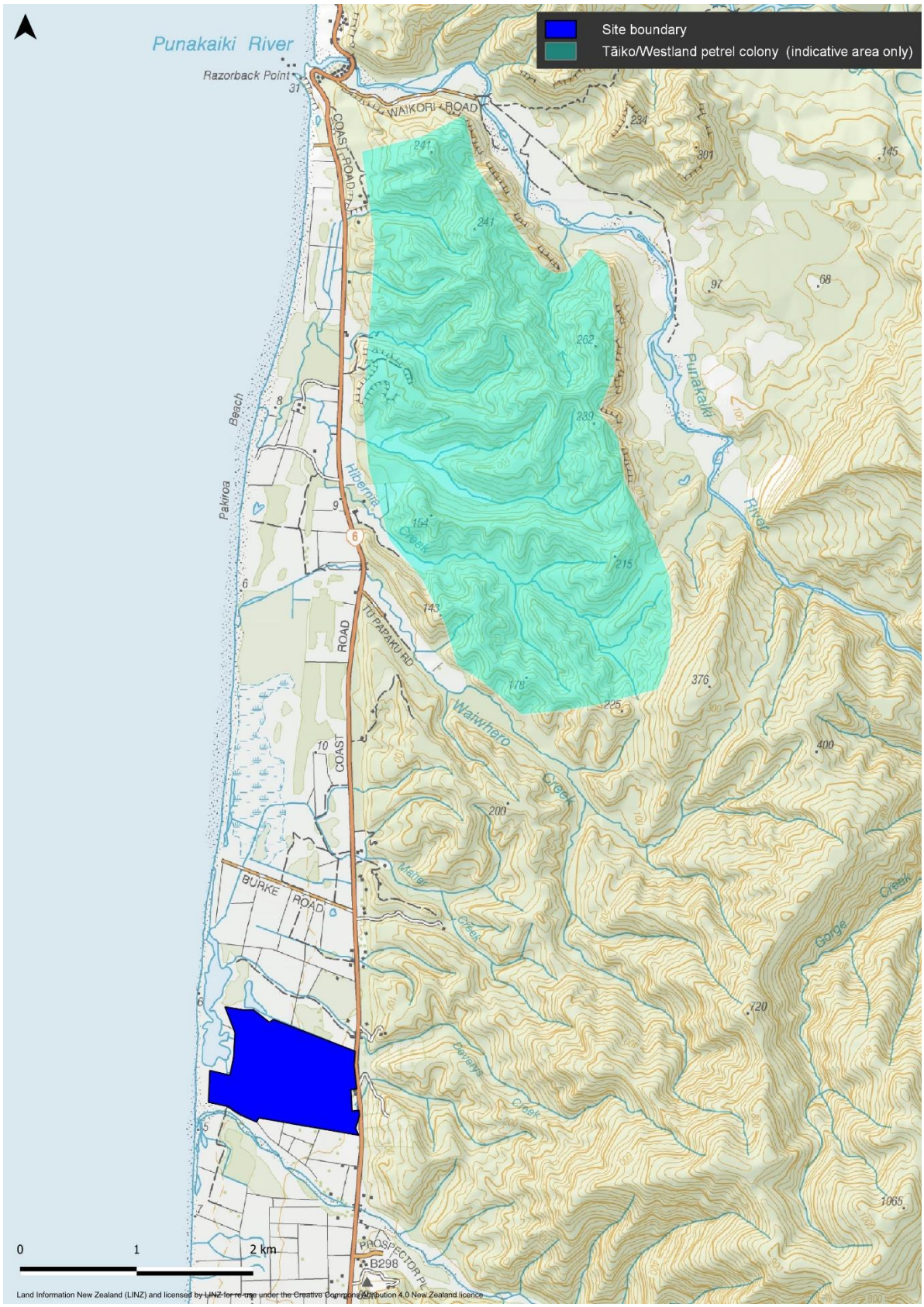

Figure 1: Approximate location of the tāiko/Westland petrel colony in relation to the Application Site.

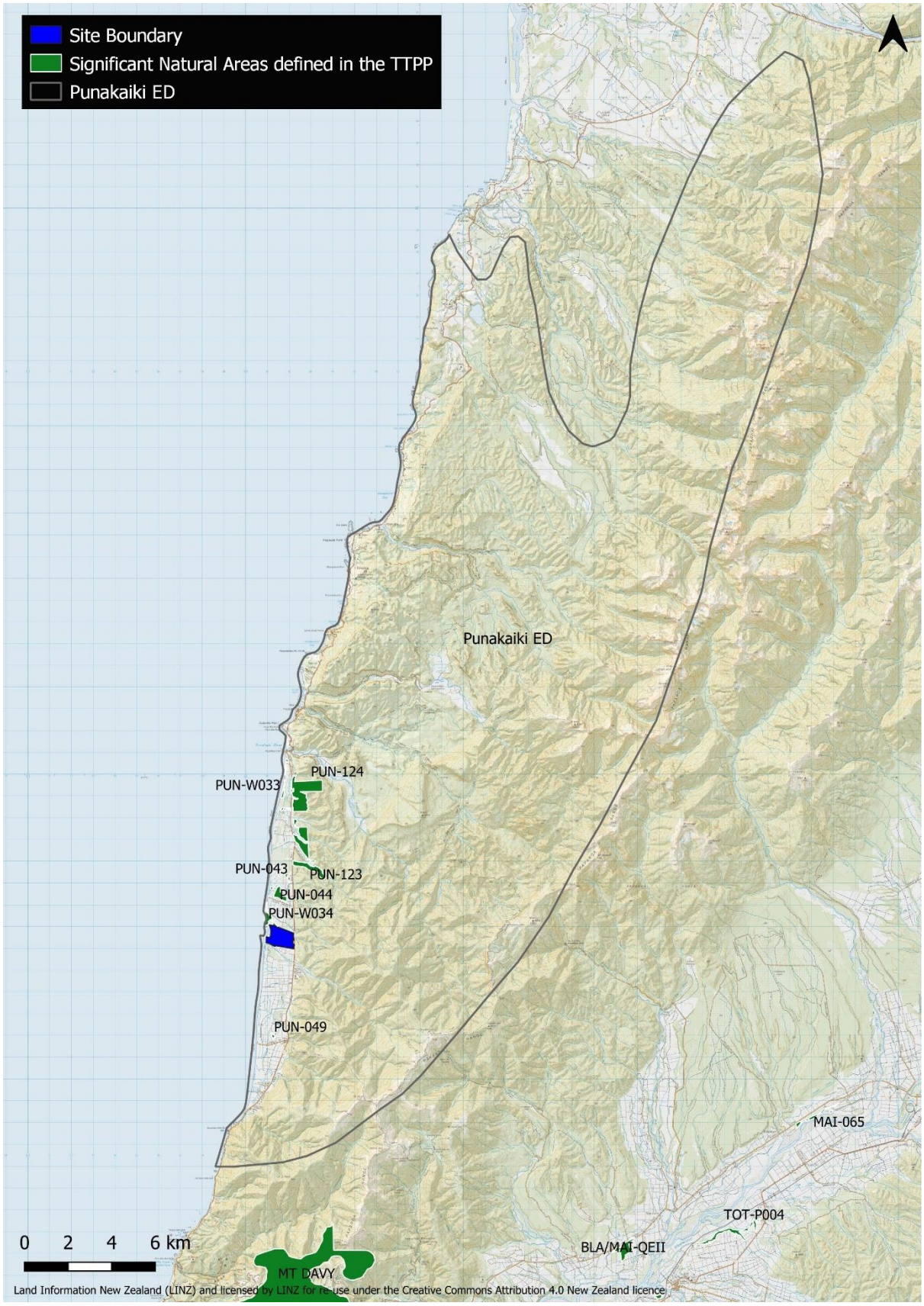

Figure 2: Location of the Punakaiki Ecological District and Significant Natural Areas mapped by the Grey District Council for the Te Tai O Poutini Proposed Plan (TTPP)

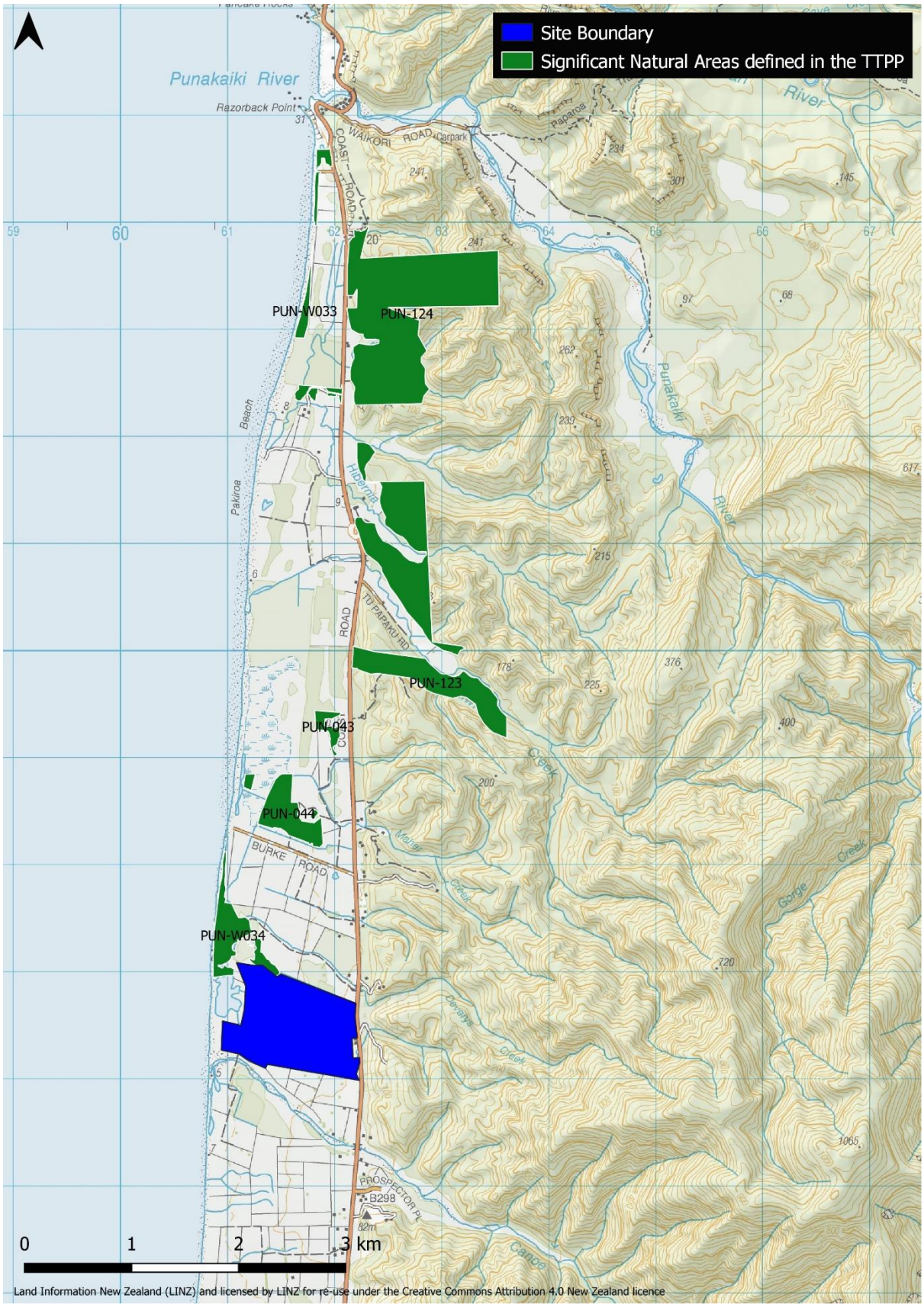

Figure 3: Location of the SNAs included in the Te Tai Poutini Proposed Plan in relation to the application site (shown in blue).

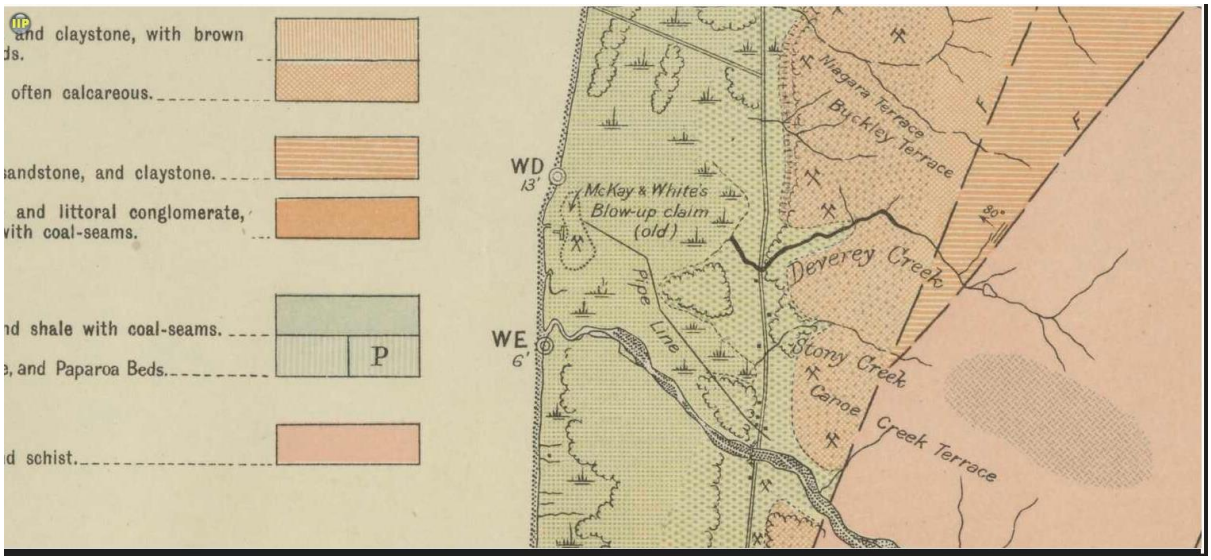

Figure 4: Geological map of the area north of Canoe Creek (from The History House, Greymouth).

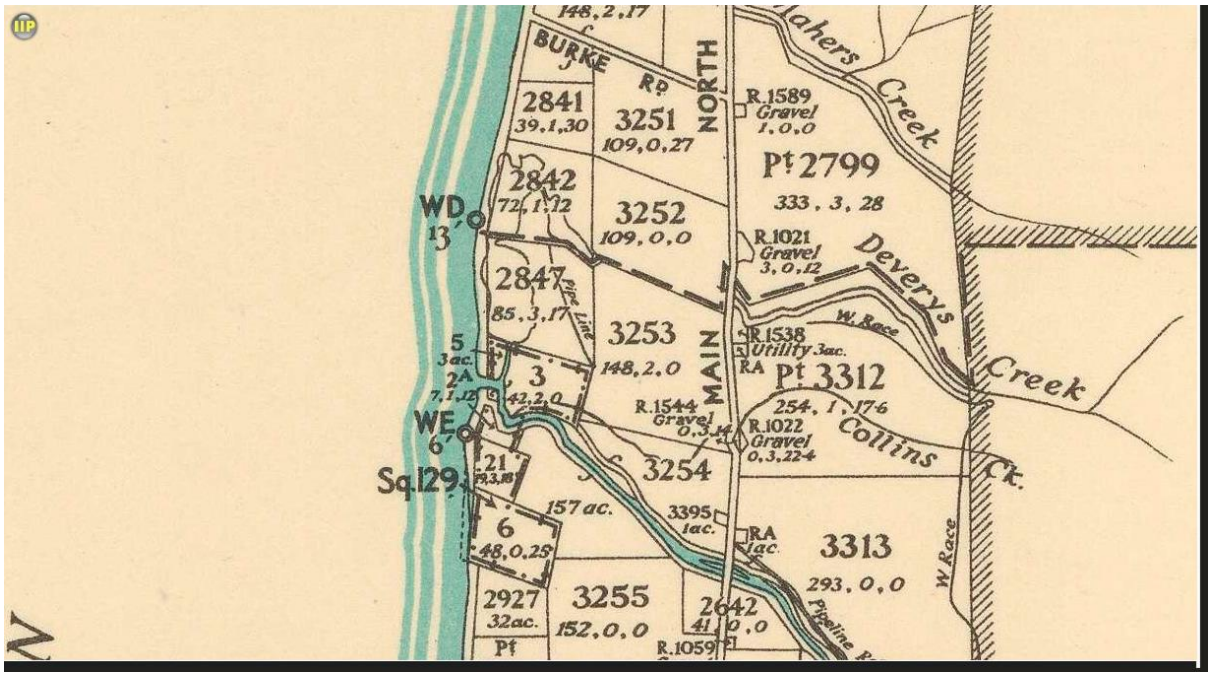

Figure 5: Survey map of the area north of Canoe Creek showing the historical pipeline location (From the History House, Greymouth).

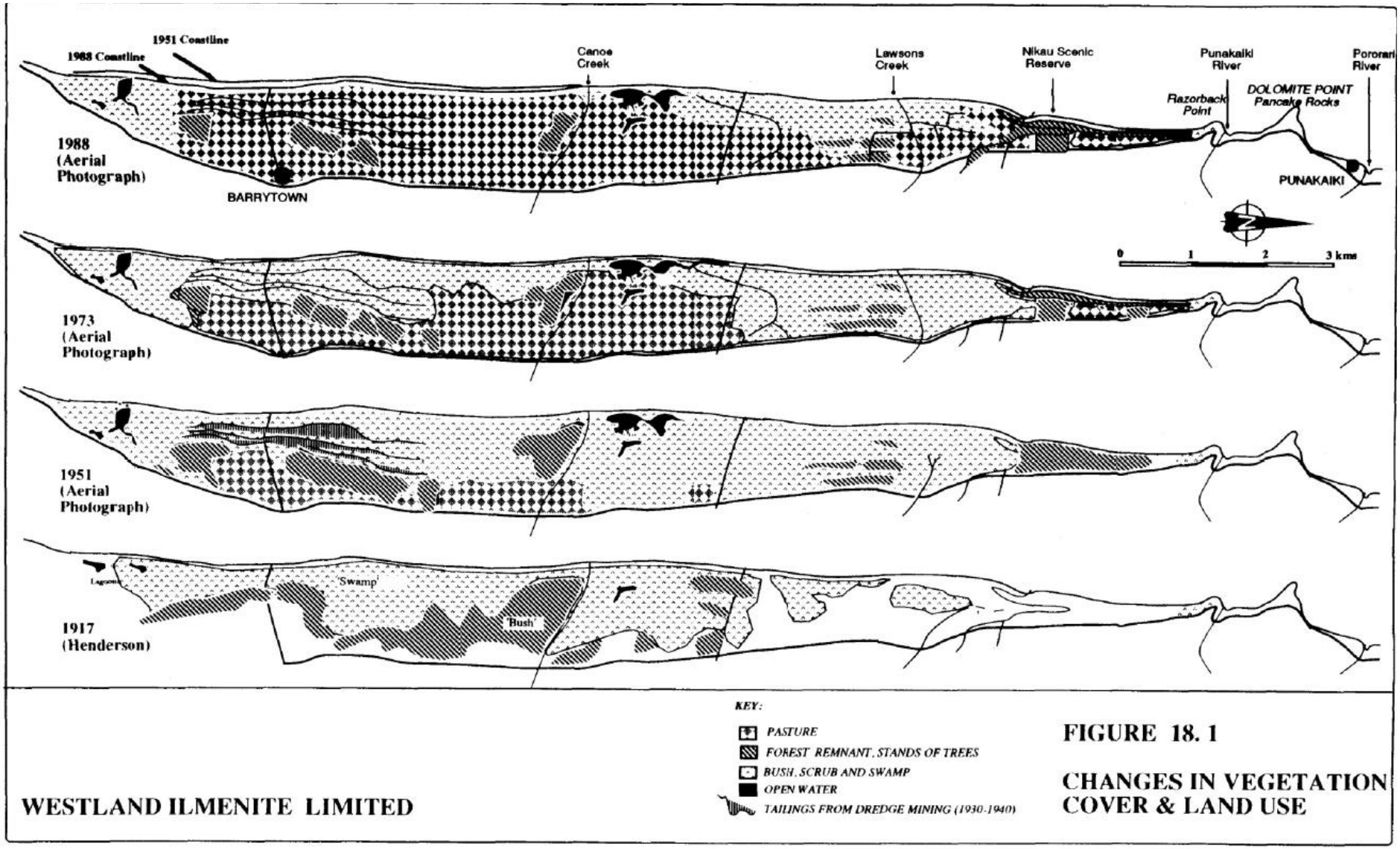

Figure 6: Vegetation changes at the Barrytown Flats 1917 – 1988 (from Murray-North 1991).

BRAMLEY - ATTACHMENT C - BIRDS

Table 1: Bird Species recorded within 10km of the Application Site in the eBird database.

Common Name[1]	**Latin Name**	**Conservation Status[2]**	**Detected during site visit**	**Main habitat**
Australasian gannet	*Morus serrator*	Not threatened		Ocean
Australasian pipit	*Anthus novaeseelandiae*	At Risk (declining)		Rough pasture
Australasian swamphen (pukeko)	*Porphyrio melanotus*	Not threatened	Yes	Wet areas
Australian magpie	*Gymnorhina tibicen**	Introduced and naturalised	Yes	Open country
Australian shoveler	*Anas rhynchotis*	Not threatened		Lakes and ponds
bar-tailed godwit (kuaka)	*Limosa lapponica*	At risk (declining)		Mudflats
black swan	*Cygnus attratus**	Introduced and naturalised	Yes	Lakes and ponds
black-billed gull (tarapuka)	*Larus bulleri*	Threatened (nationally critical)		Braided rivers, coastal
black fronted tern (tarapirohe)	*Chlidonias albostriatus*	Threatened (nationally endangered)		Coastal
Canada goose	*Branta canadensis**	Introduced and naturalised		Pasture and lakes and ponds
Caspian tern	*Hydroprogne caspia*	Threatened (nationally vulnerable)	Yes	Coastal

[1] As listed on the Ebird database. Names commonly used in New Zealand follow.
[2] According to Robertson et al. 2017.

common chaffinch	*Fringilla coelobs**	Introduced and naturalised		Widespread
common redpoll	*Carduelis flammea**	Introduced and naturalised	Yes	Open country
kakariki	*Cyanoramphus auriceps*	Not threatened		Forest
Double banded dotterel (Banded dotterel, tuturiwhatu)	*Charadrius bicinctus*	Threatened (nationally vulnerable)		Coastal
dunnock	*Prunella modularis**	Introduced and naturalised		Widespread
Eurasian blackbird	*Turdus merula**	Introduced and naturalised		Widespread
Eurasian coot	*Fulica atra*	At risk (naturally uncommon)		Lakes and ponds
Eurasian skylark	*Alauda arvensis**	Introduced and naturalised	Yes	Open country
European goldfinch	*Carduelis carduelis**	Introduced and naturalised		Widespread
European greenfinch	*Carduellis chloris**	Introduced and naturalised		Widespread
European starling	*Sturnus vulgaris**	Introduced and naturalised		Open country
fernbird (mātātā)	*Bowdleria punctata punctata*	At risk (declining)		Wetlands and saltmarsh
fluttering shearwater	*Puffinus gavia*	At risk (relict)		Ocean

grey gerygone (grey warbler, riroriro)	*Gerygone igata*	Not threatened		Widespread
grey teal	*Anas gracilis*	Not threatened		Lakes and ponds
great cormorant (black shag, kawau)	*Phalacrocorax carbo*	At risk (naturally uncommon)	Yes	Wetlands and streams
great egret (white heron, kōtuku)	*Ardea modesta*	Threatened (nationally critical)		Wetlands and harbours
great spotted kiwi (rōroa)	*Apteryx haastii*	Threatened (nationally vulnerable)		Forest
house sparrow	*Passer domesticus**	Introduced and naturalised		Associated with humans
kelp gull (Black backed gull)	*Larus dominicanus*	Not threatened	Yes	Widespread, often coastal
little penguin (kororā, blue penguin)	*Eudyptula minor*	At risk (declining)		Coastal
little pied cormorant (little shag)	*Phalacrocorax melanoleucos brevirostris*	Not threatened		Wetlands and coastal areas
mallard	*Anas platyrhynchos**	Introduced and naturalised	Yes	Lakes, ponds, wetlands and streams
mallard x Pacific black duck hybrid (mallard – grey duck hybrid)	*Anas platyrhynchos* x *A. superciliosa*	Not threatened		Lakes, ponds, wetlands and streams
masked lapwing (spur-	*Vanellus miles*	Not threatened	Yes	Open country

winged plover)				(farmed areas)
New Zealand bellbird (korimako)	*Anthornis melanura*	Not threatened		Forest
New Zealand falcon	*Falco novaeseelandiae*	At risk (recovering)		Widespread
New Zealand fantail	*Rhipidura fuliginosa*	Not threatened	Yes	Widespread
New Zealand kaka	*Nestor meridionalis meridionalis*	Threatened (nationally vulnerable)		Forest
New Zealand pigeon (kereru, kukupa)	*Hemiphaga novaeseelandiae*	Not threatened		Forest
New Zealand robin	*Petroica australis australis*	At risk (declining)		Forest
New Zealand scaup	*Aythya novaeseelandiae*	Not threatened		Lakes and ponds
Pacific black duck (grey duck)	*Anas superciliosa*	Threatened (nationally critical)		Lakes and ponds
Pacific reef heron	*Egretta sacra*	Threatened (nationally endangered)	Yes	Coastal
paradise shelduck	*Tadorna variegata*	Not threatened	Yes	Open country
parasitic jaeger (arctic skua)	*Stercorarius parasiticus*	Migrant		Ocean
pied cormorant (pied shag, karuhirui)	*Phalacrocorax varius*	At Risk (recovering)		Coastal
pied stilt	*Himantopus himantopus*	Not threatened	Yes	Coastal and paddocks
red-billed gull	*Larus novaehollandiae*	At risk (declining)	Yes	Coastal and paddocks

rifleman	*Acanthisitta chloris*	Not threatened		Forest
ruddy turnstone	*Arenaria interpres*	Migrant		Mudflats
sacred kingfisher (kotare)	*Todiramphus sanctus*	Not threatened		Widespread
shearwater spp.	*Procellaria* spp.			Ocean
shining bronze cuckoo	*Chrysococcyx lucidus*	Not threatened		Widespread
silvereye	*Zosterops lateralis*	Not threatened		Widespread
small albatross sp.	*Thalassarche s*p.			Ocean
song thrush	*Turdus philomelos**	Introduced and naturalised	Yes	Widespread
sooty shearwater	*Puffinus griseus*	At risk (declining)		Ocean
South Island oystercatcher	*Haematopus finschi*	At risk (declining)	Yes	Coastal and braided rivers
Southern boobook (ruru, morepork)	*Ninox novaeseelandiae*	Not threatened		Widespread
spotted shag	*Stictocarbo punctatus*	Not threatened		Coastal
swamp harrier (kahu)	*Circus approximans*	Not threatened	Yes	Widespread
tomtit	*Petroica macrocephala macrocephala*	Not threatened		Forest
Tui	*Prosthemadera novaeseelandiae*	Not threatened		Widespread
variable oystercatcher	*Haematopus unicolor*	At risk (recovering)	Yes	Coastal
weka	*Gallirallus australis australis*	Not threatened	Yes	Forest and dense cover

welcome swallow	*Hirundo neoxena*	Not threatened	Yes	Widespread
Westland petrel (tāiko)	*Procellaria westlandica*	At risk (naturally uncommon)		Ocean
white-capped albatross	*Thalassarche cauta*	Vagrant		Ocean
white-faced heron	*Egretta novaehollandiae*	Not threatened	Yes	Open country and wetlands
white-fronted tern	*Sterna striata*	At risk (declining)		Coastal
yellowhammer	*Emberiza citrinella**	Introduced and naturalised		Widespread

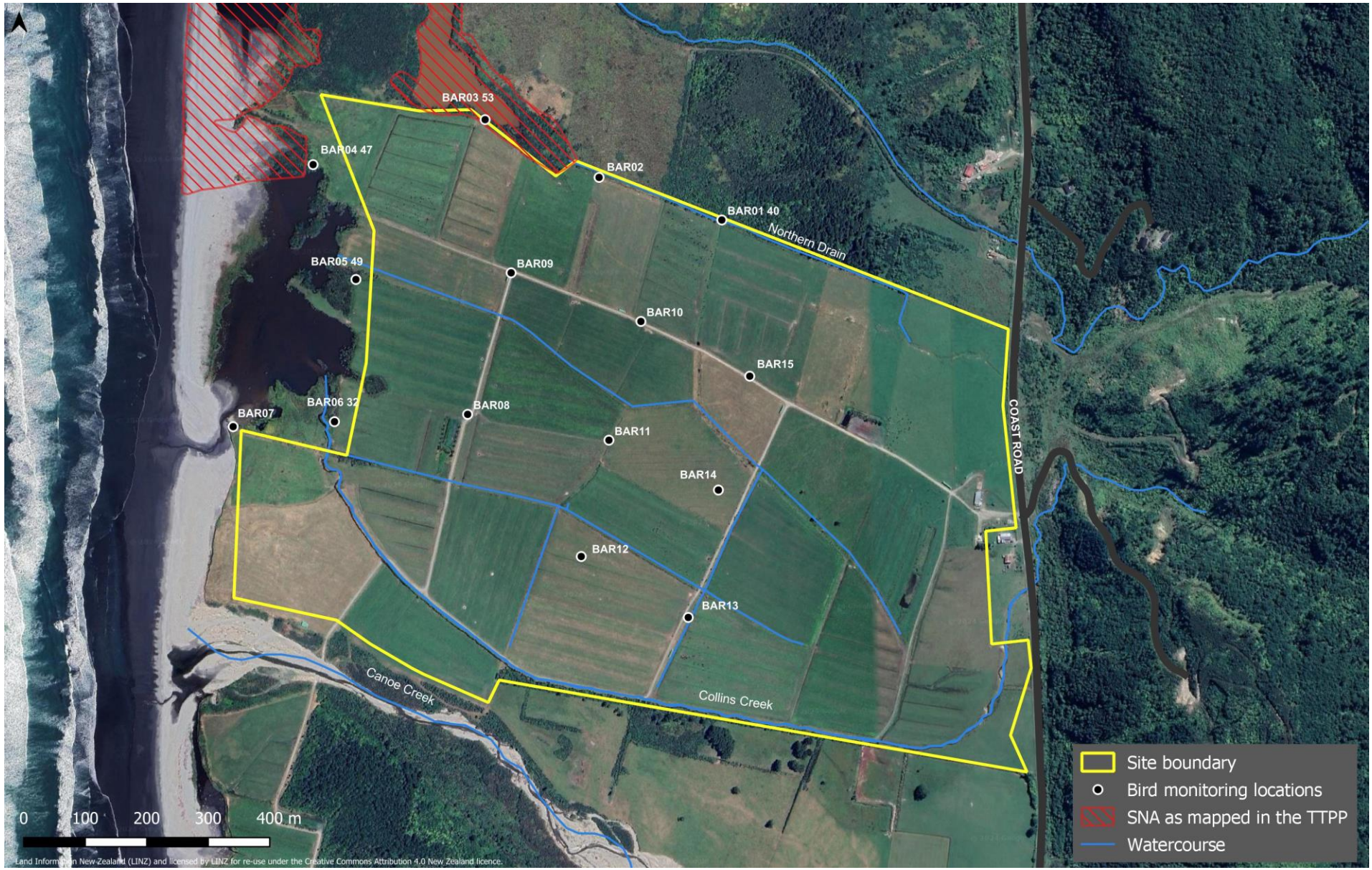

Figure 7: Location of acoustic recorders and 5-MBCs during seasonal surveys.

Table 2: Birds of Conservation Concern confirmed within or near the proposed mining area.

Common name	Scientific name	Conservation status	Highly Mobile*
Black Shag	*Phalacrocorax carbo*	At Risk (Relict)	No
Black-billed gull	*Chroicocephalus bulleri*	At Risk (Declining)	Yes
Caspian Tern	*Hydroprogne caspia*	Threatened (Nationally Vulnerable)	Yes
Grey duck	*Anas superciliosa*	Threatened (Nationally Vulnerable)	Yes
Kororā, little blue penguin	*Eudyptula minor*	At Risk (Declining)	No
Kotuku, white heron	*Ardea alba*	Threatened (Nationally critical)	Yes
Pacific Reef heron	*Egretta sancta*	Threatened (Nationally Endangered)	Yes
Red-billed Gull	*Chroicocephalus novaehollandiae*	At Risk (Declining)	Yes
Royal spoonbill	*Platalea regia*	At Risk (Naturally uncommon)	No
South Island fernbird	*Poodytes punctatus*	At Risk (Declining)	Yes
South Island Pied Oystercatcher	*Haematopus finschi*	At Risk (Declining)	Yes
Tāiko/Westland Petrel	Procellaria westlandica	At Risk (Naturally Uncommon)	No
Variable Oystercatcher	*Haematopus unicolor*	At Risk (Recovering)	Yes
White fronted tern	Sterna striata	At Risk (Declining)	Yes

*As defined in the NPS-IB Appendix 2.

Figure 8: Location of records of birds of conservation concern detected during seasonal surveys.

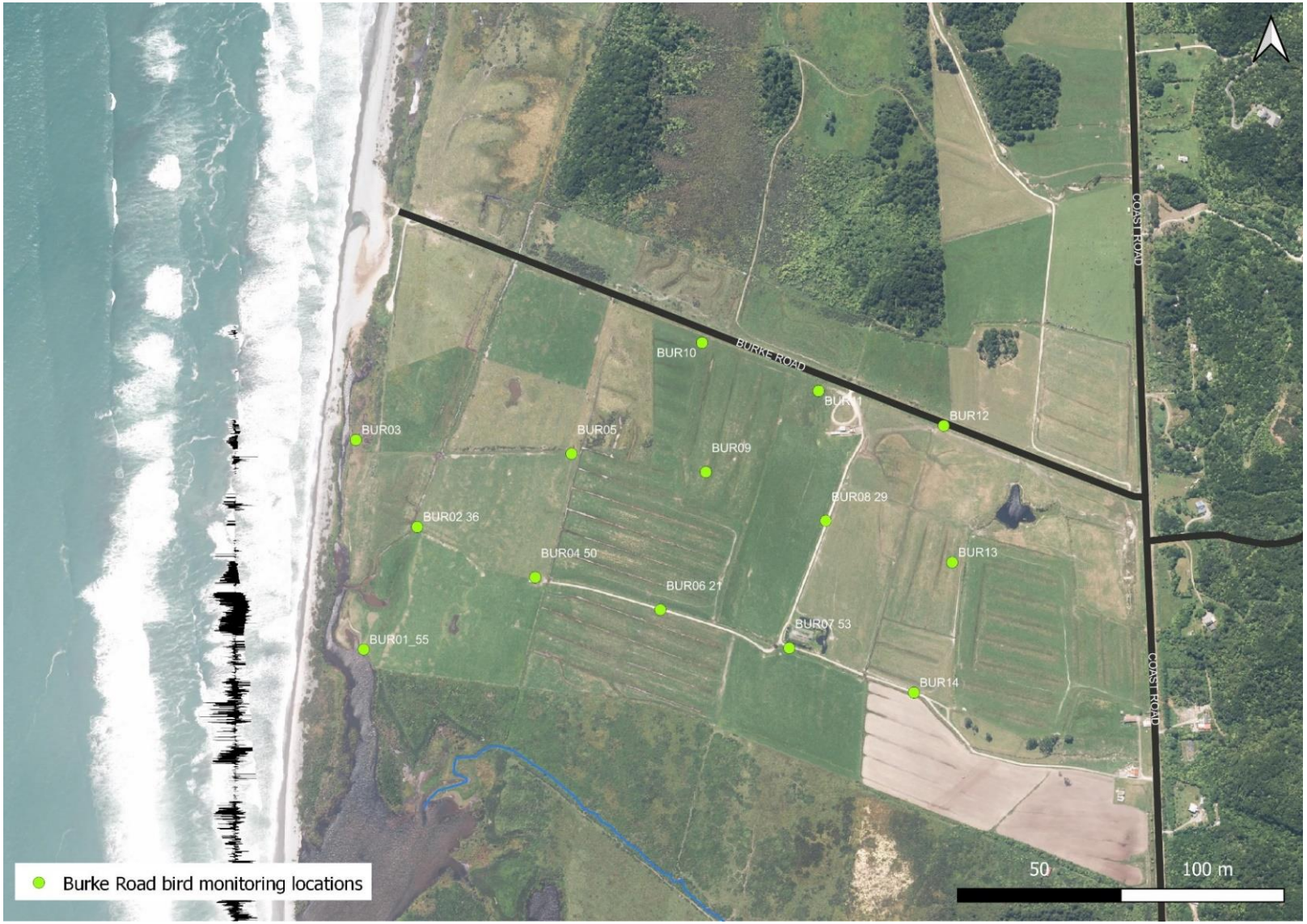

Figure 9: Location of the Burke Road bird monitoring sites.

BRAMLEY ATTACHMENT D - WETLANDS

Figure 10: Location of four plots undertaken on the Langridge property to the north of the application site by Mr Richard Nichol to inform a submission in opposition to the previous proposal (taken from Mr Nichol's evidence to the previous hearing). The water body in the left of the photograph is Rusty Pond.

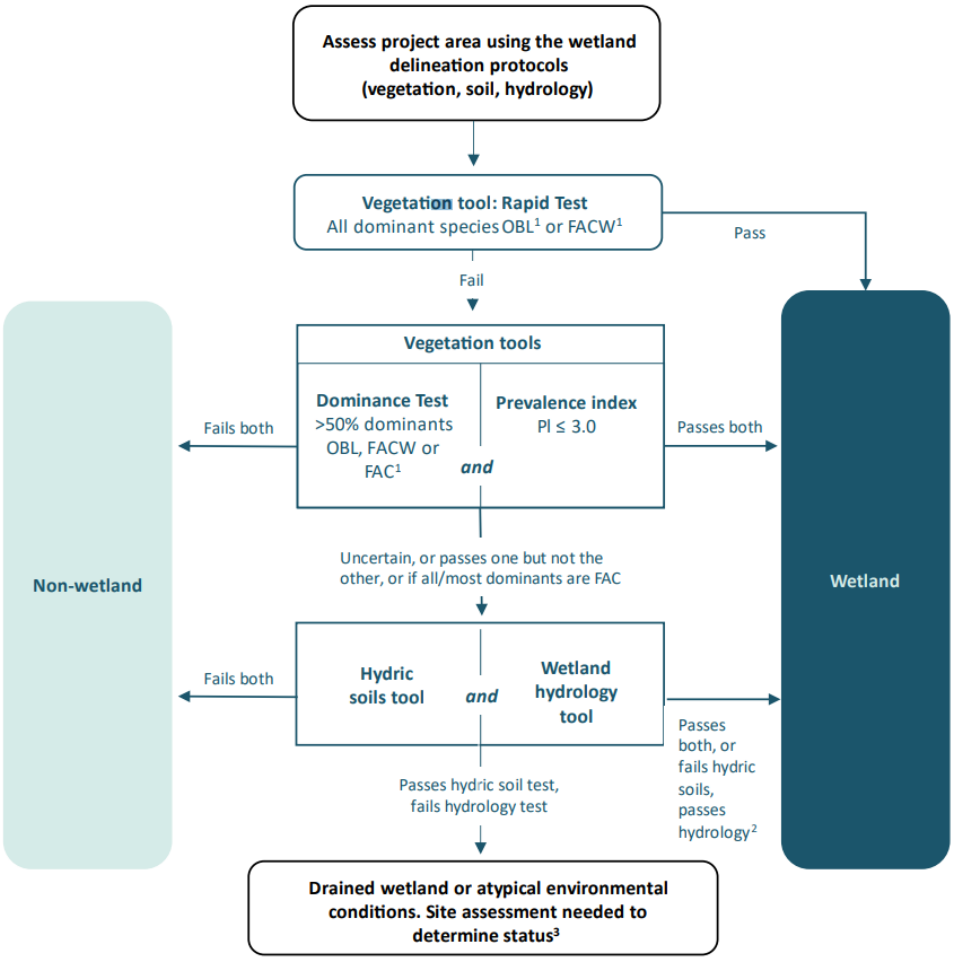

Figure 11: Hydrophytic vegetation determination (from Ministry for the Environment. 2022. Wetland delineation protocols. Wellington: Ministry for the Environment).

Figure 12: Raupō – flax rushland at Maher Swamp, Barrytown.

Figure 13: Vegetation at Maher Swamp is well buffered by adjoining coastal/wetland forest.

Figure 14: Extensive raupō rushland at Maher Swamp provides ideal bittern habitat.

Figure 15: Location of the SNA PUN-W034 identified within the TTPP and the indicative location of the CMA.

Figure 16: Location of 100m setbacks from the wetlands at the Application Site, Barrytown.

Figure 17: Collins Creek Lagoon in January 2024 showing raupo flaxland in the foreground and partially drowned rushes and sedges on the coastal edge of the lagoon (from Gary Teear).

Figure 18: Collins Creek Lagoon in June 2021 showing seasonally dead raupo in the foreground and turf vegetation developing on the right (from Luke McNeish).

Figure 19: Collins Creek Lagoon in September 2021 showing dry lagoon bed and dead turf in the foreground (from Luke McNeish).

Figure 20: Collins Creek Lagoon edge vegetation dominated by rushes and sedges (raupō, Carex) and limited turf vegetation (December 2023).

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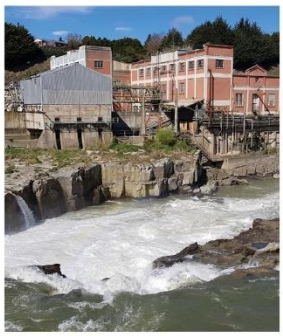

January 2024

Barrytown Mineral Sand Mine
Avian Management Plan

Submitted to:
TiGa Minerals and Metals Limited

water fauna flora land

Quality Assurance

This report has been prepared and reviewed by the following:

Prepared by: Dr Gary Bramley
Senior Terrestrial Ecologist

Reviewed by: Rebecca Bodley
Ecologist

Status: Draft v3 **Issued:** 19 January 2024

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Document sent to Grey District Council for Certification	Date Sent

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Grey District Council	Date Certified
Approved and Certified	

CONSENT (NUMBER) - REFERENCES

Condition	Matter	Page reference within this Plan

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1.0 Introduction

1.1 Overview

TiGa Minerals and Metals Limited ('TiGa') proposes a mineral sand mine located on farmland near Barrytown, approximately 36km north of Greymouth. The mining area is proximate to wetland areas, including natural coastal lagoons which provide habitat for a range of indigenous bird species, some of which are considered to be threatened or at risk. The proposed mine is located outside PUN-W034, which is mapped as a Significant Natural Area (SNA) in the draft proposed Te Tai o Poutini District Plan. The proposed mine is also located near the only known breeding colony of tāiko (Westland petrel, *Procellaria westlandica*).

This management plan has been prepared to address potential effects on 'threatened' and 'at risk' birds using the area to be mined and immediate surrounds. This plan provides for detection and monitoring of breeding birds within the mining area, protection of any nests from human disturbance and introduced predators, restrictions on lighting and traffic movements during darkness to avoid effects on tāiko and other birds, management of any grounded tāiko and monitoring of birds using the site and the adjoining lagoon area to inform operational decisions and species management.

The data collected will be compiled and presented in an annual bird management plan to be used in adaptively managing the operations to protect the birds at the site and provided to Greymouth District Council, Te Runanga o Ngāti Waewae, Paparoa Wildlife Trust, the Community Liaison Group for the project, West Coast Penguin Trust and the Buller/Kawatiri Department of Conservation office in Westport.

1.2 Background

TiGa proposes to construct and operate a mineral sand mine located north of Canoe Creek and west of State Highway 6 on the Barrytown flats approximately 36 km north of Greymouth. The location of the proposed mine is shown in Figure 1.

The mine would be set back from State Highway 6 and the property at 3261 Coast Road. Barrytown JV Limited also proposes a setback of 20m from Collins Creek, the property boundaries and the coastal lagoon. Vegetation throughout the area to be mined comprises farm pasture growing on land which has previously been 'humped and hollowed' to improve drainage for farming.

The proposal is to undertake progressive strip mining across the site moving from west to east and south to north. Each open strip would be approximately 75m x 100m wide and no more than 8ha would be "open" at any one time[1]. The indicative mining approach is shown in Figure 2. No mining or trucking would occur outside daylight hours[2].

Seasonal bird surveys including five-minute counts and the use of acoustic recorders were undertaken at the site between April 2022 and January 2024 and this was combined with database records in eBird to identify the species likely to be present at the site. Seasonal bird surveys will continue until mining commences, throughout mine life and for at least one year following the conclusion of mining at the site.

[1] This includes rehabilitated areas and the Processing Plant area.
[2] The period outside daylight hours is defined as the period between 30 minutes after sunset and 30 minutes before sunrise. Sunrise and Sunset times will differ throughout the year, and are determined by sunrise and sunset times at Greymouth which can be found at the following website: https://www.timeanddate.com/sun/new-zealand/greymouth

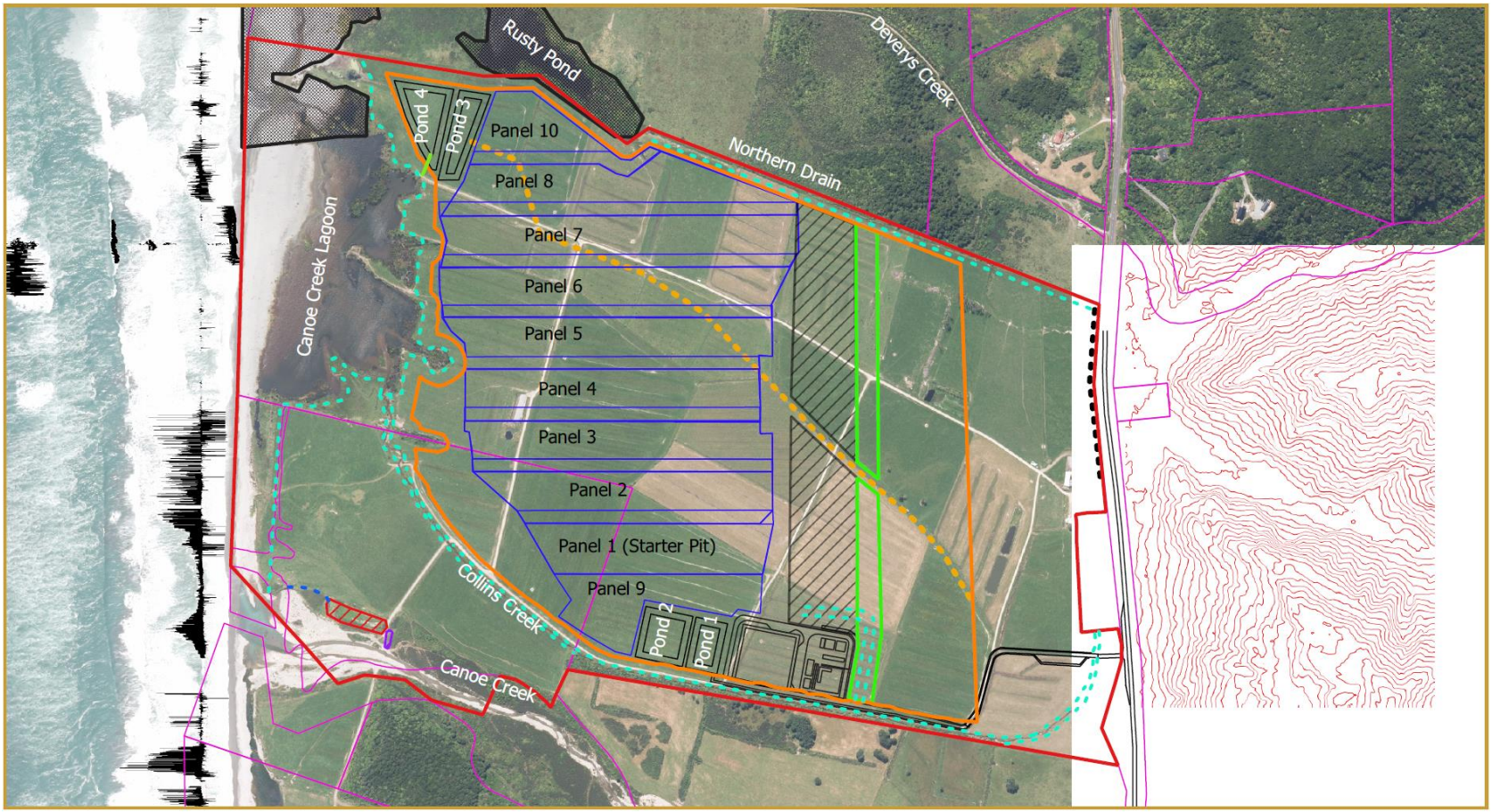

Figure 1: Location and features of the proposed mineral sand mine at Barrytown (from Tai Poutini Resources.

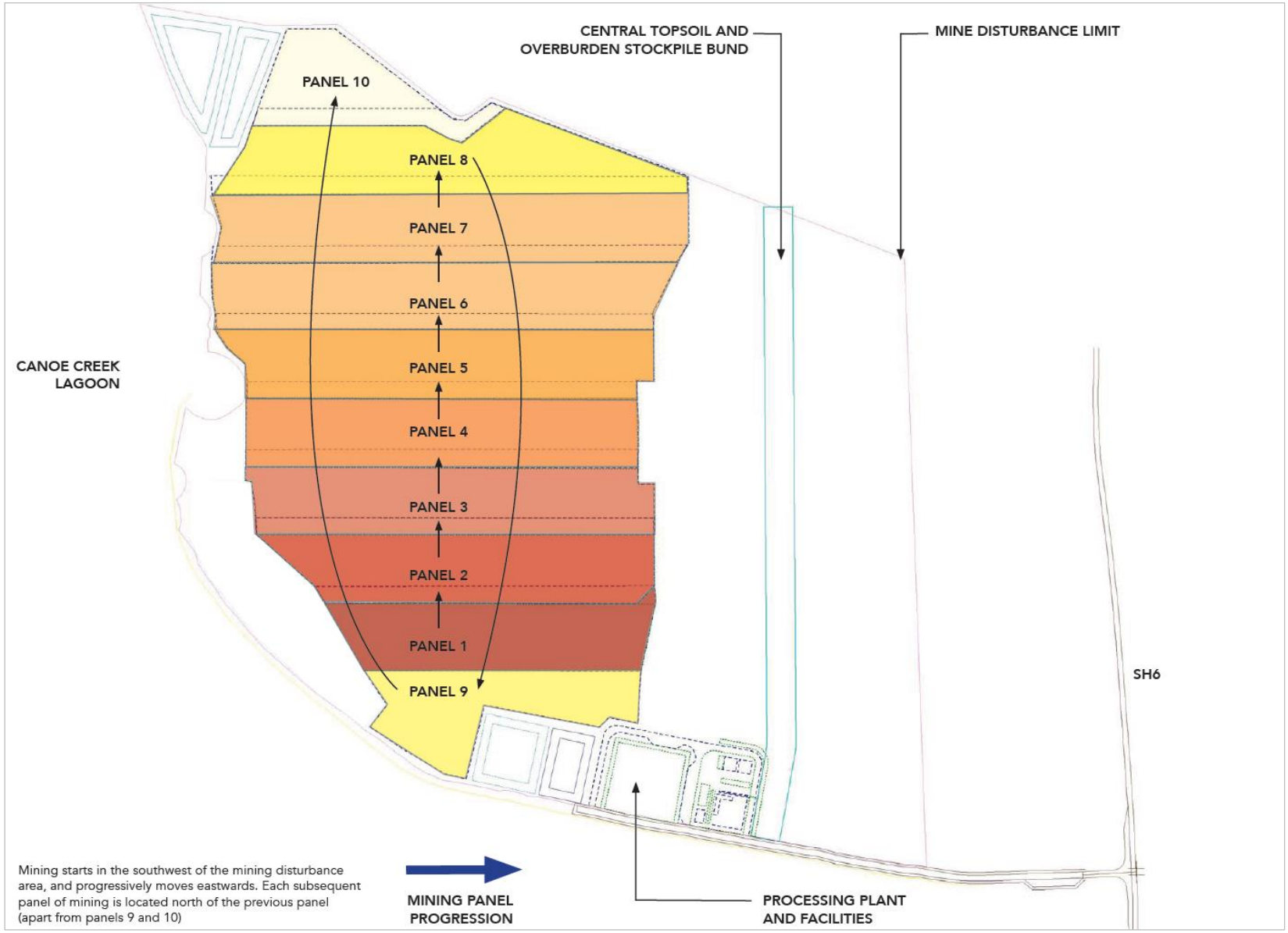

Figure 2: Indicative mining approach at TiGa mineral sand mine, Barrytown (From Glasson Huxtable Landscape Architects).

Species present were generally exotic or common native species. A total of 40 species were confirmed using the site surroundings including 14 species of conservation concern as shown in **Error! Not a valid bookmark self-reference.**.

Table 1: Birds of Conservation Interest confirmed within or near the proposed mining area.

Common name	Scientific name	Conservation status
Black Shag	*Phalacrocorax carbo*	At Risk (Relict)
Black-billed gull	*Chroicocephalus bulleri*	At Risk (Declining)
Caspian Tern	*Hydroprogne caspia*	Threatened (Nationally Vulnerable)
Grey duck	*Anas superciliosa*	Threatened (Nationally Vulnerable)
Kororā, little blue penguin	*Eudyptula minor*	At Risk (Declining)
Kotuku, white heron	*Ardea alba*	Threatened (Nationally critical)
Pacific Reef heron	*Egretta sancta*	Threatened (Nationally Endangered)
Red-billed Gull	*Chroicocephalus novaehollandiae*	At Risk (Declining)
Royal spoonbill	*Platalea regia*	At Risk (Naturally uncommon)
South Island fernbird	*Poodytes punctatus*	At Risk (Declining)
South Island Pied Oystercatcher	*Haematopus finschi*	At Risk (Declining)
Tāiko/Westland Petrel	Procellaria westlandica	At Risk (Naturally Uncommon)
Variable Oystercatcher	*Haematopus unicolor*	At Risk (Recovering)
White fronted tern	Sterna striata	At Risk (Declining)

In addition, a bird which may have been a marsh crake (*Zapornia pusilla*) was heard in September 2022 and October 2023. Assuming marsh crake are present, this brings the number of threatened or at risk bird species near the site to 15. The locations where these birds were detected during seasonal surveys is shown in Figure 3. In addition to the ten species shown in Figure 3, a pair of Pacific reef heron were observed using the coastal lagoon, a dead kororā was observed on the beach at the end of Burke Road and a single kōtuku was also observed at the site. Tāiko have not been observed within the Application site.

Figure 3: Location of threatened and at risk birds detected during seasonal surveys 2022 – 2023.

Birds of conservation concern identified as being present within 10km of the site from eBird records, but not confirmed as present during the surveys of the site include rōroa (*Apteryx haastii*), tūturiwhatu (banded dotterel, *Charadrius bicinctus*), New Zealand pipit (*Anthus novaeseelandiae*) and Australasian bittern (*Botaurus poiciloptilus*).

Of the species listed in Table 1, none are likely to rely on the pasture habitat within the site, but some species (such as gulls and oystercatchers) may visit pasture areas (particularly where soils have been turned over) for feeding or loafing. Tāiko will fly past the site and could be affected by lighting or other activities there. Pipit do use pasture as habitat, but prefer rough open habitats from the coastline to alpine shrublands at c.1900 m.

Grey District Council and West Coast Regional Council have granted TiGa resource consents (NUMBER) to construct and operate the mine subject to conditions, which includes the following conditions associated with the land use consents from the Grey District Council:

18.0 Avian Management	
18.1	The consent holder shall conduct activities on site in general accordance with an Avian Management Plan (AMP) prepared by a suitably qualified ecologist/ornothologist.The objectives of the AMP are: • To ensure adverse effects on the threatened and at risk birds present in the vicinity of the site and any other threatened and at risk species detected by subsequent monitoring are avoided. • To ensure adverse effects on the rushland, flaxland and other important bird habitats adjoining the mining site including Canoe Creek Lagoon, Rusty Pond and the coastal margin are avoided during the breeding season and minimised at other times of the year during mining. • To ensure ongoing use of the site and its environs by the birds which currently occur in the area. *Advice Note: All Management Plans are required to adhere to the requirements of Condition 6.0.* *Advice Note: Threatened or at-risk bird species refers to the Conservation Status according to the Department of Conservation's Threatened Classification System*
18.2	The AMP shall detail: ○ A description of the site and surrounding avian habitats ○ A description of the threatened and at risk birds likely to be present in these habitats and which species require specific management within the AMP ○ A description of the management and mitigation measures that are required to be implemented to avoid effects on these species A description of the monitoring requirements to assess the effectiveness of the AMP
18.3	The AMP must be reviewed annually by the Consent Holder. Any amendments to the AMP must be submitted to Council and must: ○ achieve the AMP's purpose of avoiding effects on any threatened or at-risk indigenous bird species (including specifically the Tāiko); ○ comply with the conditions of this resource consent; and ○ have been reviewed by an appropriately qualified and experienced ecologist/ornithologist;

	○ have been provided in advance to Te Runanga o Ngāti Waewae and the Buller/Kawatiri office of the Department of Conservation for comment (and feedback received collated and submitted with the amendments to be provided to Council). ○ follow the certification process set out in Condition 6.0. *Advice note: any disturbance or relocation of avifauna may require a permit from the Department of Conservation under the Wildlife Act (1953).*
18.4	The Consent Holder must undertake continuous monitoring of avian species from the commencement of consent until at least one year following the cessation of mining activities on this site. The monitoring must be carried out in accordance with the monitoring requirements in the AMP.
18.5	Mining, topsoil and overburden stripping and rehabilitation activities shall not take place within 100m of the Canoe Creek Lagoon or Rusty Pond wetland between the months of September and December each year to maintain separation from the lagoon during the bird breeding season.
18.6	The Consent Holder shall engage a suitably qualified expert to carry out annual penguin surveys of Pakiroa beach within 500m of the mining area to detect the presence of Korora. If penguin are detected the location will be mapped and the following management actions are to apply: i) If penguins are detected using the mining area to access other habitats, any existing access ways are to be maintained and/or works affecting that accessway are to be completed in the period March – June (outside the breeding and moult period). ii) Where any penguin burrows are compromised by mining (i.e., direct effects), replacement artificial burrows/nest boxes are to be installed at a rate of 2:1. Any additional nest boxes provided are to be located within the vegetated coastal foreshore habitat associated with any identified accessways. Where coastal erosion occurs and compromises breeding penguins, a specific mitigation plan is to be developed by a suitably qualified and experienced ecologist on behalf of the applicant in conjunction with the West Coast Penguin Trust.
18.7	The Consent Holder must establish a ring of traps and/or bait stations targeting rats and mustelids placed around the perimeter of the property and the coastal lagoon in accordance with the AMP. The network of traps is to be installed prior to mining commencing and serviced as required.
18.8	An annual bird management report shall be provided to Environmental Planning Team Leader Grey District Council, Te Runanga o Ngāti Waewae, the Buller/Kawatiri office of the Department of Conservation in Westport, the West Coast Penguin Trust, Paparoa Wildlife Trust, the Community Liaison Group and Waka Kotahi NZ Transport Agency Environment and Sustainability Team (via:environment@nzta.govt.nz), no later than June each year. The report shall include the following matters: ○ The timing and duration of any mining within 100m of the coastal lagoon vegetation and the SNA; ○ Results of seasonal bird surveys at the site; ○ Timing of nest detection surveys and observations relating to nesting or other behaviours observed within the area to be mined;

	○ Efforts to deter any attempts at nesting within the area to be mined and the outcome of those efforts; ○ Species attempting to nest within the area to be mined (including threatened and at risk species); ○ Date of first nesting attempts (if any) for threatened and at risk species within the area to be mined; ○ Number and location of nesting attempts by threatened and at risk species within the area to be mined; ○ Species attempting to nest within the area to be mined (including threatened and at risk species); ○ Date any predator control commenced, the location of traps and bait stations, the number of captures, the amount of bait consumed and any relevant observations; ○ Outcome of individual nesting attempts by threatened and at risk species within the area to be mined; ○ Results of annual kororā surveys on Pakiroa Beach, the implications for mine operations and any management actions undertaken; ○ Number and location of any grounded tāiko and any birdstāiko found dead on site; ○ Management undertaken and the outcome for any grounded tāiko collected; ○ Autopsy outcomes for any dead tāiko collected; ○ The number, dates and location of any near misses with vehicles for any native species; ○ The findings of any lighting audits undertaken during the year and steps taken to resolve any issues identified. ○ A summary of any revisions made to this management plan and the reasons for the changes; ○ The date and duration of any operational shut-downs; The results of the quarterly walk-through surveys of birds using the lagoon area.

1.3 Goals, Scope and Objectives

The goals of this Avian Management Plan ('**AMP**') are:

i) To ensure adverse effects on the threatened and at risk birds present in the vicinity of the site including those listed in Table 1 and any other threatened and at risk species detected by subsequent monitoring are avoided.

ii) To ensure adverse effects on the rushland, flaxland and other important bird habitats adjoining the mining site including Canoe Creek Lagoon, Rusty Pond and the coastal margin are avoided during the breeding season and minimised at other times of the year during mining.

iii) To ensure ongoing use of the site and its environs by the birds which currently occur in the area.

This will be achieved by operating so as to avoid effects on birds and important habitats identified, monitoring of birds to confirm occupancy and inform operational decisions and species management and regular review of monitoring data to inform any operational changes required to address any unanticipated effects.

This AMP also sets out the monitoring that will be undertaken to detect threatened and at-risk species at the site, actions to be taken to protect those birds as well as record keeping and reporting.

1.4 Updates

This plan will be updated annually by a suitably qualified and experienced ecologist/ornithologist taking into account the mining proposed for the coming year, as well as the results of the previous year's avian monitoring and the outcome of any management actions undertaken to protect birds in the preceding year. If a new record of a threatened or at risk species is made during monitoring, then this plan will also be updated as required.

2.0 Background

2.1 Important Habitats

The site adjoins an area identified by Boffa Miskell (2006) on behalf of the Grey District Council as a potential Significant Natural Area ('**SNA**', Site PUN-W034) as shown in Figure 4. This SNA has been amended and included in the Te Tai o Poutini Proposed District Plan ('the TTPP'). This SNA, along with the part of the coastal lagoon to the south which is outside the SNA, but adjoins the mining area, is the location of the most important bird habitats in the immediate vicinity of the site as shown in Figure 3.

Figure 4: Location of SNA PUN-W034 at Barrytown.

2.2 Threatened and At Risk Birds Likely to be Present

The species of birds which are considered to be “threatened” or “at risk” and have been confirmed using the site and the adjoining SNA during the ecological assessments for the resource consent application are shown in Species present were generally exotic or common native species. A total of 40 species were confirmed using the site surroundings including 14 species of conservation concern as shown in **Error! Not a valid bookmark self-reference.**.

Table 1. Of the birds listed in Species present were generally exotic or common native species. A total of 40 species were confirmed using the site surroundings including 14 species of conservation concern as shown in **Error! Not a valid bookmark self-reference.**.

Table 1, different species are expected to be affected by different activities. The majority of them would not use habitats within the site, rather using the adjoining beach, lagoon or wetland habitats and would therefore be affected by noise, human activities and vehicle movements near their habitats, particularly during the breeding season. For these species the following management actions are proposed:

- Commencement of mining during the first year at least 100m from the edge of the mining area. Monitoring of birds prior to the commencement of mining and throughout mining so as to inform later management. Post-mining monitoring is also proposed for at least one year to confirm species are still present in the adjoining habitats.
- Maintenance of a 20m buffer from the edge of mining to the existing lagoon vegetation. This boundary is to be permanently marked so as to avoid crossing it inadvertently.
- Planting of parts of that buffer with flax and other native species set out in the planting plan for the site (required by Condition 19.1 of the relevant resource consents) so as to visually screen the mining activities from the lagoon.
- Avoidance of mining the parts of the strips closest to the highest quality habitats (the lagoon and provisional SNA area, Panels 4-8 and 10) between the months of August and December (inclusive) in order to provide separation from activities. The purpose of this avoidance is to provide spatial separation of at least 100m for breeding birds from the mining activities.

Monitoring for these birds is described in Section 3.0.

2.3 Bird Species to be Managed

2.3.1 Introduction

For a small subset of the birds known to occur in the area, i.e., those which are known to occur there, or are likely to visit the mining area and may attempt to nest there in future, specific management activities are proposed. The three species for which specific management actions will be provided are shown in Table 2. Specific management actions are set out in Section 3.0 (for tūturiwhatu, kororā, and tōrea if they are detected at the site during ongoing monitoring) and Section 4.0 for tāiko.

Table 2: Threatened and at-risk birds to be managed at the Barrytown Site.

Common name	Scientific name	Threat classification
tūturiwhatu, banded dotterel	*Charadrius bicinctus bicinctus*	Threatened – Nationally Vulnerable
kororā, little blue penguin	*Eudyptula minor*	At Risk – Declining
tōrea, South Island pied oystercatcher	*Haematopus finschi*	At Risk – Declining
tōrea tai, variable oystercatcher	*Haemotopus bicolor*	At Risk - Recovering

2.3.2 Tūturiwhatu/New Zealand Banded Dotterel

Tūturiwhatu (banded dotterel) are the most common small plover of New Zealand seashores, estuaries and riverbeds. Their plumage varies seasonally, but they are readily identified by their brown upperparts and complete or partial chestnut breast band, which is quite obvious in breeding plumage. Like other plovers, the body is held erect and they have a characteristic run-stop-peck-run foraging behaviour in their pursuit of small invertebrates.

Typical breeding habitat for banded dotterels comprises lightly vegetated riverbeds, outwash fans, herb fields, beaches and farmland. The composition of vegetation varies regionally and particularly with altitude. Banded dotterels are often attracted to earth worked areas for breeding.

Banded dotterel pairs are solitary and territorial, but there can be high concentrations of birds in good habitat. Birds begin to arrive on the breeding grounds and set up territories in July. First eggs are laid in August to early November, in shallow scrapes in gravel, sand or soil, usually lined with tiny stones, occasionally shell. The clutch-size is nearly always three eggs, which are coloured grey to pale-green or olive with small dark spots. Incubation is performed by both adults for c. 4 weeks and chicks fledge after another 5–6 weeks.

During the West Coast Penguin Trust survey of Pakiroa/Barrytown Beach in 2014, 33 banded dotterels were recorded (I. Perkins, West Coast Penguin Trust, pers. comm.).

Management of tūturiwhatu is discussed in more detail in Section 3.0 below.

2.3.3 Kororā/Little Blue Penguin

Kororā occur throughout New Zealand and are thought to have a large, but declining population. One dead kororā has been detected at Barrytown near the end of Burke Road. West Coast Penguin Trust records confirm that kororā are resident in the Barrytown flats area with both breeding and mortality records (I. Perkins, West Coast Penguin Trust, pers. comm.). The population is thought to be a small number of birds (I. Perkins , West Coast Penguin Trust, pers. comm.).

West Coast Penguin Trust kororā survey data include 14 kororā tracks crossing Pakiroa/Barrytown Beach in 2013, 16 tracks recorded in 2014 and 17 tracks recorded in 2015. This survey has not been repeated since. The approximate location of the known penguin deaths near the site between 2007 and 2020 is shown in Figure 5.

Suitable nesting habitat for kororā is present between the coast and the mining area, although no burrows have been confirmed there during field surveys. It is possible kororā visit or use the coastal lagoon area or may come to use it in future, or that they may cross the farm to habitats further inland, although this is considered unlikely.

Figure 5: Location of little blue penguin records near Barrytown between 2007 and 2020 (Image and data from West Coast Penguin Trust).

Kororā are nocturnal on land and typically breed in small colonies numbering from a few up to 20-30 pairs, sometimes semi-colonially, or sometimes as isolated pairs. Penguins commonly nest in dunes, coastal forest, farmland and rocky areas up to 200m inland or up to 500m upstream from river mouths. (Marchant and Higgins 1990). Birds nest in a burrow, sometimes digging their own, sometimes adopting burrows of other birds, and sometimes making use of small crevices or gaps in the substrate. They also make use of small spaces under buildings and dense vegetation and nest boxes where these are provided. Penguin burrows are used throughout the year and the same site is often used for nesting over many

years. Chicks often return to their natal area to breed themselves.

During moulting, the bird will stay in or close to the burrow and is not able to enter the water to feed because they are not waterproof. Activities after moulting are uncertain, some birds continue to use burrows, but many disappear for weeks or months until the next breeding season.

The main threats to penguins while on land are predators (including dogs, stoats, cats and rats), road mortality and habitat loss and/or disturbance either due to humans or natural causes. Kororā are active ashore at all times of the year, with the breeding season being the most active period. They can be found walking across the beach, returning to their nest from the sea any time after dusk and generally leaving for the sea some time before dawn.

For the Hokitika area the breeding season through to moulting is approximately June – February (I Perkins, West Coast Penguin Trust, pers. comm.). This is likely to be similar at Barrytown. Management of kororā is discussed in more detail in Section 3.0 below.

2.3.4 Oystercatchers

Tōrea (South Island pied oystercatchers) and tōrea tai (variable oystercatchers) have both been recorded using the coastal area adjoining the site and the pasture within the farm as shown in Figure 3. Tōrea have conspicuous black and white plumage whilst mature tōrea tai's plumage is black. Both species have a long red bill. Tōrea are found on most estuaries and many coastal locations, with numbers greatest during the period December to July. Fewer tōrea remain in coastal areas during the rest of the year, with most of the population moving to inland South Island riverbeds and farmland to breed. Tōrea tai are site attached in coastal areas throughout the year.

Tōrea and tōrea tai breed in spring and summer. Nests are unlined scrapes on a mound or raised area of sand, gravel or soil with good visibility all around. Both members of the pair incubate the 1-3 eggs and care for the young. Incubation takes 24-28 days, and the young fledge 28–42 days after hatching. Tōrea have a conservation status of At Risk (Declining), whilst tōrea tai have a status of At Risk (Recovering).

During the West Coast Penguin Trust survey of Pakiroa/Barrytown Beach in 2014, five variable oystercatchers were recorded (I. Perkins, West Coast Penguin Trust, pers. comm.). Both tōrea and tōrea tai have been recorded during seasonal surveys at the site.

There is a possibility that oystercatchers of either species may choose to nest within the mining area on newly excavated soils or stockpiles. Management of oystercatchers will focus on monitoring and then deterrence from nesting in areas to be mined within the breeding season.

Management of tōrea, tōrea tai and other threatened or at risk species that may (though not expected to) be found breeding on site is discussed in more detail in Section 3.0 below.

2.3.5 Fernbird

South Island fernbird (*Poodytes punctatus punctatus*) have been detected near the coastal lagoon as shown in Figure 3. In the first instance, protection of fernbird will rely on maintaining 100m separation from mining activities during the breeding season.

In order to inform the location and number of fernbirds present and confirm they continue to persist in similar numbers throughout the project and beyond, territory mapping of South Island fernbird will take place in advance of mining commencing in Panel 4

3.0 Species Management

3.1 Detecting Breeding

Birds which might breed in the areas of pasture or areas of bare soil created by mining include tūturiwhatu and oystercatchers. New Zealand pipit may also nest in undisturbed pasture areas. The breeding season for most seasonally breeding birds in New Zealand starts between June and September with most breeding being undertaken between September and December. Some birds will attempt second clutches and breeding can extend through until February or March. Site works and other activity is likely to deter birds (except dotterel) from establishing nests near that activity, forcing them to nest elsewhere.

In advance of each breeding season, a general detection route will be devised across the area to be mined within the coming breeding season and adjoining areas (within 50m) which will be used to detect birds using the site to be mined during the upcoming season. The route will be identified by a suitably qualified and experienced ecologist experienced in the detection of breeding birds.

Fortnightly detection surveys will take place between 1 August and the onset of breeding (or the 14th September, whichever is the earlier) and weekly detection surveys between the commencement of breeding and 25 December.

During these detection surveys, suitably qualified and experienced observers will walk over the predetermined route which will cover areas intended to be mined within the forthcoming breeding season and adjoining areas in order to detect breeding behaviour or nesting that indicates species management should begin. Species management comprises discouraging nesting before it occurs and managing any established nests once they are discovered. Each of these actions is discussed further below.

This frequency of detection survey was chosen so that:

(i) There is a high probability that birds will be detected soon after their arrival at the site.

(ii) The behaviour of birds can be observed regularly, and if necessary, they can be discouraged from nesting where the presence of nests or dependent young would either put them at risk or obstruct mining activity.

(iii) The probability of detecting nest attempts (at least those that persist two weeks or more) is increased.

(iv) Nests which are abandoned or vacated (and isolated from other nests) will be detected quickly so as to minimise disruption to mining.

(v) The fate of nesting attempts and nestlings can be monitored so as to determine whether this management plan is effective at protecting the target species.

During detection surveys all birds (including non-target species) seen or heard will be recorded, and their approximate location will be marked using a GPS. The number of birds observed and their behaviour will be recorded, and if behaviours are consistent with breeding (e.g., calling, displaying, defending areas or other behaviour), then individuals will be observed from a distance for a period of at least five minutes to see if a nest can be located. All nest attempts, including locations, date and time of nest observations and the outcome (where known) will be recorded. Non-target species will be recorded so that a record of all species using the site can be compiled and any threatened or at risk species not identified in this plan can be identified and a management strategy developed to protect them from mining.

3.2 Discouraging Nesting

To reduce the need to disrupt mining activities by having to place a 50m buffer around any nests identified during monitoring, nesting birds will be discouraged from settling each prospecting season. This method is only to be used prior to the establishment of any nesting activity, and will involve the use of one or more of the following methods:

(i) Completing disruptive site walkovers regularly between the 1st August and the onset of breeding. A disruptive site walkover would involve one or more people walking through the area with a dog on a lead.

(ii) Installing streamers/tapes that flutter in breeding habitats (farmland, herb fields, gravel, burrows, earthworked areas) to deter birds from nesting. Note that this method is effective over the short term (up to 3 weeks) but decreases over time as birds become accustomed to it.

(iii) Parking earthworks machinery in future stage locations, starting the engine from time to time, but not moving equipment.

3.3 Management of Nest Sites

Any nests of threatened or at-risk species located will be subject to protection and management until such time as the chicks have successfully fledged.

A minimum separation distance of 50m will be maintained between any works and existing nest sites so as to minimise the risk of nest abandonment. All vehicles, machinery and people will be excluded from the area until either the nest is abandoned or any chicks fledge.

If a nest of any threatened or at-risk species (including those listed in Table 1) is discovered within the area to be mined, the following plan would be implemented:

(i) Minimise time spent near the nest to avoid attracting ground predators such as rats and stoats and aerial predators such as gulls.

(ii) Establish a “no go” zone approximately 50m radius around the nest using tape and markers.

(iii) If it is the first nest of the season, alert the appropriate supervisor to initiate a predator control plan immediately.

(iv) If a predator control plan is in place, adapt it as required to ensure bait stations or baited traps are located just outside the “no go” zone.

(v) Monitor the area at least twice weekly from outside the “no go” area in order to assist in estimating the time of fledging. Maintain the “no go” zone until after the chicks have fledged. This monitoring is described in more detail in Section 5.0 below.

3.4 Kororā

Given that they are nocturnal on land, only undertaking mining and trucking during daylight hours will avoid the potential for mortality and reduce the potential for disturbance of kororā due to mining at the site. Although kororā are known to burrow/nest under buildings, the processing plant would be constructed on a concrete slab and would not allow for penguin access. This reduces the potential for birds coming in contact with humans and vehicles at the processing plant.

No active kororā burrows (as indicated by guano, smell, tracks or the presence of cavities) have been detected either within the farmland or in adjoining habitats, and no kororā have been detected by the acoustic recorder monitoring at the site. We note that the habitats

adjoining the mining area have not been comprehensively searched, but do appear suitable for kororā. We have assumed the adjoining habitats are where any penguin using the area currently reside.

Kororā are expected to be present at relatively low densities at Barrytown and are also considered unlikely to cross the open farmland for significant distances, instead preferring to use denser vegetation and waterways (such as Canoe Creek) to access inland habitats. Thus, it is considered unlikely that penguin access ways to areas inland occur across the farmland to be mined. Annual monitoring of Pakiroa Beach within 500m of the mining area is proposed to detect penguin tracks crossing the beach.

Monitoring will take place during November and commence prior to the start of mining. This is an appropriate time to detect the presence of penguin activity, and in particular identify any active burrows or nests since signs such as guano and footprints are often present.

Surveys will be timed for when a low tide occurs in the morning and involve a suitably qualified and experienced person slowly walking a planned survey route in the late afternoon. Early the following morning, during low tide, the same route will be walked looking for faeces, feathers, new tracks or other penguin sign and investigating any cavities.

If penguins are detected, the location would be mapped and the following management actions are to apply:

iii) If penguins are detected using the mining area to access other habitats, any existing access ways are to be maintained and/or works affecting that accessway are to be completed in the period March – June (outside the breeding and moult period).

iv) Where any penguin burrows are compromised by mining (i.e., direct effects), replacement artificial burrows/nest boxes are to be installed at a rate of 2:1. Any additional nest boxes provided are to be located within the vegetated coastal foreshore habitat associated with any identified accessways.

v) Where coastal erosion occurs and compromises breeding penguins, a specific mitigation plan is to be developed by a suitably qualified and experienced ecologist on behalf of the applicant in conjunction with the West Coast Penguin Trust.

3.5 Pest Control

Predator control will consist of a ring of traps and/or bait stations targeting rats and mustelids placed around the perimeter of the property and the lagoon. This network of traps will be installed prior to mining commencing and serviced at least 12 times per year.

In addition, if nest attempts are recorded, a second ring of traps and/or bait stations will be installed around the 50m “no go” zone associated with a particular nest. The exact layout of traps and/or bait stations will be determined by the project ecologist at the time the predator control is initiated and will be in accordance with recognised best practice, including with respect to design and construction. In addition, traps and bait stations must be designed and deployed so as to exclude weka.

4.0 Tāiko, Westland Petrel

4.1 Potential Effects on Tāiko

4.1.1 Background

The area to be mined is located approximately 3.6km south of the only known colony of tāiko/Westland petrel. Tāiko breeding occurs between March and November. Adult birds

entering and departing the colony, and at sea close to shore, are known to be disoriented and attracted by artificial lighting and can be grounded. Young tāiko are known to be disoriented by lights when leaving the breeding colony and this can also result in birds being grounded. Groundings are most likely to occur between November and January, with a peak in early December as shown in Figure 6.

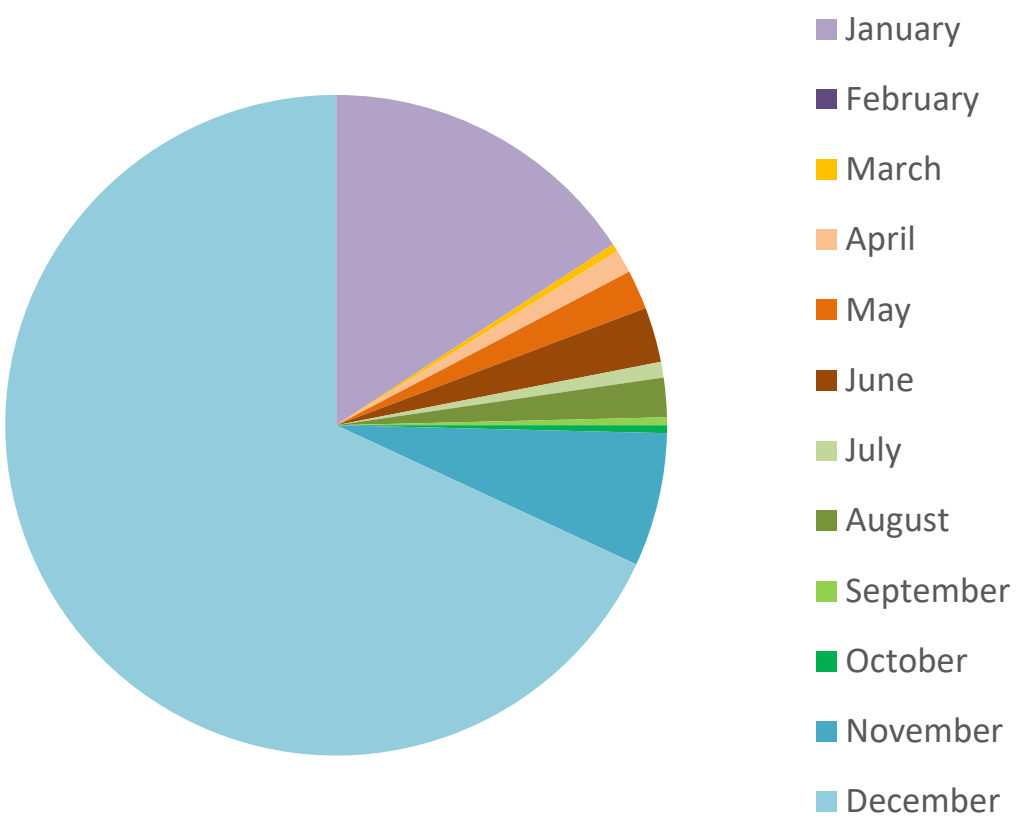

Figure 6: Records of grounded tāiko recorded between 2007 and 2022 categorised by month of occurrence (Data from Department of Conservation).

4.1.2 Fixed Lighting

In order to reduce the effects of lighting at the mine during night time operations, no mining and no trucking will occur outside daylight hours[3].

Processing will occur at night inside the processing plant. This building has been designed with exterior fixed lighting and no windows or other openings on the western (coastal) side to avoid light spill towards the coast. In addition, there are no windows on the eastern and southern sides and all doors can be closed to avoid light spill when not needed for entry or exit. Furthermore, the processing plant site will be bunded on the eastern and part of the northern sides with a 4.5m bund, the top of which will be planted with trees.

Some lighting will be at the processing plant to allow safe work conditions. Condition 16 (particularly 16.2) of the Greymouth District Council land use consents require minimisation of the amount of light at the site. This is to be achieved at the processing plant and loadout

[3] Night is defined as the period between 30 minutes after sunset and 30 minutes before sunrise. Sunrise and Sunset times will differ throughout the year, and are determined by sunrise and sunset times at Greymouth which can be found at the following website: https://www.timeanddate.com/sun/new-zealand/greymouth

area via adherence to the Australian Government's National Light Pollution Guidelines for Wildlife January 2020 (or subsequent revision), including but not limited to pointing all fixed lighting downward, shielding to avoid light spill and use of the yellow-orange spectrum. In addition, lights should only illuminate the object or area intended and be mounted as close to the ground as possible.

In addition, the following actions will be deployed as appropriate at the site[4]:

- The use of motion detectors, timing switches or similar methods to limit lighting to when it is required;
- Lighting will be used to light only the object or area intended;
- Lights will be deployed close to the ground, directed and shielded to avoid light spill as required;
- The lowest intensity lighting appropriate for the task will be used; and
- Non-reflective, dark-coloured surfaces will be used in preference to light or reflective surfaces.

Random lighting audits will be undertaken at least annually making reference to the Australian Government Lighting Guidelines for Wildlife.

4.1.3 Pit Lighting

Mining will take not take place at night as set out above. Removal of topsoil and overburden is restricted to daylight hours by Condition 12.1. It is possible that minor, temporary lighting (such as a headlamp or similar) may be required to be used in the pit at night to maintain equipment such as pumps. If so, the following actions will be deployed as required by Condition 16.2:

- Lighting to used only when and where it is required;
- Lighting will be used to light only the object or area intended;
- Lights will be deployed close to the ground, directed and shielded to avoid light spill as required;
- The lowest intensity lighting appropriate for the task will be used;
- Non-reflective, dark-coloured surfaces will be used in preference to light or reflective surfaces; and
- Light in the yellow-orange spectrum only to be used.

4.1.4 Vehicle Headlights

No trucking movements are proposed outside daylight hours. Shift changes will occur at night and TiGa proposes to provide a minivan(s) to transport staff and reduce the number of light vehicle movements associated with these shift changes from around 20 to a much lower number depending on how many people use the transport provided. These light vehicle and other movements relating to shift changeovers or infrequent maintenance requirements on the site would be subject to the management requirements set out in this AMP and the Traffic Management Plan for the site including speed limits, a requirement to dip headlights and a requirement to report all near misses with wildlife.

In addition to avoiding night time mining at the site, other actions intended to protect tāiko,

[4] These are based on best practice lighting design, Appendix A of the Australian Government Light Pollution Guidelines available at http://www.environment.gov.au/system/files/resources/2eb379de-931b-4547-8bcc-f96c73065f54/files/national-light-pollution-guidelines-wildlife.pdf

kororā and other species from accidental death due to collision with vehicles on the State Highway include:

- Monitoring and reporting of all encounters with tāiko and other wildlife by all mine related vehicles throughout the year. In the event that any native wildlife collides with a mine related vehicle this management plan will be reviewed with a view to avoiding any further mortality.

Moving vehicles within the site

In addition, the lights of vehicles travelling around the site at night, such as from the highway to the loadout, might also affect wildlife. Given that mining and trucking will not occur at night, the number of movements between the processing plant and pit would be very small and limited to those required to maintain equipment. The risk posed by these movements is very low. Actions intended to protect tāiko from accidental death due to collision with vehicles within the site include:

- Limiting the speed of vehicles to 15km per hour while on site as required by Condition 27.2 of the West Coast Regional Council consents.
- Requiring headlights to be dipped at all times within the site. The effectiveness of this action in avoiding birds remains unknown, but it may assist. This practice will be trialled for at least three months. In the event that it proves unhelpful (e.g., if it becomes difficult to see wildlife at the site) this practice will be discontinued.
- Monitoring and reporting of all encounters with wildlife by all site vehicles throughout the year. In the event that a bird collides with a vehicle within the site this management plan will be reviewed (including consideration of banning night time vehicle movements) with a view to avoiding any further mortality.

4.2 Detecting Grounded Tāiko

Mining will take place during daylight hours throughout the year, but there may be occasional vehicle movements across the site at night if required as described above. The most likely location for tāiko to be grounded is near any area where lights are being used (the processing plant and load out area and the internal road within the site).

It is the responsibility of TiGa to provide training so as to ensure staff are appropriately informed and able to implement the accidental discovery protocol set out below. It is the responsibility of all employees based at the site to be alert to the possibility that they might encounter a grounded tāiko and to know how to respond appropriately. In addition, the specific location, date and time any grounded birds are detected is to be recorded by the personnel who discover the bird(s), and this information is to be provided to the Mine Manager.

[NOTE an authority under the Wildlife Act 1953 will be required to handle absolutely protected wildlife (tāiko) if any are recovered and to implement other aspects of this Management Plan. This is a separate process administered by the Department of Conservation and can take some months to work through. A copy of the permit should be attached to this plan as [Appendix A.]

All trucking and other contractors and staff leaving the site (including those travelling to and from work past the colony) are required to report any vehicle strike of birds, as well as near misses, to the Mine Manager as soon as practicable after they occur.

Reports are to include the date, time, approximate location and number of birds (if known). The Mine Manager will be responsible for maintaining an incident log and upon receiving a

report of a bird strike will notify the Department of Conservation as soon as practicable.

Data relating to near misses will be reviewed annually in order to determine whether any changes to operations are required for the coming season.

Live birds seen on the road at any time of day/night, should be reported to 0800 DOC HOT as soon as possible.

4.3 Accidental Discovery

4.3.1 Equipment required to be kept on site

A sturdy net suitable for catching grounded birds, leather gloves for handling birds and a suitable enclosure (lined box, crate or cage) will be held on site and all staff will be informed of their location and trained in their safe use to ensure bird welfare.

4.3.2 Discovery of a Tāiko

In the event that a live grounded tāiko is discovered within the site, the bird will be caught with the minimum of disturbance and placed in the suitable enclosure in a cool place. The person undertaking capture of any wildlife will be suitably trained to undertake that task humanely and will call on a suitably qualified and experienced ecologist or the Department of Conservation as required. If the bird is heavily waterlogged then it should be dried using towels/paper towels and left in a warm, dark ventilated place. In such situations birds should be monitored regularly as once dry they can overheat. Birds should be transferred as quickly as practicable to the local Department of Conservation, who will determine if it is fit for release, undertake the release and inform the Mine Manager of the outcome. If injured the local Department of Conservation office will take responsibility for the bird and keep the Mine Manager up to date with progress.

In the event that a tāiko (either alive or dead) is recovered from within 50m of the pit, internal roads or the processing plant and loadout area, the following steps will be instigated:

- An attempt to identify the potential reason for grounding should be undertaken immediately. If the likely cause can be identified and the reason can be modified or eliminated immediately, this will be done.
- The incident must be logged, the rationale behind the identification of the likely cause and steps taken to reduce/eliminate the risk must be documented and authorised by the Mine Manager. These steps and the outcomes should be included in the annual monitoring report.
- If the cause of grounding is identified as a light source which cannot be modified or eliminated, TiGa will seek advice as soon as possible (within 24hrs) from a suitably qualified and experienced ecologist and the Buller/Kawatiri office of the Department of Conservation in Westport.
- A lighting audit will be undertaken to ensure lighting at the site complies with the requirements set out in this Avian Management Plan and the latest version of the Australian Government National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shore birds.
- This management plan will be reviewed by a suitably qualified and experienced ecologist in consultation with the Buller/Kawatiri office of Department of Conservation and any other changes to management protocols including, but not limited to, changes to light colour, intensity or timing, additional bunding or planting, the use of black out curtains, tinted windows or other methods to reduce light spill and the risk of grounding will be considered with a view to implementing them as

required.

- Any potential management protocol changes identified as likely to contribute to reducing the risk of grounding during the review of this management plan will be implemented as soon as practicable.

4.3.3 Discovery of dead birds

In the event of any dead birds (including tāiko) being located within the mining area, the Buller/Kawatiri Department of Conservation office in Westport and Te Rūnanga o Ngāti Waewae will be informed and collection by or delivery to the Department of Conservation will be arranged.

5.0 Monitoring

5.1 Monitoring Proposed

Seasonal bird surveys at the site commenced in April 2022 and will continue until 12 months after completion of mining at the site. Seasonal bird surveys will be undertaken four times each year, once each in spring, summer, autumn and winter using five-minute bird counts and acoustic recorders at the locations shown in **Error! Reference source not found.**. These surveys are intended to detect species using the parts of the lagoons and Rusty Pond closest to the mining area and other adjoining habitats where effects beyond the site are most likely, and may need to be avoided or managed.

In addition to the seasonal surveys, as set out above, detection of “threatened” and “at risk” species using the mining area, will rely on fortnightly and/or weekly detection surveys and close (twice weekly) monitoring of any nesting attempts. The number, location and outcome of all nesting attempts will be recorded, along with the number, dates and times of monitoring visits.

For kororā an annual survey of Pakiroa Beach undertaken in November as described in Section 3.4 is proposed.

For tāiko, the location, date and time of any groundings will be recorded, along with any vehicle strikes and near misses. This information will be included in the annual bird monitoring report.

In order to have the best chance of detecting Australasian bittern, acoustic surveys must be undertaken at least once annually between September and November

For South Island fernbird, territory mapping using playback of fernbird calls will be undertaken in advance of mining commencing in Panel 4 so that the number and location of fernbirds can be confirmed.

Monitoring to quantify noise levels at the site boundary adjoining the SNA and coastal lagoon habitats will be undertaken to inform management decisions with respect to noise levels in natural habitats adjoining the site.

All bird monitoring should be undertaken by suitably qualified and experienced ecologists/ornithologists to ensure all species observations are accurately captured.

This information will be compiled into an annual bird monitoring report at the conclusion of the breeding season (March) and provided to the consent authorities and others no later than 30 June each year as discussed in Section 5.2.

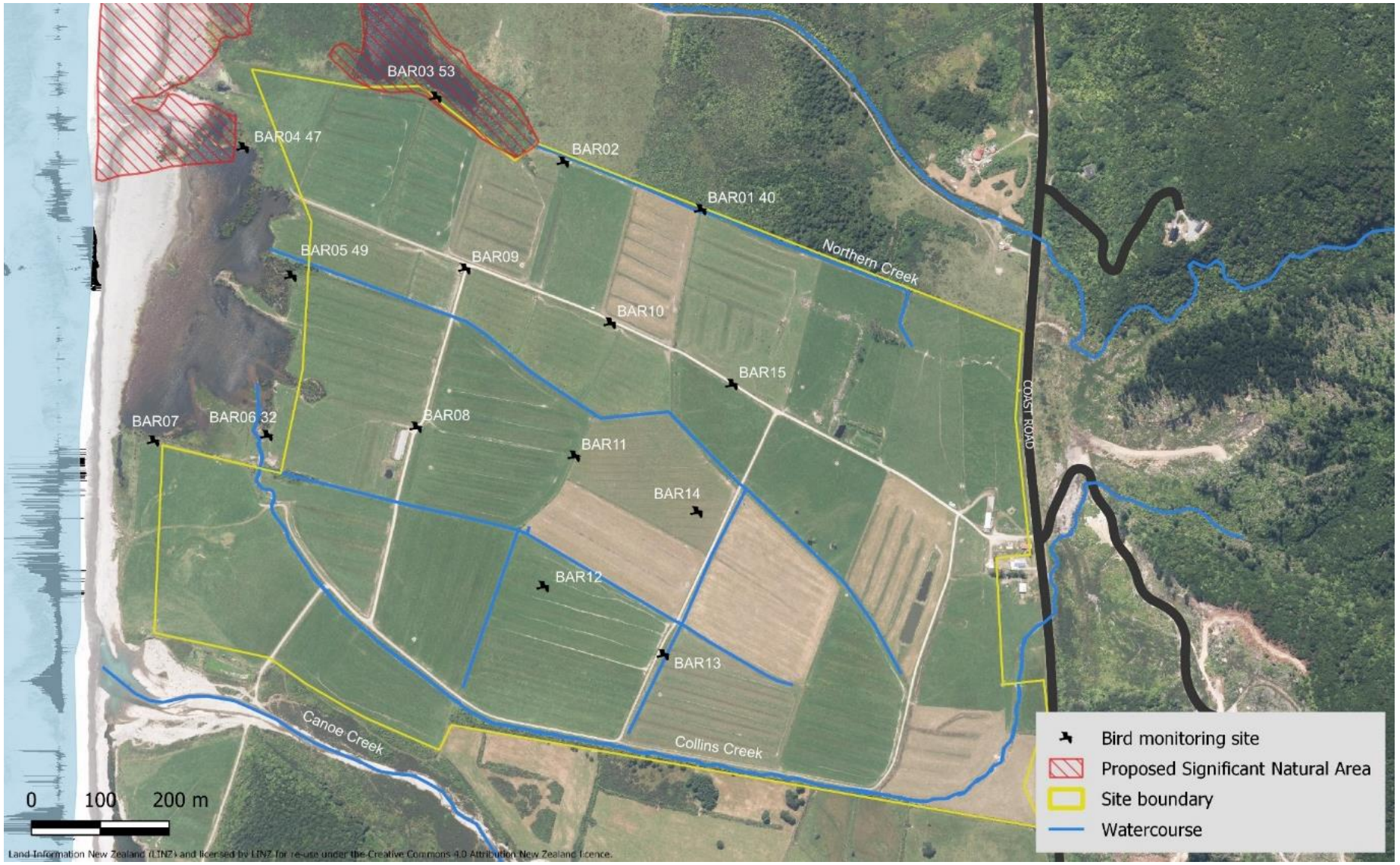

Figure 7: Location of bird monitoring sites at Barrytown.

5.2 Annual Bird Management Report

An annual bird management report will be prepared which details the following matters:

- The timing and duration of any mining within 100m of the coastal lagoon vegetation and the SNA;
- Results of seasonal bird surveys at the site;
- Timing of nest detection surveys and observations relating to nesting or other behaviours observed within the area to be mined;
- Efforts to deter any attempts at nesting within the area to be mined and the outcome of those efforts;
- Species attempting to nest within the area to be mined (including threatened and at risk species);
- Date of first nesting attempts (if any) for threatened and at risk species within the area to be mined;
- Number and location of nesting attempts by threatened and at risk species within the area to be mined;
- Date any predator control commenced, the location of traps and bait stations, the number of captures, the amount of bait consumed and any relevant observations;
- Outcome of individual nesting attempts by threatened and at risk species within the area to be mined;
- Results of annual kororā surveys on Pakiroa Beach, the implications for mine operations and any management actions undertaken;
- Number and location of any grounded tāiko and any birds found dead at the site;
- Management undertaken and the outcome for any grounded tāiko collected;
- Autopsy outcomes for any dead tāiko collected;
- The number, dates and location of any near misses with vehicles for any native species;
- The findings of any lighting audits undertaken during the year and steps taken to resolve any issues identified.
- A summary of any revisions made to this management plan and the reasons for the changes;
- The date and duration of any operational shut-downs;
- The results of the quarterly walk-through surveys of birds using the lagoon area.

The annual bird management report will summarise the above information, identify any trends or patterns and compile any relevant maps. This report will be reviewed by a suitably qualified and experienced independent ecologist/ornithologist who will evaluate the findings and provide any recommendations considered necessary to improve bird management at the site.

The annual bird management report and any updates to this management plan will be provided to the Grey District Council, Te Runanga o Ngāti Waewae, Paparoa Wildlife Trust, the Community Liaison Group for the project, West Coast Penguin Trust and the Buller/Kawatiri office of the Department of Conservation in Westport no later than 30 June each year.

6.0 Summary

TiGa proposes a mineral sand mine located on farmland near Barrytown, approximately 36km north of Greymouth. The mining area adjoins wetland areas which provide important habitat for a range of indigenous bird species, some of which are considered to be threatened or at risk. The proposed mine is also located near the only known breeding colony of tāiko (Westland petrel, *Procellaria westlandica*).

Fourteen threatened and at-risk bird species have been identified using the habitats adjoining the site. The majority of these species would not use the pastoral habitats within the site, but would be affected by noise, human activities and vehicle movements near their habitats, particularly during the breeding season. A number of management activities (e.g., maintaining buffers from key areas of habitat, planting, avoidance of mining strips adjacent to high quality habitat during breeding season) will be undertaken to minimise impacts on these species.

Specific management actions for threatened and at risk species if they are detected at the site during ongoing monitoring include: detection surveys to identify birds prospecting for nest sites, discouraging birds from establishing nests in the work site, managing established nest sites (including establishing no-go zones within 50m and initiating predator control) and monitoring identified nests twice weekly.

Annual surveys will be undertaken to locate kororā using Pakiroa Beach within 500m of the mining area and this information will be used to plan kororā management.

The area to be mined is located approximately 3.6km south of the only known colony of tāiko/Westland petrel. Both adult and young birds are known to be disoriented and attracted by artificial lighting and can be grounded. In order to avoid the effects of lighting at the mine during night time operations no mining or trucking movements outside daylight hours are proposed. Processing would occur at night within the processing plant, which will require some lighting to maintain a safe workplace. The building has been designed to avoid light spill where possible and adherence to the Australian Government's National Light Pollution Guidelines or Wildlife, January 2020 (or subsequent revision) is proposed in relation to that lighting. Minimisation techniques will include (but not be limited to) pointing all fixed lighting downward, shielding to avoid light spill and use of the yellow-orange spectrum. In addition, lights should only illuminate the object or area intended and be mounted as close to the ground as possible. Night time traffic movements to and from the site relating to shift changes will be minimised.

TiGa will also provide training so as to ensure staff are appropriately informed and able to implement an 'accidental discovery protocol' in the event a grounded tāiko is identified.

In the event any dead bird is identified within the site, the Department of Conservation office in Westport and Te Rūnanga o Ngāti Waewae will be informed, and collection or delivery of the bird arranged. In the event the dead bird is a tāiko and it is discovered within 50m of the pit or processing plant, a detailed information gathering and logging process will be followed.

Bird monitoring will include detection of "threatened" and "at risk" species using the site and adjoining areas. Given the small size of the mining area in relation to the wider site, birds using the area to be mined during any upcoming breeding season would be detected via fortnightly and/or weekly detection surveys and close (twice weekly) monitoring of any nesting attempts. Monitoring of birds using the parts of the lagoons, Rusty Pond and other adjoining habitats will be undertaken during seasonal bird surveys (four times each year in spring, summer, autumn and winter) using five-minute bird counts and acoustic recorders at 15 locations. At least one of those surveys each year will be undertaken at the appropriate time to detect Australasian bittern. Territory mapping of South Island fernbird will also take

place in advance of mining commencing in Panel 4 in order to inform fernbird management.

The data collected will be compiled and presented in an annual bird management plan to be used in adaptively managing the operations to protect the birds at the site and provided to Greymouth District Council, Te Runanga o Ngāti Waewae, Paparoa Wildlife Trust, the Community Liaison Group for the Project, West Coast Penguin Trust and the Buller/Kawatiri Department of Conservation office in Westport.

7.0 References

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APPENDIX A

Wildlife Act (1953) Authority to Handle Absolutely Protected Wildlife

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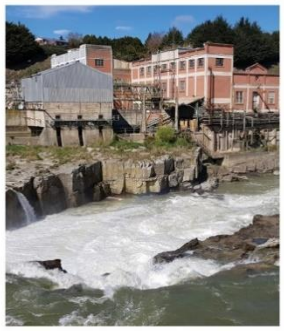
Environmental Consultants





January 2024

Wetland Construction and Riparian Planting Plan

Submitted to:
TiGa Minerals and Metals Limited

water fauna flora land

Quality Assurance

This report has been prepared and reviewed by the following:

Prepared by: Dr Gary Bramley
Terrestrial Team Lead

Reviewed by: Rebecca Bodley
Ecologist

Status: Draft v4 **Issued:** 19 January 2024

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1.0 Introduction

1.1 Background

TiGa Minerals & Metals Limited ('TiGa') proposes to construct and operate a mineral sand mine located north of Canoe Creek and west of State Highway 6 on the Barrytown Flats approximately 36km north of Greymouth. The location of the proposed mine is shown in Figure 1.

The mine would be set back from State Highway 6 and the property at 3261 Coast Road. TiGa also proposes a setback of 20m from Collins Creek, the property boundaries and the coastal lagoon. Vegetation throughout the area to be mined comprises farm pasture growing on land which has previously been 'humped and hollowed' to improve drainage for farming.

This plan specifies the planting for the constructed wetlands 3 and 4 which are to be retained after mining, as well as riparian mitigation planting along Collins Creek and the Northern Drain and coastal planting as shown in Figure 2. Note that although additional planting at the site is proposed to provide for visual screening from the lagoon, from State Highway 6 and from the coast as shown in Figure 2, this planting is not provided for in this plan. The reason for excluding these areas is that the purpose of that planting is primarily visual screening and to support natural character, although it will also have some habitat value since it comprises indigenous species and adjoins existing habitats near the lagoon edge.

The purpose of the wetland construction and riparian planting is to enhance wetland and aquatic habitats and increase the extent of wetlands at the site in accordance with the National Policy Statement for Freshwater which took effect on 3 September 2020.

1.2 Relevant Consent Conditions

The relevant consent conditions are set out below:

19.0	**Visual screening and planting**
19.1	As soon as practicable following the commencement date of this consent, and prior to the commencement of mining, the consent holder shall construct bunds and complete planting of in accordance with the attached "Landscape Mitigation Planting Plans" prepared by Glasson Huxtable Landscape Architects dated January 2024 (Schedule 4); including: (a) a 1.8m high, 13.0m wide permanent bund with planting along the bund's crest and eastern side, parallel to the State Highway for visual screening; (b) a 6.0m wide planting strip adjacent to the coastal lagoon edge; (c) a 10.0m wide band of planting along the open coastline in the south-west corner; (d) planting of the western and northern edges of the Clean Water Facility, between the coastal lagoon and ponds, so far as is operationally feasible to enable the Clean Water Facility to operate and be maintained throughout the course of the mining activity; (e) a 3.0m wide strip of planting with fencing along the edge of Collins Creek;

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	(f) a 3.0m wide strip of planting with fencing along the southern bank of the northern drain; (g) a planted strip along the north-eastern boundary of the site and adjacent to neighbouring properties at 3323 Coast Road.
19.2	As soon as practicable following the construction of the temporary stockpile near the processing plant, the consent holder shall complete planting of the stockpile area as shown in the attached "Landscape Mitigation Planting Plans" prepared by Glasson Huxtable Landscape Architects dated January 2024 (Schedule 4). *Advice Note: Planting may not be able to be undertaken during dry periods of the year, and as soon as practicable may be the start of the planting season following the stockpile construction. Disturbed area and erosion and sediment control practices will require this area to be stabilised if not planted immediately.*
19.2	Within 12 months of (but not prior to) the completion of mining, the processing plant and buildings shall be removed with the exception of the Heavy Mineral Concentrate Storage Shed, and the bund areas rehabilitated into pasture.
19.3	No later than 12 months after the completion of mining, the remaining areas of the proposed wetland area shown in the attached "Landscape Mitigation Planting Plans" prepared by Glasson Huxtable Landscape Architects dated January 2024 shall be constructed and planted.
19.4	The consent holder shall source plants required for the planting and wetland area required from within the Punakaiki Ecological District or North Westland Ecological Region in order of preference. Where this is unable to be achieved, the consent holder shall notify the Council and work with the Council and a suitably qualified practitioner to determine an appropriate alternative plant source.
19.5	The wetland construction and Collins Creek and Northern Boundary Drain riparian planting shall be undertaken in accordance with the Wetland Construction and Riparian Planting Plan (WRPP) prepared by Ecological Solutions Ltd and dated January 2024 Advice Note: All Management Plans are required to adhere to the requirements of Condition 6.0.

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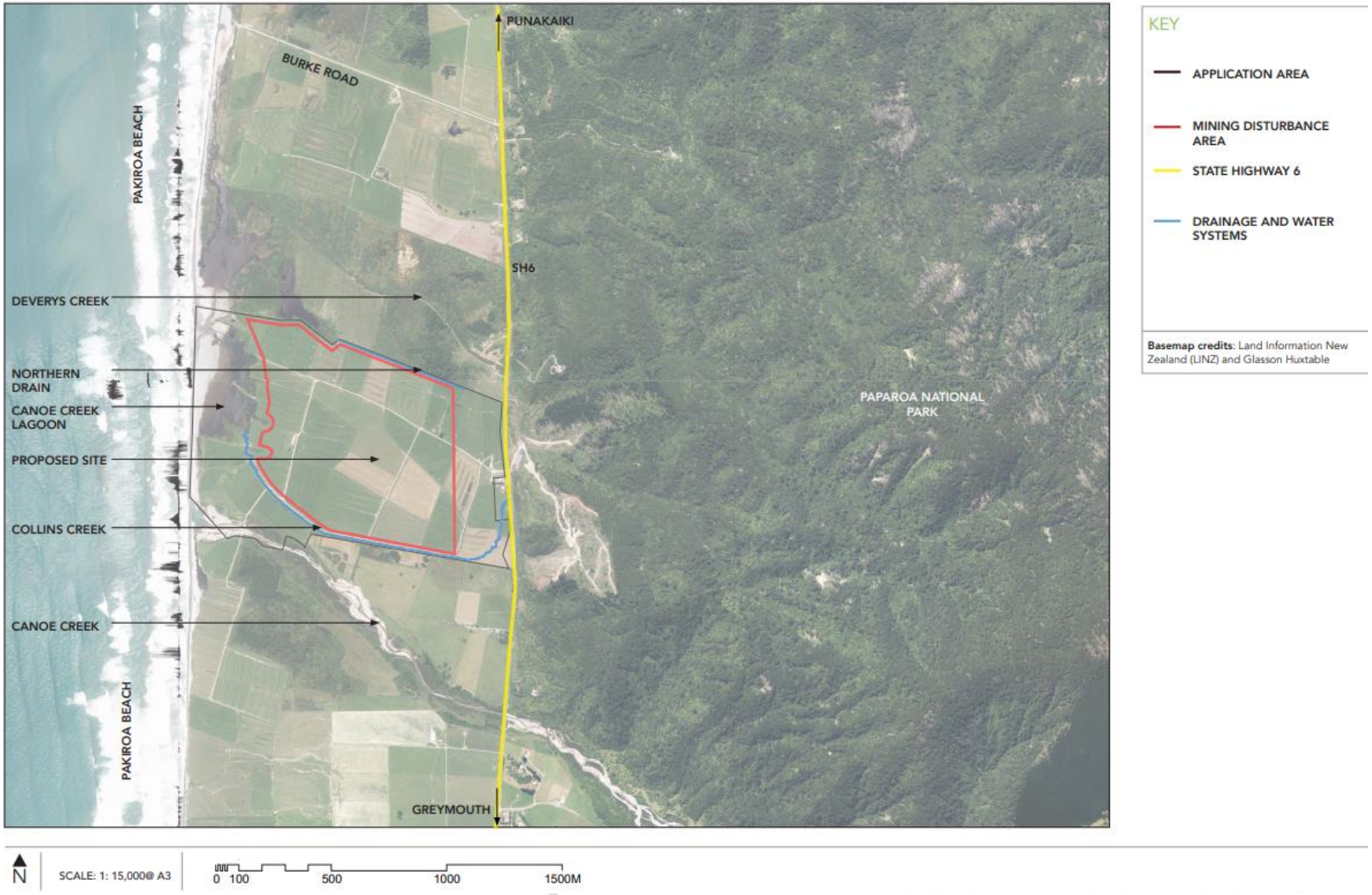

Figure 1: Location of proposed mineral sand mine, Barrytown (from Glasson Huxtable Landscape Architects 2023).

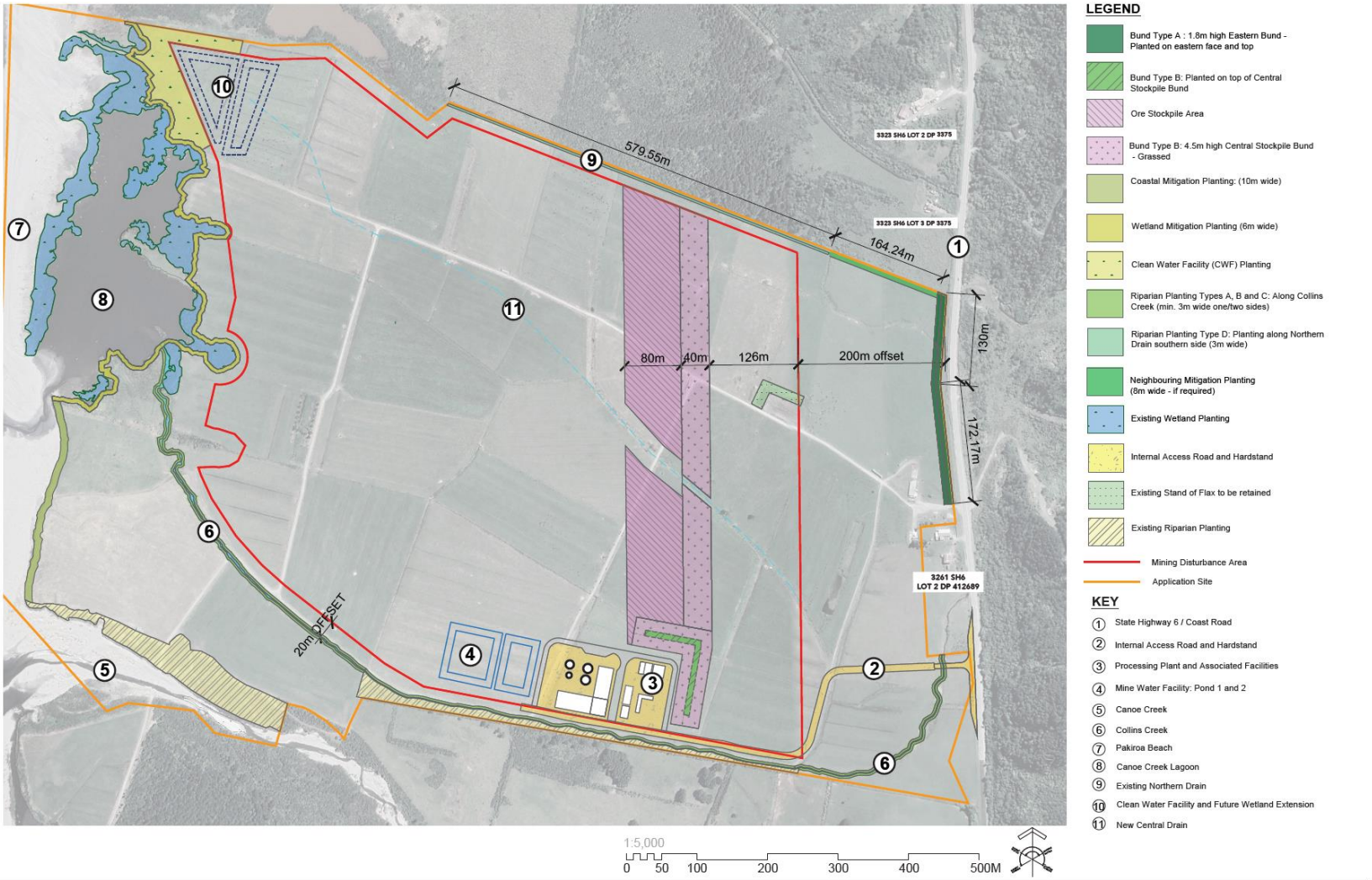

Figure 2: Proposed landscape plan for TiGa Metals and Minerals Limited mineral sand mine (From Glasson Huxtable Limited).

1.3 Goal and Objectives

The goal of this wetland construction and riparian management plan is to establish a self-sustaining native vegetation community at the restoration sites which is ecologically appropriate and once established, requires minimal further management.

The objectives of this planting plan are:

- To revegetate the constructed wetland and both edges of the part of Collins Creek and the Northern Drain and the area of coastal planting shown in Figure 2 with ecologically appropriate species and restore indigenous vegetation to at least 50% cover at 1 m height as demonstrated in plots across both wetland sites.
- Manage exotic pest plants (particularly woody weeds identified in this plan) over the restoration sites to a level of less than 5% cover as demonstrated in wetland monitoring plots across both wetland sites (refer to Section 4.1.2).
- Improve terrestrial and wetland habitat quality and create corridors for wildlife movement.
- Encourage natural ecosystem processes including the regeneration and dispersal of indigenous fauna and flora.
- Improve water quality and aquatic habitats in Collins Creek and the Northern Drain.

These objectives will be achieved by:

- Removal of unwanted plant pest species from within the areas identified for restoration.
- Revegetating the areas intended for restoration with eco-sourced, pioneer plants to establish a nurse crop into which light and moisture sensitive species will spread and establish via natural means of dispersal.
- Promoting ecological succession by including in the revegetation areas enrichment planting of terminal plant species such as kahikatea (*Dacrycarpus dacrydioides*) to initiate and promote successional processes in conjunction with natural dispersal.
- Monitoring and active control of plant and animal pests within the areas intended for restoration as required.

Plantings will be maintained for two years and management will be reviewed regularly in response to monitoring outcomes. This plan will be reviewed as required.

2.0 Background

2.1 Ecological Context

The site is located within the Punakaiki Ecological District, most of which remains in indigenous forest except for extensive pākihi (shrubland/heath) in logged areas of the Tiropahi Valley, the strip of coastal flats near Barrytown and some lower valley flats and coastal gullies which are either farmed or have been modified by coal or gold mining.

The Barrytown flats are comprised of a complex sequence of old dune ridges and alluvial deposits, which originally would have been entirely covered in lowland (coastal) forest and wetland. Nearly all of the Barrytown Flats have been modified by forest clearance and drainage for timber harvesting, mining, and farming, although remnants of wetland and forest remain. Since approximately 2010, there has been a concerted effort to rehabilitate sand plain forest on the 80ha former Rio Tinto property at the northern end of the Barrytown Flats (adjoining Nikau Scenic Reserve and known as Te Ara Tāiko Nature Reserve) with the aim

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of restoring ecological connection between the coast and habitats inland.

Adjoining the site is an area identified by Boffa Miskell as Barrytown Flats, Canoe Creek Lagoon (Site PUN-W034). Site PUN-W034 has been included in the draft Te Tai o Poutini Proposed District Plan ('the TTPP') and is shown in Figure 3.

Figure 3: Location of PUN-W034 as included in the Te Tai o Poutini draft Proposed District Plan.

2.2 Site Description

The mining site has been substantially modified for farming and other land uses and currently contains no habitats comprising predominantly indigenous vegetation beyond small planted areas of flax and three isolated kahikatea trees. Approximately 1.5km of Collins Creek flows around the southern boundary of the site to the lagoon area.

Collins Creek appears to have been channelised throughout much of its length and the riparian vegetation on the true right (north) of the upper parts of the stream has been removed by grazing. Closer to the lagoon both sides of the stream are devoid of any riparian shrubland. Livestock currently have access to the stream and stream bank erosion is evident at some locations.

The Northern Drain has been channelised throughout its length and has no indigenous riparian vegetation on the southern (true left) bank.

Because of the topography and elevation of the site, original freshwater habitats in the area would have been characterised by low order, moderate energy watercourses connected to large wetland swamps and perhaps fens. The steep upper catchments would have increased water velocity in streams, whilst nearer the coast, occasional flooding combined with poorly drained soils and high ground water would have maintained large wetland areas. These wetland areas functioned to attenuate water flows and acted as slow-release water storage areas reducing sediment load at the coast and minimising flooding. Wetland areas would have harboured a variety of native terrestrial and aquatic flora and fauna, including a high diversity of native macroinvertebrates and fish species.

Any original wetlands have been reclaimed by 'humping and hollowing' for agricultural purposes. These modifications have resulted in a near complete loss of wetland ecosystem types from the area. The ecosystem services provided by wetland systems including flow attenuation and water quality improvement have also been lost.

2.3 Wetland construction

2.3.1 Overall Outcome

The area shown as the Clean Water Facility Planting in Figure 2 and located in the northwestern corner of the Site, west of the Clean Water Facility and Future Wetland Extension (Area 10) will be planted after the water treatment ponds are established and prior to the commencement of mining. Planting is currently planned for that area for the second half of 2025.

At the conclusion of mining, the water treatment ponds referred to as Ponds 3 and 4 will be retained and reconfigured to a permanent wetland, including construction of an island. Planting of this area would be done at the completion of the project.

The wetland will cover 1.9ha in total and include the following habitats:

- An island of 2,000m^2
- At least 5,000m^2 open water up to 2m deep
- At least 5,000m^2 of shallow water (0.5m deep)
- At least 5,000m^2 of water 0.5m – 2m deep planted primarily in raupō
- At least 1,000m^2 of wet edge planting comprised primarily of rushes and sedges (*Juncus* spp., *Carex* spp.,) and shrubs such as mikimiki (*Coprosma propinqua*).
- A plant density of no less than 5,000 stems per hectare.

The wetland will include open water, an island and raupō and flaxland vegetation around the

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water margins consistent with the adjoining vegetation. The open water will be constructed to have a natural edge providing embayments and sheltered areas, as well as more exposed edges, and will vary in depth up to 2m deep. Edges will include shallow banks as well as deeper areas to provide diverse habitat for birds using the site. The island will be planted and include shallow banks to allow easy access for birds from the water. A representative concept of the wetland area is shown in Figure 4

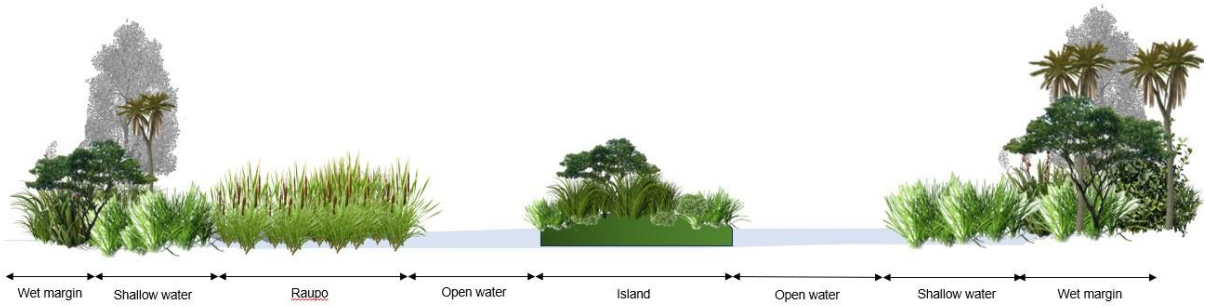

Figure 4: Conceptual cross section representation of the post-mining wetland at TiGa's Barrytown Site.

2.3.2 Methods of Construction

The pond will be constructed as part of the water treatment infrastructure at the commencement of mining. Following completion of mining at the site, as part of the removal of the water treatment system, the ponds will be reworked to conform with the specifications set out in Section 3.3.1

[Additional detail to come]

2.4 Area to be Planted

The areas to be planted are including the wetland, riparian and coastal areas are shown in Figure 2. The collective areas cover approximately 19.711m^2 (1.97ha), including 7,500m^2 at the constructed wetland, 3000m^2 of coastal planting 1,740m^2 at the Northern Drain and 7,471m^2 at Collins Creek as follows:

- Upper Reach (both banks) = 324m (2,017m^2 to be planted)
- Middle section (one bank) = 640m (1,904m^2 to be planted)
- Lower section (both banks) = 566m (3,550m^2 to be planted)

The approach taken at the terrestrial sites will be to plant at a density of between 5,000 and 10,000 stems/hectare or between 1 plant per 2 m^2 and 1 per m^2 in the riparian areas, the

coastal areas and the wetland areas. For open water areas planted with raupō, plantings will be localised in small nodes throughout the planted area which are expected to spread naturally over time. A total of 16,398 plants comprising at least 14 species will be required.

2.5 Plant Selection

- The plant species proposed to be used are shown in \

Table 1: Plant species proposed for use at TiGa wetland and riparian restoration sites, Barrytown., although other similar species may be used in addition to those listed (e.g., if a particular species is unavailable). Plant species known to have occurred within the site, that occur in similar habitats nearby and that would most likely have historically occurred on the site have been selected. The species mix has been designed to take into account the natural characteristics and variations across the site (e.g., in drainage, aspect, shelter, contour, etc.). Sufficient species diversity is present in the mix to allow the person doing the planting to use their knowledge and experience to locate plants in their preferred 'micro-zone'. Guidance for each 'micro-zone' is included in the comment section of the species list tables.

Plants have been considered for each area based on their ability to:

- Establish quickly and provide a suitable nursery crop to allow natural revegetation/ecological succession to develop;
- Grow in a high light situation;
- Tolerate the coastal location and the flooding and other water / drainage regime expected;
- Reliably establish in revegetation plantings elsewhere; and
- Contribute to natural ecological processes such as bird dispersal\

Table 1: Plant species proposed for use at TiGa wetland and riparian restoration sites, Barrytown.

Common Name	Scientific Name
makomako, wineberry	*Aristotelia serrata*
rautahi	*Carex geminata*
pūrei	*Carex secta*
pūkio	*Carex virgata*
mikimiki	*Coprosma propinqua*
karamū	*Coprosma robusta*
ti kouka, cabbage tree	*Cordyline australis*
kahikatea	*Dacrycarpus dacrydioides*
wīwī	*Juncus edgariae*.
māhoe	*Melicytus ramiflorus*
harakeke, kōrari, New Zealand flax	*Phormium tenax*
tarata	*Pittosporum eugenioides*

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kōhūhū	*Pittosporum tenuifolium*
raupō	*Typha orientalis*

With respect to the pond, areas destined to be open water and shallow water edges would include raupō, whilst wet edges on the landward side would include a high proportion of species such as wīwī rushes and sedges (*Juncus edgaria*e., *Carex* spp.,), with the areas further from the wet edge including harakeke, kahikatea (*Dacrycarpus dacrydioides*), tī kouka (cabbage tree *Cordyline australis*) and mikimiki. Across the different zones the species would be intergraded to create a natural progression from wetter areas to dry. The island would primarily be planted with flax, rushes and sedges. The coastal planting would comprise predominantly flax, so as to blend with the existing vegetation.

In riparian areas the immediate stream edge would include rushes and sedges, grading to makomako and *Pittosporum* species.

3.0 Site Preparation

3.1 Fencing

The reaches of Collins Creek, the southern side of the Northern Drain, the inland side of the coastal planting and the constructed wetland area will require fencing to exclude livestock prior to planting. Two wire electric fencing will be used to exclude livestock prior to the commencement of planting. The fence will be checked periodically and any maintenance carried out as required to ensure it remains stock proof.

3.2 Pest Plant Control

Any pest plants identified in the West Coast Regional Council's Regional plan as well as any pest plant species known to occur either within or near the restoration sites will be controlled. A list of weed species identified within the site, and recommended control methods for these species is provided in Table 2.

Table 2: Plant species to be controlled within and immediately adjacent to the wetland restoration and riparian planting area.

Common Name	Scientific Name	Control method
blackberry	*Rubus fruticosus* agg.	Dig out small patches or stem scrape and paint with glyphosate or cut and paint stumps
gorse	*Ulex europaeus*	Cut and paint stumps or spray with herbicide

The area subject to planting will need to be free of weeds and invasive grasses in preparation for successful plant establishment and subsequent weed control.

If required (i.e., if dense vegetation cover is already present), establishment of a suitable planting area will be achieved by either applying weed mat at the time of planting or applying commercial herbicides at prescribed rates (either Roundup (glyphosate) at 1% or Galant (haloxyfop) at 0.5%) to control grasses and herbaceous weeds. Planting locations will be

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spot sprayed within the area to be planted with an area of up to 1m^2 treated for each individual plant. Full foliar cover with herbicide will be achieved.

Weed spaying operators will need to take appropriate precautions to protect non-target plants and when operating near water.

3.3 Animal Pest Control

Hares (*Lepus europaeus*), rabbits (*Oryctolagus cuniculus*) and possums (*Trichosurus vulpecula*) have the potential to adversely affect newly establishing plants. Native birds such as pūkeko (*Porphyrio melanotus*) and western weka (*Gallirallus australis australis*) can also reduce planting success by removing or browsing newly planted plants.

Use of plant protectors is proposed to protect establishing plants from these browsing pests as required. It remains unknown whether control of herbivores such as rabbits, hares and possums would be required in addition to the use of plant protectors in order to protect plantings and this decision can be informed via monitoring of newly planted areas. If required hares, rabbits and possums will be controlled by shooting, spotlighting, trapping or poisoning as appropriate.

If required pest animal control should aim to:

- Maintain low numbers of rabbits, hares and possums so that loss of planted plants due to interference by these species is less than 1%.
- Reduce pūkeko and weka interference or damage to less than 5%.

If plant damage exceeds these thresholds, pre-control monitoring will be carried out to establish a baseline for pest numbers and to track the impact of pest control measures. The results of control outcomes will be measured via kill data (for mammals) and plant survival rates. Assessing both aspects will provide a strong justification for whether management actions are cost-effective and achieving their goals. Monitoring of plant survival is provided for in Section 4.0 below.

3.4 Plant Selection

All plants selected are to be sourced from the Punakaiki Ecological District (or the North Westland Ecological Region in order of preference) where possible and true to their name and species, healthy and free of disease and / or injury at the time of planting. Plant numbers and species indicated may vary depending on availability.

Plants will be well-hardened root trainer ('RT'), ½ L, 1 L, PB2 or PB3 in size (i.e., 40 – 60 cm tall at the time of planting) with no visible weed contamination.

Any myrtle species should be certified free of myrtle rust.

3.5 Planting Density and Layout

Planting density will determine a number of factors such as the overall number of plants required and the ability to establish canopy cover quickly and eliminate weed species. Higher planting densities do incur a higher cost upfront, but will need less ongoing management costs in subsequent years. Low density plantings spread the cost out, with lower upfront costs but more ongoing maintenance required in later years, but also delay the time taken to achieve an ecologically sound and visually appealing planting.

TiGa are seeking to establish these plantings and achieve self-sustainability as soon as is reasonably practicable. A final planting density of 1/m^2 with common colonist species is proposed for riparian plantings, whilst a planting density of either 1 per m^2 or 1 plant per 2m^2 is proposed for wetland areas and 1 plant per 2m^2 in coastal areas as shown in Table 3. This may be achieved by planting at lower densities initially, followed by in-fill (enrichment)

planting later. The riparian plantings will be spread over up to three years beginning prior to the commencement of mining so as to minimise the risk of adverse weather events in any one-year compromising planting success. Plantings will be supported by weed control and implementing supplementary planting amongst the established plantings after Year 1.

In order to facilitate natural regeneration and quickly achieve a natural / unmanaged aesthetic for the planting, the planting layout should mimic a natural planting regime as much as possible. In particular, large native trees (e.g., kahikatea) should be planted in small groups (3 – 5 trees) within the wider plantings. Planting of these larger trees may occur later as enrichment planting once colonist species are established if required. For these groups, larger spaces will be allowed between them to provide room for them to spread as they grow and ensure they are not overtopped.

3.6 Plants Required

A total of approximately 16,398 plants is required as shown in Table 3. Note that this is not the same total as set out in the Landscape Plans for the project (Glasson Huxtable 2024) or the Nursery Expression of Interest letter sent out in late 2023 because it does not include the additional coastal rehabilitation and visual mitigation planting (which are included in the Glasson Huxtable totals). Neither total includes additional planting after mining is completed as those totals will be confirmed closer to planting (i.e., before mine closure).

Colonising plants are typically different from those which come to dominate the canopy over time, in part because they are adapted to growing in different environments (high light versus low light). Plant numbers and species indicated may vary depending on availability.

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Table 3: Plant species proposed for use at TiGa Sand Mine, Barrytown, divided by location.

Common name	Scientific name	Percentage of Planting	Habitat	Number required
Wetland Areas				
rautahi	*Carex geminata*	14	wet soils	938
purei	*Carex secta*	7	wet soils	505
pukio	*Carex virgata*	14	wet soils	938
karamū	*Coprosma robusta*	1.5	margins	103
mikimiki	*Coprosma propinqua*	1.5	margins	103
ti kouka, cabbage tree	*Cordyline australis*	4	margins	313
wīwī	*Juncus edgarie*	14	wet soils	938
harakeke, lowland flax	*Phormium tenax*	42	margins	2,812
raupō	*Typha orientalis*	1.5	open water	104
Total wetland plants		**100**		**6,754**
Stream Riparian Areas				
Stream Edge				
rautahi	*Carex geminata*	30	Stream edge	817
purei	*Carex secta*	10	Stream edge	272
pukio	*Carex virgata*	30	Stream edge	817
wīwī	*Juncus* spp.	30	Stream edge	817
Total for Stream edge		**100**		**2,723**
Upper banks				
makomako, wineberry	*Aristotelia serrata*	10	Bank	553
tī kouka	*Cordyline australis*	10	Mid and upper bank	553
mikmiki	*Coprosma propinqua*	10	Bank	553
karamū	*Coprosma robusta*	15	Mid and upper bank	829
kahikatea	*Dacrydium dacrydioides*	20	Mid and upper bank	1,105
māhoe	*Melicytus ramiflorus*	15	Upper bank	829
harakeke, flax	*Phormium tenax*	5	Mid bank	276
tarata	*Pittosporum eugenioides*	5	Upper bank	276

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kohuhu	*Pittosporum tenuifolium*	10	Upper bank	553
Total for Upper banks		**100**		**5,527**
Total Riparian Plants				**8,250**
Coastal Areas				
harakeke, flax	*Phormium tenax*	100	throughout	1,395
Total for Coastal Plant		**100**		**1,395**
Grand Total				**16,398**

The number of plants required divided by species is shown in Table 4.

Table 4: Plant species proposed for use at wetland and riparian plantings, TiGa Sand Mine, Barrytown, divided by species.

Common Name	Scientific Name	Number required
makomako, wineberry	*Aristotelia serrata*	553
rautahi	*Carex geminata*	1,562
purei	*Carex secta*	947
pukio	*Carex virgata*	1,492
karamu	*Coprosma robusta*	1,781
mikimiki	*Coprosma propinqua*	961
ti kouka, cabbage tree	*Cordyline australis*	903
kahikatea	*Dacrycarpus dacrydioides*	1,375
wīwī	*Juncus* spp.	1,155
māhoe	*Melicytus ramiflorus*	829
harakeke, New Zealand flax	*Phormium tenax*	4,703
tarata	*Pittosporum eugenioides*	276
kohuhu	*Pittosporum tenuifolium*	553
raupō	*Typha orientalis*	135
Total		**16,398**

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3.7 Planting Method

All riparian margin and coastal plants will be planted with a slow-release fertiliser tablet beneath the root mass as shown in Figure 5. Wetland plants will be planted in a similar way without a fertiliser tablet.

All plants will be planted to the same depth as their growing container and care will be taken to avoid damaging roots during planting.

Land based plants may be mulched with coarse sawdust, bark or other material to a depth of 100mm at the time of planting in order to control sediment runoff, conserve moisture and suppress weeds if required. Alternatively, weed mat may be used. Once planted, plant protectors will be installed as required. Wetland plants may or may not be mulched

depending on their location.

Within the planting zones outlined, species should be targeted towards the most favourable microsites possible for establishment.

Soak the plant before removing from the bag / pot. Ensure the hole is 3x the diameter of the root mass (cover with dirt) and the depth is 1.5x the root mass. Place a fertiliser tablet in the hole (Dryland and Riparian areas only).

Ensure the fertiliser tablet does not directly touch the plant's root mass with dirt. Ensure dirt is not sitting around the base of the plant's stem.

Figure 5: Proposed planting method.

4.0 Monitoring and Maintenance

4.1 Monitoring

4.1.1 Plant Establishment

The aim of monitoring plant survival is to ensure that sufficient plants survive (or are replaced) to ensure that the ecological outcomes (50% canopy cover, ecological connection restored) will be achieved and provide an informed basis for ongoing management (e.g., implementation of pest control or supplementary planting).

Plants will be inspected three months after planting to determine their initial survival and establishment. Any plants which fail to establish will be replaced as required, although they may not be replaced at exactly the same microsite or with the same species. Replacement plants will be planted according to the guidelines provided above in the period between May and August following the discovery of dead plants.

Once plantings have established (after six months), monitoring will be undertaken at least twice annually for the next year (during spring and autumn).

Monitoring shall include, but not be limited to, the following:

- Success rates, including survival rate and the number of plants lost.
- Achievement of canopy closure, including notes on growth rates and natural ecological processes such as the use of the area by birds and presence of natural native seedling establishment. The target for closure (i.e., cessation of management) is 50% canopy cover at 1m height.
- Plant health, noting any indicators of ungulate, insect or disease damage or presence.
- Consideration of any follow-up maintenance required in terms of weed control, animal pest control, plant replacement, plant disease control and fence maintenance.

Monitoring will be summarised in an annual summary sheet to provide for any later reporting. A sample monitoring field sheet for restoration planting can be found in Appendix A.

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4.1.2 Wetland Quality Monitoring

The aim of the wetland monitoring is to provide quantitative and repeatable data to ensure that the proposed wetland restoration is resulting in improved ecological condition and progressing towards self-sustainability, as well as provide a basis for ongoing management.

Wetland quality monitoring will consist of two 5m by 5m monitoring plots based on the methodology described in "A Handbook for Monitoring Wetland Condition" (Clarkson et al. 2004), where vegetation is estimated over different wetland tiers depending on complexity (i.e., canopy, sub-canopy, ground cover). The location of the plots will be selected at random using a method of random point generation. Discretion will be used on site to shift monitoring plots if required (e.g., if a particular location is unsafe or if a particular site would provide biased results). The monitoring will exclude soil core and foliage laboratory analysis.

A minimum of four permanent photo points will be established at appropriate locations to visually demonstrate the restoration over time.

Monitoring will be undertaken six months after the initial planting has been undertaken following wetland construction. Monitoring of wetland condition and photographs at photo points will then be undertaken annually until closure is achieved. Review of this plan will include consideration of whether the objectives set out in Section 1.3 have been achieved or if further actions are required.

A Wetland Condition Assessment, including one Wetland Record Sheet for each site and two Wetland Plot sheets for each site will inform a brief monitoring report to be prepared after each monitoring occasion detailing results, outlining conclusions and providing recommendations as necessary.

4.2 Maintenance

General plant maintenance may involve the following (depending on requirements):

- Watering of all new plants at the frequency and amount required to sustain healthy development.
- Control of insects and disease by treatment with an appropriate chemical.
- Removal of any damaged of diseased plant material (to prevent further spread).
- Fill of any soil compaction and sinkage around plants (common post planting once the soil has settled).
- Plant releasing as required.

Plant releasing is the process of releasing young plants from competition due to surrounding growth of grasses and weeds until they can either compete effectively, or have over topped fewer desirable species.

Plants will be released using the following methods:

- Hand/manual releasing, which can involve the use of a scrub bar or hand tools to cut back grass and weed growth around plants which have or are at risk of becoming supressed. This method is labour intensive but low risk to plant health.
- Spray releasing with herbicide, this method depends on the herbicide to be used and the skill of the contractor and the proximity to open water and existing plants. Typically, selective herbicides such as Galant™ are able to be applied safely around/over most native species (excluding monocots such as cabbage tree/tī kouka, flax and *Carex, Juncus* and *Cyperus* species). In the instance where spray releasing can reduce labour, incompatible species can be manually cleared as per manual release above.

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- Non-selective herbicides (such as glyphosate) will not be used due to the high risk of spray drift and associated non-target mortality.

If spray releasing with herbicide is the method selected, operators will be required to have completed the relevant GROWSAFE course.

4.3 Plant Replacement

A 5–10% mortality rate is typical in the first year following revegetation plantings due to natural causes such as insect damage or drought along with mortality from mammal pest damage and spray drift. Plant mortality of 5% is expected in the first year post planting, followed by 3% in the second year. Species used to replace dead plants will be consistent with the species selection and proportions noted in Table 3 and Table 4, respectively.

4.4 Animal Pest Monitoring

Animal impacts on plants will be monitored during each monitoring round. If plant losses to herbivore or other animal damage exceed 1% (in the case of rabbits, hares and possums) or 5% (for all other species) then appropriate animal control or other methods of pest exclusion will be instigated.

4.5 Weed Monitoring

The goal of weed monitoring is to ensure that undesirable plants are identified as quickly as possible and removed before establishing a local population. In most plantings, woody weeds (i.e., shrubs and trees) are of more concern than grasses or herbaceous weeds because the latter will eventually be shaded out.

Monitoring of woody weeds is to be carried out twice annually in spring and autumn (at the same time as weed control) and will involve walking across as much of the restoration sites as practicable (including all tracks and the parts of the site without established tracks) ensuring that as much of the area is visited as possible and looking for weeds, recording their presence and where possible removing or otherwise treating them immediately.

In order to ensure consistent monitoring coverage, the restoration sites will be systematically searched for woody weeds by walking around the sites and looking for weeds either as new arrivals (at ground level) or as more established examples (within the canopy or emerging from it). Those doing the monitoring will either carry a GPS or plot the track walked on an aerial image or map of the property so as to record the survey coverage and allow any areas missed to be identified and visited later. The location of any weeds encountered will be recorded as they cross the site. A sample data sheet which can be adapted for the site is included in Appendix B.

All woody weed species found will be recorded, along with the approximate size of the population (either number of plants or area covered) and the management treatment applied. Where herbicide is applied a follow-up visit will be planned to confirm that it has been effective and to note whether additional applications might be required (e.g., due to regrowth).

4.6 Weed Management

The objectives of this plan relating to weed management are to:

- Prevent the establishment of new woody weed species which would impair natural succession of native vegetation within the planted areas of the restoration sites.
- Minimise the spread of existing woody weeds within or into the restoration sites.
- Maintain the distribution and abundance of weeds at the sites at low levels so that

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weeds do not impair natural succession of native vegetation cover in the medium to long term.

Weed control measures are based on four principles:

1. Preventing establishment of new weed species and populations. This involves site hygiene and measures to prevent propagules arriving on site (e.g., in plant arriving for planting) and site management to reduce suitable habitat for weeds that breach the borders.
2. Minimising the spread of weed populations within the site. This involves systematically monitoring the spread of weed populations and preventing their growth and reproduction.
3. The planting of desirable (including native) species or non-invasive species into previously cleared or unused areas allowing them to get a "head start" over the weeds and prevent them colonising.
4. Monitoring to ensure weeds are not compromising the desired outcomes.

Effective weed control requires identification of weed species, locating individual colonies and then extermination of the weeds using appropriate methods, followed by revegetation with desirable plants and monitoring to ensure the weeds do not return. There are a number of management techniques that improve the success of weed control and provide a degree of certainty about the outcome of a weed control programme. The spread of weed populations within the property will be minimised by:

i. Use of appropriate methods (including herbicide, manual or mechanical techniques) for the target species. Advice on control methods for particular species is available at www.weedbusters.org.nz.

ii. Regular systematic recording of known weed colonies and control efforts throughout the planted areas.

iii. Monitoring of weeds and undertaking weed control before seeding.

iv. Undertaking regular (twice yearly) monitoring and inspection of planted areas. In order to minimise the establishment of weeds, inspection staff will routinely carry herbicide wands or backpacks, so that, weather permitting, any plants that cannot be manually removed are treated as they are identified. The location of these plants will be recorded as part of the monitoring programme to allow identification of at-risk areas.

v. Annual checks for weeds and hand pulling or spraying will be carried out as appropriate on the undisturbed ground near roads and working areas.

The amount of time taken to carry out weed control and monitoring will decrease over time as target species are eradicated and replaced by desirable vegetation.

5.0 Proposed Timeline

It is proposed to undertake the riparian and coastal plantings within one year at the start of the project (at this stage 2025). Planting of the wetland area is proposed for the second half of 2025, but would also occur within one year. The indicative staging of the plantings is provided in Annexure 3 of the Landscape Mitigation Planting Plan (Glasson Huxtable 2024) and reproduced below as Figure 5.

Table 5: Indicative staging of planting for wetland restoration at TiGa Mineral Sand Mine, Barrytown (from Glasson Huxtable 2024).

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	LANDSCAPE PREPARATION AND ESTABLISHMENT **									ACTIVE MINING							REHABILITATION		
Year	2023	2024	Q2	Q3	Q4	2025	Q2	Q3	Q4	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Consent Term	Year0	Year 1				Year 2				Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Planting Plans																			
Nursery EO1																			
Tender Package																			
Nursery Contract Confirmed																			
Plant Seed Collected																			
Propogation/Growing of Plants																			
Confirmation of Suitable Plants																			
Planting Bund Type A*																			
Planting - Collins Creek																			
Planting - Canoe Creek Lagoon																			
Planting - Northern Neighbour																			
Planting - Coastal																			
Planting - Northern Drain																			
Planting - Bund Type B																			
Planting - CWF																			
Landscape Maintenance During Mining																			
Planting - Enrichment																			
End of Mining - Rehabilitation																			
Planting - CWF Wetland Extension																			
Removal of Stockpile Bund Planting																			

In order to be most successful, planting and weed control should be undertaken at particular times throughout the year. For example, planting is best undertaken in late autumn and winter so that plants are well established before the summer dry period arrives, whilst weed control is best undertaken in autumn (when plants are most visible because they are often flowering or fruiting) and spring (when plants are most actively growing and before they set seed).

Table 6 sets out the window of time annually within which particular management actions relating to weed control, and monitoring should be completed over the three year life of this plan.

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Table 6: Indicative annual schedule for planting activities

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 2	-	-	-	M PM	-	-	-	-	PM APC	M PM	M APC PM	-
Year 3	-	APC	PM WC	PM WC M	PR	PR	-		PM M	APC PM WC	WC	-
Year 4	-	APC M	WC PM M	WC PM M	PM PR	PR	-	M WC	WC M PM APC	M PM APC	M PM WC	-

Note: M = Monitoring- assess plant survival in order to respond to any required actions such as weed or animal control, APC = Animal pest control (of rabbits, hares, and/or possum if required), PM = Plant maintenance, including manual releasing (if required), WC = Weed control (if required), PR = Replacement planting (if required).

6.0 References

Clarkson, B.R., Sorrell, B.K., Reeves, P.N., Champion, P.D., Partridge, T.R., Clarkson, B.D. 2003. Handbook for Monitoring Wetland Condition. Revised edition 2004. Landcare Research, Hamilton, New Zealand.

McEwen, W.M. 1987. (Editor). Ecological Regions and Districts of New Zealand (third revised edition in four 1:500,000 maps). New Zealand Biological Resources Centre publication no. 5. Department of Conservation, Wellington.

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APPENDIX A

Sample Restoration Planting Monitoring Sheet

MONITORING FIELD SHEET FOR RESTORATION PLANTING

Sample field sheet for completion annually to inform annual report.

Date (d/m/y) _____ Date of last monitoring_____

Consent number _____

Address_____

Property owner and contact details:

_____

_____

Has property changed owners in the last year? YES / NO

If yes, who was previous owner?

_____

Survival Rate

Percentage survival _____

Growth estimate (cm/year)_____

Percent ground cover _____

Canopy closure achieved YES / NO

Approximate canopy cover_____

Fertilizer

Date applied _____

Product used _____

Areas applied _____

Quantity used _____

Weed control

Date undertaken _____

Sprays used _____

Application Rate_____

Weeds targeted _____

Areas targeted _____

Replacement planting

Date undertaken _____

Species being replaced _____

Species planted _____

Number of plants replaced _____

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Problems

Are certain weeds proving difficult to control and detrimental to the planting, are animal pests causing significant problems?

Nature of problem(s):

Possible solutions:

Analysis of plant losses

Are losses greater than expected, are there any obvious reasons, are losses in certain areas, are certain species showing high losses, what are possible solutions?

State of fence

Is the fence still secure? Has any maintenance of the fence been undertaken? Is any required?

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APPENDIX B

Sample Weed Monitoring Sheet

Sector Name	Habitat Type	Weed Risk	Size	Map Ref.	Search Date	Staff	Search Effort	Weeds detected	Action	Followed Up	Next Inspection Due
Block M	Streamside Planting	High	0.5ha	Area 3	1/1/22	J. Smith	1 hour	Barberry (15 m^2) Gorse (3 plants) Thistle (1 plant)	Spray (Answer) Spray (Answer) Hand pull Weeds mapped Follow up scheduled	1/03/22 All dead	1/06/22
Slope south of Block L	Regenerating shrubland	Low	500m^2	Area 1A	1/1/22	R. Jones	1 hour	None	None		5/7/22

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