**Technical Peer Review - Buller Plateaux Continuation Project**

**Dr Robyn Simcock**

**19 August 2026**

## 1. Reviewer experience relating to Stockton Mine

I have not attended any project meetings nor visited the site as part of this process, however I have over 20 years' experience of rehabilitation at Stockton. This experience has included review of earlier rehabilitation and establishment of planting and direct transfer trials associated with the Cypress Mine project from 1998/99. These were reassessed in 2006 as part of planning for Mount Augustus ridgeline project. That project involved the first large-scale use of the 'direct transfer' revegetation method (machine extraction and relocation of 1 to 2 m2 blocks of plants with their soils) which furthered techniques to protect, buffer and recreate habitats for *Powelliphanta augustus*. It also included trials of hand salvage (up to 30 by 30 cm plugs) of a wide range of small coal measures plants including *Dracophyllum, Celmisia* and *Chionochloa* species. In 2011 sandstone pavement and tarn rehabilitation trials were conducted as part of planning for the Mount Willliam project. I was also involved in development of hydro-mossing methods for highwall rehabilitation and *Juncus squarrosus* herbicide methods (with subsequent native planting) conducted through the 2000s. More recently I investigated the use of biosolids in rehabilitation in a small series of trials, however I was last at Stockton and Denniston in September 2023. At that time, I reviewed rehabilitation trials constructed pre ~2014 to support a potential guide on the history of Stockton rehabilitation. The majority of trials associated with the Mount Augustus project were present at that time, including the sandstone pavement and tarn, direct transfer and hand transfer trials.

## 2. Scope

In December 2024 Bathurst Resources invited me to peer review aspects of the Buller Plateaux Continuation Project related to rehabilitation from February 2025. The purpose of the technical reviews was 'to ensure a high-quality application and provide assurance that robust and fulsome assessments have been undertaken for the Project'. The reviews were supported by Buller District Council, the West Coast Regional Council and Te Rūnanga o Ngāti Waewae to increase their confidence 'in the assessments undertaken when providing comments to the Panel on the Project application in the required short time frames'. The following summarises a series of independent reviews of rehabilitation, including weed and biosecurity management undertaken for the Project fast-track application.

## 3. Review process

I was asked to review four, intimately linked documents that together inform, describe and underpin planned rehabilitation outcomes.

- Rehabilitation Outcomes Report (v8 June and August 2025, v10 January 2026 and final version April 2026 with formal comments provided August 2025 and April 2026).

- Biosecurity Management Plan (v5 November 2025) and final reviewed 30 January 2026 (BPCP-ENV-PLN-007)
- Buller Plateau Weed Management Plan (v2 November 2025) and final reviewed 30 January 2026 (BPCP-ENV-PLN-008)
- Continuation Rehabilitation Plan (v4, February 2026, v6 June 2026) with consolidated feedback in April 2026 and feedback on specific points through to July 2026

I did not review five ecological management plans that cross-link to Rehabilitation and the wider landscape. These management plans cover Avifauna (BPCP-ENV-PLN-003), *Powelliphanta* snails (BPCP-ENV-PLN-004), lizards (BPCP-ENV-PLN-005), aquatic ecology (BPCP-ENV-PLN-006), Pest control (BPCP-ENV-PLN-022) and Biodiversity Outcome Monitoring (BPCP-ENV-PLN-009) Management Plans (MP) and have been reviewed by other technical experts. I did not see the Sediment and Erosion MP or Engineered Landform MP.

My review of each of the four reports was an iterative process working with the primary author, Dr Gary Bramley of Ecological Solutions, over several drafts between August 2025 and April 2026. Reviews involved detailed comments and track change suggestions entered directly into each of the draft documents, and limited discussions. Overall feedback was also provided in informal letters to Bathurst in August 2025 and April 2026 (Rehabilitation Outcomes Report), February 2026 (Continuation Rehabilitation MP when some sections were incomplete), November 2025 and January 2026 (Biosecurity MP and Buller Plateau weed MP). The Continuation Rehabilitation MP was the final document reviewed and was the most dynamic document, with significant changes through the course of the multiple reviews in some sections that increased the detail and clarity of what was proposed. In mid-August 2026 I reviewed the draft Buller Continuation Project Schedule of Specific Conditions – Rehabilitation and Closure Conditions, referenced as RHM1 to RHM77.

All my recommendations in the Biosecurity and Weed MP were addressed and the majority of my recommendations in the Rehabilitation Outcomes Report and Continuation Rehabilitation MP were addressed. The focus on this summary review is the Continuation Rehabilitation MP. My comments on the proposed conditions have not been reviewed by the applicant.

## 4. Biosecurity and Weed Management Plans

The following summarises my technical assessment of the two rehabilitation reports. I have not included detailed commentary on the Biosecurity and Weed MPs, as these reviews were straightforward, all suggested changes from peer review were adopted and documents are finalised and complete. I consider the Biosecurity and Weed MPs are likely to deliver their primary stated objective, being to '*reduce the potential for pest species to compromise rehabilitation outcomes or adversely affect natural communities*'. This is important as weeds on the Plateaux are a key threat to rehabilitation and adjacent ecosystems. The high-value coal measures and pavements adjacent to roads and water infrastructure are particularly vulnerable to weeds as ongoing disturbance associated with this infrastructure provides sites for gorse, broom and heath rush to establish. All these species have long-lived (multi-decadal) seed banks that pose a threat to native ecosystems.

Together I consider the significant investment required by the Biosecurity and Weed MPs represent best practice at a mine site. The MPs describe repeated weed surveys that start before vegetation stripping and apply findings to enable transfer of weeds into rehabilitated areas is minimised, and weeds are detected before populations threaten rehabilitation outcomes. The extension of weed control to areas outside the project footprint that are potential ongoing sources of weeds, including above highwalls is key to delivering the closure objective of self-sustaining ecosystems. This is

best practice, as is the assessment of the threats that individual plant species pose in relation to the specific ecosystems on the plateaux. That assessment is based on specific weed traits and the underlying rationale provided. I consider the management detailed in the plans significantly reduces the risk of rehabilitation failure (weeds being a primary risk to many plateaux ecosystems). The management described also increases the certainty that the stated rehabilitation outcomes can be achieved with minimal ongoing management.

5. **Rehabilitation Outcomes Report**

The Rehabilitation Outcomes Report provides the rationale for many of the objectives and approaches in the Continuation Rehabilitation MP. The Rehabilitation Outcomes Report summarises rehabilitation conditions, describes rehabilitation outcomes, and recommends rehabilitation approaches. It complements plateaux-wide vegetation mapping. The core of the report summarises an impressive and unusually comprehensive monitoring effort concentrated in 2023-2024 across Stockton and parts of Denniston Plateau. The monitoring compared outcomes of rehabilitation using three different methods: 'planting' nursery-raised seedlings, 'direct transfer', or 'non-remediated'. The latter were sites that were not planted but may have included regrowth of plants surviving stripping and/or movement of soils, i.e. 'jumble dump'.

The purpose of this intensive monitoring effort over 2023-2024 was to understand rehabilitation performance with respect to variables relevant to mine closure such as species diversity, indigenous dominance, percentage cover, growth rates, colonisation rates, weed presence and species occupancy. It further summarises rehabilitation practices at Stockton and Cyress alongside a section on rehabilitation conditions. Together these form a valuable base for the Continuation Rehabilitation Plan that draws on the report's comprehensive recommendations that include landscape considerations, soils and root zones, surface micro-habitats, weed management and applied research needs.

Additional and separate studies include valuable comparisons of constructed and natural tarns and a large-scale assessment of drill sites vegetation focusing on quantifying weed presence. The report also summarises targeted earlier monitoring of *Powelliphanta* snails and earthworms (from 2024 and earlier) and some of the past research on hydroseeding and hydromossing. The long-term performance of stored direct transfer described in the Rehabilitation Outcomes report has valuable information on changes in plant species diversity and cover over time including threatened native plants and weeds.

I strongly support publishing bryophyte and plant data as scientific papers so the information can enter the formal scientific literature and therefore be more widely available. However, this is unlikely to happen without specific funding. I suggest it would therefore be useful for the Panel to explore the extent to which funding publication could be considered as contributing towards ecological compensation. Similarly, remeasuring the 2023-2024 plots using core measures as those proposed to assess new rehabilitated areas of the continuation Project is likely to be valuable. Such measurements could benchmark rehabilitation performance and inform longer-term (post closure) successions of the proposed project. More insight could also be gained from the 2023-2024 plot data, as some of my earlier recommendations were unable to be actioned due to difficulty of finding historic documentation, the additional resources required, and the tight timeframes for the reports' completion. Despite this, the Rehabilitation Outcomes Report is fundamental to support the rehabilitation practices proposed for the Buller Project rehabilitation and provide confidence as to how, and to what extent, the outcomes of planting and direct transfer are likely to be similar to past rehabilitation. Past rehabilitation by direct transfer has generally been successful where weed species have not established, and planting generally achieved native

dominance but was considered by the authors to be too uniform and contain a high proportion of native species that are restricted to small areas within natural coal measures landscapes

### 6. Continuation Rehabilitation MP

The Continuation Rehabilitation MP sets out the expectations for closure and long-term rehabilitation outcomes, the detailed methods through which these outcomes are achieved, constraints on rehabilitation outcomes and how they are addressed, monitoring and reporting to track rehabilitation resources and progress towards the specified outcomes.

The following review summarises the rehabilitation approach, objectives, closure criteria, and rehabilitation methods. It highlights strengths of the Continuation Rehabilitation MP and areas where more detail or changes are recommended to improve rehabilitation outcomes and/or certainty of outcomes. The main part of the review assesses the confidence that the proposed rehabilitation ecological types and specific habitats are achievable and the extent to which they are likely to be delivered before discussing the proposed outcome monitoring. I suggest potential solutions to improve clarity and certainty that the proposed rehabilitation goals, objectives, and closure criteria are delivered. The review concludes by identifying three issues that were unresolved in June 2026 when this final review was done.

The MP appendices explain key constraints and opportunities to rehabilitation on the Plateaux, and the features that differentiate the proposed rehabilitation techniques and outcomes from those surveyed in the Rehabilitation Outcomes Report. These features are important to understand why and how outcomes from planting in the Plateau project are expected to be different (better) than those at Stockton. Outcomes of VDT are expected to be similar. Some of the key improvements are:

- Enhancing heterogeneity by a) ensuring landforms are less uniform at the landform scale and the micro-topographic scale b) using a greater variation in 'topsoil' depth rather than using a relatively consistent 300 mm on most slopes, c) stripping in ways that deliver higher quality topsoil (higher organic content with less subsoil and 'jumble dump') and d) matching the proportions and species planted to the long-term vegetation target, approximately tripling the different vegetation types from the two or three used by Solid Energy
- Increasing the proportion of manuka so it is the dominant species planted and decreasing the extent and proportion of species that currently dominate most plantings at Stockton, being flax, toetoe, tauhinu, broad-leaved tussock and broadleaf.
- Establishing wire rush and tanglefern as major components of planted areas within rehabilitated shrubland and wetland vegetations with a minimum cover of wire-rush being a closure standard.
- Distributing VDT more evenly across mined areas in blocks ~0.5 hectares to act as dispersal nodes, among many other priority uses for this valuable resource.
- Including a moderate density of specifically designed habitat features for great spotted kiwi/roroa and lizards using salvaged wood and suitable rocks. These rocks will be weathered or Non-Acid-Forming (NAF) and may include other competent rocks that are confirmed as suitably benign by geochemists (e.g. potentially Buller Coal Measures sandstones). Such suitable rock chemistry needs to be a condition of consent.
- enhanced weed surveillance/monitoring and control with a greater range of non-native species being targeted for elimination inside and near the project areas, although the future treatment of weedy areas at Stockton that are not part of the Buller Plateaux Continuation Project is unclear.

### 5.1 Rehabilitation Objectives

The Rehabilitation MP states the aim to establish 'self-sustaining ecosystems' and is defined as 'without human intervention, management or protection'. Despite this, I recommend long term maintenance post closure is provided for in the MP and conditions to increase confidence that ecosystem values will be sustained in the face of the likely ongoing pest and weed pressures from outside the site combined with potential re-emergence of pest plants from long lived seedbanks inside the site (i.e. in the event of erosion or other disturbance).

The rehabilitation objectives set out in Section 1.5 are comprehensive with one exception. There appears to be no matching objective to the goal 'create landforms and vegetation communities that are sympathetic to surrounding landscapes'. This objective may be in the Engineered Landform MP which I have not reviewed. Figures and project descriptions indicate rehabilitation is dominated by large areas of moderate slopes (nominally 18 degrees) with regular benches, and smaller but significant areas of steeper benched highwalls, some other obviously engineered features with straight lines and sharp angles (particularly at Mount Frederick South) and large permanent water bodies. These seem inconsistent with the goal of sympathetic landforms.

Sympathetic landforms probably need to be 'reverse engineered' (from the landscape outcomes backwards) as landform shapes are unlikely to be markedly recontoured once received by the rehabilitation team. Confirmation is needed that a supporting objective is contained in the Engineered Landform or Earthworks MP. This could be supported by a condition requiring involvement from a landscape architect in a similar vein as the requirement for herpetology. Specifically, this condition could read as 'The Project landscape architect shall be consulted on the rehabilitation of the mine site and shall be an approver of parts of the Rehabilitation Management Plan where sympathy to surrounding landscapes can be enhanced'. The landscape architect could also inform assessment of the extent to which the objectives achieve 'physical continuity' and 'cross-connectivity' that complements ecological connectivity. A section in the appropriate MPs (e.g. the MP describing bulk earthworks and/or the Continuation Rehabilitation MP) would then identify methods to deliver the objectives. These methods typically include backfilling of highwall bases to intersect with valleys, placing soil on accessible highwall benches that abut forest or shrubland (to support taller vegetation than can be sustained on benches with thin or no soil), and strategic use of direct transfer.

### 5.2 Closure criteria

Table 1 is a critical part of the Continuation Rehabilitation MP. The table provides clear, measurable closure criteria supported by footnoted definitions and monitoring methods. The criteria are grouped pragmatically into forest, shrubland, low vegetation and rock field, and specify nine distinct post-rehabilitation ecosystems based on vegetation types, and tarns. This relatively large number of ecosystem types helps deliver outcomes much closer to natural ecosystems than has been achieved at Stockton (which historically has 2 to 3 planted ecosystem types) and reinforces the desired vegetation mosaic.

Influences on vegetation trajectories are explained in Section 2.3 of the report. Pairs of figures for each project sub area (Figures 2 to 4) show the link between planned topography and vegetation cover. Confidence in delivering these conceptual rehabilitation ecosystems would be enhanced if a table with minimum areas of each ecosystem type was provided, divided into the three large sub-project areas (Escarpment (ESE), Mt Frederick South (MFS), Stockton (STO) but excluding the Upper Waimangaroa Haul Road (UWHR)). This table would pragmatically complement Table 3 (reproduced below) which gives the 'expected' areas while providing the necessary flexibility for mining. This table could also support a consent condition that helps ensure heterogeneous

vegetation types are rehabilitated – re-establishing a distinctive feature of the plateaux, but necessarily at a coarser scale than in undisturbed ecosystems. Such an approach would minimise the risk of perverse outcomes that could arise if the numbers in Table 3 were used as absolute requirements – flexibility is important to deliver outcomes that are both ecologically desirable and practical. Once root zones and landforms are established with vegetation and have formed a cover, it would be demoralising (and possibly technically difficult) to change the succession trajectory or the dominant species. For example, flax dominated shrubland would be dominant on areas that are more free-draining than anticipated than manuka-dominated shrubland or pakihi.

*Table 1: Final Landform within the Project Area.*

| | Extent (ha) | | | | |
|---|---|---|---|---|---|
| Type | MFS | UWHR | ESE | STO | Total |
| **Native Ecosystem** | 99 | 8 | 303 | 1,168 | **1,578** |
| **Wetlands/ Tarns** | 18 | | 64 | 6 | **88** |
| **Rehabilitated Highwall** | 22 | | 42 | 40 | **104** |
| **Rockfield** | 11 | | 69 | 59 | **140** |
| **Undisturbed** | 44 | | 80 | 442 | **566** |
| **Infrastructure** | 3 | 8 | 13 | 70 | **93** |
| **Sumps/Water bodies** | 0 | | 13 | | **13** |
| **Water Infrastructure** | 22 | 2 | 3 | 37 | **65** |
| | **219** | **18** | **588** | **1,822** | **2,647** |

No specific closure criteria are proposed for highwalls, although the site-wide weed criterion applies to highwalls and modern drone technology provides a method to manage weeds on inaccessible faces. I recommend including a condition that requires a minimum %, minimum area or minimum linear metres of highwall benches to be established with root zones (e.g. soils) that are expected to support shrubland or forest. This would ensure some of the planting treatments described and illustrated in the MP are applied at a minimum scale. Without such a specified minimum, the creation of such areas is uncertain, as soil can usually only be placed while highwalls are accessible – this adds direct costs as well as increasing planning and operational complexity. The area or length proposed would conservatively apply experience gained from the large area of existing highwalls in a range of geologies on the Plateaux to determine what is safe to access.

### 5.3 Stripping and rehabilitation schedule

A provisional stripping and rehabilitation schedule was included in a version of the MP prior to June 2026. This showed significant areas of Vegetation Direct Transfer (VDT) were possible in most of the 10 to 12 years of mine operation when vegetation and soils are stripped. For example, the schedule showed >1 ha per year of VDT in most years at Mt Frederick South totalling up to 40 ha and larger scale VDT at Escarpment totalling up to 85 ha (>3 ha/year in 9 of the first 10 years). The

applicant has proposed a commitment to a minimum 15% VDT overall. It would be useful to ensure at least 15% coverage is achieved in each of the Project sub-areas (Escarpment, Mt Frederick South, Stockton and Waimangaroa Haul Road[1]). It would also be useful to consider how VDT over and above the 15% could be rewarded or incentivised in conditions. This is because despite being long acknowledged as the most effective rehabilitation and erosion control method it has been underutilised at Stockton over the last five to 10 years. I understand this is partly because VDT is not required under CML conditions or Crown indemnity conditions and is more expensive than planting. This higher cost particularly impacts Crown indemnity areas which have a limited revegetation budget. VDT also requires more complex planning to ensure suitable areas are available on which to place it, along with specifically trained loading/unloading machine operators and prioritisation of the machinery used for stripping and transport of VDT sods.

The provisional schedule also confirmed adequate soil volumes are available to underpin the planned rehabilitated ecosystems. This is critical, as inadequate soil volumes and poor root zone quality has limited rehabilitation outcomes in some areas at Stockton (and many other West Coast mine sites). The proposed rehabilitation outcomes for this project are based on a) adequate soil volumes that allow placement of variable soil depths (and cover) on areas to be rehabilitated and b) overall higher soil quality for planted areas compared to those assessed in the Rehabilitation Outcomes Plan. Higher soil quality is proposed by reducing the volume of subsoils that is mixed with topsoil during stripping. The variation of soil depth with different plant/ecosystems underpinned by variable soil depth (also called topsoil or Growth Medium Layer, GML) was summarised in an early version of the MP. A variation of this figure is included in the final Continuation Rehabilitation MP in 4.2.2. 'Landform capping' without the two right bars. This figure is useful as it clearly shows soil requirements for planted areas vary depending on ecosystem type: 'forest' has deep GML (50cm), 'shrublands' (25cm) and 'rockfield' minimal soil described as '2cm or less, often patchily distributed'. I understand these depths are averages, not minima, but this should be confirmed and would be useful to represent on the diagram.

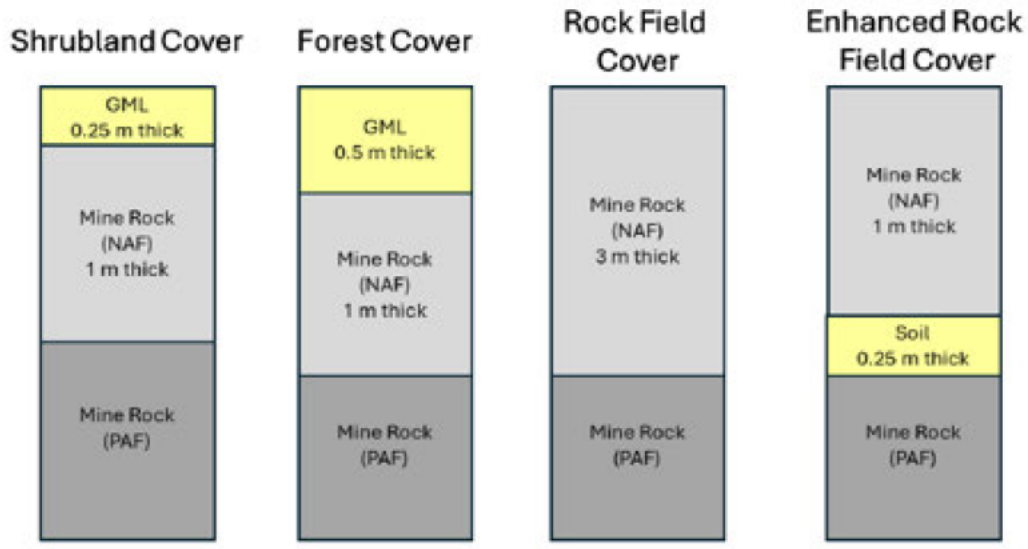


Figure 1: Cover system profiles.

*Note: not to scale.*

[1] The DT on haul road is likely to be restricted to cover of fill batters during construction, as was done very effectively along parts of the Cypress haul road.

The quality of soil/root zone influences rehabilitation outcomes. Although at least 70% and up to 85% of rehabilitated areas will be planted, the Continuation Rehabilitation MP provides minimal detail on methods used to strip and spread soils, or on stockpile management (but noting the specification that VDT bunds be used around soil stockpiles, which is best practice). It would be useful to include more detail or cross reference to the MP that contains this detail (e.g. the Earthworks MP). The Continuation Rehabilitation MP identifies the importance of limited mixing of topsoil and subsoils and promotes the use of 'jumble-dumping'[2]. When immediately placed on rehabilitation areas, the minimal handling conserves clumps of topsoil and vegetation. Jumble dump is likely to cost-effectively establish wire-rush at scale and to buffer VDT. However, the practical depth of jumble dump is usually greater than 30 cm so its use on areas other than forest is likely to 'over use' soil resources. Under Solid Energy management, jumble dump was used in small areas (e.g. Downers Dump Augustus Gardens) and as much deeper windrows (> 1 m depth). It would be helpful to propose or develop measures of 'limited mixing' that define jumble dump. This would allow annual reporting of the area and volumes of VDT, jumble dump, and conventional stripping. It could also support numerical jumble dump targets that complement VDT. Feasibility of jumble dump may include confirmation of the operational feasibility of jumble dump which included confirmation that suitable machinery is available, e.g., excavators rather than bulldozers for stripping soils and vegetation.

The quality of rehabilitation will also be influenced by the availability of suitable boulders. Like VDT, boulders are identified as being used to construct boulder fields, lizard and roroa/kiwi habitat and have stated value as part of jumble dump. Large volumes of NAF and weathered boulders will be needed for stream rehabilitation. It will be important to forecast and track volumes of boulders needed to deliver the rehabilitation outcomes. Stripping and salvaging boulders, VDT and Jumble dump are all 'slower' than conventional stripping. Further, suitable boulders are also likely to be salvaged from 'Run of Mine', stripped by large machines (not specialist rehabilitation team) where recovery of rocks can lower productivity, threatening achievement of daily or weekly production targets.

### 5.4 Rehabilitation methods

Rehabilitation methods described in the MP include protection of edges to minimise effects on adjacent vegetation, stripping and salvage of rehabilitation resources, and creation of suitable rehabilitation topographies, root zones, and plant species. These methods are generally supported by detailed design and insights from the Rehabilitation Outcomes Report based on comprehensive surveys of lichens, terrestrial and aquatic invertebrates, and small ponds/tarns (both natural and rehabilitated). A comprehensive drill site survey confirmed that high quality rehabilitation of drill sites is readily achievable using relatively straightforward techniques and with minimal ongoing weed risk. Rehabilitation methods include protection of edges to reduce edge effects to ecosystems adjacent to cleared areas and enhance recovery of stripped and rehabilitated areas through supply of natural seeds and propagules – this is a critical section that is often 'missed' in rehabilitation plans. It is particularly important here given the relatively large edges associated with the Upper Waimangaroa Haul Road.

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[2] This is defied in the Continuation Rehabilitation MP glossary as 'Placement of mixed soils, vegetation and slash on engineered landforms or elsewhere with minimal handling so as to retain patches of live vegetation and soil clods and create rough surfaces. May also include boulders. Some vegetation typically re-sprouts/germinates from this approach, some invertebrates survive, and the boulders and larger material (branches/logs) provide micro-relief for establishing plants'.

Jumble dumping and fascining are two rehabilitation methods requiring more detailed description within Section 4.3 'Revegetation'. The former is briefly described as 'Slash and Jumble-Dump' – this section would benefit from photos showing effective and poor outcomes to provide clarification. Fascining is identified as a method for establishing manuka in section 5 and referred to in proposed conditions as a 'revegetation and erosion control technique'. I recommend adding a detailed description of fascining given Stockton has used a range of fascining methods over the years with a wide range of outcomes, with the method used not the 'bundles of sticks… fixed to the ground' as defined in the glossary.

### 5.4.1 Vegetation direct transfer

VDT is unequivocally identified as the rehabilitation method delivering the best ecological outcomes (in terms of plant cover and plant and insect diversity) with low erosion risk in the shortest time. VDT is prioritised to conserve lizards (transferred within sods), provide connectivity across mined areas for lizards and *Powelliphanta*, buffer disturbed edges (particularly forest edges), surround tarns, create 0.5 ha 'inoculation areas' within rehabilitated areas and to create resilient riparian edging (~10 m width) along over 20.9 km of water courses and streams. No estimate of the VDT area needed to deliver each of these priority uses is provided. Such accounting is needed to assess the extent to which the commitment to rehabilitate 15% of the area using VDT will deliver the proposed outcomes. Estimates (perhaps as ranges) would help identify the risk not enough VDT will be available for the above priority purposes, leading to outcomes that are unlikely to be delivered by other rehabilitation methods as quickly or with as much certainty.

Priority areas from which to salvage and to place VDT are presented for the ESE and MFS project areas (Figures 8 to 11 in the report). Given the competing uses, annual reporting and auditing of VDT vegetation types, and locations where it is used for rehabilitation will be critical to ensure this technique is maximised in priority areas, and any shortfalls are obvious. Should areas of VDT be less than the commitment, adjacent areas will be planted with wilding transplants and/or nursery-grown seedlings at less than 0.5 m spacing (Section 4.1.5). This mitigation would be useful to specify in a condition that takes account of natural plant regeneration (e.g. in 'jumble dump').

## 5.5 Confidence in achieving stated the key rehabilitation outcomes

The Continuation Rehabilitation MP describes methods and success criteria that together provide confidence that the proposed rehabilitation outcomes are achievable and measurable for all three forest types, most shrubland types and pakihi, small ponds/tarns and some types of boulder field, supported by the Weed and Biosecurity MPs. The rehabilitation outcomes report applies experience from Escarpment Mine, including success propagating a range of threatened 'SOS' plant species (notably *Sticherus spp*) and from Stockton, where a range of rehabilitation trials and practices have been applied over 30 years and hundreds of hectares. This provides an unusually rich information base on which to assess rehabilitation outcomes proposed in the MP. Outcomes delivered by VDT are expected to deliver better rehabilitation outcomes than those delivered by planting, particularly greater native species diversity including bryophytes and species not readily propagated in large numbers in nurseries, larger plants that are already reproductive, and a higher cover of wire-rush and tanglefern. This is recognised in closure criteria that require higher plant species diversity for VDT areas.

The diversity and cover some of planted areas at Stockton reported in the Rehabilitation Outcomes Report are probably influenced by four factors that were unquantified: (1) additional native seed deliberately broadcast (2) regeneration of plants from 'jumble dump' soils (3) wilding transplants and (4) the species and density of nursery-raised seedlings planted. The first two factors increase

the density of native plants faster than would be delivered by nursery seedlings; regeneration and wilding transplants increase the diversity of species present. This uncertainty reinforces the importance of collecting and annually reporting baseline information for all rehabilitation sites that includes recording rehabilitation methods used (alongside information on slopes, soils, erosion control and vegetation establishment). Such collection and reporting are described in the MP.

Expected outcomes for the six rehabilitated ecosystem types (Table 1 in Rehab MP) using revegetation by planting nursery-raised species are described below. Planting into specifically designed root zones will account for up to 85% of rehabilitated areas.

### 5.5.1 Forests

Three forest variants are proposed with a minimum 1000 seedlings >1 m height per hectare of specified 'keystone' forest species established. This aims to short-cut succession and ensure the specified species are present. Experience at Stockton over more than 20 years indicates this is realistic for the three beech species and rata given adequate root zone depths and drainage (which at this site is heavily influenced by slope[3] and soil intactness) and sites are sheltered. These factors are identified in the MP. Growth rates of some species such as flax and silver beech can also be enhanced with strategic application of nitrogen and phosphorus fertilisers. However, there is little experience with pink pine (*Halocarpus biformis*) or bog pine (*Halocarpus bidwilli*) as a nursery-grown species although both *Halocarpus* species and yellow-silver pine (*Lepidothamnus intermedius*) have been successfully direct transferred at a range of sites at Stockton (as have the beech species) so it is likely that the species would be present in some rehabilitated areas. It is therefore helpful to see closure criteria that specifies a minimum density of pink pine for the forest types where it is planned expressed as the % of monitoring plots with plants present. Specifying a minimum number of seedlings could also be complementary.

### 5.5.2 Shrubland and pakihi

These rehabilitation types are feasible to establish to the closure condition proposed when supported by the root zone depths and hydrology identified in the Continuation Rehabilitation MP. The MP lists specific mixes of plant species for each vegetation type. A maximum of 10% mountain flax is specified for manuka dominated shrubland types (a) and (b), and no flax is proposed for planting in areas of pakihi vegetation. These criteria are important as flax is one of the most successful species at Stockton and would otherwise be likely to be planted over large areas. I have high confidence that flax shrubland rehabilitation can be successful where drainage, soil pH and fertility are adequate. Experience at Stockton has shown growth rates can be improved with targeted and regular fertilisation, and flax can outcompete heath rush and be successfully planted into sprayed heath rush, providing a mechanism for control of that weed.

Stockton experience also shows the subsurface compaction, microtopography and soil depths that provide suitable (impeded) drainage to support shrubland and pakihi can be established and maintained on a range of slopes. The slope range is probably influenced by the organic content and permeability of the root zone, which is higher where intact (direct transfer) soils are placed and much lower in most stripped soils due to dilution with subsoils and disruption of soil structure.

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[3] Steeper slopes drain more freely due to gravity, however intact soils and most VDT soils at Stockton generally have low lateral permeability which increases the slope at which gravity substantially enhances drainage. At Stockton, flat and gently sloping surfaces on mined areas are generally compacted or sealed, creating perched water tables; they are not generally freedraining.

The Continuation Rehabilitation MP specifies wirerush and tanglefern are included in all shrubland associations and pakihi. This reflects their status as dominant groundcovers in undisturbed ecosystems. Wirerush also has a singular role as soil trapper, soil builder and contributor to water retention through harvesting water, having a low evapotranspiration rate, and enhancing water storage in its peaty decomposing stems and roots. Both tanglefern and wirerush may also be important for *Powelliphanta* habitat by providing physical protection not delivered by open ground or mosses, although this is unproven. Within planted areas in Stockton wire-rush has slowly spread from jumble-dumped soils (including angle-of-repose slopes) and as 'hitch hikers' on individual hand-transplants (nominally 10 to 20 cm square of flax and tussocks). Hand inoculation by transplant is a backup method that provides confidence the minimum wire-rush covers at closure can be achieved given control of competition with non-native species (see later comment on erosion control seeding). However, hand inoculation of transplants is likely costly. However, neither species has been propagated in nursery settings to my knowledge. I therefore consider there is a moderate to high risk that neither plant is a dominant component of planted vegetation types on conventionally stripped and placed soils in the short to medium term due to the high cost of hand-transplanting these species.

### 5.5.3 Wetlands

Stockton rehabilitation experience provides confidence that plants characteristic of wetlands can establish and persist at least in the medium-term, and that wetland hydrology can be delivered using the techniques described in the MP on slopes <5 degrees. Wetlands are also likely to be able to be established on steeper slopes using VDT and potentially also better-quality jumble dump with the likelihood that steeper slopes can sustain wetland hydrology due to the intactness of the soils. VDT soils typically have higher organic contents, intact leaf litter layers and low horizontal soil permeability. At Stockton, mixed, stripped have lower organic content and higher rock content (in places) that infers lateral permeability is higher, although to my knowledge this has not been measured. Given there are few short-term remedial actions to change hydrology once slopes are planted, and establishing large areas of wetland is a priority objective, I recommend the hydrology of the first areas that are rehabilitated using stripped soil and jumble dump across a range of slopes is required to be measured. This could be a specific project withing the Rehabilitation Research Plan, with outcomes confirming the slopes and methods to deliver wetlands.

Contouring of compacted NAF to create a gently undulating base orientated across slopes should also increase retention of free water within replaced soil profiles. In the long term the establishment of wetlands will be more certain where wire-rush is a significant component of the vegetation as both create highly organic soil layers. Consideration could be given in the MP to sphagnum inoculation, as this peat-forming plant has successfully established on some older overburden dump benches at Stockton.

### 5.5.4 Small ponds

The comprehensive assessment of constructed ponds (and tarns) summarised in the Rehabilitation Outcomes Report provides confidence that such permanent pond features can be successfully rehabilitated. The assessment included aquatic and terrestrial plants and invertebrates. This confidence is supported by a relatively detailed methodology and photographs in the MP of target outcomes (and an outcome to avoid which would be useful to accompany with text on how to avoid or ameliorate). The methodology prioritises use of direct transfer as this enables establishment of ponds on gently sloping landforms by slowing lateral permeability, probably inoculates ponds and margins with invertebrates and fine sediments and may favourably moderate water chemistry. Planting of ponds has also been effective in the medium term as demonstrated on the Downers Dump Terraces. At Stockton small ponds have also been

established on gentle slopes using bunds to retain water; addition of bunds as a method in the MP would broaden the locations where these features could be established. The MP notes ponds will not be created on coal floor. Ponds that develop naturally on the coal floor should therefore be excluded and not contribute to tarn closure requirements given they are likely to be of low ecological value.

Ephemeral ponds are likely to be more vulnerable to weed establishment. However, given the small areas proposed to be rehabilitated to ephemeral ponds, there is the ability to intensively manage these ponds and to place them in areas well-buffered from weeds. One strategy could be to create larger areas of ephemeral ponds across the sites and use monitoring data to identify ponds to convert to drier (i.e. weed resistant) cover before closure to reduce ongoing weed management. All ponds will benefit from provision of foot access using rock/ boulders to part of their edge at construction, as this reduces the risk of damage during monitoring (the organic-rich and saturated edges being particularly vulnerable). This has been added to the methodology.

### 5.5.5 Boulderfield

Techniques used to place boulders in ways that support development of boulderfield ecosystems have been demonstrated at Stockton where large boulders (3 to 5 m length) have been placed to deliver specific designs. These include variable depths of burial to form near-level surfaces, creation of 1 to 2 m high 'escarpments', and lining of high-energy drains. Given the potential ecological values of such boulderfields (including for threatened lichens), creating significant areas of these features is beneficial.

Meeting rehabilitation outcomes for boulder field transitioning to forested blockfield and sandstone pavement are much more uncertain that for the forests, shrubland, pakihi, small ponds, wetlands and boulder field but the potential ecological gains from this rehabilitation are significant. A very small area of boulderfield transitioning to forested blockfield is present within the project footprint. The uncertainty in ability to rehabilitate forested blockfield is partly due to the small area of forested blockfield proposed as small areas allow little variation in factors that influence its development.

Confidence in outcomes would be increased by greatly increasing the total area of boulder field and forested blockfield rehabilitated from 400 $m^2$ and increasing the number of discrete areas to provide more microsites with a range of soil depth and block coverage /layouts. The minimum patch size specified of at least 100 $m^2$ is helpful as it allows some patches to be constructed with deeper soils (e.g. up to 500 mm depth) and with a wide range of boulder covers up to 70% cover. It would be useful to base the design of individual patches on a detailed characterisation of existing blockfield microclimate and conditions before rehabilitation starts. Such characterisation could inform specific boulder heights, orientation and clustering to enhance protected pockets sheltered from prevailing winds. Rehabilitated sites at Stockton demonstrate how skilful operators can stack boulders to deliver heights >3 to 4 m using suitable machinery and adequate time. Amending the MP to increase the area and variety of site locations would increase the likelihood that some develop to forested block field in the long term.

Some of the boulderfields should include VDT. A high priority would be VDT of large-diameter (>20 cm DBH) salvaged rata and beech for destinations between taller boulders. Near the top of Mt Frederick very old beech trees have been successfully transferred, showing the large potential benefits. Given the uncertainty of outcomes and small area the boulderfield and forested blockfield are likely to have closure criteria that include rock cover and weed cover, but potentially not native plant species, cover or height (i.e. they are not considered as part of 'rockfield').

### 5.5.6 Sandstone pavement

Sandstone pavements are a key feature of Buller Plateau with 64 ha stripped across project disturbance areas. Sandstone pavement is part of three 'Rockfield' rehabilitation types, all developed from coal floor. Unlike boulderfields (proposed for 400 $m^2$), pavements are proposed to cover very large areas. I have low confidence that the rehabilitation outcomes specified for sandstone pavement can be met largely due to a) lack of information on duration of acid generation until pH reaches levels allowing revegetation and b) due to high likely vulnerability to weeds that are locally abundant such as heath rush and gorse. However, I note that information on the expected spatial extent and duration of acid generation may be provided in other technical reports and is likely to include methods to identify acid-generating areas and associated seepage areas before soil/VDT placement, and methods for remediation. Given the mine schedule provides for areas of coal floor to be completed early in mine life, treatments can be confirmed and research on methods to accelerate development of benign coal floors initiated. These results can be applied to the larger areas available later in mine life. I recommend the research programme confirm the practicality of proposed methods for pavement rehab, in particular spreading '2 cm' depth of topsoil and attempting planting into this (most nursery seedlings have a root ball at least 5 cm deep).

The Continuation Rehabilitation MP specifically includes prostrate manuka for these areas. This builds on a very small nursery-plant trial more than 20 years ago and more extensive hand-transplants at Stockton more than 10 years ago. Fascining has not been attempted with prostrate manuka but could be valuable, especially in exposed areas with shallow soil that cannot feasibly be planted where manuka can kept in place (e.g. using biodegradable netting weighed down with rocks. Stockton experience shows some Celmisia species (e.g. *C. dubia* and *C. dallii*) and *Brachyglottis bellidioides* are likely to self-establish and spread into suitable areas if small numbers are introduced by hand transplanting, and that *Dracophyllum densum* can also be successfully hand-transplanted or VDT. Bryophyte hydroseeding, proposed for highwalls, could also be a valuable addition to the rehabilitation tool box for coal measures, as these plants include species that are highly tolerant of acid, help trap particles (building up soils) and create an environment into which vascular plants can establish.

Photographs in the MP of sandstone pavement rehabilitation present extreme contrasts of rehabilitation effort and outcomes. One photograph shows a combination of 'islands' of VDT sods and VDT boulders within a matrix of competent rock rubble which was among the most expensive $/ha rehabilitation at Stockton and not repeated beyond that 'boutique' demonstration. Such an outcome is probably only feasible over very small areas; it would therefore be helpful to provide a consent condition specifying a minimum area or % of coal floor that is planned to be treated to this standard.

Pavement areas, being sparsely vegetated and dominated by very low vegetation, are highly vulnerable to weeds that can tolerate low pH, notably health rush. The rehabilitation methodology could reduce risk by including specific guidance for soils used in these areas and require surveying 'upstream' vegetation as weed species are likely to invade down drainage lines. I recommend avoiding placing biking, walking and vehicle tracks into these areas to reduce weed invasion risk. The proposed medium and long term weed monitoring and reporting will provide information used to refine costs of post-closure maintenance (and potentially bonds).

### 5.5.7 Features with variable rehabilitation outcomes: haul roads and highwalls

The Upper Waimangaroa Haul Road (UWHR) and high walls are significant features of the project despite only covering 15 and 69 ha respectively, as they are likely to have disproportionately high adverse ecological impacts. Both are likely to form barriers to movement of lizards, snails and

other species unable to cross rock or water tables and may be at increased risk of predation or dehydration in such areas. The UWHR is partly constructed along existing tracks but is much wider, being described as 16.7 m wide during operations (reduced to 6.5 m at the cessation of mining).

***Upper Waimangaroa Haul Road***

Roads have potential for a disproportionate influence because they cut through otherwise intact habitats, have higher ongoing weed invasion risk and are rehabilitated at the end of mine life when resources are most likely to be limited. Roads are also connected to surface waters through water tables, include culverts and may need to be maintained in perpetuity. The main haul road is likely to have ongoing impacts linked to its use including traffic, maintenance works, and ongoing weed pressure. A post-closure level of service should be specified for the road to help protect the ecological values of adjacent areas and should be included as part of funded ongoing maintenance.

The final MP includes helpful photographs of rehabilitated access tracks, although the tracks shown are narrow and without bunds or water tables unlike the proposed haul road. The detailed design for the UWHR is not available despite this being proposed to occur early in mine life. It is therefore useful to see a condition requiring pre-construction review of the detailed design with the purpose of optimising rehabilitation, and specifically use of VDT and boulder salvage/placement. This design should include cross sections that show the variation of the cleared footprint, significant cuts and fills, any soil/wood/rock stockpiles or passing bays, safety bunds/windrows, water tables and stormwater runoff treatment ponds during operation. All these features typically create localised areas with much wider footprints, some of which are rehabilitated at construction and some that cannot be rehabilitated until the road is no longer needed. The detailed design will also identify areas where forest or pavement rehabilitation is prioritised to deliver better landscape and ecological connectivity across the road, i.e. the reduction of long term edge effects.

Because road construction occurs early in mine life there is usually potential to use a very high proportion of VDT and rock – a minimum proportion of VDT higher than the 15% for the other mine features could be a useful condition. A high standard of tussock and shrubland VDT was used on parts of the Cypress main haul road and light vehicle access road. This included placement of VDT shrubland on short, steep slopes in excess of 20 degrees (such as road cuts and fill batters). The treatment of the outer face of safety bunds/windrows with direct transfer boulders and/or or vegetation (or slash) not only minimises risk of sediment generation but also creates an important and valuable resource to pull onto the road when the running surface is rehabilitated. This method also minimises the volume of material that is needed to be moved during construction (potentially reducing disturbance areas along the roads) and at the end of mine life. This method may be applied to locations of temporary cut-off drains, which are not specifically mentioned in the Rehabilitation MP.

The review of the detailed UWHR construction and rehabilitation plan will assess optimised scheduling and use of VDT, use of salvaged boulders, stockpiling and use of soils containing weeds, and the identification and management of any PAF rocks present in the historic roads. I recommend monitoring and reporting of the UWHR rehabilitation outcomes occurs within the first 1 to 3 months of construction. I note a specific consent condition requires removal of sediment fences (and unbound sediment), avoiding long-term impacts of not removing sediment fences as seen along the Mt Augustus ridgeline.

Given the access road is proposed to be a post closure asset, it would be useful to confirm that the Closure Plan will identify which of the 50 culverts / stream crossings are likely to be converted to

fords. The long-term management of water using roadside water tables, and treatment of sediment ponds or other water quality infrastructure is an integral part of the rehabilitation but may be covered in other MP, e.g. the Aquatic Ecology MP or Koura MP. However, the Rehabilitation MP provides guidance to ensure culverts enable koura passage. It would be useful to also identify or cross-reference in the Continuation Rehabilitation MP specific surface treatments (with supporting figures) for the steep slopes upstream and downstream culverts that enhance long term stability. Exacting placement of boulders on culverts and fords at Stockton has demonstrated such features can deliver long-term stability and resistance to weed establishment (therefore minimising the risk for herbicide sprays near water).

***High walls***

The MP identifies highwalls are proposed over 68.8 ha. These are permanent barriers to connectivity for species such as lizards and snails, have limited options and opportunity to rehabilitate and are difficult to monitor given dangers of access. The proportion of bench rehabilitation treatments that will receive soil or root zone is important given the large ecological differences in outcomes likely between areas with soil (with or without planting) compared to areas that are hydroseeded. At present the flat benches 10-15 m width are proposed to be planted where access allows. These areas where rock and/or soils are placed, with or without planting, requires close coordination with mining as soil placement must be done within the limited window of access while highwalls are being cut. Soils cannot generally be placed on benches afterwards due to lack of access and high risk.

Uncertainty about the area planted could be reduced by proposing a minimum bench area (ha) and locations of planting aligned with maps of 'connectivity' for snails, lizards and kiwi/roroa. At other coal and gold mines, revegetation potential of highwalls is constrained by acid-generation from rock that then flows down across benches. Such highwall geochemistry, and in particular any areas that may be unable to be rehabilitated in the medium to long term due to acid generation, should be considered, and avoided, when drafting maps of connectivity.

Impacts of highwalls can be minimised by backfilling wedges of NAF overburden against their base. At Cypress, such fill was prioritised where valleys intersect with the top of the highwall to provide access points and improve connectivity, particularly for roroa. In addition, near the intersection of highwalls with natural ground, wedges of soils and rock placed along the base of individual benches enhance connectivity of benches to natural ground.

A comprehensive review of highwall and haul road revegetation treatments and outcomes, is a valuable part of the proposed Research Plan and should be actioned in the first year of activity using comparable sites at Stockton (including Cypress) and/or Escarpment. Such research would build on the extensive hydroseeding and hydromossing trials and practices developed by Solid Energy that developed recipes but required investment into dedicated moss propagation tunnel houses recommended to produce large volumes of weed-free materials. The results would then feedback into updated Rehabilitation MP.

**5.5.8 Stream rehabilitation was not assessed**

The project plans to remove approximately 17 km of streams and rehabilitate 21 km of streams. This rehabilitation is described in comprehensive diagrams supported by a suite of photographs. The ability to execute detailed rock placement in engineered drainage channels has been demonstrated at Stockton. High quality VDT has also been demonstrated across a range of vegetation types including placement bordering drainage channels. I do not have the hydrological expertise to review the likely resilience of hydrological designs that can deliver the specified refugia flooded to 300 to 600 mm depth and can also accommodate very large, high-energy flows and

allow for vegetation to be close enough to refugia and low-flow channels to provide shading. However, I suggest, based on observations at Stockton that successful outcomes that do not risk erosion of VDT (which is a limited resource) can be achieved by placing VDT on top of closely-spaced boulders along one side of a watercourse where the plants can provide shading and leaf litter to the waterway.

### 5.6 Wire-rush and short-term erosion control

An area of uncertainty is the extent to which nursery propagation of wire-rush is practical and how the survival and growth of both nursery plants and plug transplants will respond to proposed erosion control methods. The proposed consent conditions in MP Table 2 g) lists the methods of revegetation and erosion control techniques in order of priority. The use of hydroseeding and hydro mulching or seeding grass seed needs to be added to this table. Section 4.3.4 states 'hydroseeding with non-native (usually pasture) species provides short-term erosion control'. The MP identifies lotus will not be used and that planting 'as soon as possible after hydroseeding' is proposed to minimise smothering of native plants. However, because wirerush is short (approximately 50 to 400 mm height) and probably slow growing, it is likely to be particularly vulnerable to smothering. Close coordination and feedback between the Erosion and Sediment Control MP and the Continuation Rehabilitation MP will be important to deliver both erosion control and native plant requirements.

### 5.7 Key fauna and Habitat for Fauna in rehabilitated areas

The rehabilitation MP provides for the construction of specific habitat for fauna. The following comments are offered without seeing individual MPs for lizards, kiwi/roroa or snails which are likely to contain more detail and probably answer some of the questions posed.

#### *Powelliphanta*

Confidence in efficacy of the interventions would be increased if more specific design criteria were provided for planted areas that are designed to provide habitat. This is because the Rehabilitation Outcomes Report concludes none of the monitored planted areas were suitable snail habitat. A minimum 5000 $m^2$ of planted snail habitat is proposed to form buffers between VDT and undisturbed habitat within the known range of *P. patrikensis*. The Continuation Rehabilitation MP specifies this buffer planting using a minimum density of refugia plants/ha (specified as <0.5 m spacing). A minimum cover of suitable groundcovers at closure including wire-rush and tanglefern is a second critical component. The requirement to establish buffer zones (potentially of a defined minimum width) is a useful mitigation in the event that there is a shortfall of suitable VDT to provide connectivity between areas.

The Continuation Rehabilitation MP lists potential actions to enhance conditions for snails, including application of fertilisers to stimulate development of leaf litter layer, use of artificial covers such as 'weed free much or woodchip' and addition of locally sourced worms. Given earthworms are identified as key food sources for both snails and kiwi, it could be useful to support this within a target earthworm density. Such an initiative would build on earthworm monitoring at Stockton and findings from the captive breeding programme, which included the number and size of earthworms required to sustain healthy *Powelliphanta* of different sizes.

Use of manuka slash is recommended in the Rehabilitation Outcomes Report. Additional actions that may be beneficial are stimulation of moss cover using techniques applied to highwalls. Treatments should link to an Applied Research Plan (with minimum funding and duration) and commitment to apply favourable results over a minimum area. Over the last 30 years, many trials at Stockton have demonstrated superior rehabilitation outcomes that have not been scaled up.

***Lizards and Kiwi/Roroa***

The Continuation Rehabilitation MP includes specific guidance on density and construction of habitat features (burrows) for roroa in rehabilitation areas. For example, more than one entrance 25 to 35 cm wide leading into chambers 50 to 100 cm length that remain dry. Dense planting is specified. It would be helpful to clarify planting densities and species for lizards, snails and kiwi, and the priorities should habitats overlap. It seems likely both optimal plant species and perhaps density would differ between the three species.

Guidance for creation of log and boulder habitat features for lizards would benefit from containing detail that enabled auditing post-construction, noting this detail may be included in the Lizard MP. A detailed figure showing the areas where habitats are likely to be installed 'that adjoin natural areas known of suspected to provide lizard habitats' would be useful and would be updated based on monitoring results. These adjacent areas would then be planted at a higher density to provide a buffer if VDT was not available.

**5.8 Threatened and at-risk plants**

The approach to managing threatened plants is to identify threatened species in pre-stripping surveys of suitable habitats. For some plants this requires surveying in months when target species flower, fruit, or have leaves or they are unlikely to be detected. This includes many of the eight species that are very small or rarely recorded (<5 records across the site). The proposed mitigation for most species is direct transfer. I consider the extraction by 'hand-transfer' and placement into areas with similar light levels (and probably humidity) that are not weedy and will not be disturbed by mining probably has a moderate to low likelihood of success for forest species and perhaps a moderate success likelihood for *Calochilus* as a specialist of open ground. Three of the four orchid species are reported on the NZ Plant Conservation Network website as difficult or impossible to cultivate: *Pterosylis humilis*, *Calochilus paludosus* and *Townsonia deflexa*. While *Pterosylis humilis* forms large colonies and is 45 to 150 mm tall plants when flowering and with broad leaves, *Townsonia deflexa* is easily overlooked as it has 10 mm leaves. This, combined with very low numbers of the plant reduces the likelihood that the proposed management will be effective. Success is more certain for *Bulbinella* which is reported as being able to be grown from division of whole plants. *Bulbinella* and the following threatened and at risk species that are widespread across the site, *Chionichloa juncea, Dracophyllum densum, Pimelea longifolia, Brachyglottis traversii, Euphrasia* species and *Pseudowintera traversii* probably have a high certainty of successfully establishing larger populations in rehabilitated areas.

The Rehabilitation MP proposes a common criterion for success: 'establishing the species in the same proportion of plots'. It would be useful to add a minimum number of locations and/or number of sites, as is proposed for *Sticherus*. Confidence in outcomes for success of threatened and at-risk species that are widespread across the site is based on the following:

- successful VDT or hand transplantation of most of these species at Stockton or Escarpment (Rehabilitation Outcomes Report),
- successful propagation, identification and repartiation of Sticherus species (SOS[4] plants (Rehabilitation Outcomes Report),
- experience in other sites, notably *Peraxilla tetrapetela*.

[4] Species of Significance

It seems feasible and desirable to increase the minimum number of *Peraxilla* to more than 30 given the technique for establishing new seedlings is established, the plants are efficient to monitor, and high ecological value would be gained from re-establishing a new founder population. Natural spread is likely to be facilitated by the possum control proposed for the wider area. I agree with the proposed approach of not undertaking specific work on *Hymenopyllums* as the spores of these filmy ferns are wind-dispersed and therefore likely to re-establish in rehabilitation areas that are favourable. These ferns also potentially benefit from browser control in the wider landscape.

### 5.9 Bryophytes

The comprehensive rehabilitation approaches proposed for bryophytes are based on detailed surveys over 30 years summarised in the Rehabilitation Outcomes Report. This has enabled the development of an index of 'mature bryophyte communities' using indicator taxa. While VDT was not designed to create specific habitat for bryophytes, surveys of VDT shows boulders and large wood/stumps within VDT are associated with a range of localised lichen microhabitats that support some mature bryophyte communities. DT boulders, especially weathered boulders removed from open sandstone pavement, is therefore a priority rehabilitation method. VDT is proposed alongside hand-transfer of 20 named bryophyte species, ex-situ propagation (and repatriation) of another three species. The creation of specialised habitats is also proposed as part of a comprehensive programme that will advance knowledge and practice of lichen conservation in New Zealand.

The refinement of rehabilitation methods for lichens is included is the proposed Research Plan. It would be useful to include more detail about the planned/prioritised research, for example specifying a minimum area of individual weathered sandstone boulder direct transfer. Although it is likely this will overlap with boulder placement in boulder stacks, rockfields and block stacks and lizard habitat features, the value of a specific condition is the targeting for specific byrophytes. Similarly, a minimum number and (vertical) area of attempted perpetual wet wall seepages, overhangs and drip zones would be useful to specify, recognising these may not be successful but are never-the-less worthwhile to attempt. Finally, the areas rehabilitated to forest blockfield should be deliberately designed to favour establishment of target lichen communities using an additional variation (not shown in the existing figures) of trees planted between tall boulders and emerging above them to create deeply shaded, super-humid conditions.

### 5.10 Outcome monitoring

The MP briefly covers outcome monitoring. Further detail may be in the Biodiversity Outcomes Monitoring MP, but I have not read the latter plan. Compliance monitoring is proposed as being every 2 years for 6 years in planted areas, reducing to every 5 years – I support this approach. I suggest the monitoring frequency and number of plots be stated as a minimum, to allow for increasing plot density if 3 plots per rehabilitation type does not provide the sensitivity required (e.g. because some sites are highly variable). I also recommend requiring establishment of a minimum number of Permanent Sample Plots at least every second year, and a minimum number of these plots within the first 3 years, noting these are likely to all be in VDT (or jumble dump) based on the indicative mine schedule. The densely planted buffer areas may need to be excluded, or included as another specific rehabilitation type, as these areas are established to produce higher cover, faster, so are not representative of wider rehabilitation plantings.

The monitoring methods proposed are based on producing quantitative and repeatable data. They build on experience at Stockton and in the Rehabilitation Outcomes surveys, for example, placing plots along transects in VDT (to better account for variation) and reducing monitoring frequency in wetlands to minimise degradation associated with foot traffic. I suggest VDT surveys also record

rock and water coverages (as a percentage), and that 'wetland monitoring' includes a baseline assessment of soil hydrology that is repeated at year 10.

I note that monitoring methods for edge effects, planted 'buffers', landscape connectivity and mosaic monitoring is yet to be developed, and this is where specific maps showing more detailed locations of corridors and methods for highwall connectivity will be helpful. Habitat feature monitoring may be covered in the lizards, kiwi/roroa and snail MPs. It would be useful to clarify in the Rehabilitation MP if rock stacks are considered to be able to function for both lizards and kiwi.

**5.11 Approaches to confirm**

I consider three areas would be useful to clarify: the Rehabilitation Research Programme, the treatment of poor-quality rehabilitation at Stockton and how cultural values have been considered in the Rehabilitation MP and may be considered (including in monitoring).

Attachment Three of the Continuation Rehabilitation MP and Draft Conditions 72 and 73 provide for a Rehabilitation Research Programme, but with little supporting detail. This research is important to refine rehabilitation methods and needs to start in year 1 rather than in year 5 as proposed. The early research is important to help refine methods for rehabilitated highwalls, roads and watercourses, by surveying existing areas. I think it is also necessary to commit to a minimum duration and effort ($, excluding physical costs of constructing trials) in addition to the proposed annual reporting and five-yearly, in-depth review process. The review will be most useful if independent, if it identifies where improvement in ecological outcomes can be made and also recommend changes in operational practice. The reviewer/s would ideally be the same as those reviewing operational rehabilitation outcomes.

The Continuation Rehabilitation MP includes the following priorities for the Research Programme:

- identify roost plant density for snails (and maybe species of plants)
- develop methods to promote adequate food sources of snails
- propagate wire rush at scale and promote its natural expansion
- identify the type, application rate and method of fertiliser application to improve initial growth rates of plant species (flax, tussock, astelia, gahnia) at locations intended to provide snail habitat and assist in generating leaf litter, providing habitat and promoting nutrient recycling.

The Research Programme should also include analysis of the data proposed to be collected on each rehabilitation block, to ensure this valuable data is utilised for more than reporting.

Significant areas of Stockton are poor-quality rehabilitation that are dominated by non-indigenous vegetation (pasture) including pest plants. They have been classified as 'rehabilitated' but may pose a risk to future rehabilitation in the current project through acting as a source of weeds. It would be useful to clarify how these areas are to be managed so that they are unlikely to adversely impact future rehabilitation carried out under the proposed Buller Continuation Project.

The Continuation Rehabilitation Plan does not contain a section explaining how cultural values have been considered in design, although the final plan states 'The consent holder and Ngāti Waewae will work together to develop a cultural health index for waterways and engage iwi to assist with interpretation and reporting. Ngāti Waewae will be provided with annual monitoring reports associated with this RMP.' I suggest if the consent includes an independent peer review group, that Ngāti Waewae is invited to be part of that group. Ngāti Waewae may also be interested in developing a cultural mitigation plan, which could include aspects of rehabilitation practice and/or monitoring.

### 5.12 Consent Conditions

The following comments on consent conditions are in addition to those made above, and some may be repetitive given the short timeframe to review the final conditions.

- Definitions. Rehabilitation stages. Change stage 3 to 'Application of rehabilitation ecosystem type as these areas are not rehabilitated.
- RHM 10. I consider rehabilitation is likely to require allocation of a full-time, dedicated rehabilitation team and also may require dedicated equipment (e.g. small diggers) to ensure timely actions needed to provide high quality outcomes such as VDT and rock salvage. This is desirable. When rehabilitation teams or equipment is shared with civils work, it is not uncommon for the crew to prioritise other work. This can lead to rehabilitation works being de-prioritised compared with those linked directly to production. The consistent step up in rehabilitation outcomes described in the Continuation Rehabilitation MP requires rehabilitation to be is prioritised. A dedicated team and equipment means actions 'where practicable' occur more often because the equipment and dedicated crew is available. The proposed rehabilitation conditions include about 25 'where practicable' actions.
- RHM 28. The time at which highwalls need to be accessed is only a short period during their construction when soil or root zones are placed; some of these areas may be accessed for planting, and others for ground-based seeding or hydromulching. After this initial establishment foot access is not likely to be needed as weed control can be delivered by drone. This approach is likely to increase the area of highwall benches that can be rehabilitated.
- RHM 32. I suggest reconsidering the objective of promoting natural dispersal
- RHM 48. There may be no suitable translocation sites for some species within rehabilitation areas, for example species of taller forest habitats. It may therefore be more effective to manage some species in unmined areas, as proposed for some of the orchids
- RHM 50. It is helpful to specifying minimum numbers, as most of these species have has some success at Stockton or Escarpment rehabilitation on which to base practice; Peraxilla is an exception. The areas are variously specified as 'across the project area', 'in suitable rehabilitated habitat' (b and c) or 'in suitable post-mining vegetation types' (f); clarity would be improved by defining these different areas. It would be useful to propose a contingency action should some species be intractable.
- RHM 51. This condition requires a pre-disturbance survey. It would be useful to support this with a description of a minimum method and anticipated effort per hectare. The requirement to not disturb target species before surveying may slow mining activities and is another reason to have a dedicated rehabilitation team. It would probably be useful to include a mechanism by which a species will be added to the list of target species to allow for the potential for new species that have similar threat status to be included if found and to allow for changes to threat status during the project.
- RHM 59. Manuka seed can generally be gathered year round at Stockton so does not need to be restricted to spring or summer. It would be helpful to understand the intention of this condition. I concur with RHM 59 (2) as it is standard practice to record where and when propagation material is collected, and this condition makes reporting on provenance straightforward.
- RHM 60 maybe restrict to target non-vascular (target vascular plants probably OK most times of year espec cooler aspects)

- RHM 60A. I consider this is a pragmatic approach that provides flexibility in time to complete rehabilitation (and is consistent with RHM 71)
- RHM 61 to 71 are critical conditions that define 'closure criteria'
  RHM 63. Measures of the 'establishment of characteristic species' would be useful to include, for example experience at Stockton indicates three of the plant species could be expected to generate self-established seedlings in 10 to 20 years, but not *Halocarpus*.
  RHM 68. Permanent plots are a useful methodology. It would be useful to also specify a condition that these permanent plots must not receive any different or special maintenance than surrounding areas of similar vegetation type. This should then be verified when closure is proposed, for example by adding a specified number of randomly placed plots in a one-off less intensive measurement that includes ES weeds, stems/ha of trees >1 m and native vegetation cover.
  69 (6) I recommend including self-established plants – as these indicate rehabilitation trajectories and the species and rates that gaps may be filled.
- RHM 74 to 77 Upper Waimangaroa Haul Road. I support the solution to review design prior to construction with focus on optimising VDT and boulders etc. However I suggest removing 'where practicable' and replacing it with 'where consistent with target rehabilitation outcomes. This would allow for some areas not to be ripped (i.e. areas adjoining pavement) and soil be replaced where forest is desirable. I suggest adding connectivity and reduction of edge effects as primary objectives of rehabilitation alongside 'blending with surrounding or adjacent ecosystems'.

## 6. Summary

The Rehabilitation Outcomes Report and the Biosecurity, Weed Management and Continuation Rehabilitation Management Plans are together the foundation for a step change in rehabilitation performance across Denniston and Stockton. Each document was reviewed in an iterative process working with the primary author on drafts with interim summary comments to Bathurst, then providing final comments. All but the Rehabilitation MP were reviewed again in 'final' form, and nearly all suggestions adopted. Three versions of the Rehabilitation MP were reviewed, the latest draft being June 2026.

I consider the approach, objectives and performance criteria in the three Management Plans propose comprehensive rehabilitation outcomes that are better than those documented in the Rehabilitation Outcomes Report and current practice. I consider the significant investment signalled by Biosecurity and Weed MPs represent best practice.

Key components are:

- repeated weed surveys starting before vegetation is stripped to identify and enable minimising transfer of weeds into rehabilitated areas and to detect weeds before populations threaten rehabilitation outcomes;
- weed control including areas outside the project footprint, and;
- assessing weeds in relation to the specific ecosystems on the plateaux and based on specific weed traits.

The Continuation Rehabilitation MP proposes:

- more natural engineered landforms;
- a mosaic of nine ecosystem types sustained by root zone and topographic variation;
- a higher diversity and cover of species that reflect those that are locally-dominant (notably including the ecosystems engineer, wirerush and long-;lived trees such as beech);

- inclusion of specific habitat features for roroa, for lizards and for bryophytes, and;
- kilometres of rehabilitated stream/watercourses.

This step-change in outcomes is supported by clear, measurable closure criteria for the nine ecosystem types (Table 1, with footnoted definitions and key monitoring methods) , and underpinned by a commitment to cover at least 15% of the rehabilitated area with direct transfer and to prioritise 'jumble dump' for a further unspecified area. It would be beneficial to propose (and condition) a mechanism that rewards a greater proportion of VDT given VDT costs more per ha and requires greater logistical effort to align donor and recipient areas. At present there is only a cost to delivering less than 15%, being a high density of nursery or wild-salvaged planting to achieve specified covers.

Given most of the rehabilitated areas will be established by planting, the quality of the root zone is critical to delivering the expected outcomes. Jumble dump delivers high soil quality – therefore confidence in rehabilitation could be enhanced by including a minimum area or proportion of 'jumble dump' for ecosystem types specified as ~30 cm topsoil depth, given this is practically the thinnest that can be achieved using this minimum-damage method. Likewise, placing root zone on highwalls and placing weathered boulders on rock pavement delivers much greater ecological value than the alternative methods but at significant additional costs. It would therefore also be helpful to commit to a minimum linear m of highwall (based on the proportion that is safe to access) with soil cover and minimum area of coal floor/pavement with boulder cover.

The three management plans require and enable consistent delivery of high-quality rehab outcomes. These outcomes are based on methods informed by an impressive, quantitative analysis of large-scale planted and direct transfer concentrated in 2023-2024 across Stockton and parts of Denniston Plateau alongside some targeted monitoring of small-scale practices such as pond/tarn rehabilitation. The richness of data on bryophytes and plans to rehabilitate specific bryophyte habitats is an innovative and impressive feature of the Rehabilitation Outcomes Report and MP respectively (with the former valuable to publish in scientific literature but unlikely to be progressed without specific funding). Confidence in delivery of weed management and rehabilitation outcomes is supported by detailed and comprehensive monitoring and reporting which includes characterising each rehabilitation block at establishment, followed by 2 to 5 yearly assessments. This level of detail and consistency is important and will help underpin adaptive management alongside an unspecified Research Plan.

In my view the confidence that the specified rehabilitation outcomes can be achieved varies across the nine ecosystem types and outcomes:

- high confidence – the three forest types (using minimum 1000 seedlings >1 m height per hectare of specified 'keystone' forest species), recommending a specific minimum density and/or number of *Halocarpus biformis* seedlings for planted areas
- high confidence – most shrubland types and pakihi, while noting a) establishing wire-rush by panting or seeding is novel and untested, and minimum cover proposed would be costly to deliver using wilding transplants towards closure and b) monitoring should specifically include confirmation of the hydrology of the first rehabilitated areas to provide confidence these areas are likely to have poor enough drainage to favour shrubland rather than progress to forest (at least in the medium term).
- high confidence – wetlands and small ponds/tarns
- low to moderate confidence – riparian areas. Although the detail provided is high, the large scale of the riparian areas, reliance on VDT to deliver outcomes (without a VDT budget showing this area will be available) and lack of documented examples of rehabilitation in

areas exposed to high energy flashy flows reduced confidence. However, my assessment is limited by little experience with riparian rehabilitation in such environments and I note there are areas at Stockton that combine high-precision placement of boulders and VDT alongside drainage channels that could inform approaches.

Outcomes for highwalls and UWHR are uncertain due to linked to the wide range of outcomes possible and absence of conditions supporting use of methods that deliver higher-quality ecological outcomes but are generally more costly and/or require more planning. For example, there is opportunity to use a high proportion of VDT to cover UWHR fill and cut batters, and to place soil/root zones on accessible highwalls. In both cases higher-quality ecological outcomes placed in specific areas are important to help mitigate barriers to movement of valued fauna and to visually integrate these distinctive landforms. Further detail on UWHR is needed to increase confidence in outcomes, including locations of stockpiles, cuts and fills as well as strategies to complement the highly variable adjacent ecosystem.

Outcomes for rockfield, boulderfield and sandstone pavement are also uncertain. Confidence in rockfield and boulderfield outcome would be greatly improved by increasing the total area and the number of discrete areas rehabilitated to provide more microsites with a range of soil depth and block coverage /layouts. Specifying a minimum patch size (e.g., at least 100 $m^2$) would also allow some patches to be constructed with deeper soils (e.g. from 'up to 200 mm' to nearer 500 mm) and with a wider a range of boulder covers (from current >30% up to 70% cover). All rock fields and boulderfields are likely to add ecological value. My confidence in sandstone pavement outcomes is limited by the wide range of potential outcomes that have a wide range of costs and lack of clarity on how acidity will be characterised and managed to allow plants to establish. Rehabilitation of sandstone pavement is a high priority for research as the indicative mine schedule indicates areas will be available for trials in the first 1-3 years. This, combined with review of older equivalent areas at Stockton, would enable refining of sandstone pavement rehabilitation techniques before the majority of rehabilitation towards the end of mining.

Confidence and surety of outcomes would be increased by the following actions:

- cross reference to other plans, e.g. Engineered Landform, Lizard MP, Aquatic Ecology MP, recognising the parallel development of many plans has delayed this to date,
- adding a new table, as table 4 into the Rehabilitation MP that provides minimum areas of each ecosystem type, divided into the three large sub-project areas (i.e. excluding the UWHR)
- further detail on UWHR
- further detail on fascining and jumble dumping methods and the density and species in 'buffer planting' for various purposes (lizards, snails)
- confirmation that annual reporting includes area of VDT and jumble dump, volume of boulders suitable for rehabilitation, and the volumes of soils used, stockpiled and required to rehabilitate current open areas.
- detail on the Applied Research Plan with minimum specified funding
- provision for long term maintenance

I am impressed with the approaches proposed to rehabilitate ecosystems in this project and the investment to characterise past rehabilitation outcomes. Together the three plans support a lift in breadth and consistency of adopted best-practice rehabilitation across Denniston and Stockton level of detail. In addition, the Rehabilitation MP includes innovative techniques for rehabilitation of bryophytes across a range of ecosystem types and has potential to establish significant areas of valuable rockfield and boulder-field (threatened) ecosystems.

I am happy to provide clarification on the above comments.

Robyn Simcock

19 August 2026