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 Stephen Jeffery Miller

19 January 2024

Applicant's solicitors:
Alex Booker/Alex Hansby
Anderson Lloyd
Level 3, 70 Gloucester Street, Christchurch 8013
PO Box 13831, Christchurch 8140
p + 64 27 656 2647
alex.booker@al.nz

anderson lloyd.

Qualifications and experience

1 My full name is Stephen Jeffery Miller.

2 I hold a Bachelor of Engineering (Mining) from Curtin University, WA School of Mines in Western Australia and I am a Fellow Member of the Australian Institute of Mining and Metallurgy (AUSIMM).

3 I am currently employed as the General Owner APAC Metals for Palaris and have held that position since 1 July 2023 and prior to that held the Senior Owner APAC for 14 months and Principal Mining Engineer for 14 months, both with Palaris.

4 In the role with Palaris I am active as an Independent Technical Expert carrying out reviews of mining projects seeking funding from lenders and have completed mandates on projects in Australia, RSA, Brazil, Bosnia, Namibia, Turkey, Guinea, Mauritania, and Botswana. Commodities covered include gold, copper, lead, zinc, mineral sands, graphite and rare earths. In this role I focus on identifying project risk that could negatively impact on the projects ability to pay back the lender loan.

5 Palaris also provides mine project technical and management services and in these areas I have been active as the Project Owner and Principal Mining engineer on projects in Australia, Ghana, Greenland, USA and Canada covering commodities including gold, copper, nickel, mineral sands, graphite and rare earths. In this role in today's economic environment the focus is looking at alternative mining solutions to manage operational drivers.

6 Palaris is also active in the Decarbonisation space, and I have been involved in project electrification proposals, discussions on the Australia Safeguard Mechanism and the development of MAT curves for the purpose of assessing decarbonisation initiatives for mining projects.

7 My previous work experience includes roles as Managing Director of Red Rock Engineering, a sole trader contract business providing management and technical services into smaller companies and projects from 2003 to 2021. Prior to this I was the Resident Owner for Iluka Mid-West mining Operations in Western Australia from 2000 to 2003. In this operation it safely operated within a Class A environmental reserve area. Various other management and operations engineering roles in the hard rock mining industry from 1985 to 2000 was preceded by a technical traineeship on the Collie Coal operations from 1981 to 1982 prior to moving to Kalgoorlie, WA to attend the School of Mines. As a student, I attended trainee programs at the Paringa Gold Mine over vacation periods.

8 My role in relation to TiGa Minerals and Metals Limited's (**TiGa**) application to establish and operate a mineral sands mine at SH6 Barrytown (**Application and Application Site**) has been to provide technical inputs in relation to mine design, scheduling and operations planning for the integrated mining, processing and overall operations integration. I have provided input into the Application. I have been involved in detailing the mining methods, mine physicals and schedules.

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

10 I have been actively involved in the project since June 2022. I completed a site visit in August 2022 for the purpose of viewing the current and form, connecting with the hydrology team doing work on the project and to discuss final landform usage plans with the then current farm owner.

11 Palaris is an independent mining advisory consultant and has no material interest in TiGa or any other entity involved in the project.

Code of Conduct for Expert Witnesses

12 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

13 I have prepared evidence in relation to:

(a) Mine Planning;

(b) The extent of the mining operations and the resource;

(c) The mining methodology and options considered;

(d) The need for activities ancillary to the mineral extraction to occur within 100m from the wetlands;

(e) Rehabilitation;

(f) Hydrology, sediment control, processing and minerals.

Mine planning

14 I am the lead Mining Engineer of the mine planning works completed for the Coates Block. The mine planning process develops through the various stages of a mine project development life being adjusted as the available information increases.

15 In this case, identifying the key design drivers for the project was made clear from the responses provided in the initial mining permit application process. It was clearly understood that water management is a key project driver along with noise, dust, native fauna impacts, visual interference and general carbon footprint concerns.

16 Prior to completion of the updated Mineral Resource Estimate (MRE), and prior to any new mine design work commencing, a site visit was completed by myself, with the TiGa Minerals leadership team to allow discussions between the key technical lead team members on hydrology, process design and engineering and the farm Owner, while visiting the planned operations site. This was crucial to understand the physical space, the many contributing factors that would need consideration in the mine design and processing design all while discussing with the farm Owner the current issues and future wish list for the landform, post mine completion.

17 In addition, the site visit clarified the physical constraint of the project with the main arterial north – south road (State Highway 6) to the east, the coastal lagoon to the west, Collins Creek to the South and the existing property north drain in the north.

18 It was noted that with the existing 11 Kv power supply along State Highway 6 was a limiting factor to the project with options to power the operation via electricity limited until potential upgrades are installed.

19 As the mine planning process progressed, communication between the technical contributors (particularly hydrology and ecology), TiGa management and the farm Owner allowed for initial designs and concepts to get contributions from all involved.

20 The resulting mine planning outputs were able to be driven by the following broad principles of design:

(a) Small footprint for mining activities and processing plant;

(b) In sequence mining and rehabilitation practices required;

(c) To control noise, limited operating hours for mining activities would be adopted;

(d) All water from the mining active area would be considered as mine water and used to supply the Wet Concentrator Plant;

(e) Mining activities would be restricted from areas adjacent to the existing water ways on the property (Collins Creek, Coastal Lagoon and North Drain), and only necessary activities were to be proximate to these activities;

(f) Mining would be restricted from approaching closer than 200m to the State Highway 6;

(g) Mining fleet will be limited in numbers as much as practicable to limit fuel burn, carbon emissions and noise emissions from the mine activities. Electric powered units over diesel options were to be adopted with the adoption of the input mining unit inside the mining void being the most significant example as it reduces truck haulage and secondary handling of materials with diesel loaders by replacing this with slurry transport via the in pit mining unit.

21 Final land forms would reinstate drainage catchments with improved soil profile and better surface drainage. Designs on final landform have also considered maintaining ground levels along the western mining limit to avoid any changes along that boundary. All works operations works are within the Mine Disturbance Area.

The extent of the mining operations and the resource

22 The Coates Block Project has physical limitations as shown in Figure 1.

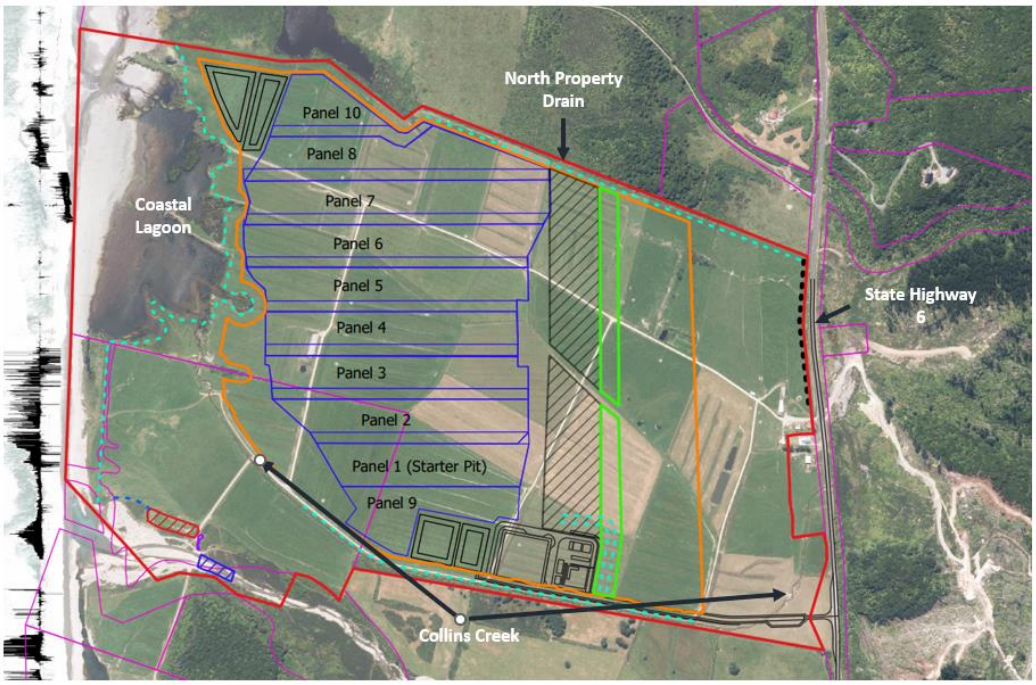


Figure 1. Coates Block Physical Limitations

23 These physical limitations being the State Highway 6, Collins Creek, The Coastal Lagoon and the northern property drain. The red line shown in Figure 1 is the granted mining lease boundary and the orange line inside that is the mining disturbance area within which all mining activities will be limited to.

24 The mine disturbance area is limited to 200m west of the SH6 and then 20m away from Collins Creek, the Coastal Lagoon and the Norther Drain/Mining Lease Boundary. No Mining production works will occur outside Mining Disturbance Area.

25 The MRE used to define the interpreted geological and mineral content for the project was finalised in March 2023 with Interim results presented in November 2022. This resource, compiled by RSC Mining and Mineral Exploration, compiled the resource estimate based assay from samples taken from historical and recent drilled exploration holes that covered the Mine Disturbance Area.

26 The MRE outputs received for the mine planning consists of wireframes/solid representing:

(a) The geological interpretations of the geology (top soil, over burden, ore, basement material etc);

(b) The surface pre-mining topography;

(c) Written descriptions of the geological interpretation and mineralisation estimation methodologies.

27 The key output from the MRE process is a three dimensional block model that provides information on the geological and mineralisation estimation into each block within the block model, based on the wireframe surfaces and industry standard estimation methods.

28 The MRE block model and wireframes plus the sites physical limitations (primarily the Mine Disturbance Area) described in Figure 1 represents the initial limits for the project.

29 The final step in defining the limits to the mining operation is the mine optimisation stage. This takes the MRE block model and using estimated mining factors (dilution and recovery) along with processing factors (ore recovery) to determine how much final saleable products can be produced from each block and by looking at estimates for the operating costs for the project and the potential revenue prices for the saleable products, each block and then column within the model is reviewed to determine the net value of the column (revenue – cost) determining the block model column economic viability. In Figure 2, the optimisation run for Coates Block is showing any block column with a positive economic return.

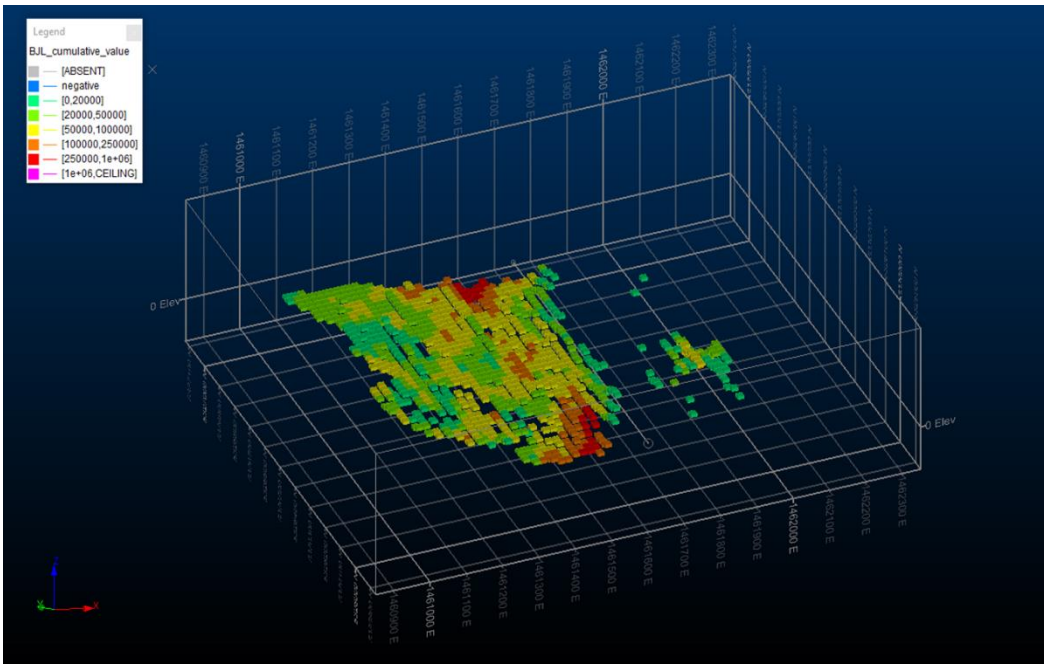


Figure 2. Coates Block Pit Optimisation

30 With the MRE economic model limits determined, strategic limits to restrict the mining operation to the west of 1,461,700 East, leaving the identified economic ore to the east, was made. In addition, low return ore in the south west corner of the project was excluded from the mine plan, increasing the 20m buffer to over 50m adjacent to lower section of Collins Creek leading into the Coastal Lagoon.

31 Blocks that fit within these limits and inside the Disturbance Area forms the basis of the mine design limit for the Coates Block.

The mining methodology and options considered

32 All mine design processes need to consider the general conditions of the planned mining area as part of the process. Understanding key contributing factors must be used in selecting an appropriate mining method. Examples of these factors include the following:

(a) Geotechnical

(b) Hydrological

(c) Geological

(d) Mechanical characteristics of the insitu material

(e) Mechanical and Chemical characteristics of the waste material

(f) Local and national regulations

(g) Local and regional environmental concerns

(h) Power supply

(i) Current and future expected climatic conditions and more recently

(j) Global ESG trends

These considerations were taken into account when the 7 Design Principles above, were developed for the Coates Block Project and the Barrytown Project in general.

33 To satisfy these principles, dredge mining was rejected as it would have the potential of impacting on the local water table and would be difficult to carry out on a minimal footprint due to the delayed rehabilitation of the dredge path.

34 Conventional open pit mining methods where the whole area was mined to completion prior to commencing rehabilitation was rejected due to its large footprint and potential noise, dust and water quality issues.

35 Hydraulic mining is often associated with mining of sedimentary style mineral deposits on a small to medium scale (diamond, gold, iron sands, mineral sands) but this was rejected due to potential issues with water quality management, footprint and delayed rehabilitation.

36 The deposit is too thin and the production rates are too low for a bucket wheel based mining method, so these style of machines were rejected.

37 The final selection of a method was driven by additional factors including equipment size and local availability, equipment flexibility, noise and over all fleet flexibility to handle the required waste and ore production rate. The option selected maximises the use of electrified methods while being conscious of the local power supply limitations, and in so doing minimising the project's carbon footprint. Identification of further options to reduce the projects carbon footprint will occur in the Front End Engineering Design (FEED) and detailed design stage.

Opportunities to reduce power draw with alternative electric drives and optimisation of material movement will be part of this exercise.

38 The mining method selected is shown in Figure 3 presenting the mining area dimension and mining sequence.

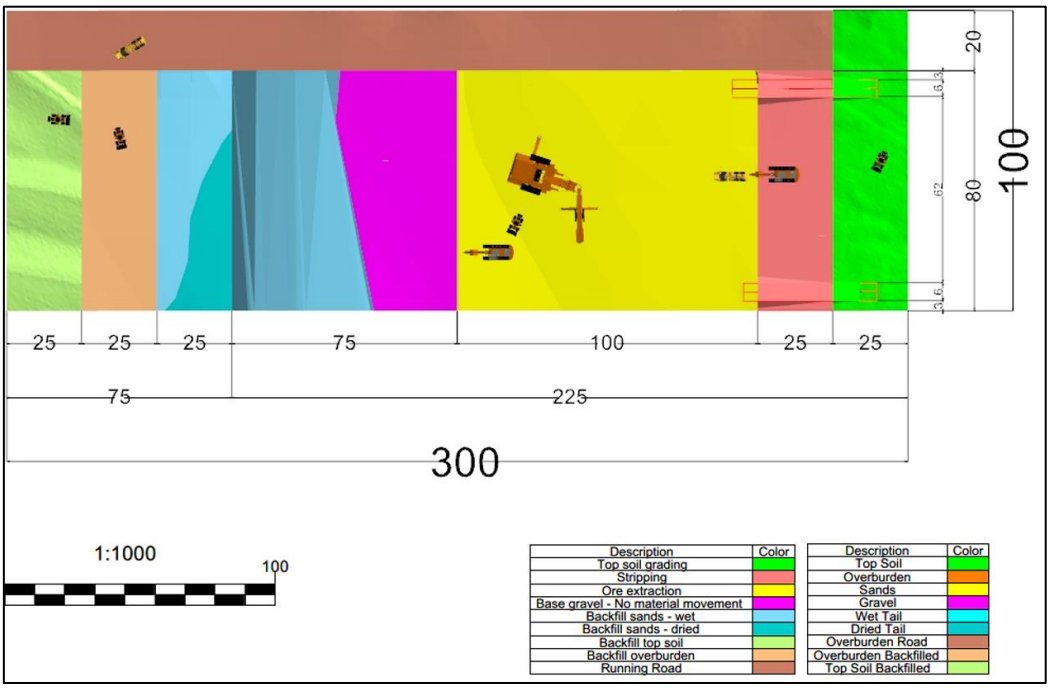


Figure 3. Active Mine Void Dimension and Mining Sequence

39 The active mining void sets up the ability to have a continuous mining followed by rehabilitation cycle that limits the mining area to 300m long by 100m wide work active work area. This is completed after an initial mining void is created in pre-production works. The pre-mining void excavation sets up the mining cycle with topsoil and waste material stockpiled near the final mining area in preparation for mine closure works. The ore is stockpiled near the concentrator for processing at the mining schedule end period. Pre-mined waste from the mining void and the site water facilities will be stockpiled along the eastern side of the operations and will have a temporary covering (grassed), which will further mitigate noise, dust, light and other community issues.

40 In consideration of identified operating risk, the initial mining will commence in the western end of Panel 1. This location has been deliberately selected as it is located away from Collins Creek and the Coastal Lagoon. See Figure 4.

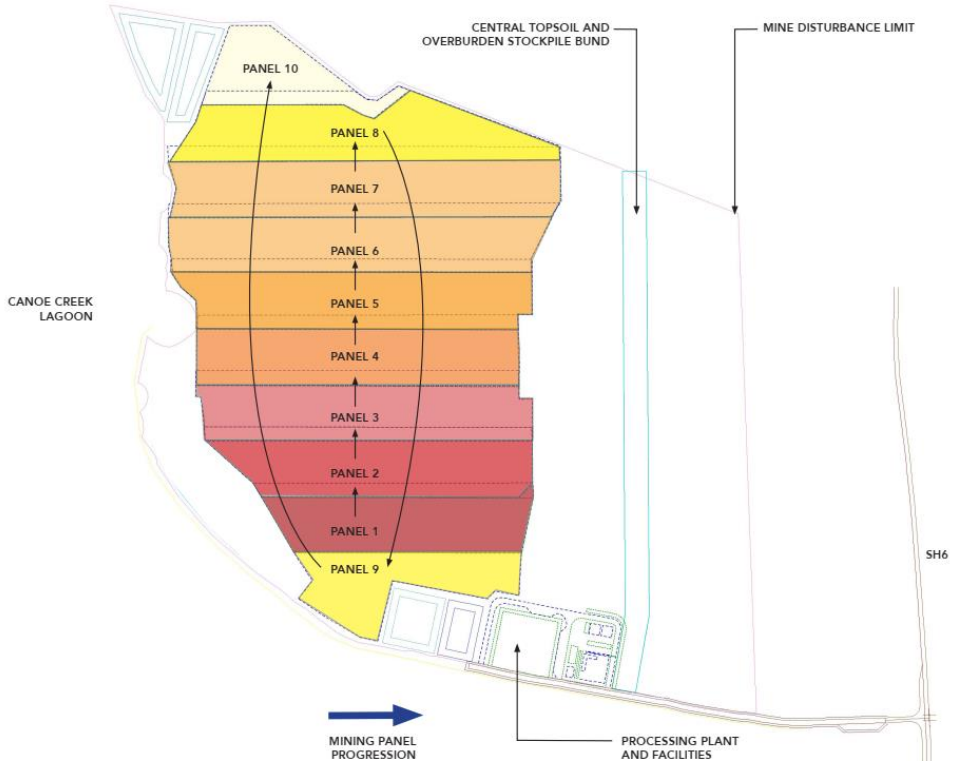


Figure 4. General Mining Sequence

41 The mining process is a continuous cycle where the different materials are mined in sequence with the top solid and waste direct carted within the mining area to the final destination and the sand ore mined, screened and then pumped to the Wet Concentrator Plant.

42 Topsoil is recovered from in front of the mining path using a front-end loader and articulated truck to move the topsoil to behind the advancing mining front and placed onto the final shaped waste overburden and replaced sand tailings.

43 The overburden waste is moved using the same equipment to be placed on top of the sand tailings after they have drained sufficiently for small D7 size bull dozers to push the tailings into the required final landform shapes.

44 The mined ore is excavated using a long stick excavator sitting on top of the sand profile to the base of mining, placing the dug sand in a pile on the bench. A front-end loader then picks up the dug ore and places that ore into the ore feed preparation plant referred to as in the Mining Unit Plant (MUP). The MUP separates out the ore sand from the other materials in the sand and pumps the ore sand in slurry to the Wet Concentrator Plant (WCP) via a pipeline and leaves the reject

waste material from the ore sand (oversize and most of the slime fines) inside the mining void.

45 The WCP uses gravity processing technology to extract the heavier heavy mineral sands from the lighter quartz sand waste, returning the sand waste in slurry form back to the mining void via pile line. The heavy mineral sand concentrate (HMC) from the WCP is stockpiled adjacent to the WCP prior to being transported. The site based mining and wet concentrator elements of the project are aimed at separating the heavier mineral sand from the quartz waste sand which combined are the mined ore. This concentration process uses particle sizing and gravity separation methods to recover the mineral sands. Only bio-degradable flocculants are added to the rejected sand stream to enhance fines settling in the water stream with no additional emissions or additions.

46 The mining face progresses from west to east in 100m wide strips and moves in a general south to north sequence. Finally, when reaching Panel 9 in the north, the MUP will start back to Panel 9 in the south prior to the closing panel 10 in the north. To confirm, in response to the Grey District Council Officer Report query, all mining works are restricted to within the Disturbance Area and do not encroach within 200m of the ST6 highway.

47 The mining process has strong advantages in that:

(a) The equipment selected is multi-functional being used for topsoil movement, waste movement, ore movement and then post mining steps and for mine closure.

(b) The material that is moved the longest distance is the ore and this is done by efficient and non-dust creating slurry transport.

(c) The mining process does not require routine access to the bottom level in the mining void eliminating risks associated with water and hydraulic tailings.

(d) The rapid treatment cycle and limited mining void limits materials from being transported large distances away from its initial location.

(e) The depth of workings will mean that only topsoil and initial overburden waste mining will be on or near ground level with ore mining being done below ground level, further reducing noise and visual impacts of mining already mitigated by site bunds and pre-mining stockpiles.

(f) In completing the final landform shaping of the tails and overburden waste, a refined hump and hollow pattern should present a marked improvement in drainage and land utilisation over the current hump and hollow configuration.

48 Operating times for the mine will be limited to daylight hours, over a 7 day week. The WCP will operate full time (24 hrs x 7 days) using stockpiled material located indoors at the WCP. Storage of run of mine material from the in pit mining unit in the WCP feed shed during mine operating hours will allow 24 hour operation of the WCP. The day shift mining feed will be split at the WCP with part directly feeding the circuit and the rest going to the Concentrator Feed Shed to be fed to the Concentrator while the mine is not operating.

The need for activities ancillary to the mineral extraction to occur within 100m from the wetlands

49 I understand that the Project must have a functional need (i.e. a need to traverse, locate or operate in a particular environment because the activity can only occur in that environment) for it to occur in the area which is 100m from identified wetland areas. I have viewed Dr Bramley's maps showing this setback.

50 The key data set used for the mine planning works is the Mineral Resource Estimate (MRE). While exploration works in the region have previous identified mineral sands deposits along the South Island West Coast in various locations, the Mineral Resource Estimate for the Coates Block has been done to a standard that will allow acceptable economic assessment. This is the only current area that TiGa Minerals has an MRE completed for and therefore is the basis of this work for the application.

51 Refer Figure 2 above shows these target minerals as occurring within the Project mining area. I have completed a mine design for this area, on the basis that exploration and detailed mineral resource estimates have been completed to the JORC standard. As I have detailed above, the extraction method proposed was selected as it would have the least impact on water management and wetlands. The other which also occur in the setback are those which are immediately required for the mining extraction such as topsoil and overburden removal and mining void rehabilitation, infiltration trenches and reinjection wells for water management. These activities are necessary to extract the targeted minerals and there are no viable alternatives that would reduce impact. Activities which could be located out of this area such as the processing plant, access road, mine water facilities have all been located out of this area.

52 Mr Rekker has confirmed that clean water facility Pond 4 and 3 is necessary within this setback as it needs to be proximate to the wetland areas and will be left as a constructed wetland area.

Rehabilitation

53 In order to minimise the active mining area, rehabilitation is progressive and is done as part of the short term mining cycle and not left until mining completion. To allow

the continuous rehabilitation during the mining cycle to be successful, the final landform and land use has to be determined and designed prior to mining commencing, allowing the run of mine work on rehabilitating the returned waste to be shaped as required. Close discussion with the farm owner has occurred and the final landform agreed to.

54 To this end, the rehabilitation plan is run concurrent with the mining operation limiting the exposed land to the working area limits of 300 m x 100 m. Once the sand tails and over burden waste a pushed into the final landform shapes, topsoil stripped from in front of the mining path is spread directly over the shaped area and immediately rehabilitated.

55 Once final mining has been completed in Panel 10, stockpiled ore will be treated from the pre-mining void and dam work. Tails from this will fill Panel 10 prior to waste overburden removal and topsoil placement, completing the mining path.

56 The final closure works will require rehabilitation of the dam areas that are not remaining and then progressive work along the eastern edge of the mined void to marry up existing land contours with the post mine area contours. This will maximise the land use opportunities for the farm Owner. I have attached the Rehabilitation Management Plan which contains a Final Landform Report in **Attachment A**.

57 The WCP and office/workshop complex will be relocated to a future project or dismantled and removed. Parts of the shed infrastructure within the WCP area and part of the Mine and Clean Water Facilities may remain for use by the farm Owner.

Hydrology, sediment control, processing and minerals

58 Key components with the mine operations is the concept of maintaining separation between contact water and non-contact water. Non-contact water is defined as water that has no contact with the immediate mining operations (mine area plus processing area) while contact water has had some contact inside the mining operations area of activity.

59 With this definition, the non-contact water is not influenced by the mine and will flow through drainage channels to the Clean Water Facility (CWF) to be discharged to the wetland areas.

60 The contact water will be treated as dirty water that has to be contained within the mines water management system. This is based on the Mine Water Facility (MWF) Dams, located on the south side of the WCP. This facility is made up of a dirty water side and clean water side, where the dirty water side has sufficient retention time to allow solids to drop out of suspension and allow overflow water into the clean water side to be of sufficient quality to maintain operations.

61 All site contact water from the mine void and plant area is collected and returned to the dirty side of the MWF.

62 If a situation occurs where excess water is in the MWF, then a clarification unit in the WCP will take water from the clean water side of the MWF via the WCP process water tanks, treat it and discharge to the central drain that feeds through to the CWF.

63 Clean rainwater that falls outside the active mining void is non-contact water and will also feed through the central drain to the CWF.

64 The Central Drain will be constructed from the southeast corner of the disturbance area down to connect with the CWF and is intended to remain as part of the final landform to improve the property water management. It will handle all non-contact water and excess contact water that has been processed through the water clarifier located in the WCP. The drain will be set up with erosion control and limestone rock gabion baskets to control flow rate, dropout any remaining suspended solids and mitigate any suspended metals.

65 The Central Drain will initially follow the current location and then when the mining path encroaches it will be modified to use one of the final landform hollows.

Conclusion

66 The evidence above outlines the design logic, processes and outcomes as well as clarifies a matter raised in the Grey District Council Officer's report, relevant to my expertise.

Stephen Jeffery Miller

Dated this 19th day of January 2023

Attachment A: Rehabilitation Management Plan

Rehabilitation Management Plan
January 2024

Table of Content

1. Introduction

Rehabilitation of the site during mining (**Progressive Rehabilitation**) and post mining (**Final Mine-Closure Rehabilitation**) is an integral part of the mining process.

Re-establishing the landforms post extraction of the HMC and replacement of the topsoil, will be undertaken in a systematic manner consistent with the objectives of the Rehabilitation Plan. Those objectives are:

a) To create a final landform with a similar contour and profile ("humping and hollowing") at final mine closure as that which existed prior to mining;

b) To establish vegetation cover on all areas disturbed by mining activity as per agreed final landform; and

c) To protect freshwater values associated with Collins Creek, Canoe Creek, Canoe Creek Lagoon, Northern Drain and surrounding wetlands.

d) To reinstate the primary pre-mining catchment areas for the Northern Boundary Drain and Collins Creek/Canoe Creek Lagoon so the contouring and surface drainage installed during mine rehabilitation does not increase the rate of groundwater drainage at the site.

The mining process is expected to be continuous. Should the mine need to cease operations for any reason for a period of more than 3 months, all disturbed areas shall be rehabilitated as detailed in this document within 6 months from the date of the last mining works.

This rehabilitation plan should be used in conjunction with the Erosion and Sediment Control Plan.

The contents of this rehabilitation plan has been extensively discussed with the landowner.

2. Resource Consent Requirements

The proposed conditions of consent which relate to rehabilitation are outlined below.

6.0 Management Plans	
6.1	The Consent Holder shall operate the site in accordance with the following management plans: • Noise Management Plan • Avian Management Plan • Wetland Construction and Riparian Planting Plan • Dust Management Plan • Rehabilitation Management Plan • Water Management Plan and Monitoring and Mitigation Plan • Erosion & Sediment Control Plan • Landscape Mitigation Planting Plans • Transport Management Plan (collectively Management Plans)
6.2	The Consent Holder may amend the management plans at any time to take into account: a) Any positive measure/s to ensure the stated objectives of the management plans are achieved; b) Any required actions identified as a result of monitoring under these consents; and

	c) Any changes required to further reduce the potential for adverse effects as a result of actions identified in the Annual Work Programme. Where management plans require the input of an appropriately qualified person, any amendments to those management plans must also be undertaken by the appropriately qualified person. *Advice Note: Some management plans have ongoing annual review requirements which are required in order to avoid, remedy or mitigate effects. These specific review requirements are stipulated in the relevant conditions of this consent.*
6.3	Any amended Plans must be provided to the Consent Authorities within 20 working days of their review, for certification in accordance with Condition 6.1.
6.4	The Plans must not be amended in a way that contravenes the matters set out in the conditions for the respective Plans.
6.5	If the Consent Holder has not received a response from the Consent Authorities within one month of the date of submission of any reviewed management plan, the management plan must be deemed certified. If the response from the Consent Authorities is that they are not able to certify the management plan, the Consent Holder must consider any reasons and recommendations provided by the Consent Authorities, amend the management plan accordingly, and resubmit the management plan to the Consent Authorities.
6.6	A copy of the latest version of the Plans must be kept on site at all times and all key personnel must be made aware of the contents of each Plan and their responsibilities under each Plan.
6.7	Subject to any other conditions of these consents, all activities must be undertaken in accordance with the latest version of the Plans.

9.0 Rehabilitation	
9.1	The Consent Holder must carry out progressive rehabilitation, to achieve the following requirements: a) Reinstatement of the landform; b) Reinstatement of existing drainage patterns to reflect pre-mining catchment areas which discharge to the major drains; c) Ensure short and long term stability of the reinstated; and d) Protect Canoe Creek, Canoe Creek Lagoon, Northern Drain, Collins Creek from the effects of erosion and sediment generation. *Advice Note: Stabilised means an area inherently resistant to erosion such as rock, or rendered resistant by the application of aggregate, geotextile, vegetation, mulch or an approved alternative. Where vegetation is to be used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once an 80% vegetation cover has been established.*
9.2	At the completion of mining (final mine closure), the mine area must be fully rehabilitated, by reinstating the productive pasture in general accordance a Rehabilitation Plan. The objectives of the Rehabilitation Plan are: a) To create a final landform with a similar contour and profile at final mine closure as that which existed prior to mining;

	b) To establish vegetation cover on all areas disturbed by mining activity as per agreed final landform; and c) To protect freshwater values associated with Collins Creek, Canoe Creek, Canoe Creek Lagoon, Northern Drain and surrounding wetlands. d) To reinstate the primary pre-mining catchment areas for the Northern Boundary Drain and Collins Creek/Canoe Creek Lagoon so the contouring and surface drainage installed during mine rehabilitation does not increase the rate of groundwater drainage at the site. *Advice Note: Final mine closure is the completion of all mining and progressive rehabilitation works and removal of buildings.* *Advice Note: All Management Plans are required to adhere to the requirements of Condition 6.0.*
9.3	The Rehabilitation Plan shall include the following: • A programme of progressive rehabilitation of the pre-mining landform, adhering to maximum disturbed area limits. • The original and final mine closure topography. • Contour and stability of all post-mining landforms. • Establishment of pasture cover over all disturbed land. • Restoration of drainage discharge channels. • Protection of water and soils from the effects of erosion. • The achievement of water quality standards for water interacting with previously distributed sites/areas in the long term to protect aquatic values. • Removal of buildings, equipment, and structures; and • Post-mining weed and pest control requirements.
9.4	If for any reason active mining ceases for more than 3 months, operational stockpiles must be removed and material returned to the mining area, and all disturbed areas must be rehabilitated as required by the conditions of these consents within 6 months from the date of the last mining activity.

3. Mining and Progressive Rehabilitation process

Progressive rehabilitation is required to achieve the following requirements:

e) Reinstatement of the landform
f) Reinstatement of drainage patterns to reflect pre-mining catchment areas which discharge to the major drains;
g) Ensure short and long term stability of the reinstated landform; and
h) Protect Canoe Creek, Canoe Creek Lagoon, Northern Drain, Collins Creek from the effects of erosion and sediment generation.

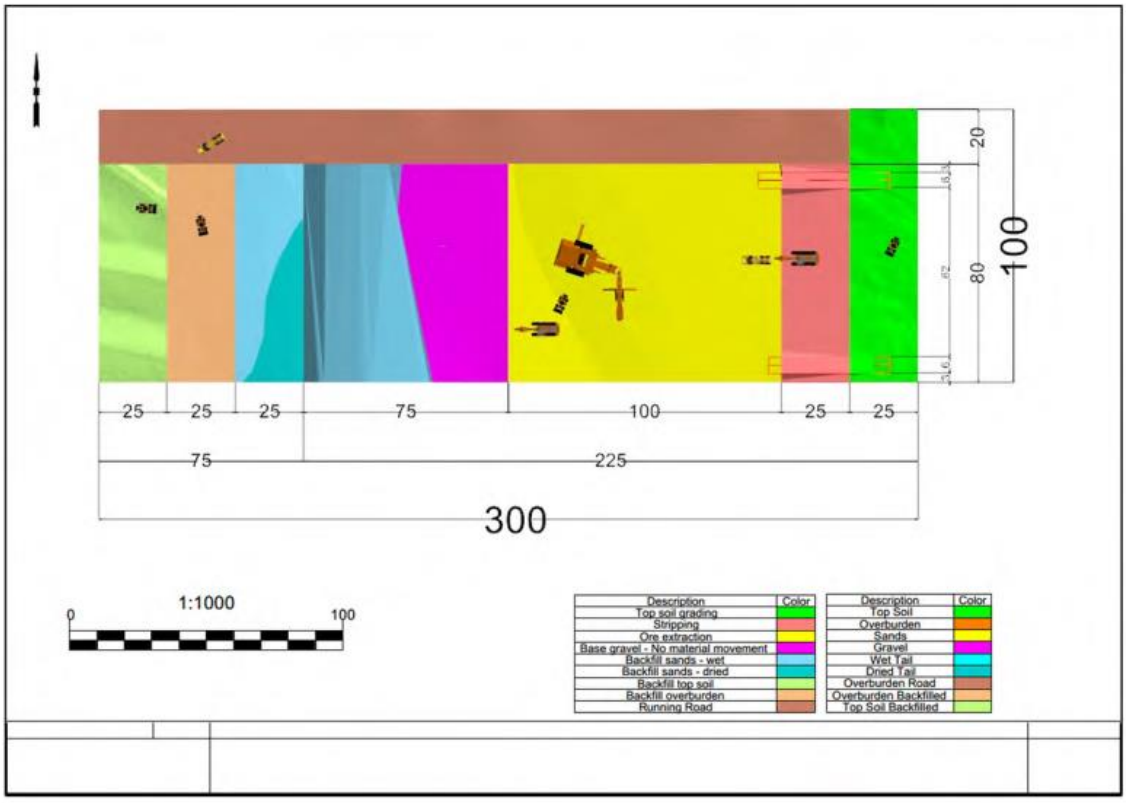
Progressive rehabilitation is defined as the 0.5ha area of progressive rehabilitation occurring as part the mine pit area. Progressive mining process involves the placement of mine tailings and waste sequentially behind the active mining area, followed by the replacement of overburden, spreading of topsoil, shaping to the final landform contours and returning the land to pasture to maintain a maximum mine pit area of 3.5ha.

The total area of the mining footprint (Mining disturbance area) is 63 hectares

Overburden and mineralised sand from the initial mining void, water treatment facilities at the plant and constructed wetland area will be stockpiled and used in the bunds and ore stockpiles. These stockpiles and bunds will be capped with the topsoil removed from the starter pit and water facilities, and temporarily rehabilitated before being recovered and processed at the end of the mining life.

The topsoil over the extraction area will be removed to allow access to the sand for mining and will be placed back onto already prepared backfilled areas as part of Progressive Rehabilitation.

The below schematic demonstrates the mining pit through extraction and Progressive Rehabilitation, with the right (eastern) part of the cross-section demonstrating extraction and the left (western) part of the cross-section demonstrating the ongoing Progressive Rehabilitation.



Schematic: Mining Pit extraction and Progressive Rehabilitation

Figure 1 (below) details the mining sequence schematics, which details the extraction and Progressive Rehabilitation process.

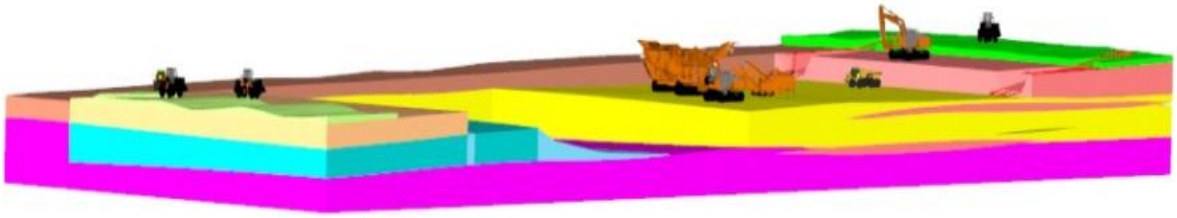


Figure 1: Mining sequence schematics

Figure 2 (below) shows the initial areas for topsoil removal. Topsoil above the sand to be mined in the:

- Mine Water Facility
- Clean Water Facility
- The access road and plant area
- Pre-mining void area

The overburden and mineralised sand removed in this construction phase will be used to create bunds and the topsoil from these areas will be used to cap the bunds and stockpiles.

Once vegetative cover is established with rye grass seeding and straw cover, these areas are removed from the disturbed area.

Figure 2: Extent of site for initial topsoil removal

Initial Soil removal will be undertaken in the following sequence.

1. Clean Water Facility - constructed wetland.
2. Central Drain
3. Mine Water Facility construction. Provides sediment control for plant site and road construction.
4. Road and Plant area
5. Mining starter pit.

As the mine progresses, subsequent topsoil removal will be immediately placed back onto backfilled and reshaped areas to minimise re-handling of topsoil as part of Progressive Rehabilitation.

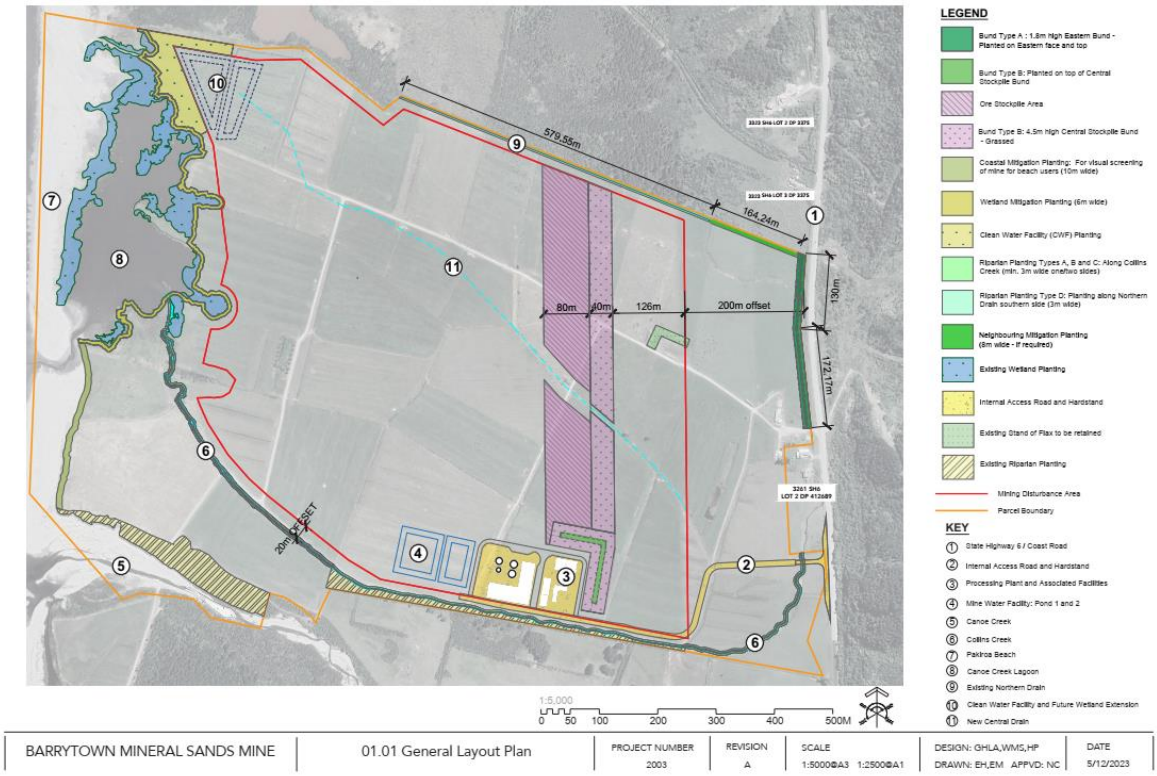


Figure 3: Visual bunding/planting

The Eastern Stockpiles and Bund has the following physical properties:

- Maximum height above current land is 4.5m;
- Maximum length and width are approximately 360 m and 125 m, total surface area of 4.5 hectares;
- Volume of overburden, Soils and Ore is approximately 250,000m3

This bund will be formed during the pre-production phase of the operation and will then be rehabilitated with topsoil and seeded to all sides and top. This will be undertaken over a 3 to 6 month period.

The bund and stockpiles will be recovered in the final mining sequence and land rehabilitated.

The maximum total site disturbed area of approximately 8 Ha occurs approximately seven months after commencement of mining. As the mining face moves, topsoil stripping occurs at the front of the mining area with waste material and topsoil being moved to the back of the mining area where progressive rehabilitation is undertaken at the same rate to keep the total disturbed area at approx. 6.5 Ha for the remainder of the mine life.

This sequence of topsoil stripping, waste mining, ore mining and tails replacement(Extraction and Progressive Rehabilitation) continues until final tails landforms are achieved.

The mining sequence now includes all seven stages of the mining process as per Figure 1.

The stages are: -

- Undisturbed farmland;
- Topsoil stripping –placed directly onto backfilled and contoured tailings and overburden;
- Removal of overburden;
- Mining of sand – pumped to the processing plant;
- Tailings deposition – tailings pumped from processing plant to back fill mining void and positioned with cyclone and contoured by use of excavator and bulldozer;
- Rehabilitation of tailings with overburden;
- Placement of topsoil then seeded with rye grass seed and straw cover.

The pre-stripped and stockpiled ore will be processed through the mining field unit and tailings discharged to the mining void (Panels 8, 9 and 10) to complete rehab. Then topsoil and overburden from the eastern bund will be used to merge the contours into the final landform shape.

Figure 4 shows the mine area final landform and the rehabilitation of pre-stripped ore stockpile and disestablishment of the eastern bund. This landform has been developed in accordance with environmental outcomes and in consultation with the landowner.

Once mining ceases, the processing plant and all associated equipment will be de-commissioned and removed from site (except a product storage shed that will be used for farming). The (Mine Water Facility) silt and settling ponds will be decommissioned and removed. The (Clean Water Facility) constructed wetland in the Northwest will be retained.

These areas will be rehabilitated using the remaining overburden and topsoil that was stockpiled.

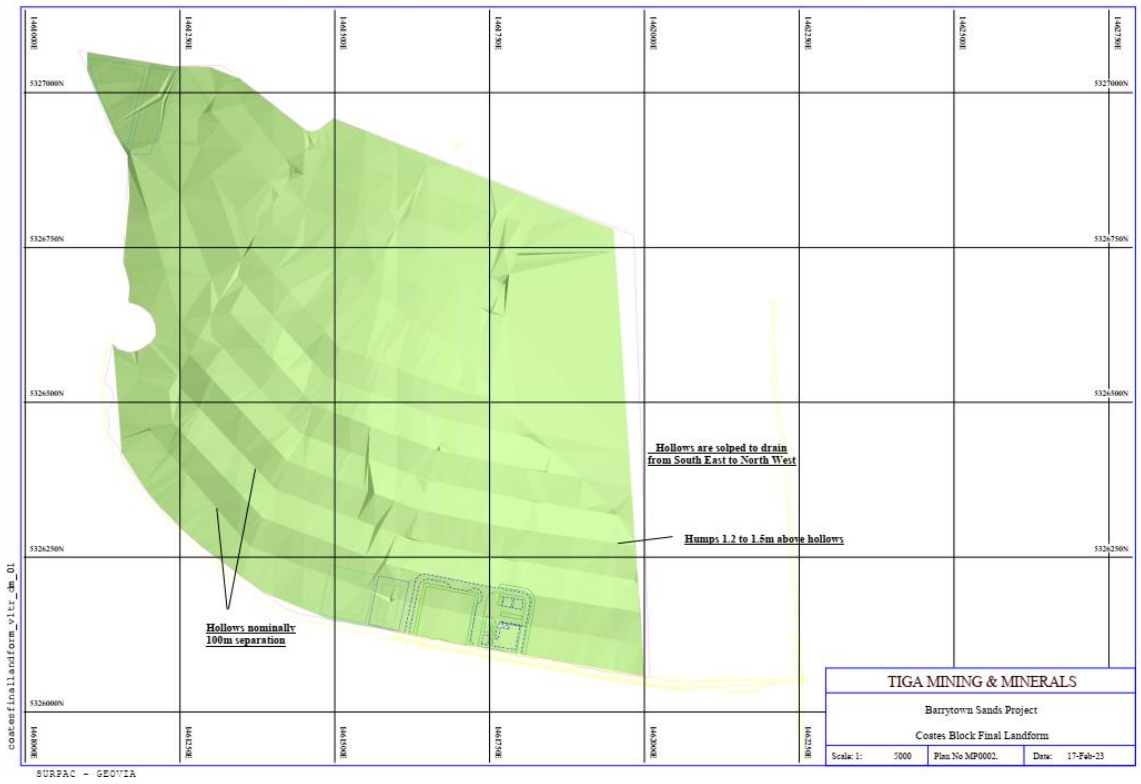


Figure 4: labelled drawing of humps and hollows

Figures 5 and 6 compare the contours of the original topography and the final site landform and figures 7, 8 and 9 show cross sections through the area with the existing and post mining ground level shown. The mix of humps and hollows that existed pre-mining is replaced with humps and hollows that generally align to the northwest. This design was the preferred option of the landowner.

During operations a Central Drain will be maintained to allow control of clean surface water run-off from areas outside the mining and plant area, and to allow excess water that has been treated to a sufficient quality to be discharged into this to then direct both water flows to the Clean Water Facility. The Central Drain will move over the project life but will be maintained to avoid erosion and with Gabion barriers installed to control water flow rates and to help drop solids from the water flow. Excess water will flow through the Clean Water Facility prior to discharge.

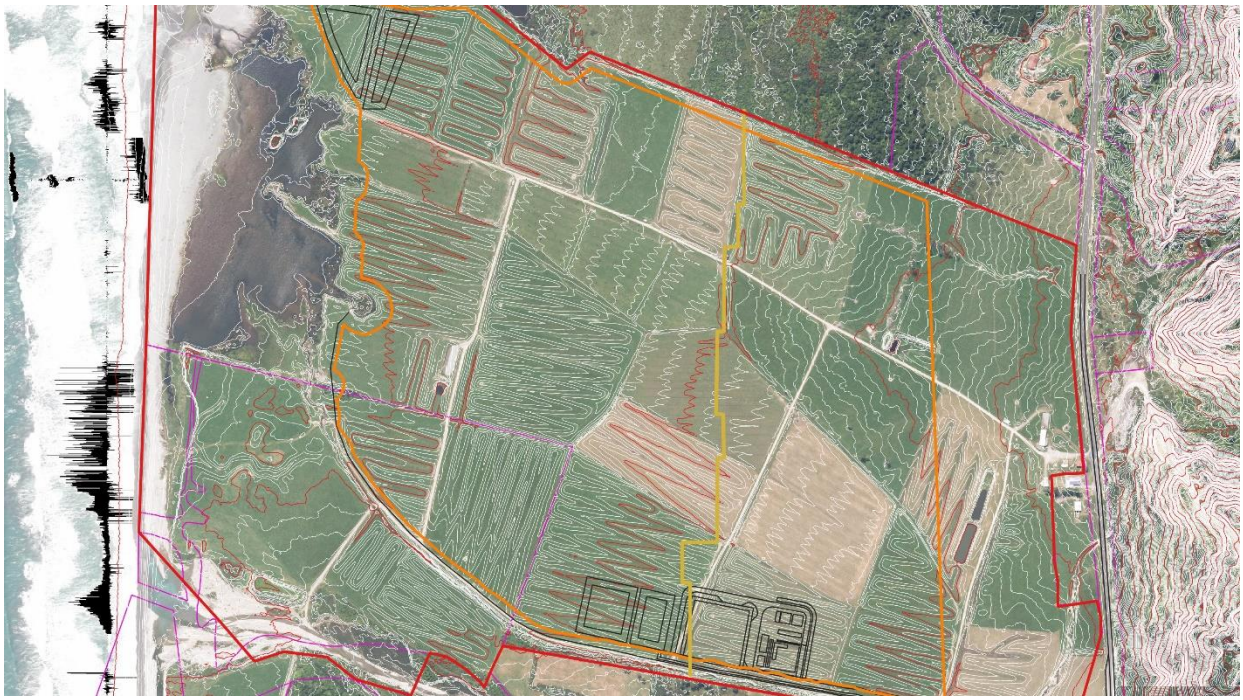


Figure 5: Contours of Original Topography

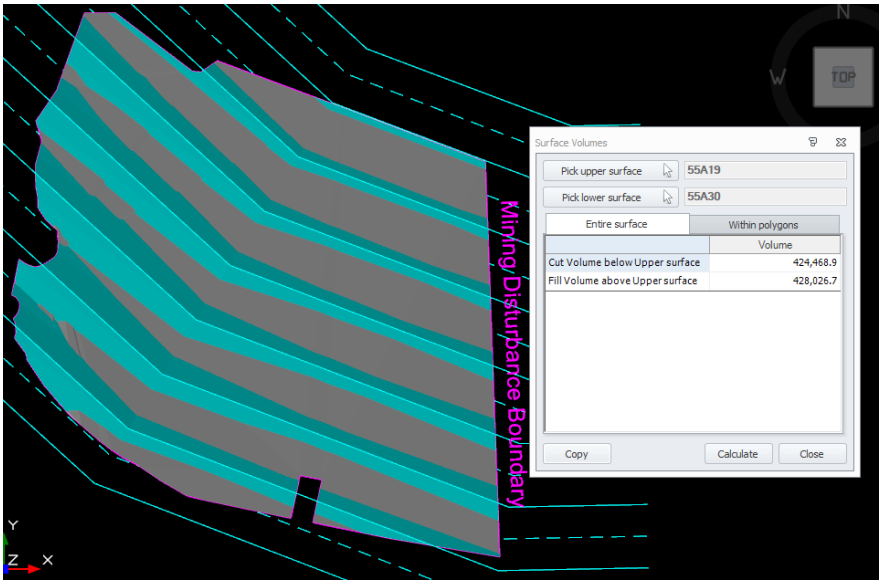


Figure 6: Contours of Final site landform

With the final landform established, the Central Drain is not a requirement to maintain the mine area drainage.

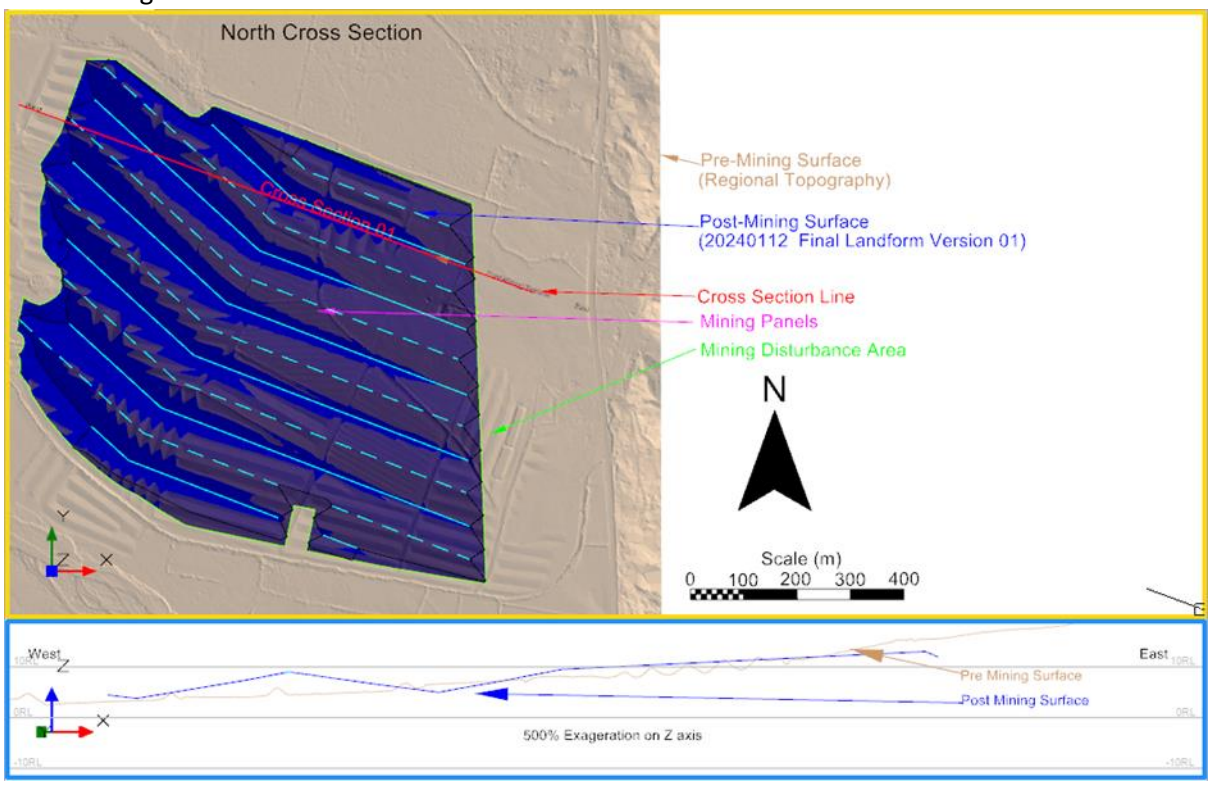


Figure 7: Northern Cross section

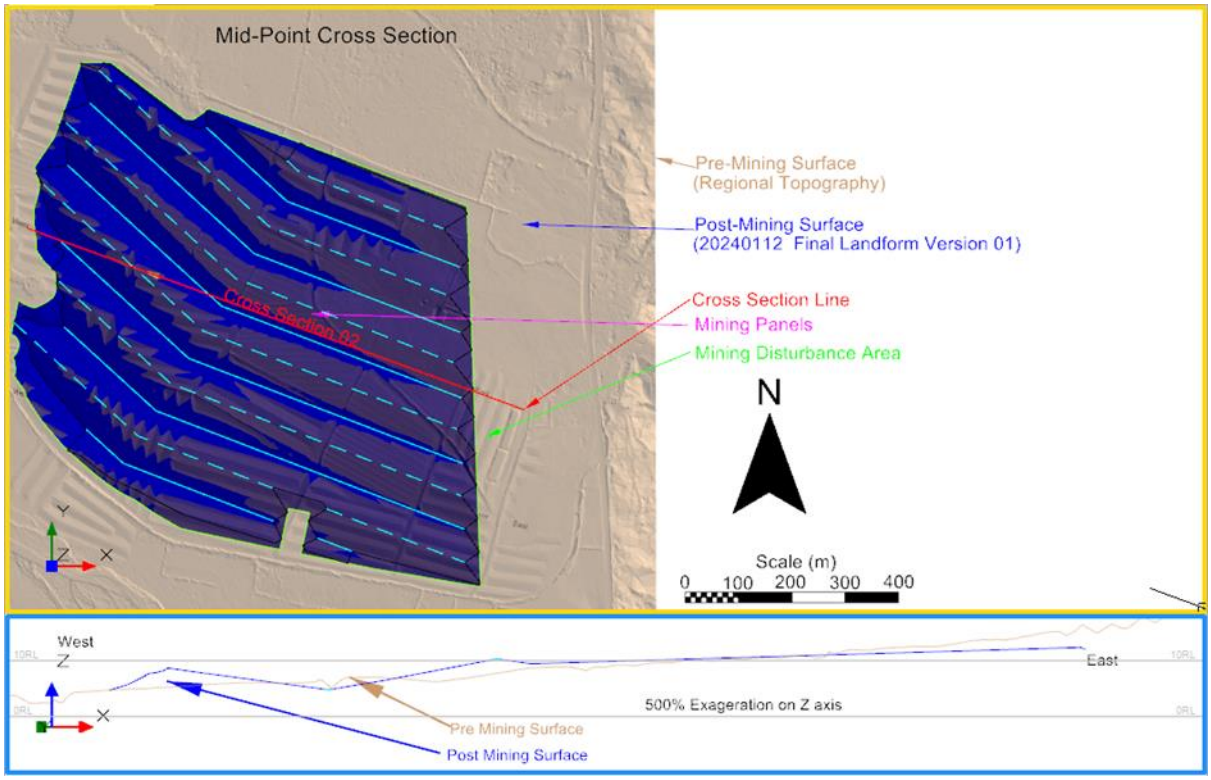


Figure 8: Mid-Point Cross Section

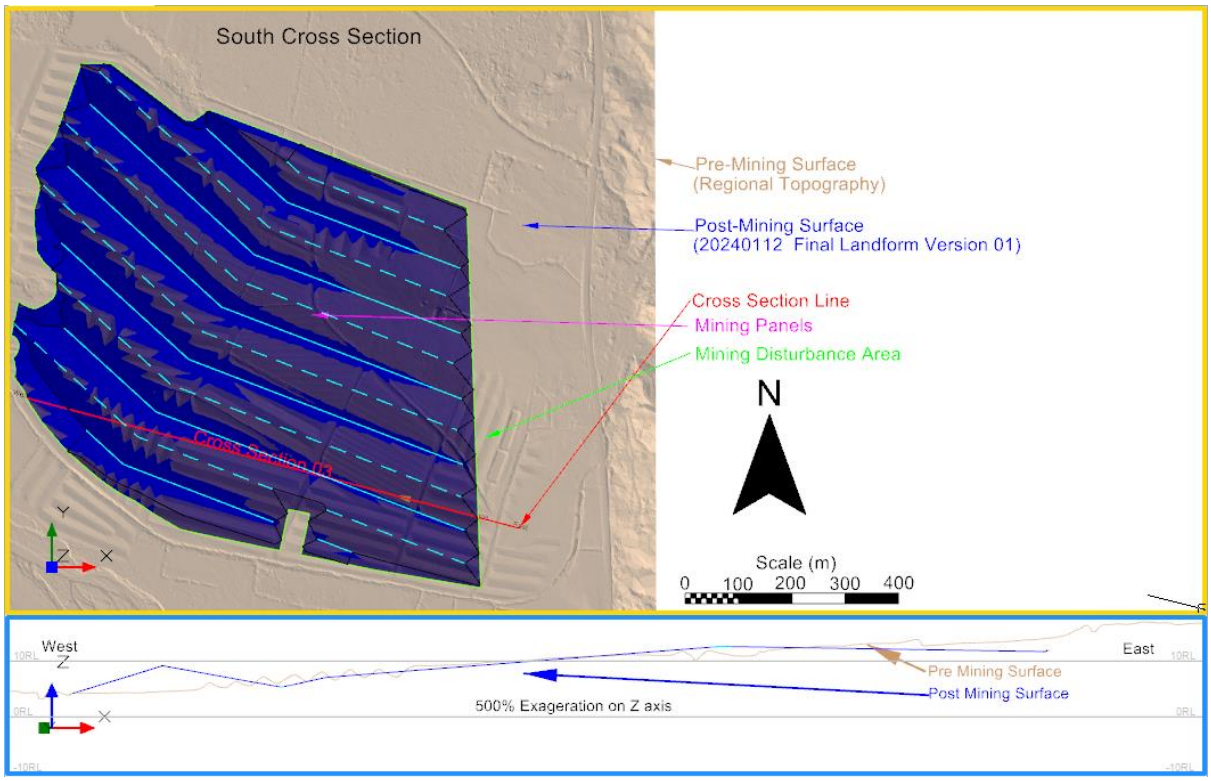


Figure 9: Southern Cross Section

The post mining contour is created from redistribution of some material located between the Mining cut off and the edge of the mine disturbance area. This area is approximately 20 hectares which be

recontoured to match in with the landform created as part of the progressive rehab. This area will also hold the pre stripped ore, overburden and topsoil extracted as part of the pre-mining activities and development of mine infrastructure.

4. Rehabilitation quality assurance

The resource consent conditions require that this Rehabilitation Plan addresses specific measures that will ensure a robust rehabilitation. These measures include:

- *A programme of progressive rehabilitation of the pre-mining landform, adhering to maximum disturbed area limits.*
- *The original and anticipated final mine closure topography.*
- *Contour and stability of all post-mining landforms.*
- *Establishment of pasture cover over all disturbed land.*
- *Restoration of drainage discharge channels.*
- *Protection of water and soils from the effects of erosion.*
- *The achievement of water quality standards for water interacting with previously distributed sites/areas in the long term to protect aquatic values.*
- *Removal of buildings, equipment, and structures; and*
- *Post-mining weed and pest control requirements.*

Each of these measures is addressed as follows:

4.1 A programme of progressive rehabilitation of the pre-mining landform, adhering to maximum disturbed area limits

The programme of progressive rehabilitation is as discussed in Section 3 above.

4.2 The original and anticipated final mine closure topography.

The original and final mine closure topography are shown in Figures 5 and 6 above. The current landform has humps and hollow aligned in different directions. The new landform will still be humped and hollowed but the humps will have a wider profile and will generally be aligned east to west with sections heading to the north west. Drainage catchment areas will remain approximately the same area as pre-mining. The post mining landform will be remaining at the same finished height in the west of the property as the pre mining land form. With material redistributed from the eastern area of the mining.

4.3 Establishment of pasture cover over all disturbed land

Once final topsoil is in place and a suitable area has been established and compacted, sowing of ryegrass seed will be undertaken and covered with straw. It is also expected that as topsoil has been relocated from the Northern areas directly to the Southern areas, a significant amount of self-seeding will also occur.

4.4 Restoration of drainage discharge channels

All the existing drainage channels from site will be retained. Catchment areas reporting to these drainage points will be approximately the same area as pre mining and will not increase the rate of groundwater drainage at the site. Further detail is set out in the Water Management Plan and rehabilitation concept.

4.5 Protection of water and soils from the effects of erosion

Topsoil removed from the plant site will largely be used for the visual bund and will be immediately profiled and planted as part of the visual mitigations. A stormwater drain will be constructed from

the plant site area to the stormwater silt and settling ponds to ensure any stormwater is controlled and directed to these ponds for treatment. Further detail regarding protection from erosion is provided in the Erosion and Sediment Control Plan.

4.6 The achievement of water quality standards for water interacting with previously distributed sites/areas in the long term to protect aquatic values

The Water Management Plan and the Monitoring and Mitigation Plan required by the conditions of consent (Condition 24) provide actions that will be undertaken to manage water quality effects. The conditions of consent also require (Condition 26) water monitoring, which will ensure the achievement of water quality standards throughout the mining process, and consequently following rehabilitation.

4.7 Removal of buildings, equipment and structures

The processing plant and any associated buildings, tanks or pipework are all of a "portable nature". This means none of the plant requires any major concrete foundations, with most simply using skids to distribute their load to the sand base. It is intended that all of the site equipment will be removed for use at a potential future operation. If any concrete is used for foundations, this will be removed before topsoil is replaced in the plant site area.

The exception to this is the product storage shed building will be retained as a building for farming purposes for the landowner. The owner has obtained a certificate of compliance for this.

The silt and settling ponds, and stormwater drains, will be cleaned of any silt and sediments followed by the backfilling, compaction and re-seeding of these areas back to pasture.

4.8 Post-mining weed and pest control requirements.

Weed control, fertilisation and land management will occur as part of sustainable farm management and stock farming.

5. Final Mine Closure

Final mine closure will occur at the completion of all mining and progressive rehabilitation works, end of mine landscaping on the northern boundary, and includes the replacement of the temporary tailings stockpile back to the mine area.

Landforms at the point of final mine-closure are detailed in the Final Landform Report attached as **Attachment A**, and will achieve the objectives of this rehabilitation plan.

,

The Consent Holder must notify the Consent Authorities of the intended completion of final mine closure rehabilitation activities at least 15 working days prior to works ceasing on-site in accordance with Condition 2.1 of General conditions of the GDC and WCRC Consent.

Attachment A: Final Landform Report

Report

Final Landform

Client	TiGa Minerals & Metals Limited
Site	Barrytown Mineral Sands Project
Date	17 Jan 2024
Doc No.	BJL6830-02

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VERSION MANAGEMENT

Process	Name	Date	Version
Author	Edison Hung	17 January 2024	2
Peer Review By	Stephen Miller	17 January 2024	2
Draft Issued To	John Berry	17 January 2024	2
Final Review By			
Final Issued To			

Final Landform Calculation

Mining Panel Excavation Boundary

As the mining panel is defined, on average the excavation is around 0.8m deep, Figure 0.1 shows the outline of mining panel that is used in the calculation (Green Polygon). Therefore the volume is removed from the mining panel is ~267,000BCM (339,813m²*0.8m)

Figure 0.1 Outline of Mining Panels (Green Polygon)

Rehabilitated Boundary

The rehabilitated zone includes all of the mining panel boundary and extended East to mining disturbance limit, this limit is used as rehabilitated zone. Figure 0.2 shows the outline of Mining Disturbance Limit (Purple Polygon). This boundary defines the cut and fill neutral surface after mining has complete (cut and fill natural minus 267k BCM).

Figure 0.2 Outline Mining Disturbance Limit (Purple Polygon)

Define Cut and Fill Neutral Surface Post Mining

Designs of final landform have been done to maintain Western Limit rehabilitation to near current landform levels. Cut and fill surfaces have taken that into account to minimise drop in landform on the Western boundary. Since the final rehabilitated surface is in the form of hump and hollow, resulting in a high and low elevation. In the final landform design, the hollows have been targeted to marry in with current landform requiring the humps to be above current landform. Figure 0.3 shows the current landform (Brown) with the existing humps and hollows and shows the average post mining surface (Gray) from which the average post mining surface is used as basis for the final landform design.

Cut and fill volume required to establish the desired post mining landform were determined by comparing the pre mining topography to the average post mining surface. The net cut is ~272k BCM, which is inline with the target of 267k BCM (~5k fill surplus), calculated by the depletion of the mineral sands from the mined area.

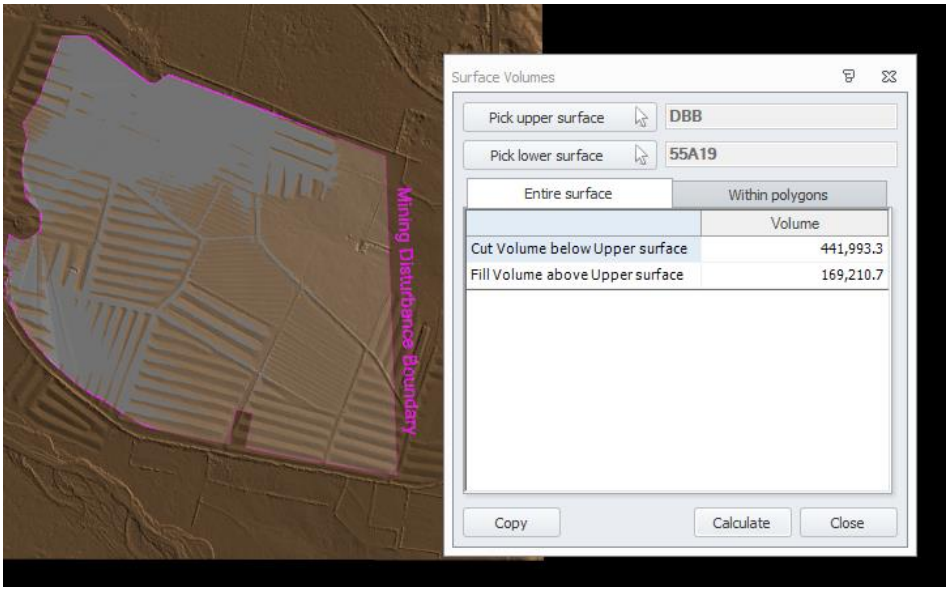


Figure 0.3 Cut and fill volume between average post mining surface and pre-mining topography

Create Rehabilitated Humps and Hollows Post Mining Surface

Guideline for previous drainage strings were adopted, register to the cut and fill surface and reduce the Z level by 2.5m. By projecting this string up by 5 m at 5º on both sides, post mining trough is created. Repeat this process to cover the final rehabilitation zone Figure 0.4 shows the cut and fill post mining surface and rehabilitation Surface.

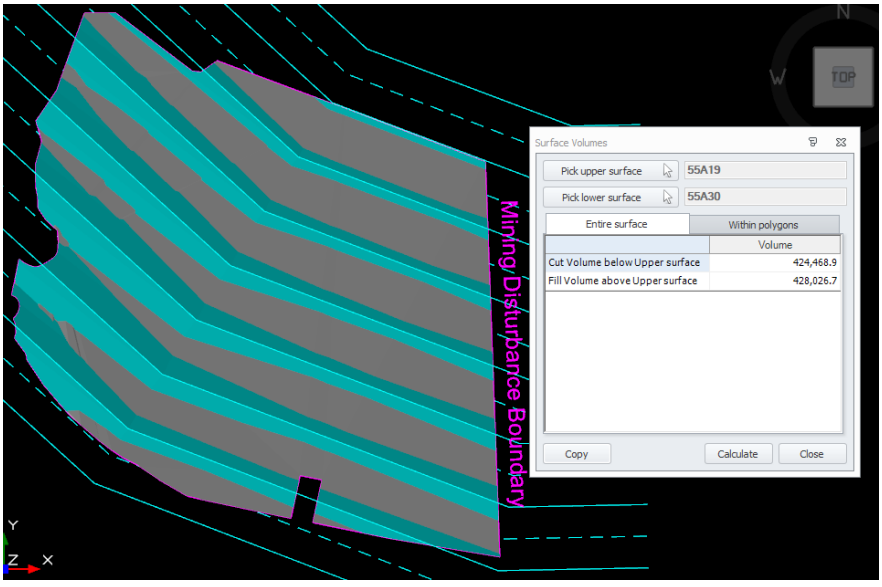


Figure 0.4 Cut and Fill Post Mining Surface and Rehabilitation Surface

The full project contour level surface with elevations (RL) can be found in 1.

Create End Wall

To allow for allowing for a gentle transition between the natural topography and the rehabilitated profile, a 5º batter (both cut and fill) were adopted. Figure 0.5 shows an example of the cut from natural surface to the rehabilitated surface. Please note that the dash cyan lines indicated the trough and solid cyan lines indicates peaks.

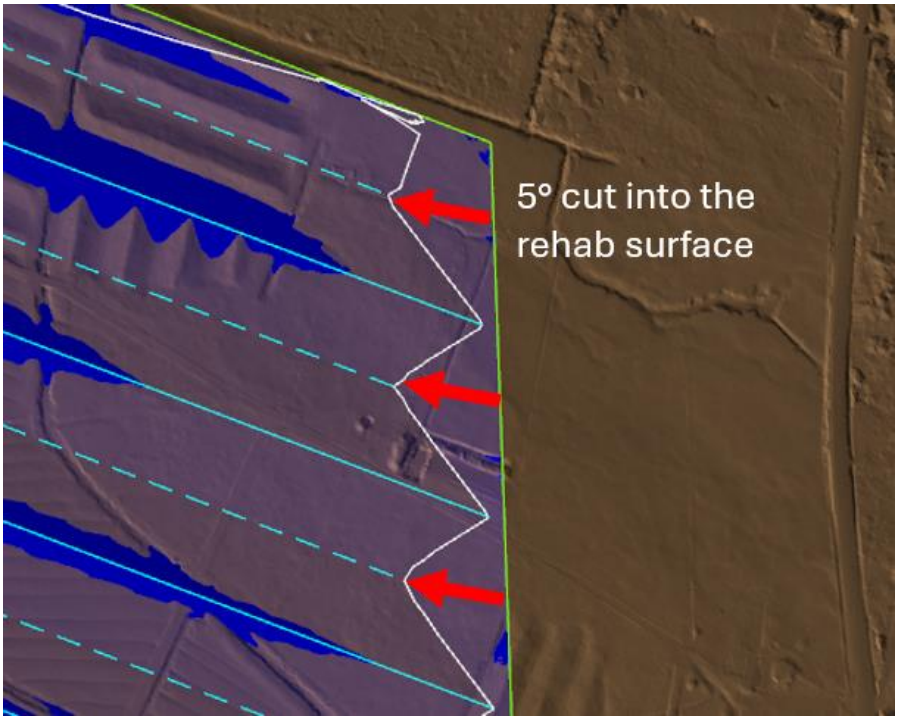


Figure 0.5 5˚ cut into rehab surface.

Create Contour

After the rehabilitation surface is created, contour can be created. In the plot, the major contour is assigned as 5.0 m (z axis) while the minor contour is assigned as 1.0 m (z axis)

Cross Section

North Cross Section

Using the final rehabilitated surface and pre-mining surface, a north cross section can be produced. Figure 0.1 shows the North Cross Section, in the cross section, there is a 500% vertical exaggeration (Z axis).

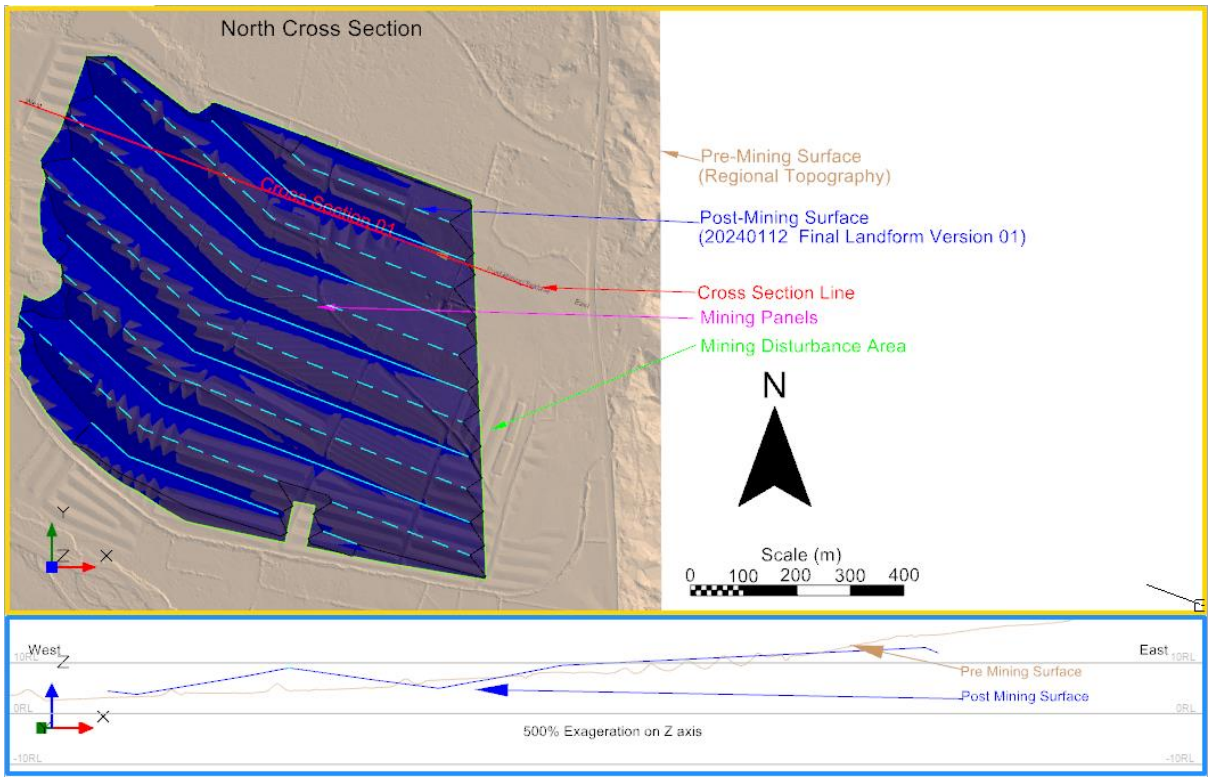


Figure 0.1 North Cross Section

Mid-Point Cross Section

Figure 0.2 shows the Mid-Point Cross Section, in the cross section, there is a 500% vertical exaggeration (Z axis).

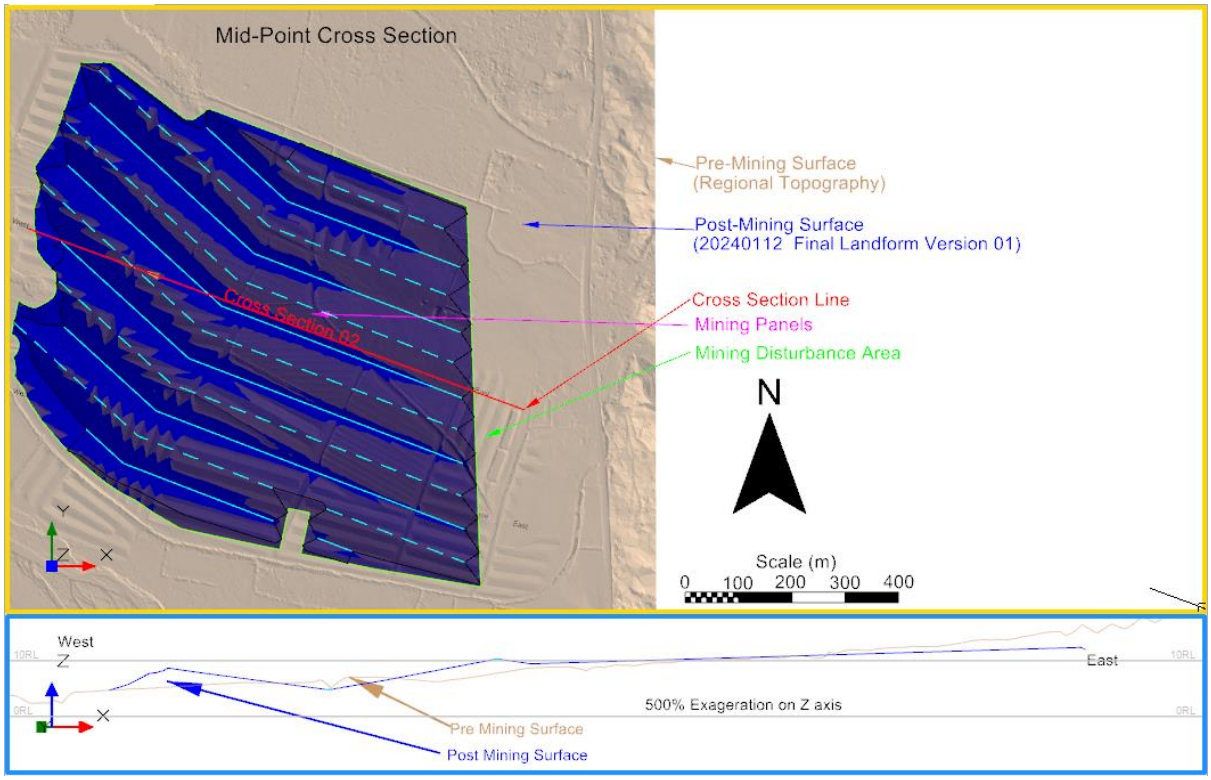


Figure 0.2 Mid-Point Cross Section

Mid-Point Cross Section

Figure 0.3 shows the Mid-Point Cross Section, in the cross section, there is a 500% vertical exaggeration (Z axis).

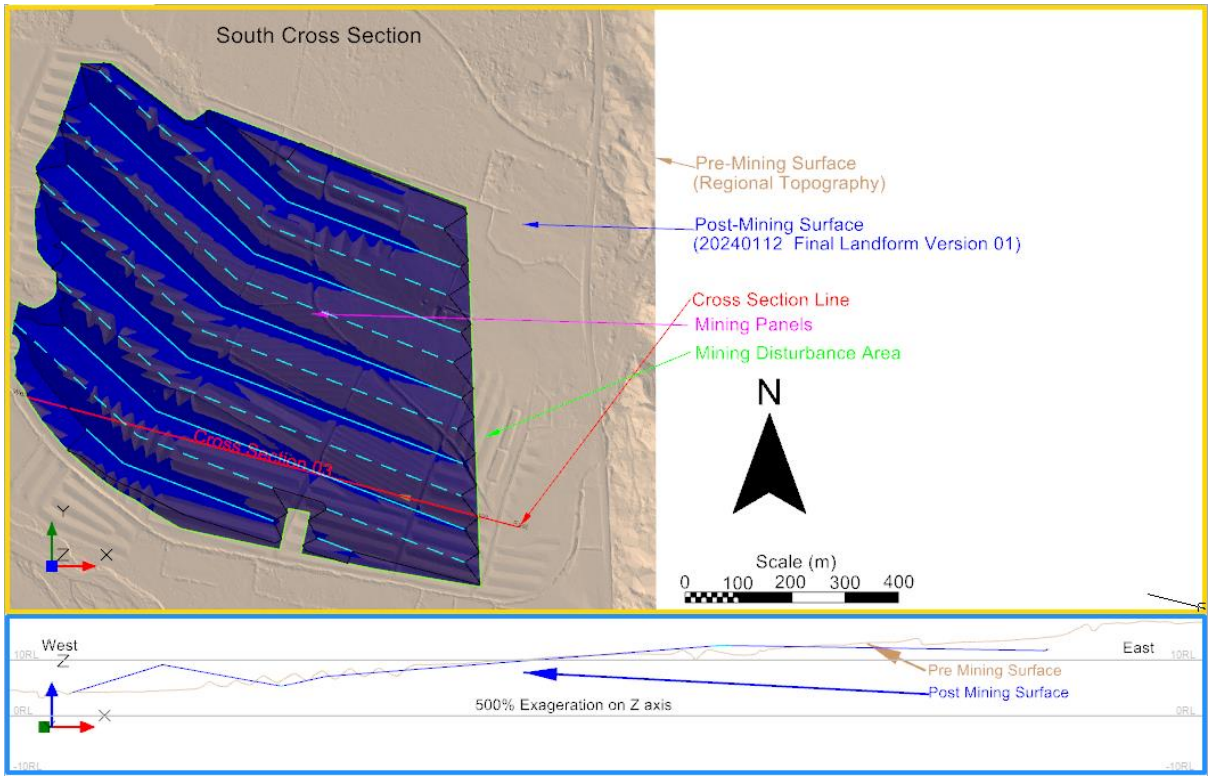
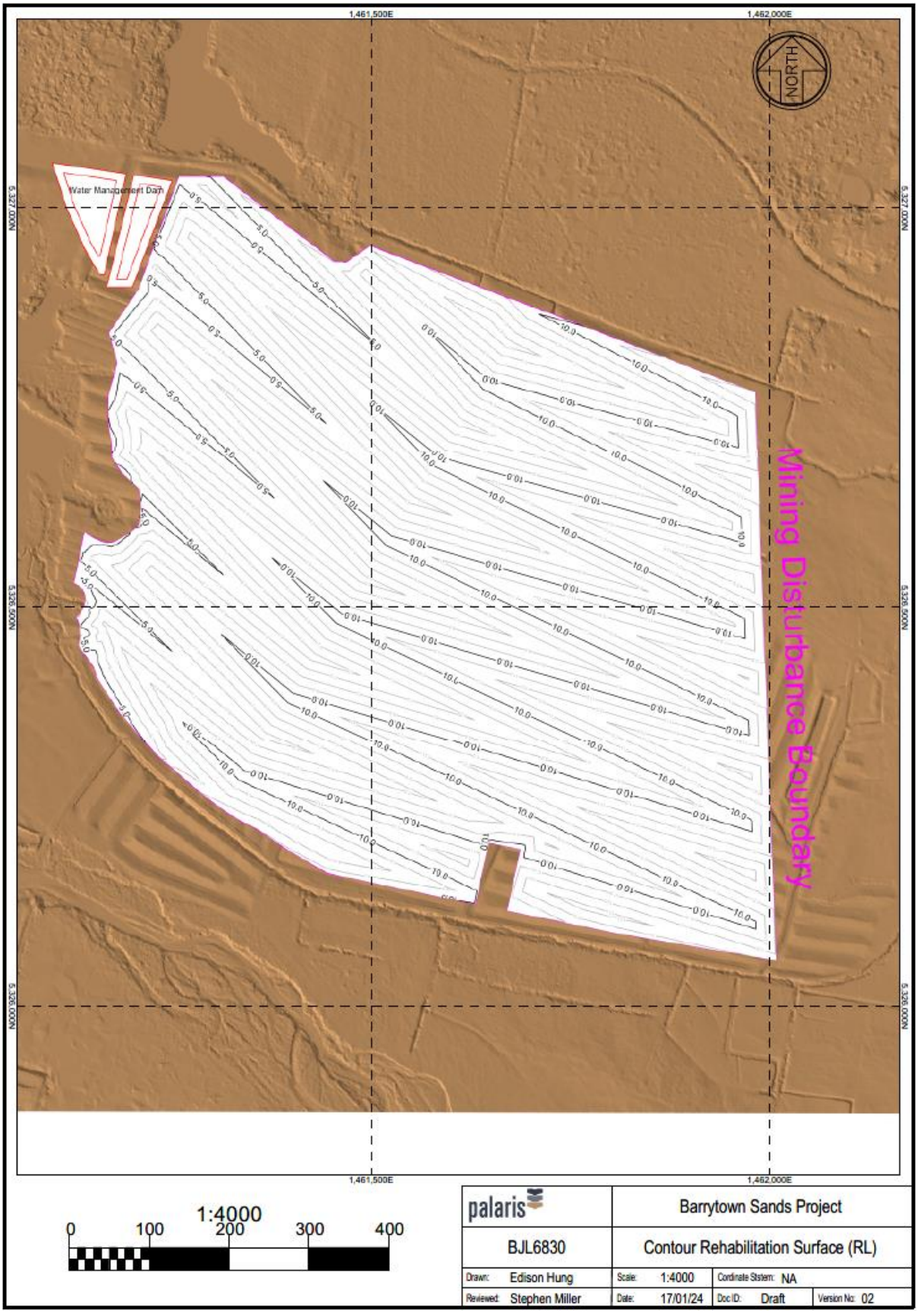


Figure 0.3 South Cross Section

1 Contour Rehabilitation Surface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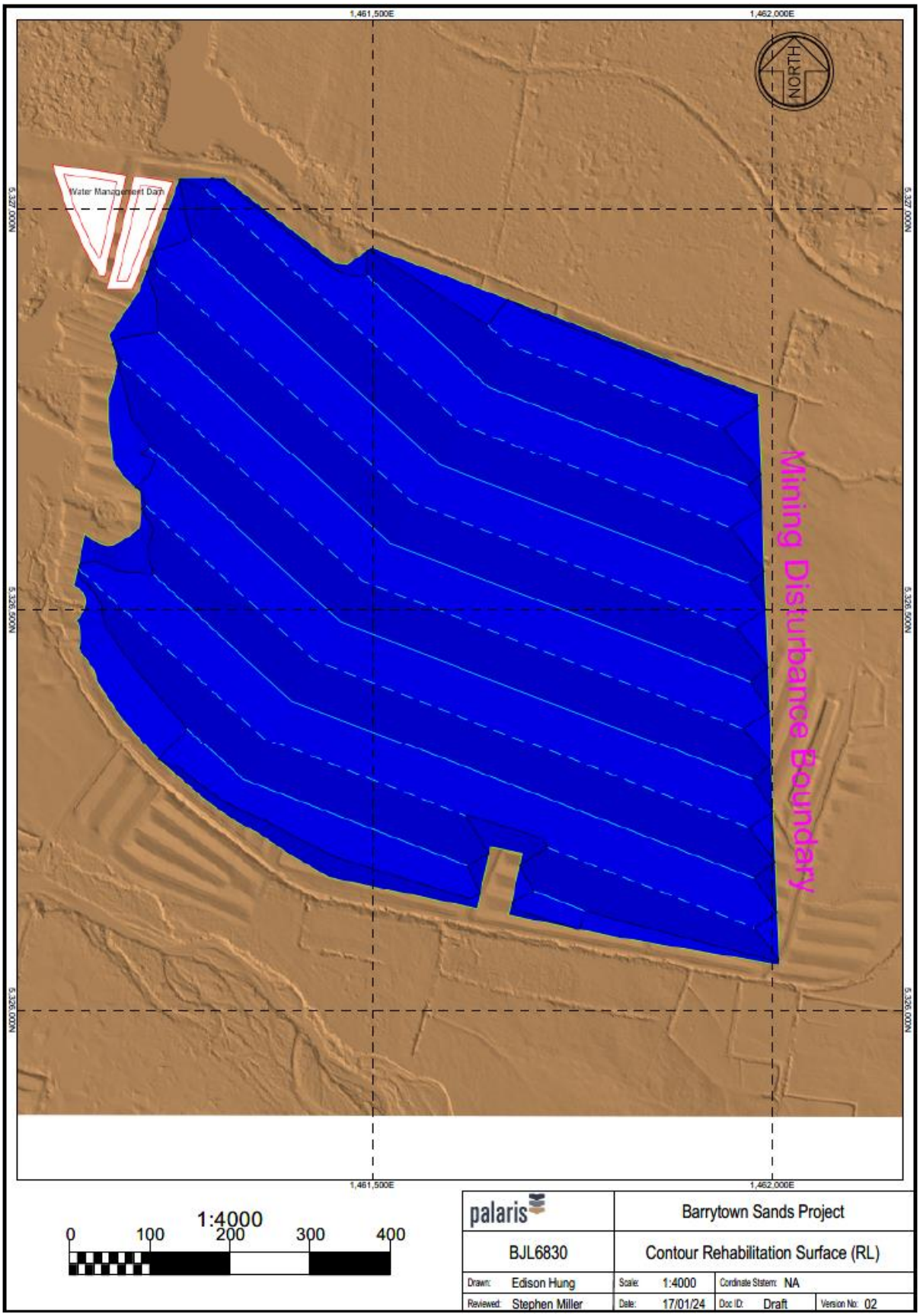
5,326,000N
NORTH
Water Management Dam
Mining Disturbance Boundary
1:4000
0
100
200
300
400
palaris
Barrytown Sands Project
BJL6830
Contour Rehabilitation Surface (RL)
Drawn: Edison Hung
Scale: 1:4000
Cordinate System: NA
Reviewed: Stephen Miller
Date: 17/01/24
Doc ID: Draft
Version No: 02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NORTH
Water Management Dam
Mining Disturbance Boundary
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