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Prepared for
Balmaine Gold Pty Ltd
ABN: 67 142 297 685

AECOM

Planning Permit Application

Development of Tailings Storage Facility 4 (TSF4)

11-Aug-2022
Ballarat Gold Mine

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Planning Permit Application

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Client: Balmaine Gold Pty Ltd

ABN: 67 142 297 685

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Reviewed by [redacted]

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	5/8/2020	Draft for client review	[redacted] Associate Director	
0	17-Aug-2020	Final	[redacted] Associate Director	
1	11-Aug-2022	Revised Final	[redacted] Associate Director	[redacted]

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Executive Summary

Applicant Details

Applicant	Balmaine Gold Pty Ltd
Contact Person	[redacted] AECOM Australia Pty Ltd [redacted]

Application Details

Site Address	10 Woolshed Gully Drive, Mount Clear 3350
Formal Property Description	Crown Allotment 10K, Section 12, Parish of Ballarat
Description of Proposal	The proposal seeks approval for the buildings and works for the development of a new tailings storage facility, associated with the land use of Earth and energy resources industry.
Permit Requirement	A permit is required for the buildings and works in accordance with Clause 35.07, Clause 36.04, Clause 42.01, Clause 52.08. A permit is required to build a fence under Schedule 5 of Clause 42.01. A permit is also required to create or alter access to a road in a Transport Zone 2under Clause 52.29.
Zones	Farming Zone (Clause 35.07) Transport Zone 2 – Principal road network (Clause 36.04)
Overlays	Environmental Significance Overlay – Schedule 5 (Clause 42.01) Bushfire Management Overlay (Clause 42.06)
Particular Provisions	Earth and Energy Resources Industry (Clause 52.08) Native Vegetation (Clause 52.17) Land adjacent to the Principal Road Network, , (Clause 52.29).
Aboriginal Cultural Heritage Sensitivity	No
Land Owner	Crown Land
Municipality	City of Ballarat

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) act on behalf of Balmaine Gold Pty Ltd (the applicant) in support of a planning application for buildings and works, and the removal of vegetation for a new Tailings Storage Facility at Ballarat Gold Mine (BGM), Ballarat.

Balmaine Gold Pty Ltd (Balmaine), a wholly-owned subsidiary of Castlemaine Goldfields Pty Ltd (CGT), own and operate an underground gold mining operation located in Woolshed Gully, Mount Clear, in central Victoria.

Ore from the underground mine is hauled to the mill site where it is processed. Tailings are pumped as a slurry from the processing plant to the Terrible Gully Tailings Storage Facility (TSF), also referred to as TSF3, located 600 metres south of the processing plant.

TSF3 has previously been expanded several times and will reach its approved capacity by 2021. Balmaine Gold are planning a new TSF, termed TSF4, and Balmaine Gold have selected a preferred site in Whitehorse Gully, south of TSF3, for which a concept design has been developed.

The Works Area for this Planning Permit application including the proposed location of the TSF4 footprint is shown in Appendix A.

The proposal seeks planning approval for the development of land associated with the use of Earth and energy resources industry in accordance with the following provisions of the Ballarat Planning Scheme (Planning Scheme):

- Buildings and works in accordance with:
  - A section 2 use under the Farming Zone (Clause 35.07).
  - A section 2 use under the Road Zone (Clause 36.04).
  - Environmental Significance Overlay (Clause 42.01).
  - Clause 52.08 Earth and energy resources industry.
  - Clause 52.29 Land adjacent to a Road Zone, Category 1, or a Public Acquisition Overlay for a Category 1 road.

This report provides a summary of the Works Area and surrounds, details of the proposal and a response to the relevant sections of the Planning Scheme, including the Planning Policy Framework and Local Planning Policy Framework.

The Planning application is supported by the following documents:

- Appendix A – Development Plans
- Appendix B – Statutory Endorsement of Work Plan Variation
- Appendix C – Registration of Instrument of Assignment of a Plantation License
- Appendix D – Copy of Planning Permit PA93/195
- Appendix E – Certificate of Title Documents
- Appendix F – Correspondence with DELWP
- Appendix G – Visual Impact Assessment
- Appendix H – Vegetation Condition Assessment
- Appendix I – Noise Assessment
- Appendix J – Air Quality Assessment
- Appendix K – Department of Transport Response

As required under Clause 52.08 of the Ballarat Planning Scheme, a Work Plan Variation to mining tenement MIN4847 was submitted in April 2020 and received statutory endorsement under the *Mineral*

Resources (Sustainable Development) Act 1990 (MRSD Act) on 10 August 2020. The Endorsed Work Plan Variation is provided in Appendix B.

It is noted that a Planning Permit (PA93/195) exists for other parts of the mining operations and no amendments are proposed by this proposal. A new planning permit specific for the defined Works Area is being sought by this proposal.

In April 2022, Balmaine Gold negotiated an operations management arrangement with Melbourne based private equity company Arete Capital Advisory. This a positive development for Balmaine Gold, as it provides access to Arete's experience in managing mining projects in regional Victoria along with avenues for capital investment that will ensure sustainable and sound economic development of the Ballarat Gold Mine.

In 2020, Balmaine Gold halted the approvals process for TSF4 in favour of trialling an alternative dry stacked tailings disposal methodology. Over the period 2021 and early 2022, a Work Plan Variation has been progressed under the *MRSD Act* to permission a dry stack tailings facility adjacent and west of the existing and approved TSF3. Once approved, the dry stacked facility will afford the mine approximately two years of tailings deposition capacity while approval of TSF4 is progressed and constructed. Under Arete's strategic mine plan, TSF4 is integral to the mine's ability to continue to operate, and as such request for approval of that facility has been re-initiated.

1.1 Engagement

1.1.1 Engagement with Council

A formal pre-application meeting was held on the 6th of February 2020 at BGM offices with [redacted] from the City of Ballarat (CoB). Representatives from Balmaine Gold and AECOM were also present for the meeting.

The outcomes of the pre-application meeting can be summarised as follows:

- It was confirmed that Balmaine Gold hold the Plantation Licence for the Crown Allotment 10K, therefore, are the current acting land manager of the Crown Land (Appendix C). The allotment is also registered on the Plantation Licences Register under Section 27L(3)(c) of the *Victorian Plantations Corporation Act, 1993*.
- The application is to be supported by:
  - A native vegetation assessment, including an assessment of the koala habitat within the area subject to Schedule 5 of the Environmental Significance Overlay (ESO5), and a request to remove native vegetation where applicable.
  - A Visual Impact Assessment (VIA) that shows the development both as worst-case scenario and as the rehabilitated final profile.
  - An air quality and acoustic model and assessment.
  - A location plan that details the route that trucks will take to enter/exit the Works Area via the proposed Whitehorse Road accessway.
  - A Traffic Impact Assessment (TIA). The TIA is presently being conducted and the results will be shared with council once complete.

A subsequent meeting was held with CoB ([redacted]), Balmaine Gold and AECOM on 20 July 2020 to provide a further update on the timing for submission and present the traffic management elements.

As outlined in section 1, Balmaine Gold paused permitting for TSF4 in 2020 in preference for considering alternative tailings disposal methodologies. However, the alternatives identified do not adequately support the strategic mine plan identified under the new management arrangement. Newly appointed General Manager for Balmaine Gold, Stephen Jeffers met with the City of Ballarat [redacted] in May 2022 to discuss the mine's intention of progressing a Planning Permit for TSF4, and to advise that the Permit Application would be lodged in coming months.

Further discussions were held over the phone between [redacted] and AECOM on the 17th August 2022. The discussions confirmed updates to clauses within the Ballarat Planning Scheme. Including the works being exempt from Native Vegetation Removal under clause 52.17 and clause 42.01.

1.1.2 Community Engagement

A dedicated webpage that includes information in relation to TSF4 is available to the public at https://ballaratgoldmine.com.au/whitehorse-gully-tsf/. This includes a fact sheet on tailings storage facilities and an explanation on their use. The website also provides an online survey for the community to participate in where they have the opportunity to provide feedback on the proposed TSF4.

Information surrounding the proposed TSF4 was also included in the February 2020 community newsletter and a Community Engagement Plan has been prepared as part of the Work Plan Variation and is included in Appendix B.

Upon re-initiating plans to permission TSF4 in 2022, Balmaine Gold has commenced a process of re-engaging with the local community. The following activities have been progressed:

- Presentation to the Balmaine Gold Environment Review Committee Meeting, June 2022;
- Article in Balmaine Gold Community Newsletter, July 2022;
- Letter to neighbouring residents informing them of the proposal, and directing them to the website or mine personnel for additional information, August 2022;
- Update of Company website with information relevant to the proposed development, July 2022;
- Letter to local community facilities (schools, aged care, churches etc) informing them of the proposal, and directing them to the website or mine personnel for additional information, August 2022;
- Meeting with adjoining landholder to present all relevant information, August 2022;
- Technical presentation on Air Quality Model for TSF4 to Environment Review Committee, September 2022; and
- Information on Geotechnical stability provided at Environment Review Committee, September 2022.

1.2 Site History

The land on which the Works Area is located was originally used by settlers for pastoral grazing, and was then severely disrupted by gold prospecting from the 1850's.

Historic mining activity included surface prospecting, shallow alluvial workings, including sluicing of the gullies which transect the area and deeper quartz reef mining with 25 historic shafts reported as the field developed. Evidence of supporting historic mining infrastructure, in particular sunken shafts and mullock heaps (typical of the goldfield) are evident. The decline of mining saw the area return to bushland with softwood plantations occurring in the general area as early as 1946.

From the 1980s onwards, open pit mining and exploration drilling were completed, with a program of costeans and bulk test pits completed in the 1990's.

1.3 Planning Permit PA93/195

Planning permit PA93/195 was granted on 22 September 1993 by the then Shire of Buninyong and was subsequently amended on 4 September 2003 and 13 August 2007 and extended by CoB until September 2027. This permit allows *Mineral Production* on Crown Allotments 2A and 2B Section 16, Crown Allotment 9C Section 14 and Crown Allotment 10K Section 12, Parish of Ballarat.

A copy of Planning Permit PA93/195 and the endorsed plans can be found at Appendix D.

2.0 Works Area and Surrounds

2.1 Land Ownership and Titles

The BGM site and surface operations that are visible from an aerial view are spread over five crown land allotments.

The proposed Works Area for TSF4 will be contained entirely within just one of the crown allotments, this being Crown Allotment 10K on Crown Diagram 121210W as shown in Figure 1 and the land Title documents contained in Appendix E.

Crown Allotment 10K is also registered on the Plantation Licences Register under Section 27L(3)(c) of the *Victorian Plantations Corporation Act, 1993*. This landform part of the Yarrowee Plantation.

Correspondence with DELWP in November 2019 (contained in Appendix F) has confirmed that they are not the Crown Land Manager for the allotment, with the responsibility vested to the Victorian Plantation Corporation (VPC). Subsequent to this, VPC divested all the plantation licences to Hancock Victorian Plantations (HVP).

Balmaine Gold Pty Ltd purchased the Plantation Licence from HVP. The Crown Land Folio statement (Appendix E) and the Plantation Licence showing ownership is provided in (Appendix C).

Balmaine Gold Pty Ltd as the licence holder acts as the current land manager for the land, in accordance with the definitions of *"Crown Land"* and *"Owner"* under the MRSD Act:

Crown Land: *means land that is, or that is by any Act deemed to be, unalienated land of the Crown, and includes –*

a. land of the Crown that is reserved permanently or temporarily by or under any Act; and

b. land of the Crown occupied by a person under a lease, licence or other right under this or any other Act-

but does not include land which is the subject of a licence granted under Part 3A of the Victorian Plantations Corporation Act 1993.

Owner: *means -*

a. in relation to Crown land, means the Crown land Minister; and

* * * * *

d. in relation to private land under the Transfer of Land Act 1958 (other than land in an identified folio under that Act), the person who is registered or entitled to be registered as the proprietor of the land; and

e. in relation to other private land—

i. if the land is mortgaged, the mortgagor; and

ia. if the land is subject to a licence granted under Part 3A of the Victorian Plantations Corporation Act 1993, the licensee, under that Part, of the land; and

ii. in any other case, the person who has the fee in the land.

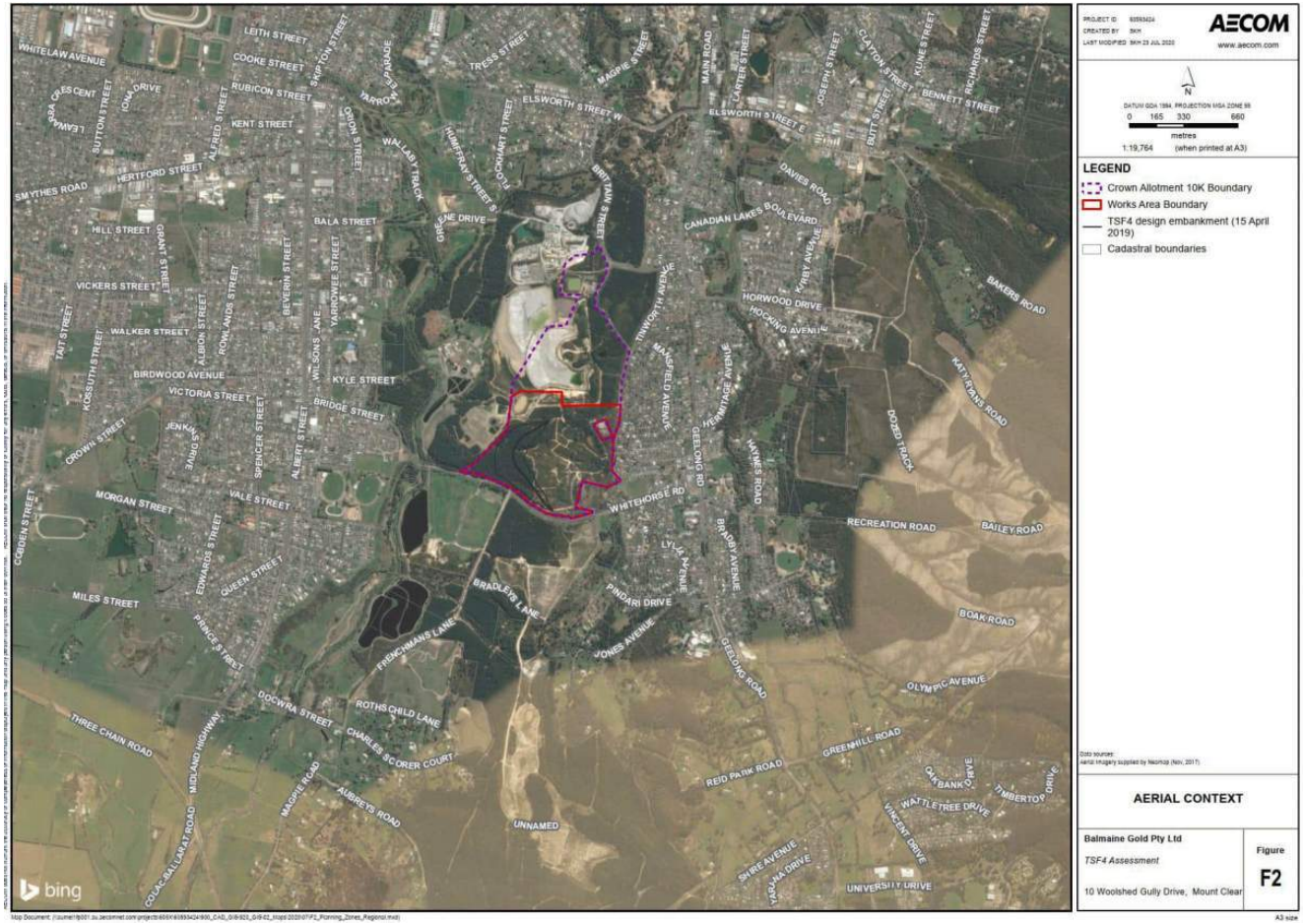

Figure 1: Aerial context of Crown Allotment 10K.

2.2 Works Area Description

For the purpose of this application, the area containing all the proposed works within Crown Allotment 10K will be defined as the 'Works Area' which is contained within the southern portion of Crown Allotment 10K, as shown in Figure 2.

The Works Area is located approximately 115 kilometres west of Melbourne and is irregular in shape with an area of approximately 43.5 hectares. North of the Works Area (the northern portion of Crown Allotment 10K) contains existing BGM mining operations that are made up of the TSF3, access tracks, a water dam and part of the Yarrowee Plantation. East of the Works Area is Tinworth Avenue and to the south is Whitehorse Road, both of which are sealed residential roads. West of the Works Area is the Central Highlands Water sewerage treatment plant.

The eastern side of the Works Area is currently occupied by the Yarrowee Plantation which commenced on the allotment in 1946 and predominately consists of pine trees. This plantation of pine trees is permitted under a plantation licence that applies to Crown Allotment 10K and is contained within Appendix C.

As discussed above, existing Planning Permit PA93/195 continues to apply to other activities within Crown Allotment 10K and will not be amended as part of this application.

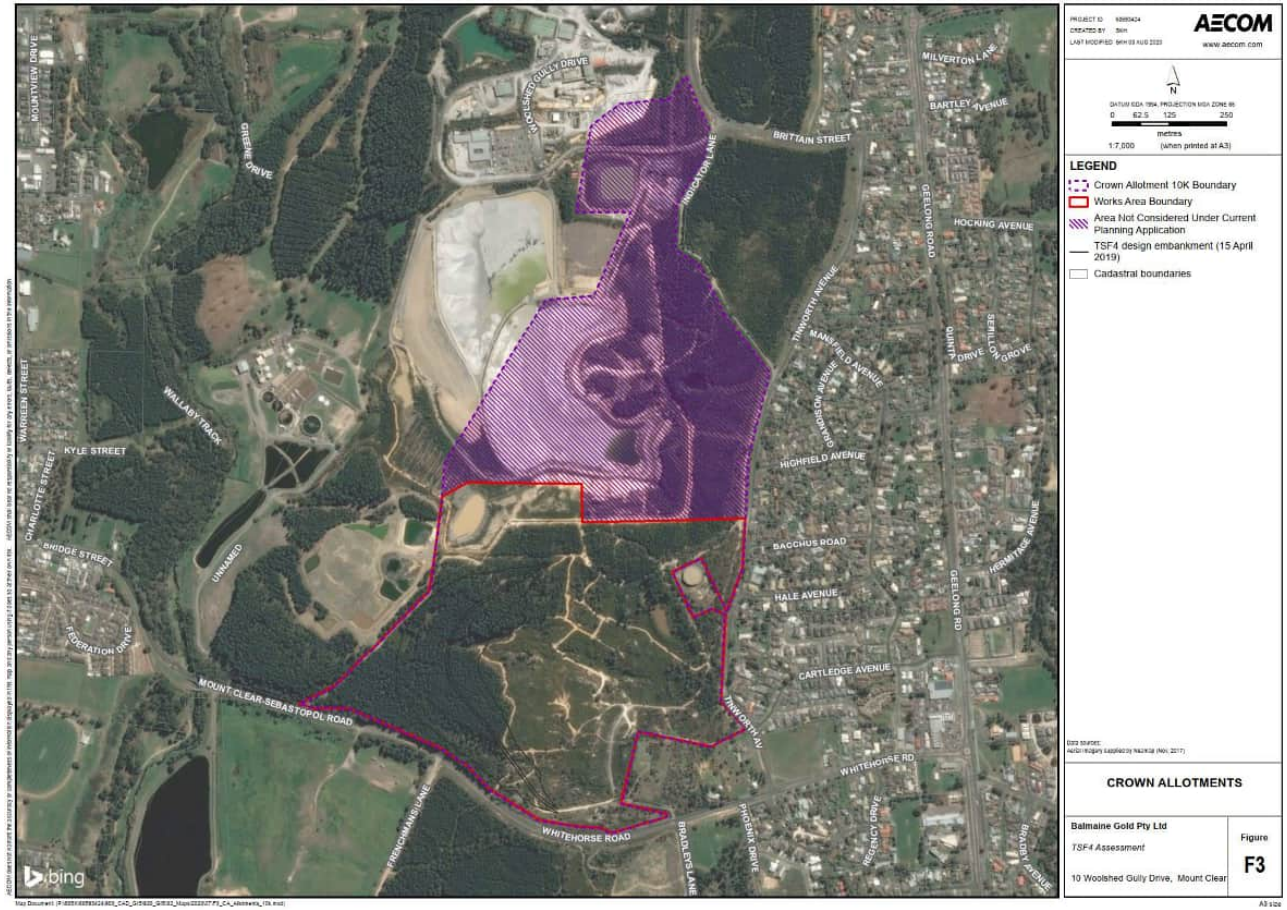

Figure 2: Works Area for this application within Crown Allotment 10K.

2.3 Surrounding Context

The land surrounding the Works Area is mixed in terms of land use and the development that occurs (refer to Figure 2). The Works Area is located in the township of Mount Clear, which is located south of Ballarat. The Works Area sits north of Whitehorse Road and east of Tinworth Avenue and has the following interfaces:

North: Existing tailings storage facility for the mine (TSF3) is located directly north of the Works Area, beyond which is the BGM offices/car park and surface mine infrastructure and processing area. Parts of the Yarrowee Plantation extend to the north adjacent to Tinworth Avenue. Approximately 1.3 kilometres further north of the Works Area is the beginning of the main residential area of the township of Mount Pleasant. The popular tourist attraction of Sovereign Hill Historical Park is also located approximately 2 kilometres north of the Works Area.

East: Directly east of the Works Area is Tinworth Avenue which is a sealed residential road that provides access to the residential zoning area located on its eastern side, and the Central Highlands Water header tank. The header tank is located on a separate allotment (Crown Allotment 10H) and will not be impacted by the proposal. Approximately 500 metres east of the Works Area is Geelong Road which is a major arterial road that provides access to the heart of Ballarat in the north and connects to the Midland Highway in the south. Approximately 1.1 kilometres further east is the beginning of an extensive area of land that is used for farming purposes.

South: Whitehorse Road runs along the entire southern boundary of the Works Area. South of Whitehorse Road is the White Horse Road Conservation Reserve (a former CoB landfill) and further crown land that is part of the Yarrowee Plantation. This part of the plantation stretches approximately a further 3 kilometres south of Whitehorse Road. Approximately 650 metres south of the Works Area is land zoned for public use that contains large water reservoirs as part of the Central Highlands Water facility. Approximately 1.6 kilometres south of the Works Area is land used for rural residential purposes and the Township of Magpie.

West: The land that adjoins the entire western boundary is zoned for public use and is occupied by the Central Highlands Water sewerage treatment plant the utilised the land for sewerage treatment activities. This site is heavily screened by vegetation as is the Works Area when viewed from Whitehorse Road (refer to Figure 3). West of the Central Highlands Water sewerage treatment plant and approximately 350 metres west of the Works Area is the Yarrowee River. Approximately a further 100 metres west (450 metres west of Works Area) is the beginning of the residential area of the township of Sebastopol.

Figure 3: The view to the west from Whitehorse Road, directly south of the Works Area. The beginning of the residential area of Sebastopol can be seen in the far background.

3.0 The Proposal

3.1 Overview

According to the *Planning and Environment Act 1987* the definition of a building and works is:

- *Building –*

  a) a structure and part of a building or a structure; and

  b) fences, walls, out-buildings, service installations and other appurtenances of a building; and

  c) a boat or a pontoon which is permanently moored or fixed to land.

- *Works – includes any change to the natural or existing condition or topography of land including the removal, destruction or lopping of trees and the removal of vegetation or topsoil.*

As the current Planning Permit PA93/195 allows for the use of Crown Allotment 10K (including the Works Area) for mineral production (refer to Appendix D), the proposal is only seeking planning approval for the buildings and works associated with the construction of TSF4 Works Area and associated infrastructure.

This proposal consists of the following components and should be read in conjunction with the application plans prepared by AECOM (refer to Appendix A).

The TSF4 footprint and the associated infrastructure, including water management was designed to avoid a number of existing key features, including the Central Highlands Water header tank and pipeline, native vegetation where possible and a Heritage Inventory Site adjacent to Whitehorse Road. In addition to this, the establishment of a buffer along the southern and eastern boundaries of the Works Area were also included in the design to mitigate impacts to surrounding amenity.

3.2 TSF4 and infrastructure

TSF4 will include the following:

- Construction of TSF4 within Whitehorse Gully. TSF4 will consist of an embankment that will be constructed to an approximate height of 35 metres (RL 444m AHD) and provide a tailings storage capacity of approximately 1.6-1.8 Mm^3. The height of the TSF is supported by a VIA (Appendix G). The TSF4 capacity would be sufficient for approximately 10 years, depending on the levels of actual production and the density of the tailings achieved.
- Pipeline corridor, including electric pumping system, for delivery of tailings from the mine operations to the Works Area, and return of decant water.
- Construction of an emergency overflow spillway to the existing surge dam. Rainfall runoff from upstream of TSF4 would be diverted to the surge dam or potentially to the proposed sediment pond at the downstream toe of TSF4 which would then be pumped to the surge dam.
- Construction of catch drains and a sediment pond/s downstream of the TSF4 embankment to manage sediment laden surface water run-off from the downstream slope of the proposed TSF4 embankment and downstream toe area. An electric pump would also be included to allow runoff to be pumped from the sediment pond to the surge dam. Diesel pumps may also be used should water management be required before power to the Works Areas is established or to provide additional pumping support if required.

The TSF4 footprint has been designed to accommodate a visual buffer along Whitehorse Road to screen the TSF, which will comprise an existing mature stand of softwood pines in a 15 metre wide strip along Whitehorse Road, with existing pines also to be retained along the southwest edge of the Works Area.

A 100 metre buffer from the closest residential properties along Tinworth Avenue and Whitehorse Road has been adopted to reduce visual and amenity impacts from noise and dust, with no works occurring within this eastern buffer.

3.3 Traffic and Site Access

The following site access is required:

- Access ramp to be constructed between TSF4 and the existing internal accessways utilised for the operation and maintenance of TSF3.
- Construction of new site access that is to be constructed of road base material. The proposed access includes a new turning lane from Whitehorse Road and access road along the western boundary adjoining Central Highlands Water sewerage treatment plant. Road widening is also proposed along Whitehorse Road to provide for an overtaking lane when exiting the Works Area from the newly proposed access and turning left to head in an easterly direction.
- During each construction phase of TSF4, the new access road is proposed to be available for use for all vehicles (including those in excess of 10T) between 7:00am to 6:00pm from Monday to Friday.
- During operation of TSF4, the new access is proposed to be available for use for vehicles 24 hours a day, 7 days a week to allow for operational activities, including inspections and maintenance, except for heavy vehicles (in excess of 10T) which will be restricted to using the new access from 7:00am to 6:00pm from Monday to Friday.

3.4 Site security

A fence will be constructed along/adjacent to the southern and eastern boundaries of the Works Area to prevent unauthorised access, the approximate alignment of the fence is shown in Appendix A. The fence will be 2.3 metre in height which includes the 1.8 metre high knuckle-to-barb mesh. The fence will be coloured either black or dark green to reduce visual impacts. The visual impacts of the fence have been assessed as part of the VIA (Appendix G).

3.5 Hours

Delivery of tailings to the TSF will take place 24 hours a day, 7 days a week consistent with the 24-hour operations at the mine. Access via the newly proposed accessway from Whitehorse Road is also proposed to be used by vehicles 24 hours a day, 7 days a week during TSF4 operations except for heavy vehicles (in excess of 10T) which will be restricted to using the new access from 7:00am to 6:00pm from Monday to Friday.

3.6 Removal of vegetation

The TSF4 footprint was designed to largely avoid the vegetation within the ESO5 overlay on the eastern side of the Works Area.

However, vegetation will still be required to be removed within the ESO5 area and the Works Area to accommodate a security fence. Native vegetation that is proposed for removal is considered to be exempt under Clause 52.17 of the Planning Scheme.

Vegetation (including native vegetation) that is proposed to be removed is also supported by a Vegetation Condition Assessment (Appendix H).

Vegetation to be removed and retained as a visual buffer in the Works Area is shown in Appendix A.

3.7 Site Rehabilitation

Once the proposed TSF4 has reached capacity and is at the end of its usable life, it will be capped and the areas affected by the site will be left in a safe, stable and sustainable state and returned to the pre-mining land use of Timber Plantation consistent with the existing use and land classification.

This also is sympathetic to the surrounding land use and was modelled as part of the VIA completed by Hansen Partnerships Pty Ltd (Appendix G). Based on the photomontages where pines were modelled at being replanted, the visual impact was assessed as being limited or negligible at the worst-case views.

The proposed land use is Timber plantation and will be replanted with commercial forestry species, such as softwood pines, following capping of the TSF. The bulk of the final TSF4 landform at closure will be revegetated back to plantation with the exception of the external walls of the embankment which will be rockfill. Vegetation cannot be established on the embankments due to its ability to significantly compromise the stability of the structure.

The process of capping TSF4 is discussed in the endorsed Work Plan Variation (Appendix B) and has been briefly summarised as follows:

- Reshaping of the tailings surface using earthmoving plant to provide controlled drainage.
- Capping with a low permeability layer
- Covering with a free draining material.
- Covering with a growth medium
- Revegetation of the site, including spreading of growth medium or topsoil which has been stockpiled during earlier construction work.

The conceptual design of the capping is included in the Endorsed Work Plan Variation (Appendix B) along with a closure plan that shows the proposed final cap extent and proposed surface and diversion drains.

Please refer to Appendix B for further details on rehabilitation.

4.0 Planning Policies and Controls

The following section outlines the relevant policy context for the proposed TSF4 at the BGM. This section includes an outline of the relevant sections of the Planning Policy Framework, the Municipal Strategic Statement and the Local Planning Policy Framework and the provisions of the relevant zone, overlays and particular provisions of the Planning Scheme. An assessment against these policies is provided in Section 6.0 of this report.

4.1 Planning Policy Framework

The Planning Policy Framework (PPF) of the Planning Scheme seeks to ensure that land use and development planning policies in Victoria meet the objectives of planning as set out in the *Planning and Environment Act 1987* (P&E Act).

The PPF clauses that are most relevant to this proposal are detailed below:

- **Clause 11** (Settlement) recognises that *'planning is to anticipate and respond to the needs of existing and future communities through provision of zoned and serviced land for housing, employment, recreation and open space, commercial and community facilities and infrastructure'*. Furthermore, it states *'Planning is to prevent environmental and amenity problems created by siting incompatible land uses close together'.*
- **Clause 11.03-6S** (Regional and local places) has the objective *'to facilitate integrated place-based planning'.* This clause considers and recognises the needs of regional and local places in planning for future land use and development.
- **Clause 13.05-1S** (Noise abatement) aims *'to assist in the control of noise effects on sensitive land uses.* Development should implement different techniques to ensure the amenity of the community is not impacted by noise emissions.
- **Clause 13.07-1S** (Land use compatibility) has the objective *'to safeguard community amenity while facilitating appropriate commercial, industrial or other uses with potential off-site effects.* The compatibility of a use or development should be appropriate to the land use functions and character of the area by directing land uses to appropriate locations and using a range of operational and land use separation measures.
- **Clause 14.01-1S** (Protection of agricultural land) seeks '*to protect the state's agricultural base by preserving productive farmland'.* Several strategies are used to implement the objective of this clause. The strategies of relevance include:
  - Identify areas of productive agricultural land, including land for primary production and intensive agriculture.
  - Consider state, regional and local, issues and characteristics when assessing agricultural quality and productivity.
  - Avoid permanent removal of productive agricultural land from the state's agricultural base without consideration of the economic importance of the land for the agricultural production and processing sectors.
  - Protect productive farmland that is of strategic significance in the local or regional context.
  - Protect productive agricultural land from unplanned loss due to permanent changes in land use.
  - Prevent inappropriately dispersed urban activities in rural areas.
  - Protect strategically important agricultural and primary production land from incompatible uses.
  - Productive farmland that is of strategic significance should be protected and inappropriate dispersed urban activities should be prevented.

- In considering a proposal to use, subdivide or develop agricultural land, consider the:
  - Desirability and impacts of removing the land from primary production, given its agricultural productivity.
  - Impacts on the continuation of primary production on adjacent land, with particular regard to land values and the viability of infrastructure for such production.
  - Compatibility between the proposed or likely development and the existing use of the surrounding land.
  - The potential impacts of land use and development on the spread of plant and animal pests from areas of known infestation into agricultural areas.
  - Land capability.
- Balance the potential off-site effects of a use or development proposal (such as degradation of soil or water quality and land salinisation) against the benefits of the proposal.

- **Clause 14.03-1S** (Resource exploration and extraction) seeks *'to encourage exploration and extraction of natural resources in accordance with acceptable environmental standards'.* There are a number of key strategies used to implement the objective of this clause. The key strategies that are of relevance to the proposal include:
  - Provide for the long-term protection of natural resources in Victoria.
  - Protect the opportunity for exploration and extraction of natural resources where this is consistent with overall planning considerations and acceptable environmental practice.
  - Recognise the possible need to provide infrastructure for the exploration and extraction of natural resources.
  - Ensure planning schemes do not impose conditions on the use or development of land that are inconsistent with the *Mineral Resources (Sustainable Development) Act 1990*, the *Greenhouse Gas Geological Sequestration Act 2008*, the *Geothermal Energy Resources Act 2005*, or the *Petroleum Act 1998.*
  - Develop and maintain buffers around mining and quarrying activities.
  - Ensure planning permit applications clearly define buffer areas appropriate to the nature of the proposed extractive uses, which are to be owned or controlled by the proponent of an extractive industry.
  - Determine buffer areas between extractive activities and sensitive land uses on the following considerations:
    - Appropriate limits on effects can be met at the sensitive locations using practical and available technology.
    - Whether a change of land use in the vicinity of the extractive industry is proposed.
    - Use of land within the buffer areas is not limited by adverse effects created by the extractive activities.
    - Performance standards identified under the relevant legislation.
    - Types of activities within land zoned for public use.
- **Clause 15.01-6S** (Design for rural areas) has the objective *'to ensure development respects valued areas of rural character'.* New developments should ensure that the siting, scale and appearance protects and enhances rural character. The visual amenity and visual impact from the development should have a minimal impact on the surrounding natural scenery, landscape features and rural landscape character.
- **Clause 17.01-1S** (Diversified economy) seeks '*to strengthen and diversify the economy'*. This will be achieved by strengthening the existing and planned employment areas whilst also facilitating in the growth of employment sectors within this region.

4.2 Local Planning Policy Framework

The City of Ballarat's Municipal Strategic Statement (MSS) and the Local Planning Policy Framework (LPPF) cover key issues including settlement and housing, environmental and landscape values, environmental resilience, natural resource management, built form, heritage and design, economic development and transport and infrastructure. Relevant objectives and strategies from the MSS and LPPF of the Scheme to this proposal include:

- **Clause 21.01** (Municipal Overview) provides the description on the natural and urban heritage of Ballarat and how it was formed from the hunt for gold and one of the most important international mass migrations of people in the 19th century: the 1850's gold rushes. The Ballarat Strategy (2015) provides the key principles as a long-term strategic direction for Ballarat towards 2040. It outlines the shared community vision for a greener, more vibrant and connected city by embracing the concepts of 'The 10 Minute City' and 'The City in the Landscape'. These concepts focus on providing destinations and services that will be more accessible for all residents whilst also guiding the growth of Ballarat in a direction that allows it to be embedded within the natural and landscape values of the city.

  In order to achieve this vision, strategic directions are provided for a number of key issues. The key issues that have been identified as relevant to this proposal are:

  - Environmental and Landscape Values
  - Natural Resource Management
  - Economic Development

- **Clause 21.03-1** (Biodiversity) has two main objectives. The objective that is of relevance to this proposal is:

  - *To protect and enhance habitats and biodiversity.*

  This is to be achieved by protecting remnant vegetation, particularly in road reserves and along waterways whilst also encouraging the use of indigenous planting in open spaces. Habitat linkages should also be enhanced and created for local fauna and flora.

- **Clause 21.03-2** (Significant environments and landscapes) identifies areas within Ballarat that have significant environmental and natural features that add to its high biodiversity value (remnant vegetation and habitat values). The objective *'to rehabilitate, protect and enhance landscapes with identified values'* will be achieved by protecting and enhancing vegetation, biodiversity, habitat, amenity and attractiveness of landscape values and significant environmental features. Protection of historic trees, both native remnants and planted specimens, with cultural values should also be protected from development.

- **Clause 21.05-1** (Agriculture) states that the rural areas of Ballarat are some of Victoria's richest agricultural areas and farming activities have some of the highest value of production in the State. Productive agricultural land is a finite resource that's value needs to be protected. The main objectives that will aim to do this and are of relevance to this proposal are:

  - *To support agriculture as an important element of the City's economic and employment base.*
  - *To ensure that productive agricultural land remains available for agricultural resource use.*

  This will be achieved by preventing urban land use and development into areas of productive agricultural land whilst also discouraging inappropriate use and development of agricultural land.

- **Clause 21.06-2** (Heritage) explains that Ballarat must protect its heritage resources for its conservation, cultural and tourism potential as well as ensuring what makes Ballarat distinctive isn't lost. It aims *to protect, conserve and enhance areas, features, structures and sites of historic, aboriginal, natural and cultural significance.*

- **Clause 21.07-1** (Economic growth) Ballarat's economic development is both continuing and changing in equal measure, with the mining sector being a significant contributor. The objective *'to encourage a city structure which supports growth and productivity in key economic industries'* will

be achieved by ensuring adequate land supply for industrial and commercial growth and planning for growth within regionally specific precincts.

4.3 Planning Controls

4.3.1 Zone

The Works Area is located in the following zones (refer to Figure 4):

- Farming Zone
- Transport Zone 2 – Principal Road Network

Clause 35.07 Farming Zone

The land is located within Farming Zone (FZ). The purpose of the FZ is:

- *To implement the Municipal Planning Strategy and the Planning Policy Framework.*
- *To provide for the use of land for agriculture.*
- *To encourage the retention of productive agricultural land.*
- *To ensure that non-agricultural uses, including dwellings, do not adversely affect the use of land for agriculture.*
- *To encourage the retention of employment and population to support rural communities.*
- *To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.*
- *To provide for the use and development of land for the specific purposes identified in a schedule to this zone.*

Pursuant to Clause 35.07-4 a permit is required for buildings and works associated with a use in Section 2 of Clause 35.07-1 (Earth and energy resources industry). A permit is not required for the use of the land for Earth and energy resources industry as this is already permitted under Planning Permit PA93/195 (refer to Appendix D).

Clause 36.04 Transport Zone 2 – Principal Road Network

A small portion of the south-eastern corner of the site falls within Transport Zone 2 – Principal Road Network (TRZ2). The purpose of the TRZ2 is:

- *To implement the Municipal Planning Strategy and the Planning Policy Framework.*
- *To provide for an integrated and sustainable transport system.*
- *To identify transport land use and land required for transport services and facilities.*
- *To provide for the use and development of land that complements, or is consistent with, the transport system or public land reservation.*
- *To ensure the efficient and safe use of transport infrastructure and land comprising the transport system.*

Pursuant to Clause 36.04-2, a permit is required for buildings and works associated with the use of the land for Earth and energy resources industry. Works are proposed outside of the Works Area along Whitehorse Road (within TRZ2) to account for the newly proposed accessway in the south western corner of the Works Area (refer to Appendix A). Therefore, pursuant to Clause 36.04-2, a permit will be required for buildings and works.

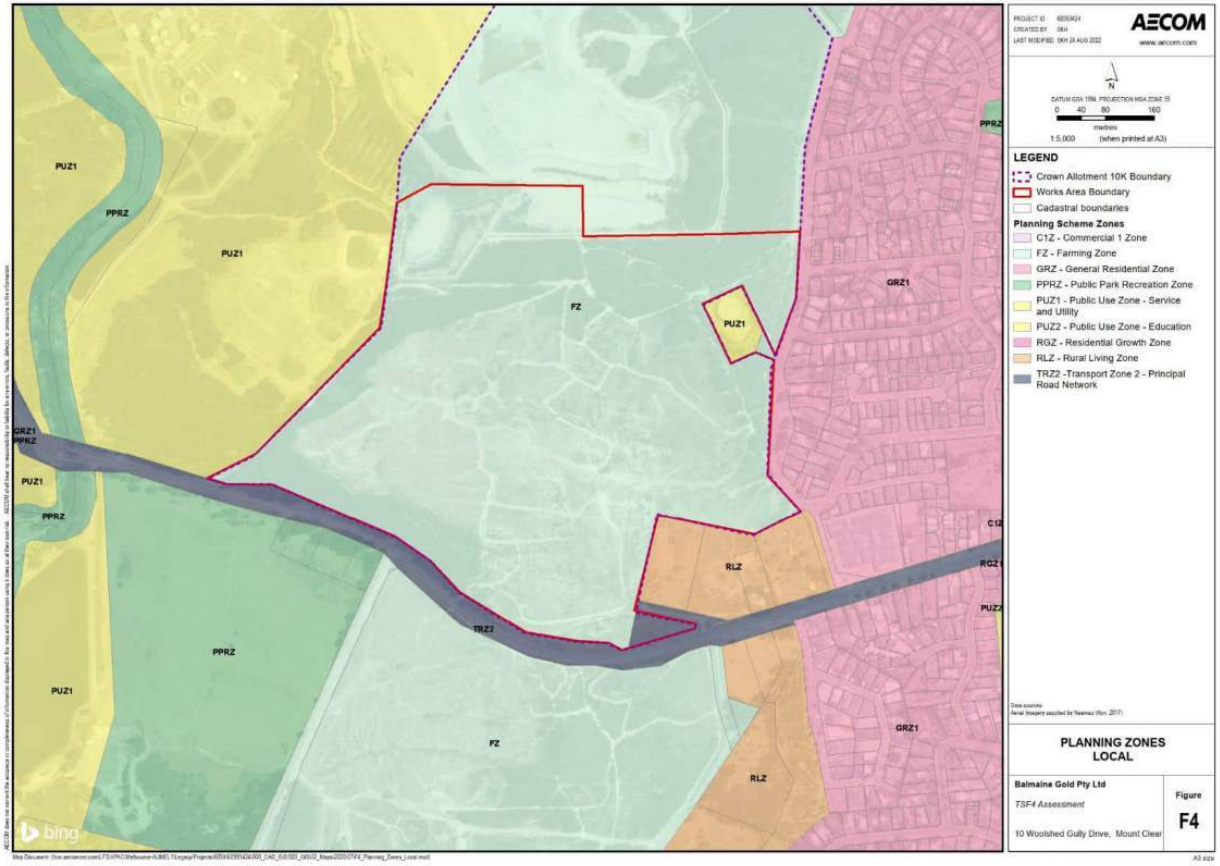

Figure 4: Zoning applicable to the Works Area and surrounding land.

4.3.2 Overlays

The Works Area is subject to the following overlays (refer to Figure 5):

- Environmental Significance Overlay – Schedule 5
- Bushfire Management Overlay

Clause 42.01 Environmental Significance Overlays – Schedule 5

A small portion on the eastern side of the Works Area is affected by Schedule 5 to the Environmental Significance Overlay (ESO5). The purpose of this overlay is:

- *To implement the Municipal Planning Strategy and the Planning Policy Framework.*
- *To identify areas where the development of land may be affected by environmental constraints.*
- *To ensure that development is compatible with identified environmental values.*

The environmental objectives to be achieved in accordance with the ESO5 include:

- *To maintain and enhance koala habitat.*
- *To ensure the type, density, design and layout of new development is such as to minimise any adverse impacts on koala movements that occur or are likely to occur throughout areas of koala habitat and associated areas and on koala behaviour and health generally.*
- *To coordinate the protection of koala habitat with the protection of native vegetation generally throughout Ballarat.*

In accordance with Clause 42.01-2 (Permit requirement), a permit is required to:

- *Construct a building or construct or carry out works. This does not apply if a schedule to this overlay specifically states that a permit is not required*.
- *Construct a fence if specified in a schedule to this overlay.*
- *Remove, destroy or lop any vegetation, including dead vegetation. This does not apply:*
  - *If a schedule to this overlay specifically states that a permit is not required.*
  - *If the table to Clause 42.01-3 specifically states that a permit is not required.*
  - *To the removal, destruction or lopping of native vegetation in accordance with a native vegetation precinct plan specified in the schedule to Clause 52.16.*

Schedule 5 to the ESO states a permit is required to:

- *To construct any buildings or carry out works where native trees are to be removed.*
- *To construct a fence.*
- *To remove native trees.*

A permit is required for buildings and works, however a permit is not required for the removal of native vegetation for mineral exploration and mining under clause 42.01-3 (Table of exemptions):

- Vegetation that is to be removed, destroyed or lopped to the minimum extent necessary by the holder of an exploration, mining, prospecting, or retention licence issued under the Mineral Resources (Sustainable Development) Act 1990:
  - *in accordance with a work plan approved under Part 3 of the Mineral Resources (Sustainable Development) Act 1990.*

A permit is also required for the construction of a fence within ESO5.

Clause 44.06 Bushfire Management Overlay

The Works Area is affected by the Bushfire Management Overlay (BMO). The purpose of this overlay is:

- *To implement the Municipal Planning Strategy and the Planning Policy Framework.*
- *To ensure that the development of land prioritises the protection of human life and strengthens community resilience to bushfire.*
- *To identify areas where the bushfire hazard warrants bushfire protection measures to be implemented.*
- *To ensure development is only permitted where the risk to life and property from bushfire can be reduced to an acceptable level.*

Pursuant to Clause 44.06-2 (Permit requirement), a permit is required to construct a building that is associated with the following land uses:

- Accommodation (including a Dependent person's unit)
- Childcare centre
- Education centre
- Hospital
- Industry
- Leisure and Recreation
- Office
- Place of assembly
- Retail premises
- Service station
- Timber production
- Warehouse

Pursuant to Clause 44.06-2 (Permit requirement), a permit is not required to construct a building or construct or carry out works associated with the land use of Earth and energy resource industry.

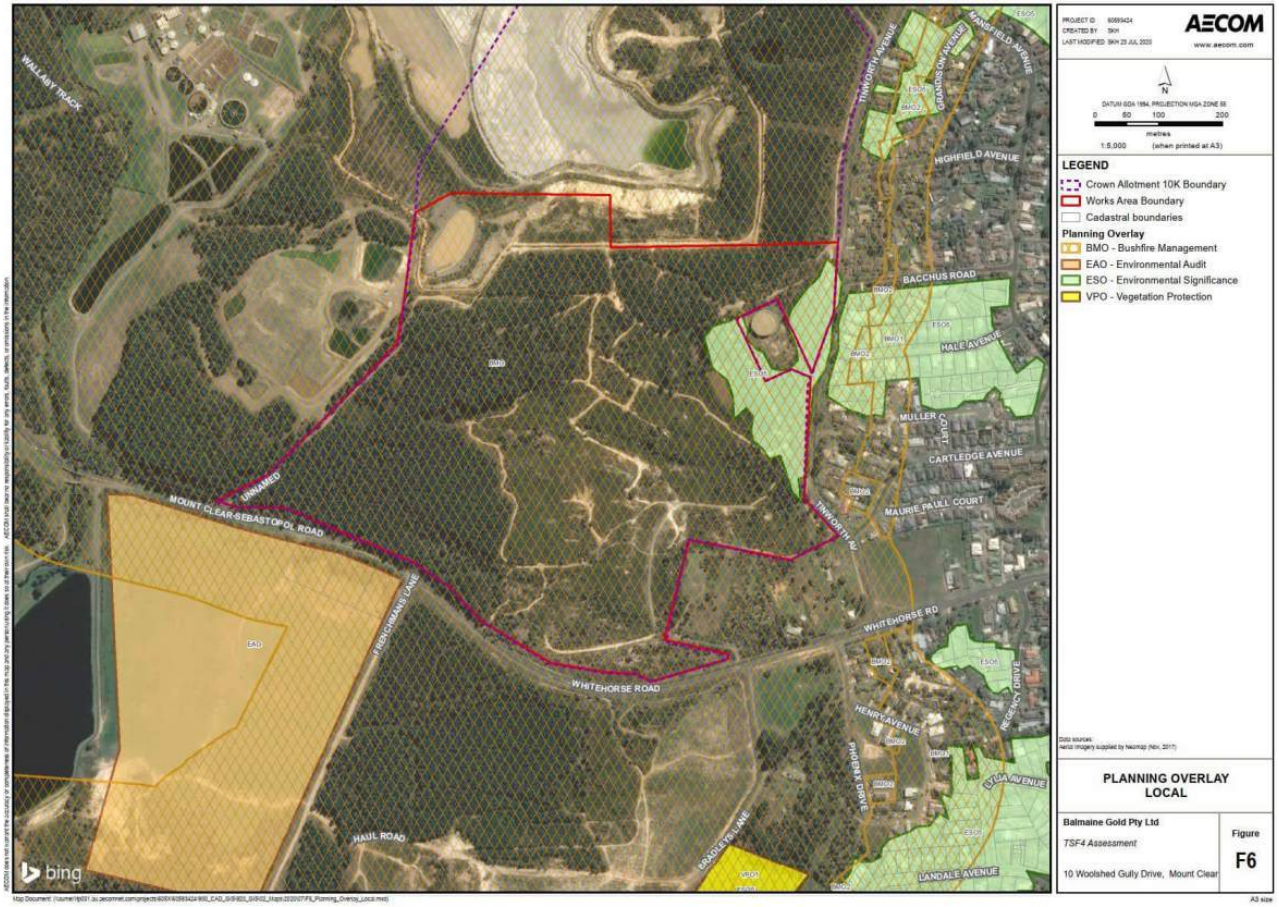

Figure 5: Overlays applicable to the Works Area and surrounding land.

4.3.3 Particular Provisions

Clause 52.08 Earth and Energy Resources Industry

The purpose of this particular provision is:

- *To encourage land to be used and developed for exploration and extraction of earth and energy resources in accordance with acceptable environmental standards.*
- *To ensure that geothermal energy extraction, greenhouse gas sequestration, mining and petroleum production are not prohibited land uses..*
- *To ensure that planning controls for the use and development of land for the exploration and extraction of earth and energy resources are consistent with other legislation governing these land uses.*

Pursuant to Clause 52.08-1 (Permit requirement), a permit is required to use and develop land for Earth and energy resources industry unless the table to this clause specifically states that a permit is not required.

In accordance with Clause 52.08-2 (Application requirements), an application to use and develop land for mineral extraction must be accompanied by:

- *A copy of a work plan or a variation to an approved work plan that has received statutory endorsement under section 77TD of the Mineral Resources (Sustainable Development) Act 1990.*
- *The written notice of statutory endorsement under section 77TD(1) of the Mineral Resources (Sustainable Development) Act 1990.*
- *Any conditions specified under section 77TD(3) of the Mineral Resources (Sustainable Development) Act 1990.*

A copy of the variation to the approved work plan that has received statutory endorsement under section 77TD of the MRSD Act, a copy of the written notice of endorsement under section 77TD(1) of the MRSD Act and the conditions that were specified under section 77TD(3) of the MRSD Act are provided at Appendix B of this report.

Clause 52.17 Native Vegetation

The purpose of this particular provision is:

To ensure that there is no net loss to biodiversity as a result of the removal, destruction or lopping of native vegetation. This is achieved by applying the following three step approach in accordance with the Guidelines for the removal, destruction or lopping of native vegetation (Department of Environment, Land, Water and Planning, 2017) (the Guidelines):

1. *Avoid the removal, destruction or lopping of native vegetation.*
2. *Minimise impacts from the removal, destruction or lopping of native vegetation that cannot be avoided.*
3. *Provide an offset to compensate for the biodiversity impact if a permit is granted to remove, destroy or lop native vegetation.*

To manage the removal, destruction or lopping of native vegetation to minimise land and water degradation.

In accordance with Clause 52.17-7 (Permit Requirement), a permit is required *'to remove, destroy or lop native vegetation. This does not apply:*

- *If the table to Clause 52.17-7 specifically states that a permit is not required.*
- *If a native vegetation precinct plan corresponding to the land is incorporated into this scheme and listed in the schedule to Clause 52.16.*
- *To the removal, destruction or lopping of native vegetation specified in the schedule to this clause.'*

In total, 2.653 hectares of native vegetation is proposed for removal. Under Clause 52.17-7 (Table of exemptions) a permit is not required for the removal, destruction or lopping of native vegetation for mineral exploration and extraction.

Pursuant to Clause 52.17-7(Table of exemptions): The requirement to obtain a permit for mineral exploration and extraction:

- *Native vegetation that is to be removed, destroyed or lopped to the minimum extent necessary by the holder of an exploration, mining, prospecting, or retention license issued under the Mineral Resources (Sustainable Development) Act 1990:*
  - *in accordance with a work plan approved under Part 3 of the Mineral Resources (Sustainable Development) Act 1990.*

A copy of the variation to the approved work plan that has received statutory endorsement under section 77TD of the MRSD Act, a copy of the written notice of endorsement under section 77TD(1) of the MRSD Act and the conditions that were specified under section 77TD(3) of the MRSD Act are provided at Appendix B of this report.

Clause 52.29 Land Adjacent to the Principal Road Network

The purpose of this particular provision is:

- *To ensure appropriate access to the Principal Road Network or land planned to form part of the Principal Road Network.*

To ensure appropriate subdivision of land adjacent to Principal Road Network or land planned to form part of the Principal Road Network. In accordance with Clause 52.29-2 (Permit Requirement), a permit is required to create or alter access to a road in a Transport Zone 2.

4.3.4 General Provisions

Clause 65 Decision Guidelines

Clause 65.01 lists all considerations that must be taken into account by the Responsible Authority before deciding on an application. Table 1 contains each consideration and corresponding section of this report that addresses that particular consideration.

Table 1 Clause 65.01 considerations and where they have been addressed in this report.

Considerations contained at Clause 65.01	Section of report that address the respective consideration
The matters set out in section 60 of the Act.	6.0, 3.7
Any significant effects the environment, including the contamination of land, may have on the use or development.	5.0
The Municipal Planning Strategy and the Planning Policy Framework.	4.2,
The purpose of the zone, overlay or other provision	4.3
Any matter required to be considered in the zone, overlay or other provision.	6.2
The orderly planning of the area.	6.1
The effect on the environment, human health and amenity of the area.	3.7, 5.0, 6.0
The proximity of the land to any public land.	2.3
Factors likely to cause or contribute to land degradation, salinity or reduce water quality.	6.2.1
Whether the proposed development is designed to maintain or improve the quality of stormwater within and exiting the site.	6.2.1

Considerations contained at Clause 65.01	Section of report that address the respective consideration
The extent and character of native vegetation and the likelihood of its destruction.	5.4
Whether native vegetation is to be or can be protected, planted or allowed to regenerate.	5.4,
The degree of flood, erosion or fire hazard associated with the location of the land and the use, development or management of the land so as to minimise any such hazard.	4.3.2
The adequacy of loading and unloading facilities and any associated amenity, traffic flow and road safety impacts.	6.2.1
The impact the use or development will have on the current and future development and operation of the transport system.	6.2

4.3.5 Operational Provisions

Clause 73.03 Land use terms

In accordance with Clause 73.03 (Land use terms) of the Planning Scheme, *'Earth and energy resources industry'* is defined as:

> *Land used for the exploration, removal or processing of natural earth or energy resources. It includes any activity incidental to this purpose including the construction and use of temporary accommodation.*

This includes Mining and Mineral Exploration.

4.3.6 Area of Aboriginal Cultural Heritage Sensitivity

The Works Area is identified as not being within or affected by any areas of cultural heritage sensitivity as described in the *Aboriginal Heritage Regulation 2018.*

4.3.7 Planning Scheme Permit Requirement Summary

A summary of the planning permit triggers for the proposed works at BGM can be found below in Table 2.

Table 2 Summary of works requiring a planning permit.

	Planning Control	Buildings and Works	Removal of Vegetation
Zones	Farming Zone (FZ)	Permit Required	No Permit Required
	Transport Zone 2 – Principal Road Network	Permit Required	No Permit Required
Overlays	Environmental Significance Overlay – Schedule 5 (ESO5)	Permit Required	No Permit Required
	Bushfire Management Overlay (BMO)	No Permit Required	No Permit Required
Particular Provisions	Clause 52.08	Permit Required	No Permit Required
	Clause 52.17	No Permit Required	No Permit Required
	Clause 52.29	Permit Required	No Permit Required

*A permit is not required for the use of the land for Earth and energy resources industry as this is already permitted under Planning Permit PA93/195 (refer to Appendix D).

5.0 Technical Studies

5.1 Visual Impact Assessment

Hansen Partnership Pty Ltd were engaged by AECOM to prepare a VIA for the proposed TSF4 (Appendix G). The report includes a series of photomontage images as a means of demonstrating the visual presence of the proposed TSF4 from a series of locations within two kilometres of the Works Area. The locations of the photomontage images were determined based on viewshed modelling to have potential detrimental visual impact.

5.1.1 Landscape Character

The VIA determined that there were two prevailing landscape character precincts within the wider surrounding area of the Works Area. These landscape character types are a subset of the broader landscape character type identified within the *Ballarat Strategy: Our Vision for 2040*: the 'Mount Clear Goldfields' and are as per the following:

- Yarrowee Valley landscape character; and
- Residential Urban landscape character.

These two landscape characters are shown below in Figure 6.

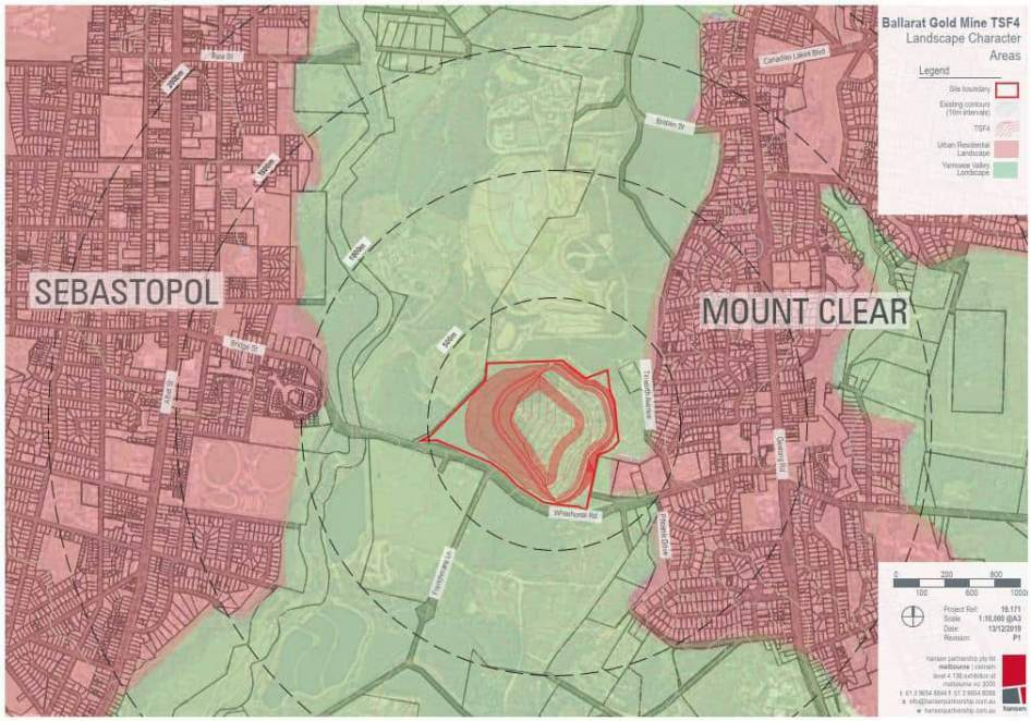

Figure 6: Locations of landscape characters.

Yarrowee Valley Landscape Character

The Works Area falls within the landscape character of the 'Yarrowee Valley' which is primarily distinguished by its undulating topography and forms a large open area occupying the Yarrowee River corridor between the residential areas of Sebastopol and Mount Clear. This landscape character area is defined by a broad north-south escarpment along the western boundary, associated with the Yarrowee

River corridor (refer to Figure 6). The eastern boundary of the character area is defined by Tinworth Avenue and Phoenix Drive.

A non-homogenous mosaic of land uses is present within this landscape character, resulting in largely modified landscapes with varying visual and recreational value. Natural landforms and features associated with the Yarrowee River corridor are utilised for recreational uses, with existing extractive and industrial uses occupying a substantial portion of the character area which has been reclaimed for timber production. These areas are also being used for public utilities such as refuse tips and water treatment plants. A typical view of the Yarrowee Valley landscape character is shown in Figure 7 below.

Views from within this landscape area are generally restricted due to its low elevation in contrast to the immediate surrounding landscape to the west, and due to extensive coverage of dense canopy vegetation.

The presence of the 'most' and 'least' preferred Yarrowee Valley landscape features were assessed to determine the value of this landscape characteristic. A 'Low to Moderate' landscape value was determined as a result of inconsistency of appearance due to the presence of existing extractive and industrial land uses, as well as the presence of some of the least preferred landscape features. See Appendix G for further details.

Figure 7: Typical view of Yarrowee Valley landscape character.

Residential Urban Landscape Character

The 'Residential Urban' landscape character forms two distinct residential areas of Sebastopol on the basalt plateau to the west and the built-up areas of Mount Clear and Canadian Valley to the east. It is distinguished by a grid-like pattern of residential streets with a homogenous land use consisting residential properties and reserves, schools and scattered local services. A typical view of the Residential Urban landscape character is shown in Figure 8 below.

Views towards the Yarrowee River escarpment and toward the Canadian Forest are afforded from residences within close proximity to the escarpment and from the high ground along adjacent residential streets, particularly where road junctions open up the view to the east.

The presence of the 'most' and 'least' preferred Residential Urban landscape features were also assessed to determine the value of this landscape characteristic. A 'Low' landscape value was

determined due to the presence of some of the least preferred landscape features. Refer to Appendix G for further details.

Figure 8: Typical view of Residential Urban landscape character.

5.1.2 Visual Impact Assessment

The VIA involved identifying all areas of existing landscape within 2 kilometres of the proposed TSF4 from which it will potentially be visible. Four locations were established where the proposed TSF4 will be visible with the highest potential for detrimental visual impact (Figure 9). The anticipated visual presence of the proposed TSF4 and the associated impacts at these locations were assessed through a series of computer generated photomontage images. The photomontages demonstrated the level of impact from the proposed TSF4 at closure, with and without vegetative rehabilitation. A level of magnitude of visual impact was then inferred through consideration of the Yarrowee Valley and Residential Urban landscape character attributes and values, and the photomontage images.

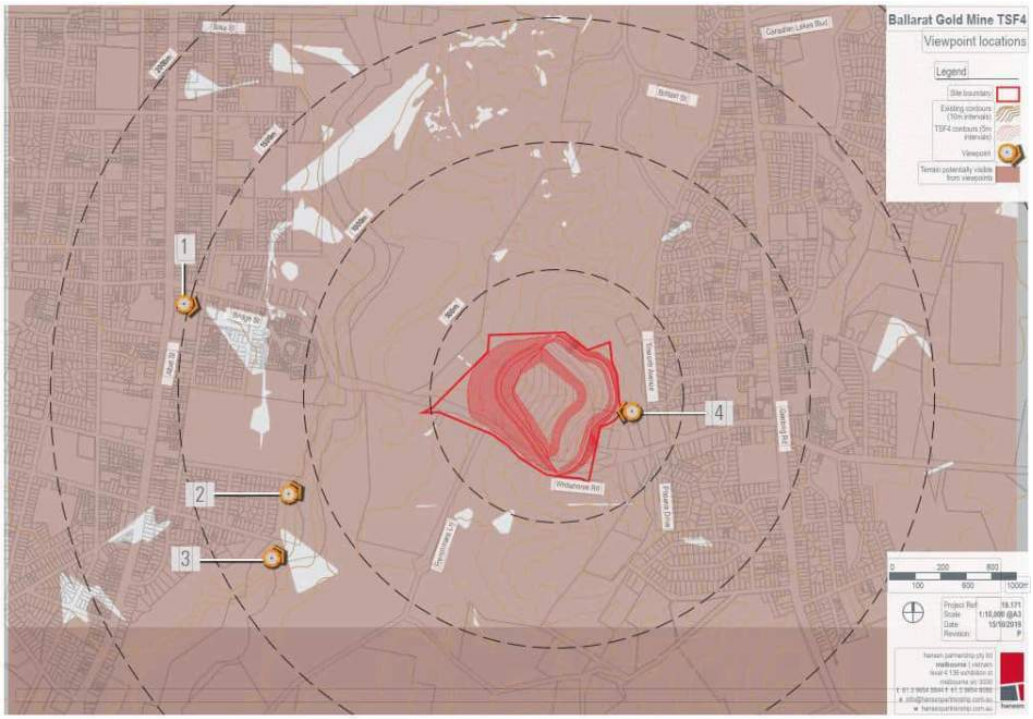

Figure 9: View locations for VIA.

A summary of the visual impact assessment at each of the viewing locations shown in Figure 9 is below.

5.1.2.1 View Location 1

View location 1 is situated at Bridge Street, Sebastopol, facing south-east towards the proposed TSF4 at BGM, at a distance of 1.8 kilometres. The view is located within the Residential Urban landscape character with narrow views of the Yarrowee Valley landscape, including views of the proposed TSF4.

Figure 10 below demonstrates the photomontage that was generated for the existing location with the outlines of the proposed TSF4 and fence line. Figures 16 and 17 of Appendix G demonstrate TSF4 at closure without and with vegetation rehabilitation, respectively. There is little to no difference between the view in Figure 16 and Figure 17 of Appendix G due to existing mature trees blocking any potential view of the proposed TSF4 from this location. As a result of this, the visual impact is considered to be negligible and no mitigation measures are considered necessary from this view location.

Figure 10: Photomontage from view location 1.

5.1.2.2 View Location 2

View location 2 is situated at Darling Street, Sebastopol facing north-east towards the proposed TSF4 at BGM, at a distance of 800 metres. The view location is within the 'Urban Residential' landscape character, with interrupted views across land which is within the 'Yarrowee Valley' landscape, including the proposed TSF4.

The existing view from this location with the outlines of the proposed TSF4 and fence line are shown in Figure 11. Changes to this existing view is anticipated as a result of the proposed development. This will include views of the exposed rock face embankment, an area of modified terrain and boundary fencing, as shown in Figure 20 of Appendix G. The vegetation that is removed from this location is included in the timber plantation and can be removed 'as of right'. Therefore, the proposed TSF4 at completion prior to revegetation would not replace views to any preferred landscape features. After vegetation rehabilitation has been undertaken, the views of the described TSF4 features will be reduced, as shown in Figure 21 of Appendix G.

As none of the most preferred Yarrowee Valley landscape features would be removed as a result of the proposed TSF4, the overall visual impact of the proposal is considered to be limited and no mitigation measures are considered to be required.

Figure 11: Photomontage from view location 2.

5.1.2.3 View Location 3

View location 3 is situated at Morgan Street, Sebastopol, facing northeast towards the proposed TSF4 at BGM, at a distance of approximately 1 kilometre away.

This view location is within the Urban Residential character, with interrupted views across land that is situated within the Yarrowee Valley landscape which includes the proposed TSF4, as shown in Figure 12.

Figure 24 of Appendix G shows the view of the proposed TSF4 without prior to any revegetation works being undertaken, resulting in a view of a rock face embankment, modified terrain and the proposed perimeter fencing. Existing trees within the plantation would be removed to allow for the development of these features. However, these existing trees are not considered to be a 'preferred landscape feature' on account of their status for removal 'as-of right' due to being within a timber plantation. Therefore, the proposed TSF4 at completion and prior to revegetation would not replace views to any preferred landscape features.

As none of the most preferred Yarrowee Valley landscape features would be removed as a result of the proposed TSF4, the overall visual impact of the proposal is considered to be limited and no mitigation measures are considered to be required.

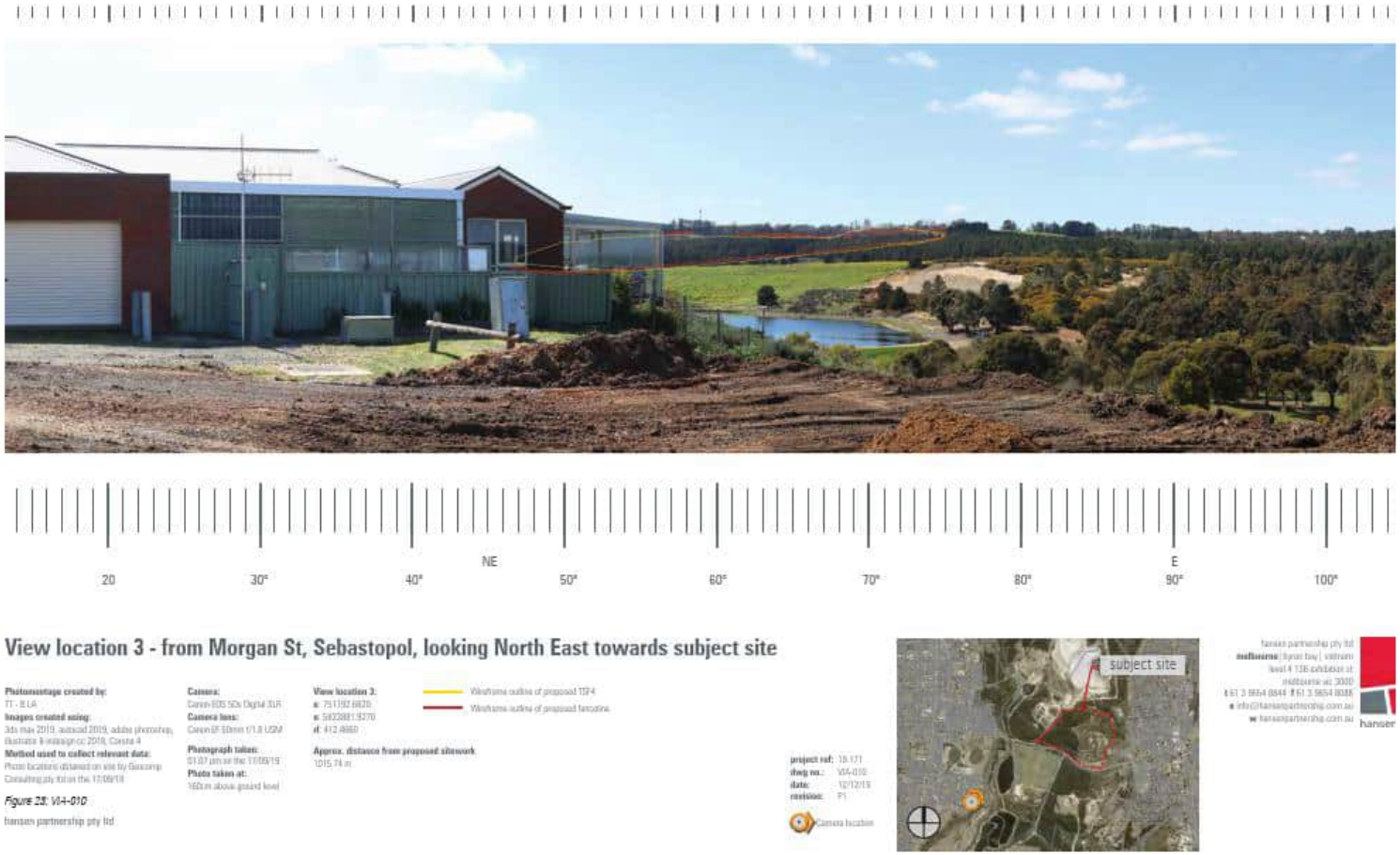

Figure 12: Photomontage from view location 3.

5.1.2.4 View Location 4

View location 4 is situated at Tinworth Avenue, Mount Clear, facing west towards the proposed TSF4 at BGM, at a distance of approximately 460 metres away.

The view location is within the 'Urban Residential' character type, with views toward land which is within the 'Yarrowee Valley' landscape and which includes the proposed TSF4, as shown in Figure 13.

Figure 29 of Appendix G shows the proposed TSF4 at completion after revegetation works have been undertaken. With respect to landscape values, the proposed TSF4 at closure with vegetative rehabilitation would not replace views from this location to views of the most preferred Yarrowee Valley landscape features. As a result, the visual impact of the proposed TSF4 from this location is considered to be negligible and no mitigation measures are considered necessary.

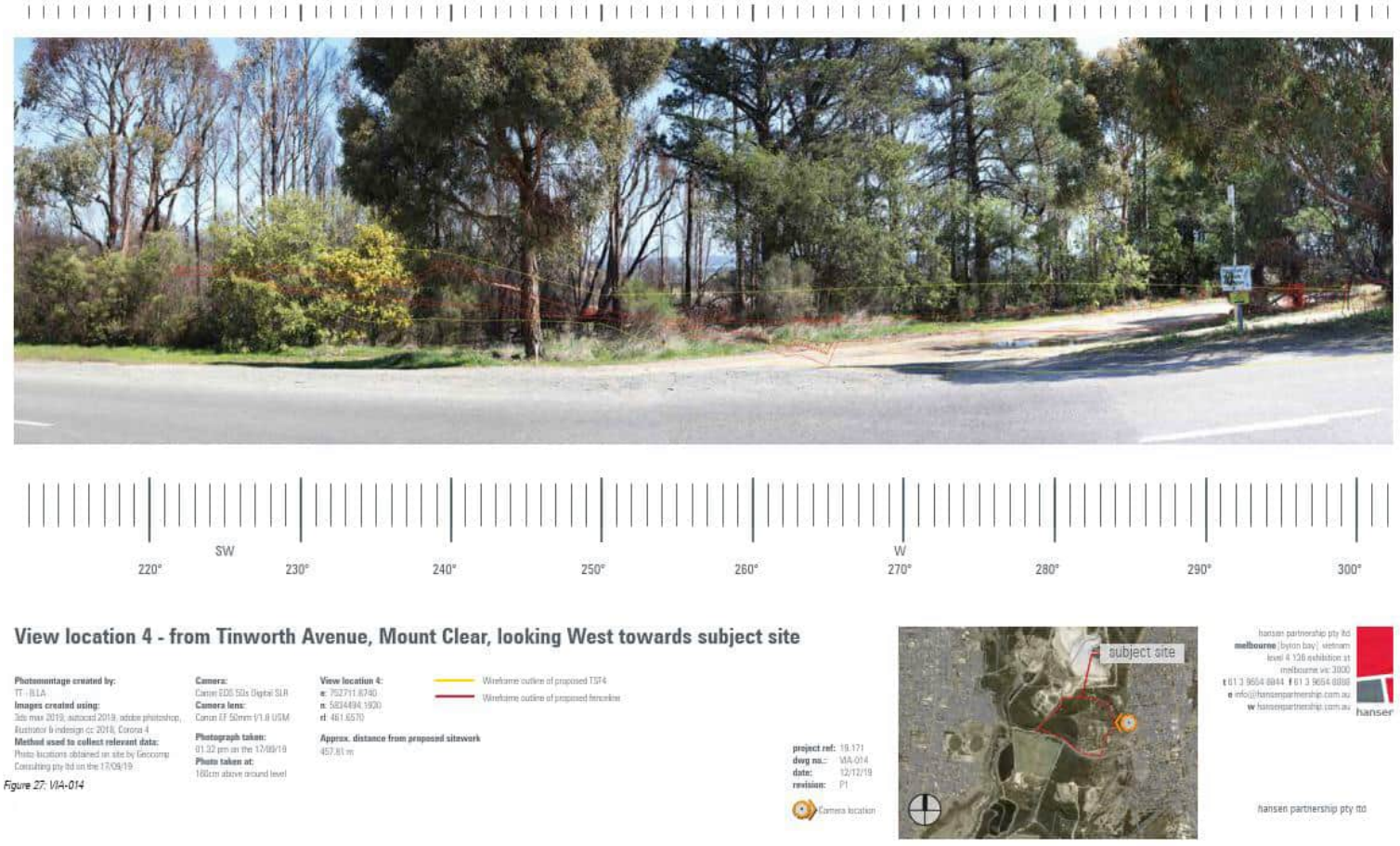

Figure 13: Photomontage from view location 4.

5.1.3 Summary of VIA

The VIA defined the two major landscape characters within the Works Area and surrounding area. Four locations were determined to have the highest potential for detrimental visual impact and were assessed.

The assessment of view location 1 revealed that the proposed TSF4 would not be visible from this location and that the visual impact from this location would be negligible.

During the assessment from view locations 2 and 3, it was found that existing views to areas of the timber plantation were not considered to be views of preferred landscape features due to these trees being able to be removed 'as of right'. As a result of this, the proposed TSF4 at completion prior to revegetation would not replace views to any preferred landscape features and the visual impact of the TSF4 at closure prior to vegetative rehabilitation is consistent with the final visual impact assessment of the TSF4 at closure with vegetation rehabilitation. For these reasons, the visual impact from these locations was considered to be limited.

From view locations 4, the rehabilitated site of the TSF4 would not be replacing views to the most preferred landscape character features, resulting in the visual impact of the development being negligible.

Overall, the visual impact from the proposed development of the TSF4 was considered to have a negligible or limited impact on each location with no mitigation measures being considered necessary.

5.2 Noise Assessment

A Noise Impact Assessment was prepared by Broner Consulting for Balmaine Gold Pty Ltd (provided in Appendix I) to assess the changes in predicted noise levels as a result of TSF4 construction and operational phase in consideration of the existing mine operational noise through the existing plant.

The noise impact assessment assumed a worst-case scenario at receiver locations which were based on established noise monitoring locations for the existing mining operations based on the existing approved noise limits.

Based on the noise impact assessment, for both the construction and operational phases, the noise level predications at critical receptor locations are well below the current approved noise limits for day, night and evening periods. Therefore, it was concluded that the construction and operation of TSF4 will not result in additional unacceptable noise impacts.

Measures to control noise emissions will be implemented as part of the construction and operations, as detailed in the Risk Management Plan in the Endorsed Work Plan Variation (refer to Appendix B).

5.3 Air Quality Assessment

An air quality assessment prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd (provided in Appendix J) was completed to assess baseline conditions at the TSF4 site and modelling of the potential air quality impacts of the construction, operation and closure of TSF4.

The air quality assessment was undertaken in order to assess compliance against the Environment Protection Authority Victoria's (EPAV) *State Environment Protection Policy (Air Quality Management) 2001* (the SEPP [AQM]) and the related EPAV Publication 1191 *Protocol for Environmental Management – State Environment Protection Policy (Air Quality Management) – Mining and Extractive Industries* (December 2007) (the PEM). As the proposed development is a mining operation, falling under Clause 40 of the SEPP (AQM), assessment of potential impacts from the TSF have been assessed in accordance with the SEPP (AQM) and the PEM.

The pollutants assessed included PM_{10}, $PM_{2.5}$ and Respirable crystalline silica (RCS) (defined as the $PM_{2.5}$ fraction). Three modelling scenarios were investigated as part of this assessment to model existing operations, future TSF4 operations and TSF4 construction phase.

The modelling results are detailed in AECOM, 2019a and are summarised as follows:

- Scenario 1 (existing operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below well below criteria. Project contributions were predicted to be up to 43% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 2 (future TSF4 operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below criteria. Project contributions were predicted to be up to 45% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 3 (TSF4 construction) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below criteria at all sensitive receptors. Project contributions were predicted to be up to 58% (24-hour PM_{10}) and 12% (24-hour $PM_{2.5}$) of their respective criteria.

Based on the modelling, concentrations during the construction and operational phases are predicted to be compliant with the criteria, however, dust may still be an issue if not controlled. Therefore, appropriate mitigation will be undertaken during both construction and operations and a construction dust management plan developed.

Dust mitigation measures are detailed in the Risk Management Plan in the Endorsed Work Plan Variation (refer to Appendix B).

5.4 Vegetation Condition Assessment

An ecological assessment was prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd (provided in Appendix H). The assessment identified and quantified the ecological values within the Works Area, including an assessment of all vegetation. In addition, a detailed koala habitat assessment was undertaken in the ESO5 area as a result of a security fence being proposed in this area.

The koala habitat assessment concluded that the vegetation in the ESO5 area did not qualify as any category of koala habitat and did not facilitate the safe movement of koalas between breeding populations or vacant preferred land. More specifically, the area of ESO5 that is to be impacted by the proposed fence contains a low quality patch of vegetation that has previously been disturbed and does not contain trees that would provide the necessary food resources for koalas. Further details on the koala habitat assessment are contained in Appendix H and are discussed in the assessment of ESO5 in Section 6.2.3 of this report.

An assessment of native vegetation within the Works Area was undertaken and it was found that native vegetation was of a patchy nature, due to forestry planting establishment, multiple fire events, and ongoing mining activity. In the plantation areas in the west, south and north of the Works Area, understorey vegetation is likely to be of similar age or younger than the established timber plantations. There is also potential for the large Scattered Trees and Large Trees in Patches to be older than the plantations. However, observations of the vegetation during the Vegetation Condition Assessment (Appendix H) suggest that the large trees have a tall and skinny growth form, indicating growth in a densely planted forestry environment, and the DBHs were generally within five centimetres of the benchmark for large trees (60cm).

AECOM considers that an exemption under Clause 52.17 of the Planning Scheme applies for the vegetation removal necessary for the construction of TSF4 and associated works. Pursuant to Clause 52.17-7(Table of exemptions): The requirement to obtain a permit for mineral exploration and extraction:

- *Native vegetation that is to be removed, destroyed or lopped to the minimum extent necessary by the holder of an exploration, mining, prospecting, or retention license issued under the Mineral Resources (Sustainable Development) Act 1990:*
    - *in accordance with a work plan approved under Part 3 of the Mineral Resources (Sustainable Development) Act 1990.*

A copy of the variation to the approved work plan that has received statutory endorsement under section 77TD of the MRSD Act, a copy of the written notice of endorsement under section 77TD(1) of the MRSD Act and the conditions that were specified under section 77TD(3) of the MRSD Act are provided at Appendix B of this report.

Since the completion of the ecological assessment, several new Planning Scheme Amendments, (VC210 and VC200), have introduced exemptions for native vegetation removal associated with mining and mineral exploration and extraction. As such the ecological assessment found in Appendix H does not reflect the exemptions that are referred to in this Planning Permit Application.

Impacts to the vegetation within ESO5 will largely be avoided, except for a small corridor for the construction of a permanent security fence (refer to Figure 14). This patch of vegetation contained a mature pine overstorey and the patch was largely determined based on the native understorey present.

Overall, the works will require the full or partial removal of 17 patches of native vegetation, removal of 108 Scattered Trees (2 large and 106 small) and 1 large tree in a patch, resulting in the removal of 2.653 hectares of native vegetation. The removal of the native vegetation is considered exempt of a permit as per 52.17-7(Table of exemptions). Further details on the removal of native vegetation are contained in Appendix H.

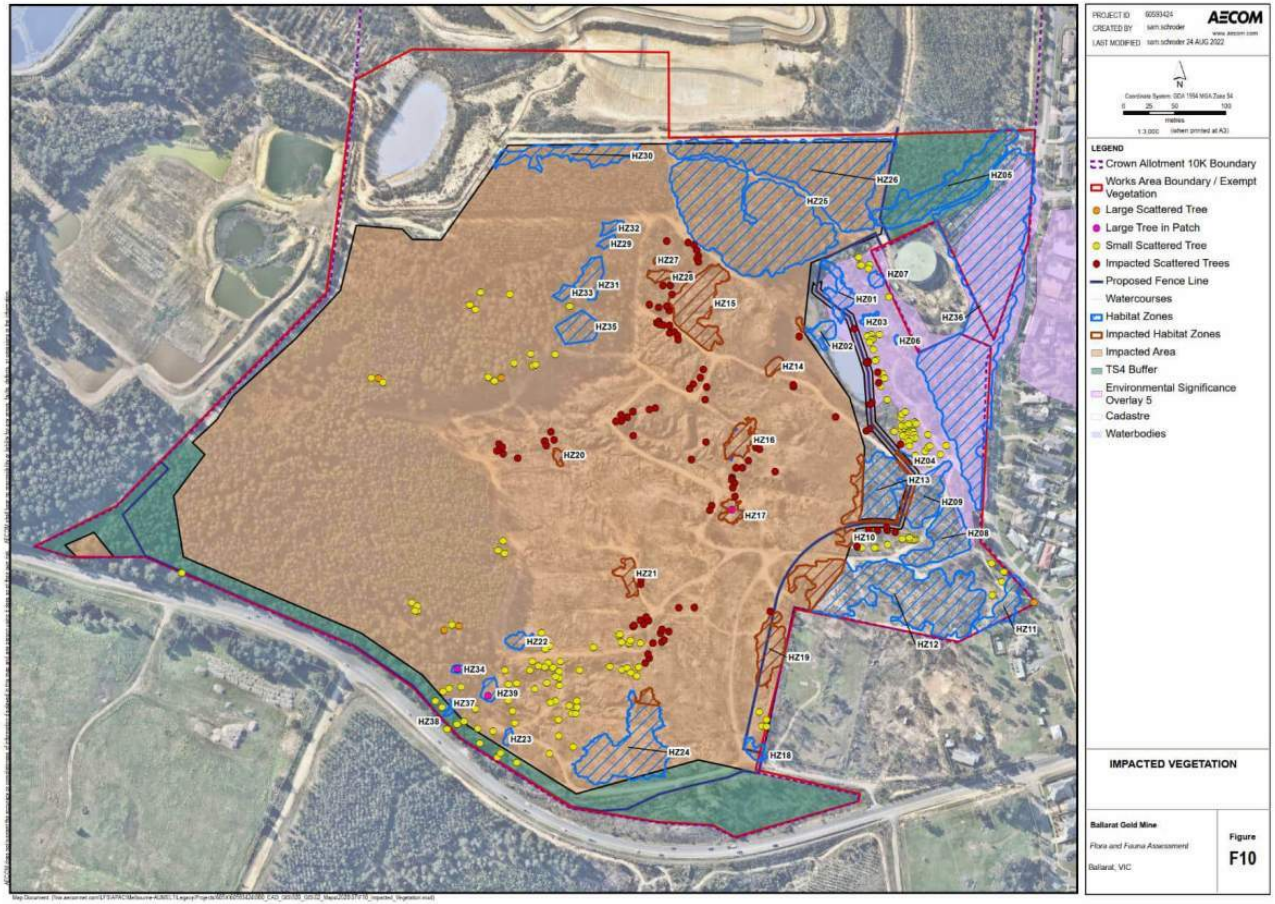

Figure 14: Map of Vegetation that is impacted and area considered exempt under Clause 52.17-7.

6.0 Planning Assessment

The following section provides an assessment of the planning permit application against the relevant planning policies and provisions of the Planning Scheme. This section also provides an assessment of the proposed buildings and works, the potential amenity impacts of the proposal, and the removal of vegetation.

The proposal is considered consistent with the strategic policies contained in the PPF and LPPF. Furthermore, the proposal will ensure the longevity of the BGM.

6.1 Planning Policy Framework

The proposal is supported by the Planning Policy framework as follows:

- **Clause 11.03-6S** requires all relevant planning considerations to be taken into consideration during the assessment of the proposal. All the relevant planning provisions have been highlighted in Section 4.0 of this report and will be assessed in the remainder of this report. The proposal of the TSF4 takes into consideration the distinctive characteristics and needs of regional and local planning for future land use by proposing it to be located on land already approved for mineral production under Planning Permit PA93/195 (refer to Appendix D).
- TSF4 does not involve any large noise sources during ongoing operation, with the exception of the pumps required for delivery of tailings and water system management. The pumps will be placed in appropriate noise mitigating enclosures. The potential sources of noise include the earth works, including plant and trucks as part of the construction and rehabilitation phases. The objective of **Clause 13.05-1** will be met by locating the proposed TSF4 in a position that it is sufficiently separated from adjoining residential developments that are located on the opposite side of Tinworth Avenue to provide a buffer from noise emissions. A noise assessment has been undertaken (included in Appendix I) which assessed the changes in predicted noise levels as a result of the construction and operation of TSF4. The predicted noise levels at critical receptor locations were all found to be well below the current approved noise limits for day, night and evening periods.
- **Clause 13.07-1S** requires the safeguard of community amenity from off-site effects from commercial and industrial developments. The amenity of the local community will be protected from the proposed works by a 100 metre works buffer from the closest residential receptors to the east and southeast of the development. The 100 metre works buffer along the eastern side of the Works Area has been implemented into the design to further reduce any other amenity impacts through noise emissions and the potential production of dust. The noise assessment and air quality assessment contained in Appendix I and Appendix J, respectively, concludes that the predicted noise levels and air pollutants will be well below the requirements. The potential production of dust would also be managed through a dust management plan.

  This works buffer already contains a significant amount of existing vegetation that will provide a natural visual screen of the proposal from the adjoining residential areas, as shown in Figure 15. In addition, a 15 metre vegetation screen along Whitehorse Road is to be maintained to mitigate visual amenity impacts.

Figure 15: Existing vegetation (to be retained) located within the works buffer that is visible from the residential area located east of the Works Area.

- The Works Area falls within the Farming Zone. The objective of **Clause 14.01-1S** states that productive farmland should be protected, however, the land is formally utilised as a pine plantation, authorised under Forestry Licence 100001R (Appendix C) and has been approved for the use of mineral production under Planning Permit PA93/195 (Appendix D). The land is also informally used as an open recreational space for the public where there is a number of walking trails. It is important to note that this area is also within the mining licence area, showing that the land has already been deemed appropriate for mining. Due to the existing use of the land and approvals for the land, there will not be any loss of agricultural land that is of regional or local significance, nor will the proposal allow any inappropriate dispersed urban activities.
- The land that is to be used for the proposed TSF4 contains areas of native vegetation. However, **Clause 14.03-1** states that the exploration and extraction of natural resources should be encouraged in accordance with acceptable environmental practice. As the existing vegetation that is located within the footprint of the proposed TSF4 has been highly disturbed by bushfires, mining and existing timber plantation, there would be minimal further impact on the environment (refer to Appendix H). The TSF4 is a key piece of infrastructure that is crucial to the ongoing operation of the BGM. A 100 metre works buffer from the closest residential receptors contains existing vegetation that would be maintained along the eastern boundary of the Works Area to provide a level of separation between the Works Area and the residential area located on the eastern side of Tinworth Avenue.
- The newly proposed TSF4 respects the value of the rural character of Ballarat and meets the objective of **Clause 15.01-6S**. This is achieved by having the bulk of the development visually screened by retaining a 15m strip of existing mature pines along Whitehorse Road and adjacent to CHW sewage treatment plant, largely comprising tall softwood pines. A VIA has been completed by Hansen Partnership Pty Ltd (Appendix G) which demonstrates that only a partial view of the top of the proposed TSF4 will be viewable from the south-west. This is a result of trees being rightfully removed due to being located within a timber plantation. Small filtered views of the proposed TSF4 will also be accessible through foliage along the eastern boundary, adjacent to Tinworth Avenue. Regardless of this, the siting of the proposal is unlikely to impact on any ridgelines, hill tops, waterways, lakes or wetlands.
- In accordance with **Clause 17.01-1S,** the protection and strengthening of the employment opportunities with the BGM is being met by ensuring the development of the TSF4 is completed. Without the proposed TSF4, the BGM would not be able to manage its tailings and would potentially result in a reduction of cessation of production BGM, resulting in a reduction in the required workforce.

The proposed works are also supported by planning policies at a local level. Specifically, the proposal is supported by the following local policies:

- Pursuant to **Clause 21.03-1**, habitats and biodiversity must be protected. This is achieved by having minimal native vegetation and habitat zones impacted within the Works Area to allow for the development of the TSF4. The Works Area has been subject to a number of disturbances for a period of time (bushfires, mining and plantation, refer to Appendix H) which has impacted much of the vegetation and natural local habitat value within the Works Area and proposed TSF4 footprint.

As a result, there is very little habitat value and biodiversity that is available to be protected. In addition to this, the TSF4 has been sited to have as little impact as possible on potential koala habitat located within ESO5 in the north-east of the Works Area.

- The Works Area is not an area identified within Ballarat that has significant environmental and natural features that adds to the municipality's biodiversity value. In accordance with **Clause 21.03-2**, the proposal will achieve the objective due to the little biodiversity value being present within the Works Area. The surrounding amenity will also be protected by the view of the proposed TSF4 being screened by existing trees (refer to Appendix G) which also allows for the landscape value to be protected.
- The Works Area is zoned Farming Zone, **Clause 21.05-1** states that agricultural land is an important element to the City's economic and employment base and should be protected from inappropriate use and development. The land of the Works Area is already included in the BGM's licenced mining area and has been approved for mineral production under Planning Permit PA93/195 (Appendix D), indicating that this agricultural land has already been decided to be used for mining rather than agriculture. Furthermore, the land will not be used for inappropriate urban development, but rather development that will result in the continual operation of the BGM whilst also retaining employment opportunities and strengthening its economic contribution.
- The TSF4 has been sited to ensure it does not impact on the Heritage Inventory Site of Woah Haup No.1 Mine (H7622-0005) located on Whitehorse Road, Canadian, south east of the Works Area as shown in Appendix A. This will ensure the protection and conservation of the historic features of the surrounding area, as stated in **Clause 21.06-3**.
- The TSF4 is required for the BGM to continue operating and for the mining sector to continue to act as a significant contributor to the Ballarat's economic development. By supporting the development of TSF4, the objective of **Clause 21.07-1** will be achieved.

6.2 Planning Control Assessment

The following provides an assessment of the Project against the purpose and decision guidelines of the specific planning controls triggered by the proposed works.

6.2.1 Clause 35.07 Farming Zone (FZ)

The proposal is considered to be consistent with the decision guidelines of the FZ for the following reasons:

General Issues

- The proposal is consistent with the Municipal Strategic Statement and the Planning Policy Framework. This is covered in more detail in Section 6.1 of this report.
- The proposal positively responds to the Corangamite Regional Catchment Strategy as it will not impact any, rivers, estuaries, floodplains, wetlands, coasts, marine environments or aquifers. The native vegetation that it will impact has been subject to historical disturbances and is exempt from the requirement to obtain a permit.. One threatened fauna species, the White-throated Needle Tail, is considered to possibly overfly the Works Area but is considered highly unlikely to be impacted by the proposal due to the lack of suitable habitat within the Works Area (refer to Appendix H for further information).
- Following the capping and decommissioning of TSF4, the proposed development will revert to a pine plantation and will be revegetated with commercial forestry species such as softwood pines. The revegetation of the area will allow for minimal potential harm to surrounding environmental values and will allow for the land to be returned to an environmentally friendly standard. The Endorsed Work Plan Variation contained in Appendix B includes a closure plan that shows the areas of the Works Area that will be capped and returned to the land use of Timber plantation which would involve being revegetated with commercial forestry species upon the decommissioning of TSF4. Additional details on rehabilitation are covered in Section 3.7 of this report.

- The Works Area is highly compatible with the proposed land use as it will be servicing the adjoining gold mine and has already been approved for the use of mineral production under Planning Permit PA93/195 (Appendix D). It will also be placed adjacent to the Central Highlands Water sewerage treatment plant which is zoned for public use and is not considered a sensitive land use that would have its amenity impacted by the proposal. There are residential developments to the east of the proposed TSF4, however, a 100 metre works buffer from the closest residential receptors contains existing vegetation that acts as a natural visual screen will be present between the two land uses, making it unlikely that impacts to the amenity of the residential developments will occur. The VIA completed by Hansen Partnership Pty Ltd (Appendix G) explains that the existing vegetation within the 100 metres works buffer that stretches along the eastern boundary of the Works Area would allow for minor proportions of the proposal to be viewed from the eastern side of Tinworth Avenue. It concludes that visual impact from the proposal would be negligible from the eastern side of Tinworth Avenue, indicating that the 100 metre works buffer is sufficient.

  Vegetation would also be retained along the southern boundary of the Works Area to provide a visual screen along Whitehorse Road of the proposed development. The VIA (Appendix G) has also assessed views from certain vantage points in the south and have determined that visual impact would be limited and that no mitigation measures are required.

  A noise assessment (contained in Appendix I) and an air quality assessment (contained in Appendix J) have also been prepared which conclude that the proposed TSF4 predicted noise levels and air pollutants would be well below the criteria during both the construction and operation phase.

- The surge dam and wetlands that are located south of TSF3 and form part of the site's existing infrastructure, will be utilised for the proposed TSF4. There will also be interconnected access between the two TSFs and the accessway that leads to the BGM office.

Agricultural issues and the impacts from non-agricultural uses

- The Works Area is currently used as a pine plantation and informal public walking track. As the land falls within the licenced mining area for the BGM and is approved for the use of mineral production under Planning Permit PA93/195 (Appendix D), it is considered it was intended to be used for mining and not for agricultural purposes.

- There are no adjoining agricultural uses that would have their operation or potential expansion limited by the development of TSF4. The only abutting land that is zoned for agricultural purposes is located to the south and on the opposite side of Whitehorse Road. Not only is this land separated by a public road, but it is also on a different title and is within the licenced mining area for BGM.

Environmental issues

- The impacts to natural physical features of the site will comprise of changes to the topography as a result of the construction of the proposed TSF4. As a result, there will be an increase in sediment from surface run-off around the TSF4. In order to manage this, a sediment pond would be constructed downstream from the TSF4 embankment (refer to Appendix A) as well as using the existing surge dam and wetlands system that is currently used for TSF3 via an emergency overflow spillway.

- Vegetation from a timber plantation which is currently partly located within the TSF4 footprint would be removed. Appendix C shows the assignment of a plantation licence that Balmaine Gold now holds which allows them to rightfully remove the pine trees within the timber plantation area. Appendix H contains a Vegetation Condition Assessment which highlights the areas of the timber plantation within the Works Area as well as detailing areas of native vegetation that will be removed. The Vegetation Condition Assessment goes into detail about how the existing native vegetation has been subject to a number of historical disturbances including bushfires, mining activities and the timber plantation. A more detailed assessment of the native vegetation is contained within Section 5.4 of this report.

  The Vegetation Condition Assessment at Appendix H also concludes that impacts to the White-throated Needle Tail is highly unlikely due to the lack of suitable habitat within the Works Area.

- As a result of a number of bushfires passing through the Works Area, as well as being subject to timber plantation and mining activities for a large period of time, the assessed habitat zones were found to be of low quality. Figure 16 below shows the location of these habitat zones, much of which are located outside of the TSF4 footprint and would avoid being impacted.

Design and siting issues

- The entirety of Crown Allotment 10K is within the FZ, with the northern half of the allotment already being developed for the use of Earth and energy resources, including the existing TSF3 and other BGM infrastructure.

  The proposed TSF4 will be sited in a pocket of land in the southern half of Crown Allotment 10K (the Works Area), directly adjacent to the existing TSF3. Considering Crown Allotment 10K is already being used for Earth and energy resource purposes, it is appropriate to site the proposed TSF4 in the Works Area location to consolidate infrastructure and not potentially impact surrounding agricultural land.

- The proposed TSF4 has been strategically sited to be naturally screened by existing vegetation provided by the existing timber plantations. The bulk of the proposal would be screened, with only the highest points of the proposed TSF4 being viewable from certain vantage points in the south-west and east (refer to VIA included in Appendix G), however, these views are minimal and are often filtered views through foliage and vegetation, and are likely to have minimal impact on existing vistas.

  The bulk of the final TSF4 landform at closure will be revegetated back to plantation at closure and will blend in with the existing landscape, with the exception of the external walls of the embankment which will be rockfill. Vegetation cannot be established on the embankments due to its ability to significantly compromise the stability of the structure.

- The proposal is aligned with the existing use and current developments on Crown Allotment 10K and will have minimal impacts on the character and appearance of the area. This is justified by the VIA completed by Hansen Partnership Pty Ltd (Appendix G) that concludes there would be little visual impact from various vantage points located around the Works Area.

- The proposal does include the development of two powerpoles and associated power lines that would be ancillary to the development of TSF4. These will allow for a power supply to be provided for the operation of the pumps for the sedimentation pond, tailings delivery and operation system. One powerpole would be located east of the proposed TSF4 and the other would be located adjacent to the south-western corner of the proposed TSF4.

  Clause 73.03 defines a minor utility installation as:

  Land used for a utility installation comprising any of the following:

  h) power lines designed to operate at less than 220,000 volts but excluding any power lines directly associated with an Energy generation facility or Geothermal energy extraction.

  Both powerpoles/power lines would meet this definition and are considered to be exempt from requiring a planning permit under Clause 62.02-1 (Buildings and works not requiring a permit) as they would be classified as *buildings and works associated with a minor utility installation.*

- The proposal includes an upgrade to an existing accessway that is located in the south-western corner of the Works Area and provides access to Whitehorse Road. A new sediment pond is also proposed to be sited in the south-western corner of the Works Area to manage sediment laden surface water run-off from disturbed areas around the proposed TSF4.

- The proposed new accessway in the south-western corner of the Works Area is detailed in Appendix A. No ongoing traffic management measures will be required as part of the operation and use of the proposal.

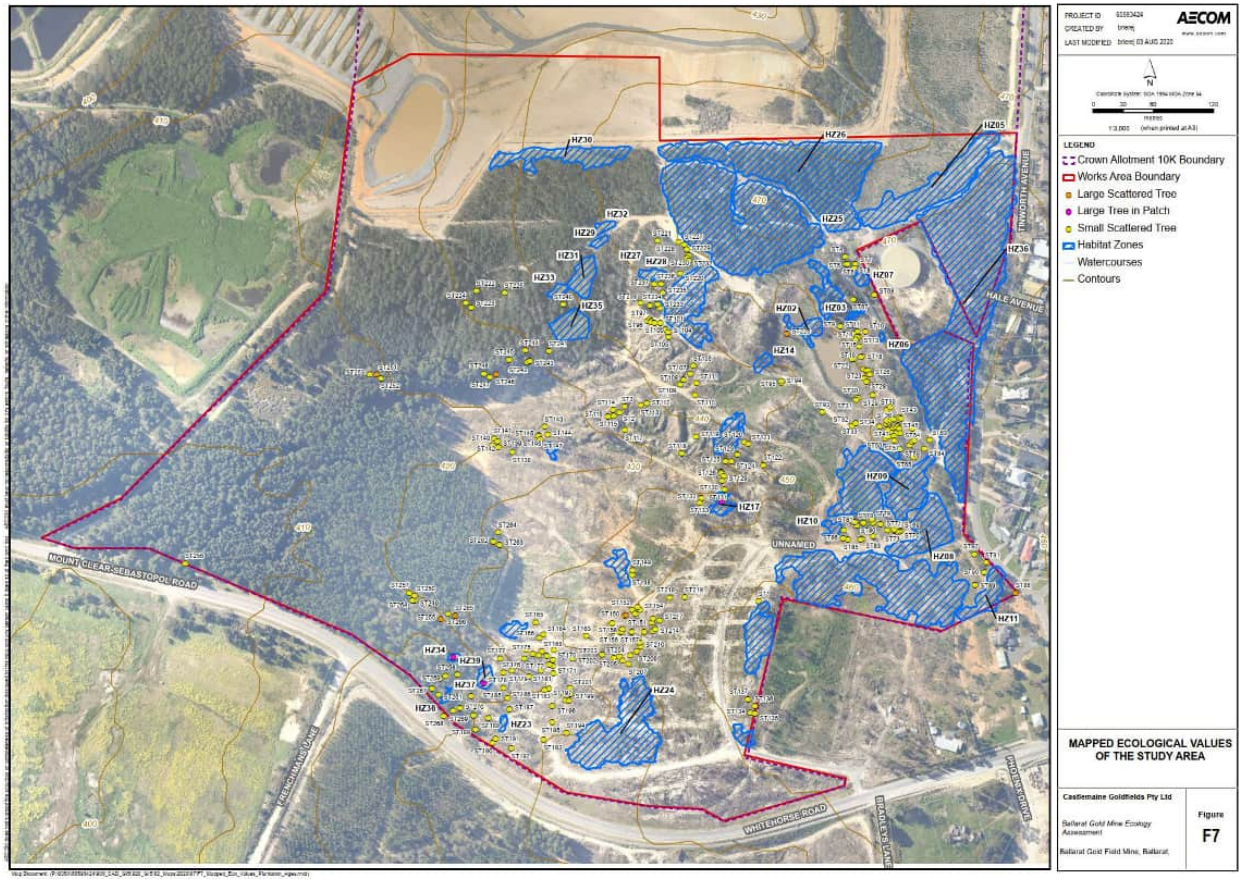

Figure 16: Mapped habitat zones within the vicinity of the proposed TSF4.

6.2.2 Clause 36.04 Transport Zone (TRZ2)

The proposal is considered to be consistent with the decision guidelines of TRZ2 for the following reasons:

- The proposal is consistent with the Municipal Strategic Statement and the Planning Policy Framework. This is covered in more detail in Section 6.1 of this report.
- The views of the relevant road authority have been sought and taken into consideration. A letter from the Department of Transport (DoT) was received on the 15/07/2020 (refer to Appendix K) detailing their support for the proposal, specifically the proposed works within TRZ2 for the access to the Works Area from Whitehorse Road.
- The proposal provides for a new left-hand turning lane into the Works Area when travelling east along Whitehorse Road (refer to Appendix A for plan of proposed road works). This allows heavy vehicles to safely enter the Works Area without disrupting the ongoing flow of traffic.

  The proposal also only allows vehicles to turn left when exiting the Works Area. Road widening has been proposed to allow for an overtaking lane to be implemented, again allowing for the safe ongoing flow of traffic along Whitehorse Road.

6.2.3 Clause 42.01 Environmental Significance Overlay – Schedule 5 (ESO5)

The proposal is considered to be consistent with the decision guidelines of ESO5 for the following reasons:

- The extent of this overlay that is impacted by the footprint of the proposed TSF4 and associated infrastructure is minimal (refer to Appendix A). The ESO5 will only be impacted by a proposed fence that runs along the perimeter of TSF4 which is to be installed for security and safety reasons. In addition to this, the majority of vegetation that will be obstructed by the proposal has already been significantly impacted by recent bushfires that passed through the area during April 2019, as well as previous bushfires that passed through the area in 1982 and 2010 (refer to Appendix H).
- Site assessments were conducted on the vegetation within ESO5 which found that none of the vegetation met the ESO criteria for the Koala Habitat categories. The vegetation also does not qualify as Tertiary Koala Habitat (Habitat buffers or Habitat Linking Areas) as it is not adjacent to any Primary or Secondary Class A Koala Habitat and does not facilitate safe movement of koalas between breeding populations or vacant preferred habitat (refer to Appendix H). The study area is isolated from other potential koala populations in the surrounding landscape due to being surrounded by mining operations, roads, residential areas, timber plantations, and generally unsuitable habitat, particularly as a result of burning.
- The vegetation within the proposed impact area for the fence does not contain any Koala food tree species, is disturbed, and is of generally low quality (refer to Figure 17 and Appendix H). Therefore, it is considered unlikely that the proposed construction of the permanent fence will have a significant impact on the safe movement of any potential Koala populations, due to the vegetation being of little to no value as koala habitat and the small proposed impact of the fence.
- The lack of established Koala Habitat within the ESO5 area demonstrates the proposal is unlikely to result in any further fragmentation to Koala Habitat. The Vegetation Condition Assessment concludes “it is unlikely that the study area contains suitable koala habitat due to the extent of burnt vegetation and lack of primary or secondary food trees (except scorched blue-gums). It is therefore considered unlikely that the proposed fence will have significant impact on any koala populations within the area”.

Further information regarding the koala habitat assessment can be found in the Vegetation Impact Assessment, Appendix H.

Figure 17: Proposed koala habitat to be cleared for TSF4 security fence.

6.2.4 Clause 52.08 Earth and energy resources industry

There are no decision guidelines contained under Clause 52.08. The application requirements of Clause 52.08-2 have been met as per Section 4.3.3 of this report and the documents for the statutory endorsement of the Work Plan Variation are found at Appendix B.

6.2.5 Clause 52.29 Land Adjacent to the Principal Road network

The existing accessways within BGM are too narrow and cannot accommodate the turning circles for the large and/or oversized vehicles that would be required for the construction of TSF4. Large and/or oversized vehicles would be required to access the south-eastern corner of the Works Area (proposed location of TSF4) and the easiest and safest way to do this would be via access from Whitehorse Road.

A new vehicle crossover (and associated turning lane) to Whitehorse Road from the southern access road to the Works Area is proposed for the construction and operation of TSF4. The details of the proposed changes to this accessway and Whitehorse Road are shown in Figure 18 below and are also contained within Appendix A.

The new access from Whitehorse Road is proposed to be used during construction activities between 7:00am and 6:00pm from Monday to Friday.

During operation of TSF4 and the new access road is to allow for access to the Works Area 24 hours a day, 7 days a week to allow for operational inspections and maintenance, except for heavy vehicles (vehicles in excess of 10T) which would be restricted to using the new access from Whitehorse Road between 7:00am and 6:00pm from Monday to Friday.

The development and rehabilitation of TSF4 would require approximately 3 construction stages, with each stage having an approximate duration of 12-18 months. Per construction stage, there would be 10-15 truck movements during the mobilisation phase (three week period), 5 truck movements during the construction phase of TSF4 (12-18 month period) and 10-15 trucks during the demobilisation phase (three week period). Figure 19 below (also contained in Appendix A) summarises the vehicle movements in and out of the Works Area in the context of the wider community.

The proposal is considered to be consistent with the decision guidelines of Clause 52.29 for the following reasons:

- Contact was made with DoT (the relevant road authority) on 06/07/2020 to seek their support and guidance of the proposal. A response was received in writing on 15/07/2020 (refer to Appendix K) where DoT expressed they had no objection and were supportive of the proposed access to the Works Area from Whitehorse Road, subject to detailed design plans being provided prior to any works being undertaken.

  We propose that this detail could be captured under Condition 1 of a planning permit, if one were to be issued by the Responsible Authority.

  An alternative design incorporating DoT comments, was submitted to DoT on the 25/07/2022. Further communication with DoT was received on 16/08/2022, by email (refer to Appendix K). DoT have requested that a TIA be submitted to their satisfaction as part of the planning permit application. BGM have engaged a traffic specialist to complete the TIA, and the results of the assessment will be shared with council once the assessment is complete.

- The proposed entrance to the Works Area is unlikely to compromise the operation of Whitehorse Road or impact on public safety. A turning lane will be provided for vehicles when entering the Works Area via the proposed southern accessway, travelling east bound on Whitehorse Road, allowing them to slow down, turn and enter the site at a safe speed, as shown in Figure 18.

  When vehicles are exiting the Works Area via the proposed southern accessway, vehicles will only be able to make a left hand turn. The northern portion of Whitehorse Road, east of the proposed accessway, will be extended to allow for the overtaking lane to be extended past the accessway. This will allow vehicles to safely exit the Works Area whilst also allowing any oncoming traffic on Whitehorse Road to safely overtake.

- The proposed crossover is to be constructed and maintained in a safe condition by the Applicant, in accordance with the City of Ballarat Road Management Plan.

This new accessway from Whitehorse Road will also improve the current access routes for oversize and overmass vehicles to the mine which are currently permitted to access the Works Area via Tinworth Avenue and Whitehorse Road (near the intersection with Tinworth Avenue) which requires an Oversize Overmass permit to be issued from the responsible authority. This has potential to impact on the amenity and safety of the residential properties along Tinworth Avenue. The amenity and safety of Tinworth Avenue would be protected by providing access to the Works Area from Whitehorse Road for all types of vehicles.

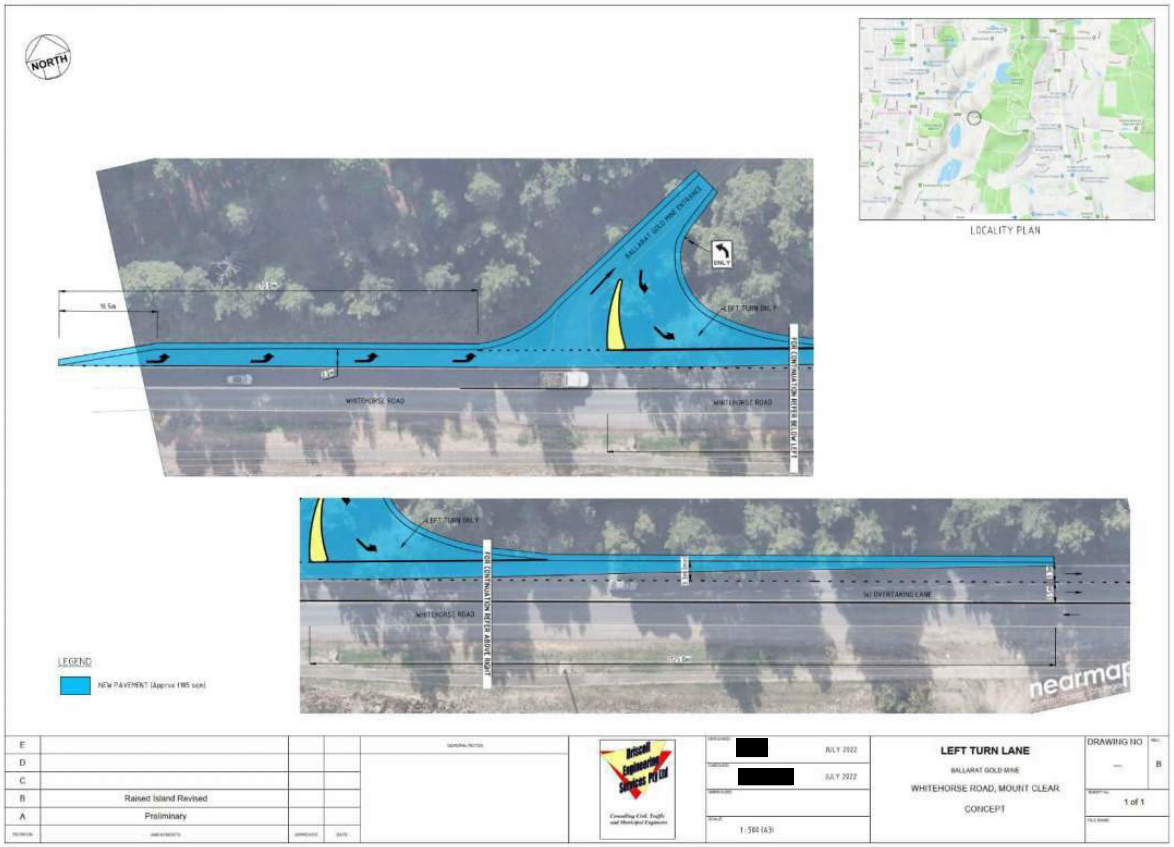

Figure 18: Proposed accessway to the Works Area from Whitehorse Road.

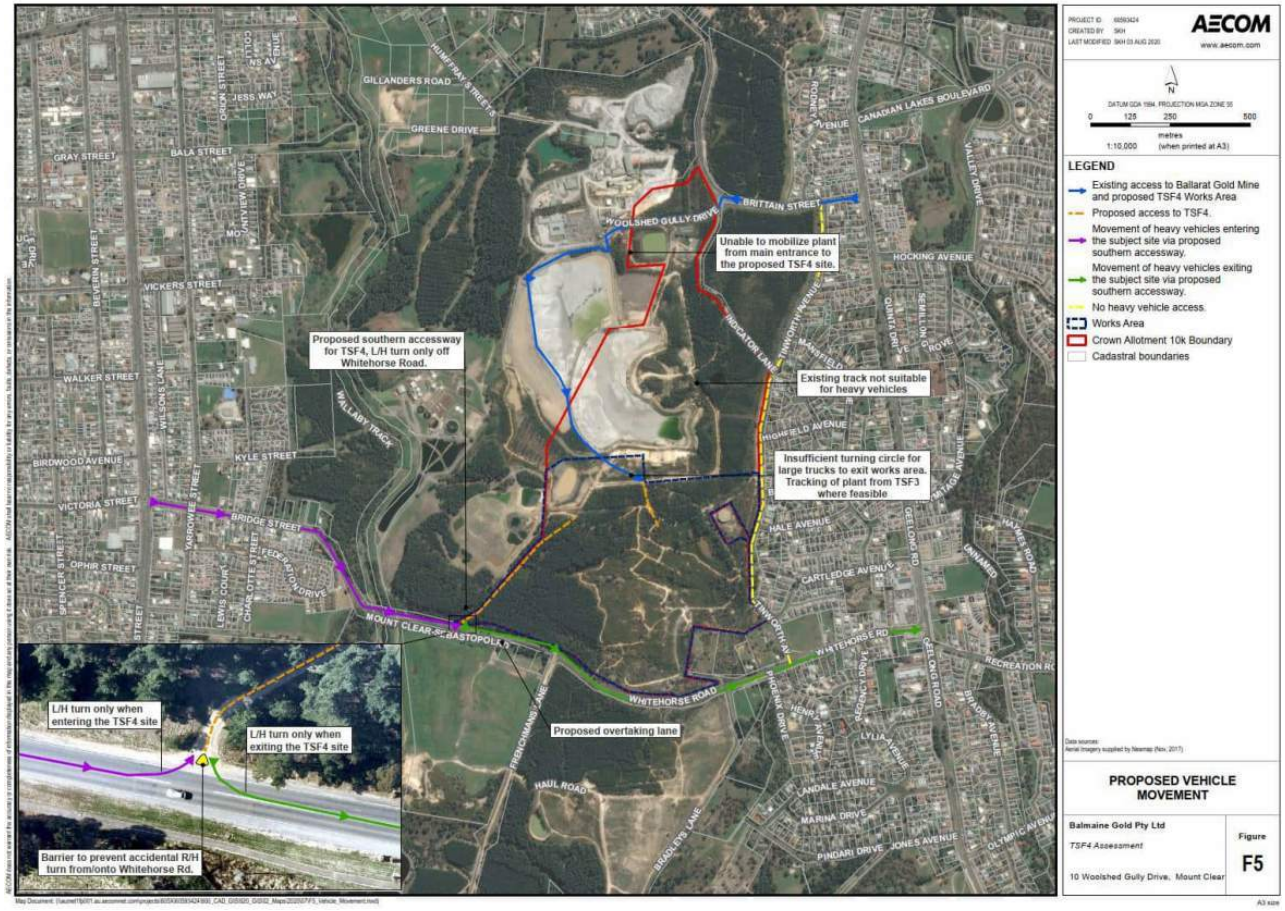

Figure 19: Vehicle movements entering and exiting the Works Area in the context of the wider community.

7.0 Conclusion

This report describes the proposed works and removal of vegetation associated with the development of TSF4 at the BGM. The application is consistent with the purpose of the relevant zones and overlays and, and the objectives of the relevant Planning Policies of the Ballarat Planning Scheme.
The proposed works has been designed with consideration of the surrounding amenities of the broader Ballarat region and is considered appropriate for the following reasons:

- A TSF is required for the BGM to continue operating. With the existing TSF3 estimated to reach capacity in 2021, the development TSF4 is required to ensure the viability of BGM's operation.
- The siting and location of the proposed development is appropriate as it will sufficiently be able to service the BGM and utilise highly disturbed agricultural land without further spreading into productive agricultural land. It will also be sited to avoid impacts to the majority of mapped habitat zones (refer to Figure 16).
- The fencing of the proposed TSF4 would only slightly pass through ESO5, which has been determined to have no impact on existing koala populations or preferred koala habitat due to a history of consistent disturbances.
- A Work Plan variation for the proposed works has received statutory endorsement under the MRSD Act (Appendix B).
- The native vegetation within the Works Area has been historically subjected to bushfires and impacts from approved mining and timber plantation activities, resulting in the native vegetation being of low quality. Furthermore, it has determined that the removal of native vegetation to the north, west and south of the proposed location is exempt from the requirements of Clause 52.17.
- The proposed accessway from Whitehorse Road in the south-western corner of the Works Area has been demonstrated that it would be constructed in a functional and safe manner and has received support from the DoT (refer to Appendix K).
- The VIA has demonstrated that the development of the proposed TSF4 would have negligible or limited visual impacts and that no mitigation measures would be required.
- Rehabilitation will be undertaken in terms of capping TSF4 and returning the Works Area to the existing land use of Timber production where the area would be planted with commercial forestry species.

For the reasons discussed within this report, we respectfully request that Council grant a Planning Permit for the proposed works and removal of vegetation in association with the development of TSF4 and associated infrastructure at the BGM.

Appendix A

Development Plans

Appendix B

Statutory Endorsement of Work Plan Variation

Appendix C

Registration of Instrument of Assignment of a Plantation Licence

Appendix D

Copy of Planning Permit PA93/195

Appendix E

Certificate of Title Documents

Appendix F

Correspondence with DELWP

Appendix G

Visual Impact Assessment

Appendix H

Vegetation Condition Assessment

Appendix I

Noise Assessment

Appendix J

Air Quality Assessment

Appendix K

Department of Transport Response

Appendix J Air Quality Assessment

AECOM Imagine it. Delivered.

Balmaine Gold Pty Ltd
16-Mar-2020

Whitehorse Gully TSF4

Air Quality Assessment

Whitehorse Gully TSF4

Air Quality Assessment

Client: Balmaine Gold Pty Ltd

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Reviewed by	[redacted]

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	4-July-19	Draft Issue	[redacted] Principal Environmental Scientist	
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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Balmaine Gold Pty Ltd, a wholly owned subsidiary of Castlemaine Goldfields Limited (both referred to as CGT in this report), to undertake an air quality assessment of particulate emissions due to construction and operation of a proposed new tailings storage facility (TSF4) at its Ballarat gold mine (the Project).

This report outlines the current regulatory context for air quality management, the baseline air quality and meteorological conditions in the Project area, the methodology used to carry out the assessment of potential air quality impacts and the results of the modelling of air quality impacts from construction and operation of TSF4. Air quality mitigation measures and strategies are also provided where relevant.

The air quality assessment was undertaken in order to assess compliance against the Environment Protection Authority Victoria's (EPAV) *State Environment Protection Policy (Air Quality Management) 2001* (the SEPP [AQM]) and the related EPAV Publication 1191 *Protocol for Environmental Management – State Environment Protection Policy (Air Quality Management) – Mining and Extractive Industries* (December 2007) (the PEM).

The existing environment in the Project area was defined in terms of meteorology and climate, pollutant concentrations and the location of sensitive receptors. As suitable on-site real-time particulate monitoring data were not available, the site assessment encompassed particulate emissions from the active mine areas, including the transport and processing of material on the site, to predict the total particulate atmospheric load on local receptors from the mining operations.

1.1 Objectives

The objectives of this air dispersion modelling assessment are to:

- Estimate the potential impact of particulate emissions resulting from the Project at the nearest sensitive receptors; and
- Compare the predicted ground level concentrations to the assessment criteria in consideration of the SEPP (AQM).

1.2 Scope of Works

To deliver the objectives of this assessment, the following tasks were undertaken:

- Compilation of a particulate emission inventory for the Project;
- Preparation of a five year meteorological dataset using prognostic meteorological data;
- Preparation of AERMOD atmospheric dispersion models for particulate emissions;
- Comparison of predicted ground level particulate concentrations to the assessment criteria in consideration of the SEPP (AQM) and the PEM; and
- Preparation of a report on the outcomes of the particulate dispersion modelling.

2.0 Site Overview

2.1 Site Location

The mine site is located at 10 Woolshed Gully Drive, Mount Clear VIC 3350, as shown in Figure 1. The site is owned by CGT and is bound by a buffer of vegetation approximately 250m wide.

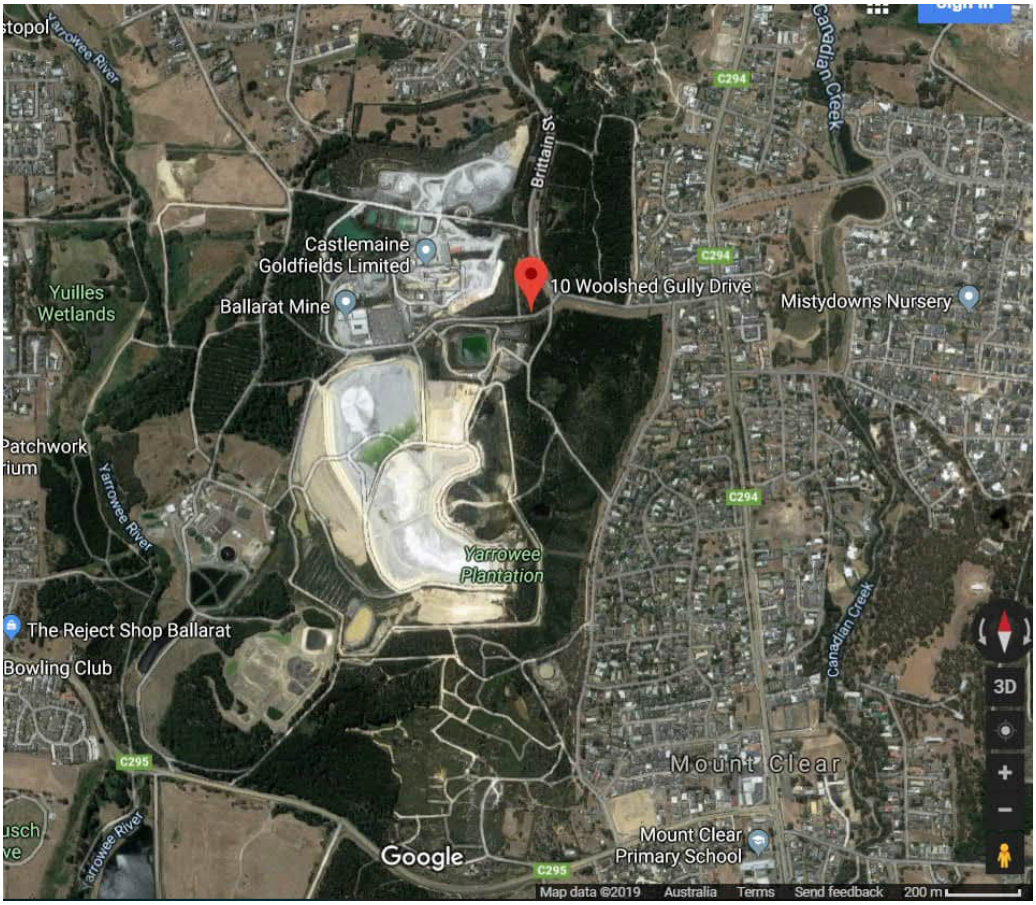


Figure 1 Site location

2.2 General Overview

CGT own and operate the underground gold mining operation located in Mt Clear, Ballarat, in central Victoria (mining license no. MIN5396). Ore from the underground mine is hauled to the surface mill site where it is processed. Tailings are pumped, as a slurry, from the processing plant to a TSF at Terribly Gully (TSF3), located 600 m south of the processing plant (and directly north of the proposed Whitehorse Gully TSF4 site).

CGT's strategy for tailings storage at the current site was reviewed in 2017 (AECOM 2017). This review identified a number of possible options to increase tailings storage, including the construction of a new TSF in other nearby locations and/or an additional raise of the existing TSF3. The option to raise the existing TSF was assessed to be the most cost-effective storage measure for the immediate future, and a 4 m to TSF3 was approved by Earth Resources Regulation (ERR) in 2018. However, CGT is progressing the development of its long-term tailings management strategy given that the current TSF3 facility will reach its approved capacity by June 2020.

The long term strategy is to construct a new TSF on a new site (TSF4). CGT's strategy (at the time of this report) is to re-mine the coarse-grind tailings from TSF3 using a ball-mill. This process will produce a finer-grind tailings which will be disposed of in TSF4. TSF4 will extend across tenements MIN5396 and MIN4847, both held by CGT.

The location of the proposed TSF4 is presented in Figure 2.

Figure 2 Location of proposed TSF4 footprint in relation to the existing processing area and TSF3

2.2.1 Underground Mining and Ore Handling

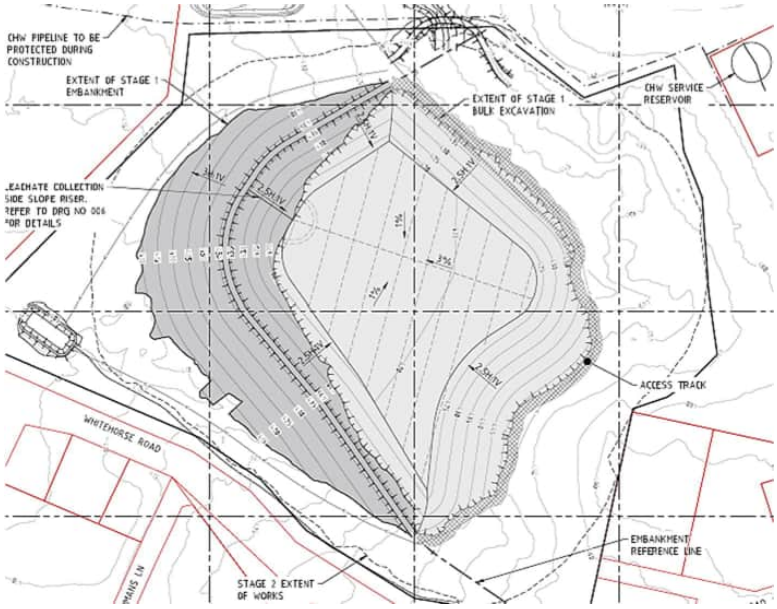
Underground mining is conducted at the Project site using a conventional mining fleet using drilling jumbos, production drills, loaders, trucks and ancillary equipment. Both ore and waste rock are brought to the surface using underground tip trucks. Ore is dumped onto designated Run of Mine (ROM) stockpiles, while waste rock brought to the surface is dumped onto the Waste Rock Bund at the northern edge of the site. Stockpiling activities and dumping of waste rock occur 24 hours a day, seven days per week. In 2018 approximately 273,000 tonnes (t) of ore and 86,000 tonnes of waste rock were brought to the surface. The mine is currently licenced to mine up to 600,000 tonnes per year of ore.

Ore is transferred from the ROM stockpile by front end loader into the crusher bin. The primary crusher operates 6 am to 10 pm. Crushed material is then moved to a contained fine ore bin before being screened. Screened material is then processed or waste piped to the tailings dam as a slurry.

2.2.2 TSF4 Construction Staging

The concept design of TSF4 allows for a staged approach; where the embankment is initially constructed with a starter embankment; and incrementally raised to its final height. This is the likely approach. An indicative two-staged program of works is presented in Figure 3. In summary, the indicative staging is as follows:

- **Stage 1:**
  - Embankment crest level at EL 435 m
  - Maximum embankment height of 25 m (approx.)
  - Tailings storage capacity in the order of 0.8 Mm^3 (approx.)
- **Stage 2:**
  - A 9 m high raise to the Stage 1 embankment by downstream construction methods, to a crest level at EL 444 m
  - This will require additional excavation from within the impoundment above EL 435 (approx.).
  - This will provide an additional 0.7 Mm^3 (approx.) of tailings storage capacity.



(a)

(b)

Figure 3 Possible staging of TSF4 (a) Stage 1 to EL 436 m; and (b) Stage 2 to EL 444 m

2.3 Pollutants of Interest

The primary air pollutants expected to be generated during the Project construction and operations are fugitive particulates, of which the following are required to be assessed under the PEM:

- PM_{10} (Particles with mean aerodynamic diameter less than 10 microns);
- $PM_{2.5}$ (Particles with mean aerodynamic diameter less than 2.5 microns); and
- Respirable crystalline silica (RCS) (defined as the $PM_{2.5}$ fraction)

Particulate matter refers to the many types and sizes of particles suspended in the air we breathe. PM_{10} and $PM_{2.5}$ tend to remain suspended in the air for longer periods than larger particles and can penetrate human lungs.

RCS is a basic component of soil, sand, granite, and many other minerals. Quartz, cristobalite and tridymite are the most common forms of crystalline silica. All three forms may become respirable size particles when workers chip, cut, drill, or grind objects that contain crystalline silica. Respirable free crystalline silica has been classified as a human lung carcinogen, and breathing respirable free crystalline silica dust can cause silicosis. The respirable free silica dust enters the lungs and causes the formation of scar tissue, thus reducing the lungs' ability to take in oxygen.

Particulate matter is unique among atmospheric pollutants in that it is not defined on the basis of its chemical composition; it includes a broad range of chemical species. Particulate matter can be emitted from natural sources (bushfires, dust storms and pollens) or as a result of human activities such as combustion activities (motor vehicle emissions, power generation and incineration), excavation works, bulk material handling, crushing operations, unpaved roads and use of wood heaters. For a mining operation, particulate matter is emitted from a number of extractive activities including disturbance of soil and rock, traffic on haul roads, movement of overburden, blasting and drilling, and wind-blown dust from exposed surfaces.

2.4 Potential Sources of Dust

The pollutants assessed in this report include:

- PM_{10};
- $PM_{2.5}$; and
- RCS.

The main potential sources of dust onsite include:

- Wind erosion from exposed surfaces and stockpiles;
- Wheel generated dust from haul trucks on unsealed roads;
- Dumping of ROM and waste rock material;
- Shaping stockpiles and materials handling;
- The North Prince Shaft ventilation portal from the underground mine;
- Primary crushing of ROM; and
- Construction activities such as borrow excavation and formation of the TSF4 embankment.

Emission rates for the sources listed above were estimated for this assessment. Details of the emission rate estimation is provided in Section 6.0.

3.0 Regulatory Context

3.1 National Environment Protection Measure

The *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) was formed in 1998 under the *National Environment Protection Act 1994* (NEPC Act). It was designed to create a nationally consistent framework for monitoring and reporting on common ambient air pollutants. The AAQ NEPM was varied in 2016 to incorporate new particle standards. A consolidated version of the AAQ NEPM lists environmental quality objectives (criteria) for priority pollutants, as specified in Table 1. By 2025 the AAQ NEPM aims to further reduce the annual average standard for $PM_{2.5}$ and PM_{10} in line with World Health Authority (WHO) standards.

Table 1 AAQ NEPM Standards

Pollutant	Averaging Time	Statistic	Criteria
			µg/m³
PM_{10}	24 hour	100th percentile	50
	Annual	-	25
$PM_{2.5}$	24 hour	100th percentile	25
	Annual	-	8

3.2 State Environment Protection Policy

The *State Environment Protection Policy – Air Quality Management (VIC) 2001* (SEPP AQM) is a framework for managing emissions from all sources of air pollutants in Victoria so the air quality objectives in the *State Environment Protection Policy - Ambient Air Quality (VIC) varied 2016* (SEPP AAQ) are met.

The SEPP (AQM) specifies the requirements for assessment of air quality impacts for a proposed development. Clause 40 of the SEPP (AQM) specifically states that mining operations are to be assessed per the relevant PEM, as reproduced below:

> ***40. Management of Large Line and Area-Based Sources of Emissions***
>
> *(1) The Authority will develop protocols for environmental management in accordance with this policy for assessing and managing the impacts of large line and area-based sources of air quality indicators in partnership with relevant Government of Victoria agencies, local government and other stakeholders.*
>
> *(2) These industries include, but are not limited to:*
>
> *(a) mining;*
>
> *(b) quarrying; and*
>
> *(c) road construction and operation.*

3.3 EPAV Publication 1191 (Mining and Extractive Industries PEM) 2007

The requirement for air quality modelling and assessment of mining activities is based on the EPAV Publication 1191 *Protocol for Environmental Management – State Environment Protection Policy (Air Quality Management) – Mining and Extractive Industries* (December 2007) (the PEM). The level of assessment required by the document is designated into three levels of assessment based on the extraction rate and the setting and distance to receptors. The three levels are defined as follows:

- A **level 1** assessment is required when developments are located close to residential areas or urban areas and have the potential to give rise to significant offsite impacts;
- A **level 2** assessment is required when the proposed development is in a rural location with residences in close proximity or where a small operation is located in an urban area; and
- A **level 3** assessment is required when the development is in a rural location with no residences nearby.

The main criteria that apply to the designation of the assessment level for the Project are if the extraction rate is greater or less than 500,000 tonnes/year and if there are residential areas within 500m, as per Table 1 of the PEM. In the case of the Project, both of these criteria are triggered. However, the practical difference between a Level 1 and Level 2 assessment is the way in which background pollutant concentrations are considered. Under the PEM, a Level 1 assessment requires pollutant concentrations measured on site to be included as background. Compliance monitoring at the site consists of dust deposition gauge monitoring. Ambient PM_{10} and $PM_{2.5}$ concentrations (pollutants relevant to this assessment) cannot be calculated from dust deposition results.

As described in Section 4.3, background concentrations were conservatively calculated using data from Footscray and Alphington (which are expected to be generally higher than those at the Ballarat site) and the 70th percentiles of daily maximum observations (as opposed to the 70th percentile hourly observation).

Given that there are no changes to the extraction limit (600,000 tonnes per year), no site specific background data is available and conservative representative background data has been used, a Level 2 assessment is considered appropriate in this circumstance.

The particulate assessment criteria for mining detailed in the PEM are provided in Table 2. The SEPP (AQM) provides the relevant average periods for assessment as follows and applied in Table 2:

Table 2 PEM assessment criteria for mining and extractive industries

Substance	Averaging Period	Statistic	Design Criterion
Particulates as PM_{10}	24-hour	100th percentile	60 µg/m³
Particulates as $PM_{2.5}$	24-hour	100th percentile	36 µg/m³
Respirable crystalline silica (as defined as the $PM_{2.5}$ fraction)	Annual	100th percentile	3 µg/m³

3.4 Adopted Project Criteria

As the proposed development is a mining operation, falling under Clause 40 of the SEPP (AQM), assessment of potential impacts from the Project have been assessed in accordance with the SEPP (AQM) and the PEM (Table 2).

The adopted criteria apply to the total pollutant load within an area rather than for individual sources. As such, existing background concentrations should be added to concentrations predicted for a particular activity before comparison to the relevant criterion.

4.0 Existing Environment

4.1 Land use and terrain

Land use surrounding the Project site is mostly a mix of low shrubland, mixed forest and low-medium density residential land. Surface roughness is moderate and will slow winds down as they blow through the area (compared with open grassland).

Terrain is the area is mostly undulating hills in the immediate surrounds, with higher hills up to about 560 m in elevation to the east of the site. The hills to the east may have a slight valley drainage flow effect on cool, still mornings, when slumping cool air moves downslope to the west. Figure 7 in Section 5.5 shows terrain elevations in the Project area.

4.2 Climate and Meteorology.

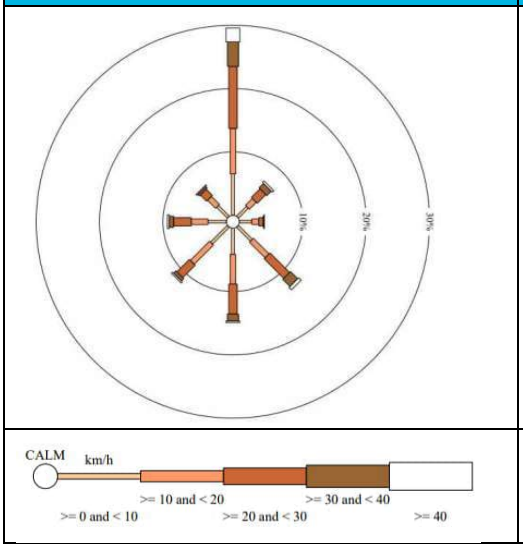
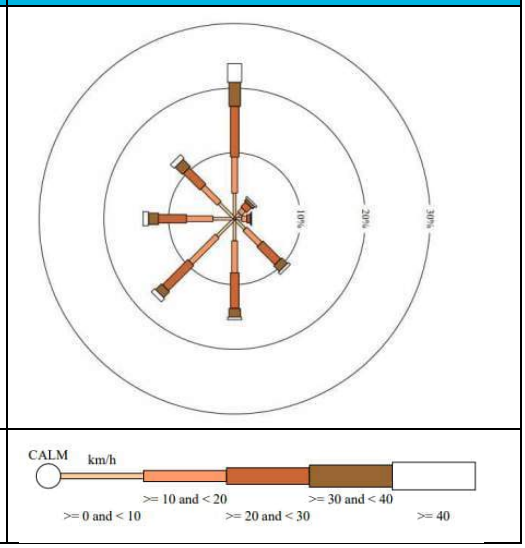
The nearest weather monitoring station to the Project is the Bureau of Meteorology (BoM) station at Ballarat Aerodrome, approximately 10 km to the north-northwest of the mine. Climate data from the station are summarised in Table 3. Mean temperatures range from about 3°C on winter mornings to around 25°C on summer days. Total rainfall amount is fairly consistent year round, although there are more days with rain during the cooler months. Morning winds are strongest in summer and lightest in winter. Afternoon wind speeds are fairly consistent throughout the year.

Table 3 Climate summary from BoM Ballarat Aerodrome

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean max. temp. (° C) (1908 to 2019)	25.2	25.1	22.3	17.7	13.7	10.8	10.1	11.4	13.9	16.7	19.7	22.7	17.4
Mean min. temp. (° C) (1908 to 2019)	11.0	11.5	10.0	7.5	5.7	4.0	3.2	3.7	4.8	6.2	7.8	9.5	7.1
Mean rainfall (mm) (1908 to 2019)	39.1	43.4	42.0	50.7	64.6	62.5	66.6	74.0	71.4	66.0	55.4	50.5	688.1
Mean rainfall days (1908 to 2019)	7.6	7.2	9.4	12.5	16.4	17.9	19.9	19.6	16.7	15.3	12.7	10.9	166.1
Mean 9am wind speed (km/h) (1957 to 2010)	20.5	19.3	17.7	16.2	13.7	14.7	14.5	16.7	19.3	20.7	19.6	19.7	17.7
Mean 3pm wind speed (km/h) (1957 to 2010)	21.4	20.9	20.0	19.6	18.6	19.8	20.7	22.0	22.2	21.3	20.6	20.8	20.7

Long term 9 am and 3 pm wind roses for the BoM Ballarat Aerodrome station are presented Table 4. Morning winds are most frequently from the north, with southerly and south easterly components also common. Afternoon winds are also most frequent from the north, with south, southwest and west winds also common. Note that winds at the Project site are expected to differ from these slightly due to differences in terrain and land use surrounding the two sites. The BoM station is located in the middle of flat and open airport grounds with long wind runs leading to the wind sensor from all directions. The Project site is more hilly and surrounded by trees and residential buildings. Wind speeds at the Project site are therefore likely to be lighter than those measured at the BoM station. Wind direction will also differ slightly due to the hillier terrain.

Table 4 Long term 9am and 3pm wind roses - BoM Ballarat Aerodrome

9 am winds (1951-2018)	3 pm winds (1951-2018)
	

4.3 Existing Air Quality

Schedule C, Part B, of the SEPP (AQM) stipulates the requirements for estimating background concentrations for use in model assessment. Specifically, the document states:

a. Proponents must include background information in the model simulation, except where the proponent can demonstrate to the satisfaction of the Authority that background levels of the pollutant are not significant.

b. Proponents required to include background data where no appropriate hourly background data exists must add the 70th percentile of one year's observed hourly concentrations as a constant value to the predicted maximum concentration from the model simulation. In cases where a 24-hour averaging time is used in the model, the background data must be based on 24-hour averages.

c. Proponents for new or modified sources of emissions adjacent to existing sources of the same pollutant must include emissions from the existing sources in the model.

For the Project assessment, PM_{10} and $PM_{2.5}$ are the pollutants of interest. As there is no PM_{10} or $PM_{2.5}$ site-specific monitoring data for the Project site, monitoring data recorded by the EPAV from its regional monitoring network have been applied. Of the operated stations, eight stations monitor for particulates. Of the eight stations, those closest to the Project site are Footscray and Alphington. The two stations assessed are situated in medium density residential / commercial areas in suburban Melbourne and would likely by heavily influenced by vehicle combustion emissions and wood smoke. The Project site is located in a semi-rural area with significantly less traffic and wood smoke, although it may be more susceptible to bushfires and natural dust events. The particulate levels measured by the EPAV at Footscray and Alphington are expected to be generally higher than those at the Ballarat site, and their use as the background data in the assessment is considered conservative.

The EPAV publish annual monitoring reports to establish compliance with the NEPM (AAQ). The reports present the results of air quality monitoring in Victoria at twelve locations and assesses them against the requirements of the NEPM (AAQ). The monitoring network includes CO, NO_2, ozone (O_3),

SO_2, PM_{10}, $PM_{2.5}$ and lead (Pb). The most recent EPAV reports from 2013 to 2017 were used to estimate the Project background data.[1]

The EPAV reports provide data for $PM_{2.5}$ for three methods; the first is by low volume sampler in accordance with AS 3580.9.10:2006, the second by tapered element oscillating microbalance (TEOM) to AS 3580.8.12:2008 and the third by beta-attenuation monitors (BAM) to AS 3580.9.12:2013. The low volume air sampler collects 24-hour average samples, whilst the TEOM and BAM collect sub-hourly values. The results provided from the TEOM and BAM data have been used in the air assessment.

A summary of the five years (2013-2017) 70th percentile 24-hour average PM_{10} and $PM_{2.5}$ data at the Footscray and Alphington EPAV network sites is provided in Table 5. A summary of annual average $PM_{2.5}$ at the same stations is presented in Table 6. The average 70th percentile value across both stations for all five years was adopted for this assessment. The average (rather than the maximum) was applied due to the expectation that particulate concentrations in the Ballarat area are lower than those measured in Melbourne.

As the PEM requires respirable crystalline silica to be assessed as a $PM_{2.5}$ annual average , the use of $PM_{2.5}$ annual average monitoring data gained from the EPAV is not suitable for such purposes. There is no other significant earth disturbance within close proximity to the mine site, and therefore it is considered likely there are no large sources of background respirable crystalline silica. The model includes all relevant dust emission sources and is considered to provide a reasonable prediction of respirable crystalline silica from the Project's operations.

Table 5 PM_{10} and $PM_{2.5}$ Footscray and Alphington EPAV monitoring summary, 70th percentile 24-hour average (2013-2017)

Year	PM_{10} 70th Percentile 24-hour Average (µg/m^3)		$PM_{2.5}$ 70th Percentile 24-hour Average (µg/m^3)	
	Footscray	Alphington	Footscray	Alphington
2013	22.5	19.9	6.4	6.6
2014	23.0	20.4	8.1	9.8
2015	21.9	20.0	9.0	10.0
2016	20.2	20.3	8.4	8.6
2017	23.0	20.0	9.2	10.2
Average	21.1		8.6	

Table 6 $PM_{2.5}$ Footscray and Alphington EPAV monitoring summary, annual average (2013-2017)

Year	$PM_{2.5}$ Annual Average (µg/m^3)	
	Footscray	Alphington
2013	4.4	4.2
2014	7.2	8.4
2015	6.9	7.6
2016	6.9	7.3
2017	7.8	8.9

[1] Background data accessed from Excel spreadsheets available at https://www.epa.vic.gov.au/our-work/monitoring-the-environment/monitoring-victorias-air/monitoring-results accessed on 2 July 2019.

Year	$PM_{2.5}$ Annual Average (µg/m^3)	
	Footscray	Alphington
Average	7.0	

4.4 Sensitive Receptor Locations

A sensitive receptor is generally defined as a building or area where people reside or are present for an extended period of time, with the PEM providing the following examples: houses, schools, kindergartens, recreation areas and sporting ovals, as well as proposed developments. The locations of nominated sensitive receptors in the Project area for the purposes of air dispersion modelling are presented in Table 7 and Figure 4. Note that only a subset of all potential sensitive receptors has been included as discrete receptors in the model. Modelling results for other locations can be inferred from the contours lots provided Section 7.0.

Table 7 Summary of discrete receptor locations

Receptor ID	X (m E UTM Zone 54)	Y (m N UTM Zone 54)	Receptor ID	X (m E UTM Zone 54)	Y (m N UTM Zone 54)
1	751,403	5,834,577	24	753,284	5,836,696
2	751,392	5,834,666	25	753,182	5,836,576
3	751,336	5,834,761	26	753,165	5,836,451
4	751,200	5,834,983	27	753,137	5,836,336
5	751,281	5,835,044	28	753,056	5,836,279
6	751,281	5,835,225	29	752,917	5,836,102
7	751,323	5,835,459	30	752,920	5,835,979
8	751,353	5,835,612	31	752,921	5,835,854
9	751,226	5,835,781	32	752,898	5,835,706
10	751,293	5,835,884	33	753,007	5,835,555
11	751,330	5,836,039	34	752,956	5,835,402
12	751,356	5,836,191	35	752,888	5,835,291
13	751,415	5,836,312	36	752,821	5,835,144
14	752,013	5,836,180	37	752,779	5,835,000
15	752,139	5,836,209	38	752,776	5,834,878
16	752,291	5,836,276	39	752,755	5,834,710
17	752,409	5,836,287	40	752,732	5,834,604
18	752,526	5,836,316	41	752,731	5,834,467
19	752,567	5,836,430	42	752,730	5,834,361
20	752,583	5,836,536	43	752,678	5,834,256
21	752,681	5,836,585	44	752,666	5,834,033
22	752,647	5,836,684	45	752,692	5,833,812
23	752,661	5,836,809			

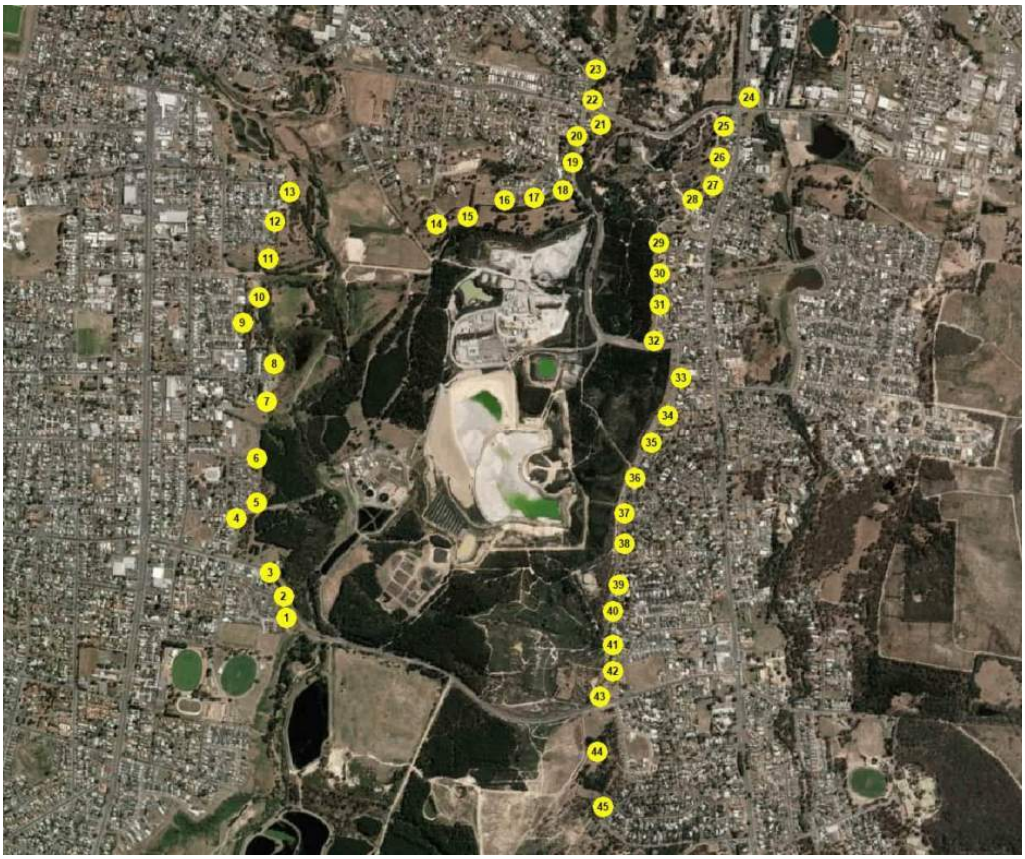


Figure 4 Location of modelled sensitive receptors

5.0 Dispersion Modelling Methodology

5.1 Modelling Scenarios

Three modelling scenarios were investigated as part of this assessment. The scenarios are described as follows:

- Scenario 1 – existing operations. This scenario is based on operations at the mine utilising the existing TSF3 tailings dam.
- Scenario 2 – future TSF4 operations. This scenario is based on future operations at the mine utilising the proposed TSF4 tailing dam. The existing TSF3 tailings dam would not be operational under this scenario.
- Scenario 3 – TSF4 construction. This scenario is based on activities involved with the construction of the proposed TSF4 tailings dam. Operations would continue as per normal during construction of TSF4, and therefore all activities included in Scenario 1 were also included in Scenario 3. Modelled construction activities for this scenario are based on Stage 2 construction works, which have a higher total excavation volume than Stage 1 and would therefore experience higher emission rates. The Stage 2 footprint would also bring construction activities closer to sensitive receptors to the south and east of TSF4 (see Figure 3). Emission rates were calculated based on eight months construction duration. Stage 2 is likely to be constructed over a longer period than eight months and therefore the modelled construction intensity is likely to be greater than reality. Estimated emission rates were applied to all hours of the model (five years) conservatively.

The mine is currently licenced at operate up to 600,000 tonnes of ore per year. Emission rates for each scenario for the existing operations were based on the licence limit. For all three scenarios operational Run of Mine (ROM) and waste material are hauled from the underground portal to the ROM stockpiling area and the northern waste dump respectively. The location of these haul routes is presented in Figure 5.

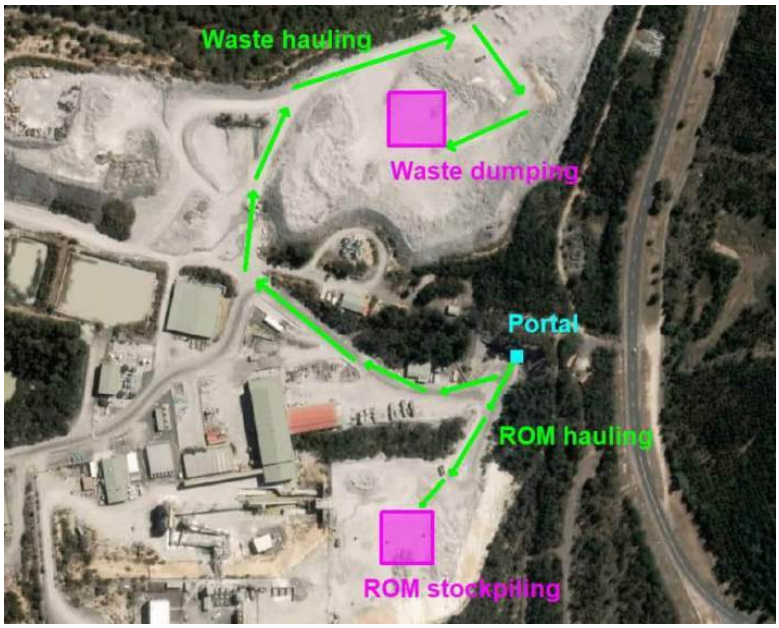


Figure 5 Location of operational haul routes, ROM stockpile and waste dump

Modelled emission sources in Scenario 3 were based on Stage 1 construction of the proposed TSF4. Excavation works were modelled along the eastern boundary of the Stage 2 footprint, nearest to

sensitive receptors. Excavated material would be hauled from the eastern side of the Stage 2 footprint via haul roads to the south. This material would be used to form the TSF4 embankments. Stage 1 would be completed prior to commencement of the Stage 2 excavation and embankment forming activities. Emissions due to the Stage 1 were therefore not included in the model. A base of waste rock may need to be sourced from the northern waste dump (north of the processing plant). However this would be hauled to TSF4 and emplaced on the embankments prior to the commencement of Stage 2 excavation and was also not included in Scenario 3. The location of modelled excavation works and haul roads are presented in Figure 6.

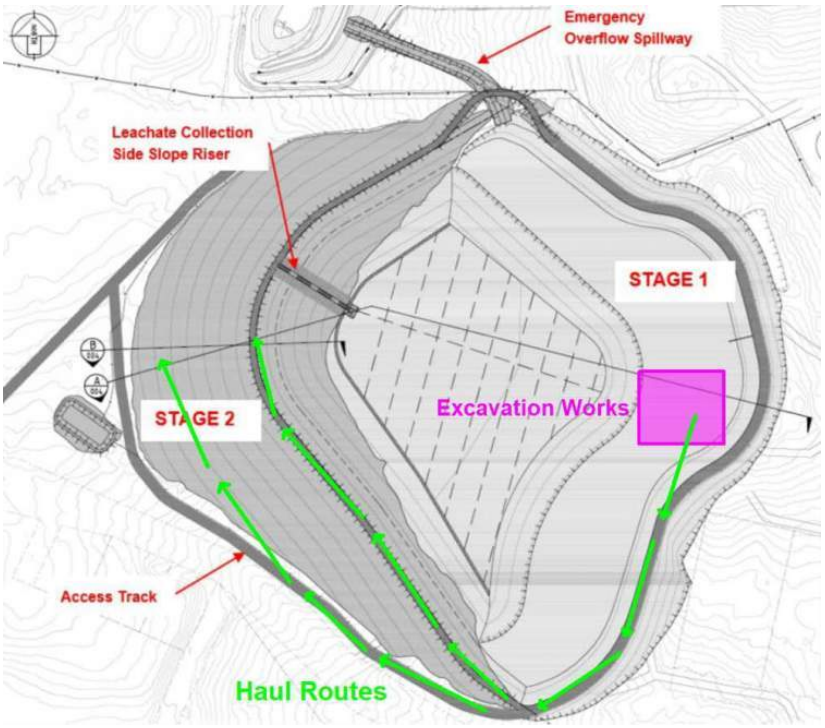


Figure 6 Scenario 3 – TSF4 construction - location of modelled construction excavation works and haul routes

5.2 Model Selection

The AERMOD (version 18081) dispersion modelling package has been used for this assessment. AERMOD is a Gaussian plume dispersion model, designed to predict ground level concentrations or the deposition of pollutants emitted from one or more sources, and is endorsed by EPAV as the regulatory model for use in air quality assessments in Victoria, as per the draft guideline document (EPAV 2014a) *Guidance notes for using the regulatory air pollution model AERMOD in Victoria* [Publication 1551].

In order to run the model, a range of information is required including meteorological data, emission source locations, pollutant emission rates, emission source characteristics (e.g. source release heights, ambient temperatures and source dimensions), and dimensions of buildings that may cause building downwash.

Default model options have been selected with the exception of those noted within this section. A sample AERMOD list file has been provided in Appendix A of this report.

5.3 Gridded Modelling Domain

In addition to the 45 discrete receptors identified in Section 4.4, modelling was performed across an 8 x 8 km multi-tier receptor grid from the centre of the site comprising the following:

- Grid centre coordinates: 752,274 mE, 5,835,172 mN
- A 100 m resolution inner tier grid extending to 2.9 x 4.4 km

5.4 Building Downwash

In this assessment there is only a single point source, the North Prince Shaft vent stack. The vent stack is a stand-alone stack 5m tall with no buildings nearby. Based on this, building downwash was is not considered in this assessment.

5.5 Terrain Effects

Terrain effects have been incorporated into the AERMOD model using terrain data sourced from the National Aeronautics and Space Administration (NASA) shuttle radar topography mission 1 arc-second terrain dataset. This equates to a horizontal resolution of approximately 30 m, which is considered suitable given the relatively flat and simple terrain within the modelling domain. Terrain used in the model is presented in Figure 7.

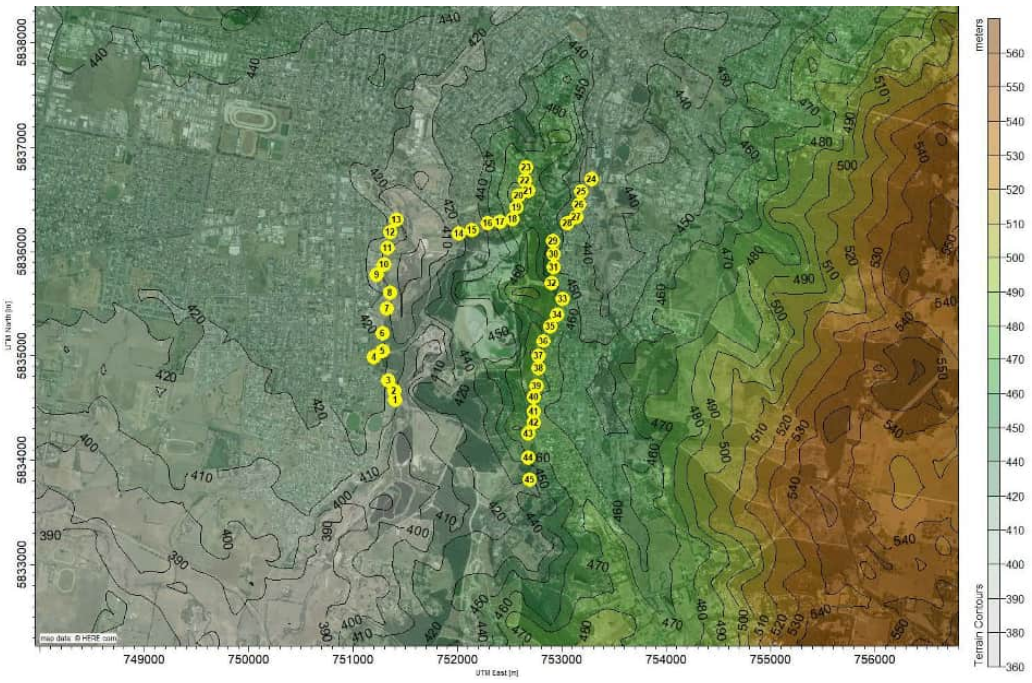


Figure 7 Terrain Elevations of Model Grid

5.6 Dispersion Meteorology

AERMOD requires a site-representative meteorological dataset that comprises a range of both directly measured and derived meteorological parameters, as relevant to the estimation of pollutant dispersion. These parameters are required as an hourly sequence of values, spanning the duration of the modelling period. The parameters required by AERMOD include the following:

- Surface (sensible) heat flux
- Surface friction velocity
- Convective velocity scale
- Vertical potential temperature gradient

- Convective boundary layer height
- Mechanical boundary layer height
- Monin-Obhukov length
- Scalar wind speed
- Vector averaged wind direction
- Temperature
- Atmospheric pressure
- Cloud cover

Surface parameters are also required, including roughness length, Bowen ratio and albedo. These can either be fixed or variable values (e.g. varied by season).

5.6.1 Meteorological Data Processing

In the absence of an existing AERMOD dataset, AECOM have prepared five annual site-specific meteorological datasets in accordance with the EPAV guidance (EPAV, 2014b) *Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD)* [EPAV 1550].

AERMOD is known to overpredict pollutant concentrations at receptors near ground-based volume or area sources under certain meteorological conditions. The overpredictions generally occur during stable conditions with low wind speeds where the calculated surface friction velocity (U*) of wind is too low. To counter this problem, a recent addition to AERMET (AERMOD's meteorological pre-processor) was adopted for use in this assessment. The AERMET adjusted surface friction velocity (ADJ_U*) function attempts to calculate a more realistic U* for stable conditions with low wind speeds. Wind speed, wind direction, temperature, cloud cover and mixing height data from the AERMOD surface file were entered into the AERMET processor in the "on-site" mode. Using the ADJ_U* option in AERMET, a new ADJ_U* version of the surface and upper data files was created for input into AERMOD. The AERMET version 18081 was used for adjusting the meteorological data with the ADJ_U* function.

5.6.2 Meteorological Data Sources

Meteorological data for use in AERMOD was sourced from The Air Pollution Model (TAPM). Observational data from the Bureau of Meteorology (BoM) Ballarat Aerodrome AQMS, which is located about 10 km north-northwest of the mine, was not considered representative of winds at the site. This is due to differences in terrain and land use surrounding the two locations. The quality of BoM cloud cover observations, however, is typically better than the prognostic cloud cover values predicted by TAPM. As cloud cover is expected to be very similar between the two locations, the BoM data were used in the model.

The preparation of the meteorological dataset used the following inputs:

1. Surface observations (wind speed, wind direction, temperature, relative humidity etc.) - TAPM
2. Upper air data - TAPM
3. Cloud cover – BoM Ballarat Aerodrome

A comparison of the modelled TAPM data and Ballarat Aerodrome BoM observations is presented in Appendix A.

6.0 Emissions to Air

Atmospheric dispersion modelling is reliant on quantitative representations of pollutant emissions, which for this assessment, have been prepared through the compilation of emission estimates for a range of emission sources into an emission inventory for the Project. This section provides detail of this process.

6.1 Emission Inventory

6.1.1 Emission Sources

As suitable on-site real-time particulate monitoring data were not available, the site assessment encompassed particulate emissions from the mine activity areas together with those from the processing of material and its transport on the site to predict the total particulate atmospheric load on local receptors from the mine operations.

A number of mining and construction activities were identified as potential significant sources of dust from the Project. The following typical activities were included in this assessment as dust sources:

- Bulldozers and other plant working on TSF4 embankments;
- Loading trucks with excavators/ shovels;
- Trucks hauling materials and returning empty;
- Trucks dumping material on stockpiles/ waste dumps/ embankments;
- Processing activities, including screening, crushing and transfer points;
- Loading product stockpiles; and
- Wind erosion.

A number of other dust sources were identified, such as dust emissions due to light vehicle movement, but were excluded from this assessment due to very small overall emissions contribution, which were expected to have negligible impacts offsite.

6.1.2 Emissions Inventory Methodology

A site-specific emissions inventory for each pollutant of interest was developed based on published emission factors listed in the National Pollutant Inventory Emission Estimation Manual for Mining (NPI 2012) and the USEPA AP-42 manuals. The published emission factors were adopted due to the absence of site-specific emissions data. Mitigation controls listed in relevant literature were applied to emission rates as discussed further below.

A summary of variables used in the emissions factor equations and emission inventory calculations is presented in Table 8 (for operations) and Table 9 (TSF4 construction). Underground air is vented via a vent stack to the north east of the underground portal. Vent stack parameters used in the modelling are presented in Table 10. PM_{10} to $PM_{2.5}$ correction factors provided by Cowherd et al (2006) were applied to gain $PM_{2.5}$ emission rates where literature emission factors were not provided. A summary of adopted emissions factors and mitigation controls for each activity is presented in Table 11.

Table 8 Variables used in the emissions inventory – existing and future operations

Variable	Value	Units	Reference / Comment
Operational days per year	365	days/yr	Modelled 365 days/yr
Operational hours per day	24 (mining); 16 (6am to 10pm)(processing)	hrs/day	As per existing operations
ROM throughput	600,000	t/yr	Modelled production rate
Waste rock throughput	189,851	%	Based on 2018/19 site data waste/ROM ratio
Wind erosion area	185,557	m^2	Estimated measurement

Variable	Value	Units	Reference / Comment
s – Silt content of ROM and waste rock	10.0	%	NPI default
s – Silt content of excavated TSF4 material	10.0	%	NPI default
s – Silt content of haul roads	10.0	%	NPI default
M – Moisture content of ROM and waste rock	4	%	Value supplied by the Proponent
U – mean wind speed	3.7	m/s	From prepared AERMET file
Frequency of winds > 5.4 m/s	20.5	%	From prepared AERMET file
Grader speed	5	km/h	NPI Default
Level of watering of haul roads	> 2	litres/m^2/hr	Based on current operations

Table 9 Variables used in the emissions inventory – TSF4 construction

Variable	Value	Units	Reference / Comment
Construction duration	8	months	Modelled 365 days/yr
Construction hours per day	11 (7am to 6pm)	hrs/day	Assumed
Total Stage 2 excavated material (foundation and borrow excavation)	854,000 1,543,605	m^3 t	From TSF4 concept design report (AECOM 2019)
Stage 1 material for embankments	870,000 1,572,525	m^3 t	From TSF4 concept design report (AECOM 2019)
Bulking factor	1.81	t/m^3	Average of TSF4 siltstone and sandstone bore hole samples from geotechnical investigation report (appendix to AECOM 2019)
Onsite concrete batching	960	t	Provided by proponent
Bulldozer utilisation	75	%	Assumed
Scraper utilisation	8	hrs/day	Assumed
Scraper/ grader speed	5	km/hr	Assumed
Scraper weight	47	t	From Cat 631G specifications
Scraper VKT	9,800	km	Calculated based on speed, utilisation and 8-month construction period
s – Silt content of excavated material	12.5	%	Median of bore hole samples from TSF4 geotechnical investigation report (appendix to AECOM 2019)
M – moisture content of excavated material	14.1	%	Average of TSF4 siltstone and sandstone bore hole samples from geotechnical investigation report (appendix to AECOM 2019)

Table 10 Modelled vent stack parameters

Variable	Value	Units	Reference / Comment
Stack height	5	m	From stack test report (Ektimo 2016, 2018)
Stack diameter	6.13	m	
Exit velocity	6.45	m/s	
Temperature	ambient	°C	Variable to match hourly ambient temperature
Location	752,879; 5,836,465	mE; mS	Approx. 650 m northeast of underground portal

Table 11 Summary of emission factors for each activity

Activity	Emission Factor	Source	Units	$PM_{10}/PM_{2.5}$ Correction[1]	Variables	Mitigation Controls
Bulldozers on embankment material	$EF_{PM_{10}} = 0.34 \times \left({(s)^{1.5}}/{(M)^{1.4}} \right)$	NPI Mining (2012)	kg/h/vehicle	0.1	s = silt content of material in % M = moisture content of material in %	-
Scraper	$EF_{PM_{10}} = 1.32 \times 10^{-6} \times s^{1.3} \times W^{2.4}$	NPI Mining (2012)	kg/VKT	0.15	s = silt content of material in % W = weight of scraper in tonnes	-
Excavators loading/unloading trucks/ dumping onto TSF4 embankments	$EF_{PM_{10}} = 0.35 \times 0.0016 \times \left({(U/2.2)^{1.3}}/{(M/2)^{1.4}} \right)$	NPI Mining (2012)	kg/t/transfer point	0.15	U = mean wind speed in m/s M = moisture content	-
Trucks dumping ROM/ waste rock	Default of 0.0043 for PM_{10}	NPI Mining (2012)	kg/t	0.15	-	-
Graders	$EF_{PM_{10}} = 0.0034 \times S^{2.0}$	NPI Mining (2012)	kg/VKT	0.15	S = grader speed in km/h VKT = vehicle kilometres travelled	-
Wheel generated dust from unpaved roads	$EF_{PM_{10}} = \frac{0.4536}{1.6093} \times 1.5 \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	AP-42 (USEPA 2006) recommended in NPI Mining (2012)	kg/VKT	0.1	s = material silt content in % W = weight of vehicle in tonnes	Level 2 watering reduction of 75%

Activity	Emission Factor	Source	Units	$PM_{10}/PM_{2.5}$ Correction[1]	Variables	Mitigation Controls
Miscellaneous transfer points at processing plant	$EF_{PM_{10}} = 0.35 \times 0.0016 \times \left(\left({}^{U}/_{2.2} \right)^{1.3} / \left({}^{M}/_{2} \right)^{1.4} \right)$	NPI Mining (2012)	kg/t/transfer point	0.15	U = mean wind speed in m/s M = moisture content of material	Enclosure reduction 70%
Screening - uncontrolled	Default of 0.0043 for PM_{10} Default of 0.000025 for $PM_{2.5}$	AP-42 Ch. 11.19.2 (USEPA 2006)	kg/t	0.15	-	Enclosure reduction 70%
Crushing - uncontrolled	Default of 0.0012 for PM_{10} Default of 0.00005 for $PM_{2.5}$	AP-42 Ch. 11.19.2 (USEPA 2006)	kg/t	0.15	-	Enclosure reduction 70%
Wind erosion	Default of 0.2 for PM_{10}	NPI Mining (2012)	kg/ha/hr	0.15	-	-

1. Correction factors from Cowherd et al (2006) – assumed 0.15 where not available

6.1.3 Wind Erosion Emissions

The default wind erosion emission factor listed in Table 11 was applied in the model. The hourly rate was then applied in the model during "active hours" such that wind erosion only occurred during hours with wind speeds greater than 5.4 m/s (SKM 2005). Winds exceed 5.4 m/s 21% of the time in the five year meteorological data set used in the modelling. CGT is committed to ensuring unused exposed areas are rehabilitated as soon as practical.

6.1.4 Engine exhaust emissions

Exhaust particulate emissions for operational and construction mobile plant were included in the model. A list of mobile plant type and model was provided by CGT. Emission factors were based on published engine specifications (as European emission tier standards) for each plant model. Plant characteristics, emission factors and emission rates are presented in Table 12. Exhaust emissions for haul trucks and bulldozers are included in the emission factors presented in Table 11 and were therefore not included here.

Table 12 Mobile plant emissions parameters

Plant	Euro Emission Tier	Number	Utilisation (%)	Load Factor	Engine Power (kW)	Emission Factor (g/kWh)		Emission Rate (g/s)	
						PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Operations									
Front end loader (ROM)	IIIA	1	0.75	0.5	150	0.2	0.2	0.003	0.003
Grader	IIIA	1	0.5	0.5	149	0.2	0.2	0.002	0.002
Waters carts	IIIA	2	0.5	0.5	200	0.2	0.2	0.006	0.006
TSF4 Construction									
Excavator	IIIA	3	0.75	0.5	205	0.2	0.2	0.013	0.013
Scraper	IIIA	1	0.75	0.5	425	0.2	0.2	0.009	0.009
Padfoot roller	IIIA	1	0.75	0.5	97	0.2	0.2	0.002	0.002
Water carts	IIIA	2	0.5	0.5	200	0.2	0.2	0.006	0.006

6.1.5 Truck and Haul Road Data

Haul road emission rates were calculated based on the type of trucks used and the number of kilometres travelled on the haul road. The weight of the loaded and unloaded trucks form part of the wheel-generated dust emission factor provided in Table 11. The distance travelled on the haul roads was calculated according to the total volume of material to be moved and the capacity of the trucks, and the length of the haul roads. A summary of this data is provided in Table 13.

Table 13 Summary of truck data and movements

Parameter	ROM Haul Truck	Waste Haul Truck	TSF4 Construction Trucks	Concrete Truck
Average loaded weight (tonnes)	60	60	72	42
Empty weight (tonnes)	35	35	32	18
Load capacity (tonnes)	25	25	40	24
Annual throughput (t)	600,000	189,851	1,572,525	960
Annual trips	24,000	7,594	39,313	40

Parameter	ROM Haul Truck	Waste Haul Truck	TSF4 Construction Trucks	Concrete Truck
Round trip haul distance (km)	0.14	0.744	0.76	1.48
Annual vehicle kilometres travelled - return trip (km)	6,624	8,414	59,756	118

6.1.6 Emission Inventory Summary

A summary of mitigated emission rates for each activity type are presented in Table 14. All emission rates were calculated using the emission factor equations described in Section 6.1.2.

Table 14 Modelled emission rates

Source	Emission Rate (g/s)					
	Scenario 1		Scenario 2		Scenario 3	
	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Vent emissions	0.077	0.020	0.077	0.020	0.077	0.020
ROM haul (including truck exhaust emissions)	0.070	0.012	0.070	0.012	0.070	0.012
Waste haul (including truck exhaust emissions)	0.082	0.008	0.082	0.008	0.082	0.008
ROM stockpile dumping and handling	0.025	0.004	0.025	0.004	0.025	0.004
Loading crusher	0.012	0.002	0.012	0.002	0.012	0.002
Processing plant (crushing, transfer points, screening)	0.041	0.006	0.041	0.006	0.041	0.006
Dumping waste onto northern waste dump	0.026	0.004	0.026	0.004	0.026	0.004
Wind erosion	0.211	0.032	0.291	0.044	0.291	0.044
Excavating by excavator	NA	NA	NA	NA	0.133	0.020
Embankment haul	NA	NA	NA	NA	1.959	0.198
Concrete batching	NA	NA	NA	NA	0.002	0.0003
Concrete haul	NA	NA	NA	NA	0.003	0.0003
Dumping onto embankments	NA	NA	NA	NA	0.135	0.020
Forming embankments	NA	NA	NA	NA	0.231	0.035
Grader	0.039	0.006	0.039	0.006	0.043	0.006
Scraper	NA	NA	NA	NA	0.357	0.054
Exhaust emissions	0.011	0.011	0.011	0.011	0.029	0.029

7.0 Potential Impacts

This section summarises the results of dispersion modelling for each pollutant of interest. Tables of the maximum predicted Ground Level Concentrations (GLCs) across all sensitive receptor are presented as Project contribution as well as a cumulative total including background concentrations. Contour plots of predicted GLCs for each pollutant of interest are provided. The contour plots were produced via interpolation of the calculated pollutant concentrations at each modelled grid point and are indicative only.

Table 15, Table 16 and Table 17 present the highest PM_{10} and $PM_{2.5}$ GLCs of the 45 discrete receptor locations for assessment of compliance against the Project criteria, for each modelled scenario. Table 18 presents the highest respirable crystalline silica (RCS) concentrations at receptors for each modelled scenario. The Project-generated $PM_{2.5}$ annual average has been included for the RCS results as this pollutant was modelled for assessment of respirable crystalline silica (as $PM_{2.5}$). As discussed in Section 4.3, the background data available are not representative of the likely silica content of the site's emissions and are not applicable for a cumulative assessment.

The individual results at each receptor are provided in Appendix B. Figure 8 to Figure 10 graphically present the maximum cumulative 24-hour PM_{10} concentrations for each scenario. Figure 11 to Figure 13 graphically present the maximum cumulative 24-hour $PM_{2.5}$ concentrations for each scenario.

Table 15 Highest predicted ground level concentration at a receptor – Scenario 1 (existing operations)

Pollutant	Averaging period	Pollutant Concentration (µg/m³)			Criteria (µg/m³)	Receptor
		Project	Background	Cumulative		
PM_{10}	24 hour	25.8	21.1	46.9	60	18
$PM_{2.5}$	24 hour	3.8	8.6	12.4	36	18
	Annual	0.3	7.0	7.3	-	17

Table 16 Highest predicted ground level concentration at a receptor – Scenario 2 (future TSF4 operations)

Pollutant	Averaging period	Pollutant Concentration (µg/m³)			Criteria (µg/m³)	Receptor
		Project	Background	Cumulative		
PM_{10}	24 hour	26.8	21.1	47.9	60	18
$PM_{2.5}$	24 hour	4.0	8.6	12.6	36	18
	Annual	0.4	7.0	7.4	-	17

Table 17 Highest predicted ground level concentration at a receptor – Scenario 3 (TSF4 construction)

Pollutant	Averaging period	Pollutant Concentration (µg/m³)			Criteria (µg/m³)	Receptor
		Project	Background	Cumulative		
PM_{10}	24 hour	34.7	21.1	55.8	60	44
$PM_{2.5}$	24 hour	4.3	8.6	12.9	36	18
	Annual	0.6	7.0	7.6	-	43

Table 18 Highest predicted ground level RCS concentration at a receptor – Scenario 3 (TSF4 construction)

Pollutant	Averaging Period	Project -only Pollutant Concentration (µg/m³)			Criteria (µg/m³)
		Scenario 1	Scenario 2	Scenario 3	
RCS (as PM2.5)	Annual	0.3	0.4	0.6	3

The modelling results are summarised as follows:

- Scenario 1 (existing operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below well below criteria. Project contributions were predicted to be up to 43% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 2 (future TSF4 operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below well below criteria. Project contributions were predicted to be up to 45% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 3 (TSF4 construction) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below criteria at all sensitive receptors. Project contributions were predicted to be up to 58% (24-hour PM_{10}) and 12% (24-hour $PM_{2.5}$) of their respective criteria.
- RCS (as $PM_{2.5}$) concentrations were predicted to be well below the criterion for all scenarios. The use of the $PM_{2.5}$ annual average data for a direct comparison to the respirable crystalline silica is highly conservative as it assumes that all of the emitted $PM_{2.5}$ is respirable crystalline silica. In reality, the respirable silica content of the $PM_{2.5}$ emissions from the site is likely to be much lower than the results predicted in this assessment.
- The results suggest a nearfield distribution of impacts, with the highest receptor results generally occurring at the southern end of the site during construction of TSF4 (Scenario 3). As shown in the contour plots, the highest particulate concentrations are predicted to be centred on the main sources of dust – the vent stack to the northeast of site, the processing area, wind erosion from TSF3 and TSF4, and the construction of TSF4.

Predicted cumulative 24-hour PM_{10} concentrations approached the criteria for the construction of TSF4 (Scenario 3). Stage 2 construction activities were modelled based on a construction period of eight months. In reality, Stage 2 is likely to be undertaken at slower pace than this, meaning that excavation and embankment construction rates and corresponding dust emission rates would be lower than those modelled. TSF4 Stage 1 would be constructed over an eight month period, however overall excavation and embankment volumes are lower than for Stage 2. The Stage 1 construction footprint is smaller than that for Stage 2 and construction activities would be slightly further away from sensitive receptors. Dust impacts due to Stage 1 construction are expected to be lower than the results presented in this assessment for Stage 2. Based on the conservatism used in the TSF4 construction model (Scenario 3), it is likely that actual concentrations during construction are lower than those predicted here. However, dust may still be an issue if not controlled, and appropriate mitigation should be undertaken and a construction dust management plan developed for the Project. This would provide the best possible chance that offsite dust impacts do not occur during construction.

Figure 8 Predicted cumulative PM_{10} GLCS, maximum 24 hour average (µg/m³) – Scenario 1 (existing operation)

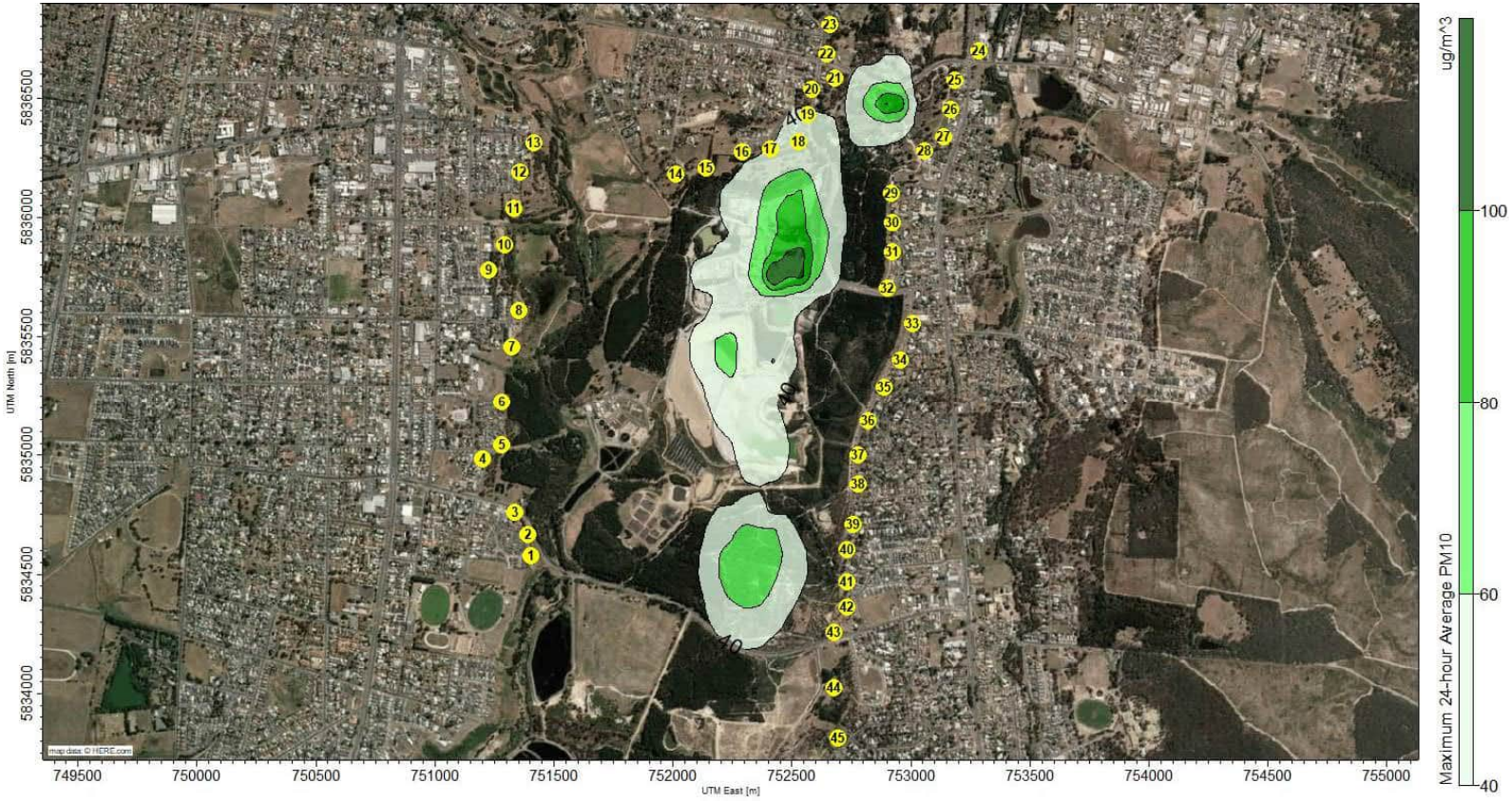


Figure 9 Predicted cumulative PM_{10} GLCS, maximum 24 hour average (µg/m³) – Scenario 2 (future TSF4 operation) – criterion 60 µg/m³

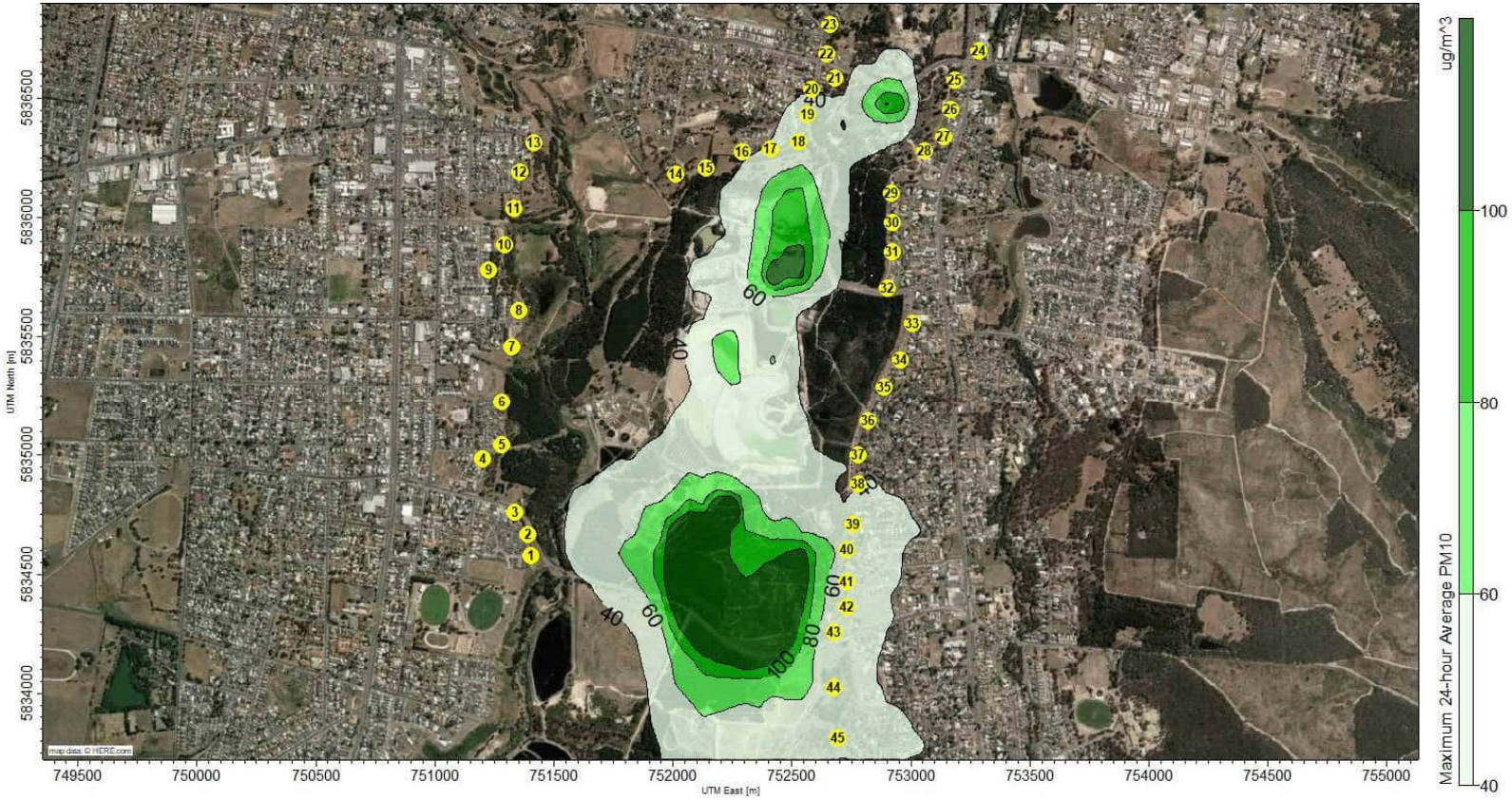


Figure 10 Predicted cumulative PM_{10} GLCS, maximum 24 hour average (µg/m³) – Scenario 3 (TSF4 construction) – criterion 60 µg/m³

Figure 11 Predicted cumulative $PM_{2.5}$ GLCS, maximum 24 hour average (µg/m³) – Scenario 1 (existing operation) – criterion 60 µg/m³

Figure 12 Predicted cumulative $PM_{2.5}$ GLCS, maximum 24 hour average (µg/m³) – Scenario 2 (future TSF4 operation)

Figure 13 Predicted cumulative $PM_{2.5}$ GLCS, maximum 24 hour average (µg/m³) – Scenario 3 (TSF4 construction)

8.0 Mitigation

The management of air emissions at the Project will involve a number of in-principle mitigation strategies aimed at reducing overall emissions from the following primary sources of dust emissions, as highlighted in :

- Trucks hauling ROM and other materials
- Movement of ROM though the processing plant
- Wind erosion on stockpiles, overburden emplacement and un-vegetated areas

Current dust mitigation strategies on the site were reviewed and identified as being acceptable and appropriate for application to the TSF4 construction and operation activities in order to minimise the likelihood of adverse offsite air quality impacts. General site mitigation measures include but are not limited to the following:

- Maintain a high degree of dust control efficiency on primary haul roads through watering
- Application of a wheel wash to minimise truck dust track-out from the site
- Cover truck loads when leaving site
- Apply water spraying on excavation activities during high dust / wind events
- Minimise the size of disturbed areas and rehabilitate as soon as practical
- Modify operations during adverse meteorological conditions - e.g. reduce operations during dry windy conditions, often cited as >
- 8 m/s or when visible dust lift off is present as much as practical
- Maintain mobile plant according to manufacturer's recommendations
- Do not allow mobile plant engines to idle when not in use

As shown in the result in Section 7.0, the construction of TSF4 has the highest likelihood of dust impacts on surrounding receptors. A construction dust management plan should be developed that incorporates, at a minimum, the mitigation strategies listed above. Implementation of the plan would ensure emissions during the construction and operation of the Project are managed at a level that is unlikely to cause adverse offsite air quality impacts.

9.0 Conclusion

An air quality impact assessment was conducted to assess the potential for offsite impacts due to dust emissions from construction and operation of the proposed Whitehorse Gully TSF4 at the Ballarat Gold Mine. Three modelling scenarios were developed for the mine; one for existing mine operations (including TSF3), one for future TSF4 operations (with TSF3 no longer in use), and one for construction of TSF4 (with TSF3 still in use during construction). An emission inventory was compiled for each scenario incorporating a range of sources and emission estimation methods. Emissions were incorporated into the AERMOD dispersion model, which utilised five years of representative meteorological data. Relevant mitigation commitments were identified and applied to the emission rates.

The following is a summary of key findings of the assessment:

- Scenario 1 (existing operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be well below criteria. Project contributions were predicted to be up to 43% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 2 (future TSF4 operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be well below criteria. Project contributions were predicted to be up to 45% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 3 (TSF4 construction) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below criteria at all sensitive receptors. Project contributions were predicted to be up to 58% (24-hour PM_{10}) and 12% (24-hour $PM_{2.5}$) of their respective criteria.
- Respirable crystalline silica (as $PM_{2.5}$) concentrations were predicted to be well below the criterion for all scenarios.

Current dust mitigation strategies on the site were reviewed and identified as being acceptable and appropriate for application to the operational activities in order to minimise the likelihood of adverse offsite air quality impacts. In-principle construction dust mitigation strategies were identified for the construction of TSF4. It is recommended that a construction dust management plan is developed to ensure these mitigation strategies are in place and that dust impacts on surrounding receptors are controlled to an acceptable level during the construction period.

The assessment showed that adverse impacts are not expected to occur during construction or operation of the proposed TSF4 at the Ballarat Gold Mine.

10.0 References

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The atmosphere is a complex, physical system, and the movement of air in a given location is dependent on a number of variables, including temperature, topography and land use, as well as larger-scale synoptic processes. Dispersion modelling is a method of simulating the movement of air pollutants in the atmosphere using mathematical equations. The model equations necessarily involve the current understanding of the complex environmental interactions and chemical reaction processes involved, available input data, processing time and data storage limitations. The model configuration particularly affects model predictions during certain meteorological conditions and source emission types. For example, the prediction of pollutant dispersion under low wind speed conditions (typically defined as those less than 1 m/s) or for low-level, non-buoyant sources, is problematic for most dispersion models. To accommodate these effects, the model is configured to provide conservative estimates of pollutant concentrations at particular locations.

The results of dispersion modelling, therefore, provide an overly conservative indication of the worst likely level of pollutants within the modelling domain. While the models, when used appropriately and with high quality input data, can provide very good indications of the scale of pollutant concentrations and the likely locations of the maximum concentrations occurring, their outputs should not be considered to be representative of exact pollutant concentrations at any given location or point in time.

Appendix A

Meteorological Data Analysis

Appendix A Meteorological Data Analysis

AERMOD Meteorological Data Review

Overview

This section presents a summary of AERMOD model predictions at the Site, with reference against observations recorded at the Bureau of Meteorology (BoM) Ballarat Aerodrome weather station. BoM Ballarat Aerodrome constitutes the closest observations station within the modelling domain which has all required data for verification, being located approximately 10km to the north-north west of the site boundary, at a height of 440m. The BoM station is located in flat terrain and open airport grassland. The Project site, in comparison is more hilly with a much higher surface roughness (tall trees and buildings) in the surrounding area, as shown in Figure 14. Given the differences in topography and land use, and the distance between the BoM station and the Project site, meteorological conditions at the Project site are likely to differ from the observations at the BoM station. Based on this, data from TAPM was used as input into the AERMOD model, rather than the BoM data. Cloud observation data from the BoM station was used due to the poor quality of cloud data generated by the TAPM model. General meteorological trends should still be comparable between the BoM data and the modelled TAPM data, and this section includes a comparison of the two data sets in the context of expected meteorological behaviours.

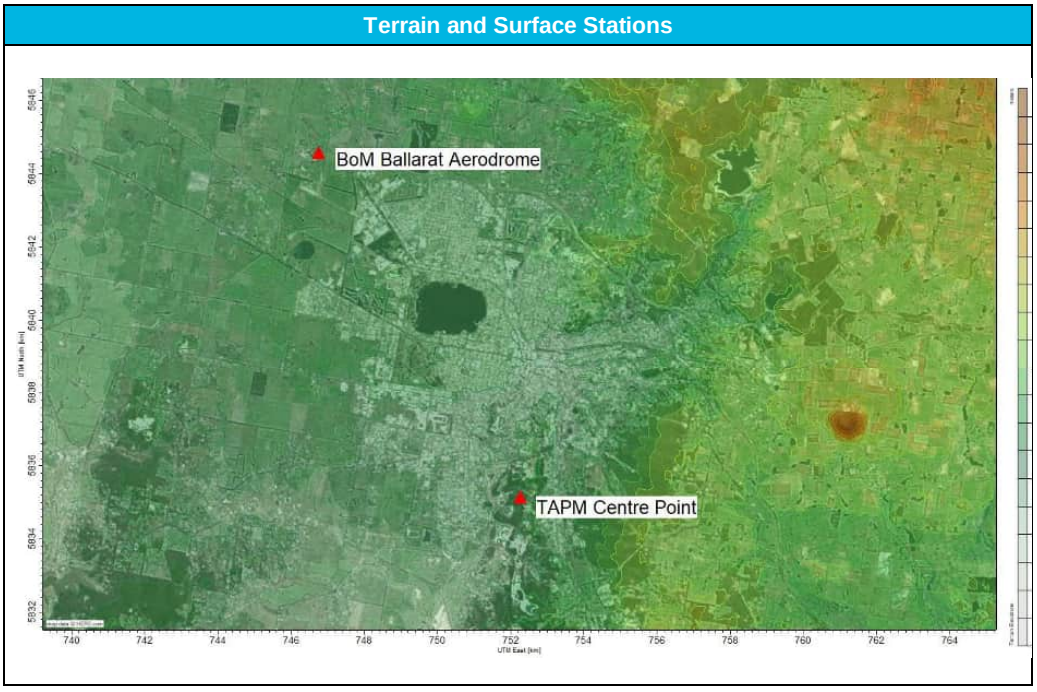


Figure 14 Terrain elevations of meteorological grid showing surface stations

Winds

Wind predictions have been extracted from AERMOD for the Project Site (hereafter referred to as AERMOD) for reference against regional observations. Table 19 to Table 22 present wind roses at the BoM Ballarat Aerodrome and AERMOD.

The annual wind roses in Table 19 show that both sites display a dominant northerly wind. The AERMOD data shows a higher frequency of north west and west winds, and a slightly lower frequency of south winds. Overall, the BoM station has higher wind speeds, although this is expected given the flat topography and open grass land surrounding the site.

Table 19 Annual wind rose comparison 2014 –2018

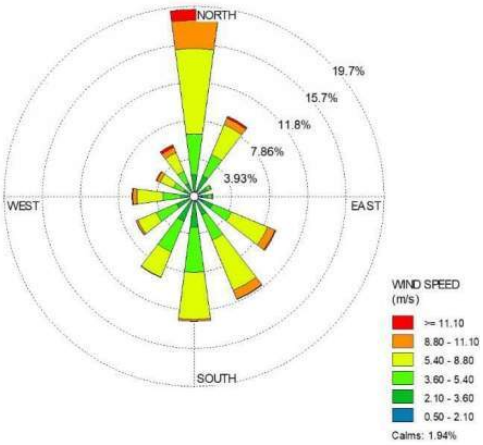
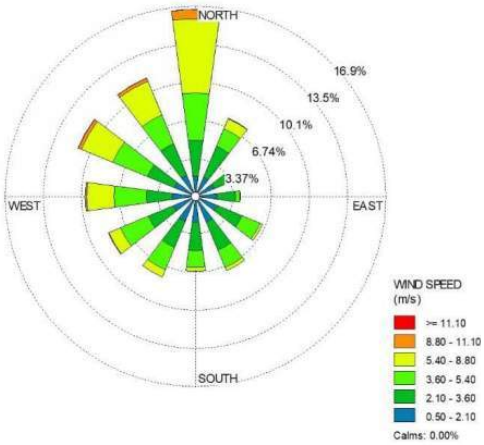
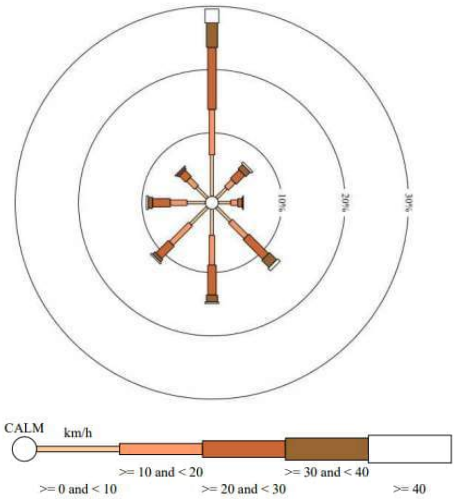
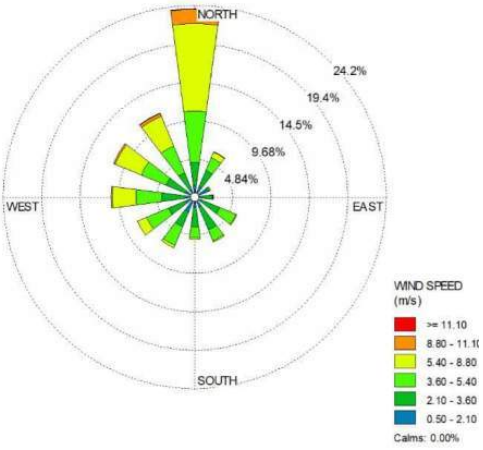
BoM Ballarat Aerodrome	AERMOD
	

Table 20 9am and 3pm wind rose comparison AERMOD 2014 –2018 to long term BoM Ballarat Aerodrome (1951 – 2018)

9am Wind Rose

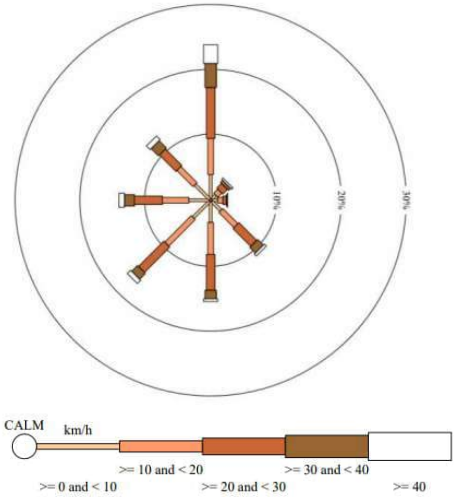


BoM Ballarat Aerodrome

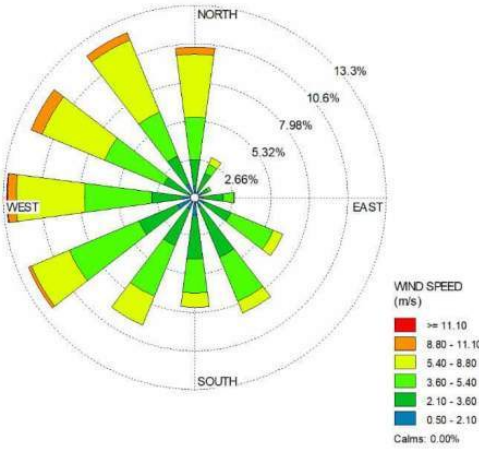


AERMOD

3pm Wind Rose



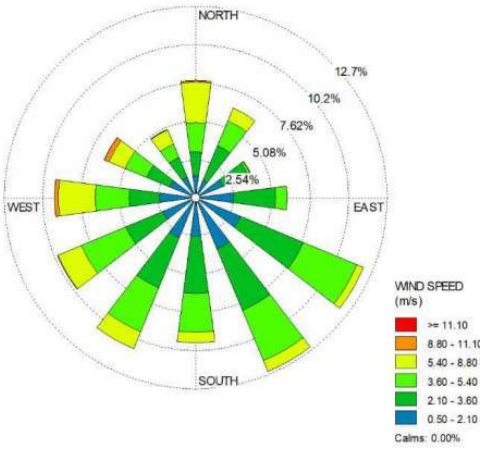
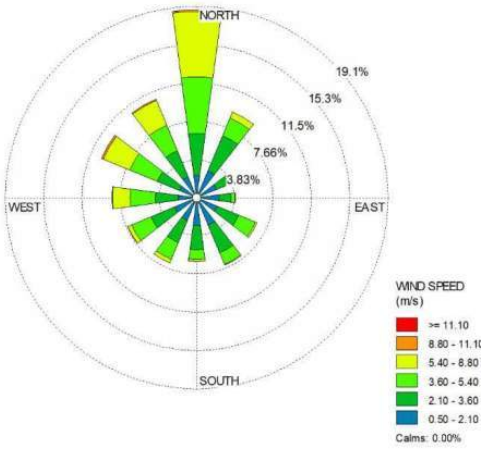
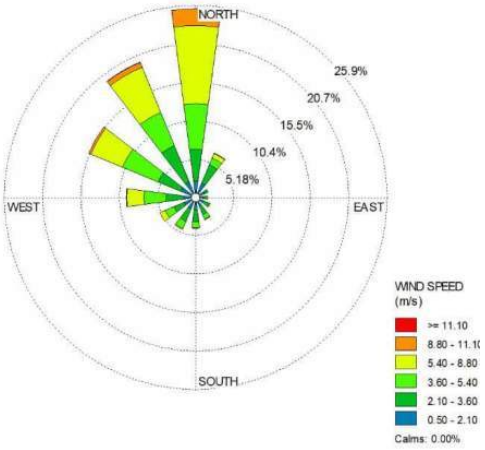
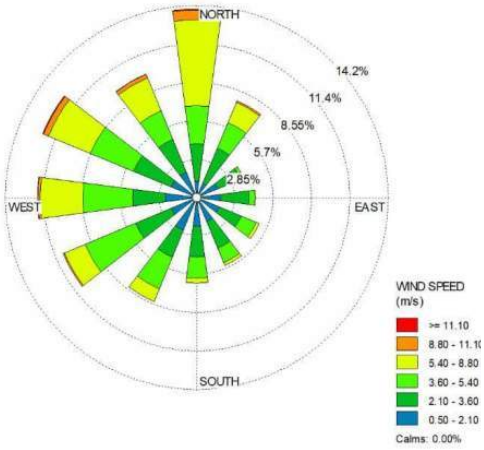
BoM Ballarat Aerodrome



AERMOD

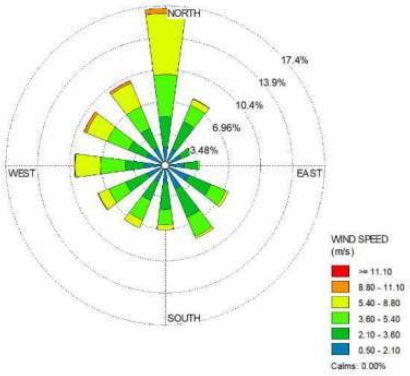
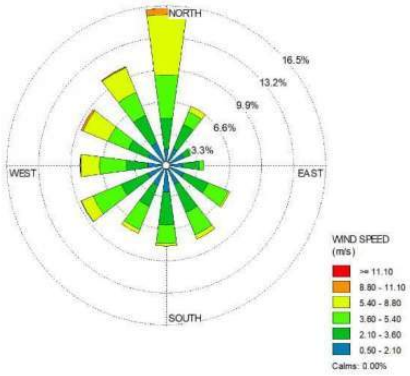
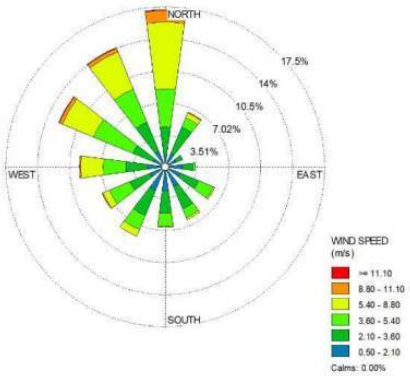
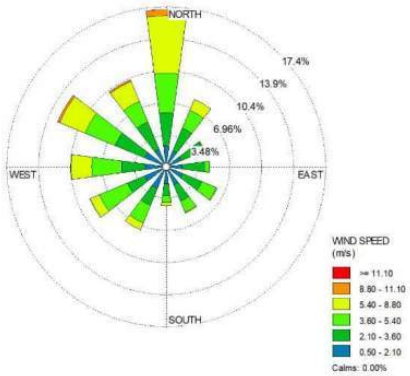
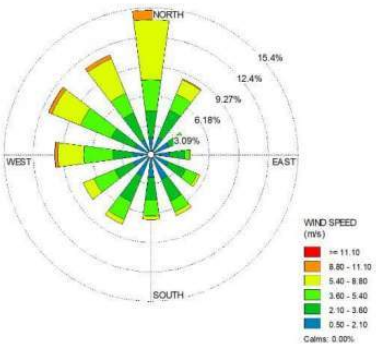
The 9am and 3pm wind roses presented in Table 20 show a reasonable correlation between the two data sets; although there are distinctly more north winds at 3 pm in the BoM data.

Table 21 AERMOD seasonal wind rose 2014 – 2018

Summer Wind Rose	Autumn Wind Rose
	
Winter Wind Rose	**Spring Wind Rose**
	

The seasonal data in Table 21 show autumn and winter are dominated by winds from the north. Summer sees more south west to south east winds, and spring sees west and north west most frequently.

Table 22 AERMOD individual annual wind rose comparison 2014-2018

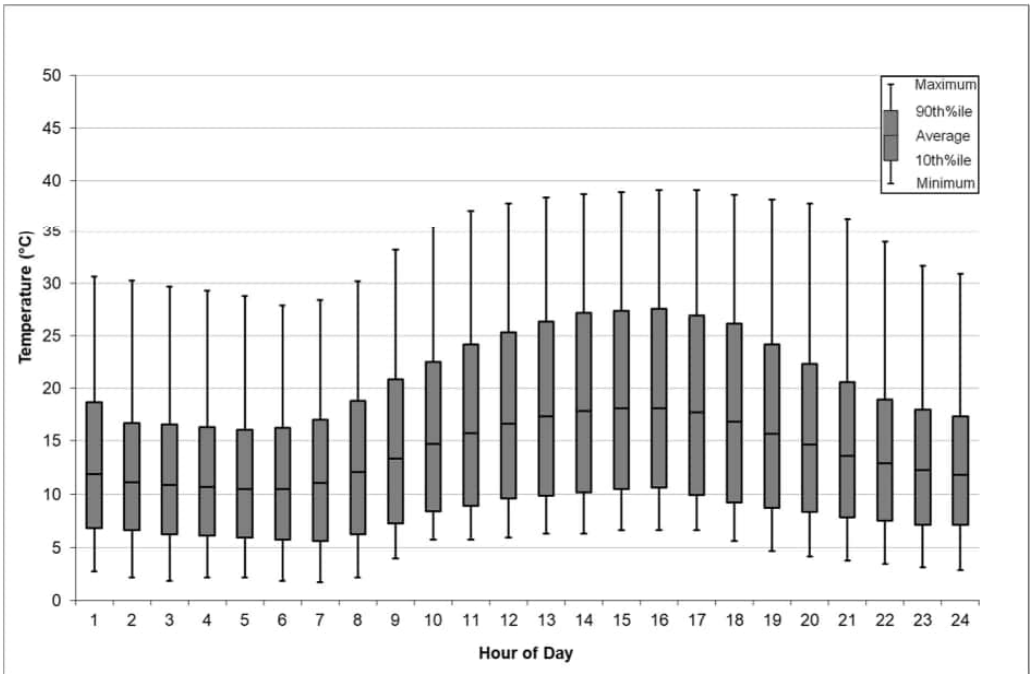
2014	2015
	
2016	**2017**
	
2018	
	

The annual wind roses prepared for the five model years in Table 22 show a great deal of consistency between years, with north, north west, and west winds dominating. All years show minimal winds from the east.

Temperature

Temperature data is required within the AERMOD program for each hour of the meteorological data set. A comparison of the temperature vs. hour of day for AERMOD is presented in Figure 15**.** The results are consistent with expected patterns, with higher values during the day compared to night.

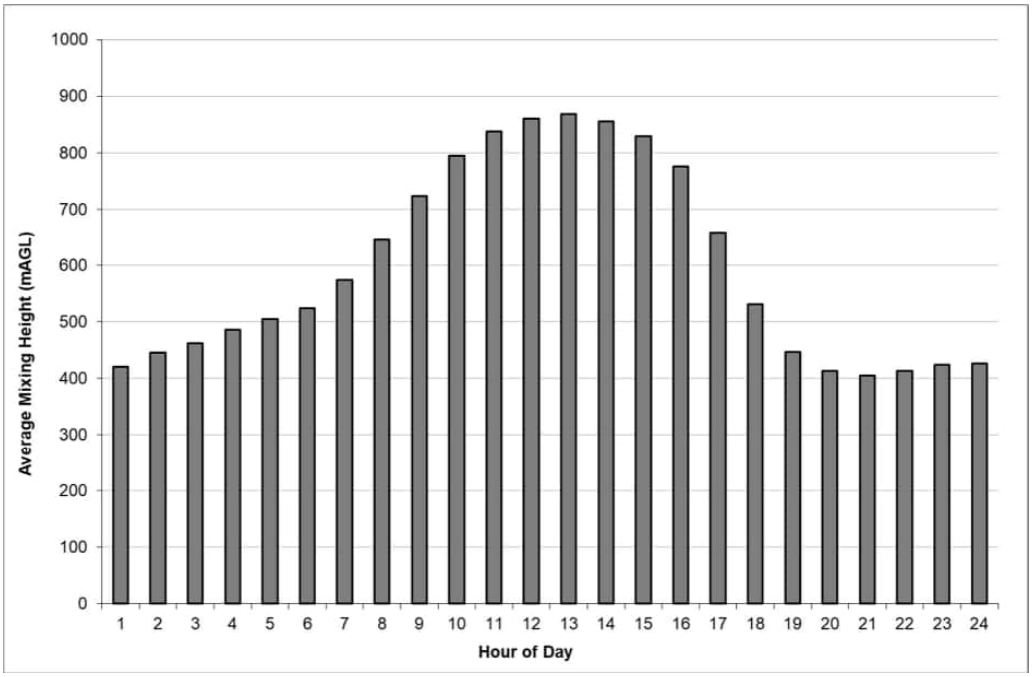
Figure 15 AERMOD box & whisker plot of temperature data for the 2014 –2018



Mixing Height

Figure 16 presents average mixing height by hour of day across the meteorological dataset for AERMOD. The mixing heights are consistent with those anticipated for the location, with higher mixing heights during the day when convective conditions are more frequent.

Figure 16 AERMOD average mixing heights by hour of day for 2014 – 2018



Conclusion

A five year meteorological dataset has been prepared for the Project site using prognostic data from the TAPM model and cloud observations data from the BoM Ballarat Aerodrome station. Data has been evaluated using hourly observation data and shows reasonable correlation with long term and expected trends. The predicted meteorology is considered to be acceptable for use in modelling of emissions from the Project site.

Appendix B

Full Modelling Results

Appendix B Full Modelling Results

Table B1 – Scenario 1 results

Receptor	24-hour Average PM_{10} (µg/m³)		24-hour Average $PM_{2.5}$ (µg/m³)		Annual Average $PM_{2.5}$ (µg/m³)	
	Project	Cumulative	Project	Cumulative	Project	Cumulative
1	2.1	23.2	0.3	8.9	0.03	7.0
2	2.5	23.6	0.4	9.0	0.02	7.0
3	2.4	23.5	0.4	9.0	0.02	7.0
4	1.7	22.8	0.3	8.9	0.02	7.0
5	1.9	23.0	0.3	8.9	0.03	7.0
6	2.1	23.2	0.3	8.9	0.03	7.0
7	1.9	23.0	0.3	8.9	0.03	7.0
8	2.1	23.2	0.3	8.9	0.03	7.0
9	2.1	23.2	0.3	8.9	0.03	7.0
10	2.1	23.2	0.3	8.9	0.04	7.0
11	2.1	23.2	0.3	8.9	0.04	7.0
12	2.1	23.2	0.3	8.9	0.04	7.0
13	2.4	23.5	0.4	9.0	0.1	7.1
14	6.4	27.5	0.9	9.5	0.2	7.2
15	9.5	30.6	1.4	10.0	0.2	7.2
16	14.5	35.6	2.0	10.6	0.3	7.3
17	18.9	40.0	2.8	11.4	0.3	7.3
18	25.8	46.9	3.8	12.4	0.3	7.3
19	18.3	39.4	2.7	11.3	0.3	7.3
20	12.5	33.6	1.9	10.5	0.2	7.2
21	14.3	35.4	2.5	11.1	0.2	7.2
22	12.4	33.5	3.0	11.6	0.2	7.2
23	9.9	31.0	1.7	10.3	0.2	7.2
24	4.5	25.6	0.9	9.5	0.2	7.2
25	7.3	28.4	1.6	10.2	0.2	7.2
26	8.0	29.1	1.9	10.5	0.3	7.3
27	8.2	29.3	2.0	10.6	0.3	7.3
28	8.1	29.2	1.9	10.5	0.3	7.3
29	11.8	32.9	1.8	10.4	0.3	7.3
30	9.6	30.7	1.5	10.1	0.3	7.3
31	10.6	31.7	1.6	10.2	0.3	7.3
32	11.5	32.6	1.8	10.4	0.3	7.3
33	10.8	31.9	1.7	10.3	0.3	7.3
34	8.0	29.1	1.2	9.8	0.2	7.2
35	6.5	27.6	1.0	9.6	0.2	7.2
36	6.9	28.0	1.0	9.6	0.1	7.1
37	4.9	26.0	0.8	9.4	0.1	7.1
38	4.8	25.9	0.8	9.4	0.1	7.1
39	4.6	25.7	0.7	9.3	0.1	7.1

Receptor	24-hour Average PM_{10} (µg/m³)		24-hour Average $PM_{2.5}$ (µg/m³)		Annual Average $PM_{2.5}$ (µg/m³)	
	Project	Cumulative	Project	Cumulative	Project	Cumulative
40	4.4	25.5	0.7	9.3	0.1	7.1
41	3.5	24.6	0.5	9.1	0.1	7.1
42	3.5	24.6	0.5	9.1	0.1	7.1
43	3.7	24.8	0.6	9.2	0.1	7.1
44	3.4	24.5	0.5	9.1	0.04	7.0
45	2.8	23.9	0.4	9.0	0.04	7.0
Maximum	**25.8**	**46.9**	**3.8**	**12.4**	**0.3**	**7.3**
Criteria	**-**	**60**	**-**	**36**	-	**-**

Table B2 – Scenario 2 results

Receptor	24-hour Average PM_{10} (µg/m³)		24-hour Average $PM_{2.5}$ (µg/m³)		Annual Average $PM_{2.5}$ (µg/m³)	
	Project	Cumulative	Project	Cumulative	Project	Cumulative
1	2.3	23.4	0.3	8.9	0.03	7.0
2	2.5	23.6	0.4	9.0	0.03	7.0
3	2.4	23.5	0.4	9.0	0.03	7.0
4	2.3	23.4	0.3	8.9	0.03	7.0
5	2.2	23.3	0.3	8.9	0.03	7.0
6	2.1	23.2	0.3	8.9	0.04	7.0
7	1.9	23.0	0.3	8.9	0.04	7.0
8	2.1	23.2	0.3	8.9	0.04	7.0
9	2.1	23.2	0.3	8.9	0.04	7.0
10	2.1	23.2	0.3	8.9	0.04	7.0
11	2.1	23.2	0.3	8.9	0.04	7.0
12	2.2	23.3	0.3	8.9	0.05	7.0
13	2.4	23.5	0.4	9.0	0.1	7.1
14	6.9	28.0	1.0	9.6	0.2	7.2
15	9.5	30.6	1.4	10.0	0.2	7.2
16	14.5	35.6	2.0	10.6	0.3	7.3
17	18.9	40.0	2.8	11.4	0.4	7.4
18	26.8	47.9	4.0	12.6	0.3	7.3
19	19.3	40.4	2.9	11.5	0.3	7.3
20	13.4	34.5	2.0	10.6	0.2	7.2
21	14.3	35.4	2.5	11.1	0.3	7.3
22	12.4	33.5	3.0	11.6	0.2	7.2
23	9.9	31.0	1.7	10.3	0.2	7.2
24	4.5	25.6	0.9	9.5	0.2	7.2
25	7.3	28.4	1.6	10.2	0.2	7.2
26	8.0	29.1	1.9	10.5	0.3	7.3
27	8.2	29.3	2.0	10.6	0.3	7.3
28	8.1	29.2	1.9	10.5	0.3	7.3
29	11.8	32.9	1.8	10.4	0.3	7.3
30	9.6	30.7	1.5	10.1	0.3	7.3

Receptor	24-hour Average PM_{10} ($\mu g/m^3$)		24-hour Average $PM_{2.5}$ ($\mu g/m^3$)		Annual Average $PM_{2.5}$ ($\mu g/m^3$)	
	Project	Cumulative	Project	Cumulative	Project	Cumulative
31	10.6	31.7	1.6	10.2	0.3	7.3
32	11.5	32.6	1.8	10.4	0.3	7.3
33	10.8	31.9	1.7	10.3	0.3	7.3
34	8.0	29.1	1.2	9.8	0.2	7.2
35	6.5	27.6	1.0	9.6	0.2	7.2
36	6.9	28.0	1.0	9.6	0.2	7.2
37	4.9	26.0	0.8	9.4	0.1	7.1
38	5.4	26.5	0.8	9.4	0.1	7.1
39	6.3	27.4	1.0	9.6	0.1	7.1
40	6.8	27.9	1.0	9.6	0.2	7.2
41	8.7	29.8	1.3	9.9	0.2	7.2
42	9.6	30.7	1.4	10.0	0.2	7.2
43	6.8	27.9	1.0	9.6	0.2	7.2
44	7.8	28.9	1.2	9.8	0.1	7.1
45	5.1	26.2	0.8	9.4	0.1	7.1
Maximum	**26.8**	**47.9**	**4.0**	**12.6**	**0.4**	**7.4**
Criteria	**-**	**60**	**-**	**36**	-	**-**

Table B3 – Scenario 3 results

Receptor	24-hour Average PM_{10} ($\mu g/m^3$)		24-hour Average $PM_{2.5}$ ($\mu g/m^3$)		Annual Average $PM_{2.5}$ ($\mu g/m^3$)	
	Project	Cumulative	Project	Cumulative	Project	Cumulative
1	14.5	35.6	1.7	10.3	0.1	7.1
2	15.8	36.9	1.9	10.5	0.1	7.1
3	13.7	34.8	1.7	10.3	0.1	7.1
4	11.1	32.2	1.3	9.9	0.1	7.1
5	14.2	35.3	1.7	10.3	0.1	7.1
6	12.2	33.3	1.4	10.0	0.1	7.1
7	9.8	30.9	1.2	9.8	0.1	7.1
8	7.0	28.1	0.9	9.5	0.1	7.1
9	6.4	27.5	0.8	9.4	0.1	7.1
10	6.2	27.3	0.8	9.4	0.1	7.1
11	6.1	27.2	0.8	9.4	0.1	7.1
12	5.9	27.0	0.7	9.3	0.1	7.1
13	5.6	26.7	0.7	9.3	0.1	7.1
14	7.1	28.2	1.0	9.6	0.2	7.2
15	10.3	31.4	1.4	10.0	0.2	7.2
16	15.5	36.6	2.2	10.8	0.3	7.3
17	19.6	40.7	2.8	11.4	0.4	7.4
18	29.4	50.5	4.3	12.9	0.4	7.4
19	21.6	42.7	3.2	11.8	0.3	7.3
20	15.6	36.7	2.3	10.9	0.2	7.2
21	16.8	37.9	2.5	11.1	0.3	7.3

Receptor	24-hour Average PM_{10} ($\mu g/m^3$)		24-hour Average $PM_{2.5}$ ($\mu g/m^3$)		Annual Average $PM_{2.5}$ ($\mu g/m^3$)	
	Project	Cumulative	Project	Cumulative	Project	Cumulative
22	17.2	38.3	3.0	11.6	0.2	7.2
23	15.4	36.5	2.1	10.7	0.2	7.2
24	7.3	28.4	1.1	9.7	0.2	7.2
25	8.4	29.5	1.6	10.2	0.2	7.2
26	8.9	30.0	2.0	10.6	0.3	7.3
27	9.6	30.7	2.2	10.8	0.3	7.3
28	8.5	29.6	1.9	10.5	0.4	7.4
29	12.0	33.1	1.8	10.4	0.3	7.3
30	10.6	31.7	1.5	10.1	0.3	7.3
31	11.9	33.0	1.8	10.4	0.3	7.3
32	16.0	37.1	2.3	10.9	0.3	7.3
33	15.1	36.2	2.2	10.8	0.3	7.3
34	10.4	31.5	1.3	9.9	0.2	7.2
35	10.8	31.9	1.4	10.0	0.2	7.2
36	11.7	32.8	1.5	10.1	0.2	7.2
37	11.8	32.9	1.5	10.1	0.3	7.3
38	18.4	39.5	2.4	11.0	0.3	7.3
39	28.7	49.8	3.4	12.0	0.4	7.4
40	29.4	50.5	3.2	11.8	0.5	7.5
41	31.9	53.0	3.3	11.9	0.6	7.6
42	30.4	51.5	3.4	12.0	0.6	7.6
43	30.5	51.6	4.0	12.6	0.5	7.5
44	34.7	55.8	3.9	12.5	0.5	7.5
45	24.8	45.9	2.9	11.5	0.3	7.3
Maximum	**34.7**	**55.8**	**4.3**	**12.9**	**0.6**	**7.6**
Criteria	**-**	**60**	**-**	**36**	-	**-**

Appendix I Noise Assessment

Ballarat Gold Mine

WHITE HORSE GULLY TSF4

Noise Impact Assessment

4/12/2019

Document history and status

Revision	Date	Description	By	Review	Approved
1	4/12/19	Noise Impact Assessment	[redacted]		[redacted]

Executive Summary

Broner Consulting Pty Ltd was engaged by Ballarat Gold Mine to undertake a noise impact assessment for the construction and operation of a proposed new tailings storage facility (TSF4) at its Ballarat gold mine.

This report details the construction operational equipment that is to be used and the sound power level of the proposed equipment. Noise level predictions were conducted for two scenarios of the construction equipment (eastern and western edge of the TSF4).

It was found that the predicted noise levels at critical receiver locations were well below the Noise Limits. Therefore, it Is predicted that the construction and operation of a proposed new tailings storage facility (TSF4) will not cause any additional noise impact.

Contents

Glossary

Term	Description
Noise Spectrum	The sound pressure level (or sound power level) as a function of frequency (eg octave band, 1/3 octave or narrow band). Generally used to identify noise sources or items contributing disproportionately to an overall noise level.
Ambient Noise Level	The prevailing noise level at a location due to all noise sources but excluding the noise from the specific noise source under consideration. Generally measured as a dB(A) noise level.
Background Noise Level	The lower ambient noise level, usually defined as the value of the time varying ambient noise level exceeded for 90% of the measurement time. Usually defined in the dB(A) scale - L_{A90}.
dB	Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure. The reference pressure is $2x10^{-6}$ Pascal (Newtons per square meter).
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when it is exposed to normal levels and correlates well with subjective perception. An increase or decrease in sound level of approximately 10 dB corresponds to a subjective doubling or halving in loudness. A change in sound level of 3dB is considered to be just noticeable.
Frequency	The rate of repetition of a sound wave. The unit of frequency is the Hertz (Hz), defined as one cycle per second. Human hearing at everyday sound pressure levels ranges approximately from 20 Hz to 20,000 Hz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands. For more detailed analysis each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
Free Field	The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls).
LA10	The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level
LA90	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level
LAeq	The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period
LAmax	Maximum A-weighted sound pressure level
dBZ/dBL	'Z' weighting is a flat frequency response of 10Hz to 20kHz ± 1.5dB. Z weighting replaced the older "linear" or "Unweighted" responses as these did not define the frequency range over which a sound level meter would be linear
Rw	The Weighted Sound Reduction Index is a single-number quantity which characterises the airborne sound insulation of a material or building element such as a wall, window or door over a range of frequencies.
C_{tr}	An adjustment factor which is used to account for low frequency noise - typically the biggest problem with sound insulation. Ctr is always a negative number, so the Rw+Ctr will always be less than the Rw value

1.0 Introduction

Broner Consulting Pty Ltd was engaged by Ballarat Gold Mine to undertake a noise impact assessment for the construction and operation of a proposed new tailings storage facility (TSF4) at its Ballarat gold mine. This report details the sound power levels of the equipment proposed for use and the predicted noise levels at the nearest residential locations. An assessment of impact is provided.

2.0 Site Location

The mine is located at 10 Woolshed Gully Drive, Mount Clear VIC 3350, and is bound by a buffer of vegetation approximately 250m wide. Ore from the underground mine is hauled to the surface mill site where it is processed. Tailings are pumped, as a slurry, from the processing plant to a Tailings Storage Facility (TSF) at Terribly Gully (TSF3), located 600 m south of the processing plant (and directly north of the proposed White Horse Gully TSF4 site). The existing TSF3 based on current production rates is predicted to be at capacity in September 2021. It is proposed to re-mine the coarse-grind tailings from TSF3 using a ball-mill, this is subject to further studies and approvals. This process will produce a finer-grind tailings which will be disposed of in the proposed Whitehorse Gully TSF4 which is directly south of the TSF3 site. Figure 1 shows the location of the proposed TSF4 site.

Figure 1 Aerial view showing the location of the proposed TSF4 development

3.0 TSF4 Construction Staging

The concept design of TSF4 allows for a staged approach; where the embankment is initially constructed with a starter embankment; and incrementally raised to its final height. This is the likely approach. An indicative two-staged program of works is presented in Figure 2.

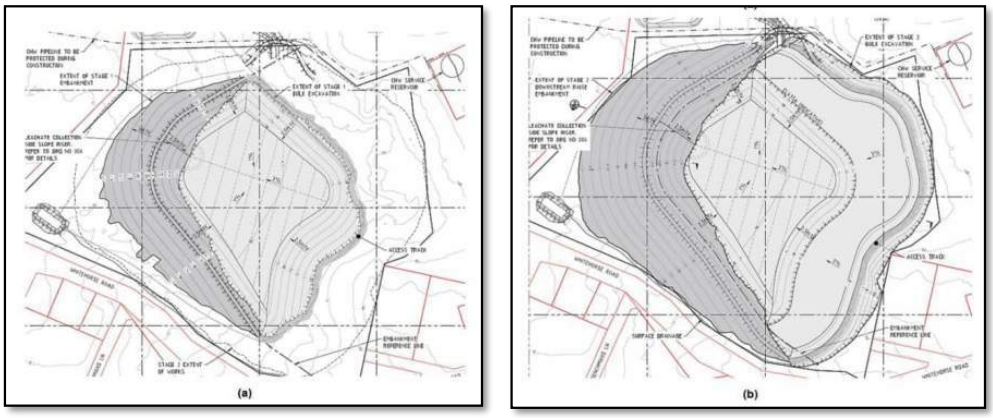


Figure 2 Possible staging of TSF4 (a) Stage 1 to EL 436 m; and (b) Stage 2 to EL 444 m

In summary, the indicative staging is as follows:

· Stage 1:

- Embankment crest level at EL 435 m
- Maximum embankment height of 25 m (approx.)
- Tailings storage capacity in the order of 0.8 Mm3 (approx.)

· Stage 2:

- A 9 m high raise to the Stage 1 embankment by downstream construction methods, to a crest level at EL 444 m
- This will require additional excavation from within the impoundment above EL 435 (approx.).
- This will provide an additional 0.7 Mm3 (approx.) of tailings storage capacity.

Construction Phase (7am to 6pm Monday to Friday, 7am – 1pm Saturday) – Equipment as provided operating at the two locations.

Operational Phase (24hr)- During this phase, the existing Gravity circuit will operate with the addition of three diesel powered pumps, one is proposed as a Stormwater pump and two for the TSF4 Decant Pond located within TSF4. This will be a worst - case scenario. The planned scenario is for the use of electric pumps. However, Ballarat Gold has adopted the approach of modelling diesel pumps to provide flexibility and backup pumping capacity during maintenance and potentially prior to power installation.

4.0 Noise Modelling

To predict the noise levels due to the construction and operation of the TSF4, we used iNoise which is a quality assured software for industrial noise calculations in the environment. The calculations are based on the ISO 9613 method and the recommendations of the quality standard ISO 17534. The topography of the area was imported into the model as a dxf file and the dominant noise sources were added based on their location and measured sound pressure level data. The prediction assumes worst case propagation in all directions.

4.1 Modelling Phases

There are two phases for noise modelling.

The Construction Phase will utilise the equipment as shown in Table 1 below during the daytime only (7am to 6pm). Two locations for the construction equipment will be modelled. One with the equipment on the eastern rim of the TSF4 and one on the western rim.

The Operational Phase will be a 24hr duration. Two diesel pumps will be used for the TSF Decant Pond (the location of these pumps is shown in Table 2). This will be the worst case scenario, the planned scenario is for an electric pump within a 30m deep concrete well which will effectively be silent. A diesel pump (or two) may also be required for breakdown/maintenance backup and potentially prior to grid connected power installation. A third pump will be used to manage Stormwater during construction and operation phase prior to installation of an electric pump, this will be located at the base of the embankment in the south west corner of the site. The three diesel pumps are included in the model.

The Sound Power Levels for the equipment are shown in Table 1 below.

TABLE 1 CONSTRUCTION EQUIPMENT AND SOUND POWER LEVELS

	Octave Band Sound Power Level (dB)								
Noise Source	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**	**Sound Power Level (dBA)**
CAT 160H	100	99	102	101	97	94	91	86	103
CAT 140M	115	114	111	112	108	105	99	90	113
CAT D8R Dozer	117	118	109	101	102	98	96	91	109
CAT 336D Excavator	102	114	104	104	106	102	99	93	110
CAT 740 Dump Truck	103	105	102	102	103	101	96	90	107
John Deere 9620 Tractor	102	116	106	106	105	107	100	93	112
Case 600 Steiger Tractor	102	116	106	106	105	107	100	93	112
CAT Scraper 631G	103	105	102	102	103	101	96	92	107
CAT CP663E Padfoor Roller	98	102	99	106	102	103	91	86	108
CAT 825C Compactor	112	111	108	110	103	101	99	93	110
Pump (Decant and Stormwater)	99	102	99	93	88	86	81	74	96

TABLE 2 LOCATION OF THE PUMPS

Pump Name	Northing	Easting	RL (m)
Decant 1	N 5834615.9	E752525.2	452
Decant 2	N 5834399.7	E 752498.5	442
Stormwater	N 5834553.1	E 751959.1	408

4.2 Receiver Locations

The receiver locations have been chosen based on established noise monitoring points associated with the existing approvals for MIN4847 and MIN5396. Figure 3 below shows the receiver locations based on existing monitoring locations. R1 is an adopted monitoring location for the nearest western residential receptor and is the same location as the AECOM Air Quality receptor (1). The noise limits for R1 are based on the MIN5396 limits. Table 3 includes the topographical data for the locations that were included in the current noise modelling.

Figure 3 Receiver Locations in the Model (RHS)

TABLE 3 RECEIVER LOCATION CO-ORDINATES

Receptor Name	Easting	Northing
N2	752526	5836316
N3	752921	5835854
N4	752013	5836180
N5	751330	5836039
N6	752409	5836287
N7	752821	5835144
V1	752731	5834467
V2	752730	5834361
V3	752666	5834033
V10	752678	5834256
R1	751403	5834577

5.0 Noise Limits

The proposed TSF4 site straddles two mining leases, MIN4847 to the east and MIN5396 to the west. The two mining leases have different nose limits within their approvals. The noise limits are based on those set out in the existing approvals for the two mining licences, MIN4847 (Environmental Management Plan, July 1995) and MIN5396 (Planning Permit PA93/195 (TP133), August 2007).

The noise limits vary depending on the location and time of day and are shown in table 4 below.

TABLE 3 NOISE LIMITS AT THE RECEIVER LOCATIONS

Receptor Name	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am	Saturday 7am to 1pm
N2	54 dB(A)	48 dB(A)	43 dB(A)	54 dB(A)
N3	54 dB(A)	48 dB(A)	43 dB(A)	54 dB(A)
N4	54 dB(A)	48 dB(A)	43 dB(A)	54 dB(A)
N5	54 dB(A)	48 dB(A)	43 dB(A)	54 dB(A)
N6	54 dB(A)	48 dB(A)	43 dB(A)	54 dB(A)
N7	54 dB(A)	48 dB(A)	43 dB(A)	54 dB(A)
V1	48 dB(A)*	44 dB(A)	35 dB(A)	48 dB(A)*
V2	46 dB(A)*	44 dB(A)	35 dB(A)	46 dB(A)*
V3	48 dB(A)*	44 dB(A)	35 dB(A)	48 dB(A)*
V10	48 dB(A)*	44 dB(A)	35 dB(A)	48 dB(A)*
R1	54 dB(A)**	48 dB(A)	43 dB(A)	54 dB(A)**

*MIN4847 Construction Noise Limits are 10 dB(A) above day time limits. ** R1 is an adopted monitoring location and uses the MIN5396 limits.

6.0 Noise Level Predictions

With the construction and operational equipment located on the western edge of TSF4, the predicted noise levels during the daytime are shown in Figure 4 below.

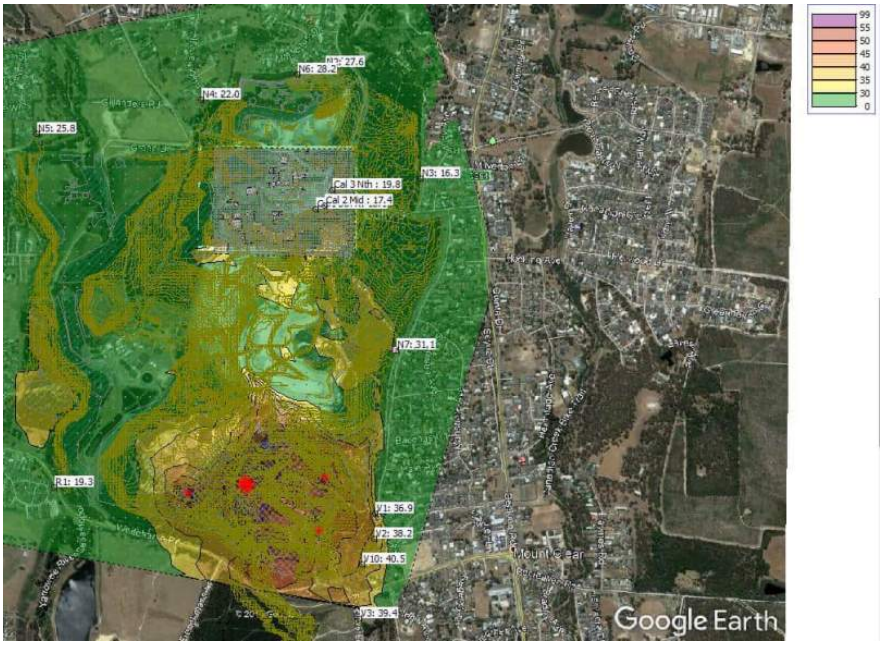


Figure 4 Predicted Noise Levels Due to Construction and Operational Equipment for the Day

For the night time, only the three diesel pumps will be operating and the predicted noise levels are shown in Figure 5.

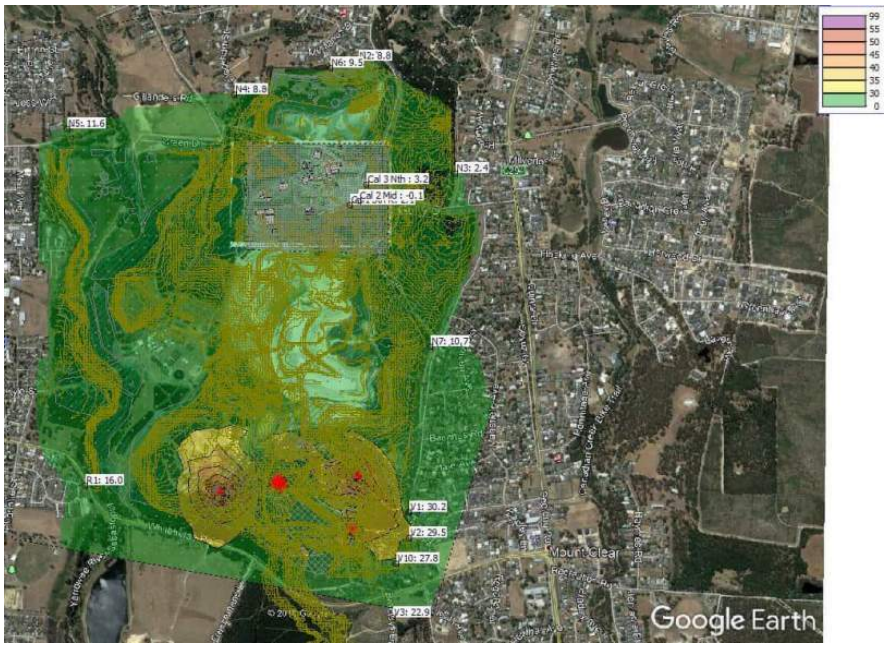


Figure 5 Predicted Noise Levels Due to Operational Equipment for the Night

With the construction equipment located on the eastern side of the TSF4 and the operational equipment on the eastern side, the following noise levels are predicted during the day

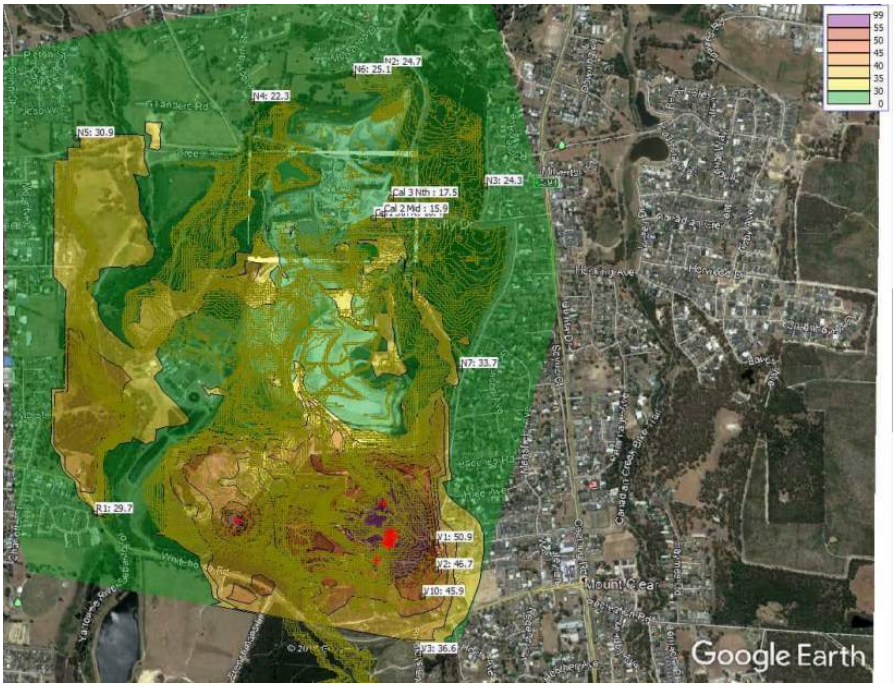


Figure 6 Predicted Noise Levels Due to Construction and Operational Equipment for the Day

The Night time predicted noise levels are the same as in Figure 4 because the only noise sources operating at night are the three diesel pumps.

Table 4 below shows the predicted Equivalent Noise Level (LAeq) at each of the Receivers for both the day and night and for the operational equipment located on the eastern and western extremities of the TSF4.

TABLE 4 PREDICTED NOISE LEVELS AT THE RECEIVERS

	Operational Equipment on Western Side		Operational Equipment on Eastern Side	
Receptor	**Day**	**Night**	Day	Night
N2	27.6	8.8	24.7	8.8
N3	16.3	2.4	24.3	2.4
N4	22	8.8	22.3	8.8
N5	25.8	11.6	30.9	11.6
N6	28.2	9.5	25.1	9.5
N7	31.1	10.7	33.7	10.7
V1	36.9	30.2	50.9	30.2
V10	40.5	27.8	45.9	27.8
V2	38.2	29.5	46.7	29.5
V3	39.4	22.9	36.6	22.9
R1	19.3	16	29.7	16

It can be seen that the predicted noise levels at critical receiver locations are well below the Approved Noise Limits. Therefore, it Is predicted that the construction and operation of a proposed new tailings storage facility (TSF4) will not cause any additional noise impact.

7.0 Summary

Broner Consulting Pty Ltd was engaged by Ballarat Gold Mine to undertake a noise impact assessment for the construction and operation of a proposed new tailings storage facility (TSF4) at its Ballarat gold mine. This report details the construction operational equipment that is to be used and the sound power level of the proposed equipment. Noise level predictions were conducted for two scenarios of the construction equipment (eastern and western edges of the TSF4). It was found that the predicted noise levels at critical receiver locations are well below the Approved Noise Limits. Therefore, it Is predicted that the construction and operation of a proposed new tailings storage facility (TSF4) will not cause any additional noise impact.

Prepared by:

[redacted]

[redacted]
Principal
Broner Consulting Pty Ltd

Appendix G Visual Impact Assessment


hansen
Ballarat Gold Mine Tailings Storage Facility
Visual Impact Assessment
Prepared by Hansen Partnership - December 2019

CONTENTS

Version	Title	Date	Issuer	Notes / changes
A	Ballarat Gold Mine TSF4 LVIA report	16/12/2019	SS	Final Report

FIGURES

1 INTRODUCTION

1.1 INTRODUCTION

Hansen Partnership have been engaged by AECOM Australia Pty. Ltd. to prepare a Landscape and Visual Impact Assessment (LVIA) for the proposed Ballarat Gold Mine Tailings Storage Facility (TSF4) located in Mount Clear, Ballarat.

The mine is located approximately 4 kilometres south east of the Ballarat CBD, on land which is currently utilised for timber production and which has a history of mining activities. The site is bound to the south by Whitehorse Road with existing mining operations adjacent to its northern boundary, and other timber production and industrial uses to the east and west of the site.

The changes associated with the expansion of the Ballarat Gold Mine which are considered in this report include the following:

- Removal of existing timber plantation trees
- Construction of an above ground tailings storage;
- Construction of a sedimentation pond
- Construction of black chain mesh perimeter fencing
- Construction of Whitehorse Road turning lane into the TSF4 entrance with retention of nearby trees
- Capping of TSF4 following closure of operations
- Revegetation with timber plantation trees following closure of operations

The areas of proposed works are shown on the 'Site Work' plan in Appendix A of this report.

The LVIA is required in order to assess the Ballarat Gold Mine TSF4 proposal in preparation of Planning Permit submission.

The VIA report provides a detailed assessment of existing landscape character and landscape values associated with the study area, followed by an assessment of the potential impacts upon these values which could occur as a result of the development of the proposed TSF4.

The report includes a series of photomontage images as a means of demonstrating the visual presence of the proposed TSF4 from a series of view locations, which are located within 2 kilometres of proposed development, and which have been determined based on viewshed modelling to have a potential detrimental visual impact.

The assessment considers the impacts of the proposed TSF4 at the time of closure prior to revegetation, and at the ultimate stage of completion following revegetation of pine plantation in accordance with the existing land use.

The report subsequently determines where amelioration to visual impact is considered necessary or desireable, and provides recommendations of mitigation measures where appropriate.

It is imperative to ground the landscape assessment with a best practice methodology, which is outlined in Section 1.2.

1.2 METHODOLOGY

This report documents the approach to the Visual Impact Assessment undertaken by Hansen Partnership and has been based on industry best practice as articulated by key reference documents, including *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design*[1] and *Guidelines for Visual Impact Assessment*.[2]

The methodology for the project is divided into the following phases:

1. Inception
2. Baseline Assessment
3. Landscape Character Assessment
4. Landscape Character Values
5. Visual Impact Assessment and Recommended Mitigation
6. Conclusions and Recommendations

Phase 1 - Inception

- Description of the site location and context
- Acquisition of base data, information and briefings
- Collation of mapping data

Phase 2 - Baseline Assessment

- Land use patterns
- Planning zones and overlays
- Topography
- Assessment of the existing study area environment
- Review of relevant landscape and visual reports / designations / planning controls and assessments

Phase 3 - Landscape Character Assessment:

- Describing the landscape character and mapping of landscape character precincts within the study area.

Phase 4 - Landscape Character Values

- Identification of visual landscape character preferences and associated values
- Mapping of relative landscape values within the study area

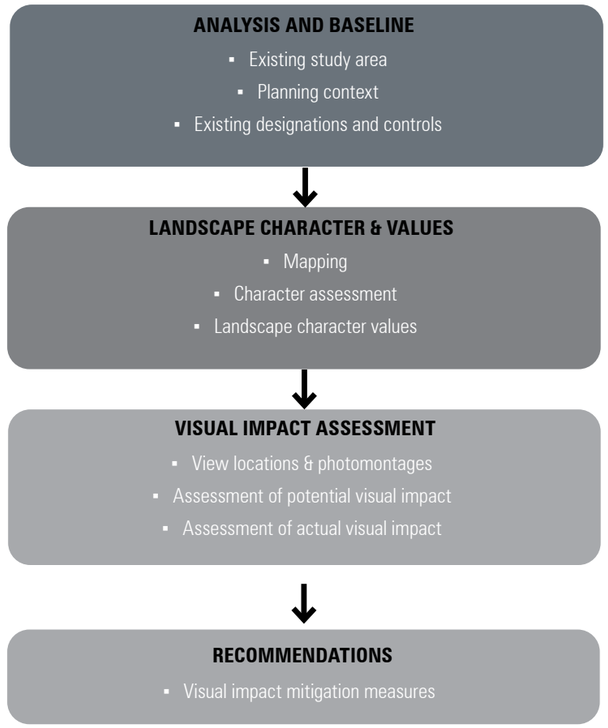
Phase 5 - Visual Impact Assessment

- Identification of zone of theoretical visual influence
- Representative view locations
- Preparation and review of photomontage images for representative view locations
- Assessment of likely impact on private residences
- Discussion of off-site mitigation measures

Phase 7 - Conclusions and Recommendations

- Provide recommendations with regard to visual impact mitigation measures where appropriate

PROJECT OVERVIEW



1 Department for Planning and Infrastructure, *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design*, November 2007

2 Landscape Institute and Institute of Environmental Management & Assessment, *Guidelines for Visual Impact Assessment*, Third Edition, 2013.

1.4 PROJECT DESCRIPTION

The proposed site of the Ballarat Gold Mine Tailings Storage Facility (TSF4) is located approximately 4 kilometres south-east of Ballarat CBD, in Mount Clear within the City of Ballarat.

The specific elements of the proposed TSF4 that are considered in this visual impact assessment include the following:

- Removal of existing timber plantation trees
- Construction of an above ground tailings storage;
- Construction of a sedimentation pond
- Construction of black chain mesh perimeter fencing
- Construction of Whitehorse Road turning lane into the TSF4 entrance with retention of nearby trees
- Capping of TSF4 following closure of operations
- Revegetation with timber plantation trees following closure of operations

The proposed TSF4 is located on land which is currently used for timber production, and the vegetation within the site is subject to removal as of right. The subject site is also bounded by land utilised for timber production to the east and south, Ballarat Sewage Treatment Plant to the northwest, and the mining operations to the north.

Further afield, the land use sharply transitions from timber production and extractive industry to urban residential land – the suburbs of Mt Clear (to the east of Tinworth Avenue) and Sebastopol (to the west). The eastern extent of residential development in Sebastopol is clearly defined by the north-south escarpment which follows the Yarrowee River. The urban residential areas are punctuated by recreation reserves, schools and local community services.

Site access to the TSF4 facility is from Whitehorse Road. Whitehorse Road provides an east-west connection for motorists travelling between Mount Clear and Sebastopol. An existing buffer of trees along this road would be retained. Travellers along this road experience the transition of landscape characterised by timber production, into urban environments which are situated both east and west of the proposed TSF4. On account of the low terrain in relation to surrounding areas, views north from this road are restricted.

The elevation of the broader surrounding landscape gently increases from the Yarrowee River to the east. West of the Yarrowee River, there is a sharp rise in elevation due to the adjacent escarpment. Residents living along the edge of Sebastopol along the escarpment are afforded extensive views across the land toward the Canadian Forest.

The land adjacent to Bridge Road is heavily vegetated with native trees and shrubs along the east-bound lane of Bridge Street. The vegetation along the east-bound lane changes to pine plantations east of Yarrowee River, which are subject to removal as of right.

Figure 1: Vew from Bridge Street, Sebastopol

Figure 2: View from intersection of Bradleys Lane and Whitehorse Road, Mount Clear

Ballarat Gold Mine
Site location

VICTORIA State Government | Environment, Land, Water and Planning

Legend

BALLARAT GOLD MINE TSF4 LOCATION

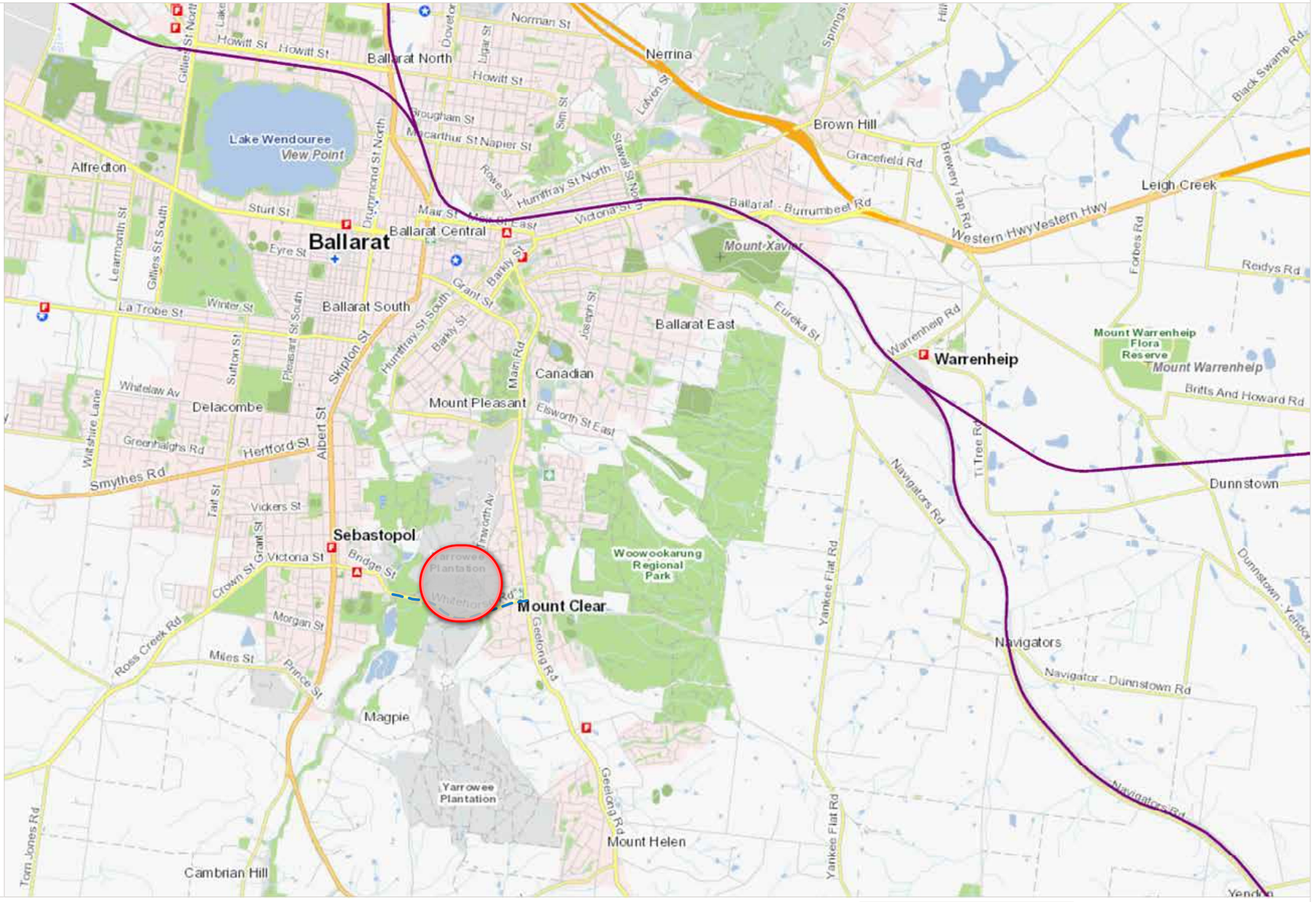


Figure 03: Site Location Map

N

0 1 2
Kilometres

Map Projection: GDA 1994 VICGRID94
Print Date: 11/10/2019

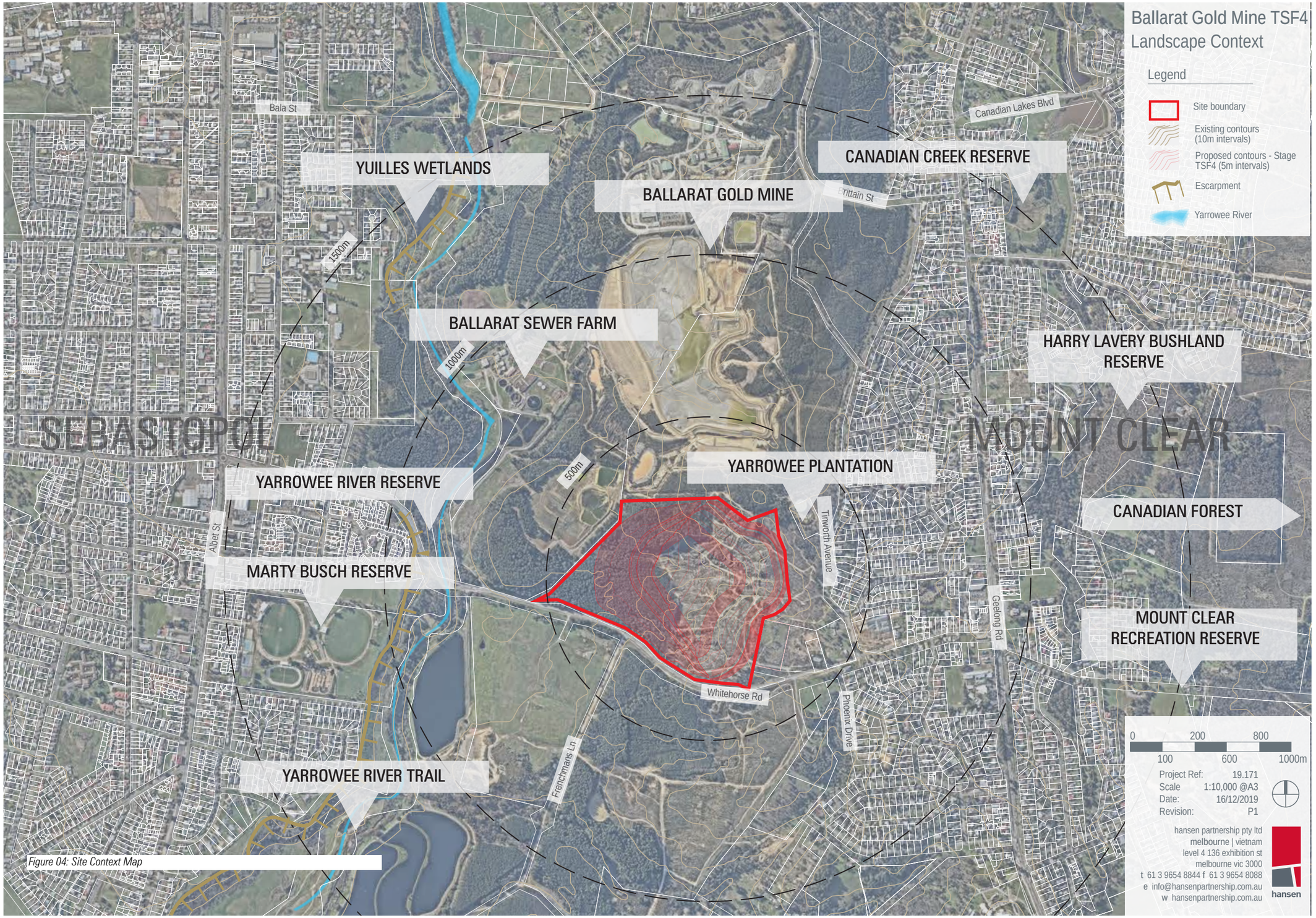


Figure 04: Site Context Map

2 General Planning Policy & Controls

Planning scheme policy and controls within the Ballarat Planning Scheme, and relevant incorporated documents have been considered on the basis of its relevance to the visual and landscape values of the study area. They are relevant in informing the Visual Impact Assessment of the proposed development, as they provide a reliable baseline for assumptions which will inform the assessment.

Key policy and controls that are relevant to visual and landscape values of the land within the study area are:

- State Planning Policy and reference documents including general provisions, particular provisions, and reference documents relevant to extractive land use
- Strategic direction within the Municipal Strategic Statement
- A range of zones that relate to uses or development within the subject site
- A range of overlay controls that relate to the specific landscape values within proximity to the site
- A number of background documents are also available which provide relevant strategic directions for the study area.

2.1 State Planning Policy Framework

Within the State Planning Policy Framework (SPPF), a number of policies encompass broad objectives relevant to the site study area. In summary, these policies promote development which appropriately responds to its surrounding landscape and character, any valued built form and the cultural context of the site of development. Specific objectives and relevant strategies are listed below:

Victorian Planning Provisions - General Provisions

- 11.03-5S Distinctive areas and Landscapes
- 12.05-1S Environmentally sensitive areas
- 12.05-2S Landscapes
- 14.03-1S Resource exploration and extraction
- 13.07 Land use compatibility
- 15.03 Heritage conservation

Victorian Planning Provisions - Particular Provisions

- 52.09 Stone extraction and extractive industry interest areas

2.2 Local Planning Policy Framework

- 21.00-10 Municipal Strategic Statement
- 22.02 Rural Land Character and Urban Design

Planning Framework - Zones

The site and surrounding area is controlled by a number of Planning Zones which are shown in Fig 5.

- 32.04 Mixed Use Residential Zones
- 32.07 Residential Growth Zone
- 32.08 General Residential Zone
- 32.09 Neighbourhood Residential Zone
- 35.03 Rural Living Zone
- 35.07 Farming Zone
- 36.01 Public Use Zone
- 37.01 Special Use Zone

Planning Framework - Overlays

Overlays within the study area extents are shown in Fig 6.

- 42.01 Environmental Significance Overlay
- 42.02 Schedule 1 to the Vegetation Protection Overlay
- 43.01 Heritage Overlays
- 45.01 Public Acquisition Overlay
- 45.03 Environmental Audit Overlay

2.3 Incorporated and Reference Documents

- The Ballarat Strategy: Our Vision for 2040, July 2015
- Ballarat Open Space Strategy, Volume 1, 2008
- Ballarat Supply Area - Extractive Industry Interest Areas Review (Geological Survey of Victoria Technical Record, 1997/3)

Planning Map - Zone

VICTORIA State Government | Environment, Land, Water and Planning

Planning Scheme Zones

Residential Zones
- MUZ - Mixed Use Zone
- RGZ - Residential Growth Zone
- NRZ - Neighbourhood Residential Zone
- GRZ - General Residential Zone

Industrial Zones
- IN1Z - Industrial 1 Zone
- IN3Z - Industrial 3 Zone

Commercial Zones
- C1Z - Commercial 1 Zone

Rural Zones
- RLZ - Rural Living Zone
- FZ - Farming Zone

Public Land Zones
- PUZ1 - Public Use Zone-Service and Utility
- PUZ2 - Public Use Zone-Education
- PUZ6 - Public Use Zone-Local Government
- PUZ7 - Public Use Zone-Other Public Use
- PPRZ - Public Park and Recreation Zone
- RDZ1 - Road Zone-Category 1

Special Purpose Zones
- SUZ - Special Use Zone

Contours
- Contours 10m
- Contours 100m

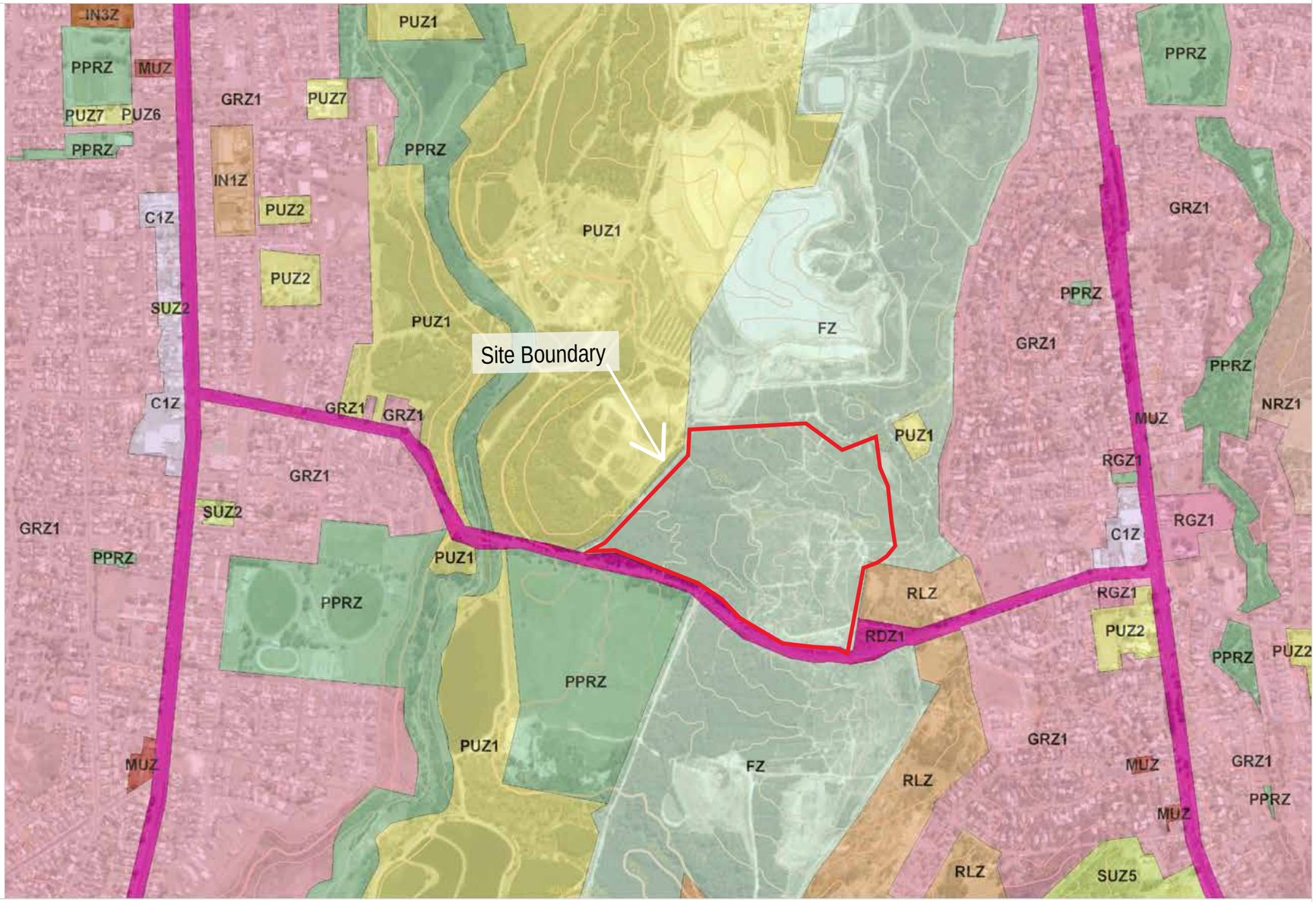


Figure 05: Planning Zones Map

N

0 0.2 0.4
Kilometres

Map Projection: GDA 1994 VICGRID94
Print Date: 15/10/2019

Planning Overlays

VICTORIA State Government | Environment, Land, Water and Planning

Planning Scheme Overlays
Environment and Landscape
- ESO - Environmental Significance Overlay
- VPO - Vegetation Protection Overlay

Heritage and Built Form
- HO - Heritage Overlay

Other Overlays
- EAO - Environmental Audit Overlay
- PAO - Public Acquisition Overlay

Contours
- Contours 10m
- Contours 100m

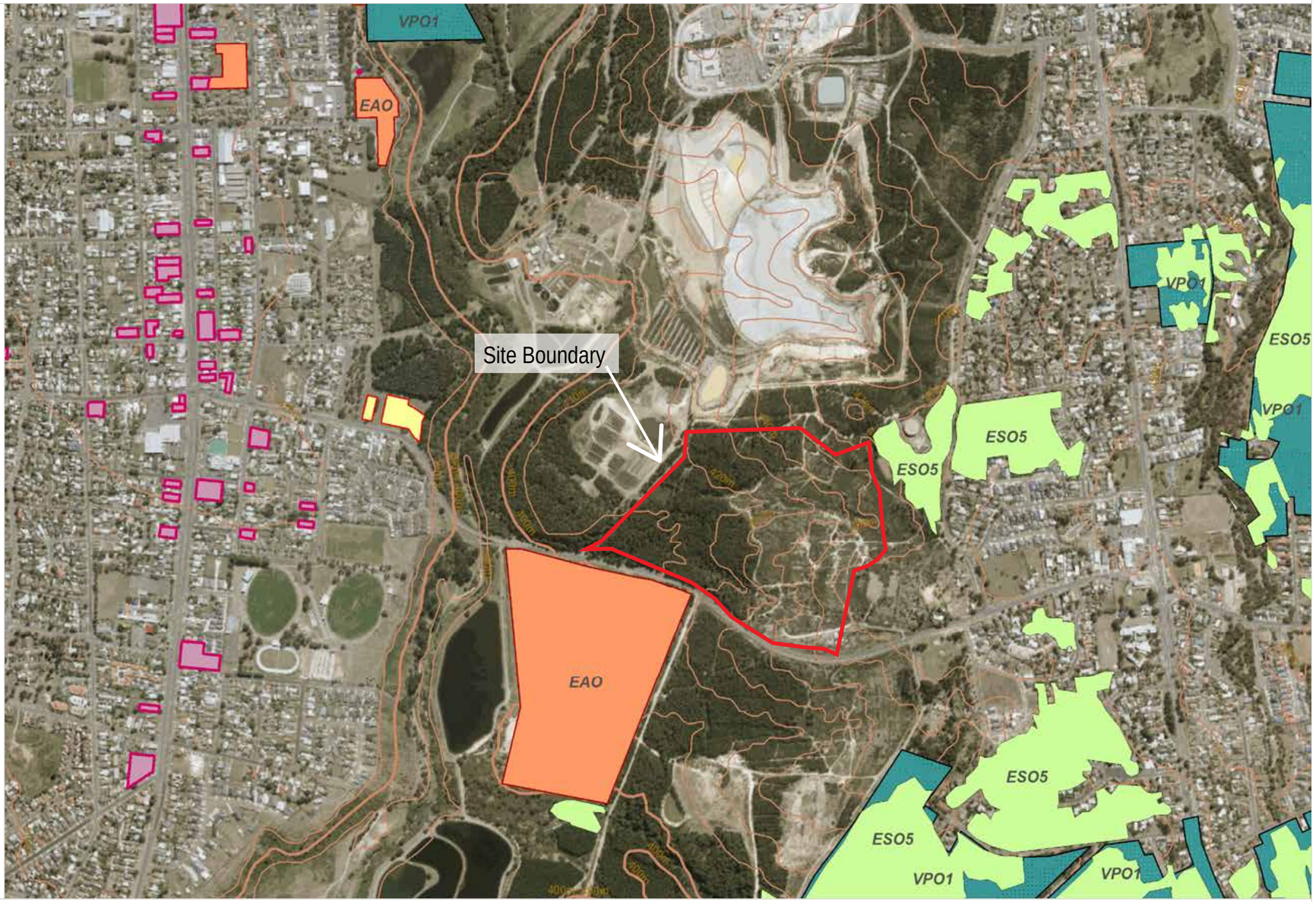
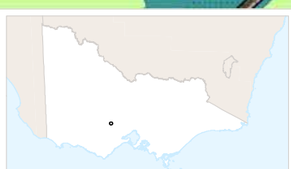


Figure 06: Planning Overlay Map

N

0 0.2 0.4
Kilometres

Map Projection: GDA 1994 VICGRID94
Print Date: 15/10/2019



3 LANDSCAPE CHARACTER ASSESSMENT

3.1 INTRODUCTION

This section of the report focuses on describing the landscape character of the study area by identifying the main characteristics of the landscape. This was undertaken to understand, through fieldwork, whether there are any further landscape character or visual amenity values which are of significance within the study area, in addition to those identified in the desktop baseline work undertaken.

The study area has been assessed to identify landscape character precincts which can be described as areas of similar patterns or elements in the landscape such as landform, vegetation, waterbodies and land use as well as individual features.

Separating the study area into landscape character precincts is the initial step in identifying areas of relative significance. This is an essential part of the landscape assessment, and leads into determining landscape values.

The landscape characteristics described within the planning scheme and other reports reviewed in the baselines assessment have also been referenced for this assessment.

3.2 LANDSCAPE CHARACTER PRECINCTS

As identified through the baseline assessment, the study area contains a range of land uses which have an impact on prevailing landscape character. Through the baseline desktop analysis and fieldwork, a two landscape character precincts have been identified within the study area as follows:

- Yarrowee Valley landscape character
- Urban landscape character

The character types are a subset of the broader landscape character type identified within the *Ballarat Strategy: Our Vision for 2040*: the 'Mount Clear Goldfields'

The landscape character precincts determined through this assessment are shown graphically in *Figure 7*.

3.2.1 'YARROWEE VALLEY' LANDSCAPE CHARACTER

The landscape character of the 'Yarrowee valley' area is primarily defined by its topography and forms a large open area occupying the Yarrowee River corridor between the residential areas of Sebastopol and Mount Clear.

A moderate portion of the study extents falls within this character area, which is close to the city centre.

The land within this character area includes a broad north-south escarpment, which defines the western boundary of the landscape area and is associated with the Yarrowee River corridor. The eastern boundary of the character area is defined by Tinworth Avenue and Phoenix Drive.

Beyond the river corridor, the land form undulates with a general fall in the easterly direction toward Canadian Creek.

The land use is non-homogenous, resulting in a mosaic pattern of largely modified landscapes with varying visual and recreational value. The presence of natural landforms and features associated with the Yarrowee River corridor are utilised for passive recreation by a series of interconnected trails and reserves.

Existing extractive and industrial uses occupy a substantial portion of the character area which has been reclaimed for timber production and utilised for public utilities including refuse tips and water treatment plants.

Views from within this landscape area are generally restricted due to its low elevation in contrast to the immediate surrounding landscape to the west, and due to the extensive coverage of dense canopy vegetation.

Unsealed roads and grassy verges are typical within this landscape character and contribute to the rural feel of the area.

The proposed site falls within this landscape character, on land currently used for Timber Plantation.

3.2.2 'RESIDENTIAL URBAN' LANDSCAPE CHARACTER

The 'Residential Urban' landscape character forms two distinct residential areas of Sebastopol on the basalt plateau to the west of the study area, and the built up areas of Mount Clear and the Canadian Valley to the east.

It is distinguished by a grid pattern of residential streets, angled in areas to navigate variations in topography. The land use is relatively homogenous, consisting of residential properties with reserves, schools and local services scattered throughout the neighbourhood.

Views out to Yarrowee River escarpment and toward the Canadian Forest are afforded from the high ground along adjacent residential streets – particularly where road junctions open up the views to the east – and from residences located close to the escarpment.

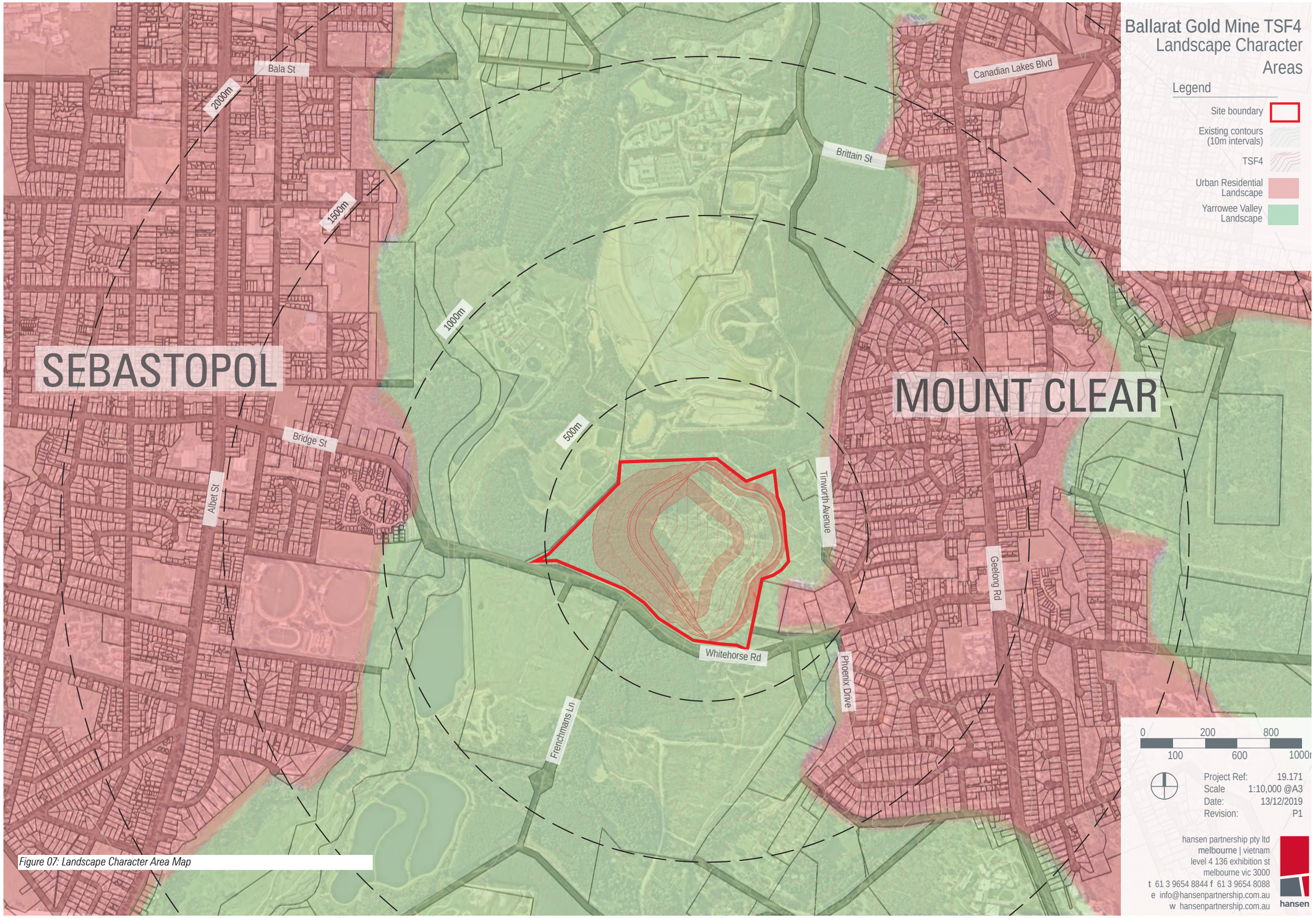


Figure 07: Landscape Character Area Map

4 LANDSCAPE VALUES

4.1 INTRODUCTION

This section of the assessment aims to assess the existing relative landscape value of the proposed development site and surrounding landscapes in an objective manner. This is to be achieved through the baseline analysis work and the fieldwork undertaken. Guidance is taken from benchmarking documents, primarily *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007.* In this manual landscape values are broadly defined as:

"Values or preferences refer to the value placed on a landscape feature by the community based primarily on its perceived visual quality[1]*."*

It is important to note that the assigned landscape values derived from this assessment are relative to the context of the proposed development site and the surrounding landscapes. Part of this is context is to acknowledge the existing high level of landscape significance attributed to some existing landscapes within the study area and its context as identified in the planning scheme as well as values identified in the baseline assessment.

The landscape values assessment will utilise the following methodology:

- The identification, through the review of benchmarking documents, of objective criteria to assess landscape value.
- Utilising these criteria, the relative value of the different landscape character precincts can be discussed and evaluated. Relative landscape value will be assigned as either *high*, *moderate* or *low* based on criteria such as:

High

- Prevalence of preferred landscape features, with minimal presence of non-preferred landscape features.

Moderate

- Some presence of preferred landscape features, with these being more prevalent than non-preferred landscape features.

Low

- Minor presence of preferred landscape features, and/or a prevalence of non-preferred landscape features.

4.2 CRITERIA FOR THE ASSESSMENT OF LANDSCAPE VALUES

For the purposes of this study a set of broad landscape values assessment criteria have been developed through professional assessments by Hansen Partnership, based on landscape character preference indicators identified in the *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007* (VLPWA Manual) .

It is intended that the landscape character preference indicators be used to assess landscape value of the site in a manner that is as objective as possible. In order to achieve this the *VLPWA Manual* has been reviewed along with the baseline analysis work to formulate the landscape character preference indicators outlined in Section 4.4 and 4.5 of this report.

To ensure that the methodology for this landscape values assessment is grounded by a best practice approach, it has been based on the methodology outlined in the guidelines provided by the *VLPWA Manual*.

It is acknowledged that the nature of landscape values inherently varies from person to person, or is subjective. Therefore it is largely based on the perceptions of individuals taking into account a variety of factors, such as cultural backgrounds, education and economic circumstances. While this is evident, the methodology above enables landscape values to be assessed in a professional and objective manner.

Planning controls which impact the study area have been used to guide the criteria for the assessment of landscape values (as outlined in Section 1). This includes the high level of value placed on the scenic character of the landscape, open views, waterways, water bodies, indigenous vegetation and landscape values. These values have been integrated into the criteria identified from the *VLPWA Manual*.

4.3 VLPWA MANUAL

The *VLPWA Manual* aims to provide a valuable resource for undertaking visual assessments of the landscape in lieu of often non-existent formal local or state planning policy. The *VLPWA Manual* has been used for this assessment as there is an absence of any similar Victorian State Government publication. This landscape values assessment conducted for the site specifically refers to: *Part Two, Section 2, Identify and assess what is valued in the visual landscape (p32-33)* and A*ppendix 7, Visual landscape character preference indicators (p175-177)* within the *VLPWA Manual*.

The landscape character preference indicators identified in the *VLPWA Manual* have been developed using community preference research and subsequently list landscape features as being either most preferred or least preferred in a generalised landscape typology. These landscape typologies are categorised broadly as being natural, rural or built. The study area is split relatively evenly between areas of 'built' and 'rural' landscape typologies.

The preference indicators provide a structured basis for the landscape values assessment criteria, which is in keeping with the methodology outlined in the *VLPWA Manual.* Each landscape typology is described in more detail on the following pages of this report.

1 Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007, Page 33

4.3.1 RURAL LANDSCAPE CHARACTER PREFERENCE INDICATORS

General Preferred Landscape Features

Most preferred landscape features for this landscape typology include:

- Unusual diversity in a landscapes (colour and contrast or species diversity);
- Agricultural patterns, colours and textures that complement natural features;
- Gradual transition zones between agricultural land and natural landscape;
- Topographic variety and ruggedness;
- Presence of water bodies (dams, lakes, inundated areas) that borrow location, shape, scale and edge configuration from natural elements;
- Areas or sites frequently prone to ephemeral features (presence of fauna, distinctive crop rotations, water conditions and climatic conditions);
- Significant landscape features (trees and tree stands, historic relics, some windmills and areas of unusual topographic variation);
- Settlement patterns and individual structures that strengthen the local rural character (silos, windmills, water tanks, historic buildings, Bridges, hay bales and dams);
- Historic features and land use patterns that strengthen the local rural character (historic farm machinery, old shearing sheds, windmills and historic buildings), and
- Distinctive remnant vegetation located along natural waterbodies, roadsides and in paddocks.

General Least Preferred Landscape Features

Least preferred landscape features for this landscape typology include:

- Areas of soil salinity/ salt scalds or dead, dying or diseased vegetation;
- Areas of extensive weed infestation;
- Eroded areas;
- Tips, dumps and landfill areas;
- Recently harvested areas (stumps, debris, abandoned off-cuts);
- Land use areas that contrast significantly from rural landscape characteristics (can include plantations, mines, rural settlement and/or housing, utility towers, roads and fencing;
- Abandoned structures in a state of disrepair or destruction;
- Unmanaged roads and access tracks;
- Farm structures and buildings in a state of disrepair;
- Eutrophied dams, lakes and water bodies.

Figure 8: Typical view of rural landscape typology

4.3.2 BUILT CHARACTER PREFERENCE INDICATORS

Preferred Landscape Features

Most preferred landscape features for this landscape typology include:

- Presence of trees, greenery, parks and gardens, street trees, canopied streets, median strip vegetation;
- Complementary building styles in neighbourhoods;
- Diverse building styles in neighbourhoods;
- Built developments that do not impinge on dominant natural features;
- Coherence of industrial buildings in one area (e.g. industrial parks and buffers);
- Presence of natural features (e.g. water bodies and natural rock features)
- Historic features including land uses that strengthen the local urban character;
- Well maintained gardens (native and exotic);
- Incorporation of significant cultural and environmental features into urban design;
- Urban water management (water bodies that are well maintained, and open drains with a complementary appearance to the surrounding built form);
- Underground services;
- Unobtrusive mobile phone towers and other utility towers;
- Unobtrusive advertising;
- Presence of artworks

Least Preferred Landscape Features

Least preferred landscape features for this landscape typology include:

- Derelict industrial areas (junkyards) or degraded areas prone to depreciative uses and unregulated vehicle activities;
- Large areas of carparking;
- Run-down residential areas (dead grass, bare sand, dead vegetation, derelict housing and/or buildings, abandoned and/or trashed cars);
- Graffiti;
- Intrusive billboards (particularly along roads and railway reserves);
- Buildings which contrast sharply from the surrounding built character (large, isolated shopping centres, apartments, hotels);
- Visibly dominant utilities (towers, transmission lines, overhead powerlines);
- Severed or badly pruned street trees;
- Poorly maintained waterways and drains prone to stagnation, pollution and littering;
- Extensive retaining walls which result in concrete canyon effects on roadways, and
- Buildings that create a solid wall effect (no gaps to allow views between buildings).

Figure 9: Typical view of an urban landscape typology

4.4 'YARROWEE VALLEY' LANDSCAPE CHARACTER PREFERENCE INDICATORS

Landscape Typology

Rural

Most Preferred Landscape features

- Presence of ancient geological features such as rock escarpments, and undulations in topography
- Views to waterbodies and streams
- Enclosed valley views, and views to valley floors
- Gradual transition zones between agricultural land and natural landscape
- Large mature trees
- Distant horizons
- Access roads and service lines which follow contour lines where ever practicable

Least Preferred Landscape Features

- Utilities that contrast significantly from rural landscape characteristics, including utility towers and power-lines.
- Areas of extensive weed infestation
- Eroded areas
- Abrupt changes in landform (cut or fill) that are conspicuous within the natural landscape
- Hard edges or surfaces in landscaping
- Unsympathetic or incongruous buildings and structures
- Development on and near prominent hilltops steep slopes and escarpments
- Exposed fill, or unvegetated/grassed modified land

Overall Relative Landscape Value

Low to Moderate

The 'Yarrowee Valley' landscape character is an extensive character type with an inconsistency of appearance due to existing extractive and industrial land use. This landscape type exhibits several preferred landscape features, and some least preferred landscape features. Hence, it is considered to be of 'Low to Moderate' landscape value.

4.5 'RESIDENTIAL URBAN' LANDSCAPE CHARACTER PREFERENCE INDICATORS

Landscape Typology

Built

Most Preferred Landscape Features

- Presence of trees, greenery, parks and gardens, street trees, canopied streets, median strip vegetation;
- Well maintained gardens (native and exotic);
- View of water bodies or natural features
- Diverse building styles
- Historic features

Least Preferred Landscape Features

- Eroded areas.
- Lack of vegetation;
- Extensive retaining walls which result in concrete canyon effects on roadways, and
- Buildings that create a solid wall effect (no gaps to allow views between buildings).
- Derelict industrial areas (junkyards);
- Visually prominent utilities (towers, transmission lines, overhead powerlines)
- Graffiti;

Overall Relative Landscape Value

Low

The 'Residential Urban' landscape character is relatively homogeneous. This landscape type exhibits some 'most preferred landscape features', and some 'least preferred landscape features'. It is considered to be of 'Low' landscape value.

Figure 10: Typical view of 'Yarrowee Valley' landscape character

Figure 11: Typical view of 'Urban Residential' landscape character

5 VISUAL IMPACT ASSESSMENT

5.1 INTRODUCTION

This section of the assessment aims to determine the visual impact of the proposed development on the surrounding landscape, through the process of undertaking the following:

- Determination of the Zone of Theoretical Visual Influence (or 'viewshed') of the proposed development as a means of identifying all areas of the existing landscape within 2 kilometres of the development site from which the development will potentially be visible;
- Identifying and describing a series of representative view locations and non-stakeholder residential view locations from which the development will be visible; and
- Preparing a series of computer-generated photomontage images as a means of demonstrating the anticipated visual presence of the development from each of the view locations; and
- In consideration of the landscape character attributes and landscape values described in earlier sections of this report, and using the photomontage images as points of reference, a level of magnitude of visual impact will be described for each representative view location.

The assessment of visual impact (level of magnitude) for each view location will discuss the need for mitigation of the visual impact in each instance, and will outline and describe appropriate measures to achieve an appropriate level of mitigation.

Mitigation measures are deemed necessary for any visual impact assessed as Moderate or above. Due to the inherent higher sensitivity of private residences to changes in the landscape, mitigation measures are also deemed necessary for any visual impact at a private residential view location which is assessed as 'Limited' or above.

5.2 ZONE OF THEORETICAL VISUAL INFLUENCE

The Zone of Theoretical Visual Influence comprises all land within 2 kilometres of the proposed TSF4 site from which one or more elements associated with the proposed TSF4 development may potentially be visible.

The following describes the viewshed assessment methodology used to develop the 'Viewshed' mapping, as represented in *Figure 12*. This mapping is a digitally-produced graphic representation of areas on and surrounding the proposed development site from which the proposed development is potentially visible. This assessment is subsequently used to guide the selection of photomontage view locations.

It is important to emphasise that the viewshed assessment process undertaken is a 'virtual' exercise, which utilises only topographical data to generate viewshed assessment mapping. It does not take into account 'real world' obstacles such as buildings and vegetation, which obstruct or reduce views. In this regard, it presents what can be described as a 'worst case scenario', as the presence of existing buildings and vegetation almost always results in a 'real' viewshed being less extensive than a virtual viewshed, for any given point. As such, the Zone of Theoretical Visual Influence mapping should not be relied upon as a definitive representation of the visibility (or otherwise) of a proposed development, but rather should be used to guide the subsequent identification of view locations for the preparation of photomontage images, which can be relied upon as definitive representations of visibility and visual impact.

A viewshed is defined as the surface area or terrain visible from a given view location. It is also the area from which that view location or series of view locations may be seen. This is referred to as the 'intervisibility' relation. The visibility between two points depends on the presence of on-ground obstacles, such as vegetation and buildings along the sight-line which connects the two points. Such obstacles may obstruct or reduce the reciprocal vision of the same two points.

Viewshed assessment to produce Zone of Theoretical Visual Influence mapping involves the use of computer software packages to translate topographical data (i.e. contour lines) into a 3-dimensional digital terrain model.

The project was modelled using *3DS Max 2019* software, and utilised 1 metre contour data obtained from Victorian Government data.

This information was subsequently used to guide the identification of view locations for which photomontages were generated as a means of demonstrating the visual impact of the proposed development, and the degree to which mitigation of visual impact is required.

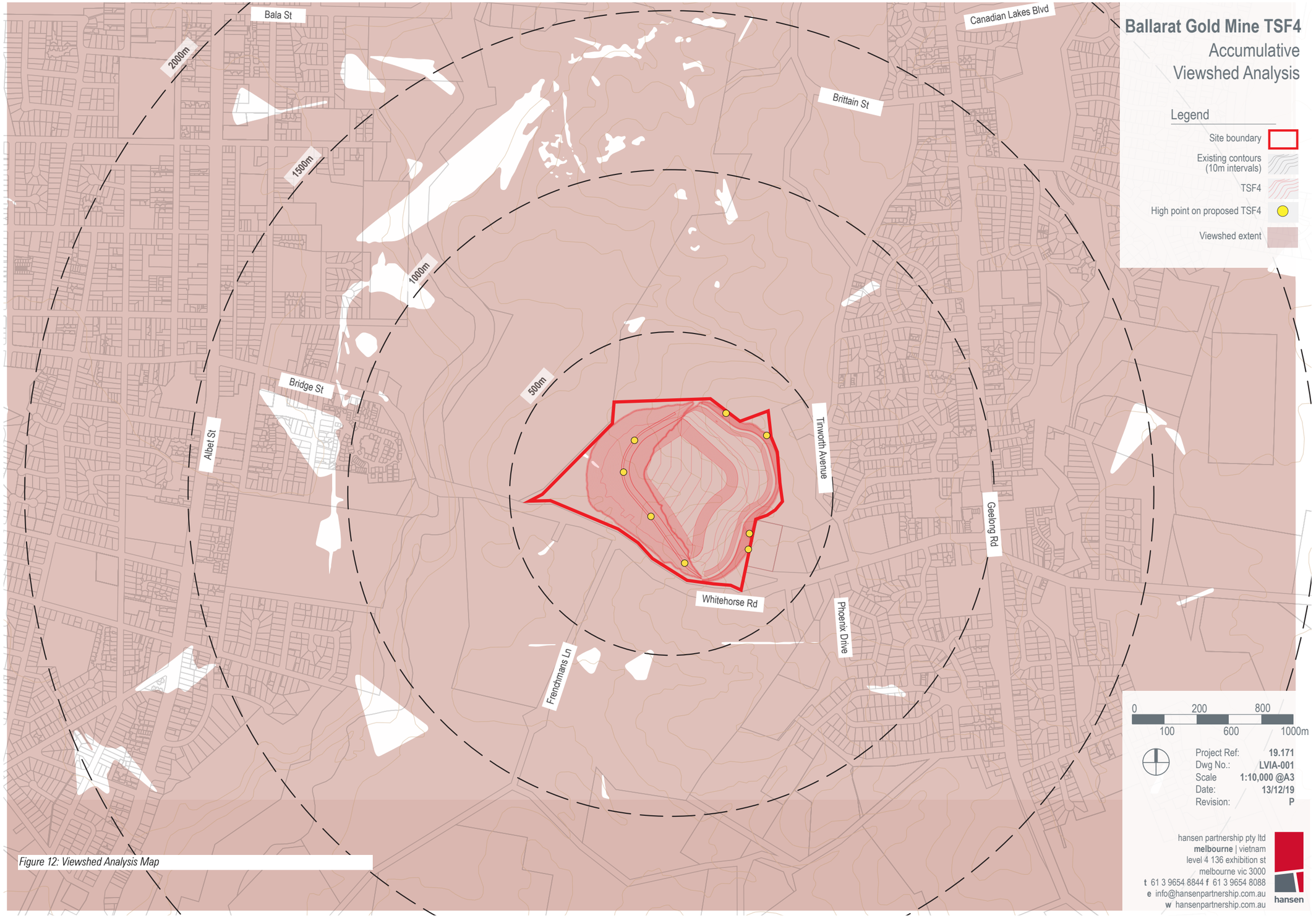


Figure 12: Viewshed Analysis Map

5.3 ASSESSMENT OF VISUAL IMPACT FROM REPRESENTATIVE VIEW LOCATIONS

5.3.1 REPRESENTATIVE VIEW LOCATIONS

A series of 4 view locations have been selected for the preparation of photomontage images to demonstrate the visibility and visual impact of the proposed development. The locations of the representative view locations are:

- View location 1 - Bridge Street, Sebastopol, some 1.18 kilometres from the proposed TSF4;
- View location 2 - Darling Street, Sebastopol, some 807 metres from the proposed tailings TSF4;
- View location 3 - Morgan Street, Sebastopol, approximately 1 kilometre from the proposed TSF4;
- View location 4 - Tinworth Avenue, Mount Clear, approximately 457.81m for the proposed TSF4

A detailed description of the location, visual character, anticipated visual impact and recommended mitigation measures is provided for each of the above view locations over the following pages.

A further four view locations initially considered on the basis of viewshed mapping have been included in *Appendix B: Existing View Photomontages* of this report. Those views which were not selected for inclusion in the report showed no or a very minimal portion of the proposed TSF4 in the view.

5.3.2 ASSESSMENT CRITERIA - REPRESENTATIVE VIEWS

In adopting a series of criteria for assessing the visual impact of representative and private view locations, it is important to define a range of terms which provide some indication of the extent to which a view location may be impacted upon visually by the proposed development, and when mitigation measures are considered necessary.

In determining this range a grading system of visual impact categories is described below. Consideration of mitigation measures is desirable for any visual impact at representative view location which is assessed as 'Moderate' or above, and for any visual impact at private view locations which are assessed as 'Limited' or above.

Extreme: entailing close proximity in an exposed location incapable of effective mitigation, where in principle the proposed structures would impact unacceptably on visual amenity, with limited opportunity for the implementation of mitigation measures.

Substantial: where impacts will be substantial, with the proposed structures forming a major element in the view. There will be a tendency for proposed structures to be more dominant than other landscape elements. Consideration of the feasibility and appropriateness of mitigation measures will determine whether or not the development results in unacceptable impacts on visual amenity.

Moderate: proposed structures will typically be visible, sometimes obviously so. Notwithstanding this, the generally greater distances involved, together with the contribution to visual screening typically provided by topography or vegetation, results in situations where proposed structures will not be a dominant element in the view. Mitigations measures are desirable.

Limited: proposed structures are visible but form only minor elements in available views as a result of distance and/or screening by vegetation and/or topography. Mitigation measures are considered unnecessary for impacts experienced from representative view locations, but are recommended for impacts experienced from private view locations.

Negligible: proposed structures are visible in clear conditions and may be recognisable, but conversely may sometimes not even be noticed. Mitigation measures are considered unnecessary.

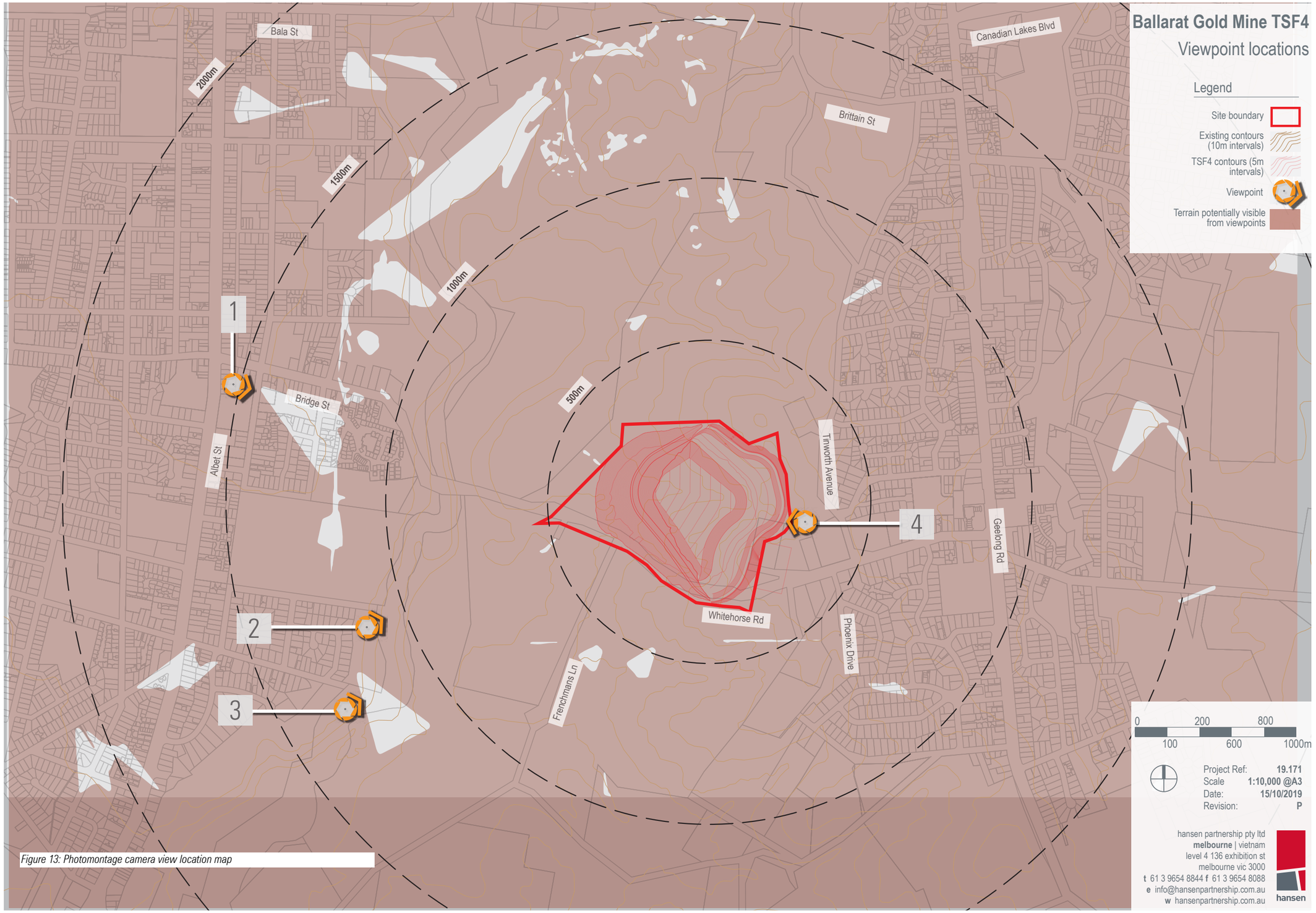


Figure 13: Photomontage camera view location map

5.3.3 View location 1

Location

View location 1 is located at Bridge Street, Sebastopol, facing southeast towards the proposed Ballarat Gold Mine, at a distance of approximately 1.18 Kilometres.

Visual character

The view is located within the 'Urban Residential' character type, with narrow views toward the 'Yarrowee Valley' landscape which includes the site of the proposed Ballarat Gold Mine Tailing Storage Facility (TSF4).

The existing view is represented in the 'existing view' photomontage (*Fig 14: VIA-001).* It shows that the foreground and middle-ground of the view consists of features typical of the 'Urban Residential' character: Paved roads, street signage and utilities including overhead powerlines which are present and obvious elements within the landscape.

The background of the view consists of dense vegetation associated with the 'Yarrowee Valley' landscape. Views toward the vegetation in the background are significantly interrupted by built elements such as houses, electricity poles and lines which also criss-cross against the sky.

Rationale for selection

This view location was selected on the basis that it is representative of views from Bridge Street toward the 'Yarrowee Valley' landscape character type to the east. These views are available to people travelling east along the road from Sebastopol toward Mount Clear. The view is located within the 'Urban Residential' landscape where a long distant view toward the proposed TSF4 site is afforded.

Anticipated visual impact of TSF4 at closure prior to vegetative rehabilitation

The photomontage view of the proposed TSF4 at closure prior to vegetative rehabilitation (*Fig 16: VIA-003)* illustrates the visibility of the proposed TSF4 facility and associated changes to the existing view. It is anticipated that the proposed TSF4 would not be visible from this location due to the presence of mature trees in front of the proposed TSF4 site. These trees would be not be removed as part of the proposed TSF4.

Therefore, with respect to landscape values, the proposed tailings storage would not replace views to the previously identified 'preferred landscape features' from this location. Nor would it diminish the visual contribution made to this view by 'preferred landscape features'.

On the basis of the above, with reference to the criteria for assessment described in Section 5.3, the visual impact at View location 1 of the proposed TSF4 at closure prior to vegetative rehabilitation (as illustrated in *Fig.16: VIA-003*) is considered to be 'Negligible'.

Anticipated visual impact of TSF4 at closure with vegetative rehabilitation

The photomontage view of the proposed TSF4 at closure with vegetative rehabilitation (*Fig 17: VIA-004)* illustrates the visibility of the proposed tailings storage and associated changes to the existing view. The photomontage shows the proposed tailings storage facility (TSF4) would not be visible from this location due to the presence of dense vegetation between the proposed TSF4 site, which would be not be removed as part of the proposed TSF4 work.

Therefore, with respect to landscape values, the proposed tailings storage would not replace views to the previously identified 'preferred landscape features' from this location. Nor would it diminish the visual contribution made to this view by 'preferred landscape features'.

On the basis of the above, with reference to the criteria for assessment described in Section 5.3, the visual impact at View location 1 of the proposed TSF4 at closure with vegetative rehabilitation (as illustrated in *Fig.17: VIA-004*) is considered to be 'Negligible'.

Recommended mitigation measures

In summary, at View location 1 the visual impact of the proposed TSF4 at closure with and without vegetative rehabilitation is 'Negligible', and the relative value of the 'Urban Residential' character within which it is viewed is 'Low'. Therefore, mitigation measures are not considered necessary for this view.

Photomontage
Exisiting view

View location 1 - from Bridge St, Sebastopol, looking East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.28 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 1:
e: 750847.8750
n: 5834897.0290
rl: 421.8210

Approx. distance from proposed sitework
1184.35 m

Figure 14: VIA-001

project ref: 19.171
dwg no.: VIA-001
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
level 4 136 exhibition st
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

hansen partnership pty ltd

Photomontage
Existing view with wireframe of proposed TSF4 at closure

View location 1 - from Bridge St, Sebastopol, looking East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.28 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 1:
e: 750847.8750
n: 5834897.0290
rl: 421.8210

Approx. distance from proposed sitework
1184.35 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

Figure 15: VIA-002

hansen partnership pty ltd

project ref: 19.171
dwg no.: VIA-002
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
level 4 136 exhibition st
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au

hansen

Photomontage
View of proposed TSF4 at closure prior to vegetative rehabilitation

View location 1 - from Bridge St, Sebastopol, looking East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.28 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 1:
e: 750847.8750
n: 5834897.0290
rl: 421.8210

Approx. distance from proposed sitework
1184.35 m

Figure 16: VIA-003

project ref: 19.171
dwg no.: VIA-003
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
level 4 136 exhibition st
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au

hansen

hansen partnership pty ltd

Photomontage
View of proposed TSF4 at closure with vegetative rehabilitation

View location 1 - from Bridge St, Sebastopol, looking East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.28 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 1:
e: 750847.8750
n: 5834897.0290
rl: 421.8210

Approx. distance from proposed sitework
1184.35 m

Figure 17: VIA-004
hansen partnership pty ltd

project ref: 19.171
dwg no.: VIA-004
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
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e info@hansenpartnership.com.au
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hansen

5.3.4 View location 2

Location

View location 2 is located at Darling Street, Sebastopol, facing northeast towards the proposed Ballarat Gold Mine, at a distance of approximately 800 metres away.

Visual character

The view location is within the 'Urban Residential' character type, with interrupted views across land which is within the 'Yarrowee Valley' landscape and which includes the proposed Ballarat Gold Mine TSF4.

The existing view is represented in the 'existing view' photomontage (*Fig 18: VIA-005)*. It shows that the foreground and middle-ground of the view consists of varied vegetation; the top portion of a patch of trees is associated with the Yarrowee River Reserve, and a deciduous tree to the left of the view screens views beyond.

The middle-ground of the existing view consists of a row of tall trees in the centre of the view, a body of water, and mown pastures.

The background of the view consists of elevated undulating land. Some patches of this land are bare, and others densely vegetated. This is consistent with the timber harvesting activity prevalent throughout the 'Yarrowee Valley' landscape.

It is noted that though the existing view shows high vegetation coverage throughout the background, this vegetation is subject to removal as of right. Therefore, the vegetation within the background of the view shall not be considered as a 'preferred landscape feature', and any impacts to this feature shall not be considered as diminishing the value of a 'preferred landscape feature'.

Rationale for selection

This view location was selected on the basis that it is representative of views experienced by local residents on Darling Street toward the 'Yarrowee Valley' character type to the north east.

Anticipated visual impact of TSF4 at closure prior to vegetative rehabilitation

Changes to the existing view at TSF4 closure prior to revegetation are illustrated in *Fig 20: VIA-007.* These changes consist of: removal of existing vegetation, addition of an exposed rock face embankment, an area of modified terrain (seen at an approximate bearing of 80 degrees), and black chain mesh boundary fencing.

Based on the photomontage proposed view of the TSF4 prior to rehabilitative vegetation it is anticipated that the existing area of pine plantation would be removed from this view and some vegetation would be replaced by new features. However, with respect to landscape values, these trees are not considered to be a 'preferred landscape feature' on account of their status for removal 'as-of'right'. Therefore, the proposed TSF4 at completion prior to revegetation would not replace views to any 'preferred landscape features'.

The elements which would be introduced to this view consist of the proposed boundary fence, the exposed rock face of the TSF4 and a portion of modified terrain. It is anticipated that the proportion of the fence which can be seen forms a very minor element in the overall view and does not represent a dominant element in the landscape.

Whilst other new elements have been introduced to the view, it is anticipated that the proposed change would not alter the existing profile of the horizon, nor would the unvegetated appearance of the tailings storage embankment be inconsistent with the visual features expected of the surrounding landscape during periods of timber harvest. Therefore, the proposed TSF4 would not introduce a new 'least preferred' landscape feature to the view.

On the basis of the above, and with consideration that the proposed change occupies a minor proportion of the overall view, with reference to the criteria for assessment described in Section 5.3, the visual impact of the proposed TSF4 at closure prior to revegetation at View location 2 (as illustrated in *Fig.20: VIA-007*) is considered to be 'Limited'.

Anticipated visual impact of TSF4 at closure with vegetative rehabilitation

The photomontage view of the proposed TSF4 (*Fig 21: VIA-008*) illustrates the visibility of the TSF4 at completion with rehabilitative vegetation. The photomontage shows that the exposed rock face of the proposed TSF4 would be visible from this location.

With respect to landscape values, the proposed tailings storage would not replace views from this location to landscape features that are consistent with 'most preferred landscape features' of the 'Yarrowee Valley' landscape. Areas of timber plantation shown in the existing view would be removed in the proposed view, and rehabilitated back to timber plantation as is consistent with the existing land use.

Whilst a new element has been introduced to the view, it is anticipated that the proposed change would not alter the existing profile of the horizon, nor would the unvegetated appearance of the tailings storage embankment be inconsistent with the visual features expected of the surrounding landscape during periods of timber harvest. Therefore, the proposed tailings storage would not introduce a new 'least preferred' landscape feature to the view.

On the basis of the above, and with consideration that the proposed change occupies a minor portion of the overall view, with reference to the criteria for assessment described in Section 5.3, the visual impact of the proposed TSF4 at View location 2 (as illustrated in *Fig.21: VIA-008*) is considered to be 'Limited'.

Recommended mitigation measures

In summary, at View location 2 the relative value of the 'Urban Residential' character within which it is viewed is 'Low' and the visual impact of the proposed TSF4 at closure with and without vegetative rehabilitation is considered to be 'Limited'. Therefore, mitigation measures are not considered necessary for this view.

Photomontage
Exisiting view

View location 2 - from Darling St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.00 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 2:
e: 751255.8050
n: 5834128.5270
rl: 413.3100

Approx. distance from proposed sitework
807.36 m

Figure 18: VIA-005
hansen partnership pty ltd

project ref: 19.171
dwg no.: VIA-005
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
level 4 136 exhibition st
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

Photomontage
Existing view with wireframe of proposed TSF4 at closure

View location 2 - from Darling St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.00 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 2:
e: 751255.8050
n: 5834128.5270
rl: 413.3100

Approx. distance from proposed sitework
807.36 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

Figure 19: VIA-006

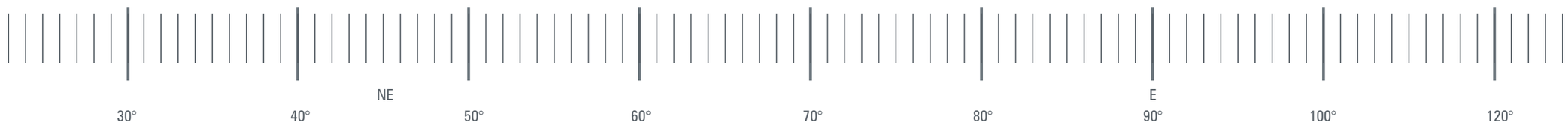
project ref: 19.171
dwg no.: VIA-006
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
level 4 136 exhibition st
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

hansen partnership pty ltd

Photomontage
View of proposed TSF4 at closure prior to vegetative rehabilitation



View location 2 - from Darling St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.00 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 2:
e: 751255.8050
n: 5834128.5270
rl: 413.3100

Approx. distance from proposed sitework
807.36 m

Figure 20: VIA-007
hansen partnership pty ltd

project ref: 19.171
dwg no.: VIA-007
date: 12/12/19
revision: P

Camera location

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hansen

Photomontage
View of proposed TSF4 at closure with vegetative rehabilitation

View location 2 - from Darling St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.00 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 2:
e: 751255.8050
n: 5834128.5270
rl: 413.3100

Approx. distance from proposed sitework
807.36 m

Figure 21: VIA-008

project ref: 19.171
dwg no.: VIA-008
date: 12/12/19
revision: P1

Camera location

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hansen partnership pty ltd

5.3.5 View location 3

Location

View location 3 is located at Morgan Street, Sebastopol, facing northeast towards the proposed Ballarat Gold Mine, at a distance of approximately 1 kilometres away.

Visual character

The view location is within the 'Urban Residential' character type, with interrupted views across land which is within the 'Yarrowee Valley' landscape and which includes the proposed Ballarat Gold Mine tailing storage.

The existing view is represented by the photomontage 'existing view' *(Fig 22: VIA-009)*. It shows that the foreground and middle-ground of the view consists of vegetation and earthworks within a road reserve. A residential building dominates the vie to the left side of the view

To the right side of the frame, landscape which is typical of the Yarrowee River Reserve extends across the middle-ground of the view composed of: presence of water bodies, native vegetation and gently undulating hills. There is a distinct area of erosion within the middle-ground on a hillside.

The view is expansive on account of the high elevation at the view location in comparison to the land in the distance. The background is comprised of elevated undulating land. Some patches of this land are bare, and others densely vegetated. This is consistent with the tree removal activity prevalent throughout the 'Yarrowee Valley' landscape.

It is noted that though the existing view shows high vegetation coverage throughout the background, and a high proportion of this vegetation is softwood plantation which is subject to removal as of right. Therefore, the vegetation within the background of the view shall not be considered as a 'preferred landscape feature' and any impacts to this feature shall not be considered as diminishing the value of a 'preferred landscape feature'.

Rationale for selection

This view location was selected on the basis that it is representative of views from local residents on Morgan Street toward the 'Yarrowee Valley' character type to the north.

Anticipated visual impact of TSF4 at closure prior to vegetative rehabilitation

Changes to the existing view at TSF4 closure prior to revegetation are illustrated in *Fig 24: VIA-011*. These changes consist of: removal of existing vegetation, addition of an exposed rock face embankment, an area of modified terrain (seen at an approximate bearing of 70 degrees), and black chain mesh boundary fencing.

Based on the photomontage proposed view of the TSF4 prior to rehabilitative vegetation it is anticipated that the existing area of pine plantation would be removed from this view and some vegetation would be replaced by new features. However, with respect to landscape values, these trees are not considered to be a 'preferred landscape feature' on account of their status for removal 'as-of'right'. Therefore, the proposed TSF4 at completion prior to revegetation would not replace views to any 'preferred landscape features'.

The elements which would be introduced to this view consist of the proposed boundary fence, the exposed rock face of the TSF4 and the face of the modified terrain. It is anticipated that the proportion of the fence which can be seen forms a very minor element in the overall view and does not represent a dominant element in the landscape.

Whilst other new elements have been introduced to the view, it is anticipated that the proposed change would not alter the existing profile of the horizon, nor would the unvegetated appearance of the tailings storage embankment be inconsistent with the visual features expected of the surrounding landscape during periods of timber harvest. Therefore, the proposed tailings storage would not introduce a new 'least preferred' landscape feature to the view.

On the basis of the above, and with consideration that the proposed change occupies a minor proportion of the overall view, with reference to the criteria for assessment described in Section 5.3, the visual impact of the proposed TSF4 at closure prior to revegetation at View location 3 (as illustrated in *Fig.24: VIA-011*) is considered to be 'Limited'.

Anticipated visual impact of TSF4 at closure with vegetative rehabilitation

The photomontage view of the proposed Tailings Storage Facility at completion *(Fig 25: VIA-012)* illustrates the associated changes to the existing view. The photomontage shows that the proposed TSF4 would be viewed from this location.

With respect to landscape values, the proposed tailings storage would not replace views from this location to landscape features that are consistent with 'most preferred landscape features' of the 'Yarrowee Valley' landscape. Areas of timber plantation shown in the existing view would be removed in the proposed view, and rehabilitated back to timber plantation as is consistent with the existing land use.

Whilst a new element has been introduced to the view, it is anticipated that the proposed change would not alter the existing profile of the horizon, nor would the unvegetated appearance of the tailings storage embankment be inconsistent with the visual features expected of the surrounding landscape during periods of timber harvest. Therefore, the proposed tailings storage would not introduce a new 'least preferred' landscape feature to the view.

With reference to the criteria for assessment described in Section 5.3, on the basis of the above, and with consideration that the proposed change occupies a minor portion of the overall view, the visual impact of the proposed TSF4 at view location 3 (as illustrated in *Fig.25: VIA-012)* is considered to be 'Limited'.

Recommended mitigation measures

In summary, at View location 3 the relative value of the 'Urban Residential' character within which it is viewed is 'Low' and the visual impact of the proposed TSF4 at closure with and without vegetative rehabilitation is considered to be 'Limited'. Therefore, mitigation measures are not considered necessary for this view.

Photomontage
Exisiting view

20 30° 40° 50° 60° 70° 80° NE 90° E 100°

View location 3 - from Morgan St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.07 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 3:
e: 751192.6820
n: 5833881.9270
rl: 412.4660

Approx. distance from proposed sitework
1015.74 m

Figure 22: VIA-009

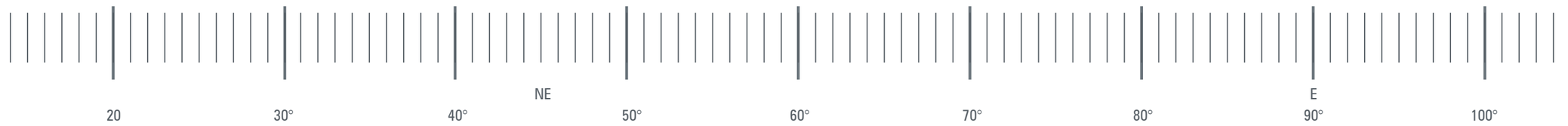
project ref: 19.171
dwg no.: VIA-009
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
level 4 136 exhibition st
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

hansen partnership pty ltd

Photomontage
Existing view with wireframe of proposed TSF4 at closure



View location 3 - from Morgan St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.07 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 3:
e: 751192.6820
n: 5833881.9270
rl: 412.4660

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

Approx. distance from proposed sitework
1015.74 m

Figure 23: VIA-010

hansen partnership pty ltd

project ref: 19.171
dwg no.: VIA-010
date: 12/12/19
revision: P1

Camera location

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melbourne vic 3000
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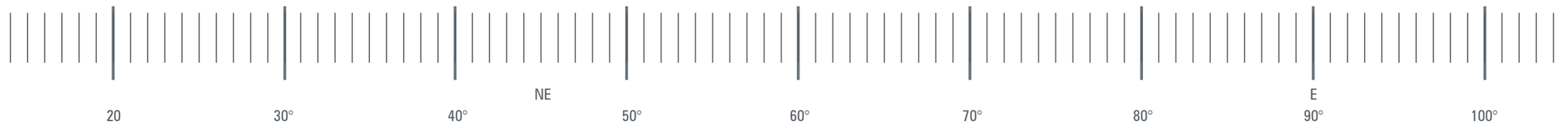
hansen

Photomontage
View of proposed TSF4 at closure prior to vegetative rehabilitation



View location 3 - from Morgan St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.07 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 3:
e: 751192.6820
n: 5833881.9270
rl: 412.4660

Approx. distance from proposed sitework
1015.74 m

Figure 24: VIA-011

project ref: 19.171
dwg no.: VIA-011
date: 12/12/19
revision: P

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
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melbourne vic 3000
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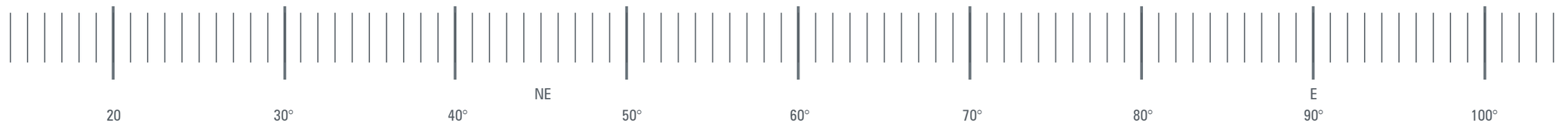
w hansenpartnership.com.au

hansen

hansen partnership pty ltd

Photomontage
View of proposed TSF4 at closure with vegetative rehabilitation



View location 3 - from Morgan St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.07 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 3:
e: 751192.6820
n: 5833881.9270
rl: 412.4660

Approx. distance from proposed sitework
1015.74 m

Figure 25: VIA-012

hansen partnership pty ltd

project ref: 19.171
dwg no.: VIA-012
date: 12/12/19
revision: P1

Camera location

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5.3.6 View location 4

Location

View location 4 is located at Tinworth Avenue, Mount Clear, facing west towards the proposed TSF4, at a distance of approximately 460 metres away.

Visual character

The view location is within the 'Urban Residential' character type, with view toward land which is within the 'Yarrowee Valley' landscape and which includes the proposed Ballarat Gold Mine TSF4.

The following description of the existing view is based upon the view represented in the existing view *(Fig 26: VIA-013)*.

The foreground and middle-ground of the view consists of mature vegetation located on a road verge consisting of tussocks, shrubs and trees. This vegetation obscures view beyond except for a small proportion of the centre of the view.

At centre of the view, filtered views of the ranges beyond are seen through the trees.

It is noted that though the existing view shows distant views to ranges beyond, the area of land beyond the roadside vegetation is used for softwood plantation which at the time the photograph was taken, has recently been harvested. Therefore, the visible range in the background of the view shall not be considered as a 'preferred landscape feature' for this existing view and any impacts to this feature shall not be considered as diminishing the value of a 'preferred landscape feature'.

Rationale for selection

This view location was selected on the basis that it is representative of views from local residents on Tinworth Avenue toward the 'Yarrowee Valley' character type to the west

Anticipated visual impact of TSF4 at closure prior to vegetative rehabilitation

The photomontage view of the proposed TSF4 at completion prior to vegetative rehabilitation *(Fig 28: VIA-015)* illustrates the associated changes to the existing view. The photomontage shows that a minor proportion of vegetation would be removed and a minor proportion of the TSF4 would been seen from this view. It is anticipated that a small proportion of the existing plantation vegetation seen in the existing view is removed. The proposed fence would not be seen in the view

With respect to landscape values, the proposed TSF4 at closure prior to revegetation would not replace views from this location to landscape features that are consistent with 'most preferred landscape features' of the 'Yarrowee Valley' or the 'Urban Residential' landscape. Moreover, the proposed TSF4 would not introduce a new 'least preferred' landscape feature to the view.

Therefore, with reference to the criteria for assessment described in Section 5.3, on the basis of the above, the visual impact of the proposed TSF4 at view location 4 (as illustrated in *Fig.28: VIA-015)* is considered to be 'Negligible'.

Anticipated visual impact of TSF4 at closure with vegetative rehabilitation

The photomontage view of the proposed TSF4 at completion *(Fig 29: VIA-016)* illustrates the associated changes to the existing view. The photomontage shows that the proposed rehabilitation vegetation associated with the TSF4 would be viewed from this location.

With respect to landscape values, the proposed TSF4 would not replace views from this location to landscape features that are consistent with 'most preferred landscape features' of the 'Yarrowee Valley' landscape.

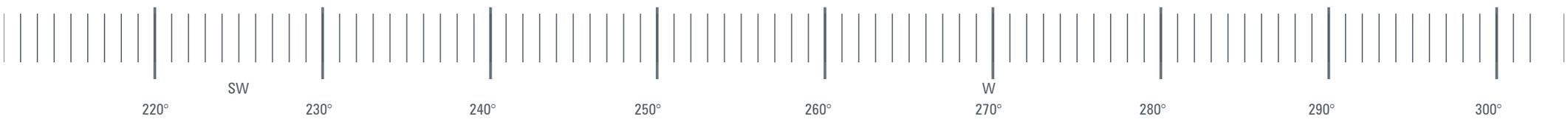
With respect to landscape values, the proposed TSF4 at closure with vegetative rehabilitation would not replace views from this location to landscape features that are consistent with 'most preferred landscape features' of the 'Yarrowee Valley' landscape. Moreover, the proposed TSF4 would not introduce a new 'least preferred' landscape feature to the view.

With reference to the criteria for assessment described in Section 5.3, on the basis of the above, the visual impact of the proposed TSF4 at view location 4 (as illustrated in *Fig.29: VIA-016)* is considered to be 'Negligible'.

Recommended mitigation measures

In summary, at View location 4 the visual impact of the proposed TSF4 at closure with and without vegetative rehabilitation is considered to be 'Negligible', and the relative value of the 'Urban Residential' character within which it is viewed is 'Low'. Therefore, mitigation measures are not considered necessary for this view.

Photomontage
Existing view



View location 4 - from Tinworth Avenue, Mount Clear, looking West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 4:
e: 752711.6740
n: 5834494.1930
rl: 461.6570

Approx. distance from proposed sitework
457.81 m

Figure 26: VIA-013

project ref: 19.171
dwg no.: VIA-013
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
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melbourne vic 3000
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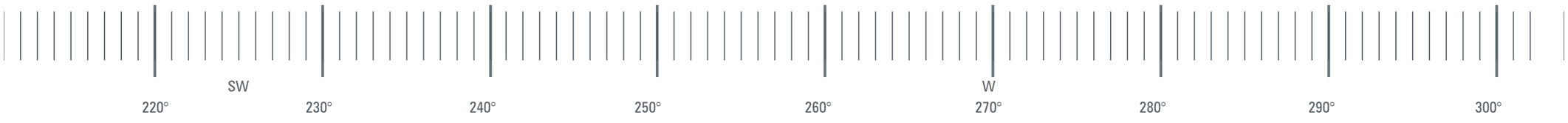
w hansenpartnership.com.au
hansen

Photomontage
Existing view with wireframe of proposed TSF4 at closure



View location 4 - from Tinworth Avenue, Mount Clear, looking West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 4:
e: 752711.6740
n: 5834494.1930
rl: 461.6570

Approx. distance from proposed sitework
457.81 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

Figure 27: VIA-014

;

project ref: 19.171
dwg no.: VIA-014
date: 12/12/19
revision: P1

Camera location

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w hansenpartnership.com.au
hansen

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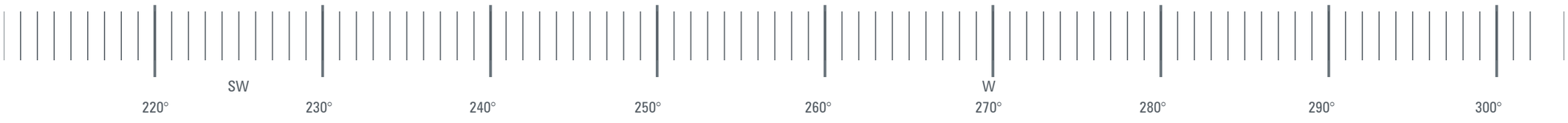
Photomontage
View of proposed TSF4 at closure prior to vegetative rehabilitation



View location 4 - from Tinworth Avenue, Mount Clear, looking West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 4:
e: 752711.6740
n: 5834494.1930
rl: 461.6570

Approx. distance from proposed sitework
457.81 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

Figure 28: VIA-015

hansen partnership pty ltd

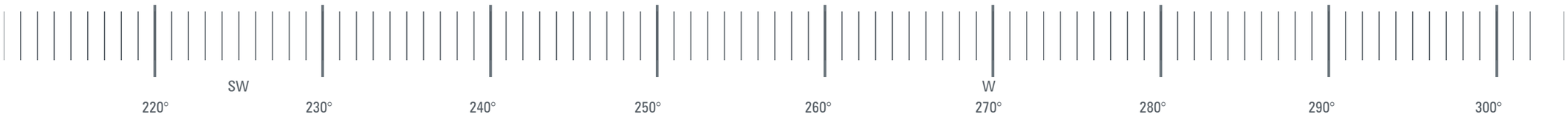
project ref: 19.171
dwg no.: VIA-015
date: 12/12/19
revision: P

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
level 4 136 exhibition st
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au

hansen

Photomontage
View of proposed TSF4 at closure with vegetative rehabilitation



View location 4 - from Tinworth Avenue, Mount Clear, looking West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 4:
e: 752711.6740
n: 5834494.1930
rl: 461.6570

Approx. distance from proposed sitework
457.81 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

Figure 29: VIA-016

project ref: 19.171
dwg no.: VIA-016
date: 12/12/19
revision: P1

Camera location

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t 61 3 9654 8844 **f** 61 3 9654 8088
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hansen partnership pty ltd

6 CONCLUSION

6.1 LANDSCAPE CHARACTER

Through the baseline desktop analysis and fieldwork, two landscape character precincts have been identified within the study area: 'Urban Residential' and 'Yarrowee Valley'

The character types are a subset of a broader landscape character type identified within the *Ballarat Strategic Plan: Our Vision for 2040, 2015*: the 'Mount Clear Goldfields' region which is described as a "*largely disturbed landscape has been reclaimed for forestry and utilised for public utilities including refuse tips and water treatment plants. It is the location for Ballarat's remaining gold mine currently in operation.*"

The landscape character precincts determined through this assessment are shown graphically in *Figure 7* within this report.

6.2 LANDSCAPE VALUE

This section of the assessment aims to assess the existing relative landscape value of the proposed development site and surrounding landscapes in an objective manner. This is to be achieved through the baseline analysis work and the fieldwork undertaken. Guidance is taken from benchmarking documents, primarily *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007* (VPLWA). In this manual landscape values are broadly defined as:

"Values or preferences refer to the value placed on a landscape feature by the community based primarily on its perceived visual quality."

The landscape character preference indicators identified in the VLPWA Manual have been developed using community preference research and subsequently list landscape features as being either most preferred or least preferred in a generalised landscape typology. These landscape typologies are categorised broadly as being natural, rural or built.

Much of the study area falls within the rural landscape typology, other than the area which falls within the 'Urban Residential' landscape character precinct, which is classed as a 'built' landscape typology.

The summarised landscape values for each landscape character are as follows:

- 'Urban Residential' - Low
- 'Yarrowee Valley' – Low to Moderate

6.3 VISUAL IMPACT ASSESSMENT CRITERIA

A series of criteria for assessing the visual impact of view locations is shown below. The criteria defines a range of terms which provide some indication of the extent to which a view location may be impacted upon visually by the proposed development:

- **Extreme**: entailing close proximity in an exposed location incapable of effective mitigation, where in principle the proposed structures would impact unacceptably on visual amenity, with limited opportunity for the implementation of mitigation measures.
- **Substantial**: where impacts will be substantial, with the proposed structures forming a major element in the view. There will be a tendency for proposed structures to be more dominant than other landscape elements. Consideration of the feasibility and appropriateness of mitigation measures will determine whether or not the development results in unacceptable impacts on visual amenity.
- **Moderate**: proposed structures will typically be visible, sometimes obviously so. Notwithstanding this, the generally greater distances involved, together with the contribution to visual screening typically provided by topography or vegetation, results in situations where proposed structures will not be a dominant element in the view. Mitigations measures are generally not necessary.
- **Limited**: proposed structures are visible but form only minor elements in available views as a result of distance and/or screening by vegetation and/or topography. Mitigation measures are considered unnecessary for representative view locations and desirable for private residential view locations.
- **Negligible**: proposed structures are visible in clear conditions and may be recognisable, but conversely may sometimes not even be noticed. Mitigation measures are considered unnecessary.

6.4 VISUAL IMPACT ASSESSMENT

The visual impact of the Ballarat Gold Mine Tailings Storage Facility TSF4 (at completion) has been assessed, and includes consideration of:

- Removal of existing timber plantation trees
- Construction of an above ground tailings storage;
- Construction of a sedimentation pond
- Construction of black chain mesh perimeter fencing
- Construction of Whitehorse Road turning lane into the TSF4 site with retention of nearby trees
- Capping of TSF4 following closure of operations
- Revegetation with timber plantation trees following closure of operations

Of a total 8 view locations considered, 4 view locations with the highest potential detrimental visual impact have been selected for detailed visual impact assessment and recommendations regarding the need for any mitigation of impacts.

The potential visual impact of the remaining 4 view locations was determined to be 'negligible' and therefore, was not considered for further assessment. The existing view locations and proposed TSF4 wireframe for each view are shown in *Appendix B* of this Report.

The visual impact of the TSF4 at closure prior to vegetative rehabilitation was also assessed for the below four view locations. It is anticipated that in view location 2 and 3, where there are existing views to areas of pine plantation, some of these trees would be removed or replaced. However, with respect to landscape values, these trees are not considered to be a 'preferred landscape feature' on account of their status for removal 'as-of'right'. In consideration of this, the proposed TSF4 at completion prior to revegetation would not replace views to any 'preferred landscape features', and the visual impact of the TSF4 at closure prior to vegetative rehabilitation is consistent with the final visual impact assessment of the TSF4 at closure with vegetation rehabilitation.

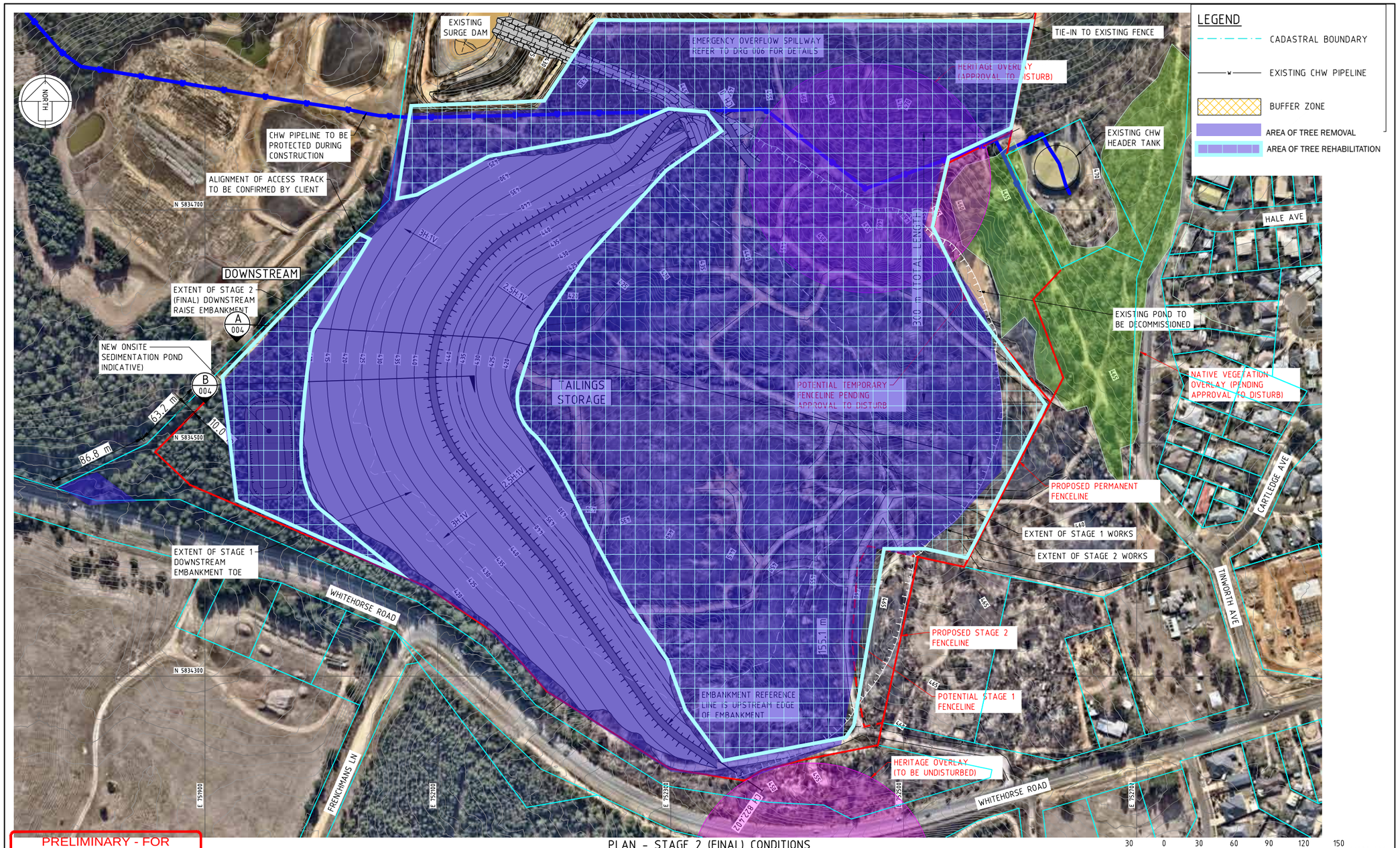
In summary, the locations of the 4 views with the highest potential visual impact, and the anticipated visual impact for each at closure of the TSF4 with vegetative rehabilitation are:

- View location 1 - Bridge Street, Sebastopol, some 1.18 kilometres from the proposed TSF4; Visual Impact is 'Negligible'
- View location 2 - Darling Street, Sebastopol, some 800m from the proposed TSF4; Visual impact is 'Limited'
- View location 3 – Morgan Street, Sebastopol, approximately 1.00 kilometre from the proposed TSF4; Visual impact is 'Limited'
- View location 4 - Tinworth Avenue, Mount Clear, approximately 460m for the proposed TSF4; Visual impact is 'Negligible'

The rehabilitation of the TSF4 at completion with timber plantation and retention trees along Whitehorse Road has resulted in only minor proportions of the views toward the TSF4 constituting 'least preferred' landscape features.

On the basis of the above assessment, the visual impact of the Ballarat Goldmine TSF4 is considered visually acceptable and mitigation measures are not considered necessary.

APPENDIX A: Site Works Plan



PRELIMINARY - FOR DISCUSSION ONLY

PLAN - STAGE 2 (FINAL) CONDITIONS
SCALE 1:1500

30 0 30 60 90 120 150
DIMENSIONS ARE IN METRES
1:1500 (A1)
1:3000 (A3)

ISO A1 594mm x 841mm

Last saved by: STEPHEN.CHIA(2019-09-06) Last Plotted: 2019-09-06
Filename: P:\605X\60593424\600_CAD_GIS\10_CAD\25_SKETCHES\FENCELINE\60593424-SKE-100 FENCELINE V2.DWG

AECOM

CONSULTANT
AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT
BALLARAT GOLD MINE
TSF4 - CONCEPT DESIGN

CLIENT
BALMAINE GOLD PTY LTD

PROJECT MANAGEMENT INITIALS		
LBB	SC	
DRAFTER	DESIGNER	APPROVED

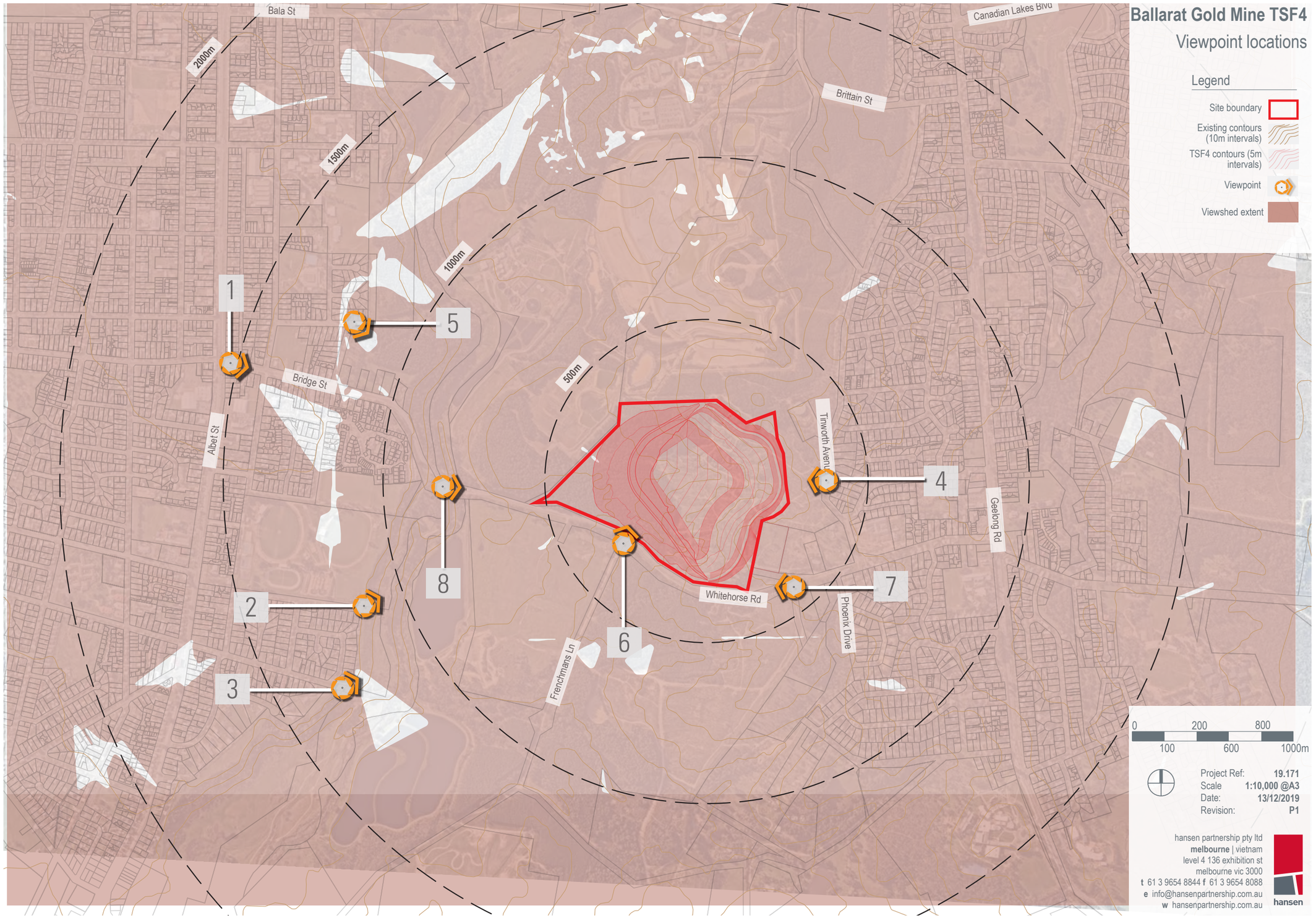
ISSUE/REVISION		
B	06.09.19	V2 CONCEPT
A	05.09.19	CONCEPT
I/R	DATE	DESCRIPTION

PROJECT NUMBER
60593424

SHEET TITLE
PROPOSED TSF4 FENCELINE

SHEET NUMBER 60593424-SKE-100
REVISION A

APPENDIX B: Photomontages


Ballarat Gold Mine TSF4
Viewpoint locations
Legend
Site boundary
Existing contours (10m intervals)
TSF4 contours (5m intervals)
Viewpoint
Viewshed extent
Bala St
Canadian Lakes Blvd
Brittain St
2000m
1500m
1000m
500m
1
2
3
4
5
6
7
8
Bridge St
Albet St
Tinworth Avenue
Geelong Rd
Whitehorse Rd
Phoenix Drive
Frenchmans Ln
0
200
800
100
600
1000m
Project Ref: 19.171
Scale 1:10,000 @A3
Date: 13/12/2019
Revision: P1
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hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Exisiting view

View location 1 - from Bridge St, Sebastopol, looking East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.28 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 1:
e: 750847.8750
n: 5834897.0290
rl: 421.8210

Approx. distance from proposed sitework
1184.35 m

project ref: 19.171
dwg no.: VIA-001
date: 12/12/19
revision: P1

Camera location

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w hansenpartnership.com.au
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4 at closure

View location 1 - from Bridge St, Sebastopol, looking East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.28 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 1:
e: 750847.8750
n: 5834897.0290
rl: 421.8210

Approx. distance from proposed sitework
1184.35 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

project ref: 19.171
dwg no.: VIA-002
date: 12/12/19
revision: P1

Camera location

hansen partnership pty ltd
melbourne | byron bay | vietnam
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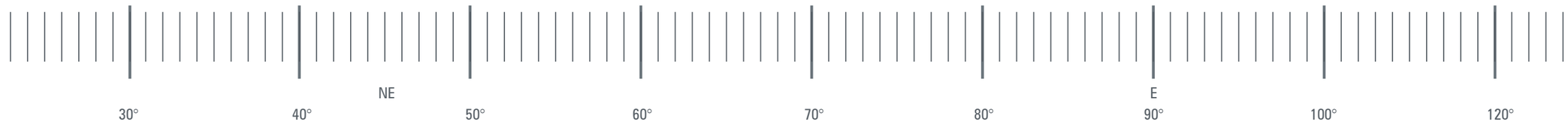
w hansenpartnership.com.au
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Exisiting view



View location 2 - from Darling St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.00 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 2:
e: 751255.8050
n: 5834128.5270
rl: 413.3100

Approx. distance from proposed sitework
807.36 m

project ref: 19.171
dwg no.: VIA-005
date: 12/12/19
revision: P1

Camera location

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melbourne | byron bay | vietnam
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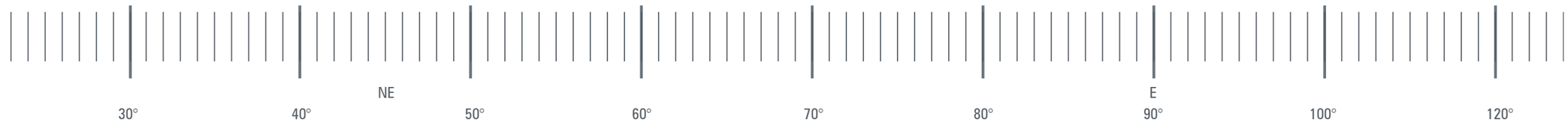
Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4 at closure



View location 2 - from Darling St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.00 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 2:
e: 751255.8050
n: 5834128.5270
rl: 413.3100

Approx. distance from proposed sitework
807.36 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

project ref: 19.171
dwg no.: VIA-006
date: 12/12/19
revision: P1

Camera location

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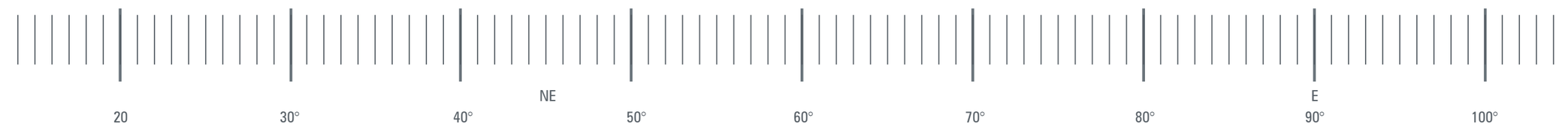
e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Exisiting view



View location 3 - from Morgan St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.07 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 3:
e: 751192.6820
n: 5833881.9270
rl: 412.4660

Approx. distance from proposed sitework
1015.74 m

project ref: 19.171
dwg no.: VIA-009
date: 12/12/19
revision: P1

Camera location

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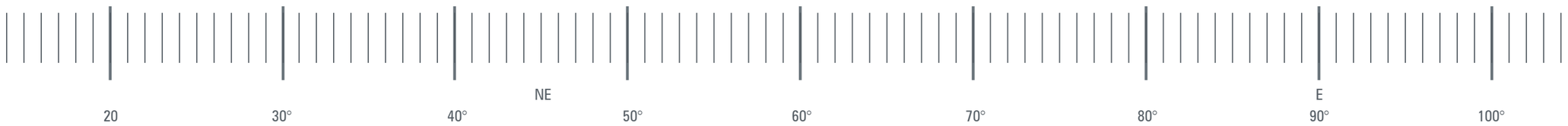
w hansenpartnership.com.au
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4 at closure



View location 3 - from Morgan St, Sebastopol, looking North East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.07 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 3:
e: 751192.6820
n: 5833881.9270
rl: 412.4660

Approx. distance from proposed sitework
1015.74 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

project ref: 19.171
dwg no.: VIA-010
date: 12/12/19
revision: P1

Camera location

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melbourne vic 3000
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e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view

View location 4 - from Tinworth Avenue, Mount Clear, looking West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 4:
e: 752711.6740
n: 5834494.1930
rl: 461.6570

Approx. distance from proposed sitework
457.81 m

project ref: 19.171
dwg no.: VIA-013
date: 12/12/19
revision: P1

Camera location

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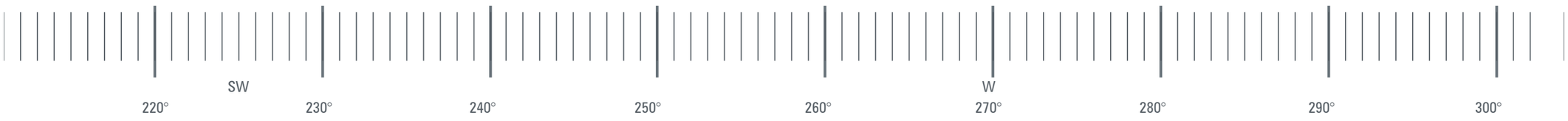
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4 at closure



View location 4 - from Tinworth Avenue, Mount Clear, looking West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

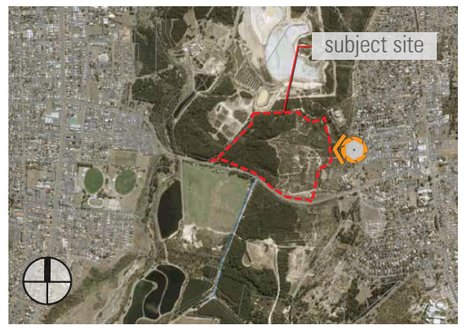
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 4:
e: 752711.6740
n: 5834494.1930
rl: 461.6570

Approx. distance from proposed sitework
457.81 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline



project ref: 19.171
dwg no.: VIA-014
date: 12/12/19
revision: P1

Camera location

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melbourne | byron bay | vietnam
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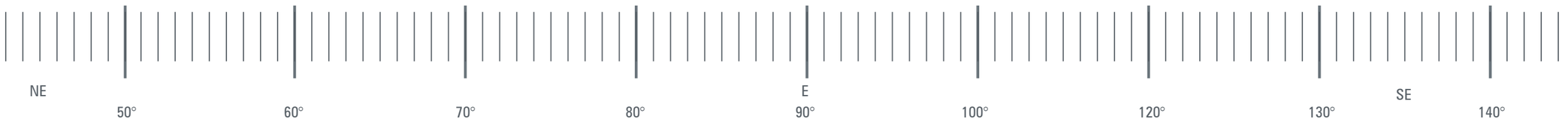
e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Exisiting view



View location 5 - from Whitehorse Rd, Sebastopol, looking South East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

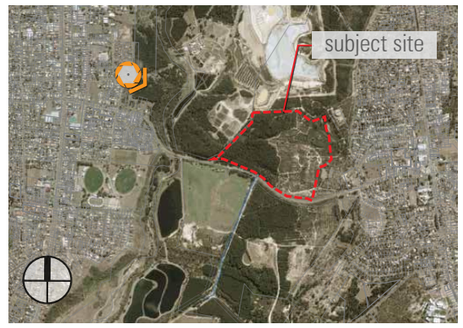
Photograph taken:
12.45 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 5:
e: 751486.2845
n: 5834513.1275
rl: 395.9645

Approx. distance from proposed sitework
497.89 m

project ref: 19.171
dwg no.: VIA-017
date: 12/12/19
revision: P1

Camera location



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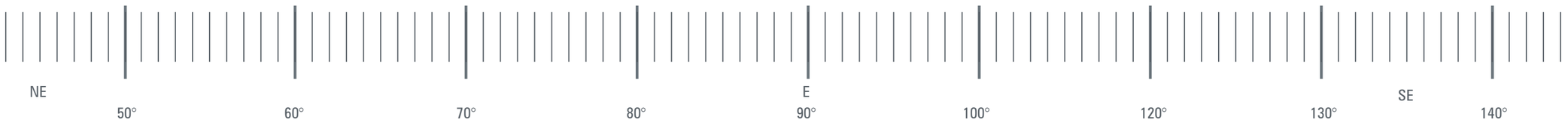
melbourne vic 3000
t 61 3 9654 8844 **f** 61 3 9654 8088
e info@hansenpartnership.com.au
w hansenpartnership.com.au
hansen

Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4



View location 5 - from Whitehorse Rd, Sebastopol, looking South East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.45 pm on the 17/09/19
Photo taken at:
160cm above ground level

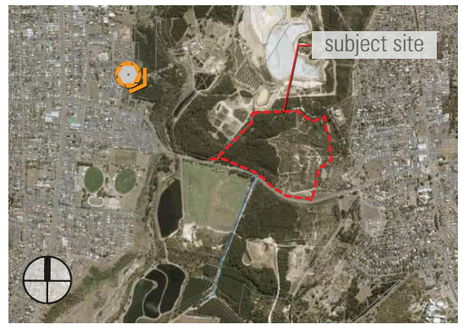
View location 5:
e: 751486.2845
n: 5834513.1275
rl: 395.9645

Approx. distance from proposed sitework
497.89 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

project ref: 19.171
dwg no.: VIA-018
date: 12/12/19
revision: P1

Camera location



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Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Exisiting view

View location 6 - from Frenchmans Lane, Mount Clear, looking North East toward subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.23 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 6:
e: 752039.0500
n: 5834257.9230
rl: 415.7950

Approx. distance from proposed sitework
132.38 m

project ref: 19.171
dwg no.: VIA-019
date: 12/12/19
revision: P1

Camera location

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Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4

View location 6 - from Frenchmans Lane, Mount Clear, looking North East toward subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
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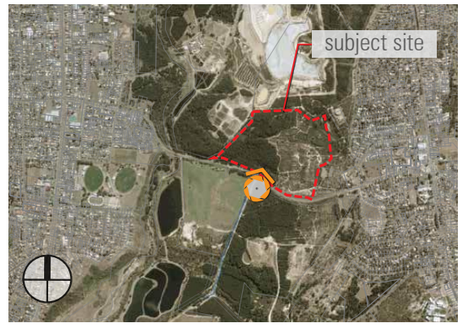
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.23 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 6:
e: 752039.0500
n: 5834257.9230
rl: 415.7950

Approx. distance from proposed sitework
132.38 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline



project ref: 19.171
dwg no.: VIA-020
date: 12/12/19
revision: P1

Camera location

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Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Exisiting view

View location 7 - from Bradleys Lane, Mount Clear, looking North West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 7:
e: 752617.7880
n: 5834200.5890
rl: 463.5060

Approx. distance from proposed sitework
279.02 m

project ref: 19.171
dwg no.: VIA-021
date: 12/12/19
revision: P1

Camera location

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Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4

View location 7 - from Bradleys Lane, Mount Clear, looking North West towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
01.32 pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 7:
e: 752617.7880
n: 5834200.5890
rl: 463.5060

Approx. distance from proposed sitework
279.02 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

project ref: 19.171
dwg no.: VIA-022
date: 12/12/19
revision: P1

Camera location

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Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view

View location 8 - from Kyle St, Sebastopol, looking South East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

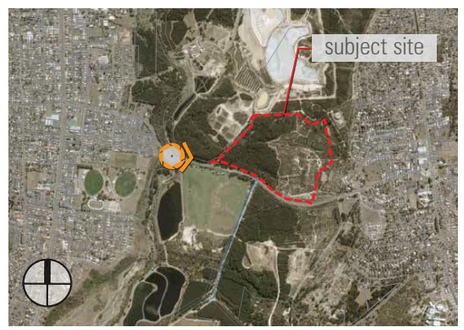
Photograph taken:
12.19pm on the 17/09/19
Photo taken at:
160cm above ground level

View location 8:
e: 751275.4590
n: 5835016.2070
rl: 419.0780

Approx. distance from proposed sitework
827.89 m

project ref: 19.171
dwg no.: VIA-023
date: 12/12/19
revision: P1

Camera location



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Ballarat Gold Mine Tailings Storage Facility (TSF4)

Photomontage
Existing view with wireframe of proposed TSF4

View location 8 - from Kyle St, Sebastopol, looking South East towards subject site

Photomontage created by:
TT - B.LA
Images created using:
3ds max 2019, autocad 2019, adobe photoshop, illustrator & indesign cc 2018, Corona 4
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 17/09/19

Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Photograph taken:
12.19pm on the 17/09/19
Photo taken at:
160cm above ground level

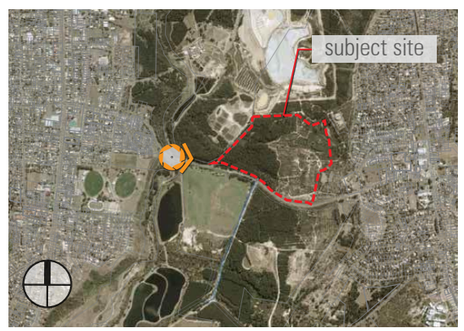
View location 8:
e: 751275.4590
n: 5835016.2070
rl: 419.0780

Approx. distance from proposed sitework
827.89 m

Wireframe outline of proposed TSF4
Wireframe outline of proposed fenceline

project ref: 19.171
dwg no.: VIA-024
date: 12/12/19
revision: P1

Camera location



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Appendix B Statutory Endorsement of Work Plan Variation

TSF4 Work Plan Variation
Balmaine Gold Pty Ltd
28-Apr-2020

AECOM Imagine it. Delivered.

Work Plan Variation - Whitehorse Gully Tailings Storage Facility (TSF4)

Ballarat Gold Mine - MIN4847 & MIN5396

Mineral Resources (Sustainable Development) Act 1990

Tenement Number: MIN4847 & MIN5396

Plan Number: PLN-001406

Work

Signed: [redacted]

Delegate of the Department Head

Date: 10/08/2020

Work Plan Variation - Whitehorse Gully Tailings Storage Facility (TSF4)

Ballarat Gold Mine - MIN4847 & MIN5396

Client: Balmaine Gold Pty Ltd

ABN: 67 142 297 685

Prepared by

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ABN 20 093 846 925

28-Apr-2020

Job No.: 60593424

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document	Work Plan Variation - Whitehorse Gully Tailings Storage Facility (TSF4)
Ref	60593424
Date	28-Apr-2020
Prepared by	[redacted]
Reviewed by	[redacted]

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	2 December 2019	Draft for client review	[redacted] Technical Director	
0	17-Dec-2019	Final- submitted to ERR	[redacted] Technical Director	[redacted]
1	28 April 2020	Revised follow ERR comments	[redacted] Technical Director	

Table of Contents

1.0 Introduction

PLAN SUMMARY DETAILS	
Project Name:	Ballarat Gold Mine – Whitehorse Gully Tailings Storage Facility (TSF4)
Plan ID:	PLN-0001406
Tenements:	MIN4847 & MIN5396
Plan Type:	Work Plan (Minerals)
Plan Sub-type:	Variation Statutory
ERRV Region:	South West

1.1 Project Background and Operational Need for a new TSF

Castlemaine Goldfields Pty Ltd (CGT) own and operate an underground gold mining operation located in Woolshed Gully, Ballarat, in central Victoria , known as the Ballarat East Project (now referred to as Ballarat Gold Mine (BGM))- refer to **Figure F1- Appendix A**. Ore from the underground mine (situated on MIN5396) is hauled to the mill site where it is processed. Tailings are pumped as slurry from the processing plant to the Terrible Gully Tailings Storage Facility (TSF), also referred to as TSF3, located 600 m south of the processing plant (TSF3 straddles MIN5396 and MIN4847).

The Terrible Gully TSF (TSF3) has been expanded a number of times and will reach its approved capacity by Jan 2022. Therefore, to continue operations at BGM there is a need to store and manage approximately 17,000m^3 of tailings per month. Avoidance of production of tailings is not possible due to processing of extracting gold from the ore which produces tailings a by-product.

A review of the options for tailings management post TSF3 was completed in 2018 as part of reviewing the strategy for tailings management going forward. The options assessment considered the three key management options, being placement of tailings underground within existing voids, construction of a new tailings dam in Whitehorse Gully, or expansion of historic tailings dam in Ballarat South.

In reviewing the options, issues considered included site constraints and available land and buffers, location of sensitive receptors, potential to sterilise resource and key risks of tailings delivery and management.

Based on the 2018 assessment, it was been determined that a new above ground facility (TSF4) immediately adjacent in Whitehorse Gully provided the optimal risk mitigation and management option. Insufficient capacity to store the tailings within existing voids and the potential to sterilise the resource meant that underground storage was limited and could not contain the full volume of tailings required to the managed and therefore was not a suitable option for storage,. Utilising Ballarat South as a TSF was also not considered an option due to the potential risks associated with the length of the delivery and decant pipeline.

Construction of a TSF in Whitehorse Gully was originally proposed as a site in 1995, however the development of a tailings dam in this area was not progressed at the time. This interest and future intensions to develop a tailings dam in Whitehorse Gully were noted by the Department in correspondence in March 1995.

A concept design has been developed for Whitehorse Gully TSF (TSF4) and is the basis of the WPV: *Whitehorse Gully TSF Concept Design Report*, prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd in 2019 (AECOM, 2020b).

The initial design aspect for TSF4 considered the operational objective of optimising the tailings storage volume by achieving close to a cut to fill balance (borrow excavation from within the Whitehorse Gully impoundment area is to be used for construction of the earthen embankment). However, beyond this point the principal design basis was based on a comprehensive understanding of the consequences of all potential TSF4 failure modes, their risks, and an iterative design process to achieve a "*As Low As Reasonable Practicable*" (ALARP) risk mitigation of the facility during operations and closure.

In summary, TSF4 has included a series of design elements which has resulted in the critical failure event that would result in a PLL of less than 1: 1 x 10^{-8}, which can reasonably be classified as almost impossible to improbable and demonstrates that the project has met the ALARP principal.

Ultimately the conclusion is that the TSF4 facility CGT is seeking approval for is well below the acceptable risk level based on ANCOLD (2003) due to the its key design elements which achieves ALARP.

As with the existing TSF3, TSF4 will extend across tenements MIN5396 and MIN4847. Both tenements are held by Balmaine Gold Pty Ltd (Balmaine), which is a wholly-owned subsidiary of CGT. The proposed location of the TSF4 footprint, including associated areas for stormwater management, site offices and stockpiling is shown in **Figure F1**-**Appendix A** and is referred to as 'the site' in this report.

This work plan variation (WPV) has been prepared to request approval for the construction, operation and closure of the TSF4 site and is seeking approval of the full TSF4 concept design. No other variations to the current BGM operations are considered within this WPV.

1.2 Work Plan Variation Objectives and Structure

The objectives of this WPV are to:

- Seek approval for the construction, operation, rehabilitation and closure of the Whitehorse Gully Tailings Storage Facility (TSF4);
- Provide the Earth Resources Regulation (ERR) branch of the Department of Jobs, Precincts and Regions (DJPR) with the required information as set out in the *Mineral Resources (Sustainable Development) Act 1990* (MRSDA) and *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019* (MRSD(MI)R; and
- Provide ERR with the required information to demonstrate how the licensee has considered and will meet the requirements of their "Technical Guidelines – Design and Management of Tailings Storage Facilities" (ERR 2017).

Under Section 41(2) of the *MRSDA 1990*, an application for approval of a variation must contain the prescribed information. The prescribed information is specified in the MRSD(MI)R and where this information is addressed are addressed in this work plan variation (WPV) is outlined in Table 1.

Table 1 MRSD(MI)R Information Required in a work plan

Section	Information Requirement	Where Addressed
42	**Information required in work plans—mining work**	
42(a)	a description of sensitive receptors in relation to the environment, any member of the public, or land, property or infrastructure in the vicinity of the work; and	Section 3.0.
42(b)	a location map of the work plan area and areas within 2 km of the work plan area, drawn at an appropriate scale, that shows— (i) the location of sensitive receptors identified; and	Figure F1, Figure F2, Figure F3- Appendix A.

Section	Information Requirement	Where Addressed
	(ii) the extent and status of Crown lands and extent of private lands; and (iii) residential, commercial and industrial development; and (iv) public facilities and infrastructure; and (v) rivers and streams; and	
42(c)	general description of geological information pertaining to the work, including— (i) stratigraphy; and (ii) any adverse geological structures; and (iii) the minerals to be extracted; and (iv) the estimated mineral resources and ore reserves; and	The geology as known for TSF4 is summarised in Section 2.3 below and in further detail in Section 3.1 of Conceptual Design report (AECOM, 2019).
42(d)	a general description of the mine operations including— (i) the method and scale of extraction; and (ii) ore processing methods and facilities; and (iii) waste disposal methods and facilities; and (iv) stockpiling facilities; and (v) other mine infrastructure; and	A description of relevant activities as it relates to the TSF4 is included in Section 4.0 of this document.
42(e)	a site map, drawn at an appropriate scale, that shows— (i) the general layout of the mine, associated facilities and infrastructure; and (ii) cross-sections and, in the case of an underground mine, long sections of the proposed extraction area; and	A site layout plan for TSF4 is included as Figure F5- and Figure F6- Appendix A. Cross sections of the proposed TSF are contained within the Conceptual Design Report (AECOM, 2019) attached.
42(f)	in the case of an underground mine, a schematic and description of the workings of underground operations.	Not applicable to this WPV.
43	**Rehabilitation Plans- work plan lodged on or after 1 July 2019 but before 1 July 2020.**	
43(4)(a)	concepts for the end utilisation of the mine site; and	Section 5.1.
43(4)(b)	proposals for the progressive rehabilitation, stabilisation and revegetation of extraction areas, waste disposal areas, stockpile areas, dams and other land affected by the mining work; and	Sections 5.2 , 5.3, 5.4
43(4)(c)	proposals for landscaping to minimise the visual impact of the mine site; and	Section 5.1 and Section 5.2.
43(4)(d)	proposals for the final rehabilitation and closure of the mine site, including the security of the site and the removal of plant and equipment, taking into account any potential long-term degradation of the environment.	Section 5.5
44	**Information required in work plans—identification of hazards and risks**	
44(b)	if mining work is to be carried out under the licence, details of mining hazards that may arise from the mining work, including mining hazards arising from— (i) set up or construction; and	Evaluated throughout the WPV document and captured in the risk register, attached.

Section	Information Requirement	Where Addressed
	(ii) operations or production;	
44(c)	details of the rehabilitation hazards that may arise from rehabilitation under the licence;	Evaluated throughout the WPV document and captured in the risk register as part of the Risk Management Plan.
44(d)	an explanation of how the identified hazards may harm or damage the sensitive receptors described in the work plan, including evidence to support the assessment of the potential for harm or damage to be caused;	Evaluated throughout the WPV document and captured in the risk register as part of the Risk Management Plan.
44(e)	an explanation of how the identified hazards may harm or damage the sensitive receptors described in the work plan, including evidence to support the assessment of the potential for harm or damage to be caused; (i) the nature of the hazard; and (ii) the likelihood of the hazard causing, or contributing to, any harm or damage; and (iii) the severity or consequence of the harm or damage that may be caused.	Refer to risk register.
45	**Information required in work plans—risk management plan**	
45(a)	measures to be applied to eliminate or minimise the risks as far as reasonably practicable;	Refer to Risk Management Plan.
45(b)	the performance standards to be achieved by either individual measures or some combination of measures;	
45(c)	management systems, practices and procedures that are to be applied to monitor and manage risks and compliance with performance standards;	
45(d)	an outline of the roles and responsibilities of personnel accountable for the implementation, management and review of the risk management plan.	
46	**Information required in work plans—community consultation**	
	how the licensee will comply with their duty to consult with the community under section 39A of the Act throughout the period of the licence, in the form of a plan that includes detail specified in 46(a) to 46(e).	Refer to CEP provided for details.

1.3 Project Overview

The site was previously approved for open pit mining and processing and bulk test pitting.

The proposed changes from previous approvals included in this WPV are:

- Construction and operation of TSF4 within Whitehorse Gully, including associated pipelines infrastructure and access from TSF3 site, which is supported by a number of technical assessments as listed in Section 1.5;

- Construction of a sedimentation pond to manage sediment laden surface water run-off from disturbed area around TSF4;
- Modification of the visual buffer previously defined in in the 1994 Environment Effects Statement (EES) for the Ballarat East Project (Valdora Minerals N.L) to accommodate the proposed TSF4 footprint and associated infrastructure. This change is being supported by a Visual Impact Assessment;
- Proposed ancillary works associated with the construction of TSF4 will be placed within the area previously referred to by Condition 5.6 of the 22 February 2000 MIN4847 conditions which states that "no mining shall occur north of AMG 5834500N without a variation to the work plan. Exploration work shall be approved by an Inspector". This condition is being sought to be removed from the area which is between the Central Highlands Water to TSF3, to allow for ancillary infrastructure to be placed in this area pipeline including pipelines and site access from TSF3 site to TSF4 site;
- Construction of new site access, which includes: a new turning lane from Whitehorse Road and access road along the western boundary adjoining Central Highlands Water sewage treatment plant;
- Construction of a security fence; and
- Site investigation works to inform the Stage 1 detailed design, which were approved by ERR as an Administrative Change on 20 November 2019.

A Planning Permit (Planning Permit No. PA93/195TP1373) was issued by the Shire of Buninyong (City of Ballarat at date of Amendment) on 22 September 1993, amended on 4 September 2003 and 13 August 2007, valid through 22 September 2027 for a permit allowing mineral production on Crown Allotments 2a and 2b Section 16, Crown Allotment (c, Section 14, and Crown Allotment 10 E[1], Section 12 Parish of Ballarat – Crown Land/State Forest Off Brittain Street, Mt Pleasant.

A Planning Permit is required from the City of Ballarat for the construction and development of TSF4, as this is considered to be a change from the existing Planning Permit issued for MIN5396, the 1994 report prepared by Valdora Minerals for the Environment Effect Statement (EES) for MIN4847[2] and previous work plans and work plan variations approved for both MIN5396 and MIN4847.

1.4 Timeframes

A preliminary site investigation program (acknowledged by ERR as part of Administrative Change on 20 November 2019) is planned for December 2019 / January 2020, which will inform the detailed design of the first stage of TSF4 (refer to Section 4.2.3).

TSF4 will be constructed in stages, with Stage 1 embankment construction planned to be completed over an 18-month construction period, and nominally available for tailings delivery in late 2021/early 2022 (dependant on approvals and also forecast production estimates). Construction of future lifts will be undertaken based on production rates and business requirements, however nominally the first stage is anticipated to have approximately 2.5- 4 years of capacity based on current production rates and the final detailed design of the stage 1 filling area.

Detailed design will be completed prior to each phase of construction, and is further discussed in Section 4.2.3, TSF4 closure plan (refer Section 5.0) will be implemented with re-contouring, capping and revegetation within 12-15 years, depending on production rates.

1.5 Supporting Technical Assessments

In preparing this WPV, a number of technical studies have been completed to support the proposal and are provided with the WPV as supporting documentation:

[1] CA 10E Section 12 does not exist on or in the immediate vicinity of the Ballarat Gold Mine. This allotment is actually CA 10K Section 12. This has been confirmed by DELWP, and CGT plan to investigate with Council to have lot reference corrected via an administrative process.
[2] Given the 1994 EES, no Planning Permit has been issued for works associated with MIN4847.

- AECOM, 2019. *Groundwater Impact Assessment TSF4*, prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd
- AECOM, 2020. *TSF4 Vegetation Condition Assessment,* prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd.
- AECOM, 2020a. *Whitehorse Gully TSF4- Air Quality Assessment,* prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd.
- AECOM, 2020b. *Whitehorse Gully TSF Concept Design Report*, prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd. This document also includes Independent Technical Review of the conceptual design completed by Golder Associates Pty Ltd (Golder) which is included in Appendix I of the document;
- Hansen, 2019. *Ballarat Gold Mine Tailings Storage Facility- Visual Impact Assessment.* Prepared by Hansen Partnership Pty Ltd for AECOM (on behalf of Balmaine Gold Pty Ltd).
- Broner Consulting, 2019. *Whitehorse Gully TSF4- Noise Impact Assessment.* Prepared by Broner Consulting for Balmaine Gold Pty Ltd.
- Driscoll Engineering Services, 2019. Left turn lane- concept plan. Prepared by Discolll Engineering Services Pty Ltd for Balmaine Gold Pty Ltd.

2.0 Plan Description

2.1 Area Details

SUMMARY	
Property Name:	Ballarat Gold Mine
Address:	10 Woolshed Gully Drive, Mount Clear VIC 3250
Area Size:	12 ha (MIN5396); 27 ha (MIN4847)
Land Tenure:	The mining licence areas are a mix of freehold and Crown Land, with TSF4 on Crown Land.
Additional Area of Disturbance (TSF4 footprint): Approximately 32 ha	
Land Tenure (TSF4): Crown Land (Crown Allotment 10K, Section 12, Parish of Ballarat)	
Depth Limitations: No	

The TSF4 site is located within Whitehorse Gully to the south of the City of Ballarat in the suburb of Mount Clear, approximately 3 kilometres (km) south from the Ballarat city centre.

The Ballarat Gold Mine (BGM) including the main access underground portal and ore processing are located to the north on MIN5396, with TSF3 constructed across MIN5396 and MIN4847 to the immediate north of the proposed TSF4 location.

The TSF4 site will also straddle two BGM Mining Licences (MIN4847 and MIN5396, as shown on **Figure F1- Appendix A**), and covers approximately 39 hectares incorporating the following areas:

- 12 ha (30%) within MIN5396 (total area of 1,486 ha); and
- 27 ha (70%) within MIN4847 (total area of 410 ha).

Of the 39 ha approximately 32 ha will be subject to disturbance for TSF4 ‘works’. However, it is noted that the majority of the site has been subject to disturbance from historic mining activities and more recently as part of the Yarrowee Plantation (plantation commencing in the allotment in 1946).

The area subject to this WPV is shown on **Figure F4- Appendix A**, and bounded by the following:

- TSF3 and plantation are immediately to the north of the site, with the Central Highlands Water (CHW) pipeline defining the maximum northern extent of TSF4 footprint;
- Whitehorse Road is to the south;
- CHW header tank (Crown Land- water production) and eastern boundary of MIN4847 to the east adjacent to Tinworth Avenue, however this is also constrained by Section 45 of the *MRSDA 1990*, whereby there are to be no works within 100 m laterally of a dwelling house which already existed before an approved work plan was registered; and
- CHW Ballarat sewage treatment plant to the west and north west.

The planning across the TSF4 site is classified as Farming Zone (FZ), with a Bushfire Management Overlay (BMO), and an Environmental Significance Overlay (ESO5) overlying a portion of the land adjacent to Tinworth Avenue (**Figure F2a- Appendix A**).

The site is Crown Land (Parish of Ballarat Allotment 10K Section 12), and currently used for softwood plantation forestry (classified as unrestricted Crown Land- Plantation) as part of the Yarrowee Plantation. The site is registered on the Plantation Licences Register under Section 27L(3)(c) of the Victorian Plantations Corporation Act, 1993 for which Balmaine Gold Pty Ltd hold the Plantation Licence.

The 2km buffer and surrounding site features are shown on **Figure F1, Figure F2a and Figure F3- Appendix A** and are summarised in Table 2 below.

Table 2 Summary of surrounding landuses at Whitehorse Gully

Direction	Surrounding Land use
North	BGM mining operations, including the processing plant, and TSF3. Commercial forestry as part of the Yarrowee Plantation (classified as Crown Land-Plantation)
South	A small number of residential blocks (Rural Living Zone 1) are situated to the immediate southeast of the TSF4 site. Allotment 10D, Section 12, Parish of Ballarat on Whitehorse Road immediately adjacent to TSF4 site is owned by Balmaine Gold Pty Ltd and therefore no residential property will be developed on the block. The site is bounded by Whitehorse Road, over which there is the continuation of the Yarrowee Plantation and the Whitehorse Road Conservation Reserve, which is a former Council landfill.
East	CHW Header Tank on the western side of Tinworth Avenue immediately adjacent to the TSF4 development, and residential properties present along Tinworth Avenue
West	CHW- Ballarat sewerage treatment plant, commercial forestry (Yarrowee Plantation)

2.2 Site History and Ownership

The land on which the site is located was originally used by settlers for pastoral grazing, and was then severely disrupted by gold prospecting from the 1850's.

Historic mining activity included surface prospecting, shallow alluvial workings, including sluicing of the gullies which transect the area and deeper quartz reef mining with 25 historic shafts reported as the field developed. Evidence of supporting historic mining infrastructure, in particular sunken shafts and mullock heaps (typical of the goldfield) are evident, and are shown on Figure 1 below. The decline of mining saw the area return to bushland with softwood plantations occurring in the general area as early as 1946.

Further description of the nature and extent of alluvial and quartz mining in the area to provide an understanding of the level of surface and sub-surface disturbance, both of which are relevant in the concept design for TSF4 is included in supporting Conceptual Design report for TSF4 (AECOM, 2019), including a summary and location of known mining operations.

From the 1980s onwards, open pit mining (completed by CRA/Valdora/Williams) and exploration drilling (266 holes) were completed. CRA also completed a program of costeans and bulk testpits in the 1990's.

Currently, the site is utilised for softwood pine plantation forestry (part of the Yarrowee Plantation), hobbyist gold prospectors and 4WD/ motorbike users, walking and mountain biking along approximately 6.4 km of tracks.

CGT has conducted minor geochemical sampling and opportunistic mapping over exposed areas to inform targeting of deeper potential gold targets.

In April 2019 the eastern portion of the TSF4 site was impacted by bushfire.

A summary of the TSF4 current land use is provided in Table 3, below.

Table 3 TSF4 Landuse

Landuse	Notes
Pine plantation	Current, managed HPV Plantations
Deep Lead mining	Historic
Shaft mining	Historic with some surface disturbance
Bulk sample pits	Historic (undertaken by predecessors CRA/ Valdora/ Williams)
Drilling	Various investigation bores undertaken
Tracks	Current used by recreational 4WD, mountain biking and walkers users. Given the site is currently unfenced and open to the public, rubbish is also routinely dumped on the site by the public.
Surface mining	Historic, shallow prospecting

2.2.1 The Company

CGT is a gold explorer and producer with five significant tenements in Australia's historic central Victoria gold belt, collectively covering over 350 square kilometres. CGT restarted underground mining and ore processing at the Ballarat tenement in 2011 and is currently producing approximately of 40-45,000 ounces of gold per annum.

The successful mining at the Ballarat tenement has led to the development of a broader regional exploration programme, devised with the intention of generating a pipeline of projects that could eventually provide ore feed to the Ballarat gold processing plant.

The company holds a high standard of environmental practice in its mining operations and stakeholder engagement with regulators and the community.

2.3 Geological Information

SUMMARY

Commodity to which this plan pertains: Gold

Geology and mineralisation: Mineralisation is found in narrow quartz veins associated with a series of major west-dipping faults which traverse the goldfield.

Total estimated ore reserves: 131,000 oz (as of February 2019)

2.3.1 Regional Geology

The regional geological setting of Ballarat is that it is located in the south-western part of the Lachlan Fold Belt (LFB) within the Palaeozoic sedimentary rocks of the Bendigo-Ballarat subdivision. The outcropping bedrocks of the region are Ordovician age turbidites of the Castlemaine Super Group, which comprises the majority of the bedrock of the Bendigo-Ballarat zone of the LFB in Victoria.

2.3.2 Local Geology

The Palaeozoic basement of the Castlemaine Group outcrops across most of the proposed TSF4 site. This is overlain by reworked Calivil Formation, locally termed the Whitehorse Gully Deep Lead, within present-day drainage lines. These two units are discussed further in the Conceptual Design Report (AECOM, 2020b) and the Groundwater Impact Assessment (AECOM, 2019) and should be referred to for detailed description of the site geology.

Figure 1 below presents a modified extract of the 1992 Ballarat Goldfields surface geology map (Finlay et al. 1992), with the location of the CHW service reservoir tank and water main, approximate site boundary and TSF4 footprint layout overlain for reference. Figure 2 below presents an annotated typical east-west cross section (extract from GSV 1982) crossing through the Yarrowee River and "The Indicator" (a thin seam of material which became a leading indication of auriferous units), indicative of the geological subsurface conditions present at Whitehorse Gully.

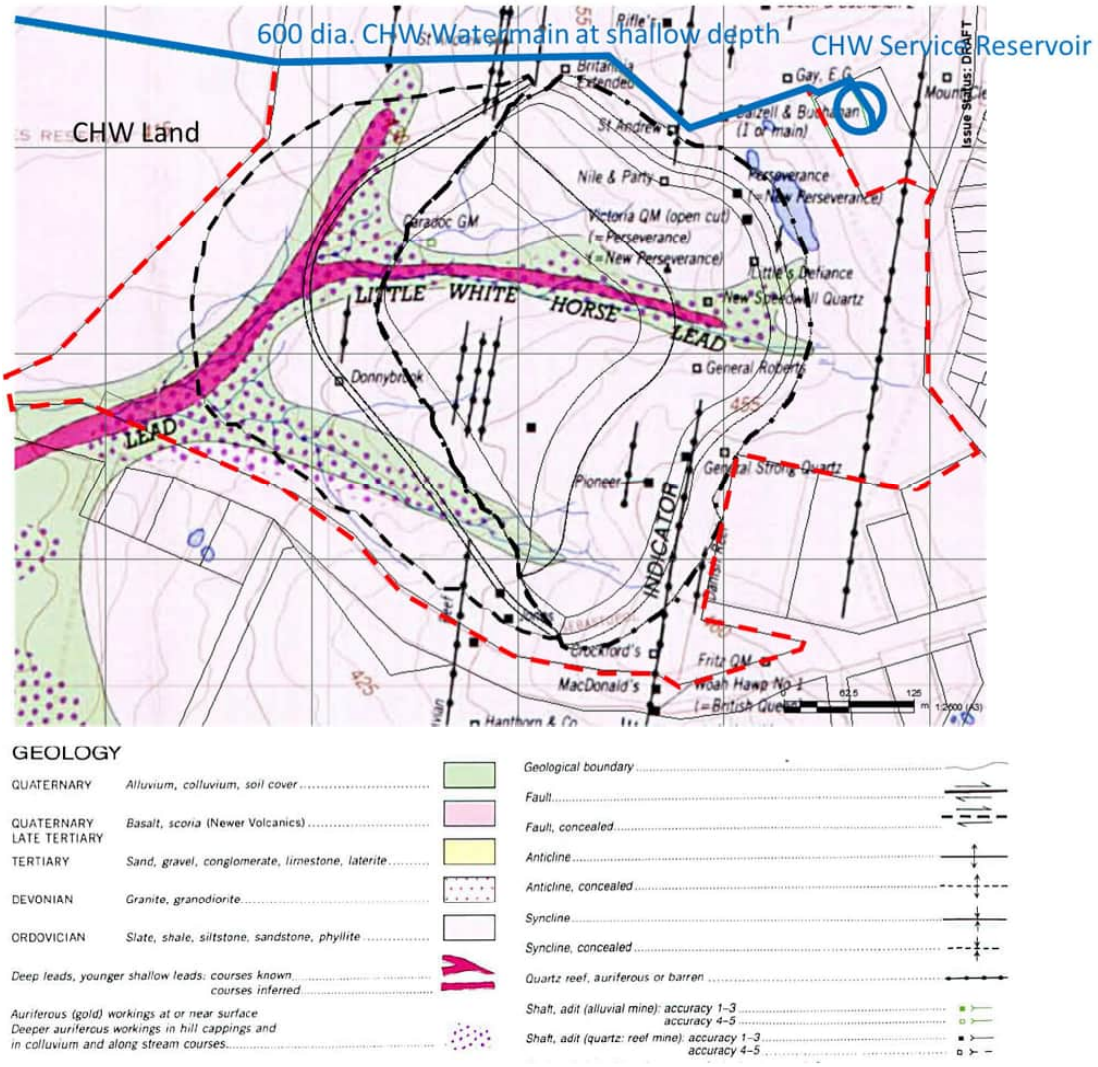


Figure 1 **Geological map of Whitehorse Gully site (modified extract from *Finlay, I.S., Plier-Malone, E.N.M., Cochrane, R.M., Bucknall, M., Douglas, P.M. & Caluzzi, J., 1992. Ballarat goldfield 1:10 000. 1:100 000 Deep Leads map 6, sheet 2. Geological Survey of Victoria.*)**

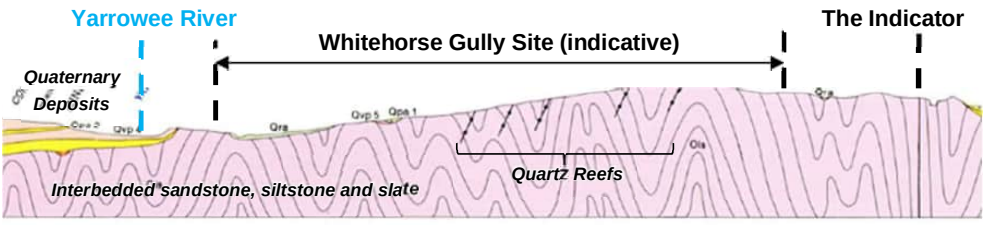


Figure 2 **Typical east-west geological cross section through Ballarat (100x vertical exaggeration) (extract from Geological Survey of Victoria, 1981. Ballarat Goldfield South 1:10 000 geological map. Department of Minerals & Energy, Victoria.)**

3.0 Sensitive Receptors

SUMMARY

Key sensitive receptors within the TSF4 site include:

- Communities and residences
- Public infrastructure and facilities
- Crown land and reserves
- Waterways
- Groundwater
- Aboriginal cultural heritage and European historic heritage
- Biodiversity (native flora and fauna)

Sensitive receptors in the vicinity of the TSF4 are shown in **Figure F3** (2 km buffer) and **Figure F5- App. A**. Key sensitive receptors are described in the following sections.

3.1 Communities and Residences

The TSF4 site is located within Ballarat's suburb of Mount Clear. The locations of residences within the near vicinity of the site are shown on **Figure F3** and **Figure F54- App. A**.

The closest residences to TSF4 are located to the east of the site, on Tinworth Avenue, approximately 100 m from the eastern batter of the TSF excavation. Other nearby residences are located to the north and south of Whitehorse Road near the intersection with Tinworth Avenue.

A 100 m buffer from the closest residential property boundaries has been defined as per S.45 of the MRSD Act 1990 and is shown on **Figure F5- App. A**. No works are proposed within this defined buffer and in accordance with S.45 of the MRSD Act 1990, no works will occur within this buffer without written consent.

There is a bike path along the Yarrowee River to the east and a walking path on the southern side of Whitehorse Road which is used recreationally.

Residential Receptors: Inherent Risk Mitigation Measure:

Establishment of 100m buffer between residential properties and any site activities.

3.2 Public Infrastructure and Facilities

The CHW Ballarat Sewage Treatment Plant (**Figure F4- App. A**) is located to the west and north west of TSF4. The CHW treatment plant comprising a number of treatment ponds is staffed, however is not topographically down gradient of the toe of the TSF4 embankment and will not be within the impacted zone if the TSF4 embankment fails (refer to AECOM, 2020b) . A CHW water main is located 10 m to the north of the TSF4 footprint and a CHW storage tank is located 90 m to the north east.

CHW's watermain, shown in **Figure F5- App. A**, runs east to west through the site beneath an access track. The depth of cover is known to be less than what is typically required for asset protection. CGT, after consulting with CHW, have requested that pipeline be surveyed and a 10 m offset (5m each side of the pipeline) from the CHW pipeline to the embankment be maintained, with the off-set shown on **Figure F5- App. A**). An open aqueduct to the treatment plant also runs from the south along the western side of Yarrowee River, with a pumping station located at 21 Dowcra Street, Magpie, approximately 1.7km south downstream.

Whitehorse Road (VicRoads) is located 15 m south of the TSF4 final embankment and Tinworth Avenue (Council) is located 80 m to the east of any disturbance works. A bridge over the Yarrowee River on Whitehorse Road as it turns into Bridge Street is to the southwest of the site (**Figure F4- App. A**).

A transmission line runs southwest to north west through the suburbs south of the TSF4 site, approximately 2.1 km from site at it's closest location. The transmission line, as shown on **Figure 2b- App. A**, also passes over the Yarrowee River approximately 5.5 km downstream of TSF4.

The closest schools to TSF4 are the Mount Clear Primary School (~650m to the south east) and Sebastopol Primary School (~1km to the north-west). Mt Clear College, Damascus, Emmaus and Ballarat Christian College.

CHW Infrastructure: Inherent Risk Mitigation Measure:

TSF4 construction works to protect the CHW water pipeline include a permanent fence and/or earthen bund on both the northern and southern edge of the access track and designated vehicle crossings.

3.3 Crown Land and Reserves

The site is located on unrestricted Crown Land which has been designated for 'Plantation'. Under the definitions in the MRSD Act 1990, Crown Land "does not include land which is the subject of the licence granted under part 3A of the Victorian Corporations Act 1993".

Correspondence with DELWP at a meeting on 30 October 2019, and subsequently via email has confirmed that they are not the Crown Land manager for any Plantation Land, including the subject land, with land management for Plantations divested to Victorian Plantations Corporation. The licences were sold to HVP Plantations, who now act as land manager for plantations. However. Balmaine purchased the Plantation Licence of a number of land parcels which includes the allotment (CA 10K, Section12 Parish of Ballarat) and thus are the current land manger, in accordance with the definition of owner under the MRSD Act where owner means private land "if the land is subject to a licence granted under Part 3A of the Victorian Corporations Act 1993, the licensee, under that Part, of the land".

A copy of the Plantation Licence is included in **Appendix D**.

Other Crown Land adjacent to the site (as shown in **Figure F1- App. A**) is managed by CGT, CHW and HVP for forestry purposes.

Public reserves in the vicinity of the site include water frontages and recreation reserves along Yarrowee River and Canadian Creek and Woorookarung Regional Park to the east of Geelong Road.

Crown Land extents and classification is shown on **Figure F1 - Appendix A.**

3.4 Waterways

The site is located within the Barwon River Basin sub-catchment of the Corangamite Catchment.

Two waterways are located within 1km of the TSF site, Yarrowee River approximately 400 m to the west and Canadian Creek approximately 800 m to the east (**Figure F3- App. A**).

The site is centred around Whitehorse Gully, an ephemeral drainage line east of the Yarrowee River. Although Whitehorse Gully is not a mapped waterway, it would likely flow to the Yarrowee River following high rainfall events.

Yarrowee River is a small permanent waterway that drains the City of Ballarat and surrounding areas and runs through open grazing country to join the Barwon River. Canadian Creek is a small tributary of Yarrowee River. A proportion of the environmental flow in Yarrowee River during the summer months is provided by outflows from the Ballarat South Sewage Treatment Plant. Yarrowee River is used for stock watering and for some irrigation.

3.5 Groundwater

A review of the hydrogeological conditions has been undertaken as part of a Groundwater Impact Assessment for the TSF4 development (AECOM, 2019). For full details on the hydrogeological conditions, refer to the supporting technical report (AECOM, 2019), with a summary provided below.

The main hydrogeological unit beneath the site is the Basement aquifer, which consists of fractured siltstone and sandstone and generally has a low hydraulic conductivity on the order of 10^{-3} to 10^{-2}

m/day. Higher hydraulic conductivities may be found in fractured zones or where historical mine adits form preferential flowpaths. Groundwater in this aquifer has a relatively high regional salinity (approximately 2,000-5,000 mg/L as total dissolved solids TDS) due to the natural evaporation and transpiration during recharge in this low permeability environment. Locally groundwater flows from the higher elevation areas in the east of the site to the lower elevation areas to the west. Local flowpaths may discharge to the Yarrowee River to the west. No impact to this aquifer has been observed at TSF3 located immediately north of the site.

A shallow, possibly perched, aquifer exists within the worked sediments of the Deep Lead Aquifer, which is located within the gullies and is up to 7.5 m thick towards the west of the site. Historical gold mining activities have resulted in hummocky deposits of sediments ranging from well sorted silts with low permeability to poorly sorted silty sandy gravels with higher permeability. The higher permeability lenses are unlikely to be continuous due to the nature of the historical mining activities. Groundwater in this aquifer is much fresher than the Basement aquifer (TDS approximately 200 mg/L) because the permeability is higher and recharge occurs more quickly. The significantly lower TDS is in the Deep Lead aquifer is consistent with the water levels which suggest that this aquifer not hydraulic well connected to the Basement aquifer, and may be perched. Vertical flow downwards towards the Basement aquifer is inhibited by the low permeability of the Basement aquifer. Therefore, most flow in this aquifer would occur laterally towards the Yarrowee River.

Nine groundwater wells are installed in the vicinity of TSF3 (which was constructed in 2005), and located immediately north of the site. A summary of these bores is included in the AECOM, 2019 report and the bore locations are presented on Figure F2 (Appendix A) of AECOM, 2019.

Monthly groundwater levels are available for these bores from 2009 or 2010. Groundwater levels and groundwater geochemical data is presented the Groundwater Impact Assessment (AECOM, 2019).

A series of groundwater bores has been installed around the TSF4 and monitored as part of establishing the baseline conditions at the site, with the results of the drilling and monitoring reported within AECOM, 2019.

During the 2019 investigations, groundwater was observed as follows:

- Approximately 30 to 34 m depth below ground surface (at EL 430 to 432 m approx.) on the higher ground upstream of the impoundment area (BH201 & BH202) – it is inferred that this is the regional groundwater table;
- Approximately 11 to 12 m bgs (at EL 397 m approx.) downstream of the proposed embankment abutments (BH204 & BH206) – it is inferred that this is the regional groundwater table; and
- Approximately 1 m bgs within the main gully (BH210) – it is inferred this is perched groundwater within the disturbed alluvial (not connected to the regional groundwater table within the bedrock) and is localised only.

The depth to water and groundwater elevations has been confirmed as part of routine groundwater monitoring events for the mining operations, including the TSF4 monitoring bores. Further groundwater assessments will be completed as part of the site investigations to inform detailed design.

3.6 Groundwater Use

Groundwater in the Basement aquifer falls within Segment B and the beneficial uses that need to be protected under the SEPP (Waters) include irrigation, stock watering, industrial water use, and water dependent ecosystems, among others.

There are 12 registered groundwater bores within 500 m of the site, of which four are licenced for consumptive use. These bores are summarised in Table 4 and the locations are presented in Figure F6-Appendix A of AECOM, 2019. All 4 bores are located on the site of the Ballarat South Wastewater Treatment Plant (WWTP) adjacent to TSF3.

Table 4 Bores within 500 m of site registered for consumptive use

Bore ID	Use	Easting	Northing	Date completed	Total depth (mBGL)	RL (mAHD)
WRK046768	Irrigation	751905	5834827	30/10/2004	150	414.0
WRK972477	Commercial	751883	5835001	8/02/2006	9	397.1
WRK972478	Domestic and stock	751869	5835152	9/02/2006	47	400.5
WRK972479	Domestic and stock	751923	5834900	10/02/2006	30	407.3

3.7 Groundwater Dependent Ecosystems

Confirmed and potential Groundwater Dependent Ecosystems (GDEs) in the vicinity of the site were sourced from the National GDE Atlas[3] ('the Atlas'). The 'aquatic' (relying on groundwater discharge to surface) and 'terrestrial' (relying on subsurface groundwater) GDEs are shown on Figure F6 - Appendix A of AECOM, 2019.

The Yarrowee River is listed as a 'high potential' aquatic GDE, meaning that it likely receives groundwater discharge.

Vegetation in the higher elevation areas bordering the site is listed as a 'low potential' terrestrial GDE. This vegetation is described as Heathy Dry Forest and is located on areas of Basement aquifer outcrop. Based on the measured depth to water in the Basement aquifer beneath the site (11-34 mBGL; this vegetation is highly unlikely to be accessing groundwater and therefore this is not likely to be a GDE.

3.8 Cultural Heritage

There are no known Aboriginal heritage sites or areas of cultural heritage sensitivity within the TSF4 site, as shown on **Figure F3- Appendix A** and the Planning Property Report (**Appendix C**). A CHMP assessment checklist which shows the development does not trigger the need for a CHMP, along with a signed declaration form is attached as **Appendix F**.

CH sensitivity within 10 km of the site is also shown on **Figure 2b- Appendix A**.

3.9 Historical Heritage

There is one VHI-listed site (Woah Hawp No. 1 Mine, Heritage Council Victoria Place ID 7035, VHI Number H7622-005) located on the southern boundary of the TSF4 site adjacent to Whitehorse Road. This feature is included on **Figure F5- Appendix A.** In designing the project, the VHI has been considered as part of the TSF4 footprint design and will be avoided. As shown on **Figure F5- Appendix A**, a fence will be constructed to exclude this HI site from the works area to avoid disturbance.

As shown on **Figure F2a- App. A**, there are a number of other heritage inventory sites within 10 km of the TSF4 site.

European Heritage: Inherent Risk Management Measures

Construct a fence to prevent disturbance to VHI number H7622 during site activities.

[3] http://www.bom.gov.au/water/groundwater/gde/

3.11 Ecology

The predominant vegetation at the TSF4 site is softwood plantation (under Plantation Licence), with the pine plantations established at the site circa 1946-1948, with additional replanting of stock at later dates, with the latest planting in 1982 in one area of the site. Prior to plantation of pines, the area was subjected to intensive alluvial gold mining over the period 1850 to early to mid 1900's and to a lesser extent quartz reef mining. Large gullies transect the mine area, which was sluiced. As a result, the land is highly degraded.

Those areas not subject to sluicing have been extensively worked over, resulting in the removal of all of the original vegetation and the destruction of most of the topsoil. Some native species have persisted or re-established from seed. Pest animals have been sighted in the area including foxes, rabbits, pigs, dogs and cats.

The disturbance area, where trees will be removed for the TSF4 operations is shown on **Figure F5-App. A.** To the east of TSF4, an Environmental Significance Overlay (ESO5) is present for the protection of koala habitat. The TSF4 footprint does not encroach on the ESO5 footprint, however the eastern length of the security fence is planned to cut through the ESO5 layer.

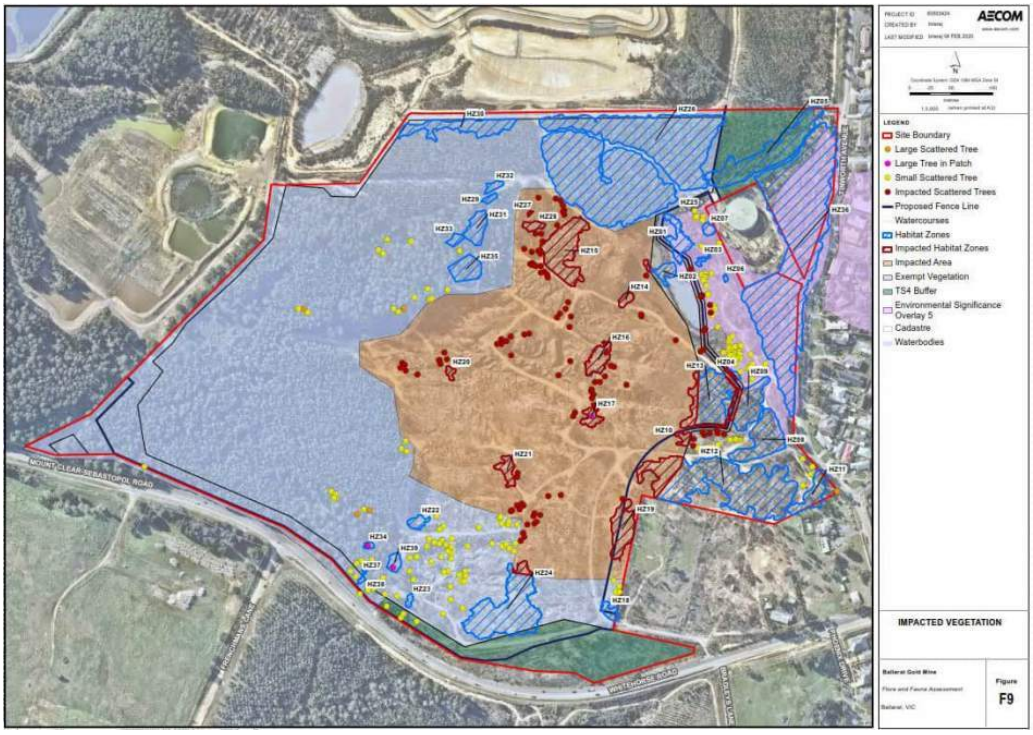
A survey of the TSF4 site was completed in 2019 to assess the current state of vegetation on the site with a subsequent assessment in 2020 to assess the eastern burnt area and to complete the Koala Habitat Assessment (AECOM, 2020). The site assessments had the following outcomes:

- April 2019 bushfire had significantly impacted the vegetation across much of the eastern portion o of the site, in a similar area understood to have been previously subject to a bushfire in December 2010;
- 'Habitat Zones' of EVC 20 Heathy Dry Forest equating to 7.41 hectares was identified which has a bioregional conservation status of Least Concern;
- 272 'Scattered Trees' comprised of amongst others, Manna Gum, Broad-leaf Peppermint and a small number of stags. These trees comprised seven large trees and 265 small trees;
- Three large trees in a patch;
- That the site presents with a long-term history of forestry uses and is heavily disturbed.
- That the site has been subject to several bushfire events including in 1982, 2010 and most recently in April 2019. The fire had significantly impacted the vegetation across much of the site;
- Six invasive weed species were identified, including gorse and blackberry.
- That vegetation in the west, south and north of the site is exempt under Clause 52.17 of the Ballarat City Planning Scheme through the '*Harvesting for timber production – naturally established native vegetation'* and '*Regrowth'* exemptions (see Figure 3 below for the area considered to plantation areas).
- Vegetation considered to be exempt under Clause 52.17 consists of 18 patches of native vegetation (partially or wholly exempt), 2 Large Trees in a Patch, and 90 Scattered Trees (4 large and 86 small).
- Vegetation retained by the project consists of 15 patches of native vegetation (partially or wholly retained), 0 Large Trees in a Patch, and 74 Scattered Trees (1 large and 73 small).
- Vegetation impacted by the project and required to be offset consists of 17 patches of native vegetation (partially or wholly removed), 1 Large Trees in a Patch, and 108 Scattered Trees (2 large and 106 small).

Balmaine Gold Pty Ltd hold the Plantation Licence however HVP owns all the tree stock within the plantations on-site. HVP Plantations holds international Forest Stewardship Council® (FSC®) certification and Responsible Wood forest certification.

Where plantations will be removed on the TSF4 (under existing Planation Licence), HVP Plantations have confirmed that all timber plantations harvested is harvested in accordance with the *Code of Practice for Timber Production 2014* and operate any activities under a Timber Harvesting Plan.

Figure 3 Results of vegetation survey (from AECOM, 2020)



4.0 Tailings Storage Facility

4.1 Tailings Description and Deposition

SUMMARY

- Tailings are to be stored in TSF4 (~1.6-1.8 Mm^3 total storage capacity), located in Whitehorse Gully.

4.1.1 Tailings Characteristics

A review of the particle size distribution for tailings samples taken during the 2017 investigations and from samples taken by CGT during operations from July 2014 to February 2015 was undertaken and the current tailings is characterised as a well graded, angular, loose to medium dense sand with some non-plastic fines (AECOM, 2019). The maximum particle size is 2.36 mm and the fines content (minus 75 µm) is generally less than 50%.

The tailings is expected to be of relatively low permeability (initial hydraulic conductivity in the order of 10^{-6} to 10^{-7} m/s and long-term permeability in the order of 10^{-7} to 10^{-9} m/s). TSF4 has been designed to manage both coarse and fine tailings.

4.1.1.1 Geochemical Characteristics

The geochemical characteristic of the tailings that will be deposited in TSF4 will be similar to that currently being deposited in TSF3.

- Based on a review of the tailings chemistry in 2007 (URS, 2007[4]), tailings are: neutral to slightly alkaline with pH ranging from 7.9-8.2
- The acid neutralising capacity (ANC) of all the tailings samples was moderate ranging from 36 to 58 kgH_2SO4/t and exceeds the MPA, indicating that there is sufficient neutralising capacity to buffer any acid generated from sulfide oxidation. Overall, the NAPP of all tailings samples is negative ranging from -24 to -54 kg H2SO4/t, indicating that all tailings materials represented by these samples are NAF.
- The ANC of all the tailings samples is moderate ranging from 36 to 58 kgH2SO4/t and exceeds the Maximum Potential Acidity (MPA), indicating that there should be sufficient neutralising capacity to buffer any acid generated from sulfide oxidation. Overall, the Net Acid Producing Potential (NAPP) of all tailings samples is negative ranging from -24 to -54 kg H2SO4/t, indicating that all tailings materials represented by these samples are not acid forming (NAF). This has also been supported by other geochemical investigations.
- Multi-element analyses on tailings in 2007 and in 2015 showed significant enrichment of arsenic.
- Multi-element analyses of water extracts from the tailings (ASLP testing) in 2015 showed low levels of solubility for the various elements at the natural pH, including arsenic.

The implications of the contaminants within the tailings are that:

- Appropriate controls for prevention and interception of seepage are put in place
- Measures are taken to prevent dust emissions from the TSF.
- Closure planning adopts an appropriate soil cover to limit oxidation of tailings

[4] URS Australia Pty Ltd, 2007. *Geochemical characterisation of waste rock and tailings from Ballarat East Gold Mine – Final Letter Report*. Prepared for Ballarat Goldfields NL.

4.1.2 Ore Processing and Residual Cyanide

The current ore processing circuit significantly reduces the amount of ore exposed to cyanide compared to conventional Carbon-In-Leach circuits and results in very low levels of cyanide in the final tailings stream.

The ore is not exposed to sodium cyanide until after the gold and sulphides have been concentrated and intensively leached in the Inline Leach Reactor (ILR). By only leaching the concentrate, as opposed to the entire ore stream, the amount of cyanide in the tailings is significantly reduced.

The amount of cyanide in the tailings is further reduced through the use of a cyanide destruction circuit (detox circuit) on the ILR tailings prior to deposition in the TSF.

The detox circuit employs the INCO method of cyanide destruction based on the introduction of sodium metabisulphite, copper sulphate and air to convert the free cyanide radical CN- to the non-toxic cyanate form. Cyanate subsequently breaks down to ammonia and water. Weakly bonded base metal cyanides (weak acid dissociable) are also converted in the process. Only strongly bonded Iron Cyanides remain.

The leach tailings is typically <5ppm WAD (Weak Acid Dissociable) cyanide, which is well less than the safe level of 50ppm as adopted by the International Cyanide management Code.

The leach tailings are then further diluted when mixed with the gravity tailings for co-disposal. In fact the water circulating within the TSF and process is less than 1ppm WAD CN.

Cyanide: Risk Management Measures

Water quality to be maintained by:

- Minimise unnecessary (non-gold containing) concentrate volumes reporting via the leach circuit Leached tailings detoxified prior to placement in TSF.

4.2 Design Process

4.2.1 Conceptual Design

The conceptual design report- AECOM, 2020b. *Whitehorse Gully TSF Concept Design Report*, prepared by AECOM Australia Pty Ltd for Balmaine Gold Pty Ltd. is attached as the key supporting document to this submission and should be referred to for the details of the design. A summary of the concept design is included in Section 4.3 below.

The conceptual TSF4 was designed in accordance with:

- Earth Resources Regulation (ERR). 2017, “Guidelines for Design and Management of Tailings Storage Facilities”, dated April 2017.
- ANCOLD, 2012, “Guidelines on Tailings Dams”, published by ANCOLD National Committee on Large Dams Incorporated, May 2012.

The concept design included the following elements:

- Site characterisation, including geological and hydrogeological conditions and historical mine workings;
- Basis of design;
- Dambreak and Consequence assessment;
- Assessment of seismic hazard;
- Definition of the design criteria;
- Conceptual design of embankment height and contours, and cross-sections;
- Conceptual design of impoundment liner and leachate collection system;
- Slope stability analysis;

- Water management;
- Monitoring during operation, construction and post-closure; and
- Conceptual rehabilitation contours and cross-sections.

A meeting was held with ERR, attended by CGT, AECOM and Golder as ITR on 8 October 2019 to discuss the conceptual design. In response to queries and discussions arising from the meeting, the Conceptual Design Report was updated, with the revised version provided as a supporting document to this WPV (AECOM, 2020b).

CGT are seeking approval from ERR for the TSF4, including the full proposed footprint and height of the TSF4 based on the Conceptual Design provided with this WPV submission.

4.2.2 Independent Technical Review

The concept design for TSF4 has been subject to an Independent Technical Review (ITR) which has been a completely independent review process of the Conceptual Design.

Dr. Brian Wrench of Golder provided ITR of the Whitehorse Gully TSF4 Concept Design. Brian was in attendance for an ITR briefing session, held at AECOM's Melbourne Office on 3 April 2019, where CGT and AECOM presented the proposed design for Brian's consideration and comment. Brian's review comments are included as an attachment in the Concept Design Report (AECOM, 2020b).

AECOM's concept design was subsequently updated to incorporate/address Brian Wrench's comments. A register of comments and how they were addressed by AECOM is included in Appendix I of AECOM, 2020b.

The concept design report and drawings were then issued to Brian Wrench for a second review. The purpose of the review was to seek Brian's endorsement of the concept design. Brian's endorsement letter is included in Appendix I of the concept design report (AECOM, 2020b). The ITR was also present at the meeting held with ERR on 8 October 2019 to discuss the Concept Design and ITR process. Going forward, CGT will follow the same ITR process for the detailed design phase. This will capture any changes that arise as the design is developed from concept to detailed design.

4.2.3 Detailed Design

Detailed design will be prepared for each phase of the construction. Two stages of construction have been nominated as part of the conceptual design, however the staging may alter based on production requirements, however the detailed design requirements apply for each phase. One of the current unknown factors is the volume and type of unsuitable material and dewatering of perched water that may be required to be excavated as part of the preparation of the foundation conditions for construction.

This information is being gathered as part of preliminary site investigation works to be undertaken in line with the Administrative Change acknowledged by ERR on 20 November 2019. The outcome of these investigations will inform the first stage of detailed design.

Further geotechnical investigation and characterisation and foundation preparation is envisaged to be required post completion of the preliminary site investigation and would be completed as part of the construction phase. The scope of these investigations is included in Section 4.4.1 below.

The detailed design of TSF4 will comprise such elements as:

- ANCOLD risk assessment and potential failure modes;
- Safety in design;
- Detailed design and drawing set including for (but not limited to) embankment, cut slope, excavation layout and design detailing for the TSF, including lining, leachate collection system and decant system;
- Design and treatment of foundation shafts and adits;
- Instrumentation including piezometers, seepage and deformation;
- Sediment pond and diversion drain design;

- Technical specifications for each construction item;
- Bill of quantities;
- Construction hold points (as listed in Section 4.5.2).

As stated above, each stage of detailed design will go through the same process of ITR.

ERR will be sent a copy of the design documentation inclusive of the design report, design drawings and technical specifications and details of ITR review for information prior to commencement of construction.

4.3 TSF4 Conceptual Design Summary

Once an initial design for TSF4 was conceived, an ANCOLD Consequence Category assessment was undertaken to gain an understanding of the Population at Risk (and Potential Life Loss) and potential economic consequences associated with failure of TSF4. Once this Consequence Categories was assigned, ANCOLD (2003a) identifies different levels of risk assessment from 'Screening' to 'Very Detailed'. The first two levels (Screening and Preliminary) are intended to be used to rank risks or to get early indication of issues.

Detailed or very detailed risk assessments are typically undertaken where it has been identified there is a Potential Loss of Life or critical infrastructure and/or essential services interdependency (i.e. High or Extreme Consequence Category dams), to assess risk and support the assessment of ALARP. Where dams meet traditional engineering standards, and they are Extreme or High consequence category, a risk assessment will identify all failure modes and required defences (controls).

The preliminary risk assessment and iterative design process concluded with the following key elements:

- downstream construction method;
- relatively broad embankment (6 m crest width);
- cohesive earthfill (clay) core;
- excavation and removal of any unconsolidated material beneath the embankment that has the potential to liquify;
- 3H to 1V downstream shoulder slope; and
- Maximum depth of flood overtopping of 1 m.

4.3.1 Risk Assessment- PLL

The preliminary TSF4 risk assessment included dam-break and consequence modelling to identify the failure mechanisms have the potential result in a Potential Loss of Life (PLL) and/or impact critical infrastructure (the full modelling is provided in Appendix F of the Concept Design report).

The results of the risk assessment were that the key failure mode is for flood induced internal erosion and piping resulting in dam breach with three scenarios considered:

1. Assumes that TSF4 is at full capacity and failure of the embankment occurs due to piping failure through the upper embankment crest, immediately following a PMF rainfall event and with maximum runoff stored.
2. Assumes that TSF4 is partially filled and failure of the embankment occurs sometime after the Probable Maximum Flood (PMF) rainfall event has occurred. In this scenario there is still stored water between the top of tailings and the Spillway sill; however, there is no coincident flooding in Yarrowee River at the time of failure.
3. Assumes that TSF4 is at full capacity and failure of the embankment occurs sometime after the PMF rainfall event has occurred, such that excess water has been safely passed through the spillway. There is still stored water between the top of tailings and Spillway sill and there is no coincident flooding in Yarrowee River.

The conclusion is that all three scenarios result in an PLL. However, only the scenario immediately following a PMF rainfall event scenario (case 1, above) is shown to have an incremental increase in PLL with implementation of Emergency Response Procedures.

The frequency of a PMF rainfall event at TSF4 has been estimated to be less than 1: 1 x10^{-7} and a likelihood of an event occurring in the order of 1:1,000. The Detailed Design will prepare a detailed risk assessment as part of its documentation requirements. However, the overall likelihood for the flood induced events (rainy day) is assessed to be well below 1: 1 x 10^{-8}.

Under Sunny Day Failure (SDF) conditions, where there is no (or limited) pool of water retained by the embankment, the failure mode considered for consequence assessment was instability of the embankment. Failures confined to the embankment only would only displace a short distance downstream and have limited travel distance downstream given that the bulk of the failure surface would pass through the embankment and its foundation. There is a very low probability that the landslide will encroach onto Whitehorse Road and as a result there is assumed to be no Population at Risk (PAR).

A tool used in a detailed risk assessment process for TSFs with an identified potential Loss of Life, is an F-N curve which relates F (the probability per year of causing N or more fatalities) to N (the number of fatalities). The plot below illustrates an F-N curve with the various risk zones. ANCOLD (2003a) provides detailed commentary on the development of such curves and their use in decision-making.

In addition to societal risk, ANCOLD (2003a) advocates compliance with individual risk. Individual risk requires assessment and evaluation, but most often societal risk will have most influence over life safety considerations.

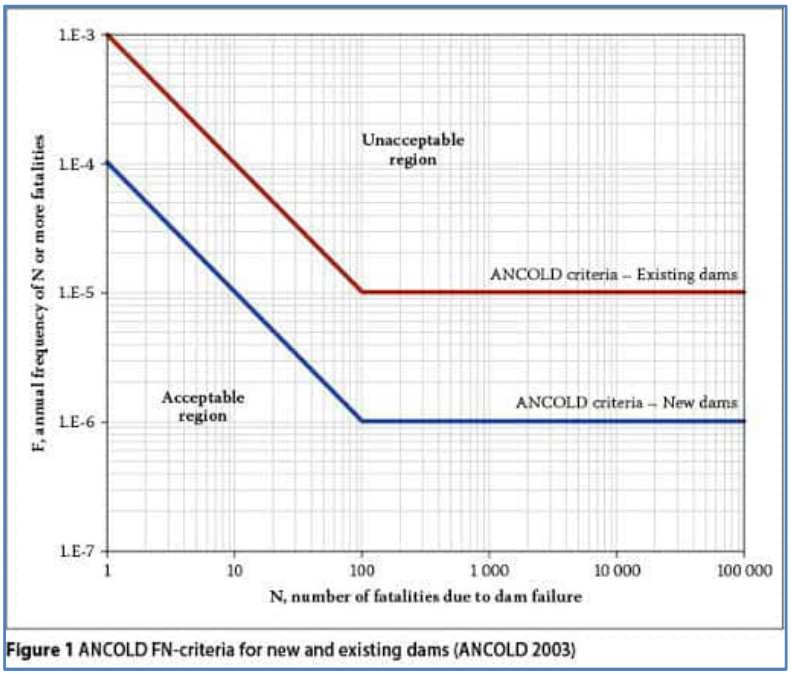


Figure 1 ANCOLD FN-criteria for new and existing dams (ANCOLD 2003)

As can be seen from the plot above, TSF4 is assessed to be 1: 1 x 10^{-8} which is well below ANCOLD's criteria for new facilities and acceptable.

4.3.2 Potential Impact on other receptors

In additional to PLL, under the worst-case scenario 1 above, there are a number of other receptors will may be within the flood zone under a PMF with a dam fail and coincident flooding:

- Bridge over Yarrowee on Whitehorse Road/ Bridge Street;
- Potential sites listed on the Heritage Inventory
- Area surrounding the Yarrowee River classified as Cultural Heritage Sensitivity;
- Area mapped as native vegetation;
- Transmission line;
- CHW aqueduct and pumping station.

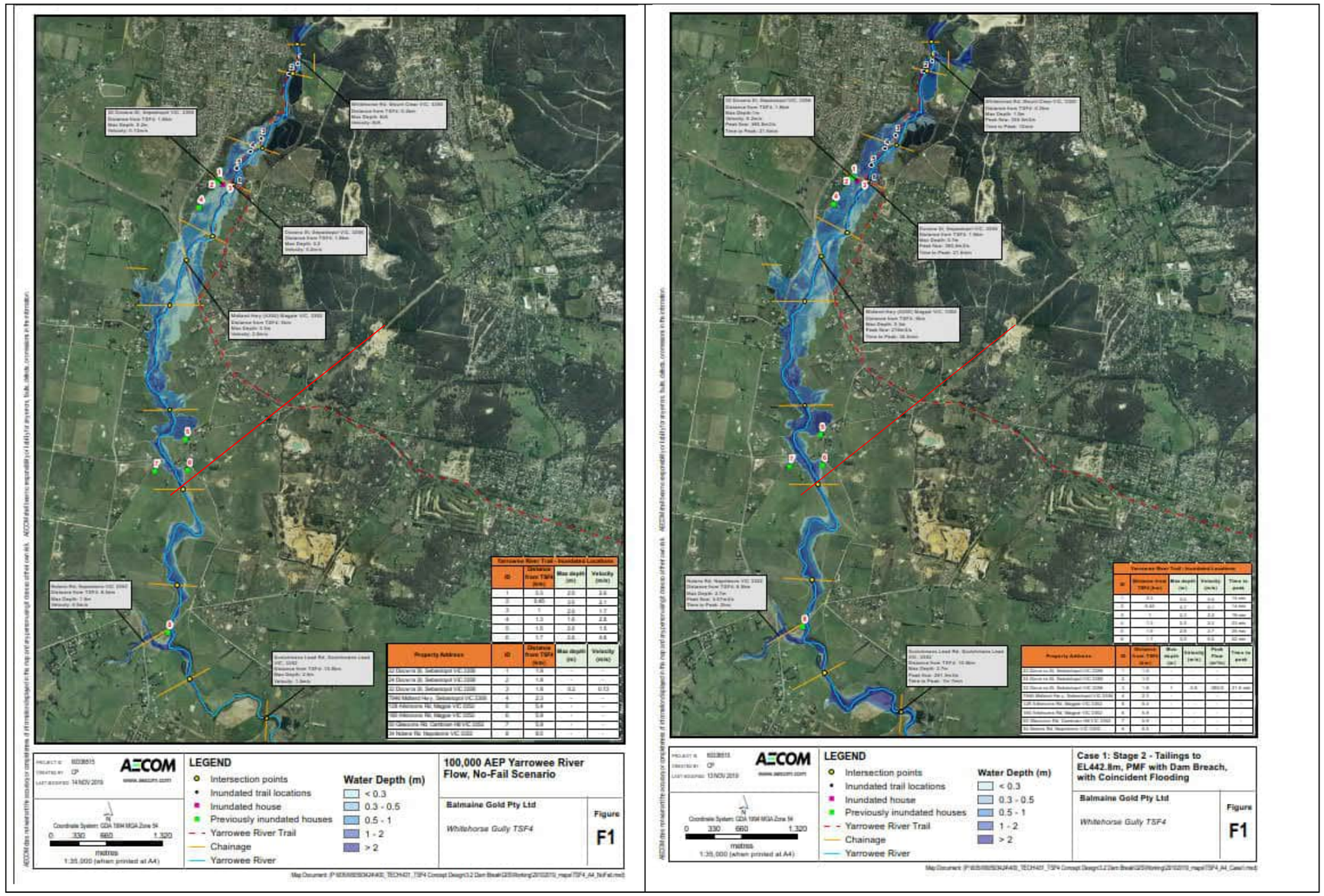
The following receptors have been considered should the dam fail when at full capacity following a PMF, along with the potential for impact. Where a material impact is identified, these will be included within the risk management plan.

Table 5 Potential Receptors within Flood Modelling

Receptor	Potential Impact	Comment
Bridge over Yarrowee on Whitehorse Road/ Bridge Street	• For the no-fail scenario (flood only), water passes under the bridge with no overtopping • For the coincident flood and breach (Case 1- included in Figure 4 below), the dam breach will flow down Whitehorse Rd, and then flow off the bridge into the creek. This is not considered to impact on the bridge the direction of flow (i.e. along Whitehorse Rd onto the bridge. • The bridge an asset that will be in the Dam Safety Emergency Response Plan (discussed in Section 4.7).	No material impact from TSF4
Potential sites listed on the Heritage Inventory	The sites listed on the Heritage Inventory downstream are shown on Figure 2b- App. A. Potentially only two sites would be in the flood zone, however as shown on the modelling figures included in Figure 4 below, where these may be inundated, they would be inundated under the 100,000 flood scenario (without a dam fail).	No material impact from TSF4
Area surrounding the Yarrowee River classified as Cultural Heritage Sensitivity	CHS layer is present over the Yarrowee River as shown on Figure 2b- App. A. As shown on the modelling figures included in Figure 4 below, where these may be inundated, they would be inundated under the 100,000 flood scenario (without a dam fail).	No material impact from TSF4
Area mapped as native vegetation	Mapped native vegetation is shown on Figure 2b- App. A. shown minimal mapped EVCs are along the Yarrowee River. As shown on Figure 4 below, where these may be inundated, they would be inundated under the 100,000 flood scenario (without a dam fail).	No material impact from TSF4
Transmission line	The transmission line shown on Figure 2b- App. A, and shown as a red line on Figure 4 below. As shown on the flood modelling, at the point where the transmission line crosses the Yarrowee River, there is minimal change to the flood extent.	No material impact from TSF4
CHW aqueduct and pumping station	The location of the aqueduct and pumping station is shown on Figure 2b- App. A. Given the aqueduct lies adjacent to the Yarrowee River, this infrastructure would be inundated under the 100,000 AEP Yarrowee River flood scenario (without a dam fail), as does the pumping station, as shown on Figure F4- Appendix F of the Concept Design Report (AECOM, 2020b).	No material impact from TSF4

Receptor	Potential Impact	Comment
	However the CHW aqueduct and pumping station are assets that will be considered in the Dam Safety Emergency Response Plan (discussed in Section 4.7).	

Figure 4 Comparison of modelled Yarrowee River under 100,000 AEP flood and Case 1 (from Appendix F, AECOM, 2020b- refer to source document for details, image provided as an illustration of flooding extent only)



4.3.3 As Low As Reasonable Practicable- ALARP

The general principals of ALARP are considered to have been met with the iterative design process that was followed and resulted in a risk assessment showing the facility when full ('worst case') to have an acceptable risk.

There are a number of other factors that can assist in the assessment of ALARP, including:

- Duration that the risk applies:
  - A greater focus on risk reduction is typically considered for failure modes associated with enduring risks compared to shorter term risks, although this is not necessarily always the case. It is noted that short duration of risk here is not to be confused with rare events or low failure probability.
  - In regard to TSF4 the overall operational life is approximately 10 years before it is dewatered, capped and reducing it to zero PAR. Furthermore, during the operation life there are limited periods when the 'rainy-day' failure modes are considered feasibly, which are towards the end of each stage and the freeboard is at or near its minimum. As a result the societal risk is only a limited portion of the 10 year operational life.
- Availability of risk reductions options:
  - In some situations, for some failure modes, it may not be possible to identify additional viable risk reduction options, thus justifying an ALARP determination. CGT will be mindful of technological and other developments and review this assessment periodically.

4.3.4 Probability of Failure

The following table puts the assessed probability in context:

Likelihood	Probability	Odds
Almost impossible – implausible	1×10^{-6} to 1×10^{-7}	1 in 1-million to 1 in 10-million
Highly improbably	1×10^{-5}	1 in 100,000
Very unlikely	1×10^{-4}	1 in 10,000
Unlikely	1×10^{-3}	1 in 1,000
Possible	1×10^{-2}	1 in 100
Highly probable	0.1	1 in 10

To further support an understanding of the probability of an event occurring the following is a summary of the one-year odds of dying. It is approximated based on dividing the 2017 U.S. population (325,719,178) by the number of deaths. The lifetime odds are approximated by dividing the one-year odds by the life expectancy of a person born in 2017 (78.6 years).

Event	Odds of dying[5]
Being hit by a meteor[6]	1 in 1,600,000
Lighting	1 in 218,106
Passenger on an airplane	1 in 188,364
Bicyclist	1 in 4,407

[5] https://injuryfacts.nsc.org/all-injuries/preventable-death-overview/odds-of-dying/
[6] https://www.nationalgeographic.com/news/2016/02/160209-meteorite-death-india-probability-odds/

Event	Odds of dying[5]
Pedestrian incident	1 in 556

In summary, TSF4 has included a series of design elements which has resulted in the critical failure event that would result in a PLL of less than 1: 1 x 10^{-8}, which can reasonably be classified as almost impossible to improbable and demonstrates that the project has met the ALARP principal.

4.3.5 Site Constraints and Sensitive Receptors

In consideration of the sensitive receptors and site constraints, the Conceptual Design was prepared to the limit of extent of TSF4, such as:

- Cadastral boundary offsets, including an off-set from Whitehorse Road in order to maintain a visual buffer utilising the existing plantation;
- Central Highlands Water (CHW) watermain to the north, including a 10m off-set from the watermain as requested by CHW (5m each side of the pipeline).
- Offset requirements from residential housing of a nominal 100m buffer establishment (as specified by the mining license and MRSD Act);
- Presence of ESO5 planning overlay;
- Presence of Heritage Inventory item-VHI Number H7622-005 which is to be avoided and remain undisturbed; and
- Maximum elevation limit.

The maximum footprint of TSF4 is included on the figures provided in **Appendix A,** in consideration of the site and surrounding features, which are also included on **Figure F5- Appendix A**.

It is noted that currently the south-eastern toe extends into eastern buffer shown on **Figure F5-Appendix A.** The reason for this is that the closest residential property on Whitehorse Road burnt down, and subsequently the off-set from the property changed from an off-set from the house, to the offset being from the cadastral boundary to be conservative as it is unknown (if) and where in the block a house may be rebuilt (as per requirements in S.45 of MRSD Act).

Given the TSF will be built in stages, the earlier stage/s of construction will be within the buffer. By the time of detailed design and construction of the final stage, the house may have rebuilt and the buffer will be refined at the time based on the distance to the receptor. If required, the final footprint extent will be modified (reduced) during detailed design so as the toe remains outside of the buffer. Any changes to the buffer or embankment will be confirmed with ERR at the time if the relevant detailed design stage.

For the purposes of approval of the Conceptual Design, it is requested that the potential maximum full footprint is approved.

4.3.6 Design overview

TSF4 has been designed as a non-release storage in accordance with the Earth Resources Regulation (ERR) *Guidelines for Design and Management of Tailings Storage Facilities* (April 2017). The ERR guidelines are based on the ANCOLD *Guidelines on Tailings Dams* (2012).

An emergency spillway is required in case of exceptional circumstances (where there is a risk of embankment failure due to overtopping). The Design Criteria are dependent on the Consequence Categories, as detailed in the conceptual report (AECOM, 2020b).

CGT's strategy is to re-mine and re-process the coarse-grind tailings from TSF3 using a ball mill to extract additional gold (subject to approval). This process will produce finer-grind tailings which will be disposed of in TSF4. The fine-grained characteristics of the reprocessed tailings means upstream construction methods will unlikely be feasible. It is therefore proposed that TSF4 lifts be constructed by downstream construction methods only in anticipation of employment of this method in the future (subject to approval). However, should re-processing of TSF3 tailings not occur, TSF4 will accept coarse tailings similar to that already being deposited in TSF3, and the construction method be re-evaluated as part of the detailed design phase for each lift (subject to ITR as per Section 4.2.2).

A summary of the design criteria is included below.

Table 6 Summary of design criteria for TSF4

Item	Criterion	Comment
Storm Storage Capacity	1:10 to 1:100 AEP, 72-hour storm event	ERR (2017) Table 3
Contingency Storage Allowance	Nil	ERR (2017) Table 3
Wave Freeboard Allowance	Nil	ERR (2017) Table 2, Table 3
Spillway Capacity	PMF	ERR (2017) Table 2
Crest Width	6 m minimum	Suitable for operating vehicular access.
Embankment Stability (FOS)	Refer to Table 7.	
Earthquake Loading	MDE: 1:10,000 AEP	ANCOLD *Guidelines on Tailings Dams (2012a),* Table 7

The design criteria for embankment stability used in the design are summarised in Table 7. These are in accordance with ERR (2017).

Table 7 Design criteria for slope stability

Loading Condition	Minimum FOS	Stage	Comment
Short Term	1.5	During / Post-Construction	For failure surfaces where there is a potential loss of containment.
	1.3	During / Post Construction	No potential loss of containment.
Long term drained	1.5	Normal Operations	For the embankment during normal conditions
Post-Seismic	1.1	Post-Earthquake	For the embankment post Maximum Design Earthquake event.

The key aspects of the concept design (AECOM, 2020b) are summarised as follows:

- Borrow excavation of residual soils and extremely to highly weathered Ordovician rock from within Whitehorse Gully to maximise the impoundment volume. Waste rock will also be used from the MIN5396 site.
- A new, 35 m high (approximate), zoned earth and rockfill embankment using excavated materials from the impoundment borrow area and waste rock, constructed to a crest elevation at EL 444 m, to provide a total tailings storage capacity of approximately 1.6-1.8 Mm^3 (to be confirmed during

detailed design process). This capacity is sufficient for approximately 10 years depending on actual production and density achieved.

- 0.8 m thick earthfill liner across the entire impoundment floor (tyning and compaction of 200 mm base layer plus 600 mm liner) with a target hydraulic conductivity of less than $1x10^{-8}$ m/sec. This is on top of the natural, low permeability substrate.
- Continuation of the earthfill liner up the impoundment slopes by construction in horizontal lifts of minimum 4 m width (giving a thickness of 1.5 m normal to the slope for the 2.5H to 1V cut slopes in rock).
- A system of leachate collection slotted pipes across the impoundment floor, at 20 m spacing, to reduce the driving hydraulic head acting on the liner and create a preferential flow path for leachate through the leachate collection system.
- Minimum 5 m wide by 1 m depth Emergency Spillway off the embankment's right abutment
- Diversion drainage with the capacity to divert rainfall runoff up from upstream of the TSF to the existing surge dam or to the Sediment Pond at the downstream toe of TSF4 to then be pumped to the surge dam.
- Sedimentation pond downstream of the embankment to capture rainfall runoff from the downstream slope of the embankment and downstream toe area.
- Construction of access tracks around the perimeter of the site and along the embankment crest. This includes a crossing over the Emergency Spillway.

The proposed liner for TSF4 is 800 mm thickness with a permeability less than 1×10^{-8} m/s.

Whilst this is less than the 1 x 10-9 m/s permeability quoted in the ERR TSF guidelines 2017, approval is sought for the 1 x 10-8 m/s liner, based on the following:

- The Terrible Gully TSF has the same geological and hydrogeological setting as TSF4, and has shown no impacts on the groundwater system since construction in 2006 (Terrible Gully TSF includes a 600 mm liner of 1 x 10-8 m/s permeability).
- Piezometers installed within the Terrible Gully TSF embankment have shown that the downstream shoulder has remained dry to date. In addition, no seepage has been observed on the downstream face or downstream toe of the dam.

The stated low risk to groundwater from seepages from the TSF4 is based on the following assumptions:

- Any alluvial sediments within the TSF footprint will be removed or encapsulated to ensure no preferential pathway off-site;
- Any sub-surface geophysical anomalies within the bedrock, such as historic adits, will be surveyed and treated; and
- An earthfill liner will be constructed within the tailings impoundment area.

Further discussion on the liner design can be found in the TSF4 concept design report, including the proposed leachate collection system across the impoundment floor.

TSF4 is planned to be constructed in stages (conceptual design has nominated two stages), however this may be refined during the detailed design process and the mine requirements, including volume of ore being processed.

4.3.7 Tailings Disposal

The disposal to the TSF4 will be similar to the existing delivery system installed for TSF3.

Ore from the underground mine is separated at the mill to recover gold and the remaining tailings slurry is piped to the TSF. Tailings will be delivered as slurry and discharged from the TSF embankment crest via a spigot and distributed across the embankment crest to form a beach. This will create a beach slope sloping towards the eastern side of the TSF, creating a decant pond in this area.

A HDPE slurry pipeline (160 mm diameter PN16 PE 100) is proposed for the tailings delivery. The pipe route will run alongside the TSF access road from TSF3 to TSF4 (shown on **Figure 4- App A**). The pipe will be contained within a concrete box culvert where the pipe is outside of the TSF, so that in the event of a pipe rupture, the tailings is contained within the box culvert and the TSF.

Similar to the current system at TSF3, the tailings delivery pipeline will have flow monitoring at the pump end and at the TSF end linked by telemetry back to the gravity control room. The plant control system (SCADA) will continuously compare the two flow readings and should any flow discrepancy exceed a predetermined amount, the tailings pump will either trigger an alarm or be automatically shutdown depending on the discrepancy.

Tailings Disposal: Risk Management Measures

To reduce spill or breach of tailings disposal line:

- Monitoring and telemetry for automated shutdown.

4.4 Investigations/ Assessments to Support TSF4 Development

4.4.1 Geotechnical Investigations

Some geotechnical and hydrogeological investigations (drilling, shallow test-pitting and groundwater water level and groundwater quality monitoring) have been undertaken to support the Conceptual Design and are summarised within the Conceptual Design (AECOM, 2020b).

In summary, the following was determined:

Proposed Embankment Abutments

The subsurface conditions up the proposed abutments generally consists of medium to high plasticity residual clays overlying highly weathered interbedded siltstones and sandstones of low to very low strength (inferred from auger drilling).

The depth of residual soil was found to be up to 2 m depth in places. In areas up the proposed left and right abutments, weathered rock sub-cropping was encountered near surface level, indicating the presence of bedrock at shallow depth.

The bedrock encountered typically consisted of thinly interbedded siltstones and sandstones. The siltstone was generally light grey in colour with red staining and material recovered from test pits and boreholes was friable and Very Low to Low strength. The sandstone was generally yellow-brown in colour, with red purple ferruginised sandstone in some zones.

The rock was encountered in all test pits and boreholes were judged to be extremely to highly weathered.

No difficulty was experienced in drilling through the weathered rock and coring progressed quickly. Minimal to no water loss occurred during the drilling of any of the boreholes through the weathered rock. Core loss through the material was on average approx. 20%, believed to be mostly from encountering quartz seams.

Excavator refusal was typically reached between 1 to 3 m depth. Refusal was on stronger bands of sandstone, including ferruginised zones, and therefore not necessarily indicative of the mass rock strength or weathering profile. The findings from the drilling indicated that these stronger zones are isolated and that in general, the weathering profile of the sedimentary rock extends much deeper (highly weathered to depths >15 m).

Little White Horse Lead Gully

Inferred sluiced materials were found within the Little White Horse Lead gully overlying the Ordovician rock, to depths up to 8 m. The material comprises fine grained soils of low plasticity. Mixed fill material up to 0.5 to 3 m depth overlies the sluiced material within the gully.

The sluiced and fill materials within the gully will be unsuitable as the embankment foundation and will need to be removed to expose the weathered Ordovician bedrock.

Impoundment/Borrow Area

Limited investigation of the proposed borrow area was performed as part of this stage of the TSF4 design (concept stage). Further investigations are planned for this area as part of the detailed design stage.

For these investigation works, two boreholes were drilled upstream of the impoundment area for the primary purpose of installing groundwater monitoring wells.

The sub-surface conditions at both holes were generally found to consist of highly to moderately weathered sandstone and shale to depths of at least 40 m with quartz seams encountered within BH-WG202 at various depths. Oxidation of the weathered rock was less apparent below 26 m depth in BH-WG201.

No laboratory testing was conducted on material from these boreholes. The material was observed to be similar to the material currently being used to construct Terrible Gully TSF3.

Additional Investigations to Inform Detailed Design

The main knowledge gaps associated with the ground conditions that influence the embankment design include:

- Unsuitable geotechnical fill material and its extent and nature, particularly within the alluvial gullies and deep lead areas. Some investigation has been undertaken and further investigation is proposed as a separate task to inform detailed design;
- The extent and nature of historical mine workings.
- The foundation conditions below the embankment and within the impoundment area. Some investigation work has been undertaken. Further investigation to be undertaken to inform detailed design so as to determine depth to rock and whether material within the impoundment area is geotechnically suitable in the construction.

The scope of the investigations was detailed in the Administrative Change request acknowledged by ERR on 20 November 2019. Broadly, the activities proposed to be undertaken include;

- Geological mapping;
- Geophysical surveys;
- Drilling a series of geotechnical boreholes and groundwater monitoring bores.
- Test-pitting and trenching using 20 to 30 tonne excavators to enable geotechnical logging and testing, and geochemical laboratory testing to inform materials management. These will confirm the fill depth and the estimated depth to a suitable foundation;
- Construction of trenches to be used as trial dewatering trenches to assess the saturation of material and management during construction. Each trench will be backfilled with washed gravel, with installation of a sump. The sumps will be 300 mm diameter slotted black brute pipe or similar;
- Undertake a dewatering trial, including pumping from each trench/ sump for a period of 1-3 days and measuring flow rates, and response in surrounding groundwater bores; and
- Undertake in-situ permeability testing (water pressure testing, or rising head test as a fall-back).

On completion of the investigation program, the findings will be used to further develop the geological model and geotechnical characterisation for the TSF4 site. These will be used as the basis for the stability analysis for the embankment and excavation slopes for the detailed design.

2020 Site Investigation

Following the Administrative Change request, some further investigations have been undertaken to assess the extent of the fill material and depth to foundation. These investigations are not yet complete, with further investigations planned to inform detailed design, however key findings are

included below as part of providing further information regarding potential risks and mitigation during construction.

Proposed Embankment Abutments

The sub-surface conditions at the abutments generally consisted of clays up to 3 m in depth, overlying the natural rock (weathered Ordovician siltstones and sandstones). No groundwater was encountered in any of the test pits.

White Horse Lead & Little White Horse Lead Gullies

Typical materials encountered in the gully areas included surficial gravelly / sandy fill (upper 1 to 1.5 m) with sandy clays & clayey sands below. The weathered siltstones and sandstones were encountered at various depths across the gully.

The majority of material encountered is likely to be suitable for use as either Zone 1 or Zone 2 material in the embankment (pending testing results). No evidence of tailings materials being present in the area were found.

Perched water within the fill was observed within an isolated area of the gully and was not encountered across the majority of the white horse lead gully area (perched water only encountered in 1 of the 4 trenches dug across the gullies) and is therefore limited in extent. Groundwater was encountered in several boreholes, with depths varying between 5 to 11 m below ground level, depending on the location.

Laboratory testing completed on soil samples collected supported the field observations regarding the lack of historic tailings observed within the gully area. Aside from soils tested at TP204A , where, due to arsenic, the soil in this location would be classified as Category B under EPA Publication 621-IWRG, all other samples tested were classified as either Fill or Category C soils. Based on the investigations to date, it appears unlikely that any soils will need to be removed from within the mining tenements. Impoundment/Borrow Area

The material encountered within the borrow area is similar to the borrow materials used for construction of the Terrible Gully TSF; primarily Ordovician sandstones and mudstones. Preliminary testing results of these materials indicate that there will be sufficient quantities of material capable of forming the ‘Zone 1’ low permeability barrier and liner.

4.4.2 Groundwater Impact Assessment

Tailings Geochemical Indicators at Existing TSF3

TSF3 was constructed in 2005 in Terrible Gully immediately north of the site in a similar geological environment. Terrible Gully is mostly underlain by Castlemaine Group with worked deep lead sediments in the gullies. Groundwater impacts resulting from this TSF are have been included in the Groundwater Impact Assessment (AECOM, 2019) in order to inform the assessment of potential impacts at TSF4.

For comparison as to potential impact seepage of tailings would have on the underlying groundwater, a review of the monitoring network established to assess seepage of TSF3 was undertaken.

The tailings in TSF3 are enriched with arsenic and sulphate. Groundwater total arsenic concentrations and groundwater sulphate/ chloride ratios in the basement aquifer at TSF3 were plotted as part of the groundwater impact assessment (AECOM, 2019).

Total arsenic at VMB4 and VMB5 has decreased over time, including from the pre-TSF construction period to post-construction. Although total arsenic concentrations down hydraulic gradient of TSF3 are not available for the pre-construction period, the data at wells BEB6 and BEB8 is in a similar range to VMB4 and VMB5, and follows a similar decreasing trend. This suggests that arsenic from the TSF3 pore water is not impacting groundwater in the vicinity of TSF3.

With respect to the sulphate/ chloride ratios, there is no significant change over time at any of the wells, including the wells downgradient of the TSF (BEB6 and BEB8) and the wells with pre- and post-construction data (VMB4 and VMB5). This suggests that sulphate from the TSF pore water is not impacting groundwater in the vicinity of TSF3. See Figure F2 (Appendix A) for monitoring well locations.

Foundation Permeability

The permeability of the foundation was investigated as part of the concept design. This included estimation of the in-situ hydraulic conductivity (k, in m/s) of the upper 20 m of siltstone/sandstone, and the unconsolidated silt unit, by undertaking the following:

- Drawdown recovery tests at select groundwater well infrastructure at the site (WG-BH204, WG-BH206, WG-BH210). This involved pumping/bailing each bore dry and measuring the well water level recovery;
- Water levels were measured using electronic data loggers and manual readings using an electronic dipper. It was found that the electronic data was at times unreliable, possibly due to turbidity, or disturbance of well columns with the bailer; and
- Data analysis on water level recoveries undertaken in AQTESOLV (computer package for assisted interpretation of pumping test results).

Two analysis methods were undertaken; the Bouwer & Rice (1976) method and Hvorslev (1951) analysis methods. The analysis assumed the following:

- Unconfined aquifer conditions.
- WG-BH204 and WG-BH206 are screened in the extremely to highly weathered sandstone/siltstone bedrock. Partial penetration of a 20 m thick aquifer was assumed.
- WG-BH210 fully penetrates the unconsolidated, disturbed, low plasticity fine grained soil aquifer.

The results of the analysis are included in AECOM, 2019b and summarised in Table 8.

Table 8 Site Specific Hydraulic Conductivity Results

Aquifer	Data	Hydraulic Conductivity		
		Bouwer Rice (m/sec)	Hvorslev (m/sec)	m/day
Bedrock	Manual	5×10^{-8}	6×10^{-8}	0.005
	Logger	4×10^{-8}	6×10^{-8}	0.005
Unconsolidated Fill	Manual	3×10^{-7}	4×10^{-7}	0.035

Summary of Potential Impacts

The groundwater impact assessment identified a number of potential impacts during construction, operation and closure. A number of potential impacts were assessed as not material, however the following risks were considered as having the potential to be material and occur (and have been taken forward into the risk management plan), including:

- Impact to groundwater quality from TSF (Bedrock Aquifer):
  - Operation: seepage of pore water within saturated tailings migrates into underlying Basement Aquifer and impacts on the beneficial uses down hydraulic gradient.
  - Closure: Infiltration of water through TSF cap, that saturates the tailings sufficiently to seep to groundwater and then impact on the beneficial uses down hydraulic gradient of site.
- Impact to groundwater quality from spill. (Bedrock Aquifer) - A spill or release of fuel (or other chemical) in sufficient quantity to migrate to groundwater and then impact on the beneficial uses down hydraulic gradient of site.

Groundwater Impacts: Risk Management Measures

To mitigate the potential identified risks from the groundwater impact assessment, management and mitigation measures are proposed as per Table 9.

Table 9 Groundwater Mitigation Measures

Potential Impact	Management/Mitigation Measure	Monitoring to assess effectiveness of mitigation
Seepage of pore water within saturated tailings migrates into underlying Basement Aquifer and impacts on the beneficial uses down hydraulic gradient	TSF4 Liner Design which include a low permeability clay liner to restrict with also the following leachate mitigation design features: • A leachate collection system installed in a herringbone arrangement across the impoundment floor. Leachate will be pumped out via an above ground pipe over the top of the embankment to avoid any pipes running through the embankment wall; and • A toe drain installed down gradient of the embankment to catch any seepage of rainfall infiltration through the downstream wall of the embankment. Decommissioning of any groundwater bores on site which will be within the footprint area must be decommissioned in accordance with the requirements of *Minimum Construction Requirements for Water Bores in Australia, third edition.*	**Groundwater Monitoring Program** Biannual gauging, sampling, and analysis (including metals, TDS, and sulphate) of the Basement Aquifer down hydraulic gradient of the TSF. This should include, at minimum, two wells down hydraulic gradient of the TSF (including at least one in the gully below the embankment toe), and two wells up hydraulic gradient of the TSF for baseline purposes. A suitable baseline of water quality analyses (minimum of three samples from each well) should be obtained prior to construction commencing. This data should be assessed in consideration of the geochemistry of the tailings deposited and reported on an annual basis for potential change in the water quality downstream of the TSF4 to assess the impact to the beneficial uses of the Basement Aquifer.
Impact to beneficial uses of the Basement or Deep Lead aquifers due to fuel spills from plant	**Construction Environment Management Plan (CEMP)** Preparation of a CEMP that contains measures to avoid contamination to land and water during construction of TSF4 and contingency actions in the event of a spill or release.	The CEMP must include triggers and actions as part of risk mitigation.

4.4.3 Visual Impact Assessment

A maximum elevation for the embankment crest of TSF4 was initially set at no higher than EL451 m by CGT aimed at reducing the visual impacts to the surrounding environment.

The proposed maximum crest elevation of TSF4 is EL 444 m and well below this elevation. This limit on elevation is driven by maintaining the TSF and excavations within the boundary constraints and maintaining a reasonable tailings volume to bank volume ratio.

As listed in Section 4.3.5, leaving a buffer for reducing the visual impact of TSF4 was considered as part of the project design. The following vegetation/ soft pines will remain for the development for the purpose of minimising impact to visual amenity;

- 15m strip of mature soft pines to be retained along Whitehorse Road;

- Vegetation (native and pines) in the 100 m buffer between Tinworth Avenue and the development;
- Development to take advantage of the natural topography and pine plantations that also exist to the west of TSF4 site.

The vegetation that is to be retained for TSF4 is shown on **Figure F5- Appendix A.** A security fence will be constructed as detailed in Section 4.9 and as part of considering to visual amenity, it will be constructed with either dark green or black coating (rather than silver galvanised steel only).

A Visual Impact Assessment was completed by Hansen Partnership Pty Ltd (Hansen, 2019) as part of the assessment for TSF4.

Eight viewpoints were selected to be assessed for the viewshed analysis based on topographic analysis (shown Hansen, 2019). The VIA considered the maximum height of the TSF4 embankment, and the maximum tree removal extent, and assumed worst-case visual impact, i.e. before any tree cover was re-established at closure, and also considered the visual impact following closure once pines had been re-planted.

The maximum extent of trees proposed to be removed to accommodate TSF4 and associated infrastructure and modelled are included in Hansen, 2019.

Following draft photomontages of the existing condition and future view based on the maximum embankment height and maximum tree removal, four photomontages were taken forward to final as they were considered have the highest potential for detrimental impact from representative locations.

Overall the VIA, assessed all the future views of potential highest impact as either being “negligible” or “low” for both the scenarios modelled. Based on this, it was concluded that no further risk mitigation (above what had been accounted for in the project design) was required.

Visual Impacts: Risk Management Measures

The project has been designed to retain a 15 m strip of mature pines along Whitehorse Road to provide a visual screening. The project design has also included a black or green PVC coated fence to reduce the visual impact of the security fencing.

Based on the VIA, no further risk mitigation is required.

4.4.4 Air Quality

An air quality assessment (AECOM, 2020a) was completed to assess baseline conditions at the TSF4 site and modelling of the potential air quality impacts of the construction, operation and closure of TSF4.

The air quality assessment was undertaken in order to assess compliance against the Environment Protection Authority Victoria’s (EPAV) *State Environment Protection Policy (Air Quality Management) 2001* (the SEPP [AQM]) and the related EPAV Publication 1191 *Protocol for Environmental Management – State Environment Protection Policy (Air Quality Management) – Mining and Extractive Industries* (December 2007) (the PEM). As the proposed development is a mining operation, falling under Clause 40 of the SEPP (AQM), assessment of potential impacts from the Project have been assessed in accordance with the SEPP (AQM) and the PEM. .

The pollutants assessed included PM_{10}, $PM_{2.5}$ and Respirable crystalline silica (RCS) (defined as the $PM_{2.5}$ fraction).

Three modelling scenarios were investigated as part of this assessment. The scenarios are described as follows:

- Scenario 1 – existing operations. This scenario is based on operations at the mine utilising the existing TSF3 tailings dam.

- Scenario 2 – future TSF4 operations. This scenario is based on future operations at the mine utilising the proposed TSF4 tailing dam. The existing TSF3 tailings dam would not be operational under this scenario.
- Scenario 3 – TSF4 construction. This scenario is based on activities involved with the construction of the proposed TSF4 tailings dam. Operations would continue as per normal during construction of TSF4, and therefore all activities included in Scenario 1 were also included in Scenario 3. Modelled construction activities for this scenario are based on Stage 2 construction works, which have a higher total excavation volume than Stage 1 and would therefore experience higher emission rates. The Stage 2 footprint would also bring construction activities closer to sensitive receptors to the south and east of TSF4 on Tinworth Avenue. Emission rates were calculated based on eight months construction duration. Stage 2 is likely to be constructed over a longer period than eight months and therefore the modelled construction intensity is likely to be greater than reality. Estimated emission rates were applied to all hours of the model (five years) conservatively.

The modelling results are detailed in AECOM, 2019a and are summarised as follows:

- Scenario 1 (existing operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below well below criteria. Project contributions were predicted to be up to 43% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 2 (future TSF4 operations) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below well below criteria. Project contributions were predicted to be up to 45% (24-hour PM_{10}) and 11% (24-hour $PM_{2.5}$) of their respective criteria.
- Scenario 3 (TSF4 construction) – cumulative 24-hour concentrations for both PM_{10} and $PM_{2.5}$ were predicted to be below criteria at all sensitive receptors. Project contributions were predicted to be up to 58% (24-hour PM_{10}) and 12% (24-hour $PM_{2.5}$) of their respective criteria.
- RCS (as $PM_{2.5}$) concentrations were predicted to be well below the criterion for all scenarios. The use of the $PM_{2.5}$ annual average data for a direct comparison to the respirable crystalline silica is highly conservative as it assumes that all of the emitted $PM_{2.5}$ is respirable crystalline silica. In reality, the respirable silica content of the $PM_{2.5}$ emissions from the site is likely to be much lower than the results predicted in this assessment.
- The results suggest a nearfield distribution of impacts, with the highest receptor results generally occurring at the southern end of the site during construction of TSF4 (Scenario 3). As shown in the contour plots in AECOM, 2019a, the highest particulate concentrations are predicted to be centred on the main sources of dust – the vent stack to the northeast of site, the processing area, wind erosion from TSF3 and TSF4, and the construction of TSF4.

Predicted cumulative 24-hour PM_{10} concentrations approached the criteria for the construction of TSF4 (Scenario 3). Stage 2 construction activities were modelled based on a construction period of eight months. In reality, Stage 2 is likely to be undertaken at slower pace than this, meaning that excavation and embankment construction rates and corresponding dust emission rates would be lower than those modelled. TSF4 Stage 1 would be constructed over an eight month period, however overall excavation and embankment volumes are lower than for Stage 2.

The Stage 1 construction footprint is smaller than that for Stage 2 and construction activities would be slightly further away from sensitive receptors. Dust impacts due to Stage 1 construction are expected to be lower than the results presented in this assessment for Stage 2.

Based on the conservatism used in the TSF4 construction model (Scenario 3), it is likely that actual concentrations during construction are lower than those predicted here. However, dust may still be an issue if not controlled, and appropriate mitigation should be undertaken and a construction dust management plan developed for the Project. This would provide the best possible chance that offsite dust impacts do not occur during construction.

Air Quality: Risk Management Measures

- Maintain a high degree of dust control efficiency on primary haul roads through watering

- Ability to wash wheels if needed or grid to minimise truck dust track-out from the site if trucks are to leave the site during wet weather conditions.
- \Apply water spraying on excavation activities during high dust / wind events
- Minimise the size of disturbed areas and rehabilitate as soon as practical
- Modify construction operations during adverse meteorological conditions - e.g. reduce operations during dry windy conditions, often cited as > 8 m/s or when visible dust lift off is present as much as practical. Maintain mobile plant according to manufacturer's recommendations
- Do not allow mobile plant engines to idle when not in use
- During operation, develop routine spigot cycling to maintain moist tailings.

4.4.5 Acoustics

A Noise Impact Assessment (Broner, 2019) was completed to assess the changes in predicted noise levels as a result of TSF4 construction and operational phase in consideration of the existing mine operational noise through the existing plant.

The noise impact assessment assumed a worst-case scenario at receiver locations. which were based on established noise monitoring locations associated with the existing MIN5396 and MIN4847 approvals. The noise limits adopted were based on the existing approvals for the respective MINS: MIN4847- (Environmental Management Plan, July 1995) and MIN5396 (Planning Permit PA93/195 (TP133), August 2007).

Based on the noise impact assessment, for both the construction and operational phases, the noise level predications at critical receptor locations were well below the current approved noise limits for day, night and evening periods. Therefore, it was concluded that the construction and operation of TSF4 will not result in additional unacceptable noise impacts.

Acoustic Impact: Risk Management Measures:

- Constrain construction periods as per project design.
- Place pumps in appropriate enclosures (hush packs)
- Employ electric pumps for the operational phase to minimise noise emissions
- Ensure plant is regularly maintained, or repair or replace equipment that becomes noisy
- Subject to safety or operational constraints, turn off equipment or machinery when not in use and minimise the number of trucks idling at one time where feasible to do so.

4.4.6 Ecological

An ecological assessment was completed for the development of the TSF (AECOM, 2020).

The outcomes of the survey completed in 2019/ 2020 are summarised in Section 4.0 above.

As stated above, the site is classified as Plantation, with Balmaine holding a Plantation Licence for the land including the area subject to TSF4 development. HVP Plantations will harvest the pine plantation in accordance with the *Code of Practice for Timber Production 2014* and operate any activities under a Timber Harvesting Plan. Under this, exemptions for permits and offsets for native vegetation removal under Planning Provision 52-17 and the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP, 2017) apply for the areas deemed to be plantations (see AECOM, 2020 for further discussion).

However, the south eastern portion of the disturbance footprint has been assessed as having native vegetation that requires a permit to remove from City of Ballarat and will require offsets.

- Offset obligations for the proposed vegetation removal include 0.841 General Habitat Units and 3 Large trees. Figure 3 above illustrates the area which will require a planning permit to remove native vegetation.

The relevant NVR, off set statement and avoid and minimise statement are included within the provided vegetation assessment (AECOM, 2020). Vegetation removal for the fence construction within ESO5 planning overlay will be minimised and has been designed to minimise impacts on koala habitat. A permit and offsets will be in place for any vegetation removal within ESO5 overlay area, as per the alignment shown in Figure 3 above).

A planning permit for permission to remove vegetation, along with the relevant offsets, will be in place prior to the removal of the native vegetation requiring permit to remove (see Figure 3 above for area).

Ecological Impacts: Risk Management Measures

Permit and offsets to remove native vegetation will be in place for native vegetation not identified under the Planning Provision 52-17 exemptions.

This includes any vegetation removed for the fence construction in the ESO5 planning overlay.

4.5 Construction Approach

Construction will be by experienced earthmoving contractors under the supervision of appropriately qualified consulting engineers, in accordance with quality assurance which will be specified in the detailed design. It is noted that the construction of TSF3 received minimal neighbour complaints, and CGT will be employing similar methods and mitigation measures to reduce impacts on the neighbours during the construction periods.

4.5.1 Site preparation and removal of unsuitable fill

The site is currently partially covered by mature pine plantation which are to be harvested prior to the first stage of TSF4 development. The plantation coupes will be removed with the trees removed from site by HVP Plantations, the remaining stumps will be cleared and grubbed (as is part of the normal timber harvest preparatory works) and will be completed within key areas of site investigation (as per Section 4.4.1) to enable access of equipment and to facilitate further site investigation works.

Vegetation (native or plantation) may be cleared in stages to suit construction staging. It is expected that only the minimum required vegetation will be cleared as part of maintaining as much visual buffer where possible and also to reduce exposed surface to minimise the potential for erosion and sediment run off.

A zone of deep fill (to at least 7.5 m depth) is inferred to be present within the former alluvial gully and deep lead. The fill overlay weathered Ordovician aged sediments (extremely to highly weathered rock with areas of residual soil). This fill material as well as any remaining sandy and gravelly soils will be removed to expose the underlying Ordovician sediments.

Further investigation is required for detailed design to confirm the nature, extent and volume of the deep fill (as outlined in Section 4.4.1). Preliminary estimates of the deep fill are in the order of 150,000 to 200,000 m^3 of material which may not be geotechnically suitable to meet the construction parameters of the TSF. The approximately anticipated extent of the potential unsuitable geotechnically material is provided on Figure 5 below.

It is inferred that some (a lesser volume potentially in the order of 10,000-20,000 m^3) of this material may be sluiced material or historic tailings, however this number is likely to be overly conservative, as supported by further geotechnical assessments (in progress). Management of the material will be confirmed following the site investigation works where the nature via laboratory analysis and volume of the material can be confirmed.

It is planned that material not geotechnically suitable to meet the design criteria will be managed by the following:

- Potential immobilisation within the core of the TSF4 embankment. This would be subject to volumes, detailed design and contaminate nature of the material- for material classified as Fill

Material under EPA IWRG 621, and would be expected to reflect the natural mineral content of the local geology rather than historic contamination/ tailings deposits and would not have a restricted use;

- Retention and placement of 10,000- 20,000 m^3 of the historic tailings (identified, if at all) within TSF3. This would slightly reduce the expected life of TSF3, however would mean that the material would remain on-site, especially if material could not be used in the embankment construction or disposed off-site (e.g. if material was classified as Category A); or
- Depending on the heavy metals, including arsenic and chromium concentrations which are the expected contaminants in historic tailings, removal, transport and disposal of the material is a licenced facility. This would be for Category B or Category C materials only.
- If historic tailings or contaminated soil were identified, a methodology would be developed, including environmental management plan for the excavation and management of the material prior to excavation of the material. This would form part of the planned Construction and Environment Management Plan; and
- All off-site transport and management would be subject to EPA requirements and would be undertaken by a licenced waste transported and treater under waste transport certificates.

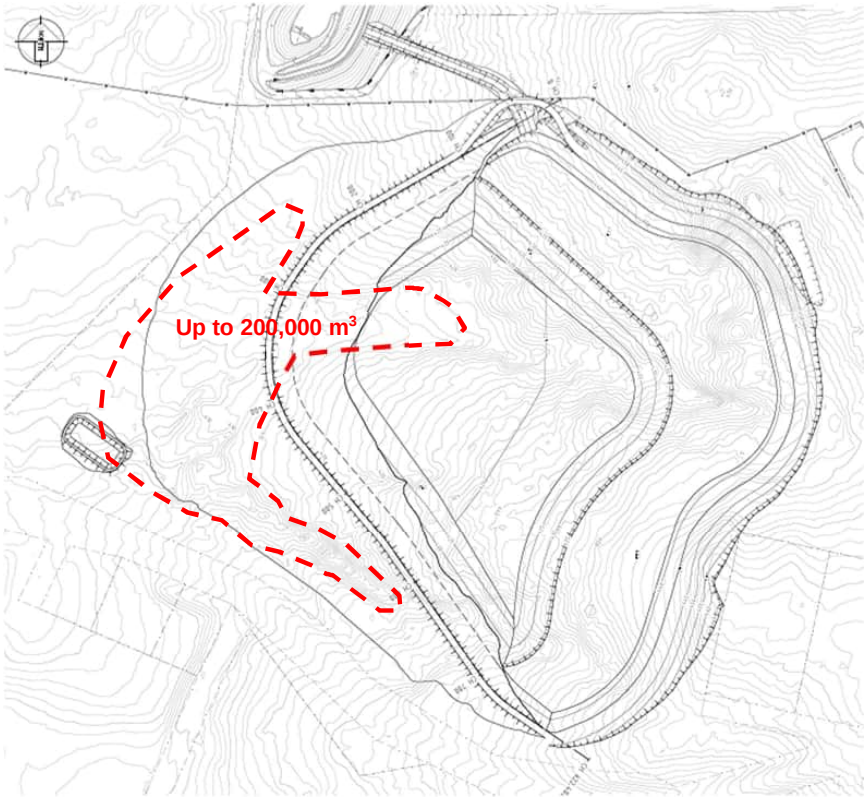


Figure 5 Approximate foundation excavation extents

Following removal of area of unsuitable fill, construction phase will commence with stripping and stockpiling of topsoil where present from all work areas including the entire storage area. Topsoil will be stockpiled in a disposal area above the storage for use in future rehabilitation works in stockpiles no more than 2 m in height (see **Figure F6-App. A** for indicative stockpiling location). Stockpile management is further discussed in Section 4.5.2 below.

The TSF embankment area will then be stripped of highly weathered soils to expose a suitable foundation of weathered bedrock. Within the proposed TSF4 site, the local siltstones and mudstones are expected to be readily excavated with normal earthmoving equipment, as was the case for TSF3.

Where necessary permeable zones such as quartz seams, will be treated as specified in detailed design, such as dug out and backfilled with "dental" concrete, and geophysical surveys completed to identify anomalies. This approach was successfully applied during the development of TSF3. The methodology associated with this task, will be part of the detailed design package.

It is not planned that material will need to be imported for construction from outside the existing MINs. All material will be sourced from the TSF4 impoundment area, or will be waste rock transported from within the mine as was part of the 1993 work plan for MIN5396.

4.5.2 Construction Hold Points

Key construction hold points will be included in the detailed design package and will include:

- Mine shafts, adits and geotechnical anomolies:
  - Review (by Design Representative) of the geophysical information;
  - Presence of the Design Representative and CGT Project Manager during any investigation of identified anomalies;
  - Confirmation of the treatment of anomalies by the Design Representative with sign off by the Design Manager for treatment works.
- Inspection and approval of the prepared foundation by the Design Representative and CGT Project Manager:
  - Embankment: inspection and approval of all areas of the foundation surface below the embankment, and confirmation of treatment measures where required;
  - Impoundment Area: Design Representative inspection and approval of all areas of the foundation surface below the earthfill liner, and confirmation of treatment measures where required.
- Design Representative and CGT Project Manager inspection of borrow areas and confirmation of material suitability for the embankment works;
- Contractor Method Statements: the specification will include a Hold Point for acceptance of submittals for all key aspects of the works including foundation preparation, borrow area preparation and working, treatment of old mining anomalies and embankment construction.

4.6 Stockpile Management

SUMMARY

Estimated volume of topsoil: 10,500m^3

Estimated volume of excavated material to stockpile: 1,105,000 m^3

Excavated volumes of material to be stockpiled are estimated to be 1,105,000 m^3, however this volume may change post the planned initial site investigation program. Where possible, material excavated will be used in the construction of the TSF. However, if historic tailings are encountered, alternate management will be developed prior to material excavation (see Section 4.5.1).

Topsoil, where present (expected to be minimal, however has been estimated at maybe being present on 25% of the site), will be stockpiled in separate stockpiles of heights no greater than 2m. Other materials excavated as part of foundation preparation and impoundment excavation will stockpiled, for use in the embankment construction or for closure.

Nominated areas for stockpiling are shown on **Figure F6- Appendix A**, including an area to the north west of the footprint, adjacent to the CHW boundary**.** A higher volume of material will be generated in the initial phase of construction. The temporary stockpile area nominated will be used during Stage 1

construction phase only, with materials moved and to be utilised during the subsequent construction phase/s. To accommodate expanding TSF4 footprint during subsequent construction stages, the stockpiling area may also include the area to the north of the CHW pipeline.

No material will be stockpiled immediately adjacent to Whitehorse Road, with stockpile kept as close to the existing mine operations as practicable so as to minimise potential for off-site dust emissions.

Mulch from clearing and grubbing of vegetation will also be stockpiled (or will remain in-situ to stabilise the post-harvest surface) and used as part of stabilisation of stockpiled materials and revegetation of the site. All stockpiles will be made safe and battered, and, vegetated or covered with mulch, to stabilise the material and reduce potential dust emissions before use.

All stockpiles are temporary only and will not remain post-rehabilitation (i.e. material would have been utilised by or during closure).

4.7 Operation of TSF4

4.7.1 Operations & Maintenance Manual

CGT's approach is to have a consolidated Operations & Maintenance (O&M) Manual that includes the following:

- Dam safety management requirements, including roles and responsibilities, incident identification processes, alert levels for credible failure modes and emergency response procedures.
- Inspection, Monitoring and Maintenance requirements including pore water pressures, deformation monitoring, seepage monitoring and general maintenance to manage dam safety.
- Normal operating procedures, including tailings deposition and water management.

The O&M manual will be developed prior to deposition of any tailings.

4.7.2 Dam Safety Emergency Response Plan

The population at risk in the very low likelihood of a dam breach event includes itinerants along Whitehorse Road, the bike path along the Yarrowee River and potentially on road crossings of the river including at Bridge Street and further downstream, and several residences that front the Yarrowee River (AECOM, 2019).

A Dam Safety Emergency Response Plan (DSEP) will be prepared prior to operation of the TSF to mitigate the number of persons at risk and include a process for identifying asset owners within the inundation zone and including a notification procedure in the event of an emergency. This is for the period during and after a significant flood event where there is the potential for an increased dam safety risk (during and post flood) associated with the high water levels within the TSF.

The DSEP will include emergency response for rainfall events of 1 in 1,000 AEP or less frequent, such as:

- Closure of Whitehorse Road from the top of TSF embankment to the opposite side of Yarrowee River;
- Closure of the Yarrowee River Trail bike path along Yarrowee River from Whitehorse Road to Midland Highway;
- Warning and advice provided to the residents of affected properties within the inundation zone;
- Warning for identified asset owners within the inundation zone;
- Inspection of the TSF by qualified Dam Engineers and confirmation of the structural integrity of the embankment such that the closures can be removed.

TSF4 operation: Risk Management Measures:

- Operation and Maintenance Manual for TSF4 to be in place prior to tailings deposition.
- Dam Safety Emergency Response Plan (DSEP) for TSF4 to be in place prior to tailings deposition

4.8 Water Management

SUMMARY

- Water captured in the sediment pond, decant and leachate will be directed to the surge dam on MIN5396, where it will enter the existing mine water circuit.

4.8.1 Groundwater

Excavation of the unconsolidated sediments that lie beneath the embankment footprint and thus comprise the perched fill aquifer located within the gully(s) of the site will be removed as part of the construction phase. Regional groundwater may be encountered in some areas where the sandy and gravelly soils extend deeper.

Management of water, including on-site disposal and permit requirements will be detailed within a Construction and Environment Management Plan (CEMP). CGT currently hold a groundwater dewatering licence (Take and Use- licence Entitlement ID: BEE022093) from Southern Rural Water which was issued 29 August 2009 (modified 25 May 2010), valid until 30 June 2021. The licence, included land for CA 10K, Section 12, for which TSF4 is to be located and is for direct extraction of groundwater for the purposes of dewatering up to a maximum annual volume of 2,920 ML or 8ML/day. Currently, the groundwater extraction related to the mine operations is well below this daily dewatering volume (extraction volumes currently are 1.7ML/day, and therefore there is sufficient redundancy in the existing T&U licence to cater for the short-term dewatering requirements during the construction period.

A copy of the licence is provided in **Appendix D**.

It is assumed that this perched aquifer will therefore be largely removed from the project area as part of early construction works which will be a key mitigation measure for management of water during the construction process. Management of perched water through the construction phase will be part of the CEMP.

Based on the groundwater impact assessment (AECOM, 201b), limited impacts to groundwater are expected during TSF4 operation, however a monitoring and management program will be established to assess potential seepage and quality throughout the life of the TSF.

Groundwater Impact: Risk Management Measures:

- Removal of shallow perched aquifer (managed through CEMP)
- Monitoring program implementation

4.8.2 TSF4 catchment and freeboard

TSF4 will effectively operate as an offline storage, with incoming surface water flows from the external catchment area in rainfall events greater than a 1 in 500 AEP event.

The catchment for TSF4 includes the surface area of the storage, plus the crest of the embankment which directs flow into the TSF (i.e. the impounded area), plus the external catchment area.

The TSF4 has been designed with the following minimum freeboard requirements (refer to AECOM, 2019 for further details):

- **No-Spill Storage Allowance (below spillway sill):**
  - Safely store a 1 in 100 AEP, 72-hour storm event. This is approximately 200 mm on the TSF surface. Note that there is no 'Contingency Allowance' above the 'Extreme Storage Allowance', based on the 'Low' dam spill consequence category and Table 5 of the ANCOLD 2012 tailings guidelines.
- **Emergency Spillway Capacity (above spillway sill):**
  - Safely attenuate and pass the Probable Maximum Flood (PMF). For a 5 m crest length spillway a minimum spillway overflow depth of 770 mm is required to pass the PMF.

Based on the tailings stage-storage relationship (presented in Section 7.2.2 of AECOM, 2019) the corresponding freeboard requirement is approximately 200 mm depth. However, the design freeboard will be finalised in detailed design.

4.8.3 Emergency Spillway

TSF4 is required to have an Emergency Spillway with flow capacity to pass the PMF.

The proposed Emergency Spillway is located off the right abutment of the TSF4 embankment, cut into the weathered bedrock (with the location shown on **Figure F5- Appendix A**, and design and cross-sections presented in AECOM, 2019). The spillway outfalls to the existing Surge Dam (currently servicing the Terrible Gully TSF) to the north-west. Features of the spillway include:

- Concrete control sill, with a sill level at 1 m below the crest of the embankment (EL 443 m).
- 60 m long, trapezoidal open channel spillway, with longitudinal grade of 4%, 5 m wide at the base and side slopes at 5H to 1V. The 4% grade is designed to keep velocities low and therefore no erosion protection is required.
- A box-culvert crossing is required to provide flow under the existing CHW watermain (understood to be a 600 mm plastic lined, DICL pipe). The design includes twin box-culverts for redundancy against blockage.
- Downstream of the box-culverts, the slope steepens to a longitudinal grade of 8 to 9% (preliminary) for a length of 90 m, conforming to the natural terrain towards the Surge Dam.

  There spillway chute intersects with a cut slope formed in the construction of the original Surge Dam. This cut slope is at approximate 2.75H 1to 1V. It is proposed that riprap scour protection is included down this steep slope, for a distance of approximately 60 m. The extent of scour protection necessary in this location will be assessed in detailed design, taking into consideration the frequency at which the spillway may operate (extremely low likelihood).

4.8.4 Decant Water

Tailings deposition will be via spigot off-takes on the embankment crest. This will result in a decant pond being formed on the eastern side of the TSF.

The decant pond water will be transferred to the process water tank (PWT), located to the north east of TSF3, and recycled for daily processing plant operations. A zero-release closed water circuit will be used between the TSF's and the process plant. Similar to the tailings delivery pipe, the return water pipe (decant water) will be contained within a box culvert where the pipe is outside of the TSF.

The decant structure itself has not been designed as part of the concept design. As discussed in the concept design report, there are a number of factors that will need to be considered in the design of the decant offtake structure, including but not limited to:

- Location of decant pond, which will depend on the location of tailings deposition into the TSF and the characteristics of the tailings slurry.
- The particle size distribution of the tailings, which will determine the filtering requirements around the decant structure so that it does not clog.
- Water balance, which will assist in sizing the decant recovery system.
- The consolidation characteristics of the tailings (function of specific gravity, initial void ratio, initial water content, particle size distribution), which will assist in sizing the decant recovery system.

It is envisaged that the decant structure will comprise a side slope riser, similar to the Leachate Collection Side Slope Riser. Key differences will be:

- The pipe(s) will be slotted for their full height.
- The pipe will be filtered by zone(s) of granular material, designed as a critical filter to minimise the risk of clogging.

- The decant return line will feature flow and pressure monitoring at the pump and at the mill discharge linked by telemetry. The control system will automatically shut down the pump in the event of abnormal fluctuation of these parameters.

4.8.5 Leachate

The leachate collection system is designed to complement the liner, by providing a high permeability preferential flow path for leachate emanating from the tailings. The leachate system is based on the guidelines of EPA *Publication 788.3*, which includes fall on the base of the liner, a network of perforated collector pipes all draining to a sump, which will have risers progressively added as tailing is placed.

The leachate will be contained within the process water circuit, with the leachate circulated between the Process Water Tank and the TSF.

As with the decant water, the leachate line will consist of HDPE pipe contained (such as within bunding, a concrete box culvert or contained within another pipe) to protect the pipe and also to minimise any environmental discharge if the pipe were to be breached.

4.8.6 Summary of risk mitigation measures

Tailings Storage: Risk Management Measures:

TSF leakage/spillage risk to be minimised by:

- TSF to be lined with a 600 mm compacted earthfill layer of 10^{-8} m/sec permeability over the full extent of the impounded tailings area.
- A system of leachate collection slotted pipes across the impoundment floor to reduce the driving hydraulic head acting on the liner and create a preferential flow path for leachate.
- Operation to maintain decant pond away from the embankment
- Minimum storage allowance for extreme flood event (1 in 100 AEP 72-hour event) with freeboard contingency and allowance for wind-generated waves
- Bunding along pipeline routes to collect water/tailings
- Dual flow meters at inlet and outlet with automatic shutdown system
- Identification of mine workings on site as part of detailed design / early phase of construction and treated (if needed) to maintain the integrity of the TSF earthfill liner

Monitoring system to include:

- Alarms and automatic shutdown on pipelines
- Alarms on high water level, alarms on return water pump failure.
- Embankment monitoring including piezometers, movement, seepage
- Routine manual inspection process
- Severe weather warning alerts from BoM, Vic Emergency

4.8.7 TSF4 Stormwater Management and Sediment Control

TSF4 Stormwater management

The proposed TSF4 lies within a sub catchment of Yarrowee River. There is an external catchment (10.5 ha) upstream of TSF4. A stormwater management strategy has been developed for the TSF4 and includes construction of a surface water drainage system that includes interception and diversion of surface run-off from the external catchment away from the TSF4 impoundment via perimeter surface diversion or catch drains for rainfall events of up to (1:100) (AEP).

The conceptual surface water drainage system is provided on **Figure F7 and Figure F8- in Appendix A** and reflect the proposed drainage system for two (potential) stages (Stage1 and Stage2) of construction.

Runoff is directed north and south around the TSF4 via existing gullies and or constructed diversion/catch drains during Stage 1 construction and primarily via new diversion and catch drains on during Stage 2 construction and during operation of the TSF4.

It is proposed that all surface runoff is directed via drains around the TSF4 to a new sedimentation basin located immediately downstream of the final TSF4 embankment.

The drains will be designed to control and contain a 1:100 AEP storm event.

Indicatively, drains will be either triangular or trapezoidal in shape and will be of varying depth and width, with minimum side batter slopes of 2H to 1V, minimum longitudinal grade of 0.5% and minimum depth of at least 1 m to allow for a minimum freeboard of at least 0.3 m.

Due to steepness of the site some drains will need to be constructed with steep longitudinal grade (up to 30%). In these areas, drains will be designed as rock chutes and or include rock lining to provide scour protection and to minimise erosion of drains. Similar erosion control measure will be applied at all culvert inlet and outlet locations. Sizing of rock for rock chutes, lining of drains and culvert inlet and outlets will be completed during detailed design phase of the project.

It is proposed that all surface runoff will be directed through the sedimentation basin for all events up to the (1:100) AEP. For events greater than the 1:100 AEP it is proposed that the sedimentation basin will be bypassed, with flood flows to discharge from the site via existing gullies and downstream road culverts.

Details of the proposed sedimentation basin design are presented below.

Sedimentation Basin

In order to manage sediment generated from surface run-off from around TSF4, sediment control is proposed by two (2) systems:

- A new sedimentation basin, to be constructed downstream from the TSF4 embankment.
- The existing Surge Dam and wetlands system currently used for Terrible Gully TSF(TSF3).

It is proposed that treated surface run-off from the TSF4 sedimentation basin will be directed to the surge dam. Water entering the surge dam will enter the mine water circuit in MIN5396 as per existing MIN5396 approvals, through the existing water treatment plant (which has an approved Works Approval from EPA), and an associated EPA discharge licence for discharge of treated waste water to Yarrowee River at a specific point (within MIN5396) (EPA licence 18092).

The sedimentation basin has been preliminarily sized in accordance with the International Erosion Control Association (Australasia) (IECA) *Best Practice Erosion and Sediment Control Guidelines* (2008).

The sedimentation basinwill be designed for the following stages of the TSF4 development:

Temporary (During site clearing and during TSF construction):

- EPA (2015) recommends sedimentation basins to be designed to treat and contain the (1:2) AEP, 6-hour storm event.
- IECA (2018) recommends treat for a (1:1) AEP, critical storm duration.

During Operations:

- EPA (2015) recommends sedimentation basins be designed to treat and contain a (1:10) AEP storm event (assuming inert waste), without spilling.
- IECA (2018) suggests a (1:5) AEP for mine sites, without spilling.
- EPA (2015) recommends that sedimentation basins should be designed to safely pass the (1:100) AEP (critical duration) storm event.

It is proposed that the sedimentation basin for the TSF4 be designed to treat and contain surface run-off for the most critical case. In this instance it is proposed that the sedimentation basin is designed to treat and contain a (1:10) AEP storm event, and safely detain without spilling up to the (1:100) AEP (critical duration) storm event.

Preliminary sizing of the sedimentation basin has been undertaken based on the TSF4 concept design (AECOM, 2019) and has since been further refined.

The sizing of the sedimentation basin is based on meeting sediment control requirements during operations. The minimum storage capacity required for treatment (settling zone) is approximately 3,500 m^3 plus freeboard allowance to safely contain up to a (1:100) AEP event. Indicative overall dimensions of the sedimentation basin (at conceptual design) are total surface area of 2,180 m^2 and overall depth of 4.8 m (approx). This includes a settling zone depth of 1.6 m, freewater zone depth of 0.3m, sediment storage depth of 0.8 m, flood storage depth of 1.6 m and freeboard of 0.5 m (approx.). The sediment basin will be bypassed for events greater than (1:100) AEP. In addition the sedimentation basin will also contain an emergency spillway, for greater than 1:100 AEP storm events, which will also discharge into the existing gully immediately downstream of the sedimentation basin and upstream of the existing road culverts, eventually flowing into the Yarrowee River.

Detailed design of the Sedimentation basin and drainage will be undertaken as part of the TSF4 detailed design. This will include considerations for the following:

- Pre-treatment pond(s)
- Flow control baffles;
- Basin inflow system;
- Specification of automated chemical flocculation system (if required);
- Primary outlet system;
- Culvert crossings under access tracks
- Pump station to pump treated water and maintain flood storage levels from TSF4 sedimentation pond to the existing surge dam
- Emergency spillway;
- Maintenance/clean out of sediment storage zone access; and
- Safety fence requirements.

The indicative sedimentation pond location is provided on **and Figure F7** and **Figure F8- Appendix A**.

Sedimentation Basin - Detailed Design

Detailed design of the sedimentation basin will be undertaken including considerations for the following basin features:

- Culvert crossings under access tracks
- Pre-treatment pond(s)
- Flow control baffles;
- Basin inflow system;
- Specification of automated chemical flocculation system (if required);
- Primary outlet system, including decant system;
- Pump station to pump treated water from TSF4 sedimentation basin to the existing surge dam
- Emergency spillway;
- Maintenance/clean out of sediment storage zone access; and

- Safety fence requirements.

Risk Mitigation Measures - Detailed Design

The following sediment control measures are proposed to be included:

- Stabilisation of batters (topsoil and revegetate)
- Stabilisation of drains (geotextile/rip rap/shotcrete/other)
- Provide erosion protection along steep drains sections, culvert inlet and outlets, and drainage outfalls
- Re-vegetate unsealed areas as part of rehabilitation
- Provide crushed rock pavement on roads

4.9 Security

A fence will be constructed around the TSF4 site to prevent unauthorised access - the approximate alignment of the fence is shown on **Figure F5- App. A**. The fence will be 2.3m in height which includes the 1.8m high Knuckle-to-barb mesh. The fence will be coated with either black or dark green to reduce visual impacts.

The fence within the farming zone will be constructed in December 2019/ January 2020 under existing approvals- MIN4847 Licence Condition 6 and under MIN5396 Licence Condition 2.

A permit from City of Ballarat is required to construct a fence through the ESO5 layer, and therefore fence construction through this area will not commence until relevant approvals have been obtained.

Signage will also be installed.

Any person that enters the site must have authorisation from the appropriate CGT supervisor.

During operations, the mine site is manned 24 hours per day, 7 days per week, and the security guard for the mine will also include external patrol of the TSF4 site periodically.

Security: Risk Management Measures

Boundary fences, sign posting, authorised entry only.

4.10 Plant and Equipment

Construction of the TSF will be undertaken by a civil earth works contractor, using mobile plant similar to that of TSF3 construction. Typical mobile plant for construction of the liner and embankment will include bulldozers, front end loaders, rollers and graders. Trucks for haulage and movement of material will also be utilised, and a water cart will be on-site for dust mitigation as required.

During the operational phase, light vehicles will be on-site for site inspections, and other equipment would be bought onto site for maintenance as needed.

Pumps will be installed within the sedimentation pond and for the decant/ leachate system for the duration of operation for fluid movement.