KCGM

KCGM Mine Closure Plan 2025 (v1) Volume 1 of 3

Mineral Field 26

Environmental Group Site Codes:

J102 Golden Mile/KCGM (S0236564, S0236565, S0236563), J177 Kaltails

Tenement Holders:

Saracen Kalgoorlie Pty Ltd & Northern Star (KLV) Pty Ltd

(wholly owned subsidiaries of Northern Star Resources Ltd)

Site contact details:

Janine Cameron 0419 930 363 jcameron@nsrltd.com

Tenements:

G24/24 G26/60 G26/107 G26/150 L26/107 L26/205 M26/264 M26/496 M26/630 P26/3357 G24/25 G26/61 G26/108 G26/159 L26/109 L26/216 M26/266 M26/503 M26/631 P26/3669 G24/26 G26/62 G26/109 G26/160 L26/114 L26/217 M26/267 M26/504 M26/645 P26/3670 G24/27 G26/63 G26/110 G26/165 L26/115 L26/254 M26/268 M26/505 M26/646 P26/3671 G24/28 G26/64 G26/111 G26/166 L26/116 L26/267 M26/294 M26/511 M26/648 P26/3779 G24/29 G26/65 G26/112 L15/154 L26/117 L26/282 M26/308 M26/518 M26/661 P26/3780 G24/30 G26/66 G26/113 L15/155 L26/118 L26/283 M26/311 M26/519 M26/662 P26/3876 G24/31 G26/67 G26/114 L15/159 L26/125 L26/284 M26/316 M26/520 M26/708 P26/3972 G24/32 G26/68 G26/115 L24/105 L26/126 L27/36 M26/326 M26/521 M26/713 P26/3976 G24/33 G26/69 G26/116 L24/147 L26/127 L27/38 M26/353 M26/522 M26/715 P26/3978 G24/40 G26/70 G26/117 L24/151 L26/130 M24/462 M26/359 M26/523 M26/724 P26/4144 G26/08 G26/71 G26/118 L24/197 L26/131 M26/27 M26/365 M26/524 M26/725 P26/4145 G26/09 G26/72 G26/119 L26/18 L26/132 M26/39 M26/373 M26/525 M26/738 P26/4146 G26/14 G26/73 G26/129 L26/19 L26/133 M26/40 M26/375 M26/526 M26/744 P26/4157 G26/15 G26/74 G26/130 L26/63 L26/134 M26/46 M26/376 M26/527 M26/745 P26/4223 G26/17 G26/75 G26/131 L26/64 L26/135 M26/54 M26/377 M26/528 M26/746 P26/4224 G26/31 G26/76 G26/132 L26/77 L26/140 M26/56 M26/379 M26/529 M26/747 P26/4225 G26/42 G26/77 G26/133 L26/80 L26/149 M26/58 M26/382 M26/530 M26/748 P26/4226 G26/44 G26/78 G26/134 L26/81 L26/151 m26/60 M26/383 M26/532 M26/760 P26/4307 G26/45 G26/81 G26/135 L26/82 L26/156 M26/61 M26/388 M26/533 M26/761 G26/46 G26/82 G26/136 L26/83 L26/159 M26/78 M26/396 M26/550 M26/778 G26/47 G26/83 G26/137 L26/84 L26/160 M26/81 M26/404 M26/552 M26/784 G26/48 G26/84 G26/138 L26/85 L26/161 M26/83 M26/405 M26/557 M26/785 G26/49 G26/85 G26/139 L26/88 L26/163 M26/86 M26/416 M26/573 M26/80 G26/50 G26/86 G26/140 L26/89 L26/172 M26/87 M26/418 M26/575 M26/803 G26/51 G26/88 G26/141 L26/90 L26/180 M26/95 M26/432 M26/577 M26/843G26/52 G26/99 G26/142 L26/91 L26/181 M26/96 M26/448 M26/581 M26/845 G26/53 G26/100 G26/143 L26/92 L26/182 M26/113 M26/451 M26/589 P26/3350 G26/54 G26/101 G26/144 L26/94 L26/184 M26/120 M26/454 M26/611 P26/3351 G26/55 G26/102 G26/145 L26/96 L26/185 M26/131 M26/459 M26/612 P26/3352 G26/56 G26/103 G26/146 L26/100 L26/186 M26/150 M26/462 M26/615 P26/3353 G26/57 G26/104 G26/147 L26/101 L26/191 M26/155 M26/463 M26/622 P26/3354 G26/58 G26/105 G26/148 L26/102 L26/192 M26/233 M26/489 M26/625 P26/3355 G26/59 G26/106 G26/149 L26/104 L26/193 M26/261 M26/495 M26/626 P26/3356

M 26/489 M 26/495 M 26/496 M 26/552 M 26/646 M 26/747 L26/254 L26/297 L26/282 L26/283 L26/284 G26/176 G26/178 G26/177

August 2025

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1. SCOPE AND PURPOSE

This document, KCGM Mine Closure Plan (MCP) 2025 (v2), is the current version of KCGM's Mine Closure Plan and supersedes all previous versions. The last version of the KCGM Mine Closure Plan 2025 v1, was submitted in to support the Fimiston TSG EGS Mining Proposal.

The MCP 2022, v1 was submitted as part of a submission to the EPA for a significant amendment of KCGM's Ministerial Statement 782. The same version was submitted to DMPE and has been reviewed. After DMPE review, the amended document, MCP 2022v2, was submitted on 20 November 2024, and is still under review.

The most recently, approved version remains the KCGM MCP 2018 Resubmission which was approved by the DWER (EPA) on 31 January 2020. A copy of the document was provided to DMPE for their records.

This document provides details of the activities and resources required for progressive rehabilitation, decommissioning and closure of all components of KCGM, during operations and post planned closure of the site (currently post 2038). The document is submitted as an attachment to the 2025 KCGM Fimiston EGS Mining Proposal, Gidji II Mining Proposal and Mt Charlotte U/G Mine Eastern Areas Mining Proposal.

Table 1-1: Recent versions of the KCGM Mine Closure Plan

MINE CLOSURE PLAN (MCP)	SUBMITTED TO	SUBMISSION DATE	APPROVED / ACCEPTED BY
MCP 2018	DMIRS DWER (EPA) All other Regulators listed in MS 782	27/03/18	DMIRS (RegID 73194) 06/08/2020
MCP 2018 - Version1 Resubmission	DMIRS (Copy for records) DWER (EPA)	26/11/19	DWER (EPA) 31/01/2020
MCP 2021(v1)	DMIRS DWER (EPA) All other Regulators listed in MS 782	31/03/21	Superseded by MCP 2022 v1
MCP 2022(v1)	DWER (EPA) DMIRS	16/08/22 TBA	RegID 115572 Reviewed by DEMIRS
MCP 2022(v2)	DMIRS DWER (EPA)	20/11/24 TBA	Document in response to DEMIRS Review RFI
MCP 2025(v1)	DMIRS	28/02/2025	To support Mining Proposal for Fimiston TSF
MCP 2025(v2) (This document)	DMPE	01/08/2025	To support Mining Proposals for 2025 - KCGM Fimiston EGS Mining Proposal, Gidji II Mining Proposal and Mt Charlotte U/G Mine Eastern Areas Mining Proposal

This MCP has been structured and prepared in accordance with the *Statutory Guidelines for Mine Closure Plans* (DMIRS, March 2020) and *Mine Closure Plan Guidance – How to prepare in accordance with Part 1 of the Statutory Guidelines for Mine Closure Plans* (DMIRS, 2020), to fulfil the requirements of:

- Ministerial Statement 782 (Fimiston);
- Ministerial Statement 1032 (Gidji)

- Mining Act 1978;
- Mine Safety and Inspection Regulations 1995;
- Tenement Conditions; and
- Stakeholders in the KCGM operations.

In accordance with Ministerial Statement 782, Section 11-3 (Rehabilitation and Closure Management Plan), and an amendment to Section 11-3, approved in July 2013, KCGM is required to "review the Rehabilitation and Closure Management Plan every three years, and shall amend the Plan as required in consultation with [the] agencies to the requirement of the Minister for the Environment on advice of the relevant agencies ".

2. PROJECT SUMMARY

2.1 Ownership

Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) is a wholly owned subsidiary of Northern Star Resources Ltd and is responsible for management of five operational areas shown in Figure 2-1. The Fimiston Operational Area is located adjacent to the City of Kalgoorlie-Boulder in the Eastern Goldfields Region of Western Australia.

The KCGM operational areas are located on tenements held by Saracen Mineral Holdings Ltd and Northern Star Resources Ltd, both wholly owned subsidiaries of Northern Star Resources Ltd. KCGM manages these tenements and their associated infrastructure on behalf of Northern Star.

The contact details for KCGM are as follows:

Nick Strong – General Manager

Northern Star, KCGM

Black Street

PMB 27

Kalgoorlie WA 6433

Tel: (08) 9022 1100

Internet: www.superpit.com.au

KCGM's current Life of Mine (LOM) is 2034 for mining operations, end of processing and end of Mt Charlotte operations.

2.2 Location and Layout

KCGM is located adjacent to the City of Kalgoorlie-Boulder, approximately 600 kilometres (km) east of Perth in the Eastern Goldfields Region of Western Australia (WA). Figure 2-1 provides a summary of tenement holdings listed in Table 2-2.

Table 2-1: KCGM Tenure Breakdown as at January 2025

TENEMENT TYPE	GRANTED TENURE
Exploration	2
General Purpose	110
Miscellaneous	74
Mining Lease	122
Prospecting Licence	53
Total	356

KCGM has five Operational Areas, which encompass all operational and exploration areas (Figure 2-1).

- Fimiston;
- Mt Charlotte;
- Gidji;
- Mt Percy; and
- Regional.

While geographically separated, the Operational Areas have significant linkages.

Table 2-2: KCGM Tenement Register

TENEMENTS								
E26/239	E26/253							
G24/24	*G26/176*	G26/54	G26/68	G26/64	G26/78	G26/105	G26/119	G26/142
G24/25	G26/17	G26/55	G26/69	G26/65	G26/81	G26/106	G26/129	G26/143
G24/26	*G26/178*	G26/56	G26/70	G26/66	G26/82	G26/107	G26/130	G26/144
G24/27	G26/42	G26/57	G26/71	G26/67	G26/83	G26/108	G26/131	G26/145
G24/28	G26/44	G26/58	G26/72	G26/68	G26/84	G26/109	G26/132	G26/146
G24/29	G26/45	G26/59	G26/73	G26/69	G26/85	G26/110	G26/133	G26/147
G24/30	G26/46	G26/60	G26/74	G26/70	G26/86	G26/111	G26/134	G26/148
G24/31	G26/47	G26/61	G26/75	G26/71	G26/88	G26/112	G26/135	G26/149
G24/32	G26/48	G26/62	G26/76	G26/72	G26/99	G26/113	G26/136	G26/150
G24/33	G26/49	G26/63	G26/77	G26/73	G26/100	G26/114	*G26/177*	G26/159
G24/40	G26/50	G26/64	G26/78	G26/74	G26/101	G26/115	G26/138	G26/160
G26/08	G26/51	G26/65	G26/81	G26/75	G26/102	G26/116	G26/139	G26/165
G26/09	G26/52	G26/66	G26/62	G26/76	G26/103	G26/117	G26/140	G26/166
G26/14	G26/53	G26/67	G26/63	G26/77	G26/104	G26/118	G26/141	G27/04
L15/154	L26/63	L26/88	L26/102	L26/125	L26/134	L26/163	L26/180	L26/283
L15/155	L26/64	L26/89	L26/104	L26/126	L26/135	L26/172	L26/192	L26/284
L15/159	L26/77	L26/90	L26/107	L26/127	L26/140	L26/180	L26/193	L27/36
L24/105	L26/80	L26/91	L26/109	L26/130	L26/149	L26/181	L26/205	L27/38
L24/147	L26/81	L26/92	L26/114	L26/131	L26/151	L26/182	L26/216	*L26/254*
L24/151	L26/82	L26/94	L26/115	L26/132	L26/156	L26/184	L26/217	*L26/297*
L24/197	L26/83	L26/96	L26/116	L26/133	L26/159	L26/185	L26/254	
L26/18	L26/84	L26/100	L26/117	L26/132	L26/160	L26/186	L26/267	
L26/19	L26/85	L26/101	L26/118	L26/133	L26/161	L26/191	L26/282	
M24/462	M26/113	M26/359	M26/451	M26/523	M26/589	M26/724		
M26/27	M26/120	M26/365	M26/454	M26/524	M26/611	M26/725		
M26/39	M26/131	M26/373	M26/459	M26/525	M26/612	M26/738		
M26/40	M26/150	M26/375	M26/462	M26/526	M26/615	M26/744		
M26/46	M26/155	M26/376	M26/463	M26/527	M26/622	M26/745		
M26/54	M26/233	M26/377	M26/489	M26/528	M26/625	M26/746		
M26/56	M26/261	M26/379	M26/495	M26/529	M26/626	M26/747		
M26/58	M26/264	M26/382	M26/496	M26/530	M26/630	M26/748		
M26/60	M26/266	M26/383	M26/503	M26/532	M26/631	M26/760		
M26/61	M26/267	M26/388	M26/504	M26/533	M26/645	M26/761		
M26/78	M26/268	M26/396	M26/505	M26/550	M26/646	M26/778		
M26/81	M26/294	M26/404	M26/511	M26/552	M26/648	M26/784		
M26/83	M26/308	M26/405	M26/518	M26/557	M26/661	M26/785		
M26/86	M26/311	M26/416	M26/519	M26/573	M26/662	M26/800		

M26/87	M26/316	M26/418	M26/520	M26/575	M26/708	M26/803		
M26/95	M26/326	M26/432	M26/521	M26/577	M26/713	M26/843		
M26/96	M26/353	M26/448	M26/522	M26/581	M26/715	M26/845		
P26/3350	P26/3354	P26/3669	P26/3780	P26/3978	P26/4157	P26/4226	P26/4193	P27/2448
P26/3351	P26/3355	P26/3670	P26/3876	P26/4144	P26/4223	P26/4307	P26/4194	
P26/3352	P26/3356	P26/3671	P26/3972	P26/4145	P26/4224	P26/4191	P26/4683	
P26/3353	P26/3357	P26/3779	P26/3976	P26/4146	P26/4225	P26/4192	P27/2446	
M 26/489	*M 26/495*	*M 26/496*	*M 26/552*	*M 26/646*	*M 26/747*	*M 26/489*	*M 26/495*	*M 26/496*
L26/254	*L26/297*	*L26/283*	*L26/284*	*G26/176*	*G26/177*	*G26/178*		
Tenements added in MCP 2025 v1 & MCP2025 v2 are in italics;								

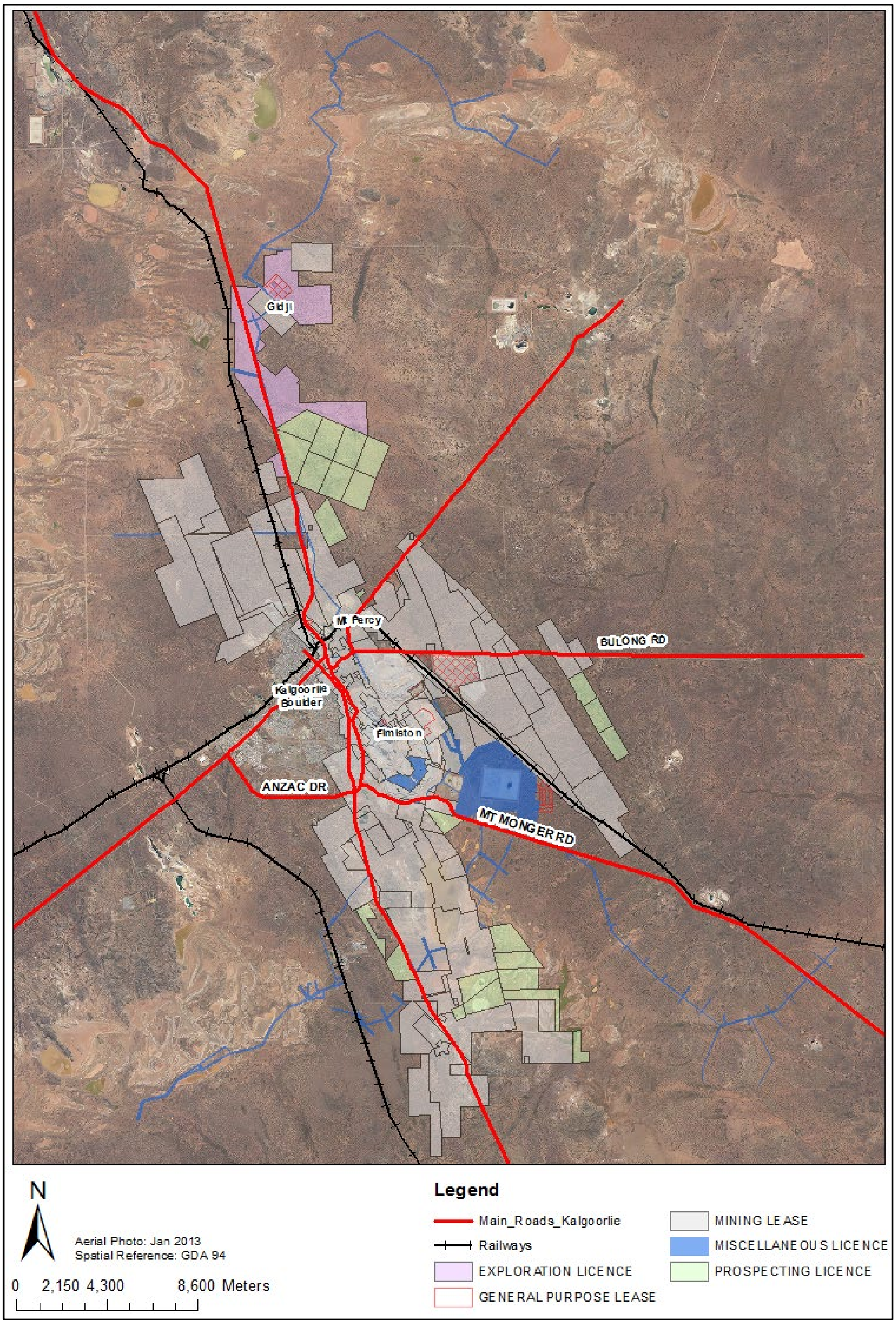


Figure 2-1: KCGM Tenements and Location

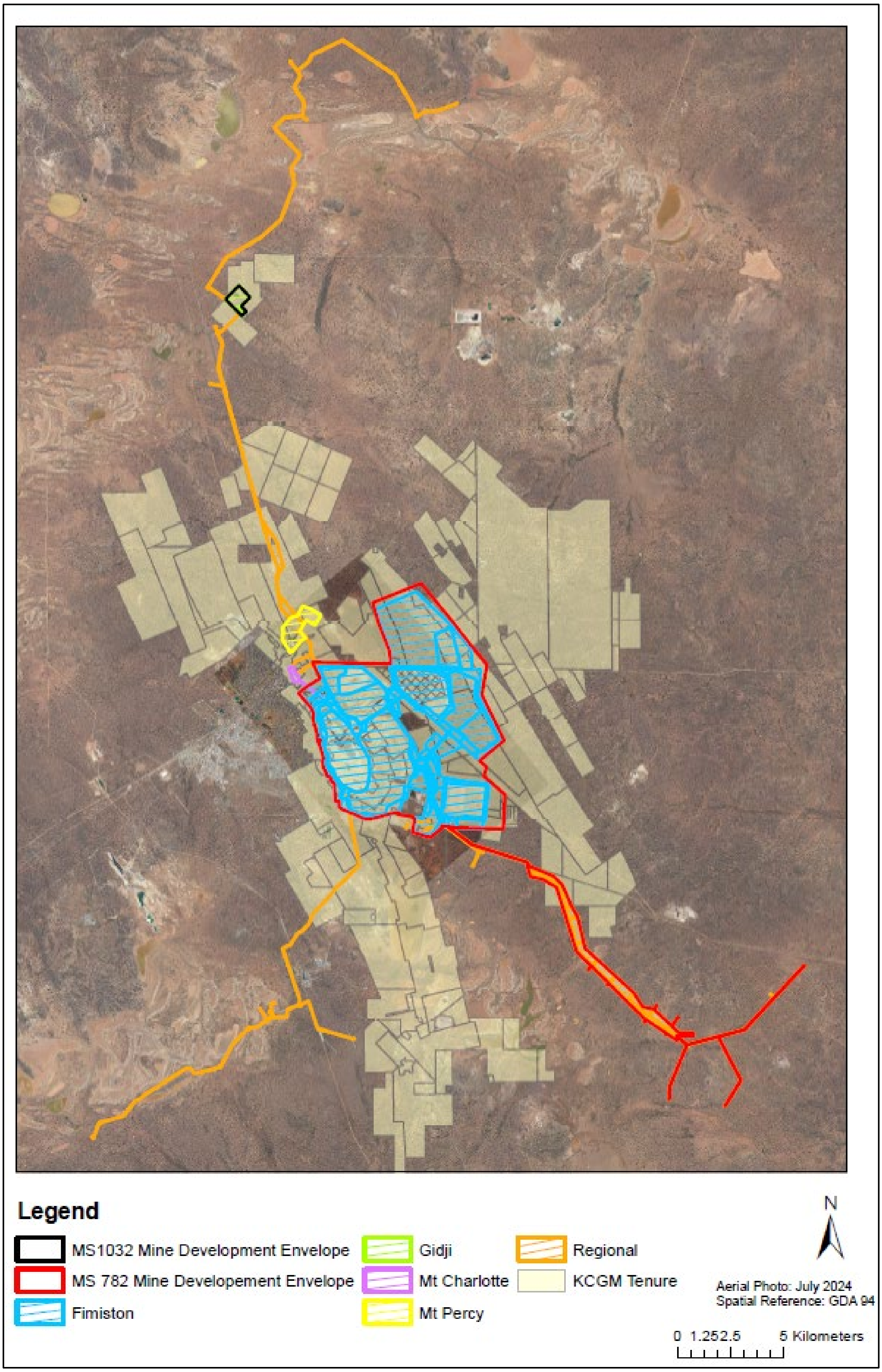


Figure 2-2: Location of KCGM Operational Areas

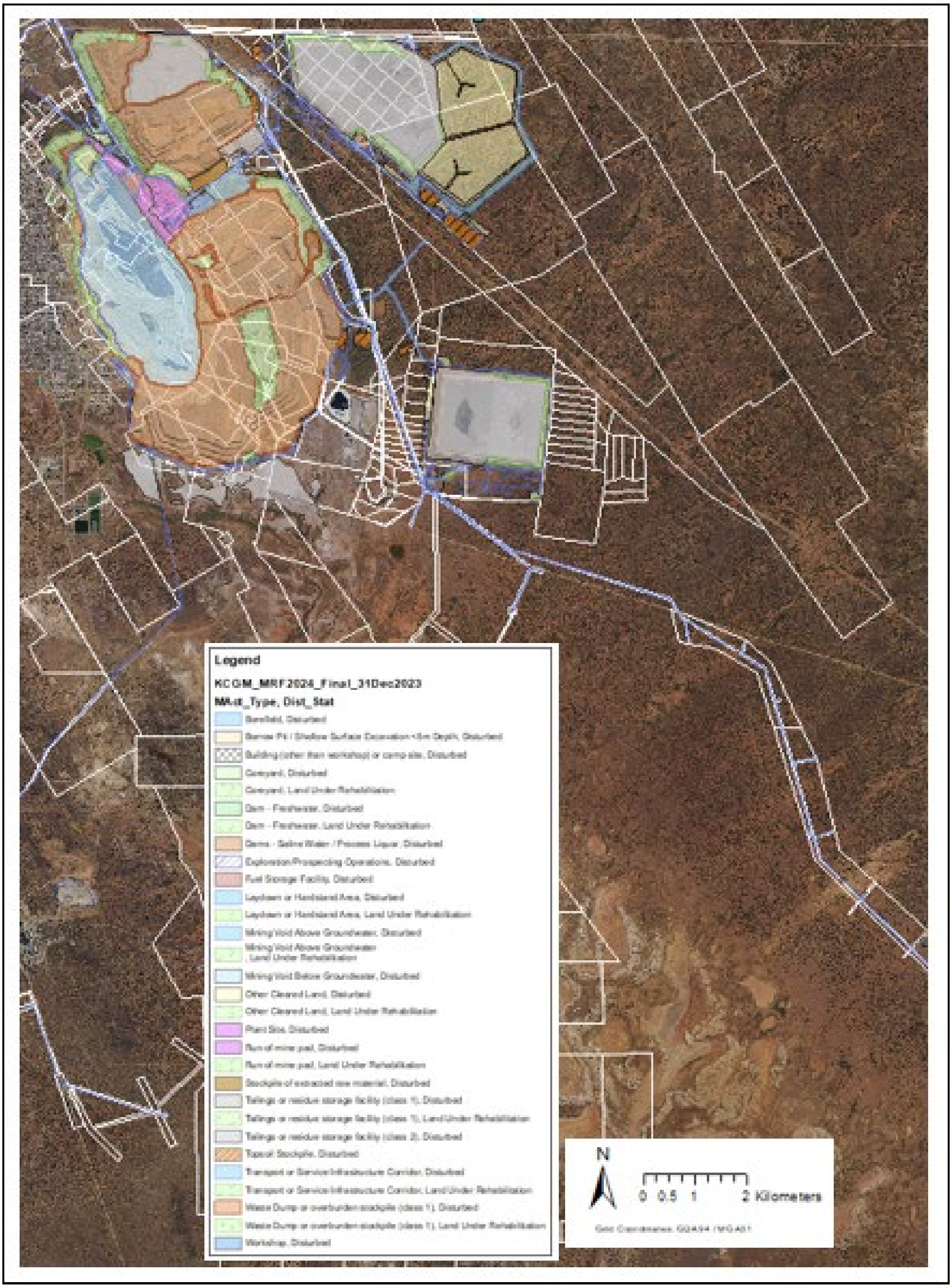


Figure 2-3: KCGM Reported 2024 MRF Disturbance for Fimiston Operational Area

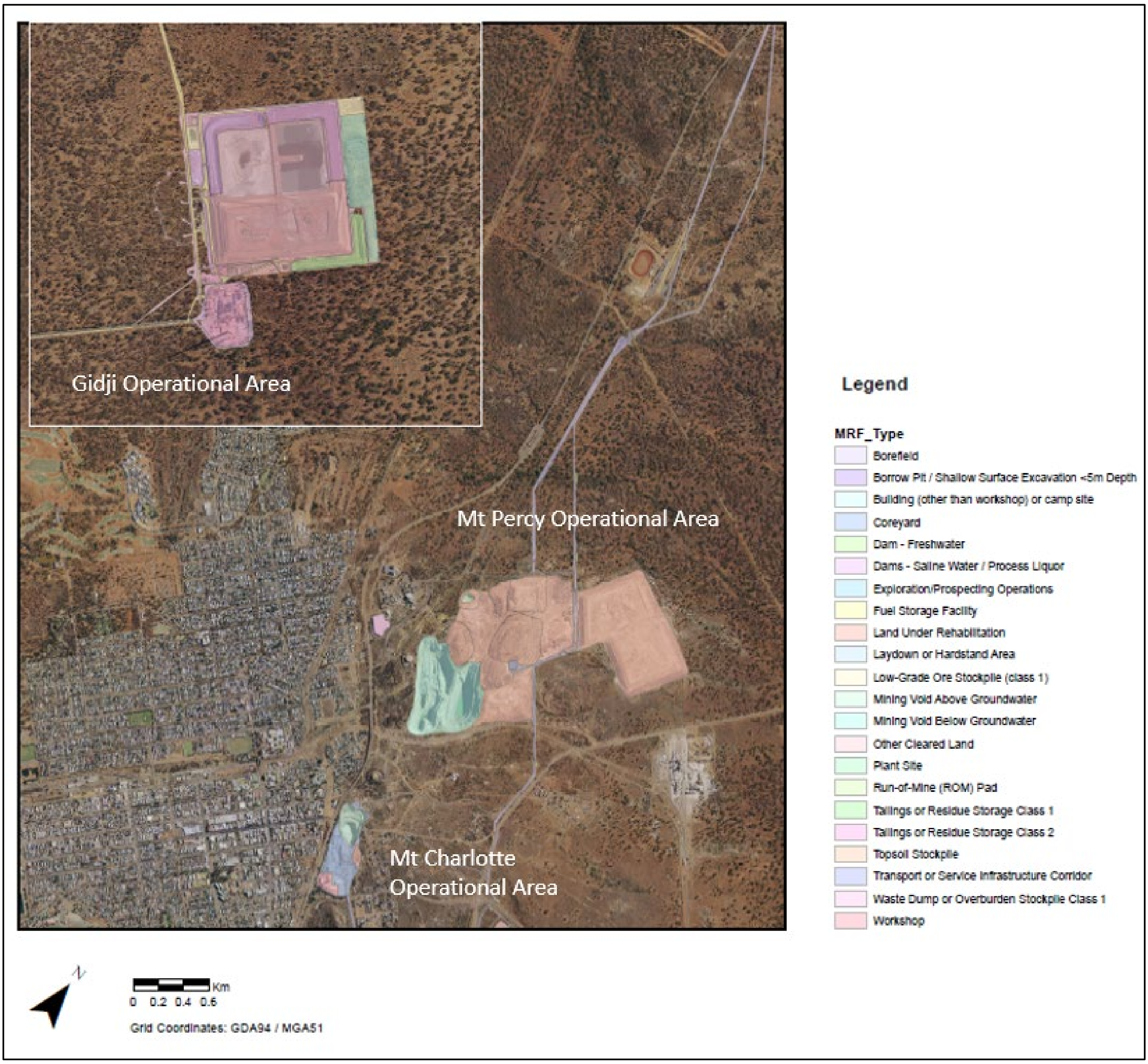


Figure 2-4: KCGM Reported 2024 MRF Disturbance for Mt Percy, Mt Charlotte, and Gidji Operational Area

2.3 Site History

KCGM is located on the Golden Mile, a world class gold resource. Mining and mineral processing has occurred in the vicinity of KCGM since gold was first discovered in 1893 by Paddy Hannan, Tom Flanagan and Dan Shea. By the mid-1980s all mining operations in Kalgoorlie-Boulder, from Mt Percy and Mt Charlotte at the northern end to Chaffers at the southern end, were effectively controlled by three companies. With a common goal of maximising the return on investment for their respective shareholders, these companies developed a loose relationship concerning the sharing of facilities and exchanging technical knowledge. This relationship was formalised on 29 March 1989 by the creation of a new management company, Kalgoorlie Consolidated Gold Mines Pty Ltd.

The original proposal to rationalise open-cut mining activities into a single operation was assessed by the Environmental Protection Authority (EPA) in 1991 (Bulletin 539). This involved a single open pit (Fimiston Open Pit) placement of waste rock in Waste Rock Dumps (WRD) to the east of the pit, and deposition of tailings in Tailings Storage Facilities (TSFs). This proposal was approved in October 1991 under Ministerial Statement 188 (MS188).

In September 2006, KCGM released a Public Environmental Review (PER) for the Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning, seeking approval to widen and deepen the Fimiston Open Pit by mining a cutback (the Golden Pike Cutback). This proposal included the Golden Pike Cutback located along the western edge of the pit, construction of additional WRDs north of the pit, and additional tailings storage capacity. Ministerial approval was granted in January 2009 under Ministerial Statement 782 (MS782) this effectively superseded MS188. Stage 3 commenced implementation in March 2010.

MS782 has been subject to seven amendments:

- 2010 – change to proposal approved under Section 45C of the EP Act (clearing for Kaltails TSF, contingency clearing for infrastructure post Kaltails re-commissioning, and inclusion of hydrogen peroxide dosing facility)
- 2013 – change to proposal approved under Section 46C of the EP Act (replacement of condition 11-3, associated with review of the Rehabilitation and Closure Management Plan every three years)
- 2015 – change to proposal approved under Section 45C of the EP Act (removal of different options for management of tailings, updating the description of the proposal and removal of elements that are not key proposal characteristics)
- 2017 – change to proposal approved under Section 45C of the EP Act (modification to the FOP to allow the required remediation works on the western wall to be completed to reduce the occupational health and safety risk to KCGM's workforce)
- 2018 – change to proposal approved under Section 45C of the EP Act (modification to the FOP to allow mining of Morrison and Brownhill extensions and clearing of 200 ha within the development envelope for infrastructure associated with rehabilitation of the Fimiston II and Kaltails TSFs)
- 2018 – change to proposal approved under section 45C on 10 October 2018. Revision of the proposal's Development Envelope to include the Kaltails Supply Borefield utilised as a water supply borefield in a defined Development Envelope (borefield formerly approved under a previous ministerial statement including establishment of a Managed Aquifer Recharge system).
- 2020 – change to proposal to extend the Fimiston II TSF and to extend the Fimiston Open Pit, approved on 30 September 2020 as part of an amendment that also granted approval for an extension to the Fimiston II TSF.
- 2022 (August) – Section 40(2)(a) Environmental Review Document submission to EPA for an application for a significant change to the existing Ministerial Statement MS782, which includes a Fimiston Pit cutback, additional tailings storage facilities and additional waste rock dump areas. The EPA Final Report and Conditions are expected to be published on 24 January 2025.

With these changes, KCGM's current LOM is 2034 for end of mining operations, mineral processing at Fimiston and Mt Charlotte underground operations.

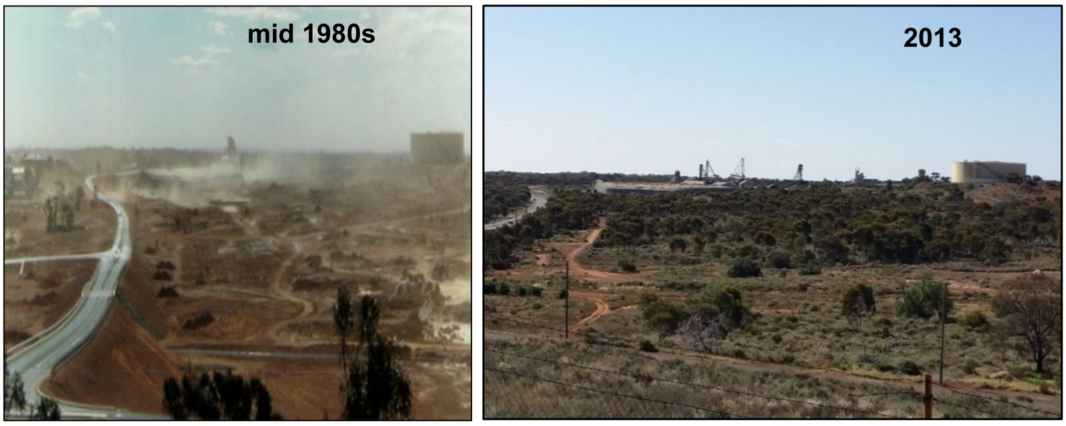
Historical Disturbance

Disturbance of the natural land surface has occurred throughout the Kalgoorlie-Boulder area since gold was first discovered causing the area to become degraded. Initiatives over time by KCGM and other organisations, particularly in the 1990s, have resulted in improvements and revegetation of the area (Figure 2-5).

Historical workings, including shafts, adits and costeans, are abundant throughout the Goldfields Region. Many of these workings were either 'made safe' to standards which were acceptable at the time of operations or abandoned without any significant rehabilitation effort. During the late 1990s and early 2000s, KCGM rehabilitated a significant area of land between KCGM Operations and the City of Kalgoorlie-Boulder ('Greening the Golden Mile'), which included fencing and backfilling, where appropriate, many of the historical workings.

During current operations, shafts and voids are 'made safe' as and when identified on KCGM tenure (VCL). Main Roads and the Shire also manage historic voids on their properties. Post closure and relinquishment, it is envisioned that historical workings will be managed under the Abandoned Mine Program by the State Government.

Several original shafts and associated headframes which were operated at the time KCGM commenced operations have since been decommissioned and mined through by KCGM.



View from Mt Charlotte Reservoir (facing North)

Figure 2-5: Progress of ‘Greening the Golden Mile’ Project

The Oroya, Paringa, and Croesus Processing Plants were operated until the mid-late 1990s, and have since been decommissioned, demolished, and rehabilitated (encapsulated or mined through) by KCGM (Figure 2-6). Tailings dams associated with these processing plants have also been decommissioned and, in some cases covered with waste rock during construction of the Fimiston Waste Rock Dumps (WRDs) (Figure 2-6).

Figure 2-6: Fimiston Historic Decommissioned Plants and TSFs

2.3.1 Overview of Operational Areas

Currently, gold production at KCGM is sourced from two primary mining locations; the Fimiston Open Pit and the Mt Charlotte underground mine (approximately 2 km north of the Fimiston Open Pit). The current mining rate is approximately 60 million tonnes per annum (Mtpa) of total material (comprising ore and waste), increasing to 75 million tonnes per annum (Mtpa) in 2022. Of this approximately 12 Mtpa of ore will be processed at the Fimiston Plant.

KCGM's current LOM is 2034 for mining operations, end of mineral processing at Fimiston and end of Mt Charlotte operations.

It should be noted that the Operational Areas are governed by differing legislative instruments and approvals (e.g., Ministerial Statements), which are discussed in detail in Section 3. The extents of Ministerial Statements 1032, 188, and 782 are shown in Figure 2-7.

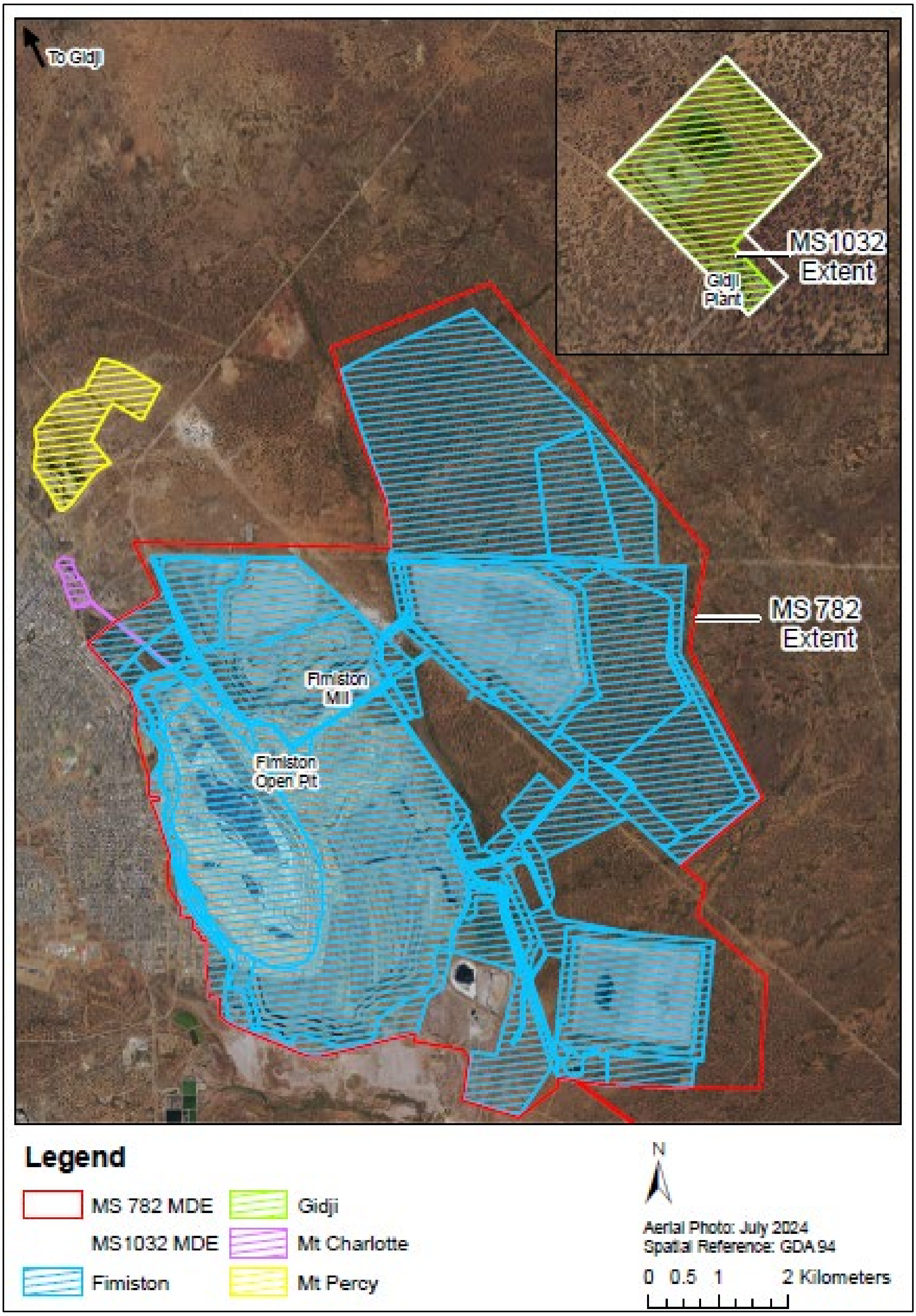


Figure 2-7: Operational Areas Current Disturbance and Extent of current Ministerial Statements (2025)

2.3.1.1 Fimiston Operational Area

Ore is transported from the Fimiston Open Pit via haul trucks and stockpiled at the Run of Mine pad (ROM pad), where is it is crushed, milled (via a Semi Autogenous Grind (SAG) Mill and Ball Mills) and then treated at the Fimiston Plant using flotation and conventional carbon in leach (CIL) circuits. A sulphide concentrate, produced as one of the CIL streams, is transferred 17 km north of Kalgoorlie-Boulder to the Gidji Plant for further processing using ultrafine grind mills (UFG). Marginal and low grade ore are selectively stockpiled to allow for processing concurrent with or after mining operations have ceased.

The majority of waste rock from the Fimiston Open Pit is placed in WRDs to the east, north and south of the Fimiston open pit. These waste rock dumps will remain in situ post closure and will be the most visible features of the post-mining landscape from Kalgoorlie-Boulder.

Tailings from the Fimiston Plant are pumped to three TSFs; Fimiston I, Fimiston II, and Kaltails. The first two cells of Fimiston IIE (Extension) TSF have been approved and construction is expected to commence in 2022. The current submission to the EPA includes additional landforms – a third cell of Fimiston IIE TSF, Fimiston III TSF and eastern extension to the Southern Waste Rock Dump.

See Section 5.3.2 for further detail regarding Fimiston Operational Area.

2.3.1.2 Gidji Operational Area

The sulfide concentrate from Fimiston Plant is processed by Ultra Fine Grind (UFG) at Gidji. Tailings from the Gidji Plant are disposed of in the Gidji TSFs to the north of the plant.

See Section 5.3.3 for further detail regarding Gidji Operational Area.

2.3.1.3 Mt Charlotte

The Mt Charlotte Underground Mine ore is transported by trucks directly to the Fimiston Processing Plant ROM via the Sam Pearce decline located within the Fimiston Open Pit north wall. Waste rock produced during mining at Mt Charlotte is not brought to the surface, instead it is used to backfill underground voids. In addition, small volumes of waste rock from the Fimiston Open Pit are crushed at Fimiston before being conveyed to the Mt Charlotte Open Pit to be used for backfilling of underground stopes at Mt Charlotte.

See Section 5.3.4 for further detail regarding Mt Charlotte Operational Area.

2.3.1.4 Mt Percy

The Mt Percy operation was active from the mid-1980s to 1997. The operation has been closed since this time, with the infrastructure removed during rehabilitation of the site in 2001. However, a mineralised zone occurs under the Mystery and Union Club Open Pits which may be a viable resource. Currently, the primary operational activities consist of infrastructure for the transfer of hypersaline water between Fimiston, Gidji and Mt Charlotte operational areas. The area is currently under exploration.

See Section 5.3.5 for further overview information regarding Mt Percy Operational Area.

2.3.1.5 Regional

A series of remote supply borefields provide hypersaline groundwater for use in processing ore. Access Roads and Service Corridors make up the balance of regional infrastructure. Two legacy TSF areas, Mullingar TSF and Morrisons Flats, are also included in this Operational Area.

See Section 5.3.6 for further detail regarding the Regional Operational Area.

3. IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

The legal obligations relevant to rehabilitation and closure for KCGM have been identified and recorded within the KCGM Closure Legal and Other Obligations Register , which can be found in Volume 3 (Appendix 1). The register includes rehabilitation and closure related conditions and/or obligations applicable under State legislation, conditions included within individual tenement conditions, mining proposals, notice of intent, letters of intent, programmes of work, ministerial statements, commitments, licence conditions and other documents relevant to KCGM. These registers have been used to assist with development of actions in planned work programmes.

3.1 Key Regulatory Approvals

KCGM has two key legislative requirements for developing a MCP; conditions within Ministerial Statements (MS) issued to KCGM and tenement conditions associated with tenements held by KCGM, including prior commitments within Notices of Intents and Mining Proposals (listed as tenement conditions) pertaining to rehabilitation and closure. The details of these commitments are contained in the KCGM Closure Legal and Other Obligations Register (Appendix 1). The Fimiston and Gidji Operational Areas each have separate MS, which are outlined below. Figure 2-7 presents the extent of each active MS in relation to the Operational Areas.

In 2017, the Government of Western Australia (WA) commenced implementation of the Machinery of Government (MOG) changes in the WA public sector. These structural changes have reduced the number of environmental regulatory agencies by amalgamating departments into new entities. Table 3-1 provides a summary of new Departments which are now relevant to compliance of the requirements of Ministerial Statements.

Table 3-1: Changes to Regulatory Agencies since Ministerial statement 782

DEPARTMENT NAME IN MINISTERIAL STATEMENT 782	CURRENT DEPARTMENT NAME
Office of the Environmental Protection Authority (OEPA)	(DWER) Department of Water and Environmental Regulation – EPA Services
Department of Environment Regulation (DER)	Department of Water and Environmental Regulation – Regulatory Services (Environment)
Department of Parks and Wildlife (DPAW)	Department of Biodiversity, Conservation and Attractions (DBCA) – Science and Conservation Branch
Department of Water (DoW)	Department of Water and Environmental Regulation – Regulatory Services (Water)
Department of Mines and Petroleum (DMP)	Department of Energy Mines, Industry Regulation and Safety (DEMIRS)
Department of Planning (DoP)	Department of Planning, Lands and Heritage
Western Australian Planning Commission (WAPC)	Department of Planning, Lands and Heritage (WAPC Branch)
Registrar of Aboriginal Sites	Department of Planning, Lands and Heritage

3.1.1 Fimiston Operational Area Part IV Approvals

The Fimiston Operational Area is governed by MS 188 and MS 782. MS 782 was issued for approval of the Golden Pike Cutback in 2009, and contains conditions relating to closure and rehabilitation that cover similar conditions within the older MS 188. It should be noted that both MS were issued prior to:

- Amendments to the *Mining Act*, which made submission of a MCP mandatory as part of the Mining Proposal approval process;
- Release of the joint EPA/DMP (now DEMIRS, see Table 3-1) *Guidelines for Preparing Mine Closure Plans* (first issued in 2011 and amended in 2015)*;* and

- Release of the current Statutory Guidelines for Mine Closure Plans (DEMIRS, 2020).

As such, KCGM considers that the conditions within MS 782 which require provision of information for specific government agencies (as outlined below) within the MCP are largely aligned with the guideline requirements. Section 11 of MS 782 contains the conditions relevant to Closure and Rehabilitation planning, including information that must be included within the plan. Condition 11-2 outlines each regulatory agency this information should be relevant to:

Department of Energy, Mines, Industry Regulation and Safety (DEMIRS):

1. Final form of landforms and voids;
2. The proposed land use for the mine site post mining operations determined after consultation with relevant stakeholders;
3. Removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders;
4. Long term management of ground and surface water systems affected by mining operations;
5. Long term management of pits, including the Superpit and public safety provisions;
6. Long term management of tailings storage facilities;
7. A detailed Rehabilitation and Revegetation programme that includes local vegetation, performance criteria and a timetable to be met,
8. Identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities;
9. Post-closure maintenance and monitoring; and
10. Contingency plan for a care and maintenance phase.

Department of Water and Environmental Regulation (DWER) and Department of Biodiversity Conservation and Attractions (DBCA):

1. Long term management of ground and surface water systems affected by mining operations;
2. A detailed Rehabilitation and Revegetation programme that includes local vegetation, performance criteria and a timetable to be met;
3. Identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities; and
4. Post-closure maintenance and monitoring.

Department of Planning (now DPLH), Western Australian Planning Commission (WAPC), and City of Kalgoorlie-Boulder (CKB):

1. Final form of landforms and voids;
2. The proposed land use for the mine site post mining operations determined after consultation with relevant stakeholders;
3. Removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders; and
4. Identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

The Registrar of Aboriginal Sites (formerly Department of Aboriginal Affairs, now part of DPLH):

1. Long term management of vegetation significant to adjacent ethnographic sites.

An amendment to Section 11-3 of MS 782, approved in July 2013, changed the submission cycle of the MCP from every two years to every three years; "review the Rehabilitation and Closure Management Plan … every three years, and shall amend the Plan as required in consultation with [the] agencies … to the requirement of the Minister for the Environment on advice of the relevant agencies …".

3.1.2 Gidji Operational Area Part IV Approvals

The Gidji Operational Area is governed by MS 1032, which supersedes MS 28 and 77. Condition 5 contains the relevant requirements for closure and rehabilitation, namely by ensuring that the Gidji Gold Processing Plant is decommissioned and rehabilitated in an ecologically sustainable manner through the implementation of the Mine Closure Plan, and that the plan is reviewed and revised every three years on the advice of the DEMIRS and to the satisfaction of the EPA, in accordance with the *Statutory Guidelines for Mine Closure Plans* (DMIRS, 2020).

3.1.3 Mt Percy, Mt Charlotte, and Regional Operational Areas

The Mt Percy and Regional Operational Areas are not covered under Part IV approvals, and therefore do not have Ministerial Statements. Closure and rehabilitation of these areas are regulated under the Mining Act, with conditions placed on the relevant tenements. The details of these commitments are contained in the KCGM Closure Legal and Other Obligations Register.

3.2 Additional Considerations

- KCGM and Northern Star Management Systems Standards and Policies;
- Height restrictions for permanent structures imposed by Civil Aviation Safety Authority (CASA) Regulations for the Kalgoorlie-Boulder Airport; and
- City of Kalgoorlie-Boulder Town Planning Scheme, including the Safety Exclusion Zone.

4. STAKEHOLDER ENGAGEMENT

4.1 Our Approach

Northern Star Resources Limited (Northern Star) values its' connection to the communities in which it operates and actively encourages open dialogue with local communities and key stakeholders. The Company regards its stakeholder relationships as a strategic advantage and seeks to ensure that local communities benefit from its presence.

Stakeholder engagement is a critical component in developing the Mine Closure Plan and Northern Star is committed to an active process of engagement with stakeholders throughout the entire Life of Mine, including for project approvals such as Fimiston South project.

Northern Star engages with various stakeholder groups to ensure closure planning is transparent, meeting regulatory guidelines and community expectations.

4.1.1 A trust-based approach

Key to engaging with the Kalgoorlie-Boulder community is a trust-based model, developed by the CSIRO, which demonstrates that community acceptance of operations is based on notions of fairness and process, not just economic benefits. This is done by:

- **Mainstreaming trust in how KCGM operates and behaves**. Local Voices data provides valuable insights on the key elements of what influences levels of trust and acceptance of Northern Star – distributional fairness, contact quality, and procedural fairness. This data allows Northern Star to engage directly with the local community and respond to any impact concerns.
- **Engaging with key stakeholders openly and in advance of any proposal submissions.**
- **Focusing on developing a meaningful relationship with near-mine communities.**

Northern Star drives relationships with local communities and key stakeholders by:

- Developing, implementing, and maintaining management systems to identify, assess and manage impacts on the community at all stages of its' operations.
- Recognising that communities are comprised of internal and external stakeholders.
- Establishing mutually acceptable methods of communication, consultation, and participation processes to create enduring and beneficial relationships.
- Engaging in open and honest dialogue with local communities over their concerns about the impacts of the Company's mining activities in their locality and incorporating these concerns into studies and business plans.
- Encouraging consultation and providing opportunities for local communities to share in the benefits which flow from mining activities in their regions, including local employment and business opportunities.
- Valuing diversity through the recognition and respect of different local cultures, values, traditions, and customs, upholding the Company's STARR Core Values.
- Incorporating sustainable development initiatives in business plans to ensure that the social and economic benefits obtained by communities are safeguarded in the long-term.
- Holding our leaders accountable for their responsibilities to local communities at all stages of Northern Star's activities and operations.
- Monitoring, continuously improving and reporting our stakeholder engagement. As a minimum, Northern Star will honour its obligations under all applicable legislation and in line with our STARR Core Values and provide guidelines and processes to respect and positively engage our local communities.

The approach for stakeholder engagement regarding closure is to inform, consult, involve, collaborate, and empower. It is intended to enact four interrelated strategies:

- Proactive, not reactive: ensure any emerging issues are identified early;

- Mitigate concerns raised by key stakeholders that are inaccurate/incorrect, by developing approved key messaging;
- Reinforce with all stakeholders that closure planning is imperative to a sustainable future for KCGM, Kalgoorlie-Boulder and the Goldfields Esperance region, with significant benefits to the wider community; and
- Work collaboratively with stakeholders to ensure the categories relating to KCGM's closure planning are communicated, and any community feedback is included in the plan.

In order to achieve these objectives, Northern Star collectively:

- Works with key stakeholders by building and fostering high level relationships, including regular engagement;
- Provides concise, accurate and reliable information and consistent messaging to all stakeholders on closure; and
- Ensures adequate resources are allocated to ensure the effectiveness of the engagement process.

Northern Star prepares closure and reclamation plans for all its' sites in accordance with our Reclamation and Closure Preparedness Global Standard.

These plans contain more detail as sites progress toward final closure, however planning for closure commences at the very beginning of a mine's life.

Northern Star operates multiple sites at various stages of development, including:

- Mines in the planning phase
- Active operational sites
- Sites under care and maintenance, where mining activities have been suspended

As a new mine undergoes planning and design, attention is given to how it will be rehabilitated and closed at the end of its life; including final landform design, topsoil requirements, reuse, removal or demolition of buildings and other infrastructure, as well as ensuring the long-term stability of pits and waste rock dumps. Stakeholder engagement for every stage is included in this planning.

Each closure and reclamation plan establishes closure objectives and criteria, along with strategies to achieve these. These are informed by site-specific risk assessments that identify the risks to safety or the environment closure.

Northern Star undertakes a stakeholder mapping exercise to ensure stakeholders who needs to be consulted with regards to our closure objectives. This includes ensuring that not only regulators, but Traditional Owners and other non regulator stakeholders have input into our closure planning. Northern Star has the opportunity, if feasible, to leave infrastructure such as bores or tracks that would benefit these stakeholders.

4.2 Stakeholder Identification

Northern Star Resources' Stakeholder Mapping and Engagement Global Standard and Stakeholder Policy outlines the company's:

- Approach to identifying stakeholders, including vulnerable groups, within our local communities;
- Approach to engaging with local communities at each phase of the life of the mine, including how the organization seeks to ensure meaningful engagement;
- Approach to developing and implementing community development programs, including how engagement with local stakeholders, impact assessments, and community needs assessments have informed the programs.

Negative, positive and neutral social impacts have been identified in a Social Impact Management Plan with accompanying actions for mitigation by the Community and Heritage team.

Northern Star's stakeholder identification process is as follows:

1. All stakeholders categorised and mapped according to:

Degree of Influence over KCGM operations; and KCGM Operations' impact on the stakeholder.

2. Stakeholder groups (and any specifically identified individuals) are prioritised based on Local Voices and demographics analysis, overlaid on the stakeholder mapping to ensure the following groups are adequately represented:

Vulnerable, including Aboriginal stakeholders; and

Impacted (near-mine) stakeholders.

3. Extent and ambition of engagement used for each prioritised stakeholder group is informed by applying the first four stages of the IAP2 Public Participation Spectrum:

Inform;

Consult;

Involve;

Collaborate; and

Empower

4. Targeted, tailored engagement approaches for each stakeholder group developed

Ensuring that engagement with priority stakeholders is a continuous process in which Northern Star follows up on key areas of concern and makes tangible changes in how it operates in response to what it hears. Near-mine communities, particularly vulnerable communities, continue to be the highest priority stakeholders. Both real and perceived impacts of operations' are considered during engagement.

All engagement with stakeholders is recorded internally with issues and impact management tracked and actioned accordingly.

4.2.1 Life of Mine

KCGM undertook considerable stakeholder consultation throughout 2009/2010 whereby the KCGM Community Closure Action Plan estimated Open Pit life until 2017. This required significant planning for closure.

Following new discoveries, the Life of Mine was extended to 2034. Community uncertainty for planning beyond this was fuelled largely by media speculation.

In late 2019, early 2020, KCGM was acquired by Northern Star Resources and Saracen Mineral Holdings. Both companies must comply with continuous and other disclosure obligations, resulting in increased stakeholder visibility of KCGM's Life of Mine (LOM) plans. This transparency and disclosure of information - combined with the owners' stated objective to grow the operations - allayed stakeholders concerns on the timing of KCGM's closure.

In August 2020, Northern Star Resources announced to the ASX, an extended Life of Mine to 2035. Until this announcement, there was some community uncertainty around the future of KCGM Operations.

A change of ownership represented a significant shift in planning for future operations, from potential closure; to focusing on growing KCGM Operations.

As a result of this growth focus, stakeholder consultation in the past 5 years has been centred on managing the social and economic impacts of growth vs the impact of closure.

Closure plans initially cover broad aspects and become more detailed over time. As a site approaches final closure, we engage with key stakeholders are engaged to explore potential post-mining land uses that could benefit them. Closure plans are reviewed every three years or whenever new activities are planned at a site.

Stakeholder consultation continues regarding each stage of mine life, with specific closure discussions to take place in the five years preceding the anticipated closure date of 2035. Therefore, an updated Community Closure Action Plan will be developed in consultation with stakeholders, 5 years prior to closure.

4.2.2 Traditional Owner Engagement

Northern Star recognises the traditional rights of Indigenous people, and their enduring right to maintain their cultures and customs, and meaningful access to their traditional lands. We acknowledge that Indigenous people are some of the most marginalised people around the world, enduring forms of social exclusion and are often under-represented in political decision-making processes. We consider Indigenous people to be key stakeholders and that to thrive as a business, we need to gain and maintain these enduring trust-based relationships. This makes the engagement of Indigenous people critically important for Northern Star, to better understand the enduring and unique connections they have to their traditional lands and waters, and how Northern Star's operations impact on that.

Our engagement with Indigenous people is aligned with the ICMM Position Statement on Indigenous People and Mining, and our commitment to uphold the principles of Free, Prior and Informed Consent (FPIC). This commitment includes the engagement of Indigenous people in relation to projects situated on their traditional lands. This allows us to understand any areas of concern, and factor that into our operational planning and priorities.

Northern Star commits to agreement making processes with all Indigenous people whose land we operate on, and who hold relevant legal Indigenous land tenure as awarded by the relevant State, Territory or Federal government. In Western Australia, our operations are either subject to a Native Title determination or are subject to a Native Title claim, under the Native Title Act 1993   Commonwealth).

As part of our agreement making process, Northern Star aims to enter into land access and heritage protection agreements with Indigenous people on whose land we operate, to:

- Identify the process for engaging Indigenous people on proposed activities.
- Seek feedback on proposed activities.
- Reach agreement on what mining or exploration activities can occur on the land.
- Agree on how Northern Star will undertake those activities.
- Set parameters for benefits that will be delivered to the Indigenous people in return for the mining or exploration activities proceeding.

During FY24 Northern Star has negotiated and executed two land access and compensation agreements with Traditional Owner groups in the Kalgoorlie and Yandal Production Centres and one agreement was executed in FY23. The Company has also made progress with three other Traditional Owner groups in relation to negotiation protocols and terms of new agreements.

4.2.3 Social Impact Data

Northern Star acknowledges the recommendations of the International Council on Mining and Metals (ICMM) that requires companies to engage with stakeholders based on an analysis of the local context. We recognise that the data generated by independent, objective social impact assessments (SIAs) can be a valuable source of information on how we are achieving social performance and how we can improve. The findings of SIA reports are used to prioritise the social performance team's work, targeted to key stakeholder areas of interest and needs, and maximise the impact of our social performance. Findings undertaken on our individual sites are used to direct social performance and stakeholder engagement efforts tailored to operational environments. Northern Star's aspiration is that social impact assessments and needs analyses are conducted for each operation, with associated Social Impact Management Plans to be developed, that consider our material risks/ opportunities at different life stages of operations and major projects. A major growth project or change in mining operations triggers the need for a Social Impact Assessment.

A Social Impact Assessment (SIA) and Social Impact Management Plan (SIMP) is used by Northern Star to identify what impacts it has or is perceived to have on neighbouring communities, and how to avoid, mitigate and manage these impacts. The SIA and SIMP focus on the following five elements:

1. Scoping – Identification of the potential SIA impacts and stakeholders to be considered through the SIA, and review of stakeholder mapping;
2. Baseline inclusion – Review of existing data and documentation that provides baseline information describing the current local social conditions and demographic trends for incorporation in the SIA;
3. Community and key stakeholder engagement – Based on KCGM's existing relationships, stakeholder mapping and community engagement planning tools;
4. Impact assessment – Identification and prioritisation of the current and potential social impacts (including potential human rights and cumulative impacts) associated with KCGM's current operations and the potential further development. Results of the identification and prioritisation of social impacts will form the basis for the 2020 KCGM SIA Report; and

5. Impact mitigation – Identification of social impact management strategies to avoid, mitigate and manage the negative, and support and enhance the positive social impacts prioritised through the SIA process.

The 2020 SIA identified the need for KCGM Operations to prioritise and focus on the existing and future impacts in the surrounding community, which are all pertinent to closure, including:

- Supporting local employment and communicating KCGM's commitment (e.g., provide a range of pathways for local people to obtain employment at KCGM's operations and continue to raise awareness of those outcomes and the shared value it creates);
- Sustaining continued improvement in operational impacts (dust and noise);
- Communicating about the future of KCGM in Kalgoorlie-Boulder and its LOM mining activities;
- Maximising aboriginal employment and procurement opportunities and building strong, sustained relationships with Native Title claimants;
- Maintaining community contributions, particularly to legacy projects such as vocational education and skill development; and
- Sustaining local tourism infrastructure where feasible.

These key impacts are incorporated into either current or planned operational plans, practices and/or community initiatives.

A 2025 Social Impact Assessment is currently in development, with updated outcomes to be included in future closure planning.

4.2.4 Communication Methods

Ongoing communication with stakeholders provides an opportunity to build an awareness closure and broaden local support, enhance the business reputation, and help foster an understanding of the importance of KCGM to the future prosperity of the City and the State.

Communication must be managed to ensure consistent messages are delivered with accurate.

Regular communication is critical to ensuring stakeholders and community are informed of operational activities. KCGM employs a range of mechanisms to facilitate consultation and solicit input from the greater Kalgoorlie Boulder community on an ongoing basis.

Local Voices

Northern Star has committed to an independent public participation tool known as "Local Voices" to measure and monitor social perceptions in the Kalgoorlie-Boulder Community.

The tool is also designed to act as a needs analysis for identifying themes of greatest community interest. Local Voices' long-term trends, as identified following 5 years of community surveys and over 3,000 participants, provide focus areas that our leaders in the Kalgoorlie Production Centre then use to inform decisions.

Areas of focus include:

- environmental impacts
- perceived dependency on mining
- social investment activities
- employee sentiment
- sentiment towards FIFO activities
- infrastructure and services – childcare, health, housing

Over a 5-year period (2019-2024), 70% of survey participants have consistently seen benefit to the activities at KCGM Operations on the regions' future economic prosperity.

4.2.4.1 Public Interaction Line

The KCGM PIL includes a 24 hour, 7 day a week staffed telephone line, which ensures a timely response to calls, whether they are complaints, feedback, or enquiries. Interactions, whether received by phone, in person, letter or email are captured in Northern Stars' internal CRM system INX Inform.

All complaints are reported to and discussed with the Site Leadership Team on a daily basis, and summarised in monthly site reports, board reports and annual reports, in accordance with the Complaints and Grievances Standard.

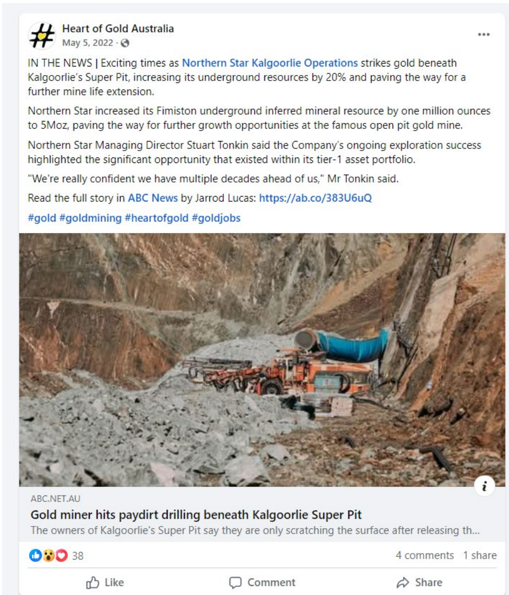
4.2.4.2 Super Pit Website

KCGM Operations' website (www.superpit.com.au) is accessed by 50,000 unique visitors each month. The site provides a range of information about KCGM, including an overview of operations, publications, reports, employment opportunities, community investment and life of mine details.

Daily noise and dust data are also published on the website. A contact form is available as an additional mechanism of the PIL database.

4.2.4.3 Social Media

Northern Star Kalgoorlie Operations' dedicated facebook page allows communication with the community and other key stakeholders. Currently sitting at 48,000 followers, this medium is used to communicate information on Life of Mine messaging.



4.2.4.4 Traditional Media

and growth activities.

Advertising campaigns, with a focus on growth, have occurred throughout 2023, 2024 and into 2025 including:

- Daily radio campaign, detailing environmental management, community investment and operational growth plans;
- Newspaper adverts, to provide community updates on KCGM Operations;
- Cinema adverts, detailing extension of mine life and community investment
- Display adverts on local buses, and billboards detailing extension of mine life.


west rewards >

Kalgoorlie Miner

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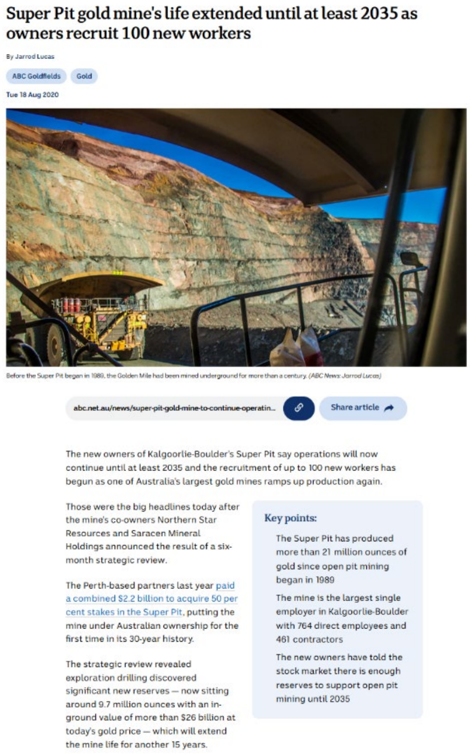
Northern Star's $1.5b KCGM mill expansion provides multi-decade confidence in future of Kalgoorlie-Boulder

Neil Watkinson | Kalgoorlie Miner
Fri, 23 June 2023 2:00AM

Northern Star's $1.5 billion Fimiston mill expansion aims to transform KCGM, centred on the Super Pit and Mt Charlotte underground mine, into Australia's biggest gold-producing operation. Credit: https://www.wingsphoto.com/Supplied

Northern Star Resources' $1.5 billion KCGM mill expansion will provide Kalgoorlie-Boulder with "multi-decade" confidence in its future, the boss of the gold miner says.

Northern Star announced the massive investment on Thursday, saying the aim was to transform the asset centred on the Super Pit and Mt Charlotte underground mine into Australia's biggest gold-producing operation, and one of the five-largest in the world.


Super Pit gold mine's life extended until at least 2035 as owners recruit 100 new workers

By Jarrod Lucas

ABC Goldfields | Gold

Tue 18 Aug 2020

Before the Super Pit began in 1989, the Golden Mile had been mined underground for more than a century. (ABC News: Jarrod Lucas)

abc.net.au/news/super-pit-gold-mine-to-continue-operatin... | Share article

The new owners of Kalgoorlie-Boulder's Super Pit say operations will now continue until at least 2035 and the recruitment of up to 100 new workers has begun as one of Australia's largest gold mines ramps up production again.

Those were the big headlines today after the mine's co-owners Northern Star Resources and Saracen Mineral Holdings announced the result of a six-month strategic review.

The Perth-based partners last year paid a combined $2.2 billion to acquire 50 per cent stakes in the Super Pit, putting the mine under Australian ownership for the first time in its 30-year history.

The strategic review revealed exploration drilling discovered significant new reserves — now sitting around 9.7 million ounces with an in-ground value of more than $26 billion at today's gold price — which will extend the mine life for another 15 years.

Key points:

- The Super Pit has produced more than 21 million ounces of gold since open pit mining began in 1989
- The mine is the largest single employer in Kalgoorlie-Boulder with 764 direct employees and 461 contractors
- The new owners have told the stock market there is enough reserves to support open pit mining until 2035

Transit WA Bus Design, 2024

WA Billboard Design, 2024

4.2.4.5 Mine Tours

An access agreement is in place with a local tourism provider for public tours. Members of the public can reserve and pay for the tour through the operator. Under this agreement, Northern Star also contracts the tour operator to provide free tours once a month, and regularly to school groups.

Northern Star undertakes a number of private site tours for key stakeholders each year to discuss LOM projects, growth, employment, environmental management, and regulatory submissions.

The Super Pit Lookout has become one of the region's main tourism attractions and has signage with a range of information about KCGM's operations, including closure. The lookout is recognised by key stakeholders as a key driver behind local tourism. Recent data as provided by the City of Kalgoorlie-Boulder Infrastructure Engineers, reveals up to 65,000 visitors to the lookout per annum.

As part of the Fimiston South Growth project, the lookout will be relocating to accommodate new cutbacks. New signage and engagement with tourism stakeholders is in development, expected to be in place by end of 2025.

ENVIRONMENT AND CLOSURE

The Kalgoorlie-Boulder environment has improved considerably over the past 30 years. Key environmental management practices have meant that the air is much cleaner, mines and processing plants are quieter, and the landscape has improved. Residents are also safer since many of the old abandoned mineshafts and mining areas close to the city have been fenced off.

All operations at KCGM are closely managed according to our extensive Environmental Management Program. This includes monitoring and reporting on dust, noise, vibration, water and air quality. Reports and management plans can be found on the KCGM website.

Dust

KCGM employs a range of dust management strategies to minimise community impacts. These include use of water carts on haul roads and active mining areas, suspending or delaying activities (such as blasting), and progressive rehabilitation.

Water carts spray hypersaline water in operational areas, which is five times saltier than sea water and occurs naturally in the Goldfields. The salt forms a crust on the road and greatly reduces the amount of airborne dust.

Air Quality

When KCGM initially formed in 1989 there were three roasters in operation. To improve local air quality, they were shut down and replaced by a satellite roasting facility located 17 kilometres north of Kalgoorlie-Boulder, the Gidji Gold Processing Plant. In 2015 the Gidji roasters were decommissioned and replaced by an Ultra Fine Grinding (UFG) Mill, eliminating sulphur dioxide emissions.

Water

Water is vital to mining, however KCGM is committed to using and managing water sustainability. Of the 12,000 megalitres used by KCGM annually, only 10% is potable water from the Goldfields water supply. The majority of KCGM's water usage, approximately 80%, is from recycled process water, dewatering operations, and seepage recovery. The remaining 10% is hypersaline water obtained from groundwater.

Noise

Extensive noise assessment and modelling work is carried out at KCGM to determine the best means of reducing noise from the Super Pit. Key measures to reduce noise include the construction of the environmental noise bund along the western side of the Super Pit, restricted hours of operation, and the use of broadband reversing alarms.

Waste

Open pit mining and mineral processing operations generate two major types of mine waste – rock and tailings.

Waste rock contains no gold, or gold in such low concentrations that it cannot be economically processed. It is trucked to waste rock dumps which are progressively rehabilitated. Other waste rock is crushed for use on mine roads, backfilling old mine shafts and for fine gravel known as stemming which is used to pack blast holes.

Waste from the gold extraction process, known as tailings, is stored in tailings storage facilities (TSFs). KCGM manage and operate four active TSFs - Gidji, Fimiston I, Fimiston II and Kaltails.

DID YOU KNOW?
Water is vital to mining, and KCGM uses about 12,000 megalitres of water annually. Eighty percent of KCGM's water usage is from recycled process water, dewatering operations, and seepage recovery.

Above: KCGM Environmental Advisor Josh in the field, monitoring one of KCGM's long-term rehabilitation sites.

Rehabilitation

KCGM is progressively rehabilitating a footprint of about 3,000 hectares of land, including waste rock dumps, TSFs and areas of degradation from historical mining operations. Research, studies and trials are used to determine final landform design and best use for available rehabilitation materials.

The Life of Mine

Mining companies must provide a nominal date for mine closure to ensure that adequate planning is undertaken by the operation, government and community to minimise potential impacts.

Life of Mine plans can change at any point and dates provided are a guide based on current economic factors such as mining and mneral processing rates, gold price, labour, equipment and consumable costs.

KCGM's current Life of Mine plan sees the company operating until 2035. KCGM has developed a Mine Closure Plan to ensure that potential impacts to the environment and community are minimised once mining and mineral processing activities cease.

The KCGM Mine Closure Plan is available on KCGM's website.

Information Panel relating to Closure Located at Super Pit Public Lookout

4.3 Engagement Register

The following section provides a summary of the most recent direct engagement KCGM has conducted regarding closure planning. Stakeholder engagement conducted between 2003 and 2015 is provided in Appendix 2.

4.3.1 Regulatory Agencies

4.3.1.1 EPA

On 2 September 2019 KCGM met with DWER EPA Services Unit representatives and DMIRS to discuss the resubmission of the 2018 MCP. Topics discussed included: Current completion criteria objectives, including their relationship to the documentation associated with the 2009 MS782; EPA indicated that they preferred to use the MCP as an 'adaptive management approach' with KCGM able to adjust the Completion Criteria and Objectives to achieve best fit. KCGM stated that they were unable to adjust the Completion Criteria in the proposed two-month timeframe and had several studies underway to refine the Completion Criteria. EPA proposed an alternate timeline for refining Completion Criteria. EPA stated it was important to clarify future Land Use for KCGM KCGM queried the term 'non-eroding' referenced in correspondence by the EPA letter providing comment on the 2018 MCP, the EPA outlined that the term is applicable to all mine sites and intended to ensure that there would be no unacceptable long term liability for the State, and that erosion should not expose problematic or high risk materials.

4.3.1.2 DMIRS / DEMIRS

On 2 September 2019 KCGM met with representatives of the EPA and DMIRS to discuss the resubmission of the 2018 MCP. Details are provided in Section 4.3.1.1.
On 15 November 2019 DMIRS senior environmental management visited KCGM operations to view recently completed and current rehabilitation efforts. Discussions were informal with representatives noting: Mine Closure planning and execution at KCGM was a whole of mine processes, with strong cross functional integration. The quality and scale of rehabilitation works being undertaken at the Fimiston TSFs was viewed positively.
On 28 November 2019, KCGM met with DMIRS Geological Survey section and DPLH Land Use Planning (including the Planning and Contaminated Sites sections) to discuss final land use for KCGM post closure, noting the following: KCGM provided an overview of likely future land use for KCGM's owned tenements, including areas that would potentially require limited access, contaminated areas that may require ongoing monitoring, fencing and future engagement requirements. Any proposed change to alternative land use for current mining tenure requires approval from DMIRS under Section 16.3 of the Mining Act 1978. DMIRS would be highly unlikely to agree to an alternate land use that would preclude mining, though each case would be assessed on merit. It was agreed in principle that KCGM would identify a final land use that would not preclude future mining activities. Regular engagement with DMIRS (GeoSurvey) and DPLH is not required. DPLH has indicated that further discussions should be initiated by KCGM five years from identified mine closure.
The CKB Town Planning Scheme prescribes that the land area currently occupied by the Fimiston Operational area is currently zoned 'rural', with a special control area to protect mining activities at the 'Super Pit'. Residential development is prohibited in this area. Periodic consultation with the Planning Department at CKB is recommended to ensure alignment between KCGM's planning and that of the CKB.

On 2 December 2020, KCGM convened a telephone meeting with DMIRS. Those present included; James Best – DMIRS, Tania Liaghatti – DMIRS, Janine Cameron – KCGM Closure and Jess Li – MBS. The discussion focused on the content and format of KCGM's MCP: Past submissions were formatted to meet the needs of various reader groups – EPA, DMIRS, other Regulatory bodies and the public. The EPA (from 2015 MCP) requested a Management Plan type document and DMIRS requested a detailed document. From the 2021 MCP, the Work Plan Appendix will be consolidated into the main body of the document (Vol. 2). Completion Criteria requirements in general terms. KCGM's strategy to conserve rehabilitation resources.
9 December 2024 Tailings Storage Facility and Pit/WRD mining proposals, in particular geotechnical aspects, were discussed with DEMIRS Environment and Geotechnical teams.
16 January 2025 Environmental consultation for Tailings Storage Facility Mining Proposal; including Water and Seepage Management and near neighbours.

4.3.1.3 DPLH

On 28 November 2019, KCGM met with DMIRS Geological Survey section and DPLH Land Use Planning (including the Planning and Contaminated Sites sections) to discuss Closure final land use for KCGM. The following can be noted from these discussions: KCGM presented to the group on likely future land use for KCGM's tenements, including areas that would potentially require limited access. Contaminated areas could potentially require monitoring, fencing and liaison with the Department. A change to an alternative land use for current mining tenure requires approval from DMIRS under Section 16.3 of the Mining Act 1978. DMIRS would be very reluctant to agree to other land use that would preclude mining, although each case would be assessed on merit. It was agreed that KCGM would select a final land use that would not preclude mining activities. DMIRS (GeoSurvey) and DPLH would not like to engage regularly. DPLH would like to engage for further discussions five years out from mine closure.
Under the CKB Town Planning Scheme, the land area currently occupied by the Fimiston Operational area is currently zoned 'rural', with a special control area to protect mining activities at the 'Superpit'. Residential development is prohibited in this area. Periodic consultation with the Planning Department at CKB is recommended to ensure alignment between KCGM's planning and that of the CKB.

4.3.2 Local Government

Several discussions with the CKB Planning Department have been held since late 2019, to discuss alignment between the current Town Planning Scheme No. 1 and proposed Town Planning Scheme No. 2, including the safety exclusion zone around Fimiston Open Pit, which will become an SCA in Town Planning Scheme No 2. This zone limits urban development in the vicinity of the Fimiston Open Pit.

4.3.3 Community Reference Group

Since 2020, the CRG was consulted in relation to LOM activities including growth projects undergoing regulatory approvals (Fimiston South and Tailings Storage Facility) and mine closure. The group have been given the opportunity to ask questions, provide feedback and take part in group discussions, followed by site tours of key areas discussed.

The following CRG engagement specific to closure planning has been undertaken:

August 2017: Life of Mine Tailings (Fimiston IIE TSF) Future tailings capacity requirements and proposed capacity increase locations; and Closure planning for TSFs – progressive rehabilitation commencing in 2018.
September 2017: Morrison and Brownhill Projects LOM to be extended, open pit mining to 2026 and mineral processing to 2034; and Super Pit Lookout to be relocated to allow for Morrison extension.
September 2017: CRG survey KCGM conducted a survey, consisting of one on one interviews with each member, to review the makeup of the group, reestablish their interest areas and ensure the group remains a robust forum.
March 2018: Growth The Southern Extension Program – key for the longer term future of the mine. Mount Charlotte Extensions Program – will assist to secure underground long term viability and value with focus on Hidden Secret and Belgravia reserves.
June 2018: Closure Planning Update Next submission March 2021 has the following closure priorities: TSF Closure Designs and TSF Haul Road. The CRG is encouraged to continue to provide feedback. KCGM continues to look for opportunities to extend the LOM, however LOM plans are subject to change due to economic conditions.
January 2019: Morrison Starter Pit Update New layback area, known as the 'Morrison Starter Pit', located at the southern end of the Fimiston Open Pit. Mining activity is associated with the Morrison and Brownhill Projects.
February 2019: Life of Mine Tailings Mining Proposal for Kaltails Height increase to 60 metres and buttressing was approved.
August 2019: Life of Mine Tailings (Fimiston IIE) Tailings Storage Facility Extension – plans submitted for regulatory approvals in October 2020.
November 2019: Life of Mine Tailings Site visit – Tailings Storage Facility Extension (Fimiston IIE)
April 2020: Growth – Fimiston South Overview of project status, environmental studies, community engagement, mine planning, infrastructure studies, approvals and benefits.
May 2020: Growth – Brownhill Overview of project status, mine planning and benefits.
June 2020: Life of Mine Tailings Gidji Tailings Storage Facility III Project overview and update.
September 2020: Life of Mine Tailings (Gidji III) – application later withdrawn Gidji Tailings Storage Facility project overview and update. Community consultation prior to regulator submission.
October 2020: Growth Overview of merger announcement between KCGM Joint Venture owners Saracen and Northern Star. Plan ahead for growth of operations. Overview of Environmental Protection Authority (EPA) application and project update of Fimiston South.
October 2020: Closure Overview of KCGM's closure objectives and guidelines ahead of the submission of its updated MCP to DMIRS in February 2021. Closure survey completed by CRG members.

November 2020: Growth Site visit of Brown Hill and Gidji Processing Plant. Update on growth projects and life of mine tailings.
March 2024: Public Environmental Review (PER) Fimiston Operations Extension (Stage 3) Northern Star is seeking approval under the Environmental Protection Act 1986 for a cutback to the Fimiston Open Pit, known as the Ivanhoe cutback, expansion of the Fimiston Tailings Storage Facilities, an extension to the Waste Rock Dump and additional supporting infrastructure. The Public Environmental Review document included information on mine closure planning.

5. COLLECTION AND ANALYSIS OF CLOSURE DATA

This Section provides an overview of the natural environment, the social environment aspects, and an overview of current status of mining features within the KCGM Operational Areas.

5.1 Natural Environment

5.1.1 Climate

The Kalgoorlie region has a semi-arid climate with hot summers and mild winters. Annual rainfall varies between 108 and 530 mm with an average of 266 mm, with rainfall occurring during all months of the year (Figure 5-1). Significant summer rainfall is experienced due to tropical monsoon systems moving across the state from the north. Winter rainfall generally originates from broad frontal lows that move in from the west.

The region is experiencing a distinctive long-term change in rainfall patterns characterised by reduced winter rainfall and a greater number of extreme rainfall events in summer. Average winter rainfall for the 2000-2019 period is about 30% lower compared to the historical long-term winter rainfall (1940-2019). Average summer rainfall for the same period is 20% higher compared to historical long-term summer rainfall (1940-2019) (MBS & GRM, 2020). Climate studies by the CSIRO (2017) indicate that the decreasing winter rainfall trend will be continuing due to climate change with higher probabilities of extreme summer rainfall events. It has been noted on site that 2019 and 2020 have been particularly hot and dry as compared to the previous several years as reflected in Figure 5-2. Pan evaporation rates in Kalgoorlie exceed precipitation for all months of the year. Average annual evaporation is 2,628 mm, ranging from 388 mm in January to 78 mm in June.

The precipitation intensities (mm/hr) for various Average Recurrence Intervals (ARI) calculated for the Kalgoorlie Airport are shown in Table 5-1. Climate data is taken into account when developing closure designs for landforms (Section 9, Volume 2).

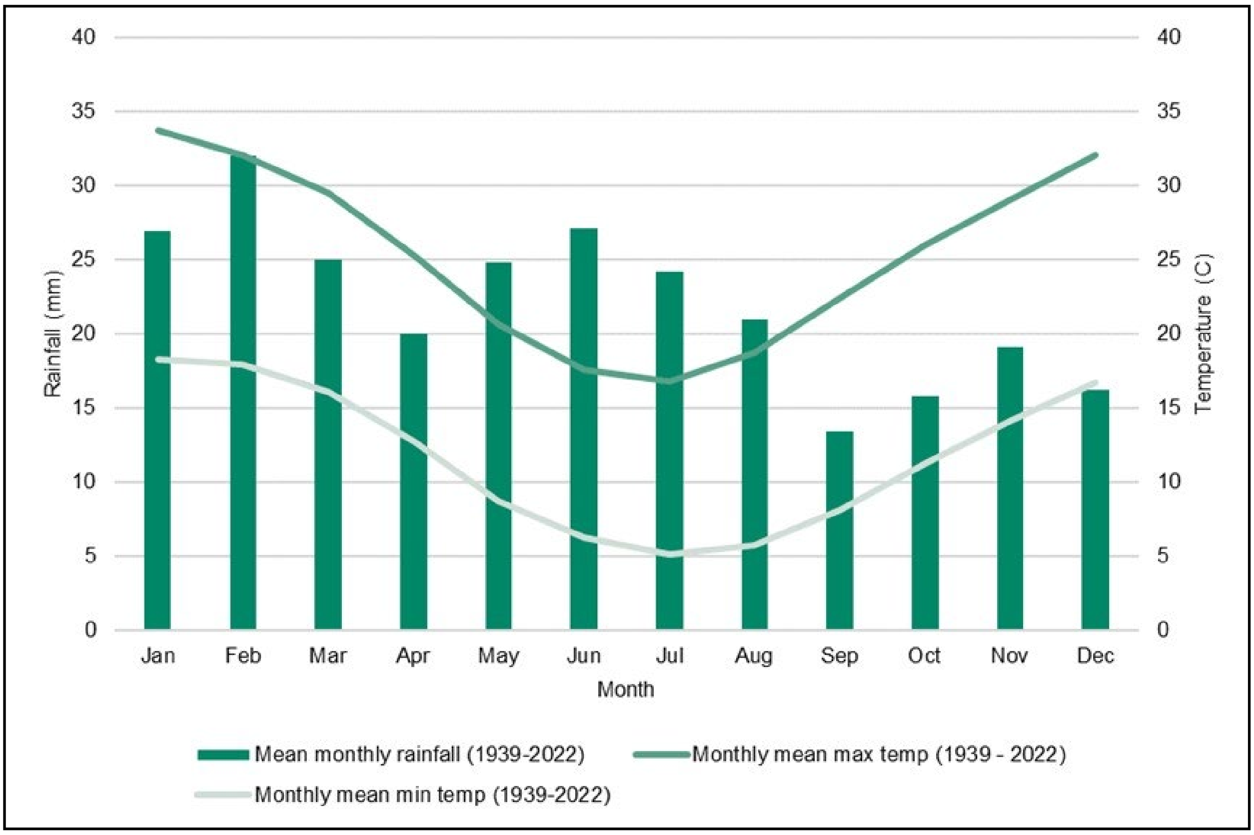


Figure 5-1: Long-term Monthly Climate Averages for Kalgoorlie-Boulder (1940-2022)

Rainfall and temperature annual averages during KCGM's operational period are presented in Figure 5-2. The graph illustrates the low rainfall and high temperatures experiences over the last few years, particularly 2019 and 2020. The impact of this has been noticeable in vegetation monitoring data.

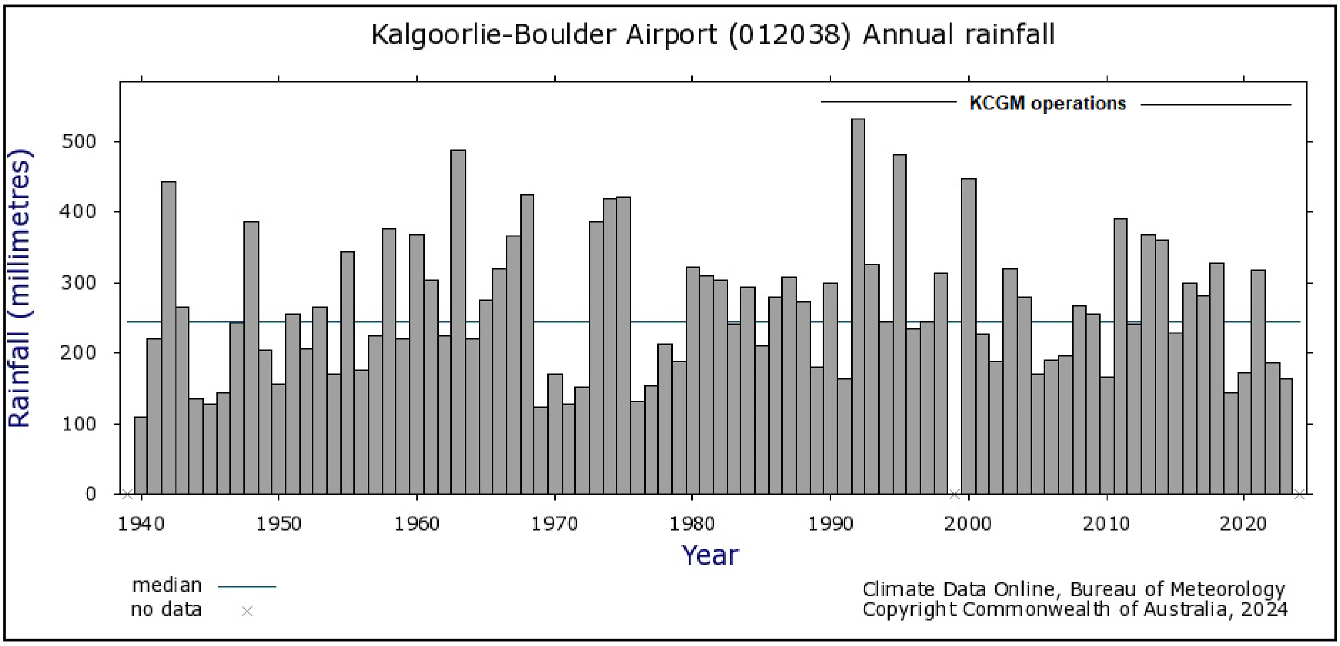


Figure 5-2: Annual Rainfall Trends Over Time

Table 5-1: Kalgoorlie-Boulder Precipitation Intensities (mm/hr) for Average Recurrence Intervals

DURATION	50	100	500	1,000	2,000	5,000	20,000	200,000	PMP
15 mins	21.8	25.9	35.4	40.5	46.4	55.4	73.2	116.4	178.9
30 mins	28.6	33.8	46.3	53.0	60.6	72.5	98.2	162.4	258.8
45 mins	32.9	39.0	54.0	62.1	71.4	85.9	117.6	198.1	321.2
1 hr	36.4	43.1	59.8	68.9	79.3	95.6	131.1	221.5	360.2
2 hrs	42.2	49.9	69.4	80.8	92.2	111.3	153.0	259.5	423.4
2 hrs	46.8	55.4	77.1	88.8	102.4	123.6	170.0	288.4	470.9
3 hrs	50.8	60.2	83.5	96.2	110.7	133.4	182.9	309.0	502.1
3 hrs	54.3	64.5	89.2	102.6	118.0	142.0	194.3	326.8	529.3
4 hrs	60.6	72.2	100.8	116.3	134.3	162.3	218.5	357.7	564.7
5 hrs	66.0	78.8	109.3	125.8	144.9	174.6	233.7	379.3	593.9
6 hrs	70.8	84.6	116.8	134.2	154.2	185.3	246.9	397.8	618.8
9 hrs	82.0	98.3	137.2	158.3	182.7	220.9	288.9	451.2	678.1
12 hrs	91.1	109.4	151.6	174.4	200.6	241.5	314.0	485.7	723.5
18 hrs	103.2	124.2	170.9	196.2	225.1	270.0	349.4	536.2	792.8
24 hrs	112.8	135.8	190.7	220.7	255.5	309.9	396.1	595.5	846.0
36 hrs	124.2	149.7	209.6	242.3	280.1	339.3	445.2	699.0	1055.6
48 hrs	133.0	160.3	227.9	265.3	308.7	377.1	501.0	802.8	1235.1
72 hrs	143.3	174.2	248.1	288.9	336.3	411.3	563.3	949.8	1541.0

(Source: Golder, 2018)

5.1.2 Relief and Drainage

The topography in the vicinity of KCGM is characterised by a gently undulating relief, with elevations ranging between 360 and 400 m above Australian Height Datum (mAHD). Greenstone belts (mafic basement rocks) form prominent hills in the area.

The Fimiston, Mt Percy and Mt Charlotte Operational Areas are located on an elevated topographic area which form a divide between two major paleo drainage systems that occupy the lower part of the subdued landscape features typical of the Kalgoorlie area. KCGM is situated within the Salt Lake Catchment region which forms part of the South Western Plateau Basin. The Salt Lake Catchment comprises numerous drainage systems draining to terminal salt lake systems, clay pans and other natural surface depressions. These salt lake systems are associated with ancient valley systems (paleo valleys) which filled up with sediments since the late Cretaceous and early Tertiary period (Figure 5-3).

The Gidji Operational Area is located close to a topographic low associated with an east trending series of playa lakes, including the King of the West Lake to the northeast. Surface drainage in the immediate vicinity of Gidji Operational Area is poorly defined but is considered to be generally north.

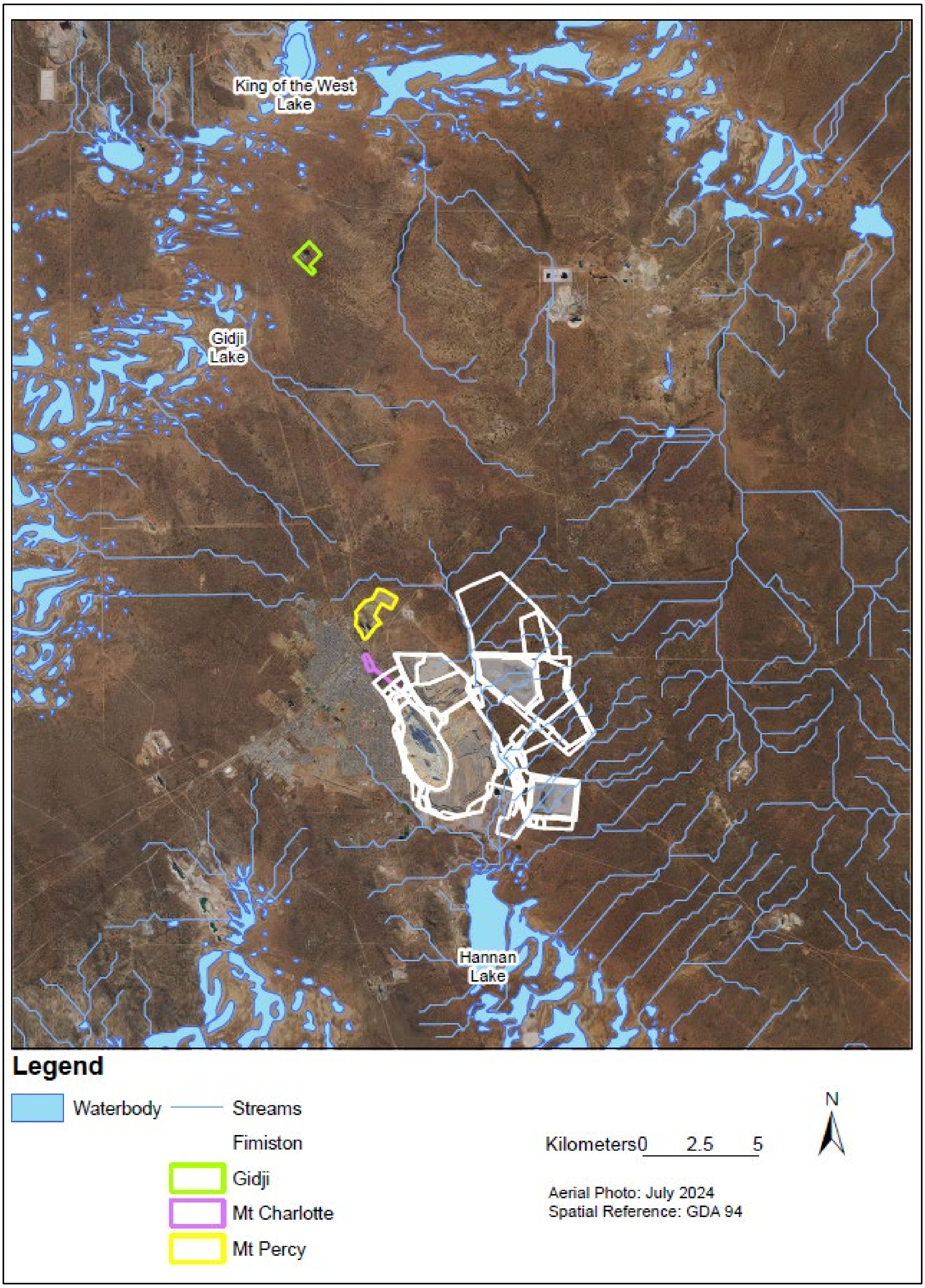


Figure 5-3: Regional Surface Water Drainage

5.1.3 Geology

The geology of the Eastern Goldfields is characterised by north-northwest trending Archaean aged Greenstone belts. The Greenstones consist of metamorphosed volcanic and sedimentary rocks. The areas between the Greenstone belts are occupied by granites. Younger Proterozoic aged dolerite dykes cut through the granites and Greenstones. Mesozoic aged glaciation formed extensive valley systems which were later filled with Tertiary sediments. These sediments have formed paleochannels, which are now buried by recent Quaternary sediments (today's land surface).

5.1.3.1 Fimiston Open Pit

Approximately 80% of the rock mined from the Fimiston Open Pit is Golden Mile Dolerite, with the remaining rock composed of Paringa Basalt (14%) and sediments belonging to the Black Flag Beds (approx. 4%). Black Flag Beds are also referred to as Black Flag or Black Flag Shale. Figure 5-4 provides a surface map of Fimiston lithology. The mineralising event at the Golden Mile led to geochemical enrichment in various elements including the following; gold, silver, bismuth, cadmium, mercury, antimony, tellurium in waste lithologies and variable enrichment in arsenic, boron, molybdenum, selenium and zinc within the Black Flag lithology (MBS Environmental 2020).

The majority of the Ivanhoe cutback mine wall exposure will be in Golden Mile Dolerite, where KCGM has a long history of open pit mining. Black Flag Beds occurs as several thin layers of subvertical sediments with major faults traversing through the middle of Golden Mile Dolerite units while Williamstown Dolerite, Kapai Slate and Devon Consols Basalt have relatively minor exposure only on the upper part (oxide and transitional) of the west wall. The Paringa Basalt has very minimal exposure in Ivanhoe cutback.

5.1.3.2 Mt Percy

The main rock types at Mt Percy are the Hannans Lake Serpentinite, Devon Consols Basalt, Kapai Slate, and Williamstown Dolerite (Figure 5-5). The Hannans Lake Serpentinite is the major rock type in the Sir John and Mystery Open Pits and is a minor rock type in the Union Club Open Pit. All four lithologies are well exposed in the Union Club and Sir John (now backfilled) Open Pits and are intruded by felsic porphyries. Mineralisation is associated with quartz veining (Mt Charlotte style mineralisation) and brecciated lodes with disseminated sulphides associated with felsic porphyries (Fimiston style mineralisation). The deposits at Mt Percy were mantled by lateritic duricrusts that formed local topographic highs. Mining at the Mt Percy Open Pits mainly focused on mineralisation in the saprolite and lateritic residuum and did not penetrate deeply into fresh rock.

5.1.3.3 Mt Charlotte

At the Mt Charlotte deposit stratigraphy consists of the basal Hannans Lake Serpentinite, overlain successively by the Devon Consols Basalt, Kapai Slate, Paringa Basalt, Golden Mile Dolerite and Black Flag Beds (minor lithology) (Figure 5-6). The Golden Mile Dolerite is the dominant lithology at the Mt Charlotte operations. Gold mineralisation at Mt Charlotte is stockwork style: an intersecting mesh of conjugate quartz veins that preferentially form within Unit 8 of the Golden Mile Dolerite, due to this stratigraphic control the veins form a steeply plunging pipe-like ore body. The veins are composed of coarse quartz-carbonate with minor scheelite, tourmaline and albite. Extensive wall rock alteration occurs around the veins, the alteration assemblage is quartz-albite-sericite-siderite-ankerite-pyrite.

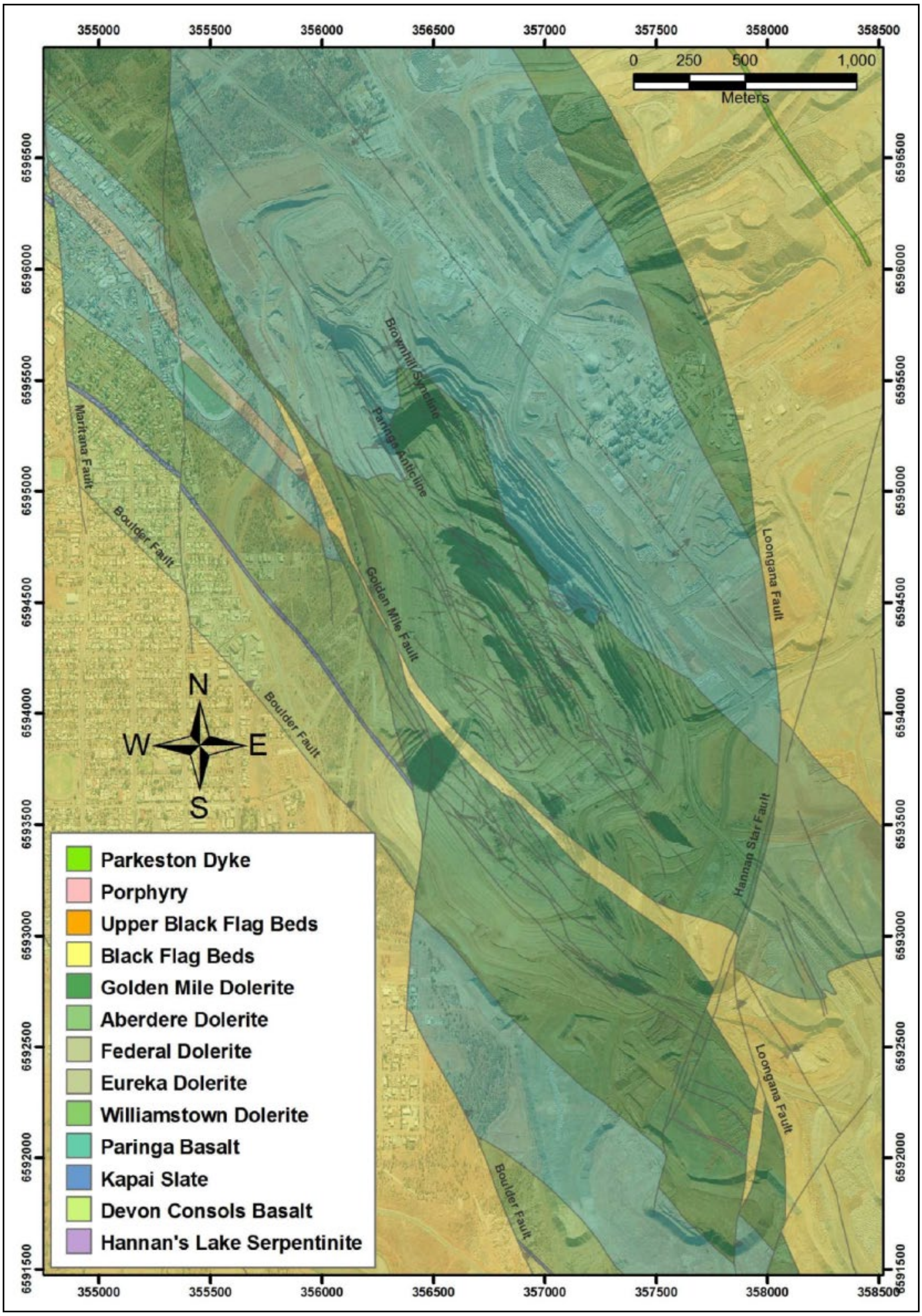


Figure 5-4: Fimiston Lithology

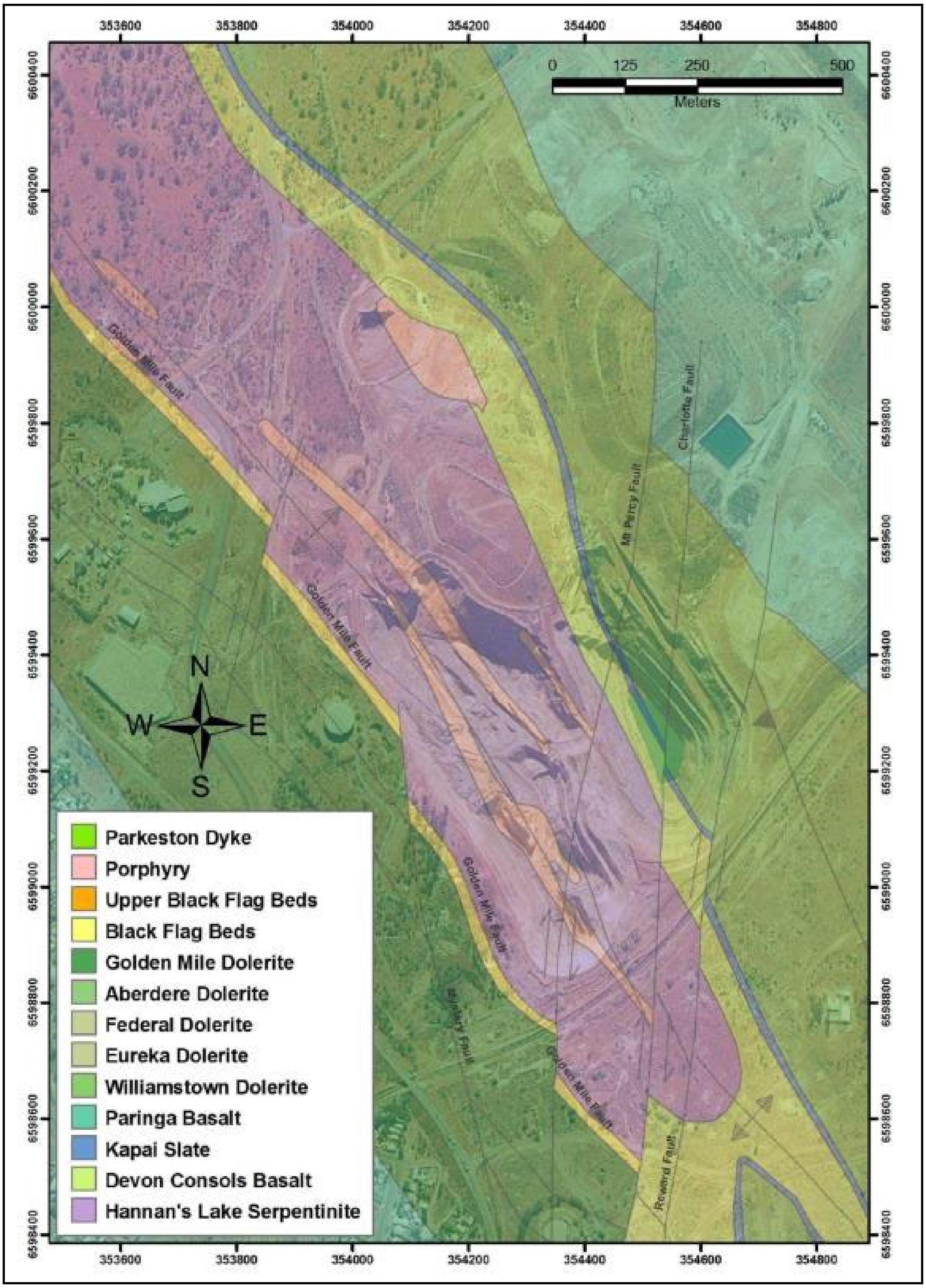


Figure 5-5: Mt Percy Lithology

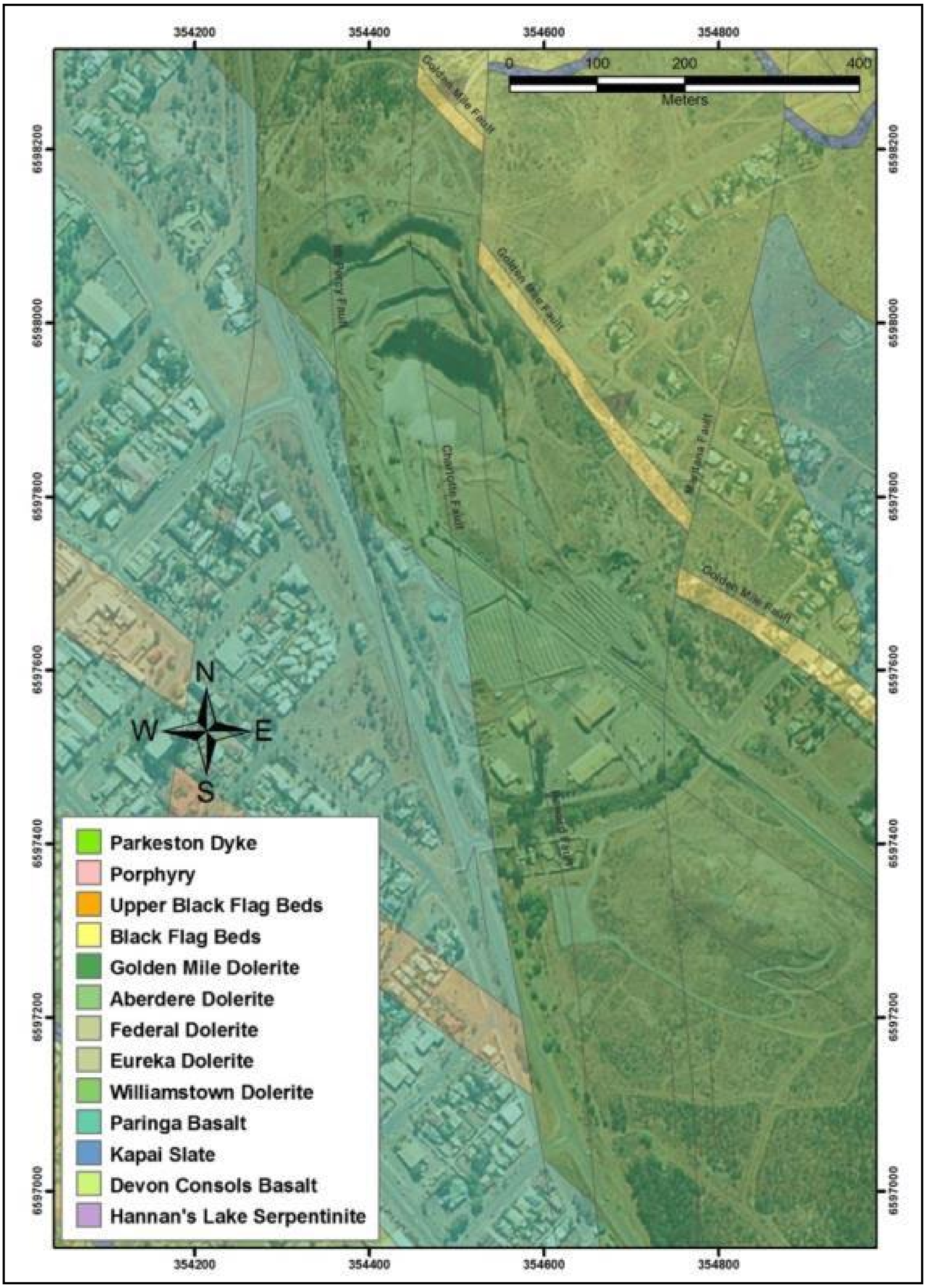


Figure 5-6: Mt Charlotte Lithology

5.1.4 Soils

Soils of the Goldfields (within the Kambalda and Norseman zones) except for those within salt lake zones are typically classed within the Australian Soil Classification scheme as either Kandosols or Calcarosols. Kandosols are soils that lack strong texture contrast, have massive or only weakly structured subsoils, and are not calcareous throughout. Calcarosols are usually calcareous throughout the profile. The undulating plains on granite have extensive areas of Calcareous loamy earths with red loamy earths, red deep loamy duplexes and red shallow loamy duplexes. Saline valley floors have salt lake soils with saline wet soils and red deep sandy duplexes. The gently sloping uplands on granite have yellow sandy earths and yellow loamy earths, with some yellow deep sands and Ironstone gravelly soils.

The hilly terrain on greenstone has red loamy earths, calcareous loamy earths and calcareous shallow loams, along with stony soils and red shallow loams. Soils tend to have sandy loam to loam textured surface soils which grade to loam and clay loam textured subsoils. Soil pH tends to be neutral to alkaline on the surface, increasing to alkaline and even moderately or high alkaline in the subsoils. For soils not within saline valley floors, salinity and sodicity values are often low in the surface soils, with these soils often becoming increasingly saline and sodic (dispersion prone) as soil depth increases. The fertility of Goldfields soils also tend to be low, as evidenced by low total Nitrogen and organic Carbon values.

5.1.4.1 Fimiston Soils Characterisation

The soil profiles at KCGM vary according to the geomorphic setting. Soils have been historically degraded in the vicinity of historical mining on the Golden Mile.

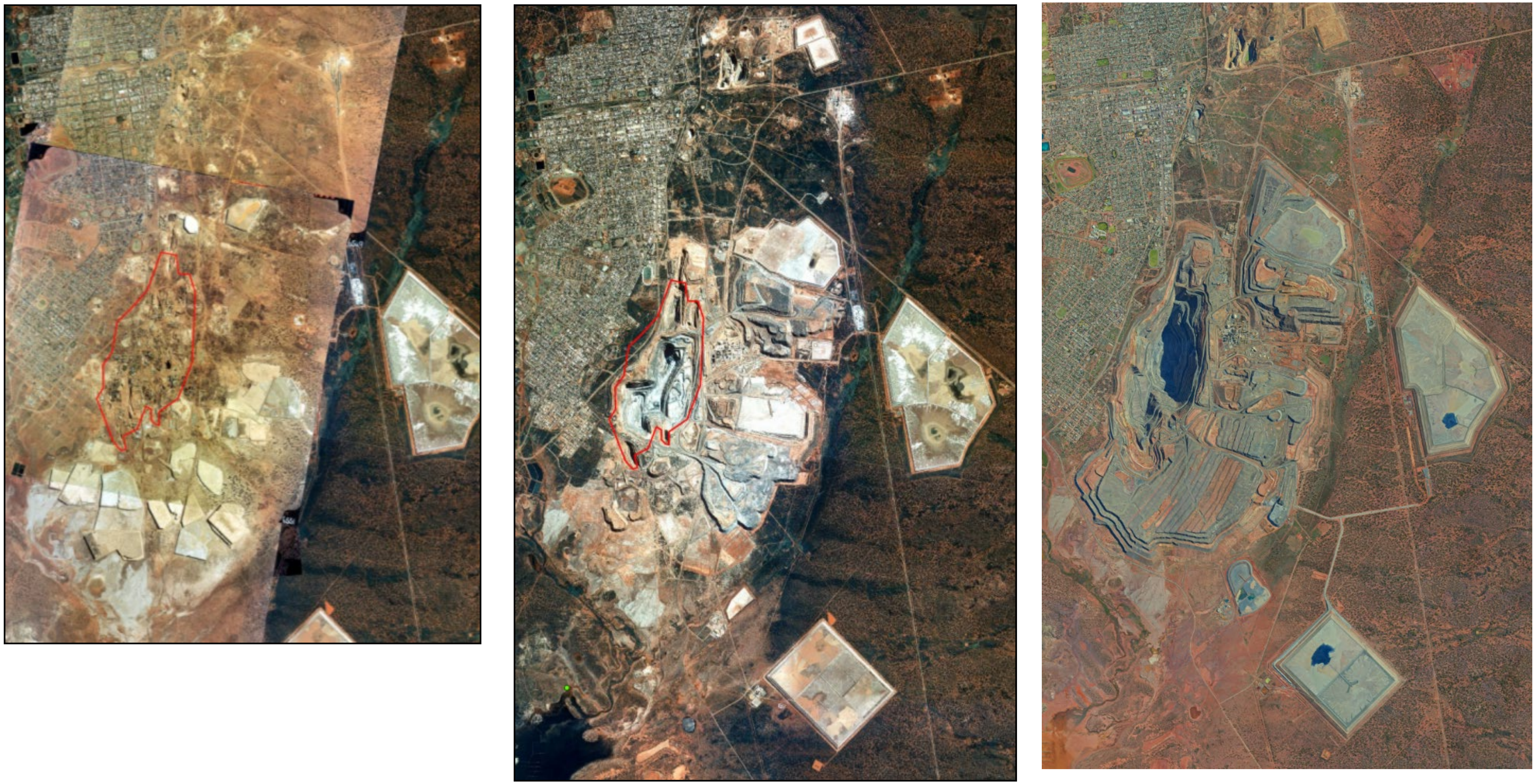
On the flat plain areas, the soil profile consists of a deep reddish brown to orange loam to silty loam. Topsoil development is typically very poor, with a thin (<100 mm) build-up of organic material. The texture of these soils is optimal for plant growth providing considerable plant-available water contents and structure for root growth. In most of the profiles on the flat plain, a well-defined layer of gypsum nodules occurs around 0.5 m below the surface.

Where small lateritic and calcareous hills occur, the soil profile consists of a massive consolidated lateritic or gravel layer overlying a well-developed calcareous layer. Considerable weathering of the laterite and limestone has occurred leaving a gravelly sand matrix greater than 2 m in depth. The major limitation to this gravelly profile is that the gravel fraction represents an inert material with no water or nutrient holding capacity; subsequently, plants must access a considerably greater volume of the profile, compared to the loamy profile on the plains, to obtain sufficient water and nutrients for growth.

The structural stability of the soils varies from good to poor depending on organic content and sodicity. The macro-structural stability of the topsoil/subsoil is typically good, and these soils do not slake or only exhibit minor slaking when immersed in water. In contrast, the deeper soils have a poor macro-structural stability and slake rapidly when re-wet.

The micro-structural stability follows a similar profile to the macro-structural stability, with the surface soil showing good stability, whilst the deeper soil exhibits poor micro-structural stability. With increasing depth there is a corresponding increase in sodicity, which favours dispersion of the clay particles and susceptibility to gully and tunnel erosion if exposed at the surface. The sodicity of the soils has been measured as non-sodic to extremely sodic (as measured by analysis of Exchangeable Sodium Percentage (ESP). The pH of the soils varies from neutral to moderately alkaline, reflecting their calcareous and/or gypsiferous nature. At both Gidji and Fimiston IIE TSF, acidic soils have been encountered.

The electrical conductivity (EC 1:5) of the native loamy soils varies from non-saline to very highly saline, with a highly saline average. A considerable variation in salinity occurs down the soil profile with the surface 0 to 20 centimetres (cm) (topsoil and subsoil) having EC values <0.2 mS/cm (non-saline), whilst at depths >20 cm the salinity rises sharply to an average of 1.6 mS/cm (highly saline) (KCGM 2012). The variation in salinity down the soil profile indicates that considerable leaching of salts has occurred in the surface 20 cm of the native profile. In the gravelly sandy profiles of the small hills, leaching of salts has occurred to depths >40 cm. The soils are low in phosphorus, to which native vegetation has adapted.



1983 (lighter photo portion) 1999 2019

(Highly disturbed nature of the Fimiston, Mt Charlotte, and Mt Percy Operational Areas – 2019 extent of Fimiston Open Pit outline shown in red)

Figure 5-7: KCGM Operations 1983, 1999, and 2019

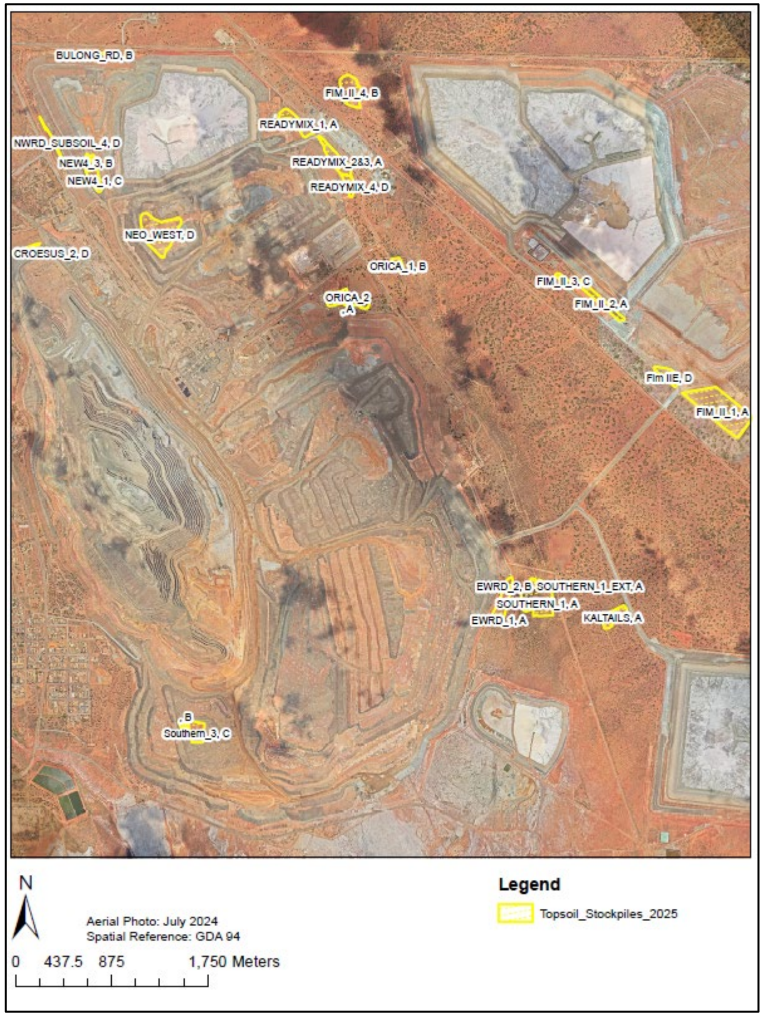


Figure 5-8: Fimiston Rehabilitation Materials Stockpiles (2025)

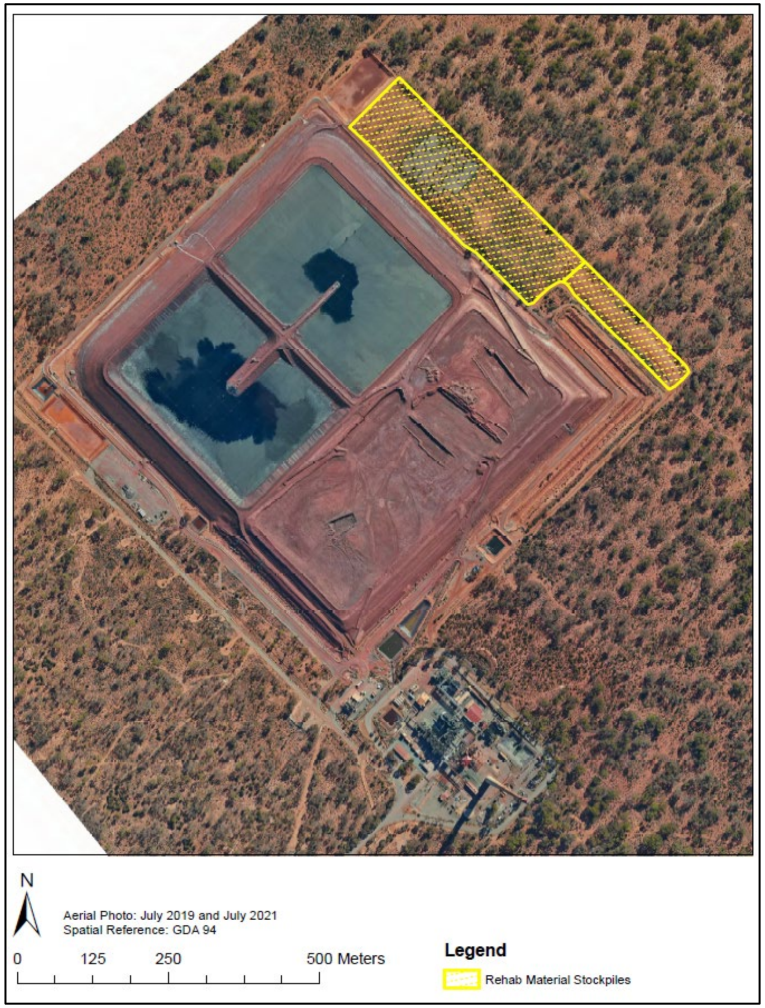


Figure 5-9: Gidji Rehabilitation Material Stockpiles (2025)

5.1.4.1.1 Rehabilitation Materials Characterisation

At KCGM, soils have been stripped and stockpiled for use in rehabilitation since the late 1980s, and some of this material has been used for progressive rehabilitation. The majority of rehabilitation materials available for use at Fimiston were stripped and stockpiled from the footprints of WRD expansions and construction of the Fimiston II TSF in the mid-1990s. Soils below the expanding waste rock dumps represented degraded soils, due to historic mining or urban activities, are illustrated in Figure 5-7. At the time of this clearing, the KCGM soil classification system did not exist. These topsoil stockpiles have been retrospectively classified, but there is a high likelihood that sodic and other materials have been combined with better soils in these stockpiles.

Topsoil stockpiles are located at Fimiston (Figure 5-8) and Gidji (Figure 5-9) Operational Areas. Rehabilitation at Mt Percy has already been completed (before 2001), with all available topsoil utilised. Mt Charlotte does not have any topsoil stockpiles due to the age of the operation. The Regional Operational Area will likely utilise topsoil pushed up to form windrows or stockpiled during construction of service corridors.

Prior to 2009, the need for material characterisation and segregation of soil types was not common practise at KCGM. As a result, materials harvested during this time were not classified or differentiated according to their properties, but rather cleared and stored in one stockpile. In order to better understand and utilise the materials available for rehabilitation, an extensive materials characterisation programme was undertaken by KCGM from 2009 to 2014, including analysis of topsoil and oxide material stockpiles. From around 2010 onwards, KCGM implemented a soil classification system based on material characterisation. A review of the characterisation classifications took place in 2013 to 2014 (Appendix 5.1, Landloch, 2014). The review focused on the physical and chemical properties relevant to erodibility potential of available materials and their suitability for use in rehabilitation of WRDs and TSFs.

The classification system uses five classes based on physical, chemical, and geochemical characteristics, and resulting suitability for placement within constructed and rehabilitated landforms. An inventory of available rehabilitation materials includes stockpiled soil and oxide. Table 5-2 summarises the general characteristics of the classes of the Rehabilitation Materials in Fimiston stockpiles, the location of which is shown in Figure 5-8.

Table 5-2: Fimiston Rehabilitation Materials Classification

	CLASS
A	Topsoil material for use as a surface rehabilitation material on highly visible areas. Can be used for outer slopes or flat surfaces provided sufficient erosional stability is achieved through the addition of rock. • Non-saline or low salinity • Soil pH within 'normal' bounds • Non-sodic • Moderate-moderately high permeability
B	Soil material for use as a surface rehabilitation material. Significant sodicity. Can be used for outer slopes or flat surfaces provided sufficient erosional stability is achieved through the addition of rock. • Non-saline or low salinity • Soil pH within normal bounds • Sodic or hard setting or slow-moderately slow permeability
C	Oxide or soil material for use as a surface material on less visible areas. Preferably used on flat areas. Growth of salt sensitive species will be limited in these materials, particularly in the early stages of rehabilitation. • Saline • Soil pH within normal bounds or less than 1 pH unit from being within normal bounds • Non-sodic or hard setting
D	Oxide or soil material for use as a surface material on less visible areas. Preferably used on flat areas. Growth of salt-sensitive species will be limited in these materials, particularly in the early stages of rehabilitation. • Saline • Soil pH within normal bounds or less than 1 pH unit from being within normal bounds

	CLASS
	• Sodic or highly sodic and hard setting or very slow permeability OR • Non-saline • Soil pH within normal bounds or less than 1 pH unit from being within normal bounds • Highly sodic and hard setting or very slow permeability

From 2013 to 2015, a project to test the erodibility of materials harvested for use in rehabilitation was conducted to review existing materials data and complete further targeted sampling. Thereafter, KCGM has continued to classify rehabilitation materials of existing stockpiles as well as soils in future clearing areas.

Laboratory erodibility tests using rainfall and overland flow simulation have been conducted on selected representative materials (Figure 5-10). Tests were conducted on topsoils and oxides, with and without waste rock. It was found that when rock is added at a given percentage to rehabilitation materials, it results in the following changes:

- Increase in effective hydraulic conductivity;
- Reduced inter-rill erodibility;
- Increased critical shear;
- Rilling does not initiate as readily when rock mixed in;
- Leaching of salts increases with rock content; and
- Reduced erosion.

The outcomes of these studies have been used to provide guidance when developing erosion resistant designs for waste landforms.

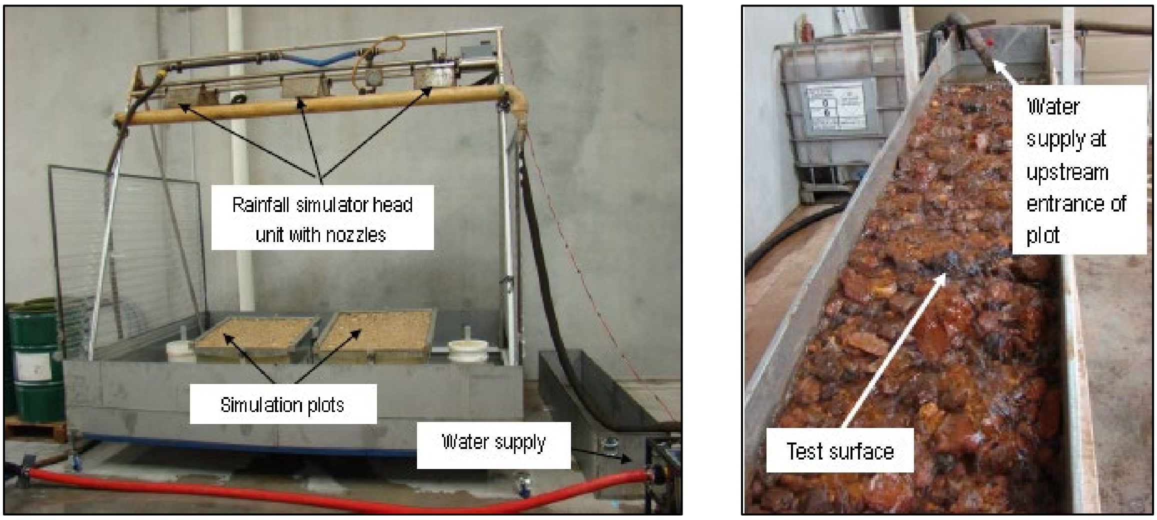


Figure 5-10: Rainfall and Overland Flow

In late 2013, early 2014, KCGM identified a large scale earthmoving operation, the Prison Redevelopment Project, as an opportunity to obtain up to 17,000 m^3 of rehabilitation materials. However, due to asbestos contamination of the majority of the material, KCGM was only able to receive 2,800 m^3. The rehabilitation materials received were provided with an asbestos free validation certificate. Large scale opportunities for acquisition of rehabilitation materials occur infrequently and are expensive and time consuming to implement.

5.1.4.2 Gidji Soils Characterisation

5.1.4.2.1 Soils

The Rehabilitation Material Stockpiles (Figure 5-84) consist of a single stockpile containing approximately 130,000 m^3 of material sourced from two relocated stockpiles stripped during construction of Gidji I and rehabilitation materials stripped during the Gidji II TSF project. Material characterisation was conducted during 2011 and 2020. The soils are generally sodic or sodic gradational, with high erodibility characteristics.

There are no remaining topsoil stockpiles at Mt Charlotte or Mt Percy, where available materials have already been used for rehabilitation.

5.1.5 Hydrogeology

5.1.5.1 Regional Groundwater Hydrogeology

Hydrogeology in the Eastern Goldfields region has been well documented through a long history of various hydrogeological programs associated with mining development completed by mining operations and government agencies.

There is no known potable groundwater in the vicinity of Kalgoorlie-Boulder and KCGM. Groundwater quality ranges from brackish (1,000 to 3,000 mg/L Total Dissolved Solids (TDS)) in shallow groundwater, to brines approximately five to six times more saline than seawater in paleochannels (up to 200,000 mg/L TDS). The primary influence on the wide variation in TDS concentrations is the topographical location and groundwater age rather than rock type hosting the groundwater system. The major ions dissolved in groundwater are mostly sodium and chloride, and in many locations the groundwater naturally has a low pH of around 3. Due to its relatively poor quality, it is recognised by DWER that the only beneficial use of groundwater is mining and mineral processing.

As a result of the large excess of evaporation over precipitation during average conditions, natural sources of recharge to the groundwater systems, such as rivers, lakes, and temporary pooling of precipitation are present infrequently for short periods. Rates of groundwater movement is low, other than where the groundwater systems interact with mining operations. Correspondingly, the operation of mine facilities is the dominant control on changes in the local groundwater systems.

The main mapped faults in the area act as either aquifer conduits or barriers within the bedrock system, depending on whether the fractures associated with the faults are open or closed/infilled. Fractures in the hanging walls of such faults are commonly water bearing, as they remain open due to local stress conditions.

5.1.5.2 Local Groundwater Hydrogeology

There are three major groundwater aquifer systems that have been defined during extensive drilling and testing in the vicinity of KCGM:

- The ferricrete and alluvial sedimentary system, an accumulation of sand, gravel and fractured ferricrete within clays, occurring typically from 5 to 40 m depth, which is present in lower elevation areas of the surface water catchments;
- The paleochannel systems, an extensive network of Tertiary alluvial sands occurring at around 60 m depth in buried river channels. This aquifer system is well understood and is utilised by KCGM and by other mining operations as the primary source of process water supply; and
- The fractured bedrock system, where groundwater flow occurs in fractured and weathered zones within the basement rocks at depth (the primary aquifer for Fimiston Open Pit).

5.1.5.2.1 Ferricrete and Alluvial Aquifer System

The ferricrete and alluvial groundwater systems occur in shallow sedimentary deposits common in the Eastern Goldfields Region of WA. Near the KCGM TSFs these deposits may extend for 30 metres below ground level (mbgl) in topographic lows and between 10 and 20 mbgl away from the centres of the catchments. The deposits are absent in areas where the basement rock approaches surface, including the Fimiston Open Pit and Mt Charlotte Underground Mine. Groundwater transmitting units within these sediments typically comprise red/brown gravels within clays and well developed nodular ferricrete horizons (often occurring as lens) with stiff blue/grey clays. Facilities at KCGM that overlie and interact with the ferricrete and alluvial system include the Fimiston I TSF, Fimiston II TSF (including Fimiston IIE TSF), Kaltails TSF and Gidji TSF (and the associated Eastern, Gidji TSF and Kaltails TSF borefields), and the Trafalgar Borefield (Figure 5-11).

There is limited data defining pre-mining groundwater levels in the ferricrete and alluvial groundwater system. Studies indicate that the natural groundwater flow directions around the Fimiston and Kaltails facilities are generally aligned with surface water flow direction. Prior to mining, depth to groundwater is inferred to have ranged from 25 mbgl at the Fimiston I and II TSFs, to around 15 mbgl near the Trafalgar borefield and 12 mbgl at the southeast corner of the Kaltails TSF. Investigations have also identified that groundwater was naturally very shallow in the area between Hannan Lake and the Kaltails TSF, including the area close to the southwest corner of the Kaltails TSF where the natural groundwater depth was around 4 mbgl or less.

Undisturbed groundwater flow was controlled by recharge in the up-gradient areas, driven by infiltration after major precipitation events, sheet flow and pooling at the surface was caused. While average rates of recharge are interpreted to be low, groundwater responses in the ferricrete and alluvial system after major cyclone events have been interpreted to show higher rates of recharge for short periods during these sporadic discrete events.

5.1.5.2.2 Paleochannel Aquifer System

The paleochannel system comprises erosion channels in the basement rock, incised during the Jurassic period and infilled with sands (the Wollubar Sandstone) and clays (the Perkolilli Shale) in the Tertiary period. The mapped extent of the Roe Paleochannel system is illustrated in Figure 5-11. The southern branch of the paleochannel system is located to the south of Fimiston Operational Area, below Hannan Lake, and the northern branch in the vicinity of Gidji Operational Area. Hydraulic and hydrochemical investigations into the Roe Paleo drainage have identified that natural recharge occurs at very low rates (less than 0.01% of annual precipitation) via direct infiltration where the sand unit outcrops occur in the upper reaches of the system to the west. Undisturbed groundwater flow within the system is from west to east, draining towards Lake Yindalgooda.

In undisturbed conditions the Wollubar Sandstone is strongly confined in nearly all locations by the overlying Perkolilli Shale and water levels in bores intersecting the Wollubar Sandstone are significantly higher than the top of the sand unit. Monitoring of groundwater levels at the KCGM Northern Borefield (paleodrainage located north of Gidji Operational Area) indicates that the groundwater system remains confined in that location. However, some sections of the Southern Borefield (located in the vicinity of Hannan Lake) are indicated to be in transition from confined to unconfined conditions as a result of depressurisation from borefield operation.

Monitoring data has established that the volume of groundwater abstracted during borefield operation is far greater than that which would be predicted to be available from confined and unconfined storage within the Wollubar Sandstone. Therefore, it has been interpreted that downward leakage of groundwater from the overlying Perkolilli Shale and upwards leakage of groundwater from weathered and fractured zones in the locally underlying basement are major contributors to groundwater abstracted by mining operations.

5.1.5.2.3 Fractured Bedrock Aquifers

Regional basement geology in the Eastern Goldfields Region generally comprises large scale granitoids cut by linear ultramafic units and Proterozoic dykes. Basement geology is intersected by; the mine workings at the Mt Charlotte underground, the Fimiston Open Pit, extensive historical underground workings present below the Fimiston Open Pit and in the pit slopes, abandoned shafts, monitoring bores drilled to investigate groundwater conditions of pit slopes and by dewatering bores operated to lower the groundwater elevation in the underground workings below the Fimiston Open Pit.

The mafic mineralised unit mined at the Fimiston Open Pit (Paringa Basalt and Golden Mile Dolerite) is high strength, has a very low in-situ porosity, and is characterised as a relatively intact rock mass with little fracturing. As a result, the dominant groundwater transmitting structures in this unit are the abandoned underground workings which are present extensively below the pit floor and within the slopes. These workings are strongly interconnected, and act to transmit and store large volumes of groundwater regardless of whether they are open, backfilled with waste rock or backfilled with historic tailings sand.

The Mt Charlotte Underground Mine is situated in Golden Mile Dolerite that is offset by two major faults; the Flanagan and Charlotte Faults. Currently the mine has relatively small natural groundwater inflows, but historically has had significant inflows associated with groundwater issuing from fractures in the proximity to the Charlotte/Flanagan Fault. The Mt Charlotte Operations are not hydraulically connected to the Fimiston Open Pit due to the presence of a fault that acts as a barrier between these areas. Dewatering of Mt Charlotte currently occurs ahead of mining.

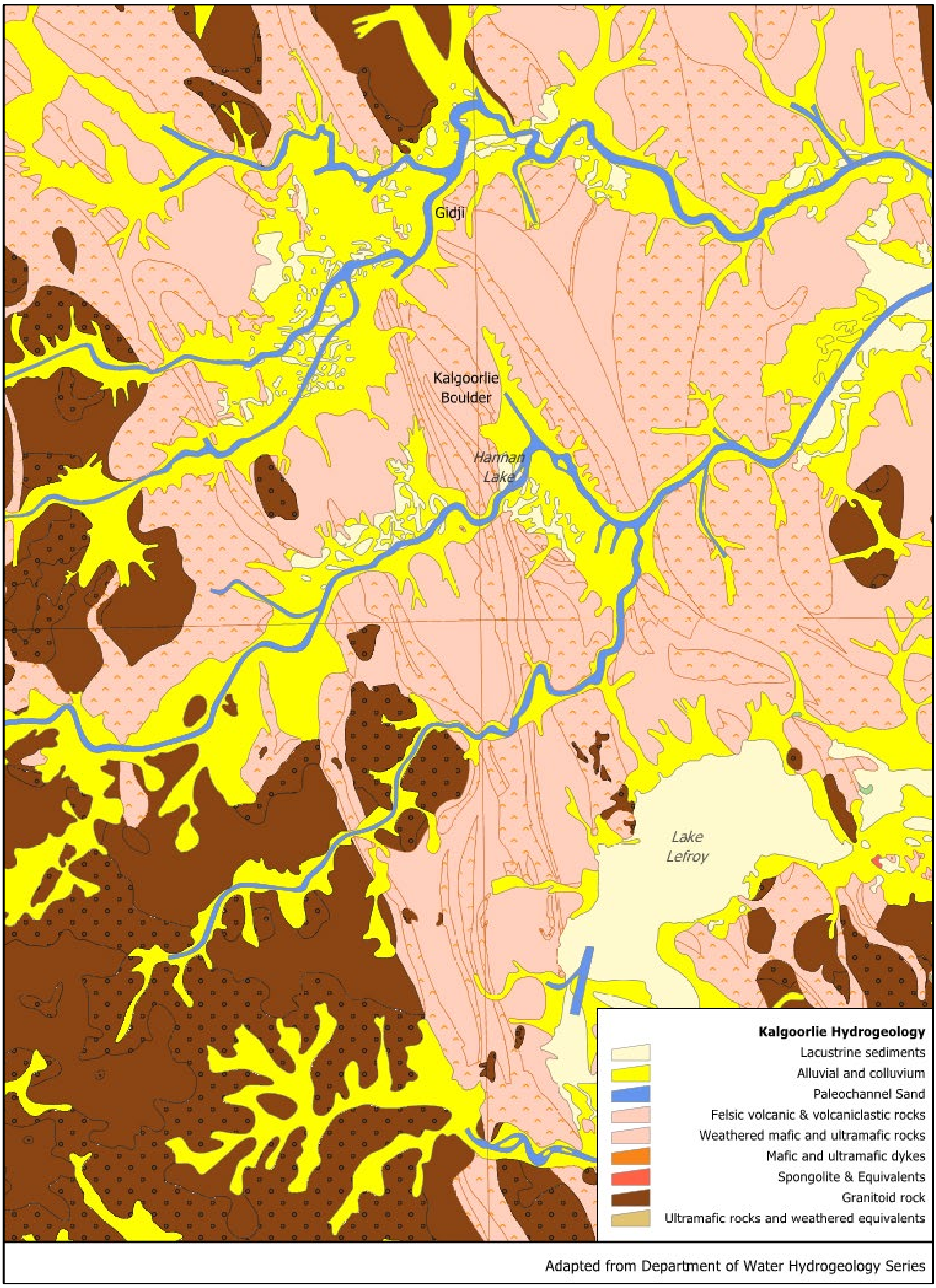


Figure 5-11: Hydrogeology of the Goldfields

5.1.6 Surface Water Hydrology

5.1.6.1 Local Hydrological Setting

The Fimiston, Mt Charlotte and Mt Percy Operational Areas lie within the Hannan Lake catchment, which is associated with the Roe paleovalley system. It drains an area of about 229.9 km^2 and flows to Hannan Lake (Figure 5-13), south of KCGM. The catchment comprises:

- The Eastern (Fimiston) Floodway sub-catchment.
- The Gribble Creek sub-catchment.
- Smaller western sub-catchments
- Smaller eastern sub-catchments.

All drainages are ephemeral and poorly defined and salt lakes and clay pans are mostly dry. Significant surface water flow in the Eastern Floodway is rare and short lived, only occurring after very large rainfall events (last significant flow occurred in 2014), and flow ceasing within a few days.

Semi-arid conditions, with relatively low rainfall and high evaporation, result in most precipitation events being stored in the vadose (soil) zone and subsequently removed by evaporation and transpiration. Flows only occur after substantial high volume and intensity rainfall during which runoff occurs, flowing to the main drainages and filling downstream salt lake systems and other surface depressions.

The Eastern Floodway sub-catchment is drained by a cross braided drainage system discharging into Hannan Lake. The natural surface water drainage features have been mostly interrupted and segmented by the construction of roads and the Trans Australian railway line and mining infrastructure. Peak stream flows are altered by the restriction of flow able to pass through the railway embankment culverts. The railway embankment has influenced the downstream drainage patterns by concentrating sheet flow runoff into discrete channels. The down gradient area of the catchment from the railway drains to the Hannan Lake by sheet flow and via a series of indistinct sheet flow areas and shallow channels with runoff diverted around the TSFs (Figure 5-13).

Local infiltration of runoff generates some sub-surface flow within the superficial sandy material that underlies the catchment to a depth of one to two metres, though deeper percolation through the underlying clay material is likely to be small.

Gribble Creek (the western tributary) runs through the City of Kalgoorlie-Boulder, with a significantly modified drainage channel. The catchment drains residential and industrial areas in the township. It is not known whether the creek's water quality has been compromised by the commercial and industrial activities in the City, including the use of herbicides.

The Hannan Lake and associated catchment characteristics have been assessed by Golder Associates (Golder 2017a). Golder determined Hannan Lake storage characteristics based upon a regional LiDAR survey in 2008. Golder estimated that the maximum storage capacity of the lake at 322.5 m AHD is about 5,396 ML with a lake area of 654 ha. Maximum depths of the lake are about 1.1 m. Once the lake reaches its full capacity, it overflows to smaller lakes, downstream of Hannan Lake.

Golder also assessed the frequency and extent of lake filling based on available Landsat satellite imagery (1986-2017). The imagery shows that the Hannan Lake is typically empty but that some rainfall runoff accumulates in the lake almost every summer. Typically, the water volume in the lake during summer is rated as low to very low, but substantial inundation occurs during very wet years. During these wet years, water remains on the lake surface for many months to a couple of years.

The lake was completely full on three occasions between 1986 and 2017:

- 1992: The lake filled up following large rainfall events in March (95 mm over three days), May (73 mm over three days) and August (72 mm over seven days).
- 1995: The lake filled in February following 178 mm of rainfall over five days.
- 1999 and 2000: The lake filled up in 1999 following 207 mm over ten days (March 1999) and then remained full following another event in January 2000 (165 mm over 6 days).

Substantial lake inundation also occurred in 2013, 2014 and 2016.

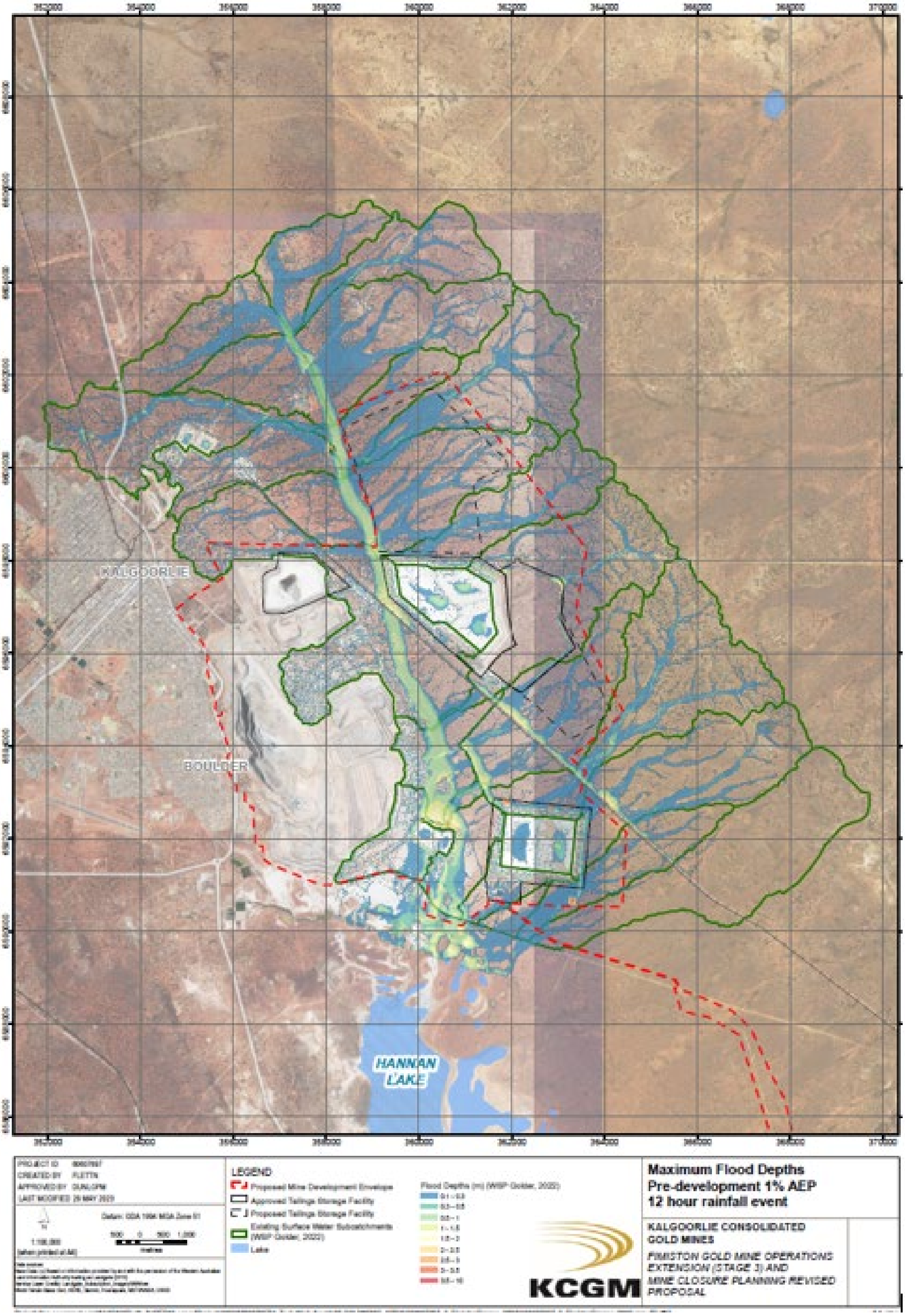


Figure 5-12: Eastern Floodway 1% AEP (12hr) in 2023

In 2015, GoldSim modelling of regional surface water runoff discharges in the Hannan Lake catchment indicated that runoff may occur at an approximate rate of one event every four to seven years, with the average volume of runoff discharging into Hannan Lake from the natural catchment being around 470,000 cubic metres (m^3), with a maximum discharge predicted to reach 1,700,800 m^3. The KCGM operational area contributes around 6% of these total catchment volumes and is not expected to be a significant influence on the chemistry of Hannan Lake after mine closure (Schlumberger Water Services, 2015).

Surface water sampling of runoff from the mining area is conducted opportunistically when the ephemeral water courses flow, usually only during infrequent sustained 1:20 year rainfall events or greater when the water course flows. Water samples from the Hannan Lake taken during the period 2012 to 2014, when the lake had received inflows, show fluctuations in lake salinity. The conditions of Hannan Lake varied from brackish conditions (EC around 9,000 µS/cm) following large rainfall events, to saline conditions as the lake water evaporated in the weeks after inundation (EC around 60,000 µS/cm, i.e., higher than seawater which has an average EC of 50,000 µS/cm). Further salt balance modelling of the lake in 2017 confirmed the dominance of evapoconcentration effects, with salinity showing peaks during years when the lake contained water, (Golder, 2017a). There is no evidence of an influence from KCGM's operations on water quality within Hannan Lake, either during operations or under post closure conditions, i.e., runoff from large rainfall events entering Hannan Lake from the Eastern Floodway has very similar salinity and metals concentrations to runoff from non-mining, i.e., urban influenced catchments.

5.1.6.2 Post Closure Mining Area Hydrology

In 2020, a closure water balance model for the Fimiston operations was undertaken which included consideration of surface water flows from WRDs and TSFs. Figure 5-13 illustrates the expected 24 hr 1% AEP flood levels within the Eastern Floodway in relation to the location of the post closure mine waste landforms. The passive draining stormwater channel eastern side of the southern WRD.

Post closure, the Fimiston Operational Area TSFs will be rehabilitated to be internal draining upper surface, i.e., rainfall runoff from the rehabilitated TSF surfaces will collect in the centre of each TSF paddock, from where it will evaporate. Evaporation rates exceed rainfall by a significant margin, hence TSF surfaces are expected to be dry for most of the time with some water accumulation following large rainfall events however this will be lost through evapotranspiration in the upper cover layers with minimal infiltration into the lower tailings pile. No seepage discharge is expected beyond the toe of the landform. Outer batters (side slopes) of the TSFs will be rehabilitated with any excessive runoff being contained by the toe bund discharging via engineered drains to the Eastern Floodway and ultimately Hannan Lake.

A conceptual numerical model was developed to determine the infiltration, evapotranspiration and rainfall runoff from the rehabilitated WRD surface (KCGM 2020) (Figure 5-14). Cover modelling indicates that most of rainfall on the rehabilitated WRDs will infiltrate the waste rock (80%). However, significant losses are predicted to occur as rainfall percolates through the waste rock due to absorption and vaporisation. Runoff rates from the rehabilitated WRDs are estimated to be small, ranging between 2% of rainfall on the waste dump surface and 5% of rainfall on the side-slopes. Runoff from the WRD surfaces will be conveyed to the Fimiston Pit via drains aligned to existing haul roads, while runoff from the WRD side slopes will flow onto the Eastern Floodway and Gribble Creek sub-catchments, respectively. During large rainfall events, macropores in the WRD form preferential pathways with rainfall infiltration rapidly percolating through the waste rock material. During such events, rainfall may discharge along the toe of the dump to the ground surface or along former drainage lines.

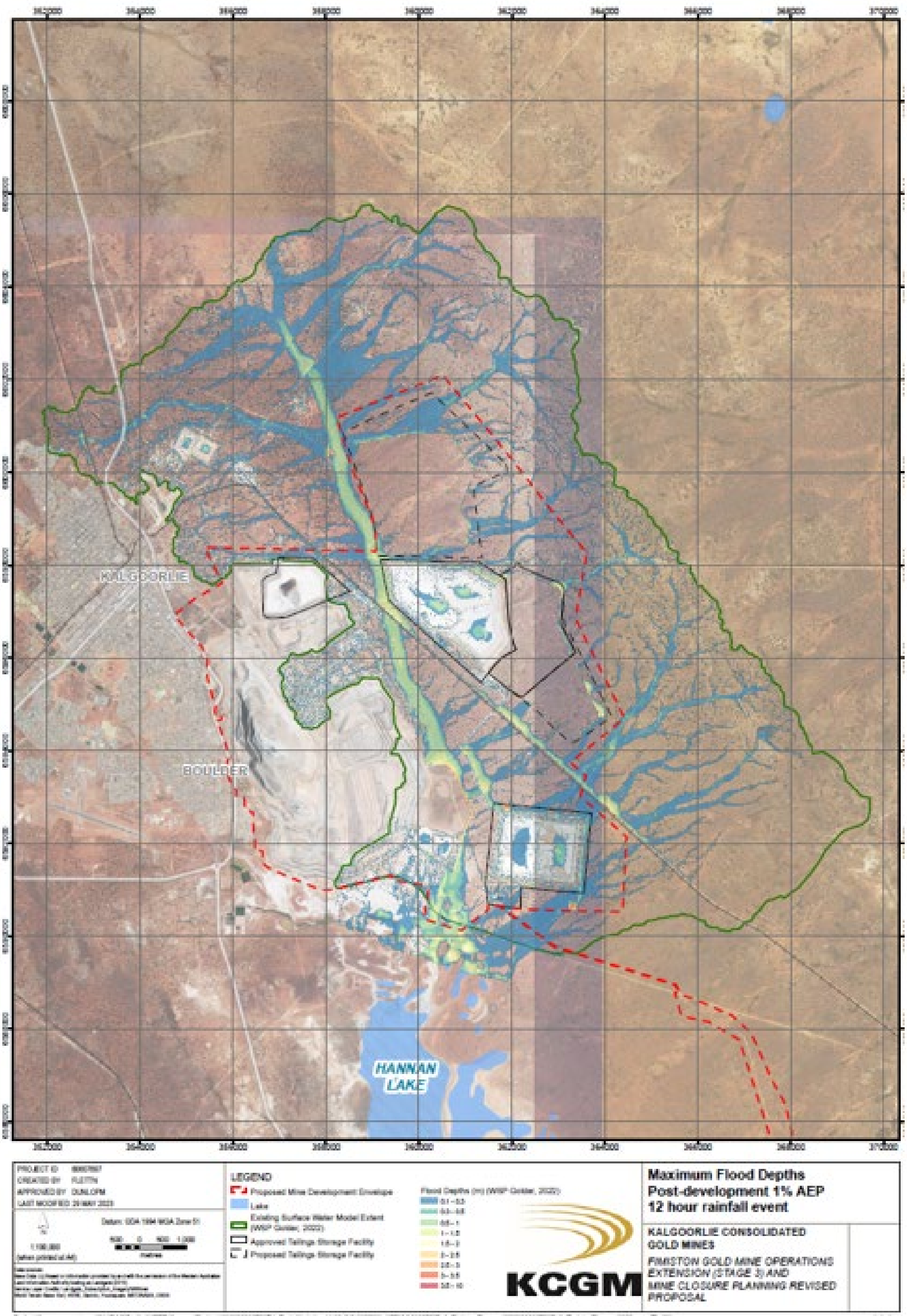


Figure 5-13: Eastern Floodway 1% AEP (12hr) at closure

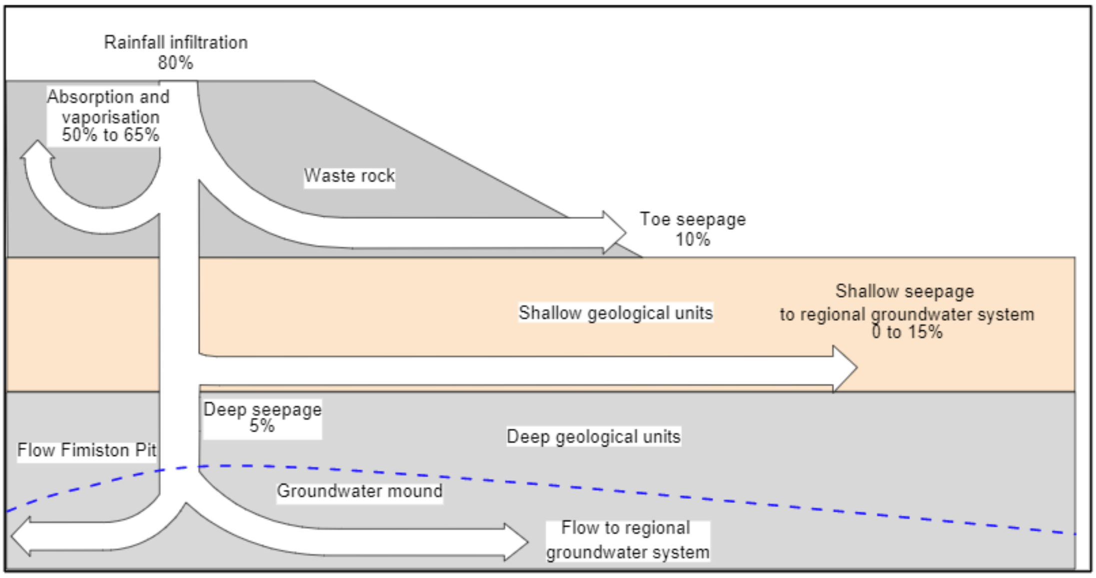


Figure 5-14: Conceptual Flow Model for WRDs

At Gidji, surface water flow paths are not well defined due to minimal elevation changes in the landscape, with no strongly developed surface water features.

5.1.7 Flora

5.1.7.1 Regional Flora and Vegetation

KCGM Operations are situated in the Interim Biogeographic Regionalisation of Australia (IBRA) Eastern Goldfields subregion (COO3) of the Coolgardie bioregion. A part of the northern portion of the Regional Operational Area occurs in the Eastern Murchison (MUR1) subregion of Murchison bioregion.

Historically, vegetation communities surrounding Kalgoorlie have been severely impacted by mining, mineral processing, pastoralism, and timber felling. Apart from mining disturbance directly related to the Golden Mile, from 1897 and 1969, the woodlands surrounding Kalgoorlie were cut to provide 22 million tonnes of timber and fuel wood for distillation of water/ generation of power and provision of mining support timber, resulting in a thinning and removal of biomass.

From a closure context, the altered state of the vegetation communities surrounding the site should be taken into account when planning rehabilitation and setting appropriate reference sites for monitoring; i.e., it would not be appropriate to aim for complete restoration of the pre-mining landscape as this would be unachievable and impractical given the level of change that has occurred.

5.1.7.2 Local Flora and Vegetation

Native vegetation exists throughout the KCGM operational areas but has been influenced more directly in the Fimiston and Gidji Operational Areas.

5.1.7.2.1 Fimiston Operational Area

In 2018 a project was undertaken to consolidate all available flora mapping data, with infill regional and details surveys undertaken by Phoenix Environmental in areas identified as data deficient. The project was consolidated with data from previous surveys to provide a comprehensive survey database of the Fimiston Operational Area. In September 2021, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned to undertake a biological desktop review and reconnaissance survey for the expansion project to identify potential terrestrial biological values and inform further baseline survey requirements.

During the 2018 surveys 88 flora species were recorded, comprising 84 native and four introduced species. Including all previous survey, a total of 247 flora species have been recorded in the study area, representing 39 families and 98 genera. One Priority 2 flora species, *Eremophila praecox*, was recorded in the survey area in 2018 (at the time of survey it was Priority 1) with just two plants recorded at two locations to the east of Fimiston II TSF. Targeted regional surveys for *E. praecox* were undertaken in 2019 and 2020 by Phoenix Environmental which identified a broader distribution for the species than previously recognised, supporting the notion that the species may in fact be widespread but infrequently recorded. The surveys also increased the known habitat types of both land systems and vegetation types for the species (Phoenix Environmental 2019a, 2020). The survey results indicate that the species may now represent a Priority 3 or 4 species as it is known from multiple records an excess of one third of plants recorded are in a conservation estate. From a closure planning perspective, taking into account the results of the survey and presence of individual plants and populations in the region, KCGM do not consider that this species requires specialist restoration effort during closure.

Under current listings, five declared pests and/or weeds of national significance have been recorded in the study area in current and previous surveys, **Echium plantagineum* (Pattersons Curse – Declared Weed), **Cylindropuntia imbricate* (Rope Pear – Declared Weed), **Opuntia ficus-indica* (Prickly Pear – Declared Weed), **Lycium ferocissimum* (African Boxthorn – Declared Weed) and **Tamarix aphylla* (Athel Pine – Declared Weed). Only **Echium plantagineum* was recorded in 2018. From a closure planning perspective, only one species remains within the Operational Area to be controlled prior to final sign-off of the site.

The Fimiston Operational Area contains 25 remnant vegetation types comprising 15 woodlands, two forests and eight shrublands (Figure 5-15). Rehabilitated areas were classified into two types, revegetated woodland and revegetated shrubland. The woodlands comprise mostly mixed *Eucalyptus* spp. over *Eremophila*, *Acacia*, *Senna* and chenopod species. Two Casuarina woodlands over *Acacia* and *Eremophila* species, sometimes with emerging *Eucalyptus salmonophloia* over low shrubland of mixed species, are also present. The shrublands are dominated by *Acacia*, *Eremophila* and *Senna* species over mixed chenopod species. The condition of remnant native vegetation across the study area was variable ranging from Excellent to Degraded.

Table 5-3: Fimiston Operational Area Vegetation Types

Type	Vegetation Description
AhEpMm	Shrubland Closed mid *Acacia hemiteles* shrubland over sparse low **Echium plantagineum* and **Monoculus monstrosus* forbland.
CLP-EW1	Woodland Low woodland of *Eucalyptus lesouefii* over low scrub of *Maireana sedifolia/ Eremophila scoparia/ Cratystylis conocephala* and dwarf scrub of *Eremophila parvifolia.*
CLP-EW2	Woodland Mid *Eucalyptus salmonophloia* woodland over tall open *Eremophila scoparia* and *Exocarpos aphyllus shrubland* over mid open *Acacia hemiteles*, *Senna artemisioides* subsp. *filifolia and* chenopod spp*.* shrubland.
CLP EW3	Forest Forest of *Eucalyptus salubris* over low scrub of *Eremophila scoparia* and low heath of *Maireana sedifolia.*
CLP-EW4	Woodland Low woodland of *Eucalyptus lesouefii* over open low scrub of *Exocarpos aphyllus* and open dwarf scrub of *Eremophila parvifolia*/*Olearia muelleri*.
CLP-EW5	Forest Dense low forest of *Eucalyptus ravida* over heath of *Senna artemisioides* subsp. *filifolia/ Eremophila scoparia* and dwarf scrub of *Atriplex vesicaria.*
CLP-MWS2	Woodland Tree mallee of *Eucalyptus griffithsii* over thicket of *Acacia acuminata* over open dwarf scrub of *Ptilotus obovatus* and open hummock grass of *Triodia irritans.*
CLP-OS1	Shrubland

Type	Vegetation Description
	Isolated *Eucalyptus griffithsii/ Eucalyptus torquata* over heath of *Acacia hemiteles/Atriplex nummularia* subsp. *spathulata* and low heath of *Atriplex bunburyana/Maireana triptera*
CpEsAh	Woodland Mid *Casuarina pauper* and *Eucalyptus salmonophloia* woodland over mid *Acacia hemiteles*, *Eremophila scoparia* and *Senna artemisioides* subsp. *filifolia* shrubland over low open *Atriplex* sp., *Maireana triptera* and *Ptilotus obovatus* shrubland.
EsAhA	Shrubland. Isolated mid *Eucalyptus salmonophloia* trees over tall open *Acacia hemiteles* and *Senna artemisioides* subsp. *filifolia* shrubland over low *Atriplex* sp. shrubland.
EsAnEc	Shrubland Tall open *Eremophila scoparia* shrubland over mid open *Acacia nyssophylla* and *Senna artemisioides* subsp. *filifolia* shrubland over low open *Eremophila caperata*, *Rhagodia drummondii* and *Scaevola spinescens* shrubland.
EsErMp	Isolated mid *Eucalyptus salmonophloia* trees over low *E. ravida* woodland with *E. celastroides* subsp. *virella* and *E. transcontinentalis* trees over low sparse *Maireana pyramidata* and *Atriplex vesicaria* shrubland.
EsEsEs	Woodland Mid *Eucalyptus salmonophloia* and *E. salubris* woodland over tall open *Eremophila scoparia* shrubland over low open *Atriplex* sp., *Acacia hemiteles* and *Senna artemisioides* subsp. *filifolia* shrubland.
MbAaEp	Shrubland Low closed *Maireana brevifolia* shrubland with occasional *Atriplex amnicola* shrubs over isolated low **Echium plantagineum* forbs.
OD-EW1	Woodland Low woodland of *Eucalyptus salmonophloia* over low scrub of *Acacia hemiteles/ Eremophila ionantha/ Maireana sedifolia* and dwarf scrub of *Atriplex vesicaria/Eremophila parvifolia.*
OD-EW2	Woodland Low woodland of *Eucalyptus stricklandii/ Eucalyptus ravida* over low scrub of *Eremophila scoparia* and dwarf scrub of *Atriplex vesicaria*.
RHS/RP-CFW	Woodland Mid open *Casuarina pauper* woodland over tall open *Acacia acuminata*, *Eremophila scoparia* and *Exocarpos aphyllus* shrubland over mid open *Acacia hemiteles*, *Senna artemisioides* subsp. *filifolia* and *Acacia nyssophylla* shrubland.
RHS/RP-EOW/CFW	Woodland Open low woodland of *Eucalyptus lesouefii/ Eucalyptus transcontinentalis/ Casuarina pauper* over low scrub of *Acacia kalgoorliensis* and open dwarf scrub of *Westringia rigida*.
RHS/RP-EW	Woodland Mid *Eucalyptus lesouefii* woodland over mid *Eremophila scoparia, Cratystylis conocephala* and *Senna artemisioides* subsp. *filifolia* shrubland over low open *Olearia muelleri, Exocarpos aphyllus* and *Scaevola spinescens* shrubland.
RP-EW1	Woodland

Type	Vegetation Description
	Low woodland of *Eucalyptus ravida* over low scrub of *Eremophila pustulata/ Eremophila scoparia* and *Atriplex vesicaria.*
RP-EW2	Low woodland of *Eucalyptus lesouefii* over scrub of *Melaleuca sheathiana* and open dwarf scrub of *Eremophila parvifolia*/ *Olearia muelleri*.

None of the vegetation types are considered regionally significant or represent a listed Threatened or Priority Ecological Community. The study area is considered unlikely to contain any highly restricted vegetation types that would be considered locally significant.

From a closure planning perspective, where progressive rehabilitation has been successful, those vegetation types can be seen to be broadly representative of the surrounding vegetation in terms of species composition. This provides valuable information for the development and setting of practical and achievable ecological closure criteria. The 'mosaic' mapped appearance of the surrounding vegetation types mirrors the eventual likely mosaic of vegetation types that will be present on the rehabilitated mining areas and landforms given the variation in reconstructed soil profiles, age of rehabilitation and methods used.

The 2021 study area was found to contain 20 vegetation types as well as disturbed areas (cleared of vegetation) and areas of rehabilitation. The vegetation types comprised 13 woodlands, two forests and five shrublands (Phoenix, 2023c). Woodlands and forests comprised majority of the areas covered by the vegetation and flora surveys. Woodlands comprised mostly mixed *Eucalyptus* spp. over *Eremophila, Acacia, Senna* and chenopod species. Two *Casuarina* woodlands over *Acacia* and *Eremophila* species, sometimes with emerging *Eucalyptus salmonophloia* over low shrubland of mixed species, were also present. Shrublands were dominated by *Acacia*, *Eremophila* and *Senna* species over mixed chenopod species. No representatives of Threatened or Priority Ecological Communities (TECs/PECs) were identified in the area.

Hannan Lake

During 2016 and 2017, baseline flora surveys were conducted on Hannan Lake and its immediate surrounds by Phoenix Environmental Services (2017). A total of 39 flora species and subspecies representing 15 families and 22 genera were recorded, including five weed species (none Declared). The most prominent family was Chenopodiaceae (18 species) followed by Poaceae (4), Asteraceae (3) and Fabaceae (2). Chenopodiaceae were represented by species from four genera; *Tecticornia*, *Maireana*, *Atriplex*, and *Sclerolaena*. No significant flora species were recorded, with all species are common to the area.

12 riparian vegetation types were defined for the study area comprising low shrublands dominated by Chenopodiaceae family with *Tecticornia* species most prominent. The most dominant type was low *Tecticornia pergranulata* subsp. *pergranulata* shrubland that covered the majority of the southern section of the lake. Distinct zonation among *Tecticornia* species was previously documented on the shore of Hannan Lake with different species adapted to specific habitats, e.g., foreslope of a dune or the lake playa. The principal environmental factors identified as affecting species zonation were drainage, soil moisture, and salt concentration. The growth and survival of *Tecticornia* species are associated with flooding, waterlogging and salinity with sensitivity to submergence variable between species.

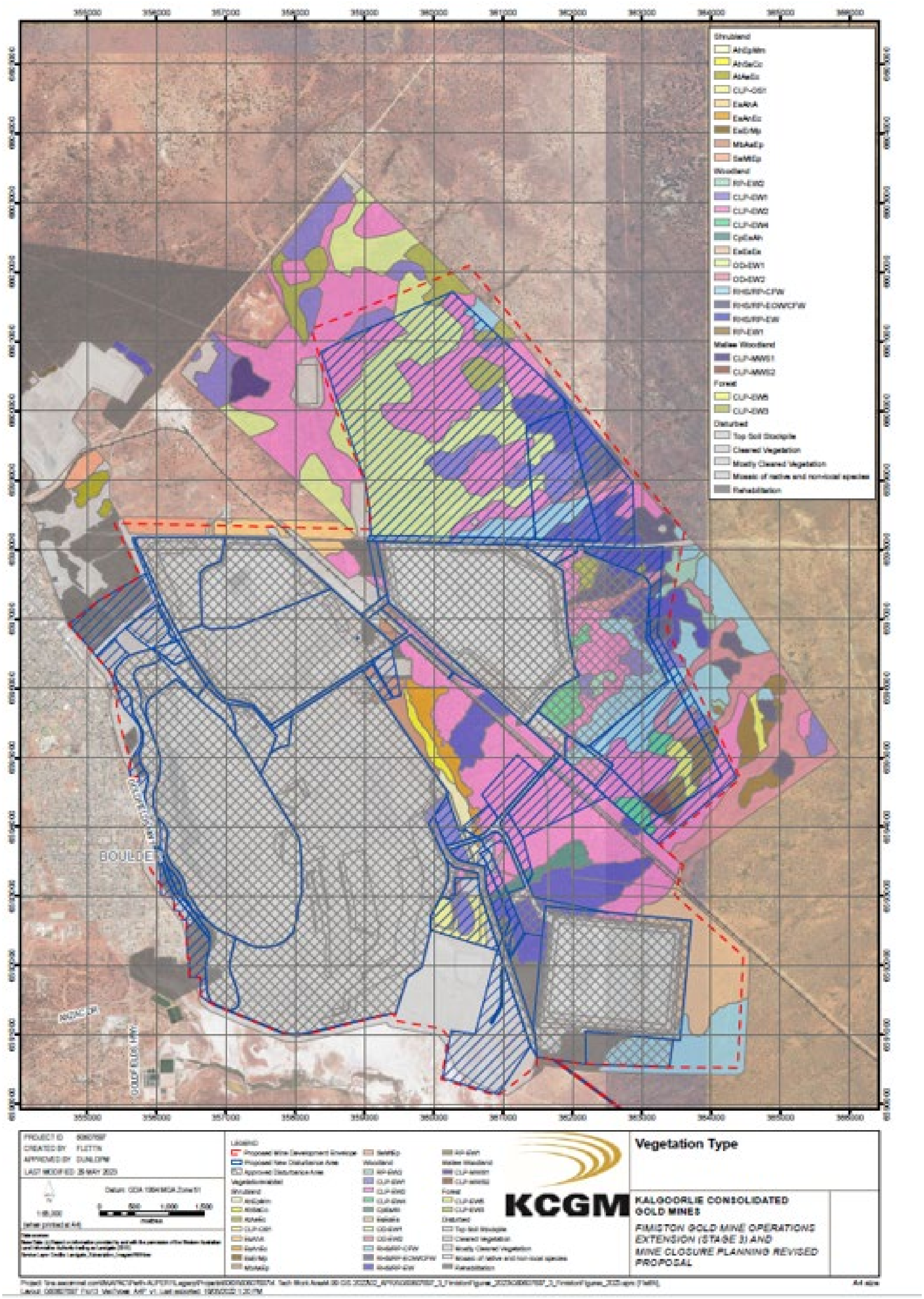


Figure 5-15: Vegetation Types within Fimiston Operational Area

None of the vegetation associations recorded within the study area were considered to represent a Commonwealth or State-listed TEC, or any State-listed PEC. None of the vegetation types are considered regionally significant as they represent vegetation with more than 90% of Pre-European extent remaining. The condition of the vegetation in the study area ranged from Very Good to Pristine with 80% recorded as Excellent and Pristine. Disturbances originated mostly from vehicle and livestock track damage, litter, and grazing.

5.1.7.2.2 Gidji Operational Area

Surveys of the Gidji area flora and vegetation were undertaken in 2017 and 2018 (Phoenix Environmental, 2019b). During these surveys 64 flora species and subspecies were recorded, representing 15 families and 30 genera, with no introduced flora. The flora species diversity and the family compositions of the study area were similar to that recorded in adjacent tenements by an earlier survey. A total of nine plants of the Priority 2 flora species, *E. praecox*, were recorded in the study area. The study area represents an approximate 240 km western extension to the recorded distribution of Brachyscome trachycarpa, which is considered locally significant as it is an isolated outlier of the main range for the species.

Vegetation in the study area comprised three vegetation types, two *Eucalyptus* spp. woodlands and a *Casuarina pauper* woodland (Table 5-4). Vegetation condition ranged from Excellent to Completely Degraded. The vegetation did not represent any Threatened or Priority ecological communities and were representative of vegetation associations with over 98% of pre-European extent remaining. Two of the woodlands, *Casuarina pauper* woodland (CoAcOm) and *Eucalyptus lesouefii* woodland (ElEcAv) may be considered locally significant as habitat for significant flora.

Table 5-4: Gidji Operational Area Vegetation Types

VEGETATION TYPE	VEGETATION DESCRIPTION
ElEsAv	Woodland Mid Eucalyptus lesouefii woodland, occasionally with E. longicornis, over mid sparse to open Eremophila scoparia, Maireana sedifolia and Senna artemisioides subsp filifolia shrubland over isolated low Atriplex vesicaria, Olearia muelleri and Scaevola spinescens shrubs.
ElEcMs	Woodland Mid Eucalyptus lesouefii and E. salubris woodland over isolated tall Eremophila caperata shrubs over low Maireana sedifolia, Scaevola spinescens and Maireana triptera shrubland.
CpAcOm	Woodland Low Casuarina pauper woodland over mid open Acacia ?coolgardiensis, Cratystylis microphylla and Eremophila oppositifolia shrubland over low sparse Olearia muelleri and Rhagodia eremaeae shrubland.

Figure 5-16: Vegetation Types adjacent to Gidji Operational Area

5.1.8 Terrestrial Fauna

5.1.8.1 Regional Fauna

The KCGM Operations lie within the Eyrean sub region and is characterised by a range of vertebrates adapted to an arid climate which follow the pattern of bird distribution (although most birds have a much wider geographic range). The extreme size and harshness of the Eyrean sub region has given rise to many specialised vertebrates and a high level of endemism in the region (Ninox, 1992).

As a direct result of loss of habitat due to vegetation community alteration or loss, fauna assemblages have been impacted from historical mining, mineral processing, pastoralism, and timber felling. The introduction of feral animals and plants have also had a detrimental impact on native fauna assemblages in this region, as in many others throughout the state. No conservation significant species remain and this should be taken into account when planning rehabilitation and setting appropriate reference sites for monitoring; i.e., it would not be appropriate to aim for complete restoration of the pre-mining landscape as this would be unachievable and impractical given the level of change that has occurred.

5.1.8.2 Local Fauna

5.1.8.2.1 Fimiston Operational Area

Survey of the Fimiston Operational Area by Phoenix Environmental in 2018 identified three broad fauna habitats; open eucalypt woodland, shrubland, and forest. All three habitats are well represented within the broader vicinity of the study area.

Taking the results of all surveys conducted to date into account, a total of 120 vertebrate species have been recorded, including 50 native and seven introduced species. The collective assemblage is represented by 70 birds, 31 reptiles, 24 mammals and three frogs.

Four conservation significant vertebrate fauna records occur in the vicinity (5km) of KCGM, with no sightings on KCGM tenure:

- Malleefowl (*Leipoa ocellata*, VU under the EPBC Act and WC Act), Peregrine Falcon (*Falco peregrinus*, SP under the WC Act) and Fork-tailed Swift (Migratory). The habitats were considered possibly suitable for foraging by Malleefowl, no Malleefowl sightings have been recorded and there is no evidence of mound construction or nesting has been observed on KCGM tenure;
- Western Rosella (inland) (*Platycercus icterotis xanthogenys*) (P4);
- Wood Sandpiper *(Tringa glareola)* (Mig);
- Numbat (Myrmecobius fasciatus) (VU/EN).

Eight SREs have been collected in fauna studies - six mygalomorph spiders, one scorpion and one millipede -

Conothele ‘kalgoorlie’, Idiommata ‘kalgoorlie’, Idiosoma ‘kalgoorlie 1’, Conothele ‘MYG554’, Antichiropus ‘DIP067’,

Missulena harewoodi.

Two conservation significant SRE species were returned in the desktop review. The Arid Bronze Azure Butterfly (Ogyris subterrestris petrina) (EPBC Act, BC Act – CR) which has been recorded from around Kalgoorlie until the early 1990s (Field 1999) and the Inland Hairstreak (Jalmenus aridus) (DBCA – P1).

In arid areas birds (in particular waterbirds and waders), may be attracted to the supernatant liquor on the surface of active TSFs, as it may appear as a suitable refuge water body in an otherwise dry landscape. Due to the use of cyanide (CN) in gold processing, access to the TSFs can be a risk to fauna. During operations active management and mitigation occurs by reducing access to the TSF waters and/or controlling the cyanide concentrations in accordance with the International Cyanide Management Code for the Manufacture, Transport and Use of Cyanide in the Production of Gold. KCGM has undertaken operational monitoring of the tailings dams on a regular basis since 2007 for fauna stress associated with tailings liquors. During this time no records of fauna mortality associated with cyanide have been recorded. After rehabilitation of the TSFs, it is not anticipated that fauna interaction with cyanide bearing liquors will be an issue post deposition and closure of the TSFs, as the upper tailings surface where any cyanide bearing liquors may collect during rainfall events will be capped with rehabilitation materials, removing any direct contact from fauna. Additionally, cyanide concentrations within ponded stormwater will likely be negligible.

Further fauna studies undertaken by Phoenix *(2023)* in the Fimiston II Ext and Fimiston III TSF areas and concurred with the earlier study results. Malleefowl (*Leipoa ocellata*) (VU) habitat was found to be marginally suitable in 60% of sites assessed (Phoenix, 2022b). Most habitat assessed was determined as being borderline suitable habitat suggesting that the area contains potentially suitable habitat for Malleefowl foraging and dispersal, however it is unsuitable for breeding.

Birds (particularly swans during their migration period) can be attracted to and become stranded in the Fimiston Open Pit (especially when lighting towers are in use at night) as there is no water body for effective take off and ascension from the pit. During active operations, birds entering the open pit are managed by 'catch and release' methods to nearby water bodies. It is less likely that birds will continue to be attracted to the Fimiston Open Pit post closure, as there will be no lighting.

5.1.8.2.2 Hannan Lake

In 2016 and 2017, a baseline survey was conducted of aquatic biota (including avifauna) within Hannan Lake and at two reference sites south of the lake (Phoenix Environmental Sciences, 2017). The survey found that waterbird assemblage at the lake reflects the species typically expected in the region, with 15 species of waterbirds recorded (approximately 10,000 individuals) with Black Swan, Grey Teal, Australian Shelduck, and Red-necked Avocet the most common birds. Although numbers are comparatively high, the lake does not seem to be an important breeding ground for any of the species.

Productivity of the lake appears high in particular in the early stages of the hydrocycle, where high numbers of invertebrates support a large number of birds. The aquatic invertebrate community is very diverse, with a taxon-richness otherwise only recorded in more comprehensive surveys of larger salt lakes which also included associated wetlands of lower salinity. However, phytoplankton taxon richness was comparatively low. A total of 44 species and 19 higher taxa ('sp. indet.') in 23 families and 13 orders of aquatic invertebrates were collected. Crustaceans (23 species) and insects (21) were represented with similar numbers of taxa; midges (Chironomidae) were the most common family with seven species, followed by the ostracod family Cyprididae (six species). Most of the aquatic invertebrates are widespread species and none are formally recognised as conservation significant; however, the ostracod species *Ilycypris* 'BOS691' is currently only known from Hannan Lake.

5.1.8.2.3 Gidji Operational Area

A fauna survey was undertaken in the area surrounding the Gidji Operational Area in 2019 (Phoenix Environmental, 2019). Forty-nine vertebrate species including seven reptiles, 31 birds and 11 mammals were recorded in the survey. No SRE invertebrates were recorded. No significant fauna species were recorded. The three vegetation types described in Section 5.1.7.2.2 represent one broad fauna habitat, an open eucalypt woodland.

During active deposition throughout operations, the Gidji TSFs are netted to prevent fauna interaction with cyanide bearing supernatant. After rehabilitation of the TSFs it is not anticipated that fauna interaction will be an issue, as the upper tailings surface where any solutions may collect during rainfall events will be capped with rehabilitation materials.

5.1.8.3 Stygofauna

Literature indicates that the stygofauna habitat is best developed in calcrete or karstic aquifers. Stygofaunal habitat may also occur in non-karstic rocks, or unconsolidated sediments, if suitable water-filled voids are present. Calcrete and laterite geology appears to be the most common habitat for stygofauna. These hydrogeological conditions have not been identified in groundwater near KCGM, which are typically hypersaline and acidic. There have been no documented findings of stygofauna within the KCGM Operational Areas and associated aquifers.

5.2 Cultural Heritage

5.2.1 Aboriginal Cultural Heritage

In the Coolgardie/Kalgoorlie/Menzies Region, Aboriginal sites mainly relate to five mythological sagas:

- the Yina Kutjara – two mythic human ancestors who brought law and religion to the region and travelled from the Coolgardie region through Kalgoorlie-Boulder, Ora Banda, Broad Arrow, and Menzies towards Lake Carey;
- the Tjilkarmarta (or echidna ancestor) – a topography creating being who travelled through Kalgoorlie and Goongarrie to a final resting place at Niagara Falls;

- the Nganamarra (or Malleefowl ancestor) – a topography creating being who appears to have circled the region;
- the Kurangara (or Pleiades) – created sacred areas of specific significance to women; and
- the Watt Kutjarra/Pap/Karlaya – deals with the exploits of two mythic men and a dog pursuing an emu ancestor through the Leonora region.

Generally, sites associated with these mythic sagas are either prominent rock outcrops or water sources (O'Connor & Quartermaine, 1989).

Thirteen sites of ethnographic significance have been identified in close proximity to KCGM's operations (Table 5-5). These sites are all included in the WA Department of Planning, Lands and Heritage (DPLH) Register of Aboriginal Sites and are mostly located outside areas that are restricted for mining purposes on vacant crown land. Vacant crown land in these areas has multiple land uses, and KCGM does not control access to the area.

Archaeological surveys indicate that the KCGM Operational Area was not originally favoured for Aboriginal habitation due to a lack of natural resources. As water and stone sources were the focal point for Aboriginal activity in the area any archaeological sites are generally found in a similar context. It is most likely that Aboriginal people would have used the watercourses as passageways to the adjacent hinterland. Hence, archaeological sites are likely to be present near lakes, creeks, and other water sources as well as on the slopes and at the bases of hills. Larger sites are expected to be located near sources of permanent or semi-permanent water while small sites are expected to be near ephemeral sources of water, such as creeks and clay pans.

The advent of European activity in the area changed the spatial pattern of Aboriginal activity. Disturbance of the traditional Aboriginal range by pastoral activities and the need for new resources to replace the traditional sources, which had effectively been fenced off, drew the Aboriginal people to camps and towns of the Europeans. Materials such as glass and ceramics were favoured for their flaking qualities and metal was used both in composite tools and to manufacture other tools.

Eight sites of archaeological significance have been identified in close proximity to KCGM's Operations (Table 5-6). These sites are included in the DPLH Register of Aboriginal Sites.

Site 18573 is a tree that is believed to have been modified by Aboriginal people. The tree is a gimlet (*Eucalyptus salubris*) with two sections of bark, one above the other, removed from the south side of the trunk. Quartermaine Consultants (2001) reported that the tree complies with the criteria for authentication and that while this tree has limited archaeological potential it is unique to the area and could be considered ethnographically important.

Site 18572 is a scatter of European debris that incorporates some flaked glass. Quartermaine Consultants (2001) reported that the area appears to have been a European settlement, or, at the very least, a dam and rubbish dump, that was visited by Aboriginal people. The assemblage included blue glass, clear glass, ale bottle bases and green glass. In the case of small glass bases, the natural shape of the base appears to have been retained and the artefact merely trimmed.

KCGM has recently updated the Cultural Heritage Management Plan to align with new WA legislation. Consultation with Native Title parties and other relevant stakeholders. KCGM has an internal ground disturbance approval process that includes assessment of proximity to culturally significant locations and sites, to ensure that appropriate controls are in place prior to any work commencing.

Table 5-5: Sites of Ethnographic Significance

SITE ID	ACCESS	SITE NAME	SITE TYPE	SITE NO.	VEGETATION TYPE
1335	Open	Kuntipilari	Mythological/Natural Feature		Eucalyptus lesouefii over mixed shrubs
1417	Closed	Ninga Mia Hill	Mythological	W01753	Open Eucalyptus woodland over mixed shrubs
1418	Closed	Karkurla	Mythological, Water Source	W01754	Within townsite boundary
1421	Closed	Paddy Hannans Tree	Mythological	W01757	Within townsite boundary
1422	Closed	Quarry Rockhole	Mythological, Water Source	W01758	Within townsite boundary
1425	Open	Kalgoorlie Reserve	-	W01761	Within townsite boundary
1476	Closed	Muruntjarta	Mythological, Camp	W01760	Open Eucalyptus woodland over mixed shrubs
1540	Closed	Kalgoorlie Rockhole	Mythological, Water Source	W01661	*Atriplex* shrubland
1541	Closed	Nanny Goat Hill (Pilyurru)	Ceremonial, Mythological, Camp	W01662	Within townsite boundary
1542	Closed	Microwave Tower Hill	Mythological	W01663	Within townsite boundary
3010	Closed	Mt Charlotte	Mythological	W00120	Within townsite boundary
18971	Closed	Women's Site 3	Ceremonial/Historical Meeting place/Natural feature		Eucalyptus woodland over mixed shrubs
30638	Open	Mididja	Mythological Ochre/Natural Feature		Eucalyptus woodland over mix shrubs

Table 5-6: Sites of Archaeological Significance

SITE ID	ACCESS	RESTRICTION	SITE NAME	SITE TYPE	VEGETATION GROUP
152	Open	-	Yarri Road Quarry	Quarry	Eucalyptus lesouefii over mixed shrubs
1280	Open	-	Hannan Lake 1	Artefacts/scatter	Open *Casuarina* woodland over mixed shrubs
1281	Open	-	Hannan Lake 2	Artefacts/Scatter	Edge of lignum swamp – samphire shrubland
1282	Open	-	Hannan Lake 3	Artefacts/Scatter	Mixed shrubland
1283	Open	-	Hannan Lake 4	Artefacts/Scatter	Open *Eucalyptus salicola* over mixed shrubs
1284	Open	-	Hannan Lake 1	Artefacts/Scatter	*Eucalyptus lesouefii* woodland over mixed shrubs
18572	Open	No restriction	Bulong Rd KCGM Two	Artefacts/Scatter, Historical	Eucalyptus woodland over mixed shrubs
18573	Open	No restriction	Bulong Rd KCGM One	Modified Tree	*Eucalyptus Salubris* woodland over mixed shrubs

5.2.1.1 Vegetation Associated with Aboriginal Heritage Sites

Ministerial Statement 786 requires KCGM to ensure mining does not impact on the vegetation associated with Aboriginal Heritage Sites (AHS). In 2013, an assessment and characterisation of the health of vegetation associated with each AHS was completed by an anthropological and botanical expert (Appendix 4.2; Botanica Consulting, 2013). The outcomes of the assessment did not identify any mining activities nearby impacting on the vegetation surrounding AHS. Feedback on the MCP 2015 from the then-DAA was that KCGM had satisfied the requirement of the MS Condition.

5.2.2 Non-Aboriginal Cultural Heritage

The Golden Mile has played an important part in the development of Western Australia and Kalgoorlie-Boulder, and so has a significant place in Australian history. The Fimiston Open Pit is the most visited free tourist attraction in Kalgoorlie-Boulder. The lookout established by KCGM is visited regularly by tourists interested in viewing the Super Pit. This interest is expected to continue during the remaining life of the operation.

Most surface infrastructure at the Mt Charlotte Operational Area has little inherent heritage value except that it was used as the last operating underground mine on the Golden Mile. The Cassidy Headframe is of distinct character and visible from much of Kalgoorlie-Boulder. The headframe is currently maintained as the primary of egress from the Mt Charlotte operations and will be retained by KCGM while seeking community input to determine its future. Any other infrastructure at Mt Charlotte that is of heritage value is likely to be relocated to an area outside the mining area.

None of the existing process plants, infrastructure, or service corridors currently at KCGM are expected to have any heritage value. The WRDs and TSFs currently have negligible heritage value. However, in the future they may be considered as evidence of the scale of modern gold mining operations at Kalgoorlie-Boulder and therefore assume some value. Mullingar, the last remaining hand-built TSF, is a reminder of the former mining landscape of Kalgoorlie-Boulder and has heritage value. Mullingar is part of the Hannan North Tourist Mine.

Exploration features are expected to have little heritage value; however, there is some value associated with old shafts on the mining lease, as they demonstrate the long and extensive history of the Golden Mile. Many of these shafts have been incorporated into the Fimiston Open Pit.

5.3 Mining Environment – Operational Areas

This section provides an overview of KCGM mining-related features and their current status.

5.3.1 Overview of KCGM Operational Areas

KCGM has five key Operational Areas, namely Fimiston, Mt Charlotte, Gidji, Mt Percy and Regional. Table 5-7 provides a summary of the Domains and Features within each Operational Area. Figure 2-2 provides an overview of the locations and relationships between the Operational Areas.

Table 5-7: KCGM Operational Areas, Domains and Features

DOMAIN	FEATURE
Fimiston (MS 782)	
Mining Infrastructure	Fimiston Open Pit and Sam Pearce Decline (includes Croesus TSF)
	ROM Pad
	Crushing Facilities and Stockpiles
	Fuel Farm
	Laydowns
	Offices, Car Parks, and Gardens
	Mining Maintenance Workshops
Waste Rock Dumps	Trafalgar WRD (including Eastern WRD and Calcine (Morrisons) TSF)
	Oroya WRD (encapsulating Oroya, Balgold and Galconda TSFs)
	Northern WRD (encapsulating Herliette and Old Croesus TSFs)
	North Eastern WRD (includes Paringa TSF)
	Environmental Noise Bund
Mineral Processing Infrastructure	Fimiston Plant
	Offices and Associated Infrastructure
	Contractor Workshops
	Laydown Areas
Tailings Storage Facilities	Fimiston I TSF
	Fimiston II TSF (3 cells)
	Fimiston II E TSF (3 cells)
	Fimiston III TSF (3 cells)
	Kaltails TSF (2 cells)
	Tailings Delivery and Decant Water Return Lines (including bunds)
Water Abstraction and Containment Facilities	Site Dams
	Fimiston Seepage Interception System (including trenches, bores, pipelines, bunds and ponds)
	Kaltails Seepage Interception System (including trenches, bores, pipelines, bunds and ponds)
Rehabilitation Materials	Rehabilitation Material Stockpiles
Gidji (MS 1032)	
Mineral Processing Infrastructure	Processing Plant (including roaster and access road)
	Tailings Delivery and Decant Return Water Pipelines (including bunds)
Tailings Storage Facility	Gidji I and II TSFs
Water Containment Facilities	Surface Water Pond
Groundwater Infrastructure	Gidji Seepage Interception System (including trenches, bores, pipelines, bunds and ponds)
Rehabilitation Materials	Rehabilitation Material Stockpiles
Mt Charlotte	
Mining Infrastructure	Mt Charlotte Open Pit
	Underground Mine

DOMAIN	FEATURE
	Surface Operations (including headframe, coreyard & conveyor)
Mt Percy	
Mining Infrastructure	Sir John Open Pit
	Mystery and Union Club Open Pits
	Underground Workings at Hannan North Mine Tourist (below the 190 m level)
Waste Rock Dumps	Sir John WRD
	Union Club WRD
	Mystery WRD
Tailings Storage Facility	Mt Percy TSF
Mineral Processing Infrastructure	Processing Plant footprint
Water Containment Facilities	Gravity Dam (includes pipelines and bunding)
Regional	
Historical, Inactive Tailings Storage Facilities	Mullingar TSF
	Morrisons Flats Tailings Area
Exploration	Drill Holes and Sumps
	Tracks and Gridlines
Groundwater Infrastructure	Regional Production Borefields (including bores, pipelines and bunds)
Miscellaneous	Potentially Contaminated Sites
	Haul, Access Roads and Service Corridors (Power lines)

5.3.2 Fimiston Operational Area (MS 782)

The Fimiston Operational Area consists of numerous large features, including the Fimiston Open Pit, WRDs, and three active TSF facilities and associated support infrastructure (Figure 5-17).

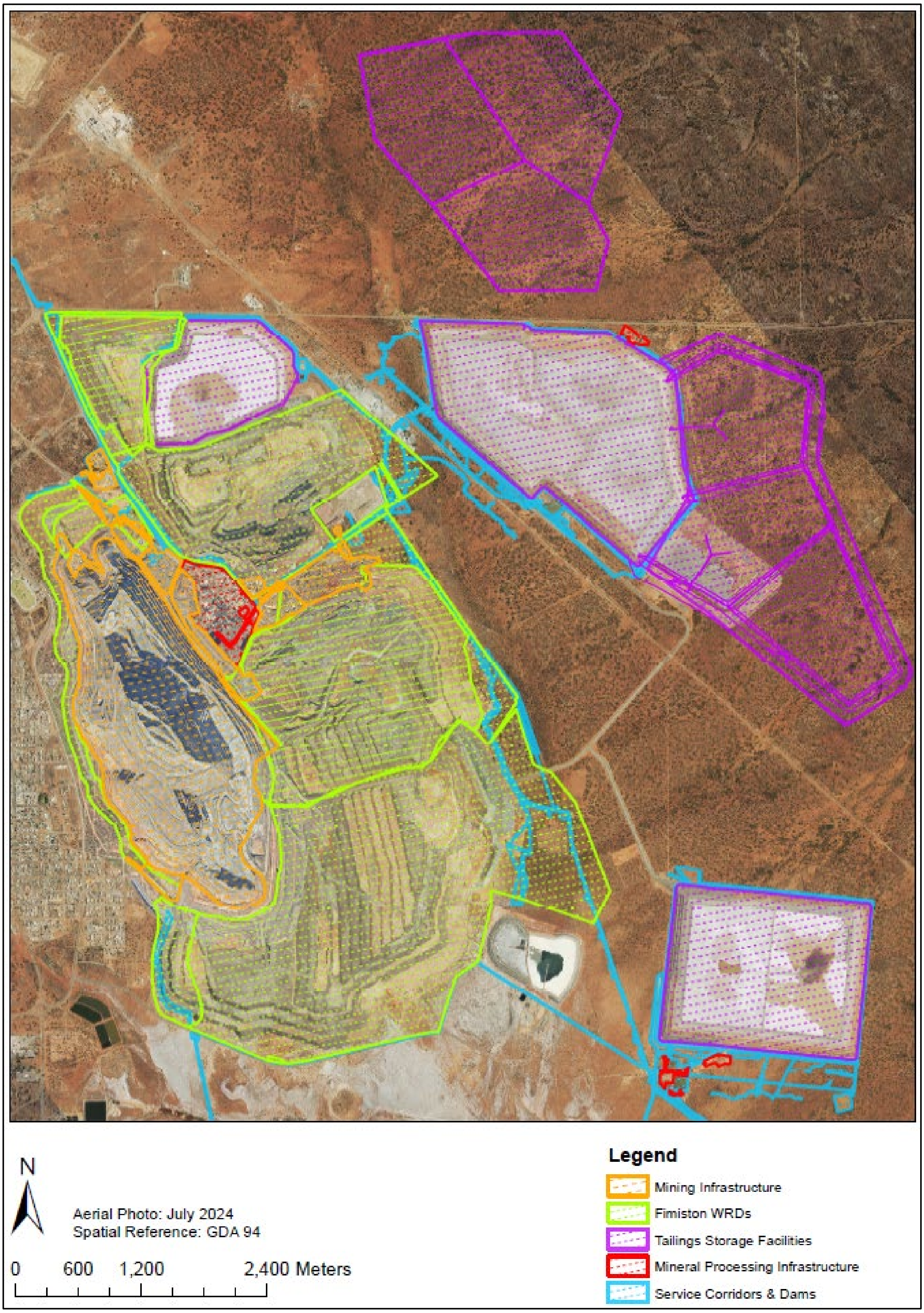


Figure 5-17: Fimiston Operational Area

5.3.2.1 Fimiston Mining Infrastructure Domain

Infrastructure specifically related to mining activities at Fimiston has been grouped within this Domain (Figure 5-18).

Figure 5-18: Fimiston Mining Infrastructure including Fimiston Open Pit and Sam Pearce Decline (current)

5.3.2.1.1 Fimiston Open Pit and Sam Pearce Decline

The Fimiston Open Pit (Figure 5-19) is currently the only active open pit managed by KCGM and is planned to continue to be mined until 2034 (2021 LOM Plan). The Open Pit footprint incorporates the Brownhill, Chaffers, Croesus, Golden Pike, North Kalgoorlie, Morrison, Oroya, Stores, Trafalgar, Great Boulder (Fimiston South S45c Approval) and Ivanhoe (Fimiston South S38 approval) pits /cutbacks. The Fimiston open pit is one of the largest open pit gold mines in Australia, extending approximately 1.5 km wide, 3.5 km long and 600 m deep.

Figure 5-19: Fimiston pit shells

The mined bench height is generally 10 m, with drilling and blasting undertaken to break and loosen the rock material for extraction by face shovels, diggers and large front end loaders. The blast pattern applied depends on the type of material being mined, as well as vibration and overpressure constraints. Ore is transported to the Fimiston Plant for processing. Waste material, marginal and subgrade grade ore is trucked to defined and recorded areas of the waste rock dumps. During operations, opportunities for backfilling certain pit areas with waste rock is planned, provided the backfill does not sterilise economically viable resources or impact the mining schedule.

The Sam Pearce Decline provides an entry point to Mt Charlotte Underground Mine and daylights in the north end of the Fimiston Open Pit. Ore from Mt Charlotte underground is transported from the portal to the Fimiston ROM, this will continue until closure of Mt Charlotte, planned to occur in 2034 (2023 LOM Plan).

Geotechnical Stability

Pit wall stability monitoring is an important safety requirement of mining and a strict monitoring and reporting regime is adhered to. KCGM currently utilises Slope Stability Radar and Robotic Total Station prism monitoring systems to provide real time measurement of pit wall stability within the open pit environment. This, coupled with photogrammetric and visual monitoring, provide the basis for pit wall stability monitoring.

As part of the approved Public Environmental Review Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning (2007), KCGM conducted extensive geotechnical stability studies of the western wall of the Fimiston Open Pit. These studies were peer-reviewed and approved as part of the PER and focused on determining the potential long term (+300 year) wall stability, the zone of instability (ZOI) and the appropriate location of the abandonment bund.

Geotechnical studies conducted by BFP Consultants (2004, 2005) indicated that the major controls on slope stability are related to structural controls and the orientation/location of old workings. Groundwater has not presented a stability problem in the Fimiston Open Pit during operations, as dewatering has maintained groundwater levels below mining activity. This work is still valid for the majority of the Fimiston Open Pit, with walls comprising Golden Mile Dolerite. The majority of the pit wall was found to be in competent rock with lesser zones of fractured/weak rock present. Current pit slope inter-ramp angles of up to 63° were considered acceptable and unlikely to be at risk of large scale instability. This work was reviewed by the Australian Centre for Geomechanics (2016, 2020). The review deemed that the previous conclusions and recommendations were relevant and appropriate for the updated design. Further information is provided on the proposed S38 cutback (Ivanhoe cutback) in Section 9, Vol 2.

The results of stress analysis calculated a minimum factor of safety of 2 for the most aggressive fresh interramp and overall slope on the west wall. On this basis, BFP considered that the fresh rock slopes are not at risk of overall failure and that location of the zone of instability for 25° from the base of the weathered zone was suitable. KCGM considers that this comprehensive geotechnical analysis satisfies the requirement specified in the DMP guideline (DOIR 1997) that states, *"in cases where the mine owner wishes to locate the abandonment bund closer to the edge of the open pit than specified by this guideline, it must be demonstrated that the stability of the ground mass between the pit edge and the abandonment bund can be ensured for the very long term".*

In 2024/25 Itasca Australia was commissioned to undertake a geotechnical feasibility study of the proposed Ivanhoe Cutback Project. This proposed cutback (extension) of the existing Fimiston (Super) Pit extends over the earlier Chaffers, Morrison, Trafalgar and Golden Pike cutbacks (Figure 201) and targets extensions to the Fimiston mineralization and geology, down dip and along strike of Chaffers, Trafalgar and Morrison areas. Of particular concern was the possible geotechnical stability risk posed by the cutback of the western edge of the mine pit towards the national road and Boulder urban infrastructure.

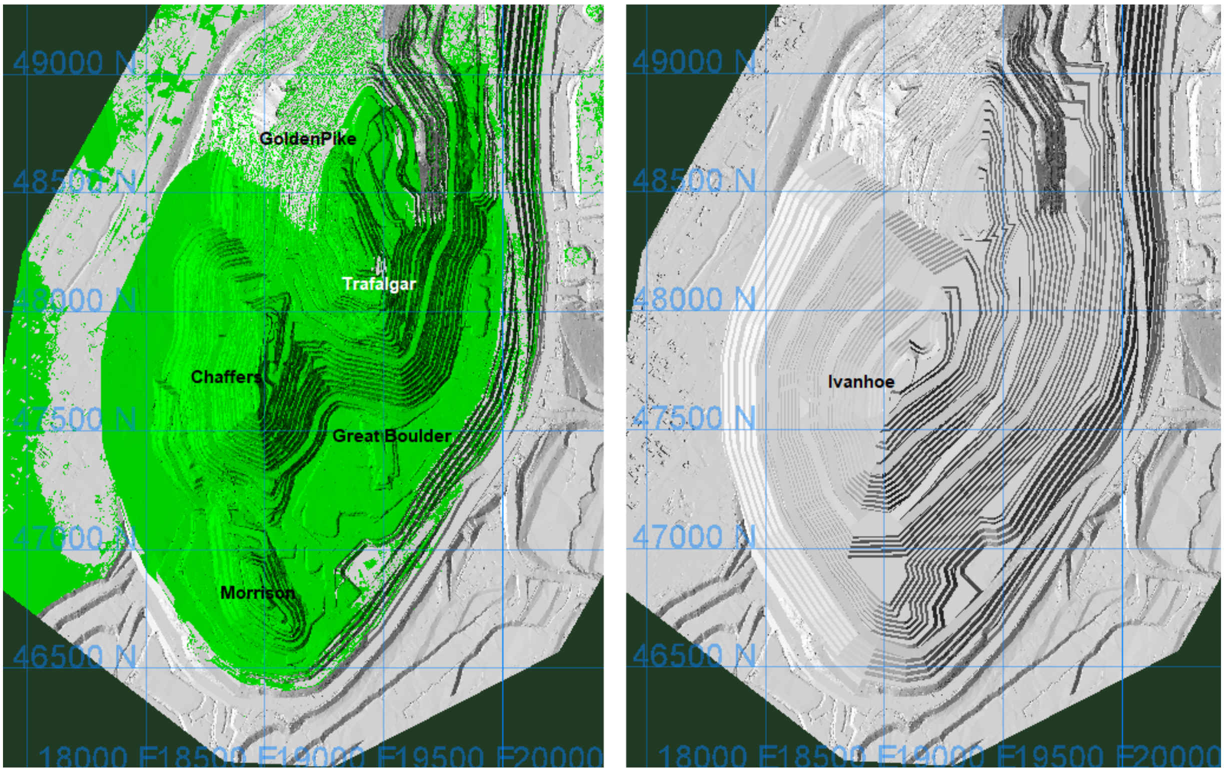


Figure 20: Ivanhoe cutback footprint (green) overlaid on existing mining areas (left frame) **and Final Ivanhoe pit shell** (right frame)

The proposed expansion would also intercept extensive underground workings. Most stopes are open voids, steeply west or southwest dipping and narrow (2-4 m wide). Past KCGM experience has shown that stopes, which have unfavourable geometry against the wall orientation, can cause wall cracking when in close proximity of a pit wall, as a response to pit blast and excavation activity. The extensive and interconnected underground workings also provide an effective drainage network beneath the current Fimiston pit. It is predicted that part of the future west and south pit wall will likely to be saturated and will require a continuation of the current Fimiston pit dewatering strategy, with extraction from two angled dewatering bores, plus additional horizontal drainage (depressurisation) holes on the wall to reduce pore pressure within rockmass and structure behind the immediate highwalls.

Seismicity

A micro-seismic monitoring system is maintained for the Fimiston Open Pit and has been recording since installation in 2001. The KCGM seismic system consisting of 6 holes, each hole has 2 geo-phones grouted at various depths. Seismic data is processed by the Institute of Mine Seismology (IMS) office remotely, and processed data is reviewed by site geotechnical team members. Seismic monitoring is not considered to be critical monitoring for open pit operation. However, it helps identify major structures which are seismically active and also provides a comprehensive background data set for possible underground mining options.

Anthropogenic seismic events as a result of mining are also known to occur. These events which generally occur close to the mine workings, are normally very small and are associated with the redistribution of natural stresses. From this it has been concluded that many of the seismic events recorded are as a result of pillar remnant failure in historic workings underneath the Pit. These expected levels of seismicity are not expected to impact on slope stability as effects are likely to be limited to the smaller scale (e.g., rockfalls). The level of anthropogenic seismic events will decrease post closure as stresses reach a new equilibrium.

Groundwater Management, Mine Dewatering and Pit Lake

Dewatering of the mines along the Golden Mile has occurred for a considerable period of time, probably since mining commenced in the late 1890s. Prior to 1992, the underground mines were dewatered by pumping from various shafts on the Golden Mile, with water levels in the late 1980s appearing to have been held at around 800 m below ground level. Production of groundwater by the Chaffers Shaft pumping station maintained water levels in the old underground workings of the Golden Mile between 720 m and 820 m below ground level between 1994 and January

2004. Groundwater levels recovered by around 130 m between January 2004 (when pumping temporarily ceased) and September 2005 (when pumping recommenced). Currently dewatering of the open pit is achieved by pumping from two angled dewatering bores located west of the pit which intersect the historical underground workings below the pit. The groundwater level is maintained at around 700 mbgl, which provides dry conditions during mining at the base of the pit. Dewatering will continue while the Fimiston Open Pit is operational and will result in the groundwater level being held at around 900 mbgl by the end of mining. Monitoring of groundwater conditions in the pit slopes is achieved via standpipe monitoring bores and Vibrating Wire Piezometer (VWP) sensors. The monitoring identifies that the position of the groundwater surface is strongly controlled by the underground workings and rises very steeply within the open pit slopes. As a result, the cone of depression in the basement groundwater system surrounding the Fimiston Open Pit is very limited and extends a maximum of 200 m from the edge of the open pit.

Groundwater produced by the Fimiston Open Pit dewatering operations is a blend of groundwater inflow, water stored in the underground mining voids below the pit, as well as runoff and direct precipitation which are captured within the pit and subsequently infiltrate the underlying workings. TDS concentrations range between 45,000 and 80,000 mg/L, with the pH consistently above 7.5. The water quality is dominated by sodium and chloride (MBS Environmental & GRM, 2021). Mining is the only identified beneficial use for this saline groundwater system and there are no potable water supplies in the vicinity of Kalgoorlie-Boulder that could be influenced by the Fimiston Open Pit dewatering operations. The nearest borefields are hypersaline seepage recovery borefields, in the ferricrete and alluvial sediment groundwater system, located several kilometres from the Fimiston Open Pit adjacent to operational TSFs. There is no evidence of any hydrogeological linkage between these aquifers.

Post closure, mine dewatering is expected to cease in 2034, after which a pit lake will develop as it gradually fills with water mainly from groundwater inflow and pit wall runoff. During the initial stages of closure, the pit will also receive water pumped from the TSF seepage interception bores (10-15 years). Minor inflows from WRD runoff, WRD toe seepage and seepage from the WRD via the fractured bedrock groundwater unit will also occur.

Pit lake development has been simulated using a water balance and hydrochemical model that was updated in 2022 (Appendix 5.9; Mine Waste Management & GRM, 2022). Initially 75l/s of TSF seepage management water is expected to be pumped via existing systems to the pit lake. This will taper off to 10l/s over the first 10 years. Modelling predicts that the Fimiston pit lake is predicted to reach equilibrium about 400 years after closure, with 73% of filling occurring within the first 50 years (with 50% of the total volume made up by TSF Seepage management water). Seasonal water fluctuations are about 0.5 m, though larger fluctuations will occur following large rainfall events.

Geochemical modelling indicates that the pit lake will be stratified during the first 50 years post closure, with less saline water (10,000 – 30,000 mg/l TDS, first 20m of depth) water over denser hypersaline water (60,000 – 100,000 mg/l TDS) at depth. Modelling accounted for exposed Black Flag shale on the pit walls and within the water body as well as the acid neutralising capacity inherent in carbonate minerals within the dolerite and basalt.

The deep equilibrium pit lake levels are indicative of the high evapotranspiration potential in the region and the relatively low groundwater inflow rates. The maximum water depth at equilibrium is 473m to 493m below the pit crest (just over half the depth of the Fimiston Open Pit and significantly less than half the pit's total volume). The pit lake level will also remain below the base of oxidation in the pit area and in all locations the lake will be in contact with competent bedrock ie wave action against pit walls is not a risk. The lake level will remain substantially below the groundwater elevation within the surrounding basement rocks (approximately 450 m deeper), ensuring the pit will act as a groundwater sink.

The model was also run for two additional scenarios which were analysed to potentially affect the future outcome of the model; climate change and an extended period of TSF seepage pumping. Results for the climate change scenario indicated that the range of predicted water levels were similar to the baseline scenario, but median pit lake levels were about 15 m higher than the baseline scenario. Neither of these two scenarios were material in terms of risks associated with the pit lake.

An integrated solute accounting, mixing, stratification and geochemical speciation model was also developed for the Fimiston Pit lake, based on water balance and flow modelling described previously, as well as materials characterisation data and water quality monitoring data.

The model predicted that in the long-term (400 years post closure), the Fimiston Pit Lake will:

- Be unstratified, hypersaline and circum-neutral (pH 6.7 – 7.2) under all modelling scenarios.
- Dominant ions will be sodium, chloride and sulfate.
- Contain marginally elevated dissolved concentrations of some potentially environmentally significant metals and metalloids – initially aluminium and copper, later antimony, boron, mercury and selenium (with boron and

antimony increasing over time), noting that the water has no known beneficial use, is considered too saline for significant consumption by fauna and will be inaccessible.

- Continue to accumulate solutes over time due to evapoconcentration (i.e in perpetuity), noting that halite (NaCl) precipitation will eventually limit salinity to <300,000 mg/L TDS.
- For the extending pumping of recovered TSF seepage after closure scenario, there would increase concentrations of some metals and metalloids in the lake by factors of up to two. These elements, which are present in the seepage at much higher levels than in other inputs to the lake, include: arsenic, cobalt, manganese, nickel, lead, selenium and uranium. Increased concentrations of this magnitude are not considered to significantly alter the overall environmental risk profile of the pit lake. This scenario is unlikely given the additional underdrainage systems planned for newer TSFs at Fimiston Operational Area.

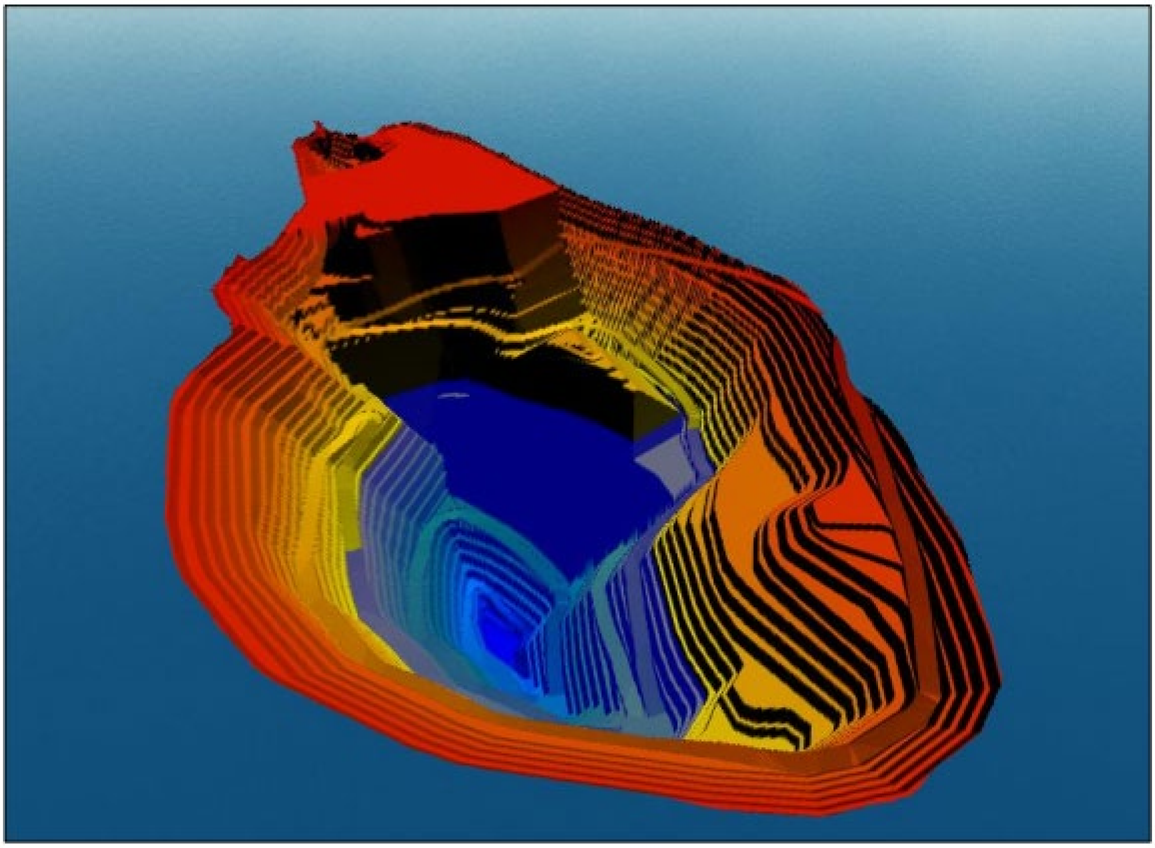


Figure 5-21: 3D of Fimiston Open Pit Closure Pit Lake Surface at Equilibrium (-122m AHD or 480m below surface)

5.3.2.1.2 ROM Pad

The Run of Mine (ROM) Pad is used for the temporary storage of ore to be processed through the Fimiston Plant. The pad itself is constructed from waste rock. The ROM Pad will remain active until mineral processing ceases and will remain *in situ* as a post closure mine waste landform.

5.3.2.1.3 Crushing Facilities and Stockpiles

The Crushing Facilities and Stockpiles consist of contractor owned ‘secondary’ crushing facilities and stockpiles that currently provide crushed waste rock to Mt Charlotte (via the conveyor) for backfill of the Glory Hole Pit and for use on site (blasting, stemming, road base sheeting of ramps and roads).

5.3.2.1.4 Fuel Farm and Mining Maintenance Workshops

The Fimiston Mining Fuel Farm (Figure 5-22) consists of seven 110,000 litre tanks in a bunded area with a concrete apron for the refuelling of light vehicles, trucks, and ancillary equipment. The area is located north of the Fimiston Plant, adjacent to Black Street.

Figure 5-22: Fimiston Mining Fuel Farm

The Mining Maintenance Workshops includes all contractor workshops at the Fimiston Operational Area (Figure 5-18), the majority of which are located to the southeast of the Fimiston Plant. Other small workshops are located at the Sam Pearce Decline, CSI crushing services and bulk explosives storage. The workshop areas are currently in active use and contain several hydrocarbon storage areas (Figure 5-23). The open pits contractor workshop area (AOC58) and the Sam Pearce support facilities area (AOC69) have been reported to the DWER as potentially contaminated sites.

Figure 5-23: Fimiston Mining Maintenance Workshops Main Hydrocarbon Area

5.3.2.1.5 Laydown and Hardstand Areas

Mining laydown areas (Figure 5-18) include a laydown area associated with the open pits mining maintenance contractor workshops, laydowns associated with Sam Pearce support facilities and the open pits haul truck hard stand area. Smaller laydown areas are located around the Fimiston Operational Area, which are actively used for storage of equipment that may be used or required in the future.

5.3.2.1.6 Offices and Associated Infrastructure

All offices are currently in use and generally have parking areas and gardens. Most buildings on site are prefabricated units, which can easily be relocated or demolished at closure.

5.3.2.2 Fimiston Waste Rock Dumps

5.3.2.2.1 Overview

The Fimiston WRD naming conventions are shown in Figure 5-24, and are listed below:

- Trafalgar WRD (including Eastern WRD, proposed Far Eastern WRD, existing Public Lookout (2022), Southern Noise Bund Extension and encapsulated historic TSFs) forms the southern portion of the Southern WRD;
- Oroya WRD (encapsulating Oroya, Balgold and Galconda TSFs and including older components Radio Hill and Old Tetley's WRD) Central Valley WRD forms the northern portion of the Southern WRD;
- Northern WRD (encapsulating Herliette TSF);
- North Eastern WRD (includes Paringa TSF); and
- Environmental Noise Bund.

Trafalgar WRD and Oroya WRD combined are referred to as the Southern WRD. WRDs at Fimiston are generally wedge shaped due to the height constraints of the Kalgoorlie-Boulder Airport. The western sides of the Southern WRD (closest to the airport) are 15 to 20 m high, rising to 140 m high on the eastern side.

The design process for WRDs includes geotechnical assessment for stability, airport height considerations, capacity assessments, and design alignment with closure requirements (including angles, ramps, bench widths and encapsulation of oxides and waste Black Flag material). WRD geotechnical design assessment ensures stability considerations are assessed prior to internal design approval and construction, incorporating a minimum factor of safety (FOS) of 1.3 static and 1.0 pseudo static conditions and location of the Zone of Instability (at the time of construction).

Fimiston WRDs have generally been built from competent hard rock (basalt and dolerite) in 20 m high lifts separated by berms, with rehabilitated slope battered to between 14° and 20°. Significant portions of Oroya and North Eastern WRD contain low grade ore stockpiles. These stockpiles are planned to be processed in parallel with mining of the Fimiston Open Pit, and their footprint replaced with waste rock.

Details of WRD designs are provided in the implementation section (Section 9.2.4 (Volume 2).

The current approved disturbance footprints for the WRDs (as reported for MRF) are presented in Table 5-8. Large areas of the WRDs are still in an active dumping phase.

Table 5-8: Fimiston Waste Rock Dump Approved / Proposed Footprints

FIMISTON WRD	PROPOSED/ APPROVED FOOTPRINT	DISTURBED LAND (HA) MRF 2021	LAND UNDER REHABILITATION (HA) MRF 2021	TOTAL
Trafalgar	598	421	166	587
Trafalgar - Far Eastern	140			
Oroya	426	225	122	347
Environmental Noise Bund (incl Southern NB)	125	0	74	74
Fimiston South Noise Bund	9			
North Eastern	323	217	32	249
Northern	102	53	33	86
Total		748	427	1175

Historical TSF Footprints

Reprocessing of old TSFs as part of the State Agreement Kaltails Project between 1989 and 1999 created numerous remnant TSF footprints, which have since been encapsulated within the Fimiston WRDs (in particular the Southern WRDs, i.e., Trafalgar and Oroya WRDs) for example, the Oroya, Balgold, and Galconda TSFs are encapsulated within the Oroya WRD. All infrastructure associated with the TSFs has been decommissioned and removed. Where TSFs were not encapsulated by the WRDs, they have been revegetated with salt tolerant shrub species by previous tenement holders or KCGM. As part of the expansion of the Fimiston WRD to the south and east, opportunities exist for further encapsulation of remnant TSF footprints.

Due to encapsulation within WRDs, characterisation data is often not available for the remnant tailings. Where possible, samples have been collected for characterization, with geochemical outcomes presented Appendix 5.8. KCGM does not consider these tailings to be an immediate risk considering the reduction in surface water infiltration and prevention of dust generation that the WRD cover provides. Further information where available is provided in the sections below on each WRD and the Contaminated Sites in Section 5.4 as well as in the Contaminated Sites Summary document in Appendix 6.

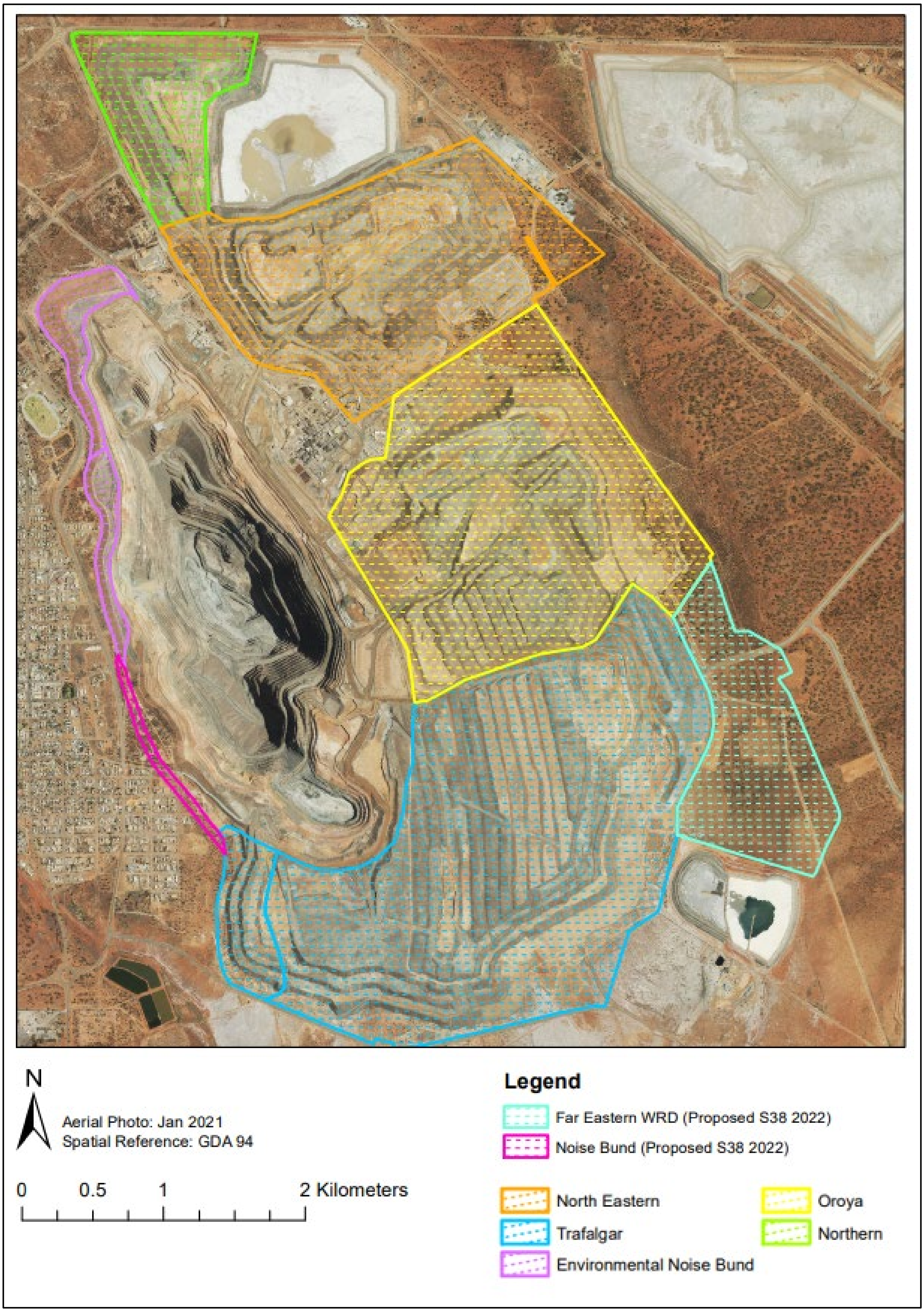


Figure 5-24: Fimiston Waste Rock Dumps

Mined Waste Characterisation

Eighty percent of the waste rock sourced from the Fimiston Open Pit and stored in the WRDs is Golden Mile Dolerite (GM Dolerite), with the remaining waste rock composed primarily of Paringa Basalt (14%) and the Black Flag Shale (BF Shale) (approx. 4%). Table 5-9 provides a summary breakdown of the lithology. During the early stages of the Fimiston South project, the amount of oxide waste will increase compared to the recent past, before again settling down to a more typical scenario. This has been considered in WRD planning, to avoid oxide slopes, and geochemical studies have been conducted to assist with this decision making (see Fimiston Geochemistry in Vol 3 – Appendix 5-4).

Table 5-9: Waste Rock Lithology from the Fimiston Open Pit

LITHOLOGY	CLASSIFICATION	PERCENTAGE
Golden Mile Dolerite	Oxide	11.6
	Transitional	6.3
	Fresh	62.9
	Total	80.8
Paringa Basalt	Oxide	3.3
	Transitional	1.3
	Fresh	9.6
	Total	14.2
Black Flag Beds	Oxide	0.9
	Transitional	0.5
	Fresh	3.1
	Total	4.5
Devon Consols Basalt	Oxide	0.4
Williamstown Dolerite	Oxide	0.1

A summary of geochemical characterisation of mined materials from the Fimiston Open Pit was conducted for the 2015 MCP and further work was conducted as identified in the original review. The amended review (Appendix 5.4; MBS Environmental, 2017) was completed on all geochemical testing and sulphur assay data available to date, as well as additional testing of a long term leach test of PAF material.

From this review it was determined that fresh mafic waste rock (Paringa Basalt and GM Dolerite) is classified as NAF with neutral to alkaline pH and low to moderate salinity levels. GM Dolerite is further classified as being primarily acid consuming (AC) for the majority of samples tested with low sulphur content (more than half of all assay samples being less than 0.3% sulphur of the analysis concept) and high ANC content. They were also found to be very low in concentrations of environmentally significant metals and metalloids, with enrichment noted for the expected gold, silver, antimony and some for mercury (tellurium would also be expected to be enriched in such samples). These metals and metalloids, however, were not found to be soluble under simulated weathering/kinetic testing conditions and as such are not of any concern for biological uptake or seepage into the receiving hypersaline groundwater at KCGM.

As such, fresh rock is considered geochemically benign and physically competent and is suitable for rock armouring and other construction purposes. In particular GM Dolerite is also suitable as high ANC (acid consuming) waste rock ideal for co-disposal of waste black flag waste rock, as per Fimiston operation's conservative waste rock management practices.

A small proportion of material from the Fimiston Open Pit consists of Black Flag shale ore. The AMD properties of this material was investigated in detail. A review of BF Shale sulphur assay results (2,687 samples) indicated a median sulphur content of 1.98% and 90th percentile sulphur content of 5.49%. Strong correlations of oxidisable sulphur (in the form of pyrite) and ANC (in the form of ankerite) were found by position within the BF Shale beds. Due to the spatial variability of the BF Shale material in composition, some inherent variability in the nature of the material and its potential to oxidise and generate AMD was observed. Overall, based on estimations from total sulphur content and measured NAGpH, it is predicted that BF shale waste containing between 2 and 4% sulphur content is required in order to potentially generate AMD. This represents between 19 and 50% of BF shale waste under worst case scenario conditions.

Study of all static results and results from long term field trials of naturally weathered Black Flag shale material confirm previous work that the BF shale ore (of sufficient sulphur content) should be classified as PAF (long lag). A long period of full exposure to the natural elements would be required prior to material potentially producing AMD, with oxidation rates seen to decrease below a depth of 1 m from the surface of the exposed material. Sulphide oxidation rates of 0.7 to 2.7 kg H_2SO_4/t per annum were estimated for fully exposed material under worst case conditions i.e., the most reactive materials.

The BF shale ore material Is enriched in various metals and metalloids (Au, Ag, Hg, Te, Sb, Se, Cd, Cu, Zn in particular) at levels significantly higher than those found for surrounding GM Dolerite and Paringa Basalt, as expected for material within or approaching the lode zone. Samples of fresh BF shale ore material have low concentrations of soluble metals and metalloids and leachates are circumneutral to alkaline with low to moderate salinity. Extreme weathering under worst case exposure conditions still did not release soluble Hg, Te or Sb. Soluble Al, Mn, Fe, Cu, Ni, Co and Zn were released under the same conditions.

The BF shale ore material is stockpiled in a specific recorded location on the northern side of the NE (Central WRD. The material will either be processed in the future or encapsulated as part of rehabilitation of the WRDs.

A recent study of the mercury characterisation of the material for the southern cutback areas was conducted (MBS Environmental, 2020). This study found that that ore sourced from the Fimiston South area (approved under the 2020 S45c) was determined to contain very similar total mercury content to existing areas of the Fimiston Open Pit, and existing conservative waste rock management practices are appropriate.

Within the pit, the overall proportion of fresh rock BF shale is minor in relation to total rock volume and not all of this material will actually be capable of generating AMD (i.e., PAF). As given above, sulphide oxidation rates are very slow with a significant lag period for acid generation. There is also significant ANC within the host rock (dolerite) such that net acid generation and associated metals leaching should only be possible after very prolonged exposure.

Given the above information, KCGM considers that current waste rock management practices of co-disposal of BF waste material, with a minimum of 40 m buffer of fresh dolerite/basalt on external faces and a 5 m capping of the final upper surfaces of the dump are more than adequate for as a highly conservative management practice for material that has been reclassified as NAF over the last 5 years through geochemical studies. It should be noted that BF ore is still considered PAF and managed accordingly.

Progressive Closure Design and Rehabilitation Performance

Throughout KCGM's operating life, since the late 1980's, a variety of as built and rehabilitation designs have been implemented for the WRDs (Figure 5-25), resulting in varied rehabilitation outcomes. During early rehabilitation in the 1990s the DMP *Guideline for Mining in Arid Environments* WRD design was used at KCGM. In addition, specifications in KCGM's original approval documents (i.e., the *Consultative Environmental Review Mine and Waste Dumps – Fimiston – August 1990;* valid for North East, Trafalgar and Oroya WRDs) required the following:

- Battering of the slopes, application of 0.5 m of oxide;
- Application of 0.2 m of topsoil; if available, placement of vegetation mulch;
- Fertiliser and deep ripping to a minimum of 0.75 m on the contour to blend the materials, with construction of cut in contour berms for water harvesting;
- Fertiliser applied at a rate of 400 kg/ha of Agras Cu-Mo-Zn broadcast before deep ripping; 5 m back sloping berms graded to rock drains and;
- Seeding.

Rehabilitation of sections of the WRD (mainly the eastern slopes) has been implemented to these approved specifications; however, the advocated standard rehabilitation practices undertaken at the time have not proven to be ideal for the rehabilitation materials available at KCGM. Rehabilitation of the Oroya and Trafalgar eastern slopes was generally completed from north to south, with corresponding progressive deterioration in the quality of rehabilitation materials (demonstrated by poorer performing revegetation and erosion). In some areas, rehabilitation materials were applied at excessive depth (generally 1 m) as per best practice at the time , which has precluded soil/rock blending into the upper surface due to equipment depth limitations.

Rehabilitation in the 1990s tended to be fertilised, but this was discontinued in the 2000s as trials indicated that there were no significant differences in plant density between fertilised or unfertilised rehabilitation.

Where they have been constructed, “water harvesting contour drains” have proven to cause erosion rather than harvest water for infiltration as many were cut in with varying accuracy along the contour resulting in the concentration of storm runoff and subsequent overtopping. In the original design, these contour drains were to have discharged to drop structures; however, as they were not constructed accurately to grade, rehabilitation outcomes remain unchanged. It should be noted that any continued erosion will be limited in depth in the majority of areas as the underlying material is competent waste rock.

In 2007 a Rehabilitation Review was completed to develop a Rehabilitation Management Plan. This plan aimed to outline objectives and processes for design and construction, rehabilitation and monitoring of the Fimiston WRDs. The review recommended that the battered hard rock surface be covered with approximately 1.2-0.25 m of rehabilitation materials in order to provide a growth medium for revegetation, whilst also minimising erosion. Gentler slope angles were considered where possible.

In 2009, due to the high erodibility of the soils at KCGM, further work was conducted to investigate rehabilitation material properties. As a result of this work a concave final slope design was considered within the *2009 Mining Proposal for the Golden Pike Cutback and Northern Waste Dump* to address the limitations of available rehabilitation materials in terms of erosional stability. However, while appropriate for the materials, the design had very large berms, resulting in an unacceptable loss of overall waste dump capacity. This was considered problematic due to KCGM’s significant footprint and vertical height constraints.

In 2012, an assessment of the status of waste dump closure designs was undertaken in respect to rehabilitation success, and can be summarised as follows:

- Availability of large volumes of competent waste rock is a significant advantage for a critical parameter for rill and gully formation;
- More refined and robust waste dump designs were required, which reflected site specific challenges;
- Available rehabilitation materials (soils) have significant limitations in terms of erodibility, salinity, sodicity and low nutrient levels;
- Erodibility, stability and dust management should be the critical drivers in development of designs, with vegetation success as a secondary driver;
- Insufficient rehabilitation material (soils) volumes exist to rehabilitate all landform surfaces in the conventional way;
- There has been very limited success, both erosionally and vegetatively, when oxides have been used in rehabilitation or insufficient hard rock has been mixed to surface;
- Rehabilitation materials take a long time to establish regrowth, often up to eight years, with establishment of vegetation on slopes often occurring after consecutive years of good rainfall;
- Visual amenity to residential areas should be a key consideration in development of designs and implementation strategies; and
- Kalgoorlie-Boulder Airport is a key consideration controlling height of WRDs.

Taking the 2012 assessment and material characteristics into account, designs were reviewed and adjusted between 2011 and 2013. A revised ‘erosion resistant’ design was developed consisting of shorter slope lengths, linear slopes, and a high percentage rock cover. This assisted in increasing the design capacity of the WRDs, whilst also maintaining successful rehabilitation outcomes. In 2014, the implementation of the design was trialled on the Northern WRD to assess constructability and practicality, and establish the most cost effective earthmoving techniques. This trial was considered successful and is now approved as the primary design basis for new rehabilitation work areas on Fimiston WRDs. Further information on this design is provided in Section 9.2.3 (Volume 2).

Further detail for each WRD is provided in the sections below.

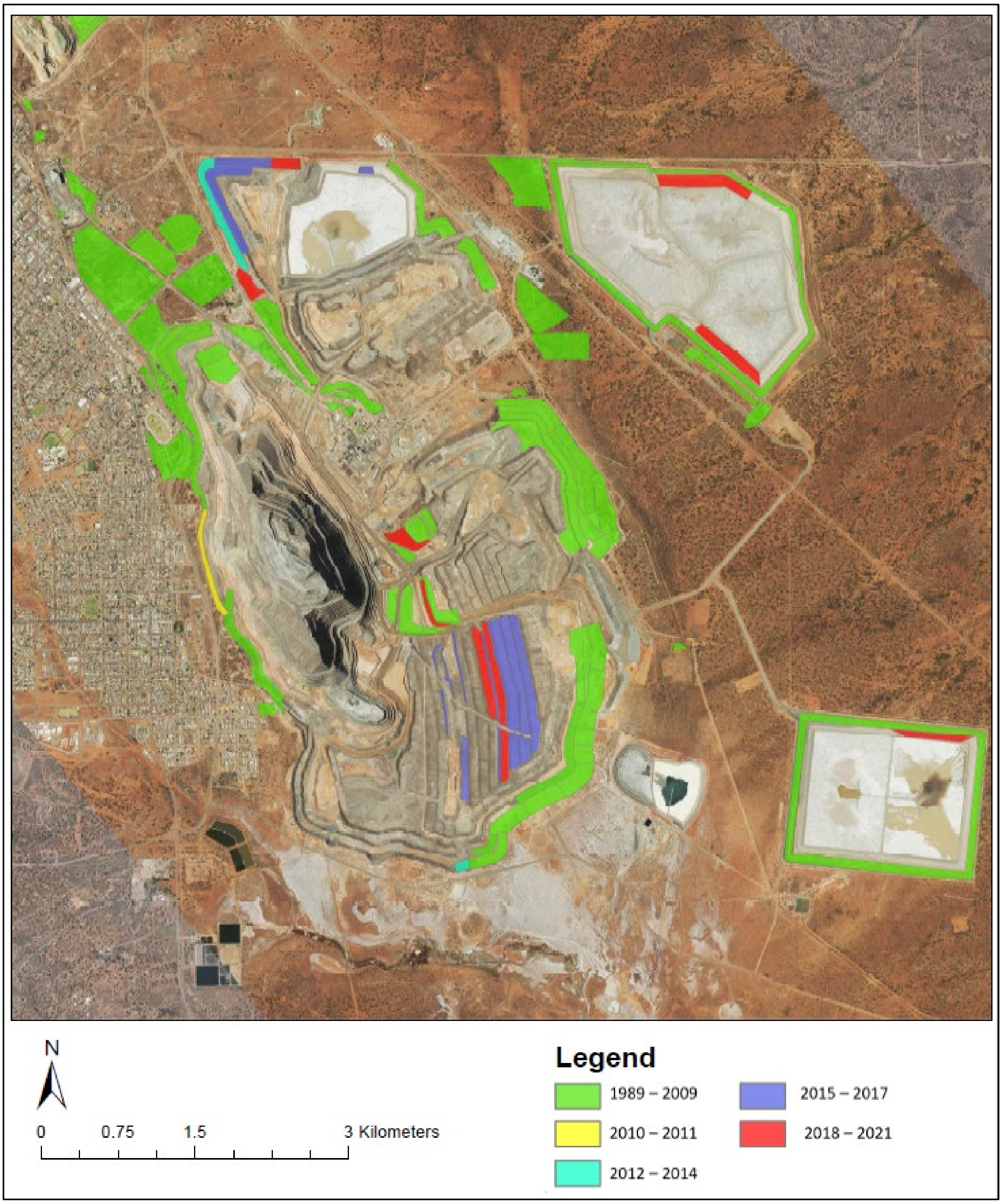


Figure 5-25: Progressive Rehabilitation at Fimiston 1995 to 2021

5.3.2.2.2 Southern Waste Rock Dumps - Trafalgar Waste Rock Dump

The Trafalgar WRD is an active WRD, located to the south and east of the Fimiston Open Pit and directly abuts the Oroya WRD to the north. Construction has been ongoing since 1992, with the landform currently covering an area of 578 ha and reaching a height of 130 m, on the eastern side, with final height planned for 140m. Design and construction has been strongly influenced by footprint constraints and airport height restrictions.

Previously, the western facing upper area of Trafalgar WRD consisted of 5 m lifts, with a terraced appearance to optimise the available waste dumping capacity (Figure 5-26) under the airport Obstacle Limiting Surface (OLS).

As it has expanded, the WRD has encapsulated smaller backfilled mine pits, remnant tailings footprints and sections of the Morrison Flats tailings wash. From 2017 onwards the development of the Eastern WRD has expanded the dump in the SE sector.

BF shale waste material will continue to be is co-disposed with waste rock within the Trafalgar WRD, with a buffer of 40 m of high ANC dolerite/basalt on the external faces of the dump and capping of 5 m of the final upper surfaces of the dump.

Figure 5-26: Trafalgar WRD viewed from the Southeast (2021)

New Design (2022)

As part of the Fimiston South Project, a new phased design height change is in progress (within the existing EPA/DMIRS) approved footprint, with a final eastern height of nominally 200m. To achieve this design, KCGM have been in discussions with relevant approvers and stakeholders in the aviation sector; namely CASA, Air Services Australia, Kalgoorlie Airport (Shire owned) as well as consultation with all main airlines flying into Kalgoorlie-Boulder. An additional height increase has been approved (higher than the OLS), with a new design implemented. Several requirements for height increases have been complied with, including aircraft warning lights on the Southern WRD. KCGM and aviation approvers are currently working through a process to approve a further height increase.

A further extension to the east, the proposed Far Eastern WRD, will provide additional waste capacity for the Fimiston South project. Due to the location, the WRD requires a floodway diversion around the eastern toe of the WRD to ensure that episodic surface water flows are diverted around and back to the main flow path of the Eastern Floodway. Continuous flow in the Eastern Floodway is episodic and usually occurs for storm events greater than an ARI of 10% (approximately a 1:10 event).

The closure design implemented on the new Trafalgar WRD/ Far Eastern WRD/ Southern WRD design will be the erosion resistant design, already implemented on the Trafalgar/ Southern WRDs, with the visual amenity strategy guiding topsoil placement. The design consists of 16° -17° slopes with 10 m wide berms, and a high percentage rock cover. Extensive technical work supports this design, including the trials undertaken at Northern WRD.

Topsoil from the footprint area will be recovered and stockpiled. Oxides (Class D) in the impacted rehabilitation have been sampled and will be assessed based on their geochemical properties to determine which areas have growth media materials suitable for recovery. Figure 5-27 shows the new Trafalgar WRD design.

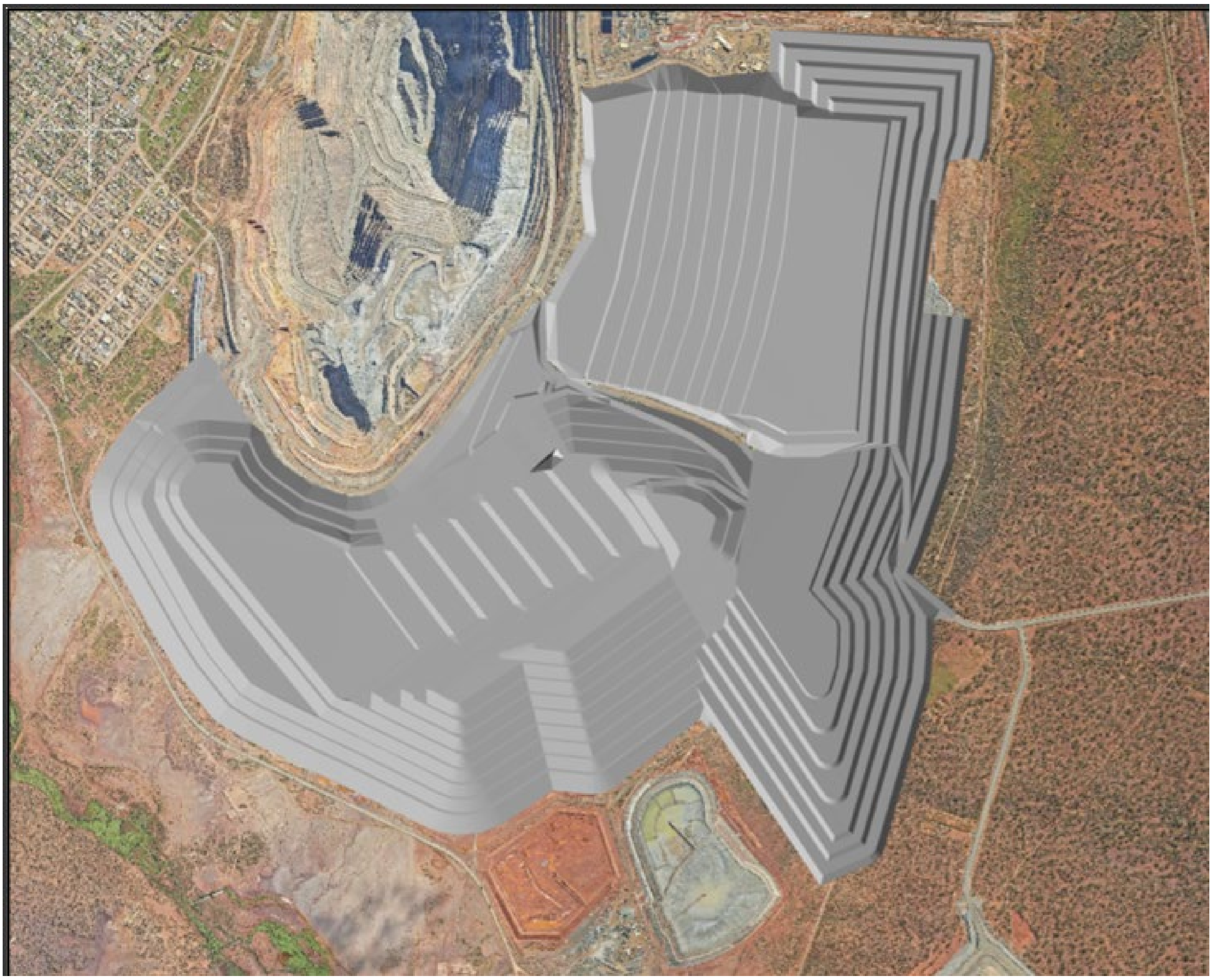


Figure 5-27: Proposed Southern WRD Design (mine site grid)

Figure 5-30 shows the design implications based on the proposed Ivanhoe Cutback Project .The additional mine waste material will be placed on the existing and expanded Southern Waste Rock Dump. The new waste dump design has a maximum height of 200m (10 benches), which is five benches more than the existing waste dump (blue area in Figure 5-30). Mine waste rock will also be used for in-pit backfill which will serve as buttressing of sections of the lower pit wall. The in-pit waste dump is to be constructed from fresh competent waste rock (Golden Mile Dolerite, Paringa Basalt and Porphyry). All weathered oxide and Black Flag material will be stored 'on-surface', as per established KCGM practice.

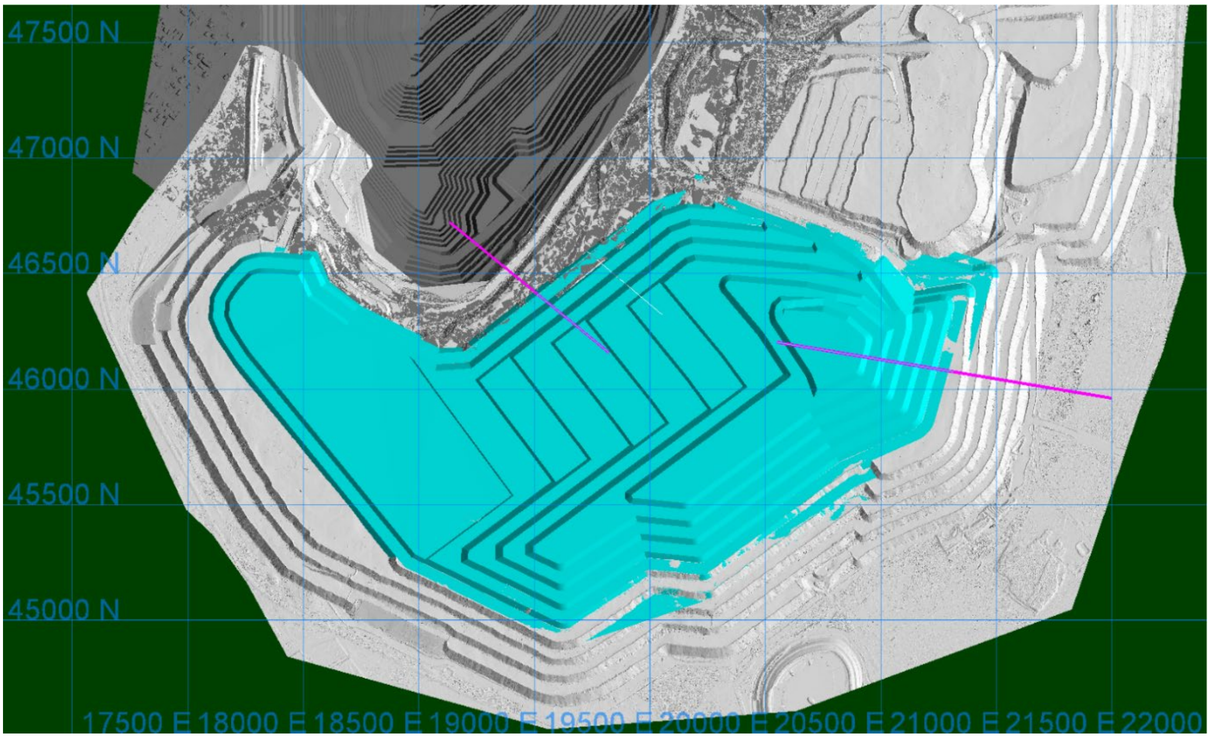


Figure 5-28: Additions to the Southern WRD Based on Proposed Ivanhoe Cutback Project

Historical TSF Footprints

Most of the remnant tailings footprints, left from the State Agreement Kaltails Retreatment Project between 1989 and 1999, as well as the Morrison calcine TSF, are now covered by the Trafalgar WRD, with planned expansion of the WRD expected to cover additional areas north of the Mt Monger road. Capping of these remnant footprints is considered an acceptable management strategy from a Contaminated Sites perspective and prevents wind and water migration of the material. The Morrison TSF, which was previously exposed, has been capped with a traffic compacted domed oxide layer and is encapsulated within the WRD.

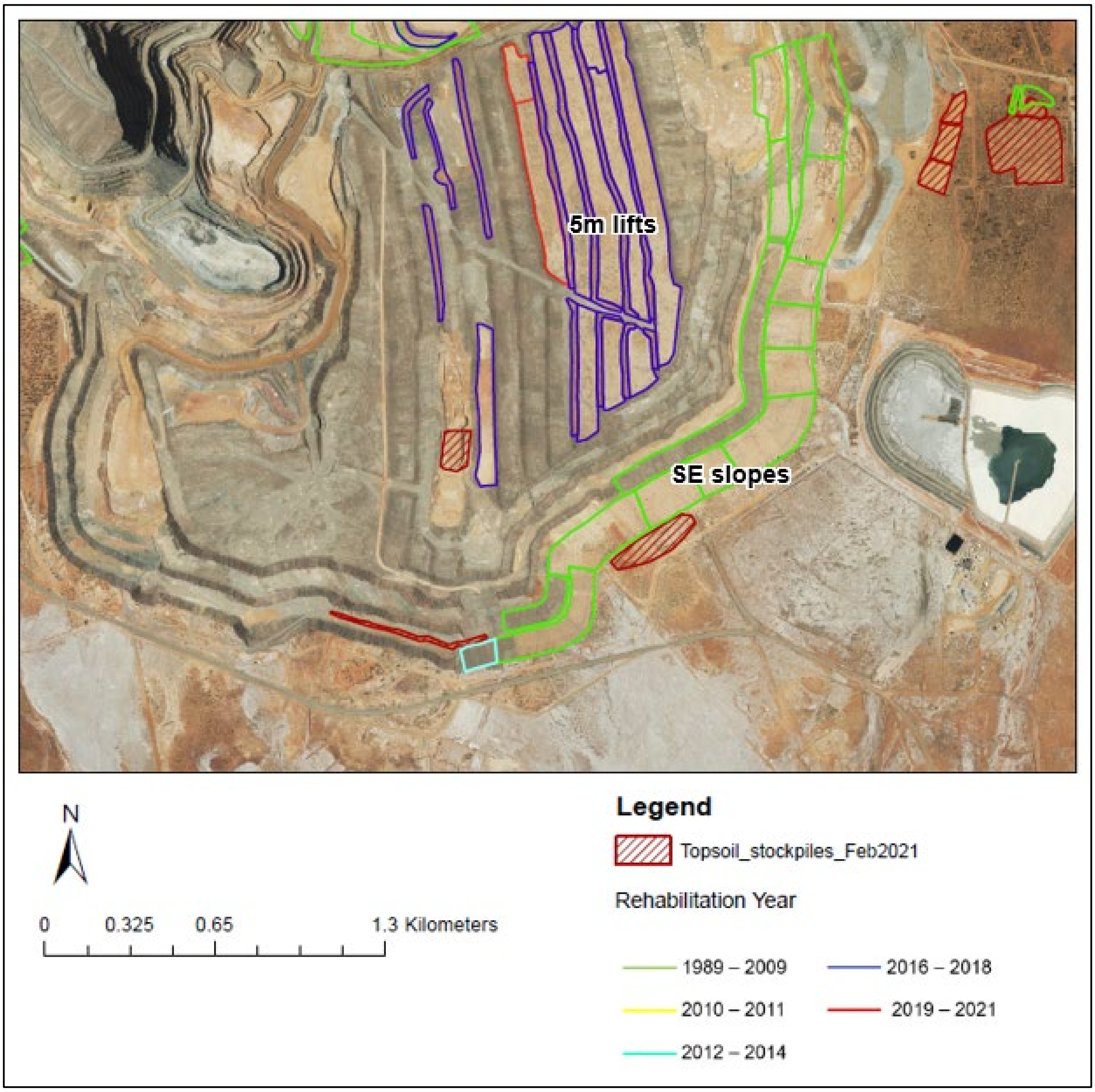


Figure 5-29: Trafalgar WRD current rehabilitation status (2021)

Completed Rehabilitation

Rehabilitation of Trafalgar WRD has occurred since 2005 (Figure 5-25). Rehabilitation styles vary, with progressive rehabilitation of the south east and south Trafalgar slopes occurring between 2005 and 2009. Rehabilitation consisted of pushing down the slopes to between 18° and 20°, retaining a berm where possible for surface water management, thick sheeting with rehabilitation material obtained from the footprint of the WRD or mined oxide material, construction of contour drains, deep ripping and seeding.

Visual inspection from 2012 to 2014 observed that while certain areas of the WRD to the south improved vegetatively, many to the south-east had very low plant cover with tunnelling and gullying present, due to the sodic, saline and hard setting nature of the oxide material used. A large portion of this area has been covered by the Eastern WRD. On the southern slopes material placement depth is varied and the amount of rock cover is insufficient to mitigate erosion, however erosion will be limited in depth due to underlying competent waste rock.

Rehabilitation of the Trafalgar 5 m lifts commenced in 2015 with rocky, shallow batters and very wide benches in alignment with the 'erosion resistant' design (Figure 5-30). Material placement has been guided by the Visual Amenity rating of the location, with better rehabilitation materials used on the western facing "highly visual" slopes. Oxide has been used on the "non visible" benches (flat areas). As this material is saline it will take time to leach to become a suitable growth medium for salt tolerant species. Good germination has occurred on the topsoiled slopes, with slower germination on the oxide covered flat area (natural leaching is required to attain a soil conductivity that is conductive to germination of salt tolerant species).

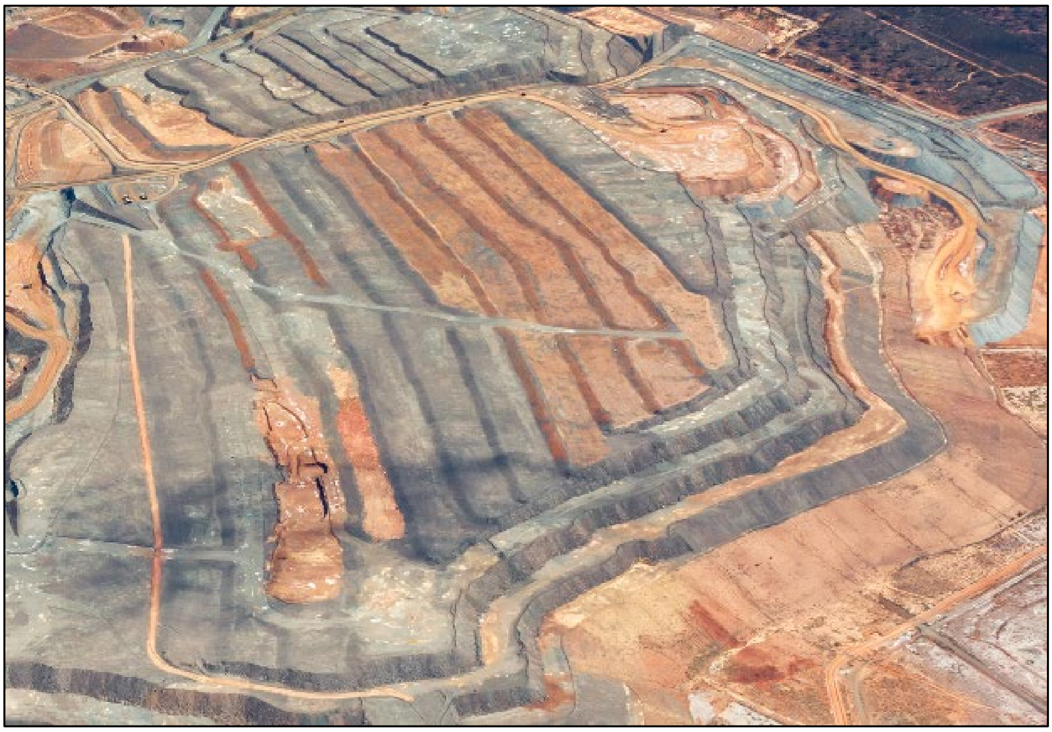


Figure 5-30: 5 m Lift Rehabilitation (2021)

5.3.2.2.3 Southern Waste Rock Dumps - Oroya Waste Rock Dump

The Oroya WRD is an active WRD, located to the north of, and abutting Trafalgar WRD, separated by the haul road to the Eastern WRD. It encompasses Radio Hill and Old Tetley's Dump (OTD) (Figure 5-31). The WRD is still active, with almost two thirds of the WRD comprising Marginal or Subgrade stockpiles which will be processed during operations.

BF shale waste material is co-disposed with waste rock within the Oroya WRD, with a buffer of 40 m of high ANC dolerite/basalt on the external faces of the dump and capping of 5 m of the final upper surfaces of the dump with benign material.

New Design (2022)

As part of the Fimiston South Project, a new phased design height change is in progress for the Southern WRD, with a final eastern height of 140 m. To achieve this design, KCGM have been in discussions with relevant approvers and stakeholders in the aviation sector; namely CASA, Air Services Australia, Kalgoorlie Airport (Shire owned) as well as consultation with all main airlines flying into Kalgoorlie-Boulder. An additional height increase has been approved (higher than the OLS), with a new design implemented on Trafalgar WRD. This design may be extended northwards over Oroya WRD. Figure 5-27 shows the new Southern WRD design.

A portion of the proposed extension to the east, the Far Eastern WRD, will potentially cover rehabilitated portions of Oroya WRD. The existing rehabilitation will be evaluated, with soil testing conducted, to develop a plan for recovery of the topsoil prior to tipping.

The closure design implemented on the new Southern WRD design over Oroya WRD will be the erosion resistant design already implemented on the western side of Oroya WRD/ Southern WRD, with the visual amenity strategy guiding topsoil placement. The design consists of 16° -17° slopes with 10 m wide berms, and a high percentage rock cover. Extensive technical work supports this design, including trials at Northern WRD. The northern portion of Oroya WRD consists of subgrade stockpiles, which will be processed, and replaced with waste rock.

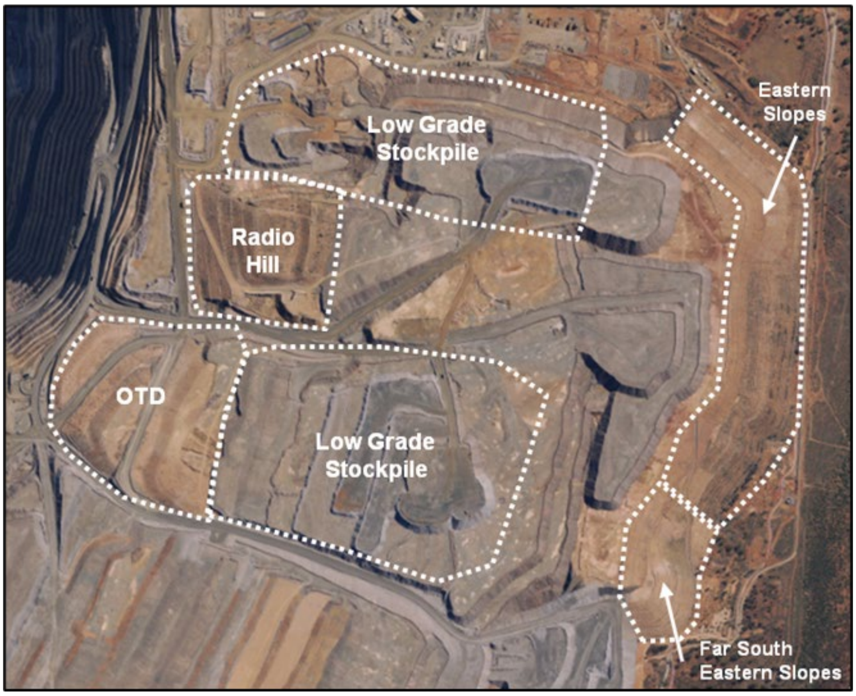


Figure 5-31: Oroya WRD Areas

Historical TSF Footprints

The Oroya, Balgold, and Galconda TSFs (including the Balgold leach vats) have been encapsulated within the Oroya WRD. The Balgold and Galconda TSFs were operational between 1984 and 1992, and the Oroya TSF was operational between 1974 and 1995. Fresh water was used for processing until 1989, thereafter hypersaline water was used. All infrastructure associated with the operation of the TSFs has been decommissioned and removed.

During encapsulation in the mid to late 1990s, elevated groundwater levels were observed in the area, which have since deepened below 14 mbgl. In 2011, a program of investigative works was conducted to establish the potential residual groundwater risk of the encapsulated Oroya TSF and if further placement of waste material over the TSF was feasible. Works involved drilling three pilot bores through approximately 20 m of waste rock material and geotechnical analysis of tailings using piezocone penetration testing (PCPT). Results determined that there was no significant geotechnical risk posed by the encapsulated TSF, as the stiffness in the tailings beds demonstrated good consolidation and settlement of the tailings material. It was also reported that seepage related to further consolidation is unlikely to occur with additional waste rock loading (Golder, 2011).

Limited information is available on the characterisation of tailings within the historic TSF footprints underlying the WRD. A single sample of oxidised tailings material was collected from a small, exposed edge of the Balgold TSF on the northern edge of the WRD (adjacent to the Open Pits Workshops) and underwent geochemical analysis in 2017. Results indicate that the tailings is NAF, with a low to moderate theoretical acid production potential and correspondingly moderate to high levels of ANC, with a significant portion of sulphur being in the already oxidised form (sulphate). Should any leachate occur, it is predicted to be alkaline and brackish.

The tailings was geochemically enriched in gold, silver, antimony, mercury and tellurium as a result of the nature of the particular gold mineralisation, but none of these elements were found to be soluble in water extracts or dilute acetic acid extracts to any extent considered to be of environmental concern post-closure when covered. The tailings are therefore considered geochemically benign, with only moderate levels of salinity in leachates and/or potential seepage, which will remain alkaline. Geochemical assessment indicates that a suitably designed waste rock cover to prevent wind and water erosion will be sufficient post-closure to mitigate risk to the surrounding environment.

Completed Rehabilitation

Rehabilitation has been completed on Oroya WRD since 1998 (Figure 5-32). Rehabilitation styles vary between areas, but generally consist of pushing down the batters to between 18° and 20°, retaining a berm where possible for surface water management, thick sheeting with rehabilitation material obtained from the footprint or oxide material, construction of contour drains, deep ripping and seeding.

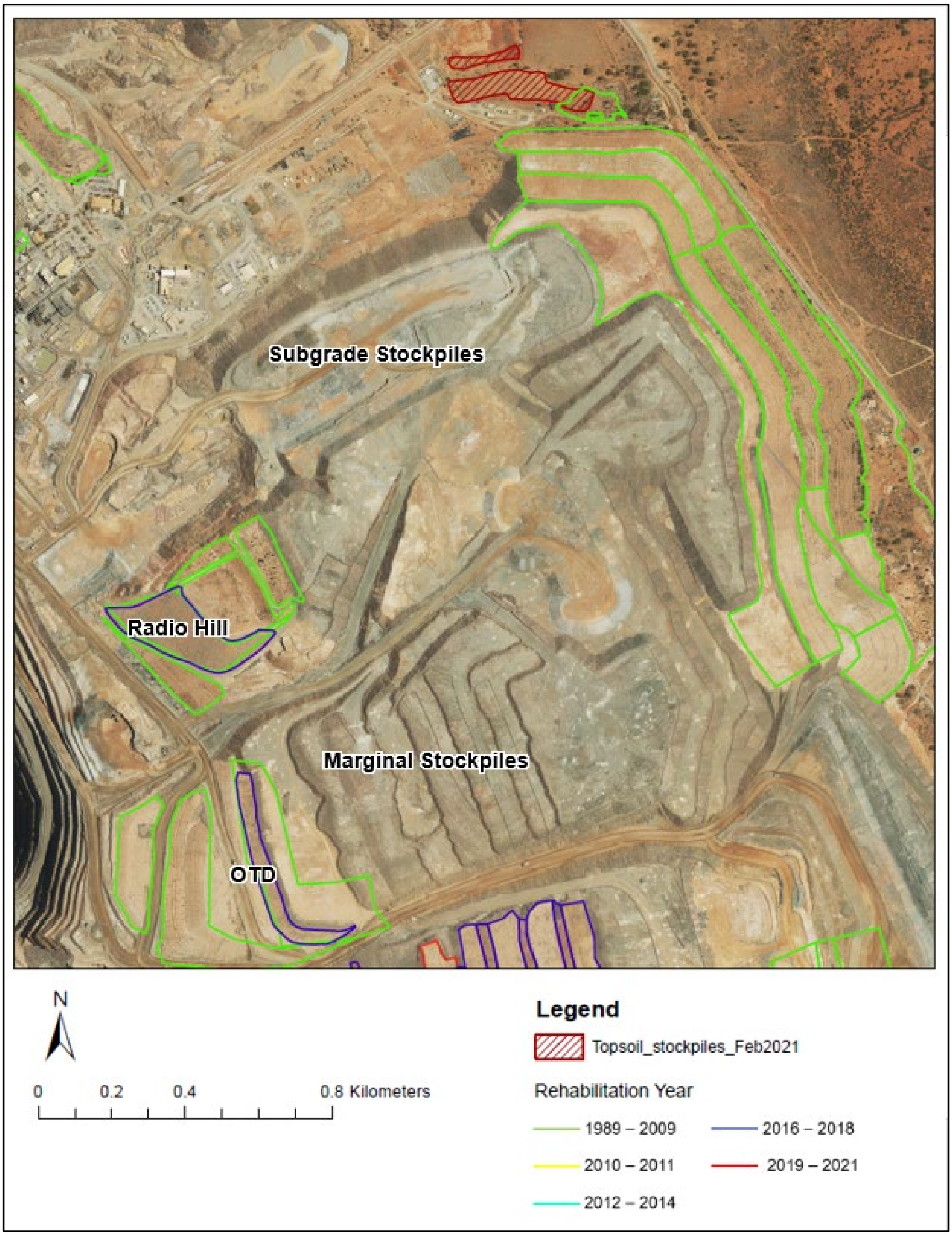


Figure 5-32: Oroya WRD Current Rehabilitation Status (2021)

Eastern Slopes Rehabilitation

Oroya WRD has some good revegetation areas, particularly on the lower eastern slopes (Figure 5-33). Better quality materials were used on Oroya lower Eastern slopes, with several trials for the use of mycorrhizal fungi and 'moonscaping' completed. The depth of materials applied to the southern slopes (abutting Trafalgar) has been significant, with the amount of surface rock cover insufficient to mitigate erosion. The batters have three "water harvesting" drainage control berms which have not been cut accurately along the contour, resulting in the concentration and subsequent spilling of storm runoff. In the original design, these contour berms were to have discharged to drop structures, but they were not installed. However, as the contour drains were installed inaccurately, the drop structures would not have functioned as intended and the final rehabilitation outcomes would not have been improved.

Figure 5-33: Oroya WRD, Eastern slopes (2021)

Eastern Slopes 1998 Rehabilitation

A section of the bottom lift of the eastern batters of the Oroya WRD (Figure 5-34) was rehabilitated in 1998 by pushing the slopes down to 14°, sheeting with growth medium, deep ripping and cutting in narrow back sloping contour berms. Seeding was undertaken at 10 kg/ha with application of Agras 1 fertiliser at 100 kg/ha, with different seed mixes applied to the lower, middle and upper parts of all slopes. In recent years, vegetation in this area is showing stress due to high average annual temperatures and several years of low annual rainfall (as discussed in Section 5.1.1).

Eastern Slopes 2003 Rehabilitation

In 2003 the northern end of the first lift and all of the second lift of the eastern slopes were battered to 16° to 20°, sheeted with oxide growth medium, ripped and seeded. Narrow back sloping 'contour berms' were cut following battering and material spreading roughly midway up each lift, with 5 to 10 m wide berms separating each lift.

Atriplex and Maireana species dominated in lower storey plant cover. A review of this area by botanical professionals indicated that while the understorey vegetation was in good condition, erosion was present. In recent years, vegetation in this area is showing stress due to high average annual temperatures and several years of low annual rainfall (as discussed in Section 5.1.1).

Erosion remains an issue for these areas due to the depth of oxide material applied. However, erosion will be limited to the interface between oxide cover and underlying waste rock. A rocky crest bund has been installed above this area to manage stormwater and prevent failure of the crest bund, which was previously constructed of low strength oxide material.

Figure 5-34: 1998 Rehabilitation – southern lower lift (2013 below and 2021 above)

Eastern Slopes 2004/5 Rehabilitation

In 2004 & 2005, the third lift of the landform was battered to approximately 20°, sheeted with oxide material, ripped and seeded. A narrow back sloping 'contour berm' was cut roughly midway up the lift, with 5 to 10 m wide berms separating each lift. A 1-2 m high crest bund was constructed and the dump top was sheeted with oxide rehabilitation material. The upper bench top was not seeded.

Visual inspections have observed that despite relatively good recruitment and growth of lower storey and emergent upper storey vegetation, many of the furrows created during contour ripping have been filled with sediment, with evidence of early gullying and tunnelling. In recent years, vegetation in this area has showed stress due to high average annual temperatures and several years of low annual rainfall (as discussed in Section 5.1.1). Progress of revegetation is shown in Figure 5-35.

A rocky crest bund has been installed above this area to manage stormwater and prevent failure of the crest bund which was previously constructed of low strength oxide material.

Eastern Slopes – 2018 Rehabilitation

In 2018, a large robust crest bund with 10 m of rock armouring behind it was constructed along the crest on the eastern side of Oroya WRD, to prevent crest bund failure.

Figure 5-35: Oroya WRD Third Lift Eastern Batter – Status of Rehabilitation (2013 left and 2021 right)

H Dam Area Rehabilitation

The H-Dam area at the eastern toe of the Oroya WRD previously included open pits, trenches and leach vats. These features were subsequently back-filled with rock, oxide and topsoil, shallow ripped to create gentle undulations and hand seeded.

Previous monitoring has indicated the presence of faunal niches including leaf litter, logs and rocks greater than 25 cm in diameter were observed and evidence of faunal utilisation (ants and kangaroos) was noted. Apparent saline capillary rise, following periods of inundation and waterlogging, has led to vegetation decline in a small portion of this area. Overall, KCGM considers that this area is performing well and is not at risk of underperformance.

Western Slopes

Western Slopes – Radio Hill Rehabilitation

Radio Hill was constructed from the early 1990s and the western faces were rehabilitated in 2006, which included battering to approximately 20°, contour ripping and application of seed in April 2007, in much the same style of rehabilitation of the eastern slopes of the Trafalgar WRD. Vegetation recruitment on the upper surfaces is good, and limited growth has occurred on the slopes. Due to the depth of material placement gully erosion had occurred.

Due to the medium visual amenity rating of the area, and potential relocation of the Public Lookout, remedial works were implemented on the WRD in 2017/8 (Figure 5-36). The WRD has been recontoured, sheeted with a layer of waste rock, and had growth media reapplied. A robust rocky crest bund and back sloping rock crest area, to prevent tunnel erosion through the upper oxides, also forms part of the design. The area was rehabilitated again in 2017/8, with a rock capping placed over the oxide waste and subsequent replacement of original Class D topsoil. Additional Class A topsoil was brought in to supplement the works. Significantly improved regrowth has occurred on the Class A soils compared to the Class D soils, highlighting the difference in soil properties (Figure 5-37).

Figure 5-36: Radio Hill Prior to 2017 (Left) and during 2017 Remedial Works (Right)

Figure 5-37: Radio Hill (2019) after remedial works

(note vegetation difference between Class D (left) and Class A (right) soils)

Western Slopes – Old Tetley's Rehabilitation

Old Tetley's Dump (OTD) is a small segment of the Oroya WRD that was rehabilitated in 2006 by reshaping to 20° with 5 m back sloping berms, ripping and seeding. Oxide was used as rehabilitation material.

Visual observations of this dump indicate that although vegetation growth has marginally increased, it is performing poorly vegetatively and erosionally. This is most likely due to placement of excessive poor quality oxide material. Due to the visual amenity rating of the area, and potential relocation of the Public Lookout, remedial works were implemented on the upper WRD lift in 2017 (Figure 5-38). The WRD has been stripped of excess material and a robust rocky crest back slope of 10m as part of the design. The upper surface was also reshaped to prevent overtopping. Vegetation performance has been slow, due to the salinity of the material and insufficient rain in recent years.

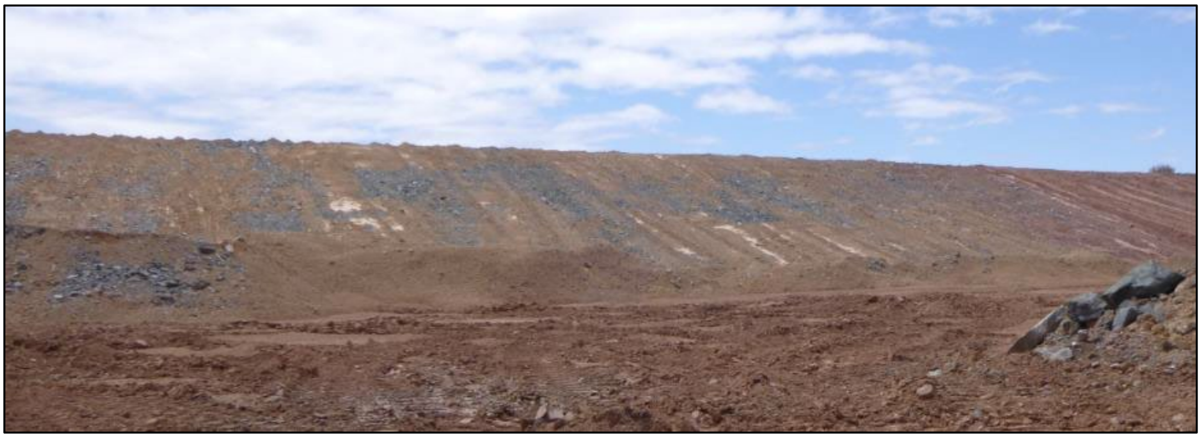


Figure 5-38: OTD Remedial Works in Progress 2017 (Oroya WRD)

5.3.2.2.4 North Eastern WRD

The North Eastern (Central) WRD (Figure 5-39) is an active waste dump, with the southern half consisting of subgrade and marginal stockpiles which will be processed during operations. A substantial volume of Pit oxides was stockpiled on the western upper section of the WRD during development of the Golden Pike Cutback intended to be used within rehabilitation of flat surfaces on the Fimiston WRDs. An inactive and closed City of Kalgoorlie-Boulder rubbish tip has been buried to the north of the north east ramp. The approved design for older rehabilitation of the Northeast WRD is the same as for the Southern (Oroya and Trafalgar) WRDs (20 m benches with berms at 10 m intervals). Berms are 4 to 5 m in width, and the rehabilitated slopes are 20° or less. A portion of the rehabilitation completed on the eastern side of the WRD has performed well, most likely due to the rockiness of the final surface. The north eastern portion has been capped with a very thick layer of oxide, and has erosion gullies.

As per KCGM waste management practices, BF shale waste material is co-disposed waste rock within the North East (Central) WRD waste section, with a buffer of 40 m for high ANC dolerite/basalt on the external faces of the dump and capping of 5 m of the final upper surfaces of the dump.

A high grade BF ore stockpile is located in the central north area of this WRD. This material is considered long lag PAF. Current closure planning assumes a conservative option of the material remaining in place. A compacted oxide capping will be placed over the material, to minimise water infiltration and oxidation. Further information on this is provided in Section 9 of the MCP.

In general, the closure design consists of 16° -17° slopes with 10 m wide berms, and a high percentage rock cover. Extensive technical work supports this design, including trials at Northern WRD. However some areas will require site specific adjustments due to historic placement of materials or are already rehabilitated as per approved designs. An additional upper approved lift of competent waste rock is being tipped to encapsulate most of the oxide on the upper NE section. The southern half of the WRD consists of subgrade stockpiles. These will be processed, and replaced with waste rock.

Figure 5-39 shows the NE WRD current status and Figure 5-40 shows the final design of NE WRD.

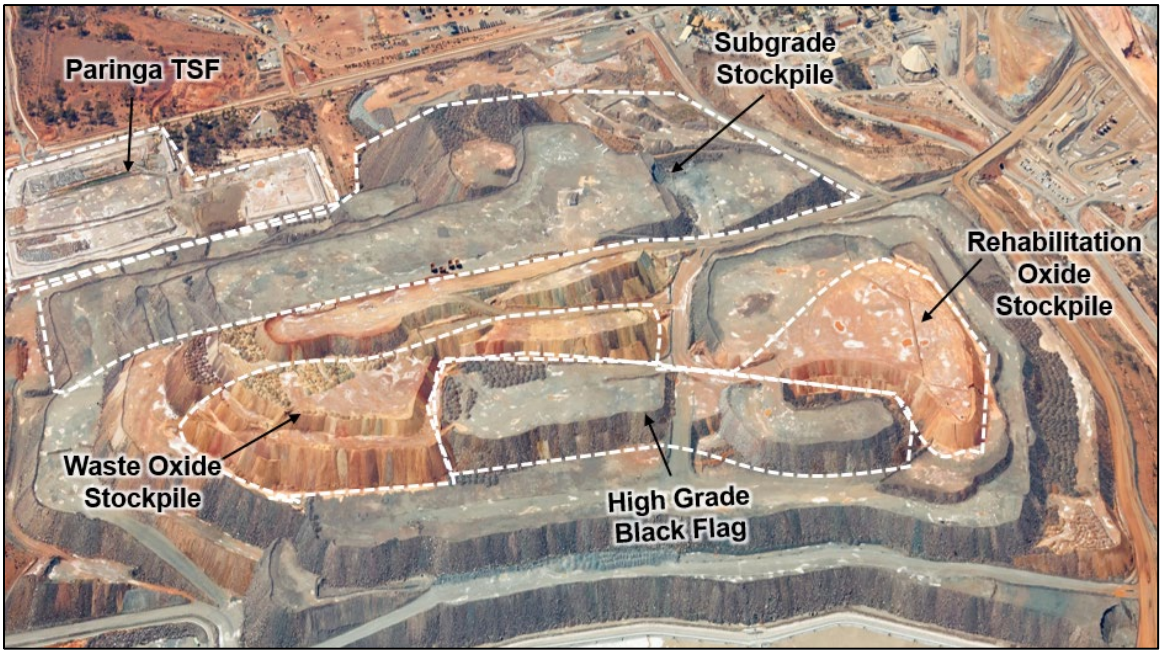


Figure 5-39: North Eastern WRD, viewed from the North West (2021)

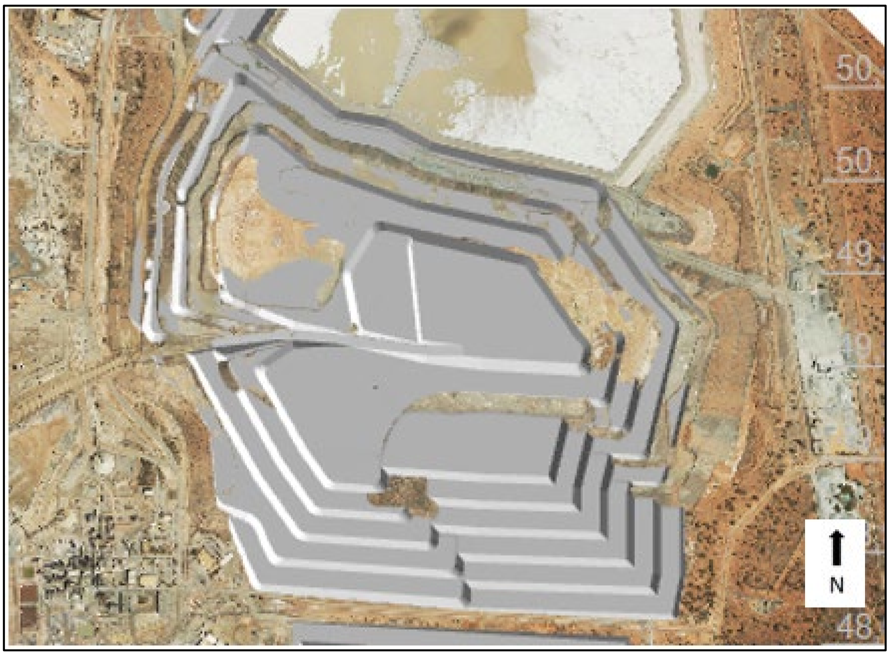


Figure 5-40: North Eastern (Central) WRD final (mine site grid), including capping Paringa TSF

Historical TSF Footprints

The inactive hypersaline Paringa TSF abuts the North Eastern WRD to the south east. It was operational between 1982 and 1991. It has been reported to the DWER as a potentially contaminated site. The initial closure strategy for this TSF was to extend the North Eastern WRD to encapsulate the TSF and to create a capping material stockpile for the Fimiston TSFs. However, due to the proximity of operational tailings and water infrastructure, a capping material stockpile cannot be established. The TSF will be encapsulated during closure of the North Eastern WRD.

In 2011 Golder Associates conducted a geotechnical investigation to establish the stability and potential risk associated with capping (Golder, 2012). Porewater pressure and undrained shear strength were determined within the tailings beds using piezocone penetration tests. It was outlined that the facility has a low potential to liquefy, is stable at its current height and Factor of Safety (FoS) is above accepted minimum values. The results also indicated that the Paringa TSF will remain stable with a 5 m capping of waste rock; placement of waste rock greater than 5 m in height is possible with step backs or buttressing of the embankments incorporated into the design.

Geochemical characterisation was conducted on a surface sample of Paringa tailings (located to the south west of the WRD) in 2017 (MBS Environmental 2018a). Characterisation determined that the tailings have low to moderate theoretical acid production potential and correspondingly moderate to high levels of ANC, with a significant portion of sulphur in most samples being in the already oxidised form (sulphate). As a result, all samples were classified as NAF, with Paringa TSF further classified as acid consuming. Leachate and hence any potential for seepage from these tailings is predicted to be alkaline and moderately saline in perpetuity. The tailings were found to be geochemically enriched in gold, silver, antimony, and tellurium as a result of the nature of the particular gold mineralisation, but none of these elements were found to be soluble in water extracts or dilute acetic acid extracts to any extent considered to be of environmental concern post-closure when covered.

The Paringa TSF is therefore considered to contain geochemically benign tailings, with only moderate levels of salinity in leachates and/or potential seepage, which will remain alkaline. KCGM considers that it is a low risk to the environment from a closure perspective. Further work (drilling) in 2019 has indicated that there is no phreatic level in the TSF.

Completed Rehabilitation

Progressive rehabilitation of the Northeast WRD has occurred between the mid-1990s and 2007 in three main areas; Black St Trials, Pad 19 and the Eastern Slopes (Figure 5-42).

Western Slopes – Black St Trials

The Black Street slopes include trial plots for cover application from the early to mid-1990s, with varying levels of vegetative success. Refer to Section 5.5 for further information.

Visual observations of the area indicate that certain treatments remain relatively more successful than others, with erosion evident on those plots with soil. However, erosion appears to have stabilised, with no large gullies present. Plots with mulch appear to be performing relatively poorly, indicating that mulch did not appear to improve revegetation success. This section of the rehabilitated slope is now more than 20 years old and gives a good indication of typical long term rehabilitation outcomes at KCGM. Overall, KCGM does not consider this area to be a high risk in terms of poor rehabilitation performance.

Western Slopes – Northern Black St Slopes

The north western slopes, located immediately north of the Black Street trials, were rehabilitated in 1998 (**Error! Reference source not found.**). Visual observations indicate that this area appears to be performing well vegetatively, with minor erosion present. Overall, KCGM does not consider this area to be a high risk in terms of poor rehabilitation performance.

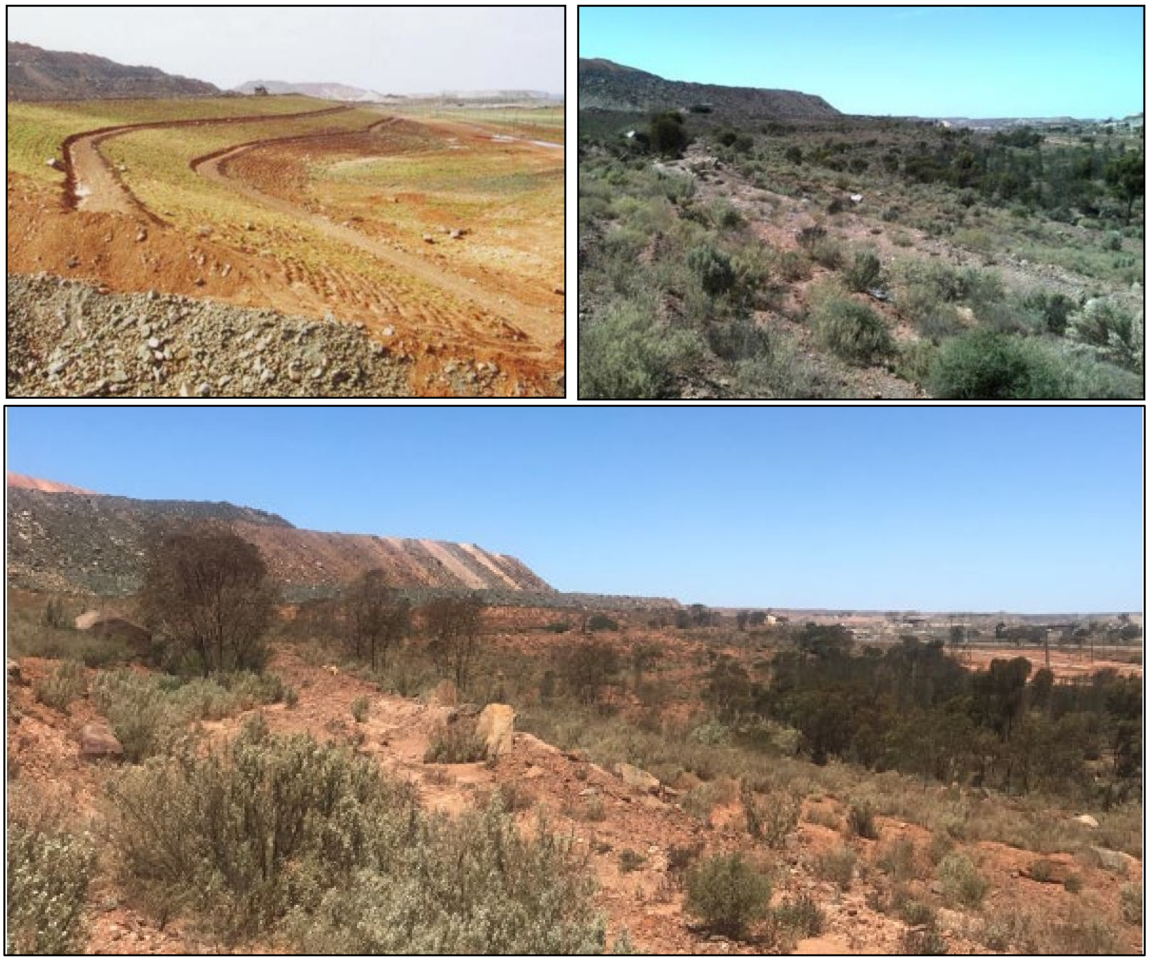


Figure 5-41: North Eastern WRD Black Street Rehab 1998 (left), 2013 (right), and 2021 (below)

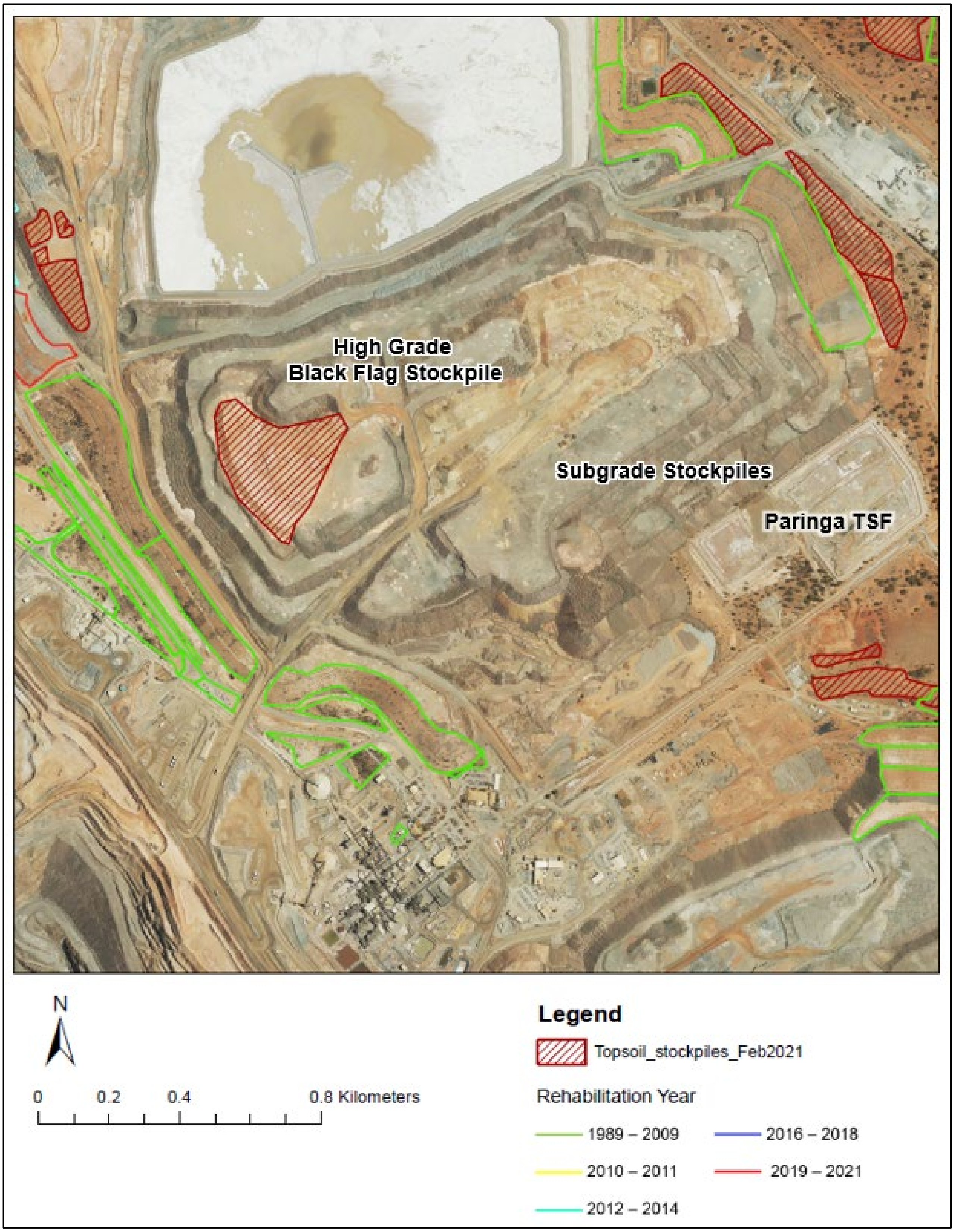


Figure 5-42: North Eastern (Central) WRD Current Rehabilitation Status (2021)

Western Slopes – Pad 19 Rehabilitation

Pad 19, located on the western/south-western side of the North Eastern WRD, was battered down, sheeted with rehabilitation material and deep ripped in 2006. The rehabilitated area was hand seeded with the KCGM pioneer species seed mix in January 2007. A section of the Pad 19 area was re-ripped in 2007 (after seeding occurred) to correct the positioning of rip lines. The area was then seeded with a secondary seed mix in January 2008.

A review of this area by botanical professionals has indicated that it was 'potentially satisfactory'; with reasonable vegetation condition and high diversity. The presence of all three strata, as well as reproductive evidence for several species, indicated the community has attained some level of resilience. Further monitoring in 2014 has classified this area as 'satisfactory' for all vegetative measures other than proportion of bare quadrats and plant cover, but with continued growth it is likely to attain a satisfactory rating for these measures.

Observations from 2015-2017 have shown a continued trend of vegetation recruitment, with minor erosion developing (Figure 5-43). Overall, KCGM does not consider this area to be a high risk in terms of poor rehabilitation performance.

Figure 5-43: Pad 19 Rehabilitation Progress (2014)

Eastern Slopes

The northern section of the eastern slopes has been rehabilitated, sheeted with oxide or topsoil, ripped, and seeded. No rehabilitation monitoring has been done, although observations show it to be performing well vegetatively with little erosion occurring. Overall, KCGM does not consider this area to be a high risk in terms of poor rehabilitation performance.

5.3.2.2.5 Northern Waste Rock Dump

The Northern WRD (NWRD) commenced construction in 2012 and is an active dumping location which has yet to reach its final height. The NWRD is located to the north of the Fimiston Open Pit and abuts the Fimiston I TSF.

The erosion resistant design was successfully trialled on this WRD. The design consists of 16° -17° slopes with 10-15 m wide berms, and a high percentage rock cover. Extensive technical work supports this design.

BF shale waste material is co-disposed with waste rock within the Northern WRD, with a buffer of 40 m for high ANC dolerite/basalt on the external faces of the dump and capping of 5 m of benign material on the final upper surfaces of the dump.

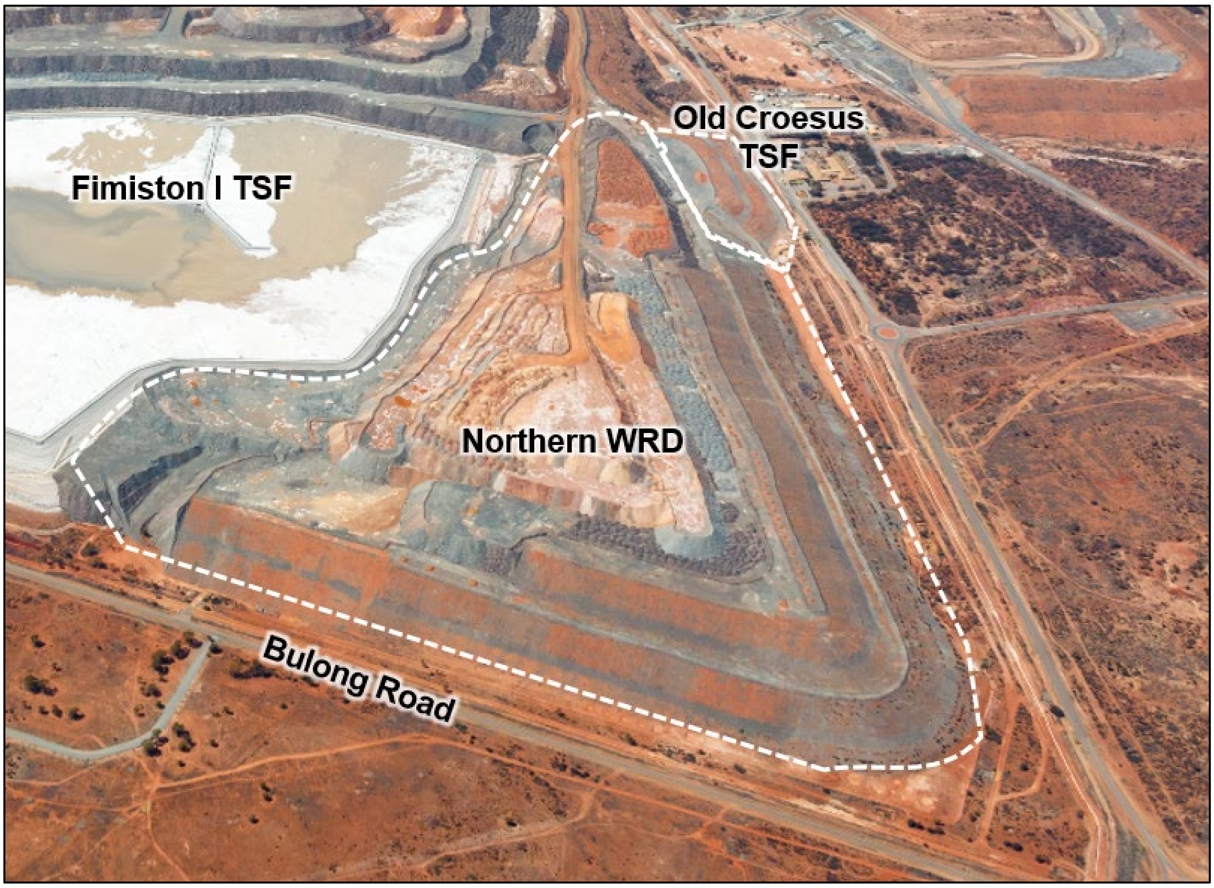


Figure 5-44: Northern WRD Viewed from the North (2021)

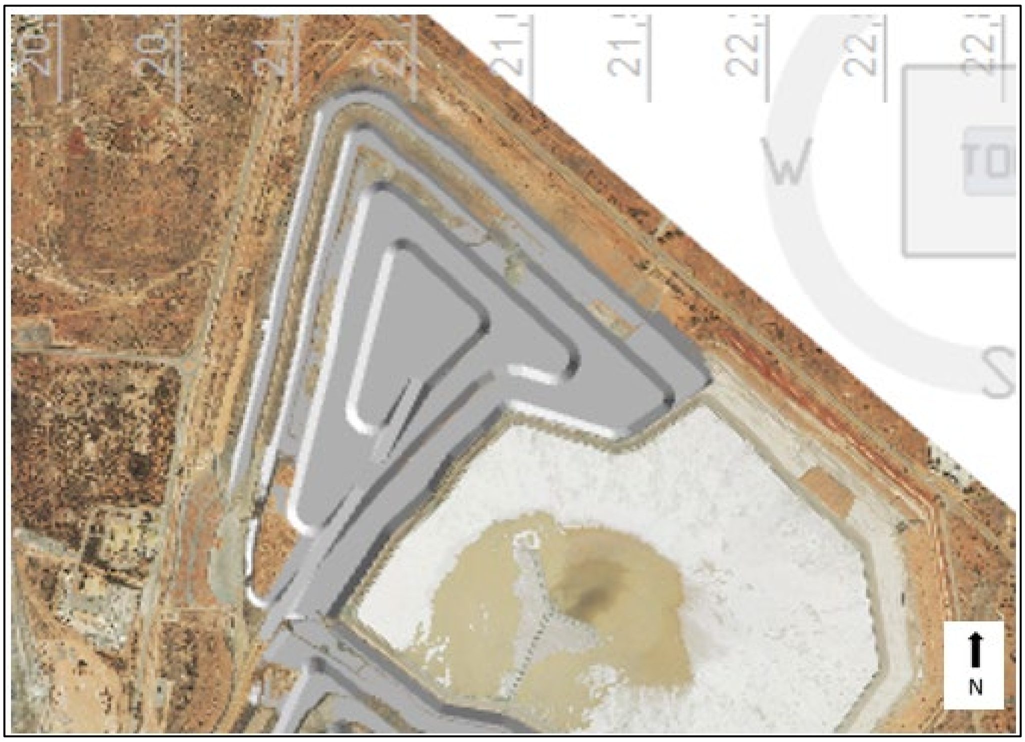


Figure 5-45: Northern WRD Final Design (mine site grid)

Historic TSF Footprints

Two historical TSFs are within the footprint of the NWRD; Herliette and Old Croesus TSFs. Following sampling of Herliette tailings material in 2012 and full encapsulation by the progression of the NWRD in 2014, KCGM considers this site low risk for adverse environmental impact.

Western Slopes – Old Croesus TSF

The Old Croesus TSF, located adjacent to Fimiston I TSF, was operational from the 1960s to 1988 and has been largely covered during construction of the Northern WRD. The western external face was rehabilitated in 1999/2000 as a dust control measure. This involved covering the batters with 1 m of competent waste rock and 0.5 m of oxide; no 'topsoil' was used as it was thought that the TSF would be encapsulated in the future. A berm was constructed approximately mid-slope for harvesting run off. The embankments were ripped on the contour and seeded in 2000. The rehabilitation was not successful, largely due to poor water control causing erosion with a large tunnel forming at the base of the western toe, opposite the Black St gate house.

Due to the continued erosion of the western flank of the TSF, remedial works were conducted during the 2020/21 period, with the TSF reshaped to a single slope, and then capped with waste rock (Figure 5-46). The upper surface was also levelled off and capped with waste rock. A robust crest bund with a backslope has been installed for water management. Class D subsoil was used as a growth medium. The slope will be seeded in 2021, although some vegetation recruitment has already occurred naturally. The TSF is now fully encapsulated.

It was determined that it was not economical to reprocess the TSF in 1997 and 2006 when it was assessed for potential re-treatment. Geochemical characterisation was conducted on a surface sample of Old Croesus tailings in 2016 (MBS Environmental 2018a). This characterisation determined that the tailings are NAF and acid consuming, with a low to moderate theoretical acid production potential and correspondingly moderate to high levels of ANC.A significant portion of sulphur in most samples was found in the already oxidised form (sulphate).

Leachate and hence any potential for seepage from these tailings is predicted to be alkaline and brackish in perpetuity. Tailings were geochemically enriched in gold, silver, antimony and tellurium as a result of the nature of the particular gold mineralisation, however, none of these elements were found to be soluble in water or dilute acetic acid extracts to an extent considered to be of environmental concern post-closure when covered.

KCGM considers this TSF a low risk in terms of adverse environmental impacts post closure; in addition, geotechnical concerns regarding erosion of the western flank have now been resolved.

Figure 5-46: Old Croesus 2021 Capping and Completed Rehabilitation

Completed Rehabilitation

Western and Northern Slopes

Sections of the first and second lift of Northern WRD were used as a trial of the newly developed erosion resistant rehabilitation design. The lift was battered to 16° or 17°, with 200 mm of rehabilitation materials from nearby stockpiles applied (excluding within a rocky band 50 m up slope) and the surface ripped to produce a sufficient rocky surface cover to reduce erodibility. Rehabilitation continues on the Northern WRD when areas become available, using the same design and implementation methods. The outcomes of the trial were successful, and have been implemented across the Fimiston WRD, as new areas become available.

Hand seeding was implemented between 2014 and 2016 on these slopes, with very good vegetation recruitment. The area is showing good vegetation diversity with Eucalyptus and other perennial species noted. No erosion had been observed.

Figure 5-47: Northern WRD Western First Lift Face 2014 (top left), 2017 (top right) and 2021 (bottom)

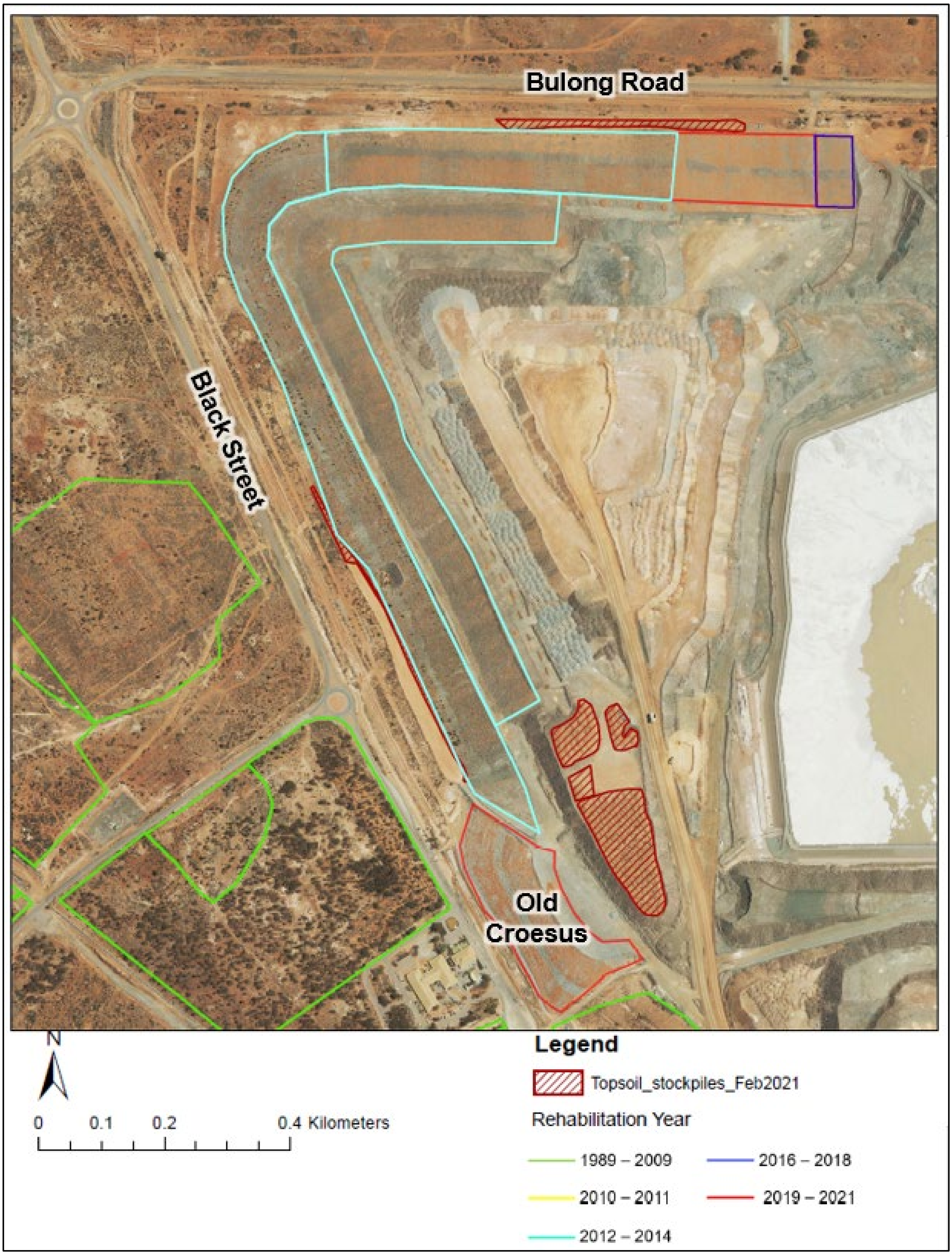


Figure 5-48: Northern WRD current rehabilitation status (2021)

5.3.2.2.6 Environmental Noise Bund

Located on the western side of the Fimiston Open Pit, the Environmental Noise Bund has been constructed from competent waste rock (with small oxide areas) to reduce noise carried across the town from mining and processing activities. It will be retained post closure to assist with noise impact to the City of Kalgoorlie-Boulder. The ENB has three distinct sections (Figure 5-49):

- The Croesus Noise Bund (CNB);
- The Golden Pike Noise Bund (GPNB); and
- The Southern Noise Bund (SNB).

The Croesus and Southern sections are the oldest components, with the central Golden Pike section the most recent.

The ENB is Highly Visible from the Goldfields Highway and some residential areas. As the landform is complete and has been rehabilitated it is not anticipated that any further material will be required for rehabilitation.

The Croesus NB (Figure 5-50) is located at the north-western corner of the Fimiston Open Pit and is Highly Visible from the Goldfields Highway. The Croesus NB partially encapsulates the Croesus processing plant footprint (decommissioned in 1997).

Figure 5-49: Environmental Noise Bund

Figure 5-50: Croesus Noise Bund (2021)

The Golden Pike Noise Bund (Figure 5-51) was constructed to replace the original noise bund that was to be mined through during the Golden Pike Cutback. It is constructed from waste rock (predominately dolerite and basalt) and, in some areas, oxide material. It is a single lift and ranges in height from 14-17 m. In 2017 a wall remediation project in Fimiston Open Pit resulted in a narrowing of the width of the Golden Pike NB footprint in the vicinity of the project, with no change to the western side of the NB.

The Southern NB (Figure 5-52) was initially constructed in 1991 with one 15 m lower lift and 10 m upper lift in waste rock and oxide, and rehabilitated in 1995/1996. The southern section was constructed in 2003 from oxide and rehabilitated shortly after.

Figure 5-51: Golden Pike Noise Bund (2021)

Figure 5-52: Southern Noise Bund (2021)

For the long-term post mine closure modelling the intact rock strength was significantly reduced for the disturbance zone simulating the long-term deterioration over >200 years. By this time pit lake water levels would have rebounded to -600mRL and the resultant pit lake providing greater stability. Modelling results indicate:

New Design (2023)

For implementation of the proposed Fimiston South project, as described in the S38 EPA submission, the Southern NB will require relocation westward. The existing Southern NB will be stripped of topsoil, dug off and become part of the pit footprint. A benefit of this adjustment will be the removal of an underperforming oxide section of the existing noise bund. The NB will be replaced by an operational NB, with a smaller footprint. The operational noise bund will be constructed of competent waste rock with a height of 15m to ensure effective operational noise management.

Geotechnical stability modelling by Itasca Australia (2025) indicates no probability of pit wall failure that could affect the public surface infrastructure or proposed abandonment bund. The study concluded that using the FOS 1.5 contour is a reasonable and conservative forecast for long term stability for closure purposes. The relatively rapid rebound of post closure pit lake water levels will result in a pit lake providing additional wall stability. Modelling results indicate:

For the long-term post mine closure modelling the intact rock strength was significantly reduced for the disturbance zone simulating the long-term deterioration over >200 years. By this time pit lake water levels would have rebounded to -600mRL and the resultant pit lake providing greater stability. Modelling results indicate:

- There is no predicted large scale (inter-ramp or overall) wall instability. Overall slope stability is still over FOS1.5 for the entire west wall.
- Oxide domains have noticeable stability drop to a minimum FOS of 1.15, indicating a circular failure mechanism as a result of reduced cohesion. These less-stable oxide areas are however still within the pit footprint (no impact on external surface public infrastructure).
- A few predicted localised multibench failures are mainly at the lower part of the pit, which have no impact on the upper wall stability or surface public infrastructure.

Historical TSF Footprints

The Croesus TSF is located at the northern end of the Fimiston Open Pit pit shell. The northern portion of the TSF was reclaimed by Normandy Kaltails between 1998 and 1999 and the recovery of any further economic grade is not considered viable. The Croesus TSF was reported to the DWER as a potentially contaminated site (AOC110). A small wedge on the eastern side of the TSF has remained exposed, allowing for sampling. The rest of the TSF is encapsulated within waste rock.

Geochemical characterisation was conducted on a surface sample of Croesus tailings in 2016 (MBS Environmental, 2018a). Characterisation determined that the tailings have low to moderate theoretical acid production potential and correspondingly moderate to high levels of ANC, with a significant portion of sulphur in most samples being in the already oxidised form (sulphate). As a result the tailings were classified as NAF. Leachate and hence any potential for seepage (depending on closure design) is predicted to be alkaline and moderately saline in perpetuity.

The tailings were found to be geochemically enriched in gold, silver, antimony, and tellurium as a result of the nature of the particular gold mineralisation, but none of these elements were found to be soluble in water extracts or dilute acetic acid extracts to any extent considered to be of environmental concern post-closure when covered. Tailings samples were also geochemically enriched in arsenic, cobalt, copper, molybdenum, selenium, and lead. Selenium, lead, and copper in these samples were not found to be soluble under the alkaline conditions expected to prevail post-closure and these elements, despite enrichment, are not considered to pose a risk to the environment. Concentrations of cobalt and molybdenum in water leachate were found to marginally exceed the livestock drinking water guidelines, however, any potential post-closure seepage from Croesus TSF would eventually report to the Fimiston pit lake.

Completed Rehabilitation

All sections of the Noise Bund have been rehabilitated, with techniques reflecting rehabilitation philosophy at the time of construction.

Figure 5-53: Environmental Noise Bund Current Rehabilitation Status (2021)

Northern Area – Croesus Noise Bund

Rehabilitation commenced in stages following construction, commencing in 1999 with the two approximately 20 m lifts having a narrow 5 m back sloping, water harvesting compartmentalised berm.

The lower lift of the west facing northern section of the Croesus Noise Bund was rehabilitated in 2001. Rehabilitation material was applied over the oxide/hard rock material. The area was ripped, hydro-mulched and seeded. Repair work was completed on several gullies on the west facing slopes in 2003, but erosion has reformed.

Rehabilitation of the second lift of the Croesus NB was originally completed in 2003; however, as the excessive application of rehabilitation materials resulted in erosion, stripping was undertaken and stockpiled on the dump top in 2008. The stripped area was re-ripped and seeded with pioneer species.

In 2009, the southern section of the first lift of this waste dump was re-graded to approximately 20°, sheeted with 300 mm of rehabilitation material and seeded by hand.

Visual observations during 2012 to 2014 have highlighted vegetation success on the lower lifts. Vegetation monitoring conducted in 2014 indicated that this landform has achieved 'satisfactory' rehabilitation success, although there were marked differences in some measures between transects. Erosion monitoring of this landform in 2014 showed actively eroding gullies, most likely due to the remaining thickness of the topsoil in some areas and the low percentage rock cover on the surface.

Figure 5-54: Croesus Noise Bund Lower Lift, Western Side 2013 (top) and 2021 (bottom)

Central West – Golden Pike Noise Bund

Rehabilitation occurred from 2011 and 2012, consisting of re-grading to 18-20°, sheeting with 300 mm of rehabilitation material (stripped from the Golden Pike Cutback and Northern WRD footprint) and deep contour ripping and seeding with the KCGM pioneer seed mix.

Visual observations from 2012 have noted good recruitment of lower storey species and minimal erosion (Figure 5-55). There is a small section of gullying which developed following large rainfall events in early 2013 where insufficient water control on the dump top led to ponding against the crest bund, with eventual failure of the bund. Due to the depth of material placement, gullying depth is limited by underlying waste rock and is unlikely to continue to deepen.

(Top: Battering 2011. Middle: 2013 Progress of rehabilitation Bottom: 2021)

Figure 5-55: Golden Pike Noise Bund

South – Southern Noise Bund

Rehabilitation consisted of re-shaping, sheeting with rehabilitation material, seeding and hand planting of native seedlings on the lower lift and on the flat at the toe of the dump as part of a community tree planting day in 1995/1996. Rock drains have also been constructed on both lifts to aid water control off the slopes. The southernmost section of the dump was constructed during the mid-2000s from oxide.

Visual observations from 2012 have indicated that the lower lift has excellent vegetation condition with high diversity, all three strata and several species indicating the community has attained some level of resilience (Figure 5-56). The upper lift is not performing as well, with limited species diversity and cover, possibly due to quality of rehabilitation material used. Some gullying has been observed in the northern section within rock drains, although this appears to be self-armouring.

The southern noise bund will be modified to a thinner shape as part of the Fimiston South project.

A portion of the southern noise bund will be dug off as part of the S38 Fimiston South project implementation. It will be replaced by a hard rock noise bund further to the west.

Figure 5-56: Southern Noise Bund Lower Lift Status of Rehabilitation 2013 (top) and 2021(bottom)

5.3.2.3 Fimiston Mineral Processing Infrastructure

Infrastructure related to mineral processing features at Fimiston has been grouped within this Domain.

5.3.2.3.1 Fimiston Processing Plant

The Fimiston Processing Plant (Figure 5-57) was constructed with the inception of the KCGM Fimiston Open Pit in 1989. It covers approximately 20 ha, and is located to the east of the Fimiston Open Pit. Two parallel circuits process refractory sulphide ore from the Fimiston Open Pit and Mt Charlotte Underground Mine. The licenced milling production rate at Fimiston is 14.5 Mtpa. During operations, ore processing at Fimiston is managed in accordance with DWER Part V Licence Conditions. The Fimiston Plant was reported to the DWER as a potentially contaminated site (AOC57).

Figure 5-57: Fimiston Processing Plant, facing west

The plant comprises (as shown in Figure 5-58):

- Two crushing circuits that supply coarse ore as a mill feed stockpile;
- Two milling circuits – Fimiston and Mt Charlotte;
  - Fimiston circuit comprises a semi autogenous grinding (SAG) mill and a pebble crushing circuit with two secondary ball mills and four Knelson concentrators.
  - Mt Charlotte circuit is a single SAG mill and a ball mill with a single Knelson concentrator.
- A flotation circuit and three Carbon in Leach (CIL) circuits through which milled ore is processed;
- Filtration and Ultra Fine Grind via a CIL circuit through which flotation concentrates are deslimed and processed; and
- A gold recovery circuit comprising an Acacia reactor, elution, electrowinning, smelting and pouring and production of gold bullion.

In the flotation circuit, the gold bearing refractory sulphide is separated and referred to as concentrate. The concentrate is de-slimed (removal of the very fine fraction), with the slimes then leached to recover the contained gold at the Fimiston Plant. The coarse fraction is then separated into two streams. Currently, one stream is washed, filtered, and transferred to the Gidji Processing Plant for further processing. The other stream is directed to a UFG circuit at Fimiston. The UFG reduces the particle size of the concentrate to expose enough gold surfaces to facilitate cyanide leach recoveries. After grinding, it joins the slimes to be leached at the Fimiston Plant in the two cyanide CIL adsorption circuits where the gold is extracted. The Fimiston Plant also comprises elution, electrowinning circuits and facilities for smelting, pouring and production of gold bullion.

Operation of the Fimiston Plant is expected to continue until 2034 when ore from the Fimiston Open Pit and viable low-grade stockpiles on site are exhausted.

Figure 5-58: Fimiston Processing Plant

5.3.2.3.2 Laydown and Hardstand Areas

Mineral Processing laydown areas (Figure 5-18) include a laydown area associated with the maintenance workshops and are actively used for storage of equipment.

5.3.2.3.3 Offices and Associated Infrastructure

All offices are currently in use and generally have parking areas and native vegetation gardens associated with them.

5.3.2.4 Fimiston Tailings Storage Facilities

5.3.2.4.1 Overview

Approximately 13 Mtpa of tailings solids are pumped through bunded delivery lines as slurry from the Fimiston Plant to the Fimiston I, Fimiston II and Kaltails TSFs, with decant return water pumped back via central decant systems to the Plant for reuse (Figure 5-59). The operation of the TSFs is managed through Works Approvals, a Part V Licence and Mining Proposals (including geotechnical aspects).

All Fimiston TSFs are relatively modern and are constructed using an initial earth starter embankment followed by upstream lifts constructed with tailings. Original designs included berms, generally 6 m wide and constructed every 10-15 m, with 14° batters. Fimiston I, II and Kaltails TSFs have approved heights of 60 m, while Fimiston II E has a currently approved height of 45 m. All three currently operational TSFs have completed rehabilitation on their lower outer batters. Construction of Fimiston II Ext TSF Cell E and F has been completed, with the TSFs currently operational.

Since 2018, Fimiston I, II and Kaltails have had buttressing of some walls to ensure satisfactory geotechnical stability parameters. Buttressing may potentially continue in locations recommended by the Engineer on Record, based on interpretation of data from geotechnical monitoring instrument installed on the TSF walls. It is unknown where the location of the weight loading from the buttressing can ever be adjusted, thus it is assumed that the buttresses will remain 'as is' at closure.

The landform areas for rehabilitation area as follows:

- Fimiston I: Batters 28 ha; Flats 85 ha; Final height approved to 60m
- Fimiston II: Batters 78 ha; Flats 255 ha; Final height approved to 60m
    - Fimiston II Ext TSF: approved 2 cell (E and F) extension, abutting Fimiston II TSF, construction commenced in 2022; Batters 45 ha; Flats 253 ha; Final height 45 m.
    - Fimiston II Extension TSF G cell, as part of EPA S38 application; will abut the southern walls of Fimiston II Ext, E and F cell with: Batters 45 ha; Flats 253 ha; Final height 30m.
- Kaltails: Batters 23 ha; Flats 197 ha; Final height approved to 60m.
- Fimiston III Batters 110ha; Flats 330ha; Final height 43m. approximately 440 ha; at conceptual design level, part of EPA S38 application. Construction will commence in 2025.

Current (July 2022) disturbance and rehabilitation areas are presented in Table 5-10.

Table 5-10: Fimiston TSF MRF Disturbance and Rehabilitation Footprint (July 2024)

FIMISTON TSF	DISTURBED LAND (HA)	LAND UNDER REHABILITATION (HA)	TOTAL
Fimiston I	112	23	135
Fimiston II	328	50	378
Fimiston II Ext	298	0	298
Kaltails	216	66	282
Fimiston III	0	0	0
Total	656	139	795

After considerable closure design work between 2015 and 2018, operation embankment design and construction has been aligned to match closure design, with the upper section of Fimiston I, II, II Extension and Kaltails aligned with final closure design. The proposed Fimiston II Ext G cell and Fimiston III TSFs operational design will be aligned with final closure design as well.

Kaltails Pre-2011

KCGM acquired Kaltails TSF in 2009, and recommissioned the TSF for usage. The tailings in the lower section of Kaltails TSF was processed from various sources (old TSFs) along the Golden Mile in a processing plant located immediately south of the TSF (State Agreement Kaltails Retreatment Project which reprocessed historic TSFs). A report into the geochemical compatibility of tailings deposited in the Kaltails TSF from the Kaltails Retreatment Project prior to 2011 indicated that Fimiston tailings is very similar in terms of AMD characteristics and metal leaching characteristics (Golder 2008). As such, KCGM considers that the geochemical characteristics presented above are representative of the TSFs as a whole.

Fimiston I Pre KCGM

Deposition of tailings has occurred at Old Croesus and Fimiston I since 1988 (pre KCGM). Geochemical characterisation of Fimiston I tailings were conducted in 2010 and 2016, with results found to be representative of the entire tailings pile, as all tailings are produced as a result of processing ore from the same mineralised area, the Golden Mile.

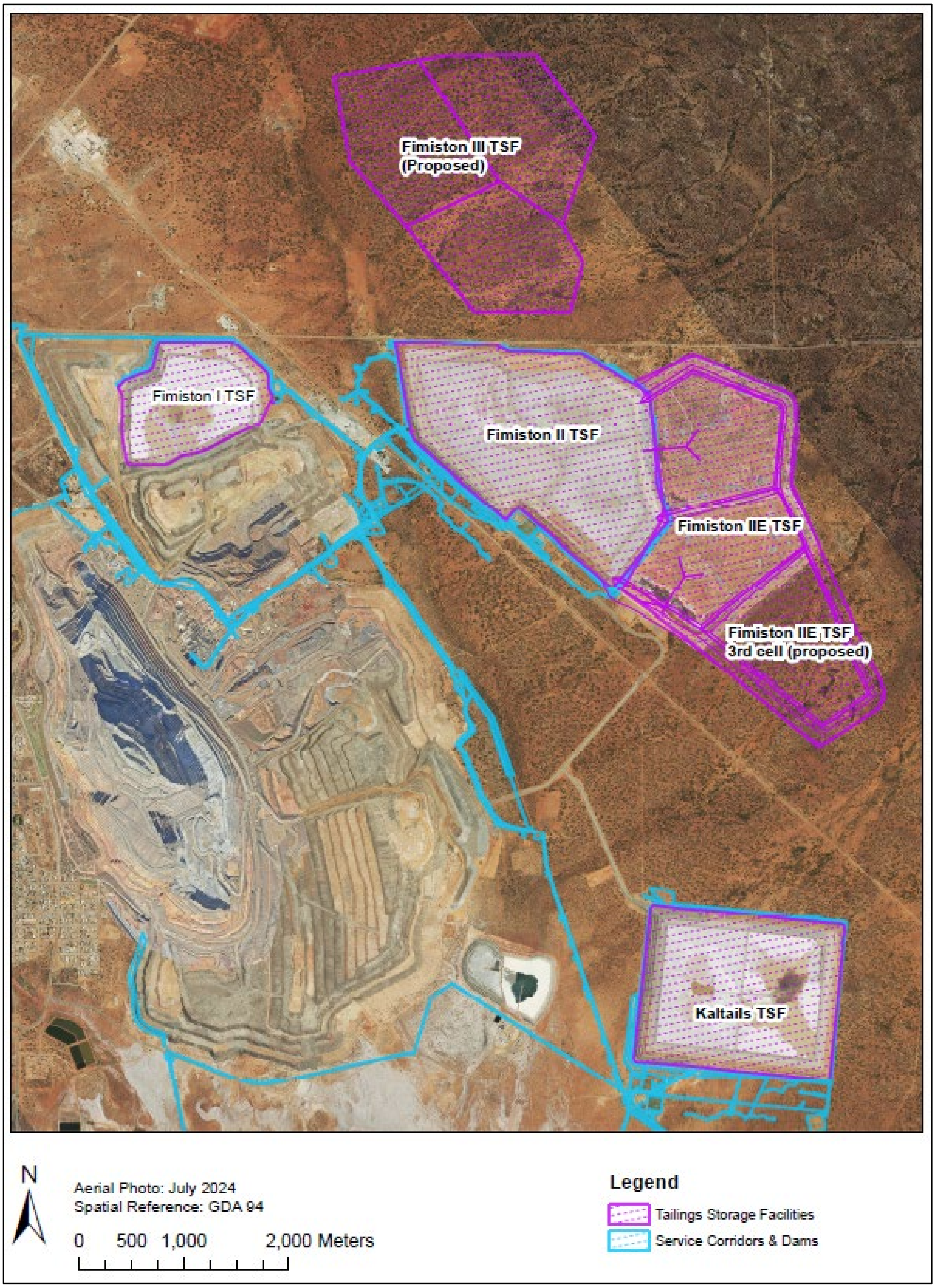


Figure 5-59: Fimiston Operational Area Tailings Storage Facilities

Tailings Geochemical Characterisation

Geochemical characterisation studies of Fimiston tailings have been conducted on five occasions. A summary of geochemical testing to date (Appendix 5.5; MBS Environmental, 2018b) and further work by MBS on mercury characterisation (MBS Environmental, 2020) indicates that, post-closure, the tailings generated by the Fimiston Processing Plant (Fimiston tailings) will:

- remain NAF (non-acid forming) with alkaline pore water
- Remain hypersaline with the predicted formation of a surface gypsum crust, which is predicted to reduce infiltration rates into underlying tailings.
- During operation the solubility of trace metals and metalloids and any potential for infiltration to groundwater will reflect cyanide-based chemistry of the Fimiston process water. Metals noted in low to moderate concentrations in Fimiston operational supernatant solution include copper, mercury, antimony, lead, nickel, and cobalt.
- Post closure the potential for leaching of trace metals and metalloids is considered very low as gradual cyanide degradation, surface adsorption (including arsenic as insoluble iron bound species) and the alkaline nature of the tailings will reduce the mobility of most metals and metalloids to very low levels. Simulation of oxidised tailings conditions by analysis of tailings solutions after accelerated laboratory oxidation with peroxide indicate extremely low levels of all environmentally significant metals and metalloids.
    - Mercury concentrations in Fimiston and Kaltails tailings solids and leachates are low.
    - Very low concentrations of tellurium in water and acetic acid leachates indicate that most of the tellurium is present as stable, insoluble minerals (namely coloradoite). Given the only beneficial use of groundwater is for industrial uses (including mining), and there are no ecological users of groundwater, the very low concentrations found in tailings leachate are unlikely to have an adverse impact.
    - KCGM tailings are not enriched with chromium. Seepage from the Fimiston TSFs is predicted to be circum-neutral to alkaline after mine closure, under which conditions trivalent chromium (III) concentrations are predicted to be very low and of limited environmental significance. Chromium (VI) is unstable in all but highly oxidising conditions and is not expected to be persistent in tailings seepage.
    - Fimiston and Kaltails tailings are not enriched with nickel. Water leachates and tailings fluids of Fimiston and Kaltails tailings contain very low concentrations of dissolved nickel and predicted concentrations are unlikely to increase after mine closure.
- The risk of leachate from the stored Fimiston tailings once rehabilitated adversely impacting groundwater is considered low, especially considering the hypersaline groundwater receiving environment.

Tailings geochemistry is discussed in detail in Volume 3, Appendix 5-5.

Seepage and Groundwater Management

The key environmental value to be protected at the Fimiston TSFs is adjacent vegetation. To protect vegetation, groundwater levels influenced by TSF seepage must be controlled.

Groundwater in the vicinity of the TSFs is naturally saline to hypersaline (pre-mining TDS concentrations are indicated to be in the range 30,000 mg/L to 40,000 mg/L at the Fimiston TSFs and 50,000 mg/L to 60,000 mg/L at the Kaltails TSF) and acidic (due to naturally occurring ferrolysis reactions which result in a naturally acidic groundwater, with a pH around 3) (Big Dog Hydrology, 2021). The DWER Goldfields Groundwater Area Management Plan (Water Authority, 1994) recognises mining related activities, such as mineral processing, as the only beneficial use for these saline groundwater resources. Current seepage bore quality is acceptable for mineral processing, as evidenced by usage of the water in the Fimiston Processing Plant.

The Fimiston and Kaltails Seepage and Groundwater Management Plans are used during operations to ensure potential adverse impacts of seepage from the TSF are managed. Key operational controls within these plans are based on managing groundwater depths below ground surface. The successful implementation of the Management Plans have controlled water levels below the ground surface for more than 15 years. Groundwater quality is monitored for operational purposes but does not trigger any required actions, as potential impacts can be controlled by managing groundwater depth. Key operational controls to manage groundwater depth include minimisation of the TSF pond size and management of groundwater levels in the vicinity of the TSFs. Seepage interception trenches and production bores have been installed around the perimeters of the TSFs to intersect the ferricrete and alluvial sediment groundwater system and recover seepage from the TSFs, with the objective to prevent the naturally saline groundwater from rising above water level targets into the root zone of vegetation. Abstracted water is pumped to the Fimiston Processing Plant to be used in processing. A vegetation monitoring program was previously used to assess the effects of seepage on the health of vegetation surrounding the TSF compared to analogue sites. The review of 15 years of monitoring data identified that the Fimiston and Kaltails Seepage Management Plans had operated effectively, with no adverse effects on the surrounding vegetation during that time frame; the vegetation monitoring programme was discontinued as a result.

Upon cessation of mineral processing, tailings deposition will also cease. An investigation into rates of draindown and residual seepage in the closure and post closure periods was undertaken in 2014 (Golder, 2014). Numerical cross section models were constructed through each deposition paddock in each TSF. The models included the thickness and hydraulic properties of the tailings material, and the inferred thickness and properties of the underling units in the groundwater system. The models accounted for both saturated and unsaturated flow conditions, and were initially calibrated by applying operational tailings deposition schedules and ensuring the model predicted that total seepage into the groundwater system was consistent with the average pumping rates from the associated seepage and groundwater recovery borefields.

The models confirmed that the primary driver for seepage from the TSFs remains the operational deposition. Rainfall events post closure will have no bearing on the drain down of the TSFs. The model results identified that TSF drain down would be achieved within two years, and that long term ongoing seepage rates to the groundwater system underlying the whole of each tailings deposition cell would be in the range of 2 to 5 L/s. These model results are consistent with the observed draindown responses when:

1. The Kaltails TSF was decommissioned in the period from 1999 (when the State Agreement Kaltails Retreatment Project terminated deposition) to 2009 (when KCGM recommissioned the TSF and recommenced deposition); and
2. The Fimiston I TSF was temporarily decommissioned from 2014 to 2019.

Post closure seepage management will involve transfer of the TSF seepage water to the Fimiston Pit; details relating to quantities can be found in Volume 3 (Appendix 5-3) and initial TSF groundwater completion criteria found in Volume 3 (Appendix 5-7).

Completed Rehabilitation

Fimiston I, Fimiston II, and Kaltails lower embankment slopes were all rehabilitated prior to 2006, with varying success. Some of this rehabilitation has been covered by recent buttressing activities. From 2018 to 2021 rehabilitation at the Fimiston TSFs recommenced, with work occurring on the upper embankment slopes. More recent rehabilitation is described in the sections below for each individual TSF.

5.3.2.4.2 Fimiston I TSF

The Fimiston I TSF (Figure 5-60) covers an approximate footprint area of 120 ha and is located to the south of (and adjacent to) Bulong Road. The facility was originally constructed in 1988/1989 as four cells and sub-aerial slurry discharge via multiple spigot discharge points commenced in 1989. The starter embankments were constructed from clayey sand/sandy clay sourced from within the storage footprint. Subsequent upstream raise construction has utilised tailings sourced from within the impoundment. During operations, the original four cells were combined into two (Fimiston I West and Fimiston I East) and subsequently into a single operational cell that also incorporated the north and south cells of the Croesus TSF (Golder, 2013). The facility is currently at a height of 44 m and has a maximum approved height of 60 m, and the external slopes are approximately 3-3.6H:1V (Golder, 2017b).

During current operations, in accordance with the Fimiston Seepage and Groundwater Management Plan, seepage interception trenches, as well as production and monitoring bores are installed to manage groundwater levels as required by the DWER Licence, with groundwater levels well managed within licencing targets.

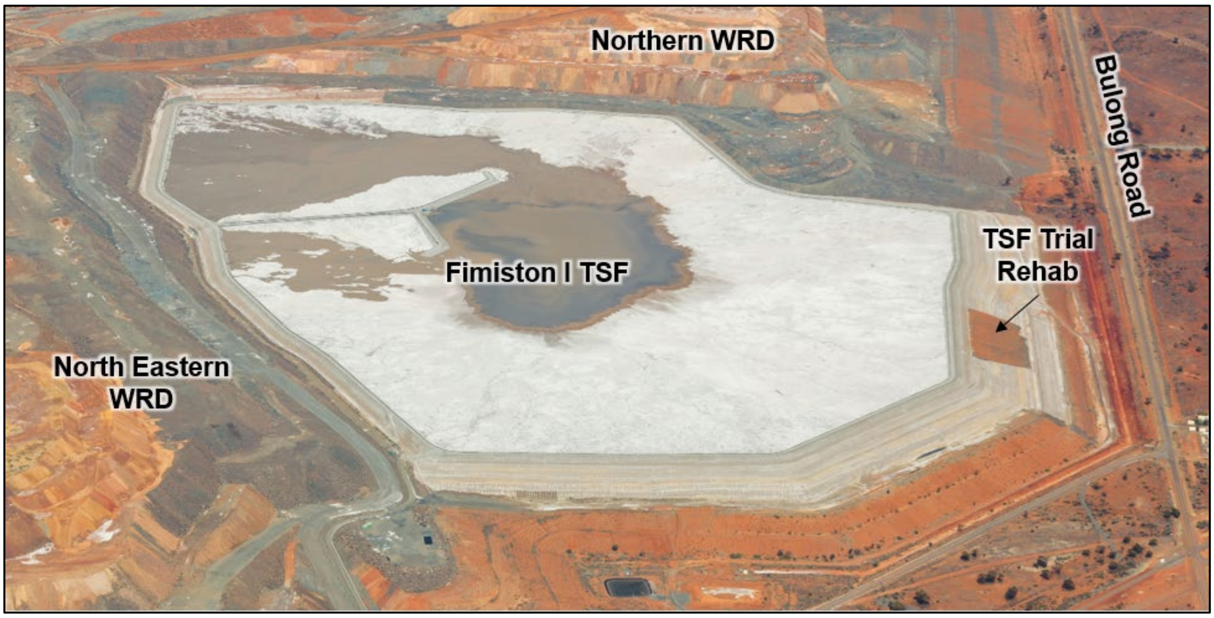


Figure 5-60: Fimiston I TSF (2021)

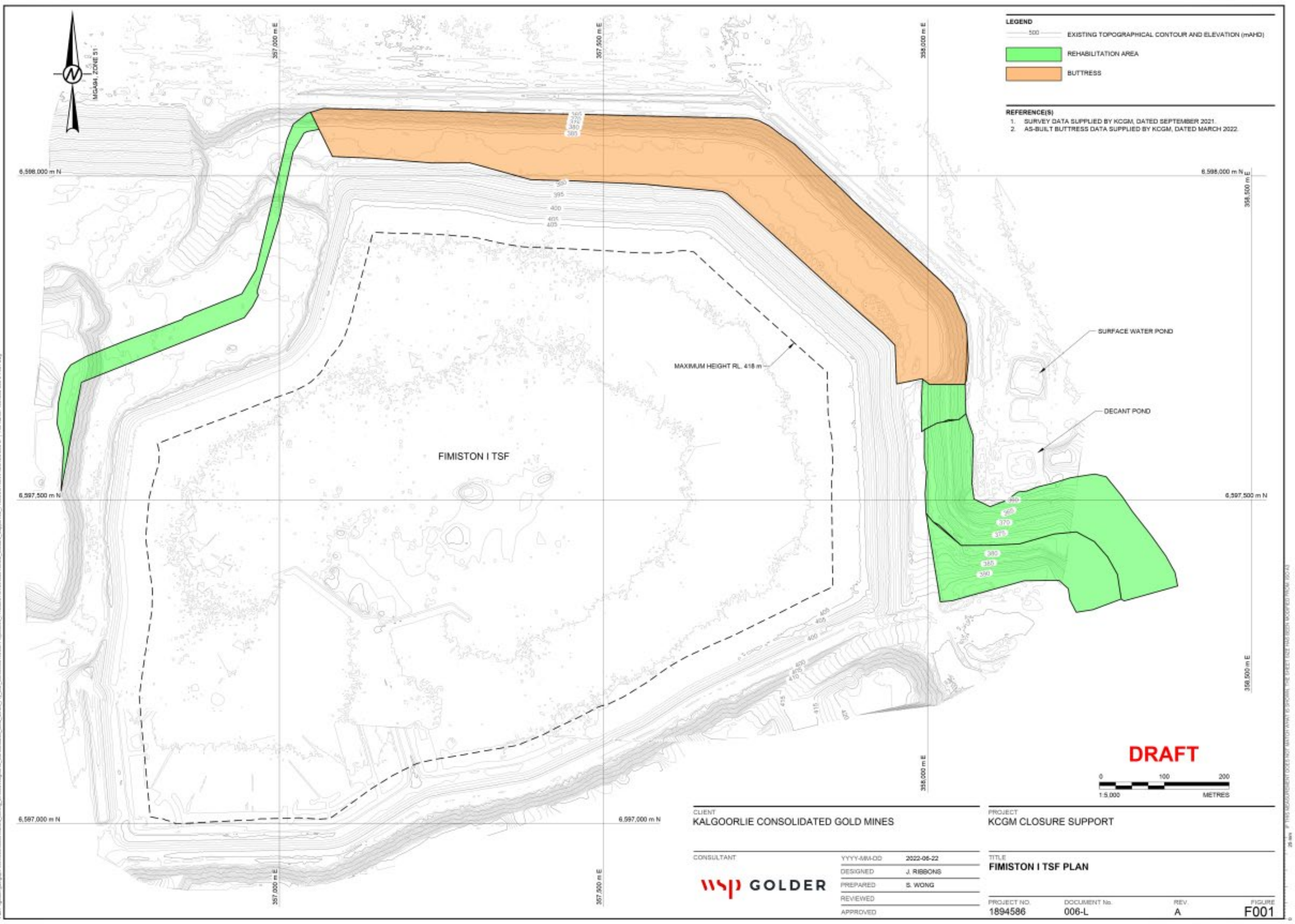


Figure 5-61: Plan View of Fimiston I TSF (final height will be up to 60m) 2022

Completed Rehabilitation

The lower outer slopes of the TSF have been rehabilitated. In addition, a rehabilitation trial was conducted on the upper northern slope in 2016, as part of the TSF closure project.

Rehabilitation was completed on the starter embankment and a section of the first upstream lift in the mid-1990s. Rock lined drop drains have been installed in the rehabilitated starter embankments in some areas.

Rehabilitation reports record that oxide waste rock and topsoil was pushed up the eastern TSF slopes in 2005. Visual observation indicates that the tailings material was capped with competent rock at depths of up to 5 m. A topsoil or oxide material has been placed over this at depths of approximately 1 m. The upper surface of the rock cover is compartmentalised and has a crest bund to assist with water control. Due to steepness of the external embankments, the eastern slopes could not be ripped on the contour. Instead, the slopes were shaped using the blade of a D6 dozer that moved progressively up the slope and then pushed the topsoil material to form furrows. This produced very shallow banks and troughs on the rehabilitated slopes (Figure 5-62) which were then seeded. The steep slopes have experienced erosion, but have high values for plant species diversity. Visual observations in 2013 indicate good vegetation recruitment, although the steep batters and excess material placement have resulted in gully formation and erosion continues to be an issue on the eastern side, with poor water control on the mid bench.

In 2021 a buttress was placed around the northern and north eastern sides of the TSF. The rehabilitated material on the northern side has been damaged by wind blown tailings and will not be recovered. Rehabilitation material on the north east embankment was placed at an excessive thickness. The slope is too steep for the material properties and insufficient rock was mixed to the surface to ensure success. The portion of this material that will be within the buttress footprint has been stripped off and stockpiled for future use. The buttress will provide easier access for future rehabilitation. It is not known whether the FoS at closure will allow for reshape of the buttress. For the purposes of closure planning, a conservative assumption that the buttress cannot be altered has been used.

Figure 5-62: Typical Fimiston I TSF Batter (2013)

Fimiston I Cover Design Trial (northern slope)

A trial of the proposed Fimiston TSF rehabilitation design was undertaken on a 1 ha area on the northern flank during late 2016 into early 2017. Objectives of the trial were to conduct earthworks to identify the optimum equipment and methodology for implementation, including slope preparation. Three plots were constructed, with varying cover thicknesses, trialling a modified version of the erosion resistant cover design successfully used on the Fimiston WRDs. Investigations also included the selection of suitable capping material from the adjacent WRD. After completion of the earthworks, excavations were done to inspect the profile of the cover. This information was fed into implementation planning for Fimiston II TSF rehabilitation works, which commenced in 2019.

Topsoil that had been stockpiled for over 20 years was used on the trial area. An intense rainfall event occurred immediately after topsoiling, with very good germination and subsequent vegetation growth. No further seeding was done, all growth was a result of the seed bank within the stockpile. It is worth noting that the topsoil stockpile was higher than the standard 2m high and had hardset, to the point of equipment refusal. However the seed bank within the stockpile was preserved. It is thought that the height and dryness of the inside of the topsoil stockpile acted as a vault for seed preservation.

Figure 5-63: Fimiston I TSF Trial Earthworks in Progress (2016 and 2017)

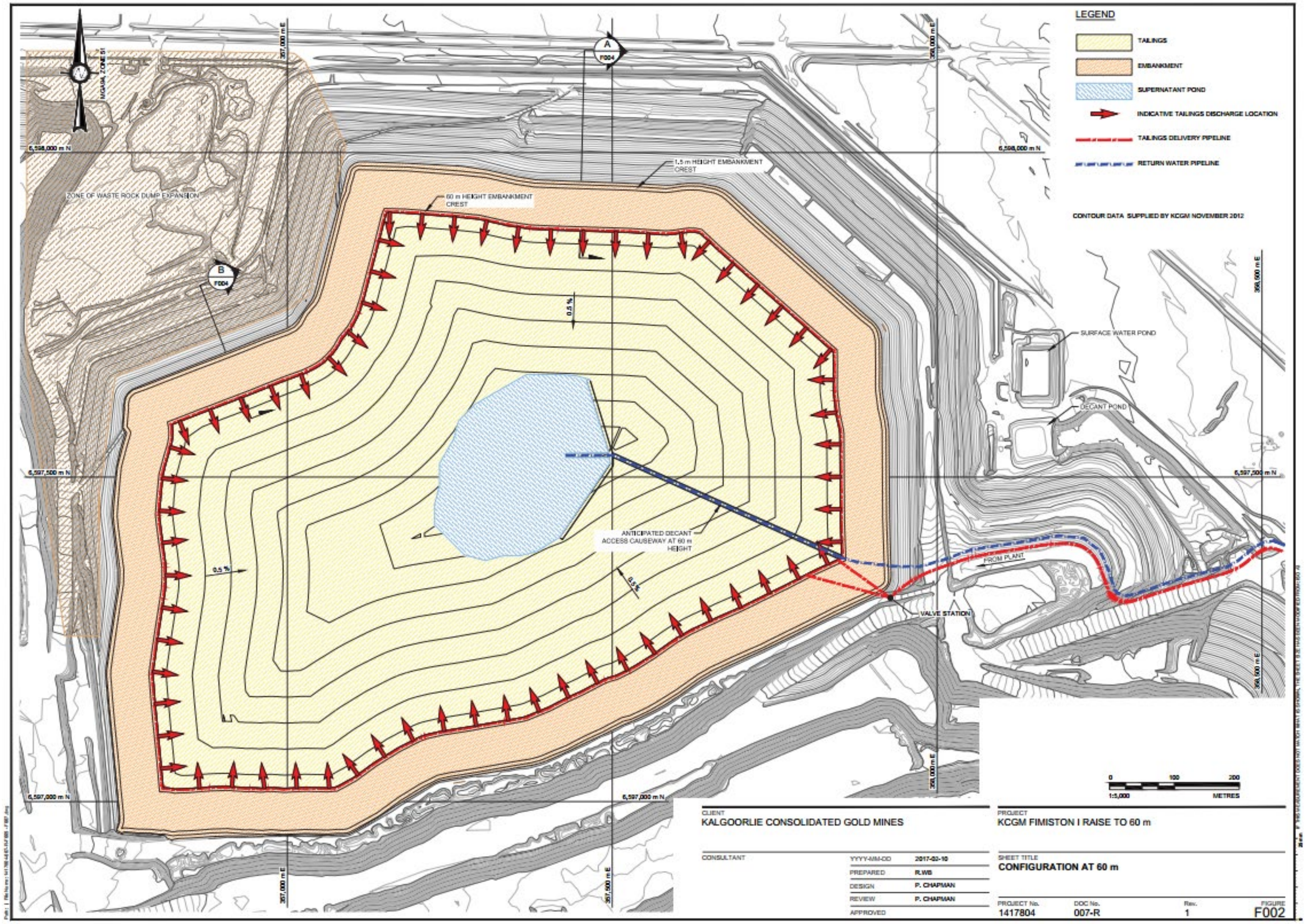
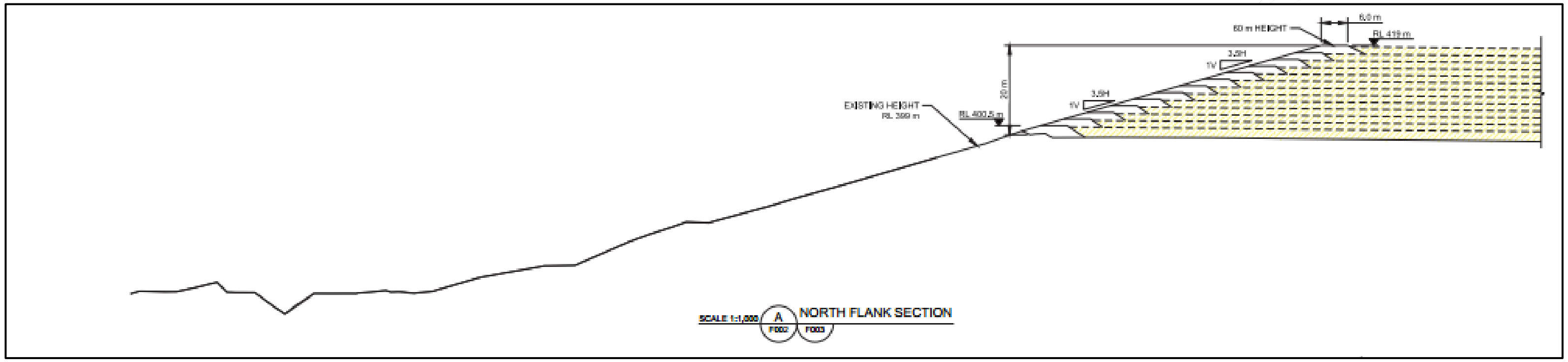


Figure 5-64: Fimiston I TSF Plan View



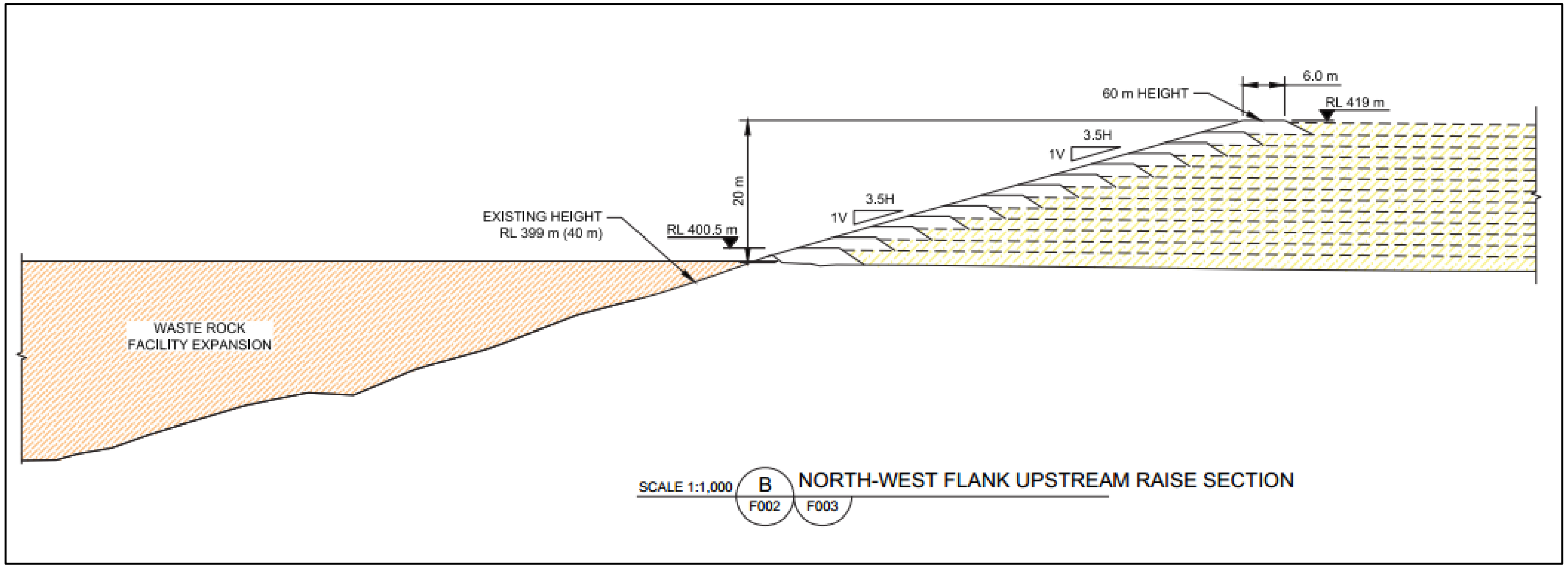


Figure 5-65: Fimiston I TSF Cross-sectional View

Figure 5-66: Fimiston I TSF Cover trials, Above, 2017 and Below, 2021

5.3.2.4.3 Fimiston II TSF

The Fimiston II TSF (Figure 5-67) covers a footprint area of 378 ha and is located to the east of the Trans-Australian Railway Corridor. A and B paddocks (now AB Paddock) were initially constructed in 1991/1992 and sub-aerial slurry discharge via multiple spigot discharge points around the perimeter and internal embankments commenced in 1992. The facility was expanded in 1994 and 1995 to incorporate C Paddock and D Paddock, respectively. The starter embankments were constructed from soils sourced from within the footprint. Subsequent upstream raise construction has utilised tailings sourced from within the TSF (Golder, 2013). Currently the TSF is approximately 50 m high and is planned to reach a height of 60 m, with embankments slopes of 14-18° (Figure 5-68 and Figure 5-69).

The TSF has a significant step in bench, called the ‘rehab’ bench around the entire perimeter. Above the step-in bench, a past decision was made to reduce the outer slope angle on the TSF. This has resulted in a convex slope shape, which has provided a closure design challenge.

In 2019 a rock buttress was placed along the lower western embankment of A/B Paddock to maintain the FoS for subsequent wall raises. It is not known whether the FoS at closure will allow for reshape of the buttress. For the purposes of closure planning, a conservative assumption that the buttress cannot be altered has been used. Additional buttressing occurred in 2021 on the eastern side of C and D paddocks, and further buttressing on the western side of C Paddock wall has been completed in 2022, with the same closure assumptions. In these areas, the topsoil in the existing rehabilitation was stripped and stockpiled for future reuse.

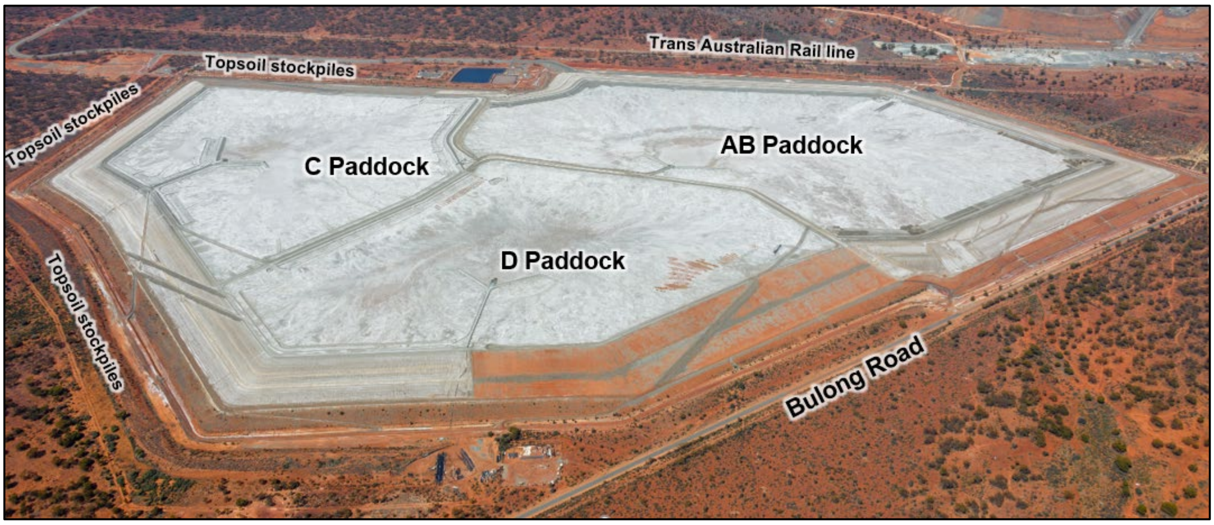


Figure 5-67: Fimiston II TSF, before buttressing (2021)

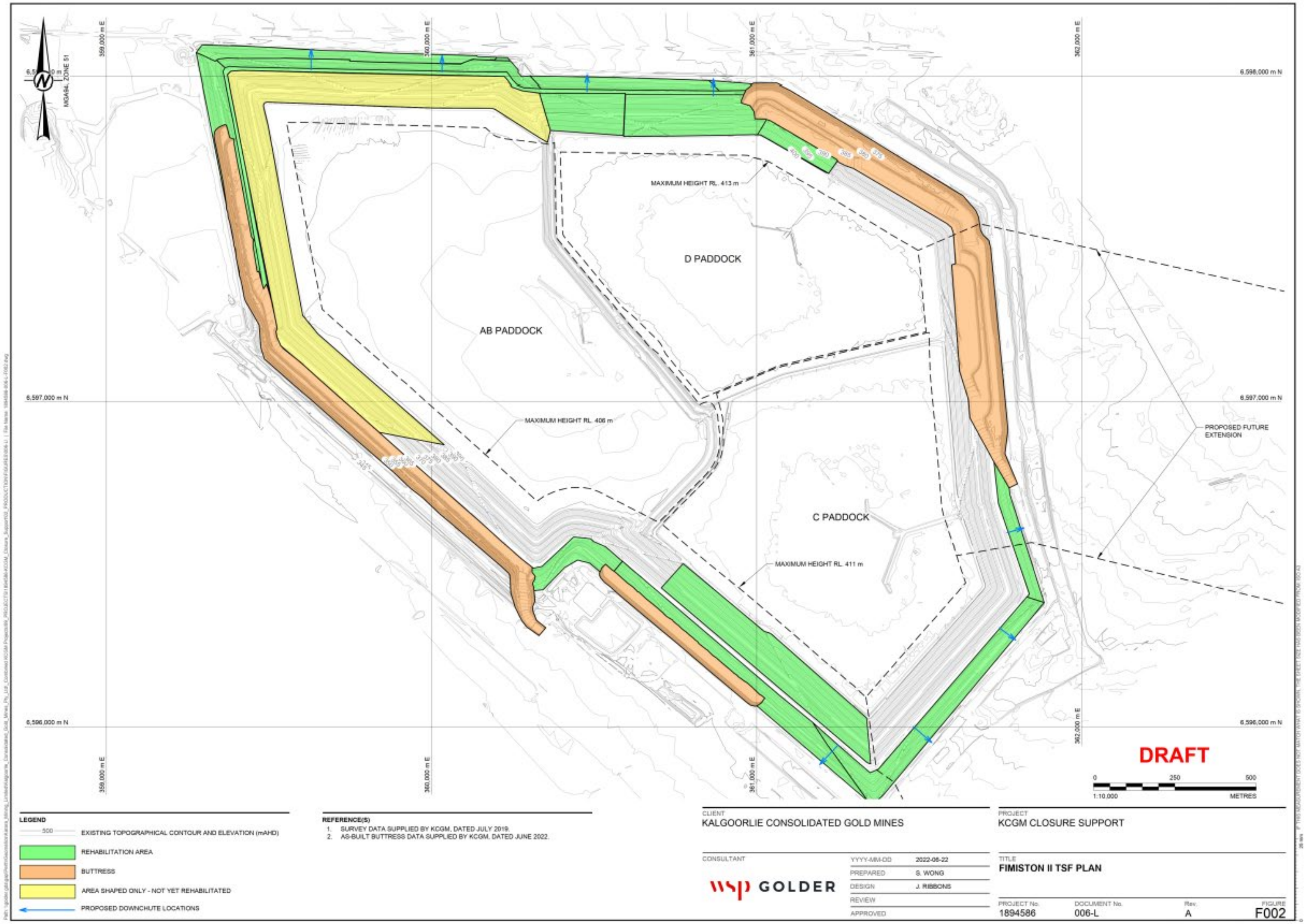


Figure 5-68: Plan view of Fimiston II TSF (2022)

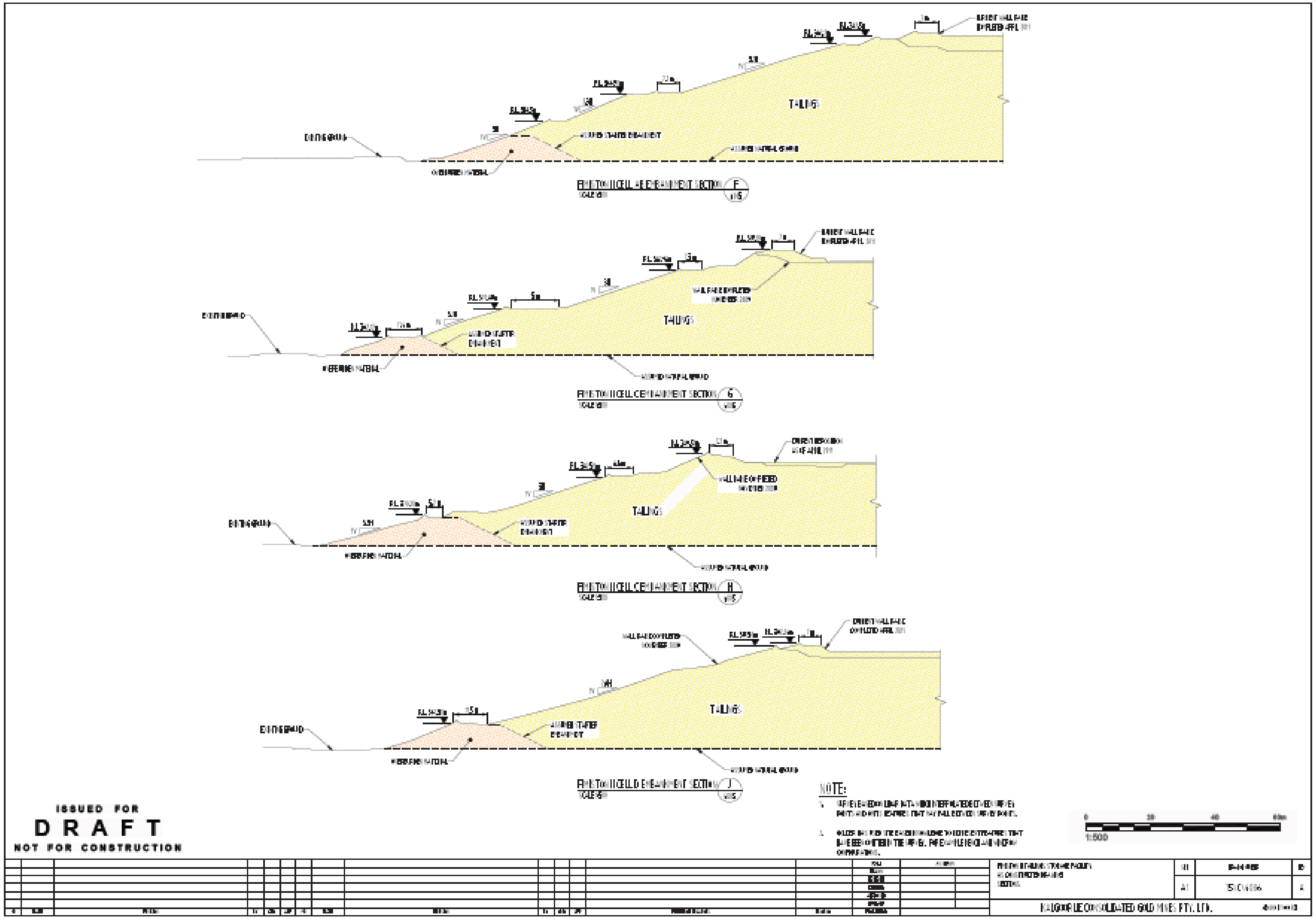


Figure 5-69: Cross sectional view of Fimiston II TSF

Completed Rehabilitation

Lower embankment (all sides) – 2001-2003 Rehabilitation

Fimiston II starter embankment and the first tailings lift were rehabilitated from December 2000 to 2003, commencing with the northern batter and working around to the western batter. The tailings material was covered with 1 m of hard rock and 300 mm of topsoil, with rock lined drop drains installed in some of the rehabilitated areas to facilitate surface water control. Seed was applied at a rate of 9 kg/ha using a hydro-mulcher, which sprayed the seed mix combined with fresh water and shredded newspaper.

This area of rehabilitation was "On track, continue monitoring" during 2011 LFA monitoring (Outback Ecology, 2012a). All key indices of ecosystem function (stability index, erosion, and lower storey plant cover) were within the average regional range. Vegetation is predominantly chenopod shrubs with a limited overstorey of perennial species. Visual observations indicate that vegetation recruitment is reduced in northern areas, possibly as a result of the harsh aspect and significantly reduced rainfall in recent years. Visual observations from 2012-2014 indicate that the south western slopes, with a southern aspect, shows particularly good vegetation growth and appears to be relatively stable with minimal erosion (Figure 5-70).

Facing East 2004 (top). Facing North 2013 (middle) & 2021 (bottom)

Figure 5-70: Fimiston II TSF 2003 Rehabilitation of Lower Lifts

Upper embankment (north & south east sides) – 2018-2021 Rehabilitation

In late 2018, rehabilitation works commenced on the upper lifts of the tailings external embankments on C and D paddocks (Figure 5-71 and Figure 5-72). Works included reshaping of the walls, capping with waste rock, topsoiling (if included in the closure design). The design is similar to the WRD design, with rocky bands. There has been some vegetation germination, with further rainfall required.

Rehabilitation works involved:

- Reshaping of the tailing flank to final closure design, removing any large step ins.
- Sheeting with at least 0.5 m of benign waste rock, using articulated dump trucks.
- Placement of topsoil (A class from the adjacent stockpile) with the flanks finished with ripping and seeding.

Learnings from the first work at D Paddock resulted in an additional rocky bank at the base of the slope at C Paddock and the use of larger rock size, with a reduced thickness of topsoil. Topsoil at D Paddock was placed too thick, and did not meet the design requirements, requiring rework. The easternmost section of the D Paddock work area cannot be accessed at this time due to geotechnical constraints. The expected location of a final closure ramp at C Paddock (approximately parallel to the existing ramp) was allowed for, with less topsoil placed in this area.

Reshaping work commenced AB Paddock in 2021, starting with reshape of the north wall and progressing onto the west wall (Figure 5-73).

Figure 5-71: Fimiston II 2019 – early 2020 rehabilitation of D Paddock

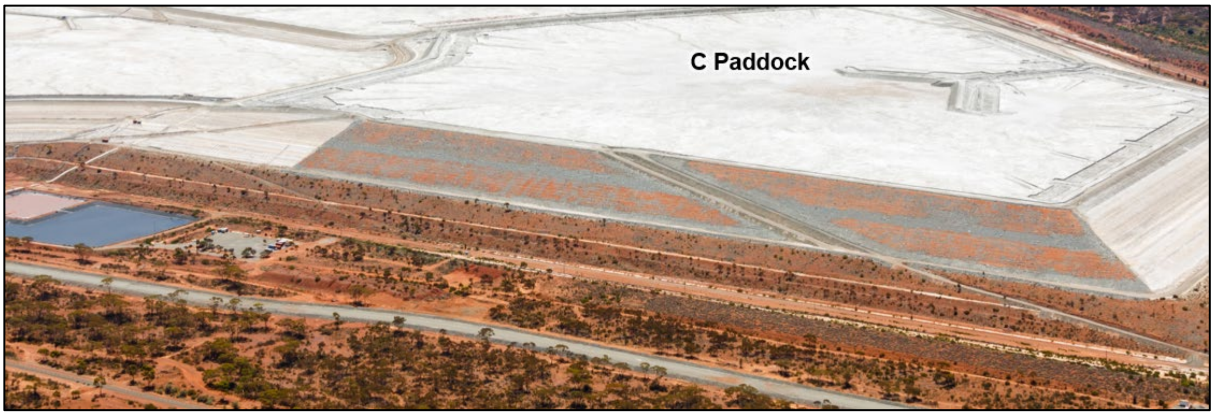


Figure 5-72: Fimiston II TSF 2020 – 2021 rehabilitation of C Paddock

Figure 5-73: Fimiston II TSF 2021 commencement of reshaping of AB Paddock

5.3.2.4.4 Fimiston II Extension TSF (extension of Fimiston II TSF)

The Fimiston II Ext TSF is planned to cover a footprint area equal to that of the existing Fimiston II TSF and will be located to the east of the Trans-Australian Railway Corridor, adjacent and abutting the existing Fimiston II TSF. The TSF will consist of three paddocks, E,F and G. Cells E and F were constructed in 2023/2024, with construction work on G cell planned for 2025.

The starter embankments will be constructed from clay rich soils sourced from within the footprint. Deposition will be as for the other Fimiston TSFs, sub-aerial slurry discharge via multiple spigot discharge points around the perimeter and internal embankments. Subsequent upstream raise construction will utilise tailings sourced from within the TSF for an eventual maximum planned height of 45m, with slope angles of 1:3 (18 degrees), aligning with the final closure design. A comprehensive underdrainage system will be installed for the new TSF, which will aid collection of seepage and is likely to reduce post closure groundwater management timelines.

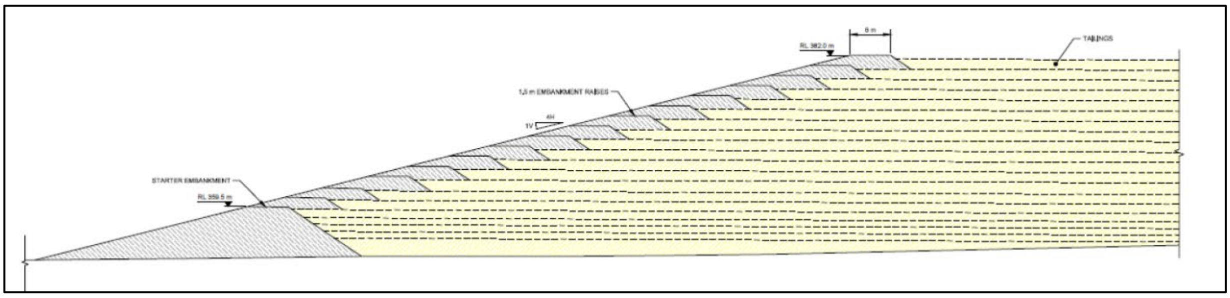


Figure 5-74: Typical cross section for Fim IIE TSF

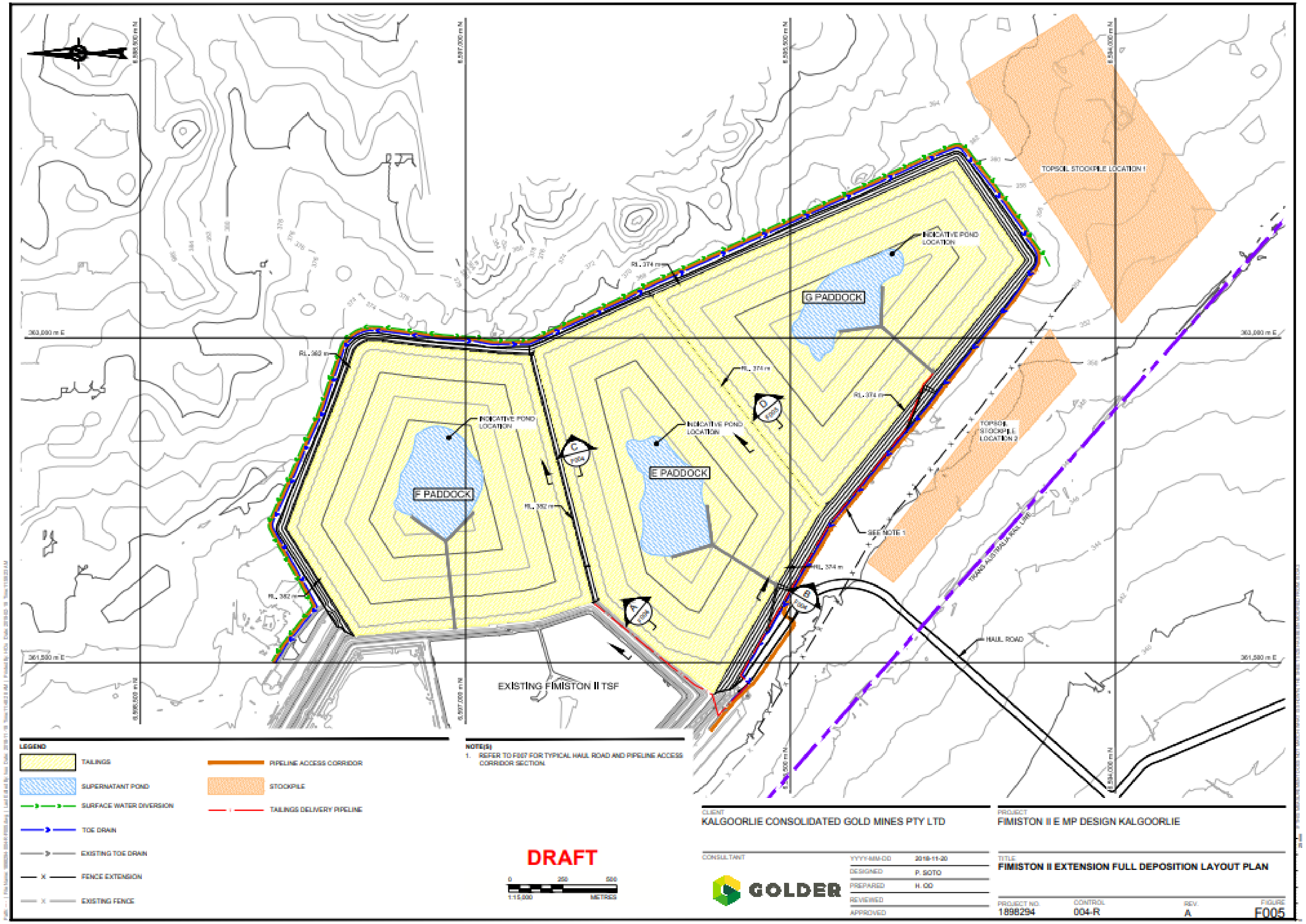


Figure 5-75: Plan view of Fim II Extension TSF

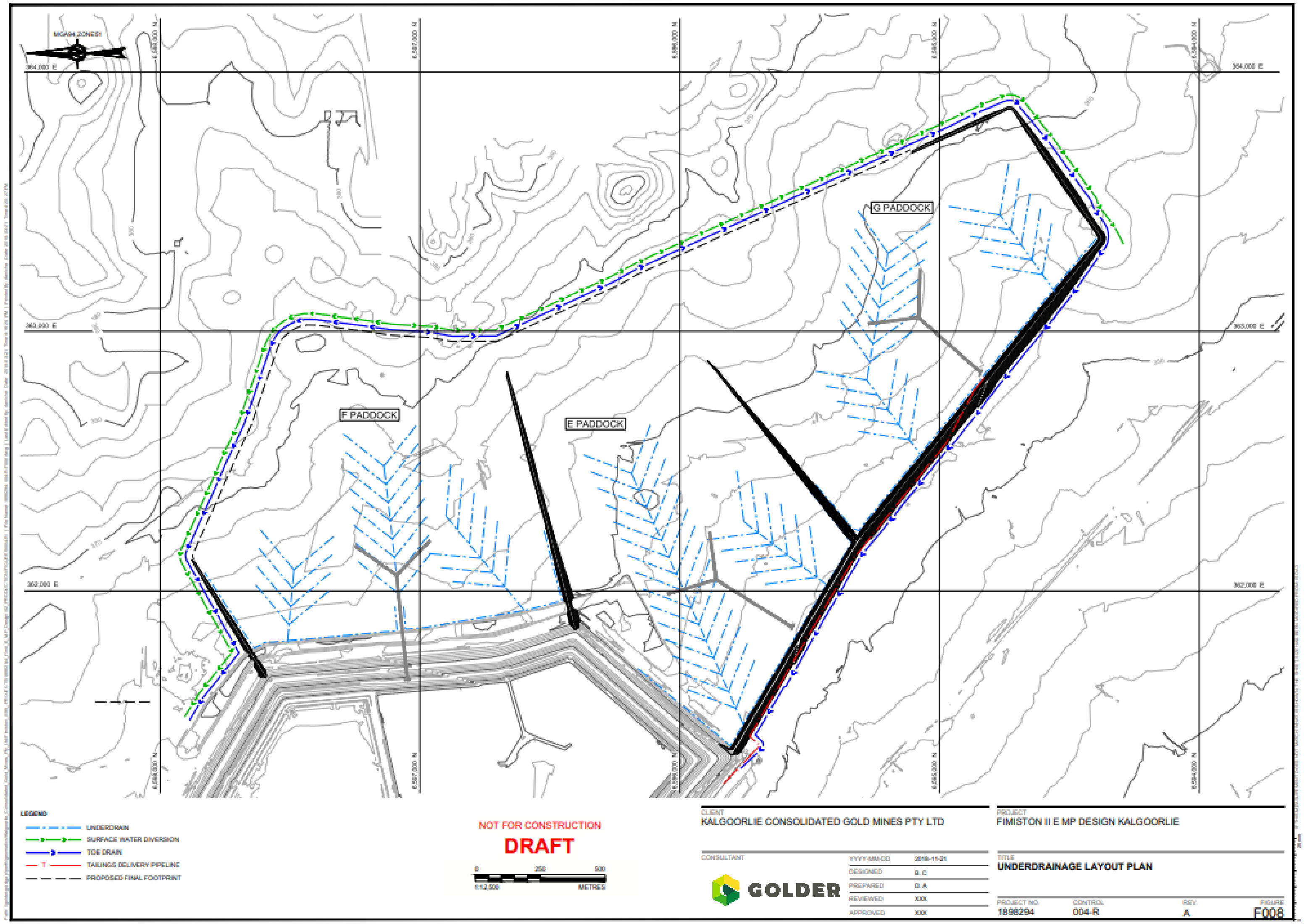


Figure 5-76: Plan view of Fim II Extension TSF showing underdrainage system

5.3.2.4.5 Fimiston III TSF

The proposed Fimiston III TSF (Figure 5-77) will be located north of Bulong Road, across from Fimiston II TSF. The starter embankment will be constructed to a maximum height of approximately 10 m using select, low permeability borrow materials sourced from within the TSF basin. In areas where a starter embankment is not necessary for tailings containment (areas where the natural topography elevation exceeds the elevation of the maximum starter embankment height), a 3m high starter bund is proposed to increase stormwater retention capacity, provide additional tailings line/spigot locations and to divert surface water from entering the facility during the initial stages of operation.

When preparing for an embankment raise, tailings deposition will be periodically suspended in particular cells/paddocks, in line with the deposition plan, to allow the tailings to dry and consolidate. External perimeter embankments will generally be raised in an upstream direction (i.e., inwardly) and formed from tailings excavated from the adjacent tailings beach. Construction of the raise increment will be an ongoing activity, requiring several (~1.5 m) raises per year.

An underdrainage system will be implemented to promote controlled seepage and reduce the phreatic surface level within the tailings stack. The underdrainage system comprises two major components:

- A series of perforated strip drains located at regular centres adjacent to the upstream toe of the starter embankment to reduce the phreatic surface development within the tailings, adjacent to the confining embankment.
- A herringbone style network of perforated drains beneath the ultimate supernatant pond location to promote controlled seepage and limit the potential for groundwater mounding.

A waste rock buttress will be required along the northern flank of the facility when raised above approximately 30 m height. This is estimated to occur in FY 2038 according to the design tailings deposition split. The buttress will assist in maintaining the factor of safety (FoS) against embankment instability for the critical embankment sections to above minimum required values (1.5 for static, and above unity for post-peak) up to the maximum embankment height. At present, the buttress construction material has been assumed to be clean, competent, run-of-mine waste rock (consistent with buttress construction material utilised for the existing Fimiston and Kaltails TSF buttresses). To allow the Fimiston III TSF to reach its final height while maintaining required FoS values, a buttress of ~10 m height, ~40 m width and batter slopes at angle of repose with an approximate waste rock volume of ~1.0 Mm required.

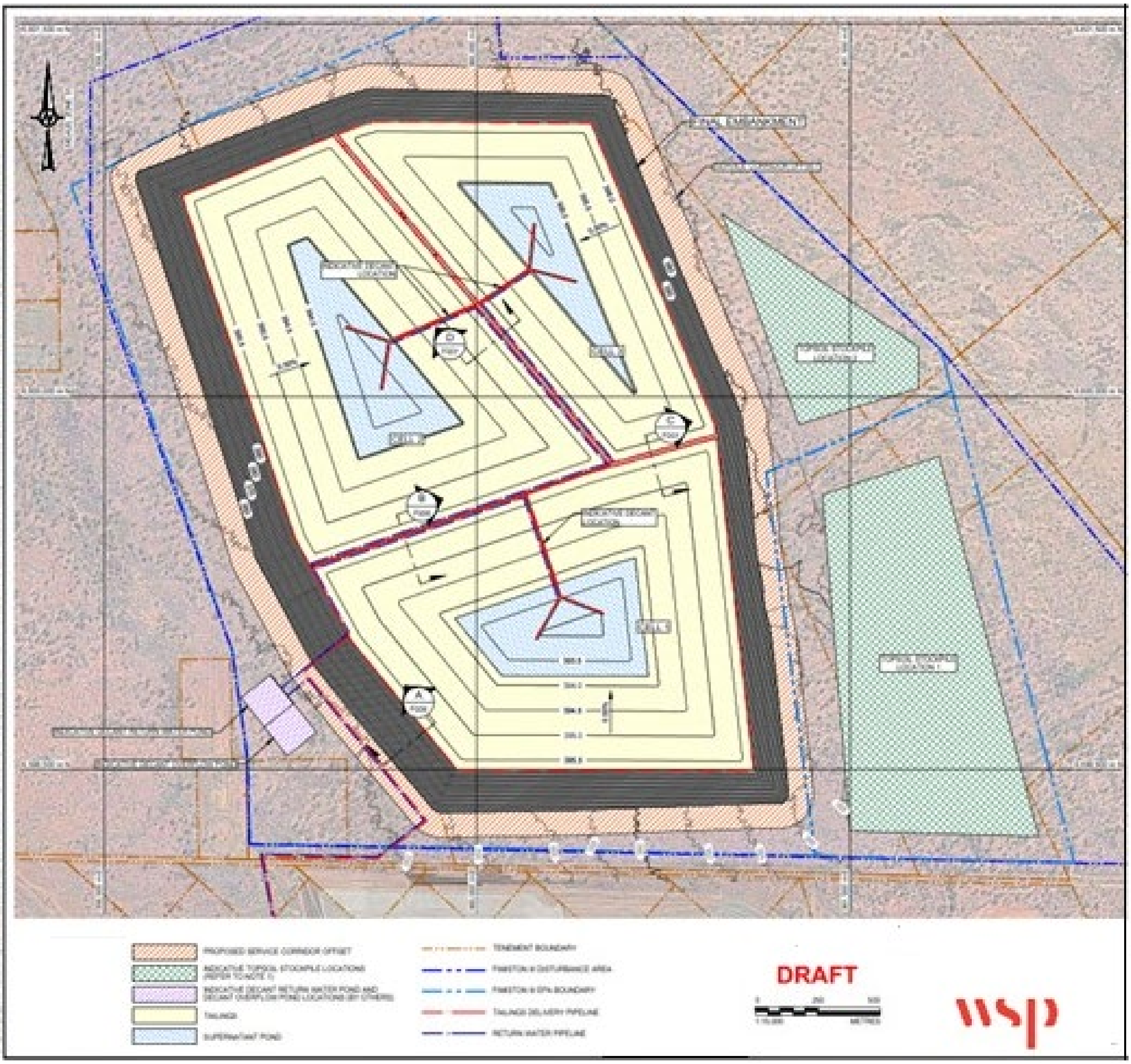


Figure 5-77: Fimiston III TSF layout

5.3.2.4.6 Kaltails TSF

The Kaltails TSF (Figure 5-78) covers a footprint area of approximately 216 ha and is located to the south of the Trans-Australian Railway corridor and to the north-east of Mount Monger Road. The Kaltails TSF was first operated between 1988 and 1999 as part of a major regional tailings retreatment project. Starter embankments for the Kaltails TSF were constructed from locally sourced clays, most of which were sourced from within the TSF footprint. Following initial construction, the TSF was raised with tailings sourced from within the TSF, using the upstream construction method (Golder, 2013). Deposition has been via sub-aerial slurry discharge via multiple spigots around the perimeter and internal embankments.

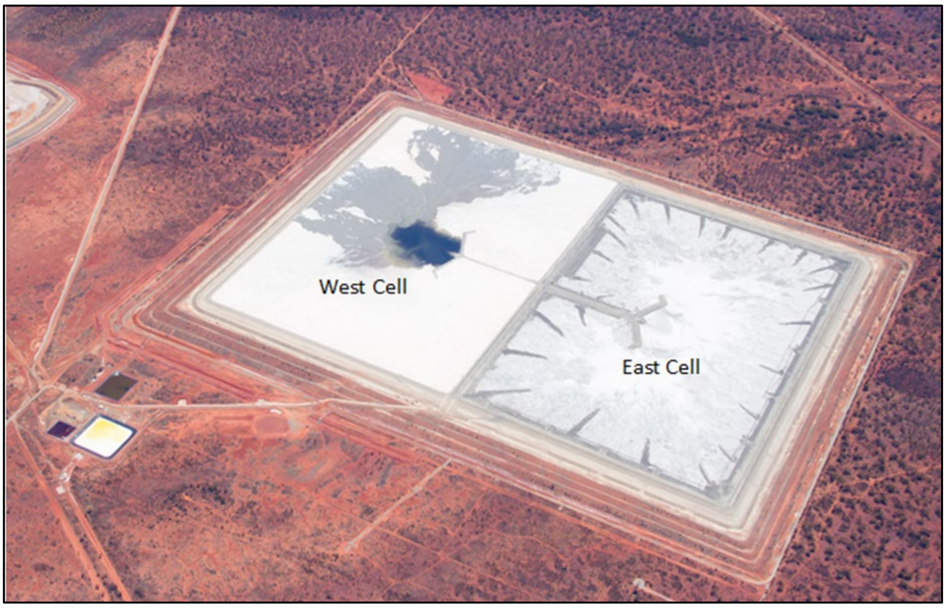


Figure 5-78: Kaltails TSF (2017)

The Kaltails TSF was originally comprised of three cells, each with approximate dimensions 500 m by 1200 m. Embankments were constructed through the centre of each cell, resulting in a configuration of six cells, each measuring approximately 500 m by 600 m. In 2011, KCGM re-commissioned the TSF by dividing the deposition area into two equal rectangles, each roughly 750 m by 1200 m in extent (Figure 5-80) (Golder, 2013). The approved height is 60 m, with outer slopes of 16-18° (Figure 5-81).

Surface water management during operations on the external batters is via penstock drains. Penstocks consist of an inlet on each berm that is made from high density polyethylene (HDPE) pipe installed under rock armouring and an outlet located at the base of the TSF. The penstocks have a history of failing and are only considered acceptable for the operational phase of the TSF. There is also one rock lined drop drain installed in response to erosion of the external embankments.

During the first period of operation, groundwater levels rose in the area resulting in vegetation death to the southwest of the TSF. In response, production bores were installed to help manage groundwater levels. During current operations, in accordance with the Kaltails Seepage and Groundwater Management Plan, two seepage interception trenches and production and monitoring bores are installed to manage groundwater levels as required by the DWER Licence, with groundwater levels well managed within licencing targets.

During the period 2019 to 2020, a rock buttress was placed on the lower flanks for the Kaltails TSF to ensure geotechnical stability criteria will be met for future lifts (Figure 5-79). Since then the buttress has been extended several times and will continue to be enlarged while the TSF is operational. The entire lower outer slopes will be buttressed by closure.

Figure 5-79: Kaltails with Buttress (2021)

Figure 5-80: Plan View of Kaltails TSF (2020)

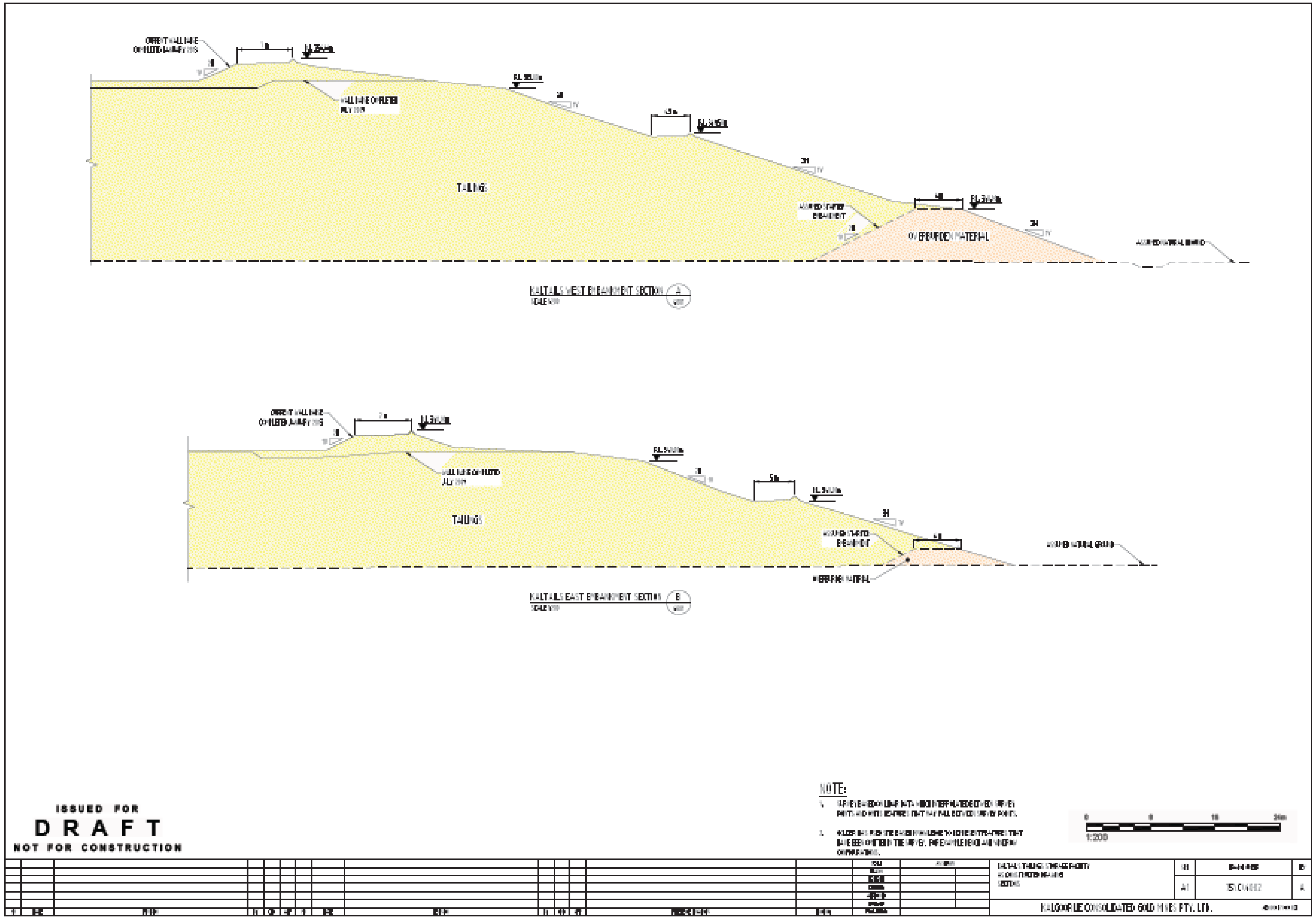


Figure 5-81: Cross-sectional View of Kaltails TSF

Completed Rehabilitation

Buttress activities in 2019 at Kaltails have covered some of the rehabilitation completed in 1999 on the western side of the facility.

Lower embankment (all sides) – 1999 Rehabilitation

At the completion of original operations in 1999, the Kaltails TSF batters were rehabilitated with a waste rock capping, and topsoil, then ripped and seeded. The TSF upper surface was not covered or rehabilitated. In 2020, due to construction of a buttress on the western flank and on portions of the northern and southern flanks, the rehabilitation has been covered by waste rock.

Kaltails rehabilitation was classified “Below expectation, continue monitoring” by LFA monitoring in 2011 (Outback Ecology, 2012a) due to several indices being below the regional range. Chenopods were the dominant vegetation type, with upper storey vegetation emergent. Visual observations have indicated that upper storey vegetation is progressing well, especially on the southern faces. Erosion gullies have been observed on the TSF, mainly due to inadequate water control on the mid berms.

Recruitment and recovery of vegetation to the south and east of the facility has also been noted following the vegetation decline during previous operation of the TSF in the early 1990s.

Upper embankment (north side) – 2020 Rehabilitation

During 2020 the northern flank of Kaltails East was reshaped and sheeted with more than 0.5 m thick waste rock, but works were interrupted by the COVID-19 pandemic. There are no topsoil stockpiles at Kaltails, as a result, rehabilitation of the upper embankment at Kaltails does not have a topsoil finish. Existing approvals acknowledge this.

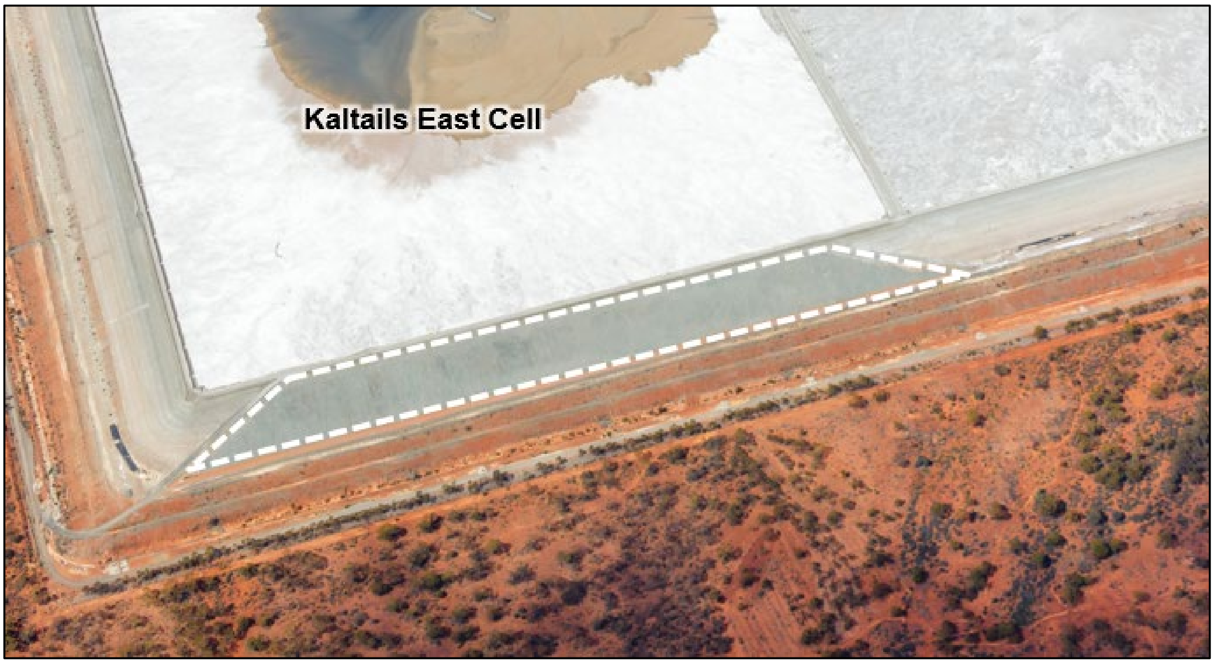


Figure 5-82: Kaltails North Flank Rehabilitation 2020

Rehabilitation of Area Adjacent to Kaltails

In the area to the south and east of the facility, natural recruitment and recovery of vegetation has been noted following the vegetation decline during previous operation of the TSF in the early 1990s (groundwater level management).

5.3.2.4.7 Fimiston Tailings Delivery and Decant Water Return Lines

The Fimiston Tailings Delivery and Decant Water Return Lines (Figure 5-59) include the pipelines and transfer stations associated with the Fimiston I, Fimiston II and Kaltails TSFs. The tailings delivery lines are currently active for all three TSFs and will remain active until completion of mineral processing in 2034. A saline water transfer station has been reported to the DWER as potentially contaminated (AOC89).

5.3.2.5 Fimiston Water Abstraction and Containment Facilities

This feature consists of lined fresh and saline water dams, Fimiston seepage interception borefield (Eastern borefield, between Fimiston I and Fimiston II TSFs), Kaltails seepage interception borefield (Kaltails TSF borefield) and Trafalgar Production Borefield and associated bunded pipelines at the Fimiston Operational Area (Figure 5-83). The borefields have DWER licences. The site dams are used for fresh or saline water storage or management. All dams used for the storage of process and saline waters are lined. The saline water transfer ponds have been reported to the DWER as a potentially contaminated site (AOC88). Site dams will be progressively rehabilitated when they are no longer required (Figure 5-83).

5.3.2.5.1 Fimiston Seepage and Groundwater Interception System

The Fimiston Seepage and Groundwater Interception System (Figure 5-83) is located around the Fimiston I and Fimiston II TSFs and consists of production and monitoring bores (called the Eastern Borefield), trenches, pipelines and dams.

Eastern Borefield (management of Fimiston I & II groundwater)

The Eastern Borefield has been established progressively since mid-1993 and draws groundwater from the ferricrete and alluvial sediment groundwater system. The borefield consists of 126 production bores, 80 monitor bores and five seepage interception trenches.

Seepage from the Fimiston I and Fimiston II TSFs has resulted in the formation of groundwater mounds, causing naturally saline groundwater to rise. The key objective of operation of the Eastern Borefield is controlling groundwater elevations around the TSFs and preventing the naturally saline groundwater from rising into the root zone of vegetation.

Groundwater levels tend to vary in response to natural recharge in the catchment associated with large precipitation events, seepage from the TSFs and seepage recovery. Depth to groundwater is typically around 6 to 10 m directly adjacent to the TSF embankments, with levels deepening further out from the TSF. Surface water drainage through the Fimiston floodway between the Fimiston II TSF and the Oroya WRD is reflected by relatively shallower groundwater levels in these areas.

Groundwater samples from most production and monitor bores are very acidic with a pH between 2 and 4. This results from naturally occurring ferrolysis reactions in the ferricrete and alluvial groundwater system. TDS concentrations currently tend to be highest in areas adjacent to the TSF embankments and decline away from the TSFs. This distribution is consistent with seepage from the TSFs mixing with the natural groundwater and dispersing in the direction of the groundwater flow. TDS concentrations of up to 140,000 mg/L have been measured in some areas adjacent to the TSF embankments where seepage has occurred (BDH, 2020a), however these decline to the background TDS concentration within 1,000 m downgradient of the TSF embankments.

The spatial distribution of TDS concentrations is not expected to change appreciably during the remaining operational life, due to the seepage management abstraction borefields. Background groundwater in the area is naturally acidic and saline, with TDS concentrations in the range of 30,000 to 40,000 mg/L (BDH, 2020a). Due to the high salinity, the groundwater is only suitable for mining and mineral processing use; therefore, the beneficial use has not been impaired by the increased TDS concentrations resulting from seepage from the Fimiston I and Fimiston II TSFs.

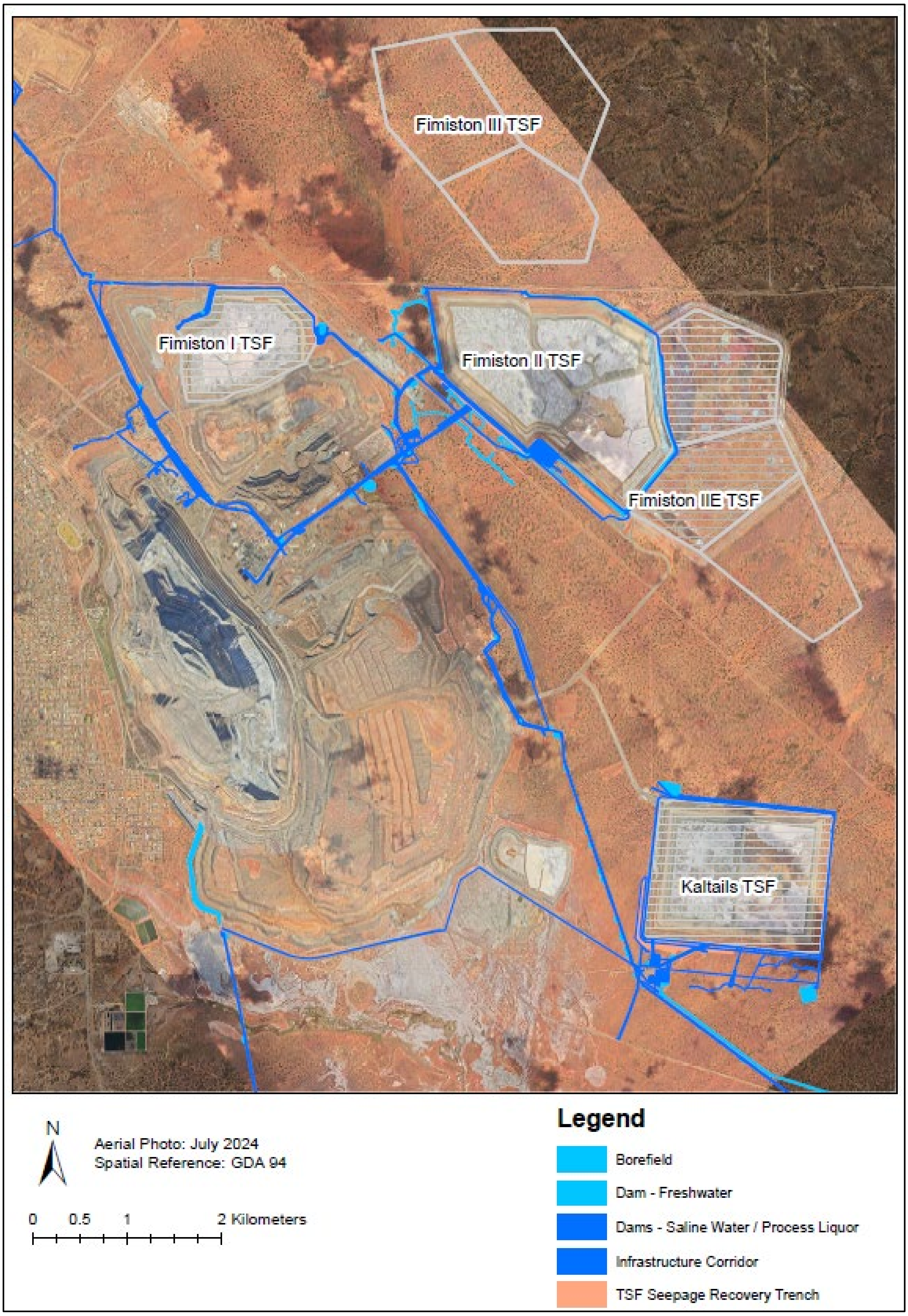


Figure 5-83: Water Containment Facilities Domain and Site Dams Feature

5.3.2.5.2 Kaltails Seepage and Groundwater Interception System

The Kaltails Seepage Interception System (Figure 5-83) is located around the Kaltails TSF and consists of production and monitor bores, trenches, pipelines and dams.

Kaltails TSF Borefield

The Kaltails TSF Borefield was re-established in 2011 upon recommissioning of the TSF by KCGM to manage groundwater levels around the TSF. The borefield consists of 44 production bores, 54 monitor bores and two seepage interception trenches which draw groundwater from the ferricrete and alluvial sediment groundwater system.

During the operational period of the TSF, groundwater elevations and quality have been affected by seepage of hypersaline water from the Kaltails TSF. Groundwater mounding is controlled by the production bores and trenches, which act to prevent the naturally saline groundwater from rising into the root zone of vegetation. Natural groundwater levels near Kaltails are shallower than in the Eastern Borefield, due to closer proximity to the playa lake system (Hannan Lake).Groundwater levels in this area react strongly to natural recharge after large rainfall events. There are few observations of groundwater conditions prior to construction of the Kaltails TSF; the pre-mining depth to groundwater is inferred to have been around 17 mbgl in the north-east corner of the facility, reducing to around 4 mbgl in the south-west corner of the facility, and further reducing to around 1 mbgl in locations 1 km south-west of the facility.

Groundwater samples from most production and monitor bores are very acidic with a pH around 3. This results from naturally occurring ferrolysis reactions within the ferricrete and alluvial groundwater system. TDS concentrations tend to be highest (up to 110,000 mg/L) in areas adjacent to the TSF embankments, and decline away from the TSF towards the natural high background TDS concentrations. Groundwater to the southwest of the TSF (in the location referred to as Morrison Flats) is around 100,000 mg/l due to the naturally hypersaline groundwater conditions as groundwater approaches Hannan Lake. Groundwater from the ferricrete and alluvial system in this area is only suitable for mining and mineral processing use without further treatment, therefore the beneficial use has not been impaired by the increases in TDS concentrations associated with seepage.

5.3.2.5.3 Trafalgar Supply Borefield

The Trafalgar Borefield is located east of the Trafalgar WRD (Eastern WRD section), between the Fimiston II and Kaltails TSFs. The borefield consists of four shallow production bores (which intermittently provide process water to the Fimiston Processing Plant) and two monitoring bores. The borefield draws water from the ferricrete and alluvial sediment groundwater system intersected by both the Eastern Borefield and the Kaltails TSF Borefield.

During operation, groundwater depth in the Trafalgar Borefield has been in the range of 2 mbgl to 10 mbgl, and has responded to recharge in high precipitation periods, and drawdown during periods of sustained operation of the production bores. Groundwater depths have shallowed since 2017 and are now close to inferred pre-mining depths of3 mbgl to 5 mbgl. This recovery of groundwater levels is due to the considerably reduced operation of the borefield since 2017, as alternative process water supplies have been provided from dewatering of the Fimiston Open Pit. The borefield will be decommissioned in 2024 due to the expansion of the Fimiston WRD.

Groundwater from the Trafalgar Borefield is naturally acidic (pH in the range of 2 to 4 due to naturally occurring ferrolysis reactions) and saline (TDS concentrations in the range 33,000 to 40,000 mg/L) (BDH, 2020c). As groundwater depths have now recovered, there has been no long-term effect on the ferricrete and alluvial groundwater system from borefield operation.

5.3.3 Gidji Operational Area (MS 1032)

The Gidji Operational Area is located 17 km north of Kalgoorlie-Boulder. The Gidji Operational Area consists of two main areas – the Gidji Plant and Gidji TSFs. The Gidji Operational Area, shown in Figure 5-84, will remain operational until 2034.

Figure 5-84: Gidji Operational Area, including Processing Plant and Tailings Storage Facility

5.3.3.1 Gidji Mineral Processing Infrastructure

5.3.3.1.1 Gidji Processing Plant

The Gidji Processing Plant (Figure 5-85 and Figure 5-86) was commissioned in 1989 to treat concentrate from the Fimiston Plant. This provided the opportunity for the phased decommissioning of the remaining three in-town roasters and the establishment of a central roasting facility, Gidji, located 18 km north of the City. The facility covers approximately 5 ha. The Gidji Processing Plant is licenced for a throughput of 438,000 tpa of gold concentrate produced by the Fimiston Processing Plant.

Currently, gold-bearing concentrate produced in the Fimiston Processing Plant flotation circuit is trucked to Gidji Processing Plant for further processing via Ultra Fine Grind enabling more effective gold recovery. Tailings from the process are deposited at the Gidji TSFs located adjacent to the Gidji Processing Plant.

Previously, concentrate trucked to Gidji was treated by a combination of roasting and UFG. In 2014, it was announced that the two roasters would cease operating by the end of 2015, and to be replaced with a larger UFG Mill. The roasters were decommissioned in 2016 and demolished in 2016/2017. The Gidji Stack has not been demolished due to the risk to the rest of the processing facility (proximity).

Figure 5-85: Gidji Processing Plant (2021)

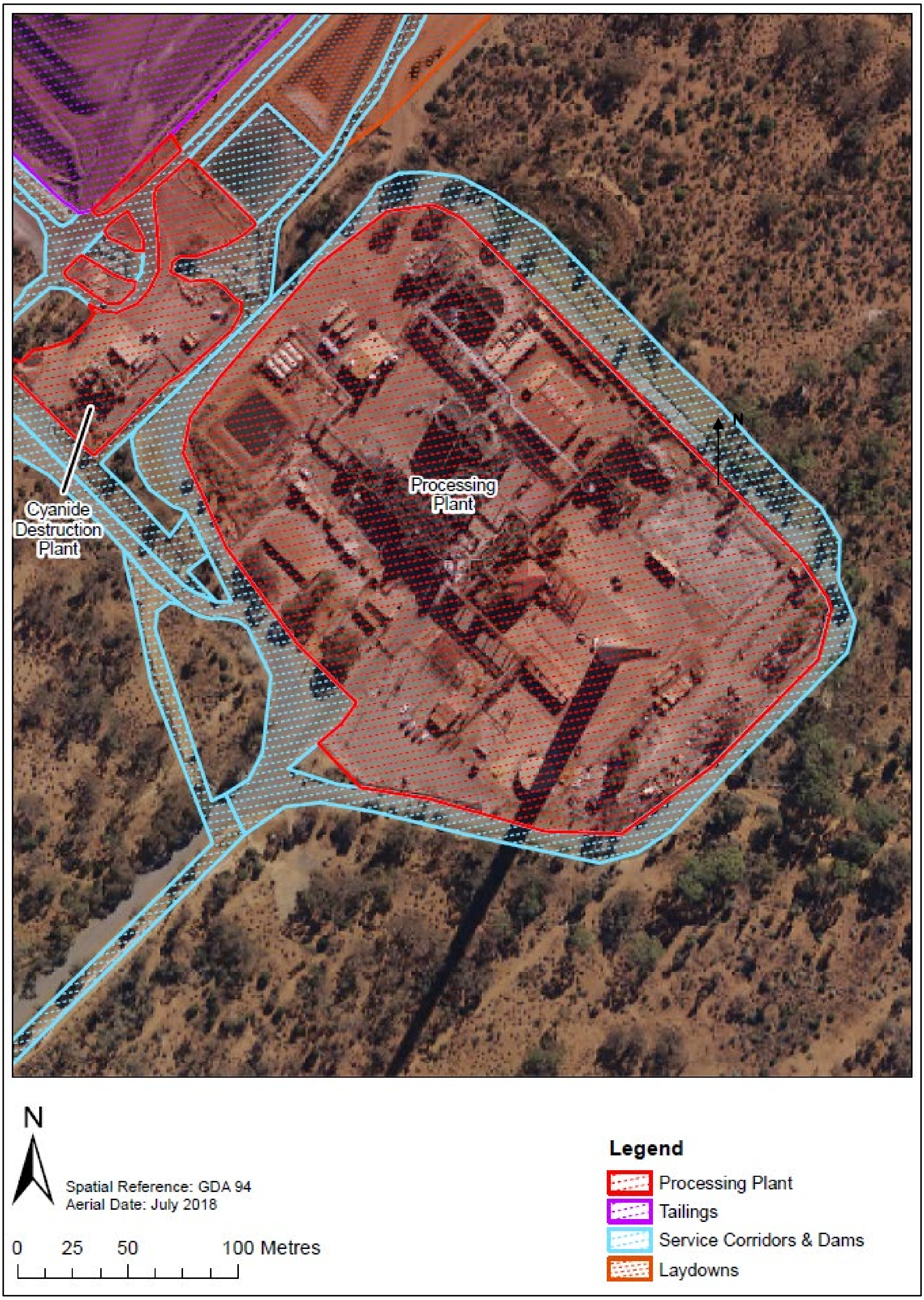


Figure 5-86: Gidji Processing Plant

Contaminated Sites

Several areas at the Gidji Processing Plant have been reported to the DWER as potentially contaminated sites:

- Chemix pond (AOC4);
- Chemix site (AOC6);
- former Gidji landfill (AOC7);
- temporary Gidji concentrate storage site (AOC9); and
- Gidji Roaster (AOC1).

The Chemix plant was located on a Miscellaneous Licence overlying KCGM tenements near the Gidji roaster. The plant was used to convert manganese oxide to manganese sulphate using the sulphur dioxide emitted by the roasting process at Gidji. Production at the Chemix site ceased in April 1995 and the site remained on the KCGM managed lease without ongoing care and maintenance by the owners who went into administration.

Sampling of materials from locations around the Chemix site was undertaken by KCGM in 1998. Analysis identified all samples collected as either manganese oxide or manganese sulphate. No significant quantities of heavy metals were identified in any of the samples. The Chemix site was decommissioned and rehabilitated by KCGM in 2000.

Opportunistic sampling has been conducted when construction activities allow, to date, substantial contamination has not been identified. This can only be verified during demolition activities, and will be guided by the Contaminated Sites procedures.

5.3.3.2 Gidji Tailings Storage Facilities

5.3.3.2.1 Overview

Two tailings facilities exist at the Gidji Operational Area; Gidji I and Gidji II, both with a 2 cell arrangement. All facilities are located immediately north of the Gidji Plant site (Figure 5-87) and cover 41 ha combined. The processing plant is licenced for up to 438,000 Mtpa of tailings solids through bunded double skinned delivery lines as slurry to the Gidji TSFs, with decant return water pumped back via central decant systems to the Plant for reuse. The operation of the TSFs is managed through Works Approvals, a Part V Licence and Mining Proposals (including geotechnical aspects). Gidji operational solutions have high cyanide concentrations.

Deposition to the unlined Gidji I TSF ceased in 2015, with the change from roasting operations (calcine tailings) to ultrafine grind tailings. Gidji I material is now used as borrow material for downstream lifts of Gidji II embankments. Rehabilitation material stockpiles are located to the east of the Gidji II TSF. Topsoil and additional material (for the closure design) will be sourced from the existing stockpiles or borrowed from nearby.

The last dam raise of the Gidji TSF was constructed in 2022 and consisted of a 4 m upstream raise of the Gidji II embankments using tailings from Gidji I. This raise extended the storage capacity of the Gidji TSF by three years. Recent changes to the Gidji operational plan have resulted in further capacity being required within Gidji II and an additional raise is being proposed through an amendment of the Mining Proposal to bring the dam to RL 368 m.

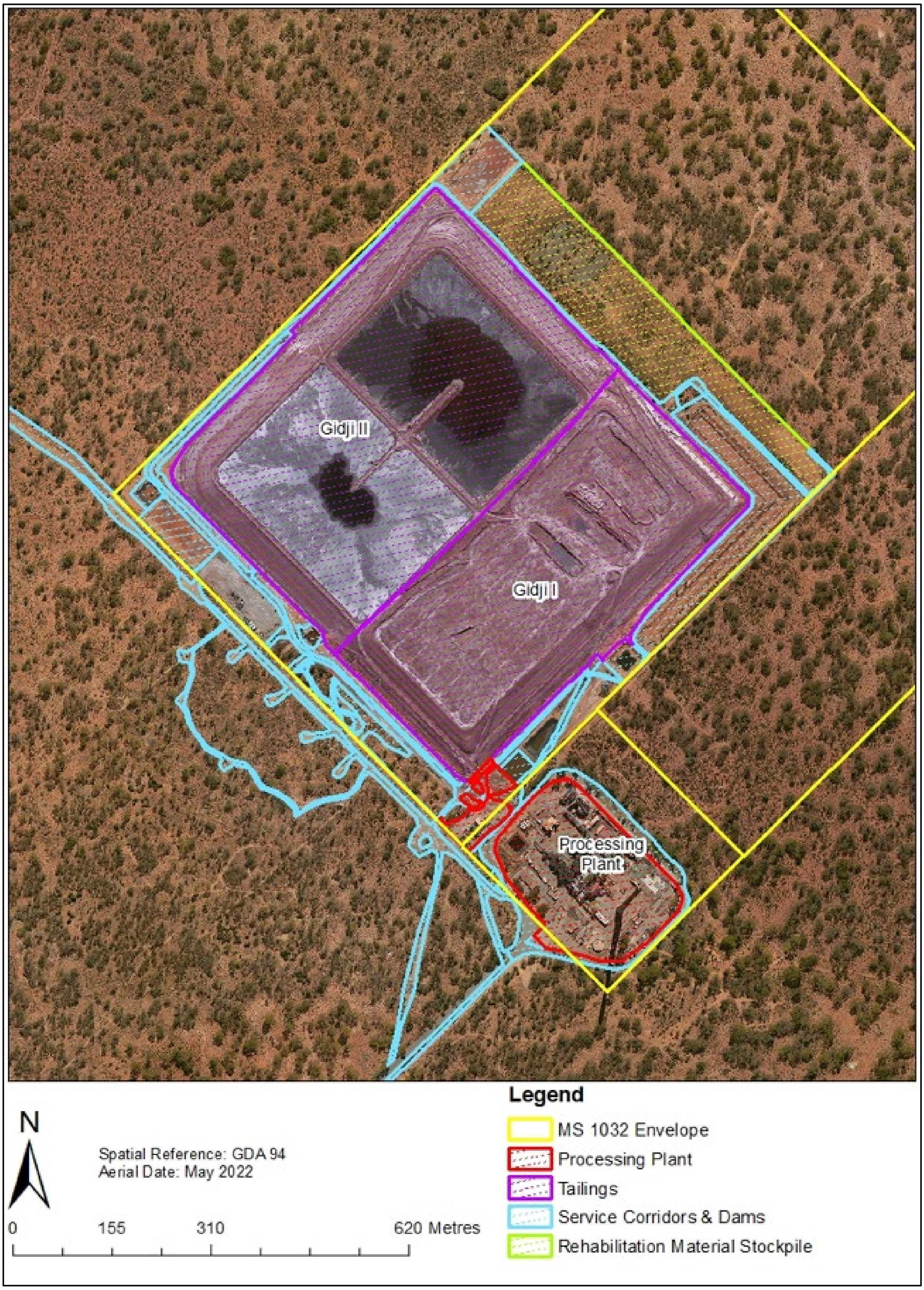


Figure 5-87: Gidji TSFs

5.3.3.2.2 Gidji I

The Gidji I TSF covers a footprint area of approximately 18 ha, comprising two cells and was constructed in 1988/1989 with sub-aerial slurry discharge via multiple spigot points around the perimeter and internal embankments commencing in 1989. The starter embankments were constructed from clay, silt and clayey sand sourced from within the storage footprint. Subsequent upstream raise construction utilised deposited tailings sourced from within the TSF (Golder, 2013). Both cells reached the approved height of 16m in 2011, with the external slopes approximately 30°. A short period of further deposition in Gidji I was undertaken from December 2014 to February 2015, after which the facility was decommissioned, with material used as wall material for Gidji II, this is slowly reducing Gidji I's height. It is expected that there will be significant reduction in remaining Gidji I material after construction of Gidji II.

Tailings Geochemical Characterisation

Tailings deposited within the Gidji I TSF are a mix of a calcine tailings stream produced by the roaster and a minor stream of tailings produced from Ultrafine Grinding (UFG), reflecting a change in processing methods over time. A review of the available geochemical data was completed in 2021 (Appendix 5.6; MBS Environmental 2021) which identified that the Gidji I tailings are:

- NAF with a greater ANC than acid production potential.
- The tailings are significantly enriched in several environmentally significant metals and metalloids (based on screening by GAI); silver, arsenic, chloride, cobalt, copper, mercury, molybdenum, lead, selenium and tellurium.
- Water leach extraction indicated that some but not all of the enriched chemical species (see above) are likely to be soluble to the extent where consideration of potential environmental risk is warranted.
- Whilst the tailings are enriched in silver, lead, selenium and antimony, water leachable concentrations of these species were below the analytical limit of reporting (LOR). Water leachable molybdenum was below the livestock drinking water default guidance values (DGV). The solubility of these species in terms of rainfall runoff and percolation/seepage is unlikely to be environmentally significant.
- Whilst arsenic was leached at around the non-potable use guidelines (NPUG) trigger level, the concentration was below the corresponding livestock DGV, at this concentration, arsenic oxyanions (e.g., arsenate) are expected to be effectively adsorbed or co-precipitated with iron oxyhydroxides present in the soils and regolith of the surrounding environment. The overall risk from arsenic leachability is considered to be low. The extraction ratio (1:1, porewater) is also noted to be substantially higher than typical used for assessments against these trigger values – a more typical extraction ratio for such comparison (1:10 or 1:20 ratio extract) would be expected to produce concentrations in the order of 0.01 mg/L (1/10th) and hence below the NPUG value.
- Cobalt, copper and mercury were leached from the tailings at concentrations exceeding broadly applicable water quality screening values. Cobalt and copper marginally exceeded the livestock drinking water DGVs of 1 mg/L, whilst mercury (0.02 mg/L) exceeded the corresponding DGV of 0.002 mg/L by one order of magnitude. These findings are consistent with the formation of soluble cyanide-metal complexes. These complexes will likely decrease in solubility over time with cyanide decomposition (aging), and again noting the high extraction ratio used for these tests.
- Water leach extraction also indicated that runoff or seepage from the Gidji 1 tailings is likely to be neutral to basic (pH 8.5), of brackish salinity (4,480 mg/L total dissolved solids, TDS) and to contain sulfate concentrations at around the livestock drinking water DGV (1,000 mg/L).
- Given the environmental context and low acid formation risk and low potential for further oxidation of the material, the tailings are unlikely to generate harmfully saline or acidic seepage.

5.3.3.2.3 Gidji II

The Gidji II TSF (consisting of East and West cells) is located immediately north and adjacent to the Gidji I TSF and covers a footprint of 23 ha. The two Gidji II cells are lined with clay and a high density polyethylene (HDPE) composite liner and overliner drainage system that has prevented seepage. The TSF is raised in a downstream direction with tailings sourced from the Gidji I cells (Golder, 2013) to an initial height of 16 m. raises. A further height increase of 20 m occurred in late 2022. Deposition is via sub aerial slurry discharge via multiple spigot discharge points around the perimeter and internal embankments. The facility is at final height of 16 m with external batters at an angle of 20°

(Figure 5 85 and Figure 5 86). Due to the high concentrations of cyanide within the processing liquids, the facility is netted to protect fauna during operations.

New Design (2025)

Recent changes to the Gidji operational plan have resulted in further capacity being required within Gidji II and a final raise is being proposed through an amendment of the mining proposal to bring the dam to RL 368 m. The raise of the dam will extend the life of the Gidji TSF to 2028. KCGM is currently exploring new closure designs for Gidji, as the ones developed in 2022 where developed when there was a possibility of a Gidji II TSF under consideration. New water shredding designs are being considered, but require further work before being adopted as the preferred design.

Tailings Geochemical Characterisation

As of 2015, tailings from Gidji Operations are produced purely from the UFG circuit and contain high percentages of sulphides. In 2016, geochemical analysis of Gidji II tailings was undertaken based on samples of tailings solids and tailings water (supernatant) (MBS Environmental, 2018b). Tailings were analysed to have very high sulfide-sulfur concentrations with limited Acid Neutralisation Capacity (ANC). Although fresh tailings are alkaline, prolonged exposure of tailings to air and water will eventually produce sufficient acidity to neutralise alkalinity provided by soluble process chemicals and inherent ANC present in Gidji ore (mainly provided by ferroan calcium and magnesium carbonate minerals such as ankerite). Once the ANC is consumed, acidic leachate is expected to be produced, therefore these tailings are considered PAF.

Tailings were substantially enriched by metals and metalloids, notably silver, arsenic, cobalt, copper, mercury, lead, molybdenum, antimony, selenium and tellurium; however, the solubilities of these elements in water and acetic acid solutions are low and of low risk to the receiving environment. Additionally, leachate from fresh tailings contains elevated concentrations of metals that form stable cyanide complexes such as copper, cobalt and mercury, however, these cyanide complexes are not expected to prevail post-closure.

At present the downstream method of construction for Gidji II; using NAF tailings material from the Gidji I TSF to raise the perimeter embankments of the lined cells, encapsulates the PAF UFG tailings during operations.

Tailings Wall Material Characterisation

In February 2021 a geochemical risk assessment for the usage of Gidji I tailings for Gidji II wall construction was conducted by MBS. As part of this process a risk assessment was conducted. The NAF Gidji I tailings material was assessed as being appropriate for use as a wall construction material. The outcome of the assessment was that usage of Gidji I tailings for wall construction would not result in unacceptable environmental outcomes.

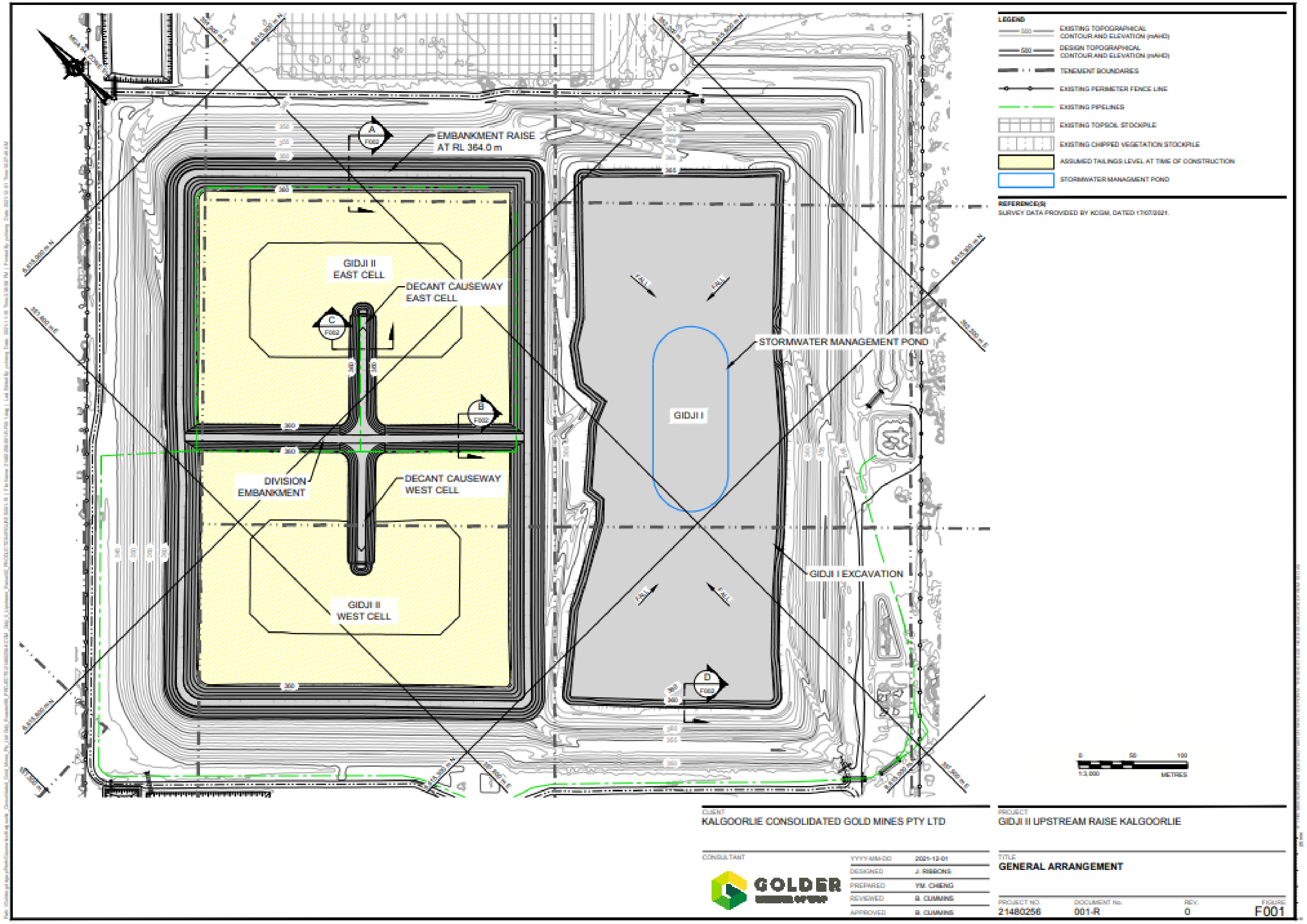


Figure 5-88: Gidji TSFs General Arrangement

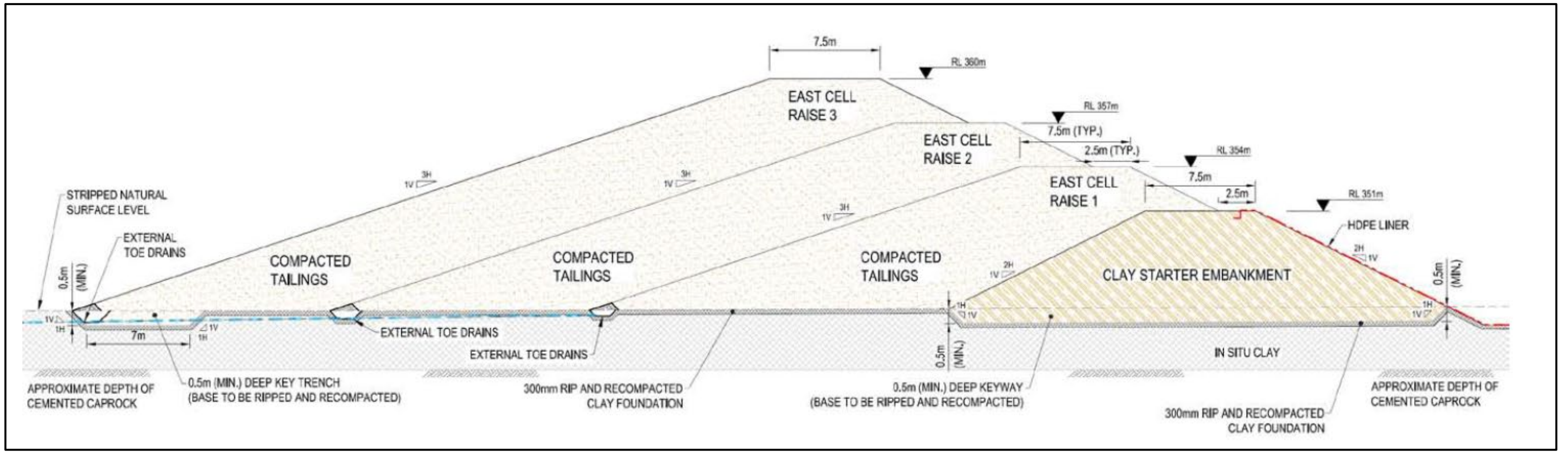


Figure 5-89: Gidji II typical cross section of outer embankment walls (downstream construction)

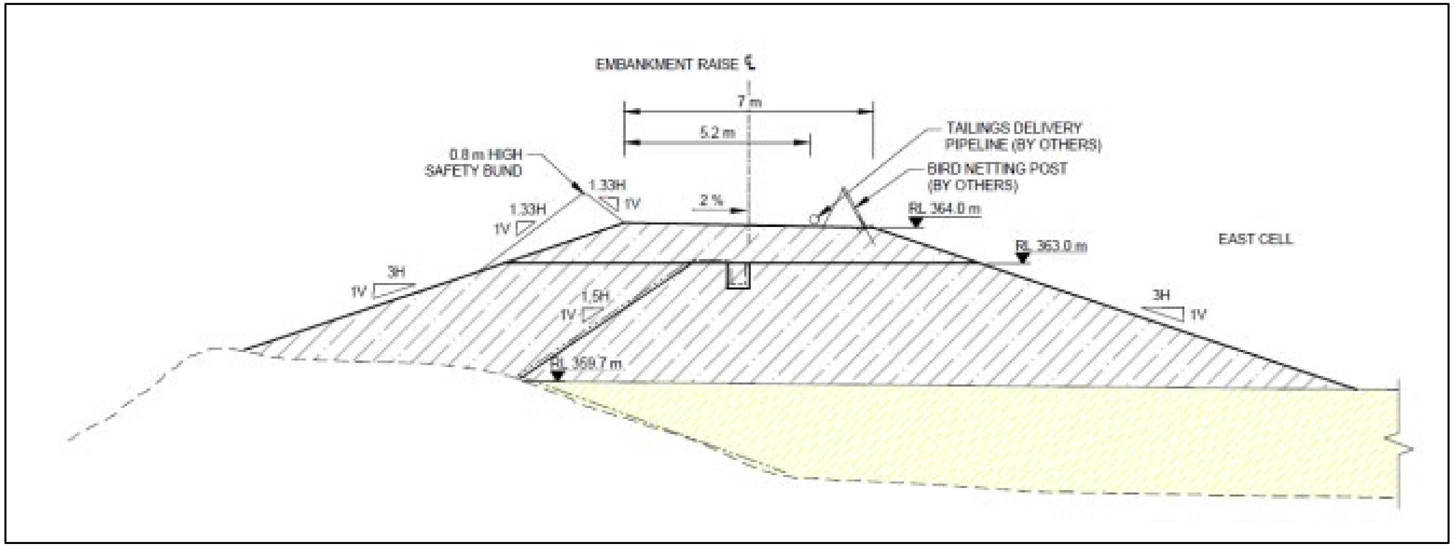


Figure 5-90: Gidji II typical cross section of 4m high upstream wall raise on Gidji II TSF (with liner detail;2022)

5.3.3.2.4 Seepage and Groundwater Management

A ferricrete and alluvial groundwater system occurs beneath the Gidji TSFs which is similar in nature to, but not connected with, the groundwater system at the Fimiston facilities. At the Gidji TSFs, the ferricrete and alluvial sediments occur at shallow depths, are predominantly present only to the west, and have a lower permeability than at the Eastern Borefield. Groundwater elevations surrounding the TSFs vary in response to; natural recharge after large rainfall events, residual mounding associated with seepage from the Gidji I TSF, and by the operation of dewatering bores and trenches (i.e., Gidji Seepage Interception System). During current operations, groundwater levels and quality of the Gidji groundwater system are not affected by seepage from the Gidji II TSF, which is a lined structure with underdrainage.

Groundwater quality has been historically affected by seepage of hypersaline process water from the unlined Gidji I TSF. A highly localised plume of groundwater containing elevated cyanide and TDS concentration extends up to 600 m to the southwest from the Gidji I TSF. Current TDS concentrations in groundwater are up to 110,000 mg/L close to the Gidji I TSF embankment and reduce towards the background concentration of around 60,000 mg/L within a few hundred metres downgradient of the embankment. The pH of groundwater ranges from 2.7 to 5.5, which reflects the naturally acidic groundwater conditions driven by ferrolysis reactions in the ferricrete and alluvial groundwater system. As this groundwater is only suitable for mining and mineral processing use without further treatment, the suitability of this resource for beneficial use has not been impaired by the presence of hypersaline seepage and cyanide from the Gidji I TSF.

During deposition in the Gidji I TSF, the Gidji Seepage Interception System was operated at around 5 L/s and successfully prevented the naturally saline groundwater from rising into the potential root zone of down-gradient vegetation. This was confirmed during operation of the Gidji I TSF by monitoring of the health condition of the Eucalyptus woodland and rehabilitated vegetation in the vicinity of the TSF which was classified as being in very good and good condition, with no impact from the TSF.

Following the decommissioning of the Gidji I TSF in 2015, the Gidji Seepage Interception System has continued to operate. As groundwater mounding around the TSF has dissipated, the total pumping rate has declined to less than 1 L/s due to the reducing submergence of the pumps installed in the bores. Groundwater levels are continuing to deepen in response to dissipation of the groundwater mound and the operation of the Gidji Seepage Interception System. It is anticipated that groundwater levels will decline to the point that the Gidji Seepage Interception System can no longer be operated within the next few years, and that the bores will be placed on standby for the rest of the operating period for the Gidji II TSF. Therefore, it is anticipated that no ongoing active management of groundwater at the Gidji operational area will be required post closure.

The Gidji II TSF has been constructed with full liners and underdrainage systems, negating any seepage of this material into the groundwater system. No seepage interception has been required during operation of the Gidji II TSF and no seepage interception will be required in closure, but the existing groundwater pumping borefield will be retained as a precautionary measure.

5.3.3.2.5 Tailings Delivery and Decant Water Return Pipelines

The Gidji Tailings Delivery and Decant Return Water Pipelines (Figure 5-84) are currently active and will remain active until the planned completion of mineral processing in 2028. The pipelines are double skinned and bunded.

5.3.3.3 Gidji Water Containment Facilities

5.3.3.3.1 Site Dams and Ponds

This feature contains all water holding facilities at the Gidji Operations including process water and saline water dams (Figure 5-91). As part of the Gidji II TSF commissioning, two surface water containment ponds were constructed at the site for stormwater management which will be maintained throughout the operation of the Gidji TSF and potentially post closure.

Rainwater incident on the TSF is captured within internal water circuits. Surface water runoff on Gidji I embankments is channelled via stormwater drop structures to a toe drain, draining to a sump on the southern side of the TSF. Gidji I has a decant pond (return water dam), with freeboard maintained at 1:100 yr 72 hr rainfall event. Surface water on Gidji II embankments reports to a toe drain which in turn reports to an eastern and western stormwater pond. Water from these stormwater control systems is pumped into the Gidji Processing Plant internal water circuit.

KCGM

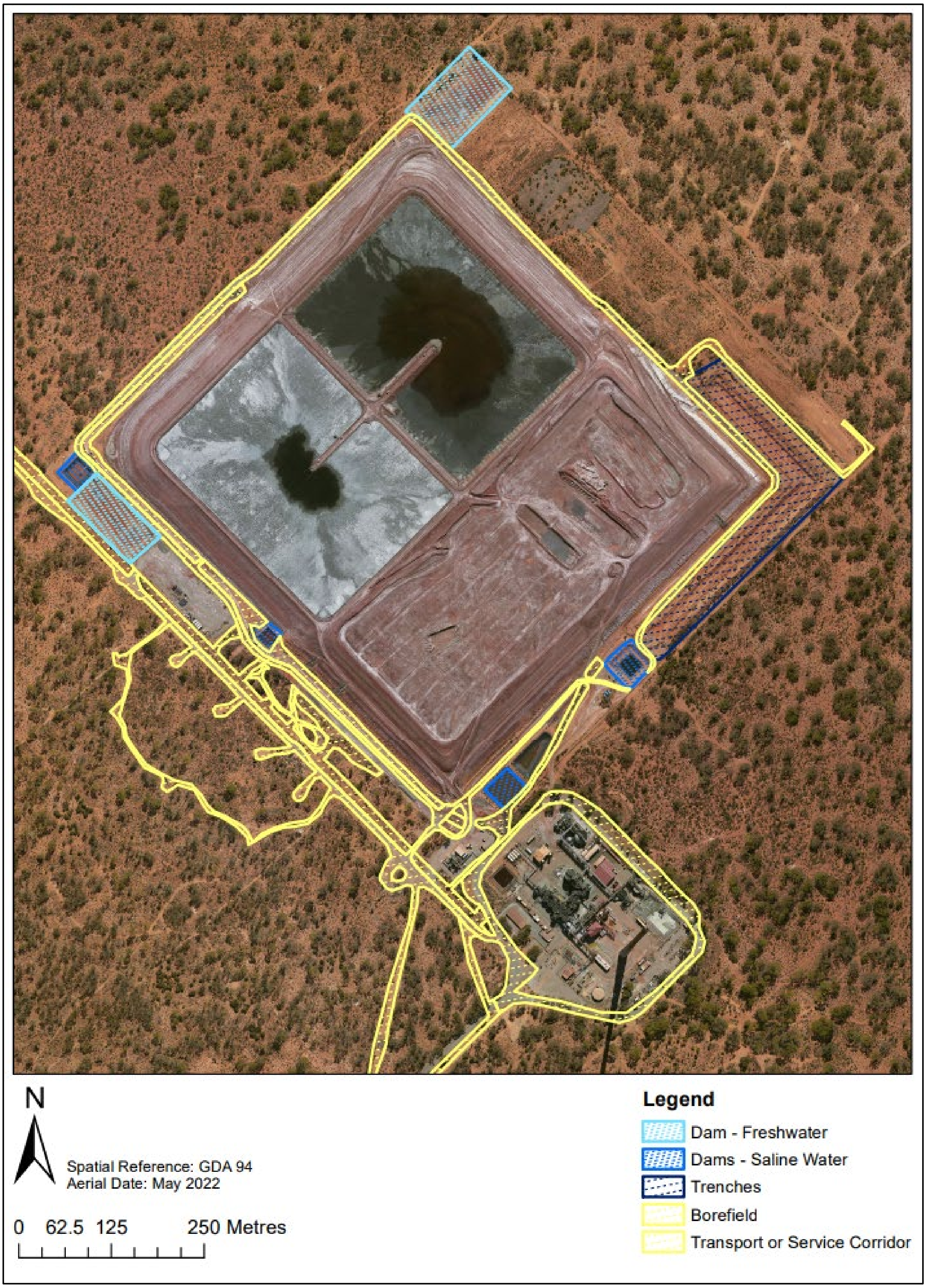


Figure 5-91: Gidji Operations Water Containment Facilities

5.3.4 Mt Charlotte Operational Area

Mt Charlotte is located between the Goldfields Highway to the west, and Williamstown to the east (Figure 5-92). The Cassidy shaft headframe is considered a landmark in Kalgoorlie.

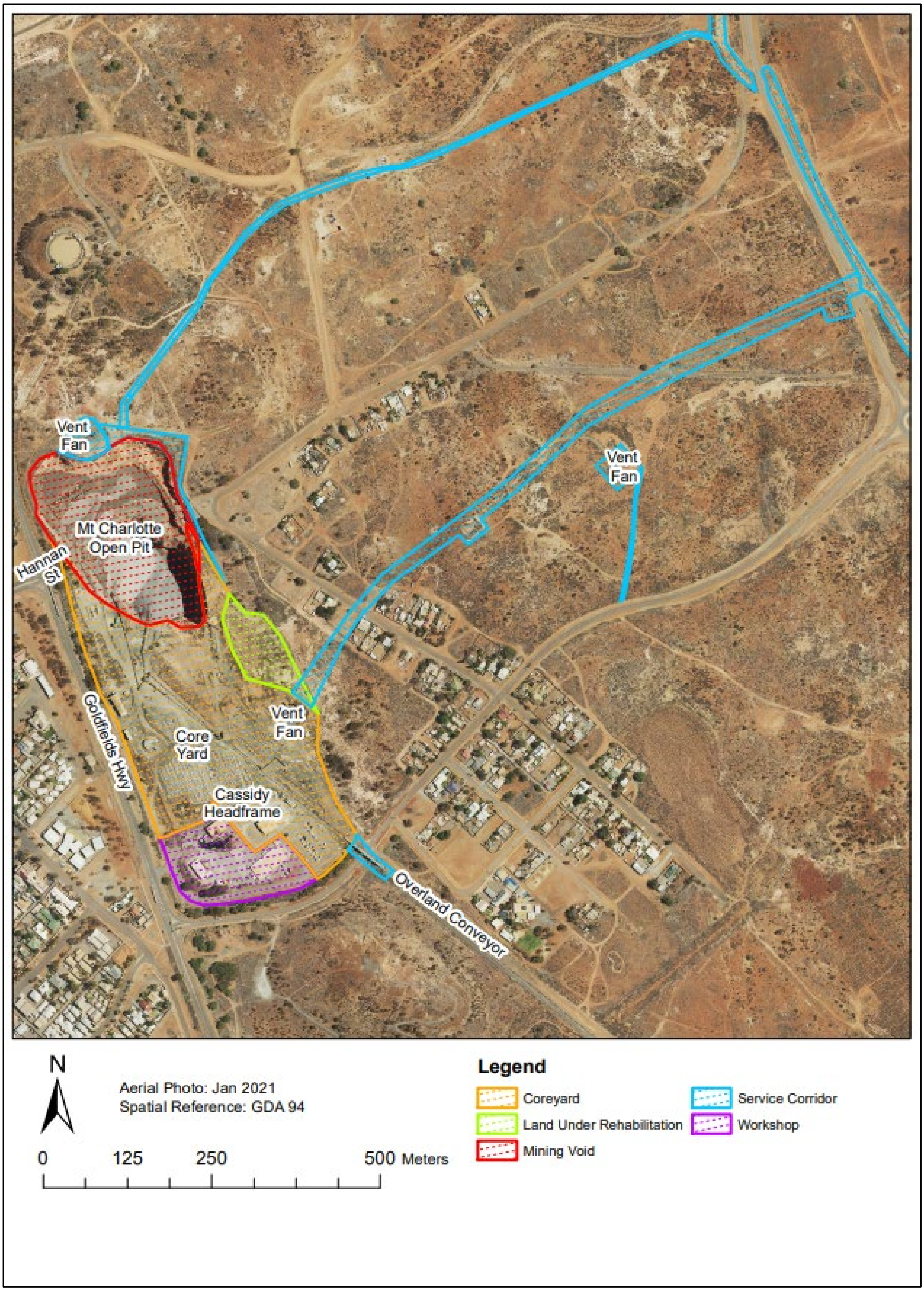


Figure 5-92: Mt Charlotte Surface Operations – August 2025

Figure 5-93: Mt Charlotte Surface Operations – August 2025 and Proposed

5.3.4.1 Mt Charlotte Mining Infrastructure

5.3.4.1.1 Overview

Mt Charlotte Mining Infrastructure includes (Figure 5-94):

- Glory Hole Pit;
- Underground Mine; and
- Surface Operations (including headframe, conveyor and core yard).

Mt Charlotte is expected to operate until 2025 (current LOM). The conveyor belt is expected to exist for some time after underground operations end, to finalise backfill of underground voids and buttressing of the MT Charlotte Open Pit.

Figure 5-94: Mt Charlotte Mining Infrastructure

5.3.4.1.2 Surface Operations

Current surface operations at Mt Charlotte consist of:

- Coreyards and shed;
- Cassidy Headframe and winder room; and
- Overland Conveyor.

Several sheds and disused offices (used when the headframe was the primary access point for the underground mine) also exist. Small workshops and hydrocarbon storage are also present.

Figure 5-95: Mt Charlotte Surface Infrastructure

Cassidy Headframe and Vent Shafts

The Cassidy Headframe and shaft at Mt Charlotte are maintained as a primary form of egress for personnel, while the Sam Pearce Decline acts as the primary access for vehicles. Several other smaller vent rises assist with underground ventilation (Table 5-11). In 2022 a new vent shaft, Fairplay, was installed due east of the Cassidy compound area for additional ventilation.

Table 5-11: Vents and Shafts at Mt Charlotte Operational Area - Existing

SHAFT OR VENT RISE	DIAMETER OR AREA
Northern Ore Body Vent Rise	2.5 m diameter
Central Ore Body Vent Rise	3.5 m diameter
Southern Ore Body Vent Rise	2.4 m diameter
Fill Pass Rise	2.4 m diameter
Cassidy Shaft	6.5 m diameter, 9.5 diameter at sub-brace
Reward Shaft	4 m × 2 m
Man & Supply Shaft	5 m × 3.5 m
Vent Rise 1	2.4 m diameter
Vent Rise 2	2.4 m diameter
Oroya	3 m × 1.2 m
Fairplay (2022)	5m diameter

Table 5-12: Proposed and Existing Vents and Shafts, Mt Charlotte

SHAFT OR VENT RISE	DIAMETER OR AREA
COB 3 Exhaust Rise	5 m diameter
MTF #1 Exhaust Rise	5 m diameter

MTF #2 Exhaust Rise	5 m diameter
Little Wonder Exhaust Rise	5 m diameter
Duke Exhaust Rise	6 m diameter

Figure 5-96: Location of Mt Charlotte U/G Mine Surface infrastructure

5.3.4.1.3 Operational Aspects

Mine Dewatering

The low yields of saline groundwater experienced over many years of mining at Mt Charlotte Operation indicate the low permeability of the country rock mass and as such groundwater seepage into the undergound mine workings is nt considered a major concern. Current Mt Charlotte mine dewatering operations will continue and extend across the proposed extended underground mine workings as and if required.

Geotechnical Stability

Waste rock generated from the underground mining will be backfilled to underground mine voids, as has historically been the practice at Mt Charlotte. Waste material will be placed both above and below the final post mining groundwater level.

It is recognised that collapse or settlement could occur if an underground void became unstable to the extent that it unravelled and could possibly migrate towards the surface. Figure 5-97 shows the extent of the proposed underground workings at the Eastern Areas extension to existing Mt Charlotte operations. It is known from existing mine data analysis that voids with minor spans of up to 15 m are stable in the long-term due to the short span remaining in equilibrium with the minor structures (KCGM, 2012). On this basis, any void of 15 m span or less is treated as a minor void and not considered as a significant geotechnical risk. The depth of the proposed mining below the base of the weathered zone further reduces the risk of any surface subsidence, however current Mt Charlotte geotechnical control procedures will ensure that if necessary any operationally identified risky voids will be backfilled prior to mine closure.

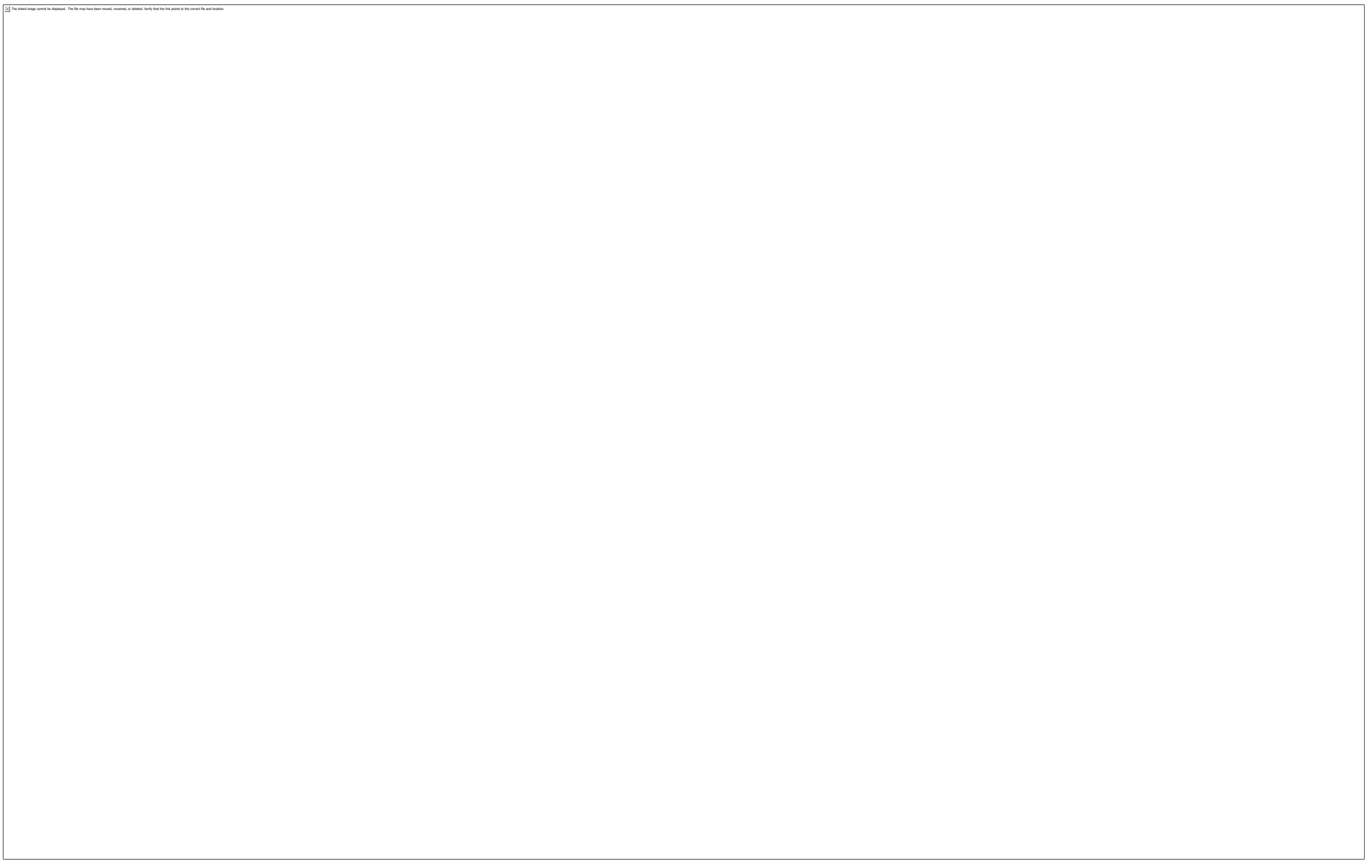


Figure 5-97: Location and Depth of the Proposed Eastern Areas Mine Workings

Shafts, rises and the Sam Pearce Decline classify as minor voids and are also not considered as a risk, however these do require effective capping and shaft exclusion zones tied to the method of shaft capping.

Mine Material Geochemical Characterisation

The desktop geochemical assessment, prepared by MBS (2025), evaluated the acid and metalliferous drainage (AMD) potential of waste rock from four deposits at Mt Charlotte: Mt Ferrum, Fairplay, Little Wonder, and Duke. All four deposits are included within the eastern areas extension.

Waste classification followed Australian Mineral Industries Research Association Limited (AMIRA) and Department of Mines and Petroleum (DMP) / Department of Industry, Innovation and Science (DIIS) guidelines, with thresholds based on (net acid producing potential (NAPP) and net acid generation (NAG) pH values. The assessment analysed each sample for:

- Contained sulfur;
- Ratio Analysis (acid neutralising capacity (ANC) / maximum potential acidity (MPA));
- Acid-Base Accounting (NAPP); and
- Net Acid Generation (NAG) testing.

Results for each deposit are summarised below:

- **Mt Ferrum**: Waste comprises 92% of the deposit, mainly Williamstown Dolerite and Paringa Basalt, both showing low sulfur content. Kapai Slate is flagged as potentially acid-forming (PAF) but represents a minor proportion.
- **Fairplay**: Majority of material is unclassified (74%). Waste lithologies show low AMD risk except Kapai Slate, which has elevated sulfur and potential for acid mine drainage (AMD).
- **Little Wonder**: Waste is only 2% of the deposit. Kapai Slate shows medium AMD risk due to high sulfur content and presence in unknowns. Devon Consol Basalt ore may generate AMD but could be buffered by high ANC.
- **Duke**: Waste comprises 41% of the deposit, mainly Williamstown Dolerite and Devon Consol Basalt. Elevated sulfur levels suggest potential AMD risk, though prior assessments indicate high ANC may mitigate this. KS is flagged for further assessment due to high sulfur content.

The only lithology identified with a consistent potential for acid generations is Kapai Slate. This slate material contains elevated concentrations of oxidisable sulfur (up to 22%) and exhibits low ANC, classifying it as potentially acid forming (PAF). However, Kapai Slate represents a minor fraction of the total waste rock by volume, typically between 1–4% within any given deposit.

Selective blending of Kapai Slate with high-ANC NAF waste rock will be undertaken to minimise the risk of AMD. Based on conservative worst-case assumptions (high sulfur concentration and ANC), approximately 1.8 tonnes (t) of Williamstown Dolerite or Devon Consol Basalt are required to neutralise the net acid potential from 1 t of Kapai Slate. Given that Williamstown Dolerite and Devon Consol Basalt together comprise over 90% of the total waste rock inventory across proposed mining areas, it is expected that there is enough acid neutralising material available to ensure full geochemical stability of the PAF material.

Waste characterisation, orebody modelling and mine scheduling will incorporate this blending strategy to ensure that PAF materials are either:

- Immediately blended with sufficient NAF waste to maintain net acid producing potential (NAPP) less than or equal to (≤) 0; or
- Isolated and encapsulated where blending is not feasible.

In addition, all unclassified lithologies will be geologically logged and geochemically tested as mining progresses to ensure correct classification and blending. This approach is consistent with the Western Australia Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) guidelines (2020) and AMIRA ARD Test Handbook protocols (2002), ensuring responsible environmental management of geochemically reactive waste streams throughout the life of the project.

Further work is planned, and an updated geochemical report will be added to the next MCP.

Core Yard

This feature covers the geology core yard at Mt Charlotte. The core yard is currently utilised by KCGM and will remain in use while KCGM has an active drilling programme. The core yard is likely to be relocated before closure.

Overland Conveyor

A conveyor previously used to transport ore has been reversed and is now used to convey waste rock from the Fimiston Operational Area to the Glory Hole for underground fill. The conveyor passes under Boorara Road and over Williamstown Road. An unsealed access road is in place along the length of the conveyor which may operate for longer than Mt Charlotte Underground Mine, to complete closure backfill requirements. No closure activities have occurred to date.

5.3.4.1.4 Mt Charlotte Open Pit

The Mt Charlotte (Glory Hole) Pit is located immediately to the north of the Cassidy Headframe, located at the eastern end of Hannan Street (Figure 5-94). It covers an area of 5 ha, has a maximum depth of 64 m, maximum length of 350 m and maximum width of 200 m. When the Mt Charlotte E1 crown pillar present in the underground workings below the pit was removed in 1978, the Mt Charlotte Open Pit was joined with the underlying stopes of the Mt Charlotte Underground Mine. The volume of the open pit is estimated at 953,700 m^3. Crushed rock from the Fimiston

Open Pit is transported to the Mt Charlotte Pit via conveyor, with the Mt Charlotte Open Pit used as a conduit to feed the crushed rock to underground through a series of voids, where it is utilised for backfilling the underground stopes. The crushed rock stockpiles in the Mt Charlotte Open Pit are managed at maximum volume, to aid buttressing of the pit walls.

5.3.4.1.5 Mt Charlotte Underground Mine

Mining at Mt Charlotte commenced in 1893, but large-scale mining did not commence until 1962. Operations at Mt Charlotte initially centred on the Reward Shaft and the Man & Supply Shaft (decommissioned). The Cassidy Shaft and associated headframe were developed in the early 1980s to access deep ore. Development of the Hidden Secret deposit (located 400 m east of the Mt Charlotte deposit) commenced during 2016. Mt Charlotte is currently the only active underground operation managed by KCGM and is scheduled to continue production until 2025.

The main historical method of mining at Mt Charlotte was open stoping. Current mining is undertaken using the modified Avoca method. Currently, stoping under rock fill (SURF) is used to recover remnant resources. New areas are mined using the modified Avoca method, with extraction from drawpoints until waste rock dilution becomes excessive. Ore from Mt Charlotte is transported to the Fimiston Plant via the Sam Pearce Decline. The major underground voids are backfilled with either mine waste or crushed rock for stability purposes.

Groundwater Management and Mine Dewatering

The low yields of saline groundwater from the Mt Charlotte Operation evidence the low permeability of the rock mass. The net abstraction of groundwater (volumes pumped out less volumes pumped in for mine use) have been less than 10 L/s over the operating period. The cone of dewatering at Mt Charlotte is very localised, and dewatering does not have any significant impact on local or regional groundwater resources in the Kalgoorlie-Boulder area. The Mt Charlotte Operations are not hydraulically connected to the Fimiston Open Pit due to the presence of a fault that acts as a barrier between these areas; there is also no known hydraulic connection between Mt Charlotte and Mt Percy. Figure 5-98 shows the current cone of depression around the Mt Charlotte underground mine workings and illustrates the steepness of the cone on either side of the mine. Mining is the only identified beneficial user for this hypersaline groundwater system.

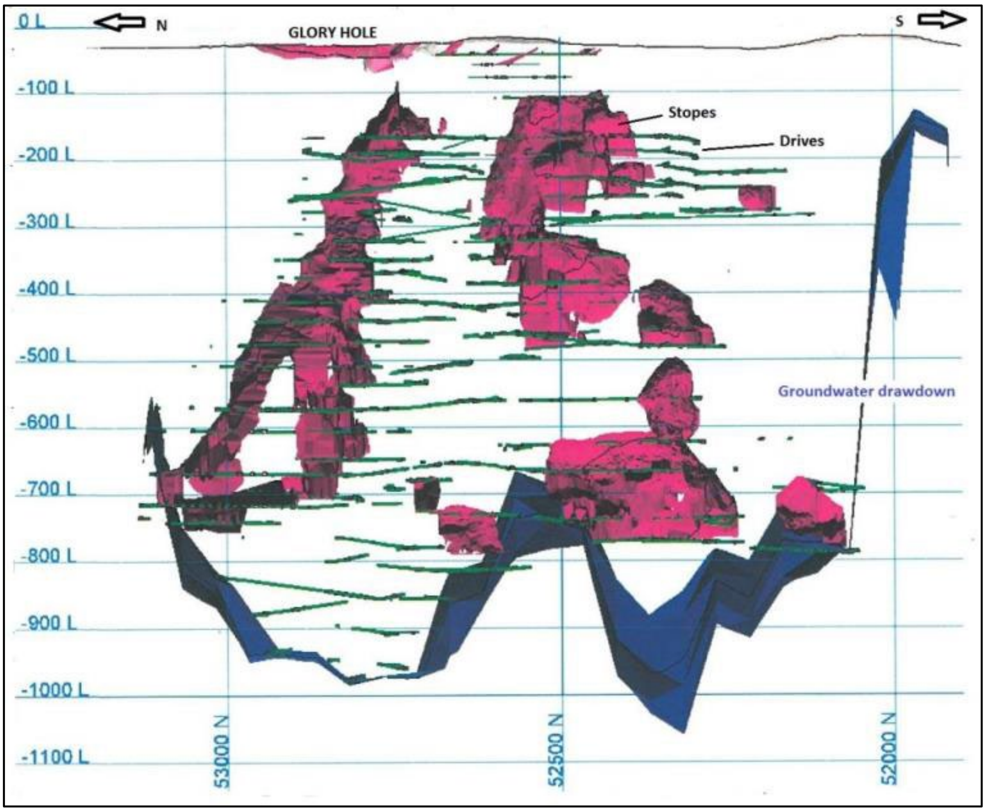


Figure 5-98: Current Groundwater Levels in Vicinity of Mt Charlotte Mine

Post closure flooding of the underground workings is dependent on the fillable void volume at the time of closure, including porosity within stope backfill, and any open stopes and access ways. The post closure groundwater model developed in 2014 used the most recent mine plan and described the locations of all underground voids (Appendix

5.8; PCA, 2014). The model was calibrated against the data collected during operations, including groundwater inflows, dewatering rates, rates of water pumped underground for mining use, water contained in ore and backfill, and water removed from the underground workings via the vent shafts.

For the prediction of pit flooding rates, the model also accounted for runoff reaching the backfilled Mt Charlotte Open Pit and infiltrating through the backfill into the underground workings. The model identified that once the underground workings are abandoned, and dewatering is completed, the water level in the workings will gradually recover towards the pre-mining groundwater elevation (335 mAHD). However, after around 99 years of filling, the water level will reach the elevation of the outlet of the Sam Pearce Decline (316 mAHD), discharge will occur into the Fimiston Open Pit from the decline portal, and the pre-mining groundwater elevation will never be reached. Outflow from the Sam Pearce Decline is predicted to average 33 kL/day (0.4 L/s), driven by a combination of groundwater inflow through fault zones at depth, and surface water infiltration through the backfilled pit (Appendix 5.8; PCA, 2014). This component has been included in water balance and geochemical modelling of the pit lake which will develop in the Fimiston Open Pit in closure.

The basement rock groundwater system, which is connected to the Mt Charlotte workings, provides the greatest inflow component during the period of mine flooding, although the actual inflow rate is relatively low (the greatest groundwater inflow occurs at the start of mine flooding and is around 7 L/s). This groundwater system is hydraulically disconnected from the Fimiston Open Pit by the presence of faults. As a result of the discharge from the Sam Pearce Decline, the Mt Charlotte workings will act as a groundwater sink to the local groundwater system in perpetuity. The resulting minor permanent lowering of the groundwater elevation (from 335 mAHD to 316 mAHD) will not cause any impacts as there are no other beneficial uses for this groundwater system which contains naturally saline groundwater.

Mine Waste Materials Characterisation

Waste characterisation was completed on waste from Mt Charlotte (Appendix 5.7; MBS Environmental, 2018c) which indicated that:

- Fresh mafic rock lithologies Golden Mile Dolerite (GMD), Williamstown Dolerite (WD), Devons Consul Basalt (DCB), Porphyry (POR) and Hannans Lake Serpentinite (HLS) are all classified as NAF with alkaline pH, moderate levels of soluble alkalinity and low salinity levels. WD, DCB, HLS and two of the four GMD samples were further classified as being acid consuming, with very high levels of readily reactive carbonate-based ANC relative to oxidisable sulfur concentrations.
- A general enrichment in silver, tellurium and antimony, which is typical of Golden Mile mineralisation and/or the presence of minerals like hessite. Fresh mafic rock lithologies GMD, WD, DCB, POR and HLS were low in most environmentally significant metals and metalloids and produced very low concentrations of soluble metals and metalloids in both water and acidic leachates. These materials are considered geochemically benign and seepage from them does not pose a risk to the receiving hypersaline groundwater at KCGM.
- Although a minor lithology (1.2% of LHSO waste mass), KS (Kapai Slate) waste rock contained significant levels of oxidisable sulfur and slightly lower levels of ANC and as such was classified as PAF – high capacity (one sample was uncertain).
- KS was the most geochemically enriched Mt Charlotte waste lithology with enrichment in silver, tellurium and antimony (as for mafics), but also mercury, copper, arsenic, selenium, tin, cadmium and zinc. The concentrations and distribution of enriched elements was broadly similar to BF shale from previous studies (MBS 2017). Despite this enrichment, levels of soluble species released during leaching with both water and weak acid were still comparatively low – likely due to insoluble mineral forms being present such as tellurides. It is noted that extreme weathering of geochemically similar PAF BF shale enriched in mercury, tellurium and antimony still did not release soluble fractions of these three elements.
- Overall, co-disposal of the minor portion of KS lithology (1.2% of LHSO waste mass) with surrounding high ANC lithologies from LHSO underground is considered to pose negligible risk of significant oxidation and metals release to groundwater. The potential for surface oxidation of KS material during the operational phase of mining will likely be constrained by limited air flow in backfilled underground stopes away from active ventilation areas and be readily neutralised by the much larger proportion of highly reactive acid consuming waste rock with moderate to high levels of soluble alkalinity. All oxidisation potential will cease after cessation of mining and the recovery of the water table which is expected to cover all such underground waste rock.

Geotechnical Stability

Backfill of Underground Voids

Collapse or settlement could occur if an underground void became unstable to the extent that it unravelled, under these conditions the instability could potentially migrate towards the surface. Figure 5-99 shows the extent of the underground workings at Mt Charlotte and provides some indication of the actual depth below surface of the original mine voids prior to backfilling. Operational waste and crushed waste supplied through the Mt Charlotte Open Pit are used to backfill old stopes.

It is known from mine data analysis that voids with minor spans of up to 15 m are stable in the long-term due to the short span remaining in equilibrium with the minor structures (KCGM, 2012). On this basis, any void of 15 m span or less is treated as a minor void and not considered as a significant geotechnical risk. Shafts, rises and the Sam Pearce Decline classify as minor voids and are also not considered as a risk, however these do require effective capping and shaft exclusion zones tied to the method of shaft capping.

Beyond a minor span of 15 m, flat voids can be unstable, and if unrestrained, falls could occur until a stable arched back shape is formed. These can occur in the major voids (Figure 5-99), and are of two types:

- Open stopes. These make up most of the voids. Stope walls and backs comprise unbroken rock. Stopes may be partly filled with broken waste rock and mixed with old sandfill in some areas.
- Voids adjacent to old sandfill. These have only been developed occasionally since 1998 when remnant mining commenced beside the old COB stopes in the upper levels. These voids are short-lived and occur when the sandfill hangs up instead of collapsing when further mining occurs. There are currently no such major voids of this configuration present in the mine.

Collapse or settlement could occur if an underground void became unstable to the extent that it unravelled, and under these conditions the instability could potentially migrate towards the surface. Figure 5-99 shows the extent of the underground workings at Mt Charlotte and provides some indication of the actual depth below surface of the original mine voids prior to backfilling. Operational waste and crushed waste supplied through the Mt Charlotte Open Pit are used to backfill old stopes. In Figure 5-99, large voids that are currently at over 80% backfill volume are shown in grey; voids that require backfill and are under 80% fill are shown in yellow; voids that are considered stable and will not require backfill are shown in blue.

Figure 5-99: Plan showing Major Voids greater than 15 m width and current status of voids requiring backfill

The overall risk to surface infrastructure is limited by the depth of the primary voids below surface. Figure 5-100 shows the "footprint" of the mine void levels projected to surface.

Figure 5-100: Projection of Various Mt Charlotte (Cassidy area) Mine Voids to Surface

Table 5-13 provides an assessment of the major voids potential instability. Ground surface collapse/subsidence was only identified as possible in two areas (ROB 2 and COB A & B), relating to the proximity to 'sandfill' and potential movement as a result of wetting (flooding) of these 'red sands'. KCGM considers that this risk is low and adequate control measures are in place. The major voids and their current backfill status are summarised in Table 5-13.

The threat of seismic vibration arising from seismic activity relates more to failure along major fault lines and KCGM recognises that there is a background level of seismicity associated with the faults independent of mining, which backfill cannot prevent.

Backfilling of stopes and for stability purposes is ongoing. Backfill of voids created by current mining operations is a cost of operations, and not included as a closure activity. Backfill of historic voids is conducted as a closure activity, against a schedule that is regularly updated. The stope and void volumes remaining to be backfilled are summarised in Table 5-13.

Once underground void backfill is complete, filling of the Mt Charlotte Open Pit will commence. Backfill of the Glory Hole Pit forms a significant portion of the total volume required, at approximately 1,072,000 m^3 (this volume allows for some subsidence).

Table 5-13: Mt Charlotte (Cassidy area) Void Backfill Analysis (status at Dec 2020)

NAME	DATE MINING COMPLETED	MINED VOLUME OF STOPE (M^3)	PORTION OF STOPE FILLED DECEMBER 2020	VOID MEASURED / EST. (M^3)	BACKFILL TONNES REQUIRED	BACKFILL CLOSURE REQUIRED?	REASON FOR BACKFILL
COB A (Open Pit)	1967	1,900,000	42%	1,155,623	2,195,683	Yes	Surface subsidence
COB B to H	Current	8,462,885	100%	0		No	None
ROB2	2015	1,550,000	82%	283,300	509,940	Yes	Some risk of subsidence
ROB3 Lower	2013	86,200	100%	0		No	None
ROB3 (sth)	2019	1,305,501	99%	5,000		No	Some risk of subsidence
ROB4	Current	250,000	87%	32,164	57,895	No	Some risk of subsidence
ROB5	2009	1,835,000	100%	0		No	None
MOB1_1&2	2020	80,000	10%	70,000	126,000	No	Some risk of subsidence
MOB1_3	2019	60,600	26^	45,000	81,000	No	Some risk of subsidence
MOB1_4	Current	98,600	0%	177,464	319,435	No	Some risk of subsidence
MOB2	Current	82,000	8%	75,500	135,900	No	Required for mining sequence
MOB4	1997	320,000	0%	320,000	576,000	No	None
I1	1996	630,000	100%	0		No	None
I2	1998	970,000	100%	0		No	Some risk of subsidence
S1	1997	45,000	24%	72,925	131,265	Yes	Some risk of seismicity
S6	1998	30,500	50%	32,100	57,775	Yes	Risk of seismicity
S2	1998	196,000	98%	5,000		Yes	Risk of seismicity
Hidden Secret	Current	-	~90%	-	-	No	Required for mining sequence

5.3.5 Mt Percy Operational Area

Mt Percy Operational Area (Figure 5-101) is located approximately 5.5 km north from Fimiston Operations and 1.5 km north east from Mt Charlotte. Mt Percy ceased operating in 1997 and was rehabilitated in the early 2000s.

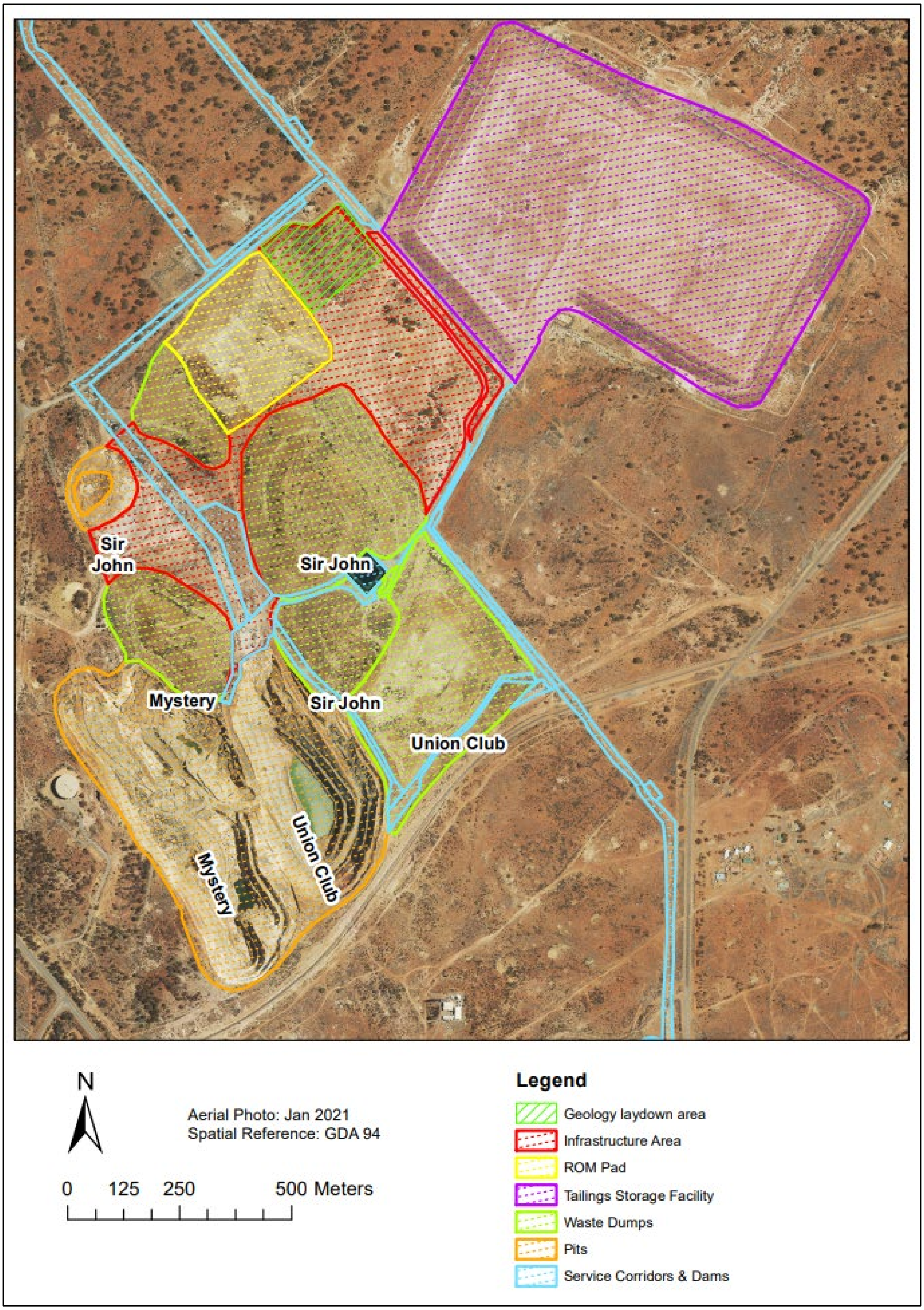


Figure 5-101: Mt Percy Operational Area

5.3.5.1 Mt Percy Mining Infrastructure

Features of the Mining Infrastructure Domain at the Mt Percy Operational Area include the Mystery and Union Club Open Pit and Sir John Open Pit (Figure 5-102). Most of the mining at Mt Percy occurred pre KCGM ownership, with the area rehabilitated by 2001. The dimensions of the Open Pits are summarised in Table 5-14.

Table 5-14: Mt Percy Open Pits Summary

OPEN PIT	SURFACE AREA (HA)	MAXIMUM DEPTH (M)	MAXIMUM LENGTH (M)	MAXIMUM WIDTH (M)	VOLUME (M^3)
Mystery	19	60	800	270	5,965,900
Sir John	0.6	22	75	110	53,000
Union Club	13	90	590	262	5,410,000

Figure 5-102: Mt Percy Open Pits and Surrounding Infrastructure

5.3.5.1.1 Mystery and Union Club Open Pits

The Mystery and Union Club Open Pits Feature encompasses the contiguous Mystery and Union Club Open Pits, including their surrounds and bunding. Bunding has been constructed around sections of the open pits at Mt Percy; however, access to this site is also currently controlled via fencing and security patrols. Mining by Mt Percy Mining Services Pty Ltd occurred between 1985 and 1992. Although mining has been completed, a mineralised zone occurs under the pits that may be viable in the future via underground operation.

The pits are located to the east of the Eastern Bypass Highway and to the north of the Trans Australian Railway, with a Water Corporation owned tank located on a lateritic hill to the west. A significant portion of the north western limb of the Mystery Open Pit has been backfilled to 380 mAHD in order to buttress the western wall adjacent to the water tank. This was done in accordance with the original mining approval agreement between the Water Corporation and Mt Percy Mining Services Pty Limited and was considered a preventative measure rather than a geotechnical necessity. While additional ore reserves were identified beneath the water tank hill these were effectively sterilised by Government as a result of geotechnical stability concerns and the protection of the integrity of the water tank. Annual visual monitoring by the KCGM geotechnical engineers has not detected any stability issues relating to the water tank.

Geotechnical Stability

The Mystery Pit was developed largely in Hannans Lake Serpentinite with a central Porphyry dyke system. A pillar of serpentinite separates the Mystery Pit from the Union Club Pit, the latter being developed in Hannans Lake Serpentinite, Devon Consols Basalt, Williamstown Dolerite and Kapai Slate. Major structures have been mapped on the south walls but, these tend to be favourably orientated and are not considered to directly affect the wall stability. Assessment of the minor structures has shown that they tend to be short; the most likely expression of any unfavourable structural combinations would be the generation of localised instability on the exposed batter slopes.

However, observation of the batter slopes shows they are in good condition, confirming structural features do not contribute to slope instability. For the inter-ramp slopes to be affected, failure mechanisms will have to involve stepped-path surfaces.

Since the mid-1990s the south wall (Figure 5-103) of both the Mystery and Union Club Open Pit received geotechnical scrutiny in the form of:

- Visual inspections every three to six months or after significant natural events, such as cyclonic rainfall events;
- Monthly checking of water levels in two piezometers located behind the Mystery and Union Club southern pit slopes and;
- Photography of pit slopes on a quarterly basis to provide a continuous record of any surface deterioration.

KCGM geotechnical engineers consider that given the competent nature of the materials exposed in the south wall, the tight slope curvature and the presence of well-defined rock structure, a circular failure mechanism is considered to be unlikely. Failure of rock slopes is usually controlled by rock structure and circular failure within slopes is generally associated with weak materials such as extremely weathered overburden and soil waste rock dumps. Circular failure analysis, although not particularly relevant to these pit slopes, did help to reinforce the notion that deep seated failures affecting the rail line reserve are extremely unlikely (KCGM, 2012). It is believed that seismicity would not trigger overall slope failure but would be more likely to shake loose blocks from individual batters.

Batters on the north wall of Mystery Open Pit and eastern wall of Union Club Open Pit show evidence of small scale slips.

Figure 5-103: Union Club Pit Southern Wall

Groundwater Management

The phreatic surface coincides with the Mystery Pit floor, and as a result this wall section appears to be fully drained and the mine void contains no permanently ponded water. The Union Club Pit floor, however, extends deeper to 300 mAHD giving a slope height to the surrounding natural surface of 105 m and resulting in the lower part of the pit intersecting the groundwater table. The intersection of the phreatic surface within the moderately to slightly weathered zone implies the uppermost 64 m of the Union Club slope, i.e., the weathered zone, is fully drained. The current pit lakes have remained relatively stable for a number of years reflecting the balance between groundwater and rainfall inflow and evaporation from the lake.

5.3.5.1.2 Sir John Open Pit

After mining of the Sir John Pit was completed, the pit was partially backfilled with mine waste, tailings material was removed from the vicinity of the Hannans North Tourist Mine (formerly the Australian Prospectors and Miners Hall of Fame site) and Black Flag Beds shale was removed from a cleanup of the Mt Percy ROM Pad (Figure 5-104). The Sir John Open Pit was reported to the DWER as a potentially contaminated site (AOC31).

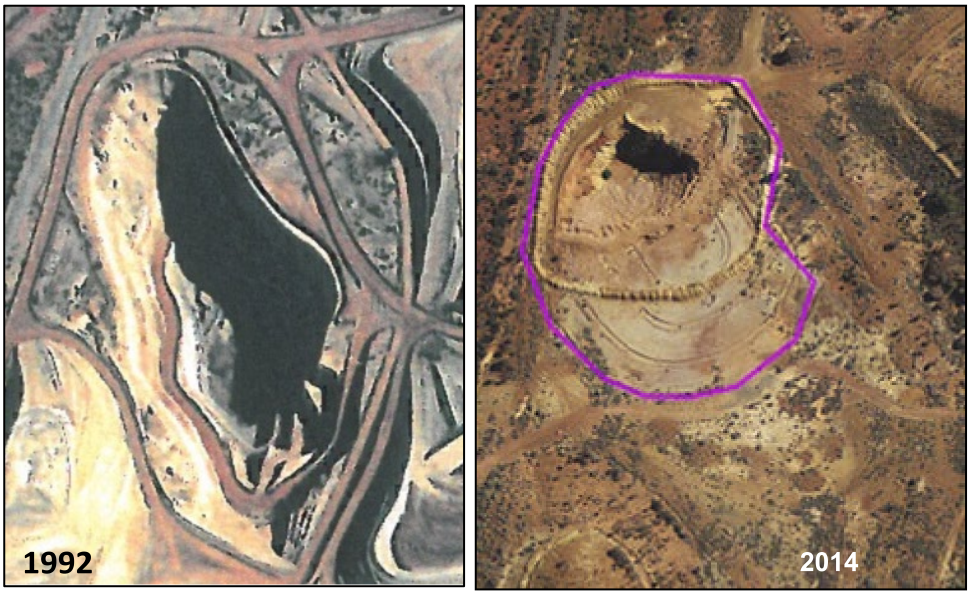


Figure 5-104: Sir John Open Pit Feature (showing extent of backfill) 1992 to 2014

5.3.5.2 Mt Percy Waste Rock Dumps

5.3.5.2.1 Overview

The Mt Percy WRDs include (Figure 5-101):

- Sir John WRD;
- Union Club WRD; and
- Mystery WRD.

All WRDs are rehabilitated, with a rehabilitation age of more than 20 years. There are no topsoil stockpiles at Mt Percy.

Material Characterisation

Characterisation work has been conducted at Mt Percy on materials used for rehabilitation of mine landforms. It was generally found that those materials that were under-performing erosionally were generally of poor structural instability and salinity. Conversely, those areas performing well generally were structurally stable, non-sodic and non-dispersive.

5.3.5.2.2 Sir John Waste Rock Dump

The Sir John WRD (Figure 5-105) was rehabilitated in 1993 by re-shaping to approximately 16°, sheeting with lateritic rehabilitation materials, contour ripping and seeding. Monitoring transects were installed for the first time in 2010 and 2011 and monitoring in 2011 classified this area as “On track, continue monitoring” (Outback Ecology, 2012b). Visual inspections from 2012 to 2014 have noted that the WRD has good vegetation condition (Figure 5-106) with multiple life stages and evidence of reproduction present; however, there are some minor erosion gullies.

Figure 5-105: Sir John WRD Progress of Rehabilitation 2021

Figure 5-106: Sir John WRD Western Batter Progress of Rehabilitation

5.3.5.2.3 Union Club Waste Rock Dump

The Union Club WRD was rehabilitated in 2001. Oxide mine waste material was sourced from the central section of Union Club WRD over a period of years for TSF capping, creating a depression in the top dump surface. Surface water runoff on this WRD has formed gullies in some areas.

EFA monitoring in 2011 classified this area as “On track, continue monitoring” (Outback Ecology, 2012b). Visual inspections from 2012 to 2014 indicate that lower storey vegetation is comprised mostly of salt tolerant species, such as *Atriplex* (Figure 5-107). Upper storey species were sparse on the batter and top of the dump, with *Casuarina sp.*

observed in areas where water was ponding at the dump toe. Erosion gullies were observed from the mid-slope drainage berm (cut in after material placement) located in the upper third of the outer slope.

Figure 5-107: Union Club WRD Upper Surface (Bottom 2014; Top 2021)

5.3.5.2.4 Mystery Waste Rock Dump

The Mystery WRD (Figure 5-101) was rehabilitated in 1992, lateritic rehabilitation materials were spread to 0.2 m depth over the underlying oxide waste rock and seeded. An access track spirals around the Mystery WRD to gain access to the top surface. Erosion is occurring on the access track which appears to be acting as a drain for excess surface water.

1992 Rehabilitation (Lift 1)

LFA monitoring in 2011 classified this area as “Below expectation” (Outback Ecology, 2012b). However, visual inspections from 2012 – 2014 indicate that vegetation appears to be in good condition (Figure 5-108), with multiple life stages and evidence of reproduction. A review by botanical professionals in 2012 described the vegetation community as a low mixed *Eucalyptus spp.* woodland over a sparse to open mid *Atriplex nummularia* shrubland over a sparse to open low *Atriplex vesicaria, Maireana pyramidata* and *M. glomerifolia* shrubland over isolated *Enneapogon caerulescens* grasses, with the surface relatively erosionally stable.

1992 Rehabilitation (Lift 2)

LFA monitoring in 2011 classified this area as "Below expectation, investigation recommended" (Outback Ecology, 2012b). However, visual inspections from 2012 – 2014 indicate that vegetation appears to be in good condition, with multiple life stages and evidence of reproduction. A review by botanical professionals in 2012 described the vegetation community as an open low to mid *Eucalyptus* spp. and *Acacia* spp. woodland over a mid to tall open A*triplex nummularia*, *Acacia* spp. and *Dodonaea lobulata* shrubland over a low *Atriplex vesicaria* shrubland over sparse *Enneapogon caerulescens* bunch grass, with the surface relatively erosionally stable.

Figure 5-108: Mystery WRD (2021)

5.3.5.2.5 Mt Percy Mineral Processing Infrastructure

The rehabilitated ROM Pad and Processing Plant are the only features of the Mt Percy Mineral Processing Domain (Figure 5-101) that remain.

ROM and Processing Plant

This Feature encompasses the site of the former Mt Percy Processing Plant including the ROM Pad. The Mt Percy Processing Plant was commissioned in 1986 and decommissioned in mid-1997. The plant had the capacity to process approximately 1 Mtpa of ore, and consisted of a two stage crushing circuit, grinding circuit, leach tanks, CIP adsorption tanks, carbon stripping circuit and a TSF.

Rehabilitation of the site was undertaken in January 2001. The Processing Plant was scrapped, and the area dug to a depth of 1 m; the ROM pad was battered down to less than 15° and ripped to 0.75 cm deep with 1.5 m spacing. No rehabilitation materials were applied. Visual inspections of this site in 2014 indicate that the site has good recruitment of understorey species, and scattered growth of over-storey species such as *Eucalyptus.*

The following areas were reported to the DWER as potentially contaminated sites:

- Mt Percy former processing plant site (AOC10);
- Mt Percy former ROM Pad (AOC90); and
- Mt Percy workshop and wash area (AOC25).

2001 Rehabilitation (Slope)

This area was classified “Below expectation, investigation recommended” during 2011 LFA monitoring (Outback Ecology, 2012b). Neither the upper nor the lower storey plant layers had developed and were below expectation for a site that was rehabilitated in 2001. The percentage of slope erosion remained consistent between monitoring years, indicating that the landform was stable enough to resist most erosive forces, particularly in the absence of vegetation cover. Visual observations of this area from 2012 indicate that this area remains below expectations, with scattered recruitment of *Eucalyptus,* but very limited lower storey cover. This is to be expected, given the rehabilitation material limitations.

2001 Rehabilitation (Flat)

Rehabilitation on the flat area of the Mt Percy ROM and Mill was monitored for the first time in 2010. Monitoring in 2011 had a classification for this area as “Below expectation, investigation recommended” (Outback Ecology, 2012b). This is to be expected, given the rehabilitation material limitations. Visual inspections of this site in 2014 indicate that the site has good recruitment of understorey species, and scattered growth of overstorey species such as *Eucalyptus.*

5.3.5.2.6 Mt Percy Tailings Storage Facility

The Mt Percy TSF (Figure 5-109) was operational between 1985 and 1997. The facility consists of two cells, covering approximately 55 ha. The starter embankment was constructed of clayey run of mine oxide waste followed by upstream lifts constructed of selected run of mine waste to produce external batters of approximately 16 to 20°. Deposition was as sub-aerial slurry discharge via multiple spigot discharge points around the perimeter. It was decommissioned and rehabilitated in 2001.

The Mt Percy TSF Feature has been reported to the DWER as a potentially contaminated site (AOC8).

Figure 5-109: Mt Percy TSF (2021)

Tailings Geochemical Characterisation

No problematic mine waste materials have been identified.

An aircore program of 42 holes was conducted in 2009 to assess the potential to re-processing the tailings contained within the Mt Percy TSF. The overall tenor of the assays and small thickness of the higher grade led to the recommendation that the Mt Percy TSF will not be reprocessed.

Material characterisation completed in 2017 on the Mt Percy tailings deemed it geochemically benign, i.e., NAF and acid consuming, with only moderate levels of salinity in leachates and/or potential seepage, which will remain alkaline (MBS Environmental, 2018a).

Rehabilitation

The external embankments of the Mt Percy TSF feature have been battered down to between 15° and 20°. It is recorded in rehabilitation monitoring reports that oxide material was applied at a depth of 0.5 m on embankments and 1 m on berms. Visual observations of the soil profile in erosion gully side walls indicate that 0.2 to 0.3 m of lateritic rehabilitation materials was applied over the oxide layer on the batters. The upper surface was ripped in a circular pattern to 0.75 m deep with 1.5 m spacing. Gypsum sourced from Wyalkatchem was spread using a multi spreader over all areas at 5 t/ha, however, adverse wind conditions meant it required reapplication shortly after. The TSF was hydro-mulched using a seed mix application of 15 kg/ha, with more mallee (*Eucalyptus* spp.) than in standard seed mixes. A mushroom compost was added to the paper mulch at a rate of 10 m^3/ha on all areas. No topsoil was used in the rehabilitation of this feature.

Visual observation of the feature shows that excessive erosion of the external batters is occurring in some areas outside of the monitoring transects. Rock lined drop drains have been installed in some areas in response to erosion occurring after the rehabilitation was completed (Figure 5-110). Significant gullying has occurred in the central area of the northern side due to inadequate water control.

Figure 5-110: Erosion and Water Control Repairs on Mt Percy TSF Completed in 2019 (2021)

1993 Rehabilitation (Slopes)

These slopes are located on the slopes of the southern cell of the TSF. LFA monitoring in 2011 indicated that this area was performing well and was classified as “Reduce or discontinue monitoring” (Outback Ecology, 2012b). All landscape function indices were similar to those of the analogue sites. The lower storey plant cover was within the range of the analogue sites. The most prolific lower storey species present were *Atriplex bunburyana,* and *Maireana pyramidata.* No upper storey was present.

2001 Rehabilitation (Slopes)

These slopes are located on upper batters of the southern TSF cell. LFA monitoring in 2011 classified this area as “Below expectation, investigation recommended” (Outback Ecology, 2012b), as all landscape function indices, and two plant indices were below those of the analogues. The lower storey plant cover index remained very low; however, lower storey plant density had increased slightly. The vegetation was dominated by *Maireana pyramidata* and *M. triptera*. The total proportion of slope erosion remained similar between 2010 and 2011, however, an increase in the number of rills was observed.

2001 Rehabilitation (Flat Areas)

Monitoring in 2011 classified this area as “Below expectation, investigation recommended” (Outback Ecology, 2012b). Some salt scalding was present on the upper surface of the TSF, which may have been affecting vegetation establishment. The most prolific flora species identified were *Maireana pyramidata* and *M. tomentose* (Outback Ecology, 2012b). Due to the flat nature of the upper surface, no erosion was observed in the transect area. Some differential settlement has occurred on the upper surface; remedial work was conducted to backfill these subsidences in 2012.

Visual observations of the TSF flats in 2012 – 2014 show similar vegetation and growth to that on Union Club WRD, this is unsurprising as oxide material from this waste dump was used for capping of the TSF. Vegetation appears to be in good condition, but there is limited overstorey of perennials, most likely due to the saline nature of the oxide capping materials.

2018 Remediation

Remedial works were conducted on the TSFs to improve water control. The crests were compacted and reshaped to drain inwards (the crest bund had previously been ripped, allowing water ponding and tunnelling to occur). Significant gullies were dug out, compacted and converted to down drains. Grades to down drains were re-established on benches.

5.3.5.2.7 Mt Percy Water Containment Facilities

The Gravity Water Dam (Figure 5-101) is contained within the Sir John WRD. The elevated water dam is rubber lined and currently retained as a water supply transfer point for the bunded pipelines between Gidji Plant and Fimiston Plant. These facilities are still operating and form part of Regional operational infrastructure.

5.3.6 Regional Operational Area

The Regional Operational Area (Figure 5-111) is defined by exploration areas, groundwater and service infrastructure, access roads and service corridors, and legacy tailings and mining features.

KCGM

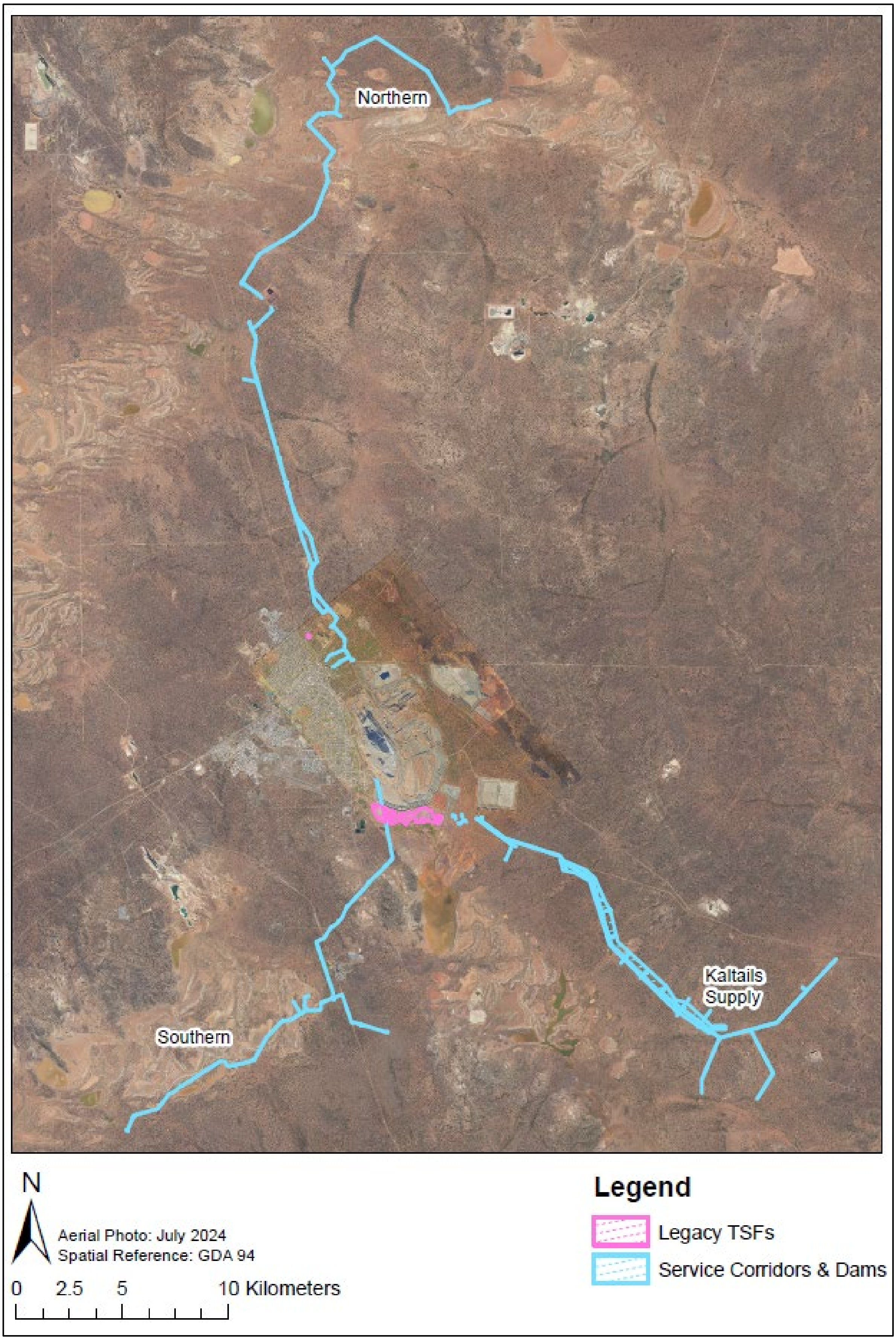


Figure 5-111: Regional Operational Area

5.3.6.1 Exploration

Exploration disturbance includes:

- drill holes and sumps; and
- tracks and gridlines.

Disturbance from exploration activities is rehabilitated within six months of the drilling programme being completed, as required by DMIRS guidelines and tenement conditions.

5.3.6.2 Groundwater and Service Infrastructure

5.3.6.2.1 Regional Production Borefields

Three regional production borefields are operated by KCGM, namely the Kaltails, Northern and Southern Borefields and are used to supply water to the Fimiston Plant (Figure 5-111). All borefields are operated under DWER licences.

Kaltails Supply Borefield

In 2009, KCGM acquired the paleochannel Kaltails Supply Borefield from Newmont. The borefield supplies water for the Fimiston Plant and is independent of the Kaltails Seepage Interception System. It is located approximately 10 km south-east of the Fimiston Plant and approximately 4 km south of the Kaltails TSF. The Kaltails Supply Borefield originally consisted of 15 production bores and 10 monitoring bores. Components of the borefield which are currently active comprise 14 production bores which have been configured to be used either for groundwater production or groundwater injection, and 16 monitoring bores. The borefield is licenced for both groundwater abstraction and for injection of surplus Fimiston Open Pit dewatering. The borefield is located on the southern Hannans tributary of the Roe paleochannel system.

Samples from the production bores are notably acidic, with pH between 3 and 6; and total dissolved solids (TDS) concentrations lie in the range 90,000 mg/L to 150,000 mg/L (BGH, 2020d). These conditions reflect the pre-mining groundwater regime. The cumulative influences of abstraction and injection had lowered groundwater levels by 10 m to 16 m from the pre mining levels in 2020. The groundwater system remains confined in the eastern portion and is now unconfined in the western portion. The paleochannel groundwater system in the Kaltails Supply Borefield continues to be capable of meeting the beneficial use, which is the use of the groundwater for mineral processing, as there remains a large amount of groundwater in unconfined storage, and the quality remains suitable for mineral processing.

Northern Borefield

The paleochannel Northern Borefield is located 15 to 30 km north of the Fimiston Plant and is in an amalgamation of the Gidji and Mt Percy borefields. The Mt Percy section of the Northern Borefield consists of four production bores (one of which is not equipped) and three monitoring bores. The Gidji section consists of 15 production bores and seven nearby monitoring bores. The borefield draws water from the Yindarlgooda North Tributary paleochannel.

Data from the production bores and observation bores in the Northern Borefield indicate that groundwater levels in the aquifer have not declined below the top of the aquifer. Thus, all production bores still appear to be drawing from the confined aquifer storage after nearly thirty years of continuous operation (BDH, 2020e).

Groundwater from the Northern Borefield is naturally mildly acidic to neutral (pH in the range 4 to 7) and hypersaline (TDS in the range 140,000 and 220,000 mg/L) (BDG, 2020e). The hydrochemistry of the water from the borefield has not changed appreciably since the borefield was commissioned in the 1980s (BDH, 2020e). The paleochannel groundwater system in the Northern Borefield continues to be capable of meeting the beneficial use, of using the groundwater for mineral processing, as there remains a large amount of groundwater in both confined and unconfined storage, and the quality remains suitable for mineral processing.

Southern Borefield (including Lakewood Borefield)

The Southern Borefield is located 15 km south of the Fimiston Plant, and is an amalgamation of the South Lakes, Hannan Lake, Hannans East and Lakewood Borefields. It is located within a series of playa lakes and gypsiferous sand dunes and draws water from the Hannan tributary paleochannel.

Data from the monitoring bores in the South Lakes, Hannan Lake and Hannan’s East sections of the Southern Borefield suggest that the groundwater levels in the paleochannel groundwater system have not declined below the top of the paleochannel sands. Thus, the operating production bores in these sections still appear to be drawing groundwater from confined aquifer storage after nearly three decades of continuous operation of the borefield, and a proportion of the abstracted groundwater is likely to have been contributed from leakage from adjacent formations or tributary paleochannels (BDH, 2020f). It should be noted that production bores have not been commissioned by KCGM in the Hannans East section of the borefield.

There are limited data defining the stratigraphy of the paleochannel groundwater system in the Lakewood section of the borefield. However, based on the relatively uniform groundwater depths in monitoring bores and the screen depths in production bores, it appears that this portion of the Southern Borefield may be in the transition from confined to unconfined conditions, consistent with responses observed in the nearby Kaltails Supply Borefield (BDH, 2020f).

Groundwater from the South Lakes and Hannan Lake sections of the Southern borefields is naturally mildly acidic (pH approximately 6). In contrast, samples from the Lakewood section are naturally quite acidic (pH <4). Groundwater is naturally hypersaline (TDS in the range 70,000 to 220,000 mg/L) (BDH, 2020f).

The paleochannel groundwater system in the Southern Borefield continues to be capable of meeting the beneficial use, which is the use of the groundwater for mineral processing, as there remains a large amount of groundwater in both confined and unconfined storage, and the quality remains suitable for mineral processing.

5.3.6.2.2 Access Roads and Service Corridors

This feature includes all access roads (unsealed tracks) in the KCGM Regional Operational Area (Figure 5-111). All roads are currently in active use and will be progressively rehabilitated as they are no longer required. Service corridors include all water pipelines, power line corridors and other service corridors.

5.3.6.3 Historical Tailings and Mining Features

5.3.6.3.1 Morrisons Flats Area

Morrisons Flats (Figure 5-112) is an area related to historical tailings storage located to the south of the Fimiston Operational Area. Tailings have been deposited in this area since before the turn of the 20th century, processing ore from the Golden Mile. Due to mineral processing methods used at the time, much of these tailings were enriched in heavy metals, including gold. Reprocessing of old TSFs in the Morrisons Flats area was undertaken as part of the State Agreement Kaltails Project between 1989 and 1999. Selected areas of the remaining TSF footprints were covered or rehabilitated to the north of Mt Monger Rd by KCGM, with further expansion of the WRD planned to gradually cover the remaining footprints. Residual footprints remain to the south of the Mt Monger road. Erosion of the historic tailing dams has resulted in an area of outwash toward Hannan Lake to the south.

Morrisons Flats has been reported to the DWER as a Contaminated Site (AOC63). Initial sampling and analysis of the tailings and tailings wash areas indicated that the tailings materials were fully oxidised and have no risk of acid generation. The tailings were found to contain variably enriched levels of mercury, arsenic, silver, antimony, and tellurium, consistent with Golden Mile mineralisation. Concentrations were highest in old TSF pore water. Analysis of underlying soils in wash areas indicated metals were not migrating through into the soil (MBS Environmental, 2018d). Speciation indicated mercury was present as either coloradoite (insoluble) or mercury salts, but not volatile elemental mercury. Concentrations in tailings pore water (but generally not the underlying soils) exceeded Ecological Investigation Limits but were below levels of concern for human health.

Figure 5-112: Morrisons Flats Historical Tailings 2021 (right of Mt Monger Rd)

5.3.6.3.2 Hannans North Tourist Mine

Underground Workings below Hannans North Tourist Mine

The Hannans North Tourist Mine, located to the north of Mt Charlotte, is currently operated by KCGM. KCGM holds the underlying tenure and is responsible for the workings below the 190 m level.

Mullingar Tailings Storage Facility

The Mullingar TSF, located on the southern portion of the Hannans North Tourist Mine, is the last remaining hand-built TSF on the Golden Mile (Figure 5-113). It was constructed by hand pre-1960 with steep (48°) external batters, has an area of 1.65 ha and is approximately 9 m high. The TSF is not included on a register of heritage sites The Mullingar TSF has been reported to the DWER as a potentially contaminated site (AOC12) and rehabilitation of the facility will be required to comply with the requirements of the Contaminated Sites Act. For this reason, the TSF will need to either be encapsulated in situ or rehandled to an appropriate location.

Figure 5-113: Mullingar Tailings Storage Facility (2021)

Historic Voids

As in the wider Eastern Goldfields district, historic voids exist on KCGM tenure. When identified, these voids are assessed and recorded by the KCGM voids team, and made safe in the shortest possible timeframe.

5.4 Contaminated Sites

125 potentially contaminated sites have been identified within KCGM leases on the basis of activity currently or historically undertaken. Whilst normally a whole land parcel (either tenement, lot or other legally defined parcel) would normally be reported, KCGM reported its contaminated sites by discreet 'Areas of concern' (AOC). Of these 125, 113 AOC had a Form 1 submitted to the DWER (formally DEC) in 2007 as required under the *Contaminated Sites Act* 2003. The remaining AOCs were reported either by Normandy Kaltails in 2007 or subsequently by KCGM in later years. Tenements were used to locate each site and the boundaries of each area of concern were provided as coordinates.

When feedback was provided by DWER, from 2010 onwards, they grouped these sites into two large 'Potentially Contaminated' zones. Some AOC were partially or completely excluded from this area, leaving KCGM uncertain of their current classification (e.g., Gidji sites). Some sites, such as Kaltails, were reported by Newmont in 2007.

KCGM has initiated a risk-based project in 2017 for the contaminated sites. The project was completed collaboratively between KCGM and Contaminated Sites consulting professionals (including a contaminated Sites auditor) to review the current risk of the reported Contaminated Sites. During this review, AOCs were grouped together into 'Zones of Influence' (ZOIs) based on geographical location, similar geochemical properties or activities conducted. ZOIs are located at Fimiston, Mt Charlotte and Mt Percy (Figure 5-114 and Figure 5-115) and Gidji (Figure 5-115). This allows for a more efficient and effective approach to be taken for risk assessment and determining further investigation of sites. A summary document (contained in Appendix 6) is updated periodically.

A risk-based methodology has been applied where those AOCs and ZOIs deemed (based on current knowledge) to potentially pose a risk to human health, the environment or environmental values, are prioritised for assessment, remediation and/or management. The conducted risk assessment utilised current understandings of sources, pathways and receptors, including acknowledgement of data gaps that may exist within the understanding of the conceptual site model, to provide a risk rating. Factors considered included, but were not limited to, the following:

- Current and future use of the area/sources (e.g., including beneficial use of groundwater).
- Contaminants of concern, including existing soil and groundwater data.
- Toxicology and fate and transport characteristics.
- Details of any existing engineering/management controls in place.
- Depth to groundwater and ambient groundwater conditions.
- Distance to sensitive receptors (including surface water discharge point, residential areas).
- Community expectations.

Based on the risk assessment, work has been conducted on several ZOIs between 2018 and 2021 as summarised in Table 5-15. As outcomes of this work, several commissioned PSI reports are still in draft as they have been significantly delayed due to the COVID19 pandemic.

Table 5-15: Contaminated Sites Work Undertaken 2018-2021

ZOI	WORK COMPLETED
ZOI 1 & ZOI 2– Fimiston I, II and Kaltails TSFs	Draft groundwater completion criteria for Fimiston TSFs were developed for the management of groundwater levels (depth below surface) to control ingress of hypersaline water into root zone of vegetation post closure.
ZOI 18 – Johnson St East	A PSI investigation and draft report has been undertaken. The outcome likely to be either commercial/industrial use with no further action required.
ZOI 19 – Dwyer St	A PSI investigation and draft report has been undertaken. The outcome likely to be either commercial/industrial use with extra sampling required before being able to close out the assessment process.
ZOI 20 – Holmes St	A PSI investigation and draft report has been undertaken. The outcome likely to be either commercial/industrial use or multiple users, with no further action required.
ZOI 21 – Oroya & Chafers St – Vacant Land	A PSI investigation and draft report has been undertaken. The outcome likely to be 'suitable for commercial/industrial use'. Further actions before closing out the assessment process likely to be required are asbestos fragments remediation and final walk over.

ZOI	WORK COMPLETED
ZOI 12 – Boorara Rd Rehabbed Areas	AOC40 Former Gold Processing Plant and AOC41 Former Force Workshop (reported as Former workshop): A PSI investigation and draft report has been undertaken. The outcome likely to be 'suitable for commercial/industrial use'. Further actions are likely to be additional sampling and asbestos fragment remediation and final walk over before being able to close out the assessment process. AOC44 & AOC45 Historic TSF and Former gold processing plant: A draft PSI has been prepared. The likely outcome is end point classification to Not Contaminated – Unrestricted Use.
ZOI 16 – Hannans Tourist Mine	AOC12 – Mullingar TSF: Drilling through the tailings dam was undertaken in 2019, with samples taken for analysis. Interpretation has not commenced. Piezometers were installed in some of the drill holes, but no phreatic surface was identified.
ZOI 18 – AOC20 Paringa TSF	Drilling through the tailings dam was undertaken in 2019, with samples taken for analysis. Interpretation has not commenced. Piezometers were installed in some of the drill holes, but no phreatic surface was identified.
ZOI 18 – Pit-adjacent Legacy TSFs	AOC75 – Old Croesus TSF: The eroding western slope was remediated, completing encapsulation of the TSF. The western slope was capped with at least 0.5 m of waste rock, and topsoiled.
ZOI 13 (Morrison's Flats Tailings Wash Area), ZOI 1 (Fimiston I & III TSFs) and ZOI2 (Kaltails TSF)	Groundwater monitoring continued, to provide a time series data set during wet and dry cycles.
ZOI 14 – AOC46 Mines Rescue Fire Training Ground	A PSI investigation and draft report has been undertaken. The outcome likely to be either commercial/industrial use with extra sampling required before being able to close out the assessment process.

The results of the risk assessment have been summarised in Table 5-16.

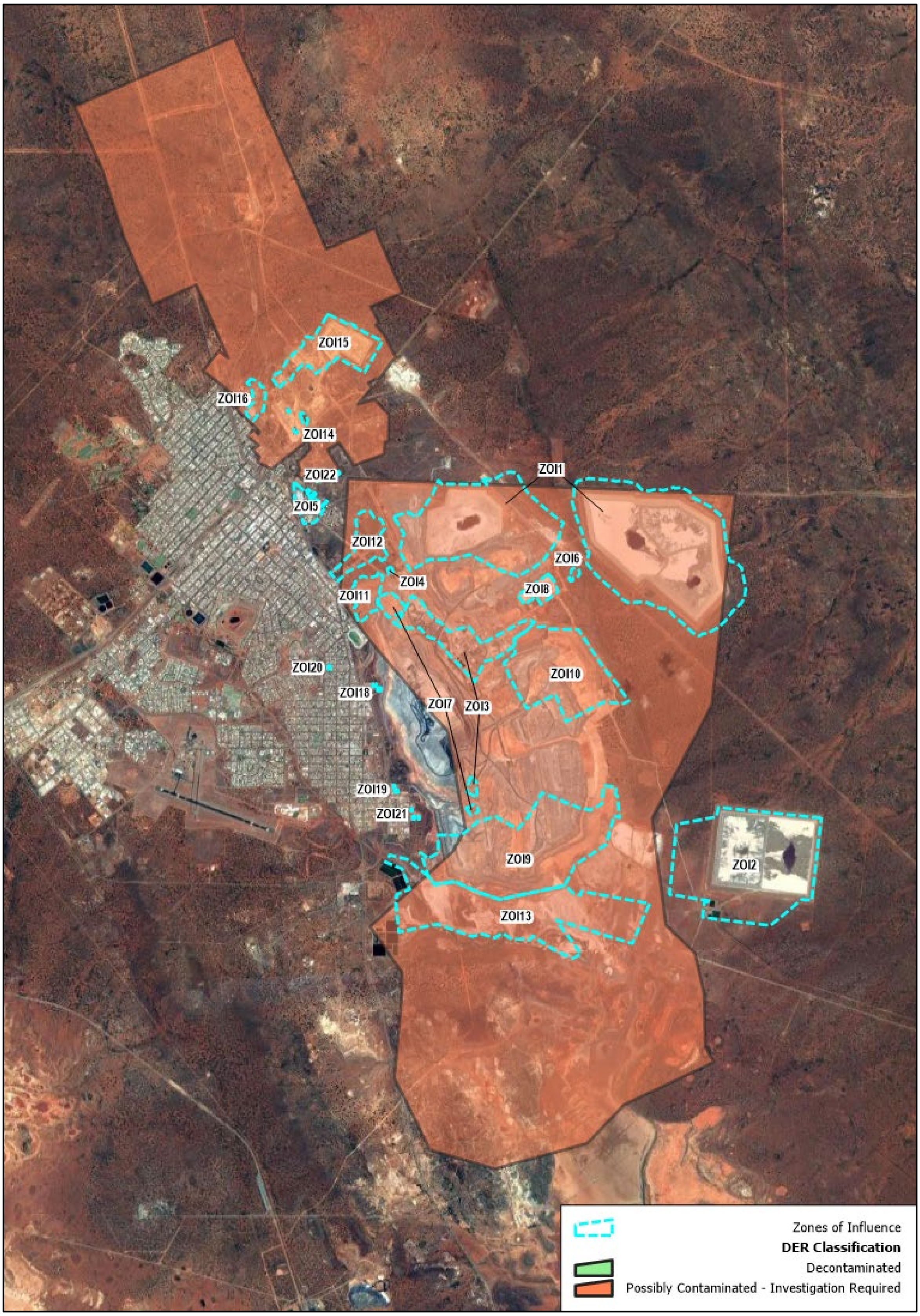


Figure 5-114: Fimiston, Mt Charlotte, and Mt Percy Contaminated Sites

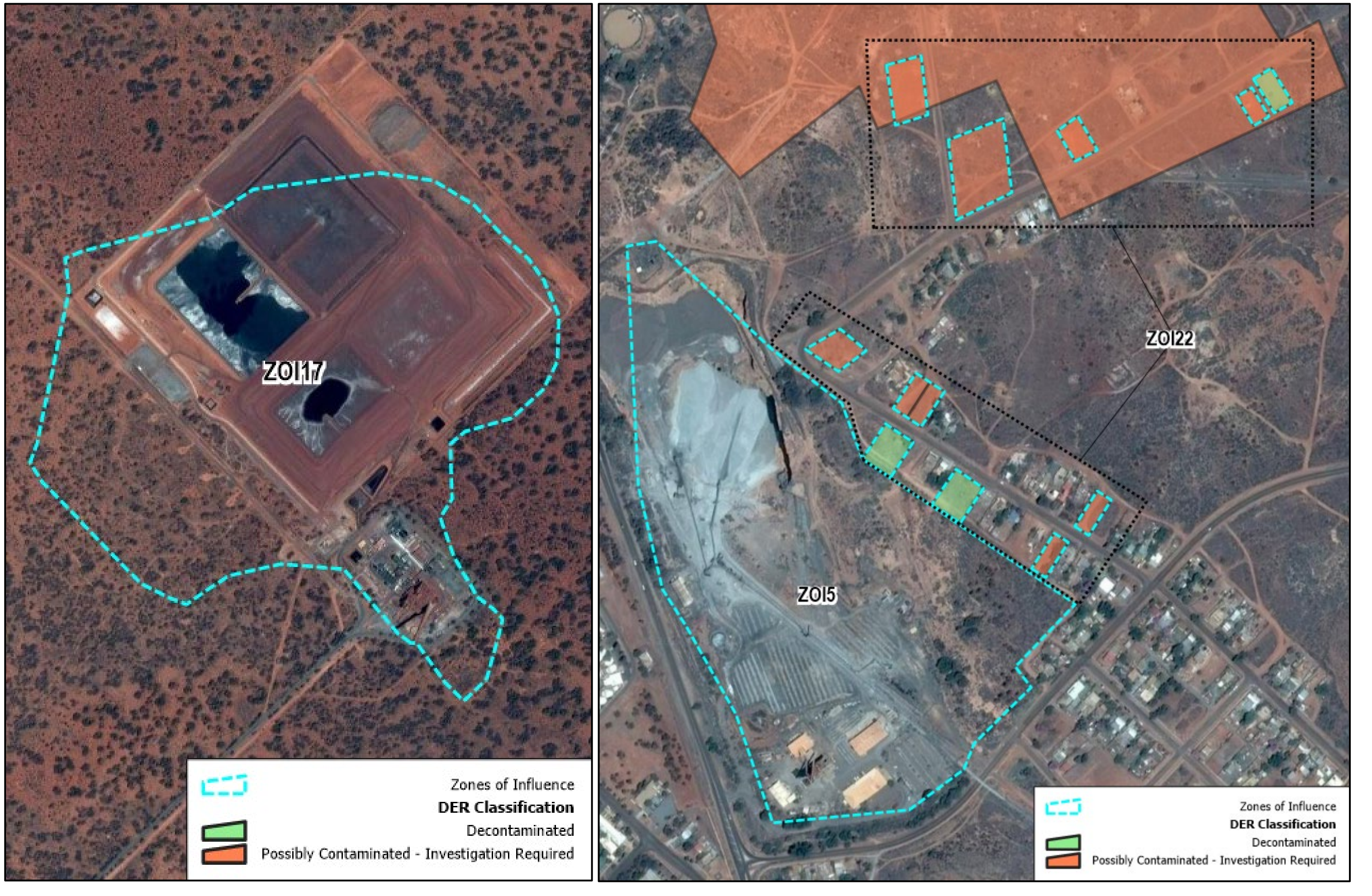


Figure 5-115: Gidji (ZOI7), Mt Charlotte (ZOI5), and Williamstown (ZOI22) Zones of Influence

Table 5-16: KCGM Potentially Contaminated Sites Status

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
ZOI1								
AOC15	Fimiston II TSF	• Tailings geochemically benign. • NAF with substantial ANC. • Leachate predicted to be alkaline and brackish to moderately saline. • After residual cyanide has degraded, leachate likely to contain very low metals and metalloids.	• Rehabilitated to modified landscape. • No urban development.	Local Environment	Nil • Operational wetting of tailings during operations minimising dust. • Erosion of tailings into surrounding environment (within immediate footprint of TSF). • Rehabilitation of lower lifts minimising dust generation.	Potentially Contaminated – Investigation Required	Closure design of TSF places rock capping on exposed tailings surfaces, effectively eliminating wind erosion and greatly reduce water erosion.	NIL
AOC14	Fimiston II TSF groundwater plume	Tailings geochemically benign	• Potential groundwater abstraction source (suited to mining/industrial only).	Local Environment	Nil • Limited due to operational management measures (seepage recovery) and proposed management measures during closure. • No other beneficial use of groundwater other than mining, so no further exposure pathways.	Pending	• Operational management measures (Part V Licence) maintain groundwater below root zone of plants. • Pumping of seepage will continue post closure until an equilibrium is reached to protect the root zone of surrounding vegetation (primary environmental value).	LOW
AOC16	Fimiston I TSF	• Tailings geochemically benign. • NAF with substantial ANC. • Leachate predicted to be alkaline and brackish to moderately saline. • After residual cyanide has degraded, leachate likely to contain very low metals and metalloids.	• Rehabilitated to modified landscape. • No urban development.	Local Environment	Nil • Operational wetting of tailings during operations minimising dust. • Rehabilitation of lower lifts minimising dust generation • Erosion of tailings into surrounding environment	Potentially Contaminated – Investigation Required	Closure design of TSF places rock capping on exposed tailings surfaces, effectively eliminating wind erosion and greatly reducing water erosion.	NIL
AOC107	Fimiston I TSF groundwater plume	Operational monitoring of seepage indicates levels of COPC away from TSF are representative of local groundwater.	• Potential groundwater abstraction source (suited to mining/industrial only)	Nil No other beneficial use of groundwater other than mining.	Pathway reduced • Limited due to operational management measures (seepage recovery) and proposed management measures during closure. • No other beneficial use of groundwater other than mining, so no further exposure pathways.	Potentially Contaminated – Investigation Required	• Pumping of seepage will continue post closure until an equilibrium is reached to protect the root zone of surrounding vegetation, therefore pathway to plants and soil organisms is limited. • Levels of metals measured within seepage outside the operational area low.	LOW
AOC38	Herliette TSF	Metals, salinity and cyanide	• Encapsulated by WRD to rehabilitated modified landscape.	Nil	Nil • TSF is encapsulated by Northern WRD and pathway for dust contamination eliminated.	Potentially Contaminated – Investigation Required	• Preliminary Site Investigation sampling and analysis conducted, results indicate that leaching of contaminants is unlikely (and will be further reduced by encapsulation). KCGM likely to apply for remediated status.	NIL
AOC75	Old Croesus TSF	Concentrations of COPC in tailings and seepage sufficiently low to indicate tailings is geochemically benign.	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development.	Local Environment	• Nil – tailings encapsulated and connection with groundwater unlikely.	Potentially Contaminated – Investigation Required	• Sampling in 2017 indicated that tailings are geochemically benign and a waste rock cover to prevent wind and water erosion will be sufficient post-closure to prevent negative impacts on the surrounding environment.	NIL

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
							• Encapsulation commenced during construction of Northern Waste Dump in 2012. Tailings will be completely encapsulated at closure. • Rehabilitation of TSF attempted in early 2000s. • Historic sampling indicates levels of nickel and copper above ecological levels confined to middle layer of TSF.	
AOC62	Historical shire tip	Unknown	• Rehabilitated to modified landscape.	Local Environment	Limited • Uptake by flora and fauna of seepage and surface water. • Transport of solutions in surface water.	Potentially Contaminated – Investigation Required	• Legacy shire tip operated until the mid-1980s. Encapsulated by North Eastern WRD during early 2000s and fully rehabilitated. • Opportunistic sampling of seepage from this area has indicated levels of contaminates below DoH domestic non-potable groundwater use guidelines. • Captured within KCGM TSF groundwater management borefields	LOW
ZOI2								
AOC 117	Former Kaltails Processing Plant	Metals, cyanide and salinity	• Modified landscape. • No urban development.	Local Environment	Nil • Uptake of COPC. • No other beneficial use of groundwater other than mining, so no further exposure pathways.	Pending	• Site rehabilitated as part of decommissioning of Kaltails Project in early 2000s. Currently utilised for water transfer ponds for current tailings operations, therefore dust generation controlled. • Contamination to groundwater likely attenuated by existing natural chemistry. • If required further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC 116	Kaltails TSF	See Fimiston I & II TSFs as all the same tailings from Fimiston Plant.	• Rehabilitated to modified landscape. • No urban development	Local Environment	Nil • Operational wetting of tailings during operations minimises dust. • Erosion of tailings into surrounding environment.	Pending	• Closure design of TSF places rock capping on exposed tailings surfaces, effectively eliminating wind erosion and greatly reducing water erosion of tailings.	NIL
AOC 115	Kaltails TSF Seepage Plume	Operational monitoring of seepage indicates levels of COPC away from TSF are representative of local groundwater.	• Potential groundwater abstraction source (suited to mining/industrial only)	Nil No other beneficial use of groundwater other than mining	Nil • Limited due to operational management measures (seepage recovery) and proposed management measures during closure. • No other beneficial use of groundwater other than mining, so no further exposure pathways.	Pending	• Pumping of seepage will continue post closure until an equilibrium is reached to protect the root zone of surrounding vegetation, therefore pathway to plants and soil organisms is limited. • Levels of metals measured within seepage outside the operational area low.	LOW

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
ZOI3								
AOC51	Open Pits fuel farm	Hydrocarbons	• Rehabilitated to modified landscape. • No urban development	Local Environment	Nil • Operational area which is not vegetated.	Potentially Contaminated – Investigation Required	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC57	Fimiston Plant	• Hydrocarbons, salinity, metals, cyanide and alkali. • Preliminary sampling has indicated low levels of contamination confined to surface soils under concrete hardstands.	• Rehabilitated to modified landscape. • No urban development	Local Environment	Nil • No connection with groundwater and surface sealed by concrete.	Potentially Contaminated – Investigation Required	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted opportunistically during operations and prior to decommissioning to aid management of any contaminated soil material.	LOW
AOC58	Contractors workshops	Hydrocarbons	• Rehabilitated to modified landscape. • No urban development	Local Environment	Nil • No connection with groundwater and surface partially sealed by concrete.	Potentially Contaminated – Investigation Required	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC69	Sam Pearce underground support facilities	Hydrocarbons	• Restricted public access due to safety • No urban development.	Local Environment	Nil • No connection with groundwater and surface partially sealed by concrete. • Surface water runoff reports to open pit area.	Potentially Contaminated – Investigation Required	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC70	Crushing Facilities	Hydrocarbons	• Rehabilitated to modified landscape.	Local Environment	Nil • No connection with groundwater • Surface water reports to mining areas	Potentially Contaminated – Investigation Required	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC79	Chaffers Workshop Area	Hydrocarbons	• Within Fimiston open Pit footprint, therefore Restricted public access due to safety	Local Environment	Nil • Within Fimiston Open Pit footprint	Potentially Contaminated – Investigation Required	• Decommissioned in late 1990s. Situated in operational area that will not be treated or rehabilitated until end of mine life. • Has been mined through as part of Morrison Cutback expansion. • KCGM likely to apply for remediated status.	NIL
AOC88	Saline Water Transfer Pond	Salinity	• Rehabilitated to modified landscape. • No urban development	Local Environment	Nil • Transfer Dam is lined, and incidental spills only likely source of salinisation. • Salinity likely to be naturally attenuated via rainfall leaching salinity through the soil profile with time.	Potentially Contaminated – Investigation Required	Operational Area that will not be treated or rehabilitated until end of mine life.	LOW

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
ZOI4								
AOC46	Mines Rescue fire training ground	Hydrocarbons; PFAS	• Rehabilitated to modified landscape.	Local Environment	Limited • Surface water infiltration from drainage sump • Connection to groundwater unlikely; groundwater is only used for mining/industrial use; Fimiston pit is groundwater sink. • No human consumption of surface or groundwater.	Potentially Contaminated – Investigation Required	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation. • Draft PSI pending.	LOW
ZOI5								
AOC29	Workshops and hydrocarbon storage area at the Cassidy headframe	Hydrocarbon and salinity	• Rehabilitated to modified landscape. • Potential for Restricted public access due to safety	Local Environment	Limited • No connection with groundwater	Pending	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC30	Mt Charlotte vent rise (north)	Hydrocarbons	• Rehabilitated to modified landscape. • No urban development	Local Environment	Limited • No connection with groundwater	Pending	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC36	Mt Charlotte vent rise (south)	Hydrocarbons	• Rehabilitated to modified landscape. • No urban development	Local Environment	Limited • No connection with groundwater	Pending	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC37	Mt Charlotte compressor house	Hydrocarbons	• Rehabilitated to modified landscape. • Potential for Restricted public access due to safety	Local environment	Soil	Pending	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC72	Historical TSF	Metals, salinity, cyanide Testing prior to earthworks around the Southern Ore body vent fan indicate tailings is approx. 60cm deep, extremely saline and had elevated levels of some COPCs.	• Rehabilitated to modified landscape. • No urban development	Local Environment	Soil	Pending	• Rehabilitated as part of 'Greening the Golden Mile' in the 1990s. Vegetation growth variable in area. Dust generation minimal. • Further Preliminary Site Investigation pending.	LOW
AOC87	Mt Charlotte hydrocarbon storage area	Hydrocarbons	• Rehabilitated to modified landscape. • Potential for Restricted public access due to safety	Local Environment	Soil	Pending	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted opportunistically during operations and prior to decommissioning to aid management of any contaminated soil material.	LOW

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
ZOI6								
AOC89	Saline Water Transfer Station	Salinity	• Rehabilitated to modified landscape.	Local environment	Nil • Secondary containment (earthen bunds) prevent spills from reaching the wider environment. • Salinity likely to naturally attenuate with time	Potentially Contaminated – Investigation Required	• Catchpit partially backfilled and rehabilitated. Remaining area is operational and will not be treated or rehabilitated until end of mine life. • Salinity likely to be naturally attenuated via rainfall leaching through the soil profile with time. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC 114	Kaltails Borefield Transfer Tank	Salinity Spills of saline water abstracted from the borefields have occurred in this area, however potential COPCs within this water are limited.	• Rehabilitated to modified landscape.	Local Environment	Nil • Secondary containment (earthen bunds) prevents spills from reaching the wider environment. • Salinity likely to naturally attenuate with time.	Pending	• Incorrectly reported – amendment will need to be submitted to correct its positioning.	LOW
ZOI7								
AOC110	Croesus TSF	Metals, salinity, cyanide Tailings are: • NAF with moderate/high ANC • Leachate alkaline and moderately saline • Enriched in Au, Ag, Sb, Te, Se, Pb and Cu but not soluble. • Co & Mo in water leachate marginally exceed livestock water guidelines	• Rehabilitated to modified landscape. • Potential for Restricted public access due to safety	• Nil • Within active mining area and open pit footprint	Nil • Partially rehabilitated in 1990s using oxide capping. Limited exposure via surface water (which reports to open pit). • Within operational area of open pit. • Groundwater in area likely >20 mbgl – no active mounding.	Potentially Contaminated – Investigation Required	• Majority of the TSF is encapsulated within waste rock in northern sector of Fimiston open pit. • Surface and groundwater drainage to Fimiston open pit.	NIL
AOC66	Historical TSF	• Leachate alkaline and moderately saline • Enriched in As, Co, Se, Mo and Cu. • Se and Cu not soluble • As & Mo in water leachate marginally exceeding livestock water guidelines	• Rehabilitated to modified landscape. • Potential for Restricted public access due to safety	Local Environment	Nil • Relocated into Trafalgar WRD, capped with a domed oxide layer and will be covered with waste rock.	Potentially Contaminated – Investigation Required	• Encapsulated within WRD • KCGM likely to apply for remediated status.	NIL
ZOI8								
AOC20	Paringa TSF	Hydrocarbons. Tailings geochemically benign: • NAF – Acid consuming • Leachate predicted to be alkaline and moderately saline • Enriched in Au, Ag, Sb, Te but not soluble.	• Rehabilitated to modified landscape. • No urban development	Local Environment	Nil Not observed to dust	Potentially Contaminated – Investigation Required	• Current final closure design is encapsulation within WRD; dust receptor eliminated, surface water erosion and transport eliminated recharge of contaminants to groundwater unlikely with impact to groundwater nil as there is no other beneficial use for groundwater other than mining. • Bores drilled, with no phreatic level within TSF	LOW

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
ZOI9								
AOC64	Historical TSF	Metals, salinity and cyanide	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Nil	Nil • Fully encapsulated by Trafalgar Waste Rock Dumps during 2000s. Pathway for exposure via dust, surface water or groundwater contamination non-existent.	Potentially Contaminated – Investigation Required	Tailings facility reprocessed during Kaltails Project in 1990s, with only footprint remaining.	LOW
AOC65	Historical TSF	Metals, salinity and cyanide	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Nil	Nil • Fully encapsulated by Trafalgar Waste Rock Dumps during 2000s. Pathway for exposure via dust, surface water or groundwater contamination non-existent.	Potentially Contaminated – Investigation Required	Tailings facility reprocessed during Kaltails Project in 1990s, with only footprint remaining.	LOW
AOC85	Historic Tailings Wash Area	Metals and salinity	• Rehabilitated to modified landscape by others. • No urban development	Local Environment	Limited • Area significantly encapsulated by Trafalgar Waste Dump. Remaining areas rehabilitated. • Surface water and dusting pathways limited.	Potentially Contaminated – Investigation Required	Remnant tailings footprints present from retreatment of tailings dams as part of Kaltails Project.	LOW
ZOI10								
AOC52	Oroya TSF	Sampled tailings geochemically benign: • NAF with moderate/high ANC • Leachate alkaline and brackish • Enriched in Au, Ag, Sb, Te but not soluble. • Marginally enriched in Hg and Te but not soluble Given age of facilities, cyanide likely attenuated naturally.	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Local Environment	Limited • Transport of sediment/solutions in surface water. • Decommissioned in late 1990s and progressively encapsulated by waste rock dump from 1999 to 2002. Rehabilitated from 1998 to 2003. • Dust generation of tailings eliminated via encapsulation.	Potentially Contaminated – Investigation Required	• Geotechnical stability of TSF confirmed during drilling in 2011. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC53	Balgold TSF		• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Local Environment	Limited • Transport of sediment/solutions in surface water • Decommissioned in late 1990s and progressively encapsulated by waste rock dump from mid-1990s to 2002. Rehabilitated from 1998 – 2003. • Dust generation of tailings eliminated via encapsulation.	Potentially Contaminated – Investigation Required	• Further investigation will be conducted as part of closure planning and closure implementation of the Oroya WRD.	LOW
AOC74	Galconda TSF		• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Nil	Nil • Exposure pathways eliminated by encapsulation of TSF.	Potentially Contaminated – Investigation Required	• Decommissioned in late 1990s and progressively encapsulated by waste rock dump from mid-1990s to 2002. Rehabilitated from 1998 to 2003.	LOW
AOC86	Balgold-Galconda Tailings Wash Area	Metals and salinity	• Rehabilitated to modified landscape. • No urban development	Local Environment	Limited • Transport of sediment/ solutions in surface water • Encapsulated	Potentially Contaminated – Investigation Required	• Operational Area that will most likely become a WRD. Currently utilised as a laydown area. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
AOC105	Former Balgold Heap Leach Pads	• Cyanide and metals • Leaching of metals unlikely. Current monitoring of surface waters from site do not show elevated metals concentrations.	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Nil	Nil • No exposure pathway via dust and limited exposure via surface water or groundwater.	Potentially Contaminated – Investigation Required	• Capped and fully rehabilitated in 1990s. Well vegetated.	LOW
ZOI11								
AOC42	Former Croesus Processing Plant	Hydrocarbons and metals	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Local Environment	Nil • Revegetation of area greatly reduced potential for dust generation. • Low traffic area, occasional foot and mine vehicle traffic on established tracks. • Connection to groundwater unlikely; groundwater is only used for mining/industrial use; Fimiston pit is groundwater sink; Groundwater within area likely to be ~20 mbgl. • No human consumption of surface or groundwater	Potentially Contaminated – Investigation Required	• Plant decommissioned and rehabilitated (including hand planting with local native seedlings) in 1997-1999 and partially encapsulated by Croesus Noise Bund in 2001 – 2003.	LOW
AOC111	Historical Concentrate Storage Area	None Mined out and backfilled as part of the Fimiston Open Pit and encapsulated by Croesus Noise Bund. Not a source of COPC.	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Nil	Nil	Potentially Contaminated – Investigation Required	• KCGM to apply for this area to have a revised classification of 'Report Unsubstantiated'.	NIL
AOC112	Historical Tailings Wash Area	Metals, salinity • Preliminary sampling has indicated that metals contamination above Ecological Investigation Limits is confined to first 5 – 40 cm of soil profile.	• Encapsulated by WRD to rehabilitated modified landscape. • No urban development	Local Environment	• Dust • Transport of erosion to surface waters • Groundwater in area likely >20 mbgl – no connection to groundwater	Potentially Contaminated – Investigation Required	• Rehabilitated as part of 'Greening the Golden Mile' in the 1990s. Vegetation growth variable in area.	LOW
ZOI12								
AOC40	Former Gold Processing Plant	Hydrocarbons and metals	• Rehabilitated to modified landscape by others. • No urban development	Local Environment	• Transport of sediments in water erosion limited due to flat profile and no local surface water features. • Revegetation of area greatly reduced potential for dust generation. • Very low traffic area, occasional foot and motorcycle traffic. • Groundwater within area likely to be ~20 mbgl.	Pending	• Liability for investigation and remediation of this site is not clear, KCGM intends to seek advice. • Site rehabilitated in 1993/94 with processing plant removed and area ripped, seeded and hand planted with local provenance species. • A draft PSI prepared during 2019 – 2021. The likely outcome is, after removal of asbestos fragments, end classification to Contaminated, Restricted Use.	LOW
AOC41	Former workshop	Hydrocarbons	• Rehabilitated to modified landscape	Local Environment	• Transport of sediments in water erosion limited due to flat profile and no local surface water features. • Groundwater within area likely to be ~20 mbgl. • Revegetation of area greatly reduced potential for dust generation.	Pending	• Site rehabilitated in 2003 with infrastructure and contaminated soils removed, ripped, seeded and hand planted with local provenance species. • A draft PSI has been prepared during 2019-2021. Additional sampling is required to	LOW

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
							make a determination on end point classification.	
AOC43	Former Gold Processing Plant	Hydrocarbons and metals Initial sampling conducted during rehabilitation establishment in the area indicated contamination below investigation levels.	• Rehabilitated to modified landscape • No urban development	Local Environment	• Transport of sediments in water erosion limited due to flat profile and no local surface water features. • Groundwater within area likely to be ~20 mbgl. • Revegetation of area greatly reduced potential for dust generation.	Potentially Contaminated – Investigation Required	• Liability for investigation and remediation of this site is not clear, KCGM intends to seek advice. • Plant decommissioned and rehabilitated in 1997-1999, including hand planting and seeding. Very successful vegetation growth present. • A draft PSI prepared over 2019-2021. The likely outcome is end point classification to Contaminated – Restricted Use.	LOW
AOC44	Historic TSF	Metals, salinity and cyanide	• Rehabilitated to modified landscape by others. • No urban development	Local Environment	• Some erosion of cover materials present, considered unlikely to intersect underlying tailings. • Rehabilitation has limited potential for dusting of tailings. • Groundwater within area likely to be ~20 mbgl.	Potentially Contaminated – Investigation Required	• Liability for investigation and remediation of this site is not clear, KCGM intends to seek advice. • Fully capped and rehabilitated in 1997. Good vegetation growth present and considered fully rehabilitated.	NIL
AOC45	Former Gold Processing Plant	Metals and hydrocarbons	• Rehabilitated to modified landscape by others. • No urban development	• Local Environment • Humans	• Some erosion of cover materials present, considered unlikely to intersect underlying tailings. • Rehabilitation has limited potential for dusting of tailings. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	Potentially Contaminated – Investigation Required	• Liability for investigation and remediation of this site is not clear, KCGM intends to seek advice. • Capped and rehabilitated in 1997. Good vegetation growth present and considered fully rehabilitated.	NIL
ZOI13								
AOC63	Morrisons Flats Tailings Wash Area	Geochemical Analysis: • Tailings is fully oxidised and NAF. Seepage will remain alkaline to circumneutral and hypersaline. • Indicative of gold mineralisation, geochemically enriched in As, Ag, Sb, Hg, and Te, with minor enrichment in Mo. • Water leachates had low concentrations of most soluble metals and metalloids. • Hg was soluble to a maximum of 43µg/L, with volumes of seepage predicted to be low.	• Incompletely rehabilitated to modified landscape by others. • No urban development	Local Environment	• Groundwater migration • Porewater concentrations of mercury and other species were elevated in TSFs, likely due to selective differences in species solubility (e.g., mercury (II) chloride) and migration of metals and metalloids from overlying tailings, or possibly by movement from upgradient sources in some instances.	Potentially Contaminated – Investigation Required	• Preliminary Site Investigation (PSI) required to assess level of ecological impact, including comparison to regional background levels. • Currently collecting monitoring data	Not Yet Determined

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
ZOI14								
AOC101, 102, 103	Mt Percy Open Pit lake	Nil Preliminary routine analysis of pit lake waters indicates that metals contamination is below investigation levels.	• Restricted public access due to safety • No urban development.	Nil	• Pit lake is a perched aquifer, and not expected to be connected to underlying groundwater. No beneficial use of groundwater other than mining. • Pit lake is not connected or recharging surface waters • No soil resource within the pit lake • Access to public to be restricted as per Mines Act.	Potentially Contaminated – Investigation Required	KCGM likely to apply for 'Report not Substantiated' given existing and planned management of the lake.	NIL
ZOI15								
AOC8	Mt Percy TSF	• Metals, salinity and cyanide • Cyanide likely naturally attenuated • Tails NAF (Acid Consuming) and geochemically benign with only moderate levels of salinity in leachates and/or potential seepage, which will remain alkaline (MBS Environmental, 2017).	• Rehabilitated to modified landscape • No urban development	Local Environment	Nil • Seepage from TSF considered negligible since closure of facility. • Capped with oxide material to reduce dust emissions. Dust generation of tailings unlikely.	Potentially Contaminated – Investigation Required	Decommissioned and rehabilitated in late 1990s and early 2000s.	NIL
AOC10	Former Mt Percy Plant	Hydrocarbons, salinity, metals, cyanide and alkali	• Rehabilitated to modified landscape • No urban development	Local Environment	• Some erosion of cover materials present, considered unlikely to intersect underlying tailings. • Rehabilitation has limited potential for dusting of tailings. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	Potentially Contaminated – Investigation Required	• Decommissioned and rehabilitated from 1997 – 1999. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC25	Mt Percy workshop and wash area	Hydrocarbons and unknown	• Rehabilitated to modified landscape • No urban development	Local Environment	• Some erosion of cover materials present, considered unlikely to intersect underlying tailings. • Rehabilitation has limited potential for dusting. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	Potentially Contaminated – Investigation Required	• Decommissioned and rehabilitated from 1997 – 1999. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC31	Sir John Open Pit	Metals, salinity and cyanide	• Restricted public access due to safety • No urban development.	Local Environment	• Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl. • Vegetation growth limited due to salinity.	Potentially Contaminated – Investigation Required	• Partially backfilled (with tailings from AOC26) and rehabilitated from 1997 – 1999. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC90	Mt Percy former ROM Pad	Acid • Some evidence of PAF materials stockpiled on ROM.	• Rehabilitated to modified landscape • No urban development	Local Environment	• Some erosion of cover materials present, considered unlikely to intersect underlying tailings.	Potentially Contaminated	• Decommissioned and rehabilitated from 1997 – 1999.	Not Yet Determined

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
					• Rehabilitation has limited potential for dusting of tailings. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	– Investigation Required	• Vegetation growth on flat appears to be in good condition with little to no growth on slope. • Further investigation will be conducted as part of closure planning and closure implementation.	
ZO16								
AOC12	Mullingar TSF	• NAF (Acid Consuming) • Marginally enriched in Pb and Hg • Relatively low concentrations of soluble mercury (0.002 to 0.007 mg/L) • Total mercury low – maximum concentration 1.1 mg/kg • Substantially enriched in Mo, Te (insoluble forms), Sb • Water leachates were brackish to saline and circumneutral to moderately alkaline.	• Restricted public access due to safety • No urban development.	• Local Environment • Humans	Limited • Direct toxicity (plants) via uptake from soil. • Groundwater within area likely to be ~20 mbgl • Dusting • Transport of sediments/solutions to surface waters	Potentially Contaminated – Investigation Required	• Historical hand built TSF. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC26	Former TSF at Hannans North Tourist Mine	Metals, salinity, cyanide	• Rehabilitated to tourism centre by others • No urban development	Local Environment	Limited • Low risk of dust inhalation and site covered with buildings or rehabilitated. • Tailings excavated and transported to Mt Percy Pit to be used as backfill. • Groundwater within area likely to be ~20 mbgl.	Potentially Contaminated – Investigation Required	• Tailings removed and area rehabilitated in late 1990s as prior to the construction of the Mining Hall of Fame. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC27	TSF wash area at Hannans North Tourist Mine	Metals, salinity, cyanide	• Rehabilitated to tourism centre by others • No urban development	Local Environment	• Groundwater within area likely to be ~20 mbgl. • Low risk of dust inhalation and site covered with buildings or rehabilitated. • Transport of sediments/solutions to surface waters – tailings transported from Mullingar TSF (AOC12) via water erosion.	Potentially Contaminated – Investigation Required	Further investigation will be conducted as part of closure planning and closure implementation.	LOW
ZOI17								
AOC1	Gidji Processing Plant	Hydrocarbons, alkali, salinity, metals, cyanide Preliminary sampling has indicated low levels of contamination confined to surface soils.	• Rehabilitated to modified landscape • No urban development	Local Environment	• Direct toxicity via ingestion or passive absorption (soils organisms). • Direct toxicity (plants) via uptake from soil. • Secondary poisoning (animals) through biomagnification. • Transport of erosion to surface waters.	Pending	• Operational Area that will not be treated or rehabilitated until end of mine life. • Further investigation will be conducted opportunistically during operations and prior to decommissioning to aid management of any contaminated soil material.	LOW

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
AOC2	Gidji I TSF groundwater plume	Cyanide, metals, salinity Highly localised plume of groundwater to the southwest of the Gidji I TSF containing elevated cyanide and TDS.	Potential groundwater abstraction source	Local Environment	Limited • Operational management measures (seepage recovery) and proposed management measures during closure. • No other beneficial use of groundwater other than mining, so no further exposure pathways.	Pending	• Gidji I TSF no longer operational • Operational management measures (Part V Licence) maintain groundwater below rooting zone of plants. • Dewatering of plume area currently in progress. Will continue until equilibrium is reached to protect the root zone of surrounding vegetation.	LOW
AOC3	Gidji I TSF	Cyanide, metals, salinity • Ongoing operational monitoring of tailings slurry being assessed. Current sampling has indicated the Gidji Tailings is PAF and may leach certain metals.	• Rehabilitated to modified landscape • No urban development • Restricted public access due to safety	Local Environment	• Dusting • Transport of sediments/solutions to surface waters	Pending	• Closure design of TSF places rock capping on exposed tailings surfaces, effectively eliminating wind erosion of tailings. • Closure design has been developed to greatly reduce water erosion of tailings. Small amounts of tailings are expected to erode to be captured within sediment retaining structures.	LOW
AOC4	Chemix pond	Metals and salinity	• Rehabilitated to modified landscape	Local Environment	• Rehabilitation has limited potential for dusting of tailings. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	Pending	• Decommissioned and revegetated. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC6	Chemix site	Metals and hydrocarbons	• Rehabilitated to modified landscape	Local Environment	• Rehabilitation has limited potential for dusting. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	Pending	• Decommissioned and revegetated. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC7	Former Gidji landfill site	Unknown	• Rehabilitated to modified landscape	Local Environment	• Rehabilitation has limited potential for dusting. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	Pending	• Decommissioned and revegetated. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC9	Temporary Gidji concentrate storage site	Metals, salinity, cyanide	• Rehabilitated to modified landscape • No urban development	Local Environment	• Rehabilitation has limited potential for dusting. • Infrequent mine vehicle traffic, very minimal dusting. • Groundwater within area likely to be ~20 mbgl.	Pending	• Decommissioned and revegetated. • Further investigation will be conducted as part of closure planning and closure implementation.	LOW
ZOI18								
AOC 104	19 Johnson St Boulder	Metals, Hydrocarbons, Unknown	• Light Industrial • Vacant Land	• Local Environment • Humans	• Intermittent use of buildings for storage • Two lots are vacant and one is	Pending	Further investigation will be conducted as part of closure planning and closure implementation.	LOW
AOC 98	24 Johnson St Boulder		• Vacant Land	Local Environment	• Vacant land has been rehabilitated – limited potential for dusting. • Groundwater within area likely to be ~20 mbgl.	Pending		NIL

AOC	SITE	POTENTIAL CONTAMINANTS OF CONCERN	PROPOSED FINAL LAND USE	POTENTIAL RECEPTORS	POTENTIAL EXPOSURE PATHWAYS	DWER ASSESSMENT	COMMENTS	IMMEDIATE RISK RATING
AOC 99	28 Johnson St Boulder		• Vacant Land	Local Environment	• Covered by the Environmental Noise Bund – dusting eliminated • Groundwater within area likely to be ~20 mbgl.	Pending	• Further investigation will be conducted as part of closure planning and closure implementation.	LOW
ZOI19								
AOC93	3 Dwyer St Boulder	Hydrocarbons	• Light commercial	• Local Environment • Humans	• Current use as light industrial premises – likelihood of exposure is low. • Groundwater within area likely to be ~20 mbgl.	Pending	• Not considered as immediate risk to the environment or human health. • PSI conducted in 2020 – recommended classification as *Potentially contaminated investigation required* due to presence of Total Recoverable Hydrocarbons at levels acceptable for the commercial/industrial setting.	LOW
AOC92	6 Dwyer St Boulder	Hydrocarbons Metal Finishing/Treatment						
ZOI20								
AOC 108	31 Holmes St Boulder	Unknown	• Light Commercial	Local Environment	• Current use as light industrial premises – likelihood of exposure is low. • Groundwater within area likely to be ~20 mbgl.	Pending	• Former metallurgical laboratory (buildings remain, but not used for this purpose). • PSI conducted in 2020 – recommended classification as *Contaminated – restricted use* due to presence of Total Recoverable Hydrocarbons and metals at levels acceptable for the commercial/industrial setting. • AOC 108 may be suitable for more sensitive use but requires further investigation and potential risk mitigation (capping etc.).	LOW
AOC 109	29 Holmes St Boulder							
ZOI21								
AOC94	13 Chaffers St Boulder	Asbestos	• Vacant Land	Local Environment	• Vacant land with vegetation coverage. • Some traffic, but minimal dust generation.	Pending	• Demolished buildings containing asbestos in 2010. • PSI conducted in 2020 – site inspection identified several suspected bonded ACM fragments in surface soils at AOC 94, 95 and AOC 97. • Asbestos removal has been completed.	LOW
AOC95	11 Chaffers St Boulder							
AOC96	3 Chaffers St Boulder							
AOC 97	15 Oroya St Boulder							
ZOI22								
-	Various lots in Williamstown	Asbestos	• Vacant Land	• Local Environment • Humans	Limited • Dusting from low quantities of exposed asbestos materials.	Decontaminated or Potentially Contaminated – Investigation Required	• Housing demolished with some remnant materials remaining. Investigations and decontamination were undertaken which resulted in three of these sites being classified as 'Decontaminated'. • Asbestos removal has been completed.	LOW

5.5 Rehabilitation Trials

Rehabilitation trials have been conducted at KCGM since the late 1980s with the majority having commenced in the early 1990s. Early rehabilitation research was often focused on the recruitment of vegetation (aiming to improve landform aesthetics) rather than slope stability, with trials conducted on application of rehabilitation materials and other methods to increase vegetation success. This often led to large-scale (dump wide) practical application of erodible deep soil profiles. Good vegetation growth has been observed in these areas, but large gullies and other erosion features are typically present (for example; Oroya WRD and Croesus Noise Bund). State wide, rehabilitation prescriptions have changed over time from a one-size-fits-all approach to designs appropriate for the rehabilitation material characteristics. Although the application of a deep soil profile was considered best practice at the time of many of KCGM's approvals, knowledge of designs has evolved to focus more strongly on slope stability.

Trials conducted to date have focused on (but are not limited to):

- Earthmoving and practical rehabilitation methods
    - WRD design implementation trial on Northern WRD;
    - Waste Rock Dump Rehabilitation Materials Trials (Black Street trials);
    - Material blending trial on Northern WRD;
    - Moonscaping trial on Oroya WRD;
    - 2013/4 TSF Erosion Studies;
    - 2016/7 TSF Earthworks Design Implementation Trial on Fimiston I TSF; and
    - TSF cover trials on the Old Croesus TSF.
- Vegetation establishment
    - Hard Rock Seeding Trial on northern WRD;
    - Mycorrhiza trial on the Oroya WRD feature;
    - Black Street Fertiliser trials;
    - Black Street Gypsum soil remediation; and
    - Rehabilitation of saline lands using native halophytic shrubs.

5.5.1.1 Earthmoving and Practical Rehabilitation Methods

5.5.1.1.1 Northern WRD Implementation Trial

From 2014 – 2015, KCGM commenced a large scale trial of a newly developed erosion resistant closure design. The intent of this trial was to ensure that the erosion resistant design was practically implementable. The trial went well, and KCGM has since formalised this as the preferred closure design in an approved Mining Proposal. Detail on the design can be found in Section 9.2.4.3 (Volume 2). A key component of the erosion resistant design is the higher percentage rock mixed to reach the outer surface of the slope. A small trial was conducted to blend the rock and topsoil prior to pushing it down the slope as an alternative earthmoving option. The outcome of this work was that:

- The technique was extremely time consuming and not cost effective;
- The outcome was that the topsoil (an identical amount of topsoil was used on this section, as for the adjacent conventional technique), was not visible on the surface, making the final finish appear to be hard rock only; and
- Revegetation was far slower, and the plant density was far lower than using a conventional technique.

5.5.1.1.2 Waste Rock Dump Rehabilitation Materials Trials (Black Street Trials)

The Northeast WRD cover trials were conducted on an area that is commonly referred to as the 'Black Street Trials'. Two trials were established in the area, which comprised six different rehabilitation treatments.

Trial 1 was established in 1992 to investigate waste rock landform revegetation, with and without the application of topsoil on waste rock/oxide (Figure 5-116). The applicable site was spread with topsoil to a depth of 20 cm, ripped and then sown with an 8 kg/ha site specific seed mix, and spread with Agras MoZnCu fertiliser at a rate 200 kg/ha. The two treatments included:

- waste rock/oxide only; and
- 20 cm topsoil on waste rock/oxide.

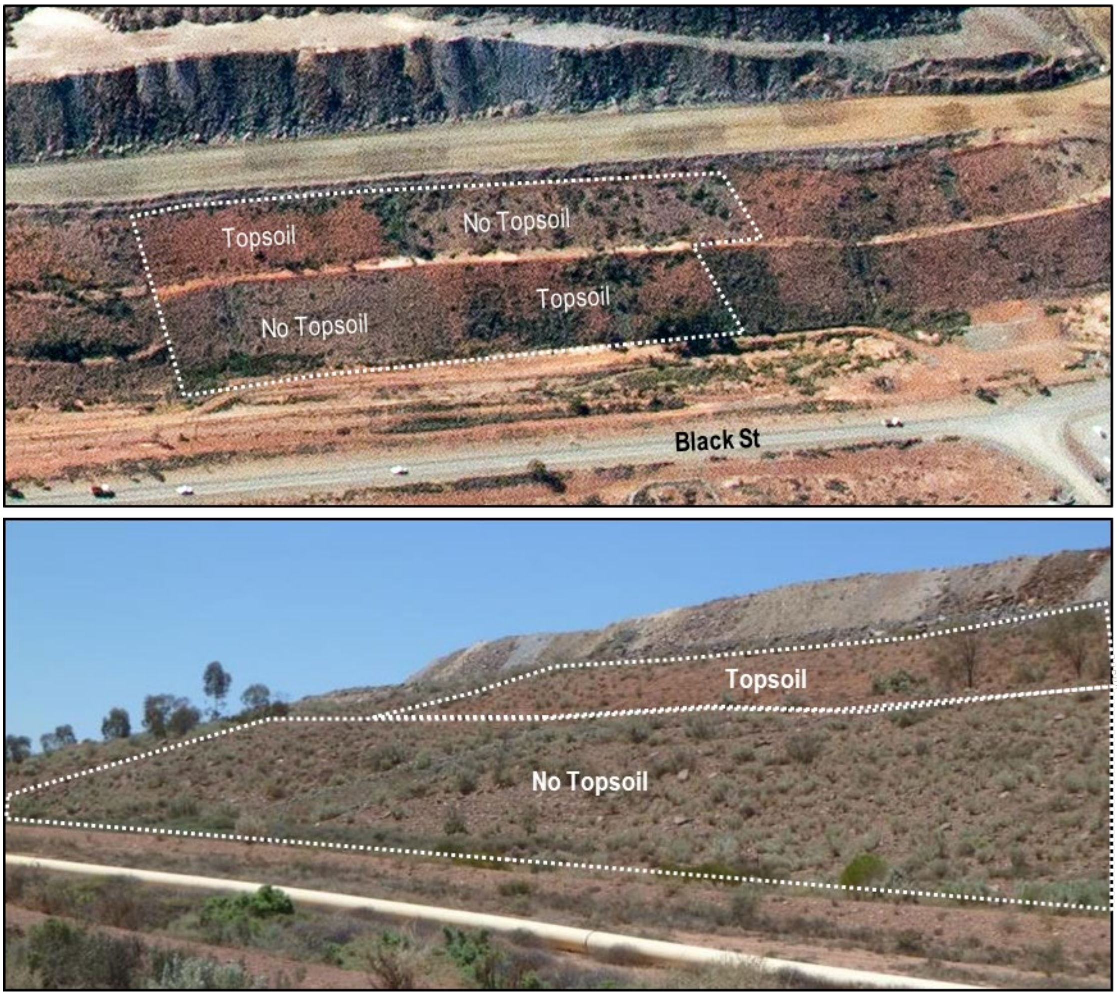


Figure 5-116: North Eastern WRD 'Black St Trials' Trial 1 Section Location

Initial outcomes of Trial 1 (waste rock/oxide only) after two to four years indicated that areas with topsoil had greater plant density, cover and species diversity than those with hard rock/oxide only. However, review of this trial area in 2012 (20 years after trial was initiated) by botanical professionals indicated that in the "No Topsoil" areas there was minimal erosion, reasonable vegetation cover but only in one stratum (shrub) and low species diversity, but with several age classes of shrubs which indicates recruitment episodes and therefore evidence of resilience.

Trial 2 was established to investigate the effect of varying topsoil layer depth and the presence or absence of wood mulch on revegetation success. The following four treatments were sown with 8 kg/ha of a site specific seed mix, and spread with Agras MoZnCu fertiliser at a rate of 100 kg/ha:

- 0.1 m topsoil with mulch;
- 0.1 m topsoil only;
- 0.2 m topsoil with mulch; and
- 0.2 m topsoil only.

Initial monitoring of Trial 2 determined that there were no statistically significant differences in the level of revegetation success with different treatments. LFA Monitoring in 2010 and 2011 determined that most sites were performing relatively poorly, with principal factors including low vegetation cover and a high degree of erosion and relatively low landscape function indices (KCGM, 2012).

Visual observations of the trial area in 2012 to 2014 indicate that certain treatments remain more successful than others, with erosion evident on those plots with topsoil. However, the plots did appear to be erosionally stable, with no large gullies present. The plots with mulch appear to be performing poorly, supporting the initial findings that mulch application did not appear to improve revegetation success.

5.5.1.1.3 Moonscaping Trial

A moonscaping trial was established on the eastern batters of the Oroya WRD in 1998. Moonscaping was a modified form of scarifying the surface of a waste rock dump into small mounds, as an alternative to deep ripping. Mounds were constructed using a D6 dozer and were 4 m wide, 1.5 m high and 2.5 m apart. Visual observations of the area have indicated that preferential flow paths for water movement are created between each mound, creating areas prone to gullying, with the sides of the mounds observed to fail during a heavy rainfall event. Moonscaping was not considered to be a viable option for future rehabilitation earthworks for this reason.

5.5.1.1.4 2013/4 TSF Erosion Studies

In 2013 KCGM conducted a study to assess:

- Possible tailings capping materials;
- Determine modelling input parameters specific to KCGM's rehabilitation materials;
- Determine erodibility parameters for the Fimiston tailings dam materials; and
- Assess the potential for erosion of tailings at the interface of a capping layer and tailings.

Two types of rock were considered: fine material, represented by crushed rock (road base) and mixed size material, represented by typical mine waste rock. The study involved application of simulated rain and overland flows to test surfaces, both in the field and in an erosion assessment facility in Perth. Sediment settling velocity distributions were measured in the field and in the laboratory. Results from this study indicated that the application of a capping layer significantly reduces erosion potential at the tailings and the rock-tailings interface.

Additionally, as part of the 2013 study, a water and solute balance model was used to consider the likelihood that salts would rise within the TSF capping profile and potentially adversely affect the growth of vegetation on surface materials. Tailings, waste rock, and oxide are most often saline, with salinity levels sufficiently high to limit (but not preclude) the growth of vegetation in the cover layer. It was thought that there was long-term potential for salts to move (either upwards to the surface or downwards) within a constructed profile, with the rate and direction of movement dependent on the material properties and the incident rainfall. However, results from the study indicate that there is no risk of the rise of salts through the rock layer as electrical conductivity (EC) values of the rock layer are predicted to reduce over time. The rock has a very high porosity, and a very high hydraulic conductivity, which significantly limits the movement of salt from the tailings into the rock. Some increase in EC occurs near the interface with time; however, this is likely to be due to leaching of salt from the rock rather than upwards movement of salt from the tailings.

5.5.1.1.5 2016/7 TSF Earthworks Design Implementation Trial

In 2016/7 an earthworks trial was conducted on the northern slope of Fimiston I TSF. The objective of the trial was to verify the optimum capping thicknesses and the best earthmoving equipment for the tasks. The trial was conducted on a section of slope that was close to the final grade for closure implementation, with three bands of capping thickness, varying from 0.5 m to 1 m thickness. Test pits were dug after completion, to study the profile.

The trial showed that

- Alternative earthmoving equipment should be considered for implementation and the moisture condition of the slope impacted on the "workability" of the material;
- During implementation, there was variability in thickness of the cover material;
- There was no visual evidence of tailings on the surface or in the cover profile of any of the three panels after ripping had occurred;
- The waste rock generally had a finer median particle size than anticipated, which would result in a lower infiltration rate; and
- Observations in test pits indicated a clear transition between the tailings and the waste rock.

After rock capping, the trial area was topsoiled using material from a stockpile that was approximately 5 m high and significantly compacted (Figure 5-117). After receiving good rainfall, germination occurred from seed stored within the seedbank, evidencing the amount of viable seed contained in the topsoil stockpile (more than 15 years old) (Figure 5-118).

The design was subsequently implemented on other TSFs. Each section of implementation has provided learnings, with designs adjusted accordingly.

Figure 5-117: Fimiston I TSF Trial Immediately after Completion of Earthworks (Feb 2017)

Figure 5-118: Fimiston I TSF Trial Observed Germination after Rains (July 2017)

5.5.1.1.6 TSF Cover Trials on the Old Croesus TSF

A TSF capping trial was established on the upper surface of the Old Croesus TSF in 1992. The trial compared the following options:

- 0.2 m topsoil;
- 1 m oxide plus 0.2 m topsoil;
- 1 m waste rock plus 0.2 m topsoil; and
- 1 m waste rock plus 1 m oxide plus 0.2 m topsoil.

The results of this trial are unlikely to be directly applicable to other TSFs at KCGM due to the lack of rehabilitation materials available for rehabilitation. However, an assessment and investigation conducted in 2010 (Outback Ecology, 2010) determined a number of practical management recommendations based on the findings of the investigation. These include:

- A layer of waste rock with a minimum depth of 30 cm and rehabilitation materials should be placed over tailings. Large, coarse, blocky rock is preferable as it will impede capillary action and the upward movement of salt within the profile;
- There does not appear to be any significant benefit in terms of vegetation establishment of using a layer of oxide in addition to a layer of waste rock and rehabilitation materials. However, if a large amount of oxide needs to be disposed of, it could be used as a cover between the waste rock and rehabilitation material layers;
- Selection of salt tolerant plant species (e.g., *Maireana pyramidata, Atriplex vesicaria, Maireana* sp.) will enhance the probability of successful establishment and the gradual increase in soil organic matter will stabilise the edaphic conditions; and
- The addition of fertiliser is unlikely to generate any significant benefit because the tailings material and cover treatments provide a similar amount of nutrients to undisturbed conditions.

This trial area has since been encapsulated by the advancement of the Northern Waste Rock Dump, and no further study is possible.

5.5.1.1.7 Vegetation Establishment Trials

Hard Rock Seeding Trial

Field observations at KCGM and other sites in the region have shown that vegetation is capable of germinating and growing on landforms with very shallow or nil rehabilitation material/soil profiles. Due to the shortage of rehabilitation materials at KCGM, it is likely that with the implementation of the Visual Amenity Concept, 'Minimally Visible' areas of site may not receive rehabilitation materials.

In 2014 KCGM initiated a trial of direct seeding into waste rock on a small section of the Northern WRD. This trial aims to evaluate the effectiveness of specialist seed mix for hard rock, consisting of species of plants that were deemed (by a botanist) to be more likely to grow within rocky profiles. It is anticipated that vegetation is likely to establish at lower densities and diversity, but the results (and botanical professional opinion) suggest it will not be precluded. Although these communities tended to have less surface vegetation and appear 'patchy', these characteristics were considered closer to native plant communities in the area (Tongway & Red dell, 1996). To date, the trial is showing some vegetation growth, which is not unexpected given the relatively small timeframes since implementation and the likely salinity of the substrate.

Mycorrhiza Trial

A mycorrhiza trial was established in 1998 on an area of 2.2 ha by distributing dried infected root pieces along the rip lines. Although performing well vegetatively, there does not appear to be a significant improvement in the trial area compared to those areas without mycorrhiza and given the significant cost, it is not a recommended rehabilitation prescription at KCGM.

Fertiliser and Soil Treatment Trials

Several fertiliser trials and gypsum trials have been conducted at KCGM. Typical methods were to apply fertiliser to ripped and seeded slopes. The results of these studies have indicated that there were no significant differences in plant density, cover or species present with different fertiliser treatments. Additionally, weed cover may be promoted by certain fertilisers with several fertilisers recording a higher percentage weed cover than the other fertilisers or control. It was suggested that the poor plant density, cover and diversity recorded in all sites, fertilised and unfertilised, indicated that there were other factors limiting plant establishment and growth.

The application of gypsum to several WRD areas at the Mt Percy operations has not shown a significant difference from those areas without gypsum. However, initial visual observations in the early 1990s from the application of gypsum at the Sir John Open Pit indicated that gypsum did result in better revegetation than surrounding areas, with monitoring results indicating that plant density, diversity and cover were significantly increased by topsoil or gypsum. Visual observations of vegetation recruitment during 2012-2014 do not indicate a significant difference between fertilised and unfertilised areas.

Native Halophytic Shrubs Use in Salt Affected Lands

In 1999 and 2000, KCGM supported a project investigating the rehabilitation of salt-affected mining lands using the native halophytic shrub *Halosarcia* (since changed to *Tecticornia)* undertaken by the Centre for Land Rehabilitation at the University of Western Australia. *Tecticornia* species are common around salt lake environments. Preliminary results from Hannan Lake near Kalgoorlie-Boulder indicated that *Tecticornia* tends to germinate in high water availability and lower salinity conditions; and germination and early growth of Tecticornia is most sensitive to salt. Considering the unique hydrodynamics of salt lakes it may be difficult to replicate the water and salinity requirements required for *Halosarcia* germination and growth in a mine site undergoing rehabilitation.

6. POST-MINING LAND USE AND CLOSURE OBJECTIVES

6.1 Post-Mining Land Use

Final land uses for KCGM will be a combination of:

- Rehabilitated modified landscapes; and
- Zones of restricted access due to safety.

On 28 November 2019, KCGM met with DMIRS Geological Survey section and DPLH Land Use Planning (including the Planning and Contaminated Sites sections) to discuss post mining final land use for KCGM. The following can be noted from these discussions:

- KCGM presented to the group on likely future land use for KCGM's tenements, including areas that would potentially require limited access. Contaminated areas could potentially require monitoring, fencing and liaison with the Department.
- A change to a land use other than mining tenure requires approval from DMIRS under Section 16.3 of the *Mining Act 1978*. DMIRS would be very reluctant to agree to other land use that would preclude mining. Each case would be assessed on merit.
- It was agreed that KCGM would select a final land use that would not preclude mining activities.
- Under the CKB Town Planning Scheme, the land area currently occupied by the Fimiston Operational area is currently zoned 'rural', with a special control area to protect mining activities at the 'Superpit'. Residential development is prohibited in this area.
- Periodic consultant with the Planning Department at CKB is recommended to ensure alignment between KCGM's planning and that of the CKB.

6.1.1 Overview

The general strategy has been to adopt post closure land uses which are aligned as far as practicably with the surrounds but do not preclude future mining in prospective areas on the Golden Mile, in alignment with the requirements of key stakeholders, DMIRS and DPLH. Mining areas (open pits, ore stockpiles) and TSFs are likely to remain restricted in access for safety reasons.

Mining landforms will be rehabilitated to 'modified landscapes'. Rehabilitation will aim to encourage vegetation growth where available rehabilitation materials properties allow, with the development of a 'modified landscape'.

A summary of the post-mining land use of the major mining features at KCGM is discussed in more detail in the following sections.

Table 6-1: Post-Mining Land Use for KCGM Domains and Features

DOMAIN	FEATURE	PROPOSED POST-MINING LAND USE
Fimiston		
Mining Infrastructure	Fimiston Open Pit and Sam Pearce Decline	Restricted access due to Safety Portal gate/seal at decline access
	ROM Pad, Crushing Facilities and Stockpiles	Modified landscape[1]
	Fuel Farm, Mining Maintenance Workshops	
	Infrastructure areas	Modified landscape
Waste Rock Dumps	All WRD including encapsulated historic TSFs and Noise Bund	Modified landscape
	Tourist Lookout	Modified landscape
Mineral Processing Infrastructure	Fimiston Plant	Modified landscape
	Infrastructure areas	
Tailings Storage Facilities	Fimiston I, Fimiston II, Fimiston II Ext, Fimiston III and Kaltails TSFs	Modified landscape Potentially fenced for Restricted access Excluding pastoral usage
	Tailings Infrastructure	Modified landscape
Water Abstraction and Containment Facilities	Seepage Management Systems Tailings Water Management Systems	Modified landscape
Rehabilitation Materials	Rehabilitation Material Stockpiles	Modified landscape
Mt Charlotte		
Mining Infrastructure	Mt Charlotte (Glory Hole) Pit	Restricted access due to Safety
	Underground Mine	Restricting access due to Safety Sealed at sub brace
	Surface infrastructure area	Modified landscape, Fenced for Restricted access due to Safety
Gidji		
Mineral Processing Infrastructure	Processing Plant	Modified landscape Potentially restricted access Potentially excluding pastoral use
	Infrastructure and Access road	Modified landscape
Tailings Storage Facility	Gidji I and II TSFs	Modified landscape Restricted access due to Safety Excluding pastoral use
Water Abstraction and Containment Facilities	Gidji Seepage Interception System (including trenches, bores, pipelines corridors and ponds)	Modified landscape Potentially restricted access Potentially excluding pastoral use
Rehabilitation Materials	Rehabilitation Material Stockpiles	Modified landscape

[1] KCGM defines 'landscape' as the combination of abiotic (landform materials, surface water flow etc.) and biotic (vegetation and fauna) aspects of a rehabilitated area.

DOMAIN	FEATURE	PROPOSED POST-MINING LAND USE
Mt Percy		
Mining Infrastructure	Sir John, Mystery and Union Club Open Pits	Restricted access due to safety
	Underground Workings at Hannans North Mine Tourist (below the 190 m level)	Restricted access due to safety
Waste Rock Dumps	All WRD	Modified landscape
Tailings Storage Facility	Mt Percy TSF	Modified landscape Potentially fenced for Restricted access
Former Mineral Processing and Infrastructure	Former Processing Plant	Modified landscape
Water Containment Facilities	Water transfer infrastructure	Modified landscape
Regional		
Historical, Inactive Tailings Storage Facilities	Mullingar TSF	Modified landscape Potentially restricted access due to Safety
	Morrisons Flats Tailings Area	
Exploration	Drilling disturbance	Modified landscape
Groundwater Infrastructure	Regional Production Borefields	Modified landscape
Miscellaneous	Potentially Contaminated Sites	Modified landscape Restricted access due to Safety
	Haul, Access Roads and Service Corridors (Power lines)	Modified landscape

6.1.1.1 Fimiston Open Pit

The Golden Mile, including the Fimiston Open Pit, remains a geologically prospective zone, with substantial potential for future mining activities. Final land use has been selected to align with the requirements of key stakeholders.

The Fimiston Open Pit will be expected to remain as a void within the defined safety exclusion zone. In time, the pit will fill to approximately halfway, developing a pit lake. Abandonment bunding, retention of existing fencing, or other suitable measures will be in place to prevent inadvertent access by the public. In order to limit long term public safety issues and liability relating to ongoing maintenance, KCGM will close the public lookout at the end of closure monitoring period.

6.1.1.2 Fimiston Waste Rock Dumps and Tailings Facilities

The WRDs and TSFs will remain as a prominent feature of the Kalgoorlie-Boulder landscape post closure. The post closure land use for these facilities will be modified landscapes, with rehabilitation guided by the material properties and visual amenity. Additional rock windrows or suitable alternatives may be implemented to restrict inadvertent public access. TSFs may require retention of existing fencing to restrict access, particularly in the short term when vegetation growth is becoming established.

6.1.1.3 Mining and Processing Infrastructure Areas

As agreed with key stakeholders, KCGM has selected final land use for the Golden Mile that does not preclude future mining. Infrastructure areas will be decommissioned and rehabilitated to 'modified landscape', with requirements the *Contaminated Sites Act 2003* met. Some areas may require exclusions to meet the requirements of the *Contaminated Sites Act (2003).*

6.1.1.4 Mt Charlotte

The Golden Mile, including the Mt Charlotte area, remains a geologically prospective zone, with substantial potential for future mining activities. Final land use has been selected to align with the requirements of key stakeholders. *Mines Safety and Inspection Regulations (1995)* require the void to be a restricted access area, precluding recreational or other uses. The shaft will be sealed at sub-brace level and surrounding infrastructure areas rehabilitated to modified landscape, with restricted access.

6.1.1.5 Gidji

The areas at Gidji will be decommissioned and rehabilitated to 'modified landscape', with requirements of the *Contaminated Site Act (2003)* met. The Gidji TSF area will likely be an area of restricted access, due to the nature of the TSF. Retention of existing fencing to restrict access, particularly in the short term when vegetation growth is becoming established and for exclusion of pastoral activities, is likely to meet the requirements of the *Contaminated Sites Act (2003)*.

6.1.1.6 Mt Percy

The Golden Mile, including the Mt Percy area, remains a geologically prospective zone, with substantial potential for future mining activities. Final land use has been selected to align with the requirements of key stakeholders.

The former processing area and TSF has been decommissioned and rehabilitated to 'modified landscape'.

6.1.1.7 Regional

The majority of the regional area consists of low impact infrastructure areas which will be rehabilitated to 'modified landscape'. Rehabilitated historic TSF areas will align with the requirements of the *Contaminated Sites Act 2003*.

7. IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

7.1 Risk Assessment Approach

Risk assessment is an essential tool to ensure appropriate management of unplanned events that might occur on the mine site during or post closure. A structured risk-based approach allows for a systematic review and analysis of risk and cost benefit in both engineering and environmental terms as well as identification of closure associated opportunities. The KCGM Closure Risk Assessment is based on the principles outlined in AS/NZS 4360:2004 Risk Management and uses likelihood, consequence, and risk rankings.

Since 2011, internal KCGM closure risk workshops and additional feature specific risk assessments have been conducted as required as part of the closure planning process. These assessments were conducted with representation provided by KCGM, its owners and nominated consultants, with the results incorporated into subsequent updates of the KCGM site closure risk register.

The KCGM Closure Risk Register is refreshed and updated regularly. During this process the risk matrix has changed several times, resulting in some changes to the levels assigned to risks. The Risk Register review has included several levels of management, including supervisory, senior leadership and corporate reviewers. Those risks KCGM has determined are the highest or the most frequently discussed risks from this revised version are presented in Table 7-4 and are discussed in the following section. As part of the risk assessment process many inherent risks have been reduced or mitigated by existing controls or the requirement to develop and implement controls. The full Risk Register is available in Volume 3 (Appendix 3).

7.2 Risk Management

The KCGM risk assessment process has been used to identify and prioritise all potential closure risks. The most appropriate management measures required to mitigate these risks have been formulated and evaluated. These measures are regularly updated based on ongoing research/study findings and field monitoring results to ensure relevance and cost effectiveness.

The KCGM post closure landscape will remain much the way it is at present, but without mine infrastructure. This is a vista to which the people of Kalgoorlie-Boulder have become accustomed and with which they have an affiliation.

Table 7-1: Risk Likelihood Characteristics

MEASURES OF LIKELIHOOD			
Likelihood	Description		Criteria (read as either/or)
	Almost Certain	A	The event is expected to occur in most circumstances Once per week
	Likely	B	The event will probably occur in most circumstances Once per month
	Possible	C	The event could occur at some time Once per year
	Unlikely	D	The event could possibly occur at some time but is unlikely Once every 5 – 10 years
	Rare	E	The event may occur in exception circumstances > 10 years

Table 7-2: KCGM Closure Risk Matrix

			CONSEQUENCE				
KCGM			Insignificant	Minor	Moderate	Major	Catastrophic
			5	4	3	2	1
LIKELIHOOD	**Almost Certain** Expected occurrences - once per week	A	5A Medium	4A Medium	3A High	2A High	1A High
	Likely Probable occurrences - once per month	B	5B Medium	4B Medium	3B High	2B High	1B High
	Possible Possible occurrences - once per year	C	5C Low	4C Medium	3C Medium	2C Medium	1C High
	Unlikely Unlikely to occur - once every 5-10 years	D	5D Low	4D Low	3D Low	2D Medium	1D Medium
	Rare May occur in exceptional circumstances >10 years	E	5E Low	4E Low	3E Low	2E Medium	1E Medium

Table 7-3: Risk Consequence Category Descriptions

Measures of Consequence					
	Insignificant (5)	**Minor (4)**	**Moderate (3)**	**Major (2)**	**Catastrophic (1)**
Health and Safety	First aid injury or Minor reversible health effects of no concern	Medical treatment of restricted work injury/illness or Reversible health effect of concern, no disability	Lost time injury/illness or Severe, reversible health effect resulting from acute, short term exposure or progressive chronic condition, infection disease	Single fatality or Permanent disability or exposure resulting in irreversible health effect of concern	Multiple fatalities or health effects resulting in multiple disabling illness leading to early mortality
Community	No negative socio-economic impact or inconvenience to the community or No media attention	Minor negative socio-economic impact or disturbance to the community or Local media attention	Negative socio-economic impact or disturbance to the community or negative local media attention with enquiries from NGOs	Major negative socio-economic impact and serious community relations impacts or negative national headlines with high levels of NGO attention	Loss of social licence to operate with disastrous community relations impacts or negative international media headlines
Environment	Localised environmental impacts, contained with no regulatory reporting	Minor on-site environmental impact, reportable to regulators	Moderate environmental impacts, extends beyond site boundary or regulatory violations with fines	Serious medium term environmental impacts or major regulatory violations	Severe irreversible environmental impacts or severe breach of regulations with operation suspended
Emergency and Crisis Management	Emergency response may be required with notification of management. No crisis or Emergency Management Activation required.	The Registered Manager and Managing Director are notified.	The Registered Manager is notified and the Emergency Management Team may be activated. The Managing Director is notified. Action by off-site persons is necessary.	The Emergency Management Team and Crisis Management Team is activated.	As for Level 2 / Major incident.

Table 7-4: KCGM Key Closure Risks

SECTION/ DOMAIN	AREA	SCENARIOS		CURRENT RISK (RESIDUAL)				TARGET RISK (POST CLOSURE RISK LEVEL)			
		Risk Description	Potential Cause	Current Controls	Consequence	Likelihood	Risk Level	Additional Future Controls	Consequence	Likelihood	Risk Level
All	Demolition	Personnel injury or death during decommissioning (demolition).	• Ineffective implementation of risk assessment and safety plans. • Ineffective decontamination of plant/equipment/buildings prior to dismantling/demolition activities commencing. • Fall from height. • Electrical isolation not implemented correctly.	• Continue to use KCGM's operational safety systems during operational demolition and rehabilitation works e.g. risk assessments, TBRA, engineering controls etc.; • Use of suitable licenced demolition company with trained and experienced staff.	Major	Unlikely	2D Med	Post closure, retain existing KCGM safety systems and procedures, and retain a core of (safety or other) competent staff to ensure continuity of systems	Major	Unlikely	2D Med
All	Financial	Underestimation of cost of closure; Closure budget not well managed causing delay in relinquishment with increased closure period and costs.	• Inadequate closure provision estimation; • Contamination remains undetected during decommissioning phase; • Non-compliance with Legislation; • Increased costs due to unforeseen additional works.	• Internal & external closure & financial audits • Adequate studies, with detailed designs and costings, to reduce risk; • Annual ongoing closure cost estimation & costing studies to improve accuracy; • Targeted cost estimation improvements during annual reviews; • Internal and External Audits of costing procedure.	Major	Unlikely	2D Med	• Internal & external closure & financial audits • Annual closure estimation including further detailed and improved closure designs and costings. • Studies e.g. TSF closure design & costing • Projects move to execution phase, with improved costing accuracy	Major	Rare	2E Med
All	TSFs	Post closure TSF outer embankment failure (geotechnical) causing release of tailings material and potential loss of infrastructure (Fimiston II TSF close to national rail line and roads).	• Excessive rainfall; • Inadequate construction of TSF; • Raised piezometric levels within embankment; • Tension cracks developing as material dries out.	• Engineered dam design and wall lift verification by Professional Engineer on Record; • Monthly inspections and annual geotechnical audits of facilities; • Trained and experienced wall lift contractors; • Geotechnical decommissioning report (Mt Percy).	Major	Unlikely	2D Med	• TSF will have erosion resistant closure capping. • Geotechnical decommissioning reports.	Major	Rare	2E Med
All	Financial	Unknown relinquishment process, with changing requirements to meet relinquishment	Regulatory processes are unclear or change through Life of Mine	• Raise concerns via internal management structure to be consider in forums between industry representatives and Regulator.	Moderate	Possible	3C Med	Communication with Stakeholders	Moderate	Possible	3D Low
Fimiston Mt Percy & Gidji	Stakeholders	Changing stakeholder expectations over life of project causing delay in relinquishment with increased closure period and costs.	• Change in government; • Change in knowledge base regarding rehabilitation; • Change in best practice over time.	• Documentation of agreed outcomes • Ongoing consultation with key stakeholders throughout Life of Mine; • Approval of closure designs and plans by Regulators.	Moderate	Possible	3C Med	• Ongoing consultation with key stakeholders throughout Life of Mine; • Approval of closure designs and plans by Regulators	Minor	Possible	3C Med

SECTION/ DOMAIN	AREA	SCENARIOS		CURRENT RISK (RESIDUAL)				TARGET RISK (POST CLOSURE RISK LEVEL)			
		Risk Description	Potential Cause	Current Controls	Consequence	Likelihood	Risk Level	Additional Future Controls	Consequence	Likelihood	Risk Level
Fimiston Mt Charlotte Mt Percy	WRDs & TSFs	Operational decisions and activities not aligned with closure outcomes potentially leading to loss of opportunities, completion criteria not being achieved, delay in seeking relinquishment and increase in closure cost (possible rework)	• Lack of understanding of consequences of decisions or inadequate maintenance works/controls; • Conflicting priorities • Time and budget constraints; • Lack of understanding of closure strategy	• Pit: Zone of instability considered during pit design, infrastructure placement, WRD design & sign off • TSFs: Pond size management • WRDs: Closure integrated into design and signoff considerations; existing systems and controls for tipping to design • Integration of closure with operational activities; • Risk based decision making includes closure considerations; • Continue socialisation of importance of maintaining controls	Moderate	Possible	3C Med	• Flexible closure planning to allow for operational changes; • Operational planning includes closure considerations	Minor	Possible	4C Med
Fimiston Mt Percy Mt Charlotte	Open Pits	Geotechnical instability of pit walls outside demarcated zone of instability causing loss of local infrastructure.	• Pit wall changes in stress regime; • Inadequate offsets for long term closure; • Unravelling of unsupported voids; • Stability of geological structures not well understood	• Fimiston: Detailed geotechnical work completed; Predicted rock mass performance has been proven. Geotechnical monitoring. Greater understanding of structural controls developed over recent years (since Golden Pike). • Mt Percy: Geotechnical monitoring; structural controls, particularly on south walls, well understood; Buttressing strategy in place. • Mt Charlotte: Backfilling strategy in place to provide buttressing of pit wall. Ongoing geotechnical monitoring and backfill assessment.	Major	Rare	2E Med	• Post-Closure Monitoring Programmes • Fimiston: Geotechnical monitoring; implement backfill • Mt Percy: Geotechnical monitoring. Implement preferred closure strategy – buttressing south and west walls • Mt Charlotte: Complete Backfilling and buttressing of pit wall; Geotechnical monitoring	Major	Rare	2E Med

7.3 Highest Potential Closure Risks

The following aspects have been rated as the most significant potential closure risks which need to be managed during and post closure. Each issue generally reflects more than one of the higher rated hazards in the risk assessment matrix.

7.3.1 Safety during Rehabilitation and Decommissioning

7.3.1.1 Risk

Poorly managed closure implementation can result in inadequately identified and managed risks during rehabilitation and decommissioning activities, with risk of personnel injury or fatality.

7.3.1.2 Mitigation Measures

KCGM has existing risk assessment processes and work procedures to ensure safe work practices. These practices and procedures, or acceptable alternatives, will be retained during closure works. Specific rehabilitation and decommissioning plans will also be developed taking into account:

- Safety plans and procedures for all closure team members during the infrastructure decontamination, dismantling and demolition activities;
- Safety plans and procedures for all closure team members during rehabilitation activities;
- Traffic management plans for KCGM usage of any public roads or non KCGM properties;
- Security plans and procedures during the entire decommissioning phase, covering working areas, salvage yards and laydown areas to prevent any theft; and
- Noise and dust restrictions imposed by proximity to Kalgoorlie-Boulder. Prevailing wind conditions and stakeholder concerns are likely to significantly impact work schedules.

7.3.2 Underestimation of Closure Costs

7.3.2.1 Risk

The under-estimation of potential closure costs and failure to establish adequate closure provisioning can have serious ramifications for both company shareholders and regulatory stakeholders. Good project management (timely and effective execution of closure) and sound financial management are essential to ensure that closure is effectively carried out. The scale of mining activity at KCGM and extent of the disturbed footprint on the edge of an urban environment necessitates closure cost estimation is relatively complex and dependent on many interrelated factors. Great care needs to be taken that the closure provision accurately reflects not only all physical closure activities, but also the many indirect costs associated with mine closure.

7.3.2.2 Mitigation Measures

KCGM has standards and procedures related to closure implementation and there are comprehensive methodologies in place for project planning, including the implementation phase of closure. Project implementation tools are available for KCGM to use to ensure that closure is effective and timely.

KCGM has a fully audited closure cost estimation model that derives costs on a first-principle approach for volume, distance and productivity. All calculations used in the model to determine the volume of cover material and other rehabilitation prescriptions are based on surface area rather than footprint area. Productivity calculations used in the cost model are largely derived from published sources such as the Caterpillar Performance Handbook, with third party rates derived by independent engineering cost estimators on an annual basis. Provision costs are reviewed against implementation costs.

Annual closure reporting to the ASX and hence must comply with established accounting standards. 3rd party review by accounting firm.

See Section 11 (Volume 2) for more information regarding closure provisioning.

7.3.3 Post-Closure TSF Outer Embankment Failure (Geotechnical)

7.3.3.1 Risk

The causes of post closure TSF embankment failure are likely to be similar to those that could result in failure during the operational period, namely:

- Excessive rainfall;
- Inadequate construction of the TSF;
- Raised piezometric levels within embankment; and
- Tension cracks developing as material dries out.

7.3.3.2 Mitigation Measures

KCGM's TSFs are well managed in operations, with operational guidance provided by the TSF Operating Manuals developed by the engineer on Record, internal inspection regimes, and regular inspections by the Engineer on Record. In addition, construction reports for lifts and annual audits are conducted and provided to the DMIRS. KCGM has recently been audited by a review group of local and international geotechnical experts. Factors that control appropriate consolidation of materials to reduce the risk of differential settlement, such as optimal management of tailings beaching during operations (which could result in subsidence of the TSF upper surface – this does not pose a risk to the TSF integrity) and pond size are well managed. Mitigation measures include:

- Compartmentalising or other means on the upper surface to control surface water and limit ponding against dam walls;
- Use of trained and experienced wall lift contractors, with construction compliance verification by an independent engineer.
- Robust, appropriately designed and compacted crest bunds to prevent over topping; and
- Appropriate closure designs for outer slopes, for effective surface water control.

Engineered dam design and wall lift verification by an independent Professional Engineer on Record is a Regulatory requirement in WA. Dam design includes dam break assessments, factors of safety, underpinned by analyses as well as the requirement for compliance with a TSF Operating Strategy. Requirements have increased in sophistication over recent years.

Damage to the outer embankments of KCGM's TSFs has the potential to result in release of tailings or water, with the potential to impact on infrastructure such as the nearby Trans Australian rail line and roads.

The KCGM TSF closure design is a conservative design with a competent engineered and rock armoured perimeter crest bund built around the upper crest of the TSFs. Engineering assessment of the upper surface of the TSF has confirmed the design capacity of 12 hour PMP (Probable Maximum Precipitation, 723.5 mm (annual rainfall is 266 mm)), without the crest bund. The bund adds additional capacity and ensure no overtopping to the external slopes.

The closure design for the outer slopes is a rocky erosion resistant design. During development of the closure design, a substantial body of work was undertaken to understand how to prevent subsurface interface erosion (Vol. 1). Mitigation of this risk is built into the closure design.

At the end of the operation life of the TSFs, a geotechnical decommissioning report evidencing appropriate closure of the facility will be prepared.

7.3.4 Changing Stakeholder Expectations over Life of Project

7.3.4.1 Risk

KCGM has been operating for over 30 years, with a variety of rehabilitation "styles" implemented over time. Older rehabilitation tended to have prescriptive approved design commitments/requirements. Changes in regulatory focus and approval strategies can often alter expectations of success over time.

Final lease relinquishment by Government is conditional upon rehabilitation performance meeting agreed upon Closure Criteria. If a MCP is not appropriate for the site conditions, no matter how well it is implemented, it is unlikely to provide the anticipated outcome (expected performance of a post closure landform/landscape over 300 years). This can lead to extended post-closure timeframes, with legal, financial and corporate image ramifications.

Closure Criteria need to be outcomes based, to accommodate variations such as changes to design or specific engineering requirements of each area, and expectations need to be realistic with regards to historic rehabilitation and poor quality rehabilitation materials. It is necessary for all key stakeholders, and in particular Government, to appreciate the need for criteria to reflect site specific conditions and mining companies do not have an infinite time frame or budget.

7.3.4.2 Mitigation Measures

Ongoing stakeholder consultation and approval of the MCP and associated Completion Criteria are the key mitigation measures for this risk. The formulation of completion criteria now takes into consideration that DMIRS and EPA endorse a risk-based approach to mine closure and have a general acceptance that “one size does not fit all” for mine sites. Earlier approaches almost exclusively focused on ecological aspects of mine closure, which now needs to be tempered with greater consideration of local physical, geochemical, climatic and socio-economic conditions.

KCGM is continuing with studies to gain the required information to better understand the achievability of outcomes and Completion Criteria, in particular across varied rehabilitation materials and locations at KCGM.

7.3.5 Alignment of Operational Decisions and Activities with Closure Outcomes

7.3.5.1 Risk

Lack of understanding of consequences of operational decisions on closure could result in damage to existing rehabilitation or result in incurring additional closure costs. Conflicting priorities or time and budget constraints could contribute to the risk.

Poorly socialised closure plans and closure strategy may contribute to a lack of awareness of implications. Inadequate maintenance works or controls, for example, poor water management or dust management from a still-operational area, could contribute to damage to progressive rehabilitation.

Failure to consider closure during implementation of a new project could result in loss of opportunities in terms of closure outcomes and cost saving. Ultimately, the consequence could be more costly closure works and delay in relinquishment.

7.3.5.2 Mitigation Measures

KCGM has processes and procedures in place to manage activities that could impact on the zone of instability for pits. The geotechnical recommendations are considered during pit design, infrastructure placement and WRD design, with a formalised signoff procedure of agreed designs.

For TSFs, operational pond size management is critical for long term ‘draindown’ of TSFs. At KCGM the pond size is closely monitored to ensure operational TSF safety. The pond sizes are surveyed and assessed every two weeks. This requirement has flow on benefits for closure draindown and predicted seepage recovery pumping durations. Regular meetings are held with TSF operational and project teams.

For WRDs, closure is integrated into design and signoff considerations and a well-established existing system and controls for tipping to design. Regular meetings are held with Mine Planning and Mining teams with respect to design and implementation of WRDs.

Annual meetings are held with Mt Charlotte to assess backfill status, geotechnical status of the Mt Charlotte Open Pit and other planning items that are required.

7.3.6 Geotechnical Instability of Pit Walls

7.3.6.1 Risk

7.3.6.1.1 Fimiston Open Pit

The proximity of the Fimiston Open Pit to the Kalgoorlie-Boulder residential area has dictated that during mining operations priority be given to geotechnical stability studies. Geotechnical instability of the pit walls could lead to slumping or collapse of significant portions of the pit walls.

7.3.6.1.2 Mt Charlotte Glory Hole Pit

The partially buttressed Mt Charlotte Open Pit is in close proximity to public infrastructure, including a main road. Any failure or instability of the pit slopes in the long term could represent a hazard to public safety and infrastructure. Infrastructure such as the main road were placed after Mt Charlotte Open Pit was established. The western side of the pit has a very small weathered zone, with the majority of the wall consisting of competent rock with a wide bench.

7.3.6.1.3 Mt Percy Open Pits

The Mt Percy Open Pits are located adjacent to infrastructure including a water supply storage tank and the Trans Australian Railway. Potential geotechnical instability zones around these mined pits in the long term could potentially impact on the adjacent infrastructure.

7.3.6.2 Mitigation Methods

KCGM's pit designs and geotechnical work has been regularly reviewed by regional and global subject matter experts in the recent past. As such, controls and management of geotechnical risk can be considered world class.

7.3.6.2.1 Fimiston Open Pit

As part of the approved Public Environmental Review Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning (2007), KCGM conducted extensive geotechnical stability studies relating to pit wall stability and abandonment for the western wall of the Fimiston Open Pit. Slope stability analyses indicate that overall slope failure envelopes on the west wall have Factors of Safety exceeding 2. The geotechnical studies were peer reviewed and approved as part of the PER. The predicted rock mass performance has been proven during implementation of the Golden Pike cutback. It was concluded that unweathered competent rock mine slopes are not at risk of overall failure. The abandonment bund position recommended in the geotechnical studies is closer to the pit edge than the current position of the Environmental Noise Bund, which implies that the Environmental Noise Bund could function as the required abandonment bund.

KCGM considers that this comprehensive geotechnical analysis satisfies the requirement specified in the DMIRS guideline that states, "*in cases where the mine owner wishes to locate the abandonment bund closer to the edge of the open pit than specified by this guideline, it must be demonstrated that the stability of the ground mass between the pit edge and the abandonment bund can be ensured for the very long term.*"

7.3.6.2.2 Mt Charlotte Glory Hole Pit

Closure designs for the Glory Hole Pit include backfill of the underlying workings in the Mt Charlotte Underground Mine to provide buttressing support to the base of the pit, followed by backfill of the Glory Hole Pit. The backfill design takes account of potential settlement of the backfill, and places buttressing material against the slopes to mitigate the risk of failure in the long term.

7.3.6.2.3 Mt Percy Open Pits

Since the mid-1990s, the south wall of Mystery and Union Club Open Pits have received geotechnical monitoring in the form of:

- Visual inspections every three to six months or after significant natural events, such as cyclonic rainfall;
- Water level monitoring of two piezometers located behind the Mystery and Union Club southern pit slopes; and
- Photography of pit slopes on a monthly basis to provide a continuous record of any surface deterioration.

KCGM geotechnical engineers consider that, given the competent nature of the materials exposed in the south wall, the tight slope curvature and the presence of well-defined rock structure, a circular failure mechanism is considered to be unlikely. Failure of rock slopes is usually controlled by rock structure and circular failure within slopes is generally associated with weak materials such as extremely weathered overburden and soil waste rock dumps. Circular failure analysis, although not particularly relevant to these pit slopes, did help to reinforce the notion that deep seated failures affecting the rail line reserve are extremely unlikely (KCGM 2012). It is believed that seismicity would not trigger overall slope failure but would be more likely to shake loose blocks from individual batters.

7.4 Other Potential Risks

This section includes risks that may be technical or topical in nature but have not been risk ranked with the highest risks group mentioned above.

7.4.1 Inadvertent Public Access and Safety

7.4.1.1 Risk

Ineffective restriction of vehicle/pedestrian access and insufficient hazard warnings (signage and/or barriers) could potentially result in harm to the public. Close proximity of much of the KCGM mining area to Kalgoorlie-Boulder poses a public safety concern, both during decommissioning and post closure.

Although all mine areas are fenced off, it remains impossible to physically restrict all access to the more remote areas of the site to those members of the public that are determined to access the site. Illegal access to closed mine sites is generally for two reasons; theft of infrastructure or plant and non-malicious adventure seekers. Both activities are risky as accidents can occur resulting in serious, if not fatal, injury.

Many infrastructure areas are classified as unsafe during demolition activities and whilst fenced, barricaded and signposted, potential thieves and adventure seekers may ignore these if 24-hour security is not present during key closure activities. The dismantling and demolition of mine infrastructure generates large volumes of building material, spares and scrap which are considered to have economic value and are therefore of considerable interest to local entrepreneurs.

The presence of open pits as well as underground mine workings pose a significant safety risk. Access to these mine features, which is strictly controlled during the operational phase, is less easily achieved after closure but every effort will be made to apply all mining industry norms at KCGM. Mine pit abandonment bunds, while designed to restrict vehicle access, are not insurmountable obstacles to humans and animals should they choose to investigate the ex-mine features at close quarters.

Numerous examples of open pits and portals near town sites exist throughout the world and are managed via conventional measures, such as abandonment bunding and/or fencing and signage. Regulation 3.16 and 13.15 of the Mines Safety and Inspection Regulations 1995, provide risk based requirements for limiting inadvertent access to “abandoned” mining operations. In addition, the DMIRS has published Guidelines based on empirical data gathered in the Goldfields Region.

Post closure, there is a high likelihood that, due to the close proximity to residential areas, 4×4 and motorbike enthusiasts will want to access the KCGM rehabilitated landforms and inadvertently cause damage to the rehabilitation.

7.4.1.2 Mitigation Measures

It is almost impossible to remove all risk; however, KCGM has accepted mining industry standard practice when formulating mitigation measures, which include:

- Maintaining strict site security during the decommissioning phase. This entails security personnel, signage, fencing, barricades and bunding;
- Formulation and implementation of all necessary safety management plans and procedures as part of the final Decommissioning Plan;
- Positioning of mine pit abandonment bunds based on site specific geotechnical investigations rather than the empirical DMIRS Guidelines;
- All underground mine shafts/vents/portals etc., to be sealed/capped as per mining industry standards; and
- Selecting abandonment features that cannot be easily altered, such as rocky abandonment bunds.

7.4.2 Inadequate Rehabilitation Performance

7.4.2.1 Risk

The goal of rehabilitation on KCGM landforms is to produce ‘modified landforms’ i.e. a constructed environment that can support, or has the potential to support, vegetation growth and ecosystem services into the future. There is a risk that using inappropriate materials or inadequate amounts of materials within rehabilitation will hinder the ability for this to occur. Previously, despite material stripping during expansion of the operations, KCGM has recognised that there is a shortfall in availability of 'good' (fertile, non-saline) rehabilitation materials due to:

- Degradation of topsoil and subsoils from legacy mining practices.
- Local conditions producing shallow and skeletal topsoils typical of the Goldfields region.
- Recovery of larger volumes of relatively deep subsoils and oxides that are sodic, saline, and dispersive and have limited rehabilitation potential.

KCGM has completed significant work to characterise available rehabilitation materials and considers that there are insufficient rehabilitation materials to cover all areas to the same rehabilitation prescription, producing areas with potentially differing rehabilitation outcomes.

7.4.2.2 Mitigation Measures

Rehabilitation materials at KCGM are a finite resource and their usage needs to be optimised or prioritised, considering that there will be insufficient rehabilitation materials to cover all areas, in particular, the eastern WRD slopes. The Visual Amenity Concept (VAC) to address this issue began to emerge in discussions with Regulators from around 2011. KCGM has now embedded the Visual Amenity Concept, a decision making tool to prioritise rehabilitation material usage. Landforms have been classified into one of four groups based on their visual amenity (visibility) to the City of Kalgoorlie-Boulder; Highly Visible, Moderately Visible, Visible at a Distance and Minimally Visible. It is intended that these ratings will be used along with other planning parameters, such as haul distances, to prioritise rehabilitation material movement from stockpiles to final placement positions. Lower quality materials will be allocated to areas that are less visible to the public, and conversely, higher quality materials to areas that are very visible to the public. By implementing the Visual Amenity Concept, KCGM feels that the risk of poor rehabilitation performance has been reduced significantly. The western side of Fimiston Operational Area will receive the best rehabilitation materials. Due to the significant shortfall of material, it is important that

- Site rehabilitation materials are viewed as a whole of site resource and scheduled accordingly;
- All rehabilitation materials are stockpiled and recovered if mine plans change.

This strategy has been integrated into the WRD and TSF closure planning strategies, in particular with respect to the rehabilitation materials balance, and has been discussed with several stakeholder groups, such as the CRG and DMIRS. Within Section 9.2.2.1.3 (Volume 2), visual amenity for each landform has been discussed and has influenced planned closure implementation tasks.

7.4.3 Stability of Mine Waste Landforms

7.4.3.1 Risk

Mining at KCGM has resulted in the construction of large mine waste landforms that are to remain post closure. These include WRDs, low grade ore stockpiles and TSFs. The landforms are located at the Fimiston, Mt Percy and Gidji Operations. The Fimiston WRDs reach heights of up to 120 m above the original land surface and need to comply with the vertical height restriction of the OLS for Kalgoorlie-Boulder Airport (CASA Regulations). Dumps extend over a substantial footprint, along with several low grade ore stockpiles that will be reprocessed, located within the overall WRD footprint.

WRDs at Mt Percy were constructed in the early 1990s by a previous operator, almost exclusively of highly oxidised material. Some waste dumps will potentially encroach into the zone of instability on the northern end of the Mystery and Union Club Open Pits, due to long term erosion of the pit walls (stability).

Risks to be considered for TSF closure design include the management of ponding on the upper surface of the TSF to ensure the risk of overtopping of the crest bund, and associated uncontrolled erosion, is effectively managed. Under-designed engineered structures such as crest bunds, bench drains or rock drains could pose a risk to surface water management on the outer surface of the TSF, which could result in concentration and ponding of storm runoff on berms and erosion of rock drop drains.

Geotechnical mass failure of these landforms could lead to damage of nearby infrastructure, risk to public or closure team safety, or transport of sediments into the wider environment. Poor design or implementation could result in erosion of constructed covers, which may lead to exposure of encapsulated materials or transport of sediments into the wider environment.

7.4.3.2 Mitigation Measures

7.4.3.2.1 Waste Rock Dumps

WRDs are designed and constructed to conform with KCGM's internal geotechnical waste dump standard and procedures. The majority of the Fimiston waste rock (94%) is competent dolerite or basalt and are considered geotechnically stable.

KCGM is implementing the erosion resistant design on new landforms (refer to Section 9.2.3.4 – Volume 2) and has recently received approval for a Mining Proposal documenting the erosion resistant design and areas where this design applies.

The external slopes of older waste dumps at KCGM were constructed to the requirements of the *DoIR Guidelines for Mining in Arid Environments (1996)*, with 20° or less slope angles and narrow 5 m wide berms. In addition, the older waste dumps have been rehabilitated to the specifications in the approved Notices of Intent (NOI, now called Mining Proposals). Examples include the successful implementation of improved water control measures on the upper surface areas of these WRD areas to prevent overtopping failure. In the case of Oroya WRD, stormwater control improvements have been made, with a new crest bund, and rework has been implemented on higher visual amenity areas on the western side of Oroya WRD.

A large proportion of the older slopes with unsuccessful rehabilitation on Trafalgar WRD will be over tipped with the approved expansion of its footprint.

The waste rock dumps at Mt Percy are of limited height and have been sheeted with a gravelly lateritic material, creating a self-armouring surface that has established a reasonable vegetation cover. The WRDs can be considered geotechnically stable.

7.4.3.2.2 Tailings Storage Facilities

KCGM TSF closure designs have been progressed significantly. Erodibility work completed for WRD outer slope designs will be used as a basis for the outer slope TSF designs. These erosion resistant designs have been trialled on site and proven successful.

KCGM's TSFs are well managed in operations, by means of the TSF Operating Manual, internal inspection regimes, and regular inspections by the Engineer on Record. In addition, construction reports for lifts and annual audits are conducted and provided to the DMIRS.

Optimal management of tailings beaching during operations controls the appropriate consolidation of materials and reduces the risk of differential settlement. As a result, differential subsidence of the TSF upper surface is well managed.

Robust engineered crest bunds form part of the TSF closure design.

7.4.4 Retraction of Agreements Related to Infrastructure

7.4.4.1 Risk

It is commonplace that when a mine site is closing, third parties are interested in the retention of facilities or infrastructure they consider of value. Unfortunately, the cost of upkeep (including engineering safety inspection and compliance requirements) and insurance (such as public liability) is often greater than expected. The interested party is often unable to fund these requirements. Should this eventuate for items of interest, KCGM may be left with unforeseen liabilities and costs and community expectations may not be met.

7.4.4.2 Mitigation Measures

KCGM will discuss transfer of items to interested parties prior to demolition. All agreements and commitments will be formalised legally prior to handover of an asset. Closure Provisioning is currently based on the assumption of demolition, i.e. the most conservative costing option will occur.

7.4.5 Geochemical Stability of Mine Wastes

7.4.5.1 Risk

The Geochemical nature of mine waste materials have the potential to impact on the beneficial use of water.

7.4.5.2 Mitigation Measures

Several in depth studies have been undertaken to assist with quantifying the risks and identifying the preferred mitigation methods.

7.4.5.2.1 WRDs

Fimiston waste characterisation studies have shown that the majority of the waste rock is non acid forming (non-PAF), and has substantial acid neutralising capacity (ANC).

Black Flag Shales form 3.1% of the total waste volume at Fimiston. Of this 3.1%, less than 50% is mineralised Black Flag Shales ore, which have the potential to be PAF, if left fully exposed. Inherent sulfide oxidation rates are very slow, with a significant lag period. This material is considered a resource and is stored in a stand-alone stockpile. The closure design for this stockpile is a water shedding cap. Closure costing is conservative, with the assumption of capping.

Current operational tipping practice for waste rock containing Black Flag Shale (i.e. non-mineralised), is co-disposal within the WRDs, with other waste rock, the majority (96%) of which is considered to have a high ANC nature. Current precautionary operational procedures include no waste Black Flag material dumping within 50m of an outer face or within 5 m of a final height of a WRD. With the closure WRD design intended to be a store and release cover, to reduce water infiltration and thereby minimising oxidation, these practices were considered to be appropriate by geochemical experts (MBS, 2017).

7.4.5.2.2 Processing Tailings (Fimiston Operational Paddock TSFs)

Geochemical characterisation was conducted on Fimiston tailings material in 2014, with further work conducted in 2016/7 (MBS, 2018b). Outcomes from this work found:

- The tailings will remain NAF, with alkaline pore water post closure;
- A surface gypsum crust would reduce infiltration rates into the underlying tailings;
- The natural degradation of cyanide, alkaline nature of the tailings and presence of iron will ensure that the mobility and potential for leaching of environmentally significant metals or metalloids will be extremely low.
- The risk of leachate from the rehabilitated TSFs adversely impacting groundwater is considered low. Potential contaminants will be chemically bound in the tailings material in insoluble forms, unlikely to be transported beyond the landform by rainfall or seepage.

The current closure design is an erosion resistant cover, considered appropriate for these TSFs. The groundwater is hypersaline, with mining identified as the only beneficial user. Production bores around the TSFs ensure that seepage is controlled and will continue to operate until no longer required.

7.4.5.2.3 Processing Tailings (Gidji Operational Paddock TSFs)

A geochemical review was conducted on Gidji tailings material in 2014, with further work conducted in 2016/7. Outcomes from this work found:

- The tailings are hypersaline and PAF, with a high sulfur content;
- The tailings are substantially enriched with metals and metalloids. Oxidation of leachates from Gidji II have the potential for significantly elevated concentrations.

Current controls include Gidji II and III TSFs being a fully lined downstream TSF. The current closure design is a water retention design to control water entering the wider environment. Design studies have been undertaken with a diverse group of professional experts involved. Production bores abstract seepage water from Gidji I from the groundwater, and will continue operation until no longer required. The groundwater is hypersaline, with mining identified as the only beneficial user.

7.4.5.2.4 Legacy Tailings (Pre-KCGM)

Most older, pre-KCGM, tailings facilities and leach ponds, or their remaining footprints, that might have been considered potential sources of contaminate seepage discharge, have been capped by the Fimiston WRDs. Under local climatic conditions and currently planned closure designs, most rain events are not expected to initiate seepage from these facilities, the majority of which are encapsulated within existing WRDs.

7.4.6 Pit Lake Hydrology

7.4.6.1 Risk

The Fimiston Open Pit is actively dewatered to allow for mining activities and will be dewatered until the end of open pit mining, with the associated cone of depression being limited in extent to within about 200 m of the pit rim. Groundwater seepage from pit walls is very low, with the majority of 'groundwater' present in old mining voids below the pit floor. This water has accumulated over a long period of time from rainfall incident on the pit and associated ramps.

The Fimiston Open Pit will be a groundwater sink and develop a hypersaline pit lake post closure.

For closure three possible risks require consideration:

- Potential impact on beneficial users of the groundwater aquifer adjacent to the pit;
- Potential for ecological impacts; and
- Potential for overtopping of the pit lake.

7.4.6.2 Mitigation Measures

7.4.6.2.1 Fimiston Pit

The Fimiston Open Pit lake model was updated in 2020 and again in 2022. The model predicts that the pit lake elevation will recover when dewatering ceases, stabilising at between 485 m and 505 m below the pit rim after around 300 years, and will not rise any further due to the large amount of water lost by evaporation from the lake surface. The water level will never rise high enough for the lake to discharge from the pit. The lake level will remain substantially below the groundwater elevation within the surrounding basement rocks, ensuring the pit will act as a groundwater sink. The lake level will also remain below the base of oxidation in the pit area and in all locations the lake will be in contact with competent bedrock.

The model predicts that although the lake may initially stratify, it will subsequently become fully mixed and within 200 years the lake will become hypersaline (100,000 mg/L TDS). TDS concentrations will continue to gradually increase until NaCl solubility limits are reached (the maximum possible TDS concentration will be less than 300,000 mg/L). The water quality will reflect natural trace concentrations of metals associated with the Fimiston ore body, including the presence of Sb, B, Cd, Cu, Mo, Ni and Se. Concentrations of these metals will increase with time due to evapoconcentration, with the exception of Se which is sourced from TSF seepage which will only be pumped to the pit lake for a short period. Total cyanide concentrations are predicted to be less than 0.6 mg/L in the pit lake.

The hypersalinity of the lake is unlikely to pose a threat to the surrounding environment since; the lake is expected to remain a terminal groundwater sink, the pit void exists in association with saline groundwater, and the lake surface will be far below ambient ground level, hence plant roots will not interact with the water. These factors also limit the environmental significance of elevated concentrations of some metals and metalloids.

Access to the lake for terrestrial fauna is likely to be extremely limited due to the steep gradients from ground level and substantial freeboard, given that ramps and roads will be rendered inaccessible at closure. Whilst flying fauna (e.g. birds and bats) may be able to access the lake surface, the water is unlikely to remain palatable for more than 50 years due to increasing salinity, particularly sulfate salinity which is purgative. Furthermore, consumption of the brackish water is unlikely to be substantial where more attractive freshwater sources are available to avifauna.

There are no operating borefields in the vicinity of the Fimiston Open Pit that could be influenced by the Pit dewatering operations. The nearest operating borefields are associated with seepage recovery at the KCGM TSFs, and are located in the ferricrete and alluvial sediment groundwater system, located several kilometres from the Fimiston Open Pit, with no hydrogeological linkage been these aquifers. As a result, there is effectively no risk of environmental harm associated with the pit lake, or as a result of indirect interactions with the groundwater system.

In 2016, an assessment was conducted by Phoenix Environmental on the potential for an ecosystem to form within the lake post closure, considering the geochemistry and the lack of shallow water areas and other key factors (Appendix 5.9). No comparable natural system, when contrasted with the modelled Fimiston Open Pit lake, was found to exist within Australia or world-wide, i.e. deep, hypersaline and with moderate acidity. The assessment found that these conditions would limit the functioning and formation of the three trophic levels of a lake (primary producers, consumers and predators) to an extent likely to preclude any functional ecosystem. These findings are still considered valid despite changes to modelled acidity within the lake.

7.4.6.2.2 Mt Percy Pits

Mining of the Mt Percy Open Pits ceased in the late 1990s. The Pits have a small volume of saline water at the base, but have never filled, even during significant cyclonic rain events.

The small pit lakes that have formed within the Union Club and Mystery Open Pits are a result of the original pit floor intersecting the bedrock groundwater. The pit lake water level has remained relatively stable for 20 years, suggesting that groundwater inflow has stabilised and is in balance with rainfall inputs and evaporation under normal climatic conditions. Groundwater levels immediately adjacent to the Mt Percy Open Pits are presently 60-65 m below surface and approximately 20 years post mining, consistent with the inferred pre-mining groundwater elevation. There is no likelihood of the pit lake overtopping the pit crest or rising significantly up the pit slopes due to the direct connection with the groundwater system at both the Union Club and Mystery Open Pits. Water quality, pit water levels and borehole water levels are monitored and correlate. As such, the pit lakes do not create a geotechnical hazard to the pit walls.

All of the KCGM mine pits will act as ‘groundwater sinks’ in perpetuity, and as such do not pose a significant environmental risk to groundwater resources, as local groundwater flow is from the groundwater systems into the pit lakes. Environmental risks to the community or wildlife are assessed to be low due to the final depth of the pit lakes being significantly below the pit crests, as well as the saline nature of the water.

See Section 5.3.2.1.1 for additional information regarding the Fimiston Pit lake hydrology.

8. CLOSURE OUTCOMES AND COMPLETION CRITERIA

8.1 Closure Aspects

The main areas of focus for closure at KCGM are driven by risk as described in Section 7. As such, over time KCGM have developed and refined several key areas that require specialised management called 'aspects' and the desired end goal of closure associated with these aspects, called 'objectives'.

KCGM documented draft Closure Aspects and Objectives in the *2006 Public Environmental Review Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning*. In February 2010, a workshop was held by KCGM in conjunction with Joint Venture Owners at the time, Barrick and Newmont and key external consultants, to determine a refined set of aspects and objectives. Following the release of the 2020 Mine Closure Plan guidelines by DMIRS, and discussions with key Regulators, KCGM has reviewed and renamed the closure 'objectives' to 'outcomes' within the 2021 iteration of the MCP (this document).

Initial development of completion criteria was undertaken prior to the 2010 KCGM MCP. KCGM has had numerous discussions with Regulators, specifically related to mine waste landforms. Regulators are aware of the site limitations with respect to rehabilitation materials availability (related to the site being extensively mined for over 100 years) and footprint constraints. A review of Closure Aspects and Objectives in 2014 allowed for greater refinement of completion criteria, however KCGM felt they needed to minimise any changes to existing wording to remain close to the original versions submitted as part of earlier approval documents.

On 2 September 2019, KCGM met with representatives of the EPA and DMIRS to discuss the resubmission of the 2018 MCP. At this meeting the EPA agreed that KCGM could review and reword closure objectives and criteria in the interests of adaptive management. This has been done for this iteration of the MCP (2021 – this document). The aspects were reviewed in 2020, with new aspects and completion criteria formulated in 2020/1. The management of the outcomes associated with these aspects is fundamental for the effective closure of KCGM and is discussed further below.

8.2 Closure Outcomes and Criteria

For each of the seven closure aspects, outcomes have been developed taking into consideration the planned post mining land use for the site. For each of these outcomes, criteria to determine successful achievement have also been developed (Table 8-1).

Closure criteria provide a guiding set of principles for progressive rehabilitation and mine closure planning and should be developed in that they:

- Allow success to be measured within realistic timeframes;
- Are sufficiently precise to allow outcomes to be effectively audited, but also allow for area specific flexibility when required;
- Are based on sound scientific principles; and
- Acknowledge the consequences of permanent changes to the landscape, soils and hydrology as a result of mining.

The completion criteria have been developed to take into consideration the planned post mining land use, which itself takes into account the unique historical and environmental setting of the Goldfields region that influences rehabilitation performance, for example, limited rehabilitation materials resources. Proposed Approaches have been provided to outline how KCGM plan to manage closure to achieve the stated outcomes and criteria. Measurement metrics are provided for KCGM to demonstrate completion of the criteria.

Table 8-1: KCGM Completion Criteria (2021 v1)

Aspect	Closure Outcome	Proposed Approach	Feature	Closure Completion Criteria	Measurement
Safe	Inadvertent access is restricted as much as practicable to any landforms or structures that are considered unsafe.	Removal or burial of all mine structures/buildings/foundations and machinery by suitable demolition / civil company unless legal liability accepted by post mining land owner. Transfer of ownership including legal documentation agreed to within reasonable timeframe (2 years), with legal documentation completed at time of closure implementation.	Buildings and Infrastructure	The footings/foundations/anchors of all mine structures/buildings/services to be buried at least 0.5m below the final land surface.	Compliance certification (photographic and survey data) provided by demolition contractor for submission in Final Mine Relinquishment Report.
			Transferred assets	The post closure retention of any mine infrastructure requires agreement from relevant Stakeholders and legal documentation of ownership transfer.	Transfer of ownership legal documentation included in Final Relinquishment Report.
		Limit ability of vehicular traffic to travel over crests through construction of adequately sized and positioned crest bunds on all possibly unsafe mine structures identified through area specific assessment. Incorporation of requirement into closure designs and planning. Fauna egress considered in design.	Mine waste landforms/ excavations	Crest / safety bunds constructed on any remaining excavation/ trench/channel/pit/embankment/ landform with slopes exceeding 25° or depth exceeding 0.5m.	Confirmation of construction of safety measures through visual inspection and/or aerial images.
		Construction of abandonment bunding around mine open pits	Open Pits (Fimiston, Mt Percy, Mt Charlotte)	Pit abandonment bunding complies with Mines Safety and Inspection Regulations 1995 and DMIRS 1997 Guidelines (DOIR 1997) requirements.	Abandonment / safety bund completion recorded in MCP or associated close out documents – assessment via aerial photography / DTM or site inspection by suitable professional.
		Proactive management of existing (historical) mine waste landforms and infrastructure that are located within the zone of instability of open pits. Identification and assessment (as to the WRD instability risks should portions of the landform collapse into the pit) of landforms that are within the mine pit instability zone is conducted by suitably qualified	Open Pits (Fimiston, Mt Percy, Mt Charlotte)	Geotechnically high risk unstable areas/mine structures/zones are captured within abandonment bunding/ safety bunds.	Completion of final assessment at end of mining operations recorded in MCP or associated closeout report. Submission of Final Relinquishment Report to DMIRS geotechnical engineers.
			Mine waste landforms	Any (older) mine waste landforms located or partially located within long term mine pit instability zone to have competent abandonment bund/s designed and implemented based on	Certification of compliance based on aerial photography / DTM and site inspection by suitable professional recorded in Final Relinquishment Report.

Aspect	Closure Outcome	Proposed Approach	Feature	Closure Completion Criteria	Measurement
		professional such as a geotechnical engineer. Calculation of pit zone of instability allows for geotechnical instability and erosion.		area specific assessment to restrict vehicle access to safe area of landform.	
		Permanent sealing of portals and vent shaft openings to U/G mine workings.	Major Underground openings	Mt Charlotte portals and vent shaft openings to underground mine workings to have an engineered permanent seal.	As-constructed engineering drawing or photographic evidence of sealing of all U/G opening seals. Completion of implementation recorded in Final Relinquishment Report, provided to Mine Safety Inspector.
		Assessment of underground voids for geotechnical risk and unravelling by a geotechnical engineer. Record of underground voids requiring backfill and their backfill status - updated record (table) in MCP, showing implementation status (% fill).	Underground voids at Mt Charlotte	Major underground voids assessed to have long term geotechnical risk to be backfilled.	Final geotechnical risk and backfill assessment completion report by suitably qualified professional provided in Final Relinquishment Report.
		Landforms compliant with CASA requirements.	Fimiston mine waste landforms	All mine waste landforms and remaining structures to be compliant with Kalgoorlie-Boulder Airport height restrictions or other CASA requirements.	Confirmation through as-constructed DTMs of height of mine waste landforms.
		Retain emergency access ramp for pit, with reasonable danger/hazard warning signage.	Fimiston and Mt Percy Open Pits	Retain pit access ramp for geotechnical monitoring during post closure monitoring and emergency access to pit lakes, with reasonable danger/hazard warning signage.	Photographic evidence provided in MCP or associated close out documents.
	Site closure activities are completed in a manner which ensures the safety and health of workers.	Standard Industry OHS procedures and standards to be adhered to during all stages mine closure.	All operations	Current WA mine industry OHS standards.	KCGM safety systems and procedures implemented for any closure related physical works/activities in compliance with Mines Safety Act.

Aspect	Closure Outcome	Proposed Approach	Feature	Closure Completion Criteria	Measurement
Geo-Physical Stability	Mine landforms achieves long term geotechnical stability.	Implementation of site appropriate geotechnically stable designs for mine waste landforms. Final batter slope angle selection dependent on landform materials properties and cover material properties.	Mine waste landforms	Mine waste rock dumps and TSFs have slopes of <25 degrees (excluding buttressed areas).	Assessment at end of operations to ensure slopes are battered down and stable through site inspections or DTMs, recorded in MCP or associated closeout report.
		Monitor TSF draindown during closure period for TSF stability.	TSFs	TSF FoS > 1.5 at completion of closure monitoring and downward trending phreatic surface (ANCOLD 2019 or approved alternative).	TSF embankment stability assessment as per ANCOLD 2019 Guidelines, verified by suitably qualified engineer.
	Open Pit wall geotechnical stability will be managed.	Open Pit wall designs will have appropriate geotechnical considerations and design criteria.	Fimiston and Mt Percy Open Pits	Open Pit wall movement not to exceed rates which could compromise the calculated zone of instability.	Geotechnical post closure monitoring methods as recommended by qualified Geotechnical Engineer. Final geotechnical zone of instability assessment report by qualified Geotechnical Engineer after post mining monitoring period, with recommendations actioned. Submission of close out report to DMIRS geotechnical engineers.
	Long term erosion stability and integrity of engineered mine landform covers based geomorphological processes observed within the local region.	Effective landform surface drainage control measures based on landform water retaining designs.	TSFs WRDs	Appropriately implemented surface water management structures on TSFs as per ANCOLD 2019 Guidelines. Rehabilitation implementation meets design intent with appropriately implemented surface water management structures on WRDs i.e. erosion resistant design has water catchment on benches and water retaining design slope cover.	Design and implementation verified by suitably qualified engineer and recorded in MCP or associated close out documents.
		Landform cover designs based on scientific modelling (300 yr time frame) or site specific trials/monitoring performance under expected regional climatic conditions.	TSFs WRDs	Rates of erosion of landform covers are within an acceptable range taking into account regional climatic conditions and material characteristics and do not impact on the geotechnical integrity of the landform.	Site inspection report and whole of landform aerial photographic analysis by suitably qualified professional.

Aspect	Closure Outcome	Proposed Approach	Feature	Closure Completion Criteria	Measurement
		Rehabilitation Performance Assessment of trial plots and implementation of findings in final cover designs.		No visual evidence of active gully erosion exposing underlying dispersive and/or unstable material.	
		Where possible, restrict access to rehabilitated mine waste landforms by human traffic and domestic livestock grazing to minimise potential for damage to constructed covers.	Mine waste landforms, especially TSFs	Where required and practicable, access to rehabilitated landforms is to be limited through the use of temporary fences and/or rock bunds. Perimeter fencing in place around all TSFs and access to Gidji TSFs restricted.	Site inspection records (including photographs and GIS mapping) to verify installation of fences to limit access recorded in MCP or associated close out documents.
Non Polluting	The landforms containing materials of concern will be managed to minimise impacts to the quality of the surrounding environment.	Materials with potential (long lag) to generate AMD are placed in a demarcated area and have an appropriate closure capping design to minimise risk of AMD.	Ore stockpile – Black Flag shale Gidji TSF	High Grade Black Flag stored within dedicated stockpile area with encapsulation closure design. Gidji TSF closure design is appropriate for AMD material	Record of high grade BF ore stockpile capping design and implementation in MCP or associated close out documents. Record of Gidji design implementation in MCP or associated close out documents.
		Minimisation of sediment movement from the immediate footprint of mine landforms through use of effective covers, drainage control and toe sediment retention bunds.	Mine waste landforms (WRDs TSFs)	Mine waste landforms do not actively discharge alluvial fans into adjacent natural drainage lines (creeks). No discharge of sediment or contaminants of concern beyond the assimilative capacity of the local environment based on Australian Standards.	Aerial photography verification of no active alluvial fans extending beyond the immediate foot print of mine waste landforms. Action if identified. Relevant post closure groundwater and surface runoff monitoring data.
		Formulation and implementation of post closure seepage management plan if impacts on the beneficial users of groundwater and vegetation.	TSFs	No discharge of seepage waters that impacts on beneficial use of groundwater. Groundwater levels remain below or at depth targets as documented in the post closure Seepage and Groundwater Management Plan	Groundwater level monitoring of appropriately scaled monitoring network, until proposed groundwater depth targets are achieved. Final groundwater closeout report by suitably qualified professional.

Aspect	Closure Outcome	Proposed Approach	Feature	Closure Completion Criteria	Measurement
		Operational hazardous materials management practices continued during closure operations. Chemical inventory drawn down close to closure with pipelines and vessels cleaned. Inspection prior to demolition. Implement requirements of Contaminated Sites Act for identified risk areas, analysis by competent specialists.	Mineral Processing areas – Fimiston and Gidji Mining Maintenance – Fimiston	All reagents and chemicals removed from site with any residual site contamination investigated and actioned as per the *Contaminated Sites Act 2003*.	As required, monitoring in accordance with Contaminated Sites requirements.
Sustainable Land Use	Rehabilitate disturbed areas to a modified landscape receptive to vegetation regrowth and recovery over time considering visual amenity and properties of available rehabilitation materials.	Vegetation attributes in rehabilitated areas to have values indicative of the target post mining land use. Salinity and other constraints on vegetation growth are acknowledged in monitoring and assessment of completed rehabilitation. These data are used to underpin the vegetation attributes criteria and understanding the performance of rehabilitation across site.	Fimiston	Fimiston operational area revegetation has values indicative of the agreed post mining land use, modified landscape, accounting for placement of rehabilitation material types (implementation of the Visual Amenity Strategy).	Rehabilitation performance monitoring using accepted vegetation monitoring techniques and measures. Includes assessment against targets values, and demonstration of the ability to become self-sustaining (as detailed in Volume 2 Section 10).
			Mt Percy Mt Charlotte	Mt Percy and Mt Charlotte operational area revegetation has values indicative of the agreed post mining land use, modified landscape, accounting for limitations of the available materials used in rehabilitation.	
			Gidji	Gidji operational area has values indicative of the planned target post mining land use of modified landscape, accounting for limitations of the largely sodic soils available for rehabilitation.	

Aspect	Closure Outcome	Proposed Approach	Feature	Closure Completion Criteria	Measurement
		Weed control on landforms during closure and rehabilitation performance monitoring period.	All areas	Management of Declared Weeds or Weeds of National Significance on landforms.	Rehabilitation performance monitoring includes identification of Declared and National Significance weeds.
Legal Compliance	Maintain compliance with all legal and other requirements during the closure planning and implementation process.	Maintain existing closure obligations register (Appendix 1) and incorporate into closure planning to ensure compliance.	All areas	Maintain closure legal commitment register with triannual review and update.	Reviewed and updated Legal Register provided in 3 yearly MCP. Legal compliance audit in final relinquishment report/MCP.
Closure Planning	Cost effective and timely closure planning and implementation	Application of current mining industry rehabilitation techniques suitable to the site conditions and constraints of the post mining environment. Maintain records of rehabilitation in the event that a 3rd Party peer review is required for signoff. Undertake continuous improvement of rehabilitation techniques where possible, recorded in the MCP.	All Areas	Rehabilitation deemed appropriate as per 3rd party review and regulatory sign off of Final Relinquishment Report.	Regulatory approval of triennial MCP. 3rd Party review of rehabilitation methods may be recorded in Final Relinquishment Report (Mine Completion Report as per DMIRS 2021 Guidelines).
		Implementation of a progressive rehabilitation schedule.	All Areas	Implementation of progressive rehabilitation within the constraints of mine development reported annually in AER and triennially in MCP.	Record of proposed and completed progressive rehabilitation in the MCP and AERs.
	Adequate closure provision is made to cover all agreed to closure commitments.	Effective resourcing of annual update of Closure Cost Estimate, 3-yearly MCP update/review, preparation of final Mine Relinquishment Report and post closure rehabilitation performance monitoring and maintenance.	All Areas	Closure Provision costing to Australian mine industry standards.	Annual 3rd Party audit of KCGM of closure cost model.

Aspect	Closure Outcome	Proposed Approach	Feature	Closure Completion Criteria	Measurement
Stakeholder Consultation	KCGM's key stakeholders will be consulted in relation to post closure outcomes.	Key Regulatory stakeholders are provided with an opportunity to comment on a 3 yearly frequency through the MCP resubmissions. Consultation with Department of Lands, Heritage and Planning from approximately 5 years prior to closure.	All Areas	Submission of triennial MCP, which considers feedback from Key Regulatory stakeholders.	Approval of MCP.
	Community stakeholder representatives will be engaged in relation to post closure outcomes.	Routine community consultation through tools such as Local Voices or the Community Reference Group will include closure planning aspects.	All Areas	Where appropriate, community consultation and outcomes reported in MCP.	Record of consultation and outcomes included in MCP.
		Inclusion of closure objectives will be included into discussions with representatives as per the Aboriginal Engagement Strategy.	All Areas		