Broken Hill Operations Pty Ltd **ABN 95 103 555 862**

Rasp Mine

Annual Environmental Management Report/Annual Review

REPORTING PERIOD

1 January 2018 - 31 December 2018

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Title Block

Name of Operation:	Rasp Mine
Name of Operator:	Broken Hill Operations Pty Ltd
Development consent / project approval:	PA 07_0018 (MOD1, MOD2, MOD3 and MOD4)
Name of holder of development consent / project approval:	Broken Hill Operations Pty Ltd
Mining Titles / Leases:	Consolidated Mining Lease 7 Mining Purpose Leases 183, 184, 185, 186
Name of holder of mining lease:	Broken Hill Operations Pty Ltd
Water licence:	85WA752823
Name of holder of water licence:	Broken Hill Operations Pty Ltd
MOP Commencement Date: 1 October 2017	**MOP Completion Date:** 30 September 2019
AEMR Commencement Date: 01/01/2018	**AEMR End Date:** 31/12/2018
I, Devon Roberts, certify that this audit report is a true and accurate record of the compliance status of the Rasp Mine for the period 1 January 2018 to 31 December 2018 (Reporting Period) and that I am authorised to make this statement on behalf of Broken Hill Operations Pty Ltd.	
Name of authorised reporting officer:	Devon Roberts
Title of authorised reporting officer:	Senior Environment and Community Liaison Officer
Signature of authorised reporting officer:	D Roberts
Date:	31/3/19

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PLANS

1. STATEMENT OF COMPLIANCE

Table 1-1 lists the development consent and mining leases and confirms compliance as at the end of the reporting period. **Table 1.2** lists the non-compliances with relevant approval conditions for the reporting period.

Table 1-1 Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	(Yes/No)
Project Approval 07_0018 (Consolidated MOD 4)	No
Consolidated Mining Lease 7	Yes
Mining Purpose Lease 183	Yes
Mining Purpose Lease 184	Yes
Mining Purpose Lease 185	Yes
Mining Purpose Lease 186	Yes

Table 1-2 lists conditions that were identified as non-compliant and provides a comment outlining actions undertaken and where appropriate, addressed in this Annual Report.

Table 1-2 Non-Compliances

Relevant Approval	Relevant Condition	Condition description (summary)	Compliance Status	Comment	Annual Review Section
PA07_0018	Schedule 3 Condition 11	Update Air Quality Management Plan for MOD4.	Non-compliant	AQMP has been updated and submitted to regulators for review following discussions with EPA in 2018.	3.4
PA07_0018	Schedule 3 Condition 30	Preparation of a Conservation Management Plan.	Non-compliant	Waiting for results of inter-governmental discussions.	3.4
PA07_0018	Schedule 3 Condition 33A	Update of Waste Management Plan with long term waste (tailings) management strategy.	Non-compliant	Propose to use Kintore Pit as TSF3 - waiting for design report from consultant and identification of new location for mine portal. Tailings will be deposited in TSF2 until mid-2022.	3.4
PA07_0018	Schedule 4 Condition 4	Update of management plans – MOD4.	Non-compliant	Management Plans have been updated and submitted to regulators for review and approval.	3.4
EPL 12559	M2	EPL Point 10 – monitoring frequency.	Non-compliant	The TSP high volume air sampler at Point 10 failed to monitor over 12 consecutive events due to a flowrate variation error.	6.3.3
EPL 12559	M2	EPL Point 14 – monitoring frequency	Non-compliant	The TEOM at Blackwoods Pit (Monitoring Point 14), while operating correctly, failed to record data to the installed compact flash card after the 19 April service, which was not noticed until May 22, and not repaired until 31 May.	6.3.4
EPL 12559	M2	EPL Points 10, 11, 12 – monitoring frequency	Non-compliant	High Volume Air Sampler filter papers from the 30 May monitoring event were lost in transit.	6.3.3

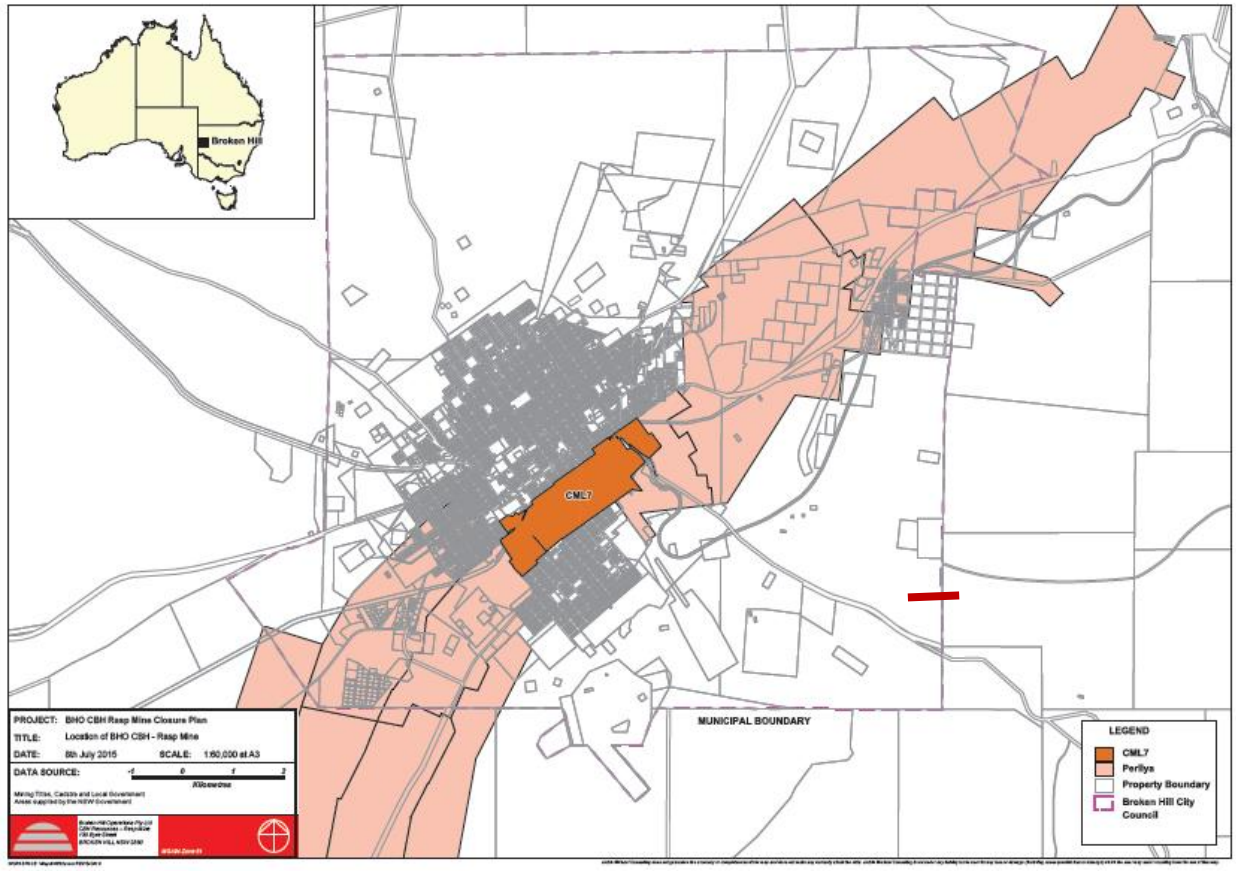
EPL 12559	U1	Annual production blast management report to be included with 2016/2017 Annual return.	Non-compliant	The Annual production blast management report was not included with 2016/2017 Annual return.	6.13

2. INTRODUCTION

2.1 Purpose

The Annual Environment Management Report (AEMR) / Annual Review documents the environmental performance of the Rasp Mine for the reporting period 1 January 2018 to December 31 2018. It has been prepared in accordance with the NSW Government *Post-approval requirements for State significant mining developments - Annual Review Guideline*, October 2015 to meet the requirements of the relevant mining leases, Project Approval 07_0018, and EPL 12559.

Figure 2-1 Location Map – Plan 1



2.2 Location

The Rasp Mine is owned and operated by Broken Hill Operations Pty Ltd (BHOP), a wholly owned subsidiary of CBH Resources Ltd (CBH). The Mine is located on Consolidated Mine Lease 7 (CML7) within the City of Broken Hill and includes several Mining Purposes Leases (183,184,185 and 186) with the entire Project extending over Western Land Leases and freehold properties.

The Rasp Mine consists of underground mining operations, a processing plant producing zinc and lead concentrates, a rail siding for concentrate dispatch to shipping facilities within Australia as well as other mining ancillary facilities. In the reporting period all concentrate product was placed in sealed containers and transported by rail to either the Port of Newcastle NSW or smelter operations in Port

Pirie SA. Rasp Mine is approved to produce 750,000 tpa of ore and 8,450,000 tonnes of ore over the life of the Project to December 2026.

The Mine is located centrally within the City of Broken Hill (Figure 2-1) and is surrounded by transport infrastructure, areas of commercial and industrial development and some residential housing. The Mine is bounded by Eyre Street to the south east, Perilya Broken Hill Operations Pty Ltd (Perilya) North Mine to the east and Perilya's South Mine to the west, and the commercial centre of Broken Hill to the north. Two major State roads dissect CML7 - South Road (Silver City Highway SH22) to the southwest and Menindee Road (MR66) to the northeast. These roads form part of the existing road train and B-double routes through Broken Hill. Mawson's Quarry lies to the east of the existing processing plant. The Broken Hill railway station is located within CML7 on a surface exclusion with the main Sydney – Perth railway line also located within the Lease on various surface exclusions. Residential and commercial areas surround the mine with pastureland to the southeast. An aerial view of CML7 is provided in **Plan 1, Figure 2-1**.

The mining leases occupy a central region of the historic Broken Hill Line of Lode ore body incorporating the original mine areas that commenced operations in the 1880s including a substantial amount of mining infrastructure from various mining phases. The Mine was the birthplace of Broken Hill Pty Ltd (BHP) in 1885. Subsequently several mining companies, including Broken Hill South and Minerals Mining and Metallurgy Ltd (MMM), have operated the mine. This past mining has left the mining lease highly modified and disturbed. The original landform has been significantly altered, the majority of native vegetation removed and soils have been degraded and covered with waste rock.

There are a number of heritage items on the site relating to historic mining activities and the site is recorded on the Register of National Estate for its heritage values. The people of Broken Hill consider the mine as an important historic site for its role in Broken Hill's history. The Broken Hill Miners Memorial and Broken Earth Café are located centrally within CML7.

The CML7 boundary is shown in Plan 2**,** which also indicates surface exclusion areas and MPLs. The Project Area includes additional areas to the south-east located on Western Land leases or freehold properties owned or leased by BHOP (highlighted in orange). Located in this area are the current Rasp Mine administration offices and stores.

The AEMR is distributed to a range of stakeholders that include government authorities and is available on the CBH website at: www.cbhresources.com.au.

2.2 Mine Level

The Rasp Mine is classified as a Level 1 Mine and in 2018 it was transitioned to a State Significant Development under the *EP&A Act* with development consent determined and authorised by the Minister for the Department of Planning and Environment.

2.3 Mine Contacts

Table 2-1 outlines the contacts for the Rasp Mine.

Table 2-1 Mine Contacts

Name	Title	Contact Details
Visko Sulicich	BHOP Director CBH Chief Operating Officer	T: 08 8088 9106 viskosulicich@cbhresources.com.au
Gwen Wilson	CBH Group Manager – Safety Health Environment Community	M: 0431 483 825 gwenwilson@cbhresources.com.au
Giorgio Dall'Armi	BHOP General Manager	T: 08 8088 9102 giorgiodallarmi@cbhresources.com.au
Joel Sulicich	BHOP HSET Manager	T 08 8088 9125 joelsulicich@cbhresources.com.au
Devon Roberts	BHOP Senior Environment and Community Officer	T 08 8088 9126 devonroberts@cbhresources.com.au
Complaints Line	Health, Safety and Environment Office	T: 08 8088 1211

3. APPROVALS, LICENCES AND PERMITS

3.1 Approvals

Table 3-1 provides a list of all current development consents, mining leases and licences held by the Rasp Mine.

Table 3-1 Rasp Mine - Current Approvals

Approval Number	Date Issued	Expiry	Purpose
Project Approval 07_0018 (Part 3A)	31 Jan 2011	31 Dec 2026	Mining production of 750,000 tpa from Western Mineralisation, Centenary Mineralisation and Main Lode Pillars. Construction and operation of minerals processing plant and rail load out facility. Supported by an EAR and PPR. MOD1 – relocation of primary ventilation shaft MOD2 – 24 hour operation of crusher MOD3 – Mining of Block 14 (Zinc & Main Lodes) MOD 4 – Installation of Concrete Batching Plant and Extension to TSF2 MOD5 – Warehouse Extension, Cement Silo and adjustment of air quality monitoriung
CML7	17 Jan 2007	31 Dec 2026	Granted 8 Oct 1987. As per Schedule 2 of the Lease - Open cutting, shaft sinking, stoping, tunnelling, building of dams, extraction and obtaining minerals, generation of electricity, erecting dwellings, storage of fuels, dumping of ore, treatment and dumping of tailing, development of roads
MPL 183	24 Apr 2007	31 Dec 2026	Granted 4 Feb 1981. Dumping of ore and mine residues, treatment of tailing
MPL 184	24 Apr 2007	31 Dec 2026	Granted 4 Feb 1981. Dumping of ore and mine residues, treatment of tailing
MPL 185	24 Apr 2007	31 Dec 2026	Granted 4 Feb 1981. Dumping of ore and mine residues, treatment of tailing
MPL 186	24 Apr 2007	31 Dec 2026	Granted 4 Feb 1981. Dumping of ore and mine residues, treatment of tailing

3.2 Mining Operations Plan

The Rasp Mine has an approved Mining Operations Plan (MOP) currently in place for the period 1 October 2017 to 30 September 2019. The AEMR, as required by the mining leases, incorporates reporting against this MOP.

3.3 Licences / Permits

Table 3-2 presents the licences and/or permits held by BHOP in relation to the Rasp Mine.

Table 3-2 Licences/Permits

Licence / Permit	Issued By	Date of Expiry/ Renewal	Purpose
EPL 12559	EPA	Upon surrender, suspension or revocation.	Authorises the carrying out of scheduled activities: Crushing , grinding or separating >500,000 – 2,000,000T processed. Mining for minerals >500,000 – 2,000,000T produced.
Dangerous Goods Explosives	Work Cover	24 Oct 2022	Store Manufacture
Refrigerant	Refrigerant Trading Council	7 Jan 2019	Use of refrigerant
Water extraction 85WA752823	NOW	29 Mar 2027	To extract 370 ML for use on site or to send to Perilya Broken Hill Operations Pty Ltd.
Radiation #5063802	EPA	26 July 2019	Sell and/or possess radiation apparatus. Sell and/or possess radioactive or items containing radioactive substances.

3.4 Management Plans

The Rasp Mine has developed a number of environmental management plans as required by PA07_0018. **Table 3-3** provides a list of these Plans together with the date last updated.

Table 3-3 Status of Environmental Management Plans

Environmental Management Plan	Condition	Updated
Environment Management Strategy	Sched 4 Cond 1	14-Dec-18
Air Quality Management Plan	Sched 3 Cond 11	15-Feb-19
Community Lead Management Plan	Sched 3 Cond 13	01-Mar-16
Noise and Blast Management Plan:	Sched 3 Cond 20	
- Noise Management Plan		19-Dec-18
- Technical Blasting and Vibration Management Plan		15-Nov-18
Site Water Management Plan	Sched 3 Cond 23	30-Jan-19

4. OPERATIONS SUMMARY

During the 2018 reporting period, the Project Approval was modified to permit the construction of a Cement Silo in the Backfill Plant, construct an extension to the site warehouse (not on CML7), and remove the requirement to monitor emissions at Shaft 6 which after April 2018 became an air intake rather than an exhaust. There were no material changes to the operations at the Rasp Mine. Construction of the concrete batching plant and associated noise bund was completed in August 2018 and the DPE were notified on 24 August 2018. All construction will be undertaken in accordance with stipulated construction hours – 7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday and no Sundays or public holidays.

Table 4-1 outlines the production summary for the reporting period. The information in this table is a result of a review of data inputs for the years 2012 to 2018 and has been amended to improve accuracy. Predictions for the next reporting period are taken from the planned 2019 budget.

Table 4-1 Production Summary – Cumulative

Material	Approved Limit	Start of reporting period	At end of reporting period	End of next reporting period
Waste rock	NA	2,022,973	2,430,418	419,453
Ore	750,000	3,557,083	4,294,551	5,020,521
Processing waste (Tailings)	NA	3,067,234	3,712,062	4,335,518
Product (Concentrates)	NA	410,901	503,541	606,056

4.1 Exploration

4.1.1 Surface exploration

Consistent with the drilling programs proposed in the MOP, the Rasp Mine completed a surface drilling program totalling 28 holes and 6,001.85m across CML7. Targets included a combination of high-grade remnants/extensions of historic workings and lower grade margins to both the 3 Lens and 2 Lens mineralised zones. The drill pads were established at McCulloch's Shaft, BHP Pit, and Blackwoods East.

The program was located on land already disturbed by historic mining and no vegetation was removed. Top soils had already been removed from the area by historic mining activities. The drill pads were installed off existing tracks with minimal earthworks required.

No surface rehabilitation activities were undertaken on CML7 during the reporting period as the drill pads were still operational, although drill holes have been capped.

Passive seismic trials were conducted at Browne's Shaft and BHP Pit areas to determine if these methods could be used to define old workings from potential pillar/remnant materials but the results were generally inconclusive.

In 2019, surface exploration will target the Western Mineralisation, Blackwoods East, Wilsons, British Shear, B Lode and Block 11 – 14.

4.1.2 Underground exploration

During the reporting period, 51,557m of underground diamond drilling was completed:

- Underground Diamond Drilling Western Mineralisation – 178 holes and 41,811.8m
- Underground Diamond Drilling Main Lodes – 70 holes and 9,745.2m

The 2019 program will continue to focus on the Western Mineralisation and Main Lodes 2 Lens and 3 Lens including the Lower Harvey Shaft remnants.

4.2 Construction

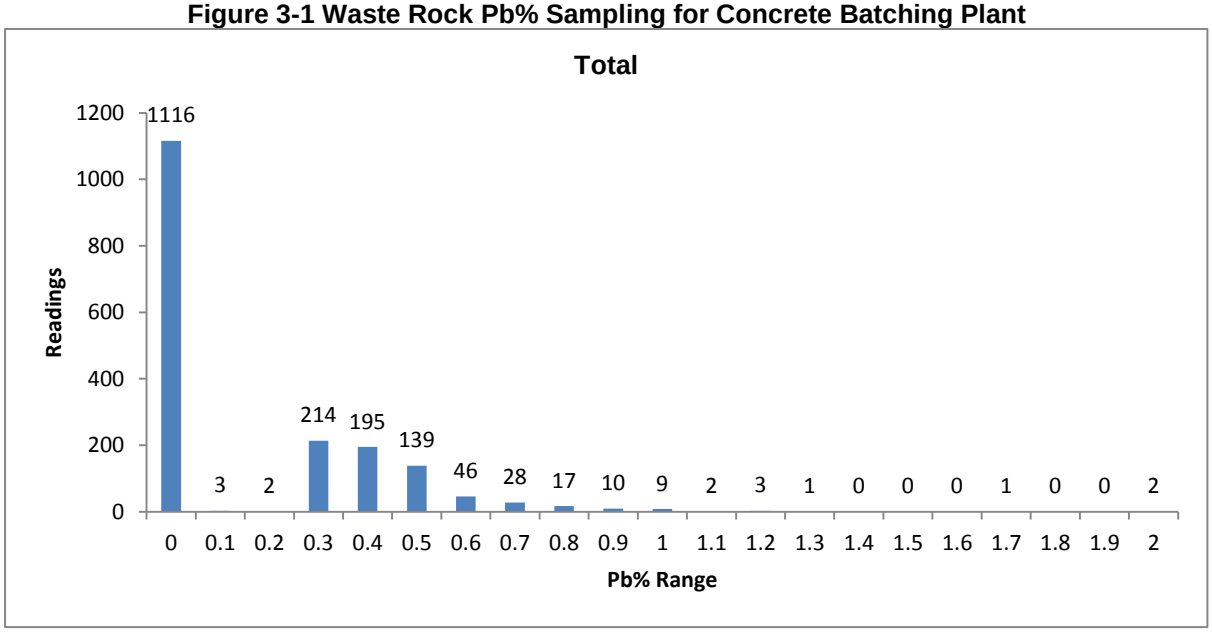
4.2.1 New buildings / structures

The installation and erection of the CBP was undertaken in 2018. A Construction Environment Management Plan was completed in December 2017 outlining environmental protection measures for this project and the Noise Management Plan was updated and approved by the DPE in January 2018.

Land preparation for the construction of the CBP commenced mid-January 2018 and consisted of levelling the area (minor works) and extending the existing noise abatement bund. The surface area for the CBP, material storage, truck delivery and turnaround was levelled using an excavator and grader. Waste rock from Kintore Pit was used to form a base over the proposed area and to form the

extension on the noise bund. The waste rock was tested prior to use to identify material suitable for use in the construction of the embankments that would minimise any increased risk to community health. A procedure for testing waste rock was developed so that the material selected averaged no more than 0.5% lead. Figure 3-1 shows the XRF test results for Pb% of lead in waste rock used in the construction of the condrete batching plant foundations and noise bund wall.

Figure 3-1 Waste Rock Pb% Sampling for Concrete Batching Plant



The noise abatement bund is approximately 6 m in height and extends along the north, east and western sides of the area. The bund acts to reduce noise levels and any visual amenity impacts to the township of Broken Hill. To minimise dust entrainment by wind the waste rock used to construct the noise bund was not crushed and a chemical dust suppressant was applied to the completed surface.

The CBP was completed in August 2018 with the installation of concrete storage bunkers, loading hopper, maintenance workshop and conveyor. Two complaints were made to BHOP on 8 and 23 January concerning noise (reversing beeper) and dust emissions (during tipping of waste rock to noise bund) from the construction of the CBP. Details are provided in **Table 9-1** Complaints register.

4.2.2 Roads and fencing

No new roadways or fencing were constructed during the reporting period. Routine maintenance of roads was undertaken as required. Boundary fencing was also inspected and repaired.

4.3 Mining

4.3.1 Mine access

All mining is undertaken underground accessed via the existing portal located at the northern end of Kintore Pit. Mining activities included mining of the Western Mineralisation, Main Lode Pillars and Zinc Lode (completed July 2018).

Mining activities were undertaken as follows and met the requirements of the Project Approval:

- Underground operations, 24 hours per day, 7 days per week;
- Truck haulage of ore from underground to ROM Pad 24 hours per day, 7 days per week;
- Production rock blasting between 6.45 am to 7.15 pm, 7 days per week;
- Development blasting concurrently with production blasting where practicable;
- Ventilation fans, 24 hours per day, 7 days per week;

4.3.2 Mining method and sequence

A variety of production methods are utilised, including open stoping (OS), uphole benching, room and pillar and uphole pillar retreat mining. OS is the most prevalent method used in the Western Mineralisation, uphole stoping (with room and pillar) and uphole pillar retreat in the Main Lode Pillars.

The ore was blasted using a bulk emulsion explosive and extracted using load haul dump vehicles (LHD's) either conventionally or under remote control and transported to loading points where mine trucks transported ore to the ROM pad.

A total 740,603 t of ore from 53 stopes was mined during the reporting period. This resulted in approximately 16,500 truck movements to the ROM pad. **Table 4-2** lists the stopes mined during the reporting period and **Figure 4-1** (**Plan 3)** provides a long section indicating location of the stopes mined. A vertical distance of 64 m was maintained (in the Zinc Lodes) from South Rd/Bonanza Street.

Figure 4-2 provides a long section for planned stopes in 2019.

Table 4-2 Mined Stopes 2018

Western Mineralisation				
WM 10_217	WM 12_234 DH	WM 16_153 DH	WM 7S_187	WM 9_225
WM 10_214 DH	WM 12_234 UH	WM 16_153 UH	WM 7S_190	WM 9S_229
WM 11_147	WM 15_148	WM 16_165	WM 8_215	WM 9S_232
WM 11_156	WM 16_138N	WM 17_135	WM 8_218	WM 9S_235
WM 11_229 DH	WM 16_141 UH	WM 17_139	WM 8_236	WM 9S_238
WM 11_232 DH	WM 16_143	WM 17_143	WM 9S_255E	WM 5_243
WM 11_236 UH	WM 16_147	WM 17_144	WM 9S_225W	WM 7_249 UH
WM 11_240	WM 16_148 UH	WM 17_146	WM 9S_143	WM 17_165
WM 12_232	WM 16_151 UH	WM 17_147	WM 9S_221	WM 5_219
WM 17_148	WM 17_165	WM 5_219	WM 17_159	WM 9S_203
Zinc Lodes				
Lower Harvey Shaft East Level 2		Lower Harvey Shaft East Level 1		Zinc Lode D Lode 371
Main Lodes				
Main Lode ML 1630_130		Main Lode ML 1630_134		

4.3.3 Void backfilling

Waste rock was used to backfill mined out stopes with a total of 332,702 t placed during the reporting period. The backfill plant did not operate during the reporting period and no tailings were placed underground.

4.3.4 Waste rock and void backfilling

Waste rock is generated from underground mining operations and is predominantly used underground for backfilling stopes and maintenance of underground roads. During the reporting period 452,445 t was extracted as waste, 332,702 t of waste rock was returned underground as void fill, 121,864 t stockpiled in Kintore Pit. At the end of the reporting period the waste stockpile in Kintore Pit held approximately 888,690 t.

Waste rock is also used for road making/repair and noise bunds. When used for these purposes the waste rock is tested to ensure that only material with less than 0.5% lead is used. No roads were installed during the reporting period.

Block modelling is used to identify underground waste material sources. Underground diamond drilling results and assays assist the geological technicians to identify waste materials earmarked for surface.

4.3.5 Underground decline development

The Rasp Decline provides access to stopes for mining. During the reporting period the Decline was extended by 304.6 m providing access to the Western Mineralisation below the 18 Level.

4.3.6 Ore and waste stockpiles

Ore (740,603 t) was transported by truck and stored on the ROM Pad before being processed. The ROM Pad is 32 m by 80 m and is surrounded by 5 m wind breaks. Water application was used to control dust. No more than a week's processing was stored on the ROM stockpile at any one time. Mined ore was below the approved maximum rate of 750,000 tpa. Closing ore stockpiles on the ROM pad at the end of the reporting period totalled 3,135 t.

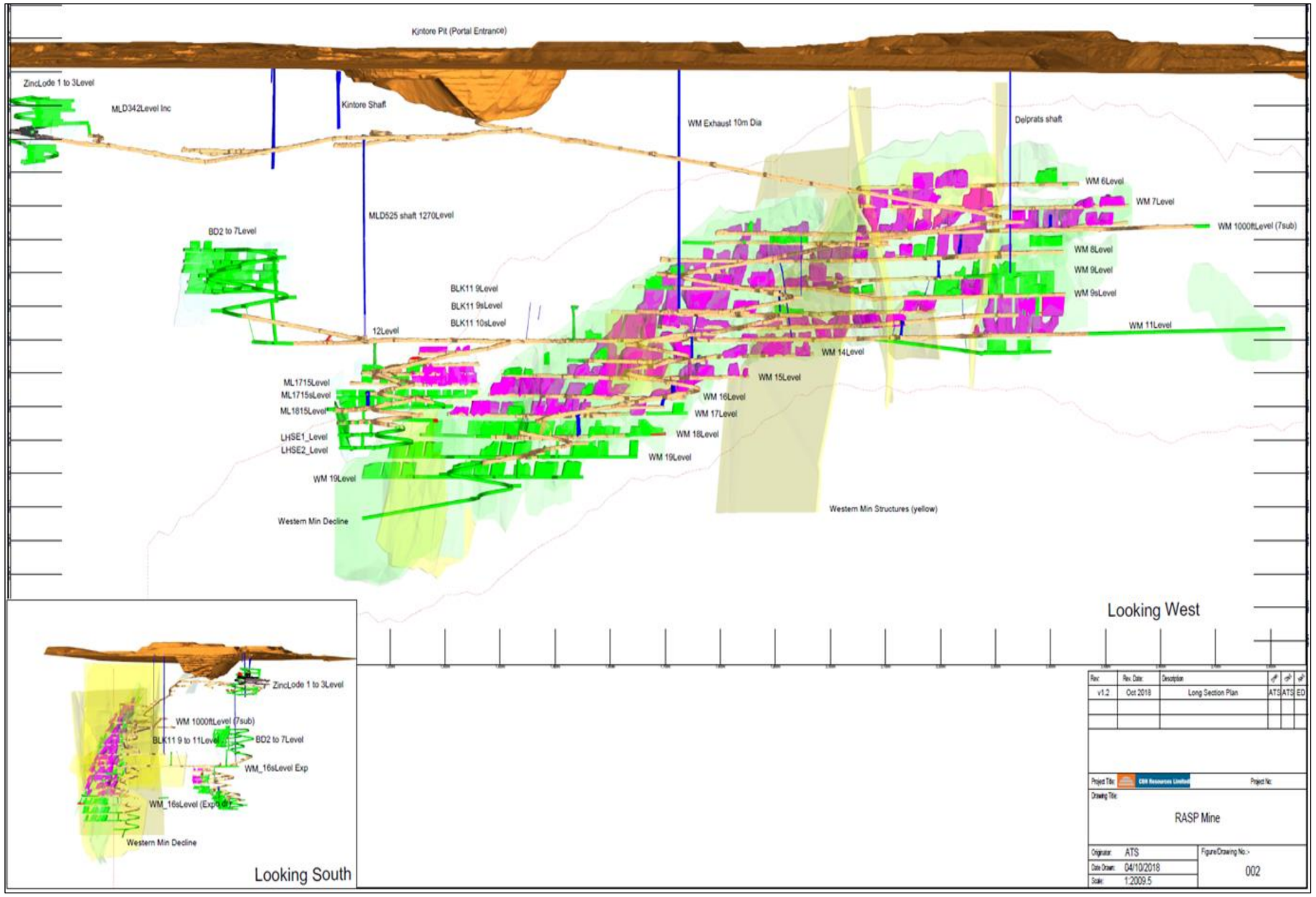
A total of 121,864 t of waste was hauled to the surface from underground during the reporting period and stored in Kintore Pit totalling 888,690 t stored.

Ore and waste production for the reporting period is summarised in **Table 4-3** Ore and Waste Summary for the Reporting Period (2018).

Table 4-3 Ore and Waste Summary for the Reporting Period (2018)

Item	Total Production Tonnes
Topsoil Stripped	N/A
Topsoil Spread	N/A
Ore Tonnes Mined: Dry Tonnes	737,468
Waste Backfill (UG voids): Tonnes	320,715
Waste Trucked to Kintore Pit	86,730

Figure 4-1 Plan 3 Mining Activities in the Reporting Period (2018)



4.4 Mineral Processing

4.4.1 Processing methods and rates

All mined ore is processed on site in the processing plant. This consists of a single stage crushing circuit with a two stage Semi-Autogenous Grind (SAG) – Ball milling circuit capable of processing ore at the required rate and to the required grind size. Material then passes through differential flotation, which incorporates conventional roughing, scavenging and multi-stage cleaning and includes concentrate regrind, to separate lead and zinc concentrates. Concentrates are dewatered using thickeners and pressure filtration. The filtered concentrates are conveyed directly into containers and sealed. The concentrate is stored in these sealed containers in readiness for loading onto rail wagons for transport to the CBH ship loader in Newcastle, NSW or to the Nyrstar Pty Ltd smelter at Port Pirie, SA. Truck movements from filtration to the rail load out during the reporting period totalled approximately 3220. In 2018 all zinc concentrate was sent via rail to the ship loader, and all lead concentrate was sent via rail to the smelter.

Reagents used in the process included pulp pH modifier, flotation frothers, collectors, activators and depressants, used in various combinations in the lead and zinc flotation circuits. Flocculants are used in concentrate and tailing dewatering.

A summary of mineral processing production rates for the reporting period is presented in **Table 4-4.**

Table 4-4 Mineral Processing Summary for the Reporting Period (2018)

Activity	Total 2018 (t)
Milled	737,468
Lead concentrate	32,627
Zinc concentrate	60,013
Tailings deposited	644,828
Tailings Storage Facility (TSF2) storage capacity as at end of period	Jun 2022

4.4.2 Mill operating hours

The processing plant operates 24 hours per day in accordance with the Project Approval. Schedule 3 Condition 16 places a restriction on milling activities - (b) *shunting of concentrate wagons shall only occur between 7:00am and 6:00pm on any day*. No shunting of concentrate wagons occurs during the loading or unloading of concentrate containers. Concentrate trains are moved into and out of the loading area by Pacific National operators as one unit and no reordering of wagons occurs. Pacific National conducts this activity twice per week taking 10 to 15 minutes, following inspection of the connection and state of the wagons. Once loaded, the train departs in the same direction as arrival. During the reporting period there were no community complaints related to this activity.

4.4.3 Mineral waste - tailings

All tailings generated from the processing plant are deposited into Blackwood Pit (TSF2). Tailings from the flotation process are pumped to and deposited at the south-western end of TSF2 via a duty/standby configuration of centrifugal pumps. Particle solids settle out of the slurry stream along the length of TSF2 in a north-easterly direction. Any excess water collects at the northeast end of the facility and is pumped back into the process water tank via a mobile diesel water pump.

During the reporting period, 644,828 t of tailings were pumped to TSF2, on average the tailings contained zinc (0.31%), lead (0.23%) and copper (0.01%), Ag (8g/t), Fe (2.97%).

In the initial Project Approval, BHOP underestimated the amount of mine development that was required to access the Main Lode and Western Mineralisation ore bodies. The need to undertake more underground mining development than anticipated has reduced the capacity of underground voids to accept both waste rock and tailings material from the Backfill Plant. In the original EA, it was predicted that approximately 250,000 t of waste rock would be produced each year for a production rate of 750,000 t of ore. In 2018 with 740,603 t mined, waste rock produced was 452,441 t. BHOP has chosen to place the additional waste rock underground to fill voids and stopes, as it is more economical to dispose waste rock underground if possible rather than transporting waste to the surface. Hence, there is no void space underground for the backfill of tailings.

BHOP also opted to only deposit tailings in TSF2 as this facility had greater capacity and was economically more viable.

Table 4-5 shows past and proposed tailings deposition and waste rock production rates.

Table 4-5 Summary of Proposed (EA) and Actual Placement of Waste Rock and Tailings

Year (to 30 June)	EA Tailings in Underground back fill per year (t)	EA Tailings deposited in TSF1 (t)	EA Tailings deposited in TSF2 (t)	EA Waste Rock U/G (t)	Actual[1]/ Predicted[2] Tailings in TSF2 (t)	Actual waste rock placed underground (t)	Actual waste rock stored Kintore Pit (t)	Actual Total waste rock (t)
2012	97,969	273,281	0	250,000	322,111[1]	47,527	150,000[3]	197,527
2013	195,938	195,138	0	250,000	574,833[1]	230,607	150,000[3]	380,607
2014	195,938	195,138	0	250,000	486,749[1]	223,473	163,304	386,777
2015	216,563	216,563	0	250,000	499,598[1]	223,611	228,942	452,553
2016[1]	247,500	88,281	159,219	250,000	555,837[1]	265,369	96,888	362,257
2017[1]	292,475	0	278,438	250,000	622,161[1]	215,897	76,578	292,475
2018[1]	309,375	0	309,375	250,000	644,828[1]	330,577	121,864	452,441
2019[1]	309,375	0	309,375	250,000	530,000[2]	332,702[2]	86,751[2]	419,453[2]
2020[1]	309,375	0	309,375	250,000	530,000[2]	332,702[2]	132,569[2]	465,271[2]
TOTALS	**2,174,508**	**968,401**	**1,365,782**	**2,250,000**	**4,651,289**	**2.202.465**	**1,206,896**	**3,409,361**

Note[1]: Actual tailings deposited.
Note[2]: Predicted .
Note[3]: Estimated from visual inspection at the time.

4.5 Mining Fleet

There were minor changes to the mining fleet during the reporting period with some trucks and light vehicles replaced and/or scrapped. Four new trucks, four new loaders, and one second-hand loader were purchased in 2018. **Table 4-6** lists the mining fleet as at the end of the reporting period.

Table 4-6 Mining Fleet 2018

Vehicle Category	Number	Vehicle Category	Number
Jumbo drill	3	Grader	1
Production Drill	2	Excavator	1
Haul Truck	5	Service Vehicle	5
Load Haul Dump	5	Wheel Loader	2
Explosive Charger	2	Prime Mover	2
Forklift IT	7	Light Vehicle	30

4.6 Next Reporting Period

4.6.1 Construction

Construction of Stage 1 works for the TSF2 Embankments, the Warehouse Extension and Cement Silo will be undertaken in 2019.

4.6.1.1 Construction of Cement silo and Warehouse Extension

Development Consent (PA07_0018) MOD5 was granted for the Cement Silo and Warehouse Extension was granted in November 2018. The EA and associated studies are available on the CBH website.

4.6.1.2 Construction of the Stage 1 TSF2 Embankment Works

Development consent (PA07_0018) MOD4 was granted to construct three embankments and a retaining wall at low points around the perimeter of the Blackwood Pit TSF (TSF2) in September 2017. The preliminary design was endorsed by the NSW Dam Safety Committee in December 2016. The EA and associated studies are available on the CBH website.

Stage 1 TSF2 Embankment works will be completed in 2019 with construction planned to commence mid-May and be completed in November. These works consist of:

- New access road to Embankment 1
- Starter embankment for Embankment 1
- Construction of Embankment 2 including the associated stormwater collection pond
- Spillway, and
- Water spray system

Construction of Embankments 1 and 3 will be undertaken when the tailings reach the required level and have settled sufficiently for installation.

The embankments will be formed from compacted waste rock excavated during mining operations and currently stored in Kintore Pit. The rockfill would also be used to form a pioneering layer for raise construction on potentially soft tailing. The testing procedure for lead content of the waste rock will be the same as used for the noise bund constructed at the CBP.

The embankments will be lined and seepage collection systems installed. A stormwater collection systems will be designed for each embankment with Embankment 2 stormwater runoff directed to a new stormwater pond to be located to the north of the embankment and rainwater from embankments 1 and 2 directed to the current stormwater management system.

Golder Associates have been engaged to design the extensions to TSF2 and associated infrastructure are currently completing the detailed design. With the completion of the detailed design the Site Water Management Plan and Air Quality Management Plan were updated and submitted to the DPE, EPA and DRG for review and approval.

In 2018, BHOP held discussions with the EPA in regards to an air quality monitoring program for the construction period and operations. BHOP updated the Air Quality Management Plan and Monitoring Program, Noise Management Plan, Site Water Management Plan, and Environmental Management Strategy, with the agreed requirements and they have been submitted to the DPE, EPA and DRG for review and approval. No works will commence for the construction of the embankments until these have been approved by the DPE.

Three portable PM10 monitors will be purchased in 2019, with two to be placed at the western and northern side of TSF2 and one held as a spare. The northern PM10 monitor will be installed in Proprietary Square in place of the TEOM, High Volume Air Samplers and Dust Gauge currently situated at Blackwoods Pit which are required to be removed during the construction of Embankment 2. When the Blackwood Pit monitoring equipment is re-installed following the Embankment 2 construction, the PM10 at Proprietary Square will be moved to the TSF2 ramp to monitor in-pit dust levels. Video cameras will also be installed on the Mill Control Room and overlooking TSF2 before the embankment works start as a means of monitoring and recording dust generation.

4.6.2 Exploration

In 2019, surface exploration will target the Western Mineralisation, Blackwoods East, and McBryde's.

The Underground program will continue to focus on the Western Mineralisation and Main Lodes 2 Lens and 3 Lens including the Lower Harvey Shaft remnants.

4.6.3 Operations

Table 4-7 outlines the planned production rates for 2019**. Plan 3** (**Figure 4-2**) shows the mining areas and stopes. Planned mine production is 725,970 t, tailings deposition is estimated at 623,884 t. It is also planned to commission the Backfill Plant in late 2019 which will result in future tailings placement in underground voids.

There are plans to replace the Jumbos, Grader and six Light Vehicles in 2019.

Table 4-7 Summary of Planned Production for 2019

Activity	January to December 2019 (t)
Ore Mined	725,970
Waste Backfill (UG Rock Places)	332,702
Waste Trucked to Surface	86,751
Milled	725,970
Lead concentrate	31,631
Zinc concentrate	70,884
Tailings deposited	623,884
TSF2 storage capacity as at end of period	2.5 years (with approved embankments)

4.6.4 Water structures - maintenance

Surveying of the water storage structures were conducted in 2018 and the development of staged storage curves enabling more accurate capacities and volumes to be determined will be completed in early 2019.

Inspections of storages for sediment build-up were conducted in 2018 and sediment removal is planned for winter of 2019 when there is less likely to be windy days, and before the Spring windy season and arrival of Spring and Summer rains.

4.6.5 Modification applications

In 2019, BHOP will apply for modification (MOD6) of the project approval to deposit tailings into Kintore Pit, relocate the mine portal, and provide for future waste rock storage.

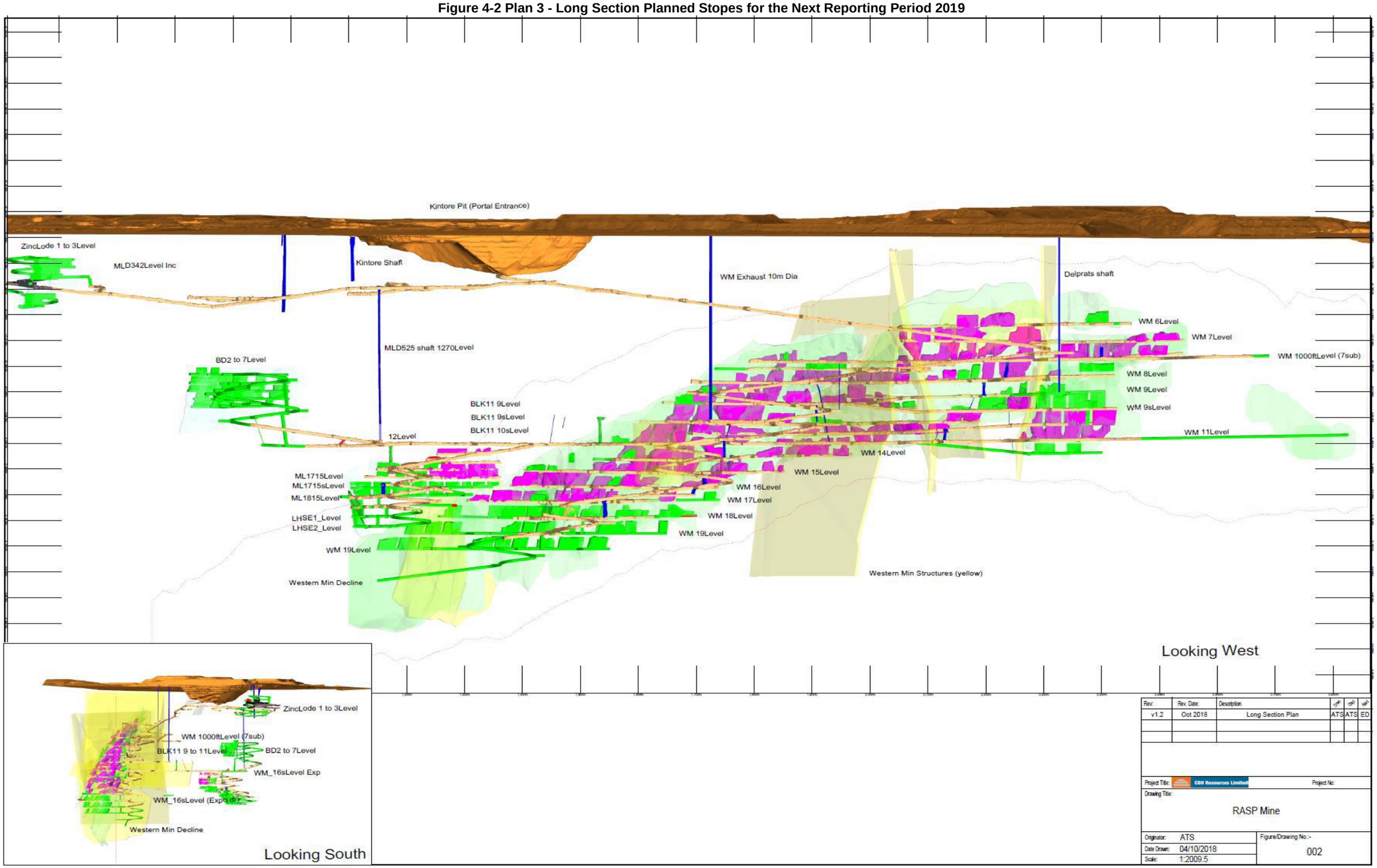
At current tailing deposition and following installation of the TSF2 embankments, the life of this facility will be completed in early 2022. In MOD4 it was identified that under current volumes storage capacity within TSF2 would cease in mid-2021. Actual experience has indicated that the tailing is settling with a higher density, increasing the maximum volume for deposition and this, together with new survey data, has extended the life of the facility to early 2022.

In the original Environment Assessment (EA) for the Project it was planned for tailing to be placed both in an above ground tailing storage facility and underground, via the Backfill Plant, to fill mining voids. The tailing waste stream from ore processing has been approved to be deposited in the historic tailing facility (TSF1) and in the disused Blackwood Pit (TSF2). BHOP chose to deposit tailing in TSF2 and not use TSF1. This decision was based on the greater capacity of TSF2 (3.1 Mt) compared to the capacity of TSF1 (970,000 t).

In the initial EA BHOP underestimated the amount of mine development that was required to access the Main Lode and Western Mineralisation ore bodies. The need to undertake more underground mining development has impacted the amount of waste generated. In the original EA it was predicted that approximately 250,000 t of waste rock would be produced each year for a production rate of 750,000 t of ore. Actual total waste rock produced has averaged 361,000 t per year since commencement of operations peaking in 2015 and 2018 with 452,000 t. BHOP has chosen to place the additional waste rock underground to fill voids and stopes, as it is more economic to dispose of waste rock underground where possible rather than transporting waste to the surface. Thus there has been no requirement to fill any underground void with tailings. **Table 4-5** summarises tailing and waste rock placement as predicted in the original EA (at a production rate of 750,000 t) and what has actually been placed since commencement of operations.

Meetings have been held with the relevant regulators to discuss the proposed modification - Department of Planning and Environment (DPE), the Broken Hill City Council (BHCC), Division of Resources and Geoscience (DRG) and the Environment Protection Authority (EPA).

Figure 4-2 Plan 3 - Long Section Planned Stopes for the Next Reporting Period 2019



5. ACTIONS REQURIED FROM PREVIOUS AEMR/ANNUAL REVIEW

Table 5-1 Actions from the previous AEMR/Annual Review

Action required from previous Annual Review	Requested By	Action taken by the Operator	Where discussed in Annual Review
Identify where waste rock sourced and the lead levels measured. 4.3.4	DPE – Resources Regulator	Waste profiling	4.3.4
Where limits for Lead are not applied and not existent determine an appropriate limit to compare results to 6.2	DPE – Resources Regulator	Reference made to predicted levels from EA	6.3.2
When discussing result for High Volume Air Samplers comment on the maximum and minimum results measured.6.3.3	DPE – Resources Regulator	Maximum and Minimum results discussed	6.3.3
Despite the hold-up with the Line-of-Lode interagency discussions BHOP still need to conduct a gap analysis and rehab trials need to be conducted.	DPE – Resources Regulator	Options Analysis being conducted	6.17.1

BHOP received a notification of a satisfactory AEMR (2017) from the DPE – Resources Regulator on 15 June 2018 and from DPE – Compliance on 19 September 2018. During the Resources Regulator site inspection of 1 May 2018 and AEMR Site Visit of 7 September 2018 the need to develop a robust methodology for testing waste rock using hand-held XRF was discussed. BHOP have conducted further field testing of waste rock and surface soils samples using a hand-held XRF device and are conducting an analysis of the XRF accuracy with lab analyses of the tested samples.

A Rehabilitation Options Analysis was also expected to be conducted by the DPE – Resources Regulator and consultants were engaged to conduct an Options Analysis in Quarter 4, 2018. The draft report is expected early in Quarter 1, 2019 and will include a revegetation assessment (with a review of previous revegetation programs) and recommendations for rehabilitation trials.

It was also requested that the source of waste rock and contained lead levels were identified, a limit for Lead developed for comparison of air monitoring results, and the minimum and maximum results for High Volume Air Samplers were discussed.

6. ENVIRONMENTAL MANAGEMENT AND PERFORMANCE

6.1 Meteorological

Figure 6-1 and

Table 6-1 provide summary weather data. This data is a combination of information from the Rasp Mine weather station and the Bureau of Meteorology station (for rain days and rainfall).

While temperatures in 2018 remained consistent with historical records, rainfall (92.2 mm) for the period was significantly lower than the BoM's long-term annual average of 259 mm. There were only 35 rain days for the period with most rain falling in spring (62.2 mm). Winds were predominantly from the south with high winds experienced during July to December.

Figure 6-1 Weather Data for the Reporting Period (2018)

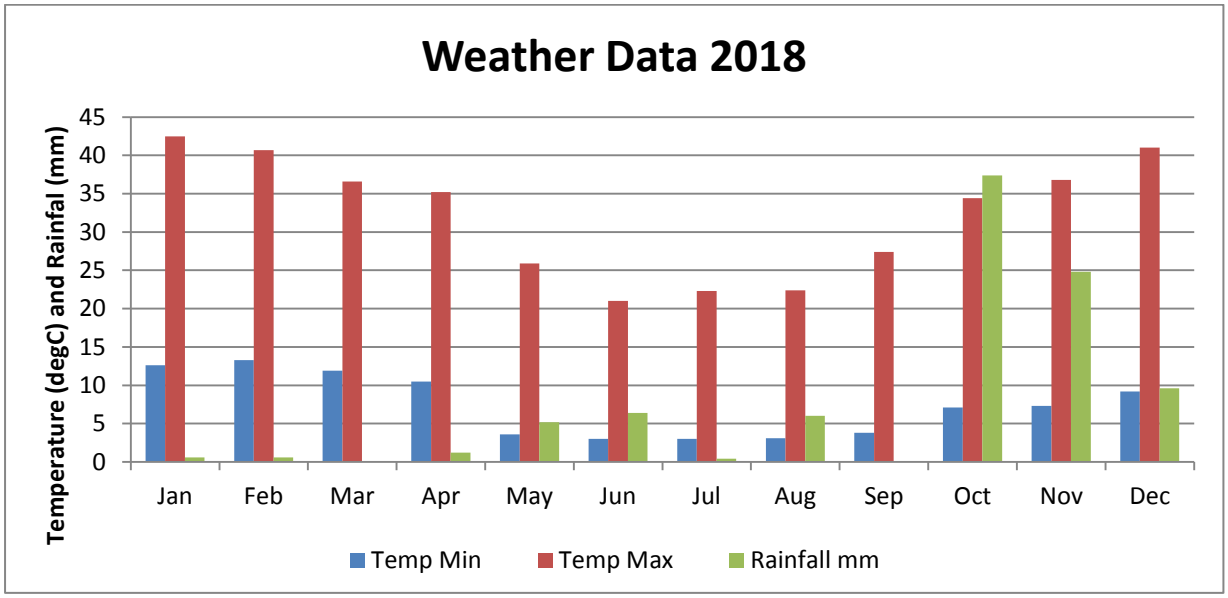


Table 6-1 Summary of Wind and Rain Days in Reporting Period (2018)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Predominant Wind Direction	S	S	S	S	S	S	N	N	S	S	S	S
Max wind speed (km/hr)	60	62	49	54	59	48	63	72	58	62	70	64
Days rained in month	5	2	0	1	2	5	1	3	0	5	8	3

6.2 Environmental Monitoring Locations

The BHOP site environmental monitoring program is summarised in **Table 6.2**, locations for sampling/monitoring points are shown in **Figure 6.2**. Shaft 6 was removed as an air quality monitoring location in MOD5, approved in November 2018, as Shaft 6 became an air intake point in April 2018. In April, blast monitor V4 at 123 Eyre St was removed at the residents request and placed at the Eyre St Bowls Club. The site weather station is due for replacement in early 2019 as the current weather station cannot calculate Sigma Theta, a requirement of EPL 12559.

Table 6-2 Summary of BHOP Environmental Monitoring Program

EPA ID	BHOP ID	Parameter	Frequency
AIR QUALITY			
1 & 56	Primary Vent Shaft and Shaft 6	- Oxides of Nitrogen (as NO_2) -Total solid particles (TSP) - Volatile organic compounds - Sb, As, Cd, Pb, Hg, Be, Cr, Co, Mn, Ni, Se, V	Quarterly (at blasting event)
2	Crusher Baghouse Stack	- Total solid particles (TSP) - Total - Sb, As, Cd, Pb, Hg, Be, Cr, Co, Mn, Ni, Se, V	Quarterly
3 - 9	D1 – D7	Insoluble solids, Lead	Monthly
10	TSP-HVAS	Total Suspended Particulate, Lead on filter paper	Every 6 days
11 & 12[1]	HVAS1 & 2	PM10, Lead on filter paper	Every 6 days
13 & 14	TEOM 1 & 2	PM10, Wind Speed/Direction	Continuous
SURFACE WATER			
29 - 36	S31-1, 44, 49, 1A, 9B-2, Horwood Dam, Upstream and Downstream	pH, EC, TDS, SO4, Cl, Na, Cd, Pb, Mn, Zn	When contain water (at least 2 per 12 mths) April & October
GROUNDWATER			
37 - 52	GW01 – GW16	pH, EC, TDS, SO4, Cl, Ca, Mg, Na, Fe, Cd, Pb, Mn, Zn	Quarterly
53 & 54	Shaft 7 & Kintore Pit extraction	pH, EC, TDS, SO4, Cl, Ca, Mg, Na, Fe, Cd, Pb, Mn, Zn	Quarterly
NOISE & BLASTING VIBRATION			
15 - 28	A1 – A14	Leq, 15min/Day Leq, 15min/Evening Leq, 15min/Night	Annually
V1 – V5	V1 – V5	dB mm/ second	Continuous (when blasting)
-	V6	dB mm/ second	Continuous (when blasting)
-			
WEATHER			
55	Meteorological Station	Temperature, wind speed & direction, rainfall	Continuous (15 minute intervals)

Note 1 = EPL 12559 lists TSP and TSP Lead to be sampling from these units, however, these units can only monitor one type of parameter. BHOP are in discussion with the EPA to resolve this.

The following sections provide a summary of these monitoring requirements together with the results for the reporting period. A discussion of any identified trends and a comparison with predictions in the original EA/PPR are also provided where available.

6.3 Air Quality

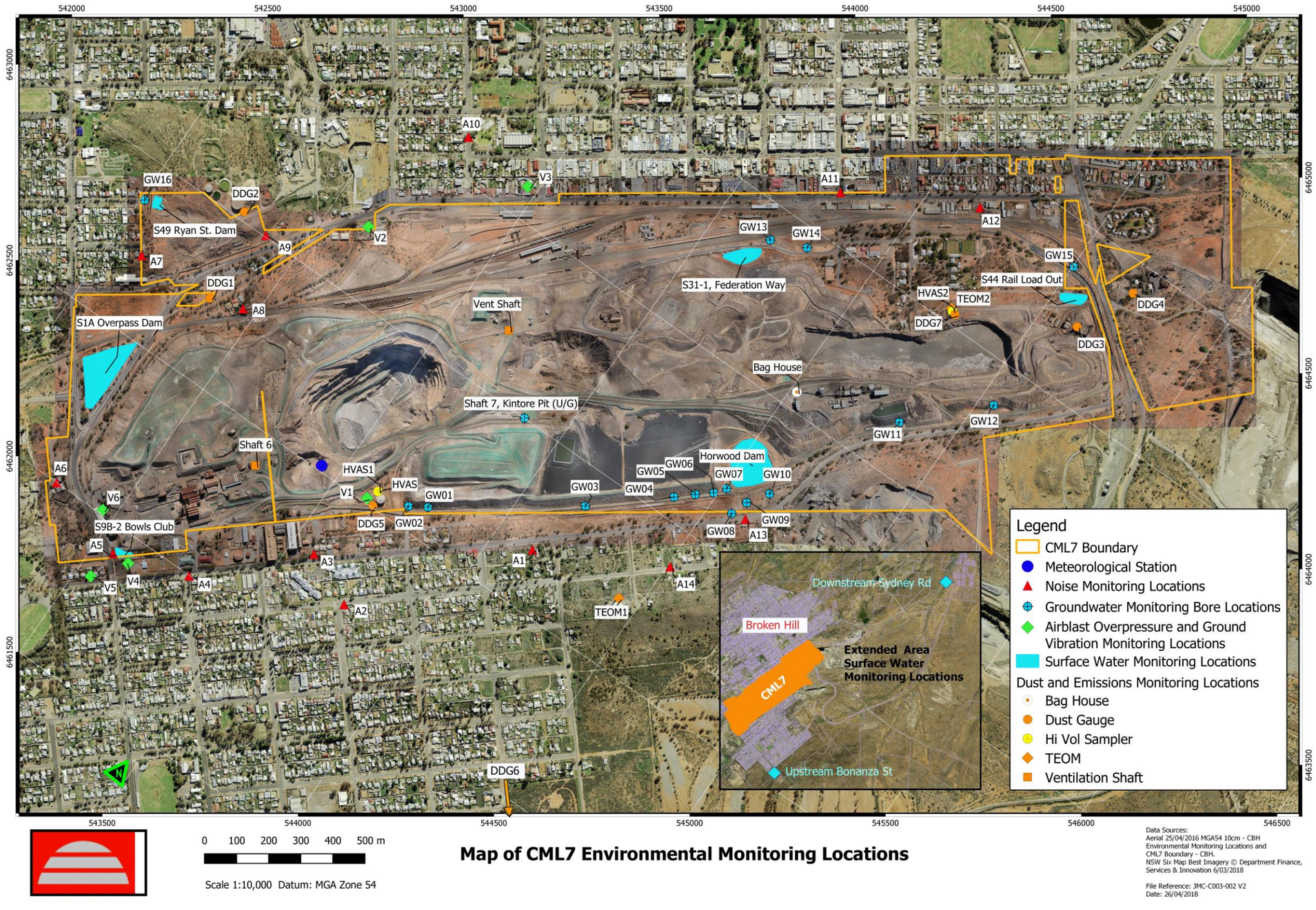
In accordance with the conditions of PA07_0018 and EPL12259 air quality is monitored:

- Air emissions from in-stack mine exhaust ventilation and the crusher baghouse are tested quarterly by an external contractor with specialised equipment;
- Ambient air quality is monitored by BHOP personnel via a combination of dust deposition gauges, high volumes air samplers (HVAS) and tapered element oscillating microbalance (TEOM) sampling units; and

Real-time information is downloaded and alerts automatically forwarded to assist in the day-to-day operational management of issues as well as long-term analysis of environmental data.

Figure 6-2 shows the sampling locations for all air quality monitoring units.

Figure 6-2 Location of Monitoring / Sampling Points



6.3.1 In-stack air quality

During the reporting period BHOP engaged Assured Monitoring Group (AMG) to conduct testing of the mine ventilation exhaust points and the crusher baghouse. Testing was performed each quarter in accordance with the EPL. AMG are NATA accredited to perform this testing. The EPL Condition L2.1 specifies the in-stack performance criteria for the two ventilation exhaust units - Primary Ventilation Shaft and Shaft 6 and the Crusher Baghouse. **Table 6-3** provides the results of the testing against the limits as set out in the EPL. All limits were met. Shaft 6 became an air intake in April 2018 but monitoring of emissions continued to the end of 2018. TSP results for the crusher baghouse in December 2018 were high but this was due to the friable Lower Harvey Shaft East material being fed through the crusher at the time. The baghouse was inspected and the bags were determined to be in good condition. The EPA received a complaint in 2018 regarding the dust emanating from the Primary (Main) Vent. While sprays in the mouth of the Primary Vent are operated following blast, dust is still emitted from the vent and can be carried off the site. BHOP engaged the services of a ventilation specialist to review the effectiveness of the spray system and recommend alternative control measures if needed.

Table 6-3 Vent and Baghouse Testing Results During the Reporting Period

	Limit	Primary Vent (EPL1)				Vent Shaft 6 (EPL 56)				Crusher Baghouse (EPL2)			
Testing Date (2018)		14/3	5/6	11/9	11/12	14/3	6/6	12/9	11/12	14/3	6/6	12/9	11/12
Nitrogen Oxides (mg/m^3)	350	5.15	4.19	2.91	6.76	<2.05	<2.05	<2.05	<2.05	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Volatile Organic Compounds (mg/m^3)	40	<0.49	<0.471	<0.475	<0.96	<0.425	<0.473	<0.475	<0.978	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Total Suspended Particles (mg/m^3)	20	2.11	1.99	7.85	6.66	0.604	5.37	0.244	5.14	10	4.71	13.8	19.8
Type 1 and Type 2[2] (mg/m^3)	1	0.009	0.023	0.142	0.191	0.069	0.039	0.022	0.066	0.385	0.161	0.328	0.831

Note 1 = Not required to be tested.
Note 2 = Type 1 substance Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. Type 2 substance Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements.

Air Quality Management Plan BHO-PLN-ENV-001 lists the controls that were in place during the reporting period. In summary, the major controls include:

- Automatic watering sprays on the ventilation shafts; and
- Fully enclosed primary crusher operating under negative pressure to a baghouse.

6.3.2 Dust deposition gauges

Dust deposition levels refer to the quantity of dust particles that settle out from the air as measured in grams per square metre per month (g/m^2/month) at a particular location. Total fallout dust (depositional dust) is continuously monitored from seven deposition gauges located on and around the Rasp Mine, as shown in **Figure 6-2**. D1 and D6 are located off-site, D1 near the St Johns training facility north of the Rasp Mine and D6 in Casuarina Avenue south of the Rasp Mine. D2 to D5 and D7 are located on the Mine lease in various locations.

Samples are collected monthly and are sent to ALS Laboratory (NATA accredited) in Newcastle and analysed for total deposited dust and deposited lead dust. Deposited dust is assessed as insoluble solids as defined by Standards Australia, 2003, AS 3580.10.1-2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method.

Dust deposition criteria are provided in terms of both an acceptable increase in dust deposition over the existing background levels and an absolute maximum value. These impact assessment criteria are summarised in **Table 6-4.**

Table 6-4 Dust Deposition Criteria

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

Provided below is a discussion of results for dust deposition during the reporting period (2018) and trends over the operational life of the Rasp Mine. Dust deposition results are reported and reviewed internally on a monthly basis.

Figure 6-3 and **Figure 6-4** show the monthly dust deposition and total deposited lead results for the reporting period. Dust deposition results are higher for all gauges in 2018 when compared to the previous year. This may be the result of significantly lower rainfall (92.2 mm) than the BOM's long-term average of 259 mm, and less rainfall than the previous year (108 mm). The average for D3-Thompson's Shaft is higher in 2018 but this is due to an unusually high result of 16.75 g/m^2/month in July 2018.

There were twenty occasions where the monitoring location exceeded the depositional dust level of 4 g/m^2/month limit (red figures in **Table 6-5**) compared to six the previous year. All occurred in the spring and summer months when wind speeds are higher and dust storms more frequent despite the majority of the year's rainfall occurring in those months. D6-Casuarina Avenue recorded more monthly results above the 4 g/m^2/month limit than any other location.

No monitoring locations exceeded the site contribution of 2 g/m$^{2/}$month for depositional dust above background. Gauges D2, D4, and D6 recorded levels greater than 2 g/m$^{2/}$month over background levels but these were due to general dust storms in the Broken Hill area in the months of October, November, and December, as lead levels were not correspondingly higher.

Table 6-5 Dust Deposition Results for the Reporting Period (g/m$^{2/}$month)

	D1 EPL3 (off site)		D2 EPL4		D3 EPL5		D4 EPL6		D5 EPL7		D6 EPL8 (off site)		D7 EPL9	
2018	DD	LD	DD	LD	DD	LD	DD	LD	DD	LD	DD	LD	DD	LD
Jan	1.75	0.001	1.64	0.001	0.96	0.002	6.22	0.002	0.85	0.002	3.17	0.007	4.98	0.006
Feb	0.91	0.002	0.79	0.002	1.30	0.004	3.23	0.007	1.53	0.005	2.66	0.001	1.70	0.007
Mar	1.00	0.003	0.50	0.001	0.80	0.001	1.90	0.008	1.70	0.005	2.00	0.002	1.40	0.009
Apr	1.30	0.005	1.30	0.002	1.40	0.008	2.60	0.012	1.50	0.010	3.00	0.003	1.70	0.011
May	0.40	0.002	0.20	0.001	0.90	0.005	2.30	0.015	0.80	0.005	1.30	0.002	1.60	0.011
Jun	1.40	0.002	0.20	0.001	0.60	0.006	0.60	0.003	0.90	0.005	0.80	0.001	0.40	0.003
Jul	1.20	0.000	0.70	0.000	0.70	0.005	2.00	0.001	3.60	0.006	2.30	0.000	1.00	0.000
Aug	1.60	0.003	0.70	0.001	1.40	0.016	3.30	0.017	3.90	0.017	6.40	0.007	1.50	0.010
Sep	1.20	0.003	1.00	0.001	1.30	0.008	3.30	0.012	1.60	0.006	4.90	0.004	1.80	0.011
Oct	5.10	0.004	3.80	0.000	3.50	0.016	8.20	0.011	5.40	0.012	9.50	0.004	4.60	0.014
Nov	5.30	0.001	7.90	0.002	5.80	0.011	9.10	0.015	9.50	0.006	11.20	0.000	5.80	0.008
Dec	3.7	0.001	2.2	0.001	2.8	0.005	8.9	0.020	4.8	0.008	8.5	0.004	4.00	0.021
2010	**4.0**	**0.0034**	**3.1**	**0.005**	**4.3**	**0.005**	**5.7**	**0.006**	**N/A[1]**	**N/A[1]**	**5.8**	**0.004**	**N/A[1]**	**N/A[1]**

Note 1 = Background is not available for these locations.

Figure 6-3 Monthly Total Deposited Dust for 2018

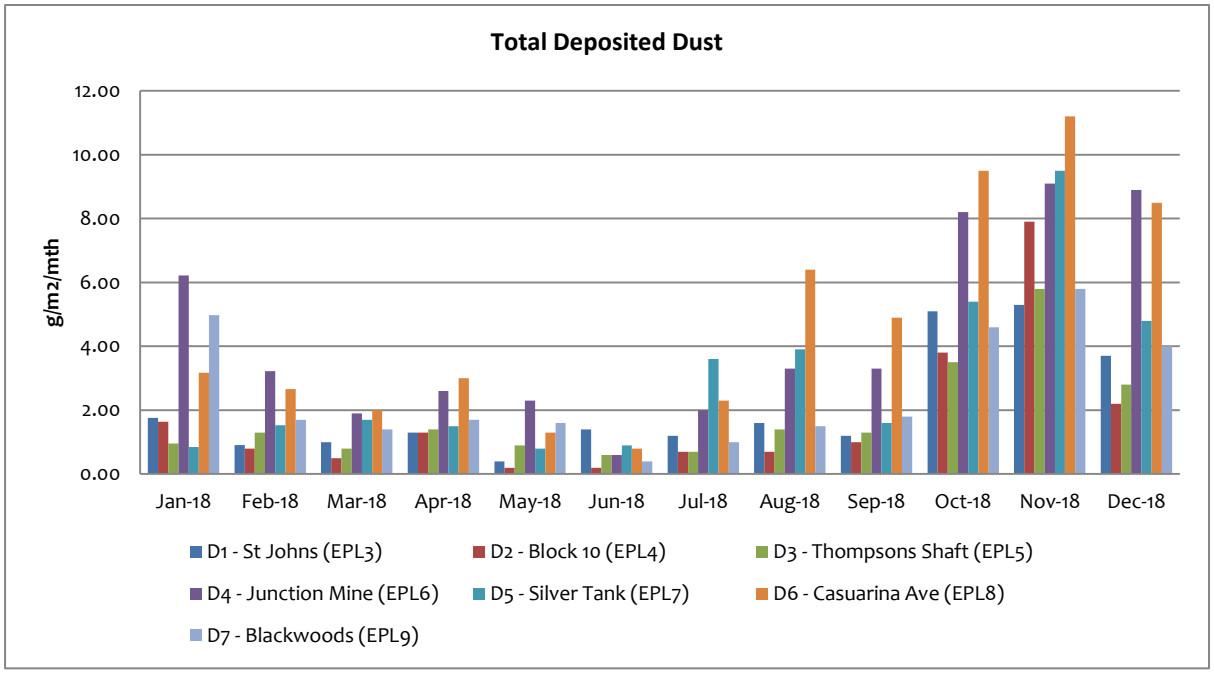


Figure 6-4 Monthly Lead Deposition for 2018

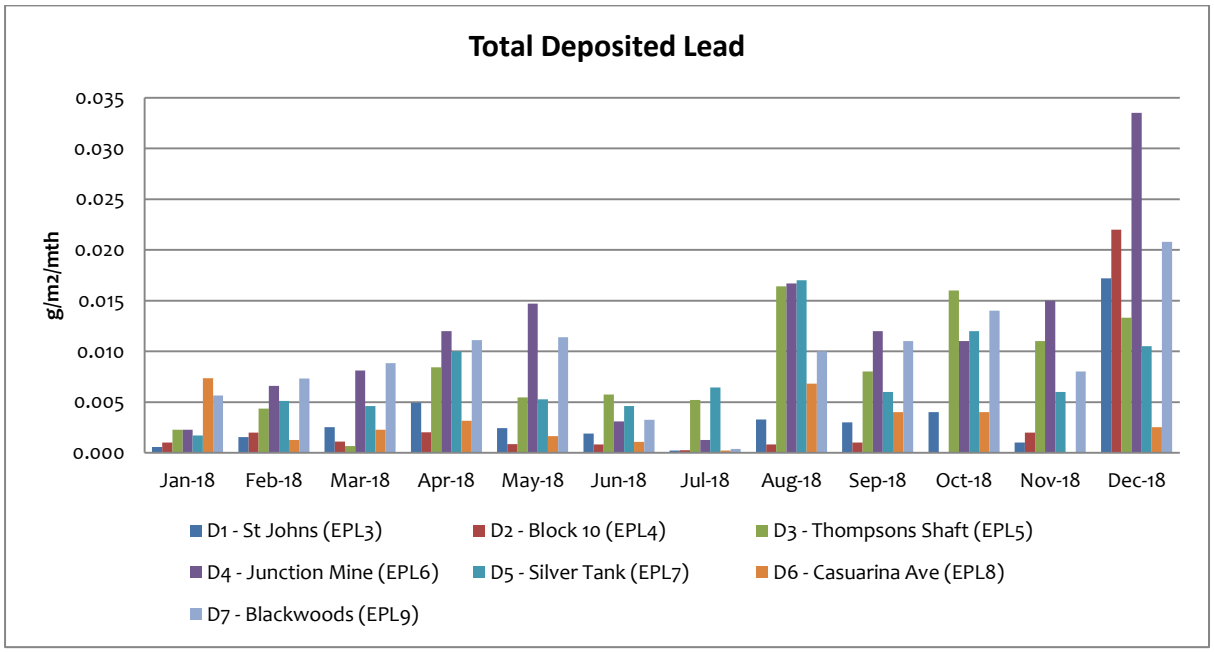


Figure 6-5 Total Deposited Dust 2007 – 2018

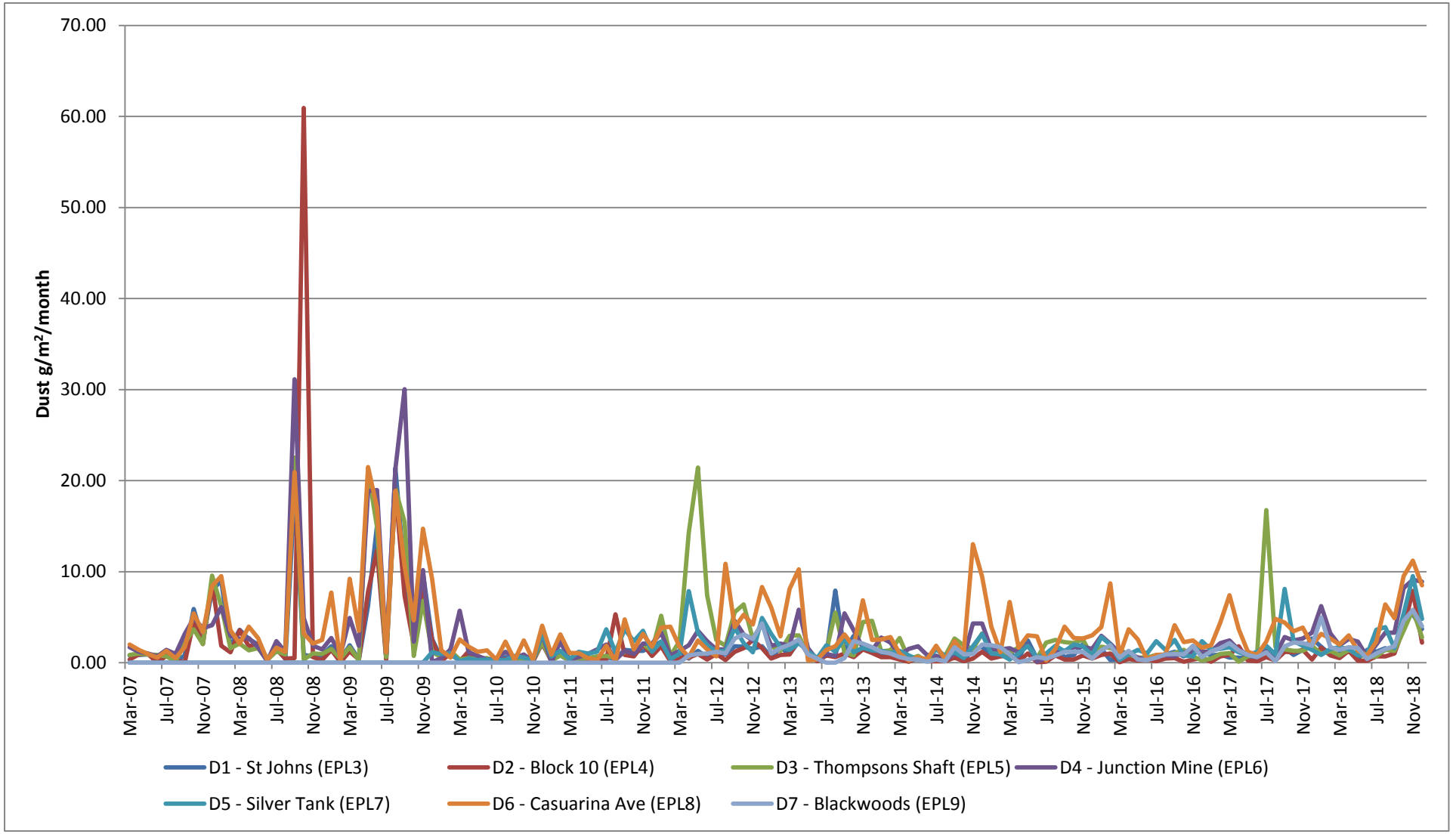
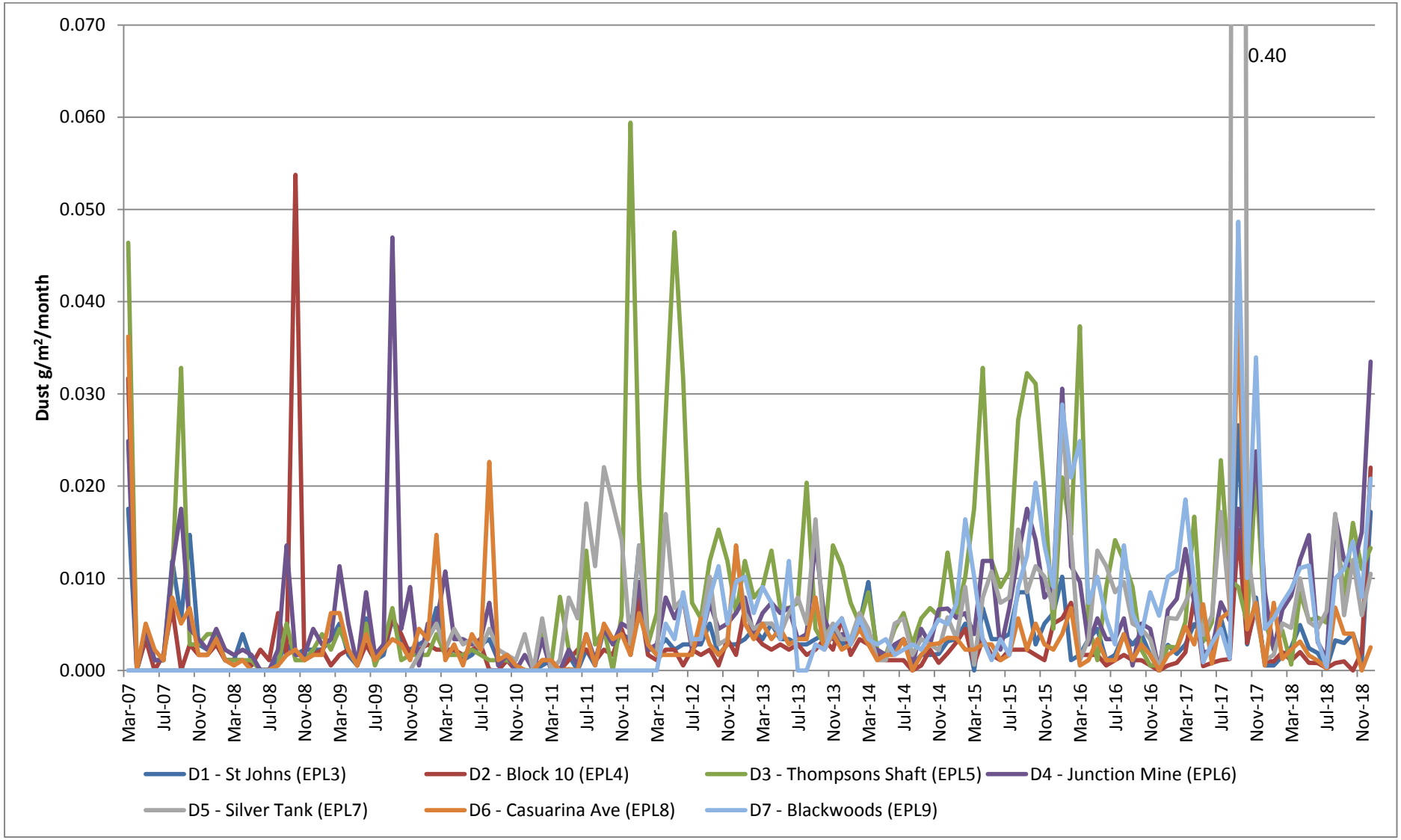


Figure 6-6 Total Deposited Lead 2007 to 2018



6.3.3 High volume air samplers

There are three high volume air samplers used to measure ambient air quality at the Rasp Mine – HVAS (EPL10) and HVAS1 (EPL11) are located at the Silver Tank, central and to the south of the mine lease, and HVAS2 (EPL12) is located adjacent to and north of Blackwood Pit. Locations are shown in **Figure 6-2**. HVAS samples for total suspended particulates (TSP) and lead dust, and HVAS1 and HVAS2 sample for particulate matter less than 10 microns (PM_{10}) and lead dust.

Samples are collected every six days and are sent to ALS Laboratory (NATA accredited) in Newcastle. **Table 6-6** outlines the impact assessment criteria as listed in PA07_0018.

In accordance with the PA07_0018 and the EPA air quality guidelines, from September 2017, the criteria for annual rolling average for PM_{10} criterion was reduced from 30 $\mu g/m^3$ to 25 $\mu g/m^3$. All other air quality criterion remain unchanged.

Table 6-6 Impact Assessment Criteria

Pollutant	Averaging Period	Criterion
Total suspended particulate (TSP) matter	Annual	90 $\mu g/m^3$
Particulate matter < 10 µm (PM_{10})	Annual	25 $\mu g/m^3$
Particulate matter < 10 µm (PM_{10})	24 hour	50 $\mu g/m^3$

Note: Criteria changed from 30 $\mu g/m^3$ to 25 $\mu g/m^3$ in September 2017

Provided below is a discussion of results for each HVAS unit during the reporting period (2018) and trends over the operational life of the Rasp Mine. HVAS unit results are reported and reviewed internally on a monthly basis.

There were two incidences of non-compliance for HVAS operations in 2018.

Between 23 February and 30 April, the TSP HVAS at EPL Monitoring Point 10 did not monitor due to a "blocked filter" error that was likely due to the variation in flowrates of the unit. The unit was serviced on 19 April but still encountered operating issues over the next two monitoring events.

The filter papers collected from the HVAS units (EPL Monitoring Points 10, 11, and 12) after the 30 May monitoring event were lost in transit. Australia Post have records of the samples being delivered to the laboratory but the laboratory could not find them. After this event, BHOP used Registered Post to send filter papers to the laboratory.

HVAS (EPL10)

TSP and TSP-lead results for 2018 recorded by HVAS are shown in **Figure 6-7** and **Figure 6-8.** These show the results have remained consistent over the reporting period.

The rolling annual average TSP at the HVAS unit recorded 62.89 $\mu g/m^3$ for the reporting period was, a significant increase over the previous period rolling annual average of 36.81$\mu g/m^3$. The result is higher than the background annual average of 56.4$\mu g/m^3$ but lower than the criteria of 90$\mu g/m^3$. Drought conditions and frequent dust storms in Spring and Summer are responsible for the high dust levels.

As shown in the figures below, with the onset of warmer weather and high winds there is an increase in the TSP and TSP-Lead recorded. The rolling annual average TSP-lead at the HVAS unit has increased to 0.28 $\mu g/m^3$ from 0.18 $\mu g/m^3$ in the 2017 reporting period and 0.23 $\mu g/m^3$ in the 2016 reporting period. The Rasp Mine PA07_0018 does not stipulate any criteria for lead, however the recorded annual average of TSP-lead remains below the NSW EPA guideline of 0.50 $\mu g/m^3$.

The highest TSP levels recorded were on 17 July (274 $\mu g/m^3$), 15 October (236 $\mu g/m^3$), and 8 December (274 $\mu g/m^3$). Winds were predominantly from the NE (55 km/hr), North (62 km/hr) and NNE

(37 km/hr), respectively. High dust levels were also recorded on PM10 High Volume Air Samplers and TEOM units on these days indicating it was likely due to regional dust storms.

The highest TSP-Lead levels were on 17 July (1.02 μg/m^3), 15 September (1.1 μg/m^3), and 8 December (1.18 μg/m^3). Winds were predominantly from the NE (55 km/hr), SW (57 km/hr) and NNE (37 km/hr), respectively. While the readings of 17 July and 8 December may have had Lead contributed from site, there may have also been Lead contributed from other locations as all high volume air samplers recorded elevated Lead levels on that day.

Figure 6-9 provides a summary of TSP and TSP-lead results from 2008 to 2018. Results for TSP are well below the EPA threshold of 90 μg/m^3 and 0.5 μg/m^3 for TSP-lead.

Figure 6-7 HVAS TSP Results for the Reporting Period (2018)

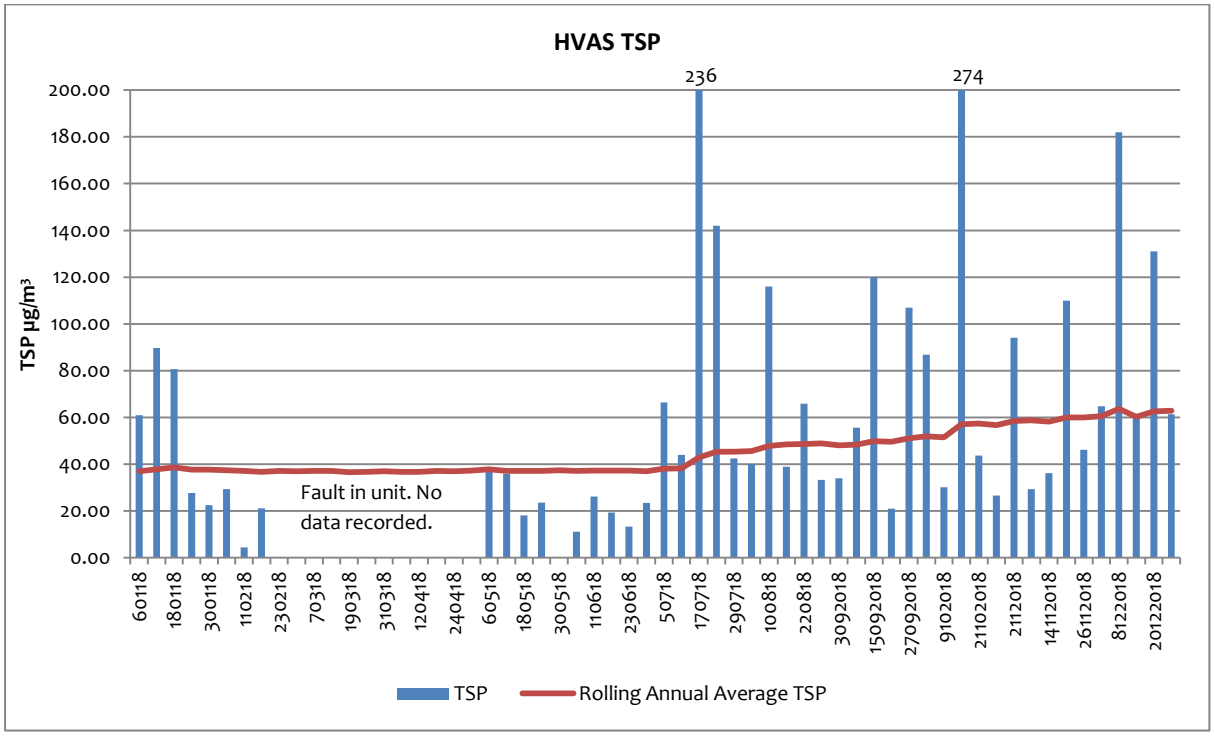
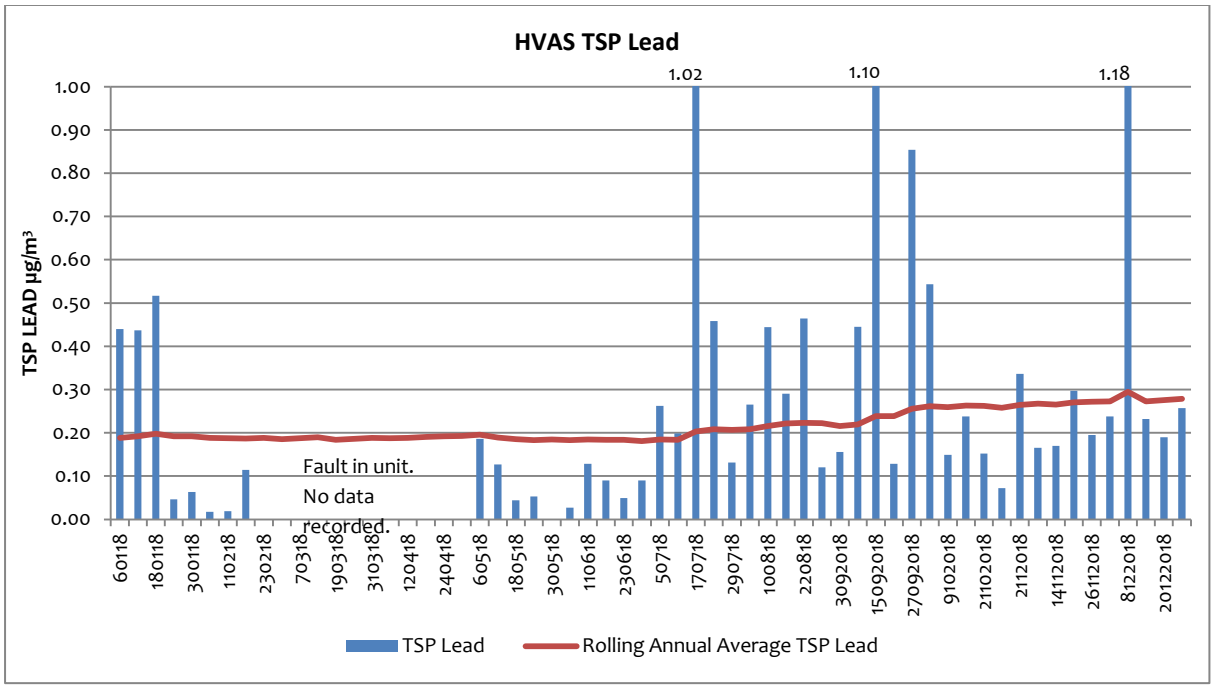


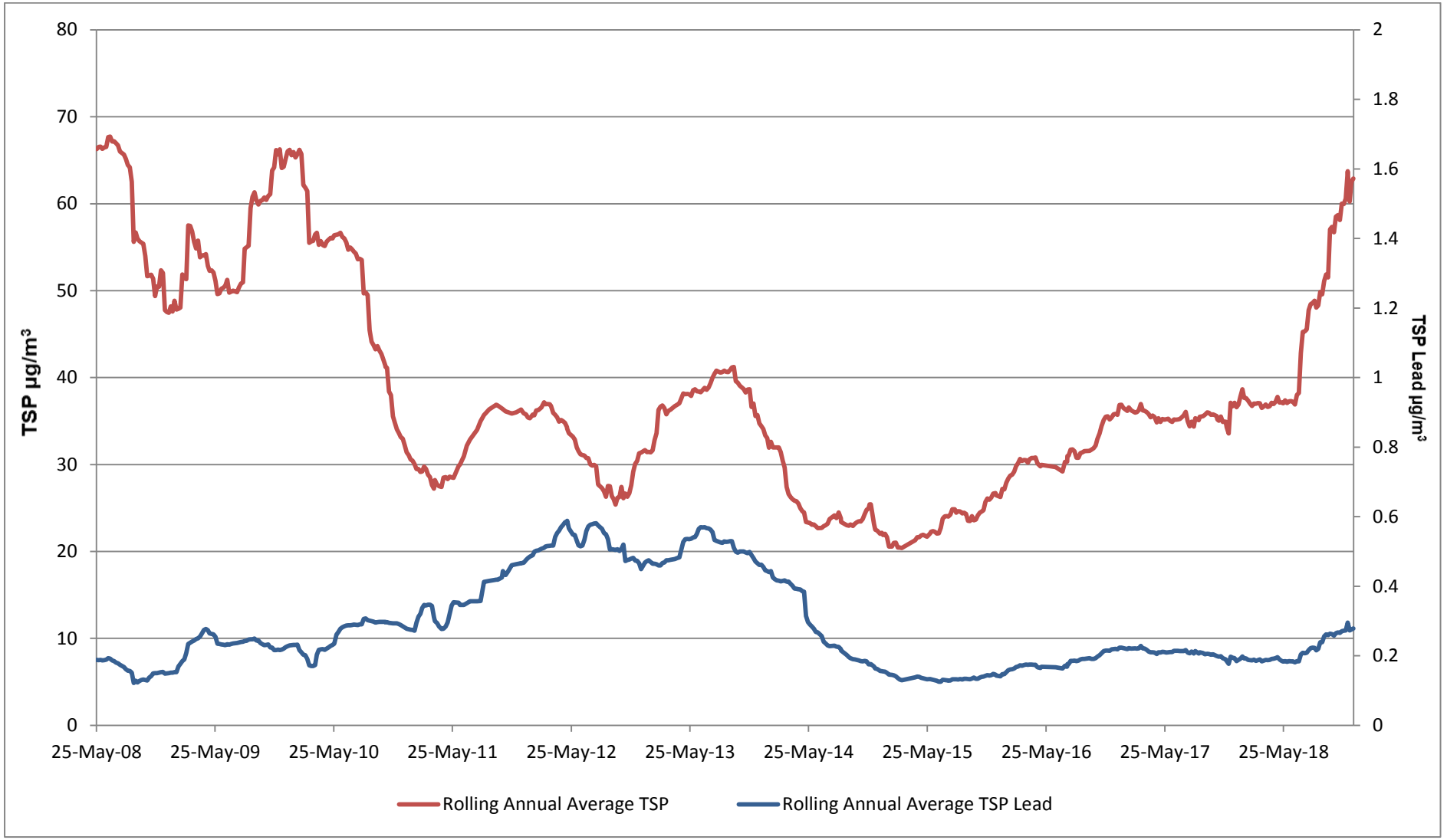
Figure 6-8 HVAS TSP-Lead Results for the Reporting Period (2018)



The original EA did not include a receptor close to HVAS in predictions for total suspended particles.

As can be seen in **Figure 6-9** there is an increase in dust levels recorded in HVAS since 2016 while Lead levels have remained stable, which suggests that much of the dust contributed is not from site and likely the result of drought conditions.

Figure 6-9 HVAS TSP and TSP-Lead Results for the Period 2008 to 2018



HVAS1 (EPL11)

HVAS1 is used for sampling PM_{10} and PM_{10}-lead. The average annual PM_{10} level recorded at this monitoring point at the end of the reporting period was 25.4 $\mu g/m^3$, which has increased from the previous reporting period of 13.62 $\mu g/m^3$ and remains below the background level reported in the EA of 29.1 $\mu g/m^3$. Results for the reporting period are show in **Figure 6-10** which indicates that a the rolling annual average for PM_{10} is slightly above the criteria of 25 $\mu g/m^3$. High winds occurred on those days when there were elevated PM10 levels which were: Winds were predominantly from the NE (55 km/hr), SW (57 km/hr) and NNE (37 km/hr), respectively.

17 July (102 $\mu g/m^3$) - winds NE (55 km/hr),

23 July (75.9 $\mu g/m^3$) – winds N (63 km/hr),

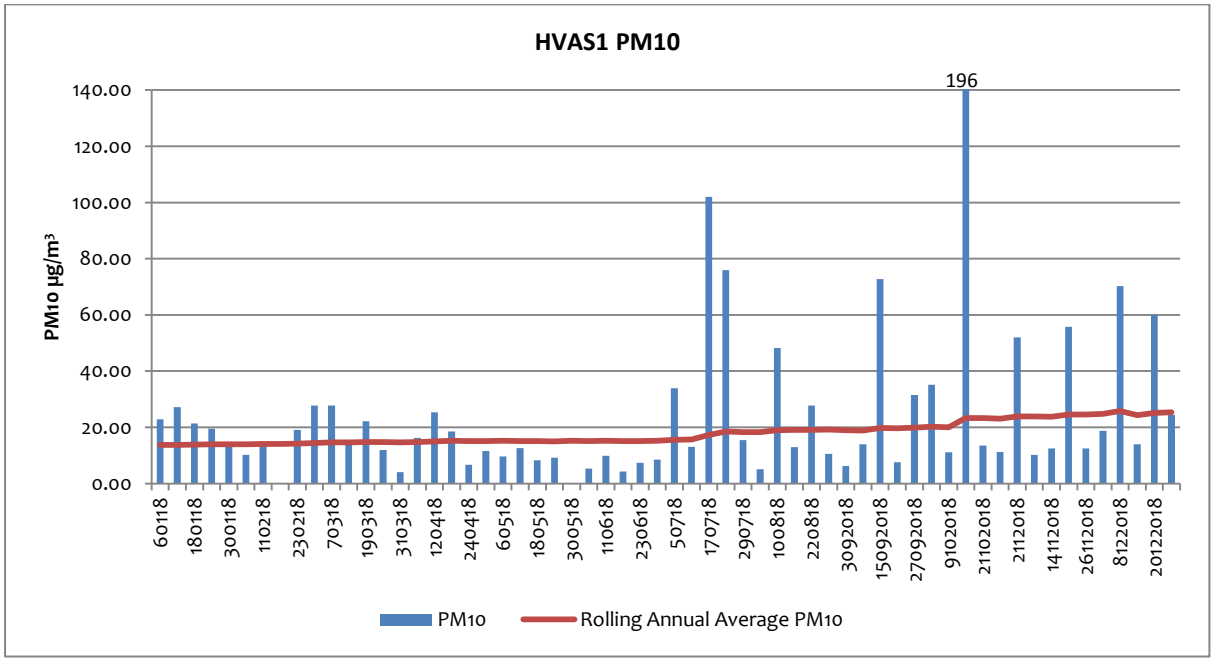
15 September (72.7 $\mu g/m^3$) – winds SW (57 km/hr),

15 October (196 $\mu g/m^3$) – winds NE (62 km/hr), and

8 December (70.2 $\mu g/m^3$) – winds NNE (37 km/hr),

Trends are discussed below and results for the period 2011 to 2018 are shown in **Figure 6-14**.

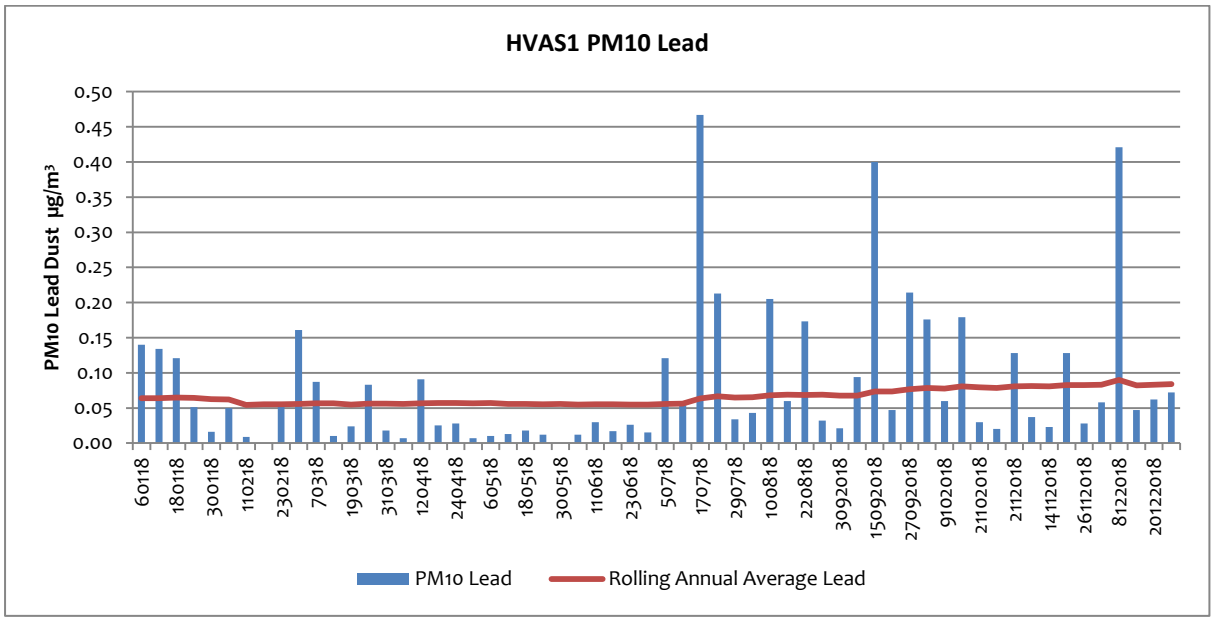
Figure 6-10 HVAS1 PM_{10} Results for the Reporting Period (2018)



The annual average PM_{10}-lead concentration has increased slightly from 0.07 $\mu g/m^3$ in the previous reporting period to 0.08 $\mu g/m^3$, **Figure 6-11.** The highest HVAS1-Lead levels were on 17 July (1.02 $\mu g/m^3$), 15 September (1.1 $\mu g/m^3$), and 8 December (1.18 $\mu g/m^3$). Winds were predominantly from the NE (55 km/hr), SW (57 km/hr) and NNE (37 km/hr), respectively.

There is no criterion for PM_{10}-lead. Trends are discussed below and results for the period 2011 to 2018 are shown in **Figure 6-15**.

Figure 6-11 HVAS1 PM_{10}-Lead Results for the Reporting period (2018)



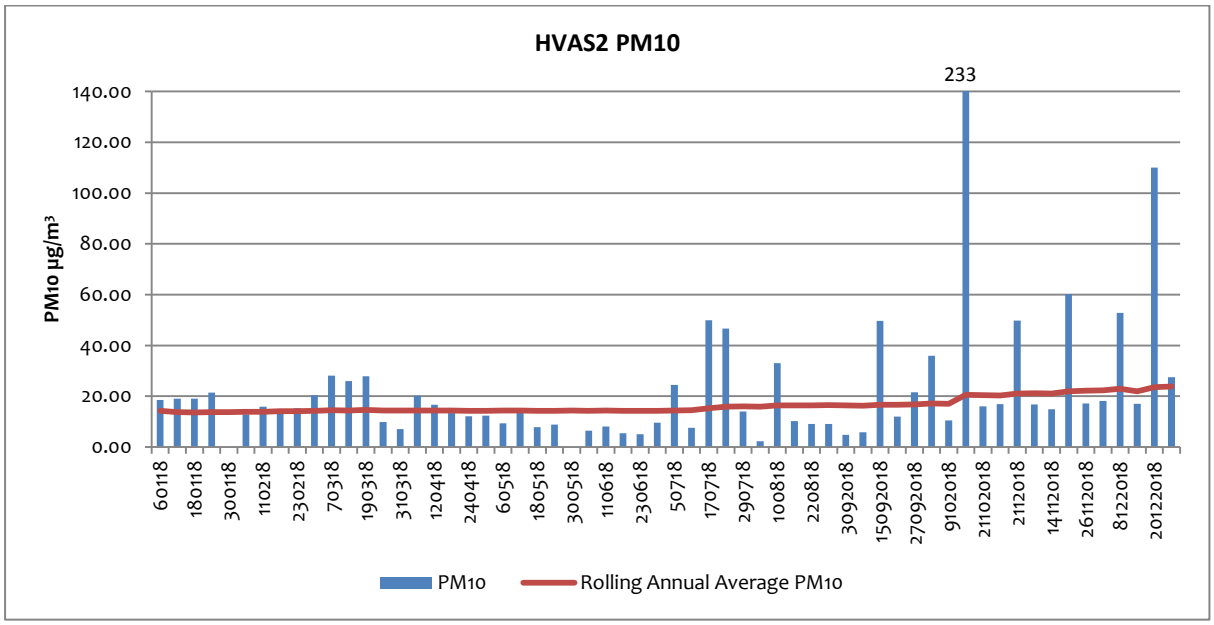
HVAS2 (EPL12)

The average annual PM_{10} level recorded at this monitoring point at the end of the reporting period was 23.78 µg/m^3, which has increased significantly from the previous reporting period (12.97 µg/m^3), however it remains below the background level reported in the EA of 29.1µg/m^3 and remains below the criteria of 25µg/m^3 (for off-site receptors), **Figure 6-12.**

The recorded PM_{10} result at HVAS2 (23.78 µg/m^3) is above the MOD4 EA predicted level of 17.54 µg/m^3 for R28, the closest receptor to this monitoring point (30 m). The highest PM_{10} levels recorded were on 17 July (49.9 µg/m^3), 15 October (233 µg/m^3), and 8 December (52.8 µg/m^3). Winds were predominantly from the NE (55 km/hr), North (62 km/hr) and NNE (37 km/hr), respectively.

Trends are discussed below and results for the period 2011 to 2018 are shown in **Figure 6-14**.

Figure 6-12 HVAS2 PM_{10} Annual Average Results for the Reporting Period (2018)



At the end of the reporting period the annual average PM_{10}-lead concentration recorded an increase from 0.06 μg/m^3 to 0.11 μg/m^3, **Figure 6-13**. The highest HVAS1-Lead levels were on 8 December (0.39 μg/m^3) and 20 December (1.17 μg/m^3). Winds were predominantly from the NNE (37km/hr) and South (53 km/hr), respectively. There is no criteria for PM_{10}-lead.

Trends are discussed below and results for the period 2011 to 2018 are shown in **Figure 6-15**.

Figure 6-13 HVAS2 PM_{10}-Lead Results for the Reporting Period (2018)

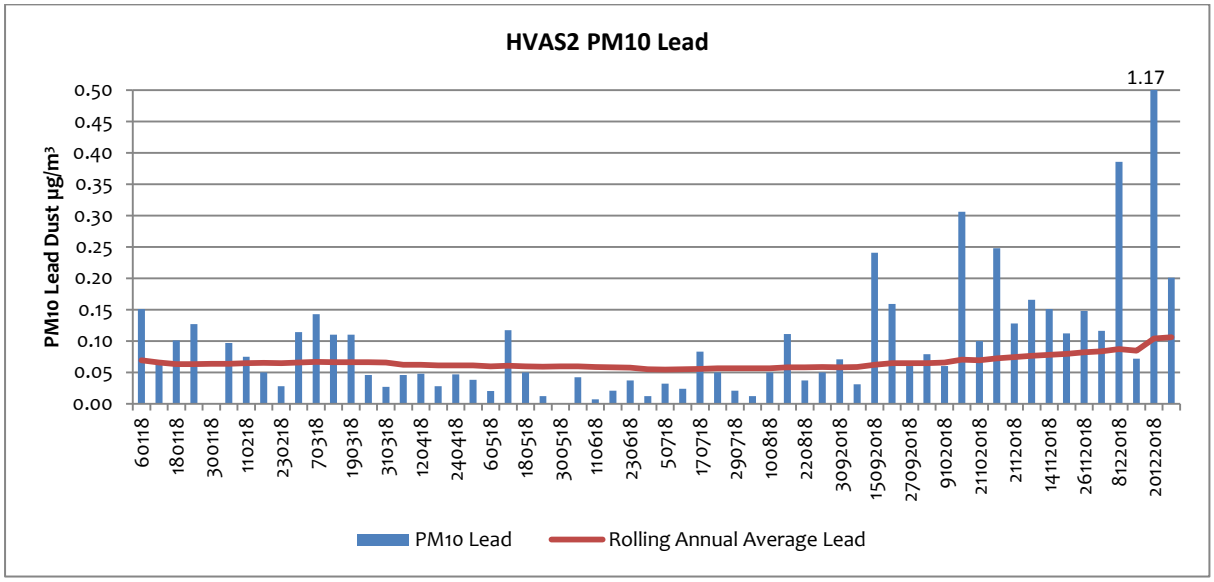


Figure 6-14 HVAS1 & HVAS2 PM_{10} Annual Average Results for the Period 2011 to 2018

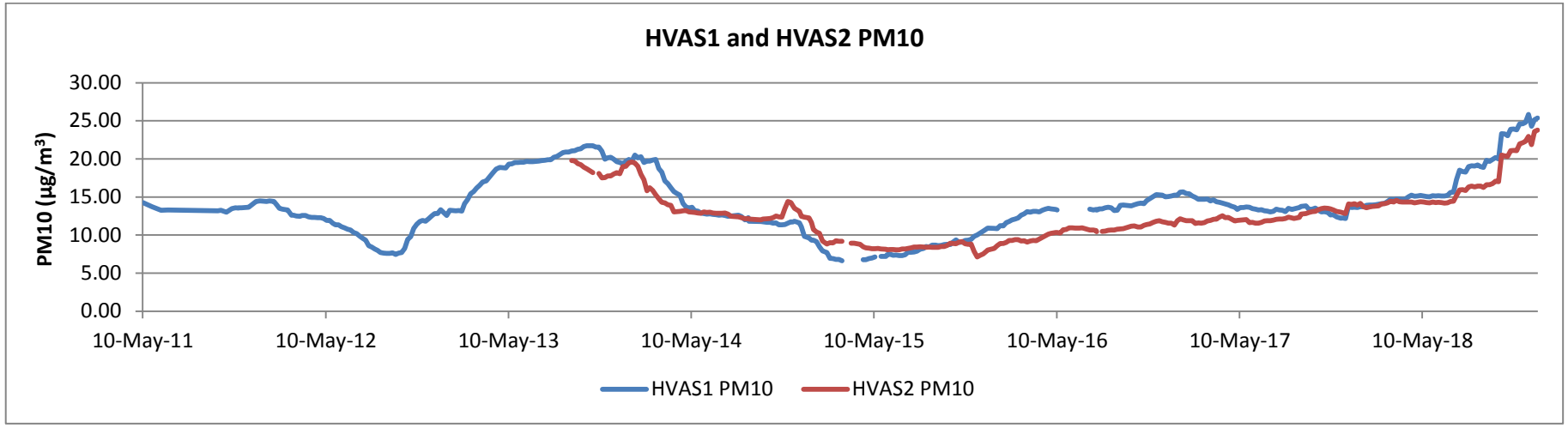
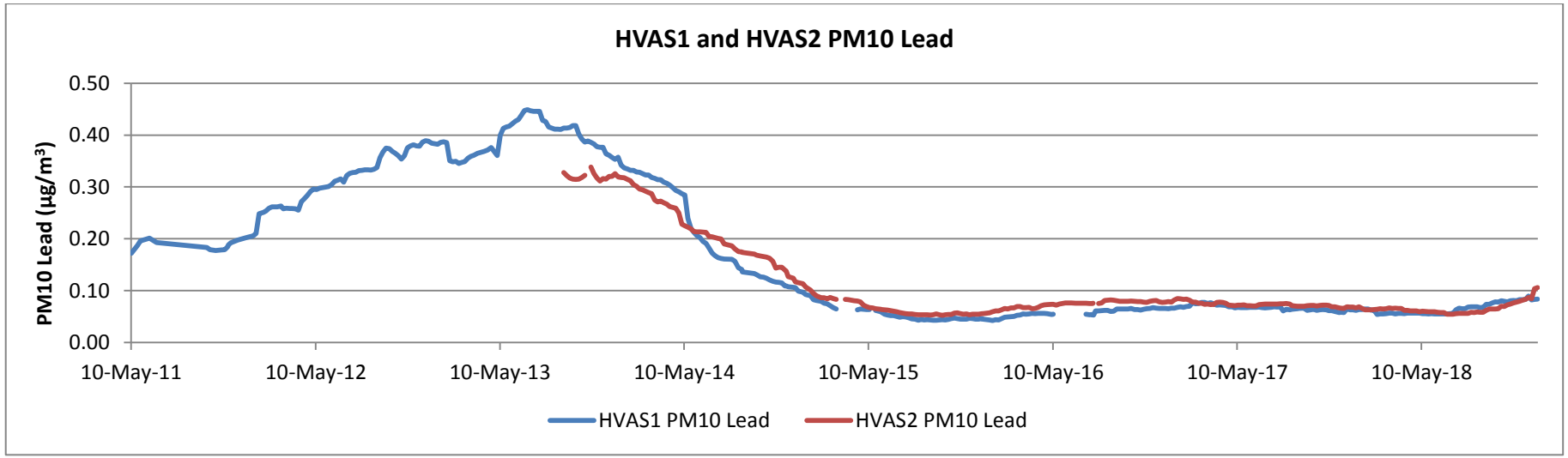


Figure 6-15 HVAS1 & HVAS2 PM_{10}-Lead Annual Average Results for the Period 2011 to 2018



6.3.4 TEOM monitors

The Rasp Mine has two Tapered Element Oscillating Microbalance (TEOM) air quality monitors, which record real time PM_{10} data. Error! Reference source not found. shows the location of these monitors.

Table 6-7 PM10 Assessment Criteria

Pollutant	Averaging Period	Criterion
Particulate matter < 10 µm (PM_{10})	24 hour	50 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	25 µg/m^3

Note: Criteria changed from 30 µg/m^3 to 25 µg/m^3 in September 2017

The monitors operate continuously over a 24 hour period and provide a real time data read out on a kiosk computer in the HSE office. The monitors also provide auto-generated notifications when triggers are exceeded (when the level exceeds 100 ug/m3 expressed as a 1 hour rolling average) the cause is investigated and controlled by the use of the water truck or by modifying work methods.

During the reporting period the TEOM units were offline due to servicing by technicians on 6 February, 19 April, 30 May, 31 July, 9 October.

The un-validated results for TEOM1 PM_{10} 24-hour average for the reporting period are provided in **Figure 6-14**. There were two very high results for TEOM1 on 15 October (306.53 µg/m^3) and 21 November (712 µg/m^3). These were the result of dust storms across Broken Hill with wind gusts of 63 km/hr from the NE and 70 km/hr from the NW. Storm events are excluded from the application for criteria.

The un-validated results for TEOM2 PM10 24-hour average for the reporting period are provided in **Figure 6-15**. There were a number of occasions during the reporting period when TEOM2 (located adjacent Blackwood Pit) recorded above the criteria for a 24-hour average. The highest records of these events was on 21 November (727.16 µg/m3). Again this was the result of dust storms across Broken Hill. Storm events are excluded from the application for criteria.

The PM10 annual average at the TEOM1 monitor at the end of the reporting period was 20.9 µg/m3 and is below the listed criteria of 25 µg/m3. The annual average PM10 at TEOM2 in December was 25.2 µg/m3 which is slightly above the criterion 25 µg/m3 required at the nearest residential location. This is likely influenced by the high regional dust levels over the last months of the year. The results for TEOM1 and TEOM2 are provided in **Figure 6-16**.

The recorded annual average PM10 result at TEOM2 (25.2 µg/m3) is above the prediction for R28, the closest receptor to this monitoring point (30 m) reported in the EA for MOD4 at 17.54 µg/m^3.

Annual average PM10 results for 2018 results for TEOM1 and TEOM2 are consistent with long term monitoring data after an increase in dust levels in early 2018, **Figure 6-17**.

On 3 July 2018 BHOP received a Show Cause from the NSW EPA and a Penalty Notice on 28 September 2018 for failing to meet Condition M2.1 of the licence which requires TEOM2 to sample air discharge quality data and Condition O2.1 of the licence that requires all plant and equipment to be maintained in a proper and efficient condition. Following a service on 19 April 2018, TEOM2 stopped collecting data due to a faulty compact flash card installed in the unit and BHOP did not identify the fault for 33 days. BHOP then did not correct the fault for a further 9 days resulting in no air quality data being recorded at TEOM2 for 42 days. Impacts as a result of the failure to monitor were believed to be minimal as a co-located PM10 High Volume Air Sampler recorded average daily results of 10.88 µg/m^3 over the event period. Daily inspections through a remote interface indicated the TEOM units

were operational and recording dust levels but the data was not being saved to the compact flash card in TEOM2. In the period after the event data is being downloaded from each unit on a daily basis, redundant communications have been installed so that a third party can monitor the units and provide alerts in the event of malfunction or trigger limit exceedences, backup CF cards are kept on site, and staff have been trained to service the units.

Air Quality Management Plan BHO-PLN-ENV-001 lists the controls that were in place during the reporting period. In summary, the major controls include:

- The use of chemical dust suppressant on non-active mining areas and roads;
- Sealing of all major roads and the use of a street sweeper and water truck;
- Wing walls and roof over the ROM Bin and water sprays on the apron feeder to the crusher;
- Fully enclosed conveyors and transfer points prior to the Sag Mill with installed dust collectors;
- Restricted access to non-active mining areas;
- Use of water sprays on the ROM Pad;
- Concentrate loading into containers occurs in an enclosed building and containers are covered prior to exiting the building; and
- All vehicles leaving site are washed, including trucks taking containers to the rail loadout area.
- Traffic light system informing all staff and contractors of wind speeds.
- Wind speed alerts from the onsite weather station notifying of wind speeds greater than 35 km/hr

Monitoring results indicate that controls have been adequate to manage dust levels during the reporting period.

Figure 6-14 TEOM1 PM_{10} 24-hour Average Results for the Reporting Period (2018)

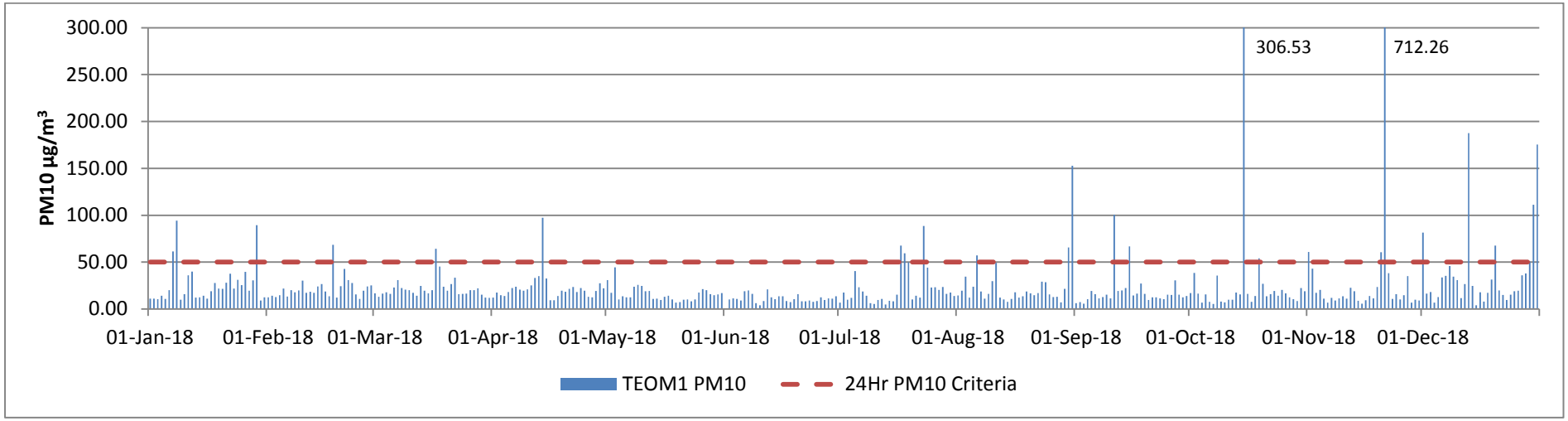


Figure 6-15 TEOM2 PM_{10} 24-Hour Average Results for the Reporting Period (2018)

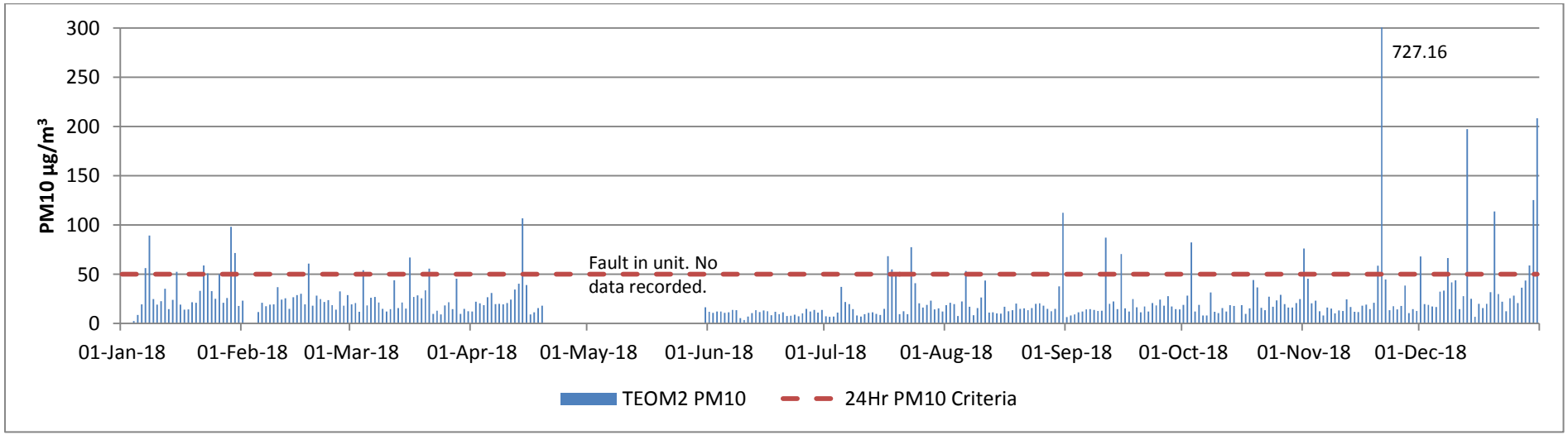


Figure 6-16 TEOM1 & TEOM2 PM_{10} Annual Average for the Reporting Period (2018)

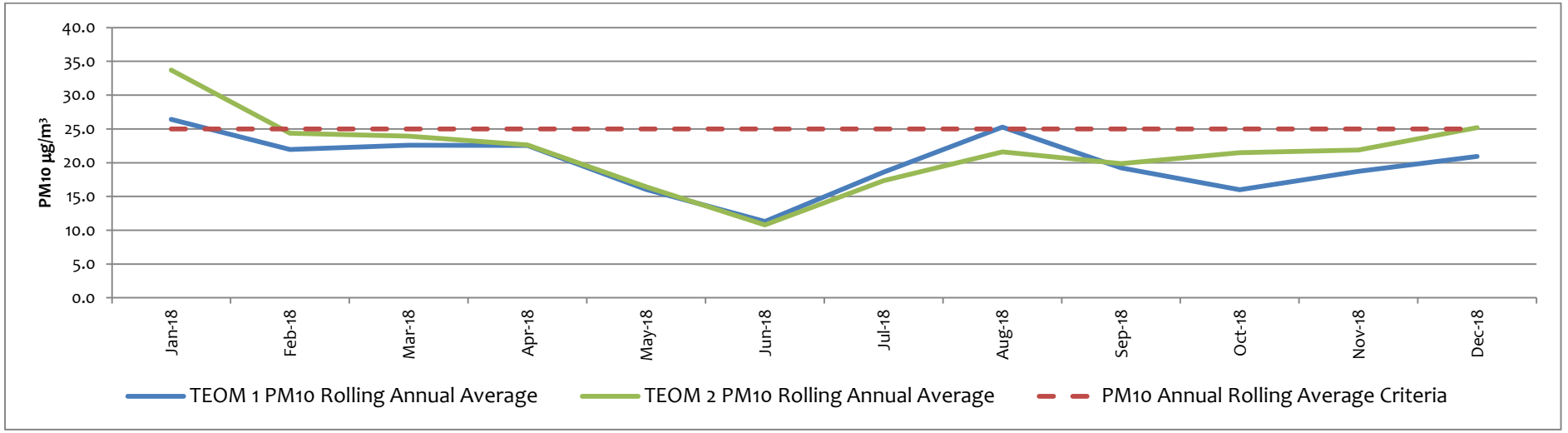
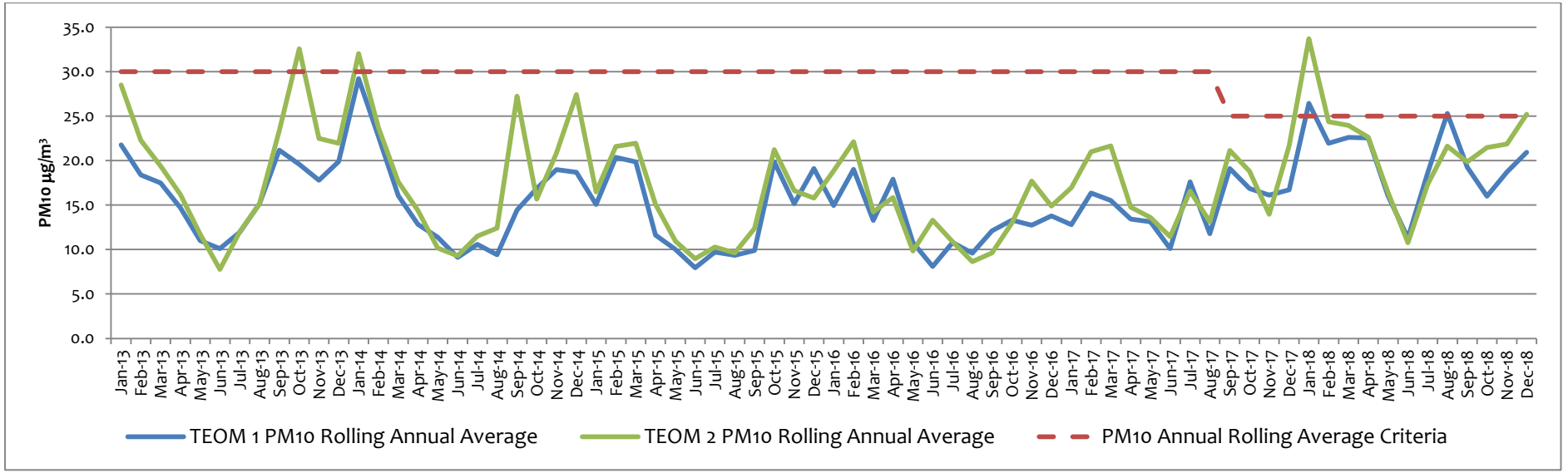


Figure 6-17 TEOM1 & TEOM2 PM_{10} Annual Average Results for the Period 2013 to 2018



6.4 Erosion and Sediment

The majority of the existing batters were constructed during former mining operations and consequently the surfaces of the batters consist predominantly of weathered rock. It is not practical to reshape the slopes, as most of the slopes are steep, on the mine lease boundary and predominantly comprise of large rock aggregate. The process of erosion over the years since the slopes were formed has removed most of the finer materials and the existing surface now comprises relatively large and coarse rock resulting in a self- armoured surface with limited erosion potential.

Inspections consist of a visual assessment for erosion, flooding, rubbish, algal growth or significant sediment build up. No major works were required as a result of these inspections.

6.5 Surface Water

There are no natural water courses or creeks flowing through the site. The drainage network layout restricts runoff leaving active mine areas of the site for a 1 in 100year 72 hour ARI rainfall event.

Surface water monitoring includes a weekly visual inspection of water storage facilities, freeboard and structural integrity. The tailings storage facility and the processing events dam are inspected and levels checked monthly. Quarterly water quality samples are taken from dams when the water levels are above 20% capacity. Samples are couriered to ALS, a NATA accredited laboratory for analysis.

There are seven sampling locations for surface water, these include surface water basins located on the mine lease to capture and retain rainfall and two locations up and down stream of an ephemeral creek located south of the mine lease boundary. Sampling requirements are provided in **Table 6-8** and locations of sampling points are shown in **Figure 6-2**.

Table 6-8 Surface Water Monitoring Requirements

Description	Frequency	Parameters to be Analysed
Federation Way Culvert EPL29/S31-1	2 x per year , six months apart	cadmium (Cd), chloride (Cl), electrical conductivity (EC), lead Pb), manganese (Mn), pH, sodium (Na), sulphate (SO4), total dissolved solids (TDS) and zinc (Zn)
Ryan Street Dam EPL31/S49	2 x per year , six months apart	
Adjacent Olive Grove EPL32/S1A	2 x per year , six months apart	
Adjacent Bowls Club EPL33 /S9-B2	2 x per year , six months apart	
Horwood Dam EPL34/Horwood Dam	2 x per year , six months apart	
Upstream Bonanza St EPL35	2 x per year , six months apart	
Downstream Sydney Rd EPL36	2 x per year , six months apart	

Ponds are sampled at least twice a year when the pond contains water for at least one week and the volume of stored water is at least 20% of the pond capacity. Sampling is undertaken in October (highest rainfall month as recorded by Bureau of Meteorology) and April. Results of the surface water analysis for the reporting period are provided in **Table 6-9**.

No storage water overflowed from these ponds during the reporting period.

Table 6-9 Stormwater Pond Water Quality Results for the Reporting Period (2018)

Site	Month Sampled	Cd	Cl	EC	Pb	Mn	pH	Na	SO4	TDS	Zn
		mg/L	mg/L	µs/cm^3	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
EPL29 S31-1	Apr 2018	Dry									
	Oct 2018	2.8	30	1940	2.76	63.3	6.09	33	722	1270	334
EPL31 S49	Apr 2018	Dry									
	Oct 2018	0.716	10	982	0.33	32.5	5.86	14	375	839	109
EPL32 S1-A	Apr 2018	Dry									
	Oct 2018	0.115	24	556	0.784	5.01	6.67	21	176	376	19.1
EPL33 S9B-2	Apr 2018	Dry									
	Oct 2018	Dry									
EPL34 Horwood Dam	Apr 2018	Dry									
	Oct 2018	8.54	3680	21700	3.73	508	6.14	3280	5740	13000	499
EPL35 Upstream Bonanza St	Apr 2018	Dry									
	Oct 2018	0.005	34	339	0.308	0.332	6.66	25	25	262	1.16
EPL36 Downstream Sydney Rd	Apr 2018	Dry									
	Oct 2018	0.0002	40	360	0.001	0.002	7.3	42	21	518	0.021

S49 Pump

S49 captures runoff from a catchment contaminated by historic mining activities. In 2011 with the end of a long term drought in Broken Hill, water escaped from this facility. A number of measures have been undertaken to address the issues. In response to a seepage issue in 2016 a solar pump was installed within the Dam in June, to remove water immediately from the dam to ensure a) water does not seep through the walls (which are lined), and b) to ensure capacity for catchment runoff is maintained. This is connected to a pipeline and sends water back onto the Rasp Mine site.

It is difficult to undertake sampling of surface waters due to the low rainfall and high evaporation rates in Broken Hill. In particular 2018 was a dry year (92.2 mm) with less than half the normal average rainfall (259 mm).

The quantity of water in the ponds at the time of sampling is unknown, this would have a major impact on the water quality results. All waters were contained within the containment structures with no off site discharges during the reporting period.

6.5.1 Water containment structures

All surface runoff on site is captured by diversion trenches or berms and channelled to site water storage structures. No changes were made to this system during the reporting period. **Plan 5** shows the water catchments and containment structures. **Table 6-10** provides the capacities and estimated stored water volumes at the end of the reporting period**.** Detailed surveying of the water storage structures is planned for the next reporting period. Surveys will be used to develop staged storage curves that will enable more accurate capacities and volumes to be determined.

Markers are placed in water ponds to indicate the maximum level to which water may be stored in the facilities to maintain sufficient free board to accommodate a 1:100 year 72 hour storm event.

Table 6-10 Water Containment Structures

	Pond Identification	Start of reporting period m^3 (1-Jan-18)	At end of reporting period m^3 (31-Dec-18)	Storage Capacity m^3
Potable and Raw Water	Workshop	9	9	14
	Boom Gate	22.5	22.5	22.5
	Mill	22.5	22.5	1400
	Delprat's Shaft	22.5	22.5	22.5
	Kintore Pit	14	14	18
	Silver Tank	6500	6500	6500
Dirty Water (rain runoff)	S2	0	0	5003
	S14	0	0	7813
	S17	0	0	4265
	S31-2	0	0	225
	S49	0	0	1951
	S35	0	0	6092
Process, underground and used water	Horwood Dam	2000	1000	7663
	Plant Water Pond	1000	1000	2000
	S22 Mine Settlement Ponds	3000	3000	20,489
	S22-A	2000	2000	2000
	Vehicle Wash	22.5	22.5	22.5

6.6 Groundwater

The regional groundwater near the site is depressed due to long term pumping from the underground mines in the area. This results in the depressed groundwater level below the site being more than 100m below the surface level, with a hydraulic gradient into the site at depth. The groundwater monitoring program is undertaken with the purpose of recording perched groundwater movement. Perched groundwater refers to surface water that has infiltrated into the near surface moderate to high permeability material generally comprising of granular soils and rock dill. The perched ground water exists for short periods of time after rainfall events and generally seeps laterally over the low permeability bedrock surface below the near surface permeable material. The rainfall events at Rasp mine site indicate that the perched groundwater has the potential to surface seep rather than seep into the regional groundwater. Considering the depth of the regional groundwater it is concluded that there is little interaction between the shallow perched groundwater and the regional groundwater.

Rasp's groundwater monitoring plan is outlined in the Site Water Management Plan.

The monitoring program includes eighteen sampling locations for groundwater, GW01 (EPL37) to GW16 (EPL52) are installed piezometers at various locations around the mine site and are sampled quarterly. There are also two sampling locations for water pumped from underground mining, Shaft 7 (EPL53) and Kintore Pit (EPL54), sampled monthly. The locations for these monitoring points are shown in **Figure 6-2**. Groundwater monitoring is scheduled for completion in March, June, September and December. A number of parameters are required to be analysed including: alkalinity (calcium carbonate ($CaCO_3$)), cadmium (Cd), calcium (Ca), chloride (Cl), electrical conductivity (EC), iron (Fe), lead Pb), magnesium (Mg), manganese (Mn), pH, sodium (Na), sulphate (SO4), total dissolved solids (TDS) and zinc (Zn). **Table 6-11** lists the location and function of each borehole.

Table 6-11 Location and Function for Groundwater Monitoring Points

Bore ID	Location	Function
GW01, GW02	Southeast of Mt Hebbard	Monitor potential seepage from Mt Hebbard
GW03 – GW09	East of TSF1	Monitor potential seepage from TSF1 towards CML7 boundary
GW10	Downstream of Horwood Dam	Monitor potential seepage north of Eyre St Dam
GW11, GW12	East of Blackwood Pit	Monitor perched groundwater mounding from TSF
GW13-GW15	Adjacent to storage areas S44, S31-1 and S31-2	Monitor movement of perched groundwater occurring from the storages
GW16	West of S49	Monitor potential seepage from S49
Shaft 7	Shaft 7	To maintain safety for underground mining at both the Rasp and Perilya South Mines
Kintore Pit - Mine dewatering	Kintore Pit decline	To maintain safety for underground mining at the Rasp Mine

Groundwater quality monitoring was undertaken in May 2007 and August 2011 at Shaft 7 to establish an initial baseline for parameters and trigger levels for the monitoring program (30% above 2011 results).

The site's groundwater is deep and is extracted as part of mining. The underground extraction system results in inward flow of the groundwater into the mine. Hence, groundwater at the mine is likely to be impacted by off-site sources due to the inward hydraulic gradient into the mine.

As shown in **Table 6-12** the majority of piezometers showed a steady or decrease in water levels during the reporting period which can be attributed to the low rainfall. Even though GW13 and GW15 show increases there is never enough water to sample. **Table 6-13** provides a summary of groundwater monitoring results for 2018, indicating highest in maroon and lowest in blue.

Table 6-15 provides a summary of water monitoring results for Shaft 7 and mine dewatering (Kintore Pit), indicating highest in maroon, lowest in blue and samples above baseline trigger in orange.

Figures 6-20 and **6-21** provide a summary of water monitoring results for the period 2012, commencement of operations, to 2018.

Table 6-12 Bore Piezometer Depths

Sample	Depth mbTOC					
	Ave 2018	Ave 2017	Ave 2016	Ave 2015	Ave 2014	Trend
GW01	8.35	6.85	7.39	7.25	7.25	Potentially falling
GW02	Dry	3.33	Dry	Dry	Dry	Dry
GW03	3.6	3.58	3.64	3.62	3.61	Stable
GW04	2.73	2.87	2.94	2.9	2.83	Stable
GW05	3.65	3.49	3.53	3.5	3.4	Stable
GW06	3.10	2.96	2.85	2.76	2.66	Stable
GW07	3.15	2.58	2.74	2.8	2.54	Variable
GW08	2.36	1.88	1.81	1.87	2.11	Variable
GW09	3.84	3.50	2.94	3.07	1.79	Variable
GW10	3.46	1.90	1.49	1.725	0.83	Potentially falling
GW11	12.00	10.00	10.10	10.4	10.69	Potentially falling
GW12	20.47	19.19	34.49	37.1	21.6	Variable
GW13	Dry	Dry	Dry	Dry	Dry	Stable
GW14	Dry	1.3	Dry	Dry	Dry	Stable
GW15	Dry	2.8	Dry	Dry	Dry	Moist
GW16	Dry	Dry	1.55	Dry	Dry	Moist

Quarterly samples were obtained from 8 of the 16 bores (GW1, GW3, GW4, GW5, GW6, GW8, GW9, and GW11), three samples were obtained from three bores (GW7, GW10, and GW12), and no samples could be obtained from bores GW2, GW13, GW14, GW15, or GW16. This was probably due to dry conditions as a results of the low rainfall in Broken Hill for 2018.

Results remained within historic ranges and were consistent with the expectation of Golder as outlined in the Site Water Management Plan, that perched groundwater quality would contain significant concentrations of lead, manganese and zinc due to the seepage contact with the near surface materials on site and the surrounding areas.

The following provides a discussion of results.

GW01 and GW2 Located Downstream of Mt Hebbard

These water bores are intended to monitor the sub-surface water fluctuations south of Mt Hebbard. GW1 had sufficient water to monitor each quarter while GW2 was dry through the year. The ground water level decreased at GW1, probably due to low rainfall; water levels for GW2 were not recorded for previous years except for 2017 but this was at bore depth. **Figure 6-18** indicates that results remain within historic ranges.

GW03, GW04, GW05, GW06, GW07, GW08, GW09 and GW10 Located Adjacent to TSF1 and Horwood Dam

Groundwater bores are located near the eastern side of the unused historic TSF1 and extend to Horwood Dam. The intent of the monitoring bores is to monitor perched water in the area that may impact on Eyre Street Dam. The monitoring is in response to surface seepage noted in the area during intense 2011 rainfall events. All bores in the series were able to be monitored each quarter, except for GW7 which was dry in June. Water levels remained stable in GW3, GW4, GW5 and GW6 with some variability in GW7, GW8, and GW9, and GW10 potentially falling. **Figure 6-18** indicates that results remain within historic ranges, with Alkalinity potentially increasing at GW10 and variable results for Alkalinity at GW4 and GW9.

GW11 and GW12 located south east of Blackwood Pit

Blackwood Pit is used for the storage of tailings. It forms part of the mining area and is surrounded by historic mine workings. Due to these historic workings any seepage from the Pit will be intercepted and collected by the underground mine water management system. Due to the north east and south west length of the pit there is a possibility for the formation of a perched aquifer as a result of groundwater mounding around the south east site of the pit once it receives tailings. If a perched water table is measured in the two bores consideration will be given to the installation of additional bores to assess the local hydrogeological conditions and risk of migration of seepage. On the advice of Golder bores were installed to the south east of the facility in order to detect any seepage.

The ground water level in GW11 was slightly lower than previous periods and the level of GW12 decreased but is higher than in 2015 and 2016. GW11 recorded elevated Calcium, Total Dissolved Solids, Electrical Conductivity, Chloride, Sulphate, Sodium, and Magnesium in October and November but the levels for these parameters returned to historic levels in December. **Figure 6-18** indicates results remain within historic ranges.

GW13) (adjacent 31-1, GW14 (adjacent BHP chimney) and GW15 (adjacent rail load out) and GW16 (adjacent S49)

As perched water seepage may occur from ponds located near the CML7 boundary when these ponds store water, bores have been installed adjacent these locations. All bores were dry in the period, with GW15 and GW16 containing enough moisture to trigger the dipper but not enough water to sample.

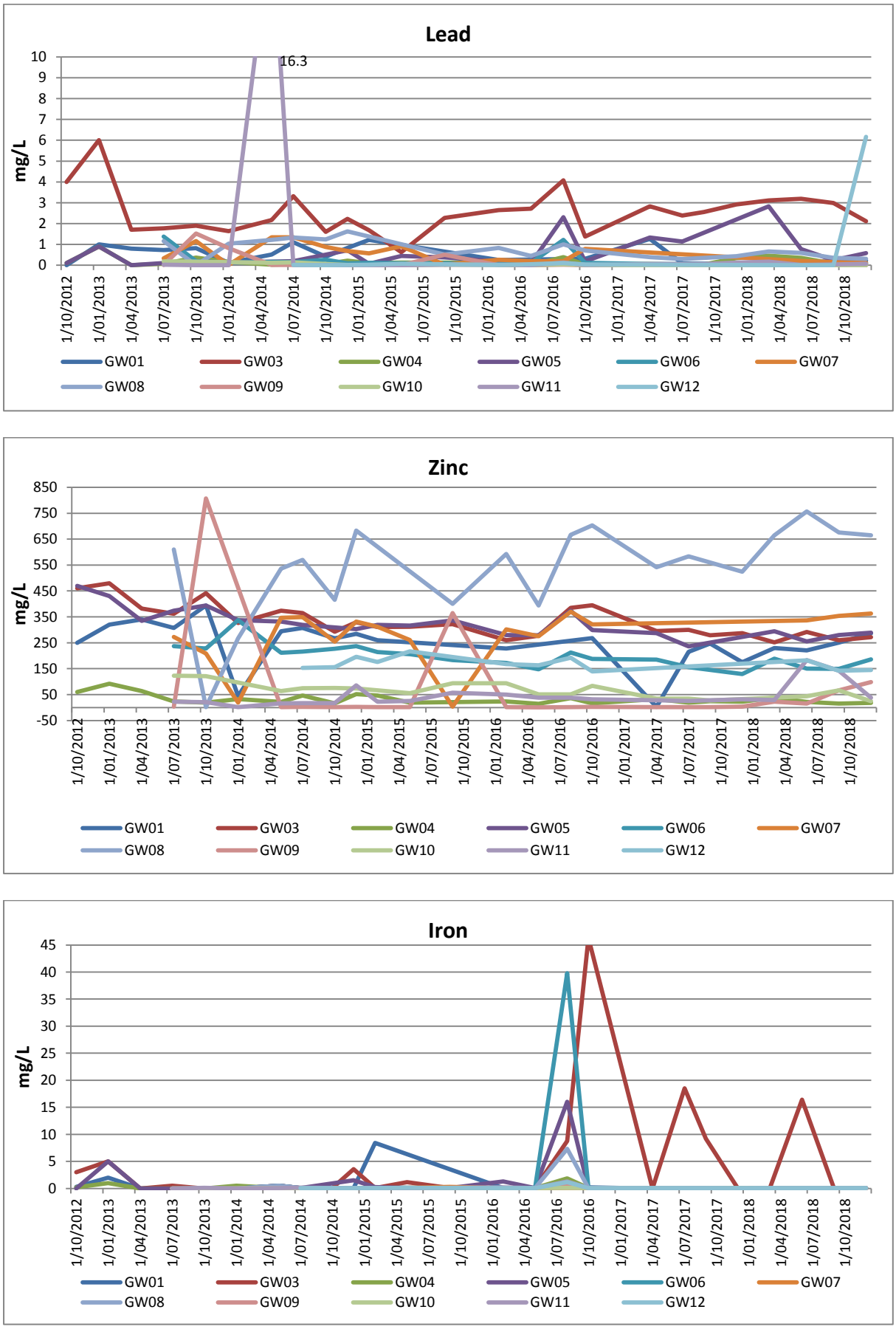
Table 6-13 Piezometer Monitoring Results for the Reporting Period (2018)

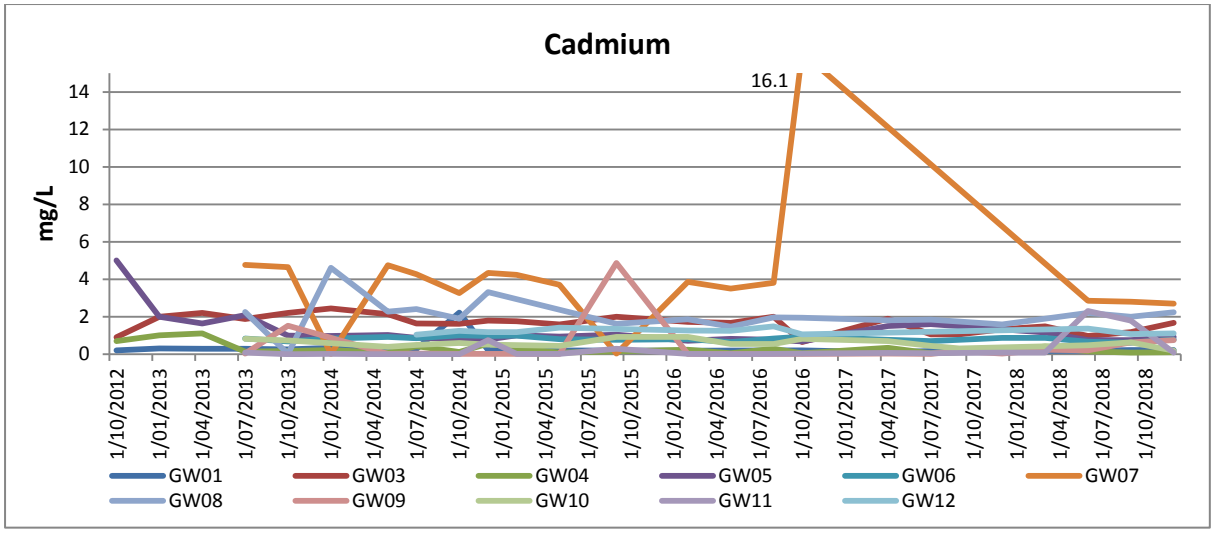
Site	Month Sampled	Alkalinity CaCO3 (mg/L)	Cd (mg/L)	Ca (mg/L)	Cl (mg/L)	EC (µS/cm)	Fe (mg/L)	Pb (mg/L)	Mg (mg/L)	Mn (mg/L)	pH	Na (mg/L)	SO as SO4 (mg/L)	TDS (mg/L)	Zn (mg/L)
GW01	Mar	1	0.164	246	928	10000	0.05	0.079	428	302	5	1430	5120	8790	230
	Jun	1	0.184	289	1260	10500	0.05	0.118	460	308	4.55	1560	5080	8930	221
	Sep	1	0.218	279	1410	12100	0.05	0.191	477	312	4.69	1530	5400	11000	251
	Dec	1	0.228	304	1190	12100	0.05	0.218	503	354	4.7	1600	5240	10800	286
GW02	Mar, Jun, Sep, Dec	Insufficient depth for sample													
GW03	Mar	1	1.49	588	2710	14600	0.05	3.11	363	273	5.91	2170	5230	12600	252
	Jun	7	0.972	597	3130	14800	16.4	3.19	388	388	5.58	2290	4860	11300	292
	Sep	1	1.18	559	3160	15400	0.05	2.99	359	254	4.82	2210	4820	12300	260
	Dec	5	1.67	563	3300	14800	0.05	2.11	346	254	5.57	2170	5230	12900	272
GW04	Mar	150	0.405	572	2450	13900	0.05	0.453	457	99.9	6.77	2300	4890	11900	38.1
	Jun	235	0.153	599	2920	14300	0.05	0.354	502	52.8	6.97	2310	4950	9980	22
	Sep	256	0.076	601	2950	15300	0.05	0.078	536	32	7.11	2360	4780	11600	14.9
	Dec	297	0.103	585	2860	14600	0.05	0.091	506	38.1	6.88	2290	5010	11300	18.3
GW05	Mar	151	1.16	544	2820	16600	0.05	2.83	647	342	6.4	2470	6690	16100	294
	Jun	137	0.753	527	3120	16700	0.05	0.772	642	323	6.31	2560	6820	15200	255
	Sep	114	0.757	521	2940	16800	0.05	0.239	632	305	6.29	2580	6210	14300	280
	Dec	131	0.922	517	1980	15900	0.05	0.576	601	317	6.06	2440	6490	13700	289

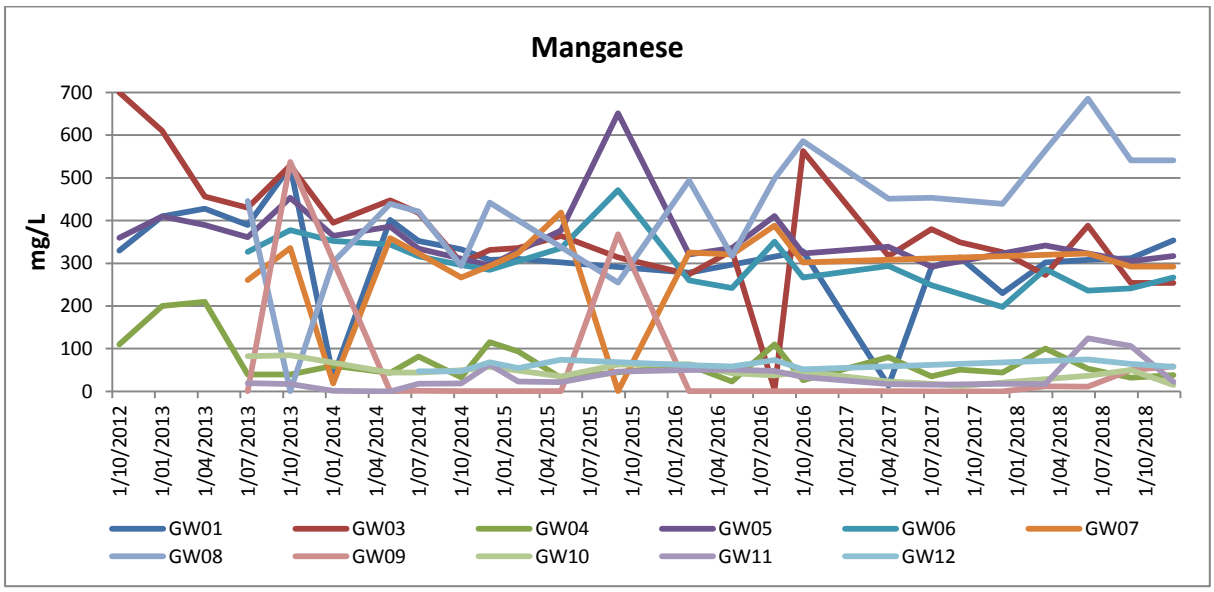
Site	Month Sampled	Alkalinity CaCO3 (mg/L)	Cd (mg/L)	Ca (mg/L)	Cl (mg/L)	EC (µS/cm)	Fe (mg/L)	Pb (mg/L)	Mg (mg/L)	Mn (mg/L)	pH	Na (mg/L)	SO as SO4 (mg/L)	TDS (mg/L)	Zn (mg/L)
GW06	Mar	1	0.867	542	2330	13400	0.05	0.062	418	286	6.28	2000	5570	12300	189
	Jun	50	0.656	567	2610	13300	0.05	0.09	416	236	6.31	2030	5280	11500	150
	Sep	47	0.618	524	2540	13800	0.05	0.062	409	241	6.36	1970	4790	11500	149
	Dec	54	0.79	527	1820	13600	0.05	0.094	408	267	6.15	1980	4970	12100	186
GW07	Mar	Insufficient depth for sample													
	Jun	34	2.86	569	2020	11800	0.05	0.211	337	323	6.23	1760	4650	9300	336
	Sep	32	2.8	572	1820	12200	0.05	0.149	337	292	6.22	1830	4720	10400	354
	Dec	38	2.7	518	1490	12000	0.05	0.118	293	292	6.11	1660	4670	11200	363
GW08	Mar	23	1.89	569	1940	11600	0.05	0.664	269	564	6.02	1310	5100	8490	665
	Jun	14	2.2	599	2460	12100	0.05	0.592	287	686	6	1410	4480	10400	757
	Sep	13	1.99	620	2460	12200	0.05	0.358	293	541	6.05	1450	4440	11000	676
	Dec	15	2.24	563	1940	11500	0.05	0.304	251	541	5.86	1260	4620	11400	665
GW09	Mar	224	0.23	656	1860	11200	0.05	0.005	553	12	7.11	1280	4300	9370	22.2
	Jun	216	0.209	679	1940	11500	0.05	0.006	608	11.2	7.15	1390	4320	9060	15.2
	Sep	122	0.638	663	1790	11400	0.05	0.005	562	50.2	6.95	1390	4300	9370	66.2
	Dec	122	0.752	617	1400	11200	0.05	0.001	512	58	6.67	1320	4470	8400	98.7
GW10	Mar	Insufficient depth for sample													
	Jun	264	0.474	603	2750	13800	0.05	0.001	512	36.3	7.07	2160	4610	8080	43.2

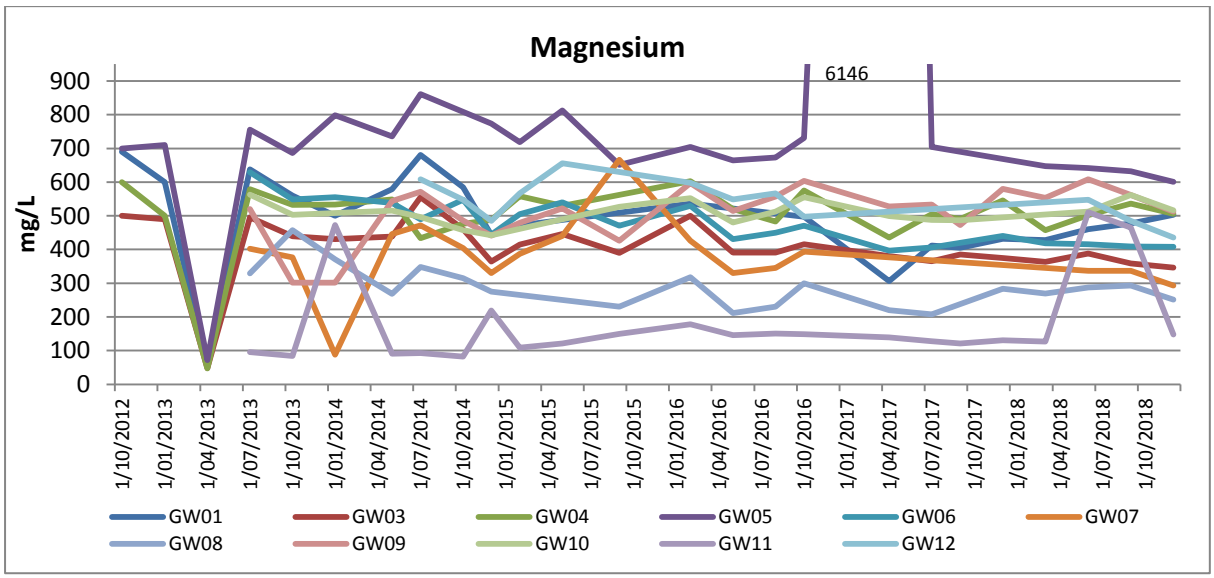
Site	Month Sampled	Alkalinity CaCO3 (mg/L)	Cd (mg/L)	Ca (mg/L)	Cl (mg/L)	EC (µS/cm)	Fe (mg/L)	Pb (mg/L)	Mg (mg/L)	Mn (mg/L)	pH	Na (mg/L)	SO as SO4 (mg/L)	TDS (mg/L)	Zn (mg/L)
	Sep	122	0.638	663	1790	11400	0.05	0.005	562	50.2	6.95	1390	4300	9370	66.2
		328	0.19	583	1990	14100	0.05	0.001	516	14.4	6.99	2200	4680	10400	24.1
GW11	Mar	68	0.0877	298	391	4420	0.05	0.172	127	16.6	6.69	564	1990	3690	29.4
	Jun	69	2.3	475	1780	11900	0.05	0.01	511	124	6.24	1670	4990	11300	183
	Sep	62	1.8	438	1550	11200	0.05	0.032	465	106	6.23	1570	4440	9230	142
	Dec	82	0.0803	292	466	5030	0.05	0.074	148	22	6.87	624	1920	3960	37.9
GW12	Mar, Jun, Sep, Dec	Insufficient depth for sample													
GW13	Mar, Jun Sep, Dec	Insufficient depth for sample													
GW14	Mar, Jun, Sep, Dec	Insufficient depth for sample													
GW15	Mar, Jun, Sep, Dec	Insufficient depth for sample													
GW16	Mar, Jun, Sep, Dec	Insufficient depth for sample													

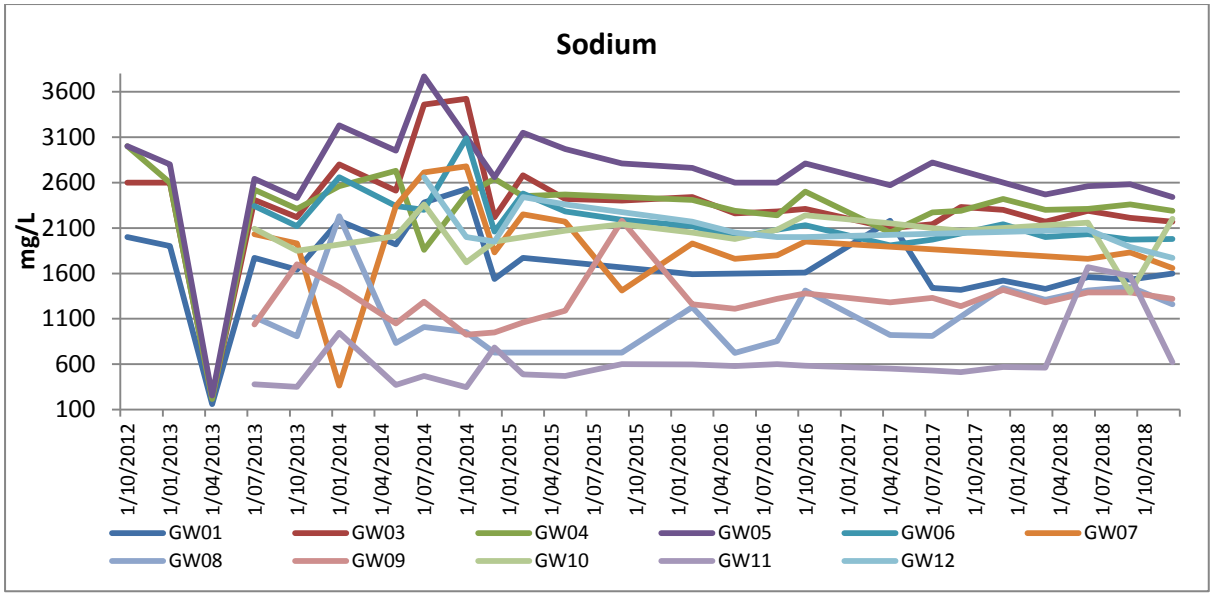
Figure 6-18 Groundwater Quality Results for Sampled Parameters for the Period 2012 to 2018

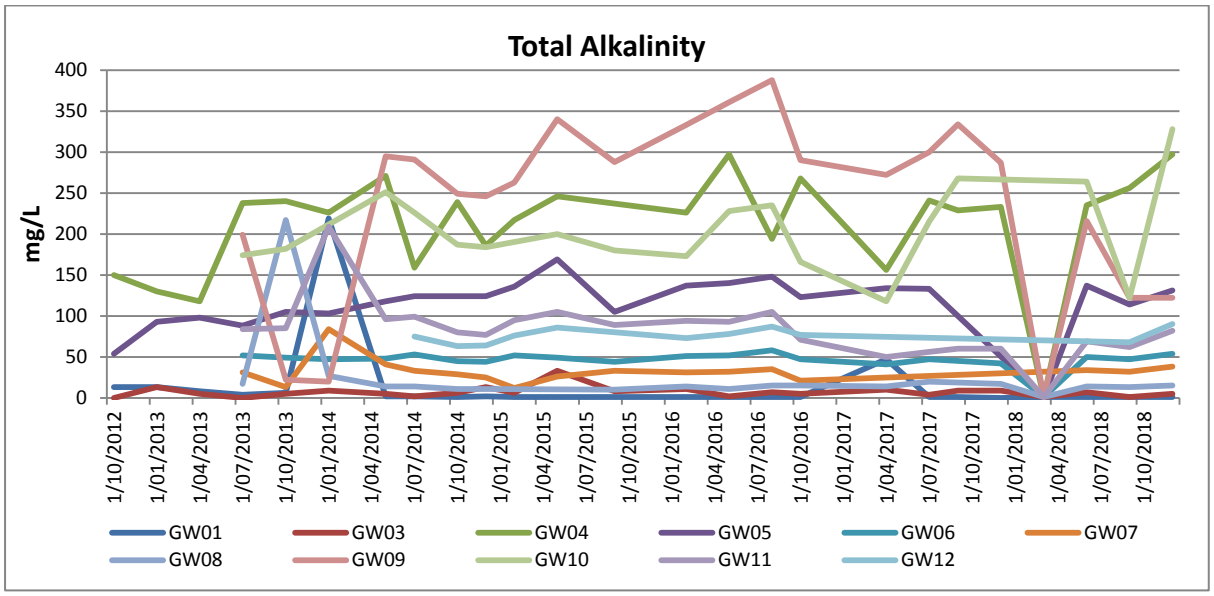


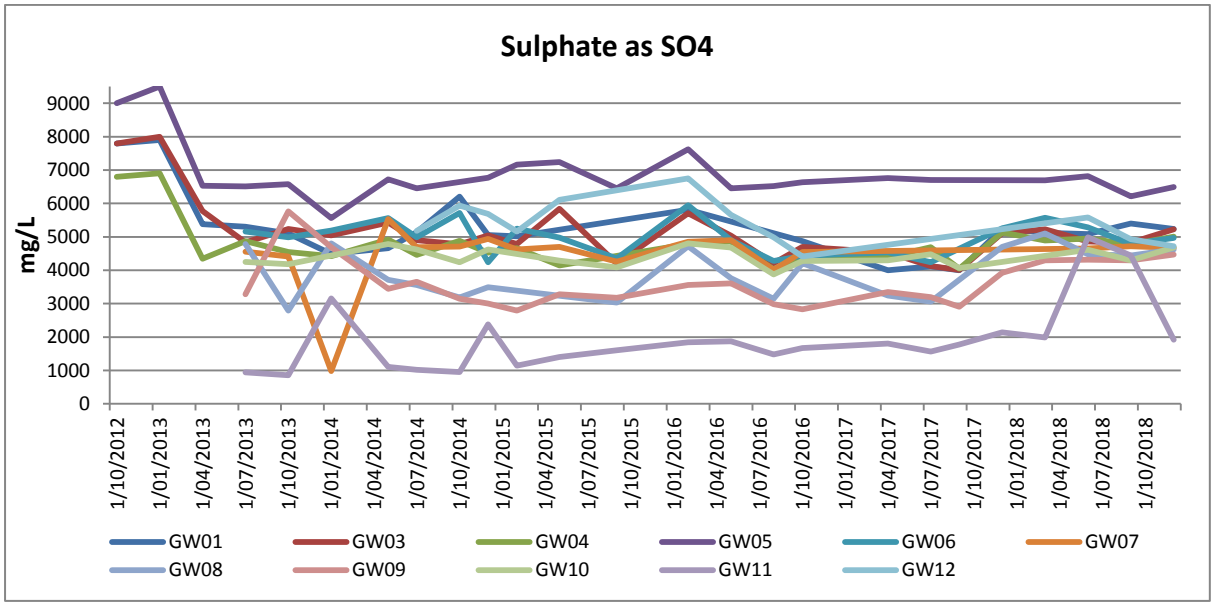

Cadmium
16.1
mg/L
14
12
10
8
6
4
2
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12

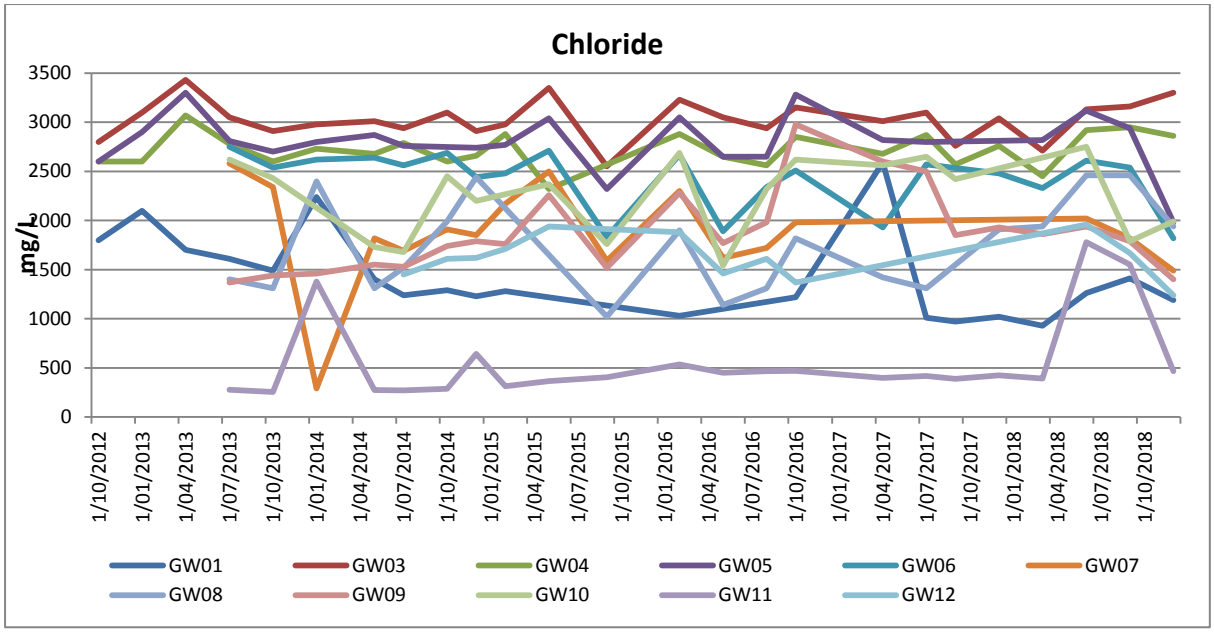

Manganese
mg/L
700
600
500
400
300
200
100
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12

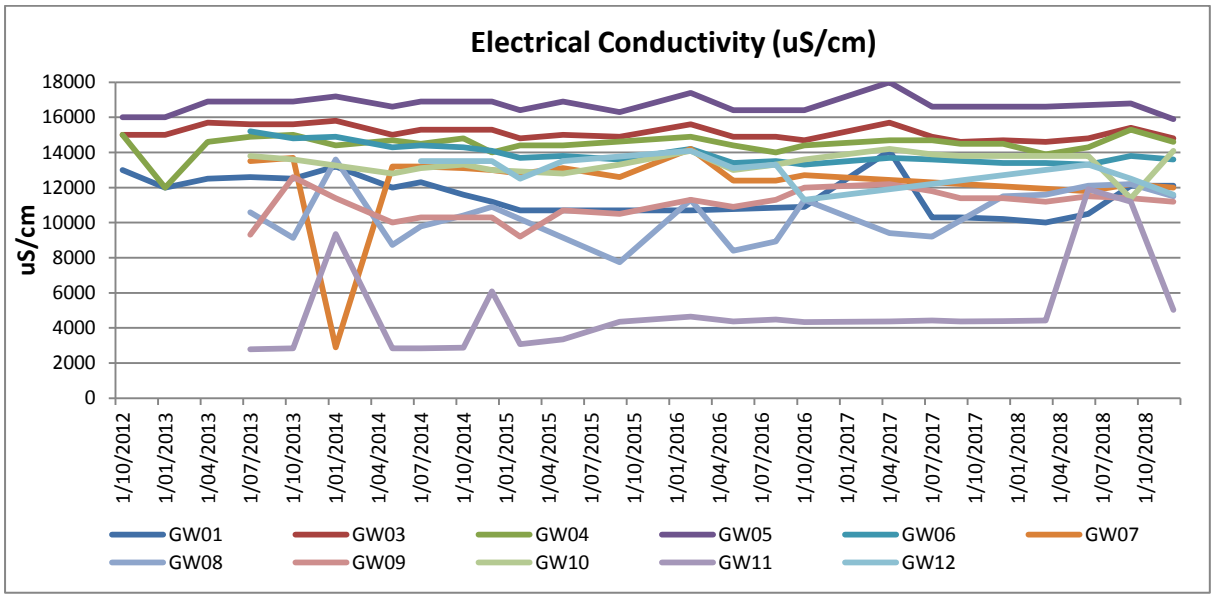

Magnesium
6146
mg/L
900
800
700
600
500
400
300
200
100
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12

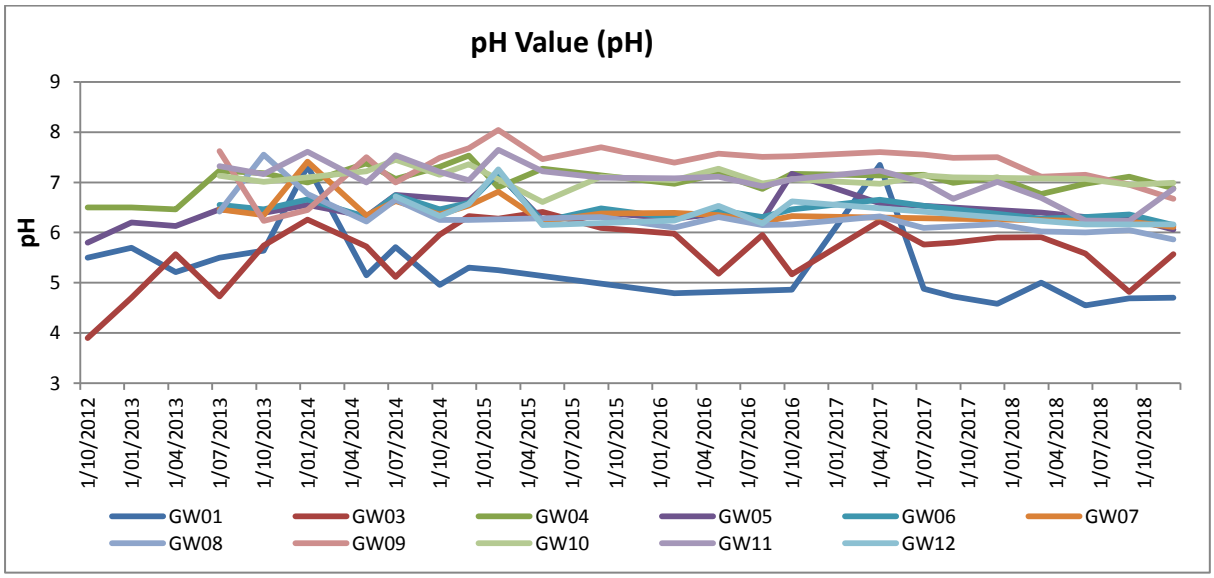

Sodium
mg/L
3600
3100
2600
2100
1600
1100
600
100
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12


Total Alkalinity
mg/L
400
350
300
250
200
150
100
50
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12


Sulphate as SO4
mg/L
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12


Chloride
mg/L
3500
3000
2500
2000
1500
1000
500
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12


Electrical Conductivity (uS/cm)
uS/cm
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12


pH Value (pH)
pH
9
8
7
6
5
4
3
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12

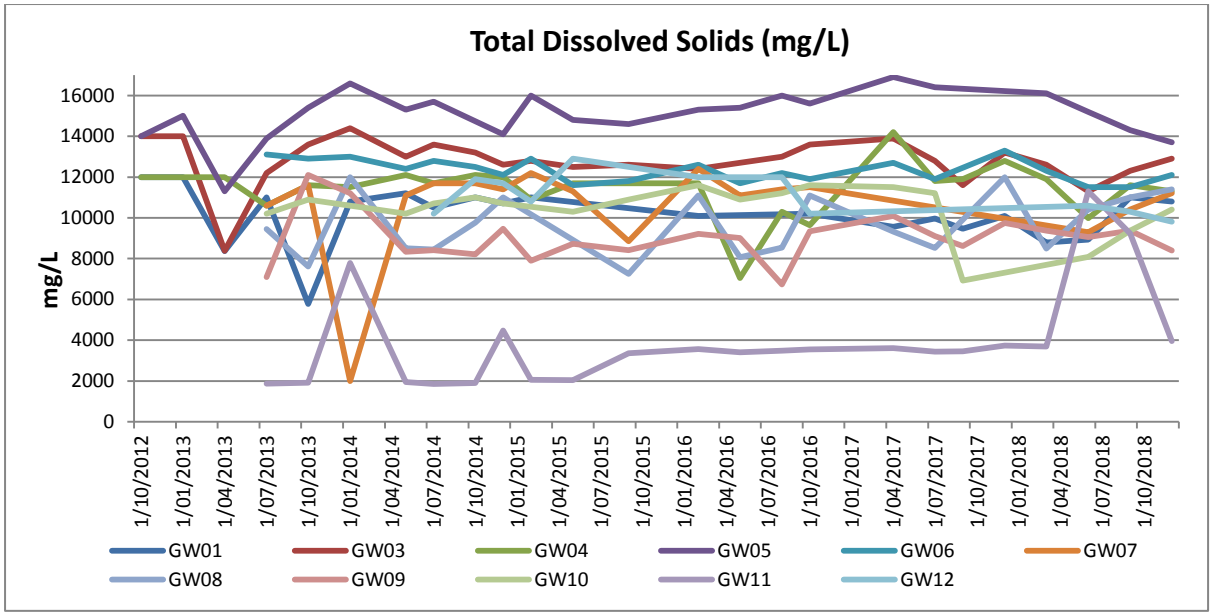

Total Dissolved Solids (mg/L)
mg/L
16000
14000
12000
10000
8000
6000
4000
2000
0
1/10/2012
1/01/2013
1/04/2013
1/07/2013
1/10/2013
1/01/2014
1/04/2014
1/07/2014
1/10/2014
1/01/2015
1/04/2015
1/07/2015
1/10/2015
1/01/2016
1/04/2016
1/07/2016
1/10/2016
1/01/2017
1/04/2017
1/07/2017
1/10/2017
1/01/2018
1/04/2018
1/07/2018
1/10/2018
GW01
GW03
GW04
GW05
GW06
GW07
GW08
GW09
GW10
GW11
GW12

Table 6-14 Groundwater Monitoring Results for Shaft 7 and Mine Dewatering for the Reporting Period (2018)

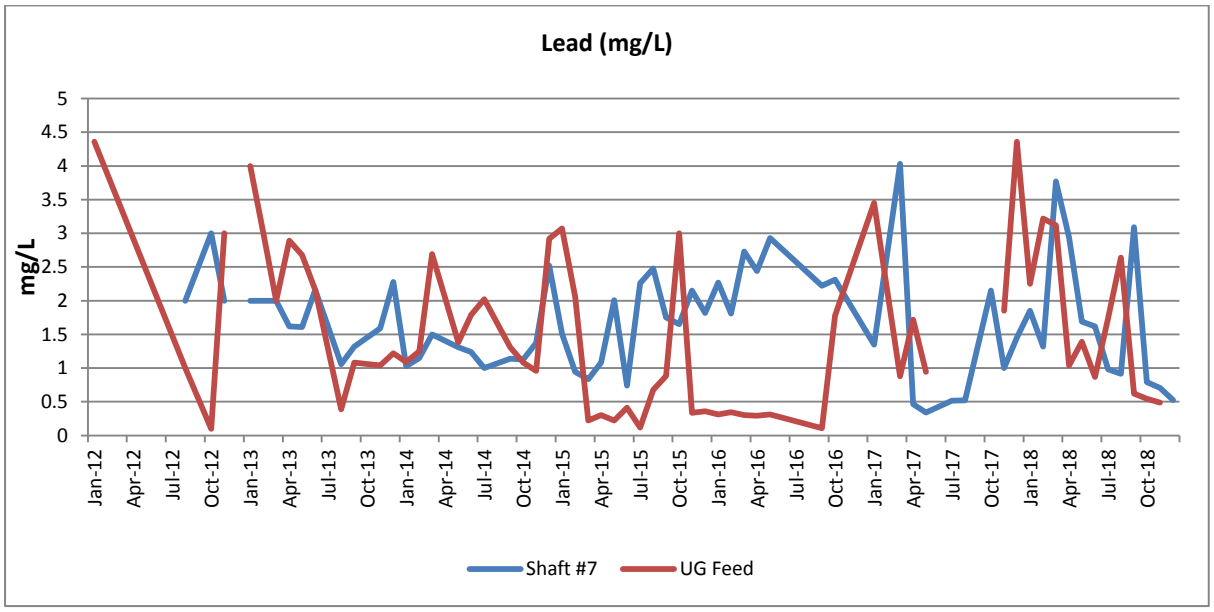
Site	Month Sampled	Alkalinity CaCO3 (mg/L)	Cd (mg/L)	Ca (mg/L)	Cl (mg/L)	EC (µS/cm)	Fe (mg/L)	Pb (mg/L)	Mg (mg/L)	Mn (mg/L)	pH	Na (mg/L)	SO as SO4 (mg/L)	TDS (mg/L)	Zn (mg/L)
Shaft 7	Jan	20	2.79	549	1820	15100	0.42	1.85	424	522	6.51	2070	6550	14500	1110
	Feb	2	3.16	513	1670	13300	2.41	1.32	344	456	5.96	1800	6420	13600	1350
	Mar	1	3.17	565	1680	12600	0.05	3.77	317	371	6.56	1600	4700	12600	1060
	Apr	13	1.88	509	1420	12700	1.25	2.94	314	310	6.6	1540	5220	13300	799
	May	8	2.69	516	1440	11700	7.49	1.69	250	378	6.22	1480	5360	9650	1330
	Jun	8	2.41	536	1610	12500	4.26	1.62	281	317	6.15	1670	5600	10100	1080
	Jul	10	2.26	503	1390	11900	0.42	0.984	273	390	6.16	1590	5720	6550	1250
	Aug	10	2.18	495	1320	12000	1.44	0.915	265	264	6.1	1540	4990	11600	829
	Sep	24	2.71	525	1910	14100	0.05	3.09	354	492	6.6	1840	5860	15200	982
	Oct	6	2.54	487	1800	14200	1.32	0.79	269	334	5.98	1580	4730	9260	1050
	Nov	8	2.46	538	1600	13600	2.29	0.705	253	336	6.22	1600	5540	12800	1120
	Dec	4	2.7	502	1580	12400	1.45	0.525	240	345	5.8	1470	6220	12500	1220
U/G water	Jan	7	2.53	534	1850	15500	0.39	4.36	417	454	6.28	2110	6290	12500	923
	Feb	2	2.68	475	1530	12200	6.42	2.25	301	356	6.05	1650	6080	7040	1130
	Mar	1	3.34	550	1710	12700	0.05	3.22	300	357	6.39	1650	5340	7710	1070
	Apr	6	2.28	481	1290	12300	6.07	3.12	263	289	6.24	1400	5250	13330	1040
	May	5	2.48	518	1500	11800	2.06	1.04	261	381	5.97	1500	5300	8070	1240
	Jun	8	2.08	538	1740	12700	0.05	1.39	322	336	6.35	1730	6720	10700	819
	Jul	10	2.58	492	1370	11700	3.12	0.868	250	398	6.2	1540	5620	6380	1440
	Aug	12	2.28	470	1290	11700	2.52	1.74	247	245	6.1	1520	4900	9560	909
	Sep	10	2.48	521	1820	13700	0.44	2.64	335	445	6.48	1770	5710	15000	1030
	Oct	6	2.64	495	1840	14500	0.42	0.621	268	333	6.03	1600	4720	10200	1060
	Nov	12	2.37	525	1540	13200	3.27	0.546	245	329	6.37	1570	5240	12800	1100
	Dec	6	2.48	483	1500	12000	3.13	0.489	229	319	5.91	1410	5820	12600	1170
Baseline		40	6.32	472	1360	13900	1.57	2.25	395	907	5.8	3550	9660	8000	3330
Trigger		52	7.58	614	1768	18070	2.04	2.93	514	1179	7.54	4615	12558	10400	4329

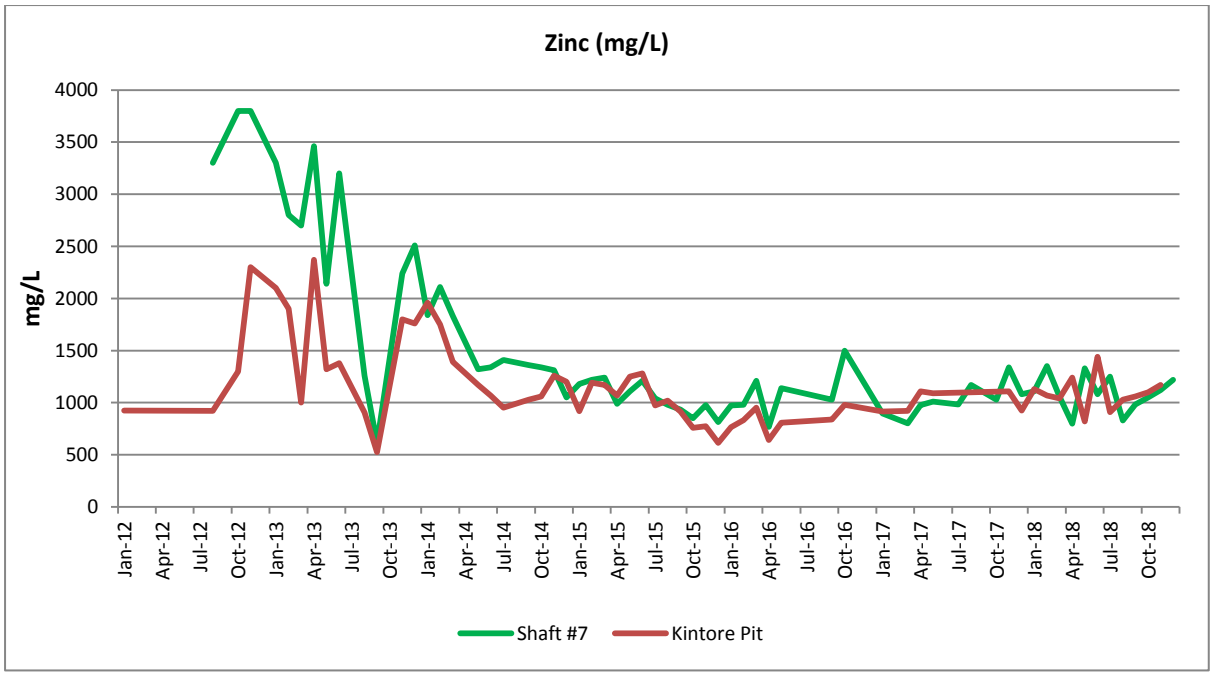
HIGHEST LOWEST >Above baseline trigger value (baseline + 30%)

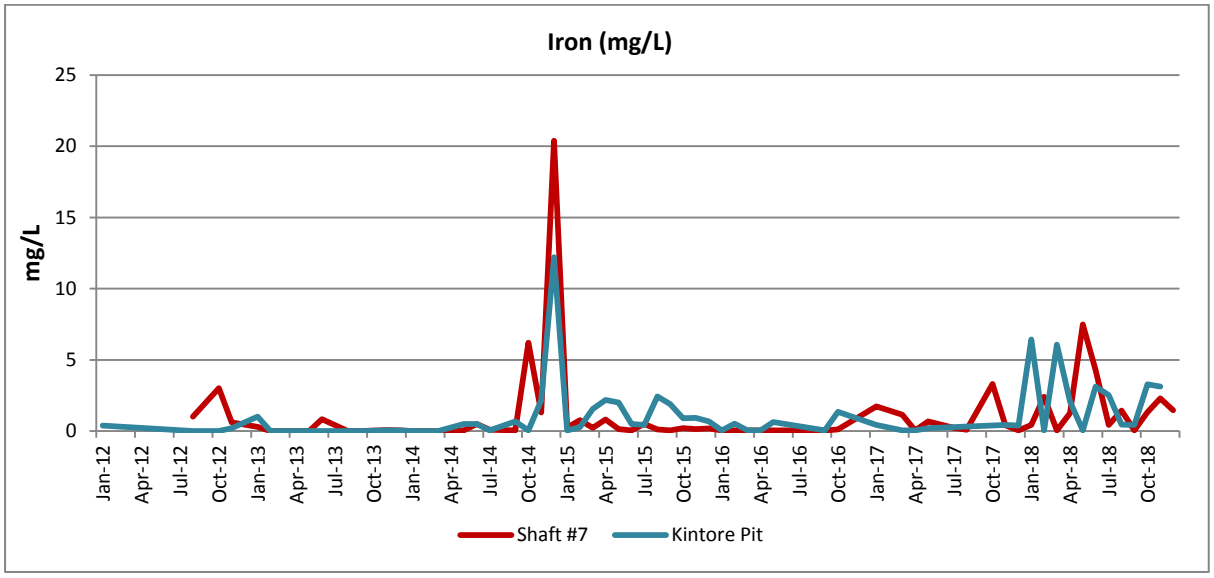
Results for both Shaft 7 and UG Feed occasionally exceeded trigger thresholds for Chloride, Iron and Lead, but are variable. Total dissolved solids (TDS) results were above the trigger threshold for most of the year, however results were within the historic range for TDS, and lower than the previous period. Iron and Chloride levels were slightly elevated compared to previous periods but within historic levels and is probably consistent with mining works in the area where the water is extracted.

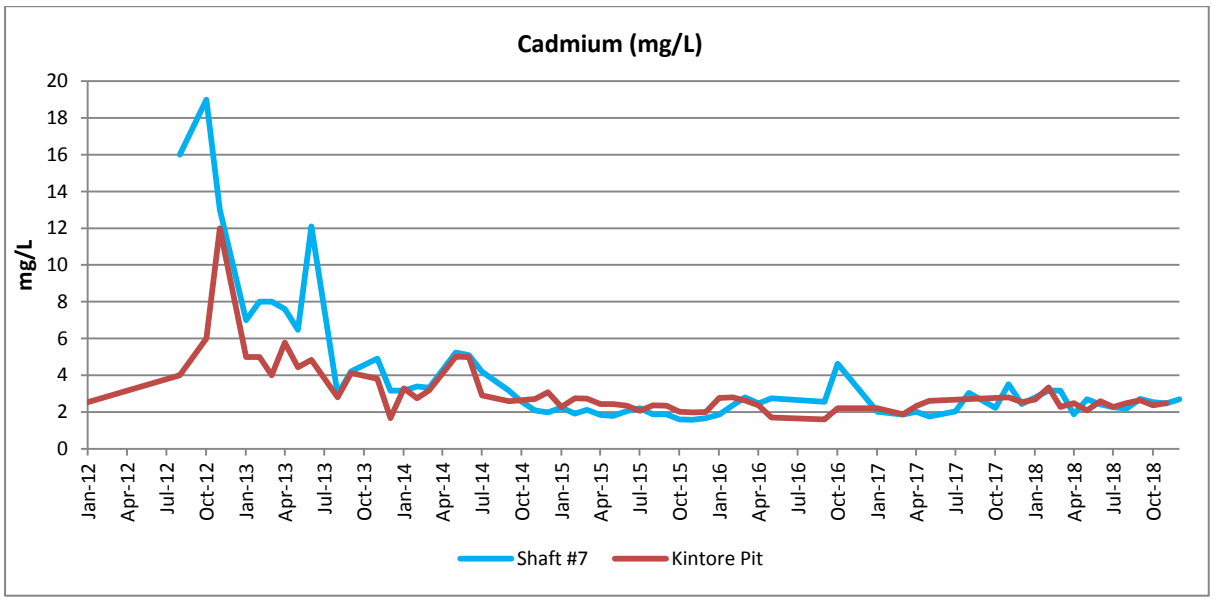
Figure 6-19 provides a series of graphs indicating results for the period 2012, commencement of operations, to 2018. Results are within the historic range for all parameters

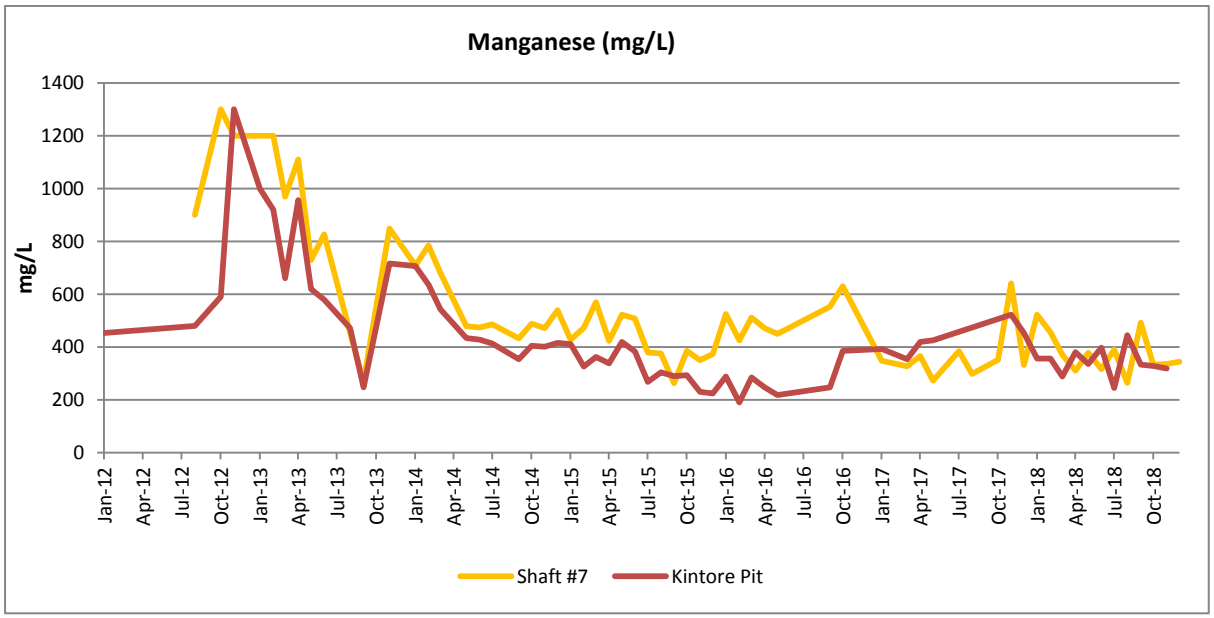
Figure 6-19 Shaft 7 & Mine Dewatering Results for Sampled Parameters - Period 2012 to 2018

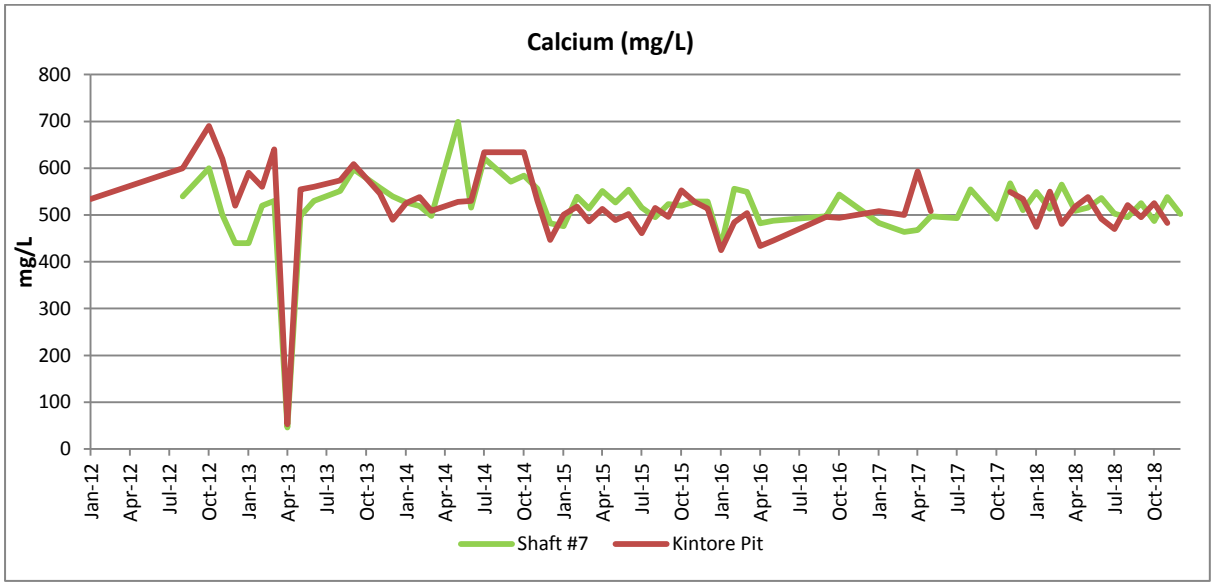


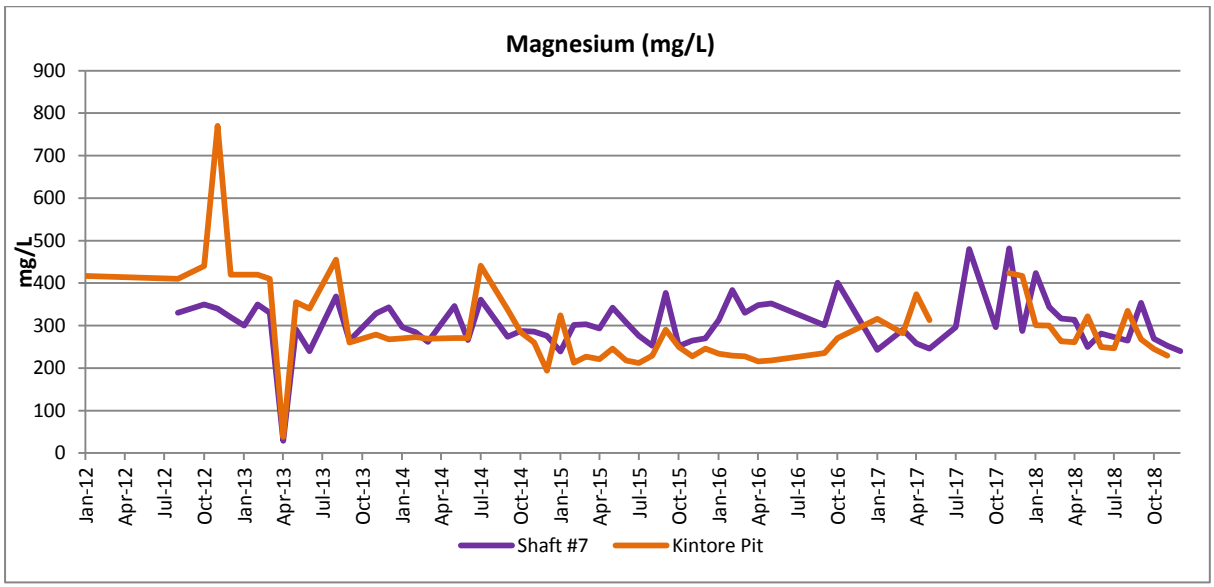


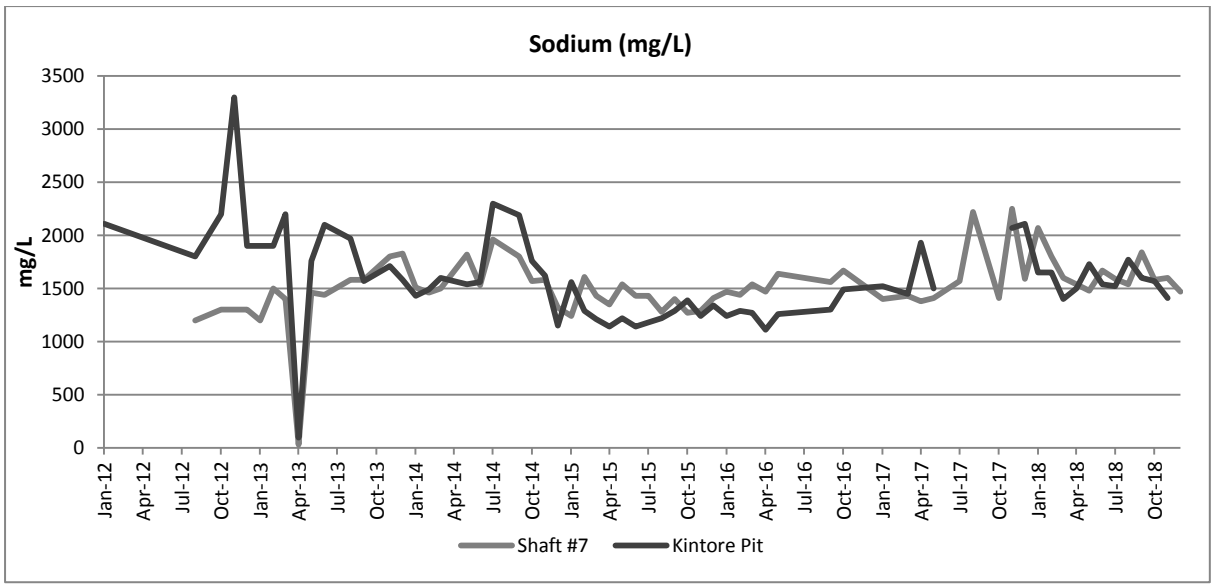

Iron (mg/L)
mg/L
25
20
15
10
5
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit

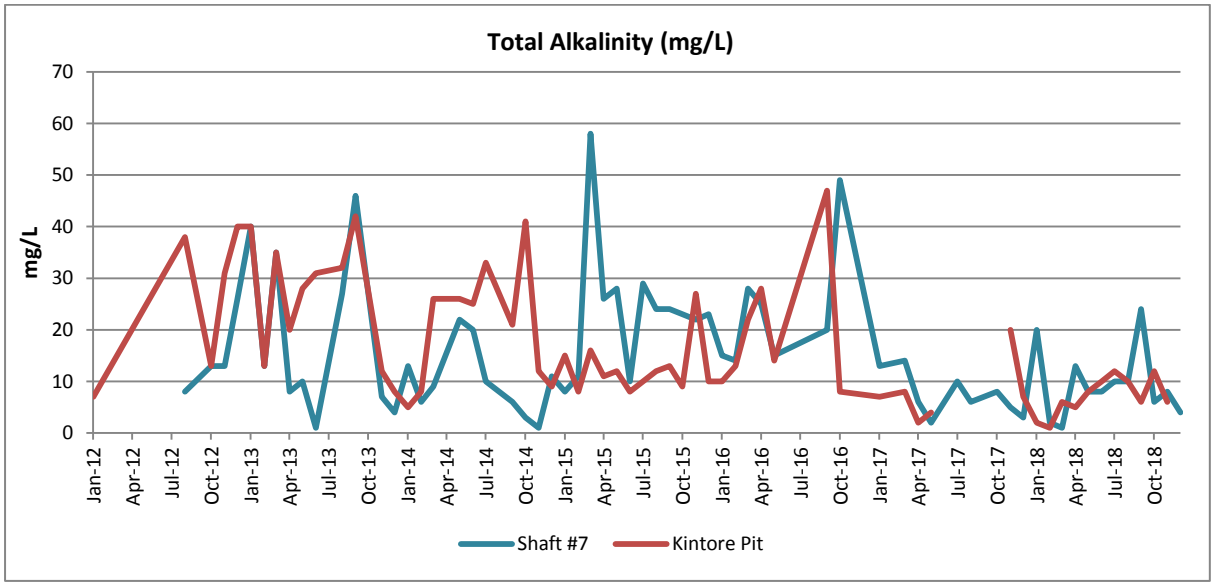

Cadmium (mg/L)
mg/L
20
18
16
14
12
10
8
6
4
2
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit

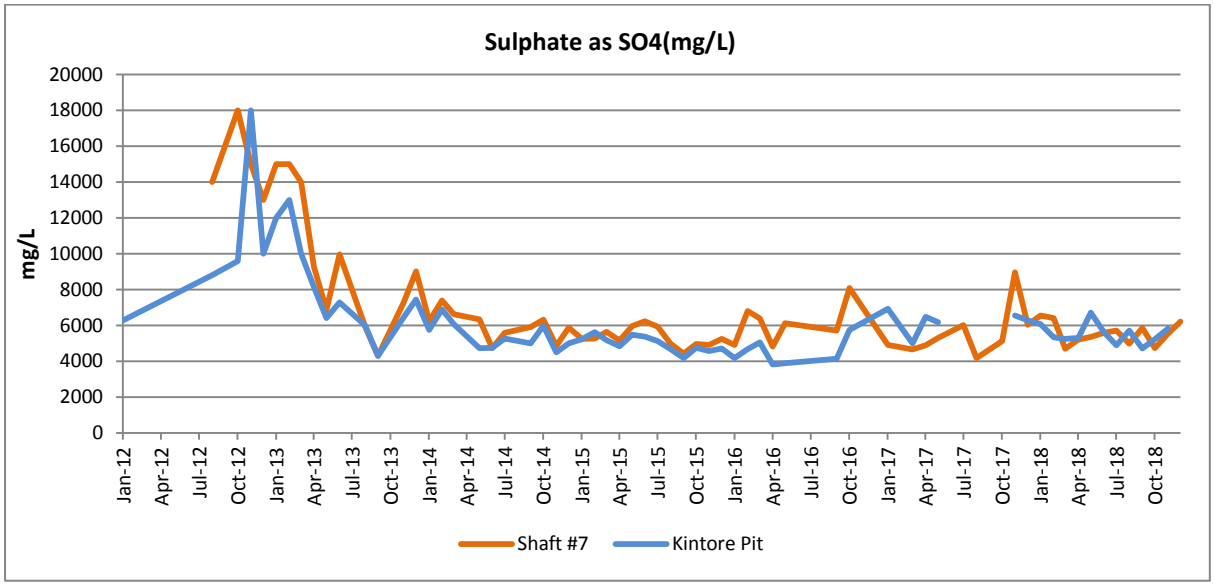

Manganese (mg/L)
mg/L
1400
1200
1000
800
600
400
200
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit

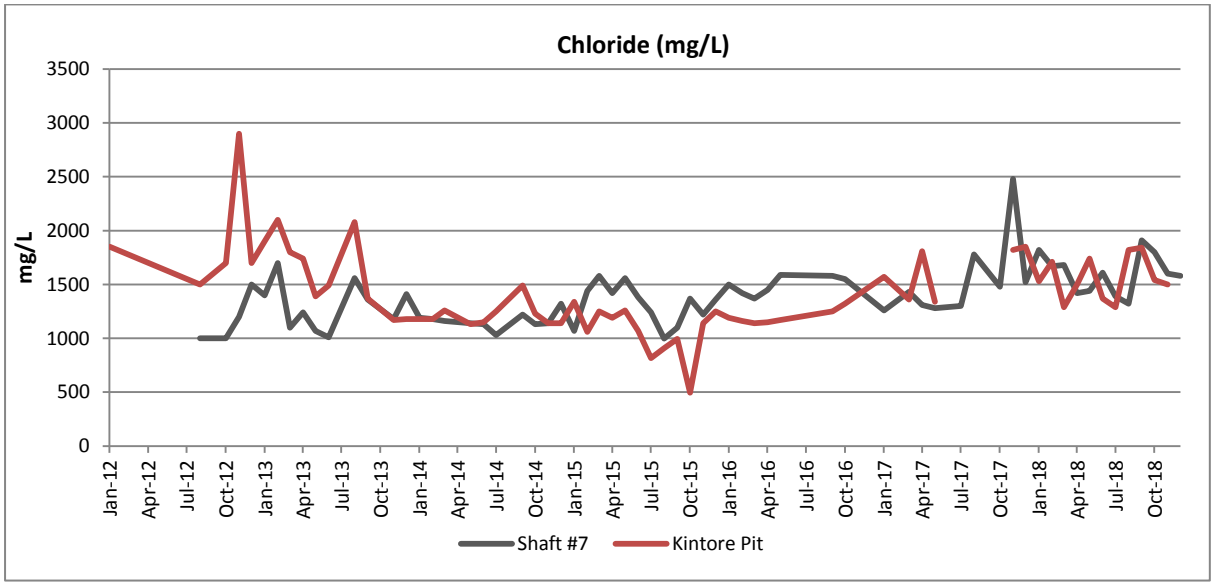

Calcium (mg/L)
mg/L
800
700
600
500
400
300
200
100
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit

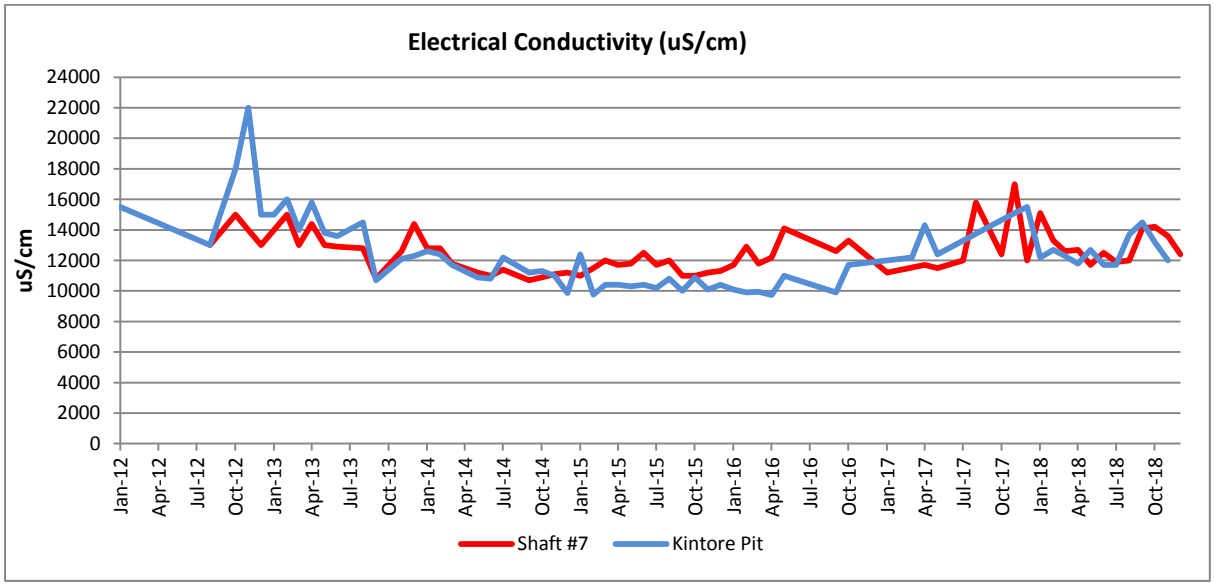

Magnesium (mg/L)
mg/L
900
800
700
600
500
400
300
200
100
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit

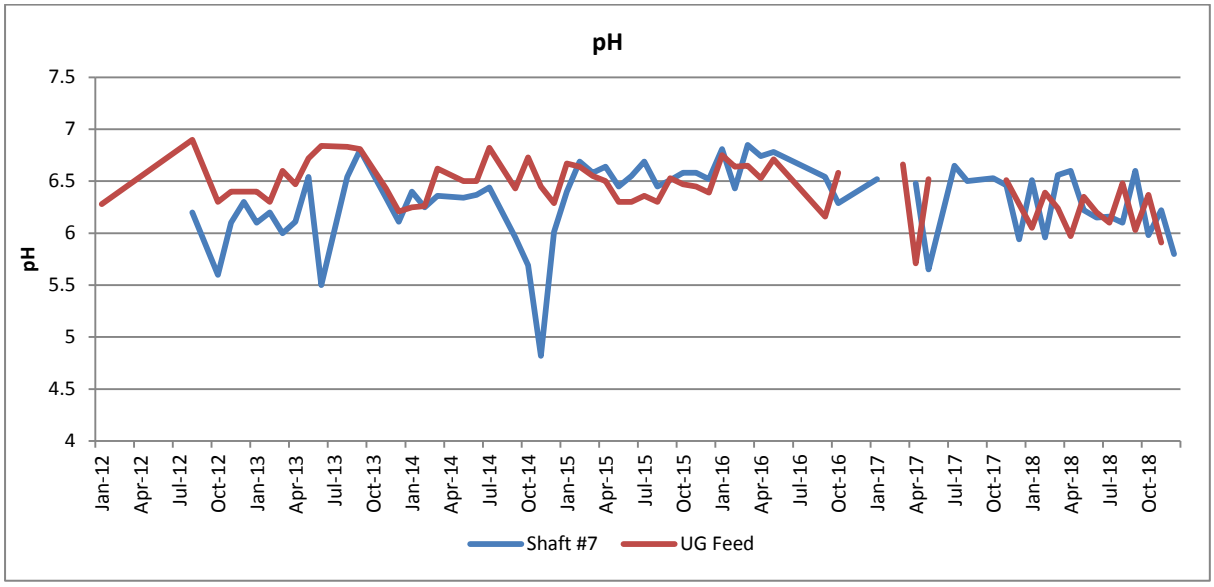

Sodium (mg/L)
mg/L
3500
3000
2500
2000
1500
1000
500
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit

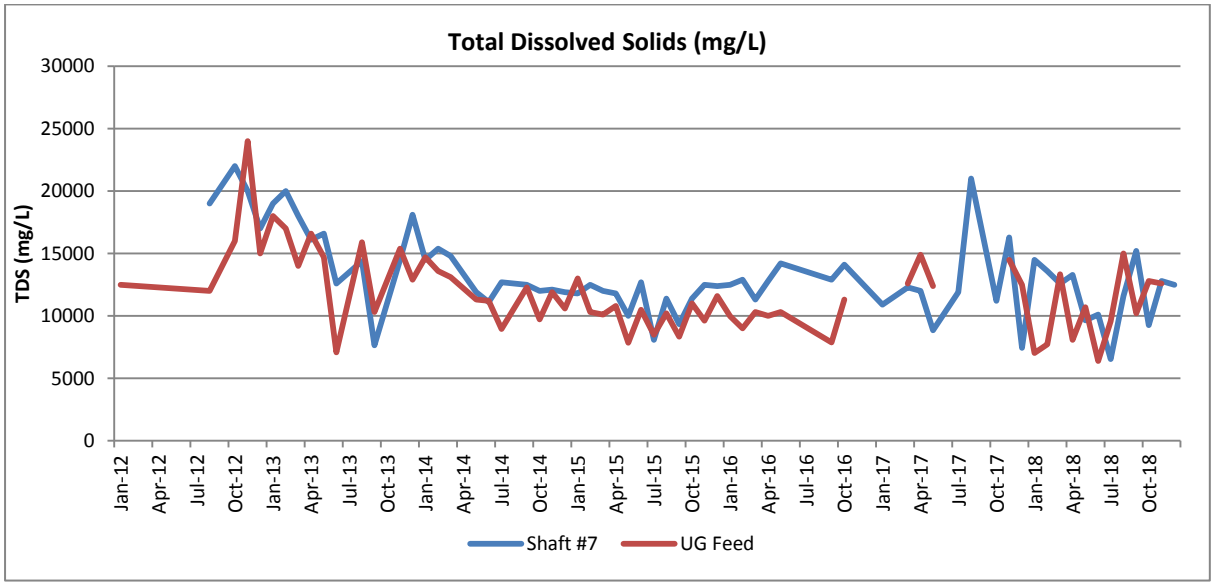

Total Alkalinity (mg/L)
mg/L
70
60
50
40
30
20
10
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit


Sulphate as SO4(mg/L)
mg/L
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit


Chloride (mg/L)
mg/L
3500
3000
2500
2000
1500
1000
500
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit


Electrical Conductivity (uS/cm)
uS/cm
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
Kintore Pit


pH
pH
7.5
7
6.5
6
5.5
5
4.5
4
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
UG Feed


Total Dissolved Solids (mg/L)
TDS (mg/L)
30000
25000
20000
15000
10000
5000
0
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Shaft #7
UG Feed

6.7 Contaminated Land

The majority of the surface land area that makes up the Rasp Mine is contaminated historic mining waste material including waste rock emplacements and tailings.

The storage and handling of diesel fuels, lubricants and oils, and waste rock material are the only aspects of the operation, which have the potential to contribute to contaminated land. The sections below outline how dangerous goods are handled onsite and procedures in place for managing and reporting spills.

6.8 Hydrocarbon and Chemical Management

The main streams of hydrocarbons managed on site include:

- Fuel (diesel) - storage and distribution;
- Grease oils and lubricants - storage distribution and recovery for recycling; and
- Solvents used in the parts washer.

6.8.1 Fuel

Diesel is stored in two tanks each with a capacity of 68,000L. These self-bunded trans-tanks are located adjacent to the workshop and are sitting on a constructed concrete re-fuelling station. The facility has been designed and manufactured in accordance with AS1940 and AS1692. BHOP has provision for diesel storage on its Dangerous Goods Licence, UN 00C1 Diesel 150,000 L. Surface distribution of diesel is by direct collection from the fuel browser. The tanks operate on a float and cut-off system that prevents overfilling of the tanks.

A 10,000L diesel tank was commissioned in October 2017. The tank is situated at the 13L Service Bay underground. It is double skinned and self-bunded.

Rasp's fuel management system enables monitoring of fuel usage by each vehicle and piece of plant. This assists with maintenance and security as well as providing an accurate reporting mechanism for the collecting of data for NPI and NGERS reporting.

6.8.2 Grease, oils and lubricants

Lubricants and oils are stored in individual pods located on a portable bund. A storage facility for these lubricants and oils has been constructed on the western side of the main workshop. It consists of a raised concrete pad incorporating drainage to a sump to facilitate cleaning.

6.8.3 Solvents

Oil solvent used for cleaning of mechanical parts at the workshop is removed by a contractor on a fixed maintenance schedule.

6.8.4 Processing reagent storage

All reagents are stored in a purpose built storage facility designed to prevent contamination and capture spillage.

The reagents stored here include:

- Hydrated Lime
- Copper Sulphate
- Sodium metabisulphite
- Sodium ethyl xanthate
- Flocculant
- InterFroth F228
- Cytec S9232 (zinc collector)
- Antiscalant

- Defoamer
- Zinc Sulphate

All quantities and map with storage locations are reference in the Pollution Incident Response Management Plan which is tested annually and available on the CBH website.

6.9 Hazardous Material Management

6.9.1 Licensing

Rasp holds Licence XSTR100095 for the storage and handling of dangerous goods and Radiation Management Licence 5063802. Additionally, Rasp holds an explosives licence (licence number XMNF200003) to manufacture, possess, store explosives and ammonium nitrate emulsion on site.

6.9.2 Dangerous goods management

Site dangerous goods management is managed according to the site Chemical Management Procedure BHO-PRO-SAF-020.

A Safety Data Sheet (SDS) database for each chemical is maintained. SDS's are kept at each location where chemicals are stored and in the mines rescue room. SDS's are also electronically available on the intranet.

General and contractor inductions outline the required actions in the event of a spill, including completing an Incident Report.

All quantities and a map with storage locations are referenced in the Pollution Incident Response Management Plan, which is tested annually and updated as required.

Storage, management and access to explosives onsite is outlined in the Store, Manage and Access Explosives Standard BHO-STD-MIN-001. A security plan compiled and submitted by the supervising licensee detailing the security measures for explosives on the Broken Hill Operations Pty Ltd, Rasp Mine site. (Document PLN- 03-06-01)

Explosives are stored both on the surface and underground. The surface explosive magazines (SEM) are located within the BHP Pit approx. 3 km north from the main office on Eyre Street. The area encompasses one detonator magazine (IE), one packaged explosives magazine (HE) and one emulsion bulk storage compound. The magazines are separated by a minimum of 7 metres and are bunded in accordance with AS 2187.1. All gates and magazines are secured with locks, and signage that meet the minimum required standards.

The underground explosive magazines (UEM) are located within the underground operations of Broken Hill Operations Pty Ltd, Rasp Mine. Separate storages are utilised for the storage of (IE) and (HE) Explosives Magazines are secured with locks, and signage that meet the minimum required standards.

SEM & UEM keys are locked in a secured key cabinet in the Broken Hill Operations Pty Ltd, Rasp Mine Site Office and are to be issued only by the Emergency Service Officers, who must check the identity and authority of the person wishing to take possession of the keys. The SEM & UEM Explosive Magazine Access Log Book BHO-TRN-REG-004 must be completed prior to issuing and returning the keys. Personnel will only be granted access if they possess a Security Clearance and their name appears on the Key Register (Section 7 of the Site Security Plan).

6.10 Waste Management

Waste management at the mine is classified into two broad categories: mineral wastes (mining and mineral processing wastes discussed above), and non-mineral wastes which include recyclables and non-recyclables.

6.10.1 Mineral wastes

Mineral wastes consist of waste rock from underground workings and tailings residue from the processing of ore.

Waste rock that cannot be returned underground to fill voids is stored in Kintore Pit or used for roads or bunding, following testing and confirmation that it contains less than 0.5% lead. In the reporting period 332,702 t of waste rock was placed underground and 121,864 t was placed on the stockpile/tipple in Kintore Pit.

Tailings is discharged into Blackwood Pit (TSF2) with water recycled for use in processing where possible. In the reporting period 644,828 t of tailings was placed in Blackwood Pit.

6.10.2 Non-mineral waste

Rasp Mine has four main laydown areas where used parts and equipment are stored for future use. The recyclable area has dedicated sections for scrap metal, timber, batteries, rubber, electronic goods and used pods. Used 1000L pods are returned to the manufacturer for reconditioning and reuse or removed by a waste contractor for recycling or disposal.

Waste oil, oily water, coolant, hydrocarbon-contaminated solids (rags, spill control material, etc), grease, oil filters, hydraulic hoses, and batteries are collected by a waste contractor for disposal or recycling.

Paper and cardboard are disposed on in blue recycling bins and skips which are collected by City Council. Printer cartridges are collected in “Plant Ark” disposal bags and delivered to the local Post Office for recycling. Scrap Metal is sold to a local scrap metal merchant.

Waste disposed of in 2018 is summarised in **Table 6-15**.

No tyres were disposed in underground workings during the reporting period. Tyres for heavy mobile equipment have been stored or reused around the mine site for barricades on roadways and within the laydown yards. All other LV and light truck tyres are removed from site under arrangement with the tyre supplier.

Table 6-15 Waste Summary - 2018

Waste	Quantity Disposed
Oil	44,250 L
Oily water	11,000 L
Coolant	2,000 L
Scrap metal	228 t
Grease	8,610 L
Oil filters, hoses,	20 m^3
Contaminated drums/IBC’s	49 m^3
Printer cartridges	8 bags
E-waste	Nil

6.11 Flora and Fauna

The site is a highly disturbed environment that provides little value as native flora and fauna habitat. There have been no threatened flora, fauna or species habitat identified at the Rasp Mine.

6.12 Weeds

During site inspections in 2018, individual Bush Tobacco (*Nicotiana glauca*) trees and a stand of rhizomatous bamboo (likely *Phyllostachys spp*) have been identified for removal in 2019. The Bush Tobacco, which grows along water storages and some isolated locations on dumps, will be removed by cutting at the stump. The bamboo is growing in the Eyre St trench and will likely be sprayed with a Glyphosate-based herbicide.

6.13 Blasting

There are six monitors installed to record blasting vibration and over pressure. Blast monitors are installed at five locations around Broken Hill and there is one monitor located on-site near the core shed (this is used to monitor blast impacts at South Road). Locations are shown on **Figure 6-2**. When a blast complaint is received, the person is given the opportunity to have a roving monitor placed at their location. By doing so BHOP can monitor the impact at the location for a time. Normally, a roving monitor is placed at the complainants' location for at least two months to develop an accurate K Factor, which is used in blast design to predict ground vibration at a set location. BHOP maintains a spare monitor to replace compliance monitors removed for calibration or due to fault, and in 2018 has purchased two monitors to be employed as roving monitors. In April, blast monitor V4 at 123 Eyre St was removed at the residents request and placed at the Eyre St Bowls Club.

Table 6-16 and Table 6-17 lists the criteria for blasting ground vibration and overpressure for Western Mineralisation / Main Lodes (Western Min/Main Lodes) and Block 7, respectively**.**

Table 6-16 Overpressure and Ground Vibration Western Min/Main Lodes (excluding Block 7)

Location	Airblast Overpressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance
Residence on privately owned land (7am-7pm)	115	5	5% of the total number of blasts over a 12-month period[ab]
(7am-7pm)	120	10	0%
(7pm-10pm)	105	-	-
(10pm-7am)	95	-	-
Public Infrastructure[d]	-	100	0%

Table 6-17 Overpressure and Ground Vibration Block 7 (includes Zinc Lodes)

Location	Airblast Overpressure (dB(Lin Peak)	Ground Vibration (mm/s)	Allowable Exceedence
Residence on privately owned land (7am-7pm)	115	3 (interim)[c]	5% of the total number of blasts over a 12-month period[a]
(7am-7pm)	120	10	0%
(7pm-10pm)	105	-	-
(10pm-7am)	95	-	-
Broken Hill Bowling Club, Italio (Bocce) Club, Heritage Items within CML7	-	50	0%
Perilya Southern Operations	-	100	0%
Public Infrastructure[d]	-	100	0%

The Project Approval provides the following notes to these **Table 6-1618** and **6-19:**

a) The allowable exceedence must be calculated separately for development blasts and production blasts;
b) The 5% allowable exceedence does not apply to production blasts until the Proponent has successfully completed a Pollution Reduction Program aimed at achieving this goal, as required by the EPA under the Proponent's EPL (No. 12559), or as otherwise agreed with the EPA;
c) The interim criteria applies unless and until such time that the Proponent has written consent from the Secretary to apply site specific criteria in accordance with condition 19 of this approval; and
d) The Proponent must close South Road to pedestrians if blasts are expected to exceed a peak particle velocity ground vibration of 65 mm/s at the road reserve surface, while the blast firing occurs.

In addition the following conditions also apply:-

- Production blasts may occur between 6.45 am and 7.15 pm on any day
- 1 production blast per day, with 6 per week averaged over a calendar year
- 6 development blasts per day, with 42 per week averaged over a calendar year

In accordance with Project Approval and EP Licence conditions:

- All production-blasting times occurred between 6.45am and 7.15pm on any day.
- Production blasts averaged 4.3 per week over the previous calendar year
- Development blasts averaged 34.2 per week over the previous calendar year

A total of 1,770 blasts were fired during the reporting period, 1,542 for development and 228 for production. **Table 6-19** and **Table 6-21** lists the total number of blasts for each area per month during the reporting period and **Tables 6-20** and **6-22** summarise the blasts over 5 mm/s (Western Min/Main Lodes) and 3 mm/s (Block 7). "No Record" are the number of blasts that did not trigger vibration monitors.

In the Western Mineralisation/Main Lodes mining areas (external to Block 7), 1,755 blasts were fired. Of these, 1,542 were for development and 213 were for production. Seven blasts exceeded 5 mm/s, all recorded from production blasts. The percentage of production blasts exceeding 5 mm/s was 3.3% and the percentage of development blasts was 0.0%, both within the criteria of 5% allowable exceedence.

Table 6-18 Western Mineralisation/Main Lodes Summary of Blasts for Reporting Period (2018)

	Western Mineralisation / Main Lode									
	Production					Development				
	Blasts	< 5	>= 5	>= 10	No Record	Blasts	< 5	>= 5	>= 10	No Record
Jan 2018	20	20	0	0	0	140	0	0	0	140
Feb 2018	17	17	0	0	0	134	4	0	0	130
Mar 2018	19	18	1	0	1	176	4	0	0	172
Apr 2018	16	15	1	0	0	142	2	0	0	140
May 2018	17	16	1	0	0	149	0	0	0	149
Jun 2018	17	17	0	0	0	151	4	0	0	147
Jul 2018	17	16	1	0	1	168	1	0	0	167
Aug 2018	18	18	0	0	0	0	0	0	0	0
Sep 2018	15	15	0	0	0	0	0	0	0	0
Oct 2018	18	18	0	0	0	160	1	0	0	159
Nov 2018	19	18	1	0	0	170	1	0	0	169
Dec 2018	20	18	2	0	1	152	1	0	0	151
TOTAL	213	206	7	0	3	1542	18	0	0	1524

Table 6-19 Western Mineralisation/Main Lodes Blasts > 5 mm/s for the Reporting Period (2018)

Production	Blasts >5 mm/s	Result	Development	Blasts >5 mm/s	Result	TOTAL	Blasts >5 mm/s	Result
213	7	3.3%	1542	0	0%	1755	0	0.0%

The EPA had imposed a Pollution Studies and Reduction Program (PRP) - Blast Compliance Management Program, U1 in EPL 12559, requiring BHOP to implement a production blast management program directed at achieving compliance with EPL Condition L5.1 - where the limit allows a 5% exceedence of the 5 mm/s ground vibration impact at any sensitive receptor outside the premises. BHOP were able to meet the requirements of the PRP by meeting the limits in the 2017/2018 reporting period. However, BHOP failed to produce and submit an annual production blast management report for the 2016/2017 period as required by the PRP and was issued with a Show Cause notice by the EPA. A report for the 2016/2017 period was issued to the EPA in December 2018, and report for the 2017/2018 period was supplied with the 2017/2018 Annual Return.

All criteria were met for the Western Mineralisation / Main Lodes during the reporting period.

In Block 7 mining areas (including the Zinc Lodes), a total of 20 blasts were fired during the reporting period. Of these, 5 were for development and 15 were for production. Two blasts exceeded 3 mm/s, all recorded from production blasts. The percentage of production blasts exceeding 3 mm/s was 13.3% and the percentage of development blasts exceeding 3 mm/s was 0.0%. In November 2018 it was determined that the percentage of production blasts exceeding 3 mm/s was over the allowable limit of 5% for the EPL 12559 reporting period and the EPA were notified of the exceedence and non-compliance with condition L5.2 of EPL 12559 on 8 November 2018. The last blasts to exceed 3mm/s were in January 2018 and the last blasts in the Block 7 area were in July 2018.

Table 6-20 Block 7 (and Zinc Lodes) Summary of Blasts for the Reporting Period (2018)

	Block 7 (includes Zinc Lode)									
	Production					Development				
	Blasts	< 3	>= 3	>= 10	No record	Blasts	< 3	>= 3	>= 10	No Record
Jan 2018	4	2	2	0	0	0	0	0	0	0
Feb 2018	2	1	0	0	0	0	0	0	0	0
Mar 2018	5	0	0	0	0	1	0	0	0	1
Apr 2018	3	0	0	0	0	2	0	0	0	2
May 2018	0	0	0	0	0	0	0	0	0	0
Jun 2018	0	0	0	0	0	0	0	0	0	0
Jul 2018	1	1	0	0	0	2	0	0	0	2
Aug 2018	0	0	0	0	0	0	0	0	0	0
Sep 2018	0	0	0	0	0	0	0	0	0	0
Oct 2018	0	0	0	0	0	0	0	0	0	0
Nov 2018	0	0	0	0	0	0	0	0	0	0
Dec 2018	0	0	0	0	0	0	0	0	0	0
TOTAL	15	4	2	0	9	0	0	0	0	0

Table 6-21 Block 7 Blasts Exceeding 3 mm/s for Reporting Period (2018)

Prod	Blasts >3 mm/s	Result	Dev	Blasts >3 mm/s	Result	TOTAL	Blasts >3 mm/s	Result
15	2	13.3%	11	0	0%	100	3	0.0%

Table 6-22 lists the highest recorded results for ground vibration (mm/s) at each of the vibration monitors.

Table 6-22 Ground Vibration Results at Vibration Monitors for the Reporting Period (2018)

Vibration Monitor/Location	Highest Recorded Ground Vibration (mm/s)
V1 Silver Tank (located on CML7)	3.31
V2 Hire yard	7.7
V3 Air Express	5.28
V4 123 Eyre St / Bowls Club	1.99
V5 80 Eyre St	3.45
V6 BHOP Core Shed (located on CML7)	13.93

All blasts recorded off-site were under 10 mm/s.

There were no exceedances of criteria for overpressure levels.

6.14 Operational Noise

During the reporting period, noise was generated by operational activities, movement of heavy vehicles and delivery trucks leaving and entering site.

Noise monitoring is completed annually at noise monitoring locations shown together with the relevant location criteria in **Table 6-23**.

During the reporting period EMM Consulting Pty Ltd conducted a noise assessment for these receptors, **Figure 6-21**. Attended noise monitoring was conducted during two consecutive night-time periods from 10 to 12 December 2018 to quantify off-site noise levels from the Rasp Mine. While the EPL nominates noise limits for day, evening and night, attended monitoring was completed during the night-time period to minimise the contamination of monitoring data by extraneous noise sources (eg domestic and road traffic noise).

A total of 28 operator-attended noise measurements were completed, including two measurements at each of the 14 monitoring locations. For 11 out of the 28 samples (39%), the wind speed was above 3 m/s and therefore the noise limits did not apply for these samples according to the site's EPL. Site noise was inaudible during both measurements at locations A2 and during one of two measurements at A1, A3, A6, A7, A10, A11 and A12. Noise monitoring results are shown in **Table 6-24**.

Figure 6-21 Noise Receptors 1

Low frequency noise was assessed by using the Noise Policy for Industry (NPfI) (EPA 2017) methodology for each attended measurement and for audible contributions only. Low frequency noise, as defined in the NPfI, was identified during one of the attended measurements at location A13, and hence a modification factor (ie 2 dB) was added to the relevant site LAeq noise contribution.

Rasp Mine LAeq,15min noise contributions (including the addition of the relevant modification factor) satisfied the relevant night-time noise limits at all assessment locations, including during attended measurements when noise limits did not apply due to adverse weather conditions

One noise complaint was made during the period and this related to a reversing beeper that could be heard during construction of the Concrete Batching Plant. The contractor operating the offending vehicle immediately removed the vehicle from site and the beeper was replaced with a squawker-type reversing beeper.

Noise attenuation measures on site include:

- Plant and equipment operator training. This included correct gear selection to minimize noise emission, retraining in travelling haul road procedure and educating personnel of the noise criteria for site.
- The use of an “ice-creaming” technique when loading the crusher allows the crusher to be loaded to maximum capacity at all times reducing the noise generated by rock fall onto the grizzly. “Ice-creaming” is where the crusher bin volume is maintained at a high level by the ROM front end loader.
- Optimisation of haul truck speed and gear changing via the use of intermediate markers along haulage route.
- Extension of both length and height of the existing earth bund along the southern haul road (from Kintore Pit to ROM pad).
- Installation of noise abatement material in the crusher house.
- A 2.5 m high by 6 m long tyre wall was constructed to reduce noise transition from the filtration area of the processing plant.

Table 6-23 Operational Noise Criteria

Location	Day (dB(A))	Evening (dB(A))	Night (dB(A))
A1 – Piper Street North	38	37	35
A2 – Piper Street Central	38	37	35
A3 – Eyre Street North	44	41	39
A4- Eyre Street Central	44	41	39
A5 – Eyre Street South	44	41	39
A6 – Bonanza and Gypsum Streets	48	41	39
A7 – Carbon Street	35	35	35
A8 – South Road	48	39	39
A9 – Crystal Street	46	39	39
A10 – Barnet and Blende Streets	42	41	35
A11 – Crystal Street	46	39	39
A12 – Crystal Street	46	39	39
A13 – Eyre Street North 2	38	35	35
A14 – Piper Street North	35	35	35

Table 6-24 Noise Monitoring Results

Location	Date	Start	LA_{EQ}	LA_{MAX}	Rasp contribution $LA_{EQ(15\text{-}min)}$	Criteria	Compliant
A1	11/12	02:42	**38**	**46**	IA	35	Y
A1	12/12	01:09	**40**	**61**	<34	35	Y
A2	11/12	03:09	**41**	**52**	**IA**	35	Y
A2	12/12	01:09	**54**	**79**	**IA**	35	Y
A3	11/12	03:33	**53**	**80**	**<25**	39	Y
A3	12/12	01:28	**46**	**70**	**IA**	39	Y
A4	11/12	03:52	**48**	**73**	**<20**	39	Y
A4	12/12	01:46	**46**	**79**	**<30**	39	Y
A5	11/12	04:11	**52**	**76**	**<29**	39	Y
A5	12/12	02:07	**48**	**69**	**<29**	39	Y
A6	11/12	04:30	54	**76**	**<28**	39	Y
A6	12/12	02:27	44	**69**	**IA**	39	Y
A7	11/12	04:53	**42**	**56**	**<34**	35	Y
A7	12/12	02:52	**34**	**48**	**<24**	35	Y
A8	11/12	05:18	**45**	**67**	**<32**	39	Y
A8	12/12	03:13	**51**	**71**	**<24**	39	Y
A9	11/12	22:47	**56**	**79**	**<35**	39	Y
A9	12/12	03:31	**49**	**75**	**<27**	39	Y
A10	11/12	**23:11**	**48**	**68**	**IA**	35	Y
A10	12/12	**03:54**	**45**	**72**	**<20**	35	Y
A11	11/12	23:31	**65**	**92**	**IA**	46	Y
A12	11/12	23:49	**51**	**73**	**IA**	46	Y
A13	11/12	01:36	45	70	<22	35	Y
A14	11/12	02:14	47	70	<30	35	Y

IA: Inaudible

6.15 Visual, Stray Light

Light towers around machinery, where practicable, are designed to face light away from residents.

There were no light complaints for the reporting period.

6.16 Indigenous Heritage

There are no known significant indigenous sites within CML7.

6.17 Natural and Social Heritage

6.17.1 Conservation management strategy

The Conservation Management Strategy draft has been developed however cannot be finalised until the Line-of-Lode Interagency Panel provides advice.

An Options Analysis Study for mine closure is being developed along with recommendations for rehabilitation methods and trials.

6.18 Spontaneous Combustion

Products with high sulphur content (tailings, ore and concentrate) are prone to spontaneous combustion. Combustion is caused by the oxidation of the sulphides, which is an exothermic chemical reaction that causes heat build-up, and the remaining sulphides begin to start smouldering.

In extreme cases the sulphides may burn producing a flame. Requirements for combustion to occur are high sulphur material, oxygen, moisture and sufficient material to generate heat build-up.

No incidences occurred during the period.

6.19 Bushfire

No bushfires affected the site during the reporting period. Broken Hill and surrounding areas have limited potential for bushfires due to the lack of suitable fuel.

The Rasp Mine has a fully equipped fire truck available at all times to respond to fires and has a trained mines rescue team for firefighting. There are fire hydrants and hoses installed at strategic locations across the mine site and within vehicles with deluge systems installed on loaders and in the underground fuel bay.

6.20 Mine Subsidence

Monitoring occurs on Bonanza St/South Road to detect any movement that may be associated with mining activities in the Zinc Lodes.

Surveying results indicate that most of the detected “movement” is due to instrument set-up errors, atmospherics etc. This is evidenced by the fact that the plot for each prism vector looks very similar to the same vector for the other prisms (i.e. all northing plots look the same, all easting plots look the same) indicating that the errors affect all prisms. Mining in the area of the Zinc Lodes has now been completed with the exception of some minor remnant ore extraction, BHOP will continue to monitor road movement and has back-filled the mining/production voids in this area.

No subsidence from mining activities was detected in the reporting period.

6.21 Methane Drainage/Ventilation

As the nature of the mine is not gassy (e.g. coal mine), there are no permanent methane monitoring locations. However, all personnel carry gas monitors while performing the following underground activities to monitor any hazardous gases:

- All production rigs while drilling;
- All production loaders(Boggers) while bogging;
- All Jumbos;
- Vent Officer while doing vent surveys;
- Re-Entry Crews while performing re-entry; and
- Service crew when required.

6.22 Public Safety

All active mine areas of the Rasp Mine site are signposted and fenced to restrict any unauthorised access.

Visitors to the mine are only allowed on site with management approval and are required to undertake a visitor briefing (induction), and are accompanied by a site representative at all times. Visitor briefing cards are distributed to ensure key information is readily at hand for visitors. Visitors must follow site policies and conform to personal protective equipment (PPE) requirements.

All employees and contractors complete a general induction and work area specific inductions where required (e.g. underground, mill).

6.23 Radiation

BHOP has a Radiation Management Licence, RML5063802 current until 26 July 2019. The Licence permits BHOP to “sell, possess, store or give away regulated material (including radiation apparatus, radioactive substances or items containing radioactive substances)”.

Radiation is used in gauges in the processing plant to measure slurry density and identify the percentage of lead/zinc/iron. Radiation is used by technical services to identify the percentage of lead/zinc or other materials. The Rasp Mine Radiation Management Plan outlines how radiation and radiation equipment must be used, stored and disposed. An external contractor conducts biennial inspections of the individual radiation gauges on site while the site RSO conducts semi-annual inspections. During the reporting period no issues were identified during inspections and audits in relation to their use.

The Rasp Mine Radiation Store meets the requirements for storage of fixed radiation gauges, Code of Practice for the Safe Use of Fixed Radiation Gauges, ARPANSA. The Radiation Store is of solid construction (historically in the early 1900's it was used as an explosives magazine store) and is located on the side of a hill so it is not prone to flooding. It is clearly signed and is not accessed by the public.

No radiation apparatus was dismantled during the reporting period. SGS are contracted to conduct inspections of individual radiation gauges on site. They are scheduled to conduct the next inspection in June 2018.

Table 6-25 lists the regulated materials (fixed radiation gauges) that make up the schedule to the licence.

Table 6-25 Regulated Radiation Equipment

Location	Rasp Mine Asset Number	Type	Equipment	Components	Purpose
Mill - Flotation building	2321727346	Radiation apparatus	X-RF	- Control console / generator - X-ray tube insert	Analysis of materials
Primary cyclone feed	1566643388	Sealed source device	Fixed Radiation Gauge	- Container - Sealed source	Density gauge
Backfill plant-transfer pump discharge	1570661547	Sealed source device	Fixed Radiation Gauge	- Container - Sealed source	Density gauge
Admin Bld, Geological vault	2321727385	Radiation apparatus	X-RF	- Control console / generator	Analysis of materials
Radiation Store 'REMOVED FROM SERVICE'	1570661354	Sealed source device	Fixed Radiation Gauge	- Container - Sealed source	Density gauge

7. WATER MANAGMENT

Raw water and potable water are supplied by Essential Water with take off valves at the Eyre Street entrance to the Rasp Mine. Raw water, water from the town supply, is supplied untreated to the mine site via existing connections.

Potable water is supplied direct from the town supply and is used for drinking, safety showers and in the crib rooms and change houses. Water from the town supply is treated at the Mica Street treatment plant and supplied to the Project via existing connections and is used for showers, toilets, and laundry. Average annual usage of potable water is 9 ML supplying the offices, workshop, core shed and processing facility.

BHOP are required to dewater the mine workings to ensure the safety of both the employees at the adjacent Perilya South Mine and its own employees. This water is extracted under licence and can be used on the Rasp Mine site or transferred for use at the Perilya operations.

Water is reclaimed onsite from various sources to be recycled for the Project, mainly from underground dewatering. If necessary, the reclaimed water is treated onsite to ensure that it is

suitable for use as process water in both the processing plant and underground operations. Reclaimed water is returned after treatment to the process water tank which has a three hour holding capacity or to the Silver Tank which has a capacity of 8 ML.

The sources for the reclaimed water include:

- No. 7 Shaft dewatering;
- Underground mine operations dewatering;
- TSF decant pond; and
- Stormwater containment dams (only during extreme rain events)

The Rasp Mine has installed a number of water meters to monitoring water supplies and movements these are listed in **Table 7-1**.

Table 7-1 Flow Meters and Recording Frequency

Flow Meter	Recording Frequency
Underground supply	Weekly
Mill supply	Weekly
Concentrate shed	Weekly
Raw water supply	Weekly
Mine water (U/G water & Shaft 7)	Weekly
Evaporation dam pump well	Weekly
Patto's Pond	Weekly

Raw water used during the period was 353ML, increased from 298 ML used in the previous period. This was primarily due to the increase in throughput through the mills, resulting in pumps running longer, more gland water and reagent mixing, when compared to the previous reporting period.

Potable water used during the period was 11.7 ML, increased from 9.95 ML used in the previous period due to an increase in personnel and contractors.

BHOP has a water extraction licence, 85BL256102, to extract by active pumping 370 ML pa.

Table 7- provide details for this licence and water pumping. The level of pumping is required to maintain the safety of personnel working underground at both the Rasp Mine and the adjacent Perilya South Mine.

Table 7-2 Water Extraction and Return during the Period (2018)

Location	Total extracted (L)	Storage Location	Total Stored as at 30 June 2018
Shaft 7	225,827,000	**S22**	0
U/G Dewatering	455,125,000	**S22A**	0
Used U/G	310,473,000	**TSF Decant**	0
Used Mill	335,710,000		
Perilya	0		

Note 1: Suspect over estimate due to intermittent pumping which results in the pipe where the meter is installed not always being full, however, both flow meters install in this pipe (mechanical and ultrasonic) continue to record even under low / insufficient flows. The meter readings are used as a guide to indicate pumping flowrate as opposed to volume being pumped from underground.

No water was transferred to Perilya South Mine Operations, during the reporting period.

8. REHABILITATION

8.1 Buildings

The Concrete Batching Plant was completed in August 2018 with the installation of enclosed loading shed, concrete storage bunkers, loading hopper, maintenance workshop and conveyor.

8.2 Rehabilitation and Disturbed Land

Dust deposition gauges were installed on top of Mt Hebbard in October 2017 as part of the waste rock trial to be undertaken in this area in 2018. It was proposed in the MOP to install the gauges to monitor current dust conditions for a 12 month period, then place the waste rock and re-install the gauges for another 12 month period and compare results. AS BHOP are still developing an updated waste rock testing procedure and are unable to crush extracted material (waste rock) on the surface, waste rock has not yet been applied to the surface of Mt Hebbard. As 12 months of dust results had been collected from the Mt Hebbard dust gauges, dust suppressant was applied at the end of 2018 to control dust as the surface of Mt Hebbard is one of the “free areas” identified on the site to be potential contributors of dust to the surrounding environment.

External assessments for buildings damaged during the 2016 hail storm were completed in 2018. The rooves of the administration buildings and core storage shed (No 4 Shaft Changehouse) are to be replaced with colourbond to maintain the current design and colour of the buildings’ rooves. The roof vents and other fixtures will be removed before works begin, and will be replaced once they are completed. BHCC have advised BHOP that under LEP section 5.10 subclause 3 development consent to repair/replace the rooves of the heritage-listed buildings will not be required as the works are for maintenance and will maintain the appearance of the buildings. During the inspections, asbestos was identified in the ceilings of Radford House and the No 4 Shaft Changehouse. A licenced asbestos removal company removed the asbestos from the ceiling of the Changehouse in 2018. The changehouse was sealed whilst work was conducted, monitoring was conducted around the perimeter of the changehouse, and the asbestos sheeting was wrapped and disposed of to a licenced facility. Asbestos lagging in the ceiling of Radford House will be removed when the roof is replaced.

Table 8-1 and **Table 8-2** detail disturbed areas. No new areas were disturbed during the reporting period.

Table 8-1 Rehabilitation Summary

	Area Affected / Rehabilitated (hectares)		
	To date 1/1/2018-31/12/2018	**Last Report 1/1/2017-31/12/2017**	**Next Report 1/1/2019 – 31/12/2019**
A: MINE LEASE AREA			
A1 Mine lease(s) Area	226.4	226.4	226.4
B: DISTURBED AREAS			
B1 Infrastructure area (other disturbed areas to be rehabilitated at closure including facilities, roads)	64.5	64.5	64.5
B2 Active Mining Area (excluding items B3 – B5 below)	11.5	11.5	11.5
B3 Waste emplacements, (active / unshaped / in or out-of-pit)	2.27	1.92	2.27
B4 Tailings emplacements (active / unshaped / uncapped)	3.8	3.8	3.8
B5 Shaped waste emplacement (awaits final vegetation)	0.0	0.0	0.0
ALL DISTURBED AREAS	77.2	77.2	77.2
C REHABILITATION			
C1 Total Rehabilitated area (except for maintenance)	149.1	149.1	149.1
D REHABILITATION ON SLOPES			
D1 10 to 18 degrees	4.1	4.1	4.1
D2 Greater than 18 degrees	14.7	14.7	14.7
E SURFACE OF REHABILITATED LAND			
E1 Pasture and grasses	N/A	N/A	N/A
E2 Native forest / ecosystems			
E3 Plantations and crops	2.6	2.6	2.6
E4 Other (include non-vegetative outcomes)	151.3	151.3	151.3

Table 8-2 Maintenance Activities on Rehabilitated Land

	Area Treated (ha)		
NATURE OF TREATMENT	**Report Period**	**Next Period**	**Comment / control strategies / treatment detail**
Additional erosion control works (drains re-contouring, rock protection)	0	0	N/A
Re-covering (detail further topsoil, subsoil, sealing etc)	0	0	N/A
Soil treatment (detail – fertiliser, lime, gypsum etc)	0	0	N/A
Treatment / Management (detail – grazing, cropping, slashing etc)	0	0	N/A
Re-seeding / Replanting (detail – species density, season etc)	0	0	N/A
Adversely Affected by Weeds (detail – type and treatment)	0	0	N/A
Feral animal control (detail – additional fencing, trapping, baiting etc)	0	0	N/A

9. COMMUNITY RELATIONS

9.1 Environmental Complaints

During the period of the AEMR, BHOP has maintained a register for community complaints and concerns which is available on the CBH website.

A total of sixteen complaints were received over the reporting period; ten relating to blasting vibration, one for noise, three for dust emissions, one for dust and surface mining, and one for mining of the slag heap. **Table 9-1**. All complainants if requested and if details were provided.

The complaint regarding the mining of the slag heap visible from Crystal St was received by the BHCC and passed on to BHOP. BHOP responded with a report containing photos showing no mining or other disturbance had taken place.

In October 2018 a complaint regarding dust and surface mining was made to the EPA. No surface mining was taking place in the area indicated although exploration drilling had been occurring in the area. Claims were made that dust could be generated in eroded material at the foot of the slag heap although the much of the material collecting there is sandy in composition. An EPA officer inspected both sites in October and BHOP applied dust suppressant to the base of the slag heap.

A complaint was made regarding smoke emanating from site during a fire training exercise when a car body was set on fire. On this occasion, the local emergency response units were notified beforehand.

The majority of complaints were made due to blast vibration and where requested a blast monitor was placed at the complainants location for at least two months. Two months is considered the minimum amount of time for a suitable K Factor to be developed for the location to be used in calculating vibration impacts at the location from future blasts. Results in the form of a letter and a visit by BHOP staff are provided to the complainants after the blast monitor is collected from the complainants' location

Table 9-1 Complaints register

Date	Complaint Type	Information
8 January 2018	Noise	A complaint by phone was made to the Senior Environmental Officer directly. The complainant called regarding excessive noise due to a beeping reverse alarm coming from the construction site for the Concrete Batch Plant. The incident was investigated and corrective actions put in place to ensure that all vehicles were fitted with a squawker type reverse alarm.
23 January 2018	Dust	A complaint by phone was made to the Senior Environmental Officer directly. The complainant called regarding dust generation at the construction site for the Concrete Batch Plant. The dust was caused by the tipping of waste rock to form the noise bund. The incident was investigated and corrective actions put in place to ensure that waste rock was wetted prior to loading on to truck.
27 April 2018	Vibration	A complaint was made via the BHOP complaints line and BHOP notified the EPA. The complainant from Williams St reported damage to the property as a result of blast vibration on 27 April at 7:00pm. The residence is 1.5Km from the nearest blast monitor which recorded a peak blast vibration of 0.92mm/sec for this event which is below licence limits. This was discussed with the resident.
23 May 2018	Vibration	A complaint was made via the BHOP complaints line and BHOP notified the EPA. The complainant reported damage had occurred to the property through years of exposure to blast vibration. BHOP staff visited the complainant on 24 May. A blast monitor was installed at the residence from 14 June to 24 July and results were provided to the complainant.
6 June 2018	Mining of Slag Heap	BHCC received a complaint of mining on the Slag Dump beneath the Miner's Memorial and the potential release of hazardous materials in the process. A report with supporting photographs was provided to the BHCC on 8 June showing that no mining activity has been conducted on the Slag Heap.

Date	Complaint Type	Information
3 July 2018	Vibration	A complainant contacted the EPA with concerns that blasting was causing damage to their house. The residence was visited by BHOP staff on 4 July. A Blast monitor was installed at the premises between 20 July and 24 December. Results were provided to the complainant. Blast monitoring data was provided upon request to the EPA on 3 July.
3 July 2018	Vibration	A complainant contacted the EPA regarding the blast of 28 July 2018 at 6:45pm and others that have been felt at the residence. No location or contact details were provided. Blast monitoring data was provided upon request to the EPA on 3 July.
3 July 2018	Vibration	A complainant contacted the EPA as they were concerned the blasting is causing damage to their house. Residence visited by BHOP staff on 4 July. No further action was required by the complainant. Blast monitoring data was provided upon request to the EPA on 3 July.
17 July 2018	Vibration	A complainant called to inform BHOP of effects of the previous night's blast. No further action requested.
26 July 2018	Smoke from site	A complainant contacted BHOP to complain of smoke emanating from site during an Emergency Response Team training exercise where a car was set alight and extinguished. Authorities were notified prior to the exercise taking place.
10 September 2018	Vibration	A complainant contacted BHOP regarding blast vibration at their premises and potential damage. The residence was inspected by BHOP staff on 11 September. A blast monitor was installed at the residence on Monday 5 November.

Date	Complaint Type	Information
13 September 2018	Vibration	A complainant contacted the EPA about blast vibration from an unspecified mine site. Blast reports were provided to the EPA upon request, which showed there were no exceedences of blast limits at any monitor. An attempt has been made to contact the complainant without a response or return call.
22 October 2018	Dust and Surface Mining	A complainant contacted EPA regarding potential for material at the base of the Slag Heap on Federation Way to cause dust, and alleged that mining activities were being conducted on Slag Heap on Federation Way. The EPA notified BHOP of the complaint on 22 October 2018. BHOP staff inspected both locations on 22 October, took photos, and sent them to the EPA to confirm no dust was being generated and no mining activity was occurring on the Slag Heap. An EPA officer inspected the sites with BHOP staff on 25 October. The visit confirmed no dust was being generated from the base of the Slag Heap and no mining activities were being conducted on the Slag Heap. At the request of the EPA, BHOP applied dust suppressant to the base of the Slag Heap on 2 November 2018 to prevent the potential generation of dust.
9 November 2018	Dust Emissions	A complainant contacted the EPA regarding dust emissions from the Main Vent. Video provided by the complainant was likely taken following a blast. BHOP staff and EPA officers observed the Main Vent following a blast on 19 November. Additional inspections and scheduled emissions testing were conducted in December. Quarterly emissions testing results are reported in the Monthly Monitoring Reports provided on the Rasp Mine website and have been complaint with approval and EPL limits. A mine ventilation consultant has been engaged to review dust control methods for the Primary Shaft. Water sprays are fitted around the inside of the shaft exit and are inspected regularly.
16 December 2018	Vibration	A complainant contacted the EPA about blast vibration from an unspecified mine site blasts potentially causing damage to the ceiling of a room and cracking in retaining walls and requested a blast monitor be placed at the residence. Blast reports were provided to the EPA upon request which showed there were no exceedences of blast limits

Date	Complaint Type	Information
		at any monitor. The residence was inspected by BHOP staff on Wednesday 19 December. A blast monitor was installed at the residence on Friday 21 December.
31 December 2018	Vibration	A complainant contacted BHOP about blast vibration from an unspecified mine site blasts potentially causing damage to the front verandah and requested a monitor be placed at the residence. The residence was inspected by BHOP staff on Thursday 3 January 2019. A blast monitor was installed at the residence on Friday 4 January 2019.

All blasts were found to be compliant with the applicable licence limits. The finalised data was distributed to the EPA and the affected resident.

9.2 Community Liaison

During the period of the AEMR, BHOP has conducted direct and indirect consultation with neighbours, members of the public, local community organisations, state government agencies and local council.

The major stakeholders include:

- Broken Hill City Council (BHCC)
- Department of Industry Resource (DIR)
- Environment Protection Authority (EPA)
- Department of Planning and Environment (DPE)
- Department of Industry- Lands (DI-L)
- Essential Energy
- Essential Water
- Australian Rail Track Corporation Ltd (ARTC)
- Roads and Traffic Authority (RTA)
- Broken Hill Health Service, Child and Family Health Centre

The following community communication activities occurred during the period:

- BHOP was represented at all meetings of the BHCC Lead Reference Group.
- Child and Family Health Centre Lead Week – BHOP participated in the 2018 Lead week program and provided water, fruit, a fruit or vegetable seedling, and bags for these items and information pamphlets provided by the Leadsmart group.

9.3 Community Support

During the reporting period, Rasp provided financial support to:

- Local high Schools for their presentation nights and awards.

Moving forward BHOP will focus on supporting local education and major events that support the promotion of the Broken Hill Community.

BHOP will fund a project proposed by the Broken Hill Lead Project for a 2019 pilot study to assess whether an intensive cleaning education package reduces indoor lead hazards and improves the lead safety of household cleaning products.

10. INDEPENDENT AUDIT

There was no independent audit during the reporting period.

11. INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

Environmental incidents are reported using the Rasp Incident Reporting Procedure BHO-SAF-PRO-101. A summary of the incidents for the reporting period are presented in

Table 11-1. BHOP maintains a Pollution Incident Response Management Plan BHO-ENV-PLN-002 on the CBH website in accordance with EPA requirements.

There were no externally reportable incidents (not including non-compliances) during the reporting period.

Twenty-five internal environmental incidents (not including complaints or non-compliances) were reported during the reporting period. Three incidents related to the spills in the mill area and one noise exceedence.

Table 11-1 Environmental Related Incidents for Reporting Period

Date	Event #	Brief Description
31-Jan-18	2500	Leaking oil drum; small volume <5L; cleaned up.
15-Feb-18	2504	Blocked ball mill grate resulted in spillage. <10L. Material recovered.
15-Feb-18	2506	Overflow of slurry due to power loss. <200L. Slurry recovered.
16-Mar-18	2615	Blocked tails thickener resulted in spillage of slurry outside of bunded area. <200L. Tailings recovered.
6-Apr-18	2741	Hole in tailings discharge valve resulted in tailings spill outside of bunded area. Tailings recovered.
8-May-18	3080	Holed tails discharge line caused pillage outside of bunded area. <200L. Tailings recovered.
15-May-18	3113	Lime powder spillage outside of bunded area. <10kg. Lime recovered.
8-June-18	3236	Lime spillage outside bunded area due to screw feeder blockage. <200L. Material recovered.
12-June-18	3243	Lime spillage outside bunded area due to sock detachment.
27-June-18	3422	Lead concentrate spilled outside of bund wall due to hole in sump pump.
28-June-18	3425	Evidence of leaking hydrocarbon bund and spillage. Minor amount. Maintenance reviewing design.
28-Jun-18	3428	Vehicle bypassed wash bay when leaving site. Stopped and asked to return to site. Reminder provided at toolbox talks.
8-July-18	3451	Lime spillage outside of bund area when lime sock blew off tank. <10kg. Material recovered.
20-Jul-18	3644	Spill of copper sulphate due to damaged bags. <50L. Material recovered.
23-July-18	3657	Lime spill outside of bunded area due to feed chute failure. <50kg. Material recovered.
25-July-18	3665	Incoming raw water line gasket failed resulting in release of raw water offsite to stormwater drain. Valve isolated within 30 minutes and gasket replaced. EPA notified.
4-Aug-18	3704	Lead concentrate spilled outside bunded area due to filtrate hopper overflow. <200L. Material recovered.
17-Aug-18	3768	Zinc slurry spilled outside bunded area. <50L. Material recovered.
2-Sept-18	3857	Slurry spilled outside bunded area due to trash screen trip.5000L. Material recovered.
6-Oct-18	4009	Spillage of Lead concentrate outside bunded area due to burnt belts. <50L. Material recovered.
7-Oct-18	4014	Hydrocarbon spill due to damaged pod. Minor. Contaminated material removed.
10-Nov-18	4140	Lead slurry spilled outside bunded area. <50L. Material recovered.
19-Nov-18	4256	Ore spillage due to bypass opening. <500kg. Material recovered.
29-Nov-18	4309	Lead concentrate slurry spillage outside bunded area. <50L. Material recovered.
30-Dec-18	4423	Lead concentrate spillage outside of bunded area. <100L. Material recovered.

The Pollution Incident Response Management Plan was tested in June 2018, in accordance with the requirements of EPL 12559.

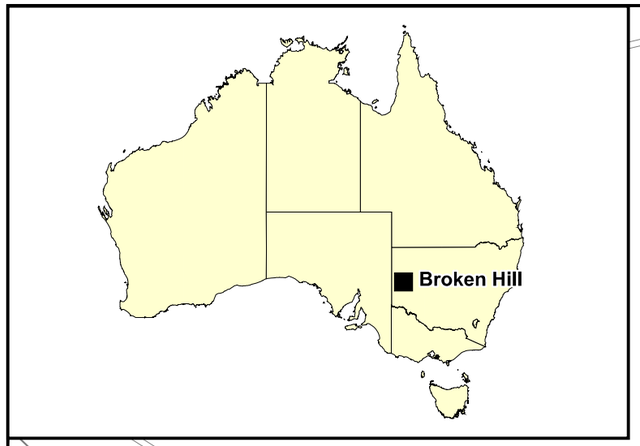
12. ACTIVITIES PROPOSED IN THE NEXT AEMR PERIOD

The following lists the proposed activities during the next AEMR period in line with the MOP some of these activities continue into the next reporting period:

- Engage with stakeholders regarding the draft CMP content as well as the concept for post-mining land uses following outcomes from the inter-governmental consultation and review. This will form part of the Rehabilitation Strategy to be developed and submitted to DRG. This is dependent on receiving advice from DRG following the inter-government discussions.
- Develop in consultation with stakeholders the Rehabilitation Management Plan to be completed within 6 months of the approval of the Rehabilitation Strategy. This is dependent on receiving advice from DRG following the inter-government discussions.
- Complete an options analysis into various dust management approaches.
- Inspect all heritage structures and install identification signage on those items where signage is deficient or lacking, continued from 2018.
- Explore potential revegetation trials as outlined in the options analysis
- Undertake further sampling of surface materials to confirm lead levels which will assist in prioritising placement of waste rock/capping material and prioritise rehabilitation activities..
- Plan to remove goats from within the CML7 fenced area, annual program.
- Waste-rock capping of Mt Hebbard.
- Undertake on-going maintenance and inspections of heritage buildings as required.
- Continue application of chemical dust suppressant to 'free areas' of the site to minimise dust generation, including the trialling of an alternative product for unsealed roads.
- Eyre Street dam project, remove contaminated bunding and materials from the dam and cap the area with suitable waste rock or revegetate the area or a mixture of the two. Sampling of rain runoff will be taken to assess if water quality has improved.
- Ryan Street dam project – BHOP has engaged consultants to determine and advise on appropriate closure strategies for this area. Water sampling of rain runoff will also be undertaken for rainfall events to confirm level of rainwater contamination.
- Weed control.
- Sediment removal in water storages.

PLANS

Plan 1a
Mine and Context - Location



CML7

MUNICIPAL BOUNDARY

PROJECT: **BHO CBH Rasp Mine Closure Plan**

TITLE: Location of BHO CBH - Rasp Mine

DATE: 8th July 2015 **SCALE:** 1:60,000 at A3

DATA SOURCE:

-1 0 1 2

Kilometres

Mining Titles, Cadstre and Local Government Areas supplied by the NSW Government

LEGEND

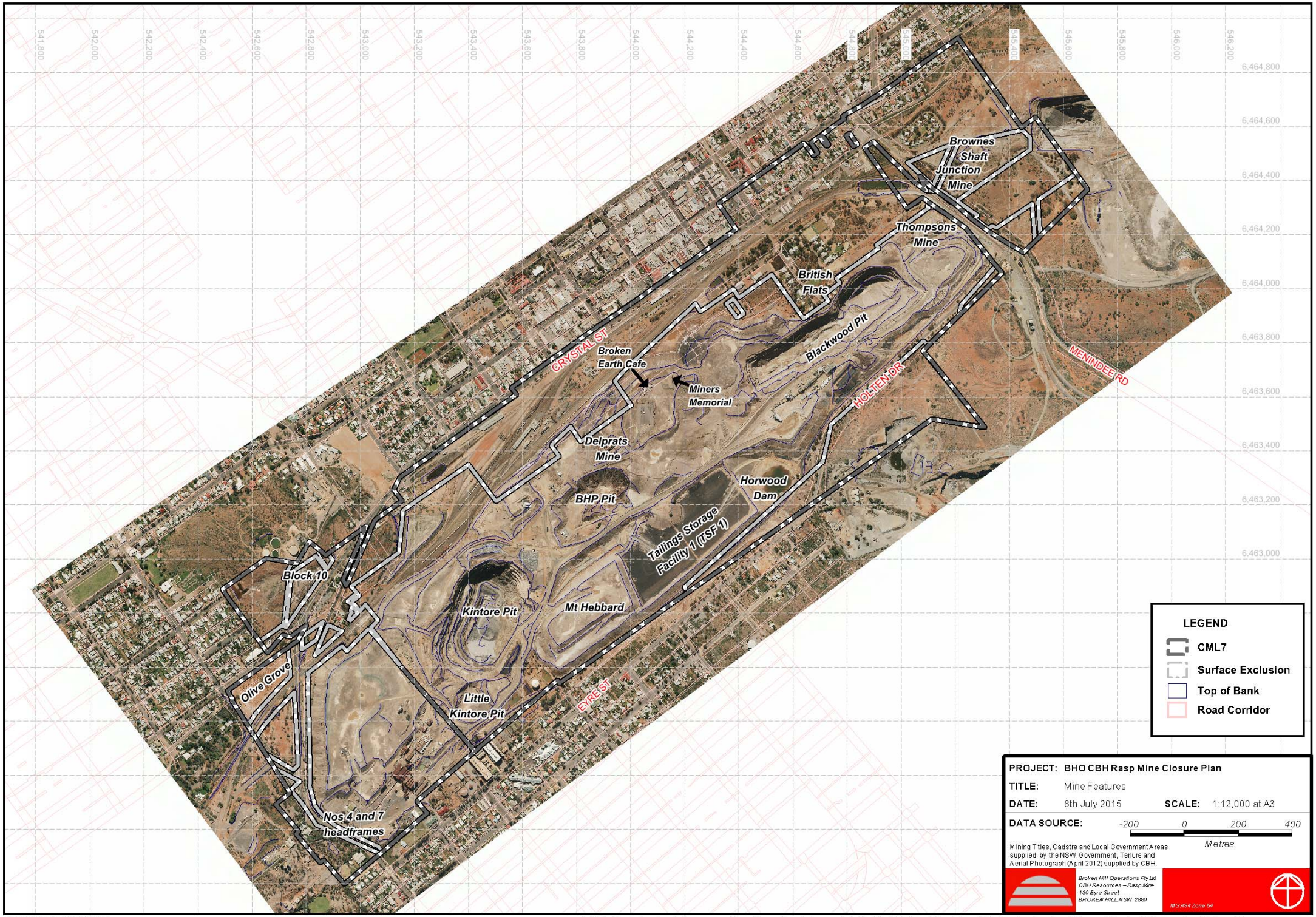
- CML7
- Perilya
- Property Boundary
- Broken Hill City Council

Broken Hill Operations Pty Ltd
CBH Resources – Rasp Mine
130 Eyre Street
BROKEN HILL NSW 2880

MGA94 Zone 54

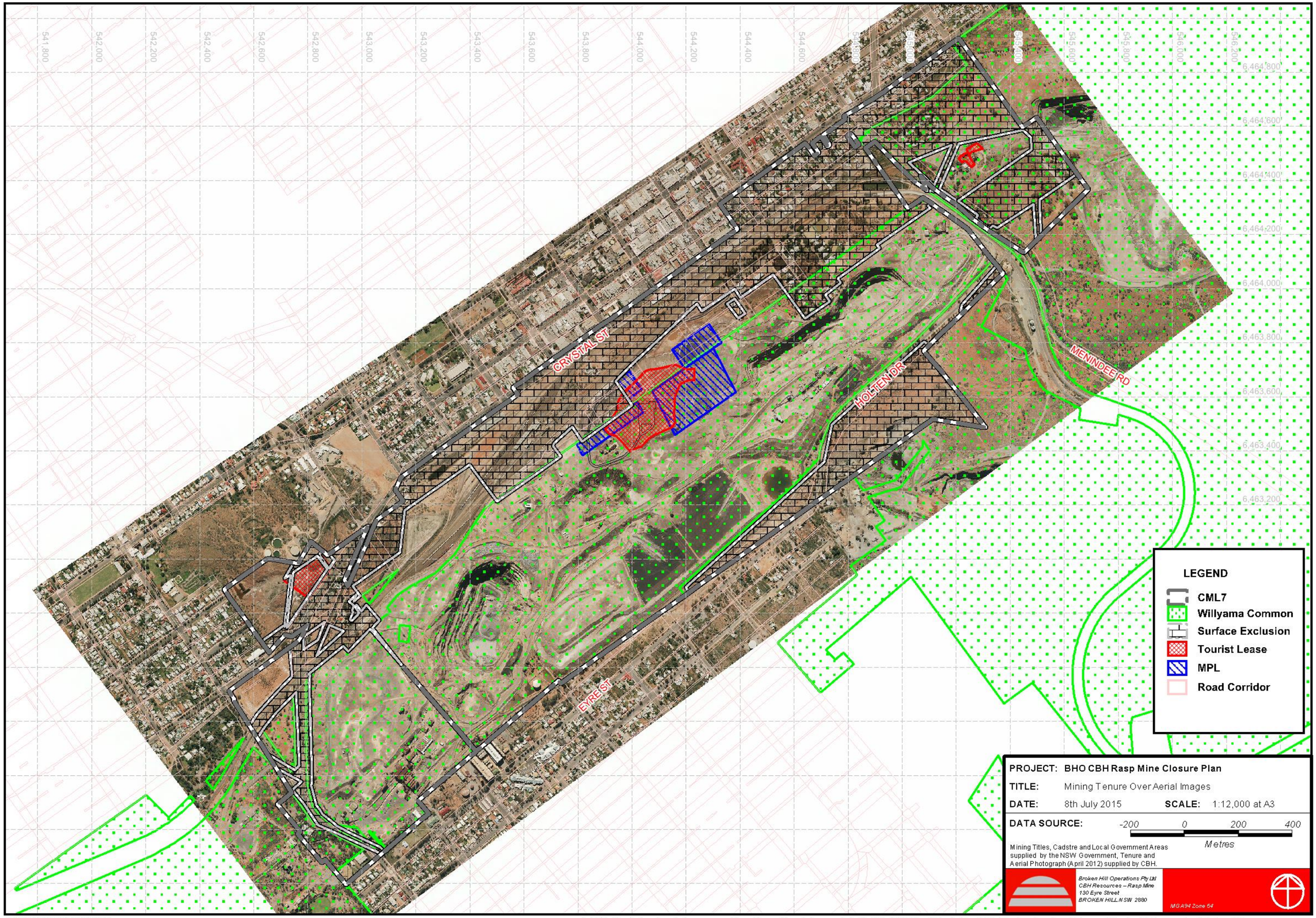
WORKSPACE: \Maps\W002a.wor REVISION: 0

Plan 1b
Mine and Context – Detail



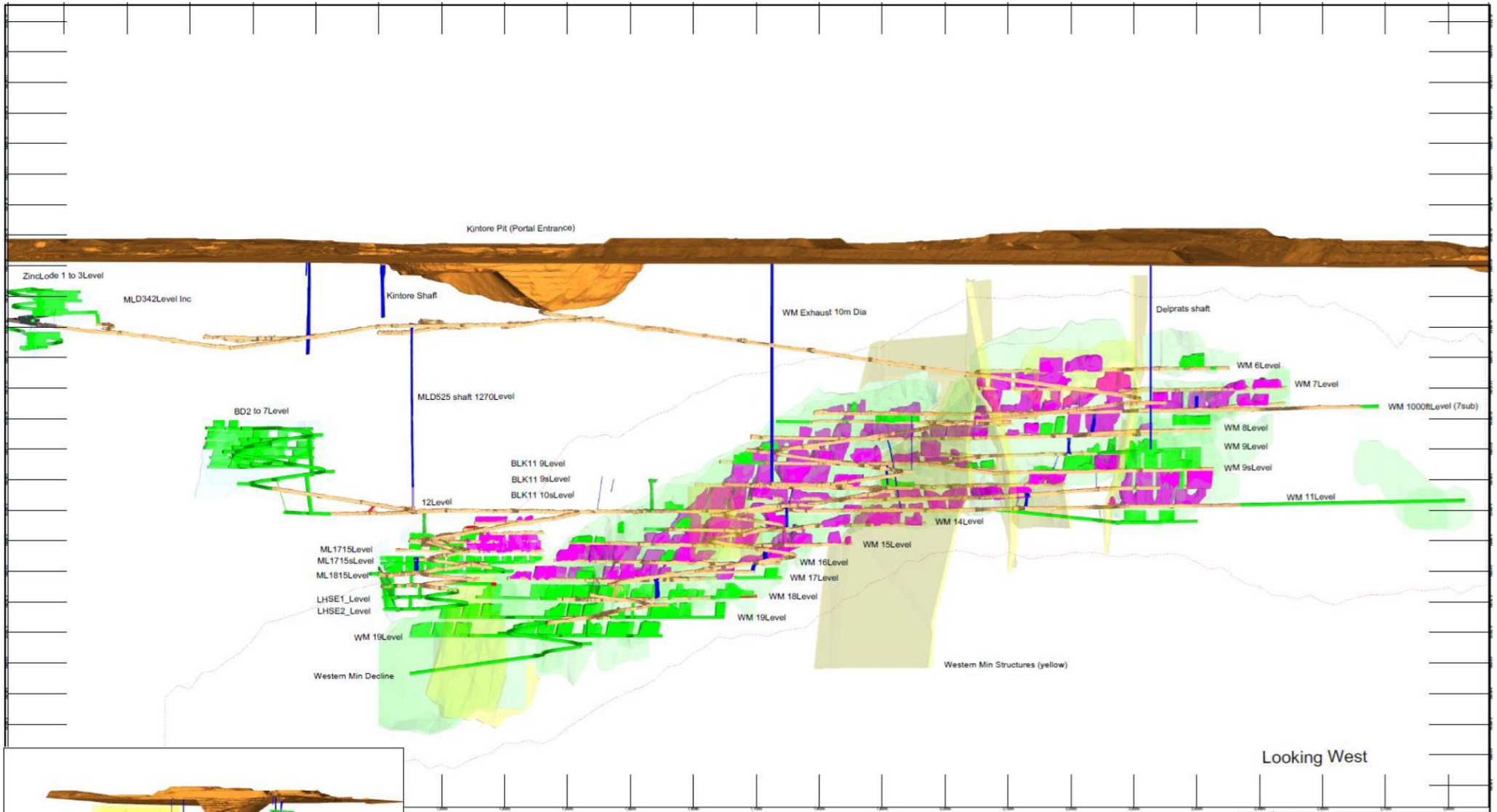
WORKSPACE: \Maps\MI003c.wor REVISION:0

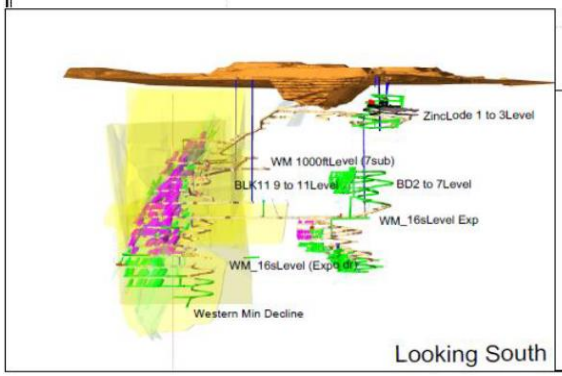
Plan 2
Leases



WORKSPACE: Maps\M004c.wor REVISION: 0

Plan 3
2018 Mining Long section





Rev:	Rev. Date:	Description			
v1.2	Oct 2018	Long Section Plan	ATS	ATS	ED

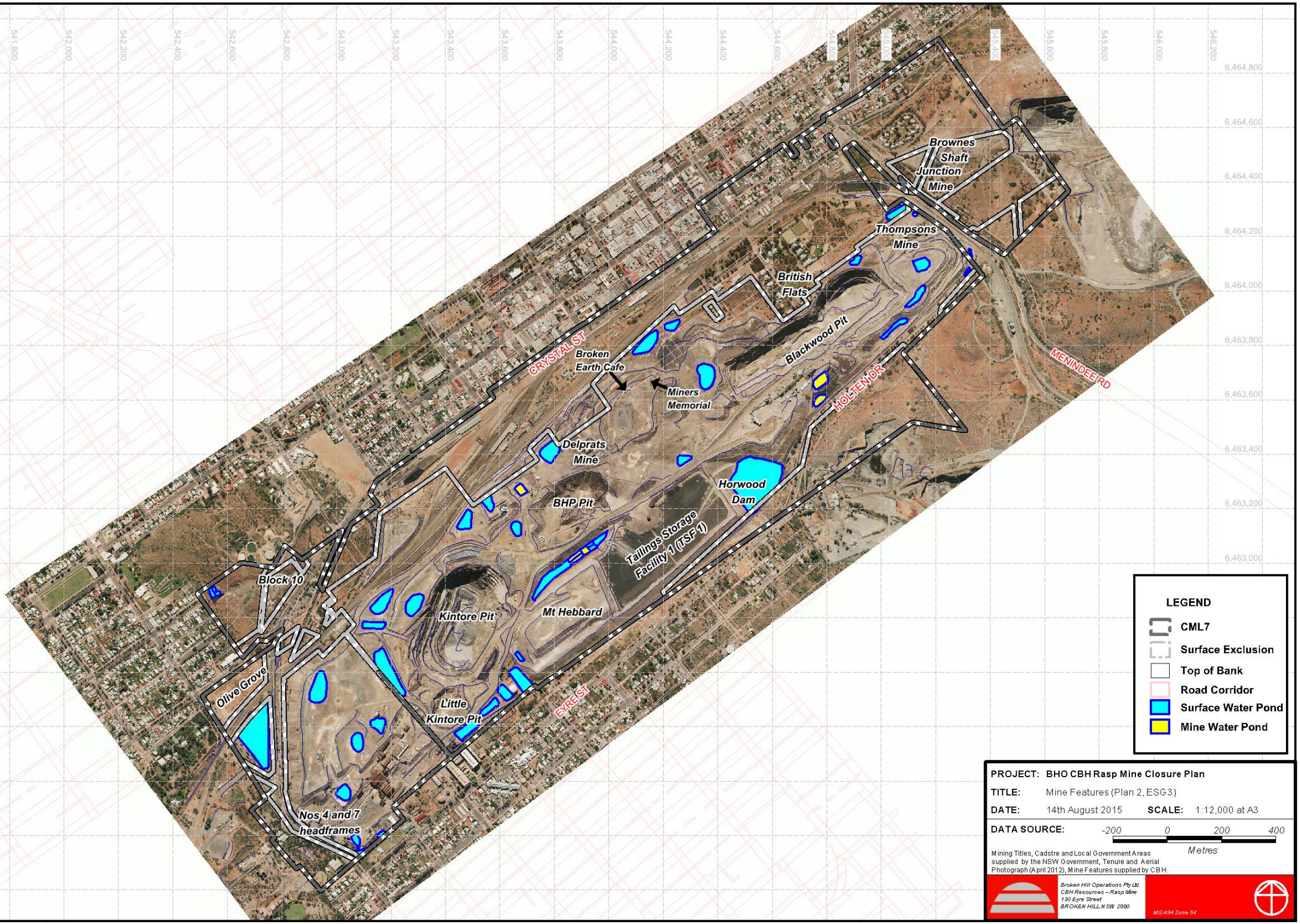
Project Title: CBH Resources Limited — Project No:

Drawing Title: RASP Mine

Originator:	ATS
Date Drawn:	04/10/2018
Scale:	1:2009.5

Figure/Drawing No.:- 002

Plan 4
Surface Water Management Plan



Plan 5
Final Rehabilitation Domains