Groundwater Management Plan
Bulk Sampling Activities, Balranald Mineral Sands Project

Prepared for Iluka Resources Limited
June 2020

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Groundwater Management Plan

Bulk Sampling Activities, Balranald Mineral Sands Project

Report Number

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Client

Iluka Resources Limited

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29 June 2020

Approved by

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29 June 2020

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1 Introduction

1.1 Overview

On 5th April 2016 Iluka Resources Limited (Iluka) was granted Development Consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for a mineral sands mine in south-western New South Wales, known as the Balranald Mineral Sands Project (the Balranald Project). The project was assessed and approved as State Significant Development 5285 (SSD-5285).

The Balranald Project includes construction, mining, primary processing and rehabilitation of two linear mineral sand deposits, known as the West Balranald and Nepean deposits located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald (Balranald town), respectively (Figure 1.1).

The Balranald Project included undertaking a bulk sampling activity (the activity) at the West Balranald deposit to test the selective in-situ removal of up to 100,000 tonnes (t) of ore.

1.2 The activity

The activity is an unconventional mining method to test the selective in-situ removal of mineral ore and reflects a continuation of a smaller bulk sampling activity (known as T1) undertaken by Iluka during Q1-2015 and Q1-2016 in accordance with approval under Part 5 of the EP&A Act from NSW Trade & Investment, Resources & Energy (Reference OUT13/28341 and OUT15/27702).

The activity commenced under SSD-5285 in Q2-2016 and Q3-2016 and successfully extracted approximately 6,400 t of ore from three stopes (referred to as Stopes 1B, 3 and 4) and backfilled approximately 700 t of mining by product (known as T2). Iluka placed the activity site into care and maintenance during 2017 and 2018 to review the mining and environmental monitoring outcomes.

Iluka now propose to recommence unconventional mining (known as T3) to trial the selective in-situ removal of the remaining 93,600 t of ore approved under SSD-5285. The objectives of T3 are to determine whether the unconventional mining method can:

- sustain production over a larger sample set (ie longer and multiple stope length);
- backfill process to deliver a mining by product management strategy; and
- further validate groundwater and subsidence impact prediction models.

T3 will create up to three additional underground cavities (referred to as Stopes 5, 6 and one of either the remainder of Stope 4, or 3B), each with an approximate volume of 21,000 cubic metres (m^3) in volume, located approximately 65–69 m below the natural surface level. The overburden typically comprises sands, clayey sands and clay layers with minimal or not continuous induration or rock.

The activity site is located entirely within the disturbance footprint of the West Balranald mine, including the area of the open cut pit. As such, all land disturbed by the activity will eventually be subsumed by mining of the West Balranald mine (Figure 1.2). T3 activities are scheduled to commence in Q4, 2019.

1.3 GMP purpose

This Groundwater Management Plan (GMP) has been prepared to manage potential groundwater risks associated with the T3 activity and considers all the requirements under SSD-5285 and matters raised by the former Department of Industry in their letter to Iluka dated 3 May 2018 (Ref: OUT18/6975).

1.3.1 Supporting documentation

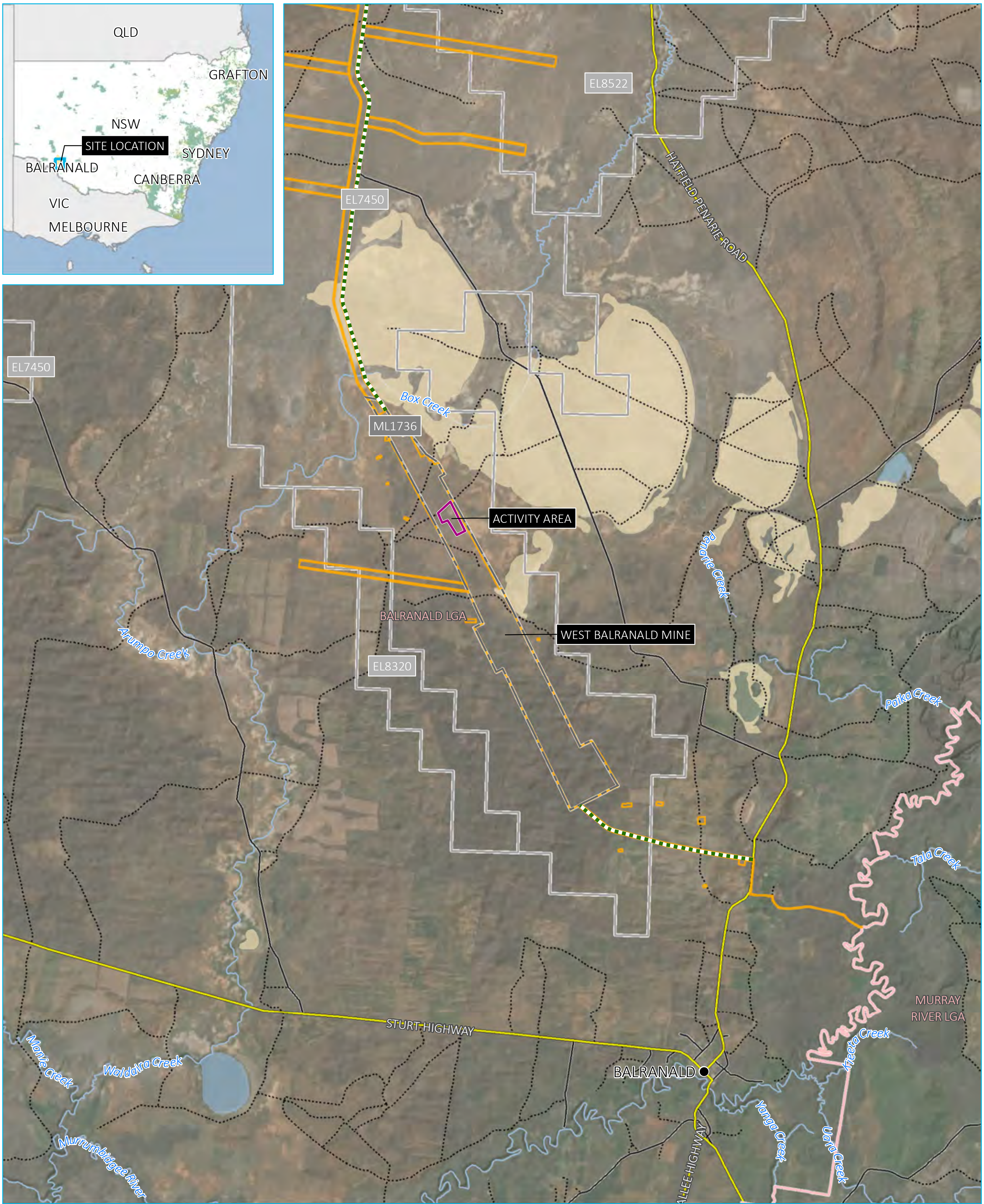
A copy of EMM's historical groundwater assessment and summary report prepared to compliment the GMP is provided in Appendix A. The intent of this report is to summarise the main hydrogeological and hydrogeochemical assessments undertaken to date and address the comments made by the Department of Planning, Industry and Environment – Water (DPIE Water) on the previous GMP (Reference number OUT18/6975).

1.4 Regulator contact details

The Government regulator contacts related to bulk sampling activities, including any reporting requirements and environmental risks are detailed in Table 1.1.

Table 1.1 Regulator contact details

Contact (position)	Department	Phone contact	Email address
Darren Wallet (Head Regional Operations Unit)	NSW EPA	T: 02 6969 0700 M: 0427 255 214	Darren.wallett@epa.nsw.gov.au
Tim Baker (Senior Water Regulation Officer)	DPIE- Natural Resources Access Regulator	T: 02 6841 7403 M: 0428 162 097	Tim.Baker@dpi.nsw.gov.au



Source: EMM (2019); Iluka (2015); DFSI (2017); GA (2011)

0 5 10 km
GDA 1994 MGA Zone 54
N

KEY

- Activity area
- Project boundary
- Place
- Access road
- Mining Lease 1736
- Iluka mineral tenement
- Main road
- Local road
- Vehicular track
- Named watercourse
- Perennial lake
- Ephemeral lake
- Local government area

Regional location

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Figure 1.1

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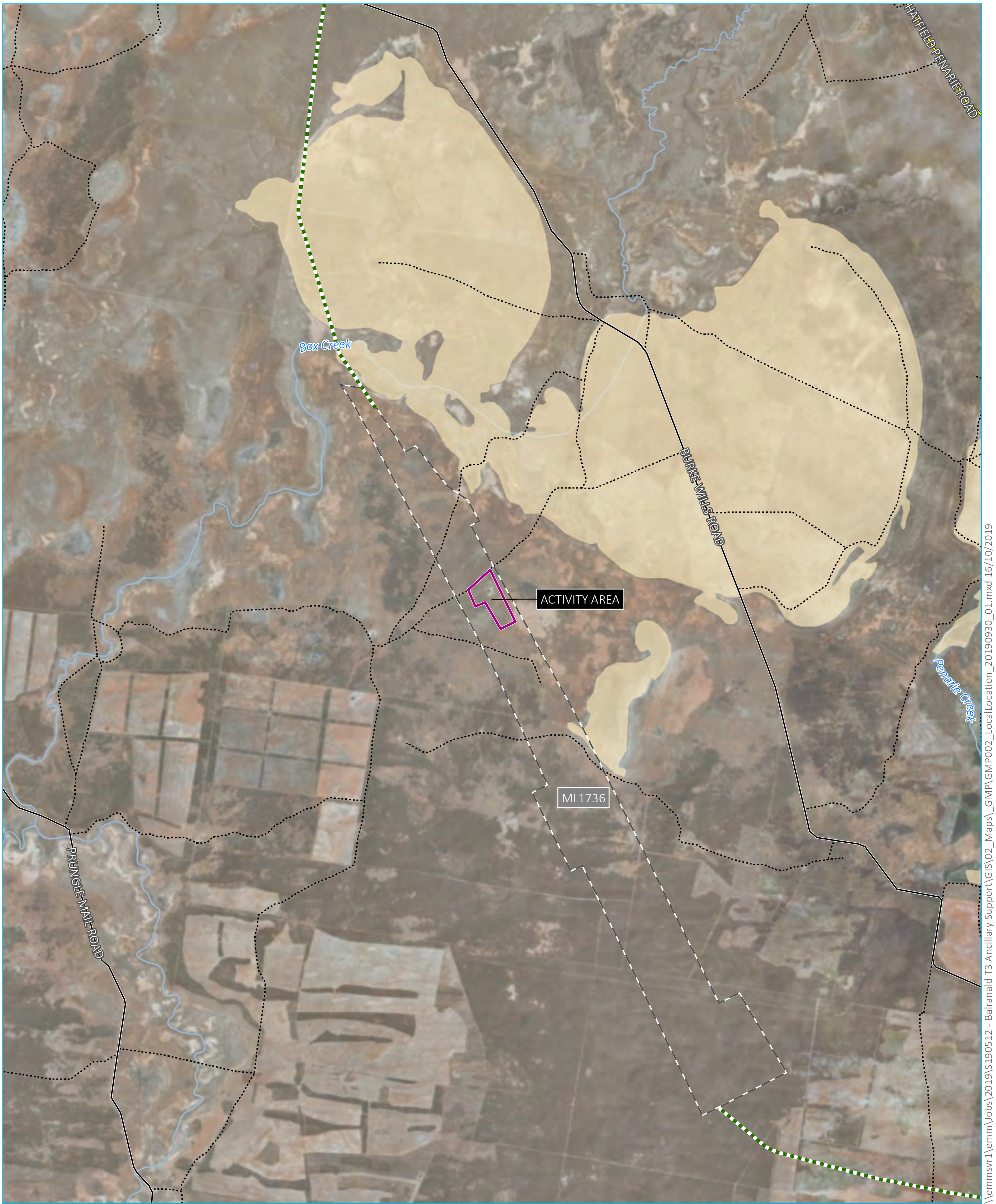

Source: EMM (2019); Iluka (2015); DFSI (2017); GA (2011)

0 2.5 5 km
GDA 1994 MGA Zone 54
N

KEY

- Activity area
- Access road
- Mining Lease 1736
- Main road
- Local road
- Vehicular track
- Named watercourse
- Ephemeral lake

Location of the T3 activity within the Balranald project mine footprint

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Figure 1.2

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2 Water Sources

Iluka's groundwater studies relating to the West Balranald and Nepean Deposits commenced with a hydrogeological review and assessment by GHD (2006). From 2009, groundwater investigation efforts increased and culminated in a series of field trials and numerical modelling activities undertaken both independently by URS (2009; 2011; 2012), SKM (2013) and Jacobs (2014; 2015a; 2015b), and internally by Iluka (2015b).

Surface water assessments have formed aspects of all the reports outlined above, however due to the limited surface water resources within the bulk sampling activity area and wider Balranald Project, WRM (2015) is the only hydrological-specific study completed to date.

This section presents a summary of the previous hydrological and hydrogeological findings of the broader Balranald Project relevant to this GMP.

2.1 Surface water

The Murrumbidgee and Murray rivers are the major permanent surface water features in the vicinity of the Balranald Project area, shown in Figure 1.1. The Lachlan River terminates at the Great Cumbung Swamp, approximately 48 km east of the Balranald Project, a major permanent surface water feature in areas upstream of Balranald. The Murrumbidgee and Murray rivers provide key water resources for large populations within the Murray Darling Basin including town water supplies, agriculture and the environment. The Murrumbidgee River is about 10 km south of the Balranald Project, and flows in a south-westerly direction, to its confluence with the Murray River about 40 km to the south-west of the Balranald township.

The main surface water feature within the Balranald Project area is Box Creek, which is an ephemeral watercourse and a tributary of the Murray River. Almost all of the Balranald Project is located within the Box Creek catchment, however the creek only flows during and immediately following heavy local rainfall or large flooding events. Flow has only occurred in Box Creek on occasions in the last 60 years (WRM, 2015). Permanent surface water flows are confined to the major rivers and their associated backwaters outside of the Balranald Project area.

2.2 Hydrogeology

There are three main aquifer units in the immediate vicinity of the Balranald Project area: the Shepparton Formation, the ore-hosting Loxton-Parilla Sands (LPS) and the Lower Renmark Group Formation (also known as the Olney Formation; Brown and Stephenson, 1991). Other units, whose sediments are heterogeneous in nature, can act as aquifers in localised instances. The Olney Formation is the regionally extensive early-Tertiary lacustrine system, specifically underlying the wider Balranald Project, and consists of the Upper, Middle and Lower Renmark Group.

The Palaeozoic rocks of the Lachlan Fold Belt underlie the Murray Basin sediments and form the basement to the basin. The basement contains structures such as ridges and troughs that have influenced deposition of the sediments and therefore also influence the hydrogeology of the Murray Basin.

2.2.1 Local Balranald Stratigraphy

The regional geology and hydrostratigraphy of the Murray Basin within the Balranald region is shown on Figure 2.1.

The local stratigraphy is shown conceptually in Figure 2.1, which represents an idealistic interpretation based on logging data acquired during the pre- and detailed- feasibility hydrogeological studies (Iluka, 2015 and 2016b) and data collected during the installation of monitoring infrastructure to support the previous T2 activity. The local stratigraphy consists of the following sequence (from shallowest to deepest):

1. The Shepparton Formation (SFM): Deposited within a fluvial-lacustrine environment, the water-table hosting unit consists of sand-clay to clay sediments with bands of fine grained sand. The base of this unit was often defined by a ferricrete/lateritic horizon. The unit was consistently 30 to 35 m thick throughout the trial sites.

2. LPS 1 dunal sequence: Occasionally, a fine to very fine narrow band of sand is encountered representing the aeolian-dunal sequence of the ancient beach. This light grey to pale yellow sand is very well sorted and sub rounded to sub-angular in nature with an abraded appearance.

3. LPS1 foreshore: Deposited within a low energy marine environment, this light to dark grey coloured sand consisted of predominantly fine, sub-angular to sub-rounded grains with moderate sorting. Above this unit, occasionally a moderate to highly plastic clay existed which resembled a “natural bentonite”.

4. LPS1 surf zone: Deposited within a high energy marine environment, this light to dark grey/brown coloured sand consisted of medium to gravel-sized sand, with moderate to well sorting. Occasionally, lignitic and/or carbonaceous material was present within this unit.

5. LPS1 lower-shore: The lower- or off-shore sediments are deposited within low energy deep water environments. These sediments generally consist of light to dark grey/black sand to silty-sand with sub angular to sub rounded grains of moderate sorting. The presence of lignitic and carbonaceous material was common and tended to be more prolific from these depths onwards.

6. LPS2 foreshore: Although the lithology of this unit is similar to the LPS1 lower-shore package above, there are subtle changes in grain morphology. The grains tend to be fine to very fine sand with less silts being present. Grain size is more highly sorted than the overlying LPS1 lower-shore package. Mica and pyrite are also present, with traces of heavy mineral (HM).

7. LPS2 surf zone: Deposited within a high energy marine environment, this light to dark grey/brown/black coloured sand consists of medium to gravel-sized grains and is well sorted. Occasionally, lignitic and/or carbonaceous lagoonal material is present. However, unlike the LPS1 surf zone package, this unit consists of mica and pyrite and generally hosts large percentages of HM on strike.

8. LPS2 lower-shore: These sediments generally consist of light to dark grey/black very fine to fine sand, which is well sorted in nature. Often lignitic with traces of HM, mica and pyrite.

9. Geera Clay: A thick regionally extensive sequence of marginal marine and estuarine clays and muds, with a confirmed thickness of greater than 70 m[1] to the west of the deposit. This unit is generally black with a blue/green tinge, highly plastic with some fossiliferous/calcareous matter. The transition zone into the Geera Clay from the LPS generally consists of a mudstone with hard red and white fine clay shards with low plasticity and the presence of low competent lignite was common.

10. Olney Formation: This formation was deposited within a fluvial/lagoonal environment and generally consists of dark grey to brown black silty sand to sand, with poorly sorted silt to medium sized sand grains. Groundwater within the Olney Formations’ Lower Renmark Group (LRG), is sub artesian to artesian, with water quality generally acceptable for most stock watering purposes.

[1] The Geera Clay thickness was confirmed at the Long Term Trial (LTT site) during the HP3 program conducted between November 2013 and May 2014.

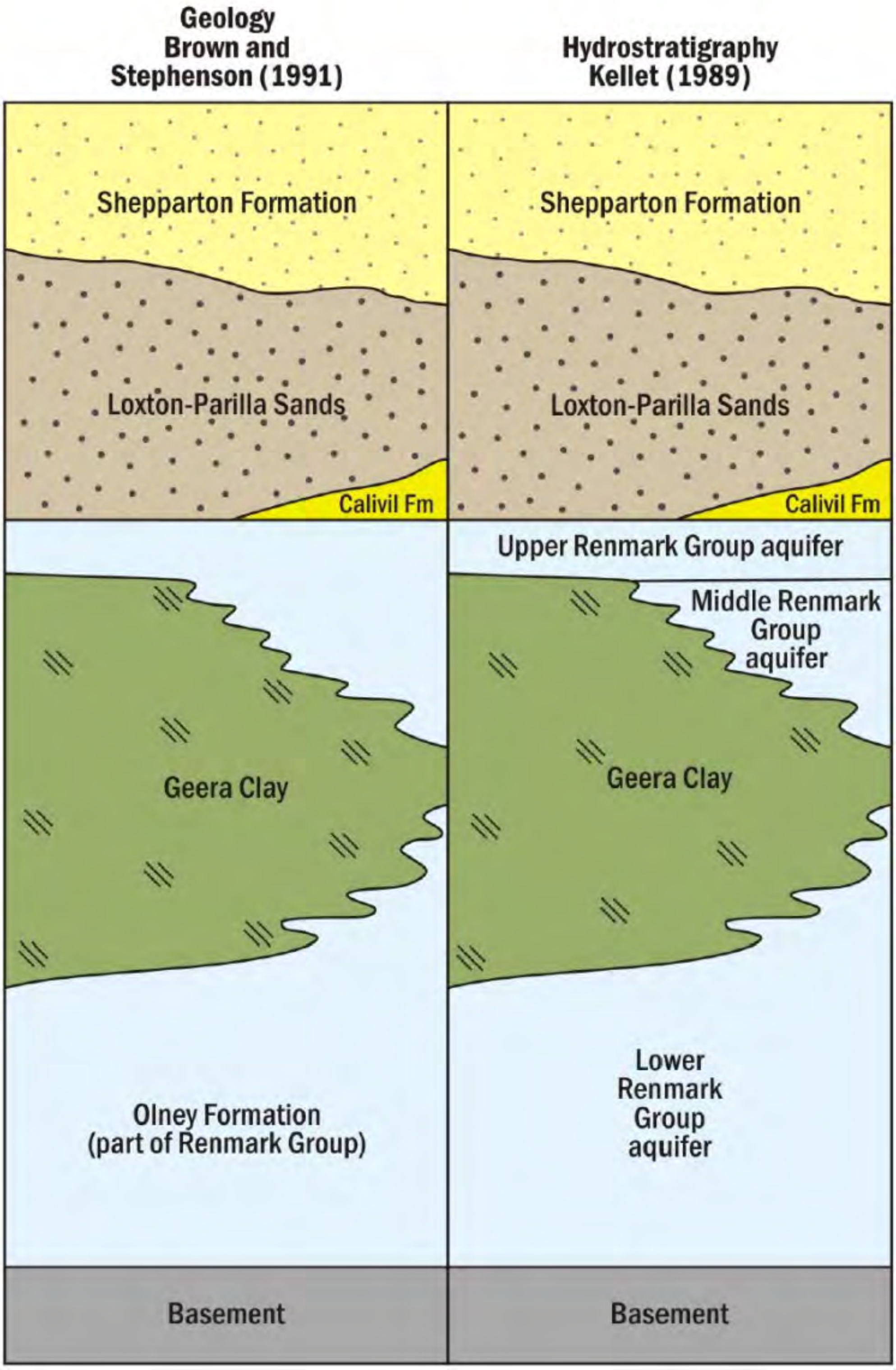


Figure 2.1 **Geological (Brown and Stephenson, 1991) and hydrostratigraphic (Kellet, 1989) models of the study area (after Jacobs, 2015).**

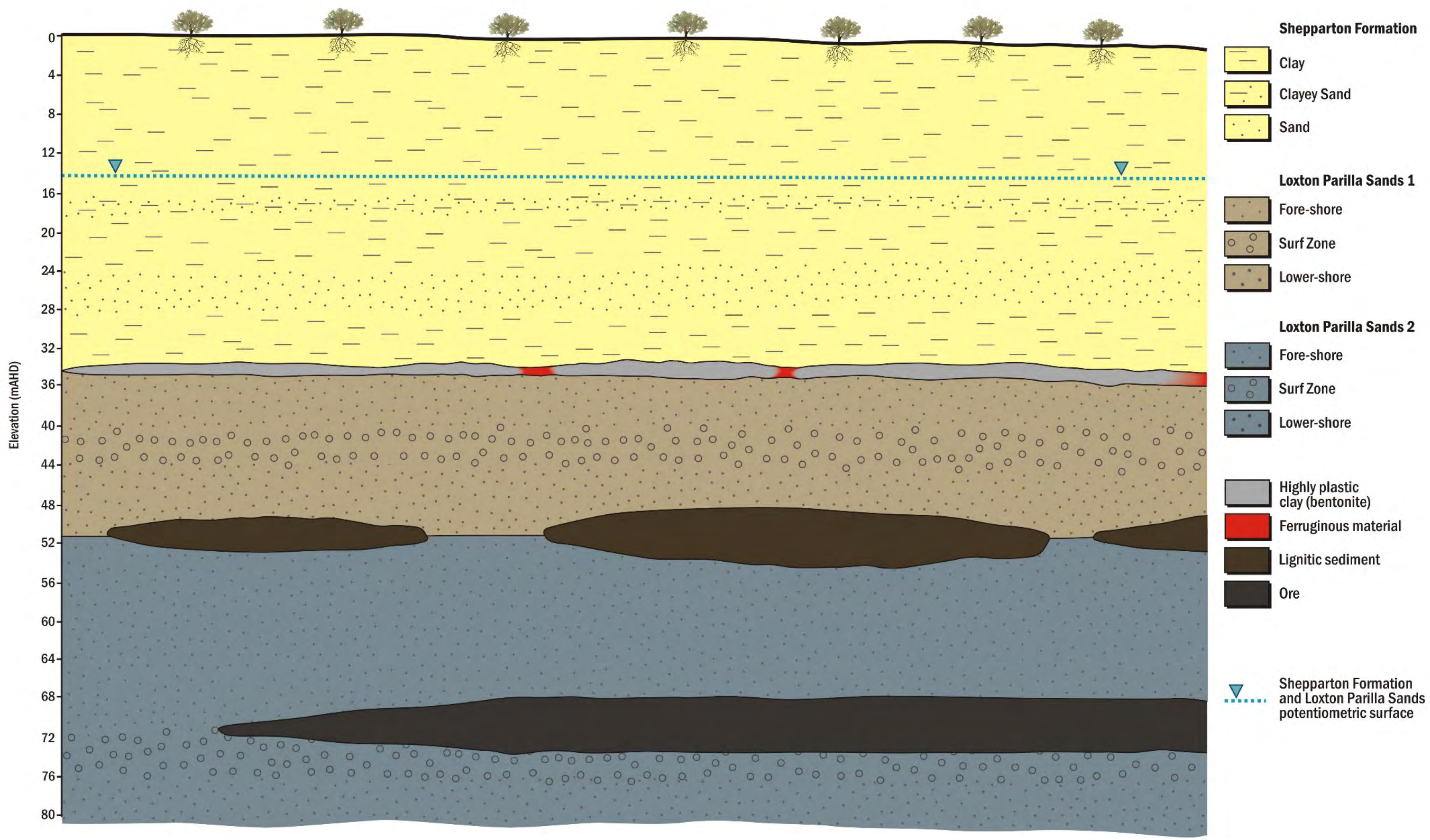


Figure 2.2 Idealised site stratigraphy

2.3 Groundwater Levels and Flow

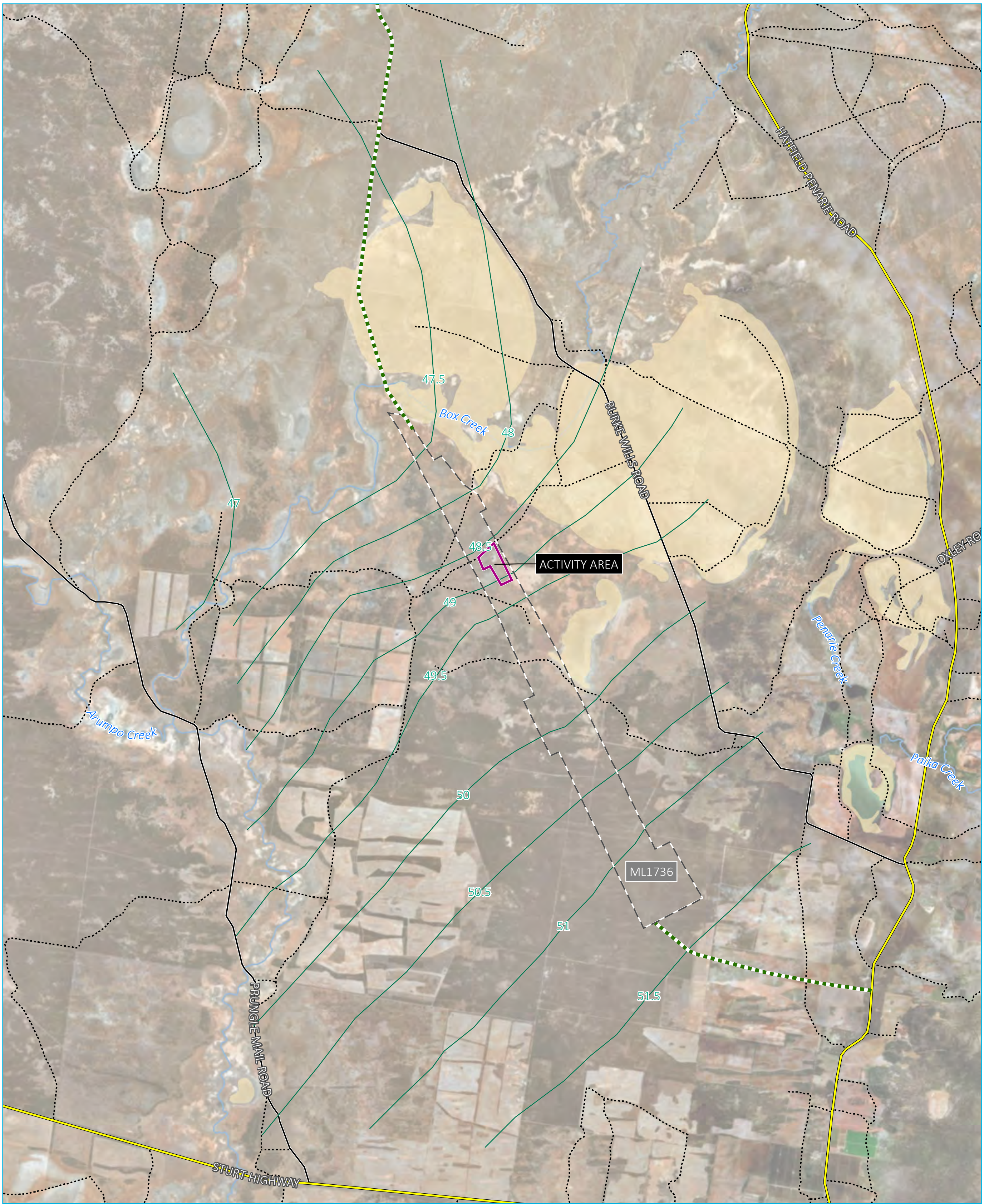
Regional groundwater level measurements during 2014 have been used to develop plan-view unstressed potentiometric surfaces for the following main aquifers of interest:

- Figure 2.3- SFM unstressed potentiometric surface shown on a 0.5 m interval.
- Figure 2.4- LPS unstressed potentiometric surface shown on a 0.5 m interval.
- Figure 2.5- Olney Formation unstressed potentiometric surface shown on a 1 m interval.

The contours have been developed using surveyed bore collars associated with previous Balranald field programs and the quarterly baseline data collection program. In summary, the potentiometric surfaces suggest:

- the potentiometric surfaces for the SFM and LPS are near identical under natural/unstressed conditions;
- local groundwater elevations greater than 52 mAHD prevail at the southern end of the West Balranald deposit. Groundwater levels between 48 and 49 mAHD dominate further north;
- the local groundwater flow direction is from the southeast to the north-west; and
- groundwater heads recorded within the Olney Formation range from 63 mAHD at the southern end of the West Balranald deposit, to 57 mAHD to the west. The prevailing groundwater flow direction in this unit is from east to west, and consistent with the historical groundwater maps produced by Kellet (1989, 1994).

Iluka undertake groundwater monitoring events (GMEs) across the Balranald site on a 6-monthly frequency. The Balranald bore network targeted for the GMEs is shown in Figure 2.6, and includes a selection of Iluka installed bores, third party bores and government bores. A selection of hydrographs across the site are shown in Figure 2.7, and the time series for all hydrographs measured between 2016 and early 2019 are shown in Appendix B.



Source: EMM (2019); Iluka (2015); DFSI (2017); GA (2011)

0 2.5 5 km
GDA 1994 MGA Zone 54
N

KEY

- Activity area
- Potentiometric surface (m AHD)
- Access road
- Mining Lease 1736
- Main road
- Local road
- Vehicular track
- Named watercourse
- Ephemeral lake

Shepparton Formation (unstressed) potentiometric surface (m AHD)

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Figure 2.3

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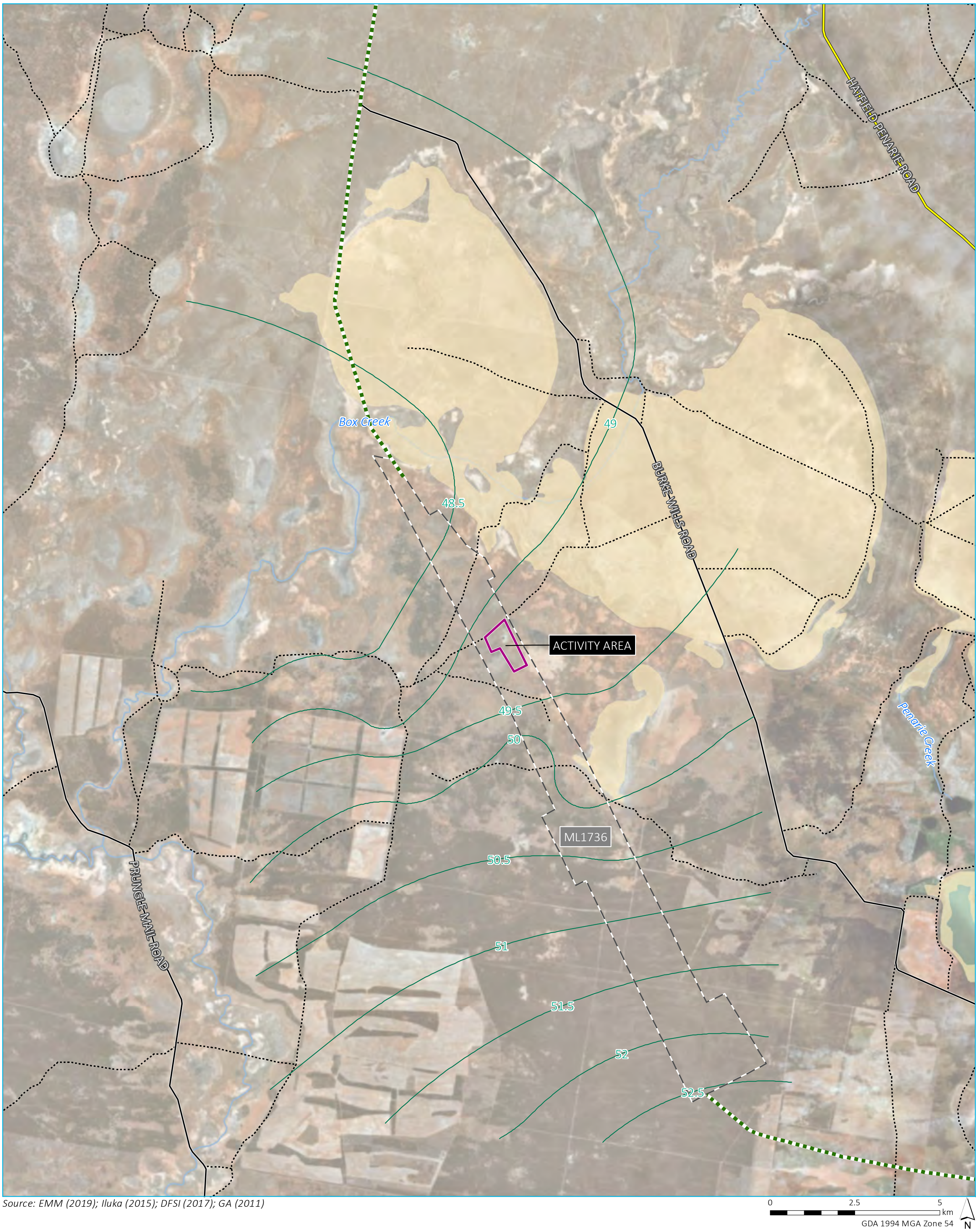

Source: *EMM (2019); Iluka (2015); DFSI (2017); GA (2011)*

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KEY

- Activity area
- Potentiometric surface (m AHD)
- Access road
- Mining Lease 1736
- Main road
- Local road
- Vehicular track
- Named watercourse
- Ephemeral lake

Loxton Parilla Sands (unstressed) potentiometric surface (m AHD)

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Figure 2.4

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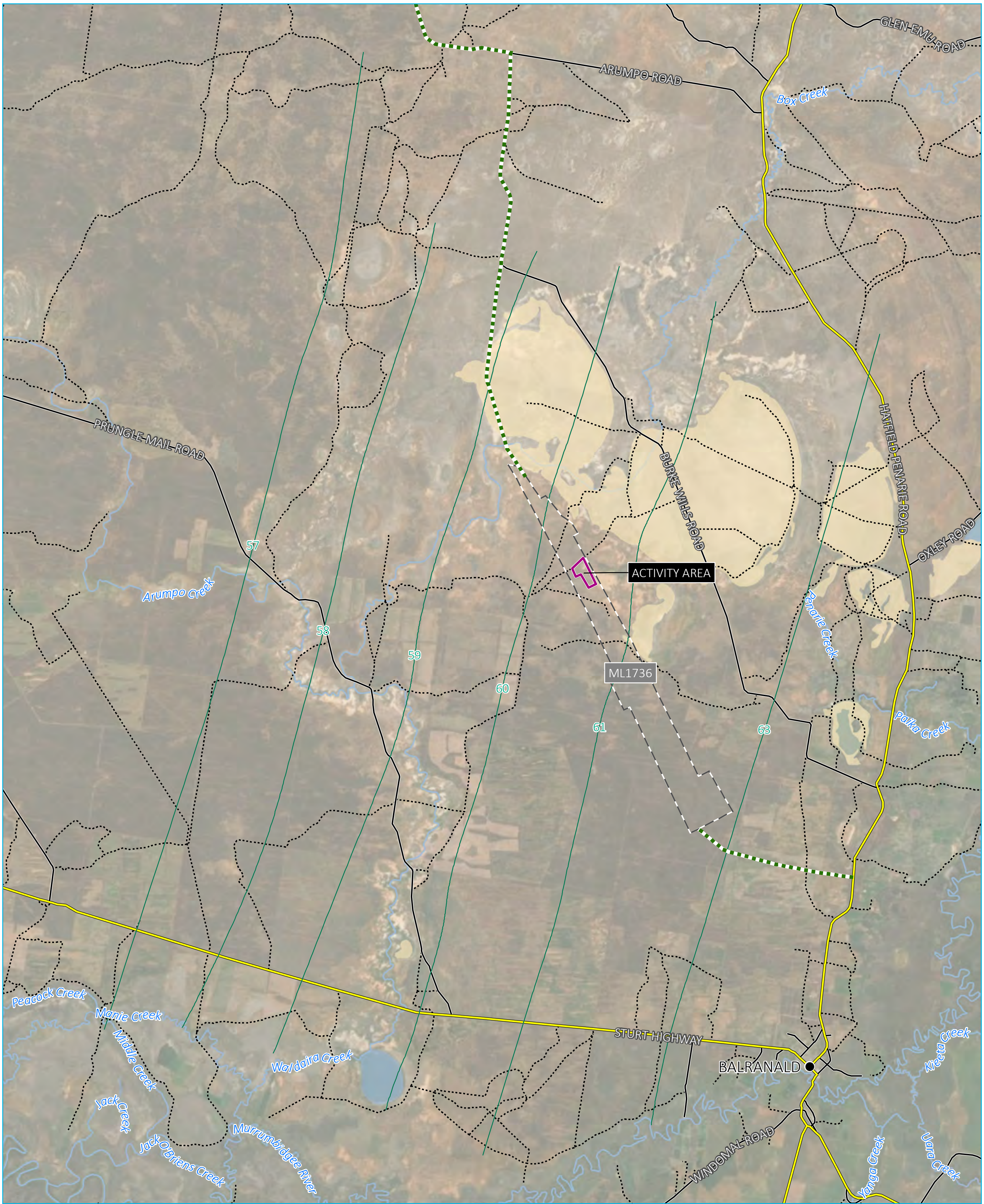

Source: EMM (2019); Iluka (2015); DFSI (2017); GA (2011)

0 2.5 5 km
GDA 1994 MGA Zone 54
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KEY

- Activity area
- Place
- potentiometric surface (m AHD)
- Access road
- Mining Lease 1736
- Main road
- Local road
- Vehicular track
- Named watercourse
- Perennial lake
- Ephemeral lake

Olney Formation (unstressed) potentiometric surface (m AHD)

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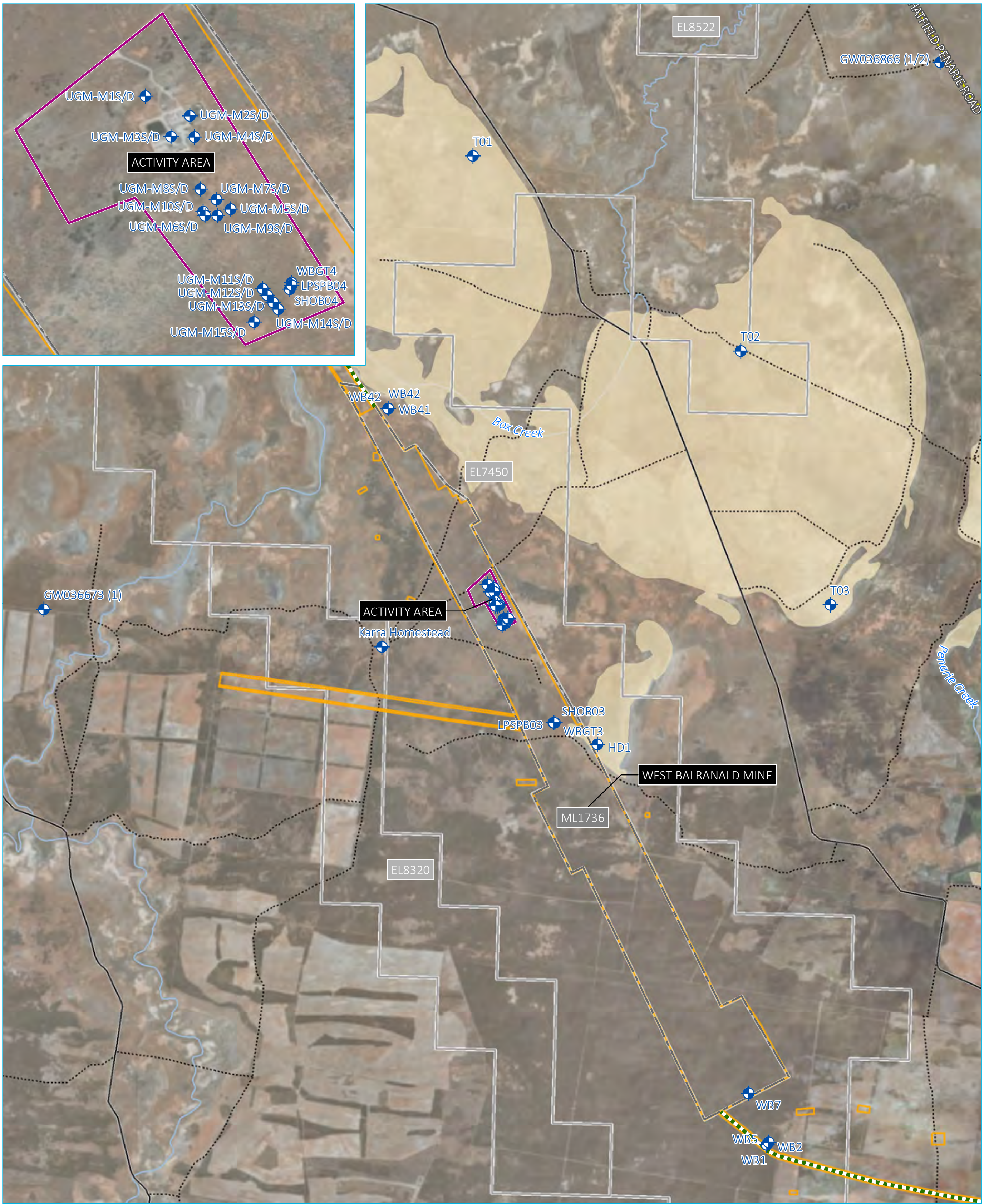
Groundwater Management Plan
Figure 2.5



Source: EMM (2019); Iluka (2015); DFSI (2017); GA (2011)

0 2.5 5 km

GDA 1994 MGA Zone 54

N

KEY

- Activity area
- Project boundary
- Groundwater bore location
- Access road
- Mining Lease 1736
- Iluka mineral tenement
- Main road
- Local road
- Vehicular track
- Named watercourse
- Ephemeral lake

Balranald monitoring network
(GME and T3 network)

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Figure 2.6

creating opportunities

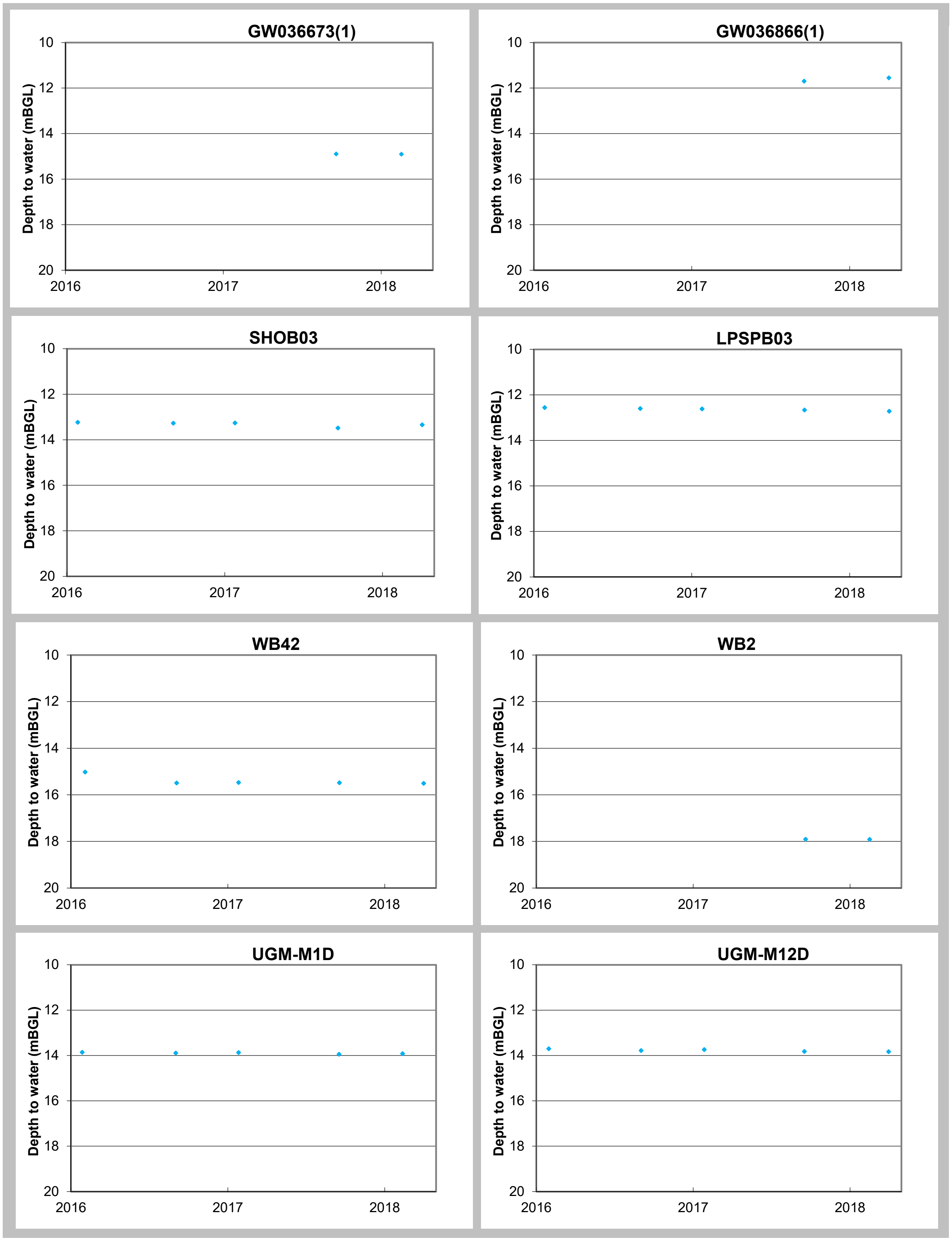


Figure 2.7 Selected hydrographs

T:\Jobs\2018\S180539 - Iluka provisional support Balranald 2019\Technical studies\Groundwater\Data\EMM Processed Data\[Balranald_GME hydrographs.xlsm]GME Fig 2.6

2.4 Groundwater Chemistry

In order to provide a regional context to the groundwater operating rules and monitoring strategies applied later in this report (Sections 4, 5 and 6), this section summarises published groundwater chemistry reports and data from Earth Systems (2015), LWC (2015) and Iluka (2015a).

The steady-state variation in groundwater chemistry from the Shepparton, Loxton Parilla Sands and Lower Renmark Group aquifers has been compiled to assist in the delineation of a tiered groundwater trigger action response plan (TARP) (Section 8). Statistical analysis of major ions and other select analytes, constituting the baseline summaries for the Shepparton, Loxton Parilla Sands and Lower Renmark Group aquifers, are presented in Table 2.1, Table 2.2 and Table 2.3 respectively. As other groundwater users predominately utilise the Lower Renmark Group Aquifer for stock purposes, the ANZG trigger values for irrigation and general use are displayed for comparative purposes only (ANZG, 2018).

In summary:

- The Shepparton Aquifer is regarded as saline to hypersaline (Median TDS = 39,650 mg/L), with TDS ranging between 19,700 and 57,200 mg/L, and is deemed unsuitable for irrigation, stock and domestic purposes (ANZG, 2018). The median pH is neutral (7.13), but ranges between 3.85 and 8.1, whilst the redox (oxidation-reduction potential) is considered denitrifying to oxidising (-2 to 253 mV; Strumm and Morgan, 1981).

- The LPS Aquifer is regarded as saline to hypersaline (Median TDS = 33,000 mg/L), with TDS ranging between 8,870 and 48,200 mg/L and is deemed unsuitable for irrigation. Certain bores are identified as a tolerable drinking source for sheep (ANZG, 2018), however these bores are located adjacent the Murrumbidgee River and, similar to the Shepparton Formation, may represent diffusion of river water into the LPS. The Murrumbidgee River is regarded as a losing-system. The median pH is neutral (7.16), but ranges between 6.19 and 8.40, whilst the redox condition is considered denitrifying to moderately reducing (-6 to 193 mV).

- Within the Balranald Project area, the Geera Clay has no representative chemical analyses and no monitoring locations are discretely screened within the formation. Pore-water samples extracted from the Geera Clay in bores drilled near Piangle in northern Victoria yielded TDS concentrations of approximately 200,000 mg/L (Evans, 2014) and EC determinations in two bores in the area yielded salinities of ~37,000 µS/cm, which are potentially associate with the Middle Renmark Group, which inter-fingers with the Geera Clay.

Brackish to saline groundwater is observed in the Lower Renmark Group Aquifer (Median TDS = 4,349 mg/L), with TDS ranging between 2,490 and 10,265 mg/L and is deemed suitable for irrigation of salt tolerant crops and as a tolerable drinking source for most stock purposes (ANZG, 2018). The median pH is circum-neutral (7.50), but ranges between 5.70 and 9.63, whilst the redox condition is considered denitrifying to slightly reducing (-1 to 254 mV).

Table 2.1 Shepparton Aquifer: Statistical summary

Statistic	pH	Total Alkalinity (mg/L $CaCO_3$)	Total Dissolved Solids (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Al (mg/L)	As (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Sr (mg/L)	U (mg/L)	Zn (mg/L)
Number	96	95	96	96	96	96	96	96	96	96	27	96	93	96	96	27	27	96	96	96
Minimum	3.85	177	19700	340	710	6800	19	1800	12300	0.003	0.001	<LOR	0.003	0.010	<LOR	<LOR	<LOR	7.320	<LOR	0.003
Lower Fence[2]	6.16	223	19700	340	710	6800	19	1800	12300	0.003	0.001	<LOR	0.003	0.010	0.001	0.001	0.001	9.213	<LOR	0.003
Quartile 1 (25th percentile)	6.85	328	33675	502	1200	9088	35	3600	15575	0.005	0.001	0.005	0.240	0.061	0.093	0.002	0.005	14.950	0.003	0.020
Median	7.13	359	39650	598	1530	11200	42	4245	20200	0.025	0.004	0.012	0.630	0.088	0.270	0.004	0.010	16.950	0.012	0.033
Quartile 3 (75th percentile)	7.30	398	43650	657	1750	13000	66	4801	23000	0.050	0.010	0.018	3.570	0.1218	0.591	0.010	0.017	18.775	0.025	0.072
Upper Fence[3]	7.98	503	57200	890	2550	16200	113	6603	30500	0.118	0.024	0.038	8.565	0.211	1.338	0.022	0.035	24.513	0.059	0.151
Maximum	8.10	570	57200	1100	2550	16200	115	9309	30500	28.90	0.028	0.071	10.400	0.368	6.200	0.053	0.057	32.900	0.229	0.244
IQR[4]	0.46	70	9975	155	550	3913	31	1201	7425	0.045	0.009	0.013	3.330	0.060	0.498	0.008	0.012	3.825	0.023	0.053
Number of Upper Outliers[5]	2	4	0	2	0	0	1	8	0	19	2	2	2	6	15	1	3	2	9	3

[2] Lower fence is defined as the 25th percentile minus 1.5 multiplied by the IQR.

[3] Upper fence is defined as the 75th percentile plus 1.5 multiplied by the inter IQR.

[4] IQR = Inter Quartile Range, which represents 50% of the data between the 25th and 75th percentile (ie. IQR = Q3-Q1).

[5] Upper outliers are defined as data that fall between the upper fence and the maximum.

Table 2.1 Shepparton Aquifer: Statistical summary

Statistic	pH	Total Alkalinity (mg/L $CaCO_3$)	Total Dissolved Solids (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Al (mg/L)	As (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Sr (mg/L)	U (mg/L)	Zn (mg/L)
Number of Lower Outliers[6]	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
ANZG 2018[7]	4 - 9	N/A	5 000	N/A	N/A	N/A	N/A	N/A	N/A	5	0.1	0.2	N/A	2.5	0.2	0.01	0.2	N/A	0.01	2

[6] Lower outliers are defined as data that fall between the lower fence and the minimum.

[7] ANZG 2018 guideline value for irrigation and general water use.

Table 2.2 Loxton Parilla Sands Aquifer: Statistical summary

Statistic	pH	Total Alkalinity (mg/L $CaCO_3$)	Total Dissolved Solids (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO4 (mg/L)	Cl (mg/L)	Al (mg/L)	As (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Sr (mg/L)	U (mg/L)	Zn (mg/L)
Number	173	173	173	173	173	173	173	173	173	173	36	173	164	173	173	36	36	173	173	173
Minimum	6.19	207	8870	105	225	3200	10	500	5240	0.005	<LOR	<LOR	0.025	0.017	0.064	<LOR	<LOR	2.990	<LOR	0.003
Lower Fence	6.30	252	8870	105	225	3200	10	500	5240	0.005	0.001	<LOR	0.025	0.017	0.064	0.001	0.001	2.990	<LOR	0.003
Quartile 1 (25th percentile)	6.93	376	18500	276	594	5330	31	991	10000	0.005	0.001	0.003	0.450	0.087	0.220	0.001	0.001	6.260	<0.001	0.013
Median	7.16	427	33000	368	1100	9000	40	2460	16600	0.025	0.001	0.005	1.370	0.112	0.427	0.001	0.002	9.480	0.003	0.029
Quartile 3 (75th percentile)	7.35	458	38000	556	1420	11000	52	3680	19400	0.050	0.008	0.008	4.120	0.155	0.620	0.003	0.004	14.600	0.005	0.080
Upper Fence	7.98	582	48200	848	2659	14200	84	6170	26000	0.118	0.018	0.016	9.625	0.257	1.220	0.006	0.009	27.110	0.012	0.181
Maximum	8.40	914	48200	848	1930	14200	110	6170	26000	0.340	0.045	0.058	12.300	0.279	1.650	0.010	0.010	33.300	0.027	1.100
IQR	0.42	83	19500	280	826	5670	21	2689	9400	0.045	0.007	0.006	3.670	0.068	0.400	0.002	0.003	8.340	0.005	0.068
Number of Upper Outliers	10	16	0	0	0	0	5	0	0	22	2	9	4	1	11	4	4	1	30	19
Number of Lower Outliers	1	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANZG 2018	4 - 9	N/A	5 000	N/A	N/A	N/A	N/A	N/A	N/A	5	0.1	0.2	N/A	2.5	0.2	0.01	0.2	N/A	0.01	2

Table 2.3 Lower Renmark Group Aquifer: Statistical summary

Statistic	pH	Total Alkalinity (mg/L $CaCO_3$)	Total Dissolved Solids (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO4 (mg/L)	Cl (mg/L)	Al (mg/L)	As (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Sr (mg/L)	U (mg/L)	Zn (mg/L)
Number	209	32	117	58	58	58	58	55	51	47	21	21	42	21	51	21	21	15	14	1
Minimum	5.70	379	2490	21	28	793	16	1	1180	<LOR	<LOR	<LOR	0.009	0.041	0.006	<LOR	<LOR	0.818	<LOR	<LOR
Lower Fence	6.72	379	2490	21	28	793	16	1	1180	<LOR	0.001	0.001	0.009	0.041	0.006	0.001	0.001	0.818	<LOR	<LOR
Quartile 1 (25th percentile)	7.29	400	3570	35	47	1073	23	1	1570	0.020	0.001	0.001	0.330	0.051	0.014	0.001	0.001	0.958	0.001	<LOR
Median	7.50	432	4349	40	59	1235	27	1	1840	0.050	0.001	0.001	0.660	0.060	0.020	0.001	0.001	1.160	0.001	<LOR
Quartile 3 (75th percentile)	7.67	445	5675	53	70	1565	29	2	2400	0.115	0.001	0.002	1.533	0.075	0.038	0.001	0.001	1.940	0.001	<LOR
Upper Fence	8.24	511	8833	81	104	2304	37	4	3645	0.256	0.001	0.003	3.336	0.111	0.075	0.001	0.001	2.830	0.001	<LOR
Maximum	9.63	603	10265	120	160	2530	49	35	4280	1.980	0.006	0.003	7.390	0.158	0.091	0.001	0.004	2.830	0.001	<LOR
IQR(1)	0.38	45	2105	18	23	493	6	1	830	0.095	0.000	0.001	1.203	0.024	0.025	0.000	0.000	0.983	0.000	<LOR
Number of Upper Outliers	5	2	2	3	8	4	7	9	7	5	5	0	2	2	4	0	3	0	0	0
Number of Lower Outliers	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
ANZG 2018	4 - 9	N/A	5 000	N/A	N/A	N/A	N/A	N/A	N/A	5	0.1	0.2	N/A	2.5	0.2	0.01	0.2	N/A	0.01	2

2.5 Sensitive Receptors

A number of natural and anthropogenic receptors have been identified as being potentially sensitive to water impacts across the Balranald Project, including:

- ecosystems that rely on groundwater, including Groundwater Dependant Ecosystems (GDEs);
- the Murrumbidgee River and ephemeral surface water courses; and
- private groundwater abstraction licensees and infrastructure.

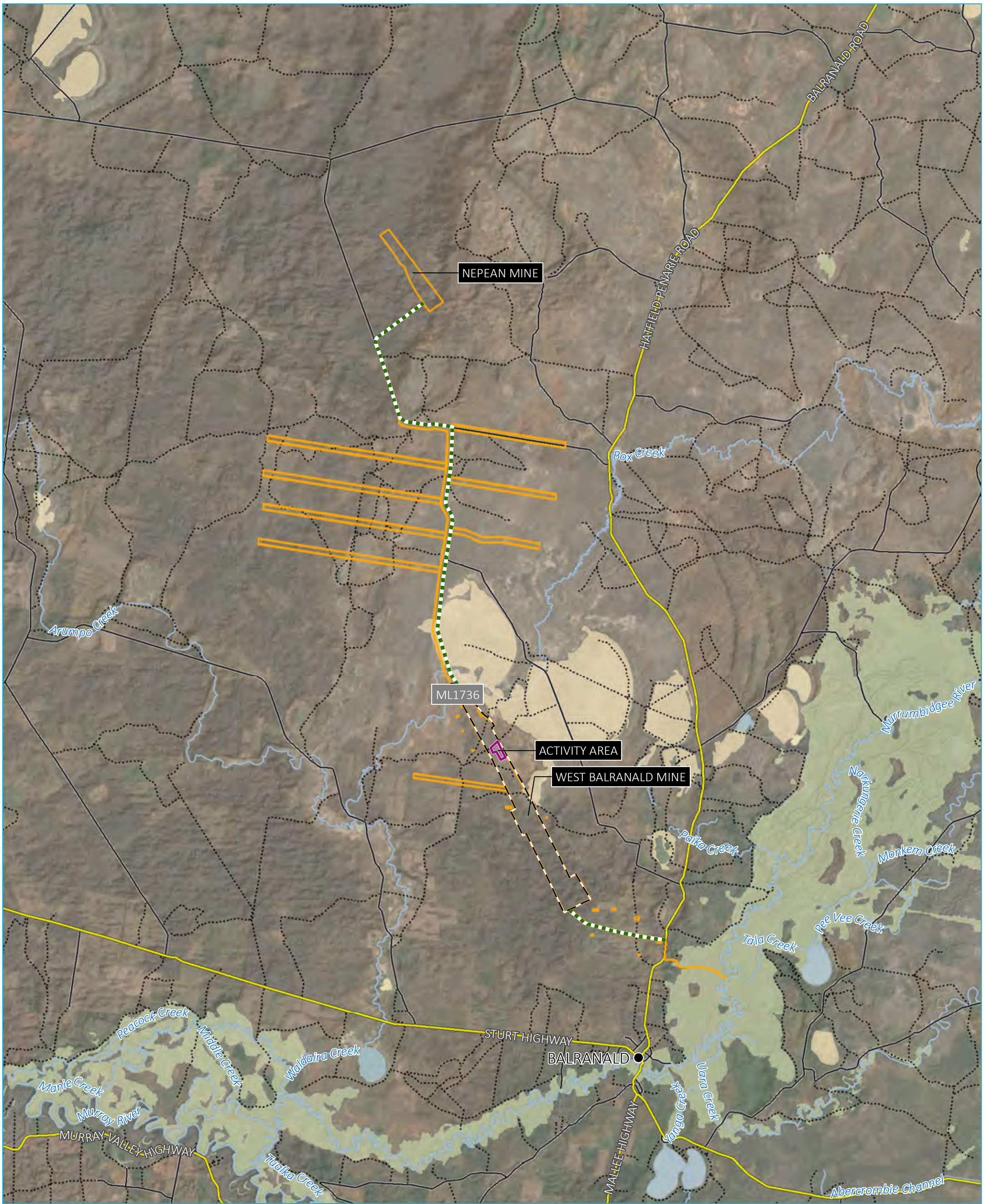
As indicated by Jacobs (2014) and CDM Smith (2015), ecosystems that rely on groundwater are important environmental assets and typically occur where groundwater is at or near the land surface, with the major potential GDE types across the Balranald Project being:

- wetlands and vegetation associated with the Murrumbidgee, Lachlan and Murray River Floodplain environments; and
- vegetation (primarily Black Box trees) located outside the floodplain area but within topographic depressions where the water table may be shallow enough and not too saline.

The Murrumbidgee River is a permanent surface water feature located to the south and east of the Balranald Project region. This river is a nationally significant river and is home to many sites of international, national and regional environmental importance. This is a critical water source for the communities that rely on water from the River for predominantly irrigation and potable supply.

A number of landholders in the area rely on groundwater, sourced from the Lower Renmark Group Aquifer, for stock, irrigation and domestic use. These landholder bores are located throughout the Balranald Project area and the groundwater that they extract can provide a vital source of water. Figure 2.6 shows the locations of known third party bores in relation to the T3 activity, which also includes the location of the T3 water supply bores; Karra Homestead and P2. Other known third party bores screened within the Lower Renmark Group Aquifer include T01, T02, T03 and HD1. Appendix B includes hydrographs at these locations.

The T3 activity area is located outside the area of any defined groundwater-reliant ecosystems and surface water resources (Figure 2.8).



Source: EMM (2019); Iluka (2015);BOM (2017); DFSI (2017); GA (2011)

KEY

- Activity area
- Project boundary
- Place
- Access road
- Mining Lease 1736
- Main road
- Local road
- Vehicular track
- Named watercourse
- Perennial lake
- Ephemeral lake
- Groundwater dependant ecosystem

Potential GDE Locations

Iluka Resources Limited
Groundwater Management Plan
Figure 2.8

3 Site overview

A site layout plan of Balranald's T3 activity site is shown in Figure 3.1, and includes the following main features:

- Site entrance track.
- The main processing area which includes the Process Water Dam (PWD); various processing plant equipment, fines storage, sand/ore stacking pad, site offices and the hard stand area which accommodates the Horizontal Directional Drilling (HDD) rig and supporting equipment.
- The T3 HDD decline holes.
- Up to three (3) mine stopes representing the T3 activity, each measuring approximately 500 m long and between 10 and 20 m wide.

3.1 Mine Water Distribution Network and Infrastructure

The process to extract the mineral ore will comprise of, in summary:

- extracting groundwater from the P2 production bore and storing in the adjacent lined PWD;
- water from the PWD will be utilised in the drilling, extraction and backfilling process;
- during extraction, the ore is fluidised and becomes a slurry, which is conveyed to the surface;
- the ore will be separated into heavy mineral and mining by-products of varying grade sizes, using a trommel, thickener, conventional cyclones and sand stacking units;
- the cyclone overflow reports to a thickener, where flocculent is added to create a thickened fines by-product stream, known as thickener underflow (fines stream);
- the thickener underflow will be stored for backfilling in the lined Fines Storage Pond. The water from the thickener will overflow to the PWD for reuse in the mining operation;
- the cyclone underflow (sand stream) is pumped through spirals circuit for separation of heavy minerals and sands tails;
- both the sand tails and ore will be stacked on an existing and new ore pad, appropriately bunded with drainage captured for re-cycling in the mining process; and
- to test the backfilling process, fines material will be combined with process water and sand fraction and re-injected via hydraulic backfill bores (HBFs) targeting the cavities.

The groundwater monitoring and management plan associated with this infrastructure is detailed in Section 5.

3.2 Water supply

Integral to the operation of the T3 activity, saline groundwater will be abstracted from the LPS Aquifer as a process water supply and during in-situ mineral extraction and backfilling. This will occur via the P2 production bore, located at the south-western corner of the PWD as shown in Figure 3.1.

Subsequently, water sourced from the PWD will be re-injected into the LPS Aquifer as a component of the in-situ mining process and during stope-backfilling with mining by-products.

A Water Trade for the LPS Aquifer of 2,350 ML for the 2019/2021 period has been secured under Water Access License (WAL) No. 3110.

Groundwater abstraction will also be undertaken from Karra Homestead Bore, which is screened within the Lower Renmark Group Aquifer. This brackish water source will be used primarily for dust suppression and soil/heavy-mineral stockpile management. A separate abstraction allowance of 150 ML has been granted by DPIE-Water under Water Access License (WAL) No. 31101 for the 2019/2021 period.

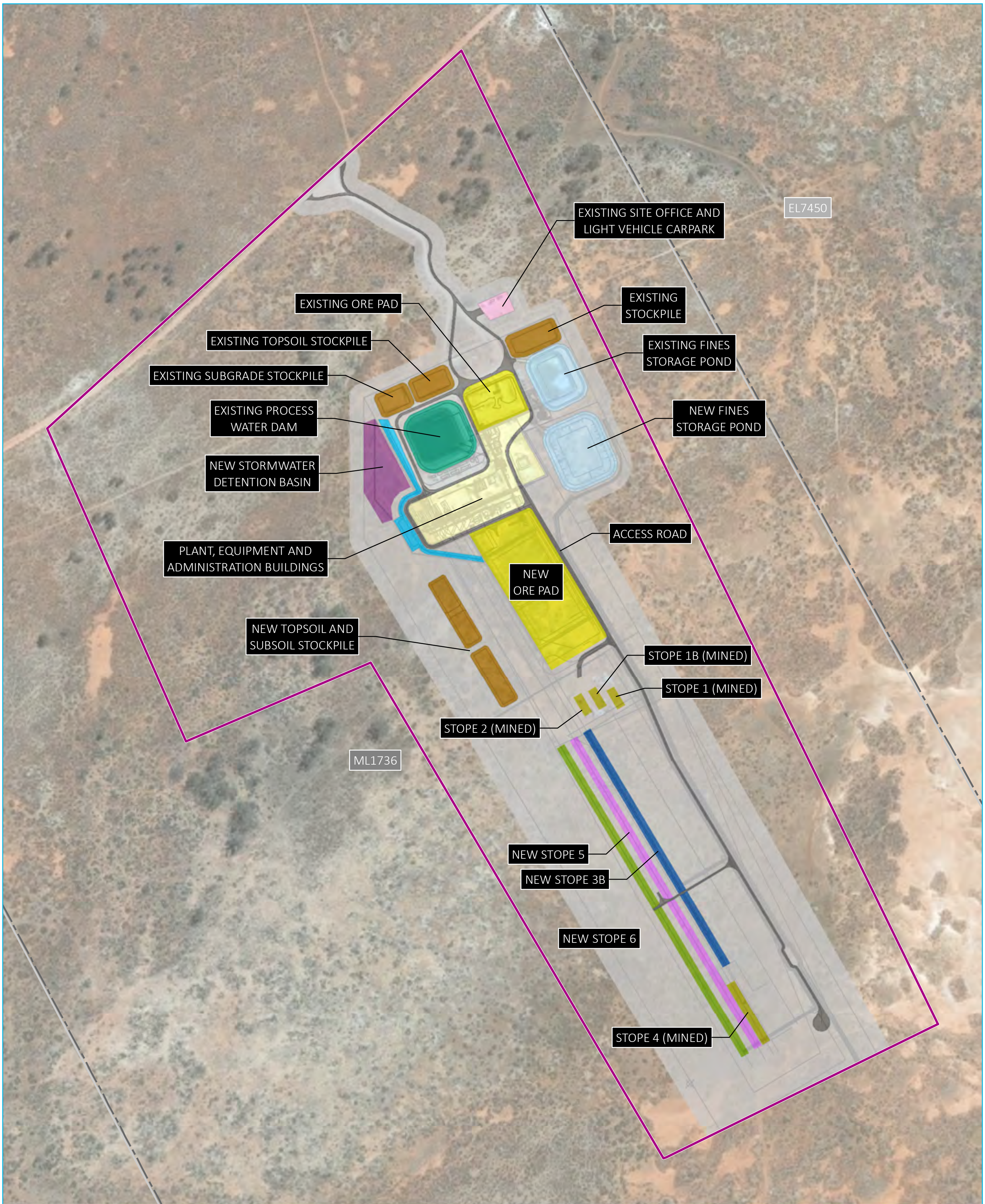
The location of the Karra Homestead bore in shown in Figure 2.6, in relation to T3 activity and other bores sampled as part of Iluka's GMEs.

The construction details for the P2 and the Karra Homestead bore are summarised in Table 3.1.

Table 3.1 Production bore construction details

Bore	Depth (mBGL)	Details
Karra Homestead	0-216.5	177 mm ND[1] blank µPVC
	216.5-218.3	100 mm ND blank µPVC
	218.3-230.3	100 mm ND stainless steel screen
	230.3-239.0	100 mm ND blank µPVC
P2 (PWD Bore)	0-57	300 mm ND CL18 blank µPVC
	57-81	300 mm ND CL18 blank µPVC

Note: 1. ND = Nominal diameter



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Source: EMM (2019); Iluka (2015); DFSI (2017); GA (2011)

0 100 200 m
GDA 1994 MGA Zone 54
N

KEY

Activity area
Mining Lease 1736
Iluka mineral tenement

Indicative site layout
Access road
Activity footprint
Existing site office and light vehicle carpark
Fines storage pond
Ore pad
Plant, equipment and administration buildings

Process water dam
Spoon drain
New stormwater detention basin
Stockpile
Stope (mined)
Stope 3B
Stope 5
Stope 6

Site map

Iluka Resources Limited
Groundwater Management Plan
Figure 3.1

creating opportunities

4 Groundwater criteria

The operational conditions for hydraulic pressures are summarized in Table 4.1 and the water quality suite specific trigger levels (SSTLs) for each aquifer unit, applicable to both field and laboratory data are summarised in Appendix C. Derivation of both the hydraulic pressure operational conditions and the SSTL's are based on baseline groundwater chemistry, the beneficial use of each aquifer, and a factor that acknowledges temporary variations that are expected during the unconventional mining activities.

4.1 Operational hydraulic pressure

The initial hydraulic operational conditions or HOCs (Table 4.1), especially related to the LPS, are identified operational site conditions and are not considered to be site/operational constraints nor reportable incidents for the purposes of the Trigger Action Response Plan (see Section 7.1) or compliance with the GMP. However, the HOCs associated with the SFM are considered to be site/operational constraints since the non-saline overburden is required to be protected from any potential upwelling of saline groundwater.

The HOCs represent the historical maximum pressures that have been experienced within the LPS aquifer without any adverse impacts being observed, including saline water movement to surface. As the T3 site activities progress, it is envisaged that the HOCs will be progressively updated as part of Iluka's adaptive management philosophy.

It is critical that the HOCs remain relatively flexible from one location to the next (to allow for localised heterogeneity in the geological conditions).

The ability for site aquifers to handle induced change without any adverse impacts to stratigraphic (aquitard) integrity will be a function of site-specific conditions, which will vary along the orebody (strike) due to the inbuilt heterogeneity within the system. During times of active mining/backfilling within the LPS, groundwater pressures within the overlying (SFM) and underlying (LRG) aquifers will be observed closely, with the results in forming a new reiteration of the HOCs. This will be facilitated by Iluka's operational adaptive management philosophy. For example, increased pressures within the SFM and LRG beyond the Yellow and Red zones indicates that the mining and backfill pressures are too large within the LPS. The HOCs for the LPS at this particular location will then need to be reduced. Likewise, if mining and backfilling activities result in pressures beyond the HOCs stated within Table 4.1 (or any new reiteration that has been iteratively established from the previous stope) with no levels occurring within the Yellow and Red zones for the SFM and LRG, then the HOCs for the LPS may be incrementally increased.

Table 4.1 Initial hydraulic operational conditions

Parameter	Shepparton			Loxton Parilla Sands			Lower Renmark Group		
	Green	Yellow	Red	Green	Yellow	Red	Green	Yellow	Red
Depth to groundwater (mounding)	>8 mBGL[1]	≤8to >6 mBGL	≤6 mBGL	<15 mAGL[2]	≥15 to <20 mAGL	≥20 mAGL	N/A	N/A	N/A
Depth to groundwater (dewatering)	N/A	N/A	N/A	N/A	N/A	N/A	≤8 mBGL	>8 to ≤10 BGL	>10 mBGL

Notes: 1. mBGL: metres below ground level
2. mAGL: metres above ground level

4.2 Water quality

Groundwater quality SSTLs have been defined for both field and laboratory analytical parameters across each formation, based on data collected before the T2 trial and up to August 2015. Post the T2 activity, Land and Water Consulting (LWC) were engaged by Iluka Resources to review groundwater data collected to date to: a) assess potential impacts as a result of the mining and backfilling trials, and b) assess the appropriateness of the SSTLs and measured suites. Appendix C incorporates these revisions and is consistent with Iuka's adaptive management philosophy. Any future proposed changes to SSTLs need to be justified, and Regulators (summarised in Table 1.1) need to be notified for approval.

As discussed in the original 2016 management plan developed for the T2 trial (Iluka, 2016),the SSTLs have been calculated in a way that acknowledges temporary variations are expected during the unconventional mining activities and groundwater quality may change spatially compared to the monitoring points used to define the historical water quality statistics (refer to Section 2.4). SSTLs are categorised as posing either a direct or indirect risk to beneficial users. Species which are classified as a direct risk could present adverse risk to beneficial users if the SSTLs are exceeded, while indirect risk species only indicate a change in groundwater chemistry, but do not present an adverse risk on their own.

'Direct' and 'Indirect' SSTLs for the Green, Yellow and Red management responses are defined below:

- Direct risk:
  - The Green SSTL indicates normal operations and incorporates all values less than the Yellow management response.
  - The SSTL for a Yellow management response is defined as the Upper fence multiplied by 1.1.
  - The SSTL for a Red management response is defined as the Upper fence multiplied by 1.25.
- Indirect risk:
  - The Green SSTL indicates normal operations and incorporates all values less than the Yellow management response.
  - The SSTL for a Yellow management response is defined as the Upper fence multiplied by 1.25.
  - The SSTL for a Red management response is defined as the Upper fence multiplied by 1.5.

The Balranald groundwater quality SSTLs are summarised in Appendix C.

5 Groundwater Monitoring and Management Program

5.1 Monitoring objectives

The monitoring objectives of the T3 network are to:

- measure the groundwater pressure and chemical changes at various locations within the SFM and LPS during both mining and backfilling periods;
- ensure adequate monitoring bores located within each SSTL zone as described in Section 5.2;
- monitor the groundwater within the SFM along the HDD access holes to ensure the water table elevation does not breach the trigger levels during mining/backfilling periods;
- measure of the variable reinjection rates and operational conditions on resulting ground water pressures and geochemical changes;
- allow for flow net/pressure analysis to be performed radially within the LPS;
- develop an understanding of operational constraints; and
- provide a robust dataset which future groundwater modelling can use to assist with assessing the feasibility of an underground mining method for the Project.

5.2 Chemical SSTL zones

It is accepted that the groundwater system will change directly adjacent to the mine stopes. However, the management objectives for groundwater chemical changes is focused on protecting the beneficial use[8] of the groundwater system down hydraulic gradient from the mining site, more-so within the mine footprint itself.

Hydrogeochemical modelling (LWC, 2017) suggest a leading edge of backfill related geochemical impact within the LPS is likely to occur if dosing the tailings prior to backfill does not take place. In order to reflect this spatial variation, a zoned approach to hydrogeochemical SSTLs has been adopted with the definitions summarised in Table 5.1 and shown spatially in Figure 5.1. The spatial SSTLs zones are based on hydrogeochemical modelling completed by LWC (2017b) that suggests large groundwater quality changes could be observed within 20 m of the stope edges, which will then dissipate to background conditions within a 300 m buffer zone from the stope edges. The zones are based on preliminary modelling and should be updated using an adaptive approach as the understanding of the system increases (see Section 7.1). The current SSTL zones also treat the T3 stopes as a small mine site and assumes the three stopes represent the entire mining footprint.

8 Although there no direct beneficial users currently identified for the SFM and LPS aquifers, the chemical SSTLs are designed to not decrease the water quality of the aquifer down gradient of the T3 activity and maintain water quality within historical statistical ranges.

Table 5.1 Zoned hydrogeochemical SSTL framework

Groundwater Monitoring Zone	Purpose	Details
Zone 1 **Mining Zone**	Operational	Adjacent and surrounding the actual mining area. Includes the stope areas plus a 20 m buffer. Required to understand immediate changes to groundwater quality and pressure. Large changes relative to baseline conditions, are expected in this zone and represent the source location of both pressure and geochemical changes. Provide a leading indicator to potential impacts within Zone 2.
Zone 2 **Transition Zone**	Operational	Non mining area and represents the zone between 20 m and 300 m from the stope edges. Data and trends within this zone are used to understand aquifer responses at various locations away from the stopes, during mining and backfill. Provide a leading indicator to potential impacts within Zone 3.
Zone 3 **Background Zone**	Compliance	Non mining area and represents the zone beyond 300 m from the stope edges. Bores located in this zone are part of the EPA Licence and will therefore be required to adhere to the nominated SSTL's and associated compliance reporting.

5.3 T3 monitoring network

Table 5.2 summarises the groundwater monitoring network for the T3 activity, and the bore locations are shown spatially on Figure 5.1. The monitoring network consists of the following:

- Ten new monitoring bores (BH-M16 to BH-M25).
- Eight existing monitoring bores.
- Nine new vibrating wire piezometers.

Note that up to five new hydraulic backfill (HBF) bores are also planned to facilitate backfill injection.

The monitoring bore network is designed to meet the objectives stated in Section 5.1.

Table 5.2 T3 activity monitoring network

Bore ID	Easting (m)	Northing (m)	Status	Screen	SSTL zone
UGM-M01	723217	6189938	existing	SFM/LPS	3 (background)
UGM -M02	723332	6189842	existing	SFM/LPS	3 (background)
UGM -M04	723348	6189745	existing	SFM/LPS	3 (background)
UGM-M09	723427	6189387	existing	SFM/LPS	2 (transition)
UGM -M12	723639	6189000	existing	SFM/LPS	1 (mining)
UGM -M15	723555	6188886	existing	SFM/LPS	2 (transition)
LPSPB04 (deep)	723702	6189053	existing	LPS	2 (transition)
BH-M16	723484	6189656	new	SFM/LPS	3 (background)
BH-M17	723318	6189364	new	SFM/LPS	2 (transition)
BH-M18	723363	6189255	new	SFM/LPS	2 (transition)
BH-M19	723377	6189038	new	SFM/LPS	2 (transition)
BH-M20	723676	6189207	new	SFM/LPS	2 (transition)
BH-M21	723672	6189008	new	SFM/LPS	2 (transition)
BH-M22	723682	6188854	new	SFM/LPS	2 (transition)
BH-M23	723631	6188619	new	SFM/LPS	3 (background)
BH-M24	723779	6189359	new	SFM/LPS	3 (background)
BH-M25	723238	6189003	new	SFM/LPS	3 (background)
VWP16	723414	6189262	new	SFM	1 (mining)
VWP17	723453	6189284	new	SFM	1 (mining)
VWP18	723466	6189175	new	SFM	1 (mining)
VWP19	723504	6189198	new	SFM	1 (mining)
VWP20	723713	6189335	new	SFM	2 (transition)
VWP21	723517	6189090	new	SFM	1 (mining)
VWP22	723555	6189112	new	SFM	1 (mining)
VWP23	723631	6188902	new	SFM	1 (mining)
VWP24	723668	6188926	new	SFM	1 (mining)
HBF4-FE1	723630	6188994	new	Stope	1 (mining)
HBF5-MP1	723551	6189121	new	Stope	1 (mining)
HBF6-MP1	723450	6189216	new	Stope	1 (mining)
HBF5- North	723399	6189356	New	Stope	1 (mining)
HBF6- North	723381	6189345	new	Stope	1 (mining)

Notes: 1. SFM: Shepparton Formation Aquifer
2. LPS: Loxton-Parrilla Sands Aquifer

5.4 GME overview

The existing Balranald bore network, including previous near-mining bores, regional monitoring bores, third party bores and process water abstraction bores is listed in Table 5.3 and shown spatially in Figure 2.6. These bores are sampled on an approximate 6-monthly basis as part of Iluka's ongoing groundwater monitoring events (GMEs) and include a comprehensive sampling regime of both field and laboratory parameters, similar to the planned T3 suites outlined in Table 5.4.

The objectives for the various bore categories are summarised below:

1. Near-mining monitoring bores – used to collect post-mining data from the LPS and SFM aquifers in the area surrounding the mining trial to assess what, if any, changes have occurred following mining.

2. Third-party bores – used to obtain pre-mining groundwater level and chemistry data, as well as investigate changes that could potentially impact third-party water users.

3. Regional bores – used to provide regional pre-mining background data in addition to ongoing data that is unaffected by mining activities.

4. Process Water – used to assess the water quality of the process water dam to determine if it is within approved ranges, which minimises impacts of the aquifer during mining/backfill trials.

Table 5.3 Existing GME bore network

Bore ID	Licence number	Easting	Northing	SFM screen interval (mBGL[1])	LPS screen interval (mBGL)	Category
UGM-M1	60BL216700	723166	6189938	15 - 18	71 - 77	near mining
UGM-M2	60BL216700	723332	6189842	25 - 28	68 - 71	near mining
UGM-M4	60BL216700	723348	6189745	24 - 27	71 - 77	near mining
UGM-M5	60BL216700	723478	6189409	26 - 29	66 - 72	near mining
UGM-M7	60BL216700	723425	6189454	29 - 32	74 - 77	near mining
UGM-M8	60BL216700	723364	6189505	26 - 29	66 - 72	near mining
UGM-M9	60BL21670	723427	6189387	24 - 27	64 - 67	near mining
UGM-M11	60BL216720	723591	6189038	15 - 18	74 - 77	near mining
UGM-M12	60BL216720	723609	6189009	15 - 18	74 - 77	near mining
UGM-M13	60BL216720	723630	6188974	15 - 18	74 - 77	near mining
UGM-M14	60BL216720	723649	6188941	15 - 18	71 - 77	near mining
UGM-M15	60BL216720	723555	6188886	15 - 18	74 - 77	near mining
GW036673 (1)	n/a	711680	6189281	32 - 37	n/a	regional
GW036866 (1/2)	n/a	734900	6203463	21 - 27	52 - 58	regional
SHOB03	60BL216540	724911	6186351	17 - 23	n/a	regional
SHOB04	60BL216539	723695	6189033	16 - 22	n/a	regional
WB41	60BL216632	720596	6194488	n/a	35 - 77	regional

Table 5.3 Existing GME bore network

Bore ID	Licence number	Easting	Northing	SFM screen interval (mBGL[1])	LPS screen interval (mBGL)	Category
WB42	60BL216625	720599	6194491	23 - 27	n/a	regional
WBGT3	n/a	724880	6186352	n/a	76 - 82	regional
WBGT4	n/a	723703	6189063	n/a	76 - 82	regional
LPSPB03	60BL216540	724893	6186351	n/a	62 - 72	regional
LPSPB04	60BL216539	723702	6189053	n/a	58 - 70	regional
WB1	60BL216637	730399	6175412	22 - 28	n/a	regional
WB2	60BL216621	730402	6175415	n/a	52 - 100	regional
WB5	60BL216646	730450	6175489	n/a	96 - 102	regional
WB7	60BL216621	729924	6176754	15 - 31	n/a	regional
HD1	n/a	726021	6185781	n/a	225 - 235 (LRG)	third-party
T01	n/a	722791	6201032	n/a	208 - 216 (LRG)	third-party
T02	n/a	729728	6195981	n/a	176.5 - 185 (LRG)	third-party
T03	n/a	732044	6189404	n/a	204 - 210 (LRG)	third-party
Karra Homestead bore	60WA583109	720430	6188310	n/a	218.3 - 230.3 (LRG)	third-party/process water
P2	60WA583169	723191	6189730	n/a	57 - 81	process water

Notes: 1. mBGL: metres below ground level
2. SFM: Shepparton Formation Aquifer
3. LPS: Loxton-Parrilla Sands Aquifer
4. LRG: Lower Renmark Group Aquifer

5.5 Bore development

Bores must be developed following installation and prior to groundwater monitoring, aquifer testing or operation. Most development methods reverse flow through the screen to loosen fine-grained materials, draw them out of the area surrounding the screen and rearrange the filter pack and the formation material for greater pumping efficiency. The flow reversals can be induced by surge blocks, bailers, pumps, airlifting with compressed air or by water jetting. To be effective, bore development must reach past the screen and the filter/gravel pack to the borehole wall to rectify drilling damage to the formation and to remove any drilling fluids.

Bore development is performed after the annular seal materials have set/cured. Development before the annular seal has set may result in the formation of gaps between the filter pack/gravel pack and the annular seal as the filter/gravel pack materials settle and compact.

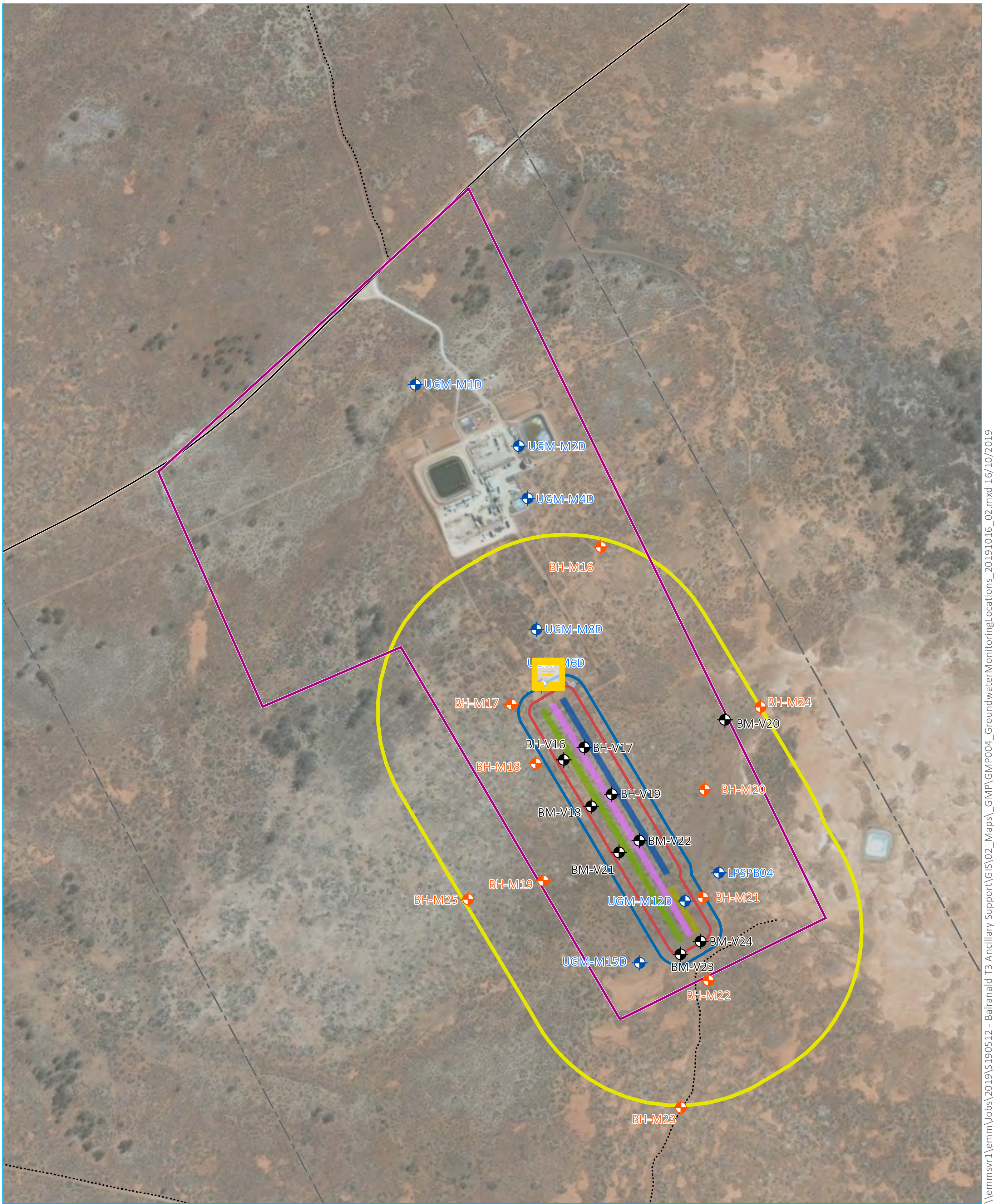
During bore development the following should be recorded:

- Initial and final groundwater level measurements.
- Airlift yield.

- Volume purged.
- Field water quality parameters, such as temperature, pH and electrical conductivity at regular intervals during the bore development process.

The bore is commonly developed until the discharge water is clear or until no further improvement is observed.

Bore development is to be undertaken in accordance with EMM's bore development Standard Operating Procedure (SOP) provided in Appendix D. This has been developed using extensive inhouse experience and following the guidance in the Minimum Construction Requirements for Water Bores in Australia, 3rd Edition (NUDLC 2012). The EMM SOP includes a template for the collection of bore development details.



Source: EMM (2019); Iluka (2015); DFSI (2017); GA (2011)

0 100 200 m
GDA 1994 MGA Zone 54
N

KEY

- Activity area
- Proposed new T3 bores
- Proposed new T3 VWPs
- Existing bores
- Local road
- Vehicular track
- Restricted area
- Mining zone boundary
- Transition zone boundary
- Mining Lease 1736
- Stope 3B
- Stope 4
- Stope 5
- Stope 6

T3 activity monitoring site plan

Iluka Resources Limited
Environmental Management Plan
Figure 5.1

EMM
creating opportunities

5.6 Groundwater monitoring suites

Monitoring suites are classified as follows:

- Suite 1- These represent the field-based properties which will be collected via a water level dipper (water levels), the YSI Pro water quality meter or something similar (EC, pH, DO, temperature and redox) and HACH portable colorimeter (Ferrous and Total Fe). Given that the field-based pH is probably the most important field analyte, it is recommended that the water quality meter be frequently calibrated.

- Suite 2- This suite represents the major cations, anions (including alkalinity) and gross alpha and gross beta and are required to consider whether the major constituents of groundwater change significantly between pre-mining, mining and post mining conditions.

- Suite 3- The species listed in this suite are considered the key leading indicators and have the most notable effect on groundwater metal composition with respect to pH-sensitive species and general dissolution of ferric hydroxide phases (which may release sorbed species). Further indicators of acidification caused by pyritic oxidation are to observe the chloride to sulphate ratio, and the ferrous and total iron relationship.

- Suite 4- Iluka is obliged to analyse and monitor for Naturally Occurring Radioactive Materials (NORM). These elements can be concentrated within heavy mineral deposits associated with monazite sands and include isotopes of uranium, thorium, radium and potassium. Two of the short-lived daughter isotopes including Ra-226 and Ra-228 are commonly monitored by Iluka, due to their high mobility under certain environmental condition and detrimental impact to ecosystems and humans following uptake (IAEA, 2014). Th, U, Ra-226 and Ra-228 should be monitored pre- and post-trial.

- Suite 5- if groundwater reduces below a pH < 6.5, certain metals may become mobile and released into the groundwater system. This suite is designed to further assess potential risk caused by potential in-situ acidification and subsequent metal mobilisation.

Table 5.4 T3 activity monitoring program overview

Suite	Description	Parameters	Frequency
1	Field parameters	Water levels, Electrical conductivity (EC), pH, dissolved oxygen, temperature, oxidation reduction potential (redox), Ferrous and Total Fe	Pre- and post-trial, daily for bore transects adjacent to active mining and backfill periods, fortnightly for other bore locations
2	Major ions	Ca, Mg, Na, K, SO_2^-, SO_4^{2-}, Cl, alkalinity (bicarbonate, carbonate, hydroxide and total as $CaCO_3$)	Pre- and post-trial, and monthly[1] during trial. Aim to collect water samples at bore transects at times adjacent to active backfill periods.
3	Leading indicators	Al, Mg, S, Cl:SO_4^{2-} , Ferrous and Total Fe. Gross Alpha, Gross Beta ('transition zone' only)	As Suite 2
4	Radionuclides	Th, U, Ra-226 and Ra-228 Gross Alpha, Gross Beta ('transition zone' only)	Pre- and post-trial As Suite 2
5	Total and dissolved metals (if pH<6.5)	Fe, Al, Mn, Zn, Cu, Pb, Ni, Co, Cd, Cr and As.	As need basis

Note: 1. Suite 2 should be sampled at times during active mining and backfilling

5.7 Groundwater monitoring schedule

Table 5.5 provides a summary of the groundwater monitoring requirements and intended monitoring frequency for the pre-, during- and post-T3 activity periods. The frequency of measurement documented in Table 5.5 refers to manual measurements only, not autonomous based datasets (which includes water pressure only) collected via loggers.

The measurement frequencies within the Mining Zone and Transition Zone will be reviewed throughout the trial and may be adjusted to suit the groundwater response being observed and would not be less frequent than in the Background Zone.

Referring to post-trial sampling schedule, a selection of the newly installed bores may be chosen to include within Balranald's standard GMEs. Post-trial cessation, a T3 assessment report will be developed and recommendations for ongoing monitoring.

In addition to the groundwater level and quality monitoring requirements, production volumes from both the Karra Homestead bore and P2 bore will be recorded. Totaliser gauges are installed on both production bores and accumulative volumes will be recorded on a weekly basis. A pre-mining gauge recording is required prior to any abstraction occurring.

Table 5.5 T3 activity monitoring schedule

Aspect	Location	Frequency	Suites	Bore ID
Pre-activity				
Groundwater quality	Mining Zone	Once off	1, 2, 3 and 4	All bores
Groundwater levels	Mining Zone	Once off	n.a	All bores
Groundwater quality	Transition Zone	Once off	1, 2, 3 and 4	All bores
Groundwater levels	Transition Zone	Once off	n.a	All bores
Groundwater quality	Background Zone	Once off	1, 2, 3 and 4	All bores
Groundwater levels	Background Zone	Once off	n.a	All bores
During activity				
Groundwater quality	Mining Zone	Daily (when mining is close to bore location) otherwise fortnightly.[1]	1	Refer to Table 5.2 for impact zones
		Monthly	2 and 3	
Groundwater levels	Mining Zone	Daily	n.a	
Groundwater quality	Transition Zone	Fortnightly	1	
		Monthly	2 and 3	
Groundwater levels	Transition Zone	Daily	n.a	
Groundwater quality	Background Zone	Fortnightly	1	
		Monthly	2 and 3	

Table 5.5 T3 activity monitoring schedule

Aspect	Location	Frequency	Suites	Bore ID
Groundwater levels		Weekly	n.a	
Post-activity				
Groundwater quality	Mining Zone	Once off as a minimum with some bores being biannual (pending T3 assessment report and on-going GME requirements)	1, 2, 3 and 4	All bores
Groundwater levels			n.a	
Groundwater quality	Transition Zone		1, 2, 3 and 4	
Groundwater levels			n.a	
Groundwater quality	Background Zone		1, 2, 3 and 4	
Groundwater levels			n.a	

Note: Bores UGM-M6, UGM-M12 and BH-M21 are located within the restricted access zone, and thus will be sampled via the remote sampling system. During active mining and backfilling, monitoring frequencies for Suite 2 and 3 will be collected from the nominated bores and aligned with the monthly schedule.
1. The suggested daily monitoring frequency will be reviewed throughout the trial and may be adjusted to suit the groundwater response being observed across the site at various locations.

5.8 Monitoring equipment

Similar equipment to the following will be used to sample and monitor groundwater during the T3 activity:

- Water level dipper (such as OTT KL010, solinst or similar).
- Water quality meter (such YSI Pro 1030, Aqua Troll or similar).
- HACH DR/890 colorimeter.
- Down-hole data level loggers (Schlumberger, Solinst or similar).
- Vibrating Wire Piezometers (VWPs) and loggers.

One of the most important requirements of the water licence conditions (reference 60WA583169 and 60BL216701) is to ensure:

- the pH of the water to be reinjected is between 6.5 and 8.5, or is treated to bring the pH within this range; and
- water injected to the aquifer to during mining and backfill periods must be of the same or better quality as the aquifer receiving water (as per the beneficial use classification) and should be free of any pollutants.

The water quality within the backfill material will be monitored (see Section 5.10), and the potential effects on the groundwater system will also be monitored. This will be accomplished by collecting real-time data from bores located close to the stopes by manually collected data via the groundwater sampling system, specifically designed to remote sample from bores located within the exclusion zone during time of active mining/backfilling.

5.9 Monitoring procedures

Best practise sampling using a combination of low-flow sampling methods and collection via passive samplers (Hydrasleeves). EMM's standard operating procedures (SOPs) for these methods are provided in Appendix D, which are consistent with the following Australian/New Zealand Standards:

- AS NZS 5667.1, 1998 – Water Quality Sampling – Part 1 Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.
- AS NZS 5667.11, 1998 – Water quality - Sampling guidance on sampling of groundwaters.

5.10 Surface water, Plant and Backfill monitoring

Prior to Iluka backfilling the stopes with tailings, a comprehensive monitoring program will be in place to assess the acidity of the tailings throughout the circuit and to inform potential dosing rates of the tailings within the spiral circuit via a dosing unit which will blend tailings with agricultural lime. Various surface water locations will also be monitored to assess the risks associated with potential acid mine drainage.

Table 5.6 Surface water, Plant and Backfill

Material	Analytes	Frequency
WATER SAMPLES		
Process Water Pond	pH	Daily
Maintain pH >6.5 and <8.5 continue with current dosing rate	Field Parameters**	Weekly
To determine whether any hydrated lime treatment is required and quantify dose rate, if any.	Suite 2***	Monthly
To investigate the extent of evaporative concentration and any potential impacts on Ca and SO4 concentrations.	Gypsum saturation index	Monthly
To determine the potential for gypsum scaling.		
Fines thickener underflow	Field Parameters**	Weekly
Fines report to the new fines dam (old T2 PWD), which will be covered with water to minimise oxidation, prior to backfilling.	Suite 2***	Monthly
Spiral plant discharge (sand stream)	pH	Daily
To determine whether any lime treatment is required and quantify dose rate, if any.	Field Parameters**	Weekly
	Suite 2***	Monthly
HBF discharge line	Field Parameters**	Weekly
To determine whether any lime treatment is required and quantify dose rate, if any. Last monitoring point before backfilling occurs to stopes.	Suite 2***	Monthly
T2 stockpile area drainage sump	Field Parameters**	Weekly
To determine whether any lime treatment is required and quantify dose rate, if any.	Suite 2***	Monthly
T3 Stockpile drainage sump	Field Parameters**	Weekly
To confirm effectiveness of limestone blending in sand and HMC stockpiles.	Suite 2***	Monthly

** Field Parameters: pH, EC, Temperature, Redox Potential
*** Suite 2: Acidity/alkalinity, pH, EC, Ca, Mg, Na, K, SO4, Cl. If pH <6.5, total and soluble metals: Fe, Al, Mn, Zn, Cu, Pb, Ni, Co, Cd, Cr, As.

5.11 Subsidence Monitoring

Iluka has prepared a separate Subsidence Management Plan (SMP) [ILUKA-TR-T19103] which details the potential subsidence risks, monitoring and mitigation strategies associated with mining and backfilling. VWPs will be monitored at key locations in between stopes to monitor vertical connection / aquitard integrity.

VWP telemetry will live feed the control room and be closely be monitored near injection points (with alerts) during the mining/fluidisation phase and the backfilling phases. The SMP forms part of the Balranald Project Safety Management System as a Principal Hazard Management Plan.

5.12 Quality Control and Quality Assurance Plan

Quality assurance/quality control (QA/QC) measures are activities undertaken to demonstrate the accuracy and precision of the monitoring program. QC consists of the steps Iluka will take to determine the validity of specific sampling and analytical procedures. QA generally refers to Iluka's broad plan for maintaining quality in all aspects of a work program. The reliability of, and confidence in, the data collected as part of this GMP will be determined by implementing the following quality controls:

- Routine and regular equipment maintenance, checks and calibrations.
- Internal data validation.
- External data validation.

All QA/QC results will be assessed firstly by an appointed hydrogeologist to inform the overall adequacy and reliability of each parameter to meet the monitoring program objectives.

Based on the quality assessment, one or more aspects of the QA/QC program may be modified as required at any stage of this monitoring program.

The following sub-sections outline Iluka's QA/QC plan associated with the T3 activity.

5.12.1 Equipment maintenance, checks and calibrations

Down-hole pH, EC and redox sensors will be installed down selected bores within the restricted access areas close to the stopes, and will be calibrated prior to use, according to the manufacturer's recommendations. At a minimum, the down-hole sensors will be calibrated again post trial datasets to assess any potential deviation or drift. Field meters used to measure water levels, pH, EC, redox, ferrous ion and ferric iron from the standard monitoring bores will be calibrated daily.

The requirement for recalibration during the trial will be assessed as needed based on any observed measurement drift, measurement error, equipment malfunction, or discrepancy with manually collected field data. At a minimum, each sensor will be calibrated according to the guidance provided by the instrument manufacturer. When not in use, equipment will be stored and maintained according to the manufacturer's guidance.

All calibrations will be recorded in an electronic calibration log that will include the sensor number (or serial number), the measured parameter both before and after calibration. This log will allow detection of possible instrument issues over time and serve as a reference to increase data confidence should future validation be required.

All equipment will be cleaned routinely as part of the calibration and maintained according to the manufacturer's specifications or more frequently as required.

5.12.2 Internal data validation

Internal data validation measures and database management will be undertaken by the appointed field hydrogeologist, and will include reviewing the following as a minimum:

- Manual groundwater level measurements and downloaded logger data from both down-hole logger sensors and VWPs.
- The Suite 1 manual discrete water quality measurements.
- Comparison of the Suite 1 measurements with the downhole logger data to assess logger performance and consistency.
- Measured water abstraction volumes and calculated rates.
- Comparison of the collected data against the HOCs and SSTLs (see Section 5.12.4).

Field based measurements and the T3 activity groundwater database will be uploaded to numerous servers on a frequent basis, which will facilitate additional reviews by senior Iluka and EMM staff.

5.12.3 External data validation

External checks are performed by non-Iluka personnel such as an external monitoring contractor and the analytical laboratory. Iluka will select one or more laboratories that are accredited by the Australian National Association of Testing Authorities (NATA). As such, each laboratory selected operates according to the guidelines set out in ISO/IEC 17025 - "General requirements for the competence of calibration and testing laboratories". Iluka will review the external laboratory QA/QC program as part of the laboratory selection process.

External laboratories should provide a QA/QC report with each batch of samples given. To avoid data entry errors, the laboratory should transcribe all data and reports electronically.

Iluka may undertake inter- and intra-laboratory testing as part of this GMP.

5.12.4 Data Management and Reporting

A summary of the data reporting requirements and timeframes are outlined in Table 11 and are discussed below.

All water monitoring and environmental data collected during the T3 activity, from automated and manual sources, will be stored and managed using Monitor Pro 5 (MP5; EHS Data, 2015). All MP5 data will sit within the Balranald Project server located at: Iluka Resources head office, located at St Georges Terrace, Perth, WA.

It will be the responsibility for the site environmental specialist to keep a field-based Excel database, which can be configured to the required MP5 format for easy upload. The internal validation process will most likely be undertaken on the Excel-based database and prior to MP5 upload and storage. The Excel database review will be conducted by the Supervising Hydrogeologist on a daily basis. Subsequent upload to the MP5 platform will occur weekly.

Automated dataloggers, which are not telemetric, will be downloaded on a weekly basis as a minimum and entered into MP5 within 24 hours of download.

All field-based worksheets, templates or similar will be captured in TRIM and uploaded to various servers at the end of each shift.

Groundwater level and water quality data will be compared to Balranald HOCs and SSTLs either on a daily basis or within 24 hours of receipt of laboratory data and/or download from automated dataloggers.

If a breach of the HOCs or SSTL occur, the procedure outlined by the Hydrogeological Trigger Action Response Plan or TARP (see Section 7), will be implemented.

In addition to the comparing the T3 activity data to the HOCs and SSTLs, additional comparisons will be made with the background data collected as part of the Balranald's GMEs. This more detailed assessment is likely to take place once the trial is completed and all data is collated. The T3 assessment report will be made available to both DPIE-Water and EPA, within six months of trial completion.

Table 5.7 Summary of Data Reporting Timeframes

Data Analysis and Reporting	Timeframe
Communication of field data results to either an Iluka Manager (email or verbal) or an Iluka appointed Hydrogeologist.	At the conclusion of each day in the field.
Entry of Field Data into the site-based MP5 Database or similar and comparison to SSTL.	Within 1 day of data being collected and entered into site Excel database.
Review and Sign-off of Field Data by Iluka Manager / Hydrogeologist.	
Review and Sign-off of Laboratory Data by Iluka Manager/ Hydrogeologist.	Within 1 week of data being entered and outputs provided.
Entry of Laboratory Data into the site-based MP5 Database or similar and comparison to SSTL.	Within 2 days of receipt of the final laboratory reports.
Downloading of logger-based data and subsequently upload to MP5.	Downloaded weekly and uploaded to MP5 at the end of each shift.
All field based data sheets and templates.	Uploaded to Iluka server, EMM server and TRIM at the end of each shift.
SSTL breach report sent to DPIE-Water and EPA.	Within 3 days of all data being received and reviewed (see Section 7).
T3 Assessment Report sent to DPIE-Water and EPA.	Within 6 months of trial completion.

6 Groundwater modelling and ongoing validation

The T2 trial demonstrated that the mining process had minor hydraulic responses in comparison to re-injection, which forms part of the backfill process. Accordingly, the T3 numerical simulations focused primarily on the responses during backfilling.

The T3 prediction scenarios simulated backfilling of Stopes 4 to 6 assuming a backfill rate of 150 m^3/hr and using the modelled calibrated parameter set based on the previous T2 activity. This parameter set enhances the vertical conductance between the LPS and the overlying SFM in order to capture the mounding impacts observed in the SFM.

There is presently significant uncertainty associated with the predicted mounding within the SFM and LPS caused by the T3 activity. Characteristics contributing to uncertainty include:

1. Stope conditions prior to commencement of backfill:

    a) A large relatively open stope will facilitate backfill with minimal observable mounding impacts initially because there is a large highly conductive void space available, which facilitates rapid propagation of pressure along the stope.

    b) A stope that has collapsed will have reduced void space and less ability to propagate pressure, which may result in large mounding impacts very early in the backfill process.

2. Integrity of the aquifer material above the stopes post-mining:

    a) If the aquifer material above the stopes remains cohesive then mounding impacts in the Shepperton are likely to remain minimal during backfill. There is a naturally occurring bentonite layer at the base of the Shepperton which confines the LPS facilitating artesian conditions with pressures well above surface level.

    b) Enhanced permeability of the bentonite layer above the mined stope may promote a rapid mounding response in the SFM, although the magnitude of this response will vary and depend on the ability of the SFM to dissipate the mounding pressure. Enhance permeability may occur for multiple reasons including slumping, weakening of material above the stope due to pressurisation during backfilling, historical exploration drilling and leakage around the annulus of monitoring and/or injection/mining bores.

3. Extraction at P2 could potentially mitigate the mounding impacts from backfilling, depending on timing and extraction rate from this bore. Likewise, Iluka may decide to extract groundwater from adjacent HBF bores as a means of managing mounding pressures during backfill stages.

Regardless of the inherent uncertainty in the current model, the prediction results still give some valuable insights to how the system may behave during the T3 activity. Referring to Figure 6.1 to Figure 6.4, notable responses are summarised below and site staff should be aware of such possible processes during the trial. To assist with interpretation, Table 6.1 summarises the bore locations which are assessed below and their distance from the nearest stope:

- The hydrographs show mounding in the SFM and LPS at specific bore locations. The three horizontal lines represent the surface level (brown), yellow (yellow) and red (red) SSTLs. The "open", "closing" and "closed" scenarios reflect different stope behaviour during backfill, with increasing difficulty of returning tailings to the voids. Backfill starts 10 weeks after siteworks commence. Note some scenarios overlie each other and the mounding contours show the modelled responses to a "closing" stope condition only, which represents the situation when the stope progressively becomes backfilled with tailings which decreases permeability over time.

- The hydrographs identify maximum mounding in the LPS at the points of injection (ie at the HBF bores). The hydrographs of monitoring points are in order of increasing distance from any stope (refer to Figure 5.1 and Table 6.1). Groundwater pressure increases within the SFM appear minimal despite significant hydraulic heads being simulated within the LPS, notably at HBF6-NTH.

- The modelled hydrographs also suggest that backfilling may cause less mounding response at the beginning of the backfill schedule, as indicated by responses simulated at HBF4-FE1, compared to the responses simulated at the end of the backfill schedule as indicated at HBF6-NTH. The modelled responses assume a constant backfill rate and may be required to reduce over time, as void spaces reduce and become increasingly filled with tailings.

- There appears to be very little East-West lateral propagation of mounding in the upper portion of SFM which can be regarded as the water table (Figure 6.3 and Figure 6.4, Layer 1) away from the stopes. The mounding propagation migrates along the stope in line with the regional gradient, which is from South-East to North-West. Mounding may show greater lateral extent in the upper SFM within the angle of draw of the void due to loss of cohesion in the overlying aquifer material.

- Mounding associated with backfilling may appears to have limited observable effect at the water table with increasing distance from the stope.

- The lower (or deeper) portion of the SFM (Figure 6.3 and Figure 6.4, Layer 2) shows greater response to the injection into the LPS.

- There is potential for excessive mounding in the LPS if the stope voids collapse or have reduced conductivity from backfilling. Continued injection into a low conductivity stope could result in head pressures tens of meters above ground level. Regardless of stope initial behaviour, these conditions are very likely in the final stages of the backfill. Careful monitoring of VWP data and trends should provide adequate warning of rapidly increasing mound trends above the stopes.

- There is no observable impact to third party bore users extracting from the LRG. Full annual entitlement extraction Karra Homestead bore during 5 months of siteworks may cause a <0.1 m drawdown impact at HD1.

- There are no identified GDEs that could be impacted by drawdown or mounding from the T3 activity.

Post-trial completion, a summary assessment report will be developed within 6-months as defined in Section 5.12.4. As part of this reporting phase, all data will be collated and assessed, which will provide valuable data to validate and possible recalibrate the numerical model. This process will further reduce uncertainty related to future model predictions.

Table 6.1 Bore locations relative to stopes

Bore	Screen	Distance to nearest stope (m)	Nearest Stope
HBF6-NTH	LPS (stope)	0	6
HBF5-MP1	LPS (stope)	0	5
HBF4-FE1	LPS (stope)	0	4
UGM-M12S	SFM	10	4
UGM-M12D	LPS	10	4
BH-M17S	SFM	75	6
BH-M17D	LPS	75	6
BH-M19S	SFM	125	6
BH-M19D	LPS	125	6
BH-M25S	SFM	250	6
BH-M25D	LPS	250	6

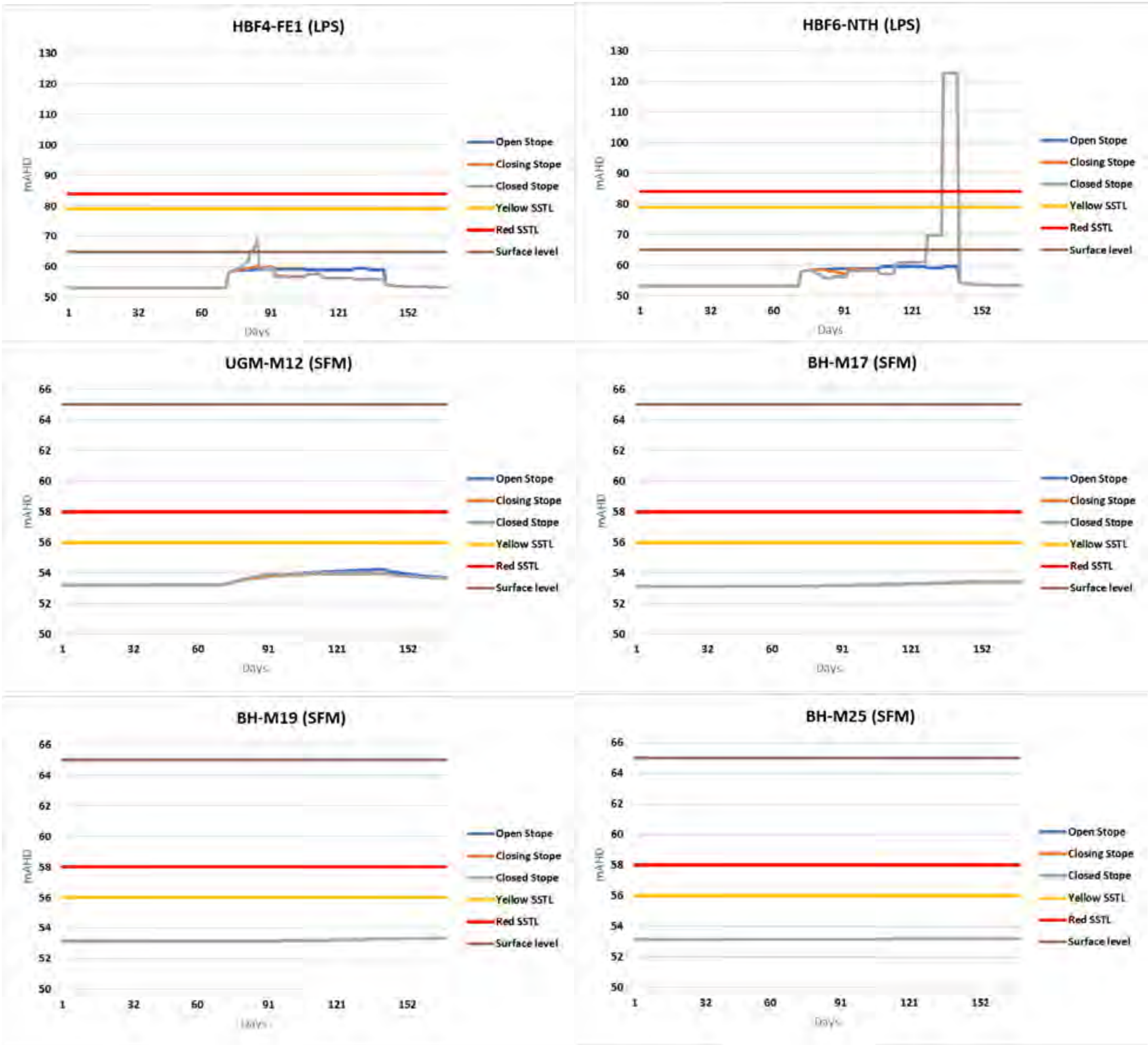


Figure 6.1 Modelled T3 activity hydrographs- HBF and SFM bores

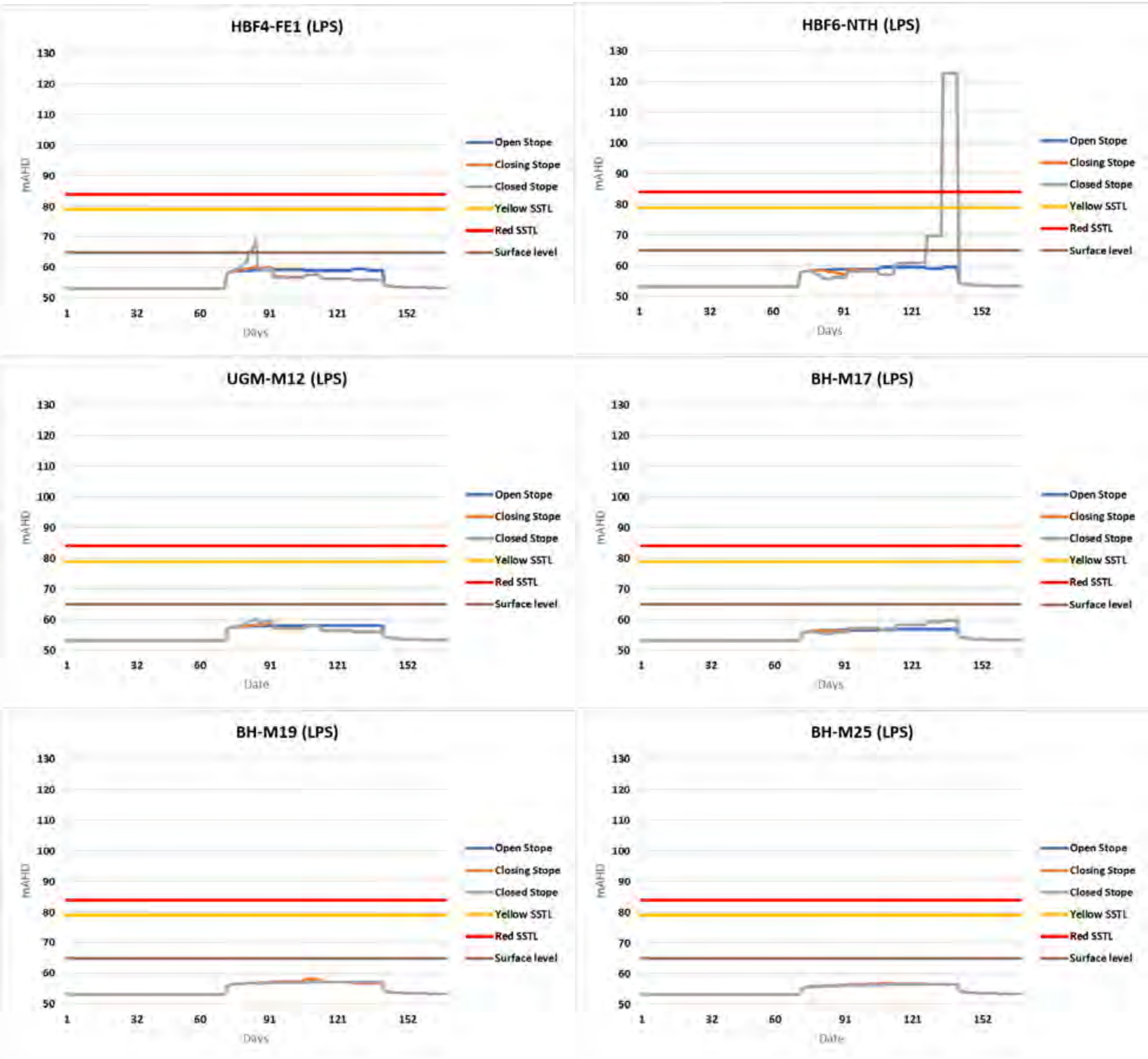
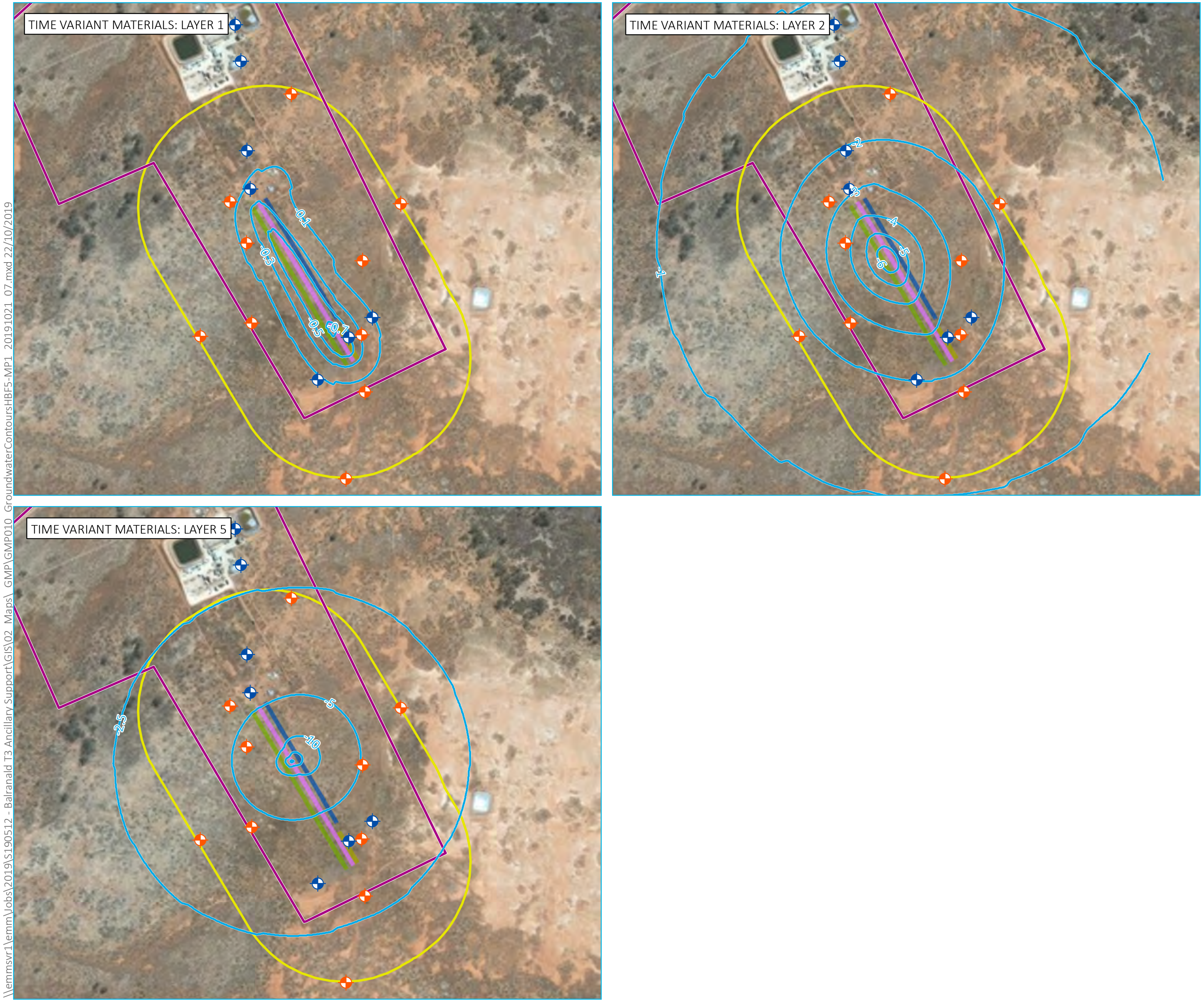


Figure 6.2 Modelled T3 activity hydrographs- HBF and LPS bores



KEY

- Activity area
- Existing bore
- Proposed new T3 bore
- Mounding contour (m)
- Transition zone boundary
- Stope 3B
- Stope 4
- Stope 5
- Stope 6

Note:
Layer 1 = Upper SFM (water table region)
Layer 2 = Lower SFM (slightly above LPS)
Layer 5 = LPS hosting ore body

Groundwater contours at the end of injection at HBF5-MP1

Iluka Resources Limited
Groundwater Management Plan
Figure 6.3

0 250 500 m
GDA 1994 MGA Zone 54

Source: EMM (2019); DFSI (2017)

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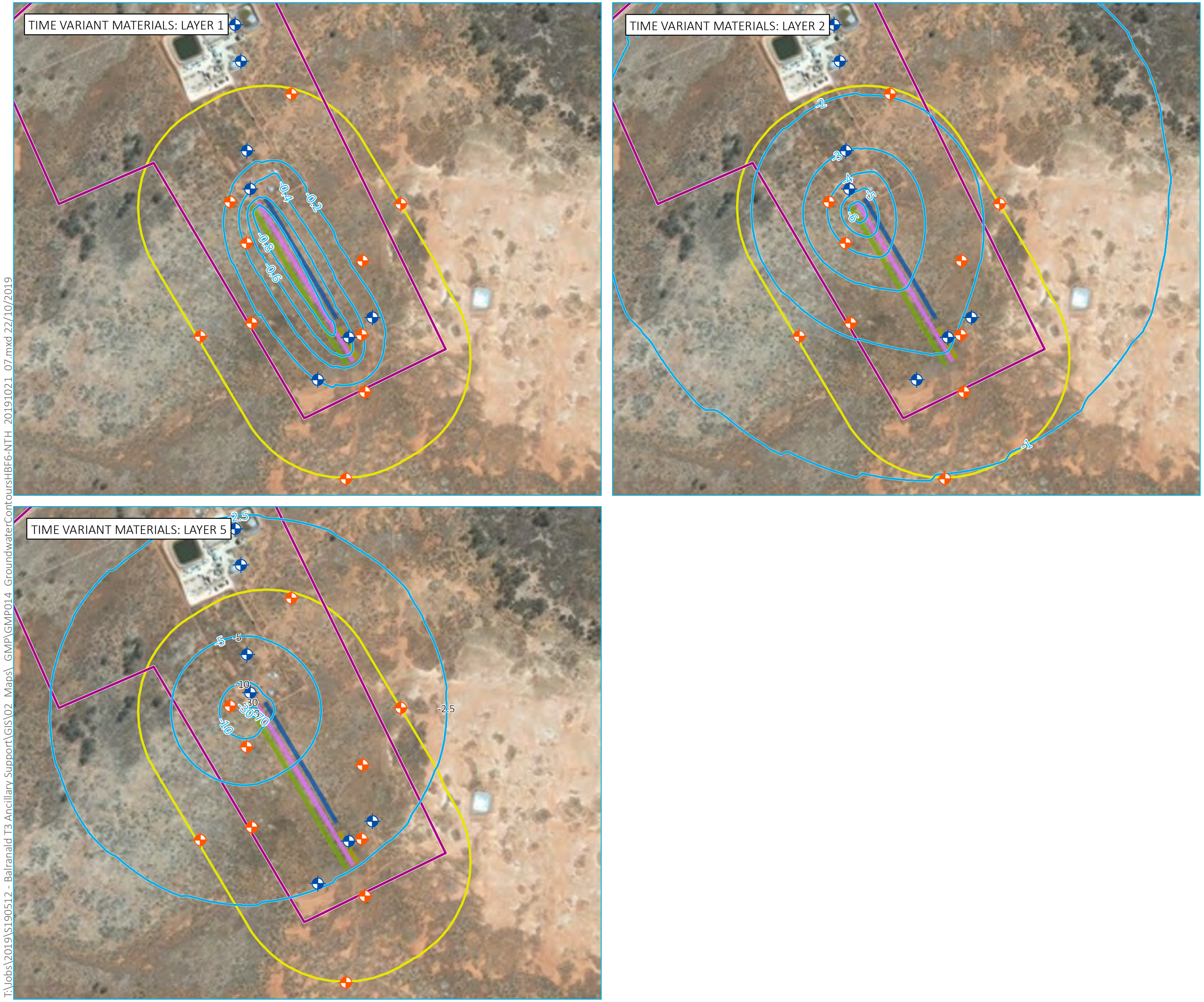

KEY
- Activity area
- Existing bore
- Proposed new T3 bore
- Mounding contour (m)
- Transition zone boundary
- Stope 3B
- Stope 4
- Stope 5
- Stope 6

Note:
Layer 1 = Upper SFM (water table region)
Layer 2 = Lower SFM (slightly above LPS)
Layer 5 = LPS hosting ore body

Source: EMM (2019); DFSI (2017)

0 250 500 m

GDA 1994 MGA Zone 54

Groundwater contours at the end of injection at HBF6-NTH

Iluka Resources Limited
Groundwater Management Plan
Figure 6.4

EMM creating opportunities

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7 Trigger action response plans and adaptive management

7.1 Trigger Action Response Plans

The approach to water and environmental management is defined by the Hydrogeological Trigger Action Response Plan (TARP). The recorded data is measured against a range of site specific trigger levels (SSTL) established to protect the groundwater resource as defined in Section 4. The type and urgency of management responses are triggered by SSTLs corresponding to a three-tiered management framework, defined in Table 7.1. This approach will allow for early and rapid intervention of possible groundwater.

Table 7.1 Hydrogeological Trigger Action Response Plan

Operating Range	Management Response
GREEN	The Green operating range indicates normal operation. Observed parameters are below the accepted SSTL range and impacts fall within acceptable limits. No action is required.
YELLOW	The Yellow operating range also indicates normal operating conditions but is designed to inform Iluka of possible future issues to allow time for adequate investigation and/or intervention. Observed parameters are marginally outside the accepted SSTL range, signifying action must be taken within 48 hours of infringement confirmation. Confirmation is defined by: • 24 hours of continuously recorded infringement in autonomous and telemetry collected data; • 2 daily consecutive infringements recorded in for-cause manual sampling; • ensuring pH of the PWD and tailings within the circuit are within the acceptable range of 6.5 – 8.5. Checking both autonomous and field readings are required; and, • additional verification of the data, if required. This allows a suitable timeframe for any local variability associated with small saline slugs, or measurement error, to be delineated and confirmed. Actions associated with the operation of the T3 activity within the yellow monitoring threshold: • increasing monitoring frequency in order to assess trends and understand processes occurring; • revising the accepted SSTL range upon assessment of the impact on environmental values (to be completed with regulator consent); • reducing the mining/backfilling and/or groundwater abstraction rates until infringements are within Green monitoring threshold or have stabilized; and • depending on trends and if the red breaches are imminent, consider remediation action. After 72 hours of continued operation in this threshold from a water quality perspective, a notification report will be forwarded to DPIE Water and NSW EPA, ideally and prior to conditions breaching the Red operating range. Hydraulic breaches against the LPS HOC's are not considered breaches of compliance criteria. *Note, although the TARP only applies to bores located outside of the defined transition zone, all bore locations will be monitored and assessed during site activities as preventative measure to minimise the risk to SSTL breaches.*

Table 7.1 Hydrogeological Trigger Action Response Plan

Operating Range	Management Response
RED	The Red operating range indicates a breach of acceptable operating conditions. Observed parameters are above the Red SSTL, signifying action must be taken 12 hours after infringement confirmation. Infringement confirmation is defined by: • 24 hours of continuously recorded infringement in autonomous and telemetry collected date; • 2 consecutive infringements recorded in manual data; and, • Additional verification of the data, if required. Actions associated with the operation of the T3 activity within the red monitoring threshold, include those listed for the previous tier, with the addition of: • Modifying the T3 operations until infringements are within the Green or Yellow monitoring threshold or have stabilised; • Investigate the cause of the SSTL breach if not adequately understood; and • If necessary, develop and implement strategies to prevent future Red SSTL breaches or to mitigate any impacts caused by the SSTL breach. Iluka are committed to not adversely impacting sensitive receivers including the environment and 3rd party bore owners. If groundwater pressures adversely impact these receptors, make good provisions would apply as defined by the AIP (2012) and in accordance with Iluka land access agreements (eg equipment replacement).If necessary, aquifer remediation to prevent Red SSTL breaches or to mitigate any impacts caused by an SSTL breach would include aquifer reinjection, whereby groundwater will be extracted from either PB1 or PB2 (LPBPB04) depending on breach location, and reinjected into the nearest HBF bores where the breach has been observed. Field properties (Suite 1) would be monitored continually until water quality along the flow path (ie at a minimum, at the observation bore where breach has been measured) returns below the 'yellow' SSTL for Suite 1 parameters. Measured groundwater pH > 6.5 would indicate acidification of the aquifer has ceased and any on-going risk associated with metal mobilisation is negligible. In the event that both PB1 and PB2 bores fall within the zone of impacted aquifer, Lower Remark Group groundwater from the Karra bore will be used to flush and remediate the LPS Aquifer.

Note: The TARP only applies to bores located outside the 300 m buffer zone for the purposes of groundwater quality (see Section 4.2 and 5.2). As detailed in Section 4.1, the TARP does not apply to the HOC associated with the LPS, which will be managed by an adaptive management process.

7.2 Adaptive Management Philosophy

The approach to management of groundwater during T3 activities will be adaptive.

The adaptive management approach will allow for the use of the monitoring data to address the risks and impacts to the groundwater system and allow immediate change in management and/or activities as may be required. By incorporating this flexibility into this plan Iluka will be able to adjust the site operations and or monitoring program (such as sampling frequency) in response to information gained from the monitoring data collected during the T3 activities. This is especially the case for developing flexible operational hydraulic triggers, which will vary along the orebody/strike due to the inherent heterogeneity within the subsurface system.

Whilst the TARP will be applied to bores located in the 'background' zone (ie UGM- M1, UGM-M2, UGM-M4, BH-M16, BH-M23, BH-24, BH-M25), to ensure protection of the regional aquifer all bores within the 'mining' and 'transition' zones will be compared to SSTLs daily (ie leading indicators). These will be field based parameters, such as pressure, pH, Eh, and dissolved oxygen.

8 References

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