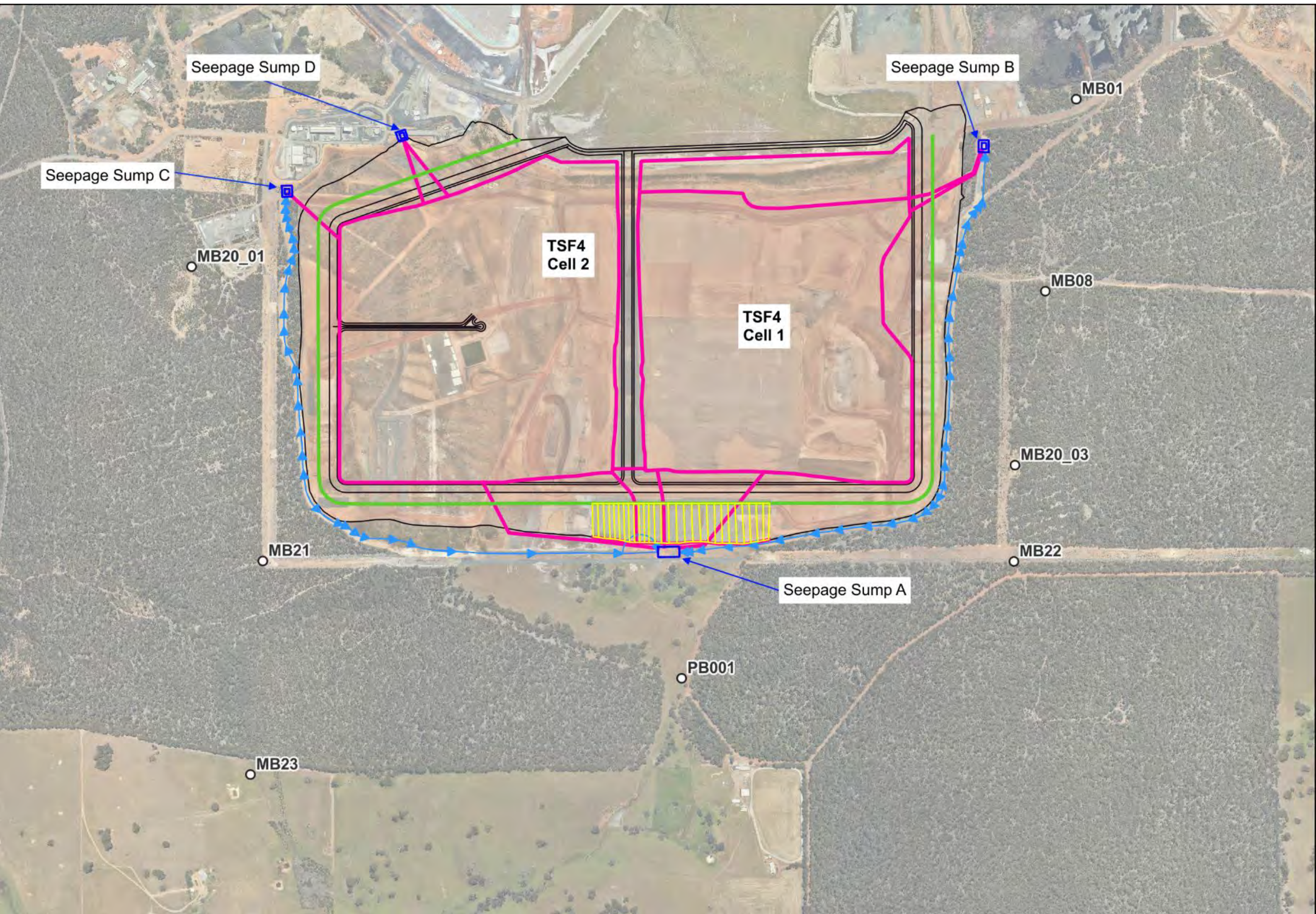
TSF4 Seepage Assessment

Seepage Monitoring and Management Plan

Talison Lithium Pty Ltd

05 February 2024

→ **The Power of Commitment**



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→ The Power of Commitment

Executive Summary

Introduction and Background

GHD Pty Ltd (GHD) was appointed by Talison Lithium Pty Ltd (Talison) to assess the potential seepage risk posed to the receiving environment from the proposed Tailings Storage Facility #4 (TSF4). This *TSF4 Seepage Monitoring and Management Plan* (SMMP) summarises the understanding of risk associated with TSF4 seepage and covers the monitoring requirements and actions to manage the risk to the receiving environment. The *TSF4 Human Health and Environmental Risk Assessment* completed by GHD (2023h), other supporting investigations, and this SMMP are required to address conditions and requests for information from the Department of Mines, Industry Regulation and Safety (DMIRS) and the Department of Environment and Regulation (DWER) related to the TSF4 approvals.

TSF4 compromises two cells with basal and embankment liners, as follows:

- Cell 1: Engineered clay-liner over ~80% of the area and Bituminous Geosynthetic Membrane (BGM) over the remaining ~20% of the area.
- Cell 2: 100% BGM liner.
- The embankments and future embankment lifts will be lined with BGM.

The operation of TSF4 has the potential to impact on the surrounding environment through mobilisation of impacted seepage and run-off derived from the facility into the surface water and groundwater systems. The following conclusions were drawn from the *TSF4 Human Health and Environmental Risk Assessment* completed by GHD (2023h):

- Predictive groundwater modelling of the subsurface beneath TSF4 shows that the Contaminants of Potential Concern (CoPCs) within seepage that migrates through and beneath the engineered basal liner will adsorb/attenuate within the underlying saprolitic aquifer and remain close to the TSF4 footprint during operations and post-closure. The CoPCs should not migrate in groundwater beyond the mine-site boundary, nor discharge and impact the beneficial uses of the Woljenup Creek catchment.
- TSF4 internal drainage (above the engineered basal liner) and external surface drainage will be directed towards and be collected in sumps located external to TSF4 (Sumps A, B, C & D). The collected drainage, which will exceed site-specific water quality criteria, will be pumped-back to the Mine Water Circuit (MWC) during operations and until such time as the water is of suitable volume and quality for release via passive management strategies post-closure.

The key objectives for managing TSF4 potential seepage impacts to groundwater and surface water systems from TSF4 are to:

- Maintain the groundwater quality at the mine premises boundary at background levels; and
- Prevent the TSF4 seepage and/or drainage causing adverse impacts to the receiving environment of Woljenup Creek.

This TSF4 Seepage Management Plan is divided into *Groundwater Management* and *Surface Water Management*, as follows:

Groundwater Management

Overview:

The aim of the groundwater monitoring program is to detect TSF4-derived seepage impacts to the groundwater system and confirm that the impacted groundwater is within that predicted by groundwater modelling (modelled TSF4 impacts indicate impacts limited to margins of TSF4 footprint).

Monitoring:

Monitoring will occur from the following monitoring bores:

- Baseline monitoring bores: Bores generally removed from the areas close to the TSF4 footprint. Undertake monthly and quarterly monitoring on the shallow and deeper bores, respectively for field parameters, CoPCs (metals) and major ions.
- TSF4 Perimeter bores (to be installed): These shallow, intermediate, and deep groundwater monitoring bores will be located at the perimeter of TSF4 (within ~50m of the external toe of the embankment). Undertake monthly and quarterly monitoring on shallow, intermediate, and deep bores respectively for field parameters, CoPCs (metals) and major-ions.

  During the initial year following commencement of operations (includes Time Limited Operations (TLO)), relatively high frequency monitoring will occur (monthly to bi- annual), with subsequent monitoring occurring less frequently (quarterly, to annually). The monitoring schedule is presented in **Appendix A Table 1.**

Reporting:

The data from the monitoring events (monthly, quarterly, bi- annual, and annually) will be evaluated against the trigger levels (presented in **Appendix A Table 2**), within two weeks of receipt of the data.

Where the trigger levels are not exceeded, **Routine Monitoring Reporting** will be undertaken, as per **Section 6.2**.

Where the trigger levels are exceeded and actions implemented, the **Non-routine Monitoring Reporting** will be undertaken as per **Section 6.3**.

Trigger Levels:

Baseline monitoring bores:

An exceedance of water quality guidelines occurs in a number of existing baseline monitoring bores (deemed as naturally occurring given the mineralised geological setting). Consequently, the trigger levels are based on a 30% increase above the baseline concentrations (seasonal maximum), for the key CoPCs at each monitoring bore (i.e.: As, Cs, Li, Rb, Sb, U). The trigger levels are presented in **Appendix A Table 2.**

TSF4 perimeter bores:

Given the occurrence of a number of CoPCs (as naturally occurring), it is anticipated that the TSF4 perimeter bores (to be installed) will also indicate impacts above the guidelines.

In addition, the groundwater modelling predictions show that TSF4 seepage (CoPCs) will impact some of the TSF4 perimeter bores into the future.

As a consequence, the trigger levels for the TSF4 perimeter monitoring bores are based on 100% percentage increase above the baseline concentrations (seasonal maximum), for the key CoPCs at each monitoring bore (i.e.: As, Cs, Li, Rb, Sb, U). The trigger levels are presented in **Appendix A Table 2.**

Where the trigger levels are exceeded, Talison will implement **Action 1**.

Action 1: Monitoring and Review

Confirmatory monitoring of baseline bores will be undertaken within one month. If elevated CoPC concentrations (above 30%) are reported, the groundwater will be assessed for TSF4 decant source signature based on the concentrations of major ions: SO_4, Na, HCO_3, Cl, which are added during ore processing. Any increasing trends in decant source signature concentrations in groundwater will be assessed against the geochemical setting to provide supporting evidence of TSF4 impacts (qualified personnel required, e.g.: geochemist).

Where TSF4 impacts to groundwater are supported, with both CoPCs and increasing trends of decant signature, then:

- Report to DWER within 2 weeks of confirmation of TSF4 impacts, include monitoring results, follow-up actions and scheduling/reporting (as per **Section 6.2**).
- Implement **Action 2**.

Action 2: Risk Assessment

Update the TSF4 seepage risk assessment, with new information including impacted groundwater extent, migration direction and fate of impacted groundwater.

Where required to support the risk assessment update, predictions of impacted groundwater fate will occur, which may include recalibration of the existing groundwater model and/or groundwater investigations.

Where the beneficial use of the groundwater is diminished (above baseline concentrations, and above site-specific Water Quality Guidelines) and these impacts occur at the following locations:

– At the premises boundary; and/or
– Discharge into Woljenup Creek;

and then present an understanding of the site-specific receptors which may be impacted (human health and the environment). If the receptors are exposed to impacted water quality above the guidelines, then the risk to the receptors is deemed unacceptable and implement **Action 3**.

Action 3: Remediation

Remedial options will be designed and implemented if risk to the receptors is assessed as unacceptable, the options which may include one or more of the following:

– Control of TSF4 source discharge (mitigation of surface water runoff and/or groundwater seepage)
– Pump-back of impacted groundwater (abstraction/recovery bores)
– Capture and management of impacted surface water within Woljenup Creek (e.g.: pump-back to mine water circuit)

Surface Water Management: TSF4 Sumps

Overview:

The aim of monitoring drainage into the external Sumps (A, B, C & D) is to detect water quality and flow rates outside the predictive modelled values. Any differences will be accommodated in the yet to be designed passive management system, which is to be implemented post closure (active pump-back to the MWC to cease).

Monitoring:

To validate the water-quality and flow rates, monitoring of TSF4 drainage into the Sumps (A,B,C & D) includes field parameters, flow rates, CoPCs (metals) and major-ions.

During the initial year following commencement of operations (includes TLO), relatively high frequency monitoring will occur (monthly to bi- annually), with subsequent monitoring occurring less frequently (quarterly to annually). The monitoring program and schedule is presented **Appendix A Table 3.**

Reporting:

The data from the monitoring events (monthly, quarterly, bi- annual, and annually) will be evaluated against the trigger levels (presented in **Appendix A Table 4**), within two weeks of receipt of the data.

Where the trigger levels are not exceeded, **Routine Monitoring Reporting** will be undertaken, as per **Section 6.2**. Where the trigger levels are exceeded and actions implemented, the **Non-routine Monitoring Reporting** will be undertaken as per **Section 6.3**.

Trigger Levels:

Applicable two years after the commencement of operations (to accommodate tailings drainage achieving a settled water quality), the trigger levels are 200% of modelled lithium concentrations, and 150% of modelled flow rates at the Sumps (A,B,C & D), averaged over a period of 12 months. The trigger levels are presented in **Appendix A Table 4.**

Action: Update Predictive Modelling

Where triggered, the existing predictive model will be updated after 3 years (2 years post operation commencement plus 1 year of (averaged) monitoring data). Modelling will continue to be updated at three yearly intervals, until no longer triggered or the passive management strategy has been implemented and is operational.

Surface Water Management: Woljenup Creek

Overview:

Impacts on Woljenup creek, recognised as the TSF4 receiving environment, may occur as surface water runoff and groundwater discharge.

Monitoring:

The monitoring program includes flow rates, field parameters, CoPCs (metals) and major-ions/nutrients.

During the initial year following commencement of operations (includes TLO), relatively high frequency monitoring will occur (monthly to bi- annually), with subsequent monitoring occurring less frequently (quarterly to annually). The monitoring program and schedule is presented **Appendix A Table 5.**

Reporting:

The data from the monitoring events (monthly, quarterly, bi- annual, and annually) will be evaluated against the trigger levels (presented in **Appendix A Table 6**), within two weeks of receipt of the data.

Where the trigger levels are not exceeded, **Routine Monitoring Reporting** will be undertaken, as per **Section 6.2**. Where the trigger levels are exceeded and actions implemented, the **Non-routine Monitoring Reporting** will be undertaken as per Section 6.3

Trigger levels:

The trigger levels are based on a 30% increase of the seasonal baseline maximum concentrations at SW20/02, or where analytes were not tested, the site-specific water quality guidelines have been adopted as trigger levels. The trigger levels are presented in **Table B6 (Appendix B),** and where they are exceeded, then implement **Action 1**.

Action 1: Review of monitoring results:

Where triggered, confirmatory monitoring will be undertaken within one month. If elevated CoPC concentrations persist (30% more than baseline), the Woljenup Creek waters (e.g.: SW20/02) will be evaluated for TSF4 decant source signature (SO_4, Na, HCO_3).

If the impact to the Creek is deemed to reflect TSF4 source seepage and/or drainage implement **Action 2**.

If a TSF4 source is not supported, then update baseline concentrations with new information, and adjust trigger levels accordingly.

In addition, increase the frequency of monitoring of Woljenup creek waters to monthly (includes all monitoring parameters). Review the requirement for monthly monitoring after six months.

Action 2: Risk Assessment

Compare Woljenup Creek water quality to the site derived Water Quality Guidelines. If TSF4 impacts cause water quality to exceed guidelines, identify site-specific receptors and identify exposure scenarios as confirmation from a potential risk to actual risk.

Where risks to the receiving environment (Woljenup Creek), are deemed to pose an adverse risk, implement **Action 3**.

Action 3: Remediation

Where CoPC concentrations in Woljenup Creek are deemed to pose an unacceptable risk to the receptors, remedial options will be designed and implemented based on the following strategy:

– Control of TSF4 source discharge (mitigation of surface water runoff and/or groundwater seepage).
– Capture and management of impacted surface water within Woljenup Creek (e.g.: pump-back to mine water circuit).

Review of Seepage Management Plan

This groundwater and surface water seepage management plan is subject to updates, based on new data and information gathered during monitoring. The review of the seepage management plan will include where justified, updates to the following:

– frequency of monitoring
– monitoring parameters/CoPCs
– reporting frequency
– actions

A review of the Seepage Management Plan will occur at the following time frames:

– End of TLO
– During operations at 5 yearly intervals
– End of operations
– End of site management.

In consultation with DWER, the seepage management plan will also be reviewed and updated at times that new information becomes available which alters the understanding of risks posed to the receptors.

Contents

Table index

Figure index

Appendices

1. Introduction

1.1 Background

Talison Lithium Pty Ltd (Talison) is constructing Tailings Storage Facility # 4 (TSF4) to facilitate ongoing operation of their Greenbushes Mine in Western Australia. The Department of Mines, Industry Regulation and Safety (DMIRS) and the Department of Environment and Regulation (DWER) has approved the respective Mining Proposal (MP Reg ID 92728) and Works Approval (WA W6618) to allow construction of TSF4, subject to certain conditions and requests for information. A list of these conditions and requests is presented in **Table 1.1**.

Table 1.1: Issues Raised by DMIRS and DWER

Item	Source of request	Agency	Request and information required
1A	Schedule 1: Areas of the Mine Closure Plan that require further development in the next revision.	DMIRS	Update the MCP with the hydrogeological information gained from the non-standard tenement condition requiring an assessment of water recharge to stock water dams 1 and 2 south of TSF4
1B			The MCP is to provide updated information on the expected timeframe for seepage water from TSF4 to reach an acceptable quality such that active management of seepage is no longer required post closure of the facility. This should include details of the test work completed to date, to determine the changes in seepage water quality over time.
2	Schedule 2: Recommended further conditions	DMIRS	Prior to 1 December 2022, the tenement holder shall undertake a hydrological and hydrogeological assessment to confirm there will be no significant reduction in the quantity of water recharge to stock water dams 1 and 2 south of the TSF4.
3A	Schedule 3: Table 11-8: Baseline Environmental Data Gaps	DMIRS	A subset of the recently identified (GHD 2020f) Contaminants of Potential Concern (CoPCs) was analysed for the first time in 2020 and do not have published guidelines (antimony, caesium, rubidium, thallium)
3B			Time for TSF4 to drain and seepage to cease after tailings deposition ceases has not yet been modelled.
3C			Further information is needed on the tailings slurry water quality during operations.
4A	TSF4 Works Approval Condition 4(f)	DWER	Updated hydrogeological conceptual model incorporating: i) additional permeability testing of the saprolitic profile beneath the TSF4 footprint
4B			Updated hydrogeological conceptual model incorporating: ii) confirmation of the permeability, lateral continuity and expected seepage and migration rates from TSF4
5A	TSF4 Works Approval Condition 16(e)	DWER	(i) updated seepage management plan, including an updated seepage model reflecting actual data collected from additional hydrogeological studies and actual tailings characteristics
5B			(ii) Trigger values for groundwater and surface water monitoring to identify potential impacts from seepage from TSF4, and actions undertaken to respond to potential seepage impacts
6	TSF4 Works Approval Condition 16(h)	DWER	(h) a groundwater monitoring report demonstrating their compliance with conditions 10, 11 and 12 for the time limited operations period…."

GHD Pty Ltd (GHD) was appointed by Talison to assess the seepage from TSF4 (the Study) in response to the issues raised. The scope of the Study will culminate in a suite of reports to be submitted to DMIRS and/or DWER in response to the various conditions and requests. Given the nature of these conditions and requests, some have been addressed across several reports detailing separate, but related, subject matter, and others have been addressed partly within a single report. A summary of the Study reporting structure is provided in **Table 1.2** and depicted schematically in **Figure 1.1**.

Table 1.2: Reporting Structure to Address the DMIRS and DWER Requests and Conditions

Report	Description	Item(s) Addressed in Table 1-1
Tailings Leach Testing (GHD, 2023a)	The Testing of the tailings (in-situ TSF1/TSF2 material and fresh tailings) characterises the leaching of CoPCs from tailings material for the modelling work and risk assessment.	1B, 3B
Sub-surface Clays Attenuation Capacity Testing (GHD, 2023b)	The Testing of the clays beneath TSF4 derived the attenuation factors for key CoPCs within clays for the seepage modelling and risk assessment.	1A, 2
Baseline Monitoring Report (GHD, 2023c)	The Report summarises the quarterly sampling and monitoring of the surface and groundwater monitoring of quality, levels and reporting to provide a pre-construction baseline.	6
Conceptual Hydrogeological Model of TSF4 (GHD, 2023d)	The Conceptual Model is a collation of drilling, hydraulic and monitoring information, to present aquifer and clays continuity, groundwater flow directions and groundwater discharge locations and surface water flows.	2, 4A, 4B
Site-Specific Water Quality Criteria (GHD, 2023e)	The Criteria have been derived for site specific conditions and form the basis for tolerable mine discharges to off-site environments. A summary of all previous guideline derivation work is included. Determined As, Li and Rb are the key CoPCs	1B, 3A, 3B, 4B
Woljenup Creek Hydrological Assessment (GHD, 2023f)	The Assessment involves the determination of the dilution effect on any released CoPCs in the downstream creeks and estimates the total load on the Blackwood River.	Required for Risk Assessment
Site Wide Seepage Modelling (GHD, 2023g)	The Modelling provides predictions for the fate and transport of impacted seepage within the groundwater system from facilities, including TSF1, TSF2, TSF4 and Floyds Waste Rock Landform (cumulative impacts for TSF4).	1A, 2, 4A, 4B
	The Modelling provides preliminary predictions of the timeframe for TSF4 to drain, the quality of the drainage waters, and an indication of how long drainage will continue after closure of TSF4.	1B, 3B, 3C
Risk Assessment (GHD, 2023h)	Assessment of risks to human health and the environment from mine site seepage and discharge, supported by the various technical studies (herein).	-
Seepage Monitoring and Management Plan (this report)	The Plan details a monitoring plan and schedule for surface and groundwater, associated trigger criteria, and actions that should be undertaken should seepage be detected above the trigger levels.	5A and 5B

This report outlines the Seepage Monitoring and Management Plan (SMMP) for TSF4 and represents one component of the overall Study. The SMMP draws on the supporting studies presented in **Table 1.2**, particularly the Human Health and Environmental Risk Assessment (HHERA) detailed in GHD (2023h) to define the monitoring regime for the operation and closure of TSF4.

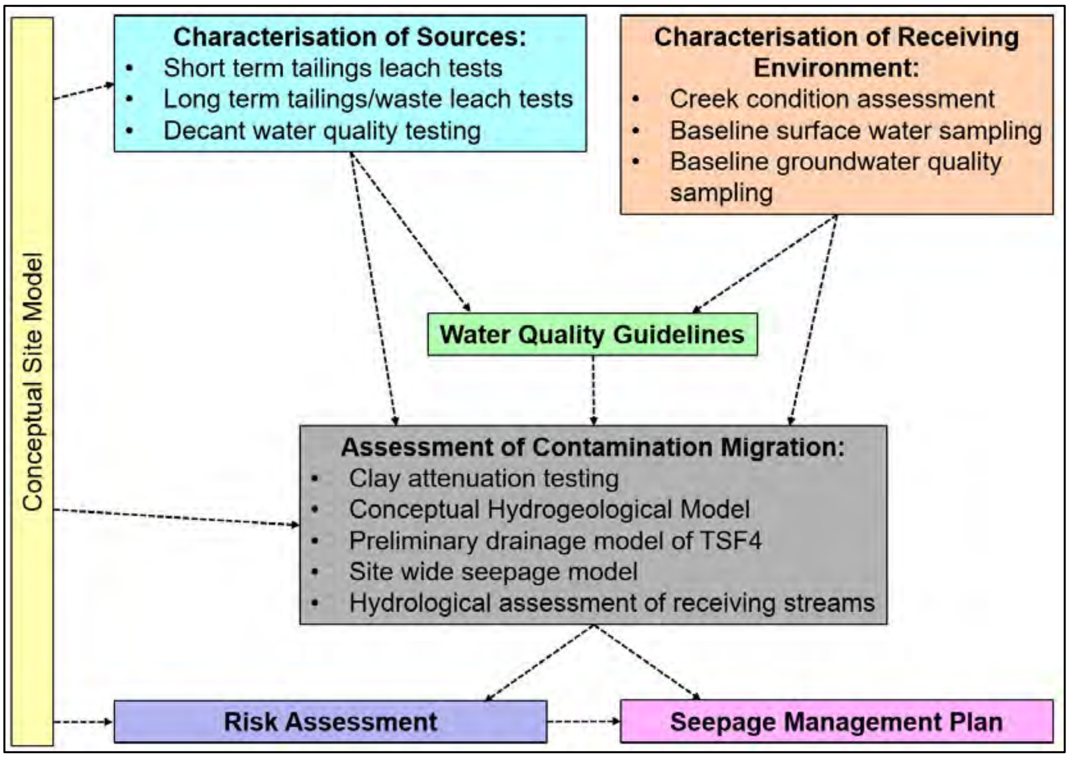


Figure 1.1: Reporting Structure for TSF4 Seepage Assessment

1.2 Purpose of this Plan

The purpose of the SMMP is to provide a monitoring regime to demonstrate that the distribution of the TSF4 seepage impacts is broadly consistent with the predicted distribution in the groundwater modelling and HHERA, and to provide a framework of action should exceedances of triggers occur.

1.3 Management Plan Structure

The reporting structure adopted for the risk assessment is as follows:

– **Introduction:** This chapter

– **Overview of TSF4 Assessment:** Presents a summary of the site setting derived from the Hydrogeological Conceptual Model (GHD, 2023d), an overview of the seepage risks based on the HHERA (GHD, 2023h), and the site-specific Water Quality Guidelines (WQGs) based on the review and adjustment of the published guidelines (GHD, 2023e).

– **Management Strategy:** Outlines the approach to monitoring and management of seepage with key monitoring sites situated along seepage pathways and action plans designed to confirm predictive modelling results and intervene to mitigate unforeseen impacts if necessary.

– **Groundwater Management:** Approach to demonstrating that the distribution of the TSF4 seepage impacts within the subsurface is broadly consistent with the modelled predicted distribution, that the risks to the primary potential receptor (Woljenup Creek) remain low, and to provide a contingency framework should groundwater seepage results indicate increased concentrations above that of the modelled predicted concentrations (i.e., the triggers) and WQGs (i.e., the thresholds).

– **Surface Water Management:** Details how water released from Sump A post-closure into Woljenup Catchment (which may impact the receptors) will be managed, the approach to identify whether concentrations of Contaminants of Potential Concern (CoPCs) in Woljenup Creek can be attributed to TSF4 seepage (i.e., triggers), and a contingency framework should TSF4 impacts (CoPCs) to Woljenup Creek be detected and/or WQGs be exceeded (i.e., the thresholds).

1.4 Overview of TSF4

The location and layout of the mine site and TSF4 is presented in **Figure 1.2**, along with the surface water drainage lines. The figure shows that the downstream waterways that may be impacted by any seepage or potential discharge from TSF4 includes Woljenup Creek and Blackwood River.

The TSF4 footprint and relevant design features are presented in **Figure 1.3**. The design and operational features aimed at managing tailings drainage/seepage are as follows:

– Embankments comprising waste rock buttresses with clay cores keyed into the underlying strata to limit seepage outside the facility.

– Cell 1 is underlain by Bituminous Geosynthetic Membrane (BGM) over 20% of the area and an engineered clay-liner over the remaining 80% of the area. Cell 2 comprises 100% BGM. The embankments and future embankment lifts will be lined with BGM.

– Natural clay materials (not shown) underlie the TSF4 footprint and wider surrounding area (~10 m to ~15 m thick), which is intern underlain by bedrock basement materials.

– Drainage from the tailings deposited via slurry methods (decant waters) is collected via the following:

  - Internal perimeter drains positioned immediately above and below the liner;
  - A tailings underdrainage system, located above the liner to collect and direct tailings drainage (under gravity) through the embankment walls into four external collection sumps (Sumps A, B, C, and D);
  - External perimeter toe drains located around the foot of the western, southern, and eastern embankments of TSF4; and
  - Network of outlet pipes directing internal and external drainage to four lined sumps located outside the TSF4 embankments (Sumps A, B, C, and D).

Figure 1.3 shows that one of the sumps, Sump A, is located within the upper parts of the Woljenup Creek catchment, while the remaining sumps (Sumps B, C, and D) are situated within the catchments of the operational mine site (discharging to Cowan Brook Dam and the open pit).

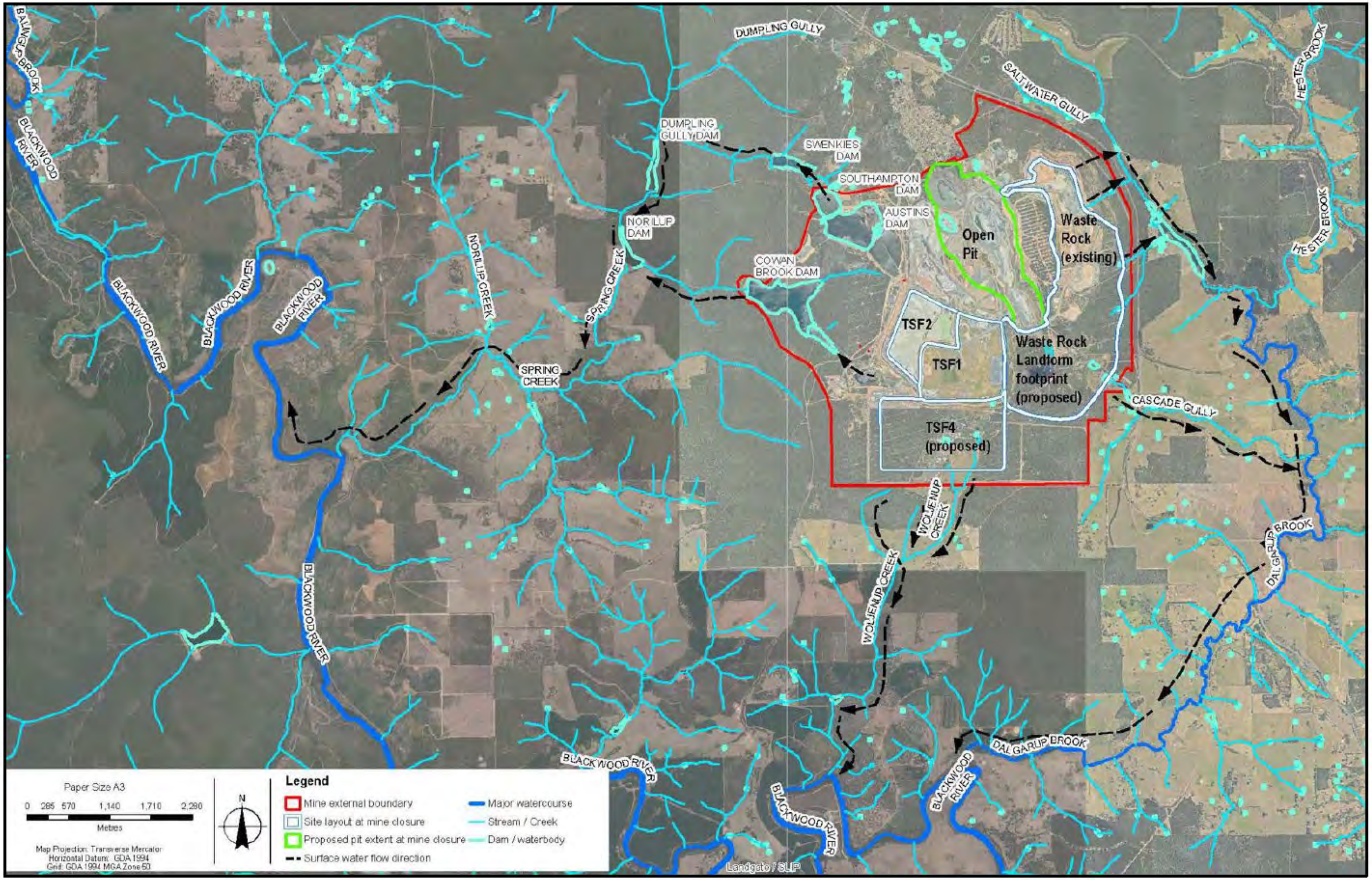


Figure 1.2: Mine Site Locality Plan Indicating Surface Water Discharge Pathways

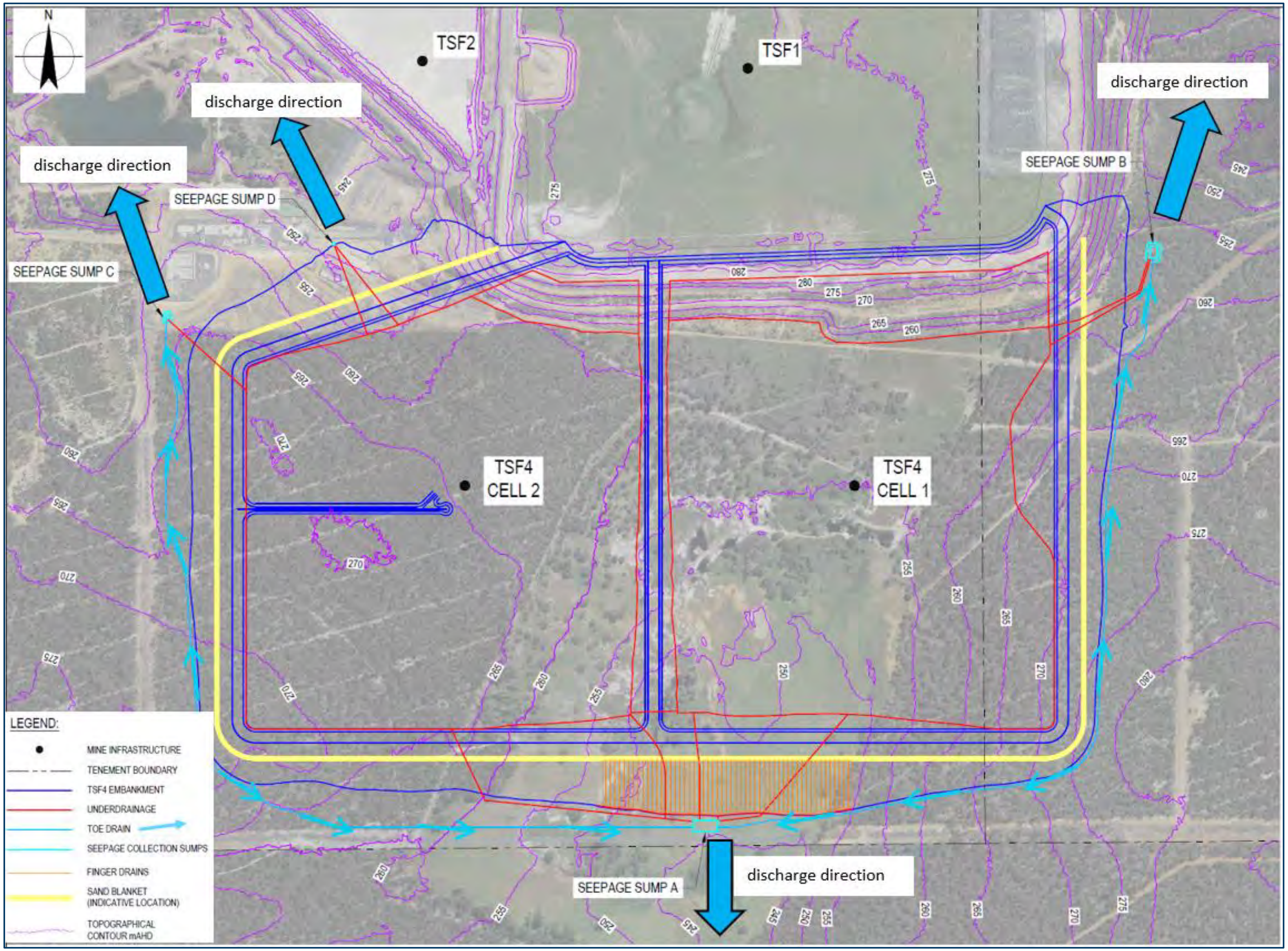


Figure 1.3: TSF4 Layout Indicating Internal and External Drainage

2. Overview of TSF4 Risk Assessment

2.1 TSF4 Risk Setting

2.1.1 Introduction

Based on the supporting investigations presented in **Table 1.2**, GHD (2023h) completed an assessment of the risk to human health and the environment based on the understanding of seepage and discharge from TSF4. For the purposes of this report:

- The term "seepage" relates to waters migrating in the natural subsurface beneath the TSF4, and
- The term "drainage" relates to waters expressed at the surface derived from internal TSF4 drainage, and TSF4 runoff.

The following summaries outline the understanding of the **source-pathway-receptor** linkages derived from TSF4 seepage and drainage.

2.1.2 Potential Sources of Impact

The sources of potential impact to the receiving environment include:

- Tailings decant and leaching (slurry/process waters), which were found to exhibit CoPC concentrations above the human health and environmental WQGs (i.e.: Al, Sb, As, Cd, Cs, Li, Mn, Rb, Tl, U, Vn, and Zn).
- Waste Rock was found to leach CoPCs with concentrations above the human health and environmental WQGs (i.e.: As, Li, Sb, Vn, NO_3, SO_4).

The WQGs for the relevant CoPCs adopted for the mine site are summarised in **Table 2.1**. The list of CoPCs was derived from testing of tailings decant, tailings leaching, and waste rock leaching, the testing, and results of which has been summarised and presented in the *TSF4 Seepage Risk Assessment* (GHD, 2023h). The WQGs are based on a combination of published criteria from the Australian and New Zealand Governments (ANZG, 2018) and the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ, 2000), as well as site-specific WQGs which were derived from a review and adjustment of these published guidelines (GHD, 2023e).

Table 2.1: Summary of Adopted Water Quality Guidelines from GHD (2023e)

CoPC (filtered)	Water quality guidelines (mg/L)[1]				
	Agricultural use - Livestock	Agricultural use - Irrigation	Aquatic Environment	Potable use	Non-potable use
Aluminium	5	5	0.055	0.2	NR
Antimony	0.15	NR	0.09	0.003	0.06
Arsenic	0.5	0.1	0.013	0.01	0.2
Cadmium	0.01	0.01	0.001	0.002	0.04
Caesium	2.0	NR	0.1	0.08	1.6
Chromium (III+VI)	1.0	0.1	0.004	0.05	1.0
Copper	0.5	0.2	0.0014	2.0	40
Lithium	0.82	2.5	2.0	0.007	0.14
Manganese	10	0.2	1.9	0.5	10
Molybdenum	0.15	0.01	0.034	0.05	1.0

[1] NR = Guideline not required (CoPC does not pose a risk to receptors).

CoPC (filtered)	Water quality guidelines (mg/L)[1]				
	Agricultural use - Livestock	Agricultural use - Irrigation	Aquatic Environment	Potable use	Non-potable use
Nickel	1.0	0.2	0.05	0.02	0.4
Rubidium	0.39	NR	0.017	0.014	0.28
Thallium	0.13	0.001	0.00003	0.00004	0.0008
Uranium	0.2	0.01	0.0005	0.02	0.4
Vanadium	0.1	0.1	0.0006	0.0002	0.004
Zinc	20	2	0.04	3	60
Sulfate	1000	NR	429	250	NR
Nitrate (as N)	90	NR	2.4	50	NR

2.1.3 Source Migration Pathways

2.1.3.1 Groundwater Seepage

Tailings impacted waters (decant, tailings and waste rock leach) that migrates downwards through the TSF4 basal liner and into the underlying saprolitic clay profile (clays of ~10 m to ~15 m thickness), will migrate southwards along with groundwater flow. The groundwater has potential of discharge, some ~750m downgradient of the TSF4 into the Woljenup Creek, at which artesian groundwater levels are indicated. The groundwater flow directions in the shallow saprolite formation in the vicinity of TSF4 are shown in **Figure 2.1**.

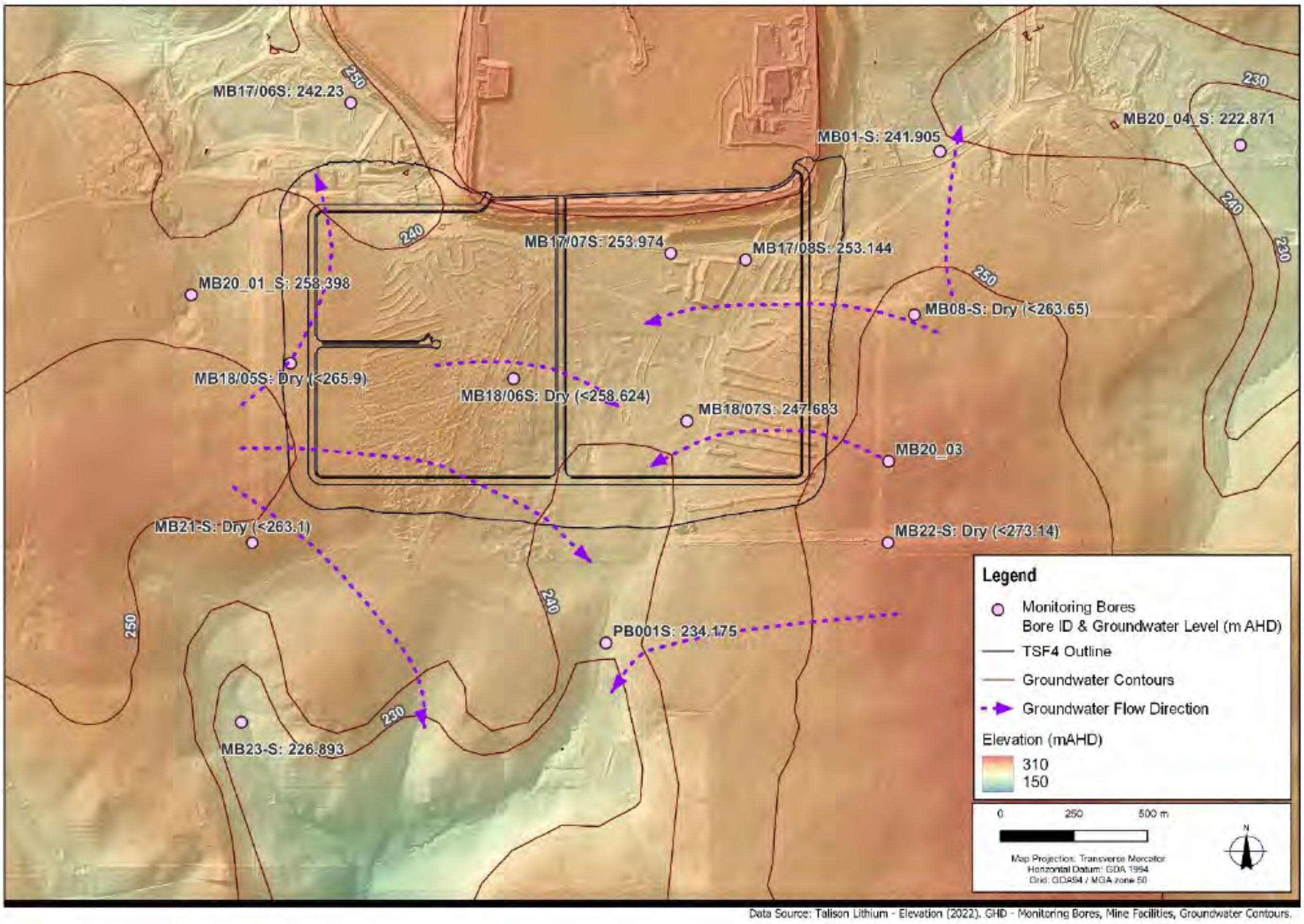


Figure 2.1: Shallow Saprolitic Profile Groundwater Contours

2.1.3.2 Drainage Waters

During operations, TSF4 impacted drainage waters (i.e., internal drainage and surface water runoff) collected into the four external sumps (Sumps A, B, C, and D) will be returned via pump-back to the mine water circuit and, as such, does not represent a migration pathway during operations.

However, post-closure (post 2037), the drainage waters will be managed until such time as the volume and water quality is suitable for the pump-back to the mine water circuit to cease. At this time, the drainage into Sump A will be managed through passive means (yet to be designed), and therefore represents a potential source migration pathway from Sump A into the Woljenup Catchment if not managed appropriately. The remaining sumps (Sumps B, C, and D) will discharge into the operational mine site (Cowan Brook Dam and the open pit catchments).

2.1.4 Receptors

The sensitive receptors of the receiving environment are associated with surface water system of Woljenup Creek, where both surface water and groundwater derived from the TSF4 may discharge. Beneficial uses of water within Woljenup Creek include the aquatic environment, non-potable, and stock water uses. A survey of the landholder water uses in the Woljenup Creek catchment was conducted by Talison between September and November of 2021, which are illustrated in **Figure 2.2**. Jones Dam, located in Woljenup Creek ~770 m downgradient of Sump A, is used for stock watering purposes and is the closest receptor to TSF4.

2.2 TSF4 Risk Quantification (Modelling)

2.2.1 Introduction

A three-dimensional numerical groundwater flow and transport model of the mine site was developed to assess potential impacts to surface water and groundwater from TSF4 (GHD, 2023g), the objectives of which were:

- Characterise the fate and transport of CoPCs in “seepage” from the TSF4, including attenuation and potential discharge locations of any impacted groundwater; and
- Estimate the expected timeframe for “drainage” from TSF4 to reach an acceptable quality such that active management of drainage into the Sumps is no longer required following closure of the facility (passive management/walk away scenario).

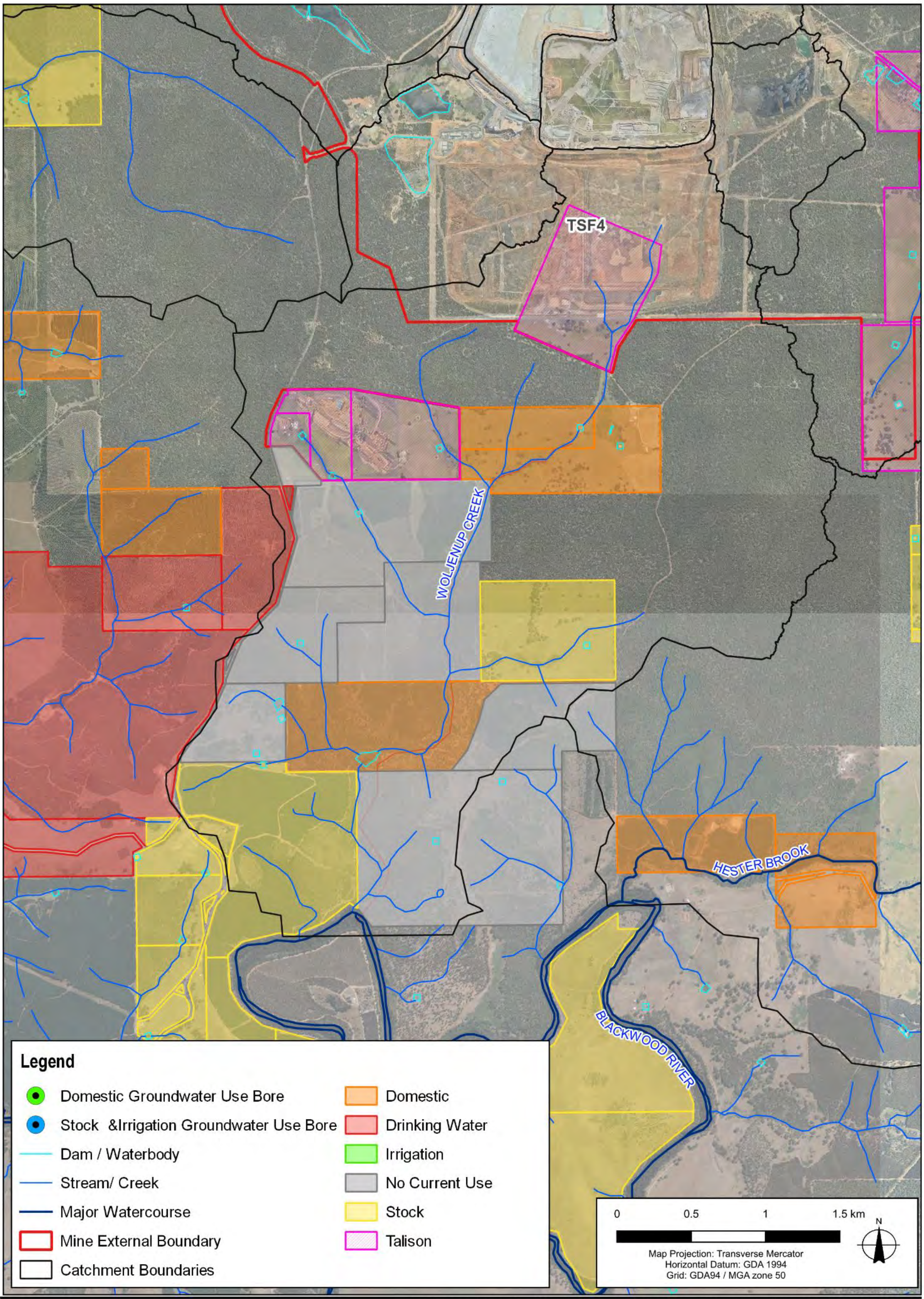
The modelling of contaminant transport included two metals/metalloids (Arsenic and Lithium) using site-specific adsorption coefficients derived from testing of clays beneath the TSF4 site (GHD, 2023b). Arsenic and Lithium were adopted in the modelling since they are considered ‘end-members’ due to their relative respective low and high adsorption and mobility characteristics, which covers the a wide range of other CoPC characteristics, including Antimony, Caesium, Rubidium, and Uranium. Consequently, the modelling of Arsenic and Lithium distribution in groundwater accommodates the distribution of other CoPCs.

The modelling also included cumulative impacts from other sources such as TSFs 1, 2 and 4 and Floyds waste rock landform.

2.2.2 Groundwater Seepage Results

An example of the predictive groundwater fate and transport modelling results for the distribution of Lithium derived from TSF4 seepage (with cumulative impacts from existing facilities), is presented in **Figure 2.3**. This figure shows the simulated distribution and concentrations of Lithium in the upper saprolite formation in 2150, which reflects the furthest extent of the simulated plumes (including those for arsenic).

The contours presented in **Figure 2.3** correspond with the Lithium WQGs presented in **Table 2.1**. The distribution shows that Lithium (and other metal CoPCs) adsorb/attenuate within the underlying saprolitic aquifer and remain close to the TSF4 footprint during operations and post-closure. The distribution also shows that the CoPCs will not migrate in groundwater beyond the mine-site boundary, nor discharge and impact the beneficial uses in the Woljenup Creek catchment.



Data Source: Talison - Water Survey Users, Mine External Boundary, Aerial Imagery (2023). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020).

Figure 2.2: Talison Survey Surface and Groundwater Users

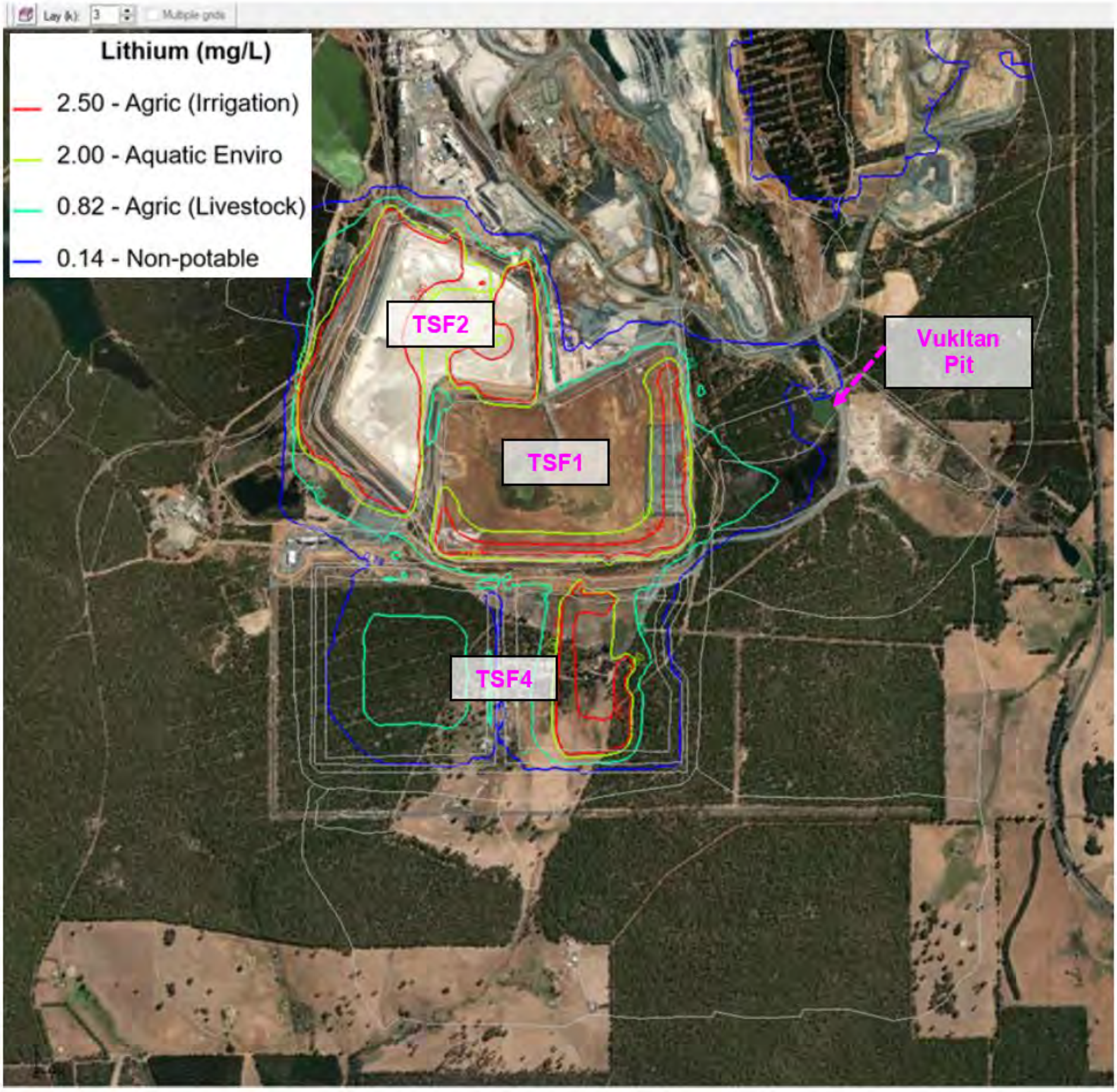


Figure 2.3: Example of Simulated Lithium Concentrations within the Pallid Saprolite Formation in 2150

The background lithium concentration in the groundwater in the areas surrounding TSF4 (and much of the mine site) is above the drinking water WQG of 0.007 mg/L (although this is not a recognised use in the Woljenup Creek catchment) as would be expected within the mineralised zone. As such, the contour associated with this WQG is affected by background to the extent that it could not be depicted in **Figure 2.3**.

Of note in **Figure 2.3** is the simulated lithium plume to the east of TSF1. Seepage from the toe of TSF1 is directed via the ponds associated with historical dredge mining and is collected within Vultan pit, where the seepage waters are returned to the Mine Water Circuit. An elevated north-south access road dams the seepage from discharging further eastwards to areas off-the mine site boundary (i.e., to Cascade Gully). Any overflows from Vultan Pit discharge towards and are captured in the central lode open pit (and sumps).

2.3 TSF4 Drainage into Sumps

The drainage from TSF4 into Sumps A, B, C and D (internal drainage and run-off), was also included in the predictive modelling, to show expected timeframe for "drainage" from TSF4 to reach an acceptable quality and volume (passive management/walk away scenario). The results for Sump A, which is in the headwaters of Woljenup Catchment, are presented herein. The results for Sumps B, C, and D, which drain into internal mine catchments) are not discussed herein, however, the modelling report includes all Sump results (GHD, 2023g).

Time series of the modelled drainage flows and lithium concentrations into Sump A are shown in **Figure 2.4** and the associated lithium loads are presented in **Figure 2.5**. The modelled drainage flows and arsenic concentrations into Sump A are shown in and **Figure 2.6** and the associated arsenic loads are presented in **Figure 2.7**. These modelling results indicate the following:

– Flows to Sump A are predicted to peak at ~150 m^3/day just after closure in 2038. Given that the groundwater mounding beneath the TSF4 dissipates slowly over time, the graphs show that the drainage flow rates to Sump A gradually decline to ~40 m^3/day in 2100.

– The lithium concentration in 2038 is ~2.7 mg/L, which is above all WQGs, and reduces to ~1.7 mg/L in 2060 and remains close to ~1.7 mg/L until 2100, which is above the drinking water, aquatic environment, and irrigation WQGs (note that drinking water and irrigation are not recognised uses in Woljenup Creek catchment). Although the lithium concentrations do not reduce after 2060, the flows do reduce resulting in the loads reducing from ~120 g/day in 2060 to 60 g/day in 2100.

– The arsenic concentration at closure in 2038 is ~0.015 mg/L, which is above the drinking water and aquatic environment WQGs and reduces to ~0.004 mg/L in 2060 and remains close to ~0.004 mg/L until 2100, which is below all the relevant WQGs. Although the arsenic concentrations do not reduce after 2060, the flows do reduce resulting in the loads reducing from ~0.34 g/day in 2060 to 0.14 g/day in 2100.

These modelling results indicate that at some point after closure (potentially 10 to 20 years), the flows into Sump A should be sufficiently low to accommodate passive management measures to mitigate discharge from Sump A and the risk to Woljenup Creek (e.g.: infiltration basin, or wetlands etc).

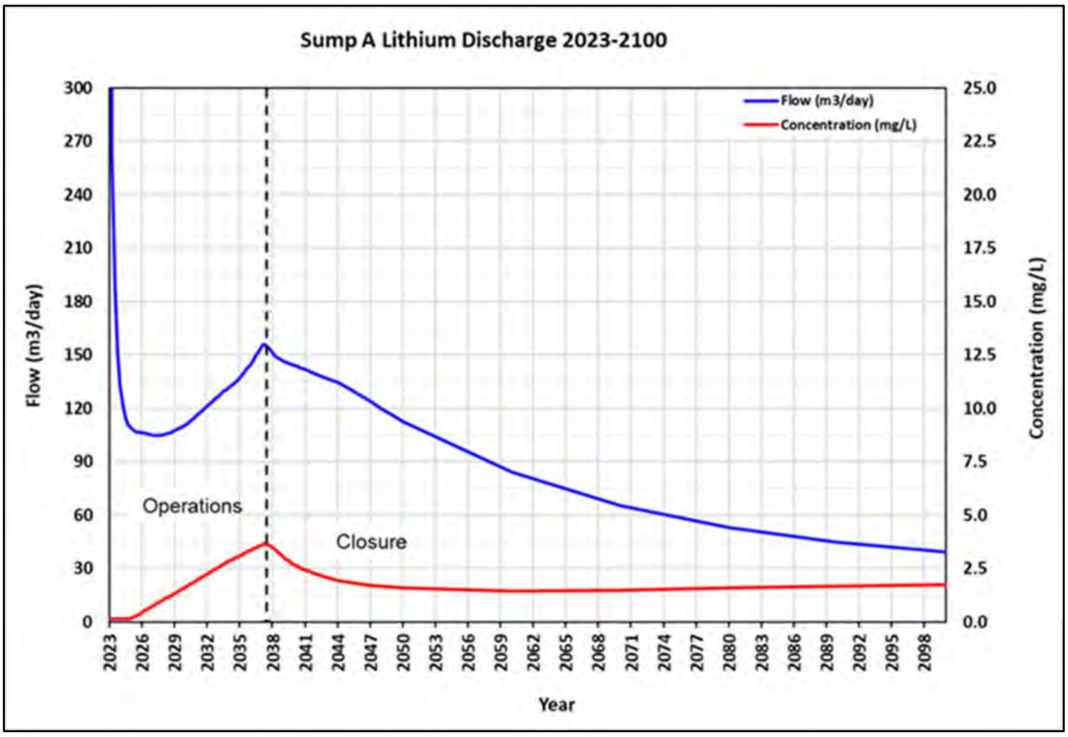


Figure 2.4: Simulated Lithium Concentrations and Flows into Sump A

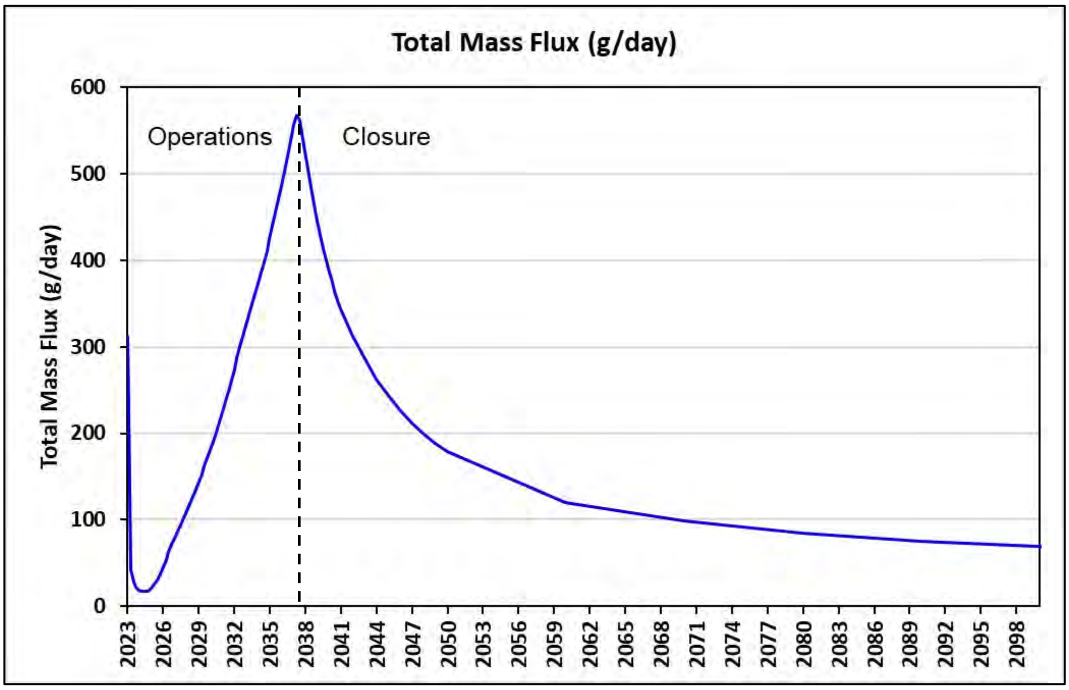


Figure 2.5: Simulated Lithium Loads into Sump A

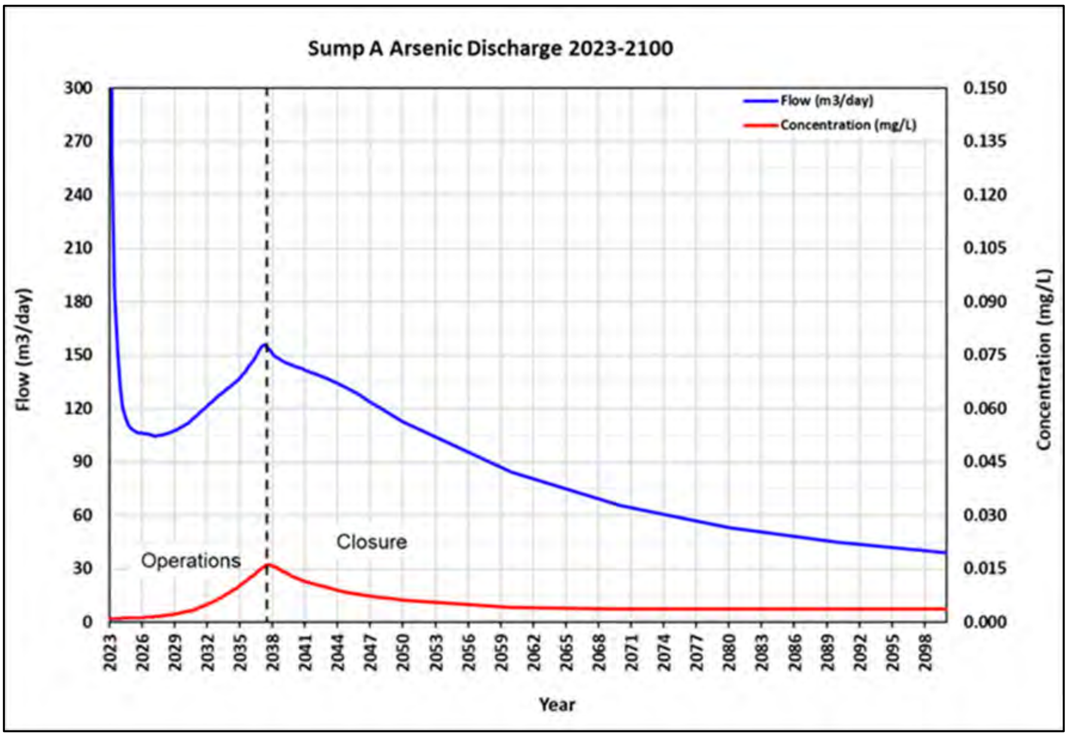


Figure 2.6: Simulated Arsenic Concentrations and Flows into Sump A

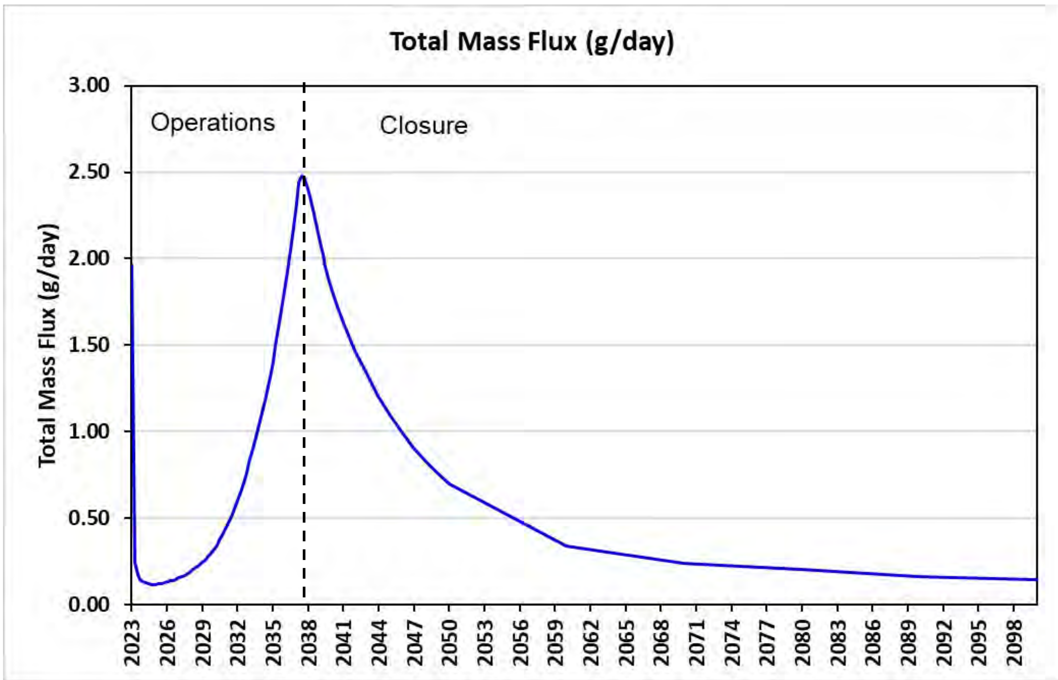


Figure 2.7: Simulated Arsenic Loads into Sump A

3. Management Strategy

3.1 Overarching Strategy

The key objectives for managing seepage and/or drainage from TSF4 are to:

– Preserve the groundwater quality at the mine premises boundary; and
– Prevent the TSF4 seepage and/or drainage causing adverse impacts to the receiving environment of Woljenup Creek.

The overarching strategy to manage seepage and/or drainage to meet these objectives is to provide a contingency framework to action should monitoring and assessment indicate the following:

– The distribution of TSF4 seepage impacts within the subsurface (aquifer) varies significantly from the modelled predictions.
– Groundwater triggers are activated with concentrations nearing or exceeding the modelled predictions, and/or concentrations exceeding baseline concentrations and/or WQGs.
– Changes in quality in Woljenup Creek attributed to TSF4 seepage/discharge and/or where surface water triggers are exceeded (i.e., concentrations nearing or exceeding baseline quality).
– Seepage/drainage from TSF4 poses unacceptable risks to receptors and where surface water WQGs are exceeded (i.e., concentrations nearing or exceeding WQGs).

To implement this strategy, monitoring will be undertaken to achieve the objectives detailed in the following section.

3.2 Monitoring Objectives

3.2.1 Groundwater Monitoring Objectives

The objective for groundwater monitoring is to monitor along identified potential seepage pathways from the source (i.e., TSF4) to the receptors (i.e., potential downgradient beneficial users) for the purposes of:

– Demonstrating that the distribution of TSF4 seepage impacts within subsurface is broadly consistent with the modelled predictions (i.e., triggers).
– Confirming baseline level and quality conditions and establishing whether these conditions change during Time Limited Operation (TLO).
– Monitoring groundwater in the underlying formations adjacent to the source (TSF 4) for early warning of exceedances (e.g., perimeter of TSF).
– Monitoring groundwater discharge areas, to assess groundwater quality that may discharge to surface water.
– Identifying groundwater seepage and drainage concentrations attributable to TSF4 that are:
  - Above modelled predictions (i.e., triggers).
  - Above WQGs at the groundwater receptors or discharge zones (i.e., thresholds).

3.2.2 Surface Water Monitoring Objectives

The objective for surface water monitoring is to monitor along identified surface flow paths (i.e., Woljenup Creek) from the potential source to the receptors for the purposes of:

– Monitoring flows and quality upstream of Jones Dam, and within Jones Dam, to identify impacts.
– Establishing baseline flow and quality conditions at key locations along the creek.
– Monitoring TSF4 drainage into Sump A (flows and quality) to validate predictive groundwater model and supply predictive information with which to develop TSF4 closure management options.
– Identifying CoPC concentrations attributable to TSF4 that are:

- Above a defined baseline quality triggers at monitoring points
- Above WQGs at monitoring points

4. Groundwater Management

4.1 Monitoring Bore Network

4.1.1 Baseline Groundwater Monitoring Bores

Groundwater monitoring bores in eight locations are currently monitored as part of the baseline monitoring program for TSF4 (GHD, 2023c), the bore details of which are summarised in **Table 4.1**, and the locations of presented on **Figure 4.1**. These bores have been monitored quarterly since May 2022 as part of the conditions of the TSF4 Works Approval (W6618/2021/1), or where the bore was unserviceable (dry) the next closest monitoring bore was incorporated into the monitoring network. The baseline groundwater conditions have been reported for by GHD (2023c). A summary of these baseline results is shown in **Appendix A Table 2** , as "italic" values, for key CoPCs, which are presented as maximum seasonal concentrations (2022/2023).

Table 4.1: Summary of TSF4 Baseline Groundwater Monitoring Locations

Bore ID	Easting	Northing	Standpipe Top Elevation (mAHD)	Ground Level (mAHD)	Screen interval (m)		Comments
					Top	Bottom	
MB01-D	414314.8	6250825	249.04	248.42	28.1	31.1	Adjacent to TSF1 seepage pond
MB01-I			249.04	248.42	11.2	14.2	
MB01-S			249.01	248.42	6	9	
MB08-D	414225.1	6250274	271.28	270.65	15	18	Dry throughout monitoring
MB08-I	414225.6	6250272	271.29	270.65	10	13	
MB08-S	414225.8	6250271	271.33	270.65	4	7	
MB20_01D	411734	6250344	260.382	259.86	24.7	27.7	Added in Oct 2022
MB20_01I	411772.9	6250341	260.432	259.9	11.85	14.85	
MB20_01S	411771.8	6250338	260.328	259.94	0.5	3.5	Targeting perched layer
MB20_03D	414138.6	6249775	281.214	280.47	33	36	Added in Oct 2022
MB20_03I	414138.5	6249774	281.166	280.53	21.8	27.8	
MB21-D	411978.6	6249500	269.8	269.21	17.7	20.7	Dry throughout monitoring
MB21-I	411978.5	6249499	269.76	269.14	9	12	
MB21-S	411978.6	6249497	269.75	269.1	3	6	
MB22-D	414133.9	6249497	282.7	282.14	21.5	24.5	N/A
MB22-I	414135	6249498	282.7	282.14	12	15	Dry throughout monitoring
MB22-S	414135.9	6249498	282.8	282.14	6	9	
MB23-D	411945.2	6248880	228.46	227.82	30	33	Artesian
MB23-I	411943	6248886	228.59	227.99	11.5	14.5	
MB23-S	411942.1	6248888	228.71	228.06	2	3	Targeting perched layer
PB001D	413181.1	6249162	238.526	237.95	18	24	Added in Oct 2022
PB001I	413180.2	6249160	238.396	237.85	9.7	12.7	
PB001S	413179.4	6249157	238.351	237.76	18	24	

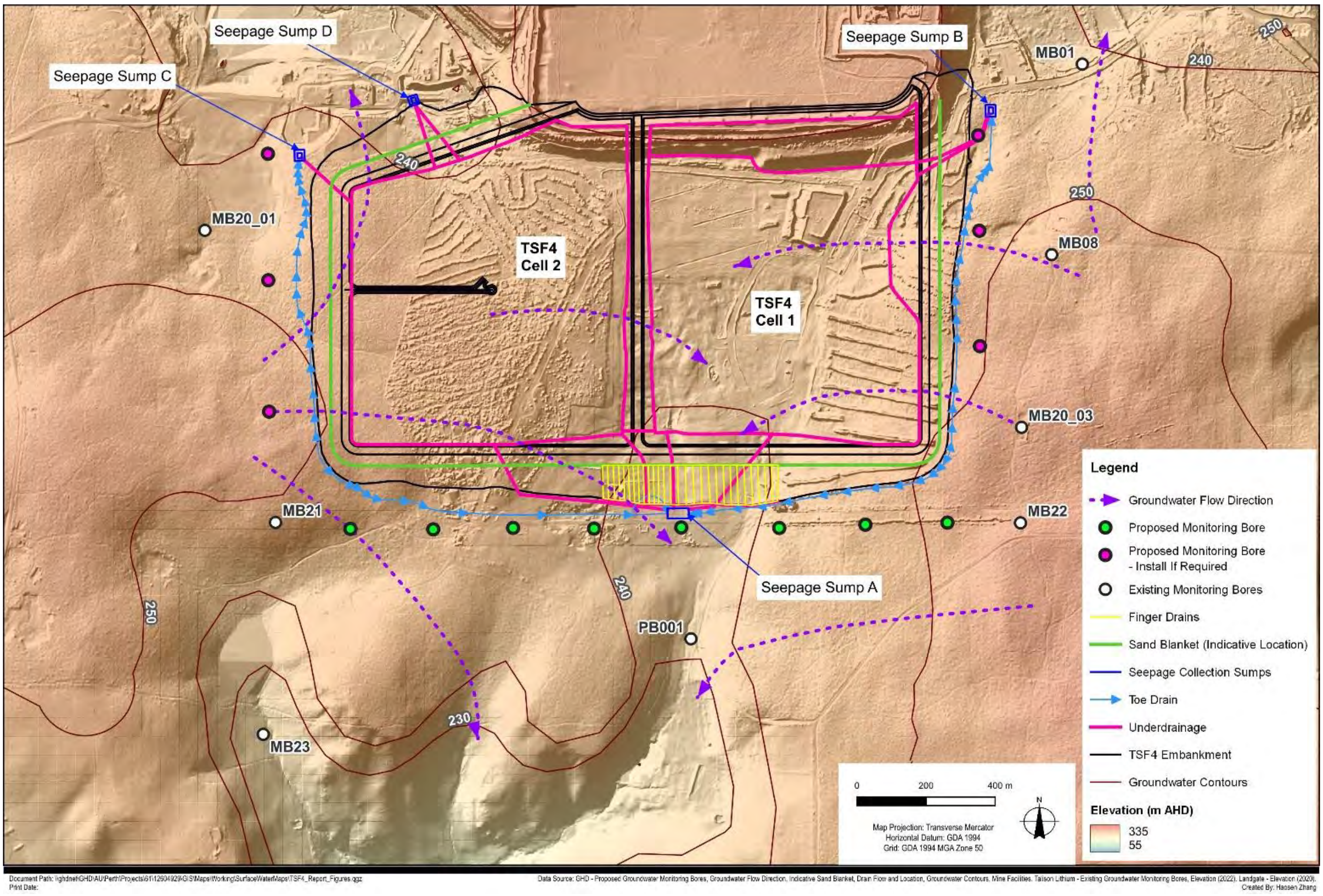


Figure 4.1: Location Plan of Existing and Potential Groundwater Monitoring Bores

4.1.2 Perimeter Groundwater Monitoring Bores

4.1.2.1 Southern Perimeter Monitoring Bores

Additional TSF4 monitoring bores are to be installed along the southern toe of theTSF4 embankment during TLO and/or as part of ongoing TSF4 operations. Given the generalised southerly groundwater flow direction (see **Figure 4.1**), the purpose of the southern perimeter monitoring bores is to detect TSF4 derived seepage into the subsurface and demonstrate that the impacts in the subsurface (saprolitic aquifer) are within those anticipated and predicted during groundwater modelling. The monitoring bores provide an early warning should unanticipated impacts occur.

The locations of the southern perimeter monitoring site are shown in **Figure 4.1**, which will comprise nested shallow, intermediate, and deep bores at each site nominally set at the base of surficial sands, within the saprolite formation, and at the base of the saprock layer. Target screened intervals, subject to confirmation during drilling, are:

- Shallow bores: 4m to 7 m.
- Intermediate bores 11 m to 14 m.
- Deep bores 26 m to 29 m.

The coordinates of the southern perimeter monitoring sites are presented in **Table 4.2**, the locations of which may vary by up to 50 m depending on site conditions for installation. The installation of the bores may be staged according to the construction schedules of the two TSF4 cells. Groundwater monitoring will be undertaken at the southern perimeter bores prior to commencement of operations to establish baseline conditions.

Table 4.2: Coordinates of TSF4 Southern Perimeter Monitoring Sites

Bore ID	Nominal Easting	Nominal Northing
MB24-01-D	412195	6249490
MB24-02-D	412435	6249490
MB24-03-D	412665	6249490
MB24-04-D	412900	6249490
MB24-05-D	413150	6249490
MB24-06-D	413435	6249490
MB24-07-D	413685	6249490
MB24-08-D	413920	6249490

4.1.2.2 East and West Perimeter Monitoring Bores

Additional TSF4 monitoring bores are to be installed along the western and eastern toes of theTSF4 embankment following the preliminary period of operations (e.g.: 2 to 5 years) and only if the groundwater mounding beneath TSF4 produces an observable outwards radial groundwater flow pattern from TSF4, and a localised reversal of the dominant southerly groundwater flow direction. The occurrence of an outwards radial flow pattern will be indicated and assessed during annual reporting via a collation and presentation of the monitored groundwater levels.

The locations of the eastern and western perimeter monitoring sites are presented in **Figure 4.1,** the nominal coordinates of which are presented in **Table 4.3** (locations of which may vary by up to 50 m depending on site conditions for installation). The monitoring sites will comprise nested shallow, intermediate, and deep bores at each site nominally set at the base of surficial sands, within the saprolite formation, and at the base of the saprock layer. Target screened intervals would be as detailed above and would be subject to confirmation during drilling.

Table 4.3: Coordinates of TSF4 Eastern and Western Perimeter Monitoring Bores

Bore ID	Nominal Easting	Nominal Northing
MB24-09-D	411960	6250565
MB24-10-D	411960	6250200
MB24-11-D	411960	6249820
MB24-12-D	414015	6250615
MB24-13-D	414015	6250340
MB24-14-D	414015	6250005

4.2 Groundwater Monitoring Program

The groundwater monitoring methods and procedures are presented in **Appendix B**. The groundwater monitoring program for the baseline and TSF4 perimeter monitoring bores is presented **Appendix A Table 1**. The first year (including the TLO) comprises higher frequency monthly monitoring of the shallow monitoring bores and quarterly monitoring on the intermediate and deep monitoring bores, with less frequent monitoring in the subsequent years (quarterly to bi- annual).

The laboratory monitoring suite includes a temporal rotating selection of some or all of the following parameters:

- **Field parameters:** Water Level (m BTOC), EC, DO, ORP, Temp,
- **Metals**: Al, As, Cd, Co, Cs, Cr, Cu, Fe, Li, Mn, Ni, U Mo, Rb, Sb, Th, Tl, Vn,
- **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4.

The laboratory limit of reporting (LoR) will be sufficiently low for comparison with the WQGs (see footnote to **Appendix A Table 1**).

4.3 Reporting and Evaluation of Groundwater Monitoring Data

The reporting and evaluation of groundwater monitoring data will be undertaken as detailed in **Section 6**.

4.4 Trigger Levels for TSF4 Impacts to Groundwater

4.4.1 Trigger Levels

The key identifiers of impacts from TSF4 include those CoPCs which are elevated in concentration within the TSF4 decant (tailings depositional slurry waters) and are at concentrations elevated above that of the background conditions of the area, as confirmed through the baseline monitoring. The key CoPCs include As, Cs, Li, Rb, Sb, and U.

In addition to CoPCs, the decant/slurry waters also comprise elevated concentrations of sulphate, carbonate, and sodium given the addition of sulphuric acid (H_2SO_4) and sodium carbonate ($NaHCO_3$) during the processing of the lithium ore. Although subject to chemical reactions within the aquifer (e.g., precipitation) these major ions, together with the CoPCs, provide verification of tailings impacts to groundwater (GHD, 2023i).

The trigger levels adopted for the baseline monitoring bores are presented in **Appendix A Table 2**. Given there is exceedance of WQGs in a number of existing baseline monitoring bores (deemed as naturally occurring given the mineralised geological setting), the trigger levels are based on a 30% increase above the baseline concentrations (seasonal maximum), for the key CoPCs at each monitoring bore (i.e.: As, Cs, Li, Rb, Sb, U).

It is anticipated that the TSF4 perimeter bores (to be installed) will also indicate CoPC impacts above the guidelines (naturally occurring). Until such time as the TSF4 perimeter bores have been installed and baseline monitoring has been undertaken, the key CoPC trigger levels for the perimeter monitoring bores are based on an interim 30% percentage increase above the averaged trigger levels the baseline monitoring bores as detailed in **Appendix A Table 2.**

4.4.2 Actions

Where groundwater trigger levels are exceeded, the following sequential actions will be implemented.

4.4.2.1 Action 1: Monitoring and Review

Confirmatory monitoring will be undertaken within one month. If elevated CoPC concentrations persist (30% higher than trigger levels) the groundwater will be assessed for TSF4 decant source signature based on the concentrations of major ions: SO_4, Na, HCO_3, and Cl (SO_4, Na, HCO_3 are added during ore processing). Any increasing trends in decant source signature concentrations in groundwater will be assessed against the geochemical setting to provide supporting evidence of TSF4 impacts (qualified personnel will be required, e.g.: geochemist).

Where TSF4 impacts to groundwater are supported with both CoPCs and increasing trends of decant signature then implement Action 2.

4.4.2.2 Action 2: Risk Assessment

Update the TSF4 seepage risk assessment, with new information including impacted groundwater extent, migration direction and fate of impacted groundwater.

Where required to support the risk assessment update, predictions of impacted groundwater fate will occur, which may include recalibration of the existing groundwater model and/or groundwater investigations and/or increased monitoring frequency.

Where the beneficial use of the groundwater is diminished (above baseline concentrations, and above site-specific WQGs) and the impacts at the premises boundary and/or in the discharge into Woljenup Creek, then present an understanding of exposure scenarios to the receptors (human health and the environment). If the exposure scenarios are complete, then the risk to the receptors is deemed unacceptable and implement Action 3.

4.4.2.3 Action 3: Remediation

Remedial options will be designed and implemented, if risk to the receptors is assessed as unacceptable, which may include but not be limited to one or more of the following:

– Control of TSF4 source discharge (mitigation of surface water runoff and/or groundwater seepage).
– Pump-back of impacted groundwater (abstraction/recovery bores).
– Capture and management of impacted surface water within Woljenup Creek (e.g.: pump-back to mine water circuit).
– Optimisation of TSF4 tailings deposition to reduce duration, extent, and storage of decant.
– Early closure and capping of the TSF4 facility.

5. Surface Water Management

5.1 Surface Monitoring Locations

The locations of the proposed surface water monitoring sites, the TSF4 drainage recovery sumps (Sump A, B, C and D) and Woljenup Creek are depicted in **Figure 5.1** (for the upper Woljenup Creek), in **Figure 5.2** (for the full Woljenup Creek catchment), and are summarised in **Table 5.1**. Surface water is currently monitored in Jones Dam (SW20-02) as part of the baseline monitoring program for TSF4 and has been monitored quarterly since May 2022 as a condition of the TSF4 Works Approval (W6618/2021/1). Jones Dam (SW20-02) is situated within the Woljenup creek flow line (surface water flow-through dam). The SW23-01 and SW23-02 monitoring points are yet to be established (e.g.: spillways and flow meters required).

Figure 5.1: Locations of Surface Water Monitoring locations in Upper Woljenup Creek

Table 5.1: details of Proposed Surface Water Monitoring Locations

General Location	Site Location	Easting	Northing	Purpose
TSF4 mining lease	Sump A	413141	6249524	Monitor TSF4 drainage returns
	Sump B	414047	6250689	
	Sump C	412047	6250558	
	Sump D	412378	6250719	
	SW23-01	412288	6248473	Monitor tributary discharging into Woljenup Creek from mine camp area[2] (different impact zone)
Woljenup Creek (off-site)	SW20-02	412993	6248778	Monitor Jones Dam within Woljenup Creek (first receptor ~770 m downstream of Sump A)
	SW23-02	411540	6246543	Large pool[3] within Woljenup Creek (receptor ~4.6 km downstream of TSF4 and ~1.2 km upstream of Blackwood River confluence)

2 Location can be moved slightly upstream to suitable site on Talison property.
3 This is Site 3 from the waterway condition assessment (GHD, 2023e).

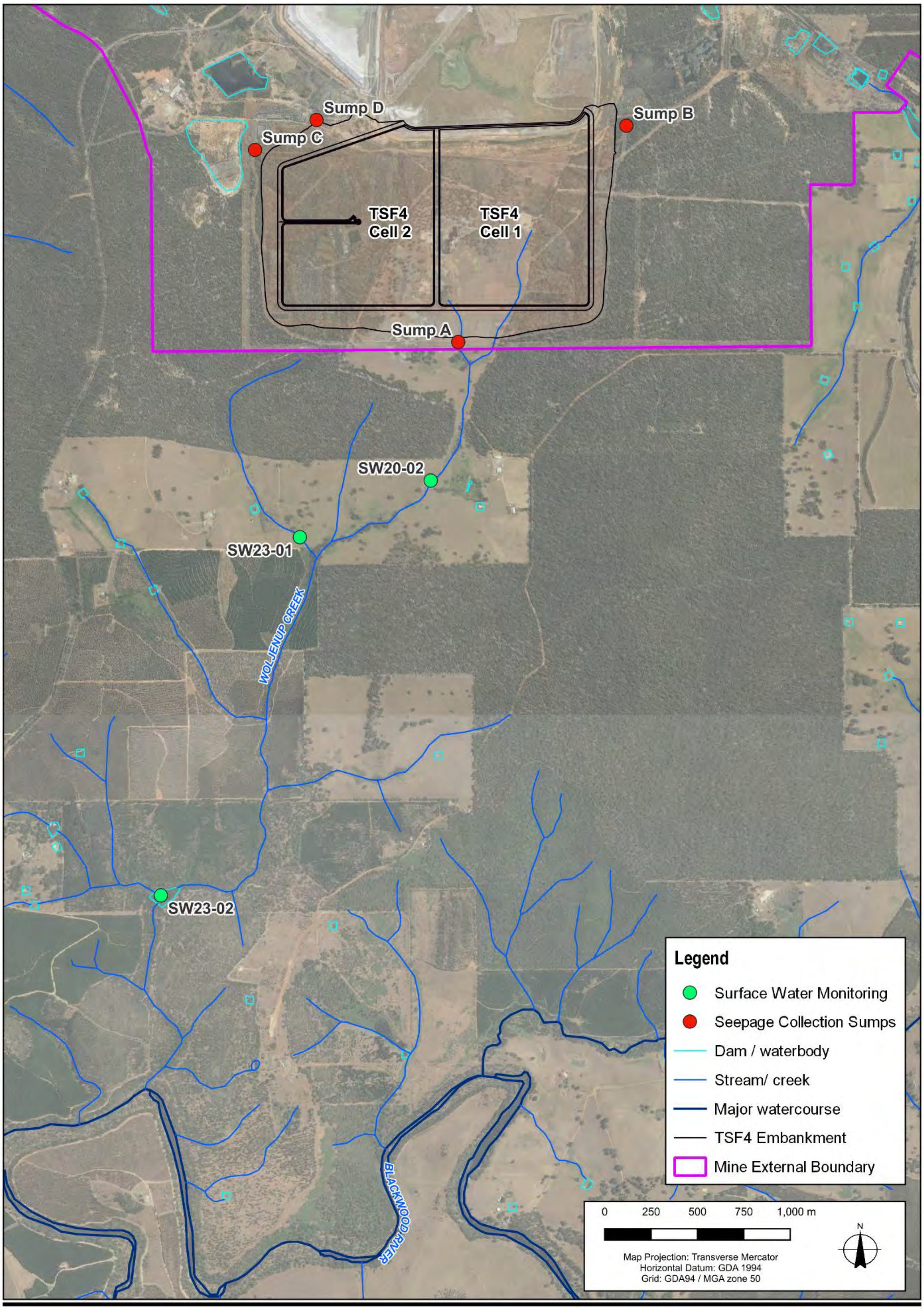


Figure 5.2: Plan of Proposed Surface Water Monitoring Locations

5.2 Management of TSF4 Sumps

5.2.1 Overview

TSF4 drainage into the Sumps will be returned to the mine water circuit until such time as the water is of suitable quality and quantity to accommodate implementation of appropriate passive management strategies. The aim of monitoring the TSF4 drainage into the external Sumps (Sumps A, B, C & D) during operations is to detect water quality and flow rates exceeding or being less than the predictive modelled values. Any differences in water volumes and flow will be accommodated in the yet to be designed passive management system, which is to be implemented post closure (active pump-back to the mine water circuit to cease).

The passive management options may include, but are not limited to the following:

– Direct discharge with lower CoPC concentrations to Woljenup Creek (potential dilution from streamflow to reduce CoPC concentrations).
– Construction of infiltration basins to promote seepage into the underlying saprolitic profile and attenuation of CoPCs.
– Construction of wetlands for the removal of metals from solution through the vegetated wetlands and favourable geochemical conditions (metals sink).
– Optimisation of TSF4 tailings deposition to reduce the duration, extent, and storage of decant in TSF4.
– Decommissioning, redirection or sealing of the drains discharging into Sump A to promote seepage into the underlying naturally occurring saprolitic profile with subsequent attenuation of CoPCs.

These options require feasibility assessments/studies to support selection of the management option, which will be based on the updated predictive and verified modelling results.

5.2.2 Trigger Levels

The trigger levels are not derived from guidelines or baseline concentrations, given that discharge to the receiving environment will not occur. The trigger levels are based on the comparison of the monitoring results against the modelled predicted flow rates and water quality (e.g.: see **Figure 2.4**).

During the initial tailings depositional stages, the TSF drainage water quality and flows are likely to be subject to significant variation. Therefore, trigger levels will not be applicable until two years of operations has elapsed, to allow for flow rates and water quality to move towards an equilibrium.

The trigger levels are based on the monitoring data showing a 100% exceedance of modelled lithium concentrations, and/or a 50% exceedance of modelled flow rates. Lithium is deemed as an appropriate indicator of the TSF4 decant source given the relatively high concentrations in the decant (15 mg/L) and the relatively low attenuation of lithium. The monitoring data should be averaged over a 12-month period (flow rate and water quality). The trigger levels are presented in **Appendix A Table 4**.

5.2.3 Action (Update Predictive Modelling)

Where triggered, the existing predictive model will be updated after 3 years (2 years post operation commencement plus 1 year of monitoring data collected/averaged).

Where the exiting model is updated, the results of the update model will be used to review and set new trigger levels.

Where triggered, the modelling will be updated at three yearly intervals, until the passive management strategy has been implemented and is operational.

5.3 Management of Woljenup Creek (Receptor)

5.3.1 Overview

Given the location of the TSF4 in the upper parts of the Woljeuup Creek catchment, the Creek is recognised as a receiving environment for TSF4 impacted surface water runoff and impacted groundwater discharge (where artesian conditions indicate discharge of groundwater may occur). The sources of potential impact to the receiving environment from TSF4 include:

- Tailings decant and tailings leaching (slurry/process waters), which were found to exhibit concentrations of CoPCs above the human health and environmental WQGs (i.e.: Al, Sb, As, Cd, Cs, Li, Mn, Rb, Tl, U, Vn, Zn).
- Waste Rock was found to leach concentrations of CoPCs above the human health and environmental WQG (i.e.: As, Li, Sb, Vn, NO_3, SO_4).

5.3.2 Trigger Levels

The seasonal baseline conditions at Woljenup Creek have been established at location SW20/02 (GHD, 2023c), comprising a surface water-dam located immediately down-gradient of the TSF4 footprint and within the flow line of the Creek (See **Figure 5.2**).

The trigger levels for the CoPCs are presented in **Appendix A Table 6** and are based on the following:

- 30% increase of the seasonal baseline maximum concentrations at SW20/02, or where unavailable,
- The site-specific WQGs have been adopted.

5.3.3 Actions

5.3.3.1 Action 1: Monitoring and Review

Where triggered, confirmatory monitoring will be undertaken within one month. If elevated CoPC concentrations persist (above 30%), Woljenup Creek waters (e.g.: SW20/02) will be evaluated for TSF4 decant source signature (SO_4, Na, HCO_3). Any increasing trends in TSF4 decant source signature concentrations in Woljenup Creek will be assessed against the geochemical setting to provide supporting evidence of TSF4 impacts, or otherwise (qualified personnel will be required, e.g.: geochemist).

If a TSF4 source is <u>not</u> supported, then update baseline concentrations with new information, and adjust trigger levels accordingly.

If the impacted Creek water <u>is</u> deemed to reflect TSF4 source seepage and/or drainage:

- Implement Action 2; and
- Increase the frequency of monitoring of Woljenup creek waters to monthly (review the requirement for monthly monitoring after six months).

5.3.3.2 Action 2: Risk Assessment

Compare of the Woljenup Creek water quality to the site derived WQGs, where TSF4 impacts cause water quality to exceed guidelines, then present the understanding of the site-specific risk through the following:

- Confirm site-specific receptors of Woljenup Creek (stock watering, domestic use, and aquatic ecology have been identified in an earlier 2021 water use survey depicted in **Figure 2.2**).
- Confirm exposure scenarios where receptors may be ingest/contact the impacted waters (e.g.: recreational exposure).

Where risks to the receptors are deemed unacceptable, that is the identified receptors will be exposed to water quality which exceeds the guidelines, then implement Action 3.

5.3.3.3 Action 3: Remediation

Where CoPC concentrations in Woljenup Creek are deemed to pose an unacceptable risk to the receptors, remedial options will be designed and implemented based on the following strategy:

- Control of TSF4 source discharge (mitigation of surface water runoff and/or groundwater seepage).
- Capture and management of impacted surface water within Woljenup Creek (e.g.: pump-back to mine water circuit).

6. Reporting

6.1 Overview

The data from the monitoring events (monthly, quarterly, bi- annual, and annually) will be evaluated against the trigger levels (presented in **Appendix A Table 2**, **Appendix A Table 4**, and **Appendix A Table 6** for groundwater quality, Sump A water quality, and Woljenup Creek water quality respectively) within two weeks of receipt of the data.

Where the trigger levels are not exceeded, the **Routine Monitoring Reporting** will be undertaken, as presented in **Section 6.2**.

Where the trigger levels are exceeded, the **Non-routine Monitoring Reporting** will be undertaken, as presented in **Section 6.3**.

6.2 Routine Monitoring Reporting

6.2.1 Quarterly Reporting

The quarterly monitoring report will summarise the monthly monitoring data and/or the quarterly monitoring data. The evaluation of the groundwater and surface water monitoring data will include the following data presentation.

– Compliance with the monitoring requirements and licence conditions (tabulated).
– Tables of water quality (metals, major ions, nutrients, field parameters), water levels, and flow rates where applicable.
– Evaluation of monitoring data against trigger levels.
– Summary of quality control and sampling methods (QA/QC).

6.2.2 Annual Reporting

The annual monitoring report will summarise the data obtained over the year, compiled from the monthly and quarterly and bi-annual monitoring events. The annual evaluation of the groundwater and surface water monitoring data will include the following data presentation.

– Compliance with the monitoring requirements and licence conditions.
– Graphs of water quality with respect to key CoPCs (As, Cd, Sb, Li) in groundwater, Woljenup Creek and Sumps (A, B, C &D).
– Tables of water quality (metals, major ions, nutrients, field parameters), water levels, and flow rates where applicable.
– Groundwater flow directions (groundwater contour plans).
– Summary of quality control and sampling methods (QA/QC).

6.3 Non-routine Monitoring Reporting

Where the monitoring data has been evaluated and deemed to exceed the trigger levels (evaluation within two weeks of receipt of the data), the exceedance of the trigger levels will be communicated to DWER within two weeks (i.e., within four weeks of receipt of data).

The communication to the DWER will comprise the following:

– Timelines for implementation of actions.
– Scope of reporting on actions.
– Timelines of reporting on actions.

7. Review

This groundwater and surface water seepage management plan will be subject to review and updates, based on the following:

- Increased understanding of the risks posed to the receiving environment.
- Decreased uncertainty in data variability (e.g.: improved reliability in trend analysis).
- Changes to TSF4 operations schedule and/or seepage collection systems.
- Changes to TSF4 source composition (CoPCs), including improvements or degradation of TSF4 decant (seepage source), and/or tailings and waste rock leaching tests.

The review of the seepage management plan will include where justified, updates to the following:

- frequency of monitoring.
- monitoring parameters/CoPCs.
- reporting frequency.
- Actions.

A review of the seepage management plan will occur at the following time frames:

- End of TLO time limited operations.
- During operations at 5 yearly intervals.
- End of operations.
- End of site management.

The seepage management plan will also be reviewed at any time new information that alters the understanding of risks posed to the receptors becomes available. Updates to the plan will only occur if deemed necessary following the review.

8. References

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9. Limitations

This report has been prepared by GHD for Talison and may only be used and relied on by Talison for the purpose agreed between GHD and Talison as set out in **Section 1.2** of this report.

GHD otherwise disclaims responsibility to any person other than Talison arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of facilities, services, and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

GHD has prepared this report on the basis of information provided by Talison and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Appendices

Appendix A

Monitoring, Triggers Levels and Response Schedules

Appendix A Table 1: Groundwater Monitoring and Management

Bore Suite	Monitoring Location	Frequency		Analytes[4]	Trigger Levels	Action 1: Monitoring and Review	Action 2: Risk Assessment	Action 3: Remediation
		Year 1 (includes TLO Period)	Year 1 End to Operations End					
Baseline Monitoring Bores:								
Shallow monitoring bores	– MB01-S – MB08-S (dry) – MB21-S (dry) – MB22-S (dry) – MB23-S (artesian) – MB20-01-S – PB001-S	monthly	quarterly	**Field parameters**: Water Level (m BTOC), EC, DO, ORP, Temp **Metals:** Al, As, Cd, Co, Cs, Cr, Cu, Fe, Li, Mn, Ni, U Mo, Rb, Sb, Th, Tl, Vn, **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4	The trigger levels are presented in **Appendix A Table 2.** Trigger levels are based on 30% above seasonal maximum concentrations for key CoCPs: – As, Cs, Li, Rb, Sb, U[5]	**Sub-action 1):** – Confirm CoCP occurrence/concentration (>30%) via next monthly monitoring. – If confirmed, then implement Sub-action 2. **Sub-action 2**): – Assess groundwater for TSF4 decant signature (source) via assessment of concentrations of SO4, Na, HCO3 (displayed as Cl ratios). – If CoPC and decant source signature support TSF4 impacts to groundwater, then implement Sub-action 3. – Otherwise implement Sub-action 4. **Sub-action 3):** – Confirm CoCP and decant source occurrence/concentration via next monthly monitoring. – If confirmed, then implement Action 2. – If CoCP concentrations are below 30% of the seasonal maximum, implement Sub action 4. **Sub-action 4):** – Return to routine monitoring, CoPC concentrations deemed to reflect natural variation (reset/review natural seasonal variation range).	– Investigate impacted groundwater extent, migration direction and fate to include additional installation of groundwater monitoring bores and additional monitoring, where required; and/or – Predict impacts at the receptors (e.g.: groundwater modelling to predict discharges to creek of CoPCs)[6]. – Where the beneficial use of the groundwater is diminished (above baseline concentrations, and above site specific WQGs) at the premises boundary and/or discharges into Woljenup Creek, then present an understanding of exposure scenarios to the receptors (human health and the environment). – If exposure scenarios are complete, then the risk to the receptors is deemed unacceptable and implement Action 3. – Otherwise develop/update monitoring schedule and network, as required.	Design and implement remediation strategy, such as: – Pump-back of impacted groundwater (abstraction bores); and/or – Pump-back of impacted creek waters; and/or – Implement source control, including mitigation of TSF4 seepage and discharge.
Intermediate and deep monitoring bores	– MB01-I & D – MB08- I & D (dry) – MB21-I & D (dry) – MB22-I & D (dry) – MB23-I & D (artesian) – MB20-01-I & D – MB20-03- I & D – PB001- I & D	quarterly	Bi-annual	As above	As above	As above	As above	As above

[4] Laboratory Limits of Reporting (LoR) to below WQGs as follows: < 1 mg/L major-ions/nutrients; < 0.1 mg/L Mn; < 0.01 mg/L Al, Cs, Mo, Ni; < 0.001 mg/L Sb, As, Cs, Cr, Li, Rb; <0.0001 mg/L Cd, Cu, U; <0.00001 mg/L Tl, Vn.
[5] Concentrations of As, Cs, Li, Rb, Sb, U are elevated in TSF4 source water (decant) compared to groundwater of the area and are deemed as key indicators of source "breakthrough".
[6] Predictive modelling estimates of impact is subject to uncertainty (probabilistic predictions).

Bore Suite	Monitoring Location	Frequency		Analytes[7]	Trigger Levels	Action 1: Monitoring and Review	Action 2: Risk Assessment	Action 3: Remediation
		Year 1 (includes TLO period)	Year 1 End to Operations End					
Perimeter Bores:								
Shallow monitoring bores	Southern Perimeter Bores: – MB24-01 S – MB24-02 S – MB24-03 S – MB24-04 S – MB24-05 S – MB24-06 S – MB24-07 S – MB24-08 S Western and Eastern Perimeter Bores (only if required): – MB24-09 S – MB24-10 S – MB24-11 S – MB24-12 S – MB24-13 S – MB24-14 S	monthly	quarterly	**Field parameters**: Water Level (m BTOC), EC, DO, ORP, Temp **Metals:** Al, As, Cd, Co, Cs, Cr, Cu, Fe, Li, Mn, Ni, U Mo, Rb, Sb, Th, Tl, Vn, **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4	The interim trigger levels are presented in **Appendix A Table 2.** Trigger levels are based on 30% above seasonal maximum concentrations[8] for key CoCPs: – As, Cs, Li, Rb, Sb, U[9] 1,	**Sub-action 5):** – Confirm CoCP occurrence/concentration (30%) via next monthly monitoring. – If confirmed, then implement Sub-action 6. **Sub-action 6):** – Assess groundwater for TSF4 decant signature (source), includes assessment of concentrations of So4, Na, HCo3 (displayed as Cl ratios). – If TSF4/decant impacts confirmed, then implement Sub-action 7. – If decant signature not supported, then implement Sub-action 8. **Sub-action 7)**. – If groundwater quality at the impacted groundwater bore(s) exceeds the predicted WQG at that bore(s), then implement Action 2. – Otherwise implement Sub-action 8. **Sub-action 8):** – Return to routine monitoring, as CoPC concentrations deemed to reflect natural variation.	**Sub-action 9:** – Recalibrate existing groundwater model with new/updated concentrations. – Present updated understanding of impacted groundwater extent, migration direction and fate[10]. – If adverse risk of impacts to receptor(s) confirmed (eg.: discharge to creek above guidelines) then implement Action 3, otherwise implement Sub-action 10. **Sub-action 10:** If required, updated monitoring network to include installation of groundwater monitoring bores to define extent of impacts and to validate the predictive modelling, otherwise continue monitoring as per regular schedule.	Design and implement remediation strategy, such as: – Pump-back of impacted groundwater (abstraction bores), and/or – Pump-back of impacted creek waters, and/or – Implement source control to mitigate TSF4 seepage and discharge to groundwater.
Intermediate and deep monitoring bores	Southern Perimeter Bores: – MB24-01 I & D – MB24-02 I & D – MB24-03 I & D – MB24-04 I & D – MB24-05 I & D – MB24-06 I & D – MB24-07 I & D – MB24-08 I & D Western and Eastern Perimeter Bores (only if required): – MB24-09 I & D – MB24-10 I & D – MB24-11 I & D – MB24-12 I & D – MB24-13 I & D – MB24-14 I & D	quarterly	Bi-annually	as above	as above	as above	as above	as above

7 Laboratory Limits of Reporting (LoR) to below WQGs as follows: < 1 mg/L major-ions/nutrients; < 0.1 mg/L Mn; < 0.01 mg/L Al, Cs, Mo, Ni; < 0.001 mg/L Sb, As, Cs, Cr, Li, Rb; <0.0001 mg/L Cd, Cu, U; <0.00001 mg/L Tl, Vn.
8 Seasonal maximum concentrations to be established following installation of TSF4 perimeter bores.
9 Concentrations of As, Cs, Li, Rb, Sb, U are elevated in TSF4 source water (decant) compared to groundwater of the area and are deemed as key indicators of source "breakthrough".
10 Predictive modelling estimates of impact is subject to uncertainty (probabilistic predictions).

Appendix A Table 2: Groundwater quality (*Italics*) and adopted trigger levels (Bold).

Bore ID11	Antimony	Arsenic	Caesium	Lithium	Rubidium	Uranium
Baseline monitoring bores (mg/L):						
MB01-D*	*<0.001*	*0.006*	*0.006*	*1.94*	*0.065*	*0.02*
	0.002	**0.0075**	**0.0075**	**2.43**	**0.081**	**0.025**
MB01-I*	*<0.001*	*0.002*	*<0.001*	*0.51*	*0.019*	*0.009*
	0.002	**0.002**	**0.002**	**0.64**	**0.024**	**0.011**
MB01-S*	*<0.001*	*0.001*	*<0.001*	*0.94*	*0.01*	*<0.001*
	0.002	**0.002**	**0.002**	**1.17**	**0.013**	**0.002**
MB20_01D	*<0.001*	*0.002*	*0.001*	*0.43*	*0.016*	*<0.001*
	0.002	**0.003**	**0.002**	**0.54**	**0.02**	**0.002**
MB20_01I	*<0.001*	*<0.001*	*<0.001*	*0.018*	*0.01*	*0.002*
	0.002	**0.002**	**0.002**	**0.023**	**0.013**	**0.0025**
MB20_01I	*<0.001*	*<0.001*	*<0.001*	*0.054*	*0.004*	*<0.001*
	0.002	**0.002**	**0.002**	**0.068**	**0.005**	**0.002**
MB20_03D	*<0.001*	*0.017*	*0.013*	*1.0*	*0.08*	*<0.001*
	0.002	**0.021**	**0.016**	**1.25**	**0.10**	**0.002**
MB22-D	*<0.001*	*0.04*	*0.006*	*1.74*	*0.08*	*<0.001*
	0.002	**0.050**	**0.008**	**2.18**	**0.10**	**0.002**
MB23-D	*<0.001*	*0.042*	*<0.001*	*0.047*	*0.005*	*<0.001*
	0.002	**0.053**	**0.002**	**0.059**	**0.006**	**0.002**
MB23-I	*<0.001*	*<0.001*	*0.001*	*0.017*	*0.023*	*<0.001*
	0.002	**0.002**	**0.002**	**0.021**	**0.029**	**0.002**
MB23-S	*<0.001*	*0.002*	*<0.001*	*0.101*	*0.018*	*<0.001*
	0.002	**0.002**	**0.002**	**0.126**	**0.023**	**0.002**
MB25-D	*<0.001*	*0.002*	*<0.001*	*0.031*	*0.002*	*0.001*
	0.002	**0.002**	**0.002**	**0.039**	**0.003**	**0.002**

[11] * = Monitoring bores are deemed impacted from TSF4 seepage ponds (e.g.: concentrations do not reflect background)

Bore ID11	Antimony	Arsenic	Caesium	Lithium	Rubidium	Uranium
Baseline monitoring bores (mg/L):						
MB25-I	*<0.001*	*0.002*	*<0.001*	*0.011*	*0.001*	*<0.001*
	0.002	**0.002**	**0.002**	**0.014**	**0.002**	**0.002**
MB25-S	*<0.001*	*0.002*	*<0.001*	*0.029*	*<0.001*	*<0.001*
	0.002	**0.002**	**0.002**	**0.036**	**0.002**	**0.002**
PB001_D	*<0.001*	*0.002*	*<0.001*	*0.042*	*0.002*	*<0.001*
	0.002	**0.002**	**0.002**	**0.053**	**0.002**	**0.002**
PB001_I	*<0.001*	*0.002*	*<0.001*	*0.117*	*0.006*	*<0.001*
	0.002	**0.002**	**0.002**	**0.146**	**0.008**	**0.002**
PB001_S	*<0.001*	*0.002*	*0.001*	*0.058*	*0.008*	*0.012*
	0.002	**0.003**	**0.003**	**0.073**	**0.010**	**0.015**
TSF4 perimeter monitoring bores mg/L (Interim Trigger levels)[12]:						
MB24 -1 to 14	**0.002**	**0.01**	**0.004**	**0.28**	**0.021**	**0.005**

[12] Trigger levels to be updated following installation of monitoring bores and review of monitoring data

Appendix A Table 3: TSF4 External Sump Monitoring and Management

Monitoring Location	Frequency	Analytes[13]	Trigger level	Action
Monitoring Period: Year 1				
Sumps A, B, C & D	Monthly	**Field Parameters:** Flow rates, EH, Ph, EC	The trigger levels are shown in **Appendix A Table 4.** Trigger levels are based on Sump A. Trigger levels based on 200% increase of the modelled lithium concentrations and/or 150% increase of the modelled flow rates[14]. The Sump A monitoring data to be averaged over 12 months.	Where triggered, the existing predictive model will be updated after 3 years. The results of the updated model will be used to review and set new trigger levels. Where new trigger levels are exceeded, the modelling will be updated at three yearly intervals, until the passive management strategy has been implemented and is operational.
	Quarterly	**Field Parameters:** Flow rates, EH, Ph, EC **Selected metals:** As, Cs, Li, Rb, Sb, U		
	Bi-annual	**Field Parameters:** Flow rates, EH, Ph, EC **Selected metals:** As, Cs, Li, Rb, Sb, U **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4		
	Annual	**Field Parameters:** Flow rates, EH, Ph, EC **Full Suite Metals:** Al, As, Cd, Co, Cs, Cr, Cu, Fe, Li, Mn, Ni, U Mo, Rb, Sb, Th, Tl, Vn, **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4		
Monitoring Period: Year 1 End to Operations End				
Sumps A, B, C & D	Quarterly	**Field Parameters:** Flow rates, EH, Ph, EC	As above	As above
	Bi-annual	**Field Parameters:** Flow rates, EH, Ph, EC **Selected metals:** As, Cs, Li, Rb, Sb, U		
	Annual	**Field Parameters:** Flow rates, EH, Ph, EC **Full Suite Metals:** Al, As, Cd, Co, Cs, Cr, Cu, Fe, Li, Mn, Ni, U Mo, Rb, Sb, Th, Tl, Vn, **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4		

13 Laboratory Limits of Reporting (LOR) to below WQGs as follows: < 1 mg/L major-ions/nutrients; < 0.1 mg/L Mn; < 0.01 mg/L Al, Cs, Mo, Ni; < 0.001 mg/L Sb, As, Cs, Cr, Li, Rb; <0.0001 mg/L Cd, Cu, U; <0.00001 mg/L Tl, Vn

14 200% increase of the lithium concentrations and 150% increase in flow rates deemed to exceed the predictive modelling uncertainty.

Appendix A Table 4: Sump A Predictive Water Quality and Adopted Trigger Levels

Year	Predictive Modelling Results		Trigger Levels15	
	Flow Rate (m3/d)	Lithium (mg/L)	Flow Rate (m3/d)	Lithium (mg/L)
2024	121	0.1	181	0.3
2025	113	0.3	169	0.5
2026	117	0.5	176	0.9
2027	122	0.7	183	1.3
2028	128	0.9	192	1.8
2029	135	1.1	202	2.2
2030	143	1.3	215	2.6
2031	154	1.5	231	3.0
2032	165	1.7	247	3.3
2033	174	1.8	261	3.7
2034	183	2.0	275	4.0
2035	195	2.1	292	4.3
2036	208	2.3	312	4.6
2037	217	2.4	326	4.9
2038	204	2.4	306	4.8
2039	191	2.2	287	4.3
2040	182	2.0	273	4.0
2041	177	1.9	265	3.9
2042	170	1.8	255	3.7
2043	163	1.8	244	3.6
2044	156	1.7	234	3.5
2045	149	1.7	224	3.4
2046	143	1.7	214	3.4
2047	137	1.7	206	3.3
2048	131	1.6	197	3.3
2049	126	1.6	189	3.2
2050	121	1.6	182	3.2
2060	87	1.6	130	3.2
2070	66	1.7	99	3.4
2080	52	1.8	79	3.6
2090	44	1.9	66	3.8
2100	38	2.0	57	4.0

[15] Trigger levels: flow rates based on 150% of modelled values, and Lithium based on 200% of modelled values

Appendix A Table 5: Woljenup Creek Monitoring and Management

	Monitoring Location	Frequency	Analytes[16]	Trigger Levels	Action 1: Monitoring and Review	Action 2: Risk Assessment	Action 3: Remediation
Monitoring period: Year 1 (includes period of TLO)							
Woljenup Creek	– SW20-02 – SW23-01	Monthly	**Field Parameters:** Flow rates, EH, Ph, EC **Selected metals:** As, Cs, Li, Rb, Sb, U	The trigger levels are presented in **Appendix A Table 6.** Trigger levels are based on 30% increase above the seasonal baseline maximum concentrations at SW20/02, or where baseline concentrations absent, adopt WQGs.	**Sub-action 1:** – Confirm CoCP concentration (>30%) via next monthly monitoring. – If confirmed, then implement Sub-action 2. **Sub-action 2**: – Evaluate creek waters for TSF4 decant source signature (SO_4, Na, HCO_3). – If the impacts to the Creek are deemed to reflect TSF4 source, then implement Sub-action 3 and **Action 2**. – If a TSF4 source is not supported implement sub-action 4. **Sub-action 3**: – Increase the frequency of monitoring of the Woljenup creek waters to monthly. – Review the requirement for monthly monitoring after six months. **Sub-action 4**: – Update baseline concentrations with new information and adjust trigger levels accordingly.	– Compare of the Woljenup Creek water quality to the site derived WQGs. – Where TSF4 impacts cause water quality to exceed guidelines, then present an understanding of risks by identifying site-specific receptors and potential exposure scenarios of Woljenup Creek (human health and the environment). – Where risks to the receptors are deemed unacceptable, implement **Action 3**.	Remedial options will be designed and implemented based on – Control of TSF4 source discharge (mitigation of surface water runoff and/or groundwater seepage),and/or – Capture and management of impacted surface water within Woljenup Creek (e.g.: pump-back to mine water circuit).
	– SW20-02 – SW23-01	quarterly	**Field Parameters:** Flow rates, EH, Ph, EC **Selected metals:** As, Cs, Li, Rb, Sb, U **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4				
	– SW20-02 – SW23-01 – SW23-03	Bi-annual	**Field Parameters:** Flow rates, EH, Ph, EC **Full Suite Metals:** Al, As, Cd, Co, Cs, Cr, Cu, Fe, Li, Mn, Ni, U Mo, Rb, Sb, Th, Tl, Vn. **Major ions/nutrients**: Ca, Mg, Na, K, HCO_3, Cl, SO_4, Total N, NO_3, PO_4				
Monitoring period: Year 1 end to operations end							
Woljenup Creek	– SW20-02 – SW23-01 – SW23-03	quarterly	**Field Parameters:** Flow rates, EH, Ph, EC **Selected metals:** As, Cs, Li, Rb, Sb, U	As above	As above	As above	As above
	– SW20-02 – SW23-01 – SW23-03	Bi-annual	**Field Parameters**: Flow rates, EH, Ph, EC **Full Suite Metals**: Al, As, Cd, Co, Cs, Cr, Cu, Fe, Li, Mn, Ni, U Mo, Rb, Sb, Th, Tl, Vn, **Major ions/nutrients**: Ca, Mg, Na, K, HCO3, Cl, So4, Total N, NO3, PO4				

16 Laboratory Limits of Reporting (LoR) to below WQGs as follows: < 1 mg/L major-ions/nutrients; < 0.1 mg/L Mn; < 0.01 mg/L Al, Cs, Mo, Ni; < 0.001 mg/L Sb, As, Cs, Cr, Li, Rb; <0.0001 mg/L Cd, Cu, U; <0.00001 mg/L Tl, Vn.

Appendix A Table 6: Woljenup Creek (SW20/02) Water Quality and Adopted Trigger Levels

Analyte	Maximum seasonal 2022/2023 (mg/L)	Trigger level (mg/L)[17]
List of CoCPs:		
Sulfate (filtered)	32	50
Nitrate (as N)	1.7	2.2
Aluminium (filtered)	0.04	0.05
Antimony (filtered)	<0.001	0.002
Arsenic (filtered)	<0.001	0.002
Cadmium	Not Analysed	0.001[18]
Caesium (filtered)	<0.001	0.002
Lithium (filtered)	0.006	0.008
Manganese (filtered)	1.56	2.0
Rubidium (filtered)	0.011	0.014
Thallium (filtered)	<0.001	0.00003[17]
Uranium (filtered)	<0.001	0.0005[17]
Vanadium*	Not analysed	0.0006[17]
Zinc*	Not analysed	0.04[17]
Major-ions (for assessment of TSF4 decant source):		
Total Dissolved Solids	612	Not applicable (not a CoPC)
Alkalinity (total as CaCO3)	184	Not applicable (not a CoPC)
Sodium (filtered)	131	Not applicable (not a CoPC)
Chloride	267	Not applicable (not a CoPC)
Total Dissolved Solids	612	Not applicable (not a CoPC)

[17] Trigger levels based on 30% above the seasonal maximum concentration
[18] Trigger levels based on fresh-water aquatic WQG, until follow-up monitoring confirms baseline concentrations

Appendix B

Methods for Groundwater and Surface Water Monitoring

Monitoring Methods and Procedures

B-1 Groundwater Monitoring

B-1-1 Groundwater Level Monitoring

Groundwater levels should be measured using an electronic interface water level meter prior to collection of groundwater samples during all groundwater monitoring events. The water level meter should be cleaned and washed between sampling locations using Decon90 detergent, tap water and deionised water.

B-1-2 Groundwater Field Water Quality Parameters

Groundwater monitoring parameters should be recorded using a calibrated field water quality meter. The following parameters should be recorded during well purging:

- Temperature (°C).
- pH (pH units).
- Electrical conductivity (EC; µS/cm).
- Dissolved oxygen (DO; mg/L).
- Oxidation-reduction potential (ORP).

Field measurements should be recorded on field sampling sheets. Field observations such as odours and colour should also be recorded on field sampling sheets.

For bores that are screened through entire saturated length, the water quality probe should be lowered into the column and a measurement taken one metre below the water surface and one metre above the base of the bore. For discretely screened bores, the measurements should be taken at the nominal centre of the screen intervals.

B-1-3 Groundwater Quality Sample Collection

Groundwater bores should be purged prior to collection of groundwater quality samples to provide representative samples of in-situ groundwater. The static water level should be measured allowing a water column depth and purge volume to be calculated, which is essential to evacuate stagnant water in the bore prior to sampling. Purging of groundwater monitoring bores should be based on AS/NSZ 5667.11-1998 (Standards Australia, 1998).

Groundwater monitoring bores should be purged until stabilisation of field parameters has occurred over three consecutive readings.

Groundwater monitoring bores should be sampled using low-density polyethylene tubing coupled to an electric pumping system. Depending on bore type (i.e., diameter), and bore yield the pump may be either a peristaltic or micro purge (‘low flow’) pump system.

B-1-4 Filtering of Groundwater Samples

Filtering is important process to remove suspended particulate that may affect sample results. Filtration of groundwater samples is generally limited to metal analysis.

Filtering can be completed in the field using in-line filters or a vacuum filter kit. Filtering of samples can also be completed by the laboratory, in which case, the samples should not be preserved and should be delivered to the laboratory within 24 hours of sample collection.

B-2 Surface Water Monitoring

Sample collection, processing, transportation, storage, preservation and labelling of surface water samples should be conducted in accordance with the appropriate industry standards and general surface water sampling guidance AS/NZS 5667.1:1998 (Standards Ausralia, 1998).

B-2-1 Field Parameters

Surface water monitoring parameters should be recorded using a calibrated field water quality meter. The following parameters should be recorded:

– Temperature (°C).
– pH (pH units).
– Dissolved oxygen (DO; mg/L).
– Electrical conductivity (EC; µS/cm).
– Oxidation-reduction potential (ORP).
– Total dissolved solids (TDS).

Field measurements should be recorded on field sampling sheets. Field observations such as odours and colour should also be recorded on field sampling sheets.

B-2-2 Surface Water Grab Sample Collection

Where the embankment of the water body is stable and the water body can be safely accessed, surface water samples should be collected by hand. Where possible, samples should be collected directly into the laboratory supplied sample containers. For samples that have preservatives, samples should be decanted into the laboratory supplied sample containers.

Where depth permits, the sample container should be positioned at least 10 cm below the surface water level, above the sediment bed and oriented with the capped opening facing downwards to avoid the collection of surface films. Once in position, the container cap should be removed to allow sample collection. Where sampling points cannot be safely accessed, surface water samples should be collected using a long-handled sampler and decanted into the laboratory supplied sample containers.

B-3 Field Sampling Program

Field sampling should be completed in accordance with industry accepted standards (Standards Australia, 2005) using uniform and systematic methods to ensure collection of representative environmental samples. Key requirements of these procedures are as follows:

– Calibration of field equipment: The water quality meter should have calibration checks completed using appropriate calibration standards prior to use.
– Appropriately trained and experienced staff should conduct and document site activities. Field activities should be conducted in general accordance with based on accepted industry protocols for environmental sampling.
– Decontamination procedures: These include the use of new disposable gloves for the collection of each sample, decontamination of reusable sampling equipment between each sampling location, and the use of appropriate sampling containers provided by the primary laboratory.
– Sample identification procedures: Collected samples should be immediately transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers should be clearly labelled with a sample number, job number, sample depth and sample date. The sample containers should then be transferred to a chilled insulated container for sample preservation prior to and during shipment to the analytical laboratory.
– Chain of Custody (CoC) information requirements: A CoC form should be completed and forwarded to the testing laboratory with the samples. A CoC form should be used for every batch of samples submitted to the laboratory. Delivery and analysis of samples to the laboratory should comply with sample holding times.
– Duplicate and blank samples: As detailed in **Section B-4**.

– Decontamination methodology:

- Where possible, single use sampling equipment which does not require decontamination should be utilised.
- When needed, equipment should be cleaned and decontaminated using a triple rinse system.

– Logging procedures: All samples should be described using a recognised system.

Samples should be taken in accordance with the following guidelines:

- Australian Standard 5667.1998 Water Quality – Sampling, Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples (Standards Ausralia, 1998)
- Australian Standard 5667:1998 Water Quality – Sampling, Part 11: Guidance on the Sampling of Groundwaters (Standards Australia, 1998).
- Monitoring and Sampling Manual – Environmental Protection (Water) Policy, (Department of Environment and Science, 2018).

Samples should be taken in laboratory provided bottles and stored in a chilled container before being couriered to the NATA accredited laboratory.

B-4 Laboratory Analysis Program

B-4-1 Laboratory Analysis

Samples should be submitted for analysis at a National Association of Testing Authorities (NATA) accredited laboratory.

B-4-2 Sampling and Analysis Control

The quality assurance samples to be collected during the assessment are described below.

Field Blind Duplicate

Duplicate sample that is used to identify the variation in the analyte concentration between samples from the same sampling point. Field blind duplicates should generally be collected from a well-mixed sample of water. A stainless-steel bowl or bucket should be used for mixing water samples. Samples should be collected at a frequency of 1 in 20 samples. Typical nomenclature for field blind duplicates would be FD1, FD2 etc.

Field Split Duplicates

Field splits are duplicate samples that are sent to different laboratories for analysis to assess the analytical proficiency of the laboratories. These samples should be collected using the same procedures as for field duplicates. Typical nomenclature for field split duplicates would be FS1, FS2 etc.

Rinsate Blanks

Rinsate blank samples are used to estimate the amount of contamination introduced during the re-use of sampling equipment. Rinsate blanks should be collected when cross contamination of the samples is likely to impact on the validity of the analytical results, for example, where the investigation level for a contaminant is near the detection limit for the contaminant.

Rinsate blank samples should be obtained by pouring laboratory supplied deionised water over decontaminated sampling equipment (water quality meter) into laboratory supplied bottles. Rinsate blanks should then kept cool in insulated containers until delivery to the laboratory. Typical nomenclature for rinsate blanks would be RB1, RB2 etc.

Transport Blanks

No trip blank samples are required since no volatile contaminants are included in the analytical schedule.

Sampling Frequency

QA/QC sample type	Rate
Field Blind Duplicate	1 in 20 samples
Field Split Duplicate	1 per day
Rinsate Blank	1 per piece of reused equipment per day
Transport Blank	Not required

B-4-3 Laboratory QA/QC

Laboratory Procedures

Laboratory quality verification is necessary to assess the accuracy and precision of analytical results and to identify assignable causes for atypical analytical results. The internal quality verification checks should consist of field and laboratory duplicate, blank and spike samples to quantify accuracy and precision and identify any problems with the sample results.

Laboratory Duplicates

The variation between duplicate analyses should be recorded for each process batch to provide an estimate of the method precision and sample heterogeneity. There should be at least one duplicate per process batch, or two duplicates if the process batch exceeds 10 samples. If results show greater than 30% difference, the analyst should review the appropriateness of the method being used.

Laboratory Control Simple (LCS)

A Laboratory Control Sample (LCS) comprises a standard reference material, or a matrix of proven known concentration, or a control matrix spiked with all analytes representative of the analyte class. Representative samples of either material should be spiked at concentrations equivalent to the midpoint of the preceding linear calibration or continuing calibration check, upon which sample quantification will be based. In this way, the concentrations should be easily quantified and be within the range of concentrations expected for real samples.

The LCS should be from an independent source to the calibration standard, unless an ICV (independent calibration verification) is used to confirm the validity of the primary calibration.

There should be at least one LCS per process batch.

Matrix Spike Non-Compliances

A matrix is the component or substrate (e.g., water, soil) that contains the analyte of interest. A matrix spike is an aliquot of sample spiked with a known concentration of target analyte. A matrix spike documents the effect (bias) of matrix on method performance.

There should be one matrix spike per matrix (and soil type) per process batch.

Poor matrix spike recovery but an acceptable LCS results may indicate that it is the matrix, not the method, that may be the issue but it is not acceptable to assign poor recovery to matrix effects, without a reasonable investigation (NEPC, 1999)

Method Blank

Method blank data should be reported with the primary sample data, thus enabling the site assessor to assess potential method bias for the relevant analytes.

There should be at least one method blank per process batch.

Data Validation Procedures

Data validation is defined as a technical review of a set of analytical data using criteria for quality verification. Initially the reviewer should determine whether all analyses were performed as requested, whether holding times were met and whether all verification checks were reported with the data. The data should be assessed against the acceptance criteria using the procedures as described below. These criteria are estimates of the degree of uncertainty that is generally considered acceptable.

Data Quality Objectives (DQOs) should be established at the outset of the project to enable an appropriate level of comparison with the investigation objectives. Refer to Schedule B2 Appendix B of the NEPM (2013).

If the amount of data that does not conform to the acceptance criteria is significant, corrective action may be necessary. This could involve re-analysing the samples, re-sampling and analysing, altering the analysis method or detection limit, or accepting, explaining, and interpreting the data.

Accuracy

The accuracy of the data should be determined by analysis of spiked samples (LCS, field spikes, matrix spikes and surrogate spikes).

Accuracy is calculated by:

$$\text{Recovery} = \frac{c-a}{b} \times 100$$

Where:

– a = measured concentration of the unspiked sample aliquot.

– b = nominal (theoretical concentration increase that results from spiking the sample.

– c = measured concentration of the spiked sample aliquot.

The QC acceptance criteria for spikes are generally ± 30% recovery (NEPC 1999).

Precision

Precision of the data should be assessed by the RPD for field and laboratory duplicate samples. The RPD is a measure of the representativeness of duplicate samples and may be used to identify issues with laboratory analysis or field sampling methods.

The following equations are used:

$$\text{RDP} = \frac{X5-XD}{\frac{X5+XD}{2}} \times 100$$

Where:

– Xs = concentration obtained for the sample.

– XD = concentration obtained for the blind/split sample.

If the results show greater than 30% difference, a review should be conducted of the cause (e.g. instrument calibration, extraction efficiency, appropriateness of the methods being used).

Some common reasons for anomalies may be attributable to one or more of the following (but not limited to):

– Errors in duplicate sample collection (i.e., in appropriate mixing of sample before collected subsamples for sample analysis).

– Heterogeneity of sample providing inconsistent results (i.e., presence of ash/coal fragments of paint chips).

– Slight differences in sample analysis technique (i.e., mixing of sample in the laboratory by either shacking vigorously or tilting back and forth).

Limit of Reporting

The Limits of Reporting (LOR) should be at or below the adopted criteria and should be equal to the lowest calibration standard.

Holding Times

Holding times should be the recommended maximum times before sample extraction (NEPC, 1999). Recommended holding times for soil are listed in Table 1 AS/NZS 5667.1-1998 (Australian Sandard, 1998).

All tests should be carried out as soon as practicable after sampling, and according to any jurisdictional requirements.

Data Reporting

Reporting of the analysis and interpretation of surface and ground water chemistry should demonstrate compliance with agreed standards and criteria such as the Australian and New Zealand Environment and Conservation Council guidelines for the protection of fresh and marine aquatic ecosystems. Examples of information that should be included in water quality reporting include:

- Water quality data and interpretation of this data (i.e., comparison to triggers).
- Identification of any issues (e.g., degrading water quality in a specific site/area).
- Potential causes of issues.
- Details of any incidents potentially affecting water quality.
- Details of actions taken to address any water quality issues.
- Commitments to specific areas for improvement in the next reporting period.

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