Report

11 May 2023

[redacted]

Dear Nicholas,

1. Introduction

1.1 Background

Due to construction and logistics challenges, the completion of the starter embankment for Tailings Storage Facility (TSF) 4 Cell 1 has been delayed. These challenges have resulted in construction extending into the winter which has caused further delays due to rainfall saturating construction material with limited solar drying with reduced winter evaporation rates. Consequently, the target crest height of the Cell 1 starter embankment of RL 1256 will not be achieved by May 2023.

TSF2 is expected to reach capacity in September 2023 and, to prevent interruptions to operations, Talison proposes to construct and commission the TSF4 Cell 1 starter embankment in two stages. The two-stage construction of the Cell 1 starter embankment will comprise:

– Stage 1a: Starter embankment constructed to < RL 1265
– Stage 1: Starter embankment constructed to RL 1265

A Critical Containment Infrastructure Report (CCIR) for Cell 1 Stage 1a is planned to be submitted in June 2023, with commissioning (Time Limited Operations – TLO) commencing in August 2023. Construction of the Cell 1 Stage 1 starter embankment will continue during Stage 1a TLO, with a CCIR for Cell 1 Stage 1 planned to be submitted in September 2023. Cell 1 is planned to receive tailings nominally for one year to allow adequate time to complete construction of Cell 2.

This report has been prepared to provide supporting information for the submission of a revised Works Approval Application (WAA) for TSF4 Cell 1 Stage 1a to the Department of Water and Environmental Regulation (DWER).

1.2 Purpose of this report

The purpose of this report is to provide information and discussion to assist with the submission of the revised WAA to support the commissioning of TSF4 Cell 1 at a crest level < RL 1265. The report focuses on technical risks to the integrity of Cell 1 and impacts to the environment.

1.3 Scope of work

The scope of work comprises:

- Assessing the impacts of reducing the starter dam crest to < RL 1265
- Identifying risks to the integrity of Cell 1 resulting from the reduction in crest level
- Identifying risks to the environment resulting from the reduction in crest level

1.4 Limitations

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

GHD otherwise disclaims responsibility to any person other than Talison Lithium Pty Ltd 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.

1.5 Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

1.6 Assumptions

This report assumes that the overall TSF4 design concept is unchanged, and the construction of Cell 1 will be undertaken in accordance with the design.

2. Impacts on TSF4 design

2.1 Storage

The TSF4 design estimated the storage provided by the starter embankment using 1.0% and 0.5% upper and lower limit beach slopes and assumed concurrent deposition in TSF1, TSF2 and TSF4. The estimated design storage capacities for TSF4 are summarised in Table 1.

Table 1 Design storage estimates

Cell	Estimated storage capacity (m^3)	
	0.5% beach slope	1% beach slope
Cell 1	5,000,000	4,800,000
Cell 2	1,300,000	1,100,000

The observed recent beach slope in TSF2 differs from the TSF4 design beach slope, as it forms the following compound beach shape, starting at the perimeter embankment:

- Initial 80 m at 2.5 %
- Further 150 m at 1.5 %
- Remainder at 0.5 %

The observed TSF2 beach slope has been used to revise the TSF4 storage estimation at RL 1265 and for an anticipated Stage 1a elevation of RL 1261. The results are summarised in Table 2.

As a result of the revised beach and the reduction in starter embankment crest, the storage in the Cell 1 starter embankment at RL 1261 will be reduced to 1.9 Mm^3 which equates to approximately 6 months storage.

Table 2 TSF4 Cell 1 capacity

Design Cell 1 capacity at RL 1265m 0.5 - 1.0% beach slope (Mm^3)	Revised Cell 1 capacity at RL 1265m with compound beach slope (Mm^3)	Cell 1 capacity at RL 1261m with compound beach slope (Mm^3)
4.8 – 5.0	3.9 (1)	1.9 (1)

(1) Numbers based on an interim survey, to be confirmed with as-constructed survey once clay liner finalised.

2.2 Rate of Rise (ROR)

2.2.1 Background

The design assumed that TSF1 and TSF2 would be operated concurrently with TSF4. Based on a starter embankment crest elevation of RL 1265 and concurrent deposition in TSF1, 2 & 4, the anticipated initial tailings deposition rate to TSF4 Cell 1 was 1.9 Mm^3/year resulting in a ROR of 3 to 4 m/year. The available storage in TSF4 Cell 1 at RL 1265 with concurrent deposition in TSF1, 2 & 4 would be exhausted in less than 3 years.

Changes to operations (deposition of all tailings in TSF4) have increased the deposition rate to TSF4 Cell 1 to 3.8 Mm^3/year, resulting in an average ROR of 6.5 m/year. The available storage at RL 1265 m in TSF4 Cell 1 will be exhausted in 1 year and the available storage at RL 1261 will be exhausted in 6 months.

2.2.2 Impact of increased ROR on seepage

The underdrainage design for Cell 1 was based on seepage modelling using the GeoStudio SEEP/W software package. The seepage modelling was undertaken for steady state conditions for the final embankment height (RL 1295 m) for Cell 1 considering the following three sections:

- Cell 1 NE Final, representing the northern embankment (common adjoining TSF1)
- Cell 1 NE 25 m High Wall, representing the southern half of the eastern embankment
- Cell 1 S Final, representing the remainder of the external perimeter and dividing embankment.

The results of the seepage modelling are summarised in Table 3 and the locations of the modelled underdrainage sections are shown in Figure 1.

Table 3 Summary of Cell 1 seepage modelling

Item	Unit	Cell 1 NE Final	Cell 1 NE 25 m High Wall	Cell 1 S Final
Flux to underdrains	$m^3/s/m$	1.89E-06	1.20E-06	1.59E-06
Representative length	m	1340	470	1400
Flow to underdrains	m^3/s	2.53E-03	5.64E-04	2.22E-03
Flow to underdrains	m^3/year	79,831	17,781	70,024
Total	**m^3/year**	**167,635**		

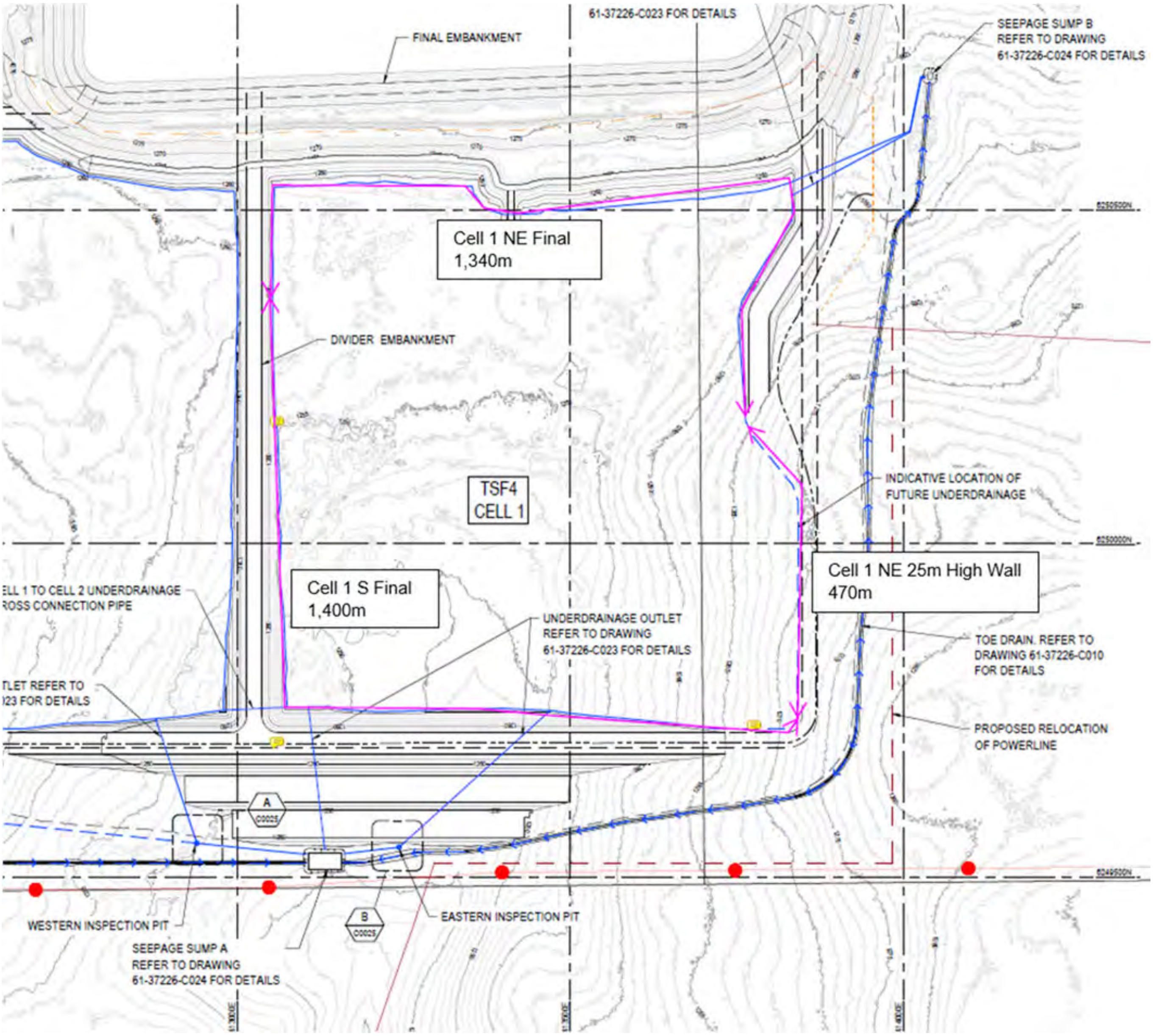

Figure 1   ***Locations of seepage modelling sections***

The underdrainage system consists of two Draincoil DN160 pipes located within a gravel trench along the upstream toe of TSF4 Cell 1. The underdrainage system has been sized to accommodate a flow of 311,900 m^3/year, which is 1.8 times greater than the anticipated full height seepage (i.e., 1.8 factor of safety).

Increase to the ROR will temporarily increase the seepage but this increased transient seepage rate will be less than the steady state seepage design capacity at the final height. Consequently, the transient increase in seepage associated with an increase in the ROR is not expected to affect the performance of the underdrainage or the design of TSF4.

2.2.3 Impact of increased ROR on stability

The TSF4 design is based on the coarser tailings adjacent to the embankments being effectively drained by the underdrainage at full height and mitigating the risk of static or seismic liquefaction of the tailings.

The capacity of the underdrainage system is greater than the transient increase in seepage and the increase in the ROR is not expected to affect the performance of the underdrainage. As the geotechnical conditions are unchanged an increase in ROR is not expected to impact the stability or design of TSF4. The increased ROR may result in a delay in the draining of the tailings. The impacts of the performance of the underdrainage on stability has been investigated below.

In addition, as per the design, an observational approach has been adopted to the operation and construction of TSF4 and vibrating wire piezometers will be installed at TSF4 and the pore pressure within the tailings will be monitored during operation to confirm that the coarser tailings are draining effectively. If the monitoring indicates that the tailings are not draining effectively additional drainage will be included in the subsequent raise designs as necessary.

To assess the impact on stability if the underdrainage did not perform as designed, a supplementary upstream stability assessment assuming undrained behaviour and liquefaction of the all the tailings has been undertaken. The supplementary stability assessment confirmed that TSF4 meets the stability requirements (FoS=1.76) in this conservative and unlikely scenario. The stability assessments for the design conditions (drained conditions with strain softening) are provided in Figure 2 and the stability assessment for undrained conditions with liquefaction are provided in Figure 3.

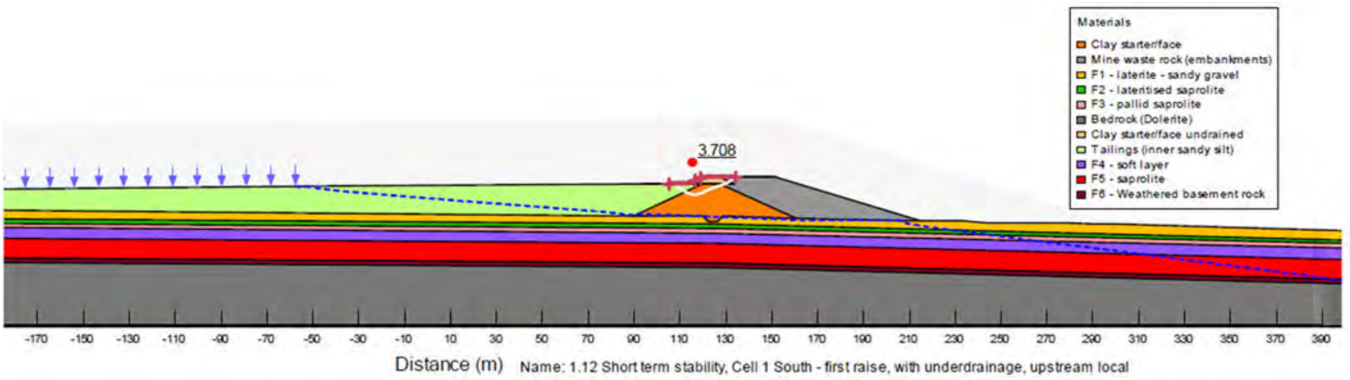

Figure 2 ***Upstream stability assessment for design conditions***

Color	Name	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Cohesion (kPa)	Piezometric Line
	Bedrock (Dolerite)							1
	clay starter/face undrained PS	19					96	1
	F1 - silty/clayey gravel	21			0	35		1
	F2 - saprolite/ferricrete	20			0	38		1
	F3 - silty clay (firm/stiff)	18			0	32		1
	F4 - silty clay (firm)	18			0	30		1
	Mine waste rock (embankments)	21			0	40		1
	Tailings liquefied	14	0	0.05				1

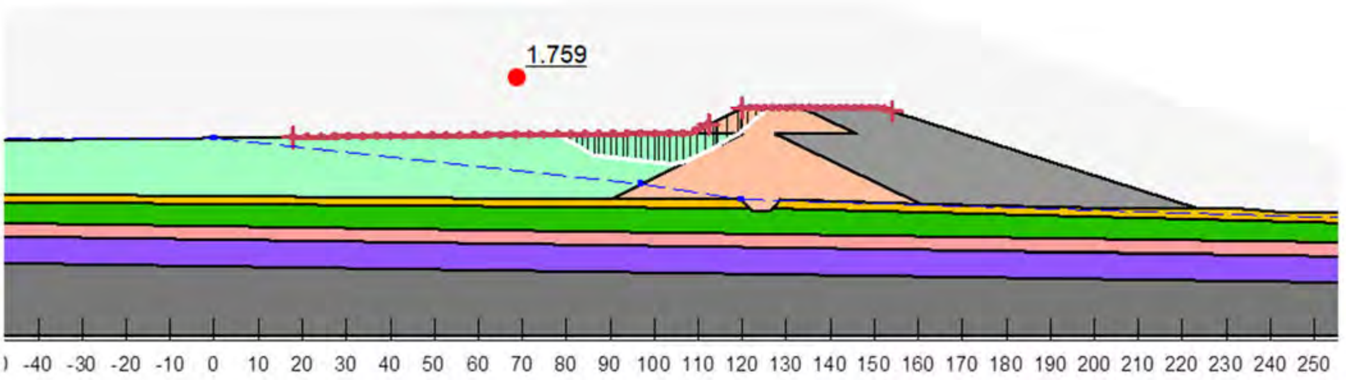

Figure 3 ***Upstream stability assessment for undrained conditions with liquefaction***

With regards to the stability of the downstream slope, stability modelling has confirmed that the failure surface does not intercept the tailings. Therefore, the stability of the downstream slope is not impacted by the increase ROR.

A review of the stability has confirmed that an increase in the ROR is not expected to affect the stability of TSF4.

2.3 Construction staging

2.3.1 Overview

An embankment elevation of RL 1261 m, for the Stage 1a starter embankment for Cell 1 will provide the following:

– Approximately 6 month of storage capacity
– Tailings beach area of ~57 hectare
– Rate of rise of 6.5 m/year when nearing RL 1261 m

2.3.2 Perimeter embankments

The starter embankment of TSF4 will be constructed and commissioned in stages. First, the construction of Cell 1 Stage 1a to RL 1261 will be completed. Cell 1 Stage 1a will be commissioned (TLO) and Cell 1 Stage 1 (RL 1265) and the Cell 2 starter embankment (RL 1265) will be constructed. Deposition will commence in Cell 1 after the completion of the Cell 1 Stage 1 construction in accordance with the approved Stage 1a TLO and will change to Cell 2 once the Cell 2 starter embankment construction has been completed. Cell 2 will be filled to the maximum storage elevation and deposition will then revert to Cell 1. Cell 1 will receive tailings until the maximum storage elevation of RL 1265 is reached. Following the initial deposition, subsequent raises will be constructed annually using a centreline raising methodology and will alternate between Cell 1 and Cell 2 to the final embankment crest elevation of RL 1295 m.

2.3.3 Dividing embankment

The divider embankment will be constructed using a staged centreline raising methodology. The initial construction comprises a clay starter embankment with general rockfill placed on the eastern side. The starter embankment will be keyed into the hard clay foundation with a 4 m wide cut-off trench. An underdrainage system will lower the phreatic surface within the tailings and ensure the tailings surface is adequately drained for subsequent embankment raise construction.

Each lift above RL 1265 will be nominally 5 m high and will be constructed along the same centreline with an 8 m wide clay zone. Cell 2 will be raised ahead of Cell 1 and therefore the raising of the dividing embankment will be undertaken in two stages (Stage A and Stage B). The Stage A construction comprises the construction of the clay zone to the full raise height while deposition occurs in Cell1. Once the full Stage A raise height has been reached deposition will revert to Cell 2 to allow the construction of Stage B raise. The Stage B construction consist of the construction of the mine waste rockfill to the full raise height. The clay zone has been designed to be on the Cell 2 side although Cell 1 will be commissioned first. The staged raising of the dividing embankment allows for continuous tailings deposition during construction by moving the pipeline to the raised zone as required.

The changes to the initial construction staging as a result of reducing the starter embankment crest height does not impact the design or the integrity of TSF4.

2.4 Embankment design

To enable TSF4 Cell 1 to receive tailings by September 2023 and allowing sufficient time for the DWER approval process, the starter embankment design for Cell 1 has been amended to Cell 1 Stage 1a (RL 1261) and Cell 1 Stage 1 (RL 1265). At the time of writing the Cell 1 starter embankment was at RL 1258.7. To ensure uninterrupted deposition of tailings, only the clay embankment portion of starter embankment will be constructed from RL 1258.7 to RL 1261 during Stage 1a. Once the clay zone construction has been completed the mine waste rock embankment will be constructed concurrently with the Cell 1 Stage 1 works.

Typical sections of the RL 1261 Cell 1 starter embankments and corresponding RL 1265 sections for comparison are provided in Appendix A.

2.5 Critical containment considerations

Based on the site's topography, the floor footprint of TSF4 is expected to develop until the RL 1275 m raise (assuming 5 m raises) as shown in Appendix A. Raise RL 1280 m onwards, until the final stage (RL 1295), will only require embankment raising.

The extent of the tailings for RL 1261, RL 1265, RL 1270 and >RL 1275 is provided in Appendix A.

The changes to the embankment design due to the stage construction the Cell 1 starter embankment does not impact the design or the integrity of TSF4.

2.6 Stability

The geotechnical conditions (strength, behaviour, etc.) for the Stage 1a and Stage 1 Cell 1 starter embankment are not changed by the reducing the Cell 1 embankment height and the design or stability of the Stage1a and Stage 1 Cell 1 starter embankment are not affected by the reduction in the height of the starter embankment.

2.7 Water balance

2.7.1 Freeboard

Freeboard will not be affected and will be maintained for both tailings and water as per original design:

– Tailings beach will not exceed 0.3 m below crest elevation (volumes noted in Table 2 account for that)
– Pond will not exceed 0.9 m below crest elevation

2.7.2 Decant

Decanting of supernatant from TSF4 Cell 1 will be increased due to the increased tailings deposition. The design decant rates was based on the concurrent deposition in TSF1, 2 & 4 and are summarised in Table 4.

Table 4 Summary of design decant rates

Item	Average decant rate (m^3/h)	Maximum decant rate (m^3/h)
"Dry" year	457	1,425
Average year	486	1,461
"Wet" year	625	1,593

To determine the impact of increased deposition on decant rates the existing tailings water balance model was updated with the amended operational procedures and recent production rates provided by Talison. The updated decant rates are summarised in Table 5.

Table 5 Summary of decant rates for increased tailings deposition

Item	Average decant rate (m^3/h)	Maximum decant rate (m^3/h)
"Dry" year	935	1,425
Average year	948	1,461
"Wet" year	1,037	1,593

Increasing the deposition rate increases the average decant rate by 165%. However, the maximum decant rate does not increase. The design decant pumping of 1,800 m3/h was based on the maximum wet decant rate with an allowance for a 1: 1000 year flood event.

The design decant pumping system capacity is greater than the increase in the average decant rate and therefore the increased decant rates does not impact the design or the integrity of TSF4.

2.8 Impact on concurrent construction

Concurrent construction of Cell 1 and deposition into Cell 1 is not expected. The construction and deposition sequencing are as follows:

– Cell 1 to be constructed to RL 1261 m, followed by Critical Containment Infrastructure Report to RL 1261 (with as constructed drawings)
– Construction to continue to final RL 1265 m
– Approval to commence TOL for Stage 1a
– Operation of Cell 1 to commence with pipelines at RL 1265 m, with freeboards maintained in reference to RL 1261 crest (while approval to operate Cell 1 at RL 1265 is being obtained)

3. Environmental impacts and risks

Reducing the crest height of the starter embankment does not change the design of TSF4 Cell 1. In particular the change will not impact the effectiveness of the low permeability clay liner, which will be complete up to RL 1261. Therefore, reducing the height of the starter embankment will not affect impacts to the environment or source – pathway – receptor assessment.

4. Risks to the integrity of Cell 1

The reduction in crest height to the TSF4 Cell 1 starter embankment to RL 1261 and the staged construction of TSF4 Cell 1 does not change the detail design principles and consequently the integrity of Cell 1 is not expected to be affected.

5. Conclusion

Construction of the TSF4 Cell 1 starter embankment in stages does not change the design of TSF4 and will have no additional impact on the receiving environment. Anticipated impacts are in line with what has already been predicted, notably seepage and the source – pathway – receptor assessment. The staged construction will not impact the structural integrity of Cell 1.

Appendix A

Figures

PERIMETER EMBANKMENT - TYPICAL SECTION RL 1261m

SCALE 1:200

NOTE: DECANT RETURN PIPE NOT SHOWN

LEGEND:

- GENERAL ROCK FILL
- MINE WASTE ROCK
- SELECT MINE WASTE ROCK
- CLEAN TAILINGS SAND
- WEARING COURSE
- ZONE 1A
- ZONE 1B
- ZONE 2B (GRAVEL)
- ROCK LINING
- CLAY LINER

PERIMETER EMBANKMENT - TYPICAL SECTION RL 1265m

SCALE 1:200

NOTE: DECANT RETURN PIPE NOT SHOWN

GHD

Talison Lithium Pty Ltd
Talison TSF4 Expansion Project
Commissioning TSF4 Cell 1 at RL1261

Perimeter Embankment Typical Sections

Job Number	12574082
Revision	A
Date	May 2023

Figure 01

Level 10, 999 Hay Street Perth WA 6000 T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com

Plot Date: 8 May 2023 - 10:16 AM Plotted by: Lani Sobrevilla Cad File No: G:\61\12574082\CADD\Drawings\FIGURES\12574082-Figure 01.dwg

PERIMETER EMBANKMENT - CH 1475 - 2060 TYPICAL SECTION RL 1261m

SCALE 1:200

NOTE: DECANT RETURN PIPE NOT SHOWN

LEGEND:

- GENERAL ROCK FILL
- MINE WASTE ROCK
- SELECT MINE WASTE ROCK
- CLEAN TAILINGS SAND
- WEARING COURSE
- ZONE 1A
- ZONE 1B
- ZONE 2B (GRAVEL)
- ROCK LINING
- CLAY LINER

PERIMETER EMBANKMENT - CH 1475 - 2060 TYPICAL SECTION RL 1265m

SCALE 1:200

NOTE: DECANT RETURN PIPE NOT SHOWN

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Talison Lithium Pty Ltd
Talison TSF4 Expansion Project
Commissioning TSF4 Cell 1 at RL1261

Perimeter Embankment
CH 1475 - 2060 Typical Sections

Job Number 12574082
Revision A
Date May 2023

Figure 02

Level 10, 999 Hay Street Perth WA 6000 T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com

Plot Date: 8 May 2023 - 10:18 AM Plotted by: Lani Sobrevilla Cad File No: G:\61\12574082\CADD\Drawings\FIGURES\12574082-Figure 02.dwg

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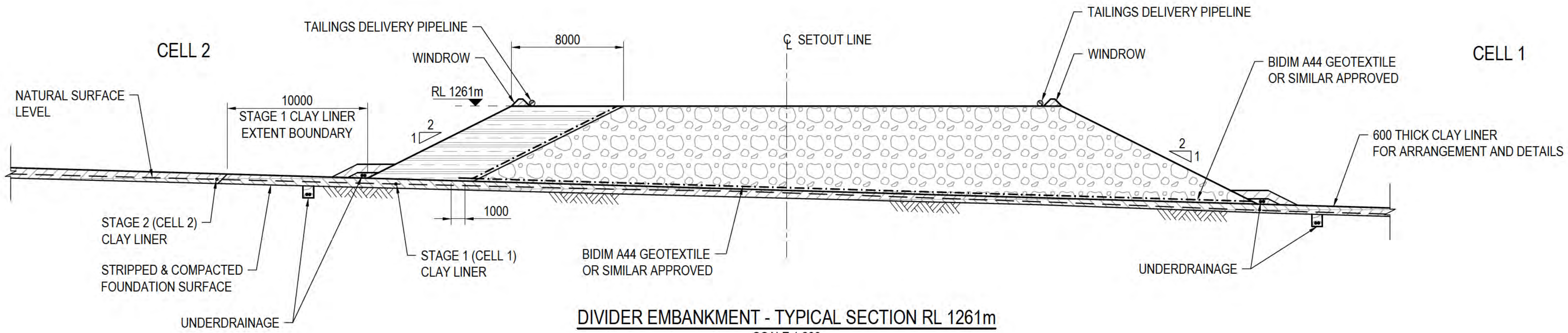
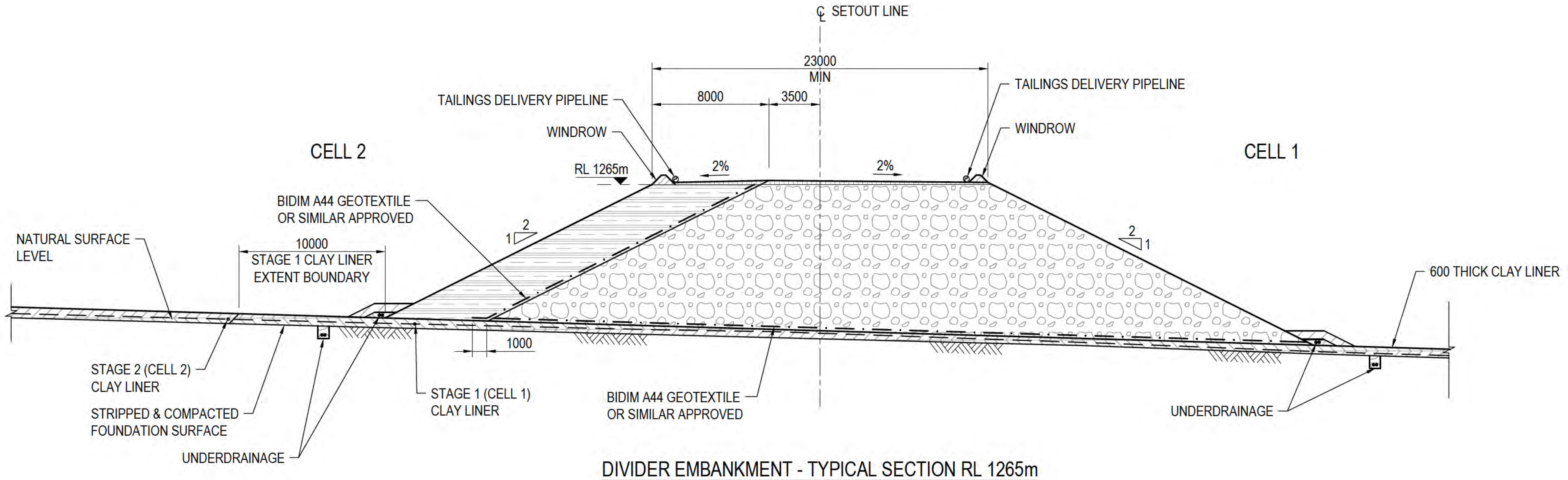


DIVIDER EMBANKMENT - TYPICAL SECTION RL 1261m

SCALE 1:200



DIVIDER EMBANKMENT - TYPICAL SECTION RL 1265m

SCALE 1:200

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Talison Lithium Pty Ltd
Talison TSF4 Expansion Project
Commissioning TSF4 Cell 1 at RL1261

Dividing Embankment Typical Sections

Job Number	12574082
Revision	A
Date	May 2023

Figure 03

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Talison Lithium Pty Ltd
Talison TSF4 Expansion Project
Commissioning TSF4 Cell 1 at RL1261
Starter Embankment Staging

Job Number	12574082
Revision	A
Date	May 2023

Figure 04

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Talison TSF4 Expansion Project
Commissioning TSF4 Cell 1 at RL1261

Embankment Staging Raise 1 (RL1270)

Job Number	12574082
Revision	A
Date	May 2023

Figure 05

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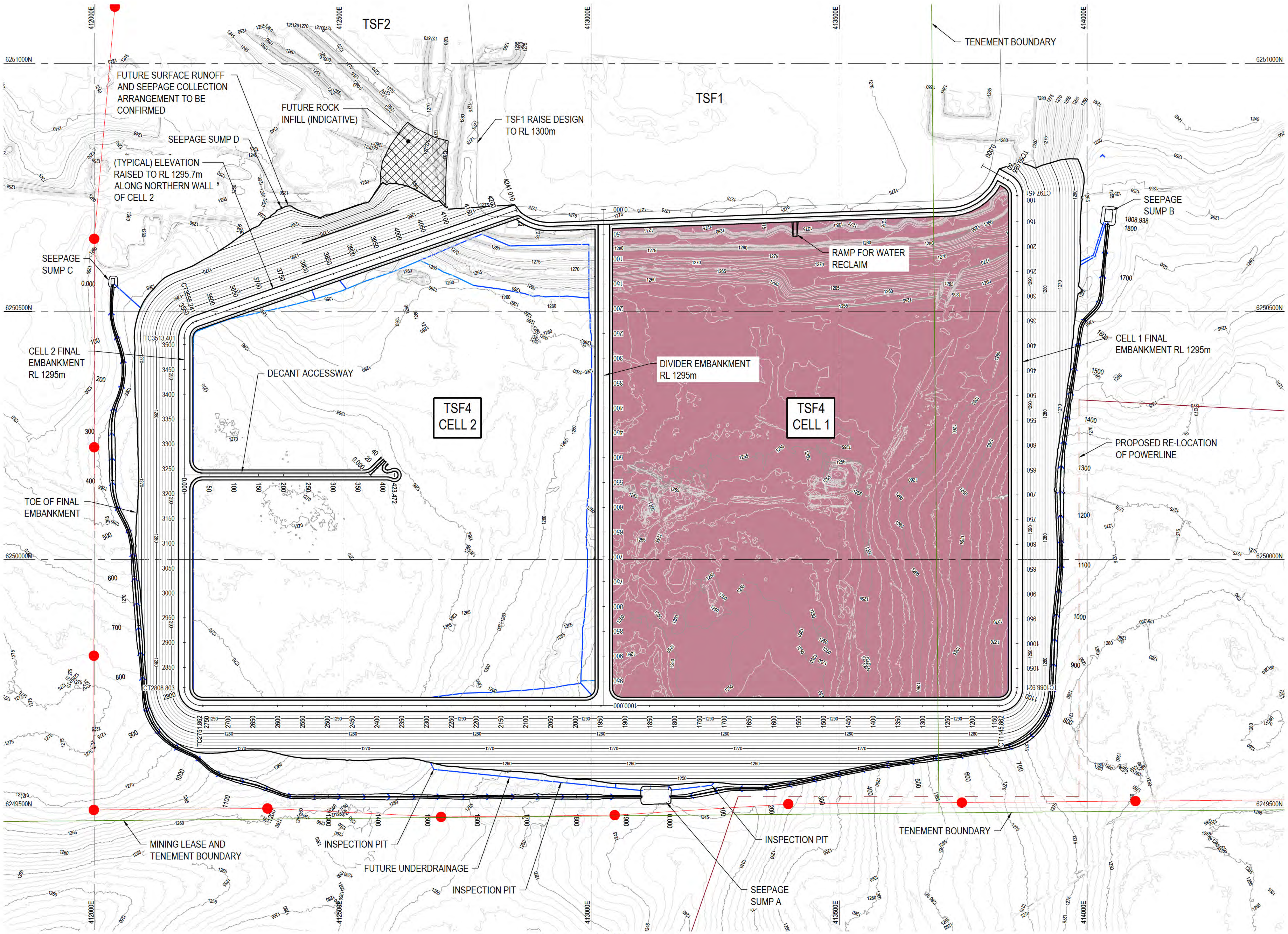

PLAN
SCALE 1:4000

LEGEND:

- EXISTING HV POWERLINE TO REMAIN
- PROPOSED RELOCATION OF EXISTING HV POWERLINE
- PROPOSED TOE DRAIN
- UNDERDRAINAGE
- PROPOSED 132kV POWERLINE (BY OTHERS)
- FUTURE ROCK INFILL
- TAILINGS STORAGE AREA FOR RL 1275

BASE SURVEY SUPPLIED BY:
TALISON LITHIUM PTY LTD
RECEIVED ON: 28 JULY 2021
CO-ORDINATE GRID: MGA 94-50
LEVEL DATUM: MINE DATUM

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Talison Lithium Pty Ltd
Talison TSF4 Expansion Project
Commissioning TSF4 Cell 1 at RL1261
Embankment Staging
Raises 2 to 6

Job Number	12574082
Revision	A
Date	May 2023

Figure 06

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