



Application for Licence Amendment

Part V Division 3 of the *Environmental Protection Act 1986*

Licence Number	L8008/2004/3
Licence Holder	FQM Australia Nickel Pty Ltd
ACN	135 761 465
File Number	DER2014/000631-1~7
Premises	Ravensthorpe Nickel Operations Legal description – Part of Mining Tenements M74/175, M74/115 and M74/116 JERDACUTTUP WA 6346 As defined by the Premises maps attached to the Revised Licence
Date of Report	22 August 2023
Decision	Licence granted

**A/MANAGER, RESOURCE INDUSTRIES
REGULATORY SERVICES**

Officer delegated under section 20 of the Environmental Protection Act 1986

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1. Decision summary

This Amendment Report documents the assessment of potential risks to the environment and public health from proposed changes to the emissions and discharges during the operation of the Premises. As a result of this assessment, Revised Licence L8008/2004/3 has been granted.

The Revised Licence issued as a result of this amendment consolidates and supersedes the existing Licence previously granted in relation to the Premises. The Revised Licence has been granted in a new format with existing conditions being transferred, but not reassessed, to the new format. In addition, the Revised Licence has been transferred from Ravensthorpe Nickel Operations Pty Ltd (the Licence Holder) to FQM Australia Nickel Pty Ltd (FQM; the Applicant) for the Ravensthorpe Nickel Operation (RNO) (the Premises).

The Premises is located within the Shire of Ravensthorpe, Western Australia, approximately 3.6 km west and 28 km south east of the Jerdacuttup and Ravensthorpe towns respectively.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this Amendment Report, the department has considered and given due regard to its Regulatory Framework and relevant policy documents which are available at <https://dwer.wa.gov.au/regulatory-documents>.

2.2 Amendment summary

This decision report documents three amendment applications requested by the applicant for licence L8008/2004/3, received September 2022, November 2022 and 30 May 2023 (see detail in sections below). The requested amendments are:

- to authorise the ongoing operation of works completed under works approval W6578/2021/1 including:
 - Operate tailings storage facility 2 (TSF 2) 'Stage 3' at relative level (RL) 126.4 m;
 - Repair and re-establish the damaged evaporation pond 12; and
 - Operation of a seepage collection trench and seepage recovery bores TSFRB01 and TSFB02 which have been installed as part of works approval W6578/2021/1.
- transfer the Licence from Ravensthorpe Nickel Operations Pty Ltd to FQM Australia Nickel Pty Ltd.

Additionally, the following conditions have been added to the licence:

- Construct groundwater recovery wells as per W6739/2022/1; and
- condition 9 and Table 4 has been updated as a result of the compliance inspection conducted May 2023 (see section 2.7 for further detail).

This amendment is limited only to the transfer and changes to Category 5 activities from the existing Licence. No changes to the aspects of the existing Licence relating to Categories 31, 52 and 54 have been requested by the Licence Holder. No changes to the throughput have been requested. The location of the TSF 2 is shown on Figure 1 below.

30 September 2022

On 30 September 2022, the Applicant, (FQM) submitted to the Department an application to amend Licence L8008/2004/3 under section 59 and 59B of the *Environmental Protection Act*

1986 (EP Act). This amendment is for on-going operation of infrastructure constructed under Works Approval W6578/2021/1 for the stage 3 embankment raise to the existing paddock style TSF2 located at the Premises (Figure 1: Location of TSF 2 on Prescribed Premises.).

25 November 2022

A second amendment application was submitted on 25 November 2022 to request that the groundwater monitoring bores required under Works Approval W6578/2021/1 be included in the licence amendment due to significant rainfall causing delays in drilling works. As part of this amendment the bore construction was assessed 21 June 2023 as compliant with Works Approval W6578/2021/1.

30 May 2023

Additionally, on 30 May 2023, the applicant applied to transfer the Licence from Ravensthorpe Nickel Operations Pty Ltd to FQM Australia Nickel Pty Ltd, who are the current occupiers of the premises. The transfer will be processed in conjunction with the above amendments.

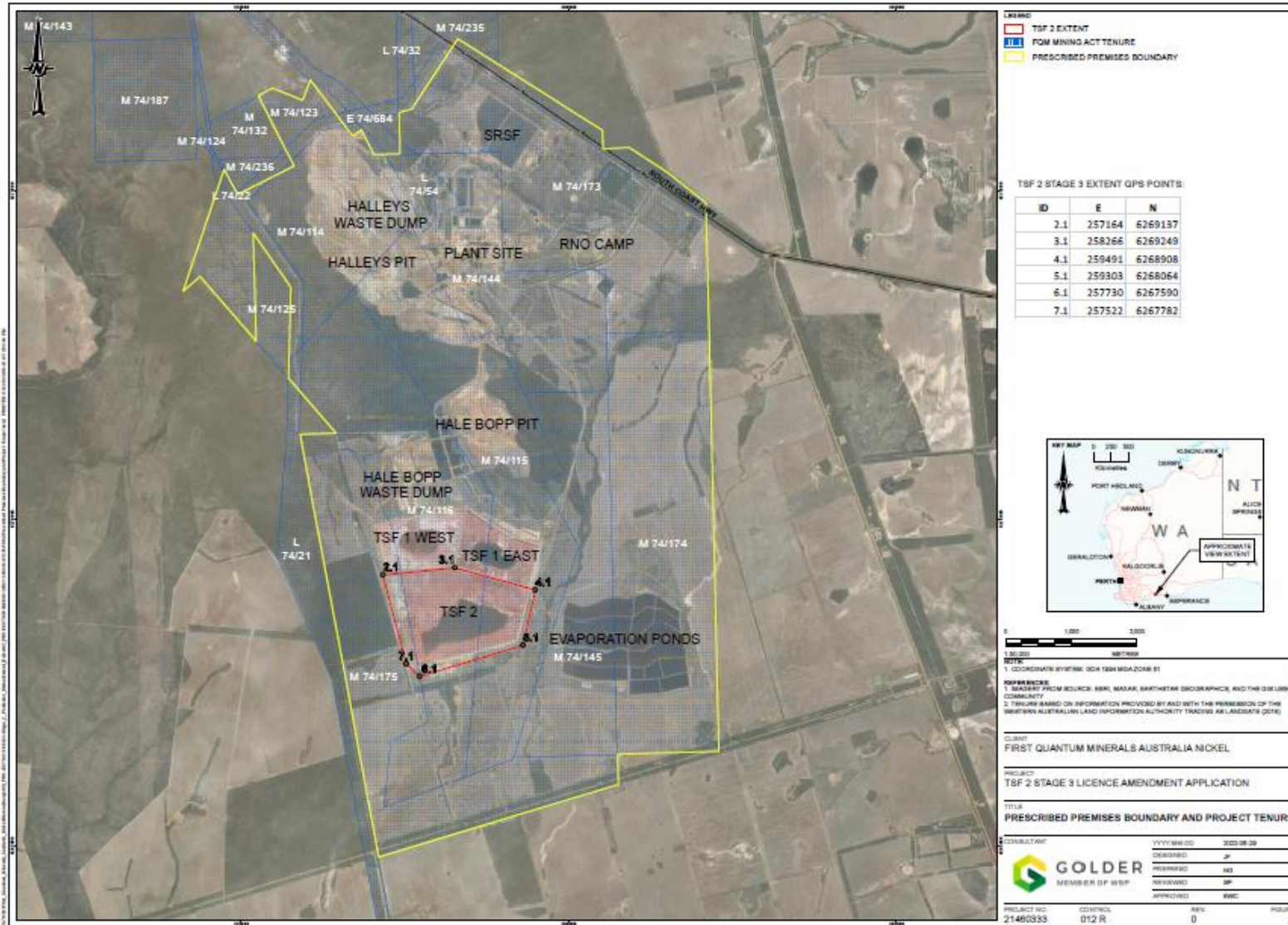


Figure 1: Location of TSF 2 on Prescribed Premises.

2.3 Project background

The TSF 2 embankment height was raised to address additional tailings storage requirements for the life of mine. This was approved under Works Approval W6578/2021/1 in October 2021. RNO is currently licensed under L8008/2004/3 to store tailings; and allows for a raise of the TSF 2 embankment height to 124.5 m RL.

This Licence amendment is to allow deposition into TSF 2 at the embankment height of 126.4 m RL, with operational freeboard of 300 mm (embankment elevation of RL 126.7 m) (TSF 2 Stage 3). The combined Stages 1 - 3 provide an additional 4 million tonnes (Mt) storage capacity over 14 months, bringing the total volumes of tailings stored in TSF 2 to 12.39 Mt.

2.4 Part IV of the EP Act

The Ravensthorpe Nickel Project has been assessed under Part IV of the EP Act by the Environmental Protection Authority (EPA). It is subject to the requirements of Ministerial Statement 633 (MS 633) which was published on 5 September 2003.

MS 633 includes conditions to minimise impacts to the following:

- priority flora species within the project area, in particular *Eucalyptus purpurata*, *Spyridium glaucum*, *Dampiera deltiodea* and *Kunzea similis*;
- significant vegetation communities within the project area, in particular *Eucalyptus flocktoniae* – *Melaleuca coronicarpa* ‘gorse’ and *Eucalyptus purpurata* woodland; and
- fauna within the project area and the adjacent Bandalup corridor, in particular Health Rat (*Pseudomys shortridgei*) and the Western Mouse (*Pseudomys occidentalis*).

Potential impacts to the above, including any requirements of monitoring in relation to these, have not be considered within the Part V assessment given these are regulated under MS 633.

The applicant has stated that no clearing of conservation significant flora was undertaken during works approval W6578/2021/1 as the TSF 2 footprint was restricted to the cleared land within the MS 633 approved development envelope.

MS 633 provides commitments to develop management plans, including in relation to the following aspects:

- surface hydrology;
- groundwater;
- flora and vegetation;
- priority flora;
- fauna;
- heritage and Aboriginal sites;
- dust and particulates; and
- noise.

The Delegated Officer notes that the above management plans are not intended to address all Part V prescribed activity emissions and discharges and that there are no specific conditions listed within MS 633 that directly relate to the management or control of Part V prescribed activity emissions and discharges.

Considering the above, all emissions and discharges related to Part V prescribed activities will be considered and risk assessed under this Licence amendment application.

2.5 Mining Proposal

A mining proposal was submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) seeking approval for a change to the design of the previously approved TSF 2 (Registration ID:56253, approved December 2015) Stage 3 embankment raise from upstream construction to downstream construction (Golder, 2021). Environmental registration ID 98221 for the Tailings Storage Facility 2 Stage 3 Raise was granted under the *Mining Act 1978* on 8 November 2021.

2.6 Compliance with Works Approval W6578/2021/1

Works Approval W6578/2021/1 was granted for the construction and time limited operations of TSF 2 (Combined Stage 2 and 3) embankment raise on 25 October 2021. The works approval is valid until 24 October 2026. The Environmental Compliance Report for the embankment raise and the vibrating wire piezometers (VWPs) installation was submitted to DWER on 1 August 2022 and was found to be compliant with conditions 1, 7 and 8 of the works approval.

A Works Approval amendment, granted 23 May 2022, extended the timeframe for construction of groundwater monitoring wells, seepage recovery bores and VWPs. On 30 September 2022, the Licence Holder installed two new seepage recovery bores (TSFRB01 and TSFRB02) to the south of TSF 2. Documents sent to the department on 25 November 2022 indicate that at the time of sending the *Construction Summary Table* and the *Preliminary Bore Logs* only TSFRB02 was complete while TSFRB01 still needed to be airlifted.

A second Works Approval amendment application was then submitted to the department on 17 November 2022 requesting an extension for the bore drilling timeframe as well as the repairs required for evaporation pond 12. This was due to heavy rainfall making access to the bore sites and pond impossible. The department concluded that the requested Works Approval amendment would be better suited as a Licence amendment (this amendment) as the bores are an essential control measure for seepage from the TSF. Bore locations are shown in Figure 2: Location of Monitoring Bores below. These bores have subsequently been assessed as complete and compliant with W6578/2021 and will and will be included on the licence for on-going monitoring.

2.7 May 2023 Compliance Inspection

On 3 and 4 May 2023 DWER's Compliance team conducted an inspection of Ravensthorpe Nickel Operations site. This involved comparing the infrastructure against the Licence conditions. Several conditions were found to be non-compliant and are in the process of being updated with target dates set. Some amendments are to be made during the draft stage of this amendment. This will include critical containment infrastructure (Table 4 of L8008/2004/3) being updated (accurately reflecting names and locations) and new maps to be provided. During the inspection FQM informed DWER that the seepage recovery bores (GWB01 and GWR02) proposed as part of this amendment are not effective in reducing seepage and seepage recovery wells are being utilised instead.

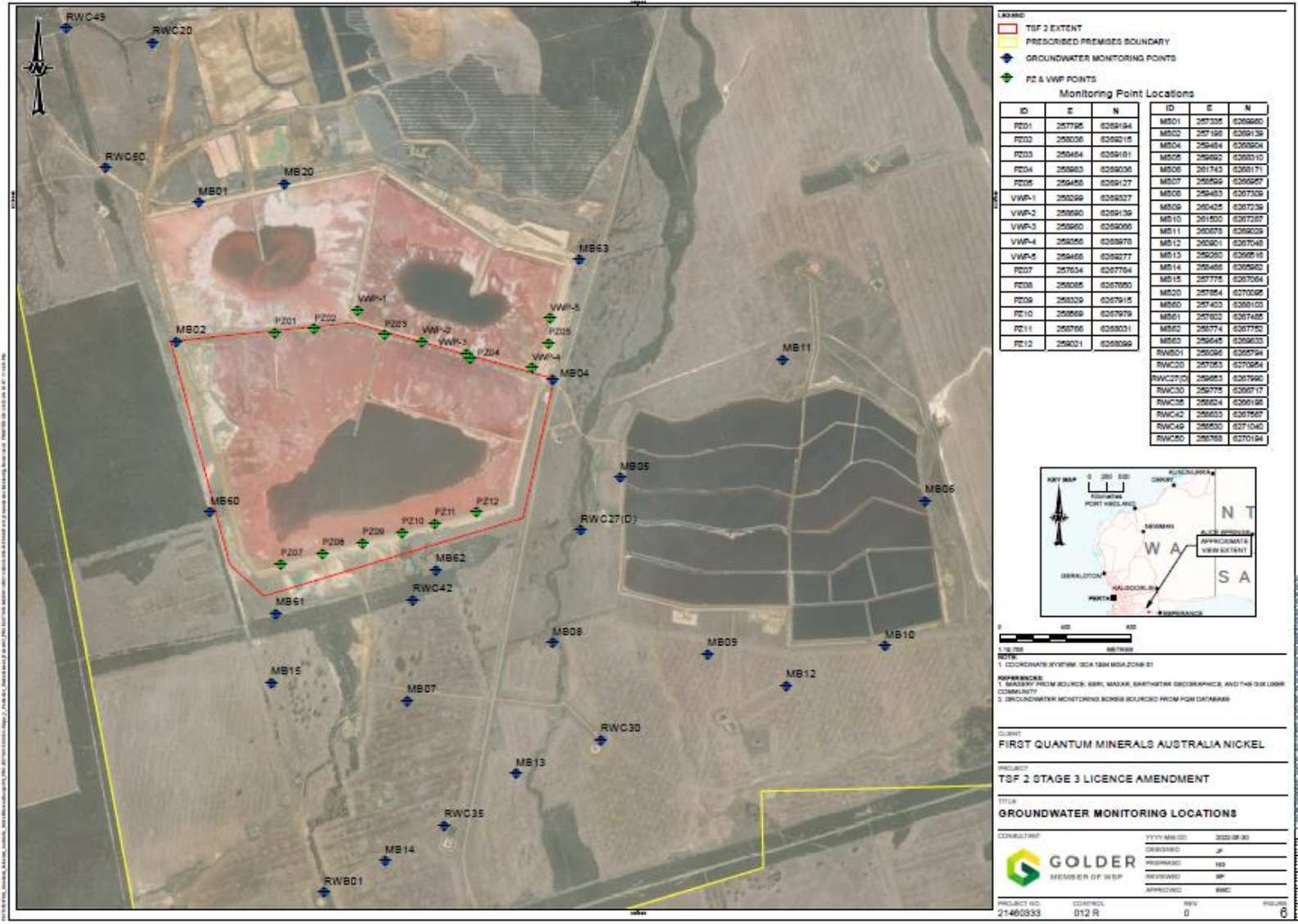


Figure 2: Location of Monitoring Bores

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2.8 Incidents and Complaints

Over the last 12 months seven incidents of tailings being discharged to the environment have been reported. The Delegated Officer consequently considers that the risk of pipeline burst needs to be considered further as part of this assessment.

Table 1: **Reported incidents and complaints.** below illustrates the environmental incidents reported to the department regarding TSF 2 and associated pipeline infrastructure. This information is maintained in the department's Incidents and Complaints Management System (ICMS).

Table 1: Reported incidents and complaints.

ICMS Number	Summary
66163	<p>Tailings slurry was released to the environment on 13/07/2022 immediately downstream of the Stormwater South (top) pond at the RNO processing plant. Tailings slurry drained downstream into the nearby dry creek bed.</p> <p>A buried section of the pipeline appeared to have failed releasing the tailings slurry to the environment.</p> <p>Outcome: Offender contacted, and remediation actions undertaken.</p>
67240	<p>Tailings pipeline burst incident that occurred on 3/11/2022 at the Northeast area of the RNO TSF.</p> <p>Tailings slurry was released to the environment at the Northeast shoulder of the TSF. Tailings slurry drained downwards around the burst point.</p> <p>Tailings slurry spill seemed shallow and extended approximately 300m² from the source.</p> <p>The v-shaped area of the pipeline seemed to have eroded internally due to increased friction resulting from flow parameters and the cross-sectional area of the affected pipe area (V-shaped area) resulting in the failure, as such releasing the tailings slurry to the environment.</p> <p>Outcome: Offender contacted, quantity and frequency of reports to be monitored through intelligence function. Identified issues to be raised during next compliance inspection. Licence holder informed of licence obligations.</p>
67555	<p>Tailings leak reported on 28/11/2022 and located north of the TSF1 diving wall.</p> <p>It was found that the spools that were being used for replacements were not stored in the correct manner. They were all project spares and had been left out in the laydown yard in the weather. All the natural rubber has been affected by UV, thus reducing their overall life.</p> <p>12 new bends were ordered and due for delivery in mid-January 2023. These new bends will be used to replace all of the old bends as well as those recently replaced. The full pipe lengths are urethane lined and the internals are fine.</p> <p>Outcome: Offender contacted, and remediation actions undertaken.</p>

67812	<p>Tailings slurry was released to the environment at the North of the TSF adjacent to the southern access road on 4/12/2022. Tailings slurry drained downwards around the leak point.</p> <p>Tailings slurry spill seemed shallow and extended approximately 115m from the source.</p> <p>The pipeline failure seems to be from the internal lifting of the pipe spool lining, especially at the bend, resulting to the release of tailings slurry to the environment.</p> <p>Outcome: Under investigation and inspected as part of the May 2023 Compliance inspection.</p>
67812	<p>Tailings slurry was released to the environment on 13/12/2022 along the South access road. Tailings slurry drained downwards around the burst point.</p> <p>Estimate difficult to determine until further investigation is undertaken.</p> <p>Tailings slurry spill seemed shallow and extended approximately 150m² from the source.</p> <p>The incident is currently under investigation. The spool seemed to have eroded internally due to increased friction resulting from flow parameters and the cross-sectional area of the affected pipe area resulting in the failure.</p> <p>Density of slurry remained at 37g/m³ and below.</p> <p>Outcome: Under investigation and inspected as part of the May 2023 Compliance inspection.</p>
68119	<p>Tailings pipeline spill incident that occurred on 11/01/2023.</p> <p>The HDPE spool failure seemed to be from the internal lifting of the pipe spool lining due to over-pressure for a HDPE material as opposed to a steel spool. This was a temporary installation pending a replacement with a steel spool once stock is received.</p> <p>Outcome: Under investigation and inspected as part of the May 2023 compliance inspection.</p>
68451	<p>Tailings slurry was released to the environment on 7/02/2023 at the Northeast of the TSF. Tailings slurry drained over to the opposite vegetation through the concrete drain.</p> <p>Tailings slurry spill seemed shallow and extended approximately 0.32 Ha as measured using the area of a polygon on Google earth.</p> <p>Review found the FQM Tailings line failure to be from an internal wear of the steel pipeline, as well as pressure build-up in the line.</p> <p>Outcome: Under investigation and inspected as part of the May 2023 compliance inspection.</p>

3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk*

assessments (DWER 2020).

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

3.1 Source-pathways and receptors

Emissions and controls

The key emissions and associated actual or likely pathway during premises operation which have been considered in this Amendment Report are detailed in Table 2 below and details the proposed control measures the Licence Holder has proposed to assist in controlling these emissions, where necessary.

Table 2: Licence Holder controls

Emission	Sources	Potential pathways	Proposed controls
Dust from dry tailings	Lift-off from the surface of the TSF2 stage 3	Air/windborne pathway	<p>The applicable controls from the existing Licence:</p> <ul style="list-style-type: none"> • Existing condition 23 for the visual inspection of all TSF's for fugitive dust emissions when the meteorological station located at the site (DDG 04) measures an average wind speed equal to or more than 15 meters per second between 0900 hours and 1600 hours for more than 30 consecutive minutes; • Existing condition 36 for the monitoring of ambient air quality of particulate matter (Total Insoluble Solids) at the monitoring locations specified in Table 14; and • Existing condition 39 for the meteorological monitoring to be undertaken at DDG04 to collect data on wind speed, wind direction and air temperature to determine the requirements of condition 14. <p>Additional controls proposed by the applicant include:</p> <ul style="list-style-type: none"> • Tailings to be maintained in a wet to moist condition; • Wet tailings deposited in sequences to maintain wet beach; • Tailings to remain 'saturated' near the surface for an extended period following deposition onto the TSF, thereby maintaining a moist tailings beach and minimizing the potential for fugitive dust lift off; • Tailings surface is below the crest of the embankments, reducing wind exposure; • Operation in accordance with FQM's TSF Operating Manual; and • Daily inspections (shift based) to include checking for dust generation on TSF2.
Tailings and contaminated water containing elements with environmental significance such as cobalt (Co), nickel (Ni),	Deposition of tailings into TSF2 (Stage 3)	Seepage of Tailings water through base and embankments of TSF2 into soil and groundwater.	<p>The applicable controls from the existing Licence:</p> <ul style="list-style-type: none"> • Condition 7 requires that the integrity of the 300 mm clay liner of TSF2 is maintained in an intact and unperforated state with a seepage rate of $1 \times 10^{-9} \text{ m/s}^1$ or less; and • Condition 9 for daily visual inspections for: <ul style="list-style-type: none"> ○ assessment of the tailings decant/supernatant ponds to determine the pond size and location; ○ maintain a record of all inspections undertaken; and ○ corrective action to taken to mitigate adverse environmental consequences as soon

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Emission	Sources	Potential pathways	Proposed controls
manganese (Mn), and high salinity.			<p>as practicable if inspections identify that an appropriate level of environmental protection has not been maintained.</p> <ul style="list-style-type: none"> • Condition 12 for the annual assessment of standing water levels and groundwater quality in groundwater monitoring bores surrounding TSF2 against previous modelled predictions to detect groundwater mounding due to seepage in the vicinity of TSF2; and • Condition 36 for the monitoring of groundwater wells at the locations specified in Table 15 to monitor changes to standing water levels and groundwater quality in response to tailings deposition to TSF2. <p>The following controls were conditioned as part of Works approval W6578/2021/1</p> <p><u>Seepage recovery:</u></p> <ul style="list-style-type: none"> • A seepage collection system comprising of collection trenches along the southern embankment and sumps has been incorporated into the design of TSF2 (Stage 3) to manage potential shallow seepage water and contaminated run-off from the downstream slope of the embankment; • Cut-off trenches have been constructed at the starter embankment of TSF2 and will be constructed along the extension of the western embankment to intercept shallow seepage; and • Installation of four additional monitoring bores and two recovery bores (to be completed as part of this Licence amendment). <p><u>Monitoring:</u></p> <ul style="list-style-type: none"> • Routine daily and monthly visual inspections of TSF2 to ensure the design strategy of the embankment raise is being implemented and identify any maintenance requirements of TSF2 that require attention; • Daily visual inspections (shift-based) to ensure the integrity of TSF2 perimeter embankments is maintained by checking for any evidence of seepage, cracking, instability, erosion or depressions; • Daily visual inspections (shift-based) to monitor tailings deposition including location of open spigots, flow rate at spigots, beach formation, beach freeboard, beach erosion and low points; and • Monthly inspections conducted to check tailings characteristics, tailings beach development, decant pond level and location, decant and return water system operation,

Emission	Sources	Potential pathways	Proposed controls
			<p>tailings and return water pipelines and surveillance of all monitoring installations.</p> <p>No additional controls were proposed in this Licence amendment</p>
	Overtopping of the TSF	TSF2 and direct discharge of tailings, hypersaline water and/or contaminated stormwater to land with infiltration to groundwater	<p>The applicable controls from the existing Licence that manage the risk of overtopping of TSF2 are outlined below:</p> <ul style="list-style-type: none"> • Condition 8 requires the maintenance of a 300mm operational freeboard for TSF2 as measured from the bottom of the spillway of TSF2 to the tailings beach; • Condition 9 for the daily visual assessment of the tailings decant/supernatant ponds to determine the pond size and location; • Condition 12 for the annual assessment of standing water levels and groundwater quality in groundwater monitoring bores surrounding TSF2 against previous modelled predictions to detect groundwater mounding due to seepage in the vicinity of TSF2 which will prevent overtopping. <p>The applicant has also proposed the following controls:</p> <ul style="list-style-type: none"> • TSF2 operational freeboard will be managed in accordance with Licence L8008/2004/3, DMIRS (2013) and ANCOLD (2012) guidelines, and existing RNO operating procedures for TSF2; • The TSF2 Stage 3 is designed in accordance with, DMP (2015) guidelines (Design Category – Category 1) to accommodate inflows from 1:100-year 72 hours rainfall event, atop normal operating pond, whilst maintaining 0.5 m total freeboard; • The TSF2 Stage 3 has been designed in accordance with ANCOLD (2012) guidelines (Design Category – High C Spill Consequence Category) to accommodate inflows from 1:100-year 72 hours rainfall event, atop normal operating pond, whilst maintaining 0.5 m freeboard and wave run up from 1:10 annual exceedance probability (AEP) wind; • The results of hydrological analysis indicate that the TSF2 Stage 3 can retain the 6-hour probable maximum flood (PMF) with a further 3.3 Mm³ of additional storage capacity; • Routine (daily and monthly) inspections of the TSF2 will be carried out to check whether the design strategy is being implemented and to identify any maintenance requirements or any circumstances associated with TSF2 performance that need further attention; • Daily inspections (shift-based) to include checking for:

Emission	Sources	Potential pathways	Proposed controls
	<p>Pipeline breakage and spillage</p>		<ul style="list-style-type: none"> ○ Decant operations including pond size and location, clarity of decant water, decant pumping, capacity, and operation of decant ponds; ○ Tailings deposition including location of open spigots, flow rate at spigots, beach formation, beach freeboard, beach erosion, and low points; ● Monthly inspections to include checking for: <ul style="list-style-type: none"> ○ Detailed inspection of embankments and associated structures; ○ Decant pond level and location; ○ Decant and return water system operation; ○ Surveillance of all monitoring installations. ● Observations made during the inspections will be recorded and appropriately reported: <ul style="list-style-type: none"> ○ Defects identified during the inspections will be repaired or replaced as required; and ● Operation in accordance with the TSF operating manual. <p>Applicant proposed controls</p> <ul style="list-style-type: none"> ● Pipelines located within bunded corridor along route between plant and TSF2. Any spills will be contained within corridor; ● Catch pit ponds were constructed at lowest points along the pipeline to contain tailings spillage from pipeline; ● TSF2 embankments are provided with a safety bund on the outer crest margin and have a 2% fall towards the inner crest margin so that spilled liquor from the tailings distribution pipelines will be contained and flow into the TSF2 basin; ● A combination of the following is already in place for TSF2 and will control potential offsite impacts: <ul style="list-style-type: none"> ○ Bunded pipeline corridor; ○ Monitoring devices; ○ Flow meters; ○ Catch pits/dump pond at low points along the pipeline route to collect the spillage; and ○ Shut off valves. ○ Condition 9 for daily visual inspections for integrity of the tailings delivery and return water pipelines to TSF2; ● Routine (daily and monthly) inspections of the TSF2 will be carried out to check whether the design strategy is being implemented and to identify any maintenance requirements or

Emission	Sources	Potential pathways	Proposed controls
			<p>any circumstances associated with TSF2 performance that need further attention;</p> <ul style="list-style-type: none"> • Daily inspections (shift-based) to include checking for: <ul style="list-style-type: none"> ○ Changes to items of concern (e.g., cracking, seepage) identified during previous inspections; ○ Serviceability of pipelines to and from the TSF2 including tailings delivery and decant pipelines, condition of pipe work, damage to pipelines, excessive movement of pipelines, pipeline or spigot blockages, pipeline leaks (leak detection) or uncontrolled discharges; • Monthly inspections to include checking for: <ul style="list-style-type: none"> ○ Tailings and return water pipelines; and ○ Surveillance of all monitoring installations. • Observations made during the inspections will be recorded and appropriately reported; • Defects identified during the inspections will be repaired or replaced as required.
Stormwater contaminated with Tailings	Deposition of tailings into TSF2	Direct discharge to land and to soil and surface water via runoff during rainfall events.	<p>The following controls were conditioned as part of Works Approval W6578/2021/1</p> <ul style="list-style-type: none"> • All embankment crests to have a 2% inward crossfall to direct surface water runoff into the TSF basin; • Existing stormwater drain located along the western flank of TSF2 to be reinstated in accordance with F003; • The existing diversion drain along the western flank of the TSF will be reinstated to provide protection from stormwater runoff and potential erosion impacts to TSF2; <p>No additional controls have been proposed.</p>
Supernatant (hypersaline water contaminated with enriched metals and metalloids e.g. Co, Ni and Mg), and/or contaminated	Evaporation ponds (EPs)	<ul style="list-style-type: none"> • Increased seepage of supernatant and/or contaminated stormwater through base and walls of HDPE-lined EPs to soil, groundwater 	<p>The following controls were conditioned as part of Works approval W6578/2021/1</p> <ul style="list-style-type: none"> • Condition 6 required synthetic liners of EPs 9, 12, 13 and 16 to be repaired and the installation of wave breakers in EPs 9, 12, 13 and 16 to reduce wave action against embankment walls. <p>The following controls have already been conditioned as part of L8008/2004/1</p> <ul style="list-style-type: none"> • Condition 8 requires a 300 mm minimum top of embankment operational freeboard for all EPs; and • shall maintain the following freeboards for specified containment infrastructure:

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Emission	Sources	Potential pathways	Proposed controls
stormwater		<p>and root zone of crops/vegetation</p> <ul style="list-style-type: none"> • Overtopping of EPs and direct discharge of supernatant and/or contaminated stormwater to land with infiltration to groundwater. 	<ul style="list-style-type: none"> ○ 800mm for all stormwater ponds, process ponds, the limonite pond and mine dams • Condition 9 requires inspection (daily during operations or weekly during care and maintenance) of the freeboard for EPs. <p>No additional controls have been proposed.</p>

¹ DWER notes that whilst this is conditioned it is unlikely that the clay liner has this permeability.

Receptors

In accordance with the *Guideline: Risk assessments* (DWER 2020), the Delegated Officer has excluded employees, visitors and contractors of the Licence Holder's from its assessment. Protection of these parties often involves different exposure risks and prevention strategies, and is provided for under other state legislation.

Table 3 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises (*Guideline: Environmental siting* (DWER 2020)). Jerdacuttup Town is located 6.6 kms southeast from the border of the TSF2 footprint. Given the distance from the works location the risk is considered low and will no longer be considered as part of the assessment.

Table 3: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	Distance from prescribed activity
Roads (residents and tourists driving along roads)	<ul style="list-style-type: none"> Jerdacuttup Road located approximately 2.5 km south of TSF2 and runs parallel along the entire southern boundary of the premises; and South Coast Highway located approximately 5.5 km north-east of the combined TSF infrastructure and runs parallel along the entire north-eastern boundary of the premises.
<p>Homesteads</p> <p><i>For noting:</i></p> <ul style="list-style-type: none"> <i>Review of DWER GIS system's (Geocortex) did not show any residential buildings at these specified homestead locations (during review undertaken in January 2023); and</i> The applicant did not list any homestead sensitive receptors within the works approval application. 	<ul style="list-style-type: none"> Wyena homestead located approximately 3.5 km south-west of TSF2; and Cambridge Downs homestead located approximately 4.5 km south-east of TSF2. (Geocortex) <p>Distance of proposed category 5 activities to these homesteads and with the consideration that these homesteads may no longer exist are sufficient to inform that project activity impacts are not foreseeable.</p> <p>Human receptors are unlikely to be impacted by the proposed activities and therefore not further considered in the risk assessment.</p>
Rural farmlands, primarily agriculture (wheat) and sheep farming (with potential for rural residential housing and groundwater abstraction bores for livestock drinking water)	<p>Properties located approximately:</p> <ul style="list-style-type: none"> 1 km east of the evaporation ponds (EPs) and 3 km east of TSF2; 2.5 km south of TSF2 and 2 km south-south-west of the EPs; 1 km south of the EPs and 3 km south-south-east of TSF2; and 2 km south-east of the EPs 5 km south-east of TSF2.

Aboriginal Heritage	<p>The closest Aboriginal Heritage site to the TSF2 footprint area is the Registered Aboriginal Site known as 'Gnamma Hole' (ID 18950), located approximately 4.2 km north of the TSF2.</p> <p>Gnamma holes are natural cavities commonly found in hard rock and acts as a source of water for Aboriginal communities.</p> <p>Topography of the area indicates a higher landform is situated in-between TSF2 and the heritage site which would act as a buffer.</p> <p>Given the distance, this site is unlikely to be impacted from the proposed activities and will therefore not be considered further in this risk assessment.</p>
Environmental receptors	Distance from prescribed activity
Remnant native vegetation	<ul style="list-style-type: none"> • Located to the east, south and west of the TSF2 footprint area; and • As close as 55 m from TSF2 footprint area.
Conservation significant areas	<p>The closest conservation areas to the TSF2 footprint area are:</p> <ul style="list-style-type: none"> • Reserve R43060 vested with the Conservation Commission of WA for the purpose of 'Conservation of flora and fauna' located approximately 1.6 km southwest of the TSF2 footprint area border; • Reserve R49054 vested with the Shire of Ravensthorpe for the purpose of 'Public utility and Parklands' located approximately 1 km west of TSF2 footprint area; and • Reserve R49742 vested with Conservation Commission of WA for the purpose of a 'Conservation Park' located approximately 3.1 km northwest of the border of the TSF2 footprint area.
Threatened ecological community (TEC)	<p>Remnant native vegetation located to the east, south and west of the TSF2 footprint is considered '<i>Proteaceae dominated Kwongkan shrublands of the southeast coastal floristic province of Western Australia</i>' TEC.</p> <p>The closest occurrence of the TEC is located west of the TSF2 area. This ecological community is listed as Priority 3 (by DBCA) and threatened under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>.</p>

<p>Conservation significant flora</p>	<p>The following conservation significant flora species may occur between 700 m and 3 km of the TSF2 footprint (DWER Geocortex):</p> <ul style="list-style-type: none"> • <i>Acrotriche orbicularis</i> (Threatened) – north of TSF2; • <i>Allocasuarina hystricosa</i> (Priority 4) –north and south-west of TSF2; • <i>Beyeria cockertonii</i> (Threatened) – west of TSF2; • <i>Eucalyptus stoatei</i> (Priority 4) – south and south-west of TSF2; • <i>Goodenia phillipsiae</i> (Priority 4) –west of TSF2; • <i>Grevillea punctata</i> (Priority 3) – west and north-west of TSF2; and • <i>Micromyrtus navicularis</i> (Priority 3) – west of TSF2.
<p>Conservation significant fauna</p>	<p>The following conservation significant fauna species have been sighted (DWER Geocortex):</p> <ul style="list-style-type: none"> • Chuditch, western quoll (<i>Dasyurus geoffroyi</i>) (considered Threatened - Vulnerable at a State level and Vulnerable at a Federal level): <ul style="list-style-type: none"> • approximately 1 km west of TSF2 (2017); and • approximately 2 km north and north-west of TSF2 (2017); • Quenda, southwestern brown bandicoot (<i>Isoodon fusciventer</i>) (considered Priority at a State level): <ul style="list-style-type: none"> • approximately 1.5 km north of TSF2 (2000). • Western brush wallaby (<i>Notamacropus irma</i>) (considered Priority 4 at a State level): <ul style="list-style-type: none"> • approximately 2 km north of TSF2 (2000); • Western whipbird (western mallee) (<i>Psophodes nigrogularis oberon</i>) (considered Priority 4 at a State level): <ul style="list-style-type: none"> • approximately 1.5 km north of TSF2 (2000); <p>Previous fauna surveys have identified the following additional protected or threatened fauna species within the greater project area (WSP Golder 2022a):</p>

	<ul style="list-style-type: none"> • Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>); • Eula's Planthopper (<i>Budginmaya eulae</i>); • Heath Mouse (<i>Pseudomys shortridgei</i>); • Malleefowl (<i>Leipoa ocellata</i>); • Peregrine Falcon (<i>Falco peregrinus</i>); and • Western Mouse (<i>Pseudomys occidentalis</i>). <p>Based on regional data and habitats identified within the project area, three additional species were considered 'Possible' to occur (WSP Golder 2022a):</p> <ul style="list-style-type: none"> • Fork-tailed Swift (<i>Apus pacificus</i>); • Ravensthorpe range spider (<i>Lerista viduata</i>); and • Western Bristlebird (<i>Dasyornis longirostris</i>).
Native fauna	<p>The most recent fauna survey found a total of 45 fauna species (comprising of three amphibians, 32 birds, 12 mammals and 29 reptiles) within the greater project area. It is noted that the proposed TSF2 works area was not included within the survey area due to all infrastructure being located on previously cleared land (WSP Golder 2022a).</p>
Surface water	<ul style="list-style-type: none"> • Minor creek lines located: <ul style="list-style-type: none"> • approximately 830 m north of TSF2; • running parallel approximately 350 m east of TSF2 and 250 m west of the Evaporation Ponds; and • approximately 1.5 km south-west of TSF2. • Burlabup Creek line located approximately 1 km south of TSF2 and 320 m south of the EPs. <p>This creek system discharges into the Jerdacuttup River, which is located approximately 11.5 km south-west of TSF2 (WSP Golder 2022a).</p> <p>Surface water flow within the creek lines tends to be intermittent because of short term and high-rate runoff and the absence of significant aquifers to sustain baseflow. Runoff can occur at any time, but mainly occurs during the winter months due to storm events (WSP Golder 2022a).</p>
Groundwater	<p><u>Depth and flow</u></p> <p>Regional groundwater flow is generally to the</p>

	<p>south-east (WSP Golder 2022a).</p> <p>The below provides the SWL as of January 2023 (FQM 2023):</p> <ul style="list-style-type: none"> • SWL surrounding TSF2 between 4.5 -19.8 m bgl; • SWL surrounding EPs between 12.2 -18.1 m bgl; and • SWL downstream of TSF2 and EPs between 12.6-15.5 m bgl. <p><u>Quality</u></p> <p>Historical hydrogeology reports provide the following baseline levels of groundwater for the premises (WSP Golder 2022b):</p> <ul style="list-style-type: none"> • TDS in the range of 4,000 to 30,000 mg/L. • pH averaging 6.3, with a range of 4 to 7.4; and <p><u>Groundwater users</u></p> <ul style="list-style-type: none"> • No groundwater uses within 5 km of the proposal area
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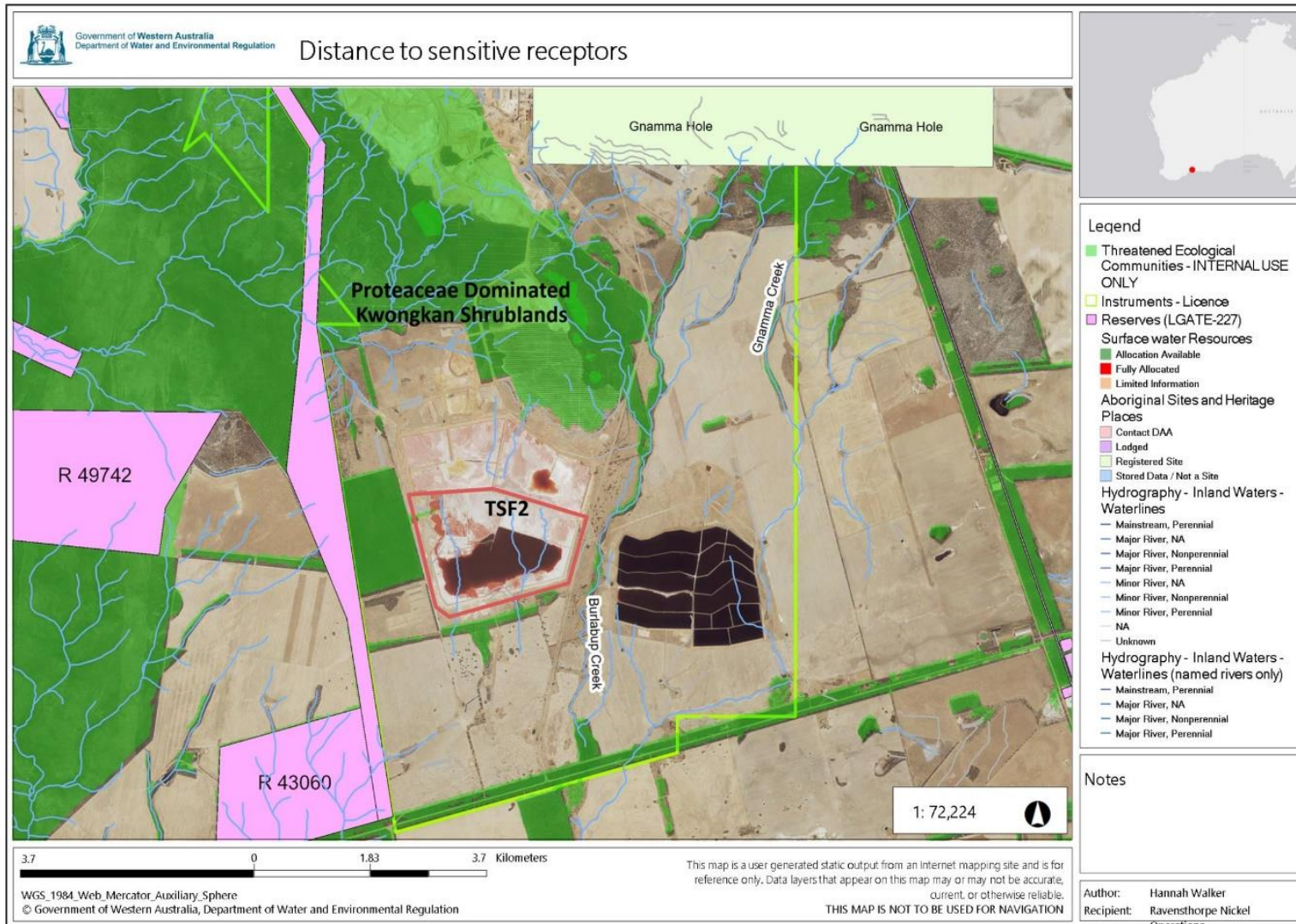


Figure 3: Distance to sensitive receptors

Licence: L8008/2004/3

IR-T15 Amendment report template v3.0 (May 2021)

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for those emission sources which are proposed to change and takes into account potential source-pathway and receptor linkages as identified in Section 3.1. Where linkages are incomplete they have not been considered further in the risk assessment.

Where the Licence Holder has proposed mitigation measures/controls (as detailed in Section 3.1), these have been considered when determining the final risk rating. Where the Delegated Officer considers the Licence Holder's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the Licence as regulatory controls.

Additional regulatory controls may be imposed where the Licence Holder's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 4.

The Revised Licence L8008/2004/3 that accompanies this Amendment Report authorises emissions associated with the operation of the Premises i.e. Category 5 activities.

The conditions in the Revised Licence have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

Table 4. Risk assessment of potential emissions and discharges from the Premises during operation

Risk Event					Risk rating ¹ C = consequence L = likelihood	Licence Holder's controls sufficient?	Conditions ² of Licence	Justification for additional regulatory controls
Source/ Activities	Potential emission	Potential pathways and impact	Receptors	Licence Holder's controls				
Operation								
Source: TSF 2 (combined stage 2 and stage 3) Activity: Deposition of tailings into TSF2	Dust lift-off (dry tailings)	Pathway: Air/windborne dispersion Impacts: Reduced native vegetation health or native vegetation death including threatened fauna habitat.	<ul style="list-style-type: none"> Remnant native vegetation Kwongkan shrublands TEC Threatened flora species Threatened fauna 	Refer to Section 3.1	C = Minor L = Possible Medium Risk	Y	N/A	Existing conditions of the Licence are sufficient, and no further actions are required.
	Tailings, hypersaline water contaminated with enriched metals and metalloids (e.g. cobalt, nickel and manganese), run-off of reject stream material with enriched metals and metalloids (e.g. arsenic, bismuth, cobalt, chromium, nickel, selenium and tellurium) and/or contaminated stormwater	Pathway: Seepage of tailings from base and embankments of TSF2 into soil and groundwater. Impacts: <ul style="list-style-type: none"> Mounding of groundwater table causing vegetation stress or deaths due to increased salinity within root zones of vegetation. Reduced quality or contamination of 	<ul style="list-style-type: none"> Surface water bodies Remnant native vegetation Kwongkan shrublands TEC Threatened flora species 	Refer to Section 3.1	C = Moderate L = Likely High Risk	N	<u>Refer to section 3.3 for additional DWER controls</u>	A detailed risk assessment has been conducted under section 3.3 of this report.

Licence: L8008/2004/3

		groundwater/soils.						
		<p>Pathway:</p> <ul style="list-style-type: none"> Direct discharge to land - overtopping of TSF2 (combined stage 2 and stage 3 lift) <p>Impact:</p> <ul style="list-style-type: none"> Reduced quality or contamination of soil, and/or sediment. Reduced native vegetation health or native vegetation death, including threatened fauna habitat. 	<ul style="list-style-type: none"> Surface water bodies Remnant native vegetation Kwongkan shrublands TEC. Threatened fauna 	Refer to Section 3.1	<p>C = Moderate</p> <p>L = Possible</p> <p>Medium Risk</p>	N	<p>Condition 8 Freeboard requirement</p> <p>Condition 41</p> <p>Monitoring of water balance</p>	To mitigate risk risk to surface water bodies, Kwongkan shrublands TEC and Threatened fauna condition 41 has been added to require monitoring of TSF water balance.
	Stormwater contaminated with tailings	<p>Pathway:</p> <p>Direct discharge to land to soil and surface water via runoff during rainfall events.</p> <p>Impacts:</p> <ul style="list-style-type: none"> Contamination to soil and surface water bodies located in close proximity to the TSF2. Reduced quality of native vegetation impacting threatened fauna habitat 	<ul style="list-style-type: none"> Surface water – creek lines Remnant native vegetation Kwongkan woodlands TEC Threatened flora Threatened fauna 	Refer to Section 3.1	<p>C = Minor</p> <p>L = Unlikely</p> <p>Medium Risk</p>	N	<p>Condition 7</p> <p>Modified to include maintenance of stormwater infrastructure</p>	DWER has conditioned that the stormwater infrastructure as required by W6578/2021/1 for TSF2 be maintained.

<p>Source: Tailings and return water pipelines</p> <p>Activity: Transport of tailings and decant return water via pipelines between TSF and processing plant.</p>	<p>Tailings, supernatant (hypersaline water contaminated with enriched metals and metalloids e.g. cobalt, nickel and manganese), and/or contaminated stormwater</p> <p>Seepage 'daylighting'</p>	<p>Pathway:</p> <ul style="list-style-type: none"> Direct discharge to land and subsequent transport through the soil profile to groundwater from pipeline leak/rupture. <p>Impacts:</p> <ul style="list-style-type: none"> Contamination of soils and deterioration of groundwater quality inhibiting the survival of native vegetation. Conservation significant fauna gaining access to TSF2 may ingest decant return water or tailings affecting the health of the fauna species. Entrapment and drowning may also occur. Overland flow following a spill event may impact on surface water bodies if not properly contained. 	<ul style="list-style-type: none"> Surface water bodies - creek lines Groundwater Remnant native vegetation and associated fauna. 	<p>Refer to Section 3.1</p>	<p>C = Moderate L = Possible</p> <p>Medium Risk</p>	<p>Y</p>	<p>Condition 5 Pipeline telemetry, automatic cut outs or secondary containment</p> <p>Condition 9 Inspection of infrastructure</p> <p>Condition 35 Process monitoring</p>	<p>The Delegated Officer is satisfied that existing Licence conditions are sufficient to mitigate the risk associated with pipeline leak/rupture.</p>
<p>Source: Evaporation pond repairs</p>	<p>Supernatant (hypersaline water contaminated with enriched metals and</p>	<p>Pathway</p> <ul style="list-style-type: none"> Increased seepage of supernatant 	<ul style="list-style-type: none"> Land/Soil Groundwater Surface 	<p>Refer to Section 3.1</p>	<p>C = Moderate L = Possible</p>	<p>Y</p>	<p>Condition 4 Construction and operation of</p>	<p>The Delegated Officer is satisfied that existing Licence conditions are</p>

<p>Activities: Supernatant water and contaminated stormwater on TSF2 pumped via existing HDPE pipelines to the HDPE-lined EPs for storage</p>	<p>metalloids e.g. cobalt, nickel and manganese), and/or contaminated stormwater</p>	<p>and/or contaminated stormwater through base and walls of HDPE-lined EPs to soil, groundwater and root zone of vegetation</p> <ul style="list-style-type: none"> • Overtopping of EPs and direct discharge of supernatant and/or contaminated stormwater to land. <p>Impact</p> <ul style="list-style-type: none"> • Reduced quality or contamination of soil/sediment, groundwater and/or surface waters (creek lines) • Groundwater mounding • Poor Threatened/Priority flora and/or TEC health 	<p>waters - creek lines</p> <ul style="list-style-type: none"> • Kwongkan shrublands TEC • Remnant native vegetation and associated fauna. 		<p>Medium Risk</p>	<p>Evaporation ponds</p>	<p>sufficient.</p>
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Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk assessments* (DWER 2020).

Note 2: Proposed Works Licence Holder's controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.

3.3 Detailed risk assessment for seepage

Overview or risk event

The premises was in care and maintenance between October 2017 until early 2020. Tailings deposition into TSF2 commenced 30 May 2021.

This detailed risk assessment considers the potential for an increase in TSF2 seepage water containing enriched metals and metalloids following the stage 3 embankment raise.

Seepage of contaminated water through the base and embankments of TSF2 may result in the following:

- further groundwater mounding around TSF2;
- near surface seepage collecting within the toe drain surrounding the TSF2 perimeter and seepage collection, with potential to contribute to further groundwater mounding if the contaminated water is not continually removed from this infrastructure.

Key potential environmental impacts associated with the above aspects include:

- poor health or death of Threatened, Priority flora and Threatened Ecological Communities due to hypersaline water migrating into root zones;
- poor health or death of native vegetation can result in subsequent loss of transpiration drawdown, with potential to extend duration of high-water table conditions during which surface evaporation and accumulation of salts can occur over an extended period of time leading to surface scalding;
- overland runoff from scalded areas risks transport of salts, metals, and metalloids to downstream environments (Threatened, Priority flora and TECs and aquatic ecosystems in creek lines and the Jerdacuttup River system); and
- Salinization of shallow sub surfaces resulting in poor soil and sediment quality that can lead to complications with future mine rehabilitation works.

Source

Tailings Characterisation

The tailings being deposited into TFS2 comprise crushed and milled iron-rich lateritic materials that are pressure leached in sulphuric acid and treated with magnesium to assist in the nickel concentrate extraction process (Tetra Tech, 2021). The tailings mixture contains elevated concentrations of sulphate, magnesium, and calcium with an approximately neutral pH due to addition of limestone during the process. Since there is no pyrite in the ore, Ravensthorpe FQM indicate there are no concerns for acid rock drainage.

The processing plant uses seawater from the coast (approximately 42km west). The seawater used to wash the ore is considered hypersaline, resulting in tailings water having a high salinity.

In 2012 Golder undertook laboratory testing for tailings slurry liquor samples. Golder indicates that the residue slurry water samples were near neutral and hypersaline with elevated nickel (Ni), manganese (Mn) and cobalt (Co) concentrations. It was concluded that salinity, and soluble forms of Ni, Mn, and Co were the main concerns for process-residue management. The soluble forms of Ni, Mn and Co have implications for leachate-seepage control and are summarised below in Table 5. The department notes that the tailings liquor is elevated in sulphate, with a returned range between 91.6 – 116.8 m/L in the 2012 tailings liquor.

Table 5. Geochemical analysis of tailings liquor (Golder, 2012)

Parameter	Unit	Value
pH	pH	6.76 – 7.15
Specific Gravity	-	1.136 – 1.157
Al	mg/L	<0.001
As	g/L	< 0.01
Ca	g/L	0.54 – 0.60
Co	g/L	0.002
Cr	g/L	< 0.001
Cu	g/L	< 0.01
Fe	g/L	0.004 – 0.011
K	g/L	0.12 – 0.14
Mg	g/L	27.82 – 32.48
Mn	g/L	0.07 – 0.14
Na	g/L	9.52 – 10.95
Ni	g/L	0.074 – 0.101
SO₄	g/L	91.6 – 116.8
Si	g/L	0.04 – 0.05
Zn	g/L	< 0.01 – 0.02

Table 1 in Appendix 2: Groundwater monitoring infrastructure arrangement provides a summary of key physical characteristics of the tailings, consistent with values reported in previous submissions to the regulatory authorities. The tailings were classified in 2017 as a clayey silt with a high percentage of fines (~92%), a low clay size fraction (~8%) and an average specific gravity of 2.77. The design tailings in situ dry density were 0.9t/m³. The tailings are classified as high plasticity silt (MH) with clay content between 8% and 13%, in accordance with actioned *Australian Standard: Geotechnical site Investigations 1726:2017*. The tailings are reported to have approximately 35% solids to liquid component.

Estimated Seepage.

A TSF water balance review was undertaken for the 2021 reporting period (Tetra 2022). The estimated annual average water return as a percentage of slurry water inflow for the period was approximately 26.33% and is presented in Table 6 below.

Table 6. TSF water balance

Inflows (m ³)		Outflows (m ³)	
Slurry water	4,259,820	Return water	1,121,518
Rainfall	1,921,444	Evaporation	1,709,817
		Seepage	659,746
		Held in tailings	2,690,183
Total inflow	6,181,264	Total outflow	6,181,264

In 2012¹ Golder (Golder a 2021) conducted seepage modelling for the Licence Holder. A two-dimensional finite-element model was used to predict seepage under two different hydraulic

¹ DWER notes that this is an old seepage model and has included these predictions for comparisons with actual data subsequently recorded.

conductivity scenarios²:

The seepage estimates were fed into a regional scale finite-difference groundwater flow model to demonstrate the implications of seepage for both groundwater levels and potential transport of magnesium sulphate. The regional scale groundwater flow model was run from 2012 to 2100, with tailings deposition ceasing in 2029. Figure 4 below shows the model predictions for magnesium and sulphate concentration in 2029 and Figure 5 shows the actual April 2022 data recorded from monitoring.

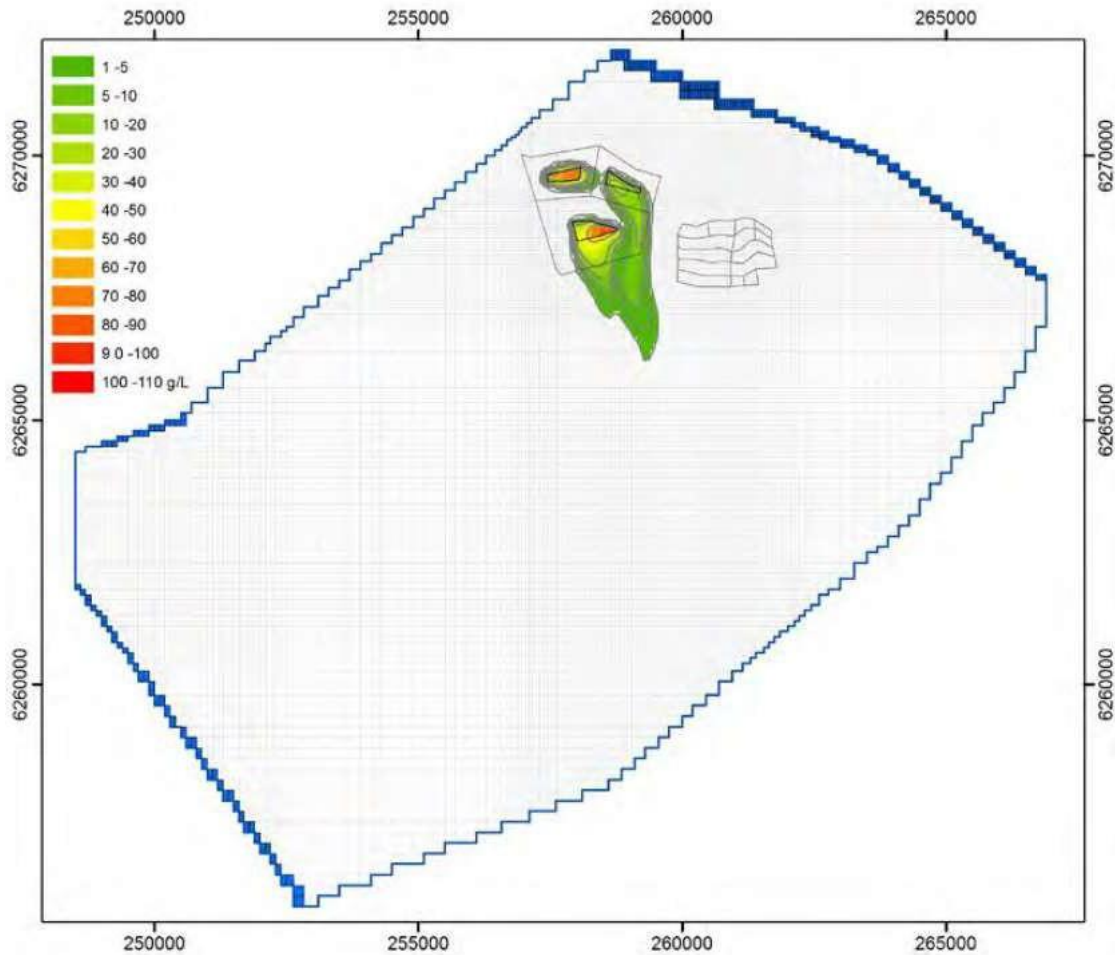


Figure 4: Magnesium and Sulphate (combined total concentration) Predicted Plume Concentration (g/L) for Scenario 2, 2029.

² Worst-case scenario with an initial vertical hydraulic conductivity of $K_y = 5 \times 10^{-7}$ m/s, decreasing to $K_y = 5 \times 10^{-8}$ m/s to represent tailings consolidation. The more likely scenario with an initial $K_y = 5 \times 10^{-9}$ m/s, decreasing to $K_y = 5 \times 10^{-10}$ m/s.

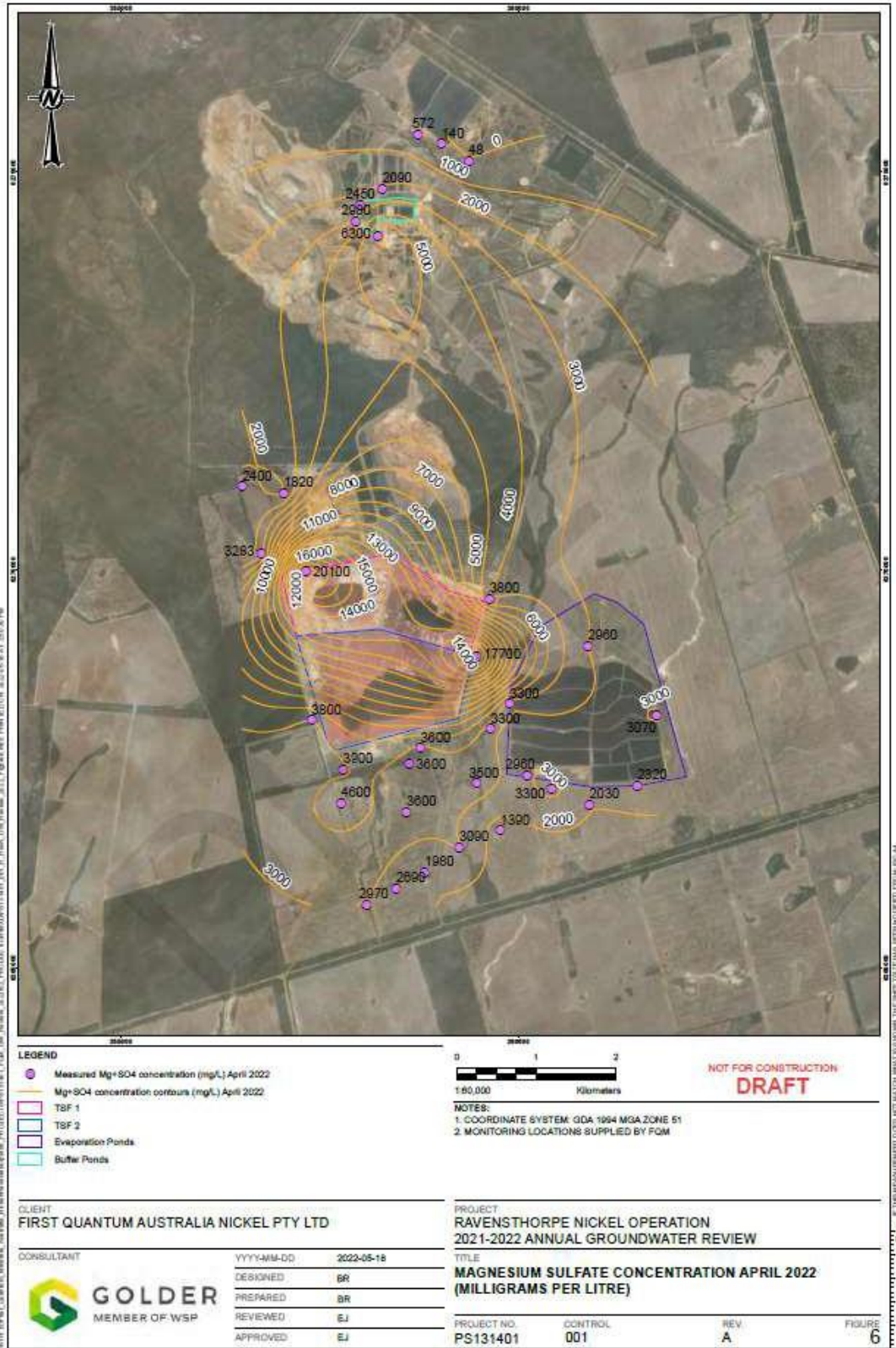


Figure 5: Magnesium Sulphate Concentration April 2022 (actual)

The “likely case” seepage prediction suggested that the magnesium and sulphate plume in Figure 4 would migrate south. Monitoring undertaken in 2022 confirms that the plume is migrating south. Figure 6 shows magnesium sulphate levels recorded in the southern monitoring wells. DWER notes a drop in magnesium sulfate levels during the period the premises was in care and maintenance.

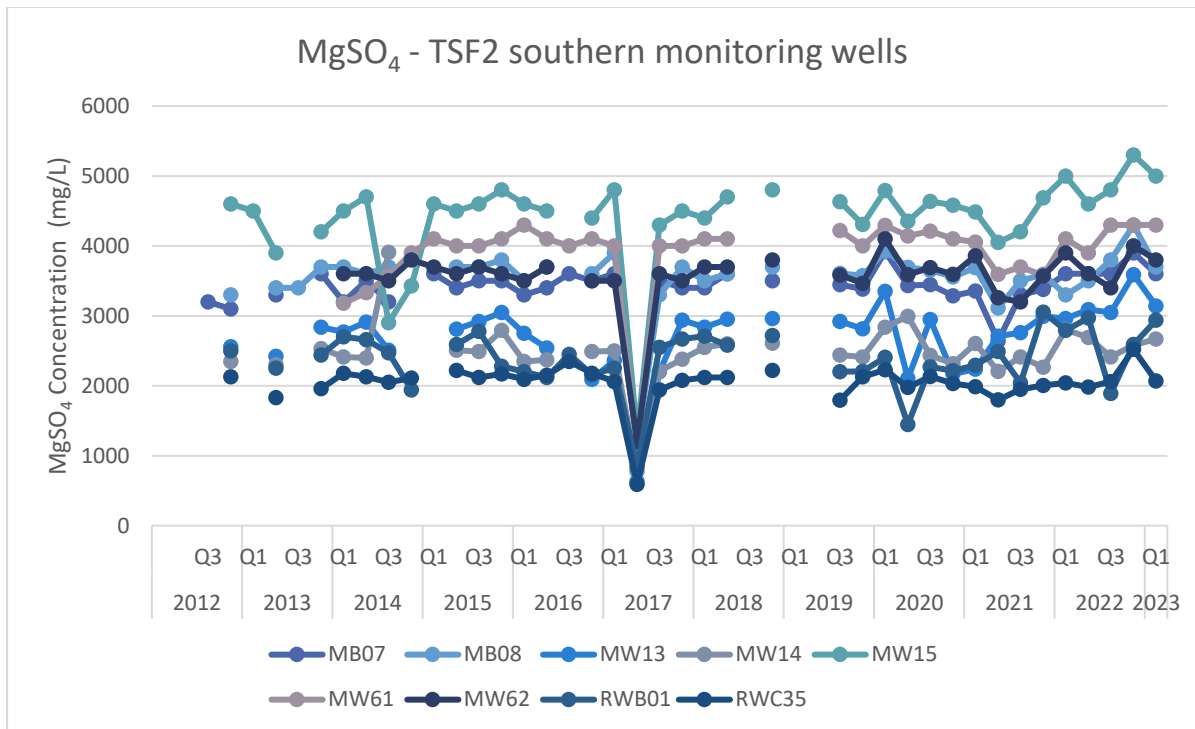


Figure 6 – Magnesium sulphate levels in the southern monitoring wells

Pathway

Hydrogeology

The area underneath TSF2 is characterised as low permeability rock, overlain and in-filled with deposits of clay, silt and sand with a series of interconnected local aquifers where groundwater resources occur within the overall low permeability ground mass. Local aquifers occur in fractured basement, sandy deposits occurring along paleochannels and some shallow patches of sand and alluvium (Golder 2021b).

The low permeability means that there is little active groundwater recharge and groundwater slowly flows to the southeast and discharges to permanent pools in the Jerdacuttup River and surrounding rivers and lakes in the coastal zone.

Groundwater levels

Groundwater levels have been measured quarterly at Ravensthorpe as per the Licence conditions since 2008. Appendix 4: Standing water level (SWL) line graphs shows that the standing water levels (SWL) surrounding TSF2 began to rise in January 2014 following the expansion of the TSF in 2013. In a technical memorandum dated 21 December 2022, the applicant's consultant, Golder, advised that:

- the rising groundwater could be attributed to TSF2 as the groundwater contours indicate that the general flow of groundwater in the area is from north to south; and
- that groundwater levels may reach 4 metres below ground level (mbgl) in June 2023 if the current rate of groundwater elevation increase continues (Golder 2022c).

The most recent rise in standing water levels (SWLs) west, east and south of TSF2 appears to coincide with the deposition of tailings into TSF2. As of January 2023, the shallowest groundwater levels were recorded immediately south of TSF2 with 4.5 mbgl at MB62 and 5.8 mbgl at monitoring well RWC42.

Monitoring of groundwater quality

According to DWER Geocortex, groundwater at the premises is considered saline to highly saline at 7,000 to 14,000 mg/L Total Dissolved Solids (TDS) with potential to impact native vegetation health if groundwater becomes shallow enough to reach root zones. Appendix 5: Electrical conductivity (EC) line graphs provides graphs to demonstrate the trends in groundwater monitoring wells surrounding TSF2.

During the most recent reporting period, groundwater pH levels ranged between 5.9 and 7.1 and remains relatively steady as compared with historical records. (FQMe). Most groundwater monitoring bores to the south of TSF 2 recorded metal concentrations generally below 0.1 mg/L, except for iron, aluminium, manganese, and nickel which are generally between 0.1 mg/L to 5 mg/L. Appendix 6: SWL and Ni concentration – TSF2 eastern monitoring wells demonstrates elevated nickel concentrations in groundwater monitoring wells located east of TSF2 (MB04 and MB63).

All groundwater chemical parameters for the Southern bores are within the historical ranges for respective parameter concentrations.

Proposed and existing seepage management and monitoring

Tailings are currently deposited sub-aerially along the perimeter embankment through 280 mm diameter spigot outlets at 60 m intervals that are sequentially opened in a cyclical manner around the facility. Tailings slurry is transported from the process plant to TSF 2 via a high-density Polyethylene (HDPE) pipeline from the process plant. Tailings slurry is to be delivered to the facility at a solids concentration of approximately 35%. (Golder 2021a)

TSF 2 was constructed to allow for normal operating decant pond equivalent to approximately 10% of the tailings beach area. The target decant pond size is achieved through the existing decant return water system that is used during operation which comprises turret pumps connected to the pumps suction hose. The maximum allowable decant pond in the facility (for a short period) is 20% of the tailings beach area.

Under W6578/2021/1, the applicant installed a seepage collection system plus additional monitoring and recovery bores as controls for managing seepage impacts and rising groundwater levels.

The applicant has committed to the following controls, which are noted in Table 7, as well as those conditioned as part of Works Approval W6578/2021/1 to manage seepage from TSF 2 include:

- A seepage collection system, comprising a collection trench along a section of the southern embankment and a collection sump, has been constructed. The trench varies in depth between ~1 m and ~3 m and grades towards the collection sump area near the south-west corner of TSF2. The collected seepage water is pumped to the evaporation ponds.
- Four new monitoring bores (MB64, MB65, MB66 and MB67), located to the west and southwest of TSF 2, will be installed to capture changes in groundwater levels and chemistry. In order to address the potential migration of magnesium sulphate the applicant has positioned MB64 downstream. The positioning of MB65 is to monitor seepage from the southeastern corner of TSF 2 and well as to aid in monitoring drawdown effects in the recovery bores.
- Two recovery bores (TSFRB01 and TSFRB02). The locations of the recovery bores are to the south of TSF 2 where existing TSF monitoring bores are showing an increasing trend in SWL's. These bores were intended to pump out mounding groundwater at an estimated maximum pumping rate of 5 L/s to reduce the rate of rising groundwater levels. The locations of the newly installed seepage recovery bores were selected following a geophysics assessment of the area downstream of TSF 2 (Golder 2022d).

In January 2023, the applicant advised that their consultant had provided preliminary indication

that the two newly installed seepage recovery bores (TSFRB01 and TSFB02) will not be effective in the management of the local groundwater table as the airlift yields are around the 0.1 to 0.2 L/s. Advice from Golder (Golder 2022d) was that drilling of additional recovery bores in the nearby vicinity of TSF 2 will not achieve desired results as the low yielding lithology remains similar throughout the local area (Golder 2022d).

Considering the above, the applicant is also investigating the below alternative groundwater recovery strategies:

- installing two additional seepage recovery bores and part of the stage 4 and 5 embankment lifts (GWR 01 and GWR 02), in between the recently installed seepage recovery bores (TSFRB01 and TSFB02). These additional seepage recovery bores are proposed to be installed within the vicinities of MB62 and RWC42, where the shallowest groundwater levels have been observed; and
- the applicant may install either one or two additional groundwater and seepage interception trenches. This infrastructure is likely to be installed if the four seepage recovery bores do not prove successful in reducing the rate of groundwater rise within monitoring bores MB62 and RWC42 (Golder 2022b).

DWER assessment and additional regulatory controls

The Delegated Officer considers the overall risk rating impacts of seepage to adjacent the adjacent TEC and priority flora to be “High”. This is because:

- the consequence rating for impacts from seepage are considered “Moderate”, given the salinity of the seepage, elevated sulfate concentrations and proximity between TSF 2 and the closest receptors;
- the likelihood is considered as “likely” as:
 - groundwater in the vicinity of the TSF is shallow, and as the December 2022 technical memorandum by Golder predicts that groundwater levels are likely to reach 4 mbgl by June 2023,
 - Monitoring bores that are located directly adjacent to remnant native vegetation (mapped as the Kwongkan shrublands TEC) to the south (MB61, MB62 and RWC42) and to the west (MB60) have recorded significant increases in groundwater levels and are likely to continue to increase.
 - The shallowest groundwater levels were recorded immediately south of TSF 2 with 4.5 mbgl at MB62 and 5.8 mbgl at RWC42. An increase in seepage could impact root zones (<6 mbgl) of the adjacent native vegetation resulting in plant stress or death.

Therefore, the following additional regulatory controls will be placed on the licence.

Table 7: Additional regulatory controls

Condition/Control	Justification
<p>Construction of additional seepage recovery infrastructure</p> <p>Condition 2 – construction of additional seepage recovery bores GWR01 and GWR02</p> <p>Condition 17 – requirement for installation of additional seepage recovery infrastructure</p>	<p>Seepage levels are already reaching 4.5 mbgl and are likely to increase to 4 mbgl and current seepage management (including recent additions as part of W6578/2021/1) does not appear to be effective at reducing groundwater mounding. This poses a risk to adjacent native vegetation. The Delegated Officer has consequently conditioned applicant proposed GWR01 and GWR02 recovery bores. Additionally, given the low yields of TSFRB01 and TSFRB02, the Delegated Officer is also conditioning a requirement for additional “seepage recovery infrastructure” which may include</p>

Condition/Control	Justification
	provision for other types of seepage management infrastructure (other than recovery bores).
On-going operation of seepage interception trench and recovery bores Condition 18 – operation of seepage interception trench and recovery bores	As the seepage recovery trench and seepage recovery bores have been installed as part of works approval W6578/2021/1, their on-going operation will be conditioned within the Licence.
Ambient environmental quality monitoring Modification to condition 36 – standing water level limit and trigger for management action Condition 37 – seepage management in the event of a standing water level or trigger level breach	For on-going management and monitoring, the Delegated Officer has also placed standing water level triggers for management action and limits on the licence, with an associated requirement for management actions if exceeded. The Delegated Officer notes that these limits are currently being breached and has consequently conditioned additional seepage recovery bore infrastructure as detailed above, in order to bring water levels back to an acceptable range.
Water balance monitoring Condition 41 – water balance monitoring	To gain a better understanding of water balance and seepage occurring on-site, a requirement for monitoring and reporting the monthly water balance have been conditioned on the Licence.
Modifications to reporting Condition 45 – Annual Environmental Requirements	To allow an appropriate assessment of monitoring undertaken at the site, the annual environmental reporting condition has been updated. This will help to ensure monitoring data is submitted in the appropriate format, with QAQC information and trend graphs etc.

4. Consultation

Table 8 provides a summary of the consultation undertaken by the department.

Table 8: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website	None received	N/A
Local Government Authority advised of proposal on 12 December 2022	None received	N/A
Department of Mines, Industry Regulation and Safety (DMIRS) advised of proposal on date 12 December 2022	None received	N/A
Applicant was provided with draft documents on 25 July 2023	FQM provided comments to the Department on 18/08/2023	Appendix 1: Summary of Licence Holder's comments on

		risk assessment and draft conditions
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5. Conclusion

Based on the assessment in this Amendment Report, the Delegated Officer has determined that a Revised Licence will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

5.1 Summary of amendments

Table 9 provides a summary of the proposed amendments and will act as record of implemented changes. All proposed changes have been incorporated into the Revised Licence as part of the amendment process.

Table 9: Summary of Licence amendments

Condition no.	Proposed amendments
All Conditions	All condition numbers updated
2	Construction of groundwater monitoring wells to be added to the Licence
3	Construction compliance reporting for groundwater monitoring wells
4	Repairs to Evaporation ponds requirements
6	Tailings permitted to be deposited into TSF2
Condition 7, Table 4	Containment Infrastructure (Table 4) has been updated with new names and locations as requested in the post inspection report.
Former condition 1.3.7 - Table 1.3.4	Removal of construction requirements for the embankment raise to TSF 1 and 2 (already completed)
Condition 9, Table 5	Inspection of Infrastructure (Table 5) updated to include freeboard markers used to confirm specific freeboards
Condition 11, Table 6	Stage 2 + 3 changed from upstream to downstream construction with addition of operating and construction height.
17	Seepage recovery infrastructure requirements
Condition 18 and Table 7	Operational requirements for seepage recovery bores
Condition 36, Table 15	TSFs and monitoring bores standing water level. Addition of 6 m bgl trigger level and 4 m bgl limit for standing water level. Monitoring bores added to table
37	Standing water level exceedance and seepage management plan
41	Water balance monitoring requirements
42	Removal of "except for records listed in 5.1.1(d)"
Condition 45, Table 17	Updated to include Table 13 and condition 43
Former condition 4.2.2	Removal of condition to update requirements

46	Updated annual environmental report requirements
48	Added for compliance for each stage

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2. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
3. Department of Mines and Petroleum (2013) *Tailings storage facilities in Western Australia – code of practice*. Perth, Western Australia.
4. Department of Mines and Petroleum (2015) *Guide to the Preparation of a Design Report for Tailings Storage Facilities (TSFs)*. Perth, Western Australia.
5. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
6. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
7. Environmental Protection Authority (EPA) 2018, *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual*, Environmental Protection Authority, Perth, WA.
8. FQM Australia Nickel (FQM) 2018, *Ravensthorpe Nickel Operations: 2017 Annual Environmental Report*, Perth, Western Australia.
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13. FQM Australia Nickel (FQM) 2023, *Request for further information response*. Ravensthorpe, Western Australia.
14. Golder Associated Pty Ltd (Golder d) 2022, *Technical Memorandum, RNO TSF2 Groundwater Level Management Concept Design*, Perth, Western Australia.
15. Golder Associates Pty Ltd (Golder a) 2021, *Mining Proposal – Ravensthorpe Nickel Operation: Tailings Storage Facility 2 Stage 3 Raise*. Ravensthorpe, Western Australia.
16. Golder Associates Pty Ltd (Golder b) 2021, *Ravensthorpe – Tailings Storage Facility No. 2 Stages 2 & 3 Development*, Ravensthorpe, Western Australia.
17. Golder Associates Pty Ltd (Golder c) 2022. DWER *Licence amendment application – Ravensthorpe Nickel Operations – Tailings Storage Facility 2 combined Stage 2 and 3 (Stage 3) embankment raise*. Ravensthorpe, Australia.
18. Snooks & Co 2002, *Style Manual for Authors, 6th Edn*, John Wiley & Sons Australia Ltd, Brisbane.
19. Tetra Tech Coffey (Tetra) 2022. *Ravensthorpe Nickel Tailings Storage Facilities and Evaporation Ponds Audit and Management Review 2021*. Perth, Australia.

Appendix 1: Summary of Licence Holder's comments on risk assessment and draft conditions

Condition	Summary of Licence Holder's comment	Department's response
2	Requested the wording "wells must be constructed with a screened interval from the water table to a depth of 2 m below the water table and 1 meter above the water table" be changed to "to be constructed as per design submitted in Technical Specification Report RNO TSF 2 Groundwater Recovery Well, project no. 21493687-017-S-Rev0"	Accepted by the Department
3	Change the wording from "production bores being constructed" to "production bores being completed"	Accepted by the Department
6	Licence Holder wishes to deposit sulphur, lime and magnesium oxide into TSF2	Denied by the Department as the requested change would require an amended risk assessment. The Licence Holder will submit a new licence amendment application.
17	The identification, investigation and installation of additional seepage recovery infrastructure will be ongoing. Can this timeframe be changed to 12 months from amendment for the first additional seepage recovery trench, i.e. Halley's Dam 2? Confirmation on development envelope change, tenement application and DMIRS approval outstanding	

Appendix 2: Groundwater monitoring infrastructure arrangement

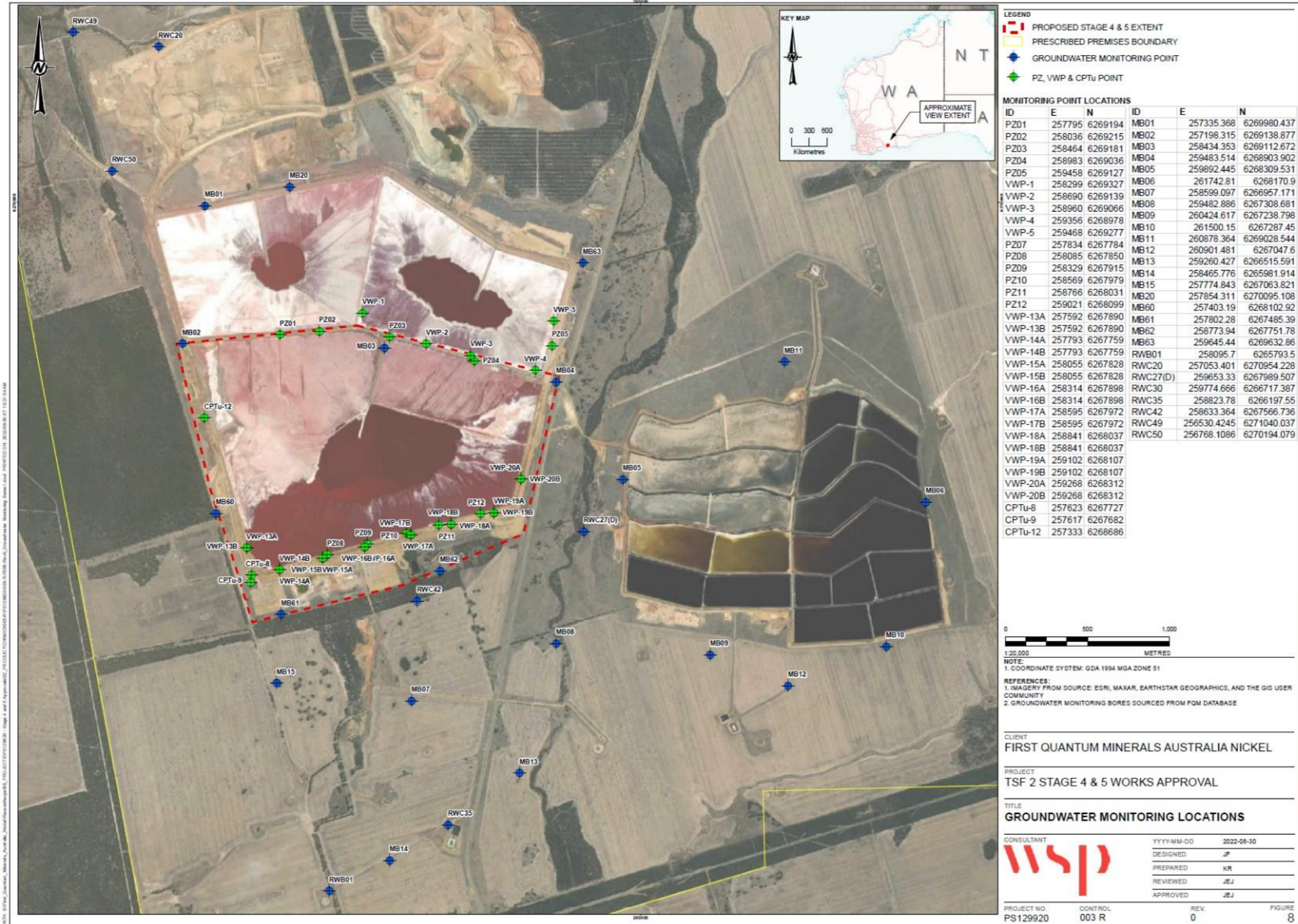


Figure 7: Map demonstrating location of groundwater monitoring infrastructure (groundwater monitoring wells and vibrating wire piezometers (VWP))

Appendix 3: Seepage recovery arrangement

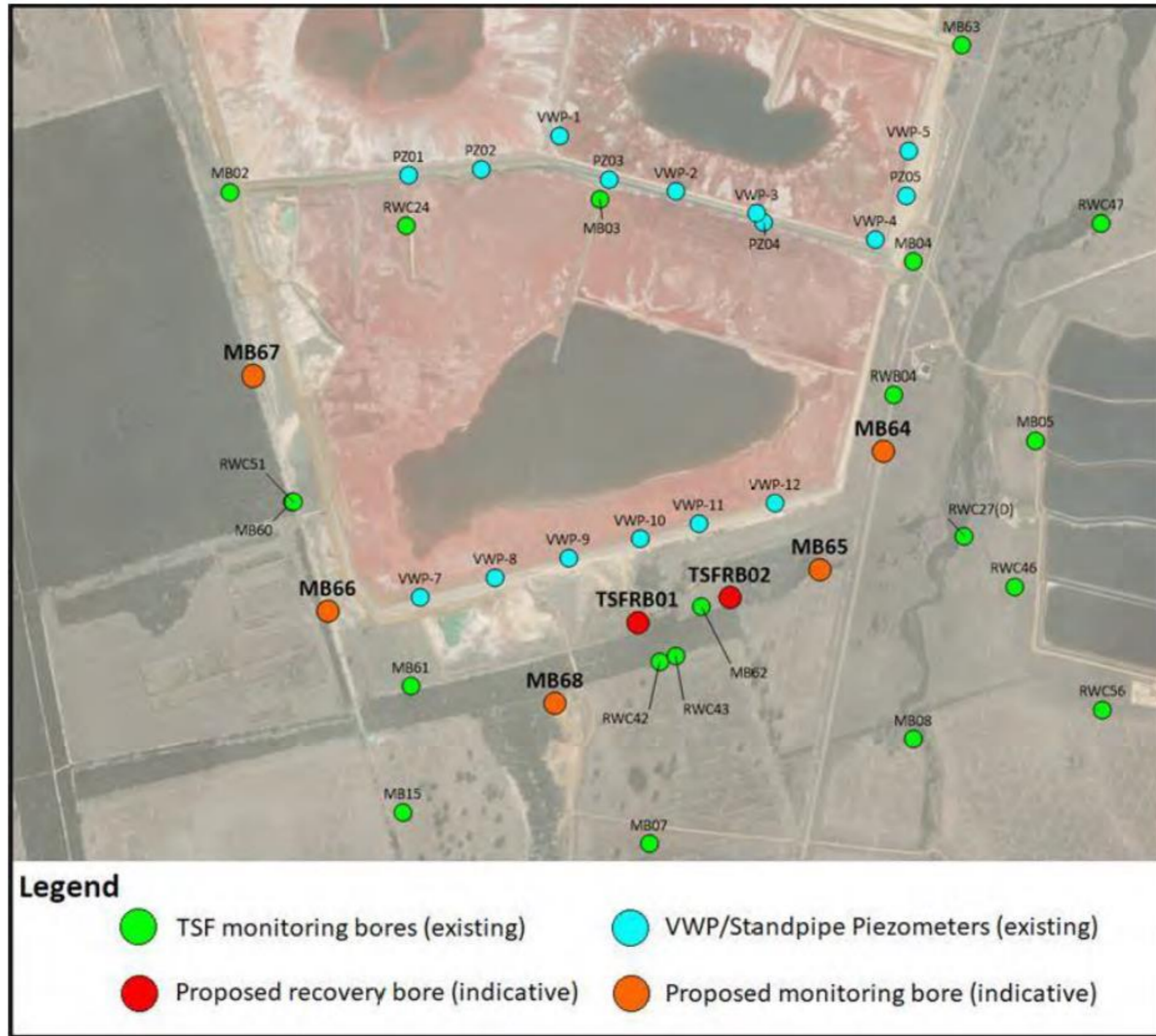


Figure 8: Map demonstrating location of newly installed seepage recovery bores

Appendix 4: Standing water level (SWL) line graphs

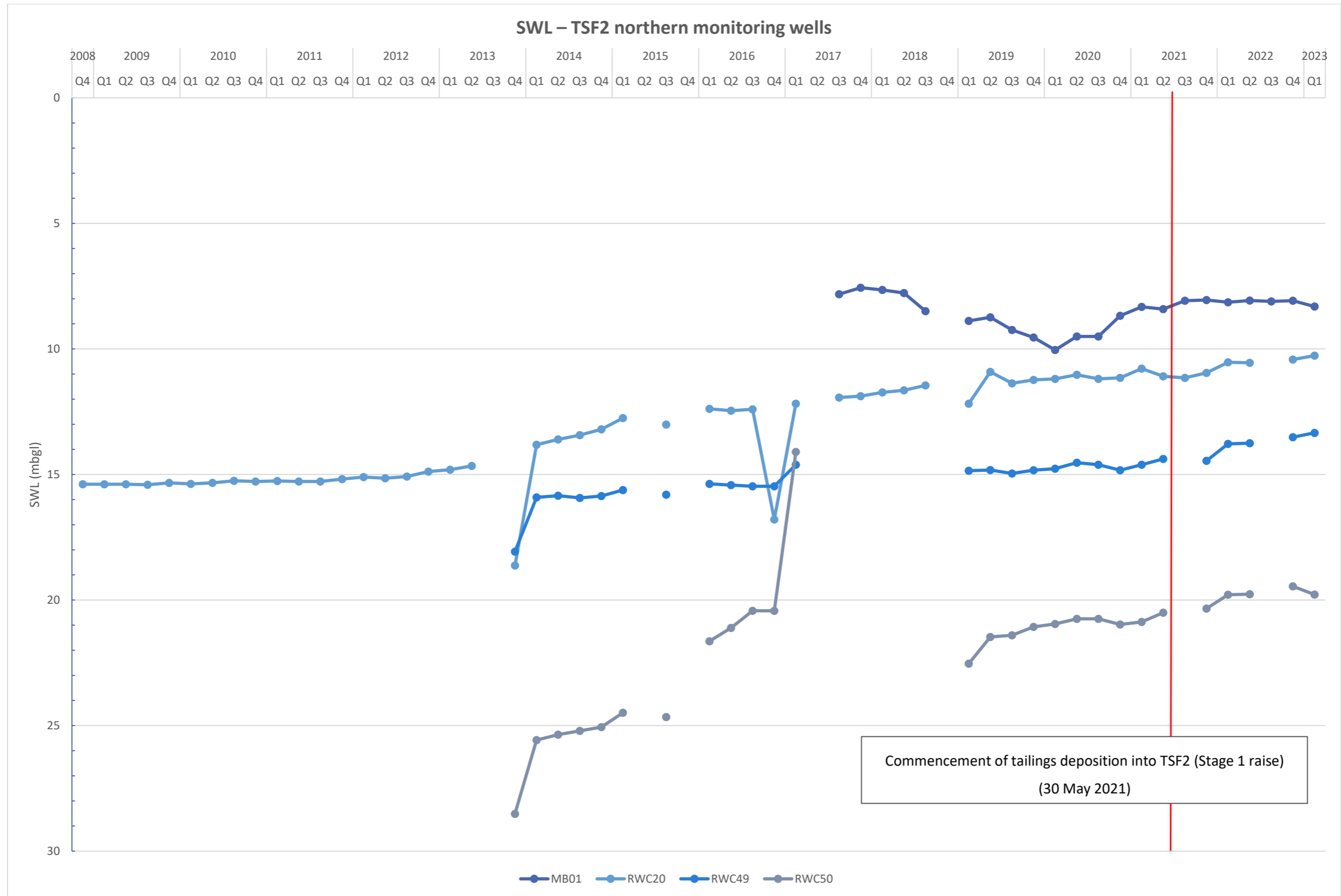


Figure 9: SWL – TSF2 northern monitoring wells

Licence: L8008/2004/3

IR-T13 Decision report template (short) v3.0 (May 2021)

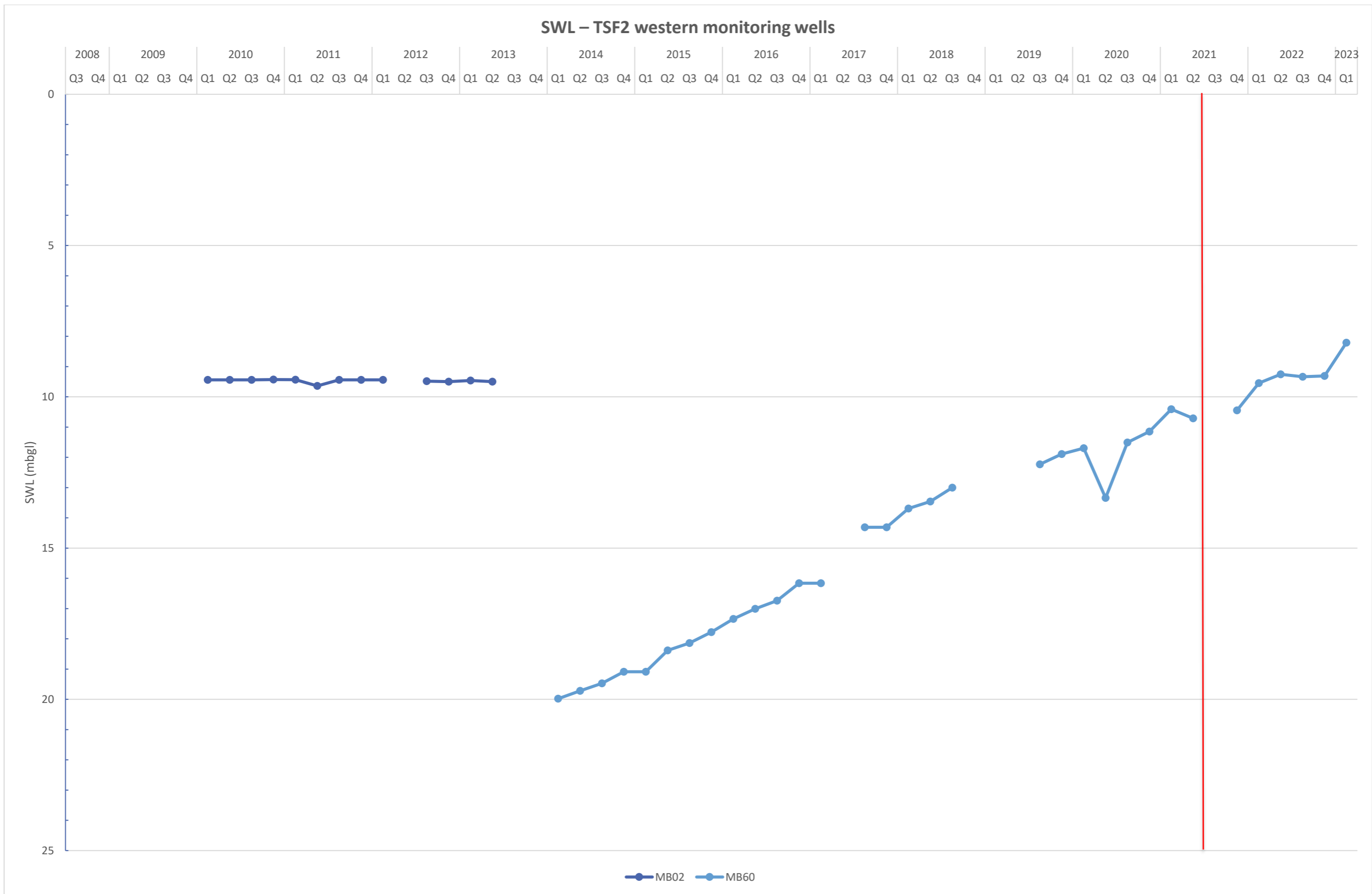


Figure 10: SWL – TSF2 western monitoring wells

Licence: L8008/2004/3

IR-T13 Decision report template (short) v3.0 (May 2021)

SWL – TSF2 southern monitoring wells

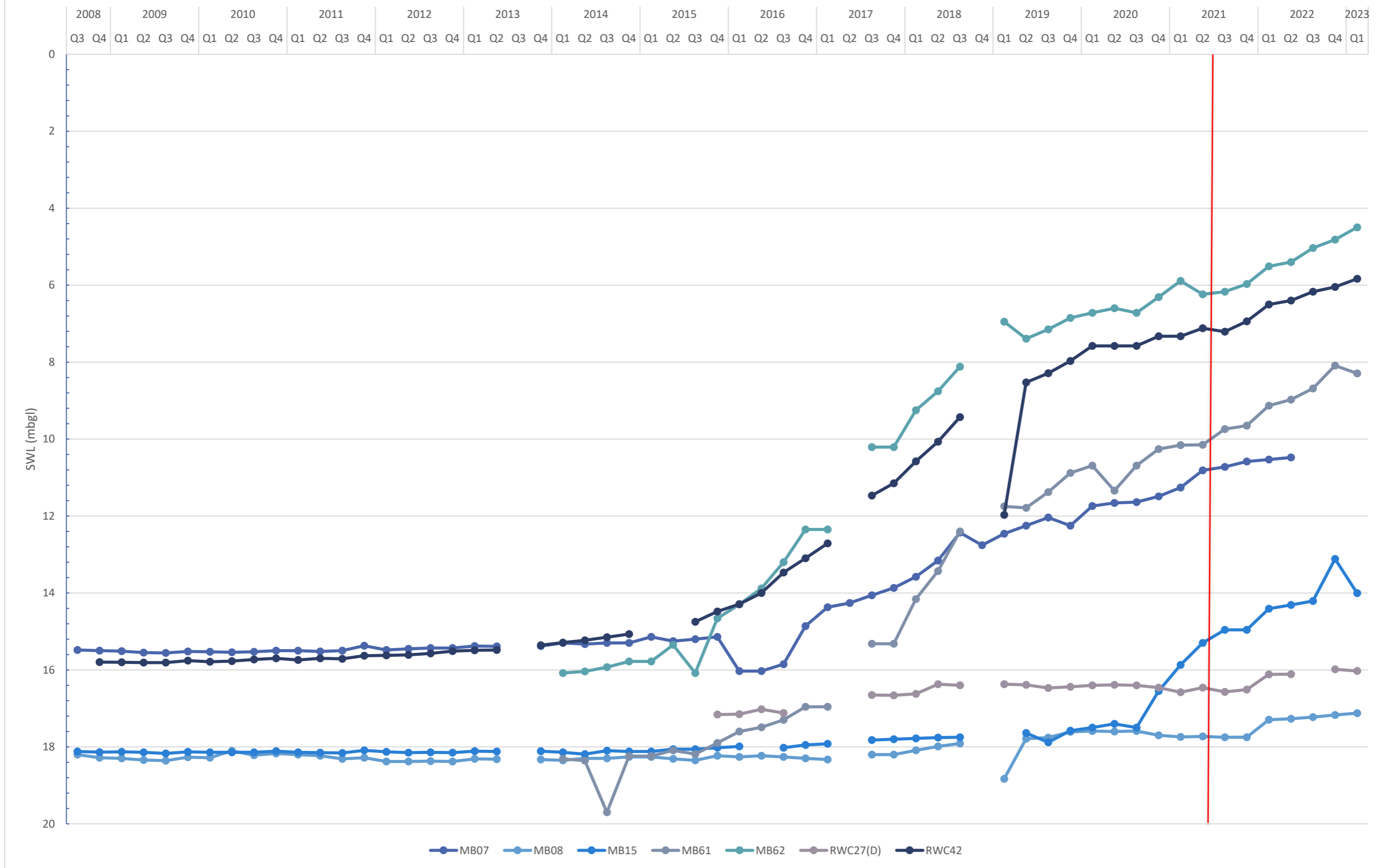


Figure 12: SWL – TSF2 southern monitoring wells

SWL – EP monitoring wells

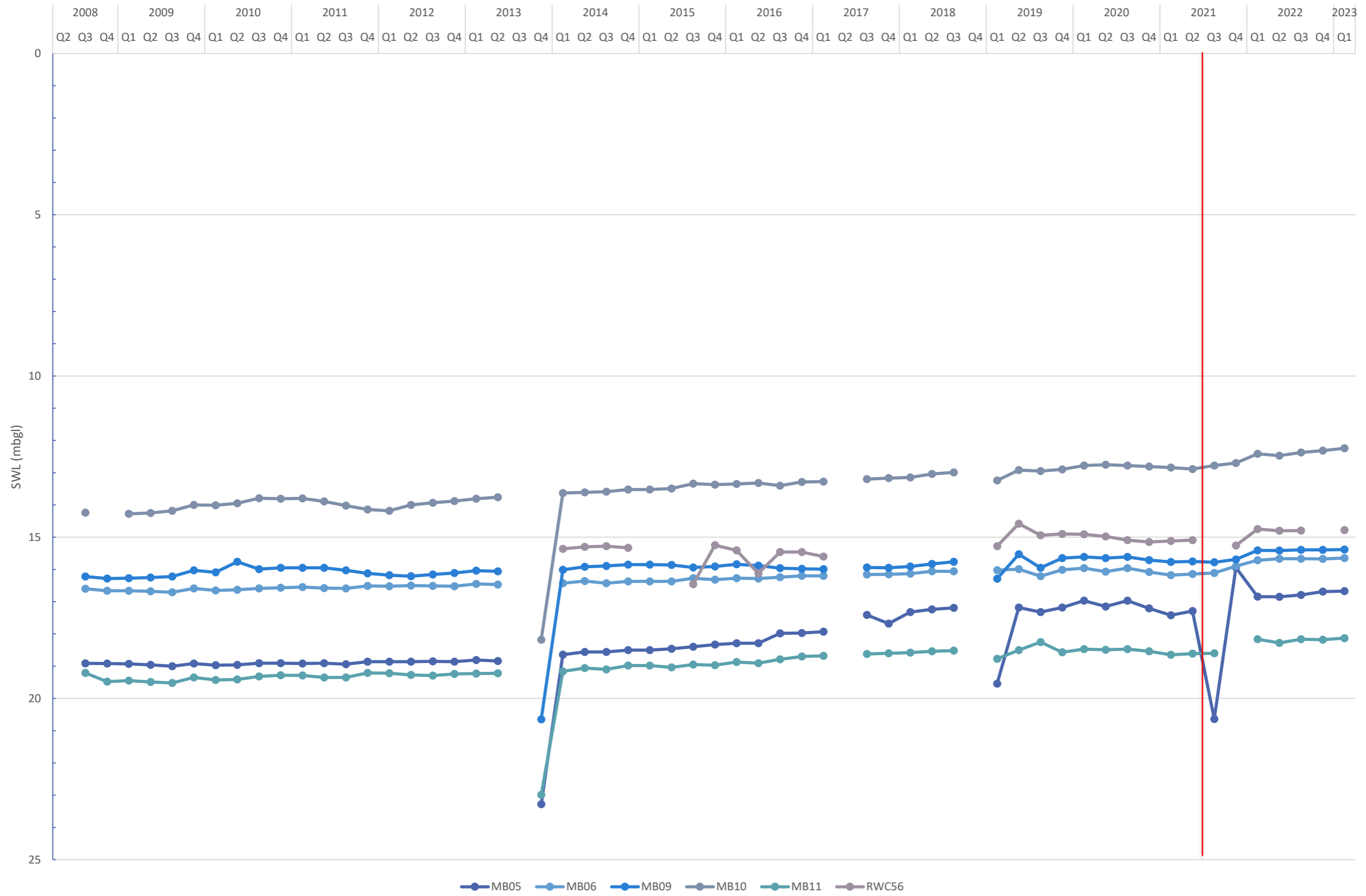


Figure 13: SWL – EP monitoring wells

Licence: L8008/2004/3

IR-T13 Decision report template (short) v3.0 (May 2021)

SWL – Monitoring wells downstream of TSF2 and EPs



Figure 14: SWL – monitoring wells downstream of TSF2 and EPs

Appendix 5: Electrical conductivity (EC) line graphs

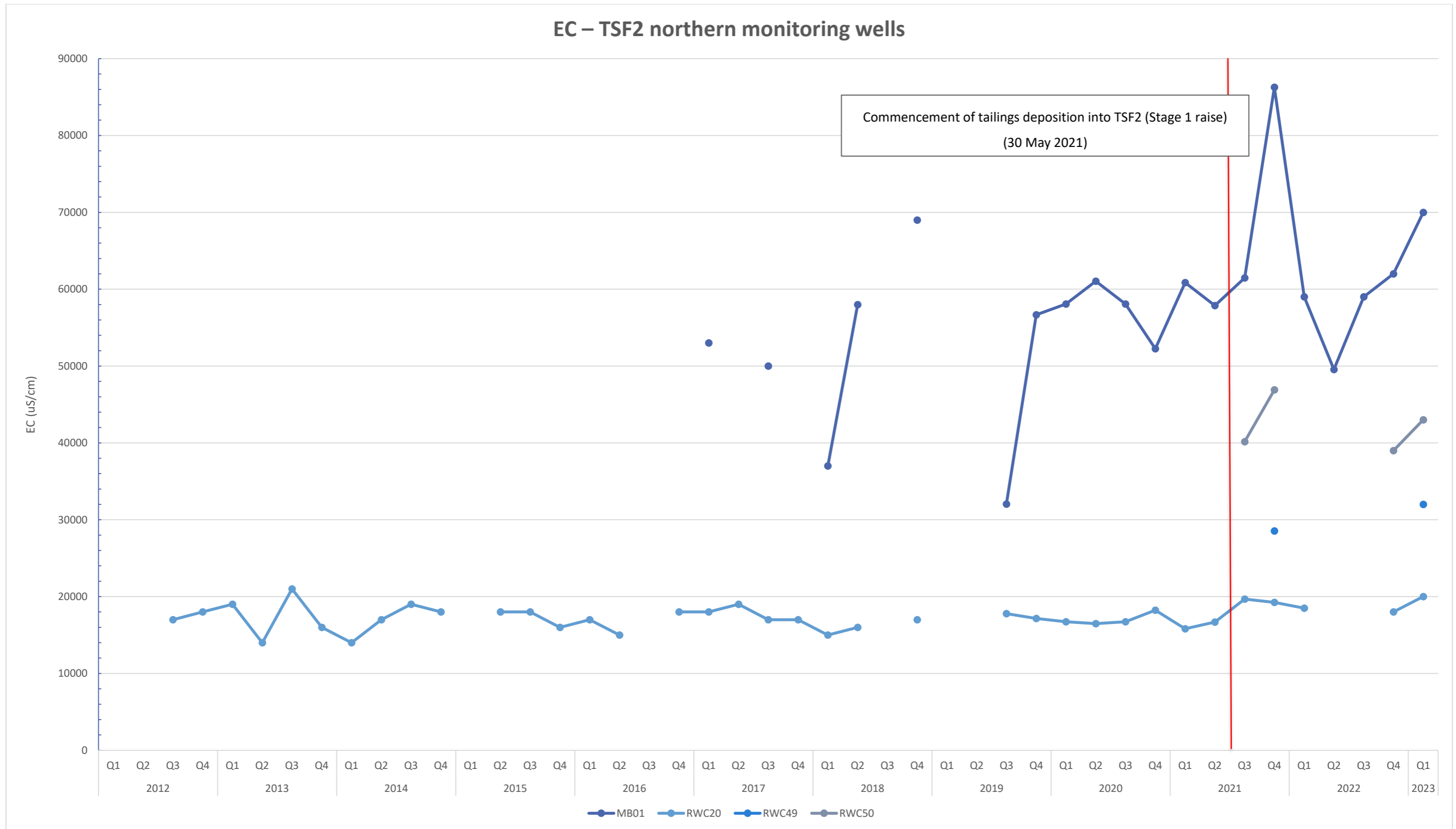


Figure 15: EC – TSF2 northern monitoring wells

EC – TSF2 western monitoring well

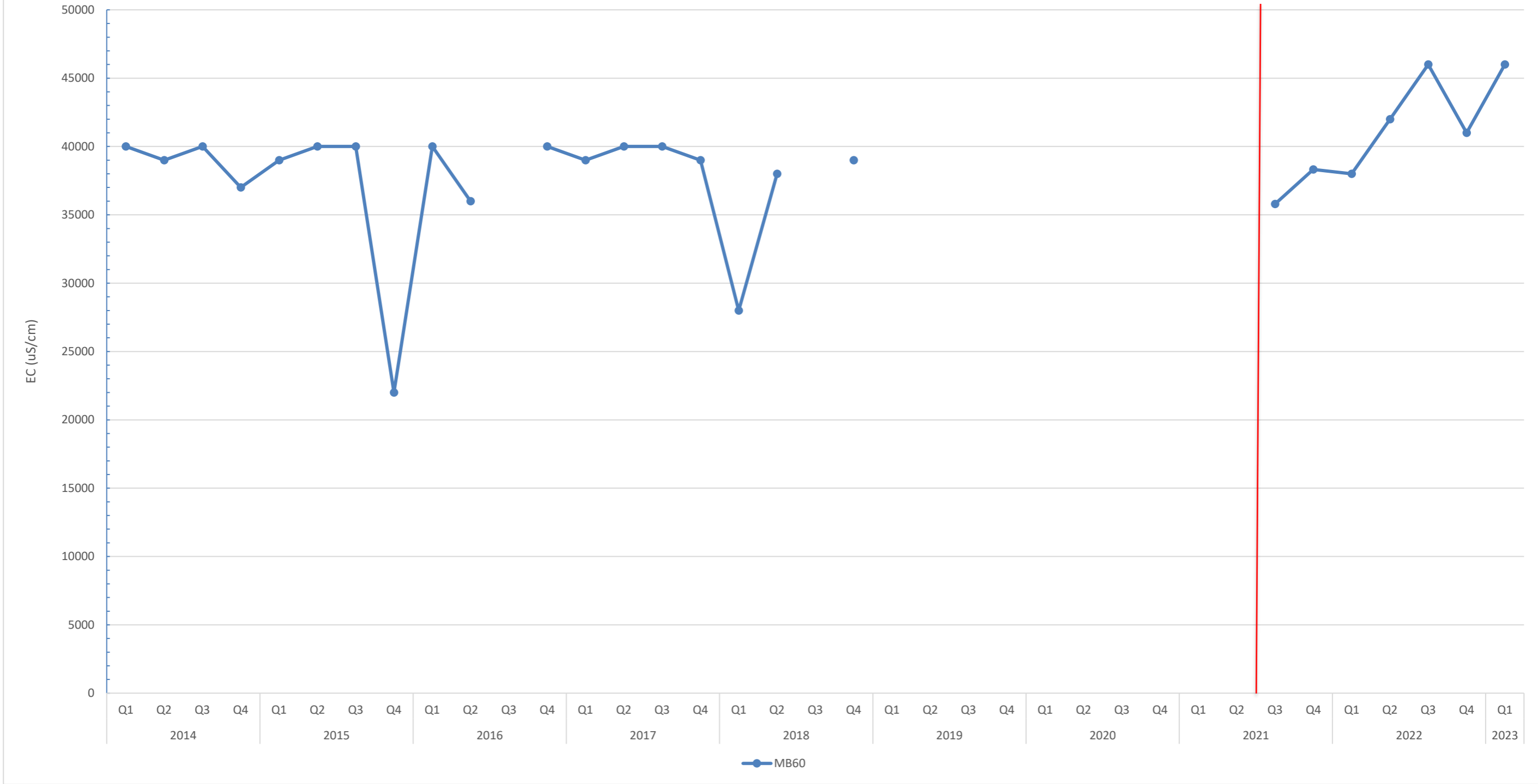


Figure 16: EC – TSF2 western monitoring well

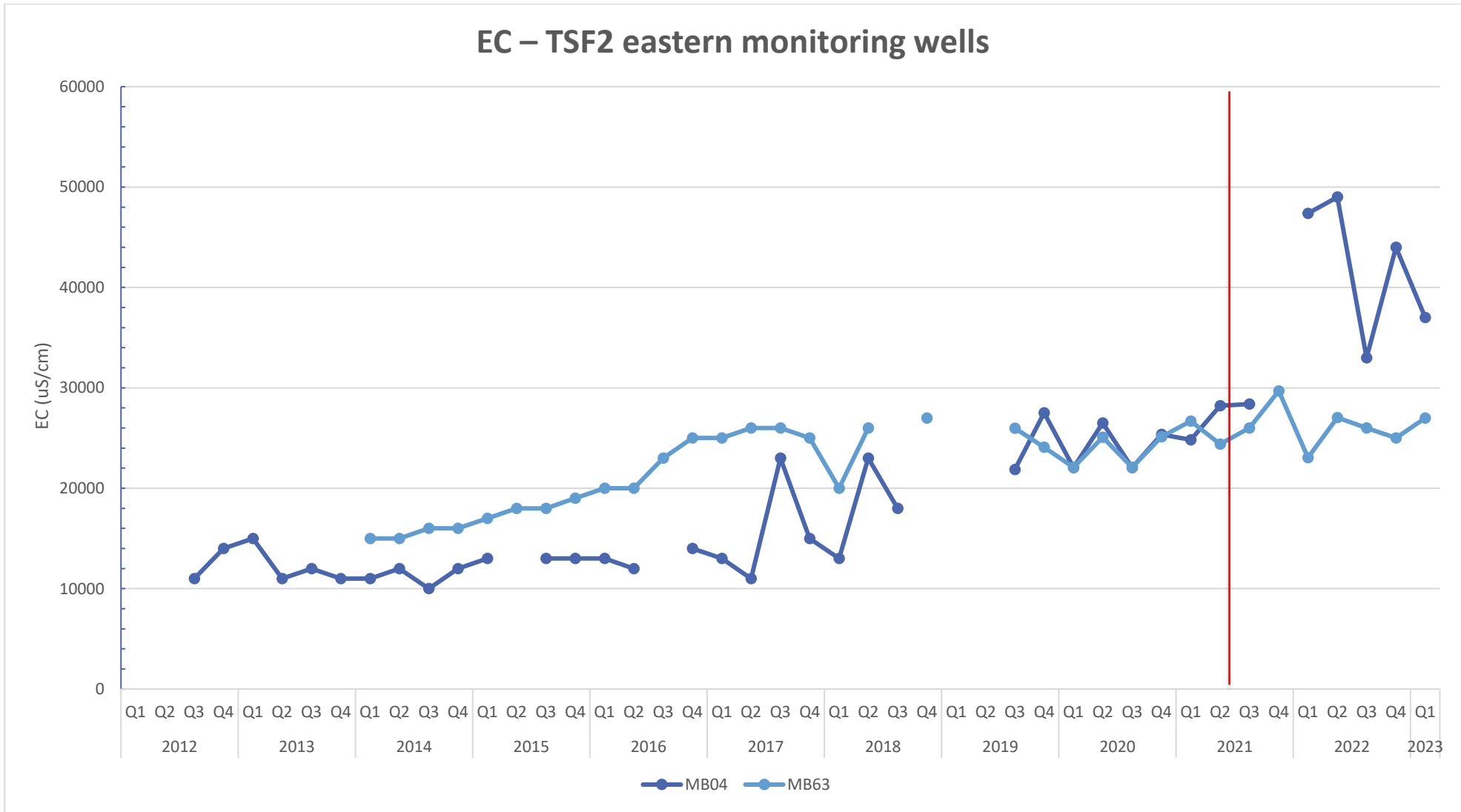


Figure 17: EC – TSF2 eastern monitoring wells

Licence: L8008/2004/3

IR-T13 Decision report template (short) v3.0 (May 2021)

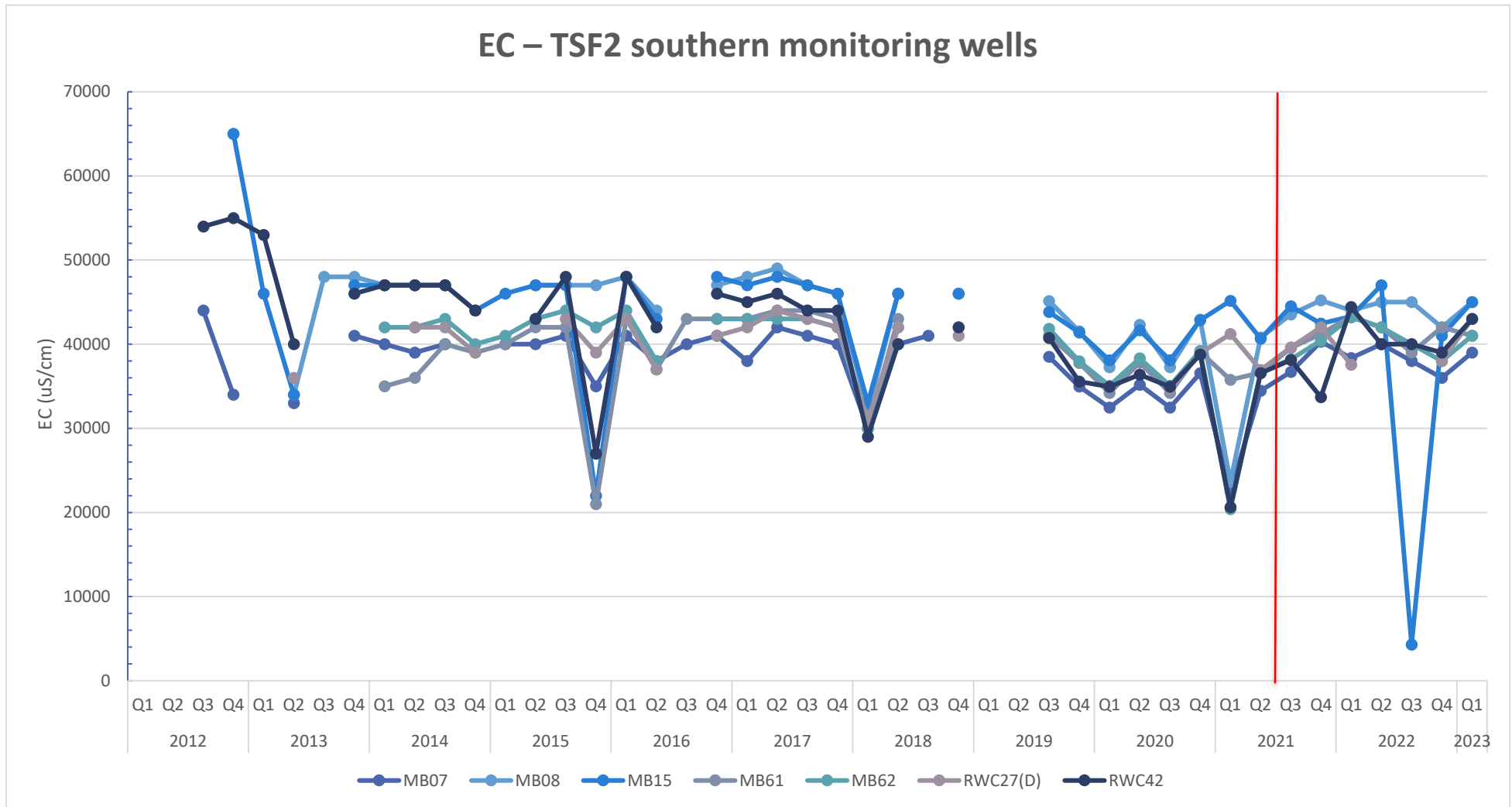


Figure 18: EC – TSF2 eastern monitoring wells

Licence: L8008/2004/3

IR-T13 Decision report template (short) v3.0 (May 2021)

Appendix 6: SWL and Ni concentration – TSF2 eastern monitoring wells

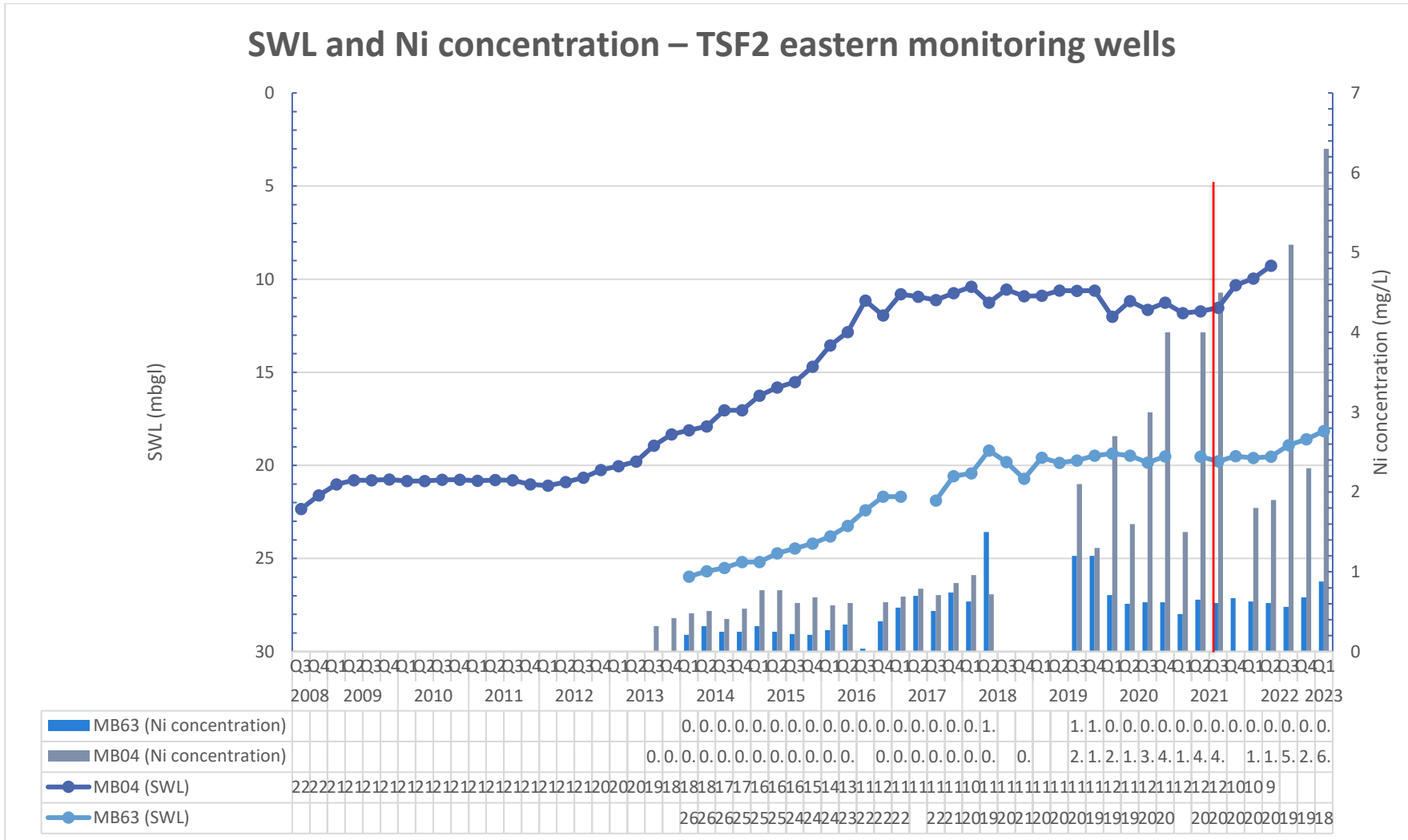


Figure 19: SWL and Ni concentration – TSF2 eastern monitoring wells

Licence: L8008/2004/3

IR-T13 Decision report template (short) v3.0 (May 2021)

Appendix 7: Additional Information

Table 10: Summary of Tailings physical characteristics

Material Characteristic	Parameter	Value
Characterisation	Passing 75 um	89-100%
	Passing 2 um	3-13%
Specific Gravity of Solids		2.73-3.01
Atterberg Limits	Liquid Limit	55
	Plastic Limit	36-48
	Plasticity Index	7-19
Settled dry density		0.82 t/m ³
Air Dry Density		0.94 t/m ³
Consolidation	Initial density	0.84 t/m ³
	Final density	1.50 t/m ³
	Coefficient of consolidation	0.08 – 0.41 m ² /year (average ~0.17)
Field density	From tube samples	0.9 – 1.1 t/m ³
Hydraulic conductivity		1 × 10 ⁻¹¹ to 8 × 10 ⁻⁹ m/s