SIMEC

MEMBER OF GFG ALLIANCE

Tahmoor Coal Pty Ltd

SIX MONTHLY SUBSIDENCE IMPACT REPORT

Tahmoor South Domain Longwalls South 1A – South 6A

1 January 2023 – 30 June 2023

Report 2 – October 2023

simecgfg.com

Document Control

PUBLICATION DATE:	12 October 2023
REVIEW DATE:	12 October 2023
AUTHORS:	April Hudson – Approvals Specialist *Tahmoor Coal – SIMEC Mining*
REVIEW:	Nick Le Baut – Acting Environment and Community Manager *Tahmoor Coal – SIMEC Mining*
VERSION NUMBER:	Rev 1
COMMENTS:	Final

simecgfg.com

Executive Summary

This report is the second six-monthly report to be submitted since the commencement of extraction in the Tahmoor South Domain, in accordance with the requirements of the Longwall South 1A to South 6A (LW S1A-S6A) Extraction Plan.

Extraction of coal from Longwall South 1A (LW S1A) commenced on 18 October 2022 and 1704.5 m of LW S1A had been extracted by 2 July 2023. Bolt up of LW S1A commenced on 12 June 2023 and was completed on 4 July 2023. Extraction of LW S2A commenced on 2 August 2023. The reporting period of this report is from 1 January 2023 to 30 June 2023 and includes observations noted during the extraction of LW S1A only.

During the reporting period, a maximum of 777 mm of vertical subsidence relating to the extraction of LW S1A was recorded at the Tahmoor Mine Boundary Survey Line (V-line).

During the reporting period, there was eleven (11) environmental aspects that were associated with a TARP triggers. These TARP triggers are summarised below:

- Surface Water Quality TARP (WMP1) – Level 1 triggered due to elevated EC, dissolved iron and dissolved zinc conentrations at pool TT7 from March to June 2023 occurred during the reporting period. These elevated concentrations were attributed to prevailing evapoconcentration of salinity due to period of below average raingall and water level decline, and interaction of underflow with subsurface geology and re-emergence of underflow as surface flow in the vicinity of pool TT7. No further actions other than ongoing monitoring is required;
- Surface Water Level TARP (WMP3) – Reduction in pool water level resulted in Level 1 triggers at monitoring sites TT2-QLa and TT9-QLa occurred during the reporting period, which was attributed to the prevailing climatic conditions and unrelated to mining effects associated with LW S1A. However, reduction in pool water level at monitoring sites TT3-QLa, TT12QLa and TT13-QLa resulted in Level 3 triggers at during the reporting period. These Level 3 triggers were attributed to mining induced fracturing and prevailing climatic conditions. A site visit to the sites of the Level 3 TARP trigger will be offered to DPE and other key stakeholders, and a WCAMP will be prepared and implemented following the cessation of subsidence movements associated with Tahmoor South mining;
- Physical Features and Natural Behaviour TARP (WMP5) – Level 1 trigger at pool TT2 due to visually observed anomalous change in water level occurred during the reporting period, which was attributed to prevailing climatic conditions and unrelated to mining effects associated with LW S1A. Level 2 TARP triggers occurred at pools TT3, TT7 and TT11 during the reporting period, and Level 3 TARP triggers occurred at pools TT12 and TT13. The Level 2 and 3 TARP triggers were attributed to mining induced fracturing, prevailing climatic conditions, and resulting reduction in baseflow conditions and negligible surface water flow. A site visit to the sites of the Level 3 TARP trigger will be offered to DPE and other key stakeholders, and a WCAMP will be prepared and implemented following the cessation of subsidence movements associated with Tahmoor South mining;
- Groundwater Level TARP (WMP8) – Level 1 triggered at P55C and P56C due to groundwater level reduction for a period of 6 months. For both bores, groundwater depressurisation could be due to ongoing mining effect. However, at P55C, the relative stability of this water level cannot definitely be attributed to extraction activites and further monitoring is required to better understand the trends. No further actions other than ongoing monitoring is required;
- Groundwater Quality TARP (WMP11) – Level 1 triggered at numerous monitoring sites for barium, strontium and manganese during the reporting period. It was determined that

extraction of LW S1A was unlikely to be influencing water quality during the reporting period, and elevated analytes were likely representative of natural fluctuations in water quality. A revision of the trigger levels of dissolved metals is recommended to be completed after a full 12-month period of monitoring data has been completed;

- Groundwater – Surface Water Interaction TARP (WMP12) – A review of groundwater – surface water interaction between P55C (Level 1 triggerd for TARP WMP8) and associated surface water monitoring site TT1-QRLa did not find any apparent correlation between the two sites. No further actions other than ongoing monitoring is required;
- Historical Heritage TARP (HMP2) – Level 1 triggered for detectable environmental consequences observed at Tahmoor Mine Site. Tahmoor Coal is currently consulting with a qualitified archaeologist / heritage architect to determine whether these observed impacts have resulted in an impact to the site as an item of historical heritage significance. In addition, restressing of the rail loop is planned prior to summer;
- Main Southern Rail TARP – Blue trigger due to poor track geometry at 98.8 km as a result of mining-induced movements. Multiple resurfacing of the track was completed during the reporting period. No further actions other than ongoing monitoring is required;
- Various Infrastructure TARPs – Triggers due to non-conventional subsidence movements and bump on Remembrance Drive. Meetings with all infrastructure owners was completed during the reporting period, and actions from these meetings are currently being implemented;
- Tahmoor Mine Site TARP – Blue trigger due to closure on the rail loop and cracking in the 6C Tunnel, as a result of mining. An inspection by a structural engineer of the 6C Tunnel noted no immediate concerns. Restressing of the rail loop is planned prior to summer; and
- 3030 Remembrance Drive TARP – Blue trigger due to failure of fuel balance tank at an above-ground diesel tank. A pressure test of the lines related to the tank is planned to be completed by Tahmoor Coal.

From the review of actions and responses for surface water TARP triggers, the finalisation of consultation on proposed amendments to the LW S1A-S6A Water Management Plan with DPE (and DPE Water) and implementation of the updated plan once approved remains outstanding.

During the reporting period, there were no exceedances of environmental performance measures or indicators, as adopted from Condition C1 and Condition C5 of SSD 8445.

1 Table of Contents

2 List of Figures

3 List of Tables

1 Introduction

1.1 Background

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing underground coal mine located approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW) (refer to **Figure 1-1**). The mine has previously extracted longwalls to the north and west of the surface facilities and has been operating continuously since 1979 when coal was first mined using bord and pillar mining methods, followed by longwall mining methods since 1987.

Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Extracted coal is processed on site at the coal handling and preparation plant (CHPP) and coal clearance facilities prior to transportation via rail to Port Kembla and Newcastle for Australian domestic and export customers.

In April 2021, Tahmoor Coal received Development Application Approval (SSD 8445) from NSW Department of Planning and Environment (DPE, formerly NSW Department of Planning, Industry and Environment (DPIE)) for the Tahmoor South Domain using existing surface infrastructure and extension of underground longwall mining to the south of existing workings. The approval allows the extraction of up to 4 Mtpa of ROM coal, with a total of up to around 33 Mt of ROM coal proposed to be extracted over a 10-year period.

In addition to the SSD 8445 approval Tahmoor Coal also received conditions of approval (EPBC 2017/8084) under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) in October 2021.

The Tahmoor South Domain is located south of the Bargo River and east of Remembrance Driveway and the township of Bargo. Longwall mining would be used to extract coal from the Bulli coal seam within the bounds of Consolidated Coal Lease (CCL) 716 and CCL 747. Twelve longwalls are proposed in this domain which are divided into a series of six northern (A series) and six southern (B series) longwalls. The A series, Longwalls South 1A to South 6A (LW S1A-S6A), were the focus of the LW S1A-S6A Extraction Plan, for which approval was granted on 20 September 2022. The Study Area for this extraction plan is provided in **Figure 1-2**.

Extraction of coal from Longwall South 1A (LW S1A) commenced on 18 October 2022 and was completed on 4 July 2023. The extraction of Longwalls South 2A (LW S2A) commenced on 2 August 2023.

1.2 Purpose

1.2.1 Six-Monthly Subsidence Impact Report Requirements

The purpose of this report is to address the requirements for six-monthly reporting on impacts and environmental monitoring results associated with the extraction of LW S1A-S6A. These requirements are outlined in Section 7.1.1 of the LW S1A-S6A Extraction Plan, which are derived from the Section 6 of the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015). It is noted that an updated version of the Guidelines was published in October 2022.

This report provides a summary of subsidence and environment monitoring results, subsidence impacts and management actions undertaken during the reporting period. The reporting period for this report is defined in **Section 1.3**.

Reporting requirements are listed in **Table 1-1** below, together with the cross-reference where the requirements are addressed in this report.

Table 1-1 Six Monthly Subsidence Impact Report Requirements

Requirement No.	Requirement Description	Section Addressed
Reporting Requirements as per Section 7.1.1 of the LW S1A-S6A Extraction Plan		
1	A comprehensive summary of all impacts, including a revised characterisation according to the relevant TARP(s);	Section 3.1
2	Any proposed actions resulting from triggers being met in the TARP, or other actions;	Section 3.2
3	An assessment of compliance with all relevant performance measures and indicators; and	Section 4
4	A comprehensive summary of all quantitative and qualitative environmental monitoring results, including landscape monitoring, water quality data, water flow and level data, piezometer readings.	Section 2

This report will be distributed to the stakeholders listed in **Section 5.4**.

1.2.2 Annual Review Requirements

An Annual Review for Tahmoor Mine operations during the previous calendar year is required in accordance with Condition E13 (SSD 8445) and is submitted by 31 March annually to Department of Planning and Environment and other stakeholders, as well as upload to the Tahmoor Coal Website. This Six-Monthly Subsidence Impact Report will assist with the completion of the 2023 Annual Review and will be included as an appendix to the Annual Review.

The Annual Review will address compliance with Condition 22 of the EPBC Act (EPBC 2017/8084) approval, which requires the submission of an Annual Compliance Report to the Department by 31 March of each year (in accordance with email confirmation received on 16 June 2022).

1.3 Scope

1.3.1 Reporting Period

This report is the second six-monthly report to be submitted since the commencement of extraction of LW S1A, in accordance with the requirements of the LW S1A-S6A Extraction Plan. The reporting period of this report is from 1 January 2023 to 30 June 2023, and covers subsidence impacts observed during the extraction of LW S1A.

Table 1-2 summarises the monitoring and reporting completed during the reporting period, as well as the timeframe of data reviewed for each monitoring component.

1.3.2 LW S1A-S6A Study Area

The Extraction Plan Study Area for LW S1A-S6A is defined as the surface area that is likely to be affected by the extraction of LW S1A-S6A from the Bulli Coal Seam. This Study Area has been calculated by combining the areas bound by the following limits:

- The predicted limit of vertical subsidence, taken as the 20 millimetre (mm) subsidence contour resulting from the extraction of LW S1A-S6A; and
- A 35^{o} angle of draw line from the limit of proposed extraction for LW S1A-S6A.

The Study Area is illustrated in **Figure 1-2**.

1.3.3 LW S1A-S6A Extraction Plan Context

The LW S1A-S6A Extraction Plan is part of the Tahmoor Coal Environmental Management Structure, as illustrated in **Figure 1-3**.

As part of the LW S1A-S6A Extraction Plan, a set of management plans was prepared to manage particular environment or built features with the LW S1A-S6A Study Area, which consisted of the following:

- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Built Features Management Plan, with a number of sub-plans to manage potential environmental consequences to infrastructure and specific building structures as a result of secondary extraction; and
- Public Safety Management Plan.

The overall framework for subsidence monitoring and management of impacts of the LW S1A-S6A Extraction Plan is provided in the relevant Subsidence Monitoring Programs. Monitoring of environmental and built features has been completed by Tahmoor Coal in accordance with management plans listed above.

It is noted that the management requirements for public safety are covered in the Built Features Management Plan and the Land Management Plan.

Table 1-2 Monitoring and Reports Reviewed for this Reporting Period

Management Plan	Aspect	Feature	Monitoring Completed By	Monitoring Reported by	Monitoring Reports Completed during this Reporting Period	Section Discussed	Reference
Subsidence Monitoring Program	Subsidence	General subsidence	• SMEC • Building Inspection Service	• Mine Subsidence Engineering Consultants (MSEC)	• Weekly reports during mining • Report for end of LW S1A (MSEC1304 Revision 38)	Section 2.1	Appendix A (referenced reports only)
Water Management Plan	Surface Water	Streamflow Pool water level Stream water quality	• ALS • SMEC	• ATC Williams	• Report for 1 January to 30 June 2023	Sections 2.2.1, 2.2.4	Appendix B
		Physical features and natural behaviour of pools and reaches Morphology and channel stability	• Brienan Environment and Safety	• Brienan Environment and Safety	• Monthly and fortnightly reports during mining	Sections 2.2.2, 2.2.3	Appendix C
	Groundwater	Groundwater quality Groundwater bore level at open standpipes and private bores Shallow groundwater pressures Deep groundwater pressures	• CES	• SLR	• Report for 1 January to 30 June 2023	Section 2.3	Appendix D
		Groundwater level and quality at Thirlmere Lakes	• NSW Government				
		Groundwater Inflow	• Tahmoor Coal				

Management Plan	Aspect	Feature	Monitoring Completed By	Monitoring Reported by	Monitoring Reports Completed during this Reporting Period	Section Discussed	Reference
Land Management Plan	Landscape	Cliffs Natural steep slopes Farm dams	• Douglas Partners	• Douglas Partners	• Geotechnical reports during mining (monthly)	Sections 2.4.1, 2.4.2, 2.4.3	Available on request
		Farm Dams	• Building Inspection Service (BIS)	• BIS	• Weekly dam inspection and reports for dams with active subsidence	Section 2.4.3	Available on request
	Agricultural Land	Agricultural Land	• SMEC • BIS	• MSEC	• Weekly inspections along local roads – completed as part of roads survey	Section 2.4.4	Appendix A (referenced reports only)
			• SLR	• SLR	• Visual inspections at the completion of LW S1A	Section 2.4.4	Available on request
Biodiversity Management Plan	Aquatic Ecology	Macroinvertebrates	• Niche	• Niche	• Aquatic Ecology Monitoring Report for Autumn 2023 (April 2023)	Section 2.5.1	Available on request
	Terrestrial Ecology	Amphibians Riparian vegetation Threatened flora and fauna Threatened Ecological Communities	• Niche	• Niche	• Terrestrial Ecology Monitoring Report for Autumn 2023 (April and May 2023)	Section 2.5.2	Available on request
Heritage Management Plan	Aboriginal heritage	Teatree Hollow 2013.1	• SMEC	• MSEC	• Weekly reports during mining • Report for end of LW S1A (MSEC1304 Revision 38)	Section 2.6.1	Appendix A (referenced reports only)
			• BIS • Douglas Partners	• BIS • Douglas Partners	• Monthly inspection and reporting (alternate fortnights) during period of active subsidence for LW S1A, S2A, S3A and S4A	Section 2.6.1	Available on request
			• EMM	• EMM	• Visual inspection at the completion of LW S1A • Rockshelter excavation report	Section 2.6.1	Appendix E

Management Plan	Aspect	Feature	Monitoring Completed By	Monitoring Reported by	Monitoring Reports Completed during this Reporting Period	Section Discussed	Reference
Heritage Management Plan	Historical heritage	Picton Weir	• SMEC • BIS	• MSEC	• Weekly reports during mining • Report for end of LW S1A (MSEC1304 Revision 38)	Sections 2.6.2, 2.7.13	Appendix A (referenced reports only)
		Great Southern Road (partial)				Sections 2.6.2, 2.7.2	
		Bargo Cemetery	• SMEC • BIS	• MSEC	• Weekly reports during mining • Report for end of LW S1A (MSEC1304 Revision 38)	Sections 2.6.2, 2.7.9	Appendix A (referenced reports only)
			• EMM	• EMM	• Visual inspections at the completion of LW S6A – not required during this reporting period	Not required	Not required
		Wirrimbirra Sanctuary (Australian Wildlife Sanctuary)	• SMEC	• MSEC	• AWS Subsidence Status Reports (weekly)	Sections 2.6.2, 2.7.12	Available on request
			• EMM	• EMM	• Visual inspections at the completion of LW S5A – not required during this reporting period	Not required	Not required
		Tahmoor Colliery (Tahmoor Mine Site)	• SMEC • BIS	• MSEC	• Tahmoor Mine Site Status Reports (weekly)	Sections 2.6.2, 2.7.11	Appendix G (referenced reports only)
			• Tahmoor Coal	• Tahmoor Coal • EMM	• Mine Site Photo Reports (weekly) • Historical Heritage Review letter	Sections 2.6.2, 2.7.11, 3.2	Appendix G (referenced reports only)
		Bargo Railway Bridge North (Wellers Road Overbridge)	• SMEC • Southern rail Services • Bloor Rail • Newcastle Geotech	• MSEC	• MSR Weekly Status Reports (weekly)	Sections 2.6.2, 2.7.1	Appendix F (referenced reports only)
			• EMM	• EMM	• Visual inspections at the completion of LW S6A – not required during this reporting period	Not required	Not required

Management Plan	Aspect	Feature	Monitoring Completed By	Monitoring Reported by	Monitoring Reports Completed during this Reporting Period	Section Discussed	Reference
Heritage Management Plan	Historical heritage	Bargo Railway Viaduct	• SMEC • Southern rail Services • Bloor Rail • Newcastle Geotech	• MSEC	• MSR Weekly Status Reports (weekly)	Sections 2.6.2, 2.7.1	Appendix F (referenced reports only)
			• EMM	• EMM	• Visual inspections at the completion of LW S6A – not required during this reporting period	Not required	Not required
Built Features Management Plan	Built Features	Local roads, bridges and culverts	• SMEC • BIS • Comms Network Solutions	• MSEC	• Weekly reports during mining • Report for end of LW S1A (MSEC1304 Revision 38)	Section 2.7.2	Appendix A (referenced reports only)
		Potable Water Infrastructure				Section 2.7.3	
		Sewerage Infrastructure				Section 2.7.4	
		Gas Infrastructure				Section 2.7.5	
		Electricity Infrastructure				Section 2.7.6	
		Telecommunications Infrastructure				Section 2.7.7	
		Residential structures				Section 2.7.8	
		Structures for public amenity, commercial, industrial and agricultural purposes				Section 2.7 (various)	
		Picton Weir				Section 2.7.13	

Management Plan	Aspect	Feature	Monitoring Completed By	Monitoring Reported by	Monitoring Reports Completed during this Reporting Period	Section Discussed	Reference
Built Features Management Plan	Built Features	Main Southern Railway (MSR)	• SMEC • Southern rail Services • Bloor Rail • Newcastle Geotech	• MSEC	• MSR Weekly Status Reports (weekly)	Section 2.7.1	Appendix F (referenced reports only)
		Wollondilly Anglican College (WAC)	• SMEC	• MSEC	• Wollondilly Anglican College Status Report (Weekly)	Section 2.7.10	Available on request
		Tahmoor Mine Site	• SMEC • BIS	• MSEC	• Tahmoor Mine Site Status Reports (weekly)	Sections 2.6.2, 2.7.11	Appendix G (referenced reports only)
			• Douglas Partners	• Douglas Partners	• Tahmoor Mine Ponds and Embankment Reports (monthly)	Section 2.7.11	Available on request
			• Tahmoor Coal	• Tahmoor Coal	• Mine Site Photo Reports (weekly)	Sections 2.6.2, 2.7.11	Appendix G (referenced reports only)
		Australian Wildlife Sanctuary (AWS)	• SMEC	• MSEC	• AWS Subsidence Status Reports (weekly)	Section 2.7.12	Available on request
		Bargo Petroleum	• SMEC	• MSEC	• Petrol Station Status Report (weekly)	Section 2.7.14	Appendix H (referenced reports only)
		Tahmoor Garden Centre	• SMEC	• MSEC	• Tahmoor Garden Centre Status Report (weeklys)	Section 2.7.16	Available on request

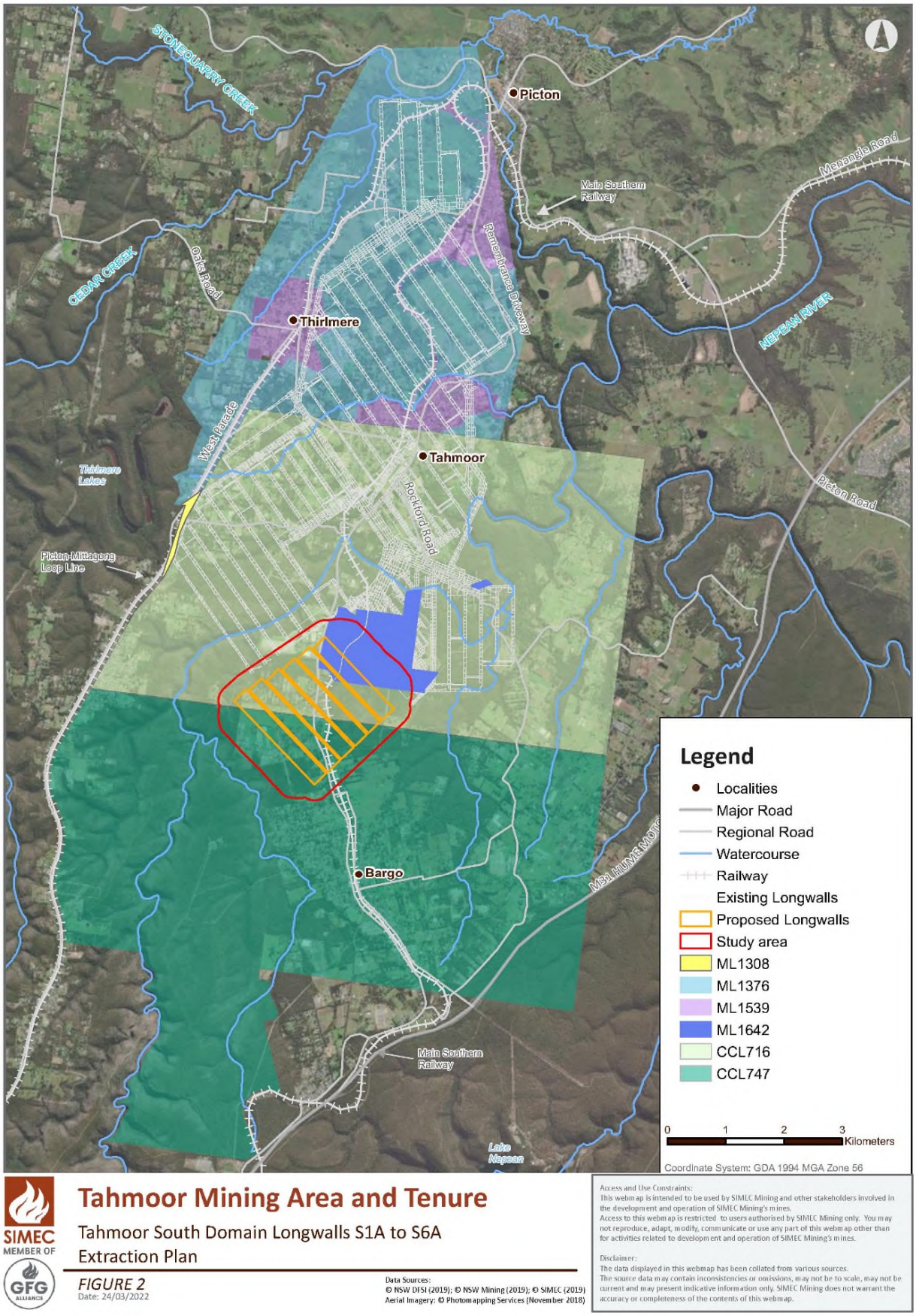


Figure 1-1 Tahmoor Mine Area and Tenure (source: LW S1A-S6A Extraction Plan)

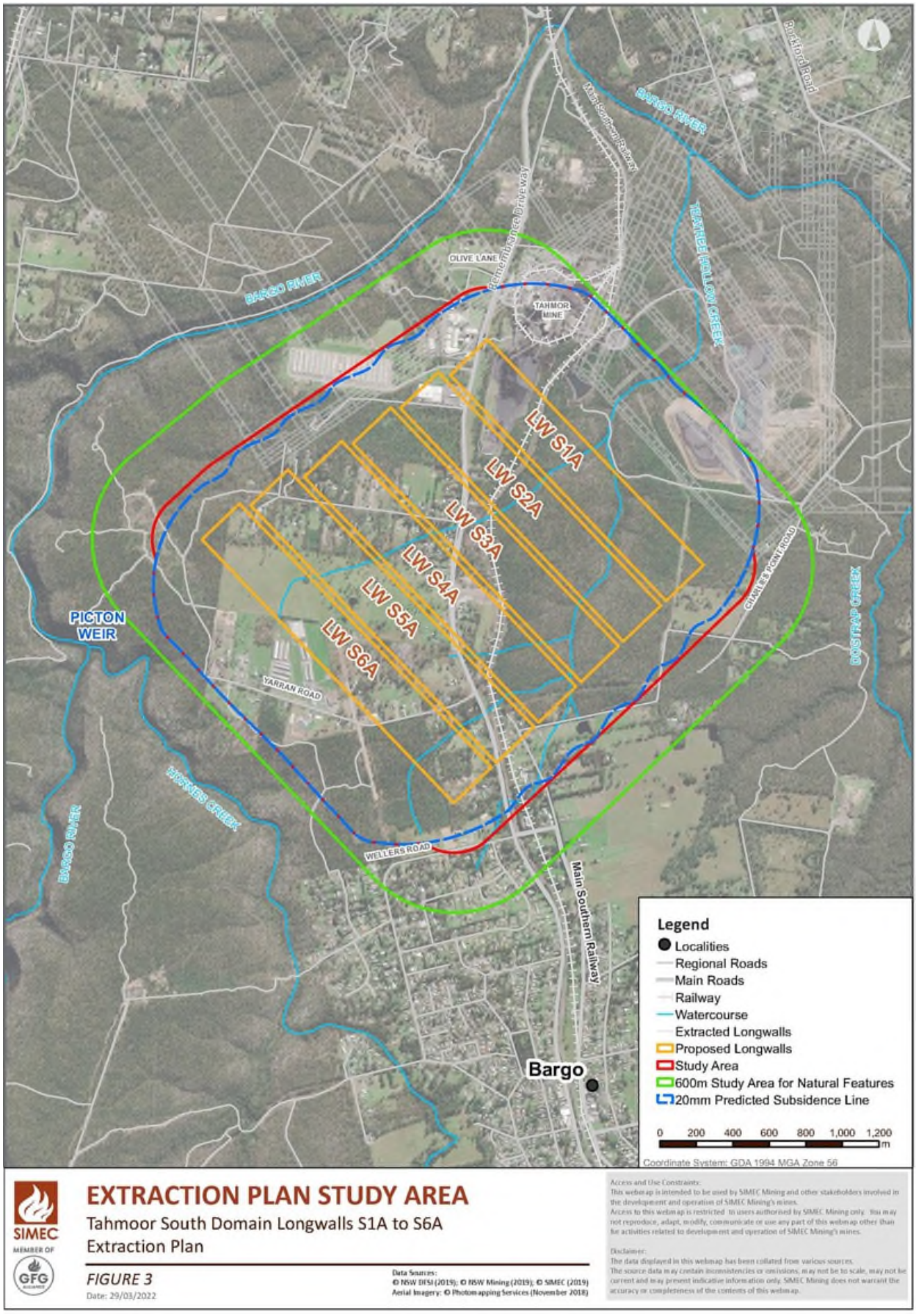


Figure 1-2 LW S1A-S6A Extraction Plan Study Area (source: LW S1A-S6A Extraction Plan)

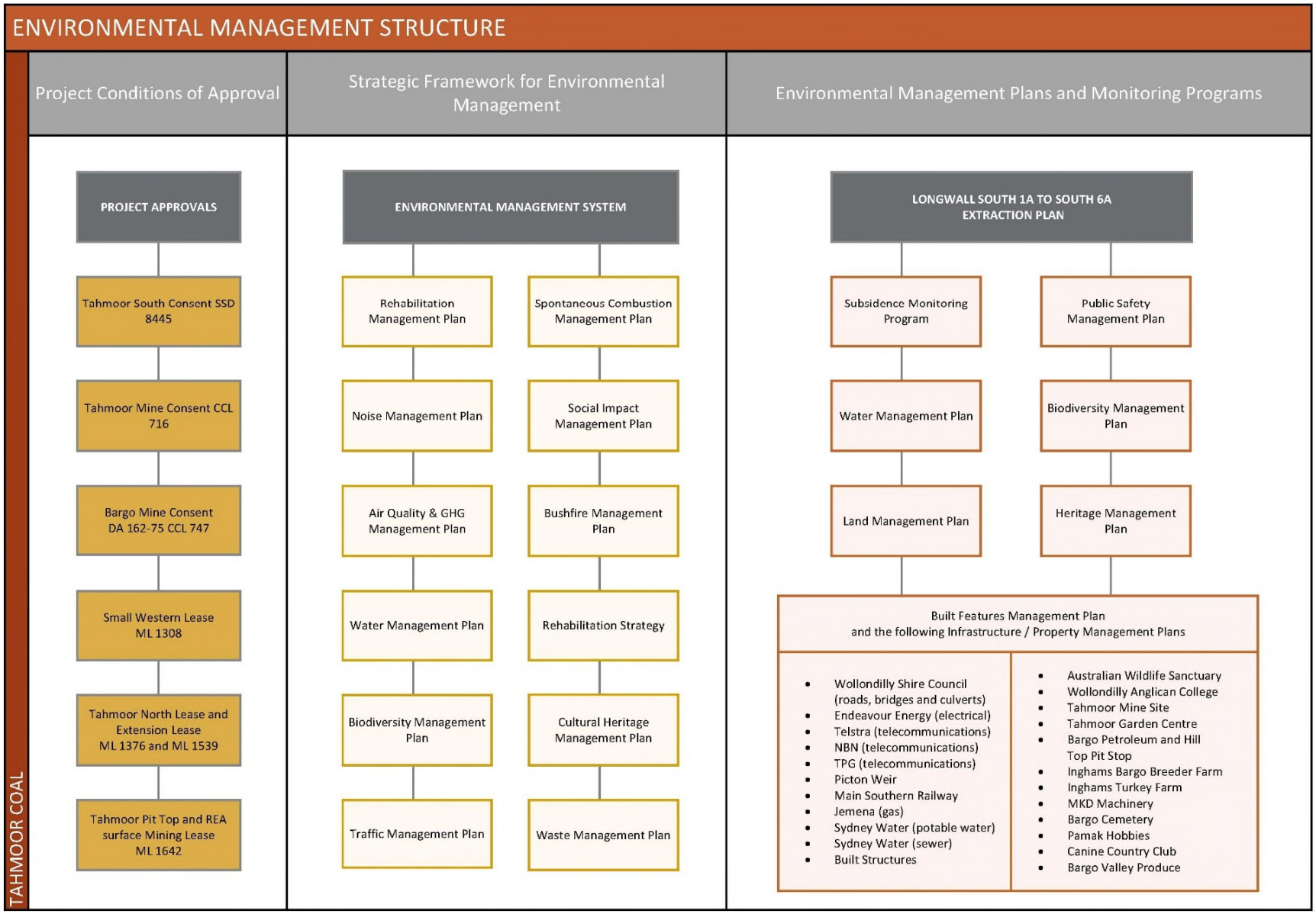


Figure 1-3 Overview of Environmental Management Structure for Tahmoor Coal (source: LW S1A-S6A Extraction Plan)

2 Summary of Environmental Monitoring Results

2.1 Subsidence Monitoring

During the reporting period, the LW S1A-S6A Subsidence Monitoring Program have been implemented to monitor subsidence impacts within the Study Area. The details of the Subsidence Monitoring Program are illustrated in **Figure 2-1**. The Subsidence Monitoring Program includes twenty (20) Global Navigation Satellite System (GNSS) units measuring absolute horizontal and vertical positions in real time installed directly above and adjacent to LW S1A-S6A. These include two units above the commencing end, and along the centreline of, LW S1A, being Sites S01 and S02.

Extraction of LW S1A commenced on 18 October 2022 and 1704.5 m of LW S1A had been extracted by 2 July 2023. Bolt up of LW S1A commenced on 12 June 2023 and was completed on 4 July 2023. Extraction of LW S2A commenced on 2 August 2023 and this reporting period includes observations noted during the extraction of LW S1A only.

Table 2-1 summarises the maximum observed ground movements within the active subsidence zone at the start and end of this reporting period (following completion of LW S1A extraction). During the reporting period, a maximum of 777 mm of vertical subsidence relating to the extraction of LW S1A was recorded at the Tahmoor Mine Boundary Survey Line (V-Line).

Table 2-1 Subsidence Monitoring Observations for the start and end of this Reporting Period (source: MSEC1304 Report 38, Appendix A)

	MSEC1304 LW S1A Subsidence Monitoring Report 38		**MSEC1304 LW S1A Subsidence Monitoring Report 38**	
Monitoring Period	26 December 2022 to 1 January 2023		Up to 29 August 2023	
Progress of extraction	LW S1A extraction – 545 metres		LW S1A extraction – 1076 metres (full extraction)	
Observed Ground Movement Parameters	**Maximum Observed Total**	**Location**	**Maximum Observed Total**	**Location**
Subsidence (mm)	200	GNSS unit Site S01	777	V-Line
Tilt (mm/m)	0.1	V-Line & Charlies Point Road	4.23	Main Southern Railway
Hogging Curvature (km^{-1})	0.01	Charlies Point Road	0.09	Remembrance Drive
Sagging Curvature (km^{-1})	-0.01	V-Line & Charlies Point Road	-0.17	Main Southern Railway
Tensile Strain (mm/m)	0.3	Charlies Point Road	0.5	V-Line
Compressive Strain (mm/m)	-0.3	Charlies Point Road	-2.4	Main Southern Railway

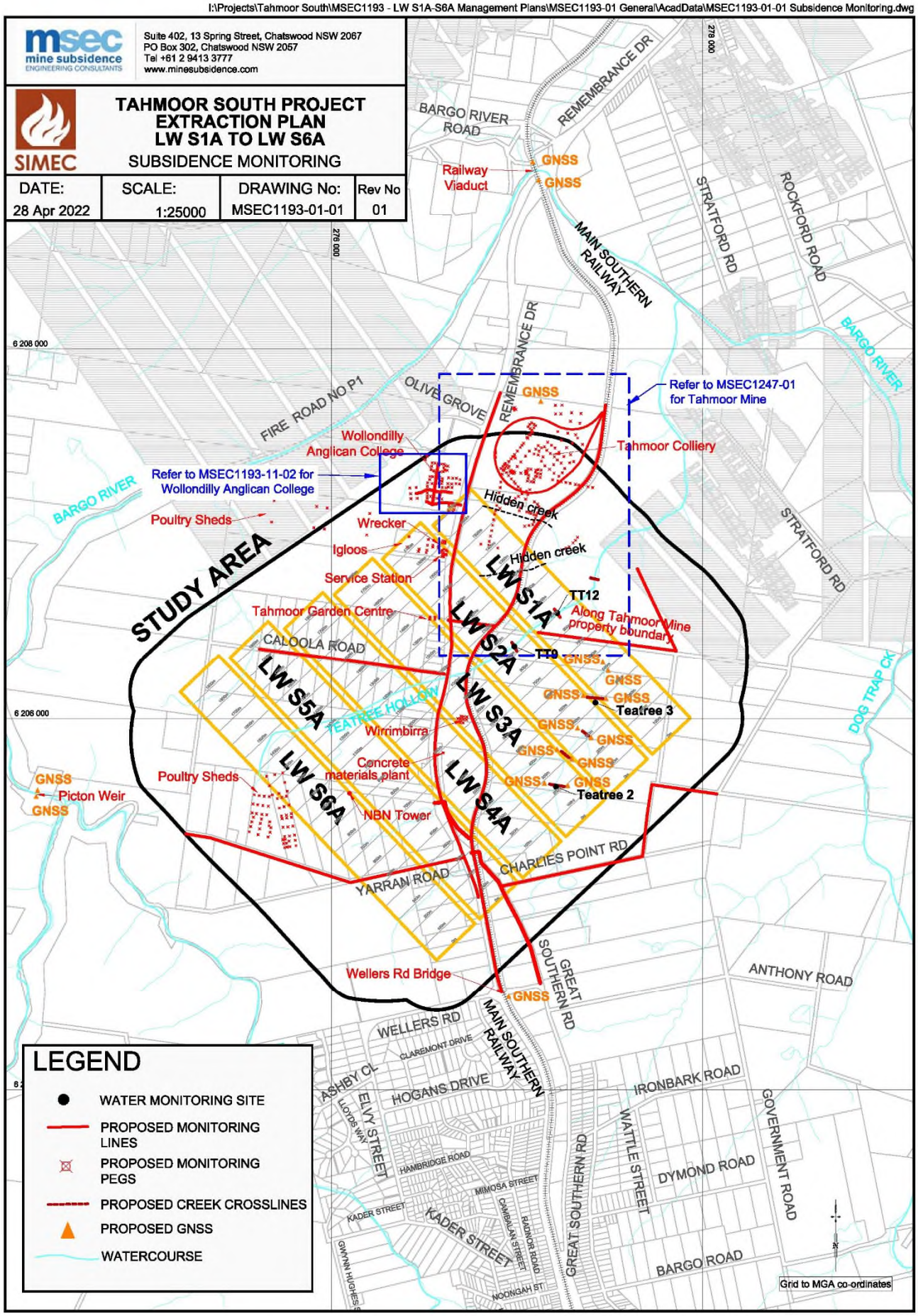


Figure 2-1 *LW S1A-S6A Subsidence Monitoring Program (source: LW S1A-S6A Subsidence Monitoring Program)*

2.1.1 Ground Survey Results

A summary of all surveys and inspections completed during the reporting period is provided in MSEC1304 LW S1A Subsidence Monitoring Report 38 (refer **Appendix A**). A weekly review of the subsidence survey results was completed by Tahmoor Coal and MSEC during the extraction period. A comparison between assessed and observed impacts to surface features is summarised in Table 3 of the MSEC Subsidence Monitoring Report 27 (refer to **Appendix A**).

Survey results associated with built features are discussed in **Section 2.7**.

2.1.2 Tahmoor Mine Boundary Survey Line (V-Line)

The latest survey along the V-Line was conducted on 24 July. Subsidence has developed above LW S1A, and compressive strain is observed between pegs V-43 and V-45 at Wirrimbirra Creek, and between pegs V50 to V52 above the centre of the longwall. The frequency of ground surveys has increased from monthly to fortnightly in light of impacts observed at Teatree Hollow during the mining of LW S1A (discussed further in **Section 2.2.2**). Minor changes were observed in the last survey as extraction was completed on 4 July.

2.1.3 GNSS Unit Results

The development of subsidence above LW S1A is illustrated in **Figure 2-2**. Subsidence has developed within predictions, with magnitudes of subsidence slightly greater than observations above previously extracted LW 22, as predicted due to the shallower depth of cover above LW S1A. Subsidence at Peg V-51 along the V Line is greater than observed at the GNSS units, and very slightly greater than predicted. Rates of change have reduced to very low levels at the end of this reporting period.

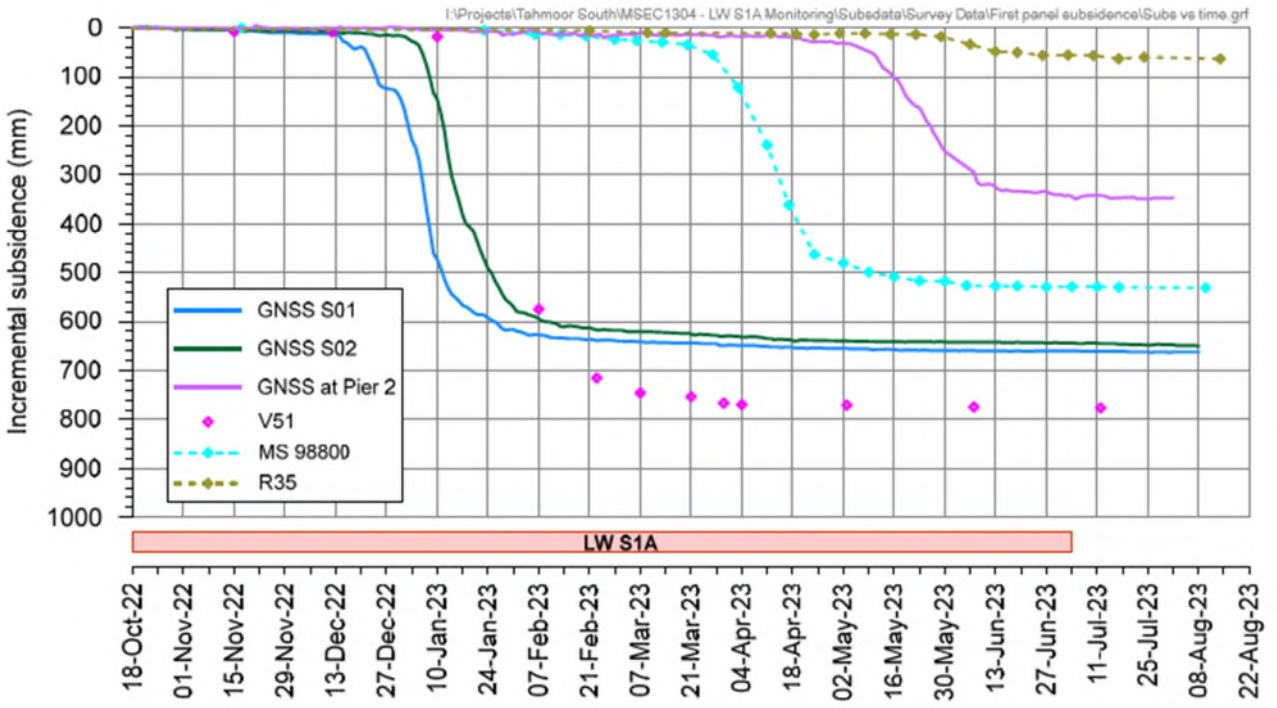


*Figure 2-2 Development of observed subsidence along LW S1A (source: MSEC, Subsidence Monitoring Report 38, **Appendix A**)*

Changes in horizontal distances between paired GNSS units that are stationed close together on opposite sides of Teatree Hollow and Teatree Hollow Tributary (also known as 'Wirrimbirra Creek') are illustrated in **Figure 2-3**. From the commencement of LW S1A to 30 June 2023, the following was recorded:

- Greater than 20 millimetres (mm) closure has developed at sites in Teatree Hollow tributary (Wirrimbirra Creek) overlying LW S1A and LW S2A;
- Approximately 145 mm closure was recorded at Teatree Hollow tributary above LW S1A (Site S01 to Site S02) as of 30 June 2023;
- Approximately 90 mm closure was recorded at pool TT3 (Ockenden Pool) as of 30 June 2023 (Site S03 to Site S04);
- Approximately 30 mm closure was recorded at pool TT5 as of 30 June 2023 (Site S05 to Site S06).
- Less than 20 mm closure was recorded at upstream sites across Teatree Hollow tributary including at pool TT2 (Site S09 to Site S10); and
- Negligible change in horizontal distance has been recorded at sites across the Bargo River.

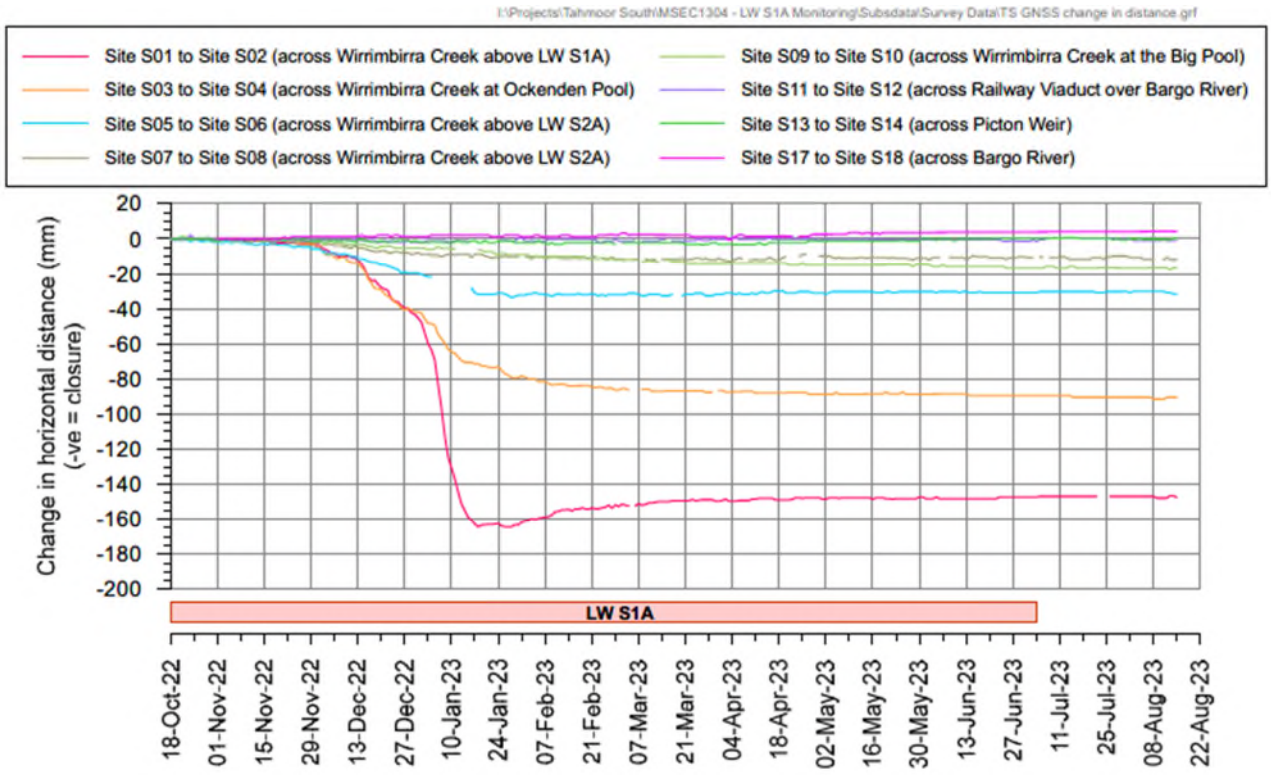


*Figure 2-3 Observed changes in horizontal distances between GNSS units during LW S1A extraction (source: MSEC, Subsidence Monitoring Report 38, **Appendix A**).*

2.2 Surface Water Monitoring

The LW S1A-S6A Water Management Plan was prepared to manage the potential environmental consequences of LW S1A-S6A extraction on surface water in accordance with Condition C8 of SSD 8445.

During this reporting period, the LW S1A-S6A Water Management Plan has been implemented to monitor surface water:

- Flow, pool water level and surface water quality monitored for Teatree Hollow, Teatree Hollow tributary ('Wirrimbirra Creek'), Bargo River, and Bargo River Tributary – monthly and fortnightly monitoring data reviewed and reported by ATC Williams on a monthly basis, as well as a fortnightly basis for impacted sites (refer to **Appendix B**); and

- Creek monitoring for physical features and natural behaviour of pools, as well as channel stability, sedimentation and erosion – visual inspections and reporting by Brienan Environment and Safety completed on a monthly basis, as well as a fortnightly basis for impacted sites (reports available on request).

The following sections summarise the observations made during the reporting period for each surface water category. Performance against all Surface Water Management Plan TARPs for the reporting period are summarised in **Table 3-1**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2**.

2.2.1 Pool Water Level

Surface water level data has been recorded at the pool monitoring sites on Teatree Hollow, Teatree Hollow Tributary (also known as Wirrimbirra Creek), Bargo River, and Bargo River Tributary as shown in **Figure 2-4**. Continuous surface water level data and manual monthly water level measurements have been recorded at seven monitoring sites on Teatree Hollow (and tributary) and six monitoring sites on Bargo River (and tributary). Sites on Teatree Hollow and Bargo River are shown in **Figure 2-4**.

During the reporting period, the following monitoring sites on Teatree Hollow and Bargo River (and their tributaries) observed a reduction below baseline minimum levels:

- Monitoring site TT2 – the water level was recorded below the cease to flow level from late April to the end of June 2023, except for a brief period in early May during and immediately following a rainfall event;
- Monitoring site TT3 – Except for brief periods during and following rainfall, the water level was below the sensor level or the pool was dry;
- Monitoring site TT9 – the water level declined intermittently below the baseline minimum during periods of negligible rainfall;
- Monitoring site TT12 – the water level initially delined below the sensor level in mid-February 2023 and for the remainder of the reporting period (excluding a very brief period in May 2023) was either below the sensor level or the pool was dry; and
- Monitoring site TT13 – the water level declined below the baseline minimum level from Mid-February to late April 2023 and from mid-May to the end of June 2023. From early March to late April and in June 2023, the water level was below the sensor level, or the pool was dry.

Charts illustrating monitored pool water level hydrographs for pools on Teatree Hollow and Bargo River (and their tributaries) are presented in the Surface Water Monitoring Report (refer to **Appendix B**).

2.2.2 Physical Features and Natural Behaviour

Visual and photographic surveys for subsidence impacts on creeks have been completed monthly for monitoring pools and reaches in Teatree Hollow and Teatree Hollow tributary within the active subsidence zone of LW S1A. An increase in frequency to fortnightly has been completed for mining impacted pools.

The purpose of these surveys is to note whether change has occurred to pool level, drainage or overland flow, and to assist in determining if any change can be attributed to mining impacts. Surveys are carried out to identify rock bar and/or stream base cracking, changes in overland connected flow, gas release, turbidity or increased iron precipitation. Creek monitoring locations for physical features and natural behaviour are illustrated on **Figure 2-5**.

During this reporting period, there were no observed gas release, as compared with baseline conditions. However there were numerous observed occurrences of impacts to pool water level, overland connected flow and observations of iron staining, turbidity and fracturing, as summarised below:

- Pool TT1 (reference site) – a decline in water level was observed in the latter half of the review period, in comparison to baseline conditions. From late April 2023, surface flow ceased approximately 95 m downstream of pool TT1;
- Pool TT2 – a notable decline in water level was observed from May 2023;
- Pool TT3 – the pool was visually observed as dry during the majority of inspection occasions from February to June 2023;
- Pool TT7 – a decline in water level was observed from March to the end of the reporting period. Iron staining was observed on exposed bedrock at the upstream extent of the pool from late March to the end of the reporting period;
- Pool TT9 – a decline in water level was observed at times from March to the end of the reporting period. An increase in turbidity was observed from February to April 2023;
- Pool TT11 – the pool was visually observed as dry during the majority of inspection occasions from February to the end of the reporting period. Mine-related fractures were initially observed approximately 90 m upstream of pool TT11 in February 2023;
- Pool TT12 – the pool was visually observed as dry from March 2023 to the end of the reporting period. Mining-related fractures were initially observed immediately upstream and downstream of the pool in March 2023. The number of fractures was noted to increase during the reporting period, as well as the length and width of individual fractures. Iron staining was observed approximately 50 m downstream of the pool in February and March 2023; and
- Pool TT13 – the pool was visually observed as dry from March to the end of the reporting period, with the exception of minimal water observed in May 2023. In March 2023, flow re-emergence was observed immediately downstream of the confluence of Teatree Hollow and Teatree Hollow tributary. From April to June 2023, flow re-emergence was observed at the upstream extent of Pool TT7.

Figure 2-7 demonstrates the location of flow re-emergence, fracturing, ponded water, iron staining and overland flow observed during this reporting period.

2.2.3 Channel Stability, Sedimentation and Erosion

Visual and photographic surveys for subsidence impacts on creeks have been completed monthly for morphology and channel stability monitoring site in Teatree Hollow and Teatree Hollow tributary within the active subsidence zone of LW S1A, with the exception of headwater sites which are completed on an annual basis.

The purpose of these surveys is to note whether change has occurred to channel stability, erosion and sedimentation, and to assist in determining if any change can be attributed to mining impacts. Surveys are carried out to identify any visual changes in knickpoint development and channel morphology. Creek monitoring locations for channel stability, sedimentation and erosion are illustrated on **Figure 2-6**.

During this reporting period, channel morphology site CM7 and knickpoint sites K71, K73, K78 and K79 were located within the active subsidence zone of LW S1A.

There was no observed increase in cracking or shearing, no reduction in overland connective flow and no additional iron seeps beyond what was identified during the baseline survey of CM7. There was no further development of knickpoints recorded during the reporting period.

2.2.4 Surface Water Quality

Surface water quality data has been recorded at the following sites (refer to **Figure 2-4**):

- Teatree Hollow:
  - Reference site: TT1-QRLa;
  - Potential impact sites: TT2--QLa, TT3-QLa, TT7-QRLa, TT9-QLa, TT12-QLa, TT13-QLa, and TT14-QLa;
- Bargo River:
  - Reference site: BR16-QLa; and
  - Potential impact sites: BR12-QRLa, BR13-QRLa.

Water quality data consisted of constituents which are considered to be primary indicators of mining includes. These constituents include pH, electrical conductivity (EC), and specific dissolved metals (aluminium, copper, iron, manganese, nickel and zinc).

A summary of observations for the reporting period is provided in **Table 2-2**. Charts illustrating water quality results for monitored pools in Teatree Hollow and Bargo River are presented in Appendix C of the Surface Water Monitoring Report (refer to **Appendix B**).

The water quality characteristics of monitoring sites following commencement of mining LW S1A have been largely consistent with baseline conditions and / or consistent with reference site conditions. During the reporting period, only site TT7 recorded an exceedance of the Site Specific Guideline Values (SSGVs) for specific constituents:

- Exceedance for dissolved iron and dissolved zinc in April, May and June 2023; and
- Exceedance for electrical conductivity for March to June 2023.

Table 2-2 Summary of Notable Results for Key Water Quality Parameters for the Reporting Period

Parameter	Teatree Hollow	Bargo River
pH	• Near neutral to slightly acidic pH recorded at the majority of sites. • pH recorded during the review period was within the range of baseline values.	• Near neutral pH recorded at all sites.
Electrical Conductivity	• Field EC values were consistent with baseline values for the majority of sites, with the exception of TT7-QLa in April and June 2023 and TT14-QLa in June 2023. • An increasing trend in EC values was recorded at the majority of the sites during the review period.	• Field EC values were consistent with baseline values for the duration of the review period. • A slight increasing trend in EC values was recorded at all sites during the review period
Dissolved Aluminium	• Dissolved aluminium concentrations were within the range of baseline concentrations for the duration of the review period (equal to or less than 0.3 mg/L recorded at all sites).	• Dissolved aluminium concentrations were within the range of baseline concentrations for the duration of the review period.
Dissolved Copper	• Dissolved copper concentrations were equal to or less than the limit of reporting for the majority of the review period.	• Dissolved copper concentrations were equal to or less than the limit of reporting for the duration of the review period.

Parameter	Teatree Hollow	Bargo River
Dissolved Iron	• Dissolved iron concentrations were within the range of baseline concentrations for all sites, with the exception of TT7-QLa in April, May and June 2023. • A historically high concentration of 9.75 mg/L was recorded in June 2023 at TT7-QLa.	• Dissolved iron concentrations were within the range of baseline concentrations for the duration of the review period. • Dissolved iron concentrations declined from around 1 mg/L in January to less than 0.6 mg/L in June 2023.
Dissolved Manganese	• Dissolved manganese concentrations recorded at all sites were within the range of baseline values. • Slightly elevated (less than 2 mg/L) dissolved manganese concentrations were recorded at TT7-QLa in April and June 2023.	• Dissolved manganese concentrations recorded at all sites were within the range of baseline values.
Dissolved Nickel	• Dissolved nickel concentrations were within the range of baseline concentrations with the exception of TT7-QLa in April and June 2023. • A historically high concentration of 0.028 mg/L was recorded in June 2023 at TT7-QLa.	• Dissolved nickel concentrations were within the range of baseline concentrations for the duration of the review period with the exception of BR12-QLa in February 2023. • A historically high concentration of 0.03 mg/L was recorded in February 2023 at BR12-QLa. • For the remainder of the review period, the dissolved nickel concentrations recorded at BR12-QLa were at or less than the limit of reporting.
Dissolved Zinc	• Dissolved zinc concentrations were within the range of baseline concentrations with the exception of TT7-QLa in June 2023. • A historically high concentration of 0.15 mg/L was recorded in June 2023 at TT7-QLa.	• Dissolved zinc concentrations were within the range of baseline concentrations for the duration of the review period with the exception of BR12-QLa in February 2023 and BR13-QRLa in May 2023. • A historically high concentration of 0.06 mg/L was recorded in February 2023 at BR12-QLa. • A historically high concentration of 0.11 mg/L was recorded in May 2023 at BR13-QRLa. • For the remainder of the review period, the dissolved zinc concentrations were at or less than the limit of reporting.

2.2.5 Recommendations and Actions

2.2.5.1 Current Surface Water Monitoring Recommendations

As discussed in the Surface Water Review for January to June 2023 (**Appendix B**), the following recommendations are relevant for this reporting period:

- Ongoing review of surface monitoring data is continued to be undertaken in accordance with the LW S1A-S6A Water Management Plan; and
- The baseline minimum for pool TT9 is revised to consider the water level data recorded to the cessation of mining of LW S1A (4 July 2023).

2.2.5.2 Previous Surface Water Monitoring Recommendations

The recommendation made in the previous Six Monthly Subsidence Impact Report (June to December 2022, submitted in March 2023) for surface water, along with an update on the progress of this recommendation, is provided below:

- *Ongoing review of surface monitoring data is continued to be undertaken in accordance with the WMP* – Since mining commencement in October 2022, review of surface monitoring data has been undertaken in accordance with the WMP.

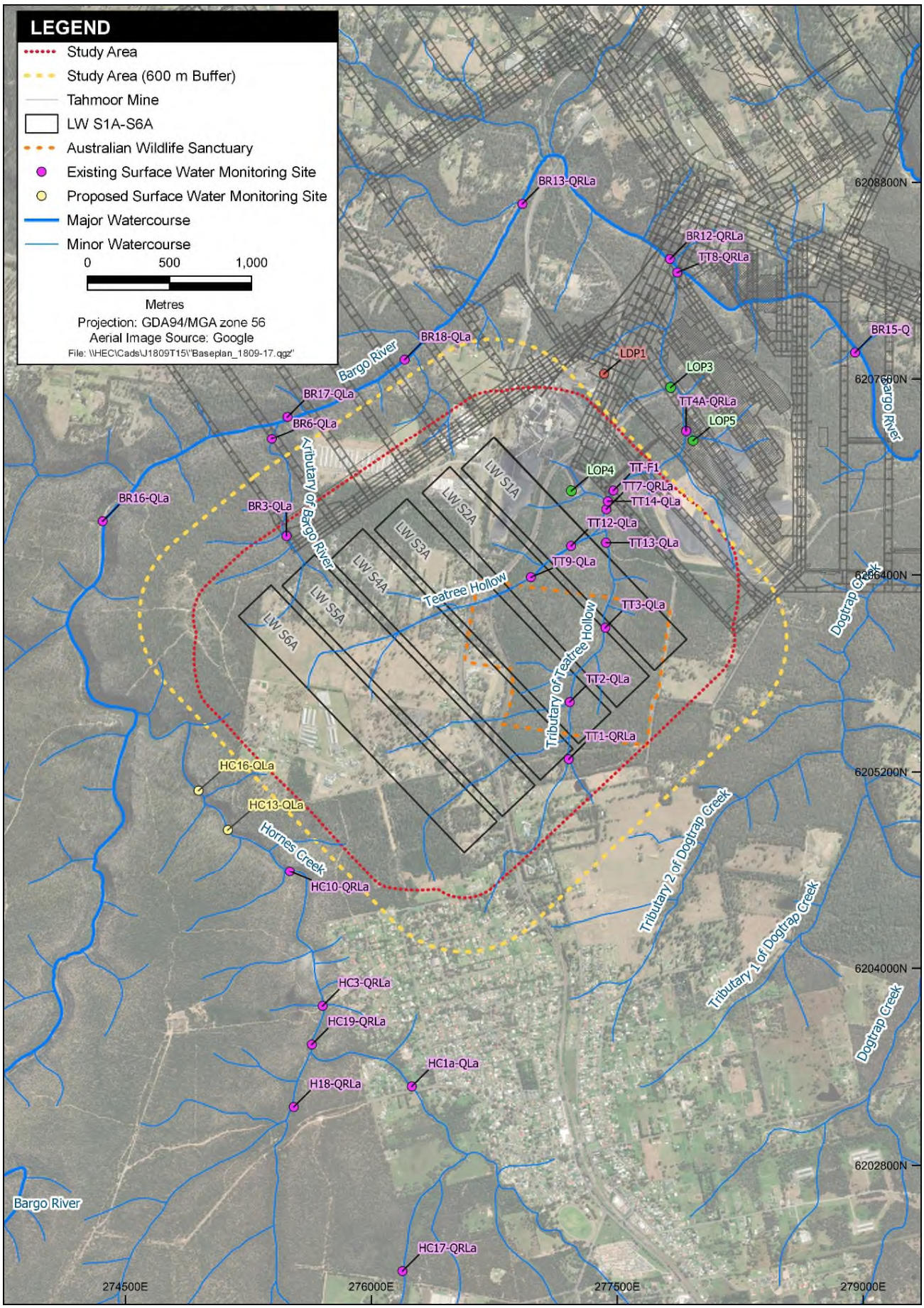


Figure 2-4 *LW S1A-S6A Surface Water Monitoring Sites Specific to LW S1A-S6A (source: LW S1A-S6A Water Management Plan)*

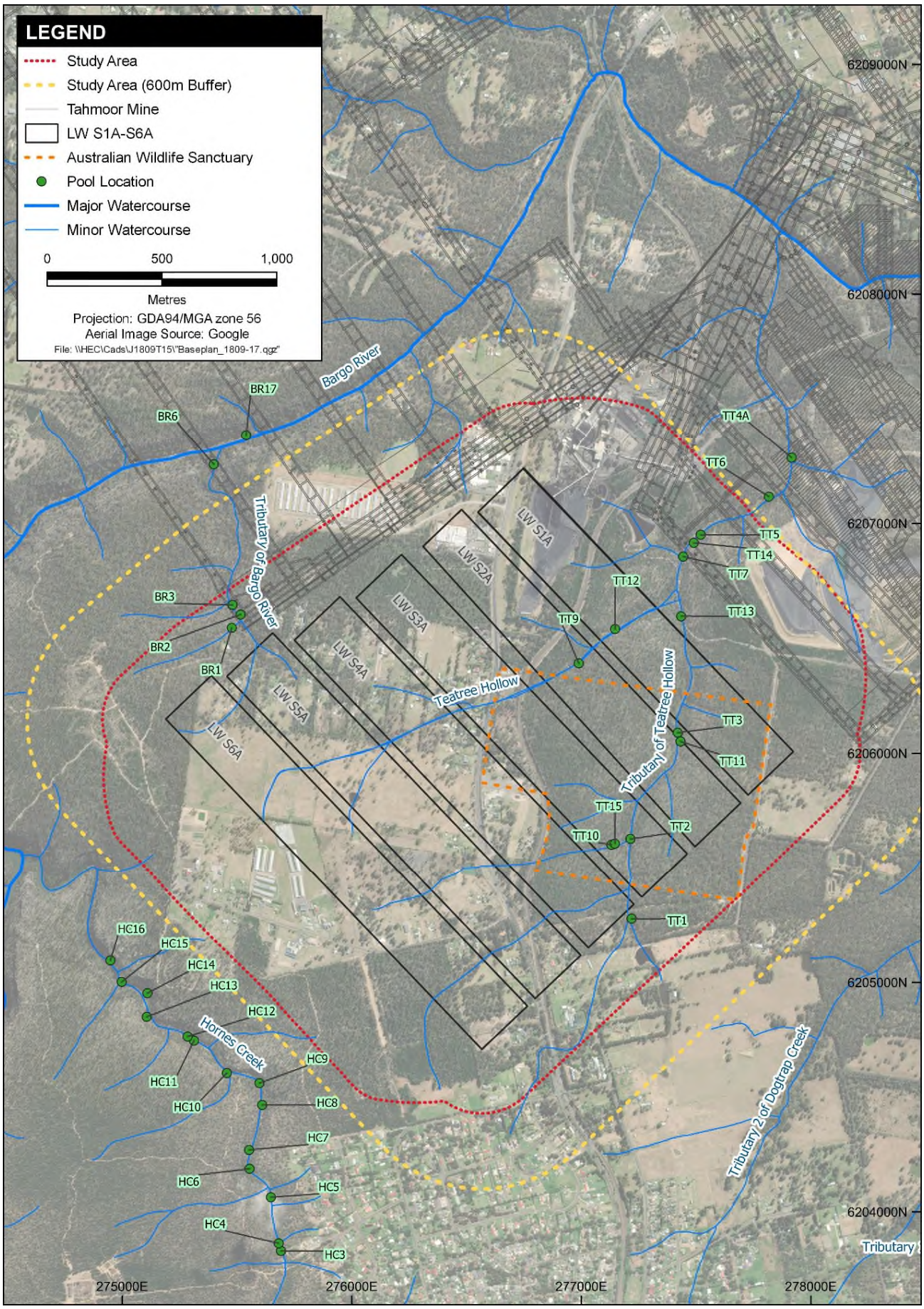


Figure 2-5 *LW S1A-S6A Pool Visual Inspection Sites (source: LW S1A-S6A Water Management Plan)*

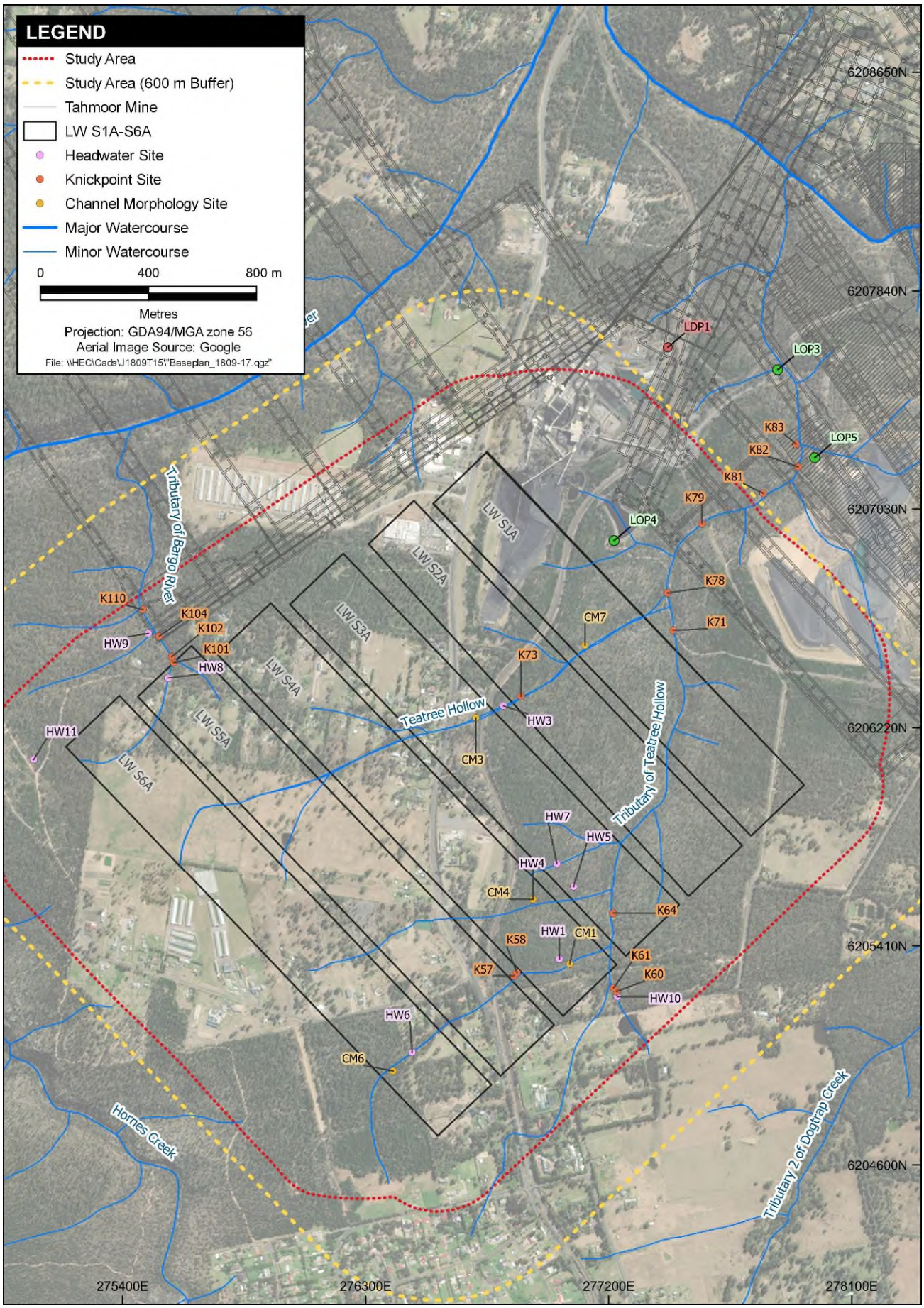


Figure 2-6 *LW S1A-S6A Morphology and Channel Stability Monitoring Sites (source: LW S1A-S6A Water Management Plan)*

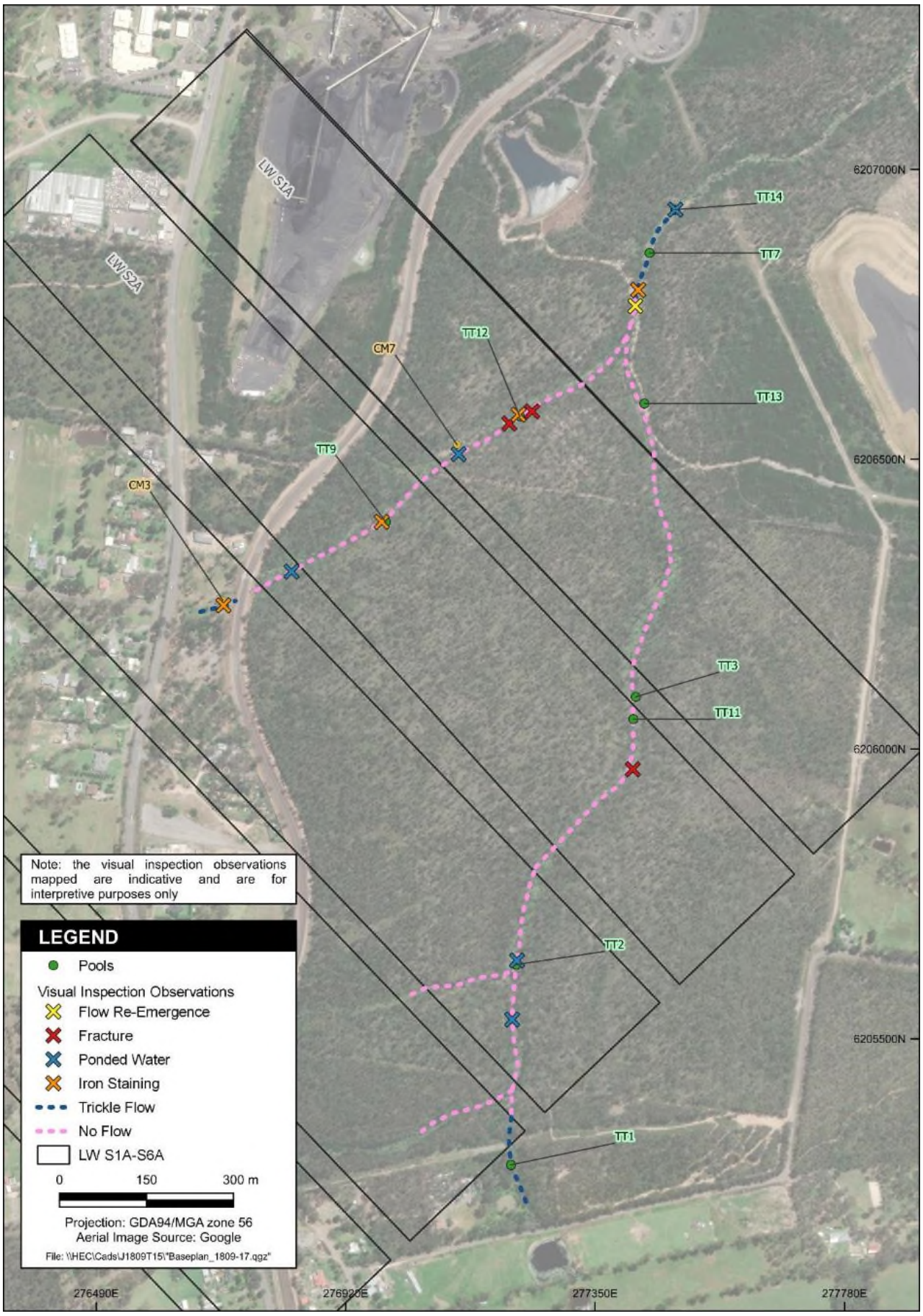


*Figure 2-7 Visual depiction of surface water characteristics and physical effects for this reporting period (source: **Appendix B**)*

2.3 Groundwater Monitoring

The LW S1A-S6A Water Management Plan was prepared to manage the potential environmental consequences of LW S1A-S6A extraction on groundwater in accordance with Condition C8 of SSD 8445.

During this reporting period, the LW S1A-S6A Water Management Plan has been implemented to monitor groundwater:

- Shallow groundwater levels, quality and pressures, and deep groundwater levels / pressures – monthly monitoring data reviewed and reported by SLR on a monthly basis (reported in **Appendix D**); and
- Mine water intake – data for this reporting period reviewed and reported by SLR (refer to **Appendix D**).

The following sections summarise the observations made during the reporting period for each groundwater category. Performance against all Groundwater Management Plan TARPs for the reporting period are summarised in **Table 3-1**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

2.3.1 Groundwater Bore Levels

The Tahmoor South Monitoring Network comprises both open standpipes (OSP) and Vibrating Wire Piezometers (VWPs). The standpipe piezometers can be used for monitoring water levels manually or with an automated datalogger (installed in 10 sites to date), as well as for collection of water samples for groundwater quality monitoring purposes. The VWPs are grouted and therefore can only be used for monitoring groundwater pressures, but do allow for multiple instruments to be installed at different depths within a single borehole. The locations of groundwater monitoring bores is provided in **Figure 2-8**.

Further detail on groundwater level results, including graphs showing progressive groundwater levels, are provided in the SLR Groundwater Monitoring Report (refer to **Appendix D**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 3.2.4**.

2.3.1.1 Shallow OSPs bores

Plots showing the groundwater levels in the Shallow OSPs are provided in the SLR Groundwater Monitoring Report (**Appendix D**).

Groundwater depressurisation has been observed in the deepest Open Standpipes at P55 (P55C) and P56 (P56C). Groundwater elevation at P55C and P56C have been reduced since November 2022 and December 2022, respectively. This groundwater depressurisation in the deeper bores could be due to an ongoing mining effect (LWS1A progression). However, the nested shallower bores (P55A&B and P56A&B are stable with no declining water trends present at all. Additionally, given the relative stability of this water level in P55C since an initial decline in November 2022 (i.e. no ongoing declining trend) this cannot definitively be attributed to extraction activities. Tahmoor Coal will continue to review the trends in this bore and the associated nested bores in coming months to better understand the trends.

Numerous sites (P51B, P53A, P53B, P53C, and REA4) are showing some consistent decline in water levels since approximately April 2023, however it is unconfirmed at this stage if these declines are related to mining impacts.

2.3.1.2 Groundwater – Surface Water Connectivity

Groundwater monitoring is undertaken within nearby vicinity of surface watering at multiple locations to assist with the review of groundwater – surface water interaction. Namely to assist with defining if surface flow changes identified are attributable to baseflow loss due to groundwater depressurisation resultant from mining activities. Further detail of the groundwater – surface water interaction review is provided in the Surface Water Monitoring Report (**Appendix B**) and Groundwater Monitoring Report (**Appendix D**).

Monitoring bores P55A-C are associated with surface water monitoring site TT1-QRLa and together they can be considered when reviewing the surface water – groundwater connectivity TARP (WMP12). TT1-QLa is located approximately 100 m to the west of monitoring bores P55A-C in the Teatree Hollow tributary. Groundwater level at monitoring bore P55C was noted to exhibit groundwater depressurisation, however this was unable to be definitely attributed to mining of LW S1A (refer **Section 2.3.1.1**). A comparison of groundwater level recorded at P55A (shallowest bore in the series) with water levels at TT1-QRLa inferred that negligible change in baseflow constributions to Teatree Hollow tributary in the vicinity of TT1-QLa have occurred during the review period. Therefore, it was concluded that there was no apparent correlation at this point in time between the apparent decline in groundwater level at P55C and the nearby surface water gauging station.

Comparison of other groundwater monitoring bore groups with associated surface water monitoring sites are provided in the Surface Water Monitoring Report (**Appendix B**).

2.3.1.3 Private bores

Plots showing the groundwater levels in the private bores are provided in the SLR Groundwater Monitoring Report (**Appendix D**).

Fluctuations in groundwater levels across the suite of private bores monitored are observed, however there were no identifiable trends and no indications of impact from extraction activities (**Appendix D**).

2.3.1.4 Shallow VWPs (sensors <200 metres)

Shallow VWPs are showing variation in responses since commencement of extraction. TBC009 (HBSS – 30m) has experienced a small steady decline of approximately 2 metres since November 2022, however the deeper sensors are remaining relatively stable. TBC018 is also showing approximately 2 metres drawdown in the three shallowest sensors (70m, 117m, 164m), approximately 1.5 metres decline in the sensor at 179 m and has remained stable in the deepest sensor at 198 m. TBC027 is showing some small steady decline, ranging between 0.5 metres to 1.5 metres across all depth sensors, although there is no apparent relationship in the depressurisation incurred and the depth profile. TBC032 is the closest VWP to current extraction activities, and is showing depressurisation of up to 12 metres in the deepest sensor (200m). The shallower sensors are all showing some minor trends in depressurisation ranging between 1 and 7 metres. TBC034 remains stable and TBC039 has observed an increase in water level (**Appendix D**).

Refer to hydrographs provided in the SLR Groundwater Monitoring Report in **Appendix D**.

2.3.1.5 Deep VWPs (sensors >200 metres)

The deep VWPs overall are showing some depressurisation but this is not consistent spatially or across depth profiles at individual sites.

TBC009 is showing maximum depressurisation of 8 metres between December 2022 and May 2023 at sensor depth 357m, however a recovery of 1 metre was observed subsequently. Approximately 2 meters of drawdown was observed in the sensors above and below (343 m and 392 m) between November 2022 and Feb 2023 after which point the levels have stabilised. TBC018 has observed steady drawdown to a maximum of two metres since November 2022, with less drawdown followed by stabilisation and some recovery in the deeper sensors. TBC020 has shown fluctuation across all sensors, the lowest three sensors have observed no overall drawdown. The shallowest sensor (211m) observed total drawdown of approximately 2 metres at June 2023, though fluctuated to a maximum of 7 metres drawdown over the reporting period.

TBC026 has shown significant fluctuations in water levels and with some overall drawdown occurring, but also an increase above baseline conditions in the deepest sensor (440m). TBC032 is the closest VWP to current extraction activities and has observed relatively steady drawdown over time, with the shallowest sensor showing the highest drawdown, which decreases with depth (220m sensor – 12.5 metres drawdown, 237m sensor – 2.5 metres drawdown, 294 metre sensor – 2 metres drawdown). TBC039 is not showing any clear response to mining with water levels stable, increasing above baseline conditions or some drawdown and stabilisation (**Appendix D**).

Refer to hydrographs provided in the SLR Groundwater Monitoring Report in **Appendix D**.

2.3.2 Mine Water Intake

Tahmoor Coal has a Groundwater Licence (WAL 36442) to extract 1642 ML/year of groundwater make from underground.

The inferred water make (groundwater that has seeped into the mine from the strata) is calculated from the difference between total mine inflows and total mine outflows. This calculation is assisted by input from flow meters installed on fresh water supply lines that pump water into the mine (mine inflow from Sydney Water supply to underground workings), and flow meters on three pipelines that extract water from underground (mine outflow). In addition, mine inflow and outflow also includes a measurement of water that enters and exits the mine through other means such as moisture in air vented in and out of the mine (water in vented air), and moisture in coal extracted from the mine.

Water make calculations provide an indication of the groundwater pumped out of the total Tahmoor Mine underground workings, which include water make from the Western Domain.

SLR completed an analysis of water make for Tahmoor Mine recorded between 1 January 2009 to 30 June 2023 (**Appendix D**). During this period, observed inflows to Tahmoor Mine have been ranging between 2 to 7 ML/d. In October 2022, the Western Domain blocks were sealed. Since this time, the average groundwater inflow from Tahmoor underground workings is reported as 2.3 ML/d.

The reporting period for this report falls within the water year calendar 2022-23. The observed cumulative groundwater make for the water year 2022-23 is 1,068 ML, which remained below the groundwater entitlement of 1,642 ML per annum (i.e. water year) (refer **Figure 2-9**).

2.3.3 Groundwater Quality

Groundwater quality has been monitored monthly in the OSPs (monitoring network and private bores) since the commencement of extraction.

Table 3 in the Groundwater Monitoring Report (**Appendix D**) summarises the Tahmoor South Groundwater Monitoring Network, and the locations of groundwater monitoring bores is provided in **Figure 2-8**.

Further detail on groundwater quality results, including graphs showing progressive groundwater quality results, are provided in the Groundwater Monitoring Report (refer to **Appendix D**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 3.2.5**.

2.3.3.1 Electrical conductivity and pH

The pH and EC across all bores show some level of fluctuation with no apparent trends across the full record (**Appendix D**).

2.3.3.2 Metal concentrations

Metals across all bores have shown fluctuation over the reporting period. Elevated dissolved barium, strontium and manganese levels were recorded during the reporting period at a number of groundwater monitoring sites. Analysis indicates that this is unlikely attributable to mining with sporadic spatial and depth profile distribution. Ongoing monitoring will be used to reassess baseline conditions and triggers.

The spatial distribution of the bores showing trends in barium, manganese, and strontium (refer to Figures 9, 12, and 14 of **Appendix D**) are inconsistent with a response to mining, with bores spatially disparate from extraction activities showing this trend. For example, bores located at a similar distance (or closer) to extraction are not showing similar trends and hence the trends are not easily attributable to mining activities. Additionally, nested sites are not showing consistent trends in barium, manganese, and strontium.

Furthermore, observed concentrations of the dissolved metals barium, strontium and manganese in groundwater is generally consistent with the observed pre-mining concentrations of these dissolved metals in surface water (**Appendix D**). Therefore, it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period.

Given that extraction at LW S1A commenced less than one year ago (i.e. October 2022), it is likely to be too early in the monitoring period to conclude that TARP exceedances related to groundwater quality are conclusively mining related. As such, it is more likely, that TARP exceedances related to groundwater quality are representative of natural fluctuations in water quality.

Groundwater trigger levels were calculated using a short baseline period which could result in a conservative trigger level for barium, strontium and manganese. It is noted that a full 12-month period of monitoring data is yet to be collected, and as such, climatic drivers and seasonality have not been fully reflected in the monitoring data. It is recommended that a revision of the trigger levels for dissolved metals, specifically barium, strontium and manganese, is undertaken once the October 2023 monitoring data has been reviewed. This would allow a full 12-month period of monitoring data to be included into 'baseline' period from which trigger values can be recalculated, and therefore capture the natural variability of the system.

2.3.4 Recommendations and Actions

2.3.4.1 Current Groundwater Monitoring Recommendations

As discussed in the Groundwater Review for January to June 2023 (**Appendix D**), the following groundwater recommendations were made for this reporting period by SLR:

- Revise the trigger levels for dissolved metals, specifically barium, strontium and manganese, by including the 12-month period of monitoring data from October 2022 to October 2023 in the 'baseline' period from which trigger values can be recalculated, such that the trigger levels capture the natural variability of the system;
- Remove monitoring site GW062068 from the groundwater monitoring program due to infrastructure issues that render the bore unsuitable for ongoing monitoring;

- Establish the historical groundwater level for VWPs TBC09 (BUSM-381m), TBC018 (WBCS-377m). TBC020 (WBCS-397m) and TBC020 (WO-439m) so that drawdown at these locations can be calculated;
- Review the configuration of all VWPs in the monitoring network as it appears there are potential issues of channels duplicating data (particularly at Site TBC024) and misalignment between the understanding of installed/labelled sensor depth and the sensor depth as per the data download;
- Following a review of the VWP configuration, consider removing VWPs TBC024 (BHCS-168m), TBC032 (in particular, HBSS-95m) and TBC034 (BHCS-176m) from the monitoring regime as data appears to be erroneous due to faulty loggers;
- Continue the monitoring program, and the reporting of groundwater level and quality data in the monthly groundwater monitoring reporting;
- Once groundwater level data become available at the Thirlmere Lakes bores, assess groundwater levels against WMP13 to confirm that no groundwater level exceedances occurred following the commencement of LW S1A; and
- Install and commence monitoring at P50, in order to replace P51 as an early warning bore in WMP13.

Progress of these recommendations will be provided in the next Six Monthly Subsidence Impact Assessment for the Tahmoor South Domain.

2.3.4.2 Previous Groundwater Monitoring Recommendations

Table 2-3 provides the recommendations as made in the previous Six Monthly Subsidence Impact Report (October to December 2022) for groundwater, along with an update on the progress of these recommendations.

Table 2-3 Groundwater recommendations from the previous Six Monthly Subsidence Impact Report and Current Progress

Item	Previous Recommendation	Progress of Recommendation
1	Update of the LW S1A-S6A Water Management Plan to incorporate revision of the TARPs.	Proposed amendments to the LW S1A-S6A Water Management Plan were submitted to DPE on 5 July 2023. Tahmoor Coal and DPE (as well as DPE Water) are in currently in consultation regarding the changes to the WMP. Following finalisation of the TARP changes, the WMP will be finalised and published on the Tahmoor Coal website.
2	In the next Six Monthly Subsidence Impact Report, review the baseline data in conjunction with the additional data collected to that point. If no impact from mining has been identified, consider incorporating the additional data points into the 'baseline' period and recalculate the triggers to capture natural variability of the system.	Review of the data in this Six Monthly Subsidence Impact Report has indicated that fluctuations noted are not attributable to mining and consequenctly can be used as additional baseline data for recalculation of triggers.
3	Install and commence monitoring at P50, and consequently replace P51 with this new bore as an early warning bore in TARP WMP13.	Due to landowner consent, the installation of P50 has been delayed. Tahmoor Coal is continuing to gain landowner consent to install this shallow bore (as per current recommendations).

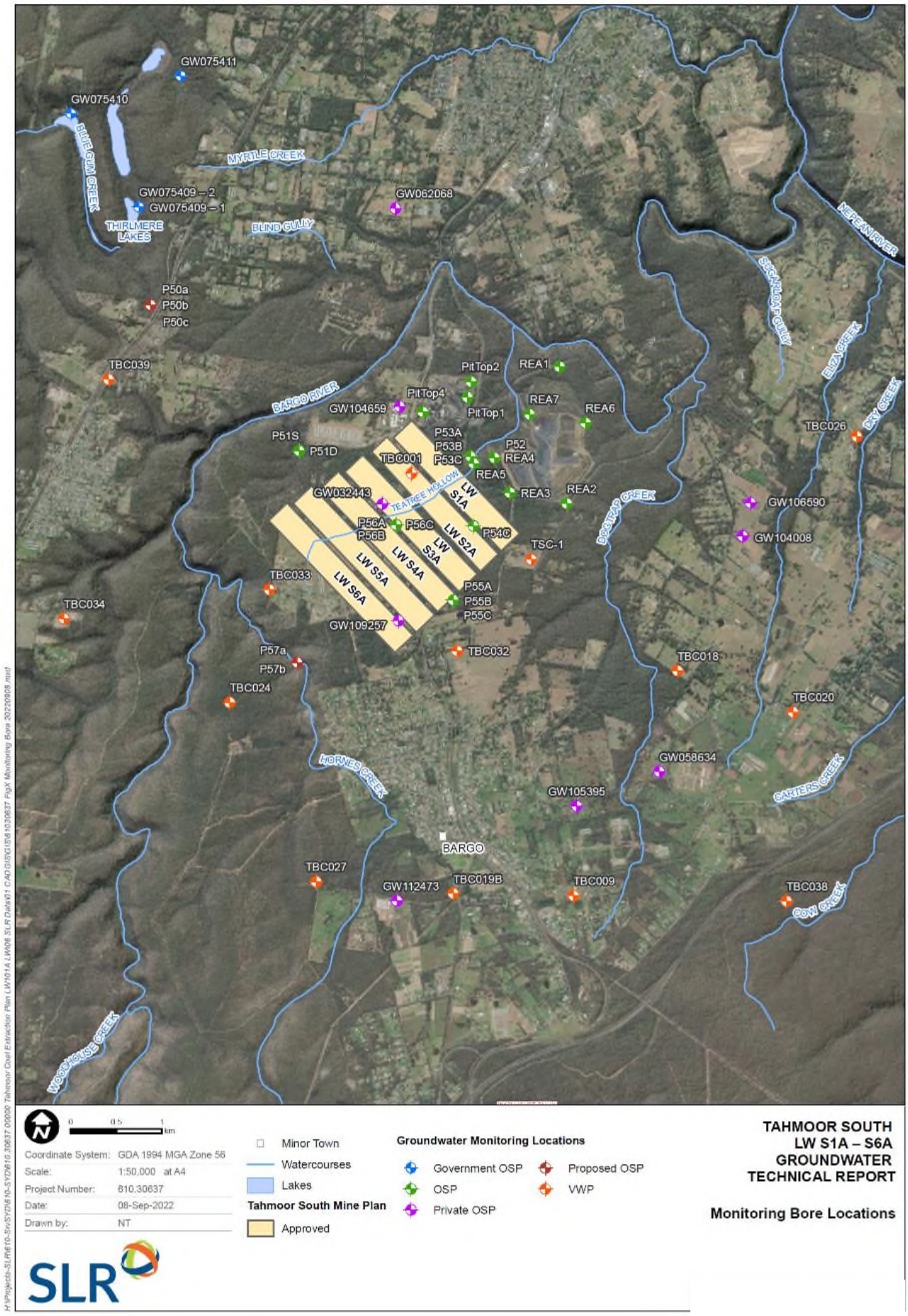


Figure 2-8 LW S1A-S6A Groundwater Monitoring Site (source: LW S1A-S6A Water Management Plan)

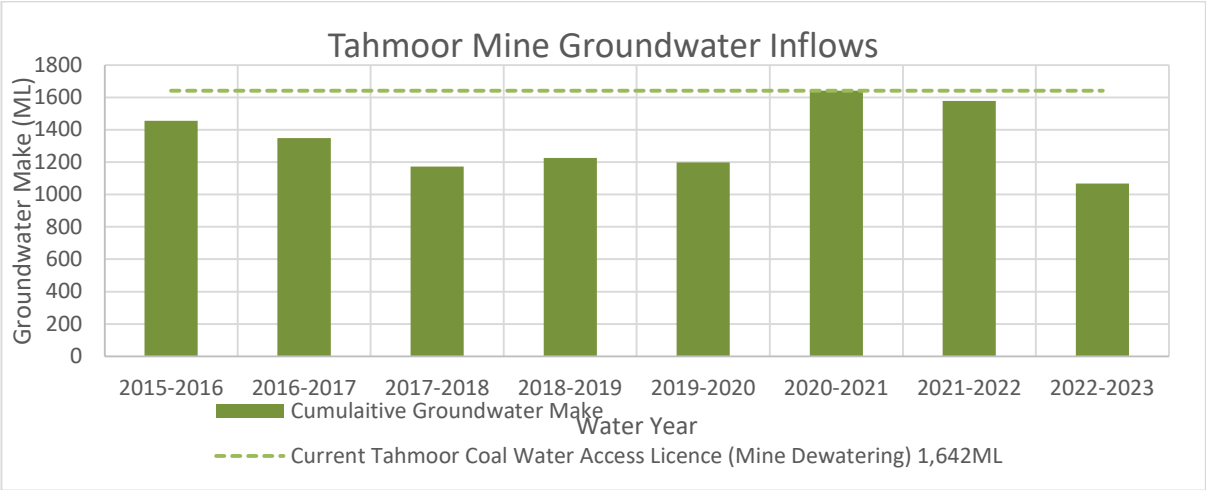


*Figure 2-9 Groundwater Make per Water Year (financial year) from 2019/20 to 2022/23 (source SLR, Groundwater Monitoring Report, **Appendix D**).*

2.4 Land Monitoring

The LW S1A-S6A Land Management Plan was prepared to manage the potential environmental consequences of LW S1A-S6A extraction on cliffs, natural steep slopes, farm dams, agricultural land in accordance with Condition C8 of SSD 8445.

During this reporting period, the LW S1A-S6A Land Management Plan has been implemented to monitor the following landscape features:

- Cliffs – visual inspection at the completion of mining by a geotechnical engineer (Cliff BC1 after LW S6A, Cliff BC2 after LW S3A, S4A, S5A and S6A). No visual inspections have been required during this reporting period;
- Natural steep slopes – monthly visual inspection during active subsidence period by a geotechnical engineer. This monitoring and reporting is completed by Douglas Partners (available on request);
- Farm dams – dam embankment integrity and water level observation every week during active subsidence, and every month the active subsidence period by a geotechnical consultant. This monitoring is completed by Building Inspection Services on a weekly basis, and Douglas Partners on a monthly basis, and reported in their reports (available on request); and
- Agricultural land – weekly inspections along local roads and farm dams, and visual inspection at the completion of each longwall for land within the predicted limit of subsidence for each longwall. This monitoring is covered by the farm dams inspections discussed above and built features monitoring discussed in **Section 2.7.2**. No post-longwall visual inspections were completed during the reporting period.

The following sections summarise the observations made during the reporting period for each land category. Performance against all Land Management Plan TARPs for the reporting period are summarised in **Table 3-1**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

2.4.1 Cliffs

The locations of cliffs (BC1 and BC2) within the LW S1A-S6A Study Area are illustrated in **Figure 2-10**.

During the reporting period, no visual inspections of cliffs were required according to the LW S1A-S6A Land Management Plan.

2.4.2 Natural Steep Slopes

The locations of natural steep slopes within the LW S1A-S6A Study Area are illustrated in **Figure 2-10**.

During the reporting period, visual and photographic surveys of natural steep slopes were completed monthly for features within the LW S1A active subsidence zone. No visual observations or cracks, localised ground bulging, buckling or shearing was observed at natural steep slopes.

2.4.3 Farm Dams

The location of dams within the LW S1A-S6A Study Area are illustrated in **Figure 2-11**.

During the reporting period, visual and photographic surveys for subsidence impacts on dams were completed on a weekly and monthly basis of dams within the LW S1A active subsidence zone.

Visual inspections of dams located in the active subsidence zone did not identify any mining-related impacts during the reporting period.

At monitored dams FD6, FD7, FD8, FD9 and FD10, visual inspections from 23 March to 17 April 2023 observed ongoing reductions of water level due to warmer weather. Both dams were partially refiled following recent rain in early May 2023, however in late May to the end of the reporting period, water levels at both dams were progressively reduced due to lack of rainfall.

At FD6, localised and discontinuous cracking in the upstream embankment was noted in February 2023. This cracking was noted to be inconsistent with cracking typically associated with mine subsidence, and is probably due to shrinkage of embankment clays which have been exacerbated by abnormal moisture conditions from trees growing close by in the embankment.

At FD8 and FD9, erosion and voids within the upstream face were noted in March 2023, and were indicated to be due to sodic soil conditions in the farm dam embankment fill which are prone to erosion.

At FD9, moise ground and green grass at the toe of the dam was noted from April 2023 to the end of the reporting period. This observation indicated seepage below or through the lower part of the dam embankment, however it was not considered to be related to mine subsidence.

2.4.4 Agricultural Land

Agricultural land identified within the LW S1A-S6A Study Area are illustrated on **Figure 2-12**.

Inspections points were set up prior to the commencement of LW S1A mining to provide vantage of agricultural land within the LW S1A-S6A Study Area. The purpose of the surveys is to note whether change has occurred to agricultural land, and to assist in determining if any change can be attributed to mining impacts. Surveys noted the presence of erosion, condition of boundary and internal fencing components, paddock gate condition, out-building condition, paddock dam condition, presence of any surface slumping or cracking, and the presence of vegetation dieback.

During the reporting period, visual and photographic surveys of agricultural land have been completed as part of inspections for local roads, which are discussed in **Section 2.7.2**.

A post-longwall visual inspection was completed on 4 July 2023 (just outside of this reporting period) following the completion of LW S1A extraction. The report noted that ground surface features observed during the post-mining agricultural land monitoring were considered typical for the age, location, type of construction and climatic conditions present at the time of the inspection. There were no identified assests or land that were associated with potential hazards as a result of LW S1A extraction.

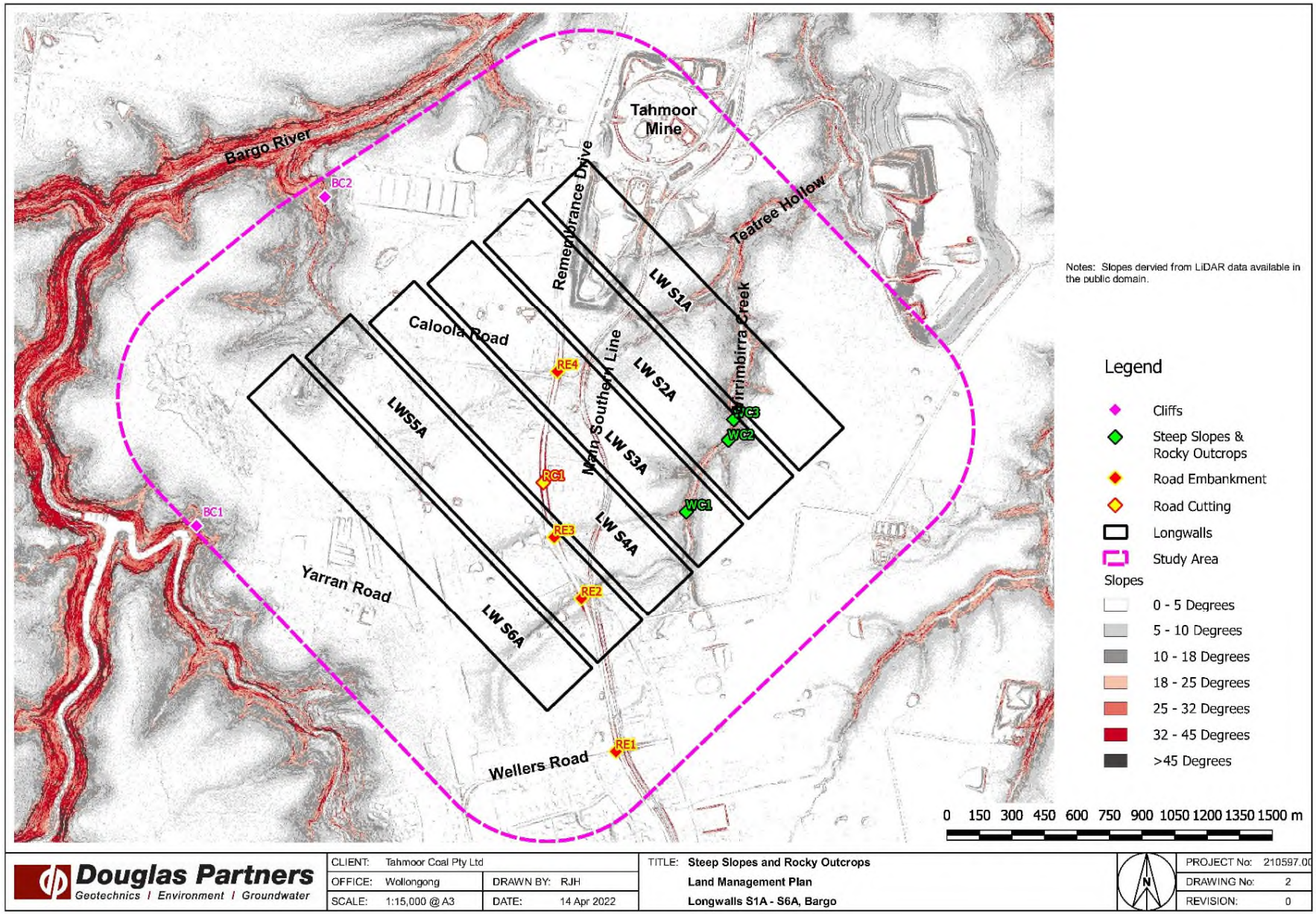


Figure 2-10 Cliffs and natural steep slopes within the LW S1A-S6A Study Area (source: LW S1A-S6A Land Management Plan)

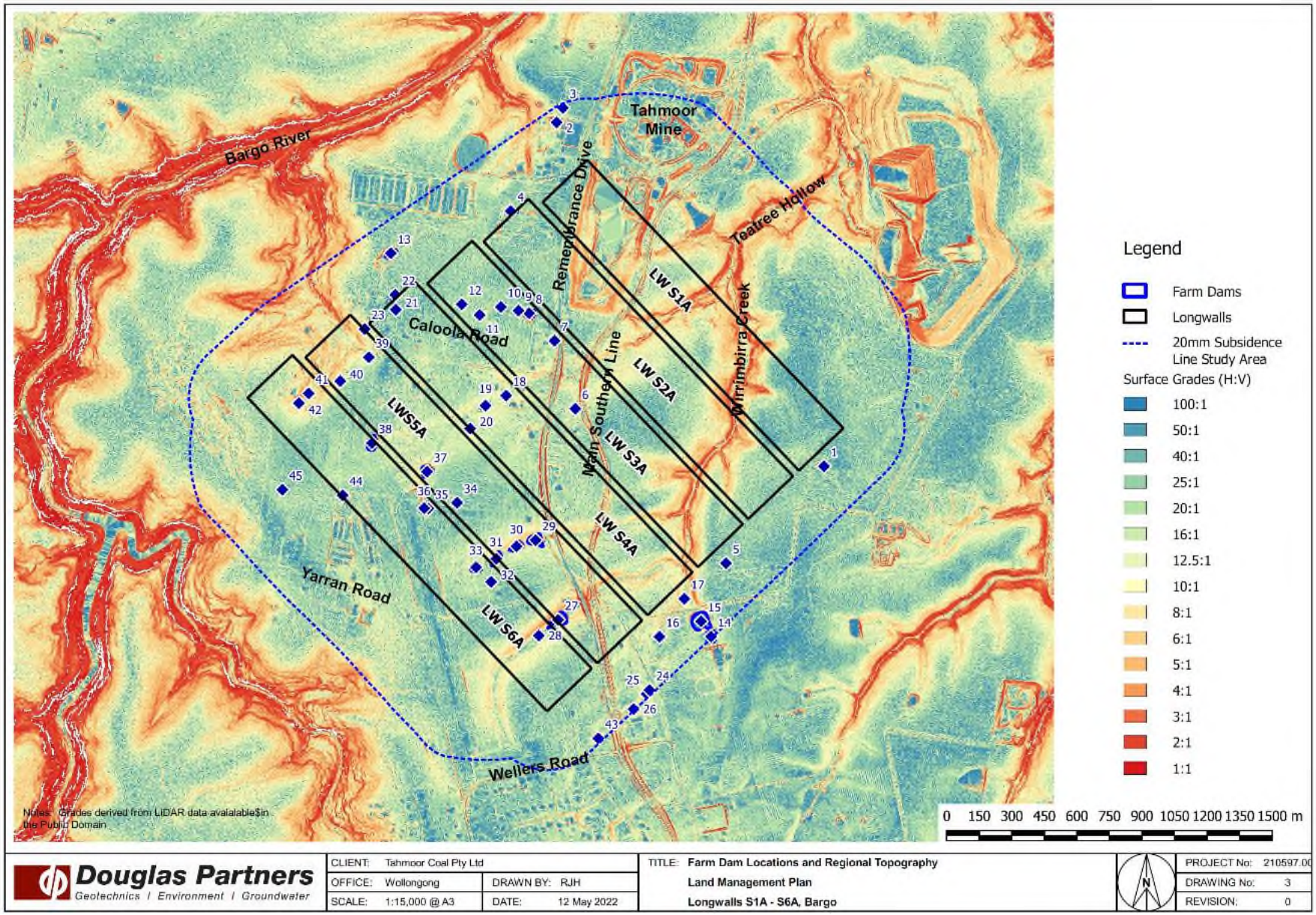


Figure 2-11 Dams within the LW S1A-S6A Study Area (source: LW S1A-S6A Land Management Plan)

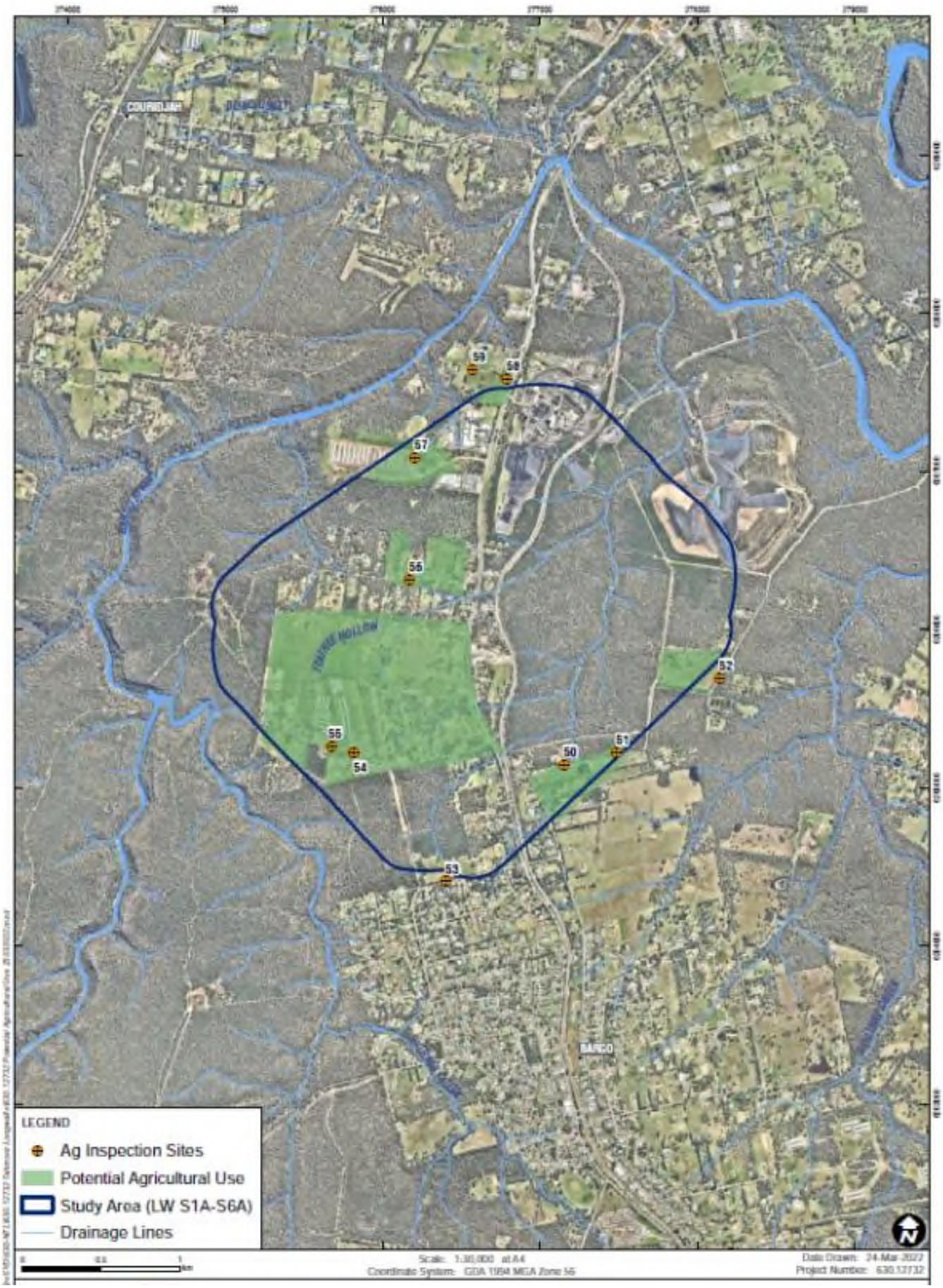


Figure 2-12 Agricultural land and inspection sites within the LW S1A-S6A Study Area (source: LW S1A-S6A Land Management Plan)

2.5 Biodiversity Monitoring

The LW S1A-S6A Biodiversity Management Plan was prepared to manage the potential environmental consequences of LW S1A-S6A extraction on aquatic and terrestrial flora and fauna in accordance with Condition C8 of SSD 8445.

During the reporting period, the LW S1A-S6A Biodiversity Management Plan has been implemented to monitor ecology in the Study Area, as outlined below:

- Aquatic ecology – Bi-annual (Spring and Autumn) monitoring. During this reporting period, monitoring was completed during Autumn 2023 by Niche Environment and Heritage (Niche, 2023a); and
- Terrestrial ecology – Bi-annual (Spring and Autumn) monitoring. During this reporting period, monitoring was completed during Autumn 2023 by Niche Environment and Heritage (Niche, 2023b).

The following sections summarise the observations made during the reporting period for aquatic and terrestrial ecology. Performance against all Biodiversity Management Plan TARPs (BMP1-4) for the reporting period are summarised in **Table 3-1**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

2.5.1 Aquatic Ecology

The aquatic ecology monitoring program for LW S1A-S6A has been designed to monitor subsidence-induced impacts on aquatic ecology. The following survey methods have been completed during baseline and during mining monitoring sampling:

- Aquatic habitat assessment of geomorphology, channel diversity, bank stability, riparian vegetation and adjacent land use, water quality, macrophytes and local impacts and land use practices in accordance with the Australian River Assessment System (AUSRIVAS);
- Macroinvertebrate survey:
    - AUSRIVAS macroinvertebrate sampling; and
    - Quantitative benthic macroinvertebrate monitoring program.

The aquatic ecology monitoring program is primarily focused on macroinvertebrate monitoring regimes including AUSRIVAS and quantitative using Before After Control Impact (BACI) design.

2.5.1.1 Autumn 2023 Monitoring Results

Aquatic monitoring for autumn 2023 was conducted by Niche Environment and Heritage from 26 and 27 April 2023. A total of eight locations were sampled within Teatree Hollow, Hornes Creek and Moore Creek comprising four impact sites (TTH12, TTH13, TTH16, TTH17) and four control sites (HC7, HC8, MC14, MC15). The locations of monitoring sites are illustrated in **Figure 2-13**.

Due to dry conditions at impact monitoring Sites 13 (TTH13) and 17 (TTH17) along Teatree Hollow in autumn 2023, supplementary AUSRIVAS samples were opportunitistically collected downstream of these locations where water returned. Sampling at these locations was opportunistic and repeat sampling at these locations do not currently form part of the formal monitoring program.

The following results were observed for this monitoring period (Niche, 2023a):

- Autumn 2023 sampling marked a return to flow conditions being more typically in line with baseflow levels than in recent seasons (2022) that have seen elevated flows and significant rainfall. This was reflected in the observations of low flows, limited organic debris and lower pool levels across the monitoring sites (other than Sites 13, 16 and 17);

- Observations of mining induced changes to aquatic habitats were observed at Impact Sites 13, 16 and 17 (loss of pool water and flocculant), but not at Site 12;
- The water quality readings collected at Impact Site 12 (upstream of observed areas of mining induced change) along Tea Tree Hollow are comparable to baseline data, and also to that of the Control sites;
- The opportunistic water quality readings collected at supplementary Impact monitoring sites (downstream of areas of mining induced change) are suggestive of impaired water quality conditions, with elevated electrical conductivity levels, and low dissolved oxygen and pH levels;
- Supplementary AUSRIVAS samples (collected downstream of areas of mining induced change) indicate that these mining induced changes do not appear to have translated into acute impacts to macroinvertebrate assemblages immediately downstream, as these sites recorded biological scores comparable to baseline data, and also to the Control sites in autumn 2023;
- It is possible that a decline in stream health indices downstream of these areas of mining induced change may be detected over time; and
- The levels of variation observed in macroinvertebrate density and abundance among the Control sites in autumn 2023 are suggestive of the fluxes in aquatic habitats associated with this transition from elevated flows to more low flow conditions.

All impact monitoring sites align with a 'Normal Condition' in accordance with the BMP1 aquatic habitat and macroinvertebrate indicators (stream health) TARP in autumn 2023. The reduction in aquatic pool habitat observed at Sites 13, 16 and 17 have only occurred during one sampling occasion, and therefore do not trigger a Level 1 TARP trigger under TARP BMP1 as the changes have not occurred over two consecutive sampling occasions.

2.5.2 Terrestrial Ecology

The terrestrial ecology monitoring program for LW S1A-S6A has been designed to monitor subsidence-induced impacts on terrestrial ecology including riparian vegetation and amphibian monitoring.

The terrestrial ecology monitoring program uses a Before After Control Impact (BACI) design to identify ecological change within the Study Area as a result of mine subsidence by permitting comparisons of population trends between control and impact areas, before and after the impact. The following survey methods have been completed during baseline and during mining monitoring sampling:

- Floristic surveys within established vegetation monitoring plots for riparian vegetation, Threatened Ecological Communities (TEC), and threatened flora species;
- Amphibian monitoring along established transects:
    - Spotlighting;
    - Call provocation;
    - Listening for diagnostic frog calls; and
    - Tadpole identification.

2.5.2.1 Autumn 2023 Monitoring Results for Riparian Vegetation

Riparian vegetation monitoring for Autumn 2023 was conducted by Niche Environment and Heritage on 19 and 26 April and 25 May 2023. A total of six locations were sampled for riparian vegetation, including three impact sites (i01, i02, and i03) and three control sites (c04, c05 and c06) (**Figure 2-14**).

The following results were observed for this monitoring period for riparian vegetation (Niche, 2023b):

- During Autumn 2023 monitoring, vegetation cover and floristics at impact Site 3 were reduced by the partial removal of native midstorey and understorey vegetation (19% reduction in vegetation cover) for the extension of the weir on Teatree Hollow Creek. Data analysis completed in this report has identified that the partial vegetation removal has resulted in this site being less comparable to pre-data and has the potential to confound the monitoring assessment methodology. It is recommended that an additional site is established in a nearby area (un-impacted by vegetation removal) to serve as a proxy for past data collection at this site;
- According to the Fire Extent Severity Mapping (FESM) mapping (DPE 2022), all riparian Sites were burnt in the 2019/2020 bushfires (prior to the commencement of monitoring) were within a 'Moderate' to 'Extreme' severity burnt class, where all stratum layers were severely burnt to canopy height. Many species and communities will take years to recover, particularly those not adapted to fire or impacted by prolonged drought or other threatening processes. As monitoring continues, the residual impacts of fire are becoming less evident;
- Dominant species in terms of percent cover for Autumn 2023 in the riparian plots include *Eucalyptus piperita*, *Pteridium esculentum* (particularly dominant at control Site 4) and Black Wattle (*Acacia mearnsii*) (particularly dominant at impact Site 3). Most dominant exotic species included Panic Veldtgrass (*Ehrharta erecta*), Common Thornapple (*Datura stramonium)*, Blackberry (*Rubus fruticosus* sp. agg.) and Trad (*Tradescantia fluminensis*);
- Across all sampling seasons, native species richness appears to be decreasing at riparian control Sites, while native cover at impact Sites is relatively stable (only fluctuating slightly across seasons). During the Autumn 2023 there was a substantial increase in native species richness at control Sites whereas native species richness at impact Sites decreased only slightly;
- During the riparian monitoring from Autumn 2020 to Autumn 2021 (before), average floristic cover was generally higher at impact Sites compared with control Sites in both native and exotic species, whereas in Autumn 2022 to Autumn 2023 (after), average floristic cover is generally higher at control Sites or similar in both native and exotic species; and
- The Vegetation Integrity (VI) of the six riparian plots, across sampling seasons ranged between low to moderate condition. The VI scores for Autumn 2023, ranged between low to moderate condition. The fluctuation in VI scores is attributed to seasonality, reduced structural condition, and shifts in exotic species, which is likely due to past stochastic events observed earlier in 2022.

2.5.2.2 Autumn 2023 Monitoring Results for Threatened Ecological Communities

Monitoring of TEC vegetation for Autumn 2023 was conducted by Niche Environment and Heritage on 19 and 26 April and 25 May 2023. TEC monitoring was conducted at six sites including three impact sites (TEC4, TEC5 and TEC6) and three control sites (TEC1, TEC2 and TEC3). The locations of monitoring sites are illustrated in **Figure 2-15**.

TEC monitoring focused on Shale Sandstone Transition Forest in the Sydney Basin Bioregion (listed as Critically Endangered under the *Biodiversity Conservation Act 2016*) which is in moderate to high condition within the monitoring plots.

TEC monitoring for Autumn 2023 indicated that TEC remnants within the Tahmoor South Study Area were in moderate condition across control and impact Sites. There is variance in the scores, which may be due to seasonality, with greater influx of exotic species observed in Autumn.

2.5.2.3 Autumn 2023 Monitoring Results for Threatened Flora Species

Monitoring of threatened flora species for Autumn 2023 was conducted by Niche Environment and Heritage on 19 and 26 April and 25 May 2023. Threatened flora species were monitored at six plot sites in areas with known threatened flora records, including three impact sites (TF4, TF5 and TF6) and three control sites (TF1, TF2 and TF3). The locations of monitoring sites are illustrated in **Figure 2-15**.

The threatened flora monitoring was established in September 2022, and the baseline number of threatened individuals at each site was recorded within a fixed 10 x 10 m plot (prior to the commencement of mining) at each monitoring site. The threatened flora monitoring was established in September 2022 (prior to the commencement of mining). Two rounds of monitoring have occurred after the commencement of mining (Spring 2022 and Autumn 2023).

The six plots were designed to monitor a subset of individuals of the following species, Brown Pomaderris (*Pomaderris brunnea*), Bargo Geebung (*Persoonia bargoensis*), and small-flowered Grevillea (*Grevillea parviflora* subsp. *parviflora*).

During Autumn 2023 monitoring, the highest number of individuals was identified at the impact Sites. Given that there is a slight decline in the number of individuals across both control and impact sites, there are no observable subsidence related impacts on threatened flora populations.

Monitoring to date has indicated that the control and impact Sites are sufficiently similar (species and abundance) to be suitable for long-term monitoring.

2.5.2.4 Autumn 2023 Monitoring Results for Amphibian Monitoring

Amphibian monitoring for autumn 2023 was conducted by Niche Environment and Heritage on 19 and 26 April and 25 May 2023. A total of six locations were sampled for riparian vegetation, including three impact sites (i01, i02, and i03) and three control sites (c04, c05 and c06). The locations of monitoring sites are illustrated in **Figure 2-14**.

Amphibian monitoring targeted two threatened frog species – the Giant Burrowing Frog (*Heleioporus australiacus*) and the Red-crowned Toadlet (*Pseudophryne australis*).

The following results were observed for this monitoring period (Niche, 2023b):

- Frog detection rates were variable across Autumn monitoring events. The species driving this variation was the Common Eastern Froglet (*Crinia signifera*). The Autumn 2023 monitoring surveys were completed following several consecutive months of substantially below average monthly rainfall, with the exception of April 2023;
- A total of two frog species were detected across the Autumn 2023 monitoring event, which represents a reduced level of species detection that is observed across both control and impact monitoring sites, in comparison to the Autumn 2022 surveys;
- The targeted threatened frog species appears not to be present in the Study Area, based on baseline and post-impact monitoring completed to date. While the study area contains superficially suitable habitat, it is possible that these species would no longer be able to survive in the area due to number of factors such as:
    - Absence of suitable non-breeding habitat for Giant Burrowing Frog at most monitoring Sites (due to removal of groundcover from fire, heavy weed encroachment and erosion);
    - Increased urban encroachment resulting in habitat removal, altered hydrological flows, water quality and nutrient loads; and
    - Potential predation pressures from two introduced predators: Eastern Gambusia (*Gambusia holbrooki*) and the Yabby (*Cherax destructor*), both of which were detected at all Sites.

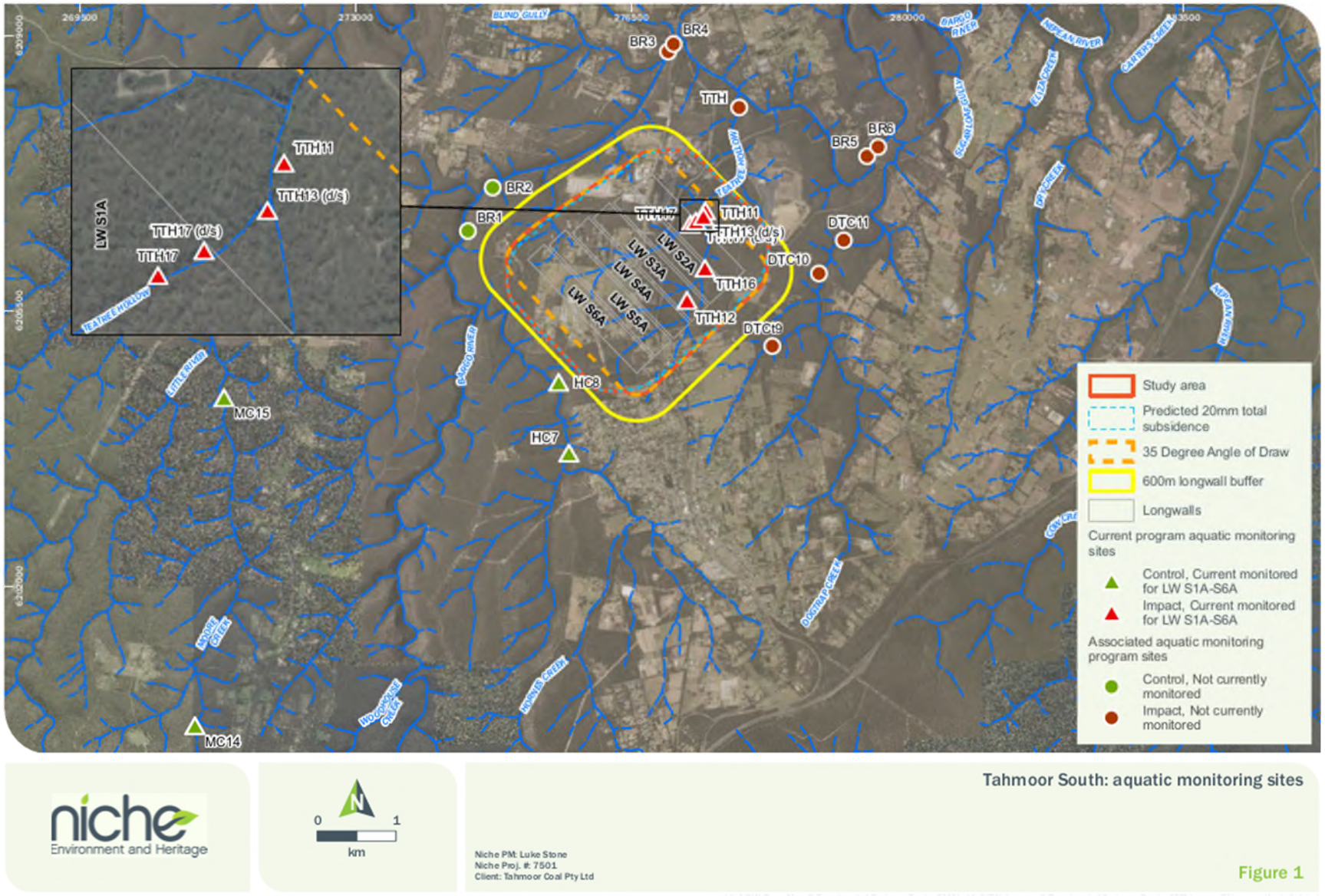


Figure 2-13 LW S1A-S6A Aquatic Ecology Monitoring Locations (source: Niche, 2023a)

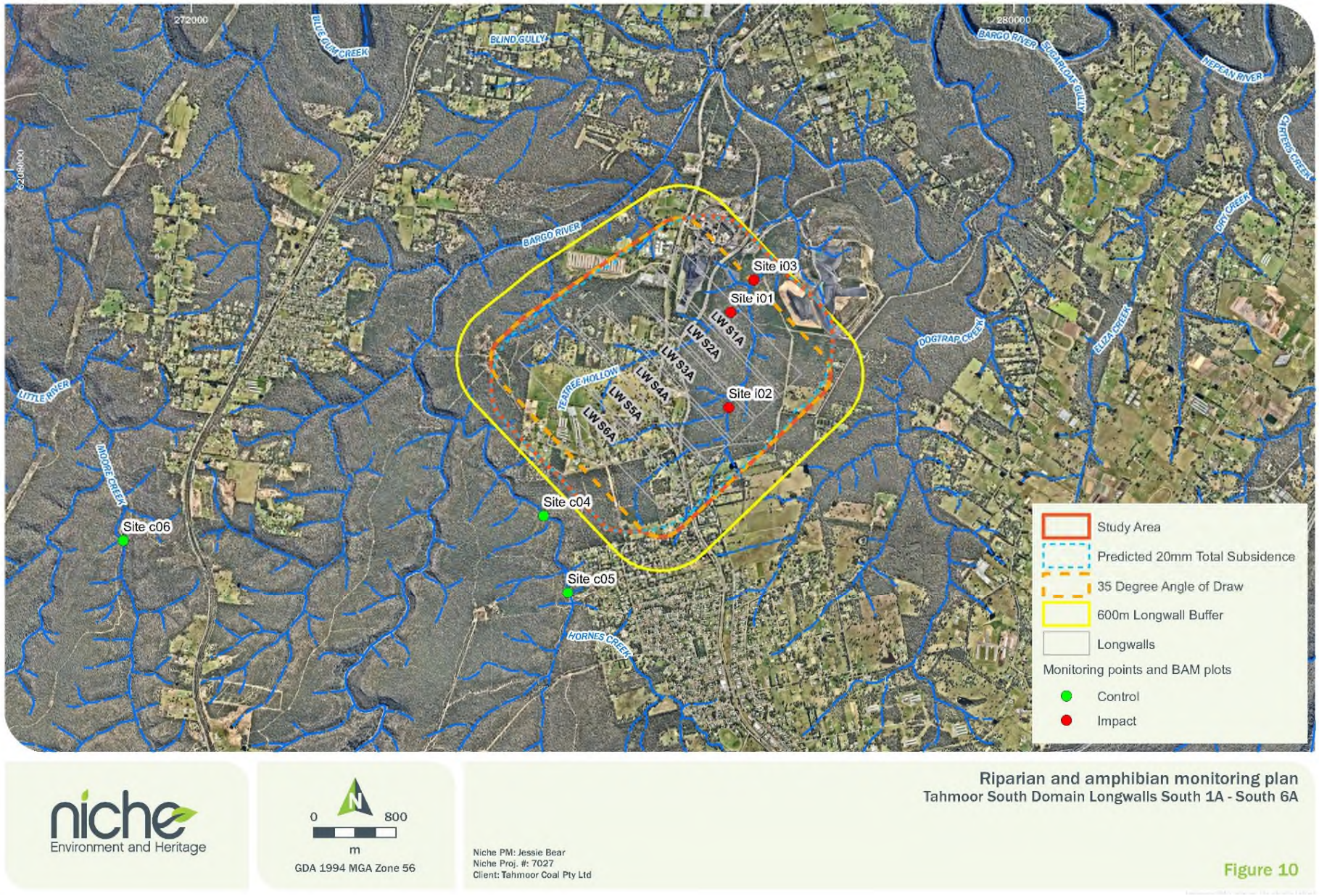


Figure 2-14 LW S1A-S6A Riparian Vegetation and Amphibian Monitoring Locations (source: LW S1A-S6A Biodiversity Management Plan)

This information has been retracted
- For more information contact Tahmoor Coal

SIMEC
Level 28, 88 Phillip Street,
Sydney NSW 2000
Legal entity name goes here ABN: 00 000 000 000

T: +61 (0) 2 0000 0000
E: xxxxxxx.xxxxxxx@simecgfg.com
simec.com

2.6 Heritage Monitoring

The LW S1A-S6A Heritage Management Plan was prepared to manage the potential environmental consequences of LW S1A-S6A extraction on Aboriginal heritage and historical heritage sites and values in accordance with Condition C8 of SSD 8445.

The following sections summarise the observations made during the reporting period for Aboriginal and historical heritage items. Performance against all Heritage Management Plan TARPs (HMP1 and HMP2) for the reporting period are summarised in **Table 3-1**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

2.6.1 Aboriginal Heritage

During this reporting period, the LW S1A-S6A Heritage Management Plan has been implemented to monitor subsidence impacts on the rockshelter Teatree Hollow 2013.1 (AHIMS 52-2-4471) (refer **Figure 2-16**). The Aboriginal heritage monitoring of this rockshelter requires the following monitoring during and post-mining:

- Fortnightly visual inspection of the rockshelter (monitoring overall rockshelter stability) during periods of active subsidence for LW S1A, S2A, S3A and S4A, to be completed from a safe distance. This monitoring is completed by Building Inspection Services and Douglas Partners on an alternative monthly schedule, and reported in their monthly reports (available on request);
- Monitoring of GNSS units / survey lines in proximity to the rockshelter, reviewed on a monthly basis during periods of active subsidence for LW S1A, S2A, S3A and S4A. This monitoring is summarised in the weekly MSEC Subsidence Reports (refer to **Appendix A** for referenced reports); and
- Visual inspection by archaeologist with RAPs at the completion of LW S1A, S2A, S3A and S4A. An end of panel inspection for LW S1A was completed shortly after this reporting period (10 July 2023), and the results have been included in this report (refer **Appendix E**).

It is noted that the artefact scatter Remebrance Drive 2013.1 (AHIMS 52-2-3968) and isolated find TC14-2-19 (AHIMS 48-2-0275) were also assessed in the LW S1A-S6A Heritage Management Plan, however no pre-mining, during mining or post-mining monitoring is required for these sites.

During the reporting period, minor ground movements have been measured by GNSS units S03 and S04 located on either side of Wirrimbirra Creek (in vicinity of the rockshelter site) (**Appendix A**).

The end of panel inspection following the extraction of LW S1A did not identify any observable impacts such as cracks, exfoliation, or collapse, as a result of subsidence or other activities. Further, the floor of the rockshelter showed no evidence of recent rockfall or other moved material that may suggest collapse or movement has occurred (**Appendix E**).

A small patch of the rear wall at the southern end of the site appeared to exhibit signs of fresh abrasion, however this was noted to likely be the result of animal activity or changing climatic conditions. There is no evidence that this relates to mining activities, nor does it require any form of remediation (**Appendix E**).

Teatree Hollow Creek adjacent to the rockshelter was notably empy at the time of the site inspection. While not part of the rockshleter site itself, the proximity of the site to the creek provides both a probable reason for its original use in the past and contributes to its aesthetic significance. Further discussion of changes in creek flow in relation to mining and climatic conditions is discussed in **Section 2.2**.

2.6.2 Historical Heritage

During this reporting period, the LW S1A-S6A Heritage Management Plan was implemented to monitor subsidence impacts for the following historical heritage items (refer **Figure 2-17**):

- Wirrimbirra Sanctuary (Australian Wildlife Sanctuary):
  - Various monitoring as per the Australian Wildlife Sanctuary Management Plan - This monitoring is summarised into a Weekly Subsidence Status Report by MSEC (refer **Appendix A** for referenced reports);
  - Visual inspection by a heritage consultant at the completion of LW S5A - No visual inspections have been required during this reporting period;
- Bargo Railway Bridge North (Wellers Road Overbridge) and Bargo Railway Viaduct:
  - Various monitoring as per the Main Southern Railway Management Plan and the Wellers Road Overbridge Management Plan (to be prepared) - This monitoring is summarised into a Weekly Subsidence Status Report by MSEC (refer **Appendix A** for referenced reports);
  - Visual inspection by a heritage consultant at the completion of LW S6A - No visual inspections have been required during this reporting period;
- Bargo Cemetery:
  - Various monitoring as per the Bargo Cemetery Management Plan - This monitoring will be summarised into a Weekly Subsidence Status Report by MSEC and is not yet required;
  - Visual inspection by a heritage consultant at the completion of LW S6A - No visual inspections have been required during this reporting period;
- Picton Weir:
  - Various monitoring as per the Picton Weir Management Plan - This monitoring will be summarised into a Weekly Subsidence Status Report by MSEC and is not yet required;
- Tahmoor Colliery (Tahmoor Mine Site):
  - Various monitoring as per the Tahmoor Mine Site Management Plan - This monitoring is summarised into a Weekly Subsidence Status Report by MSEC (refer **Appendix A** for referenced reports);
- Great Southern Road (partial):
  - Various monitoring as per the Main Southern Railway Management Plan - This monitoring is summarised in the weekly MSEC Subsidence Reports (refer to **Appendix A** for referenced reports).

During the reporting period, no observations of impact were made at the Australian Wildlife Sanctuary (Refer **Section 2.7.12**), Wellers Road Overbridge and Bargo Railway Viaduct (refer **Section 2.7.1**), Bargo Cemetery (refer **Section 2.7.9**), Picton Weir (refer **Section 2.7.13**) or the Great Southern Road (refer **Section 2.7.2**).

During the reporting period, the following changes were observed at the Tahmoor Mine Site (refer to **Appendix G** for further information):

- 11 mm of closure between Pegs BL600 and BL700 of the rail loop, initially observed 15 May 2023. It is noted that this change has not resulted in any damage to the rail loop; and
- Cracks observed at two locations at 6C Tunnel and vent shaft interface initially observed on 29 May 2023. The number of cracks grew to seven (7) by the end of the monitoring period, all of them being less than 1 mm in width.

Impacts to Tahmoor Mine Site infrastructure were noted to be *possible* in the LW S1A-S6A Heritage Management Plan. A review of the changes observed at the 6C Tunnel noted that the hairline cracks are minor and, if required, could be repaired in a manner that preserves the heritage value of the mine (refer **Appendix E**). Therefore, it is unlikely that the performance measures identified in the LW S1A-S6A Heritage Management Plan will be exceeded. During the reporting period, the Tahmoor Mine Site remained safe and serviceable.Further discussion of these observations are provided in **Section 3.2**.

This information has been retracted
- For more information contact Tahmoor Coal

SIMEC
Level 28, 88 Phillip Street,
Sydney NSW 2000
Legal entity name goes here ABN: 00 000 000 000

T: +61 (0) 2 0000 0000
E: xxxxxxx.xxxxxxx@simecgfg.com
simec.com

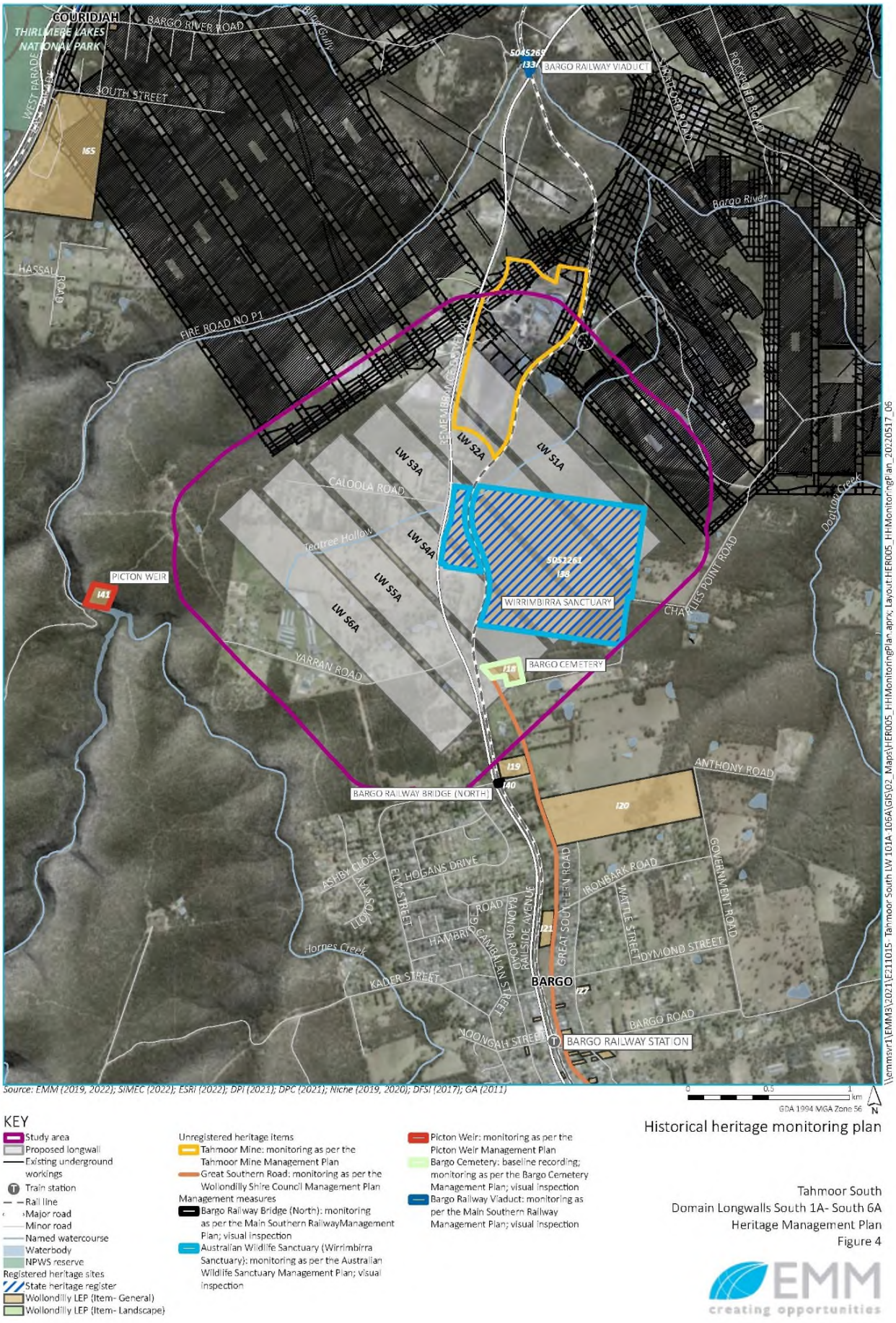


Figure 2-17 Historical Heritage Sites in the LW S1A-S6A Study Area and Surrounds (Source LW S1A-S6A Heritage Management Plan)

2.7 Built Features Monitoring

The LW S1A-S6A Built Features Management Plan and associated sub-plans were prepared to manage the potential environmental consequences of LW S1A-S6A extraction on built features in accordance with Condition C8 of SSD 8445.

During this reporting period, the LW S1A-S6A Subsidence Monitoring Program was implemented to monitor subsidence impacts on infrastructure owned by Wollondilly Shire Council (roads, bridges and culverts), ARTC (rail infrastructure), Sydney Water (potable water infrastructure and sewer infrastructure), Endeavour Energy (electrical infrastructure), Jemena (gas infrastructure), Telstra (telecommunications infrastructure), NBN (telecommunications infrastructure), TPG (telecommunications infrastructure) and private property owners. The details of the Subsidence Monitoring Program are illustrated in **Figure 2-1**.

A weekly review of the subsidence survey results during the reporting period has been completed by MSEC during mining of LW S1A (referred documents provided in **Appendix A**). In addition, weekly reports by MSEC are prepared for specific built features including the Main Southern Railway, Tahmoor Mine Site, and Australian Wildlife Sanctuary.

The following sections summarise the observations made during the reporting period for built features. Performance against all built features TARPs for the reporting period are summarised in **Table 3-1**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

2.7.1 Main Southern Railway

Monthly and weekly surveys have been conducted on the Main Southern Railway during LW S1A, with the latest survey conducted on 10 August 2023. Rates of change have reduced to very low levels.

Weekly Subsidence Status Reports have been prepared for the Main Southern Railway, which summarise monitoring and inspection results for the railway track, early warning monitoring, embankment and culvert at 98.445 km, embankment and culvert at 98.739 km, embankment and culvert at 99.035 km, embankment and culvert at 99.338 km, cuttings, coal conveyor at 98.160 km, Bargo River Railway Viaduct at 96.256 km, Remembrance Drive Bridge over Bargo River at 96.385 km, Bago River Road Overbridge at 96.049 km, and Wellers Road Overbridge at 101.162 km.

During the reporting period, poor track geometry at 98.8 km was noted 15 April 2023 to have occurred. The cause of this change was confirmed to be due to mining-induced movements. Resurfacing on 3 June 2023 was noted to have improved track condition on both tracks. Further discussion of this observation is provided in **Section 3.2**.

During the reporting period, there were no adverse impacts were observed on bridges or the Viaduct. In addition, the Main Southern Railway was maintained in a safe and serviceable conditions during mining of LW S1A.

2.7.2 Local Roads and Bridges

Monthly and weekly surveys have been conducted on local roads and bridges during LW S1A in accordance with the Wollondilly Shire Council Managment Plan, Jemena Management Plan, Sydney Water Potable Water Management Plan, Sydney Water Sewer Management Plan, Telstra Management Plan, NBN Management Plan and TPG Management Plan. Observations have been reported in the weekly Subsidence Monitoring Reports (refer to in **Appendix A** for referenced reports).

2.7.2.1 Remembrance Drive

On 22 May 2023, non-conventional subsidence movements were initially measured at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47 (refer to **Figure 2-18**). Compression strain was measured to have increased between Pegs R47 and R48 on 29 May 2023. A localised resurvey of strain distances on 31 May 2023 found that compressive strain had reduced very slightly but remained approximately 1 mm/m. Compressive strain was measured to have increased between Pegs R47 and R48 on 6 June to approximately 1.4 mm/m. A localised resurvey of strain distances on 8 June found that compressive strain had increased very slightly to approximately 1.5 mm/m. No change was measured on 13 June. A localised resurvey of strain distances on 15 June found that compressive strain had increased very slightly to approximately 1.6 mm/m. No change was measured on 19 June. A localised resurvey of strain distances on 22 June found that compressive strain had increased very slightly to approximately 1.7 mm/m. The latest survey on 14 August measured changes within survey tolerances.

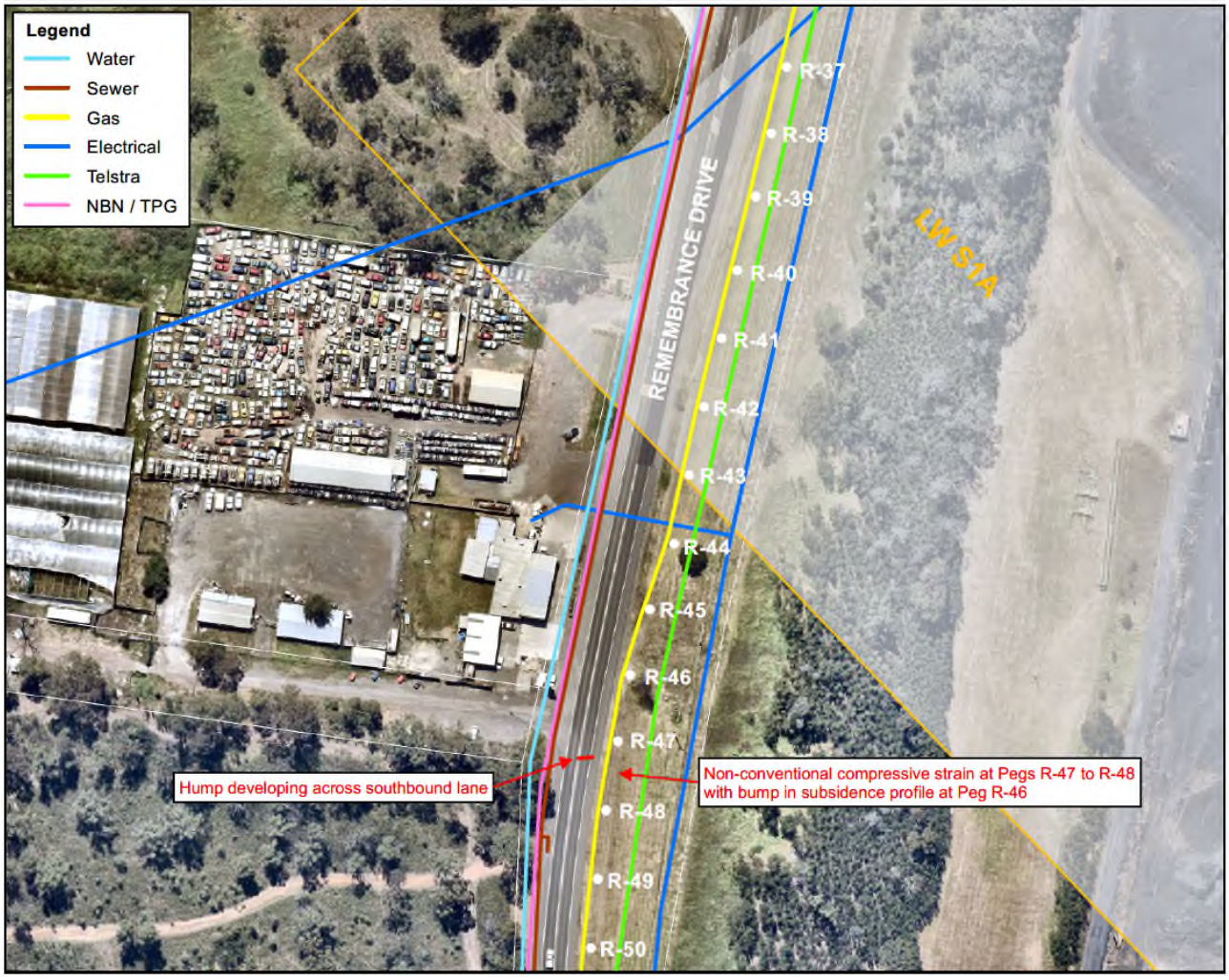


Figure 2-18 Location of non-convensional compressive strain, bump and hump on (Source: MSEC1304 Report 38, Appendix A)

A focused visual inspection was conducted on 31 May, which identified a small compression bump in the southbound lane of Remembrance Drive between Pegs R47 and R48. A photograph of the bump on 31 May is shown in **Figure 2-19**. The bump intersects with a number of utility services, including Jemena's gas main, Sydney Water's potable water main and sewer main, and optical fibre and copper telecommunication cables.

A visual inspection on 9 June found that the bump had extended slightly across towards the Northbound lane since the inspection on 31 May. Minor changes were observed on 20 and 23 June. A faint bump is visible on the edge line of the northbound lane south of Peg R46. No significant changes were observed on 18 August.

The management of this change is discussed further in **Section 3.2.5.**

Figure 2-19 Small bump observed in southbound land of Remembrance Drive near Peg R46 on 31 May 2023 (Source: MSEC1304 Report 38, Appendix A)

2.7.2.2 Other Roads

Monthly ground surveys have been conducted along Charlies Point Road, with very minor changes observed on 7 February 2023. A visual inspection of Charlies Point Road on 31 January found no issues. Ground surveys and visual inspections have ceased as Charlies Point Road is beyond the zone of active subsidence.

Surveys of Rockford Road Bridge and Arina Road Bridge were conducted on 25 July (outside of this reporting period), with observed changes within survey tolerance. Visual inspection of Arina Road Bridge on 2 August found no issues.

2.7.3 Potable Water Infrastructure

Monthly and weekly surveys have been conducted on local roads and bridges during LW S1A in accordance with the Wollondilly Shire Council Managment Plan, Jemena Management Plan, Sydney Water Potable Water Management Plan, Sydney Water Sewer Management Plan, Telstra Management Plan, NBN Management Plan and TPG Management Plan. Observations have been reported in the weekly Subsidence Monitoring Reports (refer to in **Appendix A** for referenced reports).

As discussed in **Section 2.7.2**, non-conventional subsidence movements were initially measured on 22 May 2023 at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47 (refer to **Figure 2-18**). The management of this observation is discussed further in **Section 3.2.5.**

No impacts to Sydney Water potable water infrastructure was observed during the reporting period.

2.7.4 Sewer Infrastructure

Monthly and weekly surveys have been conducted on local roads and bridges during LW S1A in accordance with the Wollondilly Shire Council Managment Plan, Jemena Management Plan, Sydney Water Potable Water Management Plan, Sydney Water Sewer Management Plan, Telstra Management Plan, NBN Management Plan and TPG Management Plan. Observations have been reported in the weekly Subsidence Monitoring Reports (refer to in **Appendix A** for referenced reports).

As discussed in **Section 2.7.2**, non-conventional subsidence movements were initially measured on 22 May 2023 at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47 (refer to **Figure 2-18**). The management of this observation is discussed further in **Section 3.2.5.**

No impacts to Sydney Water sewer infrastructure was observed during the reporting period.

2.7.5 Gas Infrastructure

Monthly and weekly surveys have been conducted on local roads and bridges during LW S1A in accordance with the Wollondilly Shire Council Managment Plan, Jemena Management Plan, Sydney Water Potable Water Management Plan, Sydney Water Sewer Management Plan, Telstra Management Plan, NBN Management Plan and TPG Management Plan. Observations have been reported in the weekly Subsidence Monitoring Reports (refer to in **Appendix A** for referenced reports).

As discussed in **Section 2.7.2**, non-conventional subsidence movements were initially measured on 22 May 2023 at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47 (refer to **Figure 2-18**). The management of this observation is discussed further in **Section 3.2.5.**

No impacts to Jemena gas infrastructure was observed during the reporting period.

2.7.6 Electrical Infrastructure

Ground surveys of critical power poles are conducted when Endeavour Energy electrical poles are within the active subsidence zone. The latest survey was on 25 May 2025. Observations have been reported in the weekly Subsidence Monitoring Reports (refer to in **Appendix A** for referenced reports).

Observations on Remembrance Drive (refer to **Section 2.7.2**) did not adversely affect Endeavour Energy infrastructure during the reporting period. No impacts to Endeavour Energy electrical infrastructure was observed during the reporting period.

2.7.7 Telecommunications Infrastructure

Monthly and weekly surveys have been conducted on local roads and bridges during LW S1A in accordance with the Wollondilly Shire Council Managment Plan, Jemena Management Plan, Sydney Water Potable Water Management Plan, Sydney Water Sewer Management Plan, Telstra Management Plan, NBN Management Plan and TPG Management Plan. Observations have been reported in the weekly Subsidence Monitoring Reports (refer to in **Appendix A** for referenced reports).

As discussed in **Section 2.7.2**, non-conventional subsidence movements were initially measured on 22 May 2023 at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47 (refer to **Figure 2-18**). The management of this observation is discussed further in **Section 3.2.5.**

No impacts to telecommunications infrastructure was observed during the reporting period. This was confirmed by visual inspections and OTDR testing.

2.7.8 Built Structures (General)

Monthly and weekly surveys are conducted at farm structures (farm buildings, sheds, tanks, fences) and residential structures (houses, swimming pools, associated residential structures, fences, pavement) during active subsidence as required.

During the reporting period, no impacts were observed at farm structures as a result of LW S1A extraction. No residential structures were located within the active subsidence zone of LW S1A.

A summary of observations of farm dams is provided in **Section 2.4.3**.

2.7.9 Bargo Cemetery

This location is located directly above LW S5A and was outside the active subsidence zone of LW S1A.

2.7.10 Wollondilly Anglican College

Weekly Subsidence Status Reports have been prepared for the Wollondilly Angligan College, which summarise monitoring and inspection results for the Remembrance Driveway, monitoring lines between College buildings, structures, fence lines, dams, and sensitive equipment.

During the reporting period, there were no triggers under the Wollondilly Anglican College Management Plan. One gate at the Wollondilly Anglican College has jammed and has been repaired.

2.7.11 Tahmoor Mine Site

Monthly and weekly surveys were conducted at the Tahmoor Mine Site during LW S1A in accordance with the Tahmoor Mine Site Management Plan. The latest survey was conducted on 17 July 2023, and the rates of change have reduced to very low levels.

Weekly Subsidence Status Reports have been prepared for the Tahmoor Mine site, which summarise monitoring and inspection results for general mine site monitoring, the stockpile area (including conveyor 5C and reclaim tunnel conveyor 6C), overhead conveyors, drift, winder, rail loop, mine site structures, overhead crane and monorails, shaft No. 3, dams, embankments and site servies, and the reject emplacement area.

During the reporting period, the following changes were observed:

- 11 mm of closure between Pegs BL600 and BL700 of the rail loop, initially observed 15 May 2023; and
- Cracks observed at two locations at 6C Tunnel and vent shaft interface initially observed on 29 May 2023. The number of cracks grew to seven (7) by the end of the monitoring period, all of them being less than 1 mm in width. Refer to **Appendix G** for relevant photo reports.

A schematic of the cracks at 6C Tunnel and a photo example of one crack is provided in **Figure 2-20**.

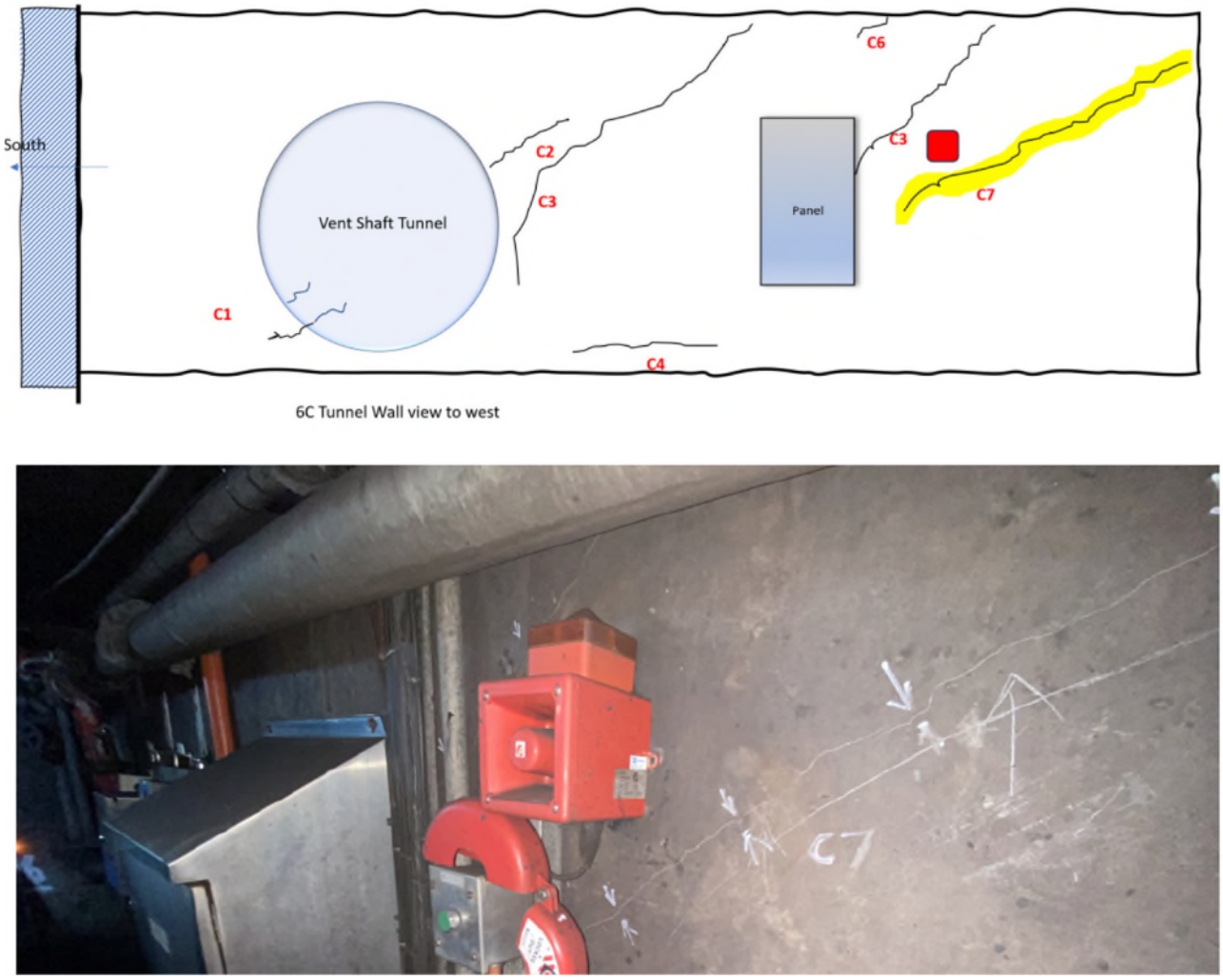


Figure 2-20 Schematic of cracks located in 6C Tunnel and example of crack (crack C7 taken 27 June 2023) (Source: Photo report: Tahmoor Mine Conveyors 27/9/2023, Appendix G)

Further discussion of these observations are provided in **Section 3.2**.

The mine site remained safe and serviceable during LW S1A extraction. A structural engineer inspected the cracks in the 6C Tunnel on 30 May 2023 and reported no immediate concerns.

2.7.12 Australian Wildlife Sanctuary

Weekly Subsidence Status Reports have been prepared for the Australian Wildlife Sanctuary, which summarises monitoring and inspection results from relevant GNSS units, ground survey (Tahmoor Mine Boundary line (V line)), survey and visual inspections of Main Southern Railway, local streets, structures; and natural features observations.

During the reporting period, there were no triggers under the Australian Wildlife Sanctuary Management Plan and no impacts were observed at this property.

2.7.13 Picton Weir

This built feature is located outside the active subsidence zone of LW S1A.

2.7.14 Bargo Petroleum (3030 Remembrance Drive)

Weekly Subsidence Status Reports have been prepared for the Bargo Petroleum (3030 Remembrance Drive), which summarise monitoring and inspection results from survey and visual inspections on Remembrance Driveway and structures, fuel balance monitoring and pressure testing of fuel tanks and fuel lines, hydrocarbon testing and visual inspections of groundwater, and alignment survey of vehicle hoists.

During the reporting period, an above-ground diesel tank failed a fuel balance test, resulting in further investigation. The cause of the tank failure was determined to be unlikely related to mining as surveys around the tank measured very small ground strains that were close to survey tolerance. Further discussion of this observation is provided in **Section 3.2**.

2.7.15 Inghams Farms

During the reporting period, there were no triggers under the Inhams Bargo Chicken Breeder Production Complex Management Plan and no impacts were observed at this property.

The Inghams Bargo Turkey Breeder Production Complex was not located within the active subsidence zone of LW S1A.

2.7.16 Tahmoor Garden Centre

Weekly Subsidence Status Reports have been prepared for the Tahmoor Garden Centre, which summarise monitoring and inspection results from the Remembrance Drive, structures, and outdoor storage racks.

During the reporting period, there were no triggers under the Tahmoor Garden Centre Management Plan and no impacts were observed at this property.

2.7.17 MKD Machinery

This property is located outside the active subsidence zone of LW S1A.

2.7.18 Bargo Valley Produce

This property is located outside the active subsidence zone of LW S1A.

2.7.19 Canine Country Club

This property is located outside the active subsidence zone of LW S1A.

2.7.20 Pamak Hobbies

This property is located outside the active subsidence zone of LW S1A.

2.8 Public Safety Monitoring

The LW S1A-S6A Public Safety Management Plan was prepared to manage the potential consequences as a result of LW S1A-S6A extraction on public safety within the Study Area in accordance with Condition C8 of SSD 8445.

As noted in **Section 1.3.3** of this report, management requirements for public safety are covered in the Built Features Management Plan and the Land Management Plan. Monitoring of cliffs, natural steep slopes and other landscape features has been conducted for the reporting period in accordance with the LW S1A-S6A Land Management Plan (refer to **Section 2.4** for a summary of monitoring results). In addition, monitoring of built features has been conducted for the reporting period in accordance with the LW S1A-S6A Built Features Management Plan (refer to **Section 2.7** for a summary of monitoring results).

No subsidence impacts were identified during the reporting period that were considered to pose a risk to public safety.

3 Overview of Impacts and Actions

3.1 Summary of Impacts

This section provides a comprehensive summary of all impacts during the reporting period, including a revised characterisation according to the relevant TARPs (if required).

A full list of TARPs for environmental features that are applicable is provided in Appendix B of the LW S1A-S6A Extraction Plan.

A summary of monitoring results for relevant TARPs is provided in **Table 3-1**.

Table 3-1 Summary of TARP Triggers for January to June 2023

Management Plan	TARP Reference / Sub-Management Plan	TARP Description	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
Water Management Plan	WMP1	Stream Water Quality for all Watercourses within the Subsidence Area	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	LEVEL 1 TRIGGERED[1] Exceedance of an SSGV occurred at a given potential impact site in three consecutive months at TT7 (for EC from March to May 2023).	LEVEL 1 TRIGGERED[1] Exceedance of an SSGV occurred at a given potential impact site in three consecutive months at TT7 (for dissolved iron and dissolved zinc from April to June 2023). LEVEL 2 TRIGGERED[2] Exceedance of an SSGV occurred at a given potential impact site in four or five consecutive months at TT7 (for EC from March to June 2023).
	WMP2	Stream Water Quality for other Watercourses (Bargo River and Hornes Creek)	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.	Exceedance of an SSGV did not occur or occurred for less than three consecutive months.
	WMP3	Pool Water Level for all Watercourses within the Subsidence Area	LEVEL 1 TRIGGERED[3] The recorded water level declined by greater than 10 centimetres (cm) below the recorded baseline minimum level at TT3 (11 – 17 January 2023).	LEVEL 1 TRIGGERED[3] The recorded water level declined by greater than 10 centimetres (cm) below the recorded baseline minimum level at TT9 (24 February to 13 March 2023) and TT12 (18 February to 15 March 2023). LEVEL 2 TRIGGERED[4] The recorded water level declined atypically below the recorded baseline minimum level for less than one month (as a consecutive period) at TT3 (7 February to 6 March 2023) and TT13 (21 February to 20 March 2023).	LEVEL 1 TRIGGERED[3] The recorded water level declined by greater than 10 centimetres (cm) below the recorded baseline minimum level at TT9 (24 February to 13 March 2023, and 20 March to 23 March 2023) and TT12 (18 February to 15 March 2023). LEVEL 2 TRIGGERED[4] The recorded water level declined atypically below the recorded baseline minimum level for less than one month (as a consecutive period) at TT3 (7 February to 6 March 2023), TT12 (16 March to 15 April 2023) and TT13 (21 February to 20 March 2023). LEVEL 3 TRIGGERED[5] The recorded water level declined atypically for greater than one month (as a consecutive period) at TT3 (7 March to 30 June 2023) and TT13 (21 March to 30 April 2023).	LEVEL 1 TRIGGERED[3] The recorded water level declined by greater than 10 centimetres (cm) below the recorded baseline minimum level at TT9 (20 April to 29 April 2023). LEVEL 2 TRIGGERED[4] The recorded water level declined atypically below the recorded baseline minimum level for less than one month (as a consecutive period) at TT12 (16 March to 15 April 2023). LEVEL 3 TRIGGERED[5] The recorded water level declined atypically for greater than one month (as a consecutive period) at TT3 (7 March to 30 June 2023), TT12 (16 April to 30 June 2023) and TT13 (21 March to 30 April 2023).	LEVEL 1 TRIGGERED[3] The recorded water level declined by greater than 10 centimetres (cm) below the recorded baseline minimum level at TT2 (23 May to 30 June 2023). LEVEL 3 TRIGGERED[5] The recorded water level declined atypically for greater than one month (as a consecutive period) at TT3 (7 March to 30 June 2023), TT12 (16 April to 30 June 2023) and TT13 (14 May to 30 June 2023).	LEVEL 1 TRIGGERED[3] The recorded water level declined by greater than 10 centimetres (cm) below the recorded baseline minimum level at TT2 (23 May to 30 June 2023) and TT9 (18 to 30 June 2023). LEVEL 3 TRIGGERED[5] The recorded water level declined atypically for greater than one month (as a consecutive period) at TT3 (7 March to 30 June 2023), TT12 (16 April to 30 June 2023) and TT13 (14 May to 30 June 2023).
	WMP4	Pool Water Level for other Watercourses (Bargo River and Hornes Creek)	The recorded water level did not decline below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	The recorded water level did not decline below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	The recorded water level did not decline below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	The recorded water level did not decline below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	The recorded water level did not decline below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	The recorded water level did not decline below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).

Management Plan	TARP Reference / Sub-Management Plan	TARP Description	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
	WMP5	Physical Features and Natural Behaviour of Watercourses within the Subsidence Area	No observed impacts to pool water level, overland connected flow, iron staining, gas release or turbidity – as compared with baseline conditions.	LEVEL 1 TRIGGERED[6] Visually observed anomalous change observed for one month at monitoring sites TT3 and TT11.	LEVEL 1 TRIGGERED[6] Visually observed anomalous change observed for one month at monitoring sites TT7, TT12 and TT13. LEVEL 2 TRIGGERED[7] Visually observed anomalous change observed for two consecutive months at monitoring sites TT3 and TT11.	LEVEL 1 TRIGGERED[6] Visually observed anomalous change observed for one month at monitoring sites TT3, TT7, and TT11. LEVEL 2 TRIGGERED[7] Visually observed anomalous change observed for two consecutive months at monitoring sites TT12 and TT13.	LEVEL 1 TRIGGERED[6] Visually observed anomalous change observed for one month at monitoring sites TT2, TT3, and TT11. LEVEL 2 TRIGGERED[7] Visually observed anomalous change observed for two consecutive months at monitoring site TT7. LEVEL 3 TRIGGERED[8] Visually observed anomalous change observed for three consecutive months at monitoring sites TT12 and TT13.	LEVEL 1 TRIGGERED[6] Visually observed anomalous change observed for one month at monitoring sites TT2, TT3, and TT11. LEVEL 2 TRIGGERED[7] Visually observed anomalous change observed for two consecutive months at monitoring site TT7. LEVEL 3 TRIGGERED[8] Visually observed anomalous change observed for three consecutive months at monitoring sites TT12 and TT13.
	WMP6	Physical Features and Natural Behaviour of Pools for other Watercourses (Bargo River and Hornes Creek)	No observed impacts to pool water level, overland connected flow, iron staining, gas release or turbidity – as compared with baseline conditions.	No observed impacts to pool water level, overland connected flow, iron staining, gas release or turbidity – as compared with baseline conditions.	No observed impacts to pool water level, overland connected flow, iron staining, gas release or turbidity – as compared with baseline conditions.	No observed impacts to pool water level, overland connected flow, iron staining, gas release or turbidity – as compared with baseline conditions.	No observed impacts to pool water level, overland connected flow, iron staining, gas release or turbidity – as compared with baseline conditions.	No observed impacts to pool water level, overland connected flow, iron staining, gas release or turbidity – as compared with baseline conditions.
	WMP7	Channel Stability, Sedimentation and Erosion	No further development of soft knickpoints or increased erosion of headwater streams.	No further development of soft knickpoints or increased erosion of headwater streams.	No further development of soft knickpoints or increased erosion of headwater streams.	No further development of soft knickpoints or increased erosion of headwater streams.	No further development of soft knickpoints or increased erosion of headwater streams.	No further development of soft knickpoints or increased erosion of headwater streams.
	WMP8	Shallow Groundwater Level (Open Standpipes and Private Bores)	Groundwater level remained consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two metres.	Groundwater level remained consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two metres.	Groundwater level remained consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two metres.	Groundwater level remained consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two metres.	Groundwater level remained consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two metres.	LEVEL 1 TRIGGERED[9] Greater than 2 m water level reduction for a period of 6 months at P55C and P56C.
	WMP9	Shallow Groundwater Pressure (VWP Sensors < 200 m Depth) – original TARP	No observed mining induced changes at VWP intakes, and no water level reduction greater than 5 metres in VWP intakes following the commencement of extraction for a period of less than six months (revised TARP wording*).	No observed mining induced changes at VWP intakes, and no water level reduction greater than 5 metres in VWP intakes following the commencement of extraction for a period of less than six months (revised TARP wording*).	No observed mining induced changes at VWP intakes, and no water level reduction greater than 5 metres in VWP intakes following the commencement of extraction for a period of less than six months (revised TARP wording*).	No observed mining induced changes at VWP intakes, and no water level reduction greater than 5 metres in VWP intakes following the commencement of extraction for a period of less than six months (revised TARP wording*).	No observed mining induced changes at VWP intakes, and no water level reduction greater than 5 metres in VWP intakes following the commencement of extraction for a period of less than six months (revised TARP wording*).	No observed mining induced changes at VWP intakes, and no water level reduction greater than 5 metres in VWP intakes following the commencement of extraction for a period of less than six months (revised TARP wording*).
	WMP10	Groundwater Level / Pressure Deep VWPs (> 200 m Depth excluding Monitoring the Bulli Coal Seam)	No observed exceedance of modelled impacts to predicted drawdown by greater than 30 metres, or exceedance of the modelled predicted drawdown by greater than 30 metres occurred for less than three consecutive months (revised TARP wording*).	No observed exceedance of modelled impacts to predicted drawdown by greater than 30 metres, or exceedance of the modelled predicted drawdown by greater than 30 metres occurred for less than three consecutive months (revised TARP wording*).	No observed exceedance of modelled impacts to predicted drawdown by greater than 30 metres, or exceedance of the modelled predicted drawdown by greater than 30 metres occurred for less than three consecutive months (revised TARP wording*).	No observed exceedance of modelled impacts to predicted drawdown by greater than 30 metres, or exceedance of the modelled predicted drawdown by greater than 30 metres occurred for less than three consecutive months (revised TARP wording*).	No observed exceedance of modelled impacts to predicted drawdown by greater than 30 metres, or exceedance of the modelled predicted drawdown by greater than 30 metres occurred for less than three consecutive months (revised TARP wording*).	No observed exceedance of modelled impacts to predicted drawdown by greater than 30 metres, or exceedance of the modelled predicted drawdown by greater than 30 metres occurred for less than three consecutive months (revised TARP wording*).
	WMP11	Groundwater Quality (Open Standpipes and Private Bores)	No observed changes in salinity, pH or metals outside of the baseline variability (revised TARP wording*).	No observed changes in salinity, pH or metals outside of the baseline variability (revised TARP wording*).	No observed changes in salinity, pH or metals outside of the baseline variability (revised TARP wording*).	No observed changes in salinity, pH or metals outside of the baseline variability (revised TARP wording*).	No observed changes in salinity, pH or metals outside of the baseline variability (revised TARP wording*).	LEVEL 1 TRIGGERED[10] Observed salinity and/or metals or pH outside of defined trigger levels for 3 consecutive months or more at P53A (Sr, Ba), P53C (Sr, Ba), P55B (Ba), P55C (Mn), P56C (Mn), REA4 (Mn, Sr, Ba) and GW109257 (Sr) (revised TARP wording*).
	WMP12	Groundwater – Surface Water Interaction	Recorded (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent	Recorded (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent	Recorded (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent	Recorded (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent	Recorded (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent with	LEVEL 1 TRIGGERED[11] Recorded groundwater levels at surface water monitoring site decline below

Management Plan	TARP Reference / Sub-Management Plan	TARP Description	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
			with baseline variability and/or pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.	with baseline variability and/or pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.	with baseline variability and/or pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.	with baseline variability and/or pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.	baseline variability and/or pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.	Level 1 (in TARP WMP8) at for P55C (and associated surface water monitoring site TT1-QRLa).
	WMP13	Groundwater Bores Monitoring for Thirlmere Lakes	Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge event (revised TARP wording*).	Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge event (revised TARP wording*).	Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge event (revised TARP wording*).	Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge event (revised TARP wording*).	Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge event (revised TARP wording*).	Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge event (revised TARP wording*).
Land Management Plan	LMP1	Cliffs	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.
	LMP2	Natural Steep Slope (excluding Constructed Steep Slopes associated with Roads, Railway and the Tahmoor Mine Site)	No observations of surface cracking, or localised ground bulging, buckling or shearing as a result of mining.	No observations of surface cracking, or localised ground bulging, buckling or shearing as a result of mining.	No observations of surface cracking, or localised ground bulging, buckling or shearing as a result of mining.	No observations of surface cracking, or localised ground bulging, buckling or shearing as a result of mining.	No observations of surface cracking, or localised ground bulging, buckling or shearing as a result of mining.	No observations of surface cracking, or localised ground bulging, buckling or shearing as a result of mining.
	LMP3	Farm Dams	No observations of cracks developing within dam embankments as a result of mining.	No observations of cracks developing within dam embankments as a result of mining.	No observations of cracks developing within dam embankments as a result of mining.	No observations of cracks developing within dam embankments as a result of mining.	No observations of cracks developing within dam embankments as a result of mining.	No observations of cracks developing within dam embankments as a result of mining.
	LMP4	Agricultural Land	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.
Biodiversity Management Plan	BMP1	Aquatic Habitat and Macroinvertebrate Indicators (Stream Health)	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	Visual monitoring indicates aquatic pool habitat parameters have been impacted by mining at Impact Sites 13, 16 and 17. However a Level 1 TARP trigger has not occurred as changes have not occurred over two consecutive sampling occasions.	NA – No monitoring is required.	NA – No monitoring is required.
	BMP2	Amphibian Populations	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	Amphibian populations are stable and habitat parameters are predominantly within a reasonable range of baseline data.	Amphibian populations are stable and habitat parameters are predominantly within a reasonable range of baseline data.	NA – No monitoring is required.
	BMP3	Riparian Vegetation	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	Riparian vegetation parameters are predominantly within a reasonable range of baselines data, and monitoring indicates native vegetation cover is within a reasonable range of baseline data.	Riparian vegetation parameters are predominantly within a reasonable range of baselines data, and monitoring indicates native vegetation cover is within a reasonable range of baseline data.	NA – No monitoring is required.
	BMP4	Threatened Species, Threatened Populations and Endangered Ecological Communities	NA – No monitoring is required.	NA – No monitoring is required.	NA – No monitoring is required.	TEC parameters are within a reasonable range of average baseline data and targeted threatened flora species numbers are stable.	TEC parameters are within a reasonable range of average baseline data and targeted threatened flora species numbers are stable.	NA – No monitoring is required.
Heritage Management Plan	HMP1	Aboriginal Cultural Heritage Sites – Teatree Hollow 2013.1	No detectable environmental consequences observed.	No detectable environmental consequences observed.	No detectable environmental consequences observed.	No detectable environmental consequences observed.	No detectable environmental consequences observed.	No detectable environmental consequences observed.

Management Plan	TARP Reference / Sub-Management Plan	TARP Description	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
	HMP2	Historical Heritage Items - Wirrimbirra Sanctuary (Australian Wildlife Sanctuary) - Bargo Cemetery - Bargo Railway Bridge North (Wellers Road Overbridge) - Picton Wier - Tahmoor Colliery (Tahmoor Mine Site) - Bargo Railway Viaduct - Great Southern Road (partial)	No detectable environmental consequences observed.	No detectable environmental consequences observed.	No detectable environmental consequences observed.	No detectable environmental consequences observed.	LEVEL 1 TRIGGERED[12] An environmental consequence of mining was detected at the Tahmoor Mine Site (cracking of the 6C Tunnel and shortening on rail loop).	LEVEL 1 TRIGGERED[12] An environmental consequence of mining was detected at the Tahmoor Mine Site (cracking of the 6C Tunnel and shortening on rail loop).
Built Features Management Plan	1. Main Southern Railway Management Plan	Main Southern Railway Infrastructure	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	BLUE TRIGGER Poor track geometry observed at 98.8 km.	BLUE TRIGGER Poor track geometry observed at 98.8 km.	BLUE T BLUE TRIGGER Poor track geometry observed at 98.8 km.
	2. Wellers Road Overbridge Management Plan	Wellers Road Overbridge	NA – This structure is located outside the active subsidence zone of LW S1A.	NA – This structure is located outside the active subsidence zone of LW S1A.	NA – This structure is located outside the active subsidence zone of LW S1A.	NA – This structure is located outside the active subsidence zone of LW S1A.	NA – This structure is located outside the active subsidence zone of LW S1A.	NA – This structure is located outside the active subsidence zone of LW S1A.
	3. Wollondilly Shire Council Management Plan	Public roads, bridges and culverts	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	Non-conventional subsidence movements measured at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47.	Non-conventional subsidence movements measured at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47.
	4. Sydney Water Potable Water Management Plan	Potable Water Infrastructure	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.
	5. Sydney Water Sewer Management Plan	Sewerage Infrastructure	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.
	6. Jemena Management Plan	Gas Infrastructure	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.
	7. Endeavour Energy Management Plan	Electricity Infrastructure	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.
	8. Telstra Management Plan	Telecommunications	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.
	9. NBN Management Plan	Telecommunications	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.
	10. TPG Management Plan	Telecommunications	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.	No mining impacts or environmental consequences observed.
	11. Built Structures Management Plan	Public amenities, private structures and farm dams	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.
	12. Bargo Cemetery Management Plan	Bargo Cemetery (Heritage Site)	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.

Management Plan	TARP Reference / Sub-Management Plan	TARP Description	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
	13. Wollondilly Anglican College Management Plan	Wollondilly Anglican College	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.
	14. Tahmoor Mine Site Management Plan	Tahmoor Mine Site	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	BLUE TRIGGER Cracks observed in 6C Tunnel and long bay length survey reporting shortening on rail loop.	BLUE TRIGGER Cracks observed in 6C Tunnel and long bay length survey reporting shortening on rail loop.
	15. Australian Wildlife Sanctuary Management Plan	Australian Wildlife Sanctuary	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.
	16. Picton Weir Management Plan	Picton Weir	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.
	17. 3030 Remembrance Drive Management Plan	Bargo Petroleum and Hill Top Pit Stop	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	BLUE TRIGGER Above-ground diesel tank failed a fuel balance test.	BLUE TRIGGER Above-ground diesel tank failed a fuel balance test.
	18. Inghams Bargo Chicken Breeder Production Complex Management Plan	Inghams Bargo Breeder Farm	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.
	19. Inghams Bargo Turkey Farm Management Plan	Inghams Bargo Turkey Farm	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.
	20. Tahmoor Garden Centre Management Plan	Tahmoor Garden Centre	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.	No mining impacts observed.
	21. MKD Machinery Management Plan	MKD Machinery	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.
	22. Bargo Valley Produce Management Plan	Bargo Valley Produce	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.
	23. Canine Country Club Management Plan	Canine Country Club	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.
	24. Pamak Hobbies Management Plan	Pamak Hobbies	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.	NA – This property is outside the active subsidence zone of LW S1A.

Notes:

NR – Monitoring not required this month.

NA – Monitoring data not available as monitoring not completed this month or reporting not yet available.

* A review of TARPs WMP9, WMP10, WMP11 and WMP13 was required due to multiple triggers in October to December 2022 from short term fluctuations in parameters demonstrated that the TARP triggers were too sensitive. Re-assessment of groundwater data against the revised TARPs was completed following this review process. This table presents the TARP triggers in accordance with the revised TARPs. Further discussion of these TARP triggers and the TARP review process is provided in Section 1.3 of the Groundwater Monitoring Report (Appendix D).

[1] TARP WMP1 Level 1 Trigger (LW S1A-S6A Water Management Plan): Exceedance of an SSGV occurs at a given potential impact site in three consecutive months and the same has not occurred at the reference site(s).

[2] TARP WMP1 Level 2 Trigger (LW S1A-S6A Water Management Plan): Exceedance of an SSGV occurs at a given potential impact site in four or five consecutive months and the same has not occurred at the reference site(s).

[3] TARP WMP3 Level 1 Trigger (LW S1A-S6A Water Management Plan): The recorded water level has declined by greater than 10 centimetres (cm) below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) and the same has not occurred at the at the reference site(s).

[4] TARP WMP3 Level 2 Trigger (LW S1A-S6A Water Management Plan): The recorded water level has declined atypically below the recorded baseline minimum level for less than one month (as a consecutive period) and the same has not occurred at the reference site(s).

[5] TARP WMP3 Level 3 Trigger (LW S1A-S6A Water Management Plan): The recorded water level has declined atypically below the recorded baseline minimum level for greater than one month (as a consecutive period) and the same has not occurred at the reference site(s).

[6] TARP WMP5 Level 1 Trigger (LW S1A-S6A Water Management Plan): Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs in one month and the same has not occurred at the reference site(s) AND/OR Visual observation of fracturing.

[7] TARP WMP5 Level 2 Trigger (LW S1A-S6A Water Management Plan): Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for two consecutive months and the same has not occurred at the reference site(s).

[8] TARP WMP5 Level 2 Trigger (LW S1A-S6A Water Management Plan): Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for three consecutive months and the same has not occurred at the reference site(s) AND The change in behaviour has been investigated and confirmed to be related to mining effects.

[9] TARP WMP8 Level 1 Trigger (LW S1A-S6A Water Management Plan): Greater than 2 m water level reduction for a period of 6 months following the commencement of extraction.

[10] TARP WMP11 Level 1 Trigger (LW S1A-S6A Water Management Plan): Observed salinity and /or metals or PH outside of defined trigger levels for 3 consecutive months or more. The effect does not persist after a significant rainfall recharge event. AND a similar trend or response is noted at other moitored bores or private groundwater bores.

[11] TARP WMP12 Level 1 Trigger (LW S1A-S6A Water Management Plan): Recorded (or inferred where not immediately neighbouring a surface water site) groundwater levels at surface water monitoring site decline below Level 1 (in TARP WMP8) following the commencement of extraction.

[12] TARP HMP2 Level 1 (LW S1A-S6A Heritage Management Plan): Historical heritage site monitoring indicates potential detectable environmental consequences, but with negligible impacts to the heritage value of the heritage site(s).

3.2 Summary of Actions and Responses

During the reporting period, there were eleven (11) environmental aspects that were associated with a TARP triggers. This section provides a summary of actions resulting from triggers being met in the TARPs, as well as the progress and success of any remediation actions.

3.2.1 Pool Water Quality TARP (WMP1) – Level 1 and 2 Triggers for Surface Water Quality

3.2.1.1 Background

During the reporting period, a number of surface water quality TARP triggers occurred in accordance with TARP WMP1 at TT7-QLa (monitoring site TT7). Electrical conductivity (EC) triggered a Level 1 TARP trigger in May 2023 for three consecutive months of exceedance of the EC SSGV from March to May 2023, before triggering a Level 2 TARP trigger in June 2023 for four consecutive months (March to June 2023) of exceedance of the EC SSGV. Similar elevated EC values were not recorded at the upstream reference site (TT1-QLa) for this time period. With the exception of June 2023, similar elevated EC has been recorded historically at monitoring site TT7.

During the reporting period, the SSGVs for dissolved iron and dissolved zinc were exceeded for three consecutive months from April to June 2023. This triggered a Level 1 TARP trigger in June 2023. Similar elevated dissolved iron and dissolved zinc concentrations were not recorded at the upstream reference site (TT1-QLa) for the entire time period, nor at the downstream monitoring site (TT14-QLa) for this time period. Similar elevated dissolved iron and dissolved zinc concentrations have been recorded historically at monitoring site TT7 (with the exception of June 2023).

The elevated EC, dissolved iron and dissolved zinc observations recorded at pool TT7 from March to June 2023 are considered to be related to the following:

- Evapoconcentration of salinity during periods of below average rainfall and water level decline; and
- Interaction of underflow with subsurface geology and re-emergence of underflow as surface flow in the vicinity of pool TT7.

Further discussion of these triggers is provided in the Surface Water Report (refer **Appendix B**) for this reporting period.

3.2.1.2 Actions and Responses Completed

Table 3-2 outlines the actions and responses that are required to be completed in accordance with a Level 1 and 2 TARP triggers for pool water quality (TARP WMP1), as well as how these actions and responses have been addressed.

Table 3-2 Actions and Responses for Level 1 and 2 TARP Triggers for Pool Water Quality Reduction (TARP WMP1)

Action / Response from TARP WMP1	Tahmoor Coal response
Actions	
All TARP levels Continue monitoring and review of data as per monitoring program.	Monthly (or more frequent) monitoring and review of data is ongoing according to the monitoring program.

Action / Response from TARP WMP1	Tahmoor Coal response
Level 1 and 2 TARP Assess if the trigger was exceeded during the baseline period prior to commencement of mining activities.	Exceedance of the trigger level during the baseline period was reviewed (refer Section 6.2.3 of **Appendix B**). A Level 1 trigger or above for EC and dissolved iron was not recorded at pool TT7 during the baseline monitoring period. A Level 1 trigger for dissolved zinc was recorded at pool TT7 during the baseline monitoring period.
Level 1 and 2 TARP Review water quality trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions.	Water quality trends were reviewed for the watercourse reach of TT7 (refer Section 6.2.3 of **Appendix B**).
Level 1 and 2 TARP Discuss findings with and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater quality monitoring results) necessary to inform assessment.	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 6 of **Appendix B**).
Level 1 and 2 TARP Consider and decide on reasonable and feasible options for remediation as relevant (e.g. limestone cobbles for increasing pH level).	Reasonable and feasible options for remediation were considered where relevant (refer Section 7.3 of **Appendix B**). There are limited feasible corrective management actions (CMAs) that could be implemented prior to the cessation of subsidence movements associated with mining of LW S1A-S6A. In addition, the water quality effects recorded at pool TT& are considered immaterial and, as such, CMAs are not considered required at this stage.
Level 2 TARP Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows: • Fortnightly, for sites within the active subsidence zone; and • Monthly, outside of the active subsidence period. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change or confirmed as a mining-related impact that resulted in a water quality change).	Increased monitoring and review of data frequency was considered (refer Section 6.2.3 of **Appendix B**). As similar elevated EC values, dissolved iron concentrations and zinc concentractions were recorded at TT7-QLa historically, the frequency of monitoring was not increased during the reporting period. For all three elevated paragements, the causation was determined to be due to interaction of underflow with surface geology and re-emergence of elevated dissolved iron underflow as surface flow in the vicinity of pool TT7. In addition, evapoconcentration of salinity during period of below average rainfall and water level decline was also noted to contribute to elevated EC values at pool TT7.
Level 2 TARP If increased monitoring is undertaken, conduct further analysis of water quality trends along creek (upstream to downtream) to identify spatial changes with consideration to climatic conditions.	Increased monitoring was not undertaken during the reporting period.
Level 2 TARP Review CMAs in light of findings from further investigations and consider additional remediation options.	As discussed in Section 7.3 of **Appendix B**, CMAs were not considered reasonable or feasible.

Action / Response from TARP WMP1	Tahmoor Coal response
Level 2 TARP Review Water Management Plan and modify if necessary.	The LW S1A-S6A Water Management Plan was reviewed and proposed amendments to the plan were submitted to DPE on 5 July 2023 for approval.
Responses	
Level 1 and 2 TARP Report trigger exceedance to DPE and key stakeholders.	Trigger exceedance notifications were provided to DPE and NRAR on 16 August (Level 2 TARP trigger at TT7 for EC). Notification to NRAR was required as part of the conditions of the Enforceable Undertaking (in force from 24 July 2023). Trigger exceedance notification for the Level 1 TARP trigger at TT7 for dissolved zinc and dissolved iron is completed as part of this report. Tahmoor Colliery Community Consultative Committee was advised of the EC trigger at TT7 on 7 September 2023. Future meetings will include further notification of additional TARP triggers.
Level 1 and 2 TARP Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.
Level 1 and 2 TARP Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. limestone cobbles for increasing pH level).	As discussed in Section 7.3 of **Appendix B**, CMAs were not considered reasonable or feasible.
Level 1 and 2 TARP Implement CMAs, subject to land access.	As discussed in Section 7.3 of **Appendix B**, CMAs were not considered reasonable or feasible.
Level 1 and 2 TARP Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.	As discussed in Section 7.3 of **Appendix B**, CMAs were not considered reasonable or feasible.
Level 2 TARP Advise DPE and key stakeholders of any required amendments to Water Management Plan	Proposed amendments to the LW S1A-S6A Water Management Plan were submitted to DPE on 5 July 2023. Tahmoor Coal and DPE (as well as DPE Water) are in currently in consultation regarding the changes to the WMP.
Level 2 TARP Provide findings of CMA review to DPE and key stakeholders for consultation.	As discussed in Section 7.3 of **Appendix B**, CMAs were not considered reasonable or feasible.
Level 2 TARP Implement additional CMAs, subject to land access.	As discussed in Section 7.3 of **Appendix B**, CMAs were not considered reasonable or feasible.

3.2.1.3 Proposed Actions and Responses

From the review of actions and responses, the finalisation of consultation on proposed amendments to the LW S1A-S6A Water Management Plan with DPE (and DPE Water) and implementation of the updated plan once approved remains outstanding.

The current monitoring program will continue in accordance with the LW S1A-S6A Water Management Plan. The next update will be provided as part of the next Six Monthly Subsidence Impact Assessment report, to be provided to DPE by 31 March 2024.

3.2.2 Pool Water Level TARP (WMP3) – Level 1, 2 and 3 Triggers for Pool Water Level Reduction

3.2.2.1 Background

During the review period, a Level 1 trigger exceedance (TARP WMP3) in relation to pool water level was recorded at monitoring sites TT2-QLa (May and June 2023) and TT9-QLa (February to April and June 2023). It is considered that the decline in water level at monitoring sites TT2-QLa and TT9-QLa is related to the prevailing climatic conditions and unrelated to mining effects associated with LW S1A.

During the review period, a maximum Level 3 trigger exceedance (TARP WMP3) was recorded for monitoring sites TT3-QLa (March 2023 onwards), TT12-QLa (April 2023 onwards) and TT13-QLa (intermittently from March 2023 onwards). It is considered that the decline in water level at the aforementioned monitoring sites is related to the:

- Cessation of surface water flow in Teatree Hollow and Teatree Hollow Tributary due to mining induced fracturing upstream of pools in Teatree Hollow (pool TT11) and a reach of Teatree Hollow Tributary (pool TT12);
- Prevailing climatic conditions; and
- Negligible surface water flow reporting from the upstream reach of Teatree Hollow as of March 2023 and from the upstream reach of Teatree Hollow tributary as of late April 2023.

Overall, it is considered that monitoring sites TT3-QLa, TT12-QLa and TT13-QLa have been impacted directly and indirectly by mining. Pool TT12 has been directly impacted by mining due to the presence of physical impact features (fractures), while pools TT3 and TT13 have been indirectly impacted by mining (refer Section 7.2 of **Appendix B**).

Further discussion of these triggers is provided in the Surface Water Review report (refer **Appendix B**).

3.2.2.2 Actions and Responses Completed

Table 3-3 outlines the actions and responses that are required to be completed in accordance with a Level 1, 2 and 3 TARP triggers for pool water level (TARP WMP3), as well as how these actions and responses have been addressed.

Table 3-3 Actions and Responses for Level 1, 2 and 3 TARP Triggers for Pool Water Level Reduction (TARP WMP3)

Action / Responses from TARP WMP3	Tahmoor Coal response
Actions	
All TARP levels Continue monitoring and review of data as per monitoring program.	Monthly (or more frequent) monitoring and review of data is ongoing according to the monitoring program.
Level 1, 2 and 3 TARP Review water level trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions.	Water level trends for all sites in Teatree Hollow and Teatree Hollow tributary were reviewed with consideration to climatic conditions (refer Section 6 of **Appendix B**).
Level 1, 2 and 3 TARP Review streamflow data recorded at TT-F1 and conduct streamflow reduction assessment.	Streamflow data recorded at TT-F1 was reviewed and streamflow reduction assessment conducted (refer Section 5.3 and Section 6.2 of **Appendix B**). The streamflow assessment indicated that streamflow trends recorded at monitoring site TT-F1 in Teatree Hollow have been consistent with rainfall trends for the duration of the review period.

Action / Responses from TARP WMP3	Tahmoor Coal response
Level 1, 2 and 3 TARP Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater level monitoring results) necessary to inform assessment.	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 6 of **Appendix B**).
Level 2 and 3 TARP Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached or at other relevant sites, subject to land access, as follows: • Fortnightly, for sites within the active subsidence zone; and • Monthly, outside of the active subsidence period.	Monitoring and review of data frequency was increased to fortnightly at sites TT3-QLa, TT12-QLa and TT13-QLa.
Level 2 and 3 TARP Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change or confirmed as a mining-related impact that resulted in a water level change).	Monitoring and review of data frequency was increased to fortnightly at sites TT3-QLa, TT12-QLa and TT13-QLa.
Level 2 and 3 TARP If increased monitoring is undertaken, conduct further analysis of water level trends along creek (upstream to downtream) to identify spatial changes with consideration to climatic conditions.	Water level trends for all sites in Teatree Hollow and Teatree Hollow tributary were reviewed with consideration to climatic conditions (refer Section 6 of **Appendix B**).
Level 2 and 3 TARP Review Water Management Plan and modify if necessary.	The LW S1A-S6A Water Management Plan was reviewed and proposed amendments to the plan were submitted to DPE on 5 July 2023 for approval.
Level 3 TARP If mining related impact unconfirmed, increase monitoring and review of data frequency at sites where Level 3 has been reached or at other relevant sites, subject to land access, as follows: • Fortnightly, for sites within the active subsidence zone; and • Monthly, outside of the active subsidence period.	As discussed in Section 6 of **Appendix B**, mining has been confirmed to have contributed to surface water level impacts observed at sites TT3-QLa, TT12-QLa and TT13-QLa. Although this action is therefore not required, monitoring and review of data frequency was increased to fortnightly at sites TT3-QLa, TT12-QLa and TT13-QLa.
Level 3 TARP Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effect unrelated to mining or the prevailing climate.	Detailed investigation has been undertaken to identify cause of atypical water level decline at sites TT3-QLa, TT12-QLa and TT13-QLa (refer Section 6 of **Appendix B**). As discussed in **Section 3.2.1.1**, It is considered that the decline in water level at the aforementioned monitoring sites is related to the: • Cessation of surface water flow in Teatree Hollow and Teatree Hollow Tributary due to mining induced fracturing upstream of pools in Teatree Hollow (pool TT11) and a reach of Teatree Hollow Tributary (pool TT12); • Prevailing climatic conditions; and

Action / Responses from TARP WMP3	Tahmoor Coal response
	• Negligible surface water flow reporting from the upstream reach of Teatree Hollow as of March 2023 and from the upstream reach of Teatree Hollow tributary as of late April 2023.
Responses	
Level 1, 2 and 3 TARP Report trigger exceedance to DPE and key stakeholders	Trigger exceedance notifications were provided to DPE on 28 February (Level 1 TARP trigger at TT9), 14 April (Level 1 TARP trigger at TT12, Level 2 TARP trigger at TT13, and Level 3 TARP trigger at TT3) and 2 June 2023 (Level 3 TARP trigger at TT12 and TT13). Trigger exceedance notification for the Level 1 TARP trigger at TT2 is completed as part of this report. Tahmoor Colliery Community Consultative Committee was advised of triggers on 2 March, 1 June and 7 September 2023.
Level 1, 2 and 3 TARP Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.
Level 2 and 3 TARP Advise DPE and key stakeholders of any required amendments to Water Management Plan	Proposed amendments to the LW S1A-S6A Water Management Plan were submitted to DPE on 5 July 2023. Tahmoor Coal and DPE (as well as DPE Water) are currently in consultation regarding the changes to the WMP.
Level 3 TARP If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts: • Offer site visit with DPE and other key stakeholders.	To be completed by Tahmoor Coal.
Level 3 TARP If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts: • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. Implement approved WCAMP, subject to land access.	In accordance with C12 of SSD 8445 and as detailed in the WMP, a Watercourse Corrective Action Management Plan (WCAMP) will be prepared for watercourses damaged by subsidence impacts. The WCAMP will be prepared in consultation with relevant government agencies, as defined in the WMP. The WCAMP will be prepared and implemented following the cessation of subsidence movements associated with Tahmoor South mining.

3.2.2.3 Proposed Actions and Responses

From the review of actions and responses (as discussed in **Table 3-3**), the following actions and responses remain outstanding:

- Finalisation of consultation on proposed amendments to the LW S1A-S6A Water Management Plan with DPE (and DPE Water) and implementation of the updated plan once approved;

- Offer site visit with DPE and other key stakeholders to the site of the Level 3 TARP triggers (monitoring sites TT3-QLa, TT12-QLa and TT13-QLa); and
- Preparation of a WCAMP to address water level decline at monitoring sites TT3-QLa, TT12-QLa and TT13-QLa will be prepared and implemented following the cessation of subsidence movements associated with Tahmoor South mining.

The current monitoring program will continue in accordance with the LW S1A-S6A Water Management Plan. The next update will be provided as part of the next Six Monthly Subsidence Impact Assessment report, to be provided to DPE by 31 March 2024.

3.2.3 Physical Features and Natural Behaviour TARP (WMP5) – Level 1, 2 and 3 Triggers for Fracturing and Anomalous Changes to Water Level and Overland Connected Flow

3.2.3.1 Background

A level 1 TARP trigger exceedance (TARP WMP5) was reported for pool TT2 (May 2023 onwards) in relation to visually observed anomalous change in water level. It is considered that the decline in water level is related to the prevailing climatic conditions and unrelated to mining effects associated with LW S1A.

During the review period, a maximum Level 2 trigger exceedance (TARP WMP5) was recorded for pools TT3 (March 2023), TT7 (May 2023 onwards) and TT11 (March 2023). A visually observed anomalous change in water level was recorded for pools TT3, TT7 and TT11. Additionally, from March to June 2023, iron staining was observed at pool TT7 and mining related fractures were observed upstream of pool TT11 in February 2023.

It is noted that the return to 'normal conditions' at pool TT3 and TT11 with the observations that both pools were no longer dry following a 23.6 mm rain event (refer 15 March 2023 report in **Appendix C**).

During the review period, a maximum Level 3 trigger exceedance (TARP WMP5) was recorded for pools TT12 and TT13 from May 2023 onwards. An anomalous change in water level was recorded for 3 months at pools TT12 and TT13. In addition, fracturing was observed immediately upstream and downstream of pool TT12.

It is considered that the decline in water level recorded at pool TT7 during the review period is consistent with historical behaviour and partly related to the prevailing climatic conditions. However, it is noted in Section 7.2 of **Appendix B** that iron staining at pool TT7 may be an indirect impact of mining.

The decline in water level recorded during the review period at pools TT3, TT11, TT12 and TT13 is considered to be related to the:

- Cessation of surface water flow in Teatree Hollow tributary due to mining induced fracturing upstream of pool TT11;
- Prevailing climatic conditions;
- Potential reduction in baseflow contribution (for pools on Teatree Hollow tributary (relevant for pools TT3, TT11 and TT13));
- As of late April 2023, negligible surface water flow reporting from the upstream reach of Teatree Hollow tributary (relevant for pools TT3, TT11 and TT13); and
- As of March 2023, negligible surface water flow reporting from the upstream reach of Teatree Hollow (relevant for pool TT12).

Overall, it is considered that pools TT3, TT11, TT12 and TT13 have been impacted directly and indirectly by mining. Pool TT12 and a reach of Teatree Hollow tributary (between pool TT11 and 95 m upstream of TT11) have been directly impacted by mining due to the presence of physical impact features (fractures). Pools TT3, TT11 and TT13 have been indirectly impacted by mining (refer Section 7.2 of **Appendix B**).

Further discussion of these triggers is provided in the Surface Water report (refer **Appendix B**) for this reporting period.

3.2.3.2 Actions and Responses Completed

Table 3-4 outlines the actions and responses that are required to be completed in accordance with a Level 1, 2 and 3 TARP triggers for physical features and natural behaviour (TARP WMP5), as well as how these actions and responses have been addressed.

Table 3-4 Actions and Responses for Level 1, 2 and 3 TARP Triggers for Physical Features and Natural Behaviour of Watercourses (TARP WMP5)

Action / Responses from TARP WMP5	Tahmoor Coal response
Actions	
All TARP levels Continue monitoring and review of data as per monitoring program.	Monthly (or more frequent) monitoring and review of data is ongoing according to the monitoring program.
Level 1, 2 and 3 TARP Assess visual change along watercourse (upstream to downstream) to observe any spatial changes with consideration to climatic conditions.	Visual changes along watercourse were reviewed with consideration to climatic conditions (refer Section 6 of **Appendix B**).
Level 1, 2 and 3 TARP Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results) necessary to inform assessment.	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 6 of **Appendix B**).
Level 2 and 3 TARP Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 1 has been reached and at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency coulc include confident identification of causation (e.g. surface fracturing of weathered bedrock that does not affect water holding capacity of rockbar control or pool base).	Monitoring and review of data frequency was increased to fortnightly at pools TT3, TT7, TT11, TT12 and TT13, as well as relevant reference sites (pools TT9 and TT1).
Level 2 and 3 TARP Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing other catchment changes, effect unrelated to mining or the prevailing climate).	A detailed investigation was undertaken to assess if the change in behaviour at pools TT3, TT7, TT11, TT12 and TT13 is related to mining effects (refer Section 6 of **Appendix B**). As discussed in **Section 3.2.2.1**, direct and indirect impacts from mining have been confirmed at the pools in question.
Level 2 and 3 TARP Review Water management Plan and modify if necessary.	The LW S1A-S6A Water Management Plan was reviewed and proposed amendments to the plan were submitted to DPE on 5 July 2023 for approval.
Level 3 TARP If the changes have been confirmed to be related to mining effects, increase monitoring and review of data frequency to fortnightly for sites where Level 2 has been reached and at corresponding reference sites, subject to land access.	Monitoring and review of data frequency was increased to fortnightly at pools TT3, TT7, TT11, TT12 and TT13, as well as relevant reference sites (pools TT9 and TT1).

Action / Responses from TARP WMP5	Tahmoor Coal response
Responses	
Level 1, 2 and 3 TARP Report trigger exceedance to DPE and key stakeholders	Trigger exceedance notifications were provided to DPE on 28 February 2023 (Level 1 TARP trigger at TT11 and TT3), 20 March 2023 (Level 1 TARP trigger at TT12 and TT13), 14 April 2023 (Level 1 TARP trigger at TT7), 5 May 2023 (Level 2 TARP trigger at TT12 and TT13) and 2 June 2023 (Level 3 TARP trigger at TT12 and TT13, Level 1 TARP trigger at TT2). Tahmoor Colliery Community Consultative Committee was advised of triggers on 2 March, 1 June and 7 September 2023.
Level 1, 2 and 3 TARP Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.
Level 2 and 3 TARP Advise DPE and key stakeholders of any required amendments to Water Management Plan	Proposed amendments to the LW S1A-S6A Water Management Plan were submitted to DPE on 5 July 2023. Tahmoor Coal and DPE (as well as DPE Water) are in currently in consultation regarding the changes to the WMP.
Level 3 TARP Offer site visit with DPE and other key stakeholders.	To be completed by Tahmoor Coal.
Level 3 TARP Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection.	In accordance with C12 of SSD 8445 and as detailed in the WMP, a Watercourse Corrective Action Management Plan (WCAMP) will be prepared for watercourses damaged by subsidence impacts. The WCAMP will be prepared in consultation with relevant government agencies, as defined in the WMP. The WCAMP will be prepared and implemented following the cessation of subsidence movements associated with Tahmoor South mining.
Level 3 TARP Implement approved WCAMP, subject to land access.	Refer to response above.

In response the notification of the Level 1 TARP trigger at pools TT12 and TT13 on 20 March 2023, DPE requested a number of items to be discussed in the next Six Monthly Subsidence Impact Report (this report) as detailed in their letter dated 21 March 2023. **Table 3-5** outlines these requests as well as Tahmoor Coal's responses.

Table 3-5 Response to DPE requests relating to Level 1 TARP trigger at Pools TT12 and TT13 (TARP WMP5)

DPE Requests	Tahmoor Coal Response
Advise whether the reported Level 1 trigger was caused by the development.	As discussed in **Section 3.2.2.1** (and Section 6 of **Appendix B)**, mining was confirmed to have had a direct and indirect impact to pools TT12 and TT13, respectively.
Identify an exceedance of the relevant limits and/or performance criteria.	No greater impact than that predicted in the Tahmoor South Project EIS has occurred to watercourses within the Subsidence Area. Therefore, as discussed in **Section 4** of this report, there has been no exceedance of performance measures during this reporting period.

DPE Requests	Tahmoor Coal Response
Identify whether there was actual and/or potential material harm to the environment.	Negligible indication of material environmental harm to Teatree Hollow or other watercourses has occurred. Impacts to Teatree Hollow are within predictions in accordance with the Tahmoor South Project EIS.
Details of any measures taken prior to the incident to prevent from the same happening.	No preventative measures were taken prior to mining of LW S1A as there are no preventative measures that would be effective in this situation (i.e. prevention of fracturing and changes to water flow in watercourses in the subsidence zone of longwall mining). As identified in the Tahmoor South Project EIS, impacts to watercourse features as a result of mining were predicted and anticipated.
Details of any corrective and preventative actions that have been, or will be, implemented to address the incident and/or prevent recurrence.	In accordance with C12 of SSD 8445 and as detailed in the WMP, a Watercourse Corrective Action Management Plan (WCAMP) will be prepared for watercourses damaged by subsidence impacts. The WCAMP will be prepared in consultation with relevant government agencies, as defined in the WMP. The WCAMP will be prepared and implemented following the cessation of subsidence movements associated with Tahmoor South mining.
Details of any communication with any NSW government agencies and any actions taken/requested by these agencies regarding the incident.	Other than notification to DPE, no other government agencies have been notified of the TARP triggers. There are no additional direct notification requirements as identified in the SSD 8445, LW S1A-S6A Extraction Plan or the Commonwealth EPBC Approval of the Tahmoor South Project. Notification to NRAR is required as part of the conditions of the Enforceable Undertaking from the date that it came in force (24 July 2023). Future TARP trigger notifications will be provided to NRAR as part of this requirements.

3.2.3.3 Proposed Actions and Responses

From the review of actions and responses (as discussed in **Table 3-4**), the following actions and responses remain outstanding:

- Finalisation of consultation on proposed amendments to the LW S1A-S6A Water Management Plan with DPE (and DPE Water) and implementation of the updated plan once approved;
- Offer site visit with DPE and other key stakeholders to the site of the Level 3 TARP triggers (pools TT12 and TT13); and
- Preparation of a WCAMP to address water level decline at pools TT12 and TT13 will be prepared and implemented following the cessation of subsidence movements associated with Tahmoor South mining.

The current monitoring program will continue in accordance with the LW S1A-S6A Water Management Plan. The next update will be provided as part of the next Six Monthly Subsidence Impact Assessment report, to be provided to DPE by 31 March 2024.

3.2.4 Groundwater Level TARP (WMP8) – Level 1 Trigger for Groundwater Level Reduction in Shallow Groundwater

3.2.4.1 Background

During the reporting period, groundwater level reduced for a period of 6 months at P55C and P56C from January to June 2023. This resulted in a Level 1 TARP trigger exceedance (TARP WMP8) in June 2023.

At P55C, groundwater depressurisation could be due to an ongoing mining effect (LWS1A progression). However, given the relative stability of this water level (i.e. no ongoing declining trend) this cannot definitively be attributed to extraction activities. It is suggested to continue to review the trends in this bore and the associated nested bores in coming months to better understand the trends.

At P56C, the relatively steady decline of groundwater depressurisation could be due to an ongoing mining effect (LWS1A progression).

Further discussion of these triggers is provided in the Groundwater Monitoring Report (refer **Appendix D**).

3.2.4.2 Actions and Responses Completed

Table 3-6 outlines the actions and responses that are required to be completed in accordance with a Level 1 TARP triggers for shallow groundwater level reduction (TARP WMP8), as well as how these actions and responses have been addressed.

Table 3-6 Actions and Responses for Level 1 TARP Triggers for Groundwater Level Reduction (TARP WMP8) (Open Standpipe Monitoring Bores only)

Action / Response from TARP WMP8	Tahmoor Coal response
Actions	
Continue monitoring and review of data as per monitoring program.	Monthly monitoring and review of data is ongoing according to the monitoring program.
Undertake an investigation to assess cause and determine if mining related.	An investigation to assess cause of the water level decline at P55C and P56C is provided in **Section 3.2.4.1** and Section 4 of **Appendix D.** For both bores, groundwater depressurisation could be due to ongoing mining effect. However, at P55C, the relative stability of this water level cannot definitely be attributed to extraction activites.
Undertake investigation to determine if the decline will impact the long-term viability of the affected water supply works.	Current drawdown associated with exceedances is localised, and only observed in the deepest of the nested sites. Consequently, there no indication that regional aquifer drawdown is occurring of that any impact would be observed in existing water supply works.
Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 4 of **Appendix D**).
The investigation will be commenced/completed as efficiently as practicable. If the changes have been confirmed to be related to mining effects: For Open Standpipe Monitoring Bores: For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	For both bores, groundwater depressurisation could be due to ongoing mining effect, however this has not been confirmed based on the current data. TARP WMP12 (Groundwater – surface water interaction TARP) has been initiated for P55C due to TARP triggers at both P55C (WMP8) and changes observed at the relevant surface water site TT1-QRLa. Refer to **Section 3.2.6** for further details.
Responses	

Action / Response from TARP WMP8	Tahmoor Coal response
Report trigger exceedance to DPE and key stakeholders.	Notification of this exceedance to DPE is completed as part of this report.
Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.	Completed as part of this report.

3.2.4.3 Proposed Actions and Responses

The current monitoring program will continue in accordance with the LW S1A-S6A Water Management Plan. The next update will be provided as part of the next Six Monthly Subsidence Impact Assessment report, to be provided to DPE by 31 March 2024.

3.2.5 Groundwater Quality TARP (WMP11) – Level 1 Trigger for Groundwater Quality Changes

3.2.5.1 Background

During the reporting period, a number of groundwater quality exceedances of trigger levels occurred from April to June 2023, resulting in Level 1 TARP triggers (TARP WMP11) in June 2023. In summary, the following groundwater quality triggers occurred:

- Barium – Trigger exceedances at P53A, P53C, P55B, and REA4;
- Strontium – Trigger exceedances at P53A, P53C, REA4 and GW109257; and
- Manganese – Trigger exceedances at P55C, P56C and REA4.

As discussed in **Section 2.3.3**, it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period. It is more likely that TARP exceedances related to groundwater quality are representative of natural fluctuations in water quality. Further discussion of these triggers is provided in the Groundwater Monitoring Report (refer **Appendix D**).

3.2.5.2 Actions and Responses Completed

Table 3-7 outlines the actions and responses that are required to be completed in accordance with a Level 1 TARP triggers for groundwater quality reduction (TARP WMP11), as well as how these actions and responses have been addressed.

Table 3-7 Actions and Responses for Level 1 TARP Triggers for Groundwater Quality Reduction (TARP WMP11)

Action / Response from TARP WMP8	Tahmoor Coal response
Actions	
Continue monitoring and review of data as per monitoring program.	Monthly monitoring and review of data is ongoing according to the monitoring program.
Undertake an investigation to assess cause and determine if mining related.	An investigation to assess cause of the groundwater quality decline is provided in **Section 3.2.5.1** and Section 4 of **Appendix D.** It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality.

Action / Response from TARP WMP8	Tahmoor Coal response
Undertake investigation to determine if the change in quality will impact the long-term viability of the affected water supply works.	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality. Therefore long-term impacts are unlikely to occur at this stage.
Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 4 of **Appendix D**).
If the changes have been confirmed to be related to mining effects: For Private Bores: • Initiate negotiations with impacted landholders as soon as practicable. Consider all reasonable and feasible options for remediation as relevant. This could include potential for implementation of make-good provisions as per Section 6.2.1.4 of the Water Management Plan for affected private bore owners (e.g. provision of access to an alternative source of water).	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality.
If the changes have been confirmed to be related to mining effects: For Open Standpipe Monitoring Bores: • For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality. None of the bores specified in WMP13 were triggered within the reporting period.
Responses	
Report trigger exceedance to DPE and key stakeholders.	Notification of this exceedance to DPE is completed as part of this report.
Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.
If the changes have been confirmed to be related to mining effects: For Private Bores: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. provision of access to an alternative source of water as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality.

3.2.5.3 Proposed Actions and Responses

The current monitoring program will continue in accordance with the LW S1A-S6A Water Management Plan. The next update will be provided as part of the next Six Monthly Subsidence Impact Assessment report, to be provided to DPE by 31 March 2024.

It is recommended that a revision of the trigger levels for dissolved metals, specifically barium, strontium and manganese, is undertaken once the October 2023 monitoring data has been reviewed. This would allow a full 12-month period of monitoring data to be included into 'baseline' period from which trigger values can be recalculated, and therefore capture the natural variability of the system.

3.2.6 Groundwater – Surface Water Interaction TARP (WMP12) – Level 1 Trigger for Reduction in Groundwater and Surface Water Levels

3.2.6.1 Background

As discussed in **Section 3.2.4.1**, a Level 1 trigger of TARP WMP8 at P55C had occurred. P55C is associated with surface water monitoring site TT1-QRLa and together the two sites are assessable under TARP WMP12.

As discussed in Section 4.3 of **Appendix D**, there is no apparent correlation at this point in time between the apparent decline in groundwater level and trigger breach at P55C and the nearby surface water gauging station.

Further discussion of these triggers is provided in the Groundwater Monitoring Report (refer **Appendix D**).

3.2.6.2 Actions and Responses Completed

Table 3-8 outlines the actions and responses that are required to be completed in accordance with a Level 1 TARP triggers for groundwater – surface water interaction (TARP WMP12), as well as how these actions and responses have been addressed.

Table 3-8 Actions and Responses for Level 1 TARP Triggers for Groundwater – Surface Water Interactions (TARP WMP12)

Action / Response from TARP WMP12	Tahmoor Coal response
Actions	
Continue monitoring and review of data as per monitoring program.	Monthly monitoring and review of data is ongoing according to the monitoring program.
Undertake an investigation to assess cause and determine if mining related.	An investigation to assess cause of the water level decline at P55C is provided in **Section 3.2.4.1** and Section 4 of **Appendix D.** TARP WMP12 has been initiated for P55C due to TARP triggers at both P55C (WMP8) and changes observed at the relevant surface water site TT1-QRLa. Further detailed investigation into the site-specific groundwater surface water relationship is required. Given no trigger is breached in the shallow groundwater bore (P55a or P55b), there is unlikely to be a direct relationship between groundwater drawdown and surface water changes. It was determined that it is unlikely that extraction at LW S1A is influencing groundwater – surface water interactions during the reporting period.
Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 4 of **Appendix D**).

Action / Response from TARP WMP12	Tahmoor Coal response
Responses	
Report trigger exceedance to DPE and key stakeholders.	Notification of this exceedance to DPE is completed as part of this report.
Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.	Completed as part of this report.
If the changes have been confirmed to be related to mining effects: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.	It was determined that it is unlikely that extraction at LW S1A is currently impacting groundwater – surface water interactions, with shallowest groundwater levels currently unimpacted by longwall extraction. Therefore, these responses have not been enacted at this time.

3.2.6.3 Proposed Actions

The current monitoring program will continue in accordance with the LW S1A-S6A Water Management Plan. The next update will be provided as part of the next Six Monthly Subsidence Impact Assessment report, to be provided to DPE by 31 March 2024.

3.2.7 Historical Heritage TARP (HMP2) – Level 1 Trigger for impacts to Rail Loop and 6C Tunnel

3.2.7.1 Background

During the reporting period, a Level 1 TARP trigger of the TARP HMP2 (historical heritage items) occurred due to the following detectable environmental consequences at the Tahmoor Mine Site (or Tahmoor Colliery):

- 11 mm of closure between Pegs BL600 and BL700 of the rail loop, initially observed 15 May 2023; and
- Cracks observed at two locations at 6C Tunnel and vent shaft interface initially observed on 29 May 2023. The number of cracks grew to seven (7) by the end of the monitoring period, all of them being less than 1 mm in width.

These triggers are documented in the reports included in **Appendix G**.

3.2.7.2 Actions and Responses Completed

Table 3-9 outlines the actions and responses that are required to be completed in accordance with a Level 1 TARP trigger for change to historical heritage items (TARP HMP2), as well as how these actions and responses have been addressed.

Table 3-9 Actions and Responses for Level 1 TARP Trigger for Change to Historical Heritage Item (TARP HMP2)

Action / Response from TARP HMP2	Tahmoor Coal response
Actions	
Continue monitoring and review of data as per monitoring program.	Monitoring is ongoing in accordance with the LW S1A-S6A Tahmoor Mine Site Management Plan and the LW S1A-S6A Heritage Management Plan.
Co-ordinate a site inspection with a structural engineer.	A structural engineer inspected the cracks in the 6C Tunnel on 30 May 2023 and reported no immediate concerns as the structure remains safe and servicable. The changes to the rail loop track were discussed by Mine Site and Rail Management Groups on 19 May 2023. It was noted that closure is distributed over bay lengths, with a maximum of 4 mm closure between BL600 and BL620. No bump was observed in the subsidence profile and the site does not coincide with creek crossings or known geological structures. Gradual rates of changes were noted to be observed. No issues with rail stress were noted until summer, when restressing is planned prior to hot temperatures. A focused inspection will be conducted along the track, Rail Loader, Conveyors 4S and 4C and Washery, which are located in this area.
Consult with a qualified archaedologist or heritage architect to determine whether impacts to heritage sites have occurred.	A review of cracks in the 6C Tunnel was completed by a qualified archaeologist (refer **Appendix E**). Hairline cracks in the concrete within the 6C Tunnel were considered to be minor and, if required, could be repaired in a manner that preserves the heritage value of the mine. In addition, the Tahmoor Mine Site is a working site and minor impacts such as hairline cracks are unlikely to affect its heritage values. It is noted that changes at the rail loop did not result in any visual changes, and were therefore not considered by the archaeologist as a potential historical heritage impact.
Consider increasing monitoring and review of data frequency for sites subject to a Level 1 trigger event, subject to land access.	The 6C Tunnel and rail loop at the Tahmoor Mine Site are considered to be adequately monitored in accordance with the LW S1A-S6A Tahmoor Mine Site. The current frequency of monitoring at the 6C Tunnel and rail loop is weekly.
Detailed photographic recording of any damage to be documented.	Photographic evidence of any damage to the 6C Tunnel was completed on a weekly basis as part of the weekly Mine Conveyor Photo Reports (refer to **Appendix G** for referenced reports).
Erect warning signs and restrict access to areas where necessary.	The Tahmoor Mine Site remained safe and serviceable during the reporting period, and no warning signs or restricted access to the areas in question were deemed necessary.

Action / Response from TARP HMP2	Tahmoor Coal response
Responses	
Report trigger exceedance to DPE and Heritage NSW.	Notification of this exceedance to DPE is completed as part of this report. As discussed in the historical heritage review (refer **Appendix E**), as the heritage values of the item have not been impacted, there is no requirement to report this trigger to Heritage NSW.
Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.

3.2.7.3 Proposed Actions

The current monitoring program will continue in accordance with the LW S1A-S6A Tahmoor Mine Site Management Plan.

The review of the 6C Tunnel by a qualified archaeologist (refer **Appendix E**) recommended the following actions:

- The site should continue to be monitored and the data reviewed as per the Tahmoor Mine Site Management Plan;
- At the conclusion of mining of LW S1A-S6A, the cracks within Tunnel 6C should be assessed by a suitably qualified heritage advisor to determine whether remediation is required;
- If it is determined that remediation of the tunnel is required and/or the impact cannot be repaired at the conclusion of mining of LW S1A-S6A to a level that preserves the heritage values of the site, the TARP requires that the trigger exceedance be report to DPE (already completed) and Heritage NSW; and
- The TARP requires that trigger exceedance and investigation outcomes be included in the Six Monthly Subsidence Impact Report (this document) and Annual Review.

Tahmoor Coal will coordinate restressing as planned prior to hot temperatures, as well as a focused inspection along the track.

3.2.8 Main Southern Railway TARP – Blue Trigger due to Poor Track Geometry

3.2.8.1 Background

During the reporting period, a blue trigger occurred on 15 April 2023 due to poor track geometry at 98.8 km (refer to Report 12, **Appendix F**). This change was noted to be an increasing 14m twist on both tracks at this location. The cause of this change was confirmed to be due to mining-induced movements.

This trigger is documented in the reports included in **Appendix F**.

3.2.8.2 Actions Completed

During the reporting period, the following actions were completed with regards to the blue trigger:

- A focussed inspection and additional track geometry survey was completed on 20 April 2023, noting the poor track during these visual inspections (refer to Report 12, **Appendix F**);
- The Rail Management Group met on 21 April 2023 to discuss the finding. It was agreed to conduct local resurfacing on 22 April and continue with twice weekly trolley surveys in the affected area (refer to Report 12, **Appendix F**);
- Local resurfacing was completed on 22 April 2023, resulting in an improvement of track track twist (Report 13, **Appendix F**);

- The Rail Management Group met again on 27 April 2023 to review the latest track geometry data. It was agreed to conduct manual board surveys to confirm trolley readings and locally resurface the track on 28 April 2023. The manual board surveys on 27 April 2023 correlated well with trolley readings. Twice weekly trolley surveys were recommended to continue in the affected area (Report 13, **Appendix F**);
- Local resurfacing was completed on 28 April 2023, which improved track twist on Down Main. However, blue triggers for increasing 14m twist on Down Main at 98.820 km and Cant Difference from Design at Up Main 98.813 km to 98.845 km were noted on 4 May 2023 following some deterioration after resurfacing (Report 14, **Appendix F**);
- Additional local resurfacing was completed on 5 May 2023, resulting in improved track twist on Up Main (Report 15, **Appendix F**); and
- Resurfacing on 3 June 2023 improved track condition on both tracks (Report 19, **Appendix F**).

At the end of this reporting period, the blue trigger for poor track geometry was still in effect.

3.2.8.3 Proposed Actions

Continuous monitoring is ongoing for the Main Southern Railway in accordance with the Main Southern Railway Management Plan.

3.2.9 Various Infrastructure TARPs – non-conventional subsidence movements and bump on Remembrance Drive

3.2.9.1 Background

As discussed in **Section 2.7.2**, non-conventional subsidence movements were measured on 22 May 2023 at Pegs R46 to R48 on Remembrance Drive, accompanied by a bump in the observed subsidence profile at Peg R47 (refer to **Figure 2-18**). The observation exceeds trigger levels in the Management Plans for Wollondilly Shire Council, Jemena, Sydney Water (potable and sewer) and telecommunication owners Telstra, TPG and NBN.

3.2.9.2 Actions Completed

Following the trigger of numerous management plans, the Structures Review Group discussed the observation, and implemented the following management actions:

- Increase 2D survey of the over the target location by Tahmoor Coal to twice weekly;
- Increase visual inspections over the target location by Tahmoor Coal to twice weekly;
- Weekly Gas Detection Survey; and
- Increase testing of the Telstra cable line in the area as required.

In accordance with the Wollondilly Shire Council Management Plan, Tahmoor Coal completed the following actions:

- Notification to Wollondilly Shire Council on 31 May;
- Meeting with representatives from Tahmoor Coal, Wollondilly Shire Council and MSEC on 2 June 2023 and 23 August to review the latest observations and decide whether any additional management measures are required. Council advised that a speed restriction was not required at this stage. The following additional management measures were agreed:
    - Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June, and monthly surveys continue);
    - Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;

- Frequency of focussed visual inspections is currently weekly;
- Tahmoor Coal to continue to keep Council informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and by direct communication if required;
- Tahmoor Coal to arrange for contractor on standby to repair the road at short notice, when required by Council;
- Council to install warning signs and temporary speed restriction signs, when required; and
- Notify and inform Council staff about the impact site, in the event of enquiries from the travelling public.

In accordance with the Sydney Water Potable Water Management Plan and Sydney Water Sewer Management Plan, Tahmoor Coal completed the following actions:

- Notification to Sydney Water on 31 May;
- Tahmoor Coal met with Sydney Water to inspect the impact site on 1 June and via teleconference on 2 June and 5 September 2023 to review the latest observations and decide whether any additional management measures are required. It was agreed that local excavation of pipework or repairs are not required at this stage. The following additional management measures were agreed:
  - Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June and monthly surveys continue);
  - Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
  - Frequency of focussed visual inspections is currently weekly;
  - Sydney Water confirmed that valves have been marked out on site, as planned. Valves to the north of the site have been audited to ensure that they are in working condition. A valve audit was completed for valves located to the south of the site on 15 June;
  - Sydney Water confirmed that reservoirs in the network are currently operating at 87% to 93% full, as planned;
  - Sydney Water confirmed that this section of the water main has no history of previous leaks;
  - Sydney Water will arrange for an acoustic detector to identify leaks along this section of the water main;
  - Tahmoor Coal and Sydney Water plan to install an expansion joint (e.g. gibault joint) near the site prior to the influence of LW S2A. The work is planned for 11 September;
  - Tahmoor Coal to continue to keep Sydney Water informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and via weekly teleconferences (last consultation was 5 September);
  - Sydney Water confirmed that there are no signs of impact on the sewerage system from automated monitoring results from sensors located upstream and downstream of the site;
  - Tahmoor Coal to continue to keep Sydney Water informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and by direct communication if required; and
  - Sydney Water remains on standby to conduct repairs if required.

In accordance with the Jemena Management Plan, Tahmoor Coal completed the following actions:

- Notification to Jemena on 31 May;

- Representatives from Tahmoor Coal, Jemena and MSEC met on 5 June 2023 and 22 August 2023 to review the latest observations and decide whether any additional management measures are required. It was agreed that local excavation of pipework or repairs are not required at this stage. The following additional management measures were agreed:
    - Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June and monthly surveys continue);
    - Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
    - Frequency of focussed visual inspections is currently weekly;
    - Commence weekly gas detection surveys along affected section of Remembrance Drive. This will be conducted by Tahmoor Coal. Jemena will also investigate deploying its recently commissioned vehicle mounted gas detector (to be confirmed);
    - Tahmoor Coal to continue to keep Jemena informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and by direct communication if required;
    - Jemena remains on standby to conduct repairs if required; and
    - Planned uncoupling of the Jemena gas main will be completed as a mitigation measure prior to the zone of subsidence influence of Longwall S2A.

In accordance with the Telstra, TPG and NBN Management Plans, Tahmoor Coal completed the following actions:

- Notification to Telstra, TPG and NBN on 31 May.
- Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June and monthly surveys continue);
- Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
- Frequency of focussed visual inspections is currently weekly;
- Increase frequency of OTDR testing of the Telstra cable from weekly to twice weekly;
- Comms Network Solutions to continue to keep Telstra, NBN and TPG informed on the status of ground movements, visual inspections and OTDR; and
- Comms Network Solutions remains on standby to locally excavate and expose the buried cables if required.

3.2.9.3 Proposed Actions

The current monitoring program will continue in accordance with the various Management Plan discussed in the sections above.

Any identified actions from the various meetings that have not yet been implemented will be implemented by Tahmoor Coal as required.

3.2.10 Tahmoor Mine Site TARP – Blue Trigger at Rail Loop and 6C Tunnel

3.2.10.1 Background

During the reporting period, the following blue triggers occurred (refer to Report 14, **Appendix G**):

- 15 May 2023 – Blue trigger as a result of 11 mm of closure between Pegs BL600 and BL700 of the rail loop, exceeding the 10 mm trigger level; and
- 29 May 2023 – Blue trigger as a result of cracks observed at two locations at 6C Tunnel and vent shaft interface, one along the western face and one at the edge of the vent shaft. Cracks were less than 1 mm in width.

These triggers are documented in the reports included in **Appendix G**.

3.2.10.2 Actions Completed

Mine Site and Rail Management Groups met on 19 May 2023 to discuss the trigger associated with the rail loop. It was noted that closure is distributed over bay lengths, with a maximum of 4 mm closure between BL600 and BL620. No bump was observed in the subsidence profile and the site does not coincide with creek crossings or known geological structures. Gradual rates of changes were noted to be observed. No issues with rail stress were noted until summer, when restressing is planned prior to hot temperatures. A focused inspection will be conducted along the track, Rail Loader, Conveyors 4S and 4C and Washery, which are located in this area.

A structural engineer inspected the cracks in the 6C Tunnel on 30 May 2023 and reported no immediate concerns.

3.2.10.3 Proposed Actions

The current monitoring program will continue in accordance with the Main Southern Railway Management Plan.

Although the blue trigger associated with the Rail Loop has been resolved, Tahmoor Coal will coordinate restressing as planned prior to hot temperatures, as well as a focused inspection along the track.

Continuous monitoring is ongoing for the 6C Tunnel and the blue trigger was still applicable at the end of the reporting period.

3.2.11 3030 Remembrance Drive TARP – Blue Trigger at Fuel Tank

3.2.11.1 Background

During the reporting period, a blue trigger occurred on 16 May 2023 (Report 6, refer **Appendix H**) as an above-ground diesel tank had previously failed a fuel balance test. A loss trend was observed for this tank from 18 April to 30 May 2023. The blue trigger was resolved in early June 2023.

This trigger is documented in the reports included in **Appendix H**.

3.2.11.2 Actions Completed

The owner tested the calibration of the diesel tank and the pump and advised no issues were observed. Tahmoor Coal arranged to pressure test the lines on 28 June 2023 in light of these observations, however was not able to complete this test due to access issues to the pump (Report 13, refer **Appendix H**).

The cause of the blue trigger is unlikely to be a mining issue. Surveys around the tank measure very small ground strains that are close to survey tolerance (Report 13, refer **Appendix H**).

3.2.11.3 Proposed Actions

The current monitoring program will continue in accordance with the 3030 Remembrance Drive Management Plan.

Although this blue trigger has been resolved, Tahmoor Coal will continue to arrange for the completion of a pressure test of the lines related to this tank.

4 Assessment of Environmental Performance

4.1 Environmental Performance Measures and Indicators

The following development consents include subsidence impact performance measures as conditions for the extraction of LW S1A-S6A:

- SSD 8445:
  - Performance Measures – Natural and heritage features: Condition C1 (Table 7); and
  - Performance Measures – Built Features: Condition C5 (Table 8).

The subsidence impact performance measures were adopted as part of the LW S1A-S6A Extraction Plan and associated management plans. To assist in defining the performance measures, each measure has been assigned subsidence performance indicator(s) and addressed in relevant TARPs.

These performance measures and indicators are provided in **Table 4-1**, as well as an assessment of performance in accordance with the TARPs (as discussed previously in **Table 3-3** and **Section 3.2**.

Table 4-1 Assessment of Environmental Performance

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Relevant TARP	Subsidence Performance Measure Exceeded?
Water Resources				
All watercourses within the Subsidence Area	• No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS.	Exceedance of the impact assessment criteria, as defined in the relevant Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure.	TARP WMP1, WMP3 and WMP5.	**No**
Other watercourses	• Negligible environmental consequences including beyond those predicted in the EIS, including: - Negligible diversion of flows or changes in the natural drainage behaviour of pools; - Negligible decline in baseline channel stability; - Negligible gas releases and iron staining; and - Negligible increase in water turbidity.	The performance measure will be considered to be exceeded if a Level 3 TARP is triggered in relation to water level decline and/or water quality changes and the investigation outcomes indicate a mining related impact based on monitoring data for sites in Hornes Creek and the Bargo River. Performance indicators in relation to channel stability are not proposed as soft knickpoints have not been mapped in Hornes Creek or the Bargo River.	TARP WMP2, WMP4 and WMP6.	**No**
GDEs including Thirlmere Lakes	• Negligible impacts including: - Negligible change in groundwater levels; and - Negligible change in groundwater quality.	The performance measure will be considered to be exceeded if a Level 3 TARP is triggered and the investigation outcomes indicate a mining related impact based on monitoring data for the Thirlmere Lakes.	TARP WMP13.	**No**

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Relevant TARP	Subsidence Performance Measure Exceeded?
Land				
Any cliff located directly above longwalls	• Minor environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total face area of the cliff within any longwall mining domain)	This performance measure is not relevant to this Extraction Plan, as there are no cliffs located directly above LW S1A-S6A.	None, not applicable to LW S1A-S6A.	Not applicable.
Any cliff within Subsidence Area beyond the extent of longwalls	• Negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs within Subsidence Area)	This performance measure will be considered to be triggered if more than 0.5% of the total face area of the cliffs within the 600 m Environmental Features Study Area is impacted by mining (i.e. by occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing).	TARP LMP1.	**No**
All land within the Subsidence Area	• No greater subsidence impacts or environmental consequences than predicted in the EIS	This performance measure will be considered to be triggered if mining results in mine subsidence-induced slope instability, which would be a greater subsidence impact or consequence than predicted in the EIS.	TARP LMP2.	**No**
All land outside the Subsidence Area	• Negligible subsidence impacts or environmental consequences	This performance measure is not relevant to this Extraction Plan, as there are no steep slopes identified within the 600 m Environmental Features Study Area, other than the three steep slopes located within the Subsidence Area and already assessment in accordance with the 'All land within the Subsidence Area' performance measure.	None, not applicable to LW S1A-S6A.	Not applicable.

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Relevant TARP	Subsidence Performance Measure Exceeded?
Biodiversity				
Threatened species, threatened populations, or endangered ecological communities	• No greater subsidence impacts or environmental consequences than predicted in the EIS. • Negligible impacts on threatened species, populations or communities due to remediation of subsidence cracking.	This performance measure will be triggered if subsidence impacts cannot be remediated in a manner that restores habitat of threatened species, threatened populations, or endangered ecological communities.	TARP BMP4.	**No**
GDEs including Thirlmere Lakes	• Negligible impacts including: - Negligible change in groundwater levels; and - Negligible change in groundwater quality	The performance measure will be considered to be exceeded if the groundwater levels or groundwater quality decline below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction, and the investigation outcomes indicate a mining related impact based on monitoring data for riparian vegetation.	TARP BMP3.	**No**

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Relevant TARP	Subsidence Performance Measure Exceeded?
Heritage sites				
Aboriginal cultural heritage sites listed in Appendix 4	• No greater subsidence impacts or loss of heritage values than predicted in the EIS.	**TC14-2-19** (Isolated find): No performance indicators are currently established as impacts are predicted to be negligible.	None, not applicable to LW S1A-S6A.	Not applicable.
		Remembrance Drive 2013.1 (open camp site): No performance indicators are currently established as impacts are predicted to be negligible.	None, not applicable to LW S1A-S6A.	Not applicable.
		Teatree Hollow 2013.1 (rockshelter with art and deposit): This performance indicator will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: • Subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and • These subsidence impacts result in impacts to the heritage values of the site, e.g. cracking or spalling of the art work panels or, elsewhere in the shelter, cracking or spalling greater than naturally caused examples in the rockshelter. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Teatree Hollow 2013.1. Such impacts would not exceed the 10% threshold of impacts to the 19 total rockshelters in the longwalls A and B Study Area.	TARP HMP1.	**No**

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Relevant TARP	Subsidence Performance Measure Exceeded?
Heritage sites				
Historical heritage sites listed in Appendix 4	• No greater subsidence impacts or loss of heritage values than predicted in the EIS.	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance indicator is applicable to the following historical heritage items: • Wirrimbirra Sanctuary (Australian Wildlife Sanctuary); • Bargo Cemetery; • Bargo Railway Bridge North (Wellers Road Overbridge); • Picton Weir; • Tahmoor Colliery (Tahmoor Mine Site); • Great Southern Road (partial); and • Bargo Railway Viaduct.	TARP HMP2.	**No**
Mine workings				
First workings	• To remain long term stable and non-subsiding.	None allocated.	None – ongoing assessment in accordance with mine design.	**No**
Second workings	• To be carried out only within the approved mine plan, in accordance with an approved Extraction Plan.	None allocated.	None – ongoing assessment in accordance with LW S1A-S6A Extraction Plan mine plan.	**No**

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Relevant TARP	Subsidence Performance Measure Exceeded?
Public Infrastructure				
Key public infrastructure: • Main Southern Railway • Remembrance Drive • M31 Motorway • Moomba to Sydney Gas Pipeline • Gorodok Ethane Pipeline • Bargo Waste Management Centre	• Always safe and serviceable • Damage that does not affect safety or serviceability must be fully repairable, and must be fully investigated and repaired at the cost of the Applicant	None allocated.	Addessed in TARPs contained in the Main Southern Railway Management Plan and Wollondilly Shire Council Management Plan. It is noted that the Bargo Waste Management Centre, M31 Motorway, Moomba to Sydney Gas Pipeline, and the Gorodok Ethane Pipelines are not located within the Study Area of this Extraction Plan.	**No**
• All other public infrastructure including roads, culverts, bridges, viaducts, water supply pipelines, sewerage mains, gas pipelines, electrical and telecommunication infrastructure and survey control marks.	• Always safe • Serviceability should be maintained wherever practicable • Loss of serviceability must be fully compensated • Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant	None allocated.	Addressed in TARPs contained in Subsidence Management Plans for various built features.	**No**

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Relevant TARP	Subsidence Performance Measure Exceeded?
Other Built Features				
• Public amenities including schools, churches and community centres • Industrial, commercial and business premises • Bargo Cemetery • Wirrimbirra Sanctuary • Privately-owned residences • Other privately-owned built features and improvements, including petrol stations, sheds, garages, farm dams, tanks, swimming pools, tennis courts, roads, tracks and fences	• Always safe • Serviceability should be maintained wherever practicable • Loss of serviceability must be fully compensated • Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant.	**Farm dams**: This performance measure will be considered to be triggered if mining results in damage to a farm dam such that the dam is not safe and serviceable and/or any damages cannot be fully repairable and/or compensated.	TARP LMP3.	**No**
		All other features: None allocated.	Addressed in TARPs contained in Subsidence Management Plans for various built features.	**No**
Public Safety				
• Public safety	• Negligible additional risk	This performance measure will be considered to be triggered if subsidence monitoring identifies a mining induced hazard to the public that cannot be controlled or managed.	Assessed indirectly through TARP LMP1, LMP2, LMP3. Addressed in TARPs contained in Subsidence Management Plans for various built features.	**No**

5 Document Information

5.1 References

Department of Planning and Environment (DPE) (2015), Draft Guidelines for the Preparation of Extraction Plans V5.

Niche (2023a), Tahmoor South, Aquatic Monitoring Report Autumn 2023, report to Tahmoor Coal, 11 September 2023.

Niche (2023b), Tahmoor Mine South, Terrestrial Ecology Monitoring Report: Autumn 2023, report to Tahmoor Coal, 28 September 2023.

Tahmoor Coal Documents:

- Extraction Plan LW S1A-S6A Extraction Plan Main Document, TAH-HSEC-00360
- Extraction Plan LW S1A-S6A Water Management Plan, TAH-HSEC-00361
- Extraction Plan LW S1A-S6A Land Management Plan, TAH-HSEC-00362
- Extraction Plan LW S1A-S6A Biodiversity Management Plan, TAH-HSEC-00363
- Extraction Plan LW S1A-S6A Heritage Management Plan, TAH-HSEC-00364
- Extraction Plan LW S1A-S6A Built Features Management Plan, TAH-HSEC-00366
- Extraction Plan LW S1A-S6A Public Safety Management Plan, TAH-HSEC-00365
- Extraction Plan LW S1A-S6A Subsidence Monitoring Program, TAH-HSEC-00367

5.2 Glossary of Terms

Terms references to this document are provided below in **Table 5-1**.

Table 5-1 Glossary of Terms

Term	Definition
Active Subsidence Zone	The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 mm subsidence contour for the active longwall and a distance of 150 m in front of the active longwall face and 450 m behind the active longwall face or following 500 m of longwall extraction.
Angle of draw	The angle of inclination from the vertical of the line connecting the goaf edge of the workings and the limit of subsidence (which is usually taken as 20 mm of subsidence).
Built features	Includes any building or work erected or constructed on land, including dwellings and infrastructure such as a formed road, street, path, walk, or driveway; any pipeline, water sewer, telephone, gas or other infrastructure service main.
Cliff	A continuous rock face, including overhangs, having a minimum length of 20 metres, a minimum height of 10 metres and a minimum slope of 2 to 1 (>63.4°).
Closure	The reduction in the horizontal distance between the valley sides. The magnitude of closure, which is typically expressed in the units of mm, is the greatest reduction in distance between any two points on the opposing valley sides. It should be noted that the observed closure movement across a valley is the total movement resulting from various mechanisms, including conventional mining induced movements, valley closure movements, far-field effects, downhill movements and other possible strata mechanisms.

Term	Definition
Curvature	Second derivative of subsidence, or the rate of change of tilt, and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections. Curvature is usually expressed as the inverse of the Radius of Curvature with the units of 1/km (km-1), but the value of curvature can be inverted, if required, to obtain the radius of curvature, which is usually in km. Curvature can be either hogging (i.e. convex) or sagging (e.g. concave).
Longwall	A system of mining coal in which the seam is extracted on a broad front or long face using a coal shearer and the roof is supported by hydraulic roof supports.
Reporting period	1 January 2023 to 30 June 2023.
Run of mine (ROM)	Raw coal production. The unprocessed mined coal that is conveyed to the CPP. ROM may consist of coal and rock.
Steep slope	An area of land having a gradient between 1 in 3 (33% or 18.3°) and 2 in 1 (200% or 63.4°).
Strain	The change in the horizontal distance between two points divided by the original horizontal distance between the points, i.e. strain is the relative differential displacement of the ground along or across a subsidence monitoring line. Strain is dimensionless and can be expressed as a decimal, a percentage or in parts per notation. Tensile Strains are measured where the distance between two points or survey pegs increases and Compressive Strains where the distance between two points decreases. Whilst mining induced strains are measured along monitoring lines, ground shearing can occur both vertically, and horizontally across the directions of the monitoring lines.
Study Area	Study Area as defined in the LW S1A-S6A Extraction Plan.
Subsidence	The vertical movement of a point on the surface of the ground as it settles above an extracted panel, but 'subsidence of the ground' in some references can include both a vertical and horizontal movement component. The vertical component of subsidence is measured by determining the change in surface level of a peg that is fixed in the ground before mining commenced and this vertical subsidence is usually expressed in units of mm. Sometimes the horizontal component of a peg's movement is not measured, but in these cases, the horizontal distances between a particular peg and the adjacent pegs are measured.
Subsidence impacts	The physical changes or damage to the fabric or structure of the ground, its surface and environmental features, or built structures that are caused by the subsidence effects. These impacts considerations can include tensile and shear cracking of the rock mass, localised buckling of strata, bed separation, rock falls, collapse of overhangs, failure of pillars, failure of pillar floors, dilation, slumping and also include subsidence depressions or troughs.
Subsidence consequences	The knock-on results of subsidence impacts, i.e. any change in the amenity or function of a natural feature or built structure that arises from subsidence impacts. Consequence considerations include public safety, loss of flows, reduction in water quality, damage to artwork, flooding, draining of aquifers, the environment, community, land use, loss of profits, surface improvements and infrastructure. Consequences related to environmental features are referred to as environmental consequences.

Term	Definition
Tilt	The change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the horizontal distance between those points. Tilt is, therefore, the first derivative of the subsidence profile. Tilt is usually expressed in units of mm/m. A tilt of 1 mm/m is equivalent to a change in grade of 0.1 %, or 1 in 1000.

5.3 Abbreviations

Abbreviations used in this document are provided below in **Table 5-2**.

Table 5-2 Abbreviations

Abbreviation	Definition
AHIMS	Aboriginal Heritage Information System
ARTC	Australian Rail Track Corporation
AUSRIVAS	The Australian River Assessment System
BACI	Before After Control Impact design
BGSS	Bargo Sandstone
BIS	Building Inspection Service
CTF	Cease to flow
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPIE	NSW Department of Planning, Industry and Environment (now DPE)
EC	Electrical conductivity
EPA	NSW Environment Protection Authority
EPT	Ephemeroptera Plecoptera Trichoptera scores
GFG	GFG Alliance
GNSS	Global Navigation Satellite System units
HBSS	Hawkesbury Sandstone
Km	Kilometres
LW S1A	Longwall South 1A
LW S2A	Longwall South 2A
LW S3A	Longwall South 3A
LW S4A	Longwall South 4A
LW S5A	Longwall South 5A
LW S6A	Longwall South 6A
LW S1A-S6A	Longwall South 1A to South 6A
m	metres
mbgl	Metres below ground level
mg/L	Milligrams per litre
ML	Mining Lease
mm	millimetre
MSEC	Mine Subsidence Engineering Consultants
MSR	Main Southern Railway

Abbreviation	Definition
NRAR	NSW Industry – Land & Water – Natural Resources Access Regulator – East
NSW	New South Wales
OE	Observed expected score
OSP	Open Standpipe Piezometers
pH	pH units
SSGVs	Site Specific Guideline Values
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine
TARP	Trigger Action Response Plan
TDS	Total dissolved solids
TfNSW	Transport for NSW
VMP	Vibrating Wire Piezometer

5.4 Document Distribution

This report and associated documents have been distributed according to **Table 5-3**.

Table 5-3 Distribution List for Six Monthly Subsidence Impact Report

Agency	Contact Person	Position	Electronic Copy
DPE	(Planning Portal)	(Planning Portal)	(https://www.planningportal.nsw.gov.au/major-projects)
	Jessie Evans	Director – Resource Assessments	Jessie.evans@planning.nsw.gov.au
	Gabrielle Allan	Team Leader	Gabrielle.Allan@planning.nsw.gov.au
DPE - Resources Regulator (Subsidence)	(General email)	(General email)	subsidence.monitoring@planning.nsw.gov.au nswresourcesregulator@service-now.com
	Ray Ramage	Mine Safety Officer - Subsidence	ray.ramage@planning.nsw.gov.au
DRNSW – Mining Exploration and Geoscience	(General email)	(General email)	resource.operations@planning.nsw.gov.au
DRNSW – Resources Regulator – Mining Act Inspectorate	(General email)	(General email)	nswresourcesregulator@service-now.com
	Greg Kininmonth	Manager Environmental Operations (Southern)	greg.kininmonth@planning.nsw.gov.au
Wollondilly Shire Council	(General email)	(General email)	council@wollondilly.nsw.gov.au
	David Henry	Acting Team Leader Environmental Services	david.henry@wollondilly.nsw.gov.au
Subsidence Advisory NSW	(General email)	(General email)	subsidencetechnical@customerservice.nsw.gov.au
	John Johnston	Technical Manager	John.Johnston@customerservice.nsw.gov.au

Agency	Contact Person	Position	Electronic Copy
NRAR	(General email)	(General email)	nrar.servicedesk@dpie.nsw.gov.au
	Guy Ohandja	Manager Compliance Monitoring & Audit	guy.ohandja@nrar.nsw.gov.au
EPA	(General email)	(General email)	epa.illawarra@epa.nsw.gov.au
	Andrew Couldridge	Senior Operations Officer - Metropolitan Illawarra	andrew.couldridge@epa.nsw.gov.au
Commonwealth Department of Climate Change, Energy, the Environment and Water	(General email)	(General email)	epbcmonitoring@dcceew.gov.au
TCCCC Committee Members	Documents sent to TCCCC Committee Members at private email addresses.		

Appendix A – Subsidence Monitoring Reports

End of Panel Subsidence Monitoring Report for Tahmoor South LW S1A

Summary	
Monitoring period	29 July to 29 August 2023
Length of extraction of LW S1A	1706 metres LW completed extraction on 4 July 2023
Distance travelled by longwall since previous report	
Distance to completion of LW S1A	

Summary of observed ground movements

Subsidence Parameter	Maximum observed at completion of LW S1A	Location
Subsidence (mm)	777	V-Line
Tilt (mm/m)	4.23	Main Southern Railway
Hogging Curvature (km^{-1})	0.09	Remembrance Drive
Sagging Curvature (km^{-1})	-0.17	Main Southern Railway
Tensile Strain (mm/m)	0.5	V-Line
Compressive Strain (mm/m)	-2.4	Main Southern Railway

Actions

HAVE ANY DEFINED TRIGGERS BEEN REACHED SINCE PREVIOUS REPORT?	Watching gradual development of non-conventional compressive strain along Remembrance Drive between Pegs R47 and R48 and bump in observed subsidence profile at Peg R46. Small bump observed in southbound lane at this location, which is south of Bargo Petroleum. Rates of change reduced very low levels.
IS ANY URGENT ACTION REQUIRED?	NO. Consultation with infrastructure owners regarding observation of non-conventional subsidence movement on Remembrance Drive. Rates of change reduced to very low levels.

This monitoring report provides the results of the latest ground surveys during the mining of LW S1A, in accordance with the requirements of subsidence management plans.

Longwall face position

LW S1A commenced on 18 October 2022, and completed extraction on 4 July 2023. The mine layout and the monitoring peg positions are shown in Drawing No. MSEC1304-01.

Monitoring results

Ground monitoring is being undertaken within the active subsidence zone of LW S1A. Maximum incremental subsidence parameters at the completion of LW S1A are summarised in Table 1.

Table 1 Summary of maximum observed subsidence parameters

Monitoring Line	Maximum observed subs (mm)	Maximum observed tilt (mm/m)	Maximum observed hogging curvature (km^{-1})	Maximum observed sagging curvature (km^{-1})	Maximum observed tensile strain (mm/m)	Maximum observed comp. strain (mm/m)
V-Line - monthly extent - weekly extent	777 48	6.2 0.3	0.08 0.02	-0.16 -0.01	0.5 0.1	-1.9 -0.1
Main Southern Railway	531	4.3	0.05	-0.17	0.3	-2.4
Remembrance Drive	66	1.2	0.09	-0.07	0.3	-1.7
Caloola Road	33	0.4	0.02	-0.03	0.2	-0.2
Charlies Point Road	25	0.8	0.04	-0.04	0.2	-0.2

Ground survey results

Ground monitoring has been undertaken within the active subsidence zone of LW S1A. Monitoring results are shown graphically at the back of this report.

The spatial distribution of incremental subsidence is shown in Drawing No. MSEC1304-02.

Tahmoor Mine Boundary Survey Line (V Line)

The latest survey along the V-Line was conducted on 24 July. Subsidence has developed above LW S1A, and compressive strain is observed between pegs V-43 and V-45 at Wirrimbirra Creek, and between pegs V50 to V52 above the centre of the longwall.

The frequency of ground surveys has increased from monthly to fortnightly in light of impacts observed at Teatree Hollow during the mining of LW S1A. Minor changes were observed in the last survey as extraction was completed on 4 July.

Main Southern Railway

Monthly and weekly surveys have been conducted during LW S1A. The latest survey was conducted on 10 August. Rates of change have reduced to very low levels.

GNSS monitoring

Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure their absolute horizontal and vertical positions in real time. There are 20 units located directly above and adjacent to LW S1A to S6A. These include two units above the commencing end, and along the centreline of, LW S1A, being Sites S01 and S02.

The measured position of each GNSS unit varies depending on atmospheric conditions and the array of satellites that are present in the sky at each time, and the vegetation cover surrounding each unit. Measured variations in height are typically greater than the variations for eastings and northings.

The results from the GNSS units are shown in Fig. S01 to Fig. S10. The 7-day running average readings are the most appropriate reflection of measured changes to date. Mining-induced movements have developed at the GNSS units, with maximum measured subsidence of 662 mm at S01.

Observed development of subsidence above LW S1A is shown in Figure A. Subsidence has developed within predictions, with magnitudes of subsidence slightly greater than observations above previously extracted LW 22, as predicted due to the shallower depth of cover above LW S1A. Subsidence at Peg V-51 along the V Line is greater than observed at the GNSS units, very slightly greater than predicted. Rates of change have reduced to very low levels.

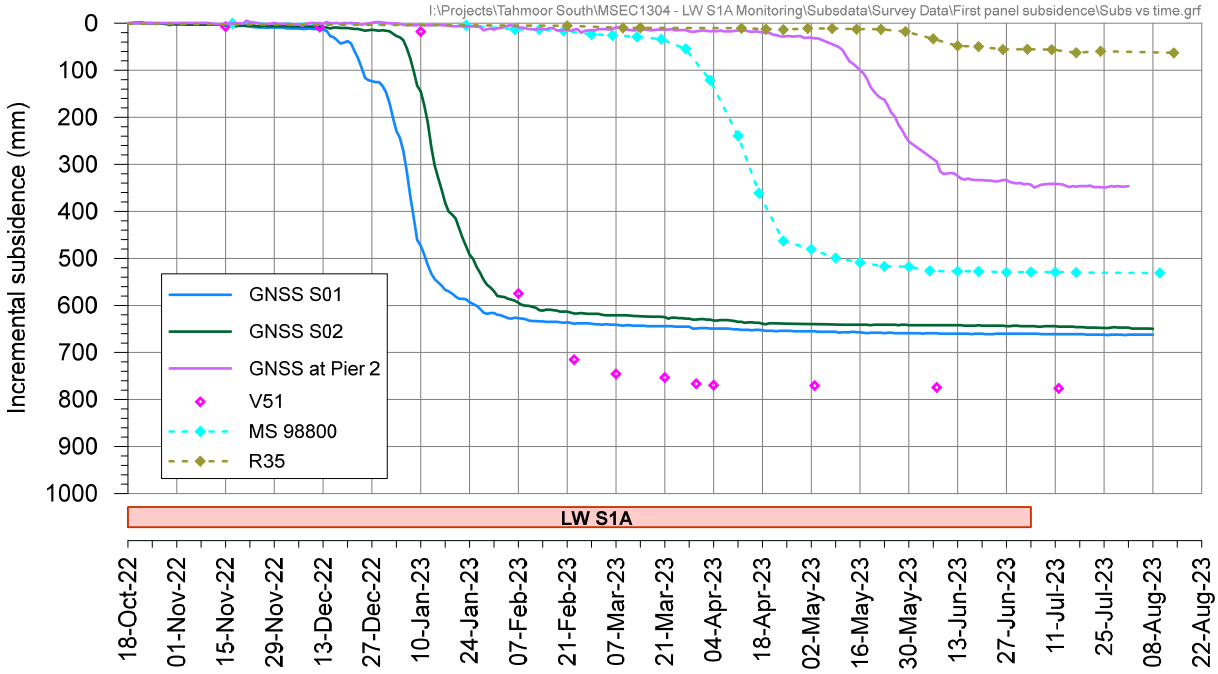


Figure A Observed development of subsidence above LW S1A

Changes in horizontal distances can be calculated between GNSS units that are stationed close together and results are shown in Figure B. Closure has developed between Sites 01 and 02, and Sites 03 and 04 across Wirrimbirra Creek. Rates of change at these sites have reduced to low levels. Minor changes currently observed between other pairs of GNSS units.

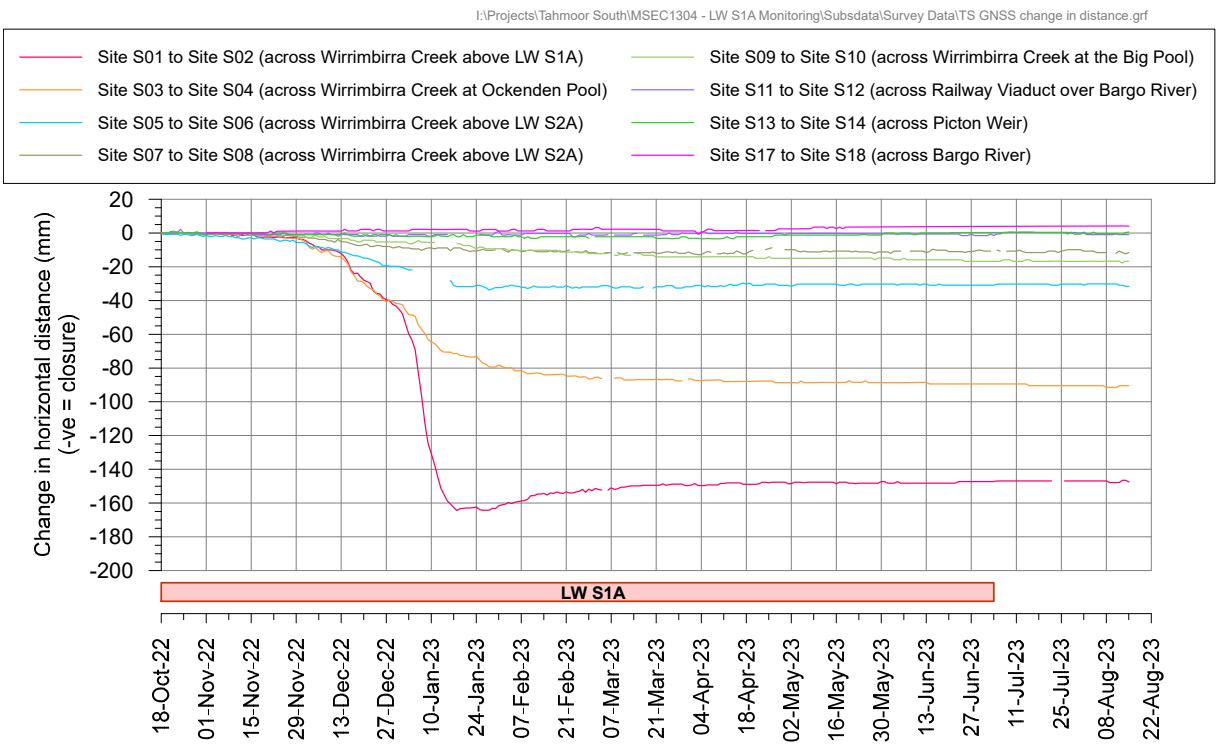


Figure B Observed changes in horizontal distances between GNSS units

Remembrance Drive

Non-conventional subsidence movements are observed at Pegs R46 to R48. Increased compressive strain is observed between Pegs R47 and R48, accompanied by a bump in the observed subsidence profile at Peg R47.

The observed development of compressive strain is shown in Figure C. Increased compressive strain and a small bump in the observed subsidence profile was first identified from the ground survey on 22 May 2023.

Compressive strain was measured to have increased between Pegs R47 and R48 on 29 May 2023. A localised resurvey of strain distances on 31 May 2023 found that compressive strain had reduced very slightly but remained approximately 1 mm/m. Compressive strain was measured to have increased between Pegs R47 and R48 on 6 June to approximately 1.4 mm/m. A localised resurvey of strain distances on 8 June found that compressive strain had increased very slightly to approximately 1.5 mm/m. No change was measured on 13 June. A localised resurvey of strain distances on 15 June found that compressive strain had increased very slightly to approximately 1.6 mm/m. No change was measured on 19 June. A localised resurvey of strain distances on 22 June found that compressive strain had increased very slightly to approximately 1.7 mm/m.

The latest survey on 14 August measured changes within survey tolerances.

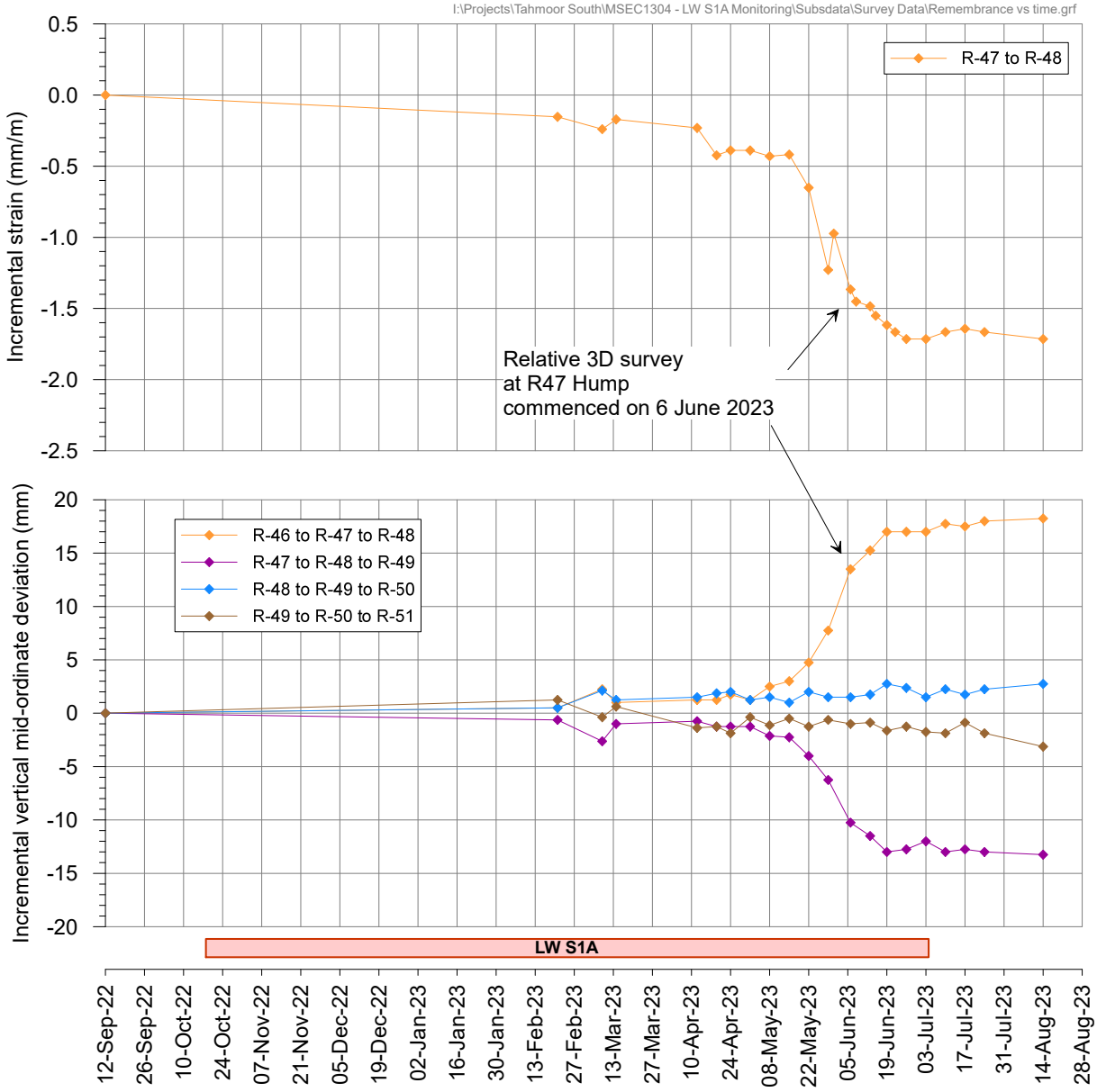


Figure C Observed development of ground strain and changes in vertical alignment at selected pegs along Remembrance Drive

As shown in Figure C, the observed compressive strain between Pegs R47 and R48 is accompanied by a bump in the observed subsidence profile at Peg R46, and the dip in the observed subsidence profile at Peg R47. The survey on 29 May 2023 found that the bumps in the observed subsidence profile had increased since 22 May 2023. The survey on 6 June 2023 found that the bumps in the observed subsidence profile had increased since 29 May 2023. Minor changes were observed in the survey of 14 August. Monthly surveys will continue as LW S2A is extracted.

A focussed visual inspection was conducted on 31 May, which identified a small compression bump in the southbound lane of Remembrance Drive between Pegs R47 and R48. A photograph of the bump on 31 May is shown in Figure D. A map showing the location and orientation of the bump relative to nearby building structures and utility services is shown in Figure E. It can be seen that the bump is located to the side of LW S1A and above future LW S2A. It is oriented at an angle to the pavement and does not intersect with the Bargo Petroleum petrol station or any other structures. The bump intersects with a number of utility services, including Jemena's gas main, Sydney Water's potable water main and sewer main, and optical fibre and copper telecommunication cables.

Photograph courtesy Building Inspection Services

Figure D Small bump observed in southbound lane of Remembrance Drive near Peg R46 on 31 May 2023

In light of the survey results on 22 May, which were confirmed by survey results on 29 May and identification of a bump in the road pavement on 31 May, the location is considered to be experiencing non-conventional subsidence movements. The observation exceeds trigger levels in the Management Plans for Wollondilly Shire Council, Jemena, Sydney Water (potable and sewer) and telecommunication owners Telstra, TPG and NBN. Tahmoor Coal has notified and met with the infrastructure owners as required under the Management Plans. Summaries of decisions made in the meetings are discussed later in this report.

Visual inspections were conducted on 18 August and a photograph of the bump is shown in Figure F. No significant changes were observed since the inspection on 30 June. A faint bump is visible on the edge line of the northbound lane south of Peg R46.

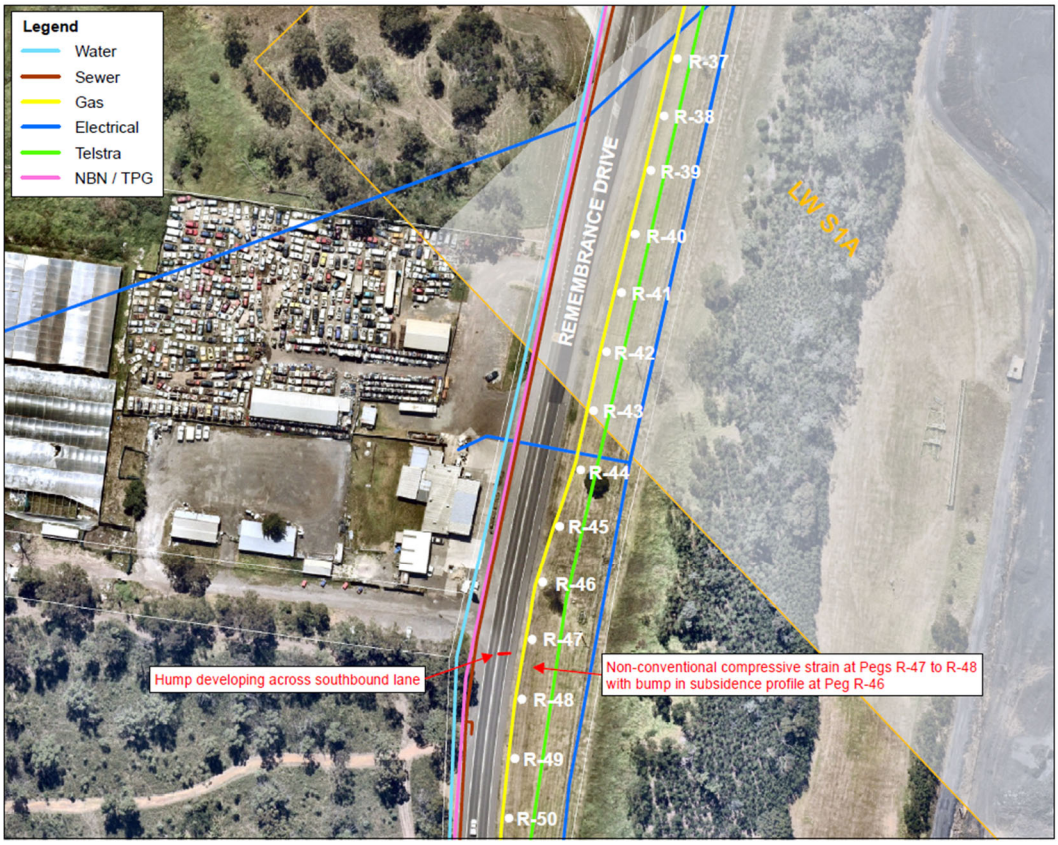


Figure E Location of small bump observed in southbound lane of Remembrance Drive near Peg R46 on 2 June 2023

Photograph courtesy Building Inspection Services

Figure F Small bump observed in southbound lane of Remembrance Drive near Peg R46 on 18 August 2023 (no significant changes observed since 30 June)

Natural Features

In addition to the GNSS units, survey marks have been installed at four locations across the Tributary to Teatree Hollow (Wirrimbirra Creek), and at four locations across Teatree Hollow, as shown in Drawing No. MSEC1304-01.

Visual inspections have been conducted in September, October and November 2022, all three of which could be considered to be baseline inspections. Visual inspections in December 2022 and January 2023 did not detect mine subsidence impacts.

Tributary to Teatree Hollow (Wirrimbirra Creek)

Impacts were first detected in the Tributary to Teatree Hollow (Wirrimbirra Creek) on 8 February 2023. Minor changes were observed on 11 August 2023. Surface water flows were first observed to stop approximately 120 metres upstream of monitoring site TT3, above the centreline of future LW S2A. A surface crack was observed in the bedrock downstream of this location. On 11 August, flows in the creek had reduced after a period of little rainfall, with no surface water flows observed downstream of TT1 until it reappears at knickpoint 64 but only as a depression. No water was flowing into or out of TT2.

Surface water was first observed to re-emerge upstream of monitoring site TT13 and on 11 August, surface flows were observed to re-emerge downstream from the junction to Teatree Hollow at TT7, though no overland flow was observed. While this section of the Tributary to Teatree Hollow has been previously observed to be dry during periods of dry weather, the observations indicate that the changes may be mining-induced.

A visual inspection of the rock shelter on 2 June found no water in the pool at TT3, and the pool was also observed to be dry on 17 May, 31 May, 14 June, 2 June and 6 July.

Teatree Hollow

Surveys were conducted across Teatree Hollow on 23 February, 7 March, 21 March, 30 March, 4 April and 7 June, with very little closure observed at TT6, TT9 and TT12 (5 mm or less).

Impacts were first observed along Teatree Hollow directly above LW S1A on 1 March 2023. Surface water flows have been observed to stop near the upstream edge of LW S1A and reappear with iron staining present above the downstream edge of LW S1A. Minor changes were observed on 11 August. As observed in the Tributary to Teatree Hollow, surface flows were not observed in the creek upstream of the mining area. Surface cracking is observed at monitoring site TT12 and downstream of TT12. The inspection on 11 August observed no changes since the previous inspection on 25 July.

Structures

Surveys are being conducted at Bargo Petroleum and Wollondilly Anglican College. Visual inspections on 25 July found no issues. One gate at the Wollondilly Anglican College has jammed and has been repaired.

Local Roads

A focussed detailed inspection on 31 May identified a bump in the southbound lane of Remembrance Drive where non-conventional subsidence movements have been observed between Pegs R46 and R48.
A visual inspection on 9 June found that the bump had extended slightly across towards the Northbound lane since the inspection on 31 May. Minor changes were observed on 20 and 23 June. A faint bump is visible on the edge line of the northbound lane south of Peg R46. No significant changes were observed on 18 August.

MSEC notified Wollondilly Shire Council on behalf of Tahmoor Coal on 31 May. Representatives from Tahmoor Coal, Wollondilly Shire Council and MSEC met on 2 June 2023 and 23 August to review the latest observations and decide whether any additional management measures are required. Council advised that a speed restriction was not required at this stage. The following additional management measures were agreed:

- Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June, and monthly surveys continue);
- Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
- Frequency of focussed visual inspections is currently weekly;
- Tahmoor Coal to continue to keep Council informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and by direct communication if required;
- Tahmoor Coal to arrange for contractor on standby to repair the road at short notice, when required by Council;
- Council to install warning signs and temporary speed restriction signs, when required; and

- Notify and inform Council staff about the impact site, in the event of enquiries from the travelling public.

Monthly ground surveys have been conducted along Charlies Point Road, with very minor changes observed on 7 February. A visual inspection of Charlies Point Road on 31 January found no issues. Ground surveys and visual inspections have ceased as Charlies Point Road is beyond the zone of active subsidence. A survey will be completed following completion of LW S1A.

Surveys of Rockford Road Bridge and Arina Road Bridge were conducted on 25 July, with observed changes within survey tolerance.

Visual inspection of Arina Road Bridge on 2 August found no issues.

Gas Infrastructure

Minor subsidence movements and ground strains are developing along Remembrance Drive. Non-conventional subsidence movements are observed at Pegs R46 to R48 on Remembrance Drive.

It is noted that no odours have been detected during visual inspections. Gas detection surveys were completed on 25 July, with no issues observed.

MSEC notified Jemena on behalf of Tahmoor Coal on 31 May. Representatives from Tahmoor Coal, Jemena and MSEC met on 5 June 2023 and 22 August 2023 to review the latest observations and decide whether any additional management measures are required. It was agreed that local excavation of pipework or repairs are not required at this stage. The following additional management measures were agreed:

- Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June and monthly surveys continue);
- Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
- Frequency of focussed visual inspections is currently weekly;
- Commence weekly gas detection surveys along affected section of Remembrance Drive. This will be conducted by Tahmoor Coal. Jemena will also investigate deploying its recently commissioned vehicle mounted gas detector (to be confirmed);
- Tahmoor Coal to continue to keep Jemena informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and by direct communication if required; and
- Jemena remains on standby to conduct repairs if required.

Electrical Infrastructure

Minor subsidence movements and ground strains are developing along Remembrance Drive. Non-conventional subsidence movements are observed at Pegs R46 to R48 on Remembrance Drive. The observations do not adversely affect Endeavour Energy infrastructure at this stage.

Ground surveys of critical power poles are conducted when poles are within the active subsidence zone. The latest survey was on 25 May.

Telecommunications Infrastructure

Minor subsidence movements and ground strains are developing along the optical fibre cables on Remembrance Drive, the southern end of the mine and the Main Southern Railway. Visual inspections and OTDR testing have not observed impacts, including where a bump has been observed in the pavement on Remembrance Drive.

Non-conventional subsidence movements are observed at Pegs R46 to R48 on Remembrance Drive. Comms Network Solutions notified Telstra, TPG and NBN on behalf of Tahmoor Coal on 31 May. It is noted that the Telstra cable is the most vulnerable as it is direct-buried, while the NBN and TPG cables are in 100 mm diameter conduit.

The following additional management measures are being conducted:

- Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June and monthly surveys continue);
- Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
- Frequency of focussed visual inspections is currently weekly;
- Increase frequency of OTDR testing of the Telstra cable from weekly to twice weekly;
- Comms Network Solutions to continue to keep Telstra, NBN and TPG informed on the status of ground movements, visual inspections and OTDR; and

- Comms Network Solutions remains on standby to locally excavate and expose the buried cables if required.

Potable Water Infrastructure

Minor subsidence movements and ground strains are developing along Remembrance Drive.
Non-conventional subsidence movements are observed at Pegs R46 to R48 on Remembrance Drive.

MSEC notified Sydney Water on behalf of Tahmoor Coal on 31 May. Tahmoor Coal met with Sydney Water to inspect the impact site on 1 June and via teleconference on 2 June and 5 September 2023 to review the latest observations and decide whether any additional management measures are required.

It was agreed that local excavation of pipework or repairs are not required at this stage. The following additional management measures were agreed:

- Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June and monthly surveys continue);
- Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
- Frequency of focussed visual inspections is currently weekly;
- Sydney Water confirmed that valves have been marked out on site, as planned. Valves to the north of the site have been audited to ensure that they are in working condition. A valve audit was completed for valves located to the south of the site on 15 June;
- Sydney Water confirmed that reservoirs in the network are currently operating at 87% to 93% full, as planned;
- Sydney Water confirmed that this section of the water main has no history of previous leaks;
- Sydney Water will arrange for an acoustic detector to identify leaks along this section of the water main;
- Tahmoor Coal and Sydney Water plan to install an expansion joint (e.g. gibault joint) near the site prior to the influence of LW S2A. The work is planned for 11 September;
- Tahmoor Coal to continue to keep Sydney Water informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and via weekly teleconferences (last consultation was 5 September); and
- Sydney Water remains on standby to conduct repairs if required.

Sewer Infrastructure

Minor subsidence movements and ground strains are developing along Remembrance Drive.
Non-conventional subsidence movements are observed at Pegs R46 to R48 on Remembrance Drive.

MSEC notified Sydney Water on behalf of Tahmoor Coal on 31 May. Tahmoor Coal met with Sydney Water via teleconference on 2 June to review the latest observations and decide whether any additional management measures are required.

It was agreed that local excavation of pipework or repairs are not required at this stage. The following additional management measures were agreed:

- Install additional survey pegs on the northbound side of Remembrance Drive and measure changes along both sides of the pavement in local 3D (pegs installed 5 June and monthly surveys continue);
- Frequency of surveys has reduced from weekly to monthly until LW S2A approaches the site;
- Frequency of focussed visual inspections is currently weekly;
- Sydney Water confirmed that there are no signs of impact on the sewerage system from automated monitoring results from sensors located upstream and downstream of the site;
- Tahmoor Coal to continue to keep Sydney Water informed on the status of ground movements and visual inspections, and on the status of potential impacts at the petrol station and utility services via this monitoring report and by direct communication if required; and
- Sydney Water remains on standby to conduct repairs if required.

Dams

Weekly visual inspections, and monthly geotechnical inspections will be undertaken when dams are within the active subsidence zone.

A visual inspection of FD-1 on 9 December found no issues, however, the water level has dropped since the previous inspection due to drier weather conditions. The small dam is holding a small volume of water following recent rainfall. No significant changes were observed on 8 March.

Visual inspections of FD-6 and FD-7 on 23 March found further reduction of water levels due to recent warmer weather. There was no evidence of surface cracking. Visual inspections on 12 April found reduced water levels in both dams, with dam FD-7 almost completely dry. Visual inspections on 17 April found a further reduction in water level at dam FD-6, and no significant changes at dam FD-7. Visual inspections on 24 April found no significant changes at dams FD-6 and FD-7. Visual inspections on 1 May and 5 May found both dams had partially refilled following recent rain. No significant changes were observed on 8 May, 15 May and 22 May. On 29 May, 5 June, 12 June, 20 June, 26 June, 3, 18 and 25 July, water levels had reduced at dam FD-6 due to lack of rainfall. On 20 June water levels had reduced at dam FD-7 due to lack of rainfall, but no significant changes were observed on 26 June. Dam FD-7 was dry as at 25 July at dam FD-7 due to lack of rainfall.

A baseline visual inspection of FD-8 was completed on 3 March. Minor water loss was observed on 18 April. No significant changes were observed on 24 April. Water levels had increased on 5 May following recent rain. No significant changes were observed on 8 May, 15 May and 22 May. On 29 May, 6 June and 12 June, minor water loss was observed due to lack of rainfall. No significant changes were observed on 25 July.

A baseline visual inspection of FD-9 was completed on 9 March. Reduced water level was observed on 18 April and 24 April. Water levels had increased on 5 May following recent rain. No significant changes were observed on 8 May, 15 May and 22 May. On 29 May, minor water loss was observed due to lack of rainfall. No significant changes were observed on 5 June. Minor water loss was again noted on 12 June. No significant changes were observed on 25 July.

A baseline visual inspection of FD-10 was completed on 8 May from the fence line. The toe of the embankment was dry and the water level was not visible. No significant changes were observed on 25 July.

Archaeological Sites

Minor ground movements have been measured by GNSS units S03 and S04 located on either side of Wirrimbirra Creek, with no impacts observed. A visual inspection at rock shelter site 52-2-4471 on 6 July found that the creek bed was dry.

Mine Site

Monthly and weekly surveys have been conducted at the mine site during LW S1A. The latest survey was conducted on 17 July. Rates of change have reduced to very low levels.

Summary of surveys and inspections completed

Surveys and inspections have been conducted to meet the requirements of the LW S1A-S6A Extraction Plan. A timeline showing when each type of survey and inspection was conducted is shown in Figure G.

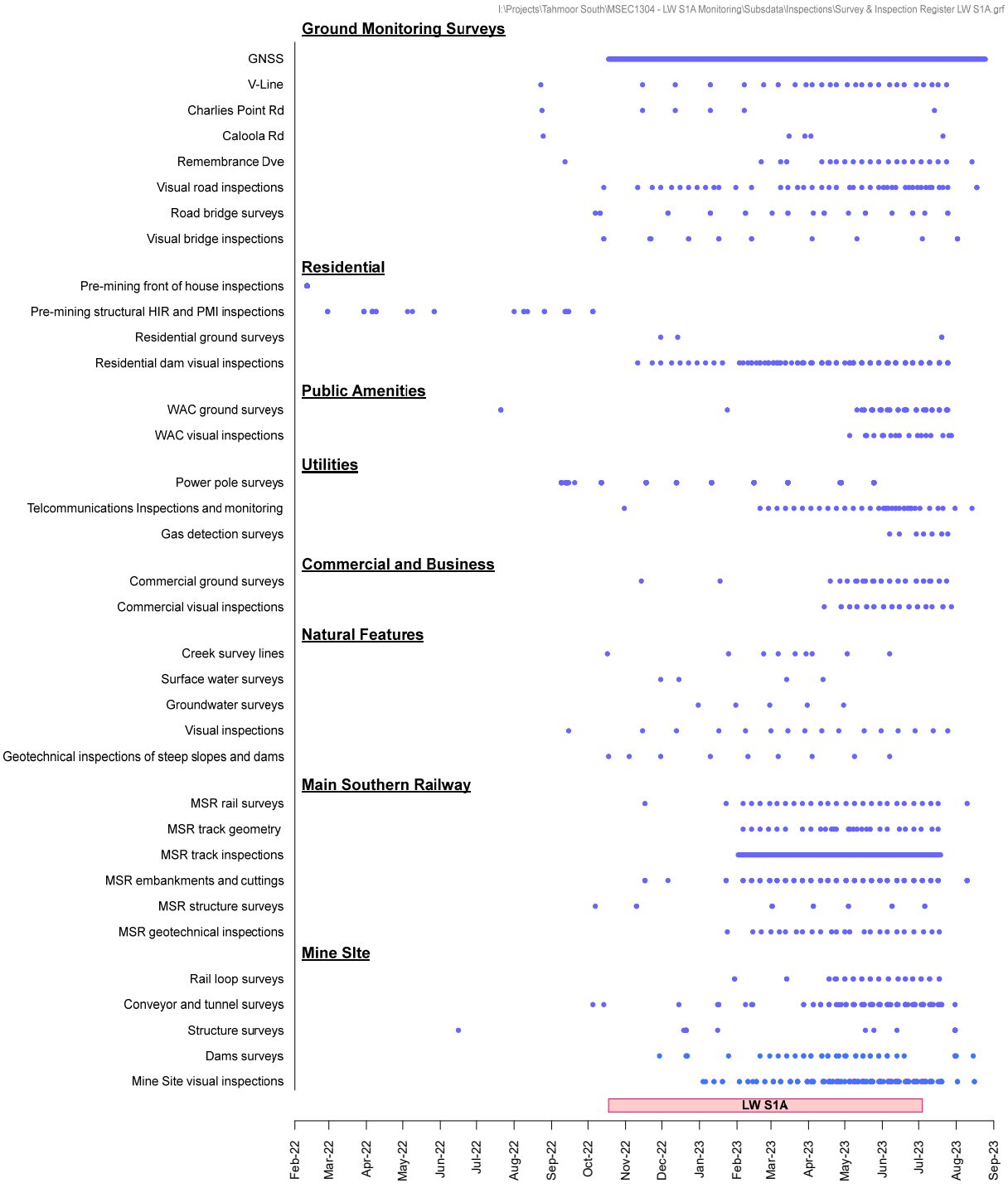


Figure G Surveys and inspections during LW S1A

A summary of surveys and inspections is provided in Table 2.

Table 2 Surveys and inspections conducted during LW S1A

Inspection / Survey	Responsibility	Number of Inspections / Surveys
Ground Monitoring Surveys		
GNSS	GNSS Monitoring	312
Local road surveys	SMEC	58
Local road inspections	BIS	43
Local road bridge surveys	SMEC	24
Local road bridge inspections	BIS	15
Sub-Total		**452**
Natural Features		
Teatree Hollow and Wirrimbirra Creek Survey Lines	SMEC	9
Teatree Hollow and Wirrimbirra Creek Visual inspections	Brienan Environment & Safety ENRS	16
Surface water manual monitoring	ATC Williams	4
Groundwater manual monitoring	SLR	3
Cliffs and steep slopes geotechnical inspections	Douglas Partners	9
Sub-Total		**41**
Main Southern Railway		
Ground Surveys	Southern Rail Surveys	27
Track Geometry Surveys	BloorRail	28
Track Inspections	BloorRail	168
Main Southern Railway structure surveys	Southern Rail Surveys	14
Embankments and cutting surveys	Southern Rail Surveys	28
Embankments and cuttings geotechnical inspections	Newcastle Geotech	24
Sub-Total		**289**
Utilities		
Endeavour Energy Power Pole Surveys	SMEC	15
Telecommunications Monitoring	CNS	36
Gas Detection Surveys	BIS	7
Sub-Total		**58**
Mine Site		
Rail Loop Surveys	Southern Rail Surveys	32
Conveyor and Tunnel Surveys	SMEC	31
Structure Surveys	SMEC	18
Dam Surveys	SMEC	38
Visual inspections	Tahmoor Coal & BIS	241
Sub-Total		**360**
Public Amenities		
Wollondilly Anglican College Ground Surveys	SMEC	37
Wollondilly Anglican College Visual inspections	BIS	17
Sub-Total		**54**
Commercial and Business		
Commercial Ground Surveys	SMEC	28
Commercial Visual inspections	BIS	27
Sub-Total		**55**
Residential		
Pre-mining Front of House inspections (LW W S1A-S6A)	JMA Solutions	41
Pre-mining Structural Hazard Identification inspection and PMI (LW W S1A-S6A)	JMA Solutions	32
Private property ground surveys	SMEC	2
Private property dam inspections	BIS	116
Sub-Total		**191**
Total		**1500**

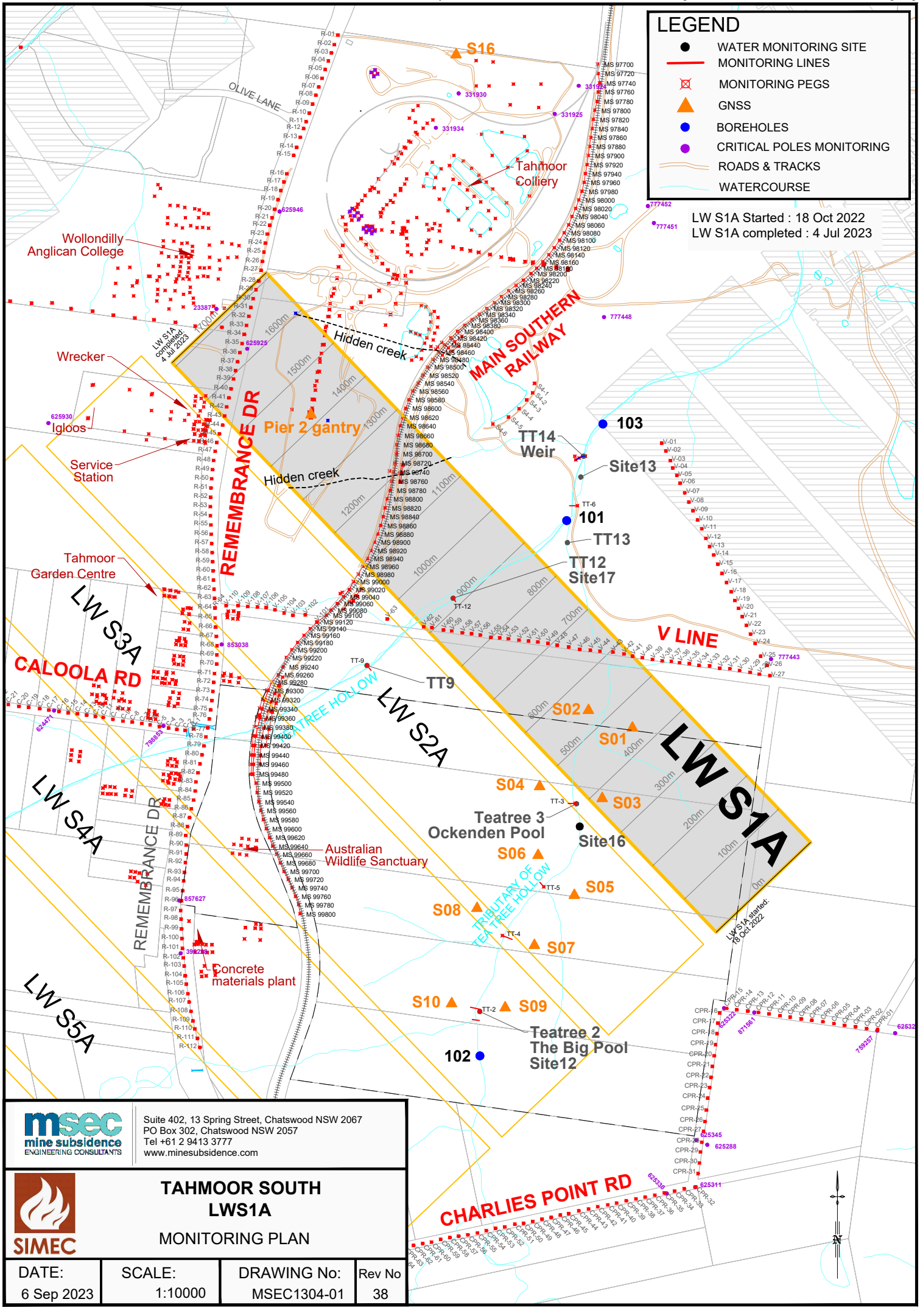
A comparison between assessed and observed impacts to surface features is summarised in Table 3. The assessed and observed impacts to surface features compare reasonably well with predictions.

Table 3 Summary of predicted and observed impacts during LW S1A

Surface Feature	Predicted Impacts	Observed Impacts
Natural Features		
Teatree Hollow and Wirrimbirra Creek	Likely fracturing in creek bed. Likely surface flow diversion Likely reduction in water quality during times of low flow. Likely gas emissions.	Fracturing, surface flow diversion and reduction in water quality observed in Tributary to Teatree Hollow and Teatree Hollow. No gas emissions observed.
Aquifers or known groundwater resources	Temporary lowering of piezometric surface by up to 4m. Groundwater levels should recover with no permanent post mining reduction in water levels in bores. Potential impacts to privately owned groundwater bores. Please refer Water Management Plan.	Groundwater levels fallen in response to mining. Please refer report summarising 6 months of results by SLR.
Steep slopes and cliffs	Potential soil slippage and cracking to slopes. Large scale slope failures or cliff instabilities unlikely.	No impacts observed during LW S1A.
Natural vegetation	No impacts anticipated.	No impacts observed during LW S1A.
Public Utilities		
Main Southern Railway	Impacts expected at isolated locations. Railway bridges and Viaduct very unlikely to experience adverse impacts. Railway will remain safe and serviceable with a management plan in place.	Impacts to track geometry observed at one location above LW S1A. No adverse impacts observed on bridges and Viaduct. Railway maintained in safe and serviceable condition during mining.
Tahmoor Mine Rail Loop	Very minor impacts possible at isolated locations. Railway will remain safe and serviceable with a management plan in place.	Railway maintained in safe and serviceable condition during mining. No adverse impacts observed.
Roads and Bridges (all types)	Cracking and buckling may occur in isolated locations. Road bridges very unlikely to experience adverse impacts. Local roads will remain safe and serviceable with a management plan in place.	Small bump observed in southbound lane of Remembrance Drive at location of compressive strain near Peg R47. Faint bump visible on the edge line of the northbound lane south of Peg R47. No impacts observed to bridges.
Potable water pipelines	Impacts and minor leakages possible at isolated locations, particularly at creek crossings. Potable water pipelines will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Sewer pipelines	Impacts possible at isolated locations, particularly at creek crossings. Sewer pipelines will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Gas pipelines	Impacts possible at isolated locations, particularly at creek crossings. Gas pipelines will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Electricity infrastructure	Some adjustments of power poles, catenaries or aerial powerline connections may be required. Electricity infrastructure will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Telecommunication infrastructure	Impacts possible at isolated locations, particularly at creek crossings. Telecommunications cables will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.

Surface Feature	Predicted Impacts	Observed Impacts
Public Amenities		
Wollondilly Anglican College	Damage may occur in isolated locations but will remain safe and serviceable with a management plan in place.	One gate jammed, which was repaired.
Australian Wildlife Sanctuary	Damage may occur but will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Bargo Cemetery	Damage may occur but will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A. Cemetery is located directly LW S5A.
Commercial and Business Establishments		
Tahmoor Garden Centre	Damage may occur but will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Bargo Petroleum	Damage may occur but will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Poultry sheds	Damage may occur in isolated locations but will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A.
Tahmoor Mine Site	Damage may occur but will remain safe and serviceable with a management plan in place.	Minor cracks observed at one location but mine site remains safe and serviceable during LW S1A.
Farmland and Facilities		
Farm buildings, sheds, tanks	Negligible to slight impacts predicted for all farm buildings and sheds with management plan in place.	No impacts observed during LW S1A.
Fences	Potential for impacts to fences and gates.	No impacts reported to fences on farm properties during LW S1A.
Farm dams	Potential adverse effects on dam walls and storage capacity.	No impacts observed during LW S1A.
Wells or bores	Potential impact to groundwater bores, particularly bores located directly above LWs.	No impacts observed during LW S1A.
Areas of Archaeological Significance	Rock shelter site may experience adverse impacts. Open Camp site and Isolated Find site unlikely to experience adverse impacts.	No impacts observed during LW S1A.
Areas of Heritage Significance	Picton Weir extremely unlikely to experience adverse impacts. The Weir will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A. Picton Weir is located west of LW S6A.
Permanent Survey Control Marks	Ground movement predicted at identified survey marks.	Ground movement occurred.
Residential Establishments		
Houses	Damage may occur to houses but they will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A. No houses within influence of LW S1A.
Swimming pools	Damage may occur to pools but they will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A. No pools within influence of LW S1A.
Associated structures such as workshops, garages, on-site wastewater systems, water or gas tanks or tennis courts	Potential impact to pipes connected to inground septic tanks. Damage may occur to structures but they will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A. No structures within influence of LW S1A.
External residential pavements and fences	Damage may occur but they will remain safe and serviceable with a management plan in place.	No impacts observed during LW S1A. No houses within influence of LW S1A.

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\AcadData\MSEC1304-01 LWS1A Monitoring.dwg



msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

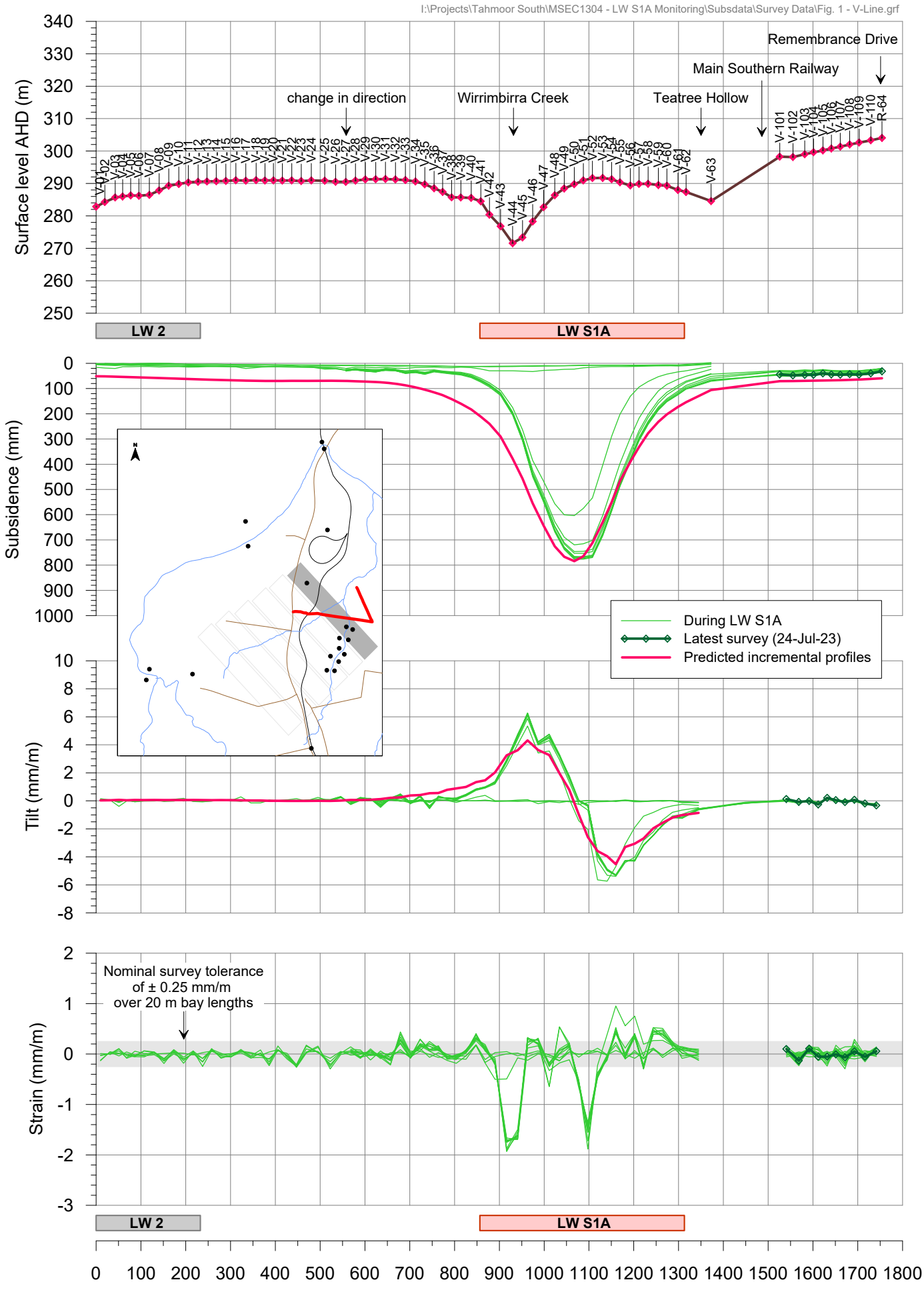
SIMEC

TAHMOOR SOUTH LWS1A

MONITORING PLAN

DATE:	SCALE:	DRAWING No:	Rev No
6 Sep 2023	1:10000	MSEC1304-01	38

Tahmoor South LW S1A
Incremental subsidence profiles along V-Line



Tahmoor South LW S1A
Incremental subsidence profiles along Charlies Point Road

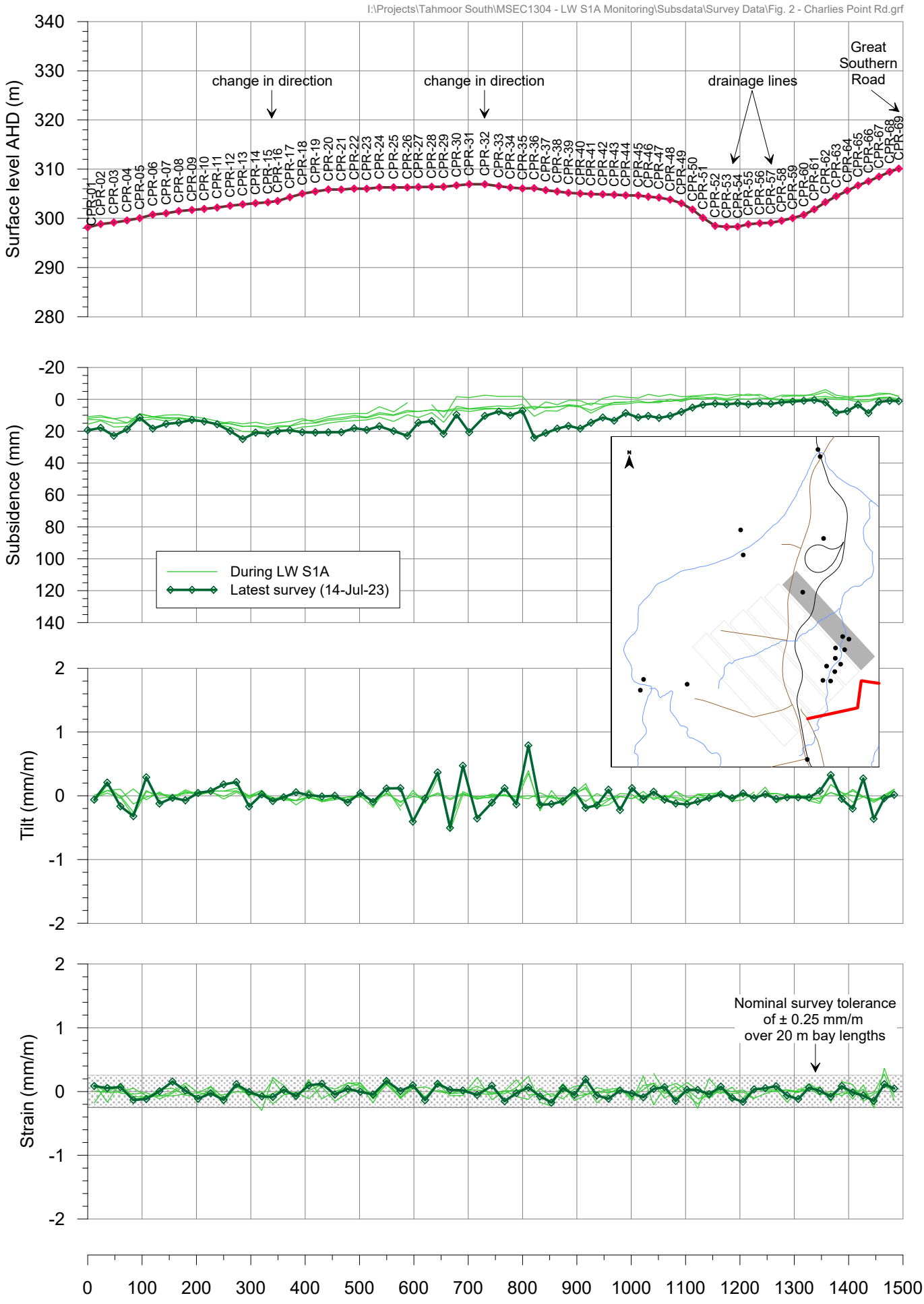
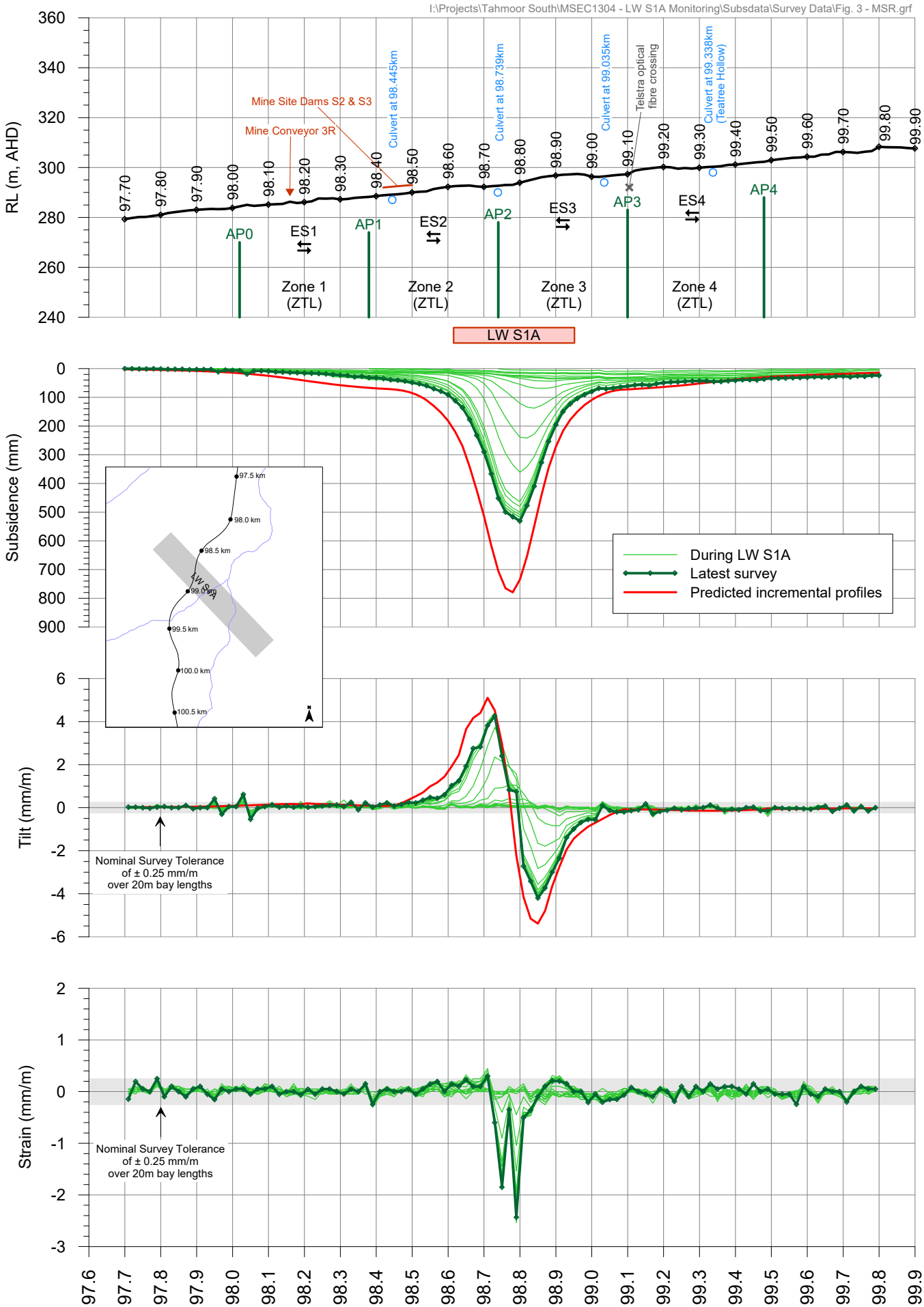


Fig. 2-R38

Tahmoor South LW S1A - Main Southern Railway
Incremental subsidence profiles
Survey date: 10 August 2023



msec

Fig. 3-R38

Tahmoor South LW S1A - Mine Site Rail Loop
Incremental subsidence profiles
Survey date: 18 July 2023

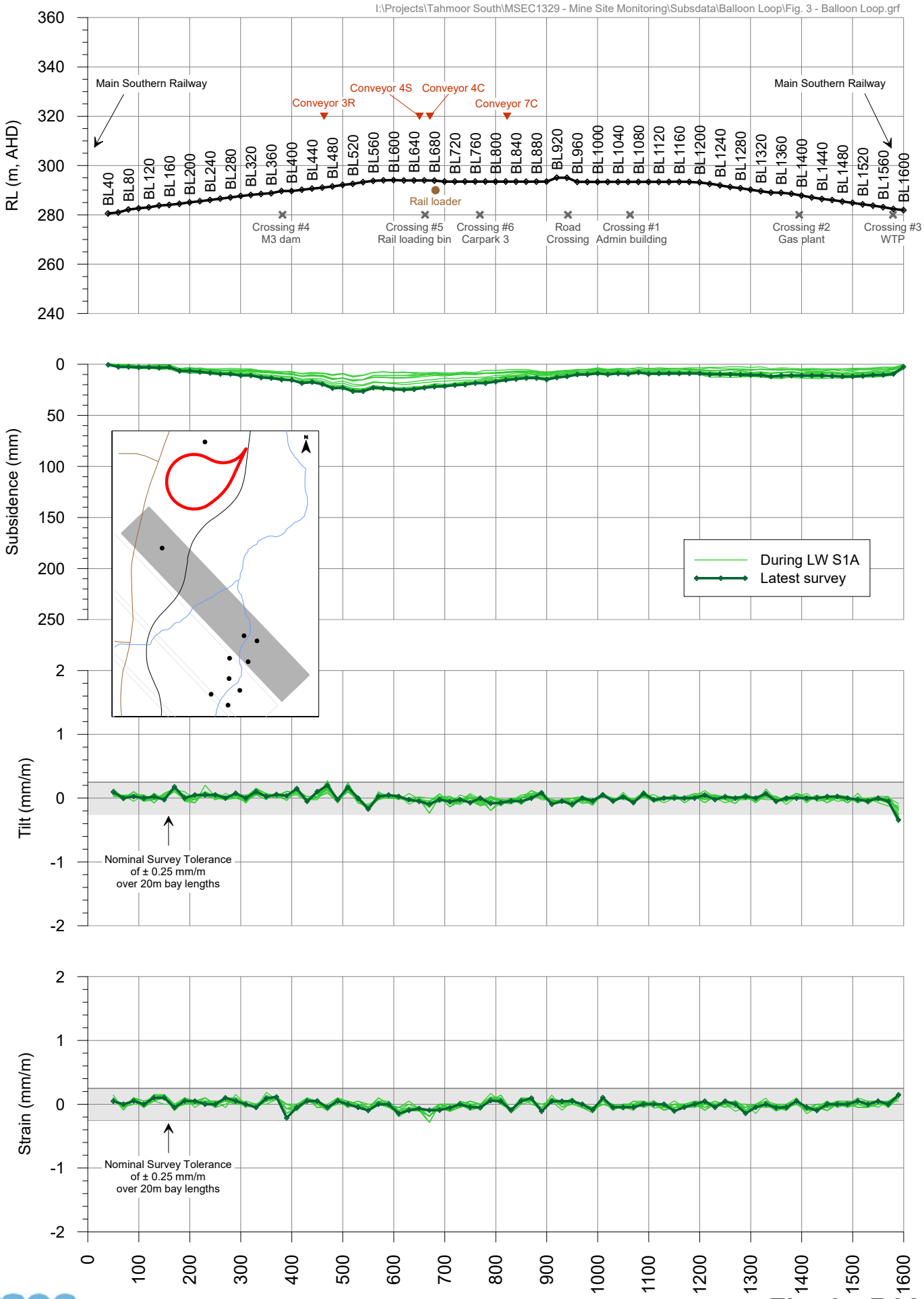


Fig. 3a-R38

Tahmoor South LW S1A
Incremental subsidence profiles along Remembrance Drive

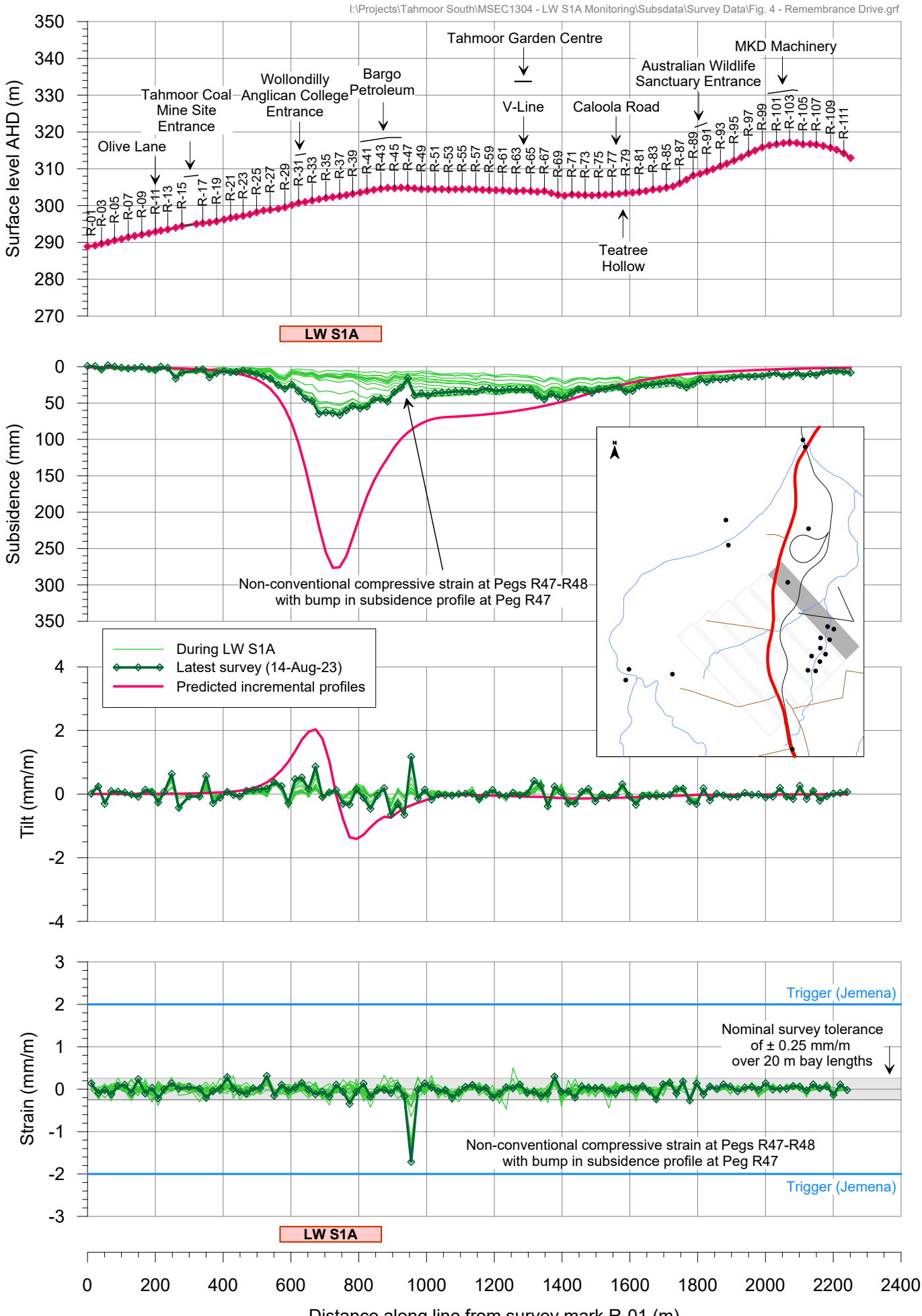
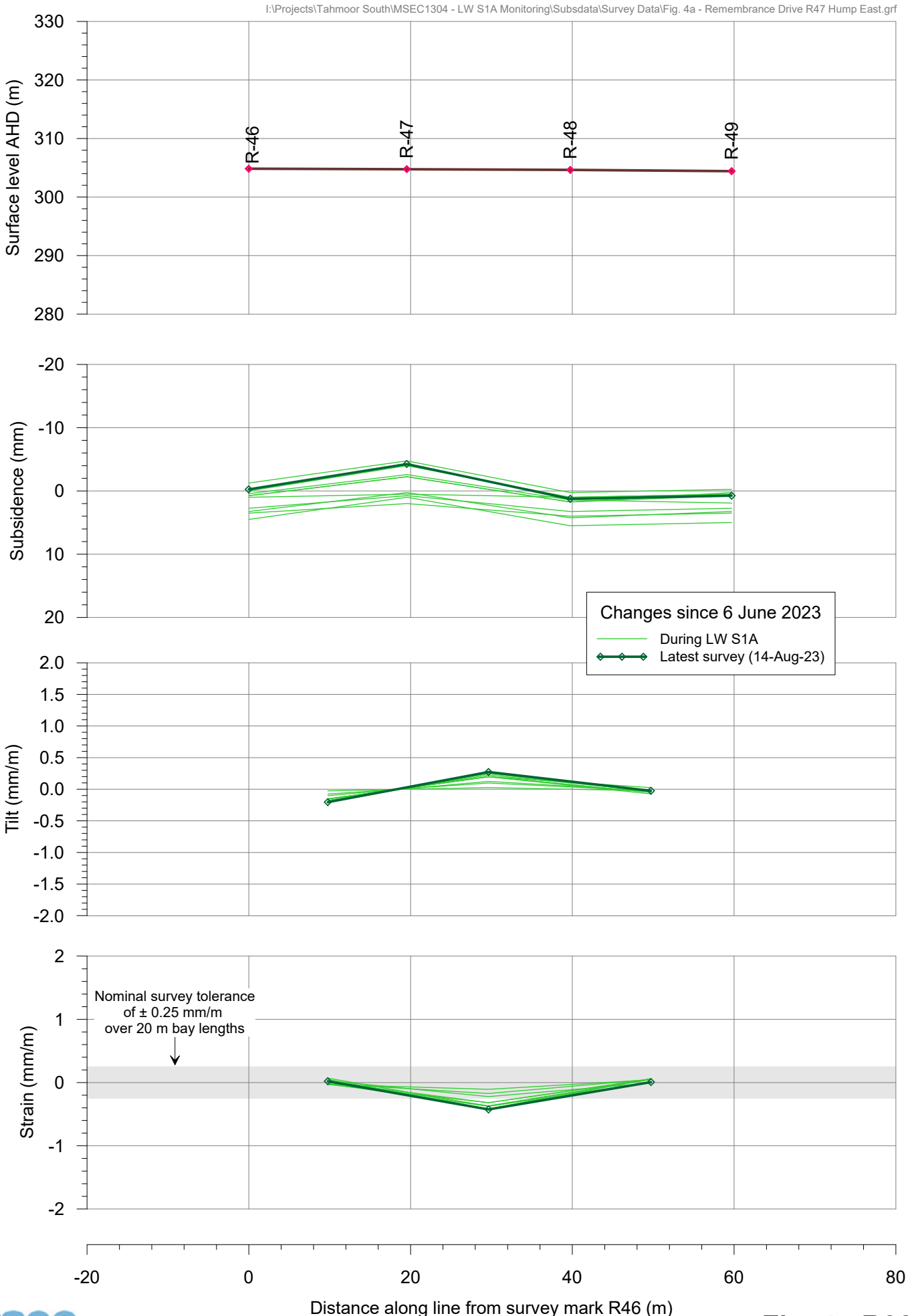


Fig. 4-R38

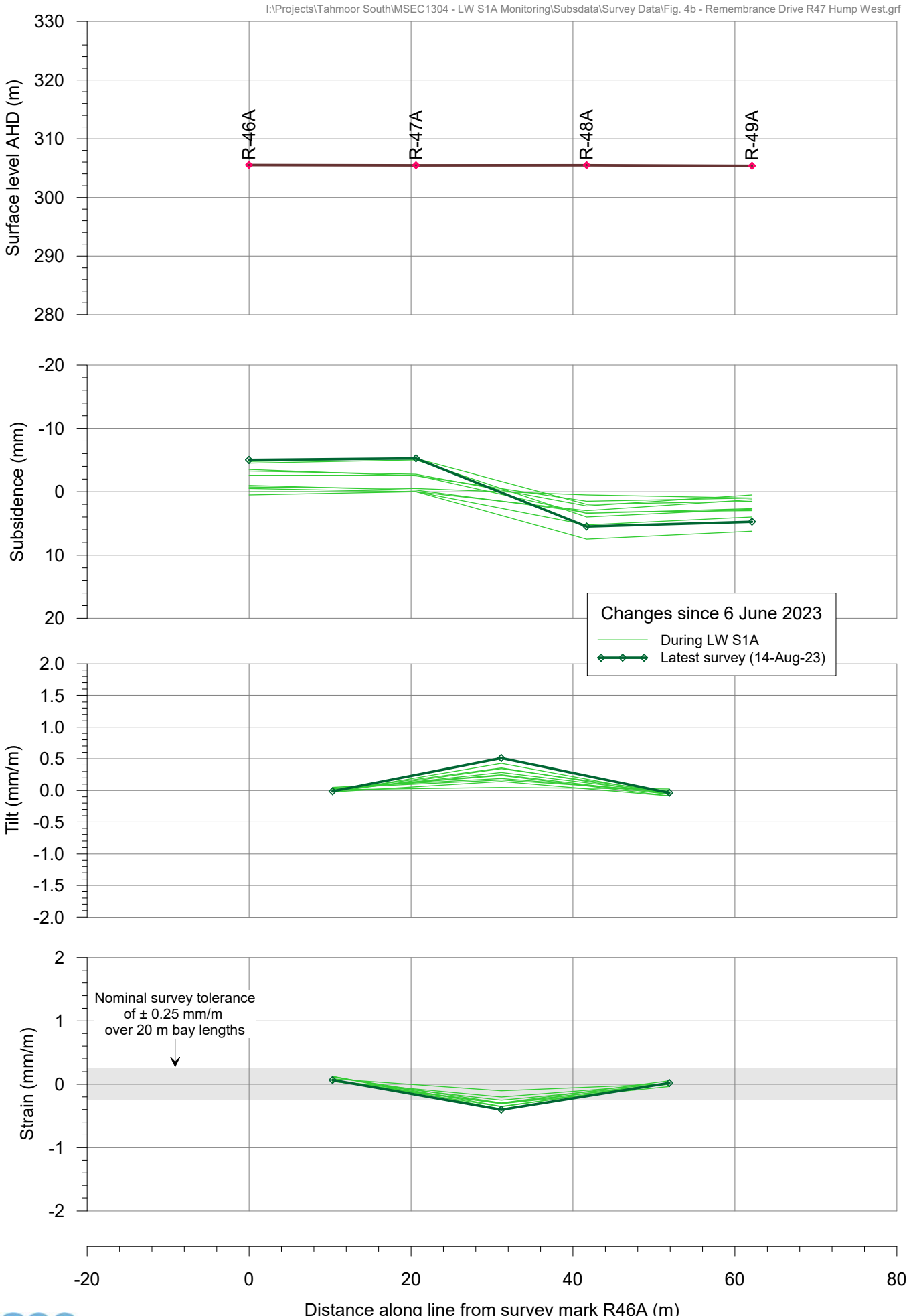
Tahmoor South LW S1A - Remembrance Drive R47 Hump
Incremental subsidence profiles along eastern side of pavement



msec

Fig. 4a-R38

Tahmoor South LW S1A - Remembrance Drive R47 Hump
Incremental subsidence profiles along western side of pavement



msec

Fig. 4b-R38

Tahmoor South LW S1A
Incremental subsidence profiles along Caloola Road

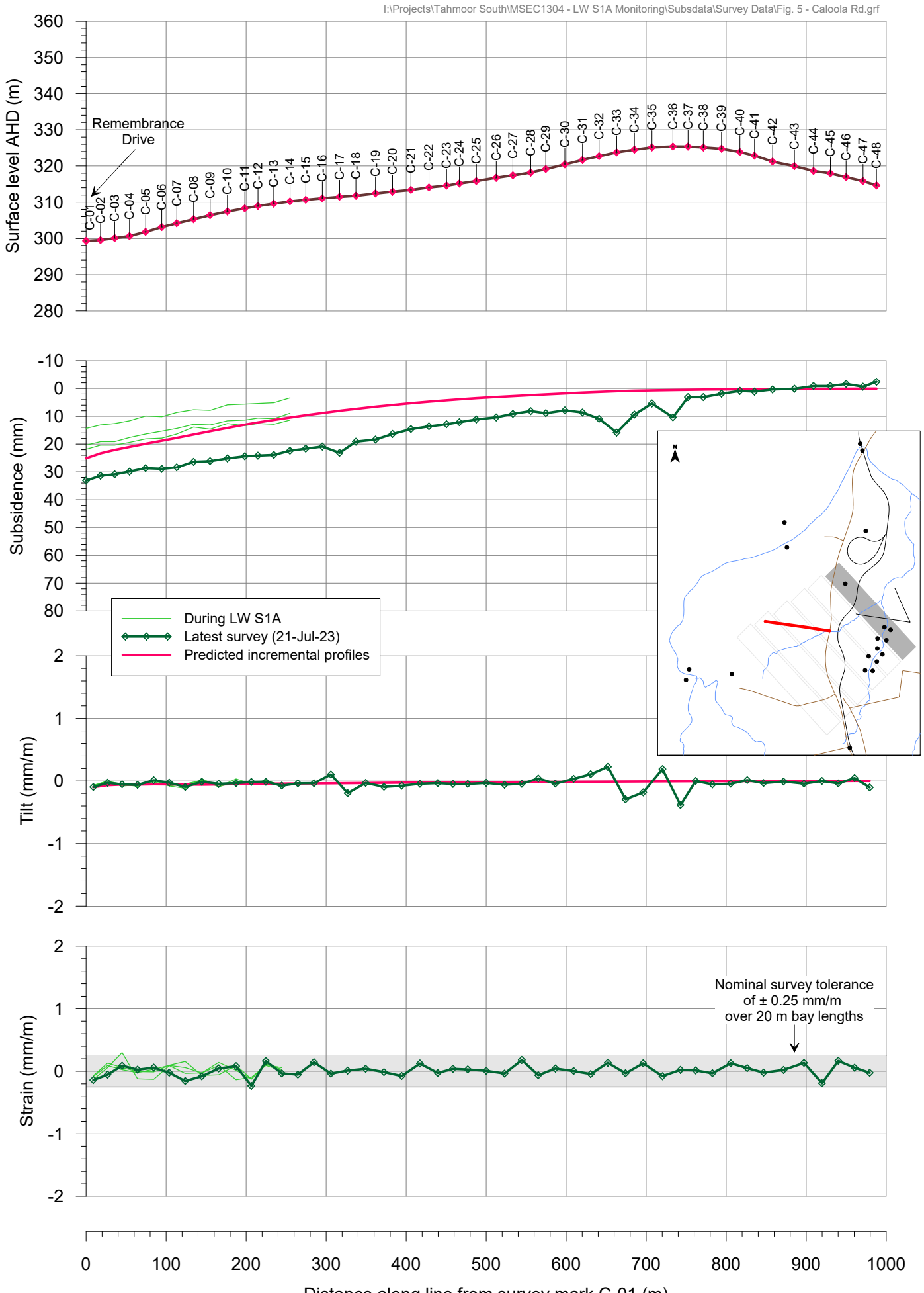
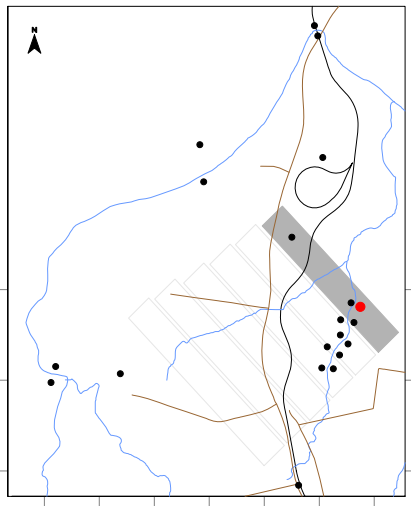


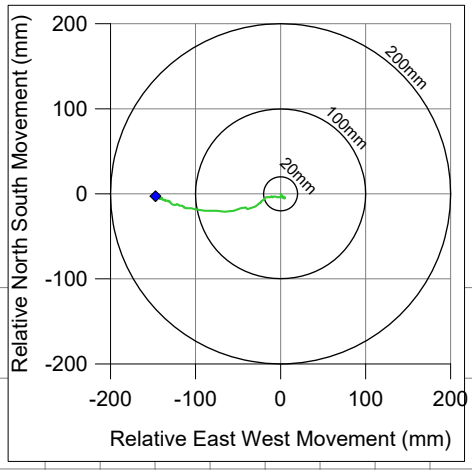
Fig. 5-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S01 above LW S1A

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S01 GNSS.grf





During LW S1A

Change in easting (mm)

300
200
100
0
-100
-200

Daily change

7 day running average

Change in northing (mm)

100
50
0
-50
-100

Change in height (mm)
(+ve = subsidence)

0
100
200
300
400
500
600
700
800

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

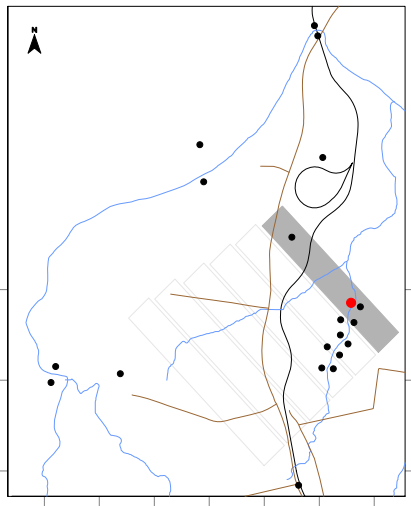
msec

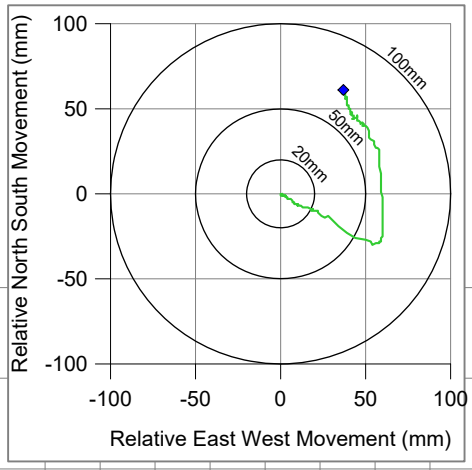
Fig. S01-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S02 above LW S1A

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S02 GNSS.grf





During LW S1A

Change in easting (mm)

200
150
100
50
0
-50

Change in northing (mm)

150
100
50
0
-50
-100

Daily change

7 day running average

Change in height (mm)
(+ve = subsidence)

0
100
200
300
400
500
600
700
800

LW S1A

LW S2A

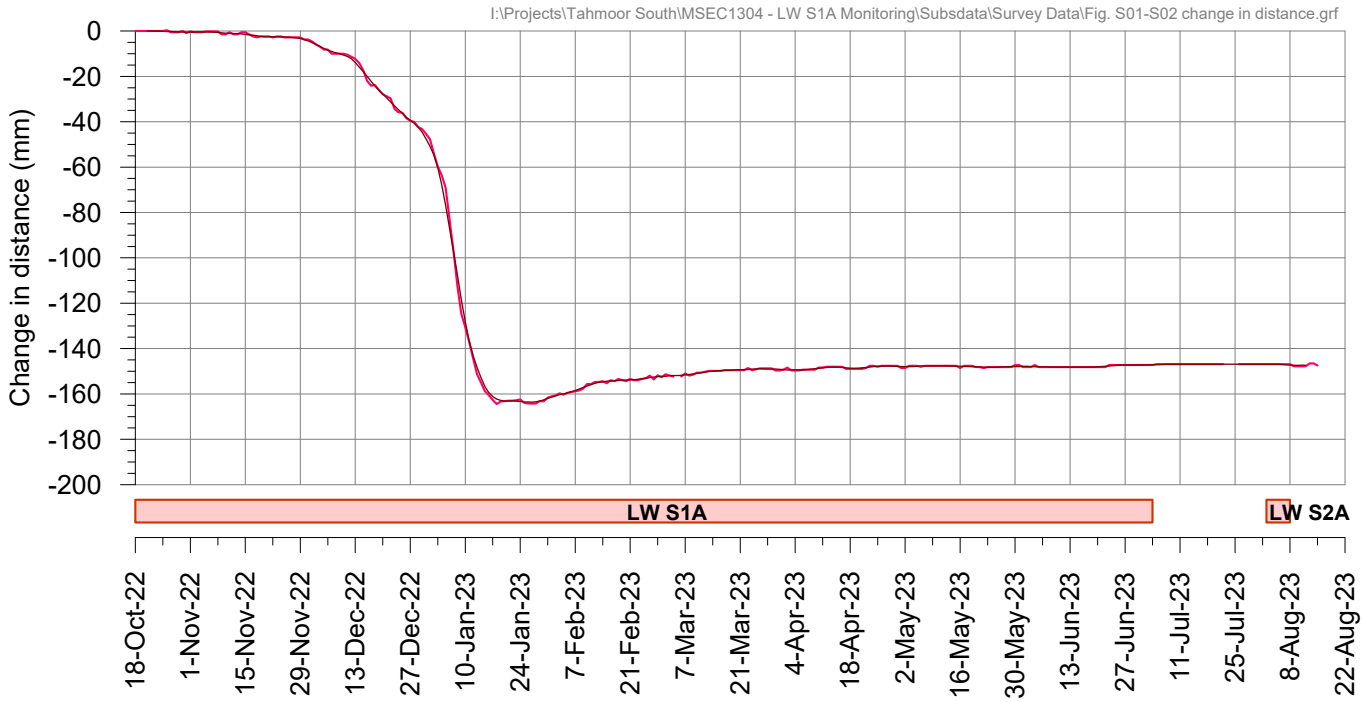
18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

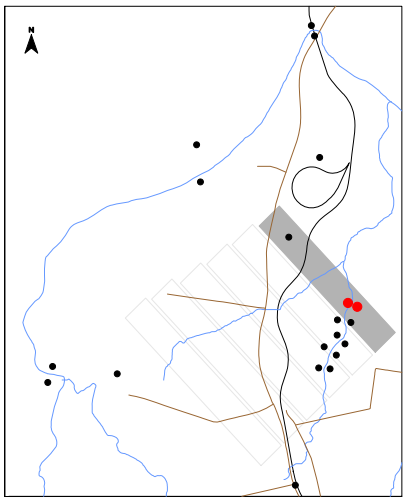
msec

Fig. S02-R38

Tahmoor South LW S1A - GNSS Monitoring

Change in distance across Wirrimbirra Creek
Sites S01 and S02 above LW S1A

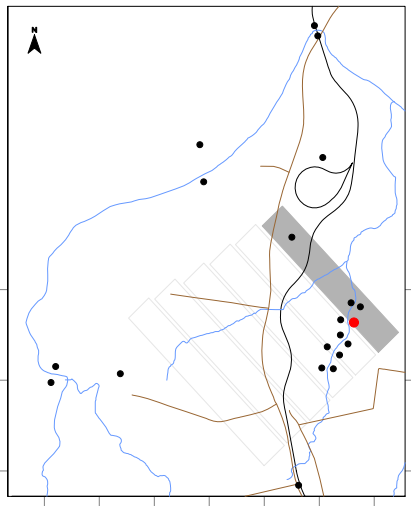


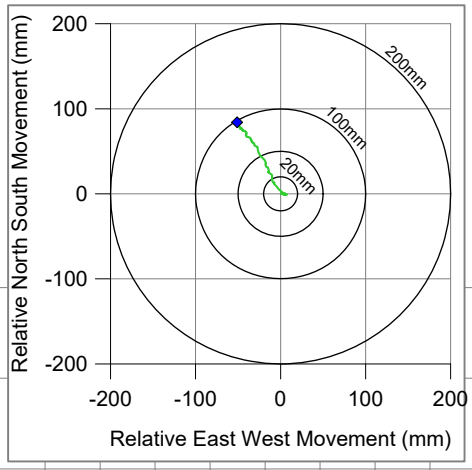


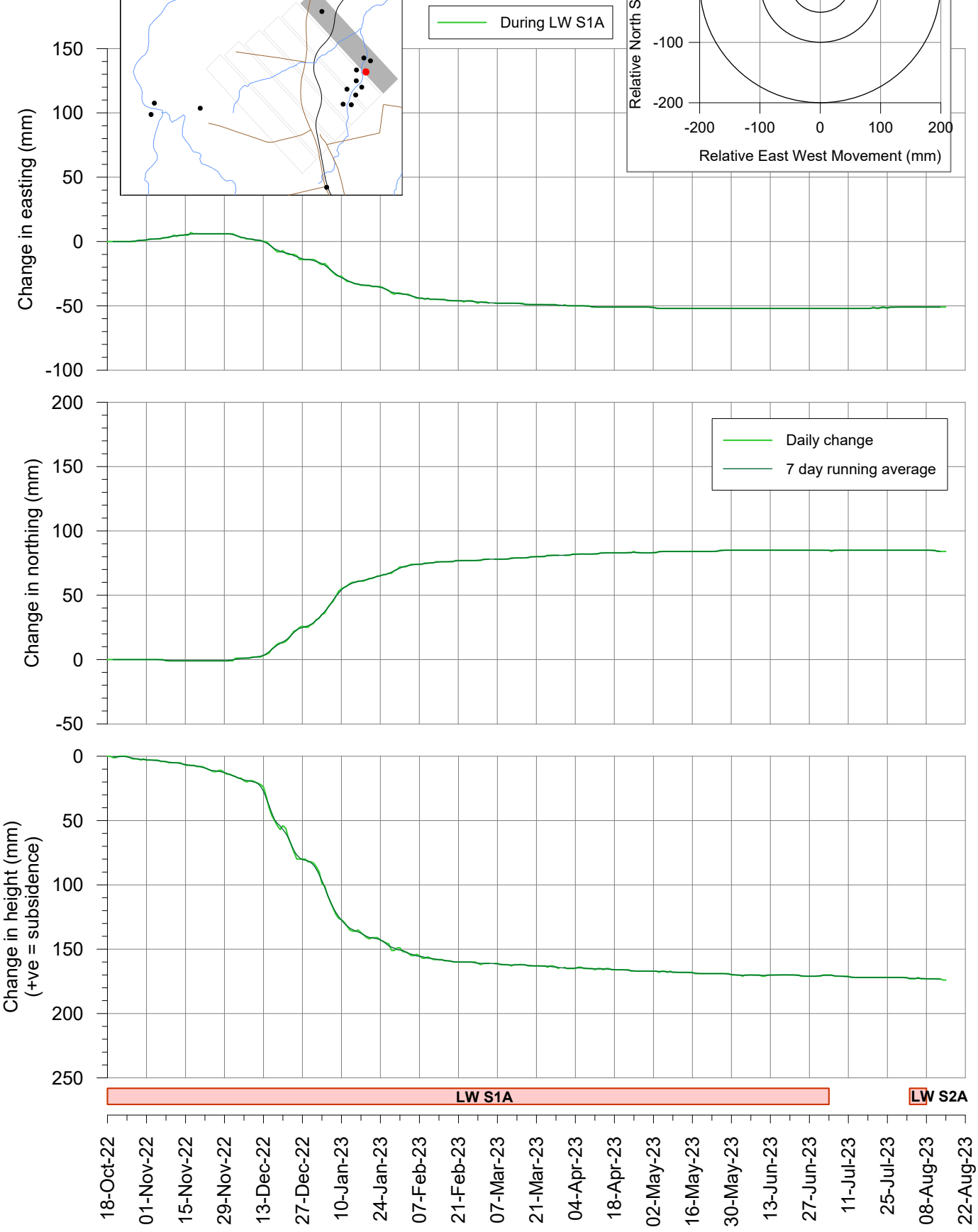
Tahmoor South LW S1A - GNSS Monitoring

Site S03 above LW S1A at Teatree 3

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S03 GNSS.grf







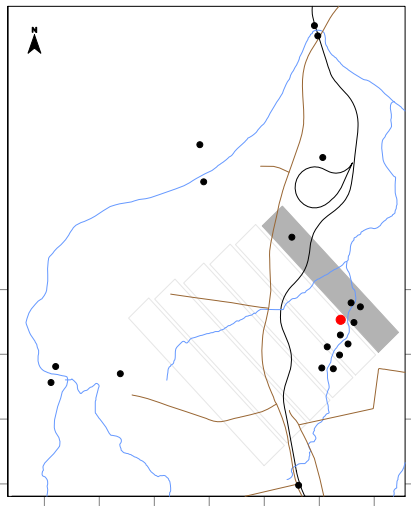
msec

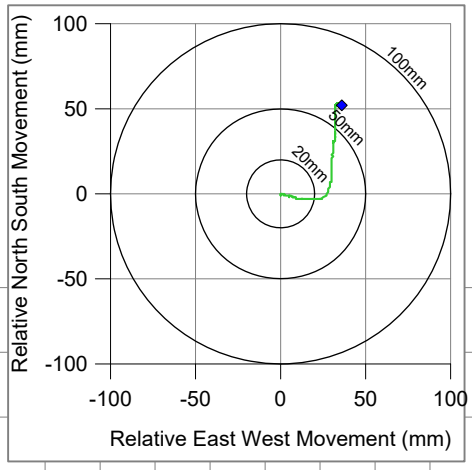
Fig. S03-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S04 above LW S2A at Teatree 3

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S04 GNSS.grf





During LW S1A

Change in easting (mm)

120
100
80
60
40
20
0
-20

Change in northing (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in height (mm)
(+ve = subsidence)

0
20
40
60
80
100
120

LW S1A

LW S2A

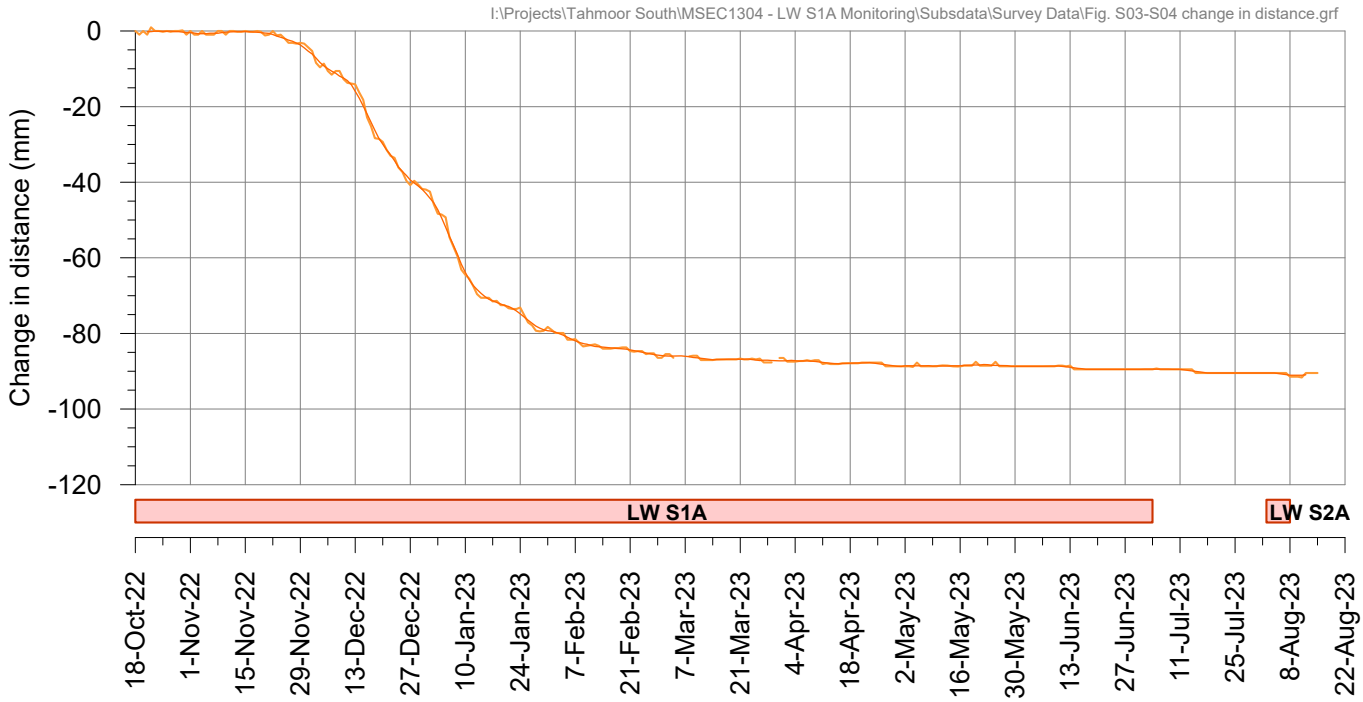
18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

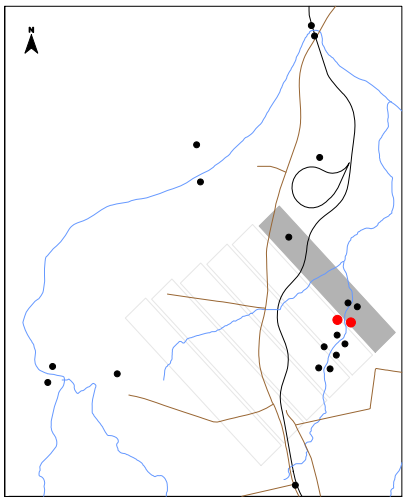
msec

Fig. S04-R38

Tahmoor South LW S1A - GNSS Monitoring

Change in distance across Wirrimbirra Creek at Teatree 3
Site S03 above LW S1A and Site S04 above LW S2A

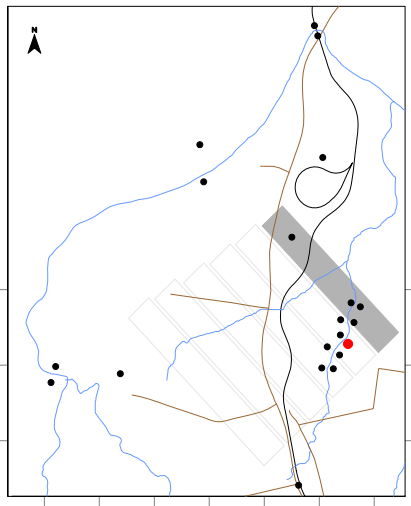


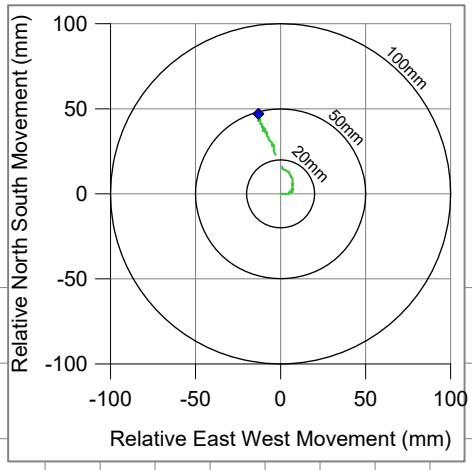


Tahmoor South LW S1A - GNSS Monitoring

Site S05 above LW S2A

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S05 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in northing (mm)

100
80
60
40
20
0
-20

Change in height (mm)
(+ve = subsidence)

0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

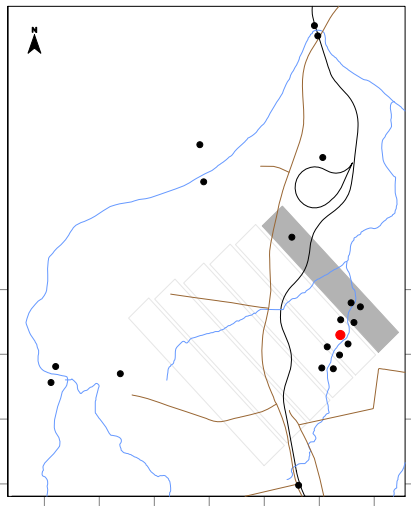
msec

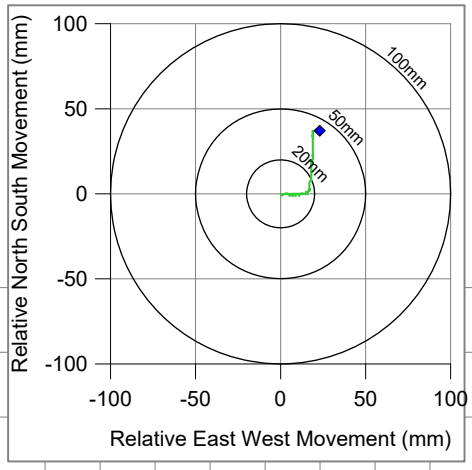
Fig. S05-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S06 above LW S2A

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S06 GNSS.grf





During LW S1A

Change in easting (mm)

100
80
60
40
20
0
-20
-40

Change in northing (mm)

Daily change
7 day running average

100
80
60
40
20
0
-20

Change in height (mm)
(+ve = subsidence)

0
20
40
60
80
100

LW S1A
LW S2A

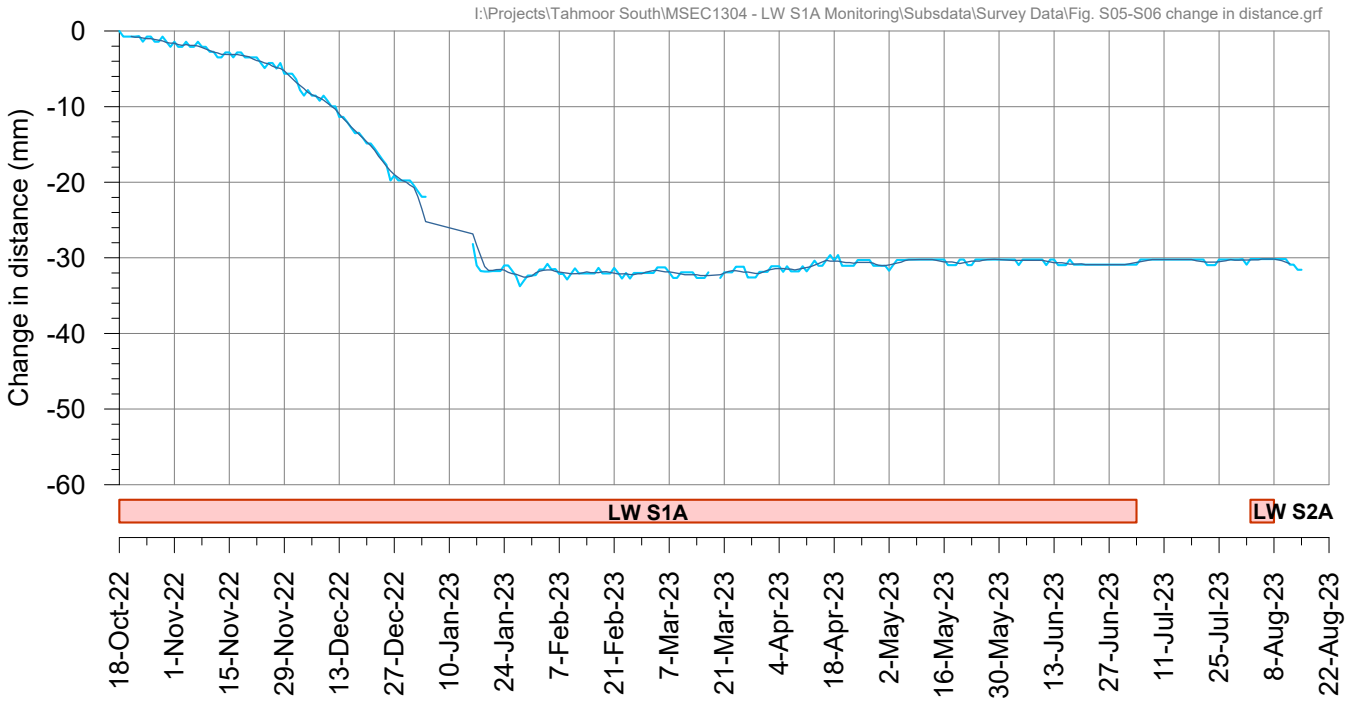
18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

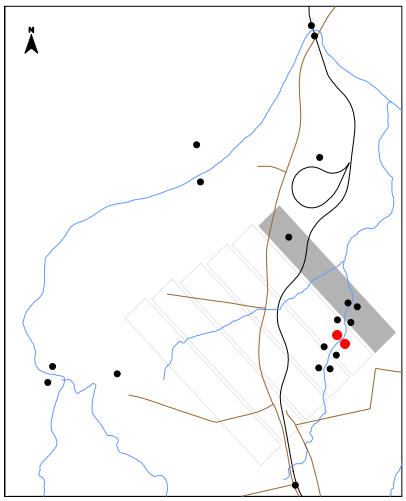
msec

Fig. S06-R38

Tahmoor South LW S1A - GNSS Monitoring

Change in distance across Wirrimbirra Creek
Sites S05 and S06 above LW S2A

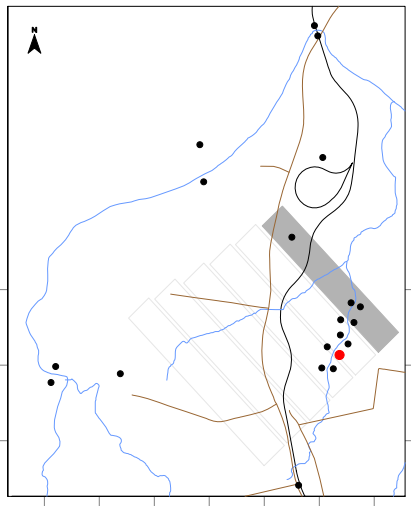


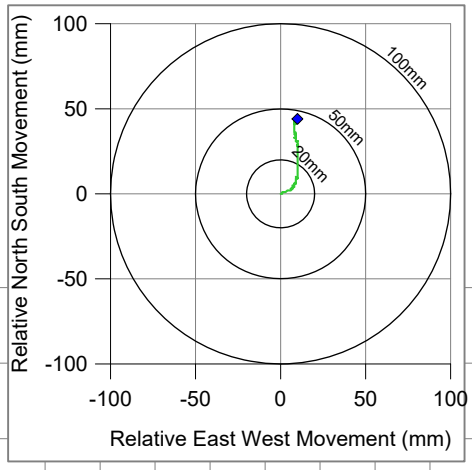


Tahmoor South LW S1A - GNSS Monitoring

Site S07 above LW S2A

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S07 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Change in northing (mm)

100
80
60
40
20
0
-20

Daily change

7 day running average

Change in height (mm)
(+ve = subsidence)

0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

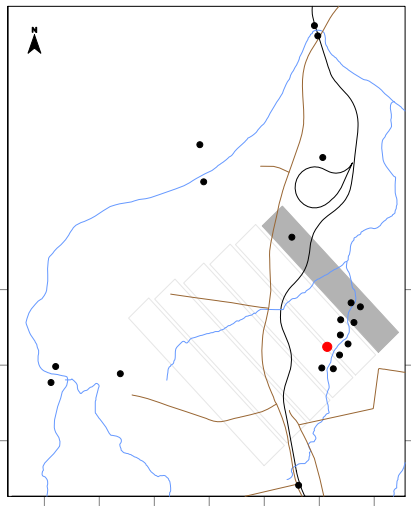
msec

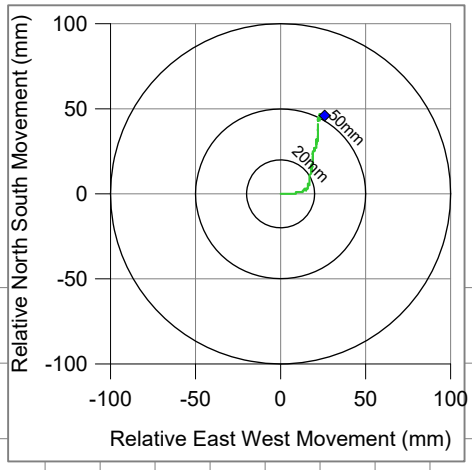
Fig. S07-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S08 between LW S2A and LW S3A

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S08 GNSS.grf





During LW S1A

Change in easting (mm)

Change in northing (mm)

Daily change

7 day running average

Change in height (mm)
(+ve = subsidence)

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

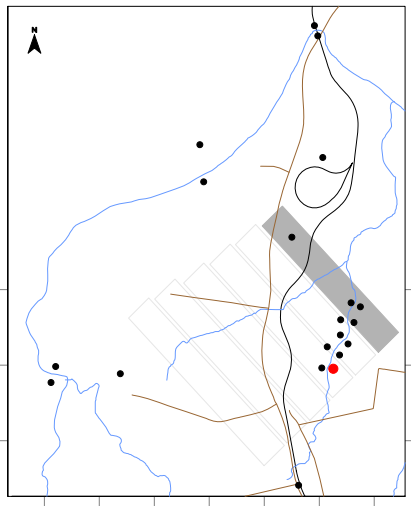
msec

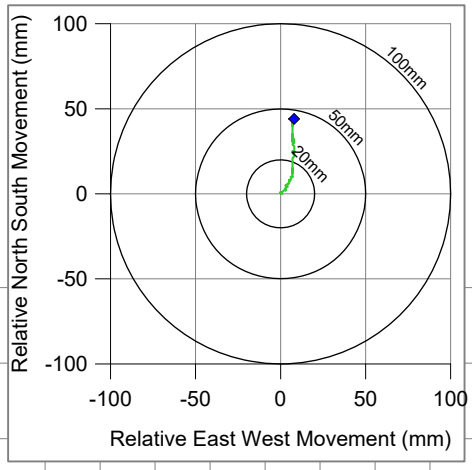
Fig. S08-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S09 above LW S3A at Teatree 2

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S09 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Change in northing (mm)

100
80
60
40
20
0
-20

Daily change

7 day running average

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

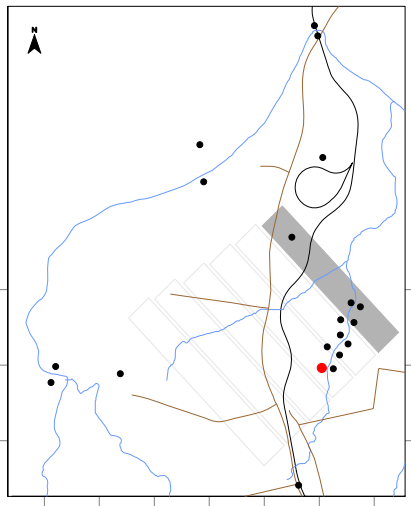
msec

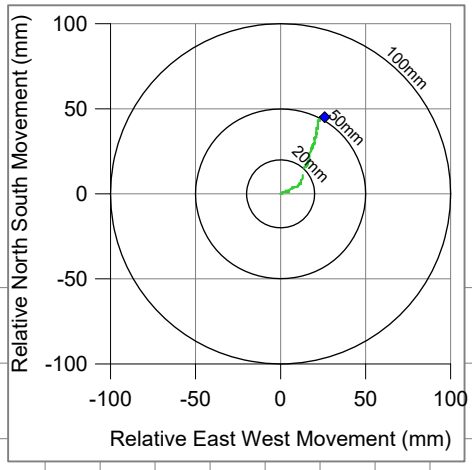
Fig. S09-R38

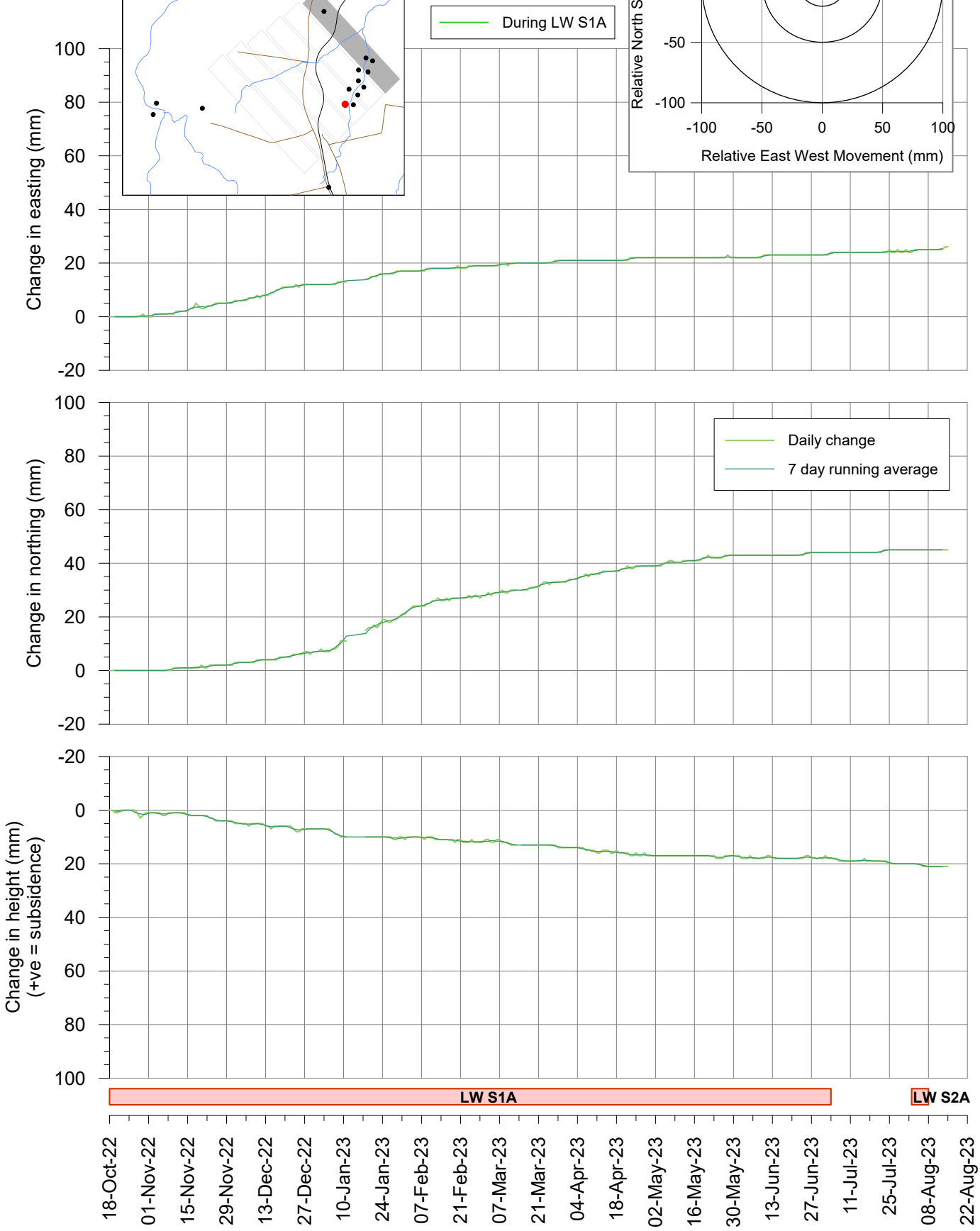
Tahmoor South LW S1A - GNSS Monitoring

Site S10 above LW S3A at Teatree 2

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S10 GNSS.grf





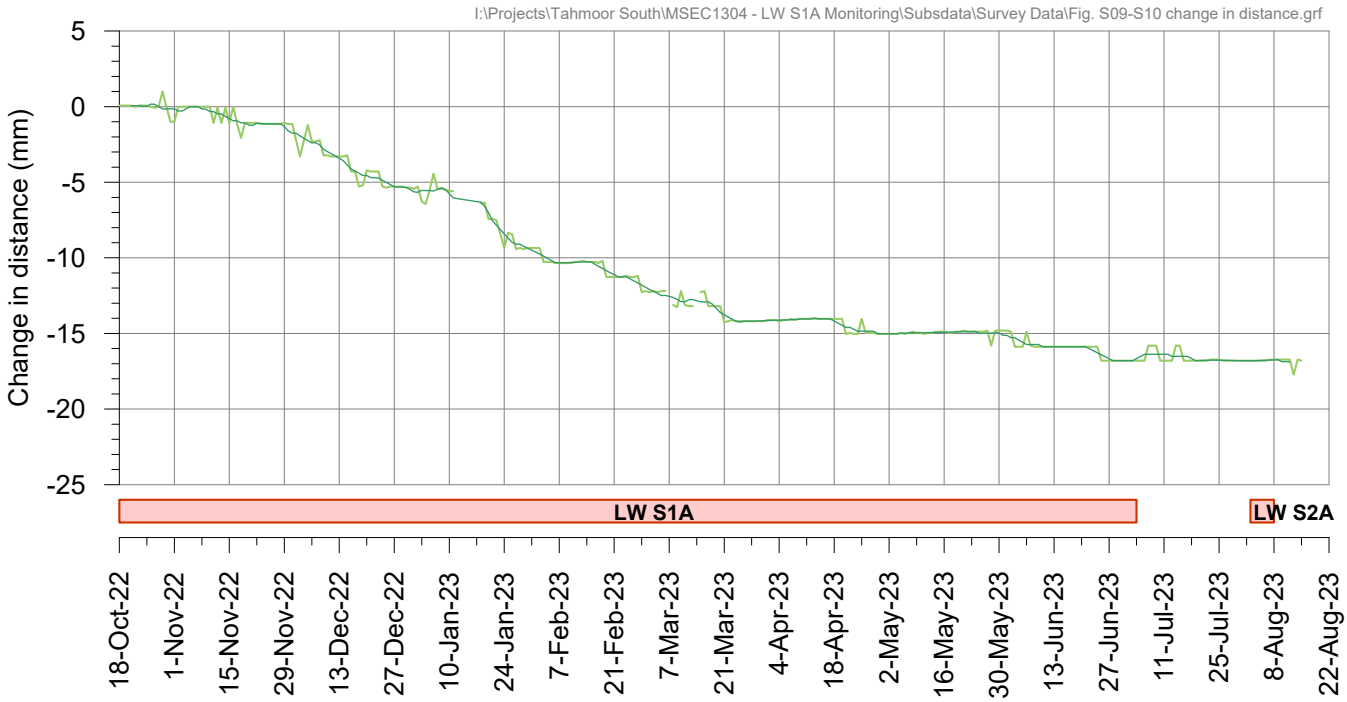


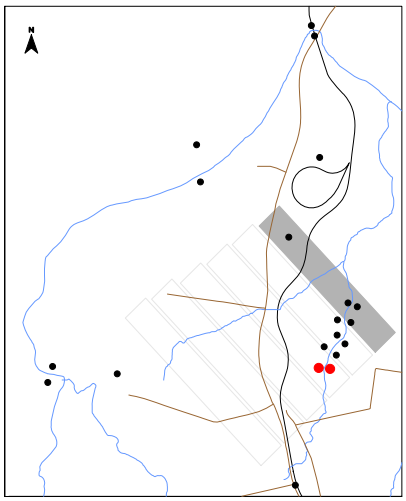
msec

Fig. S10-R38

Tahmoor South LW S1A - GNSS Monitoring

Change in distance across Wirrimbirra Creek at Teatree 2
Sites S09 and S10 above LW S3A

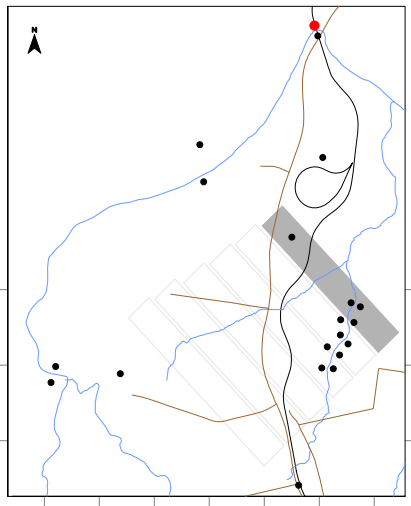


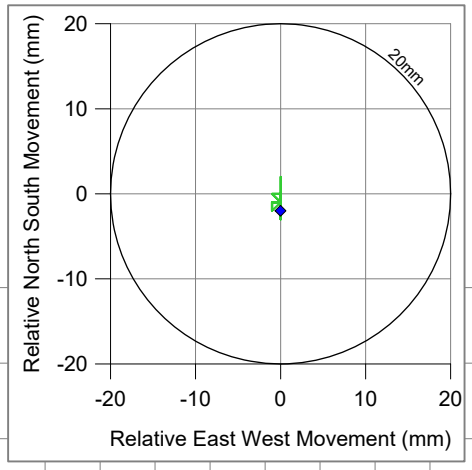


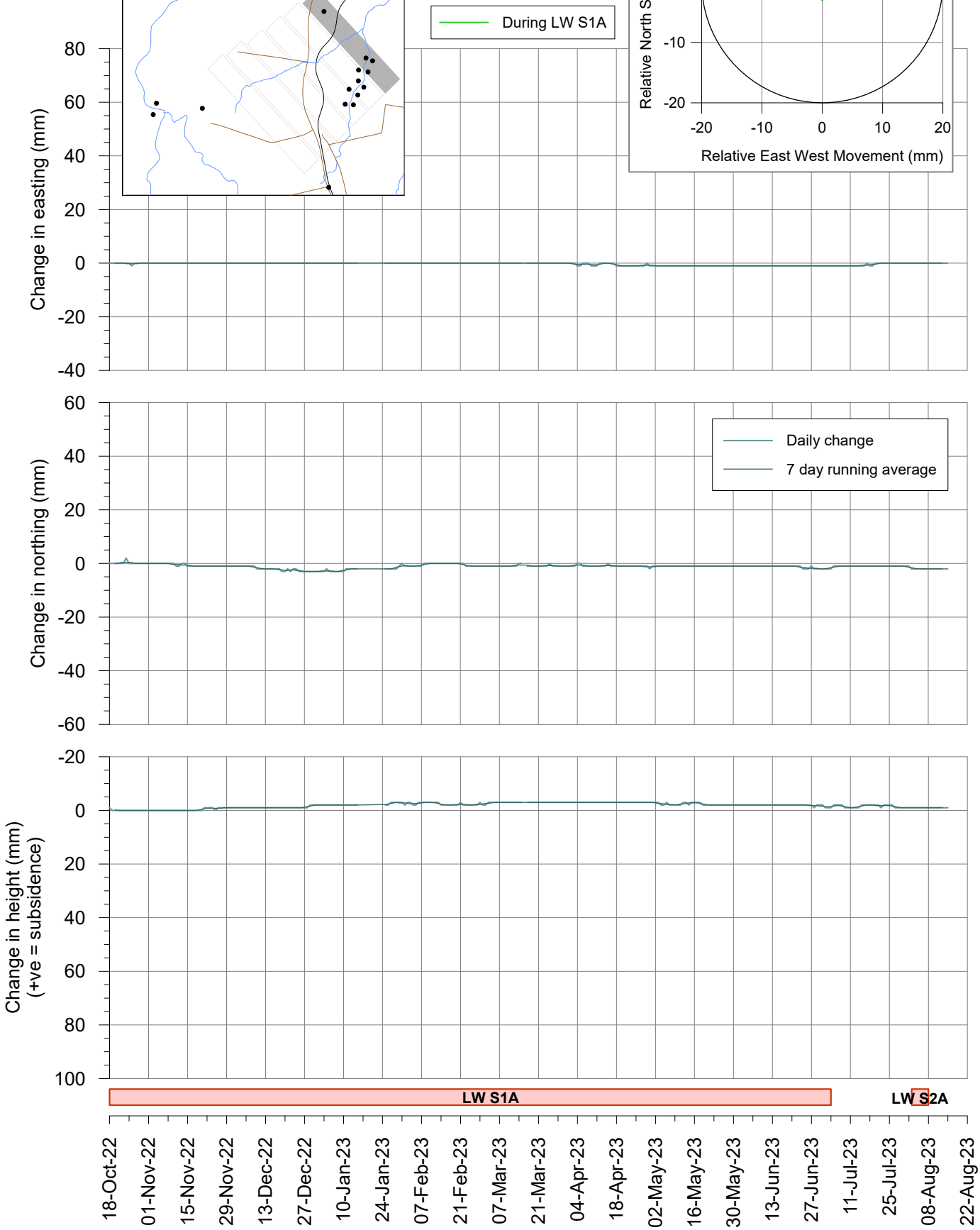
Tahmoor South LW S1A - GNSS Monitoring

Site S11 at northern end of railway viaduct over Bargo River

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S11 GNSS.grf







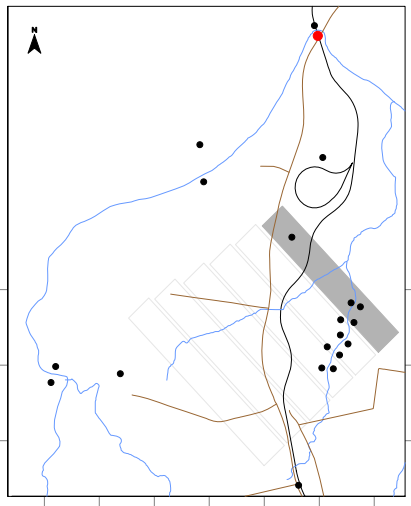
msec

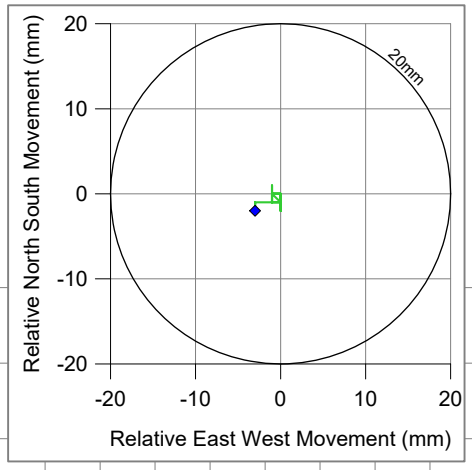
Fig. S11-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S12 at southern end of railway viaduct over Bargo River

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S12 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Change in northing (mm)

60
40
20
0
-20
-40
-60

Daily change

7 day running average

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

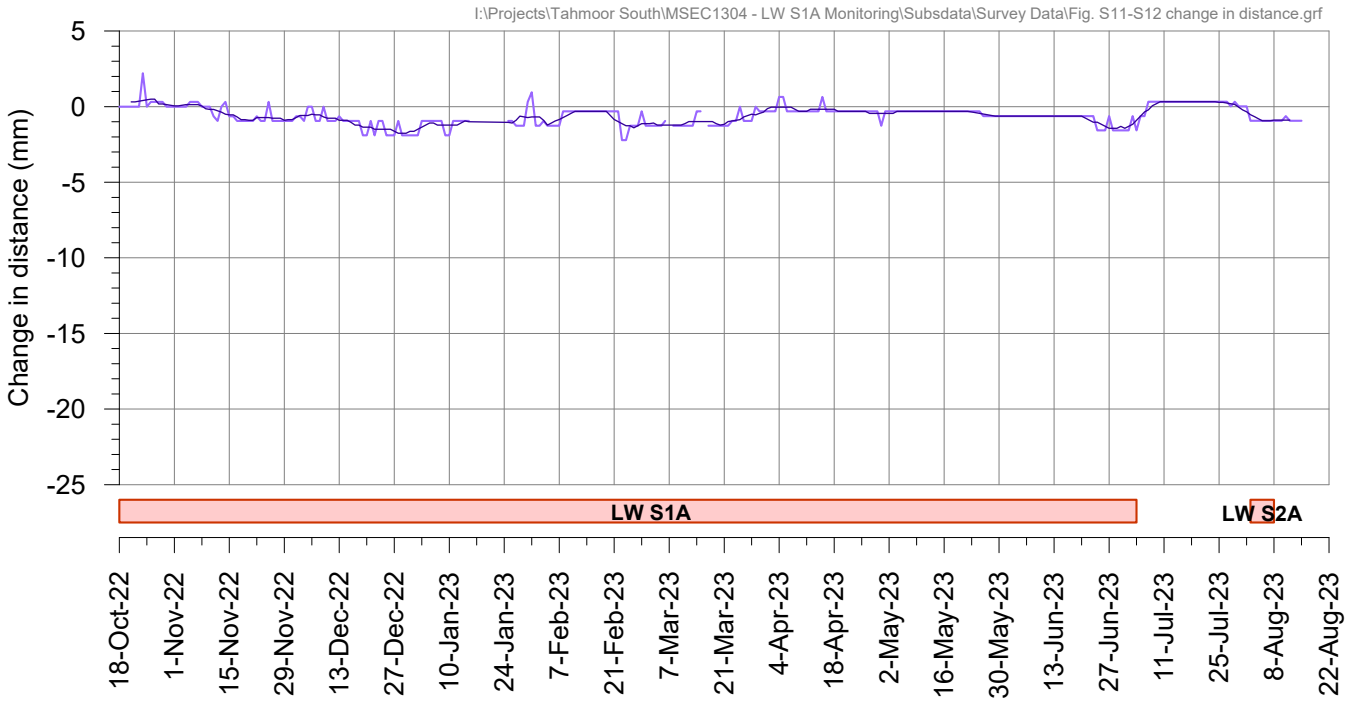
18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

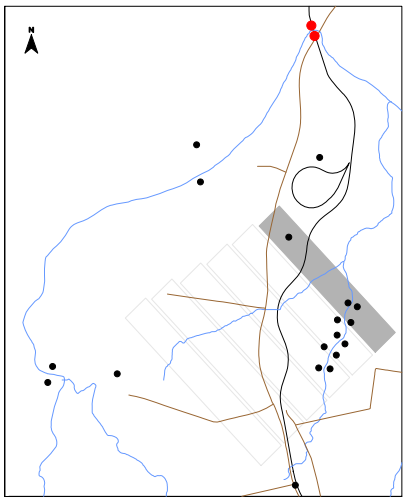
msec

Fig. S12-R38

Tahmoor South LW S1A - GNSS Monitoring

Change in distance across Railway Viaduct over Bargo River
Sites S11 and S12

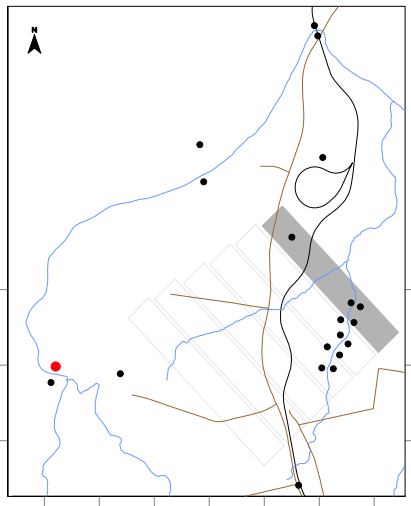


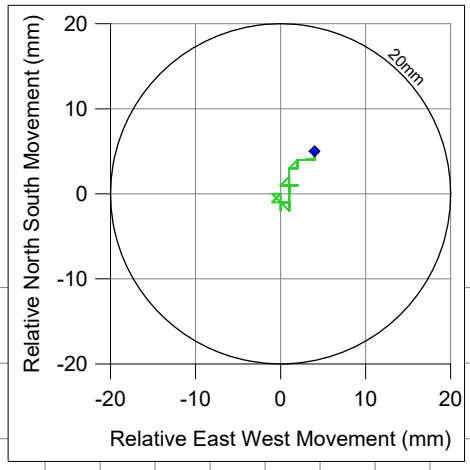


Tahmoor South LW S1A - GNSS Monitoring

Site S13 on northern side of Picton Weir

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S13 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in northing (mm)

60
40
20
0
-20
-40
-60

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

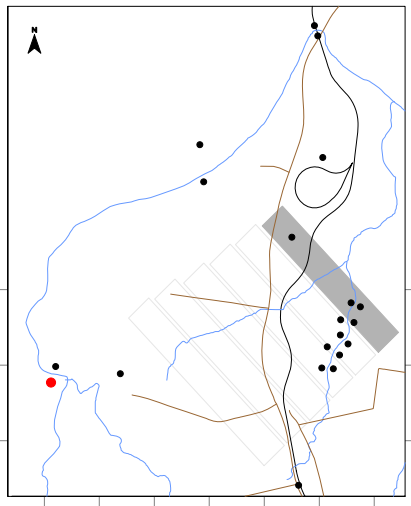
msec

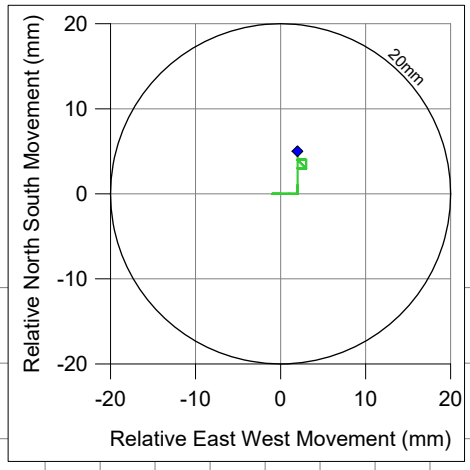
Fig. S13-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S14 on southern side of Picton Weir

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S14 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in northing (mm)

60
40
20
0
-20
-40
-60

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

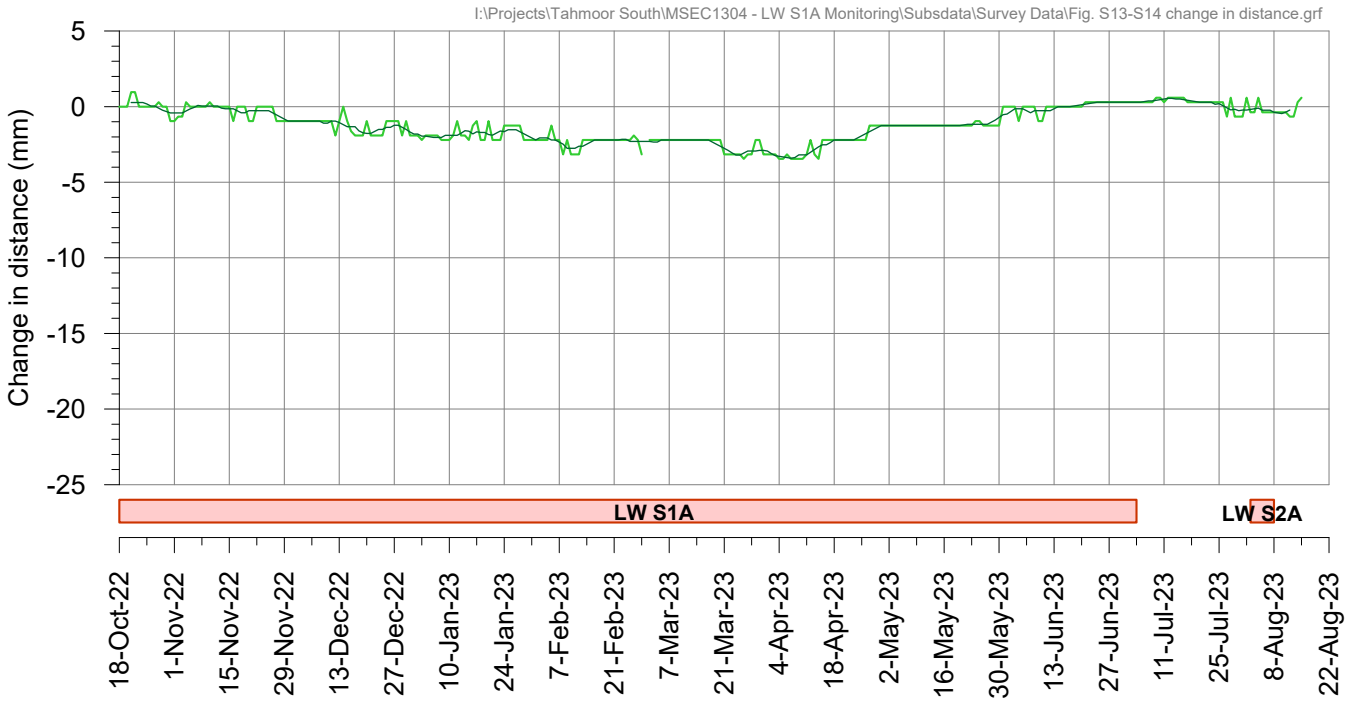
18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

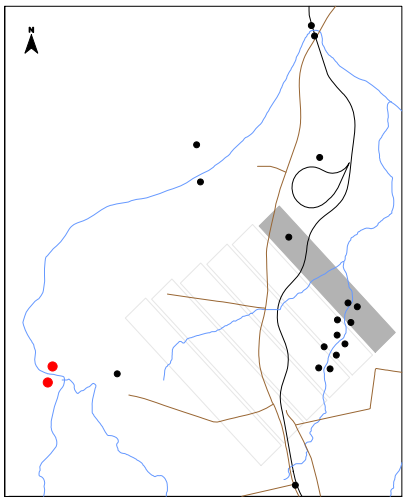
msec

Fig. S14-R38

Tahmoor South LW S1A - GNSS Monitoring

Change in distance across Picton Weir
Sites S13 and S14

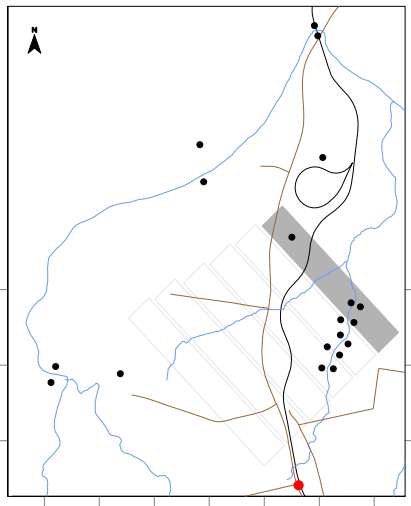


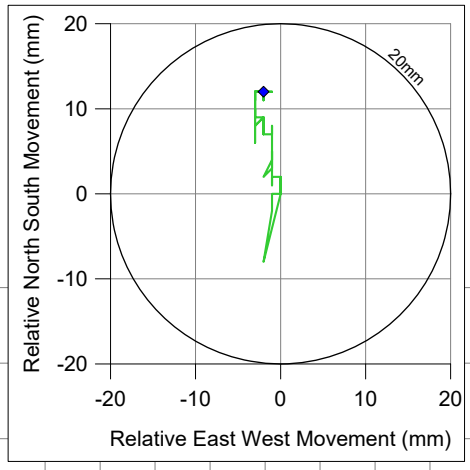


Tahmoor South LW S1A - GNSS Monitoring

Site S15 at Wellers Road Overbridge

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S15 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in northing (mm)

80
60
40
20
0
-20
-40

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

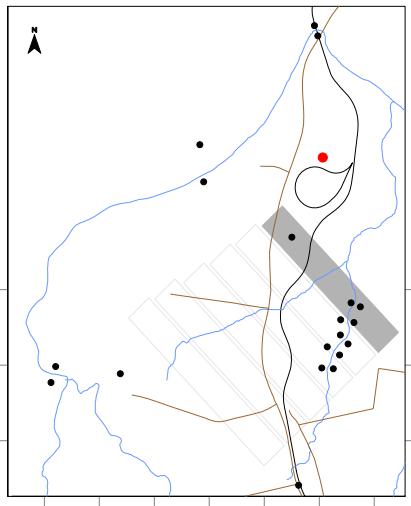
msec

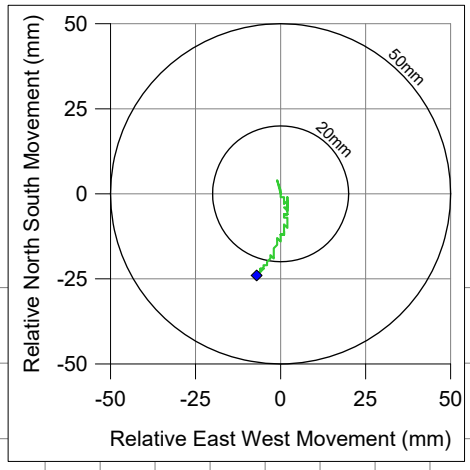
Fig. S15-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S16 at Tahmoor Mine site

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S16 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in northing (mm)

40
20
0
-20
-40
-60

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

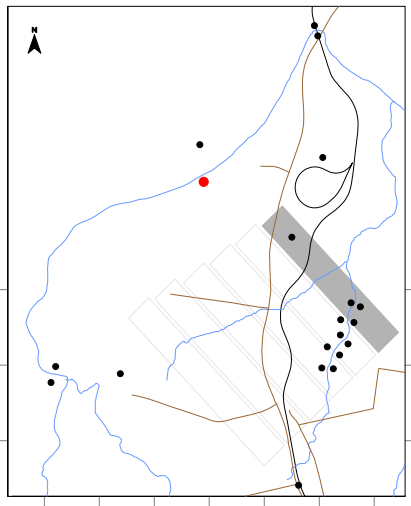
msec

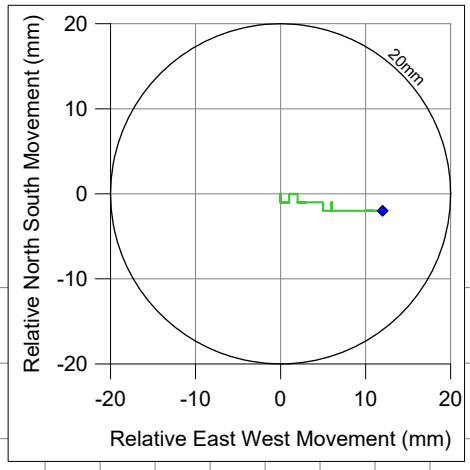
Fig. S16-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S17 on east bank of Bargo River

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S17 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Change in northing (mm)

60
40
20
0
-20
-40
-60

Daily change

7 day running average

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

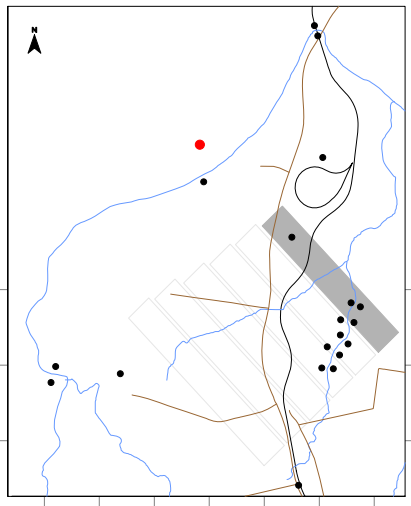
msec

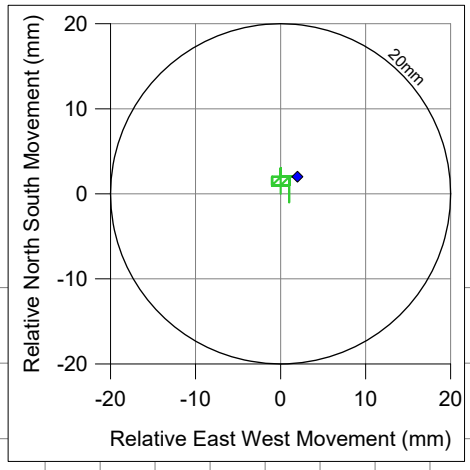
Fig. S17-R38

Tahmoor South LW S1A - GNSS Monitoring

Site S18 on west bank of Bargo River

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S18 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in northing (mm)

60
40
20
0
-20
-40
-60

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

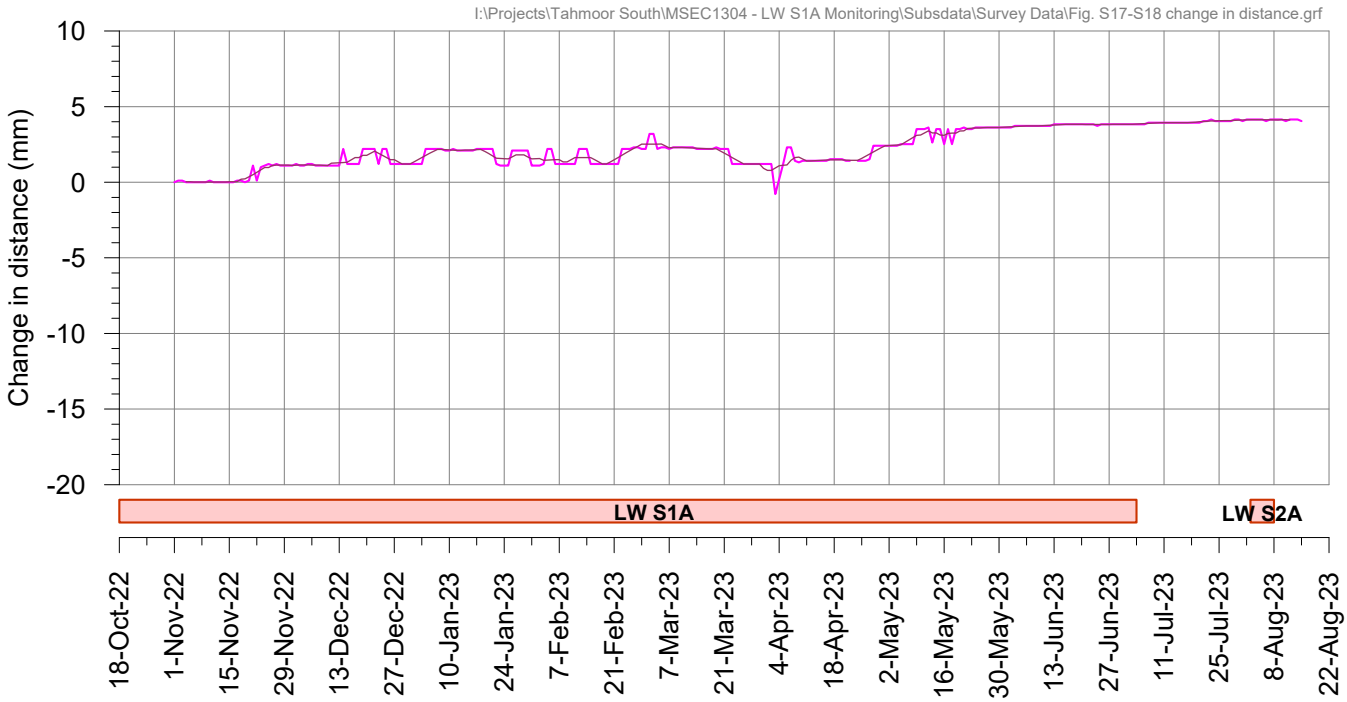
18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

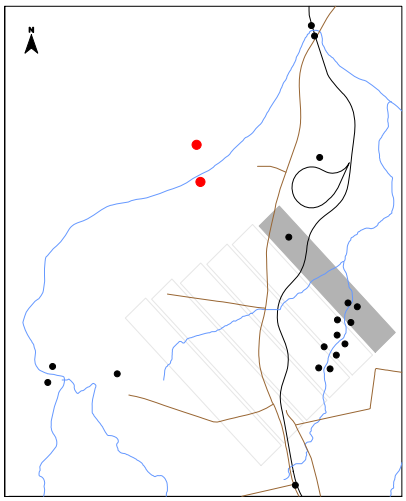
msec

Fig. S18-R38

Tahmoor South LW S1A - GNSS Monitoring

Change in distance across Bargo River
Sites S17 and S18

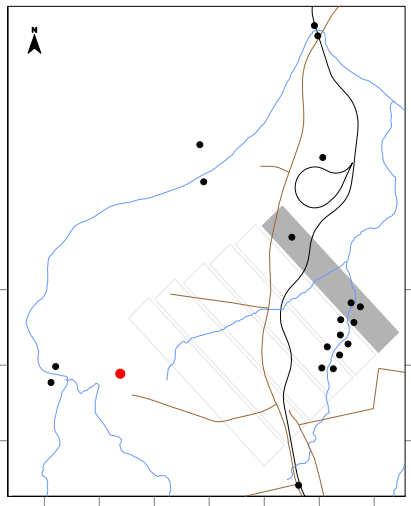


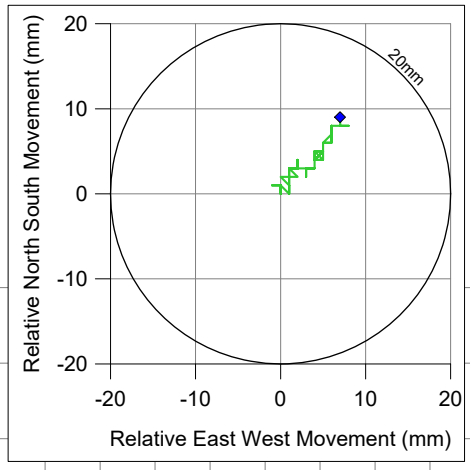


Tahmoor South LW S1A - GNSS Monitoring

Site S19 near Hornes Creek

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S19 GNSS.grf





During LW S1A

Change in easting (mm)

80
60
40
20
0
-20
-40

Daily change

7 day running average

Change in northing (mm)

60
40
20
0
-20
-40
-60

Change in height (mm)
(+ve = subsidence)

-20
0
20
40
60
80
100

LW S1A

LW S2A

18-Oct-22
01-Nov-22
15-Nov-22
29-Nov-22
13-Dec-22
27-Dec-22
10-Jan-23
24-Jan-23
07-Feb-23
21-Feb-23
07-Mar-23
21-Mar-23
04-Apr-23
18-Apr-23
02-May-23
16-May-23
30-May-23
13-Jun-23
27-Jun-23
11-Jul-23
25-Jul-23
08-Aug-23
22-Aug-23

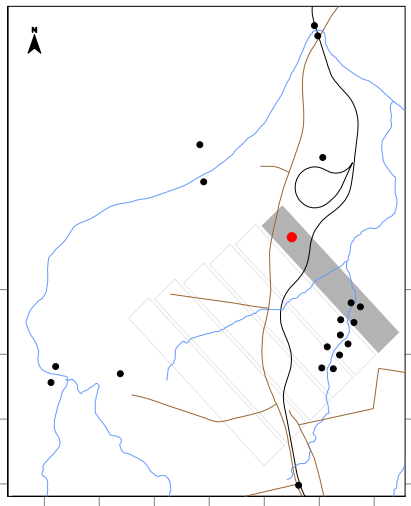
msec

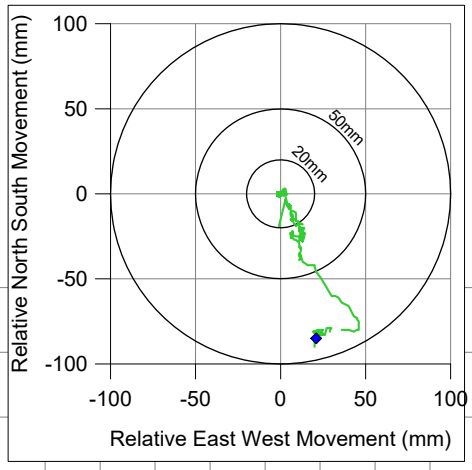
Fig. S19-R38

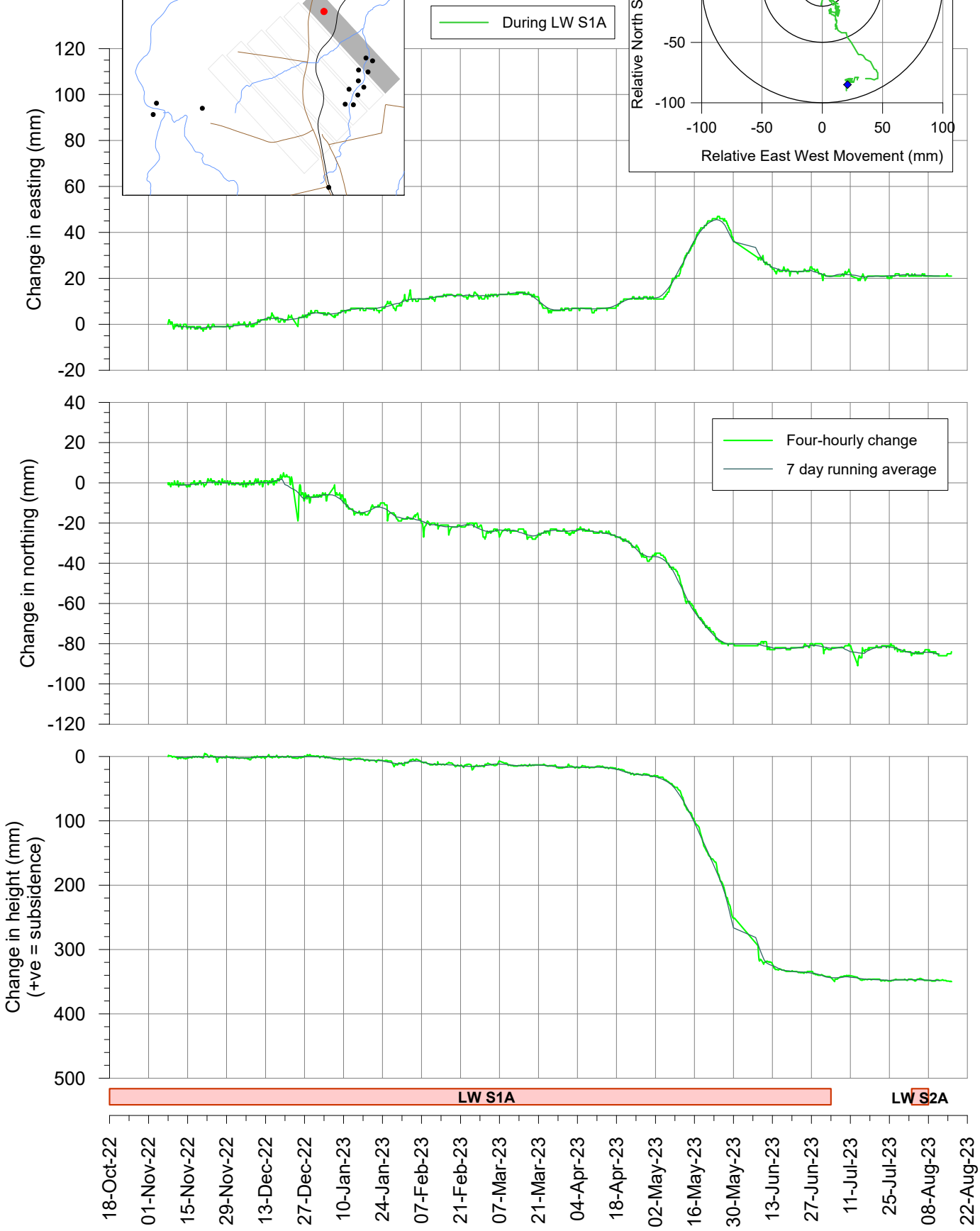
Tahmoor South LW S1A - GNSS Monitoring

Gantry at Tahmoor Mine site

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\Subsdata\Survey Data\Fig. S20 GNSS gantry.grf







msec

Fig. S20-R38

Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at base of 2A conveyor and drift portal

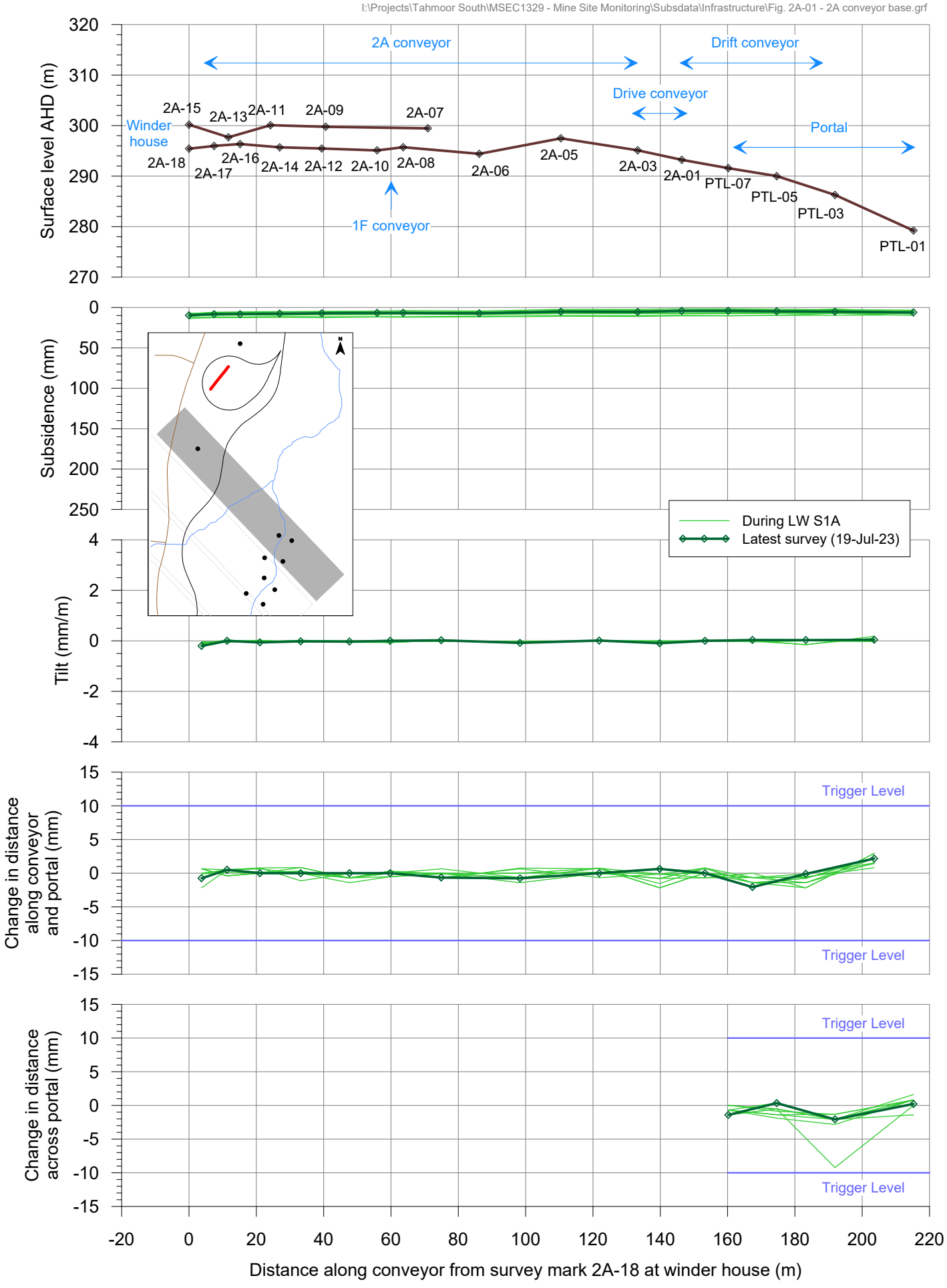
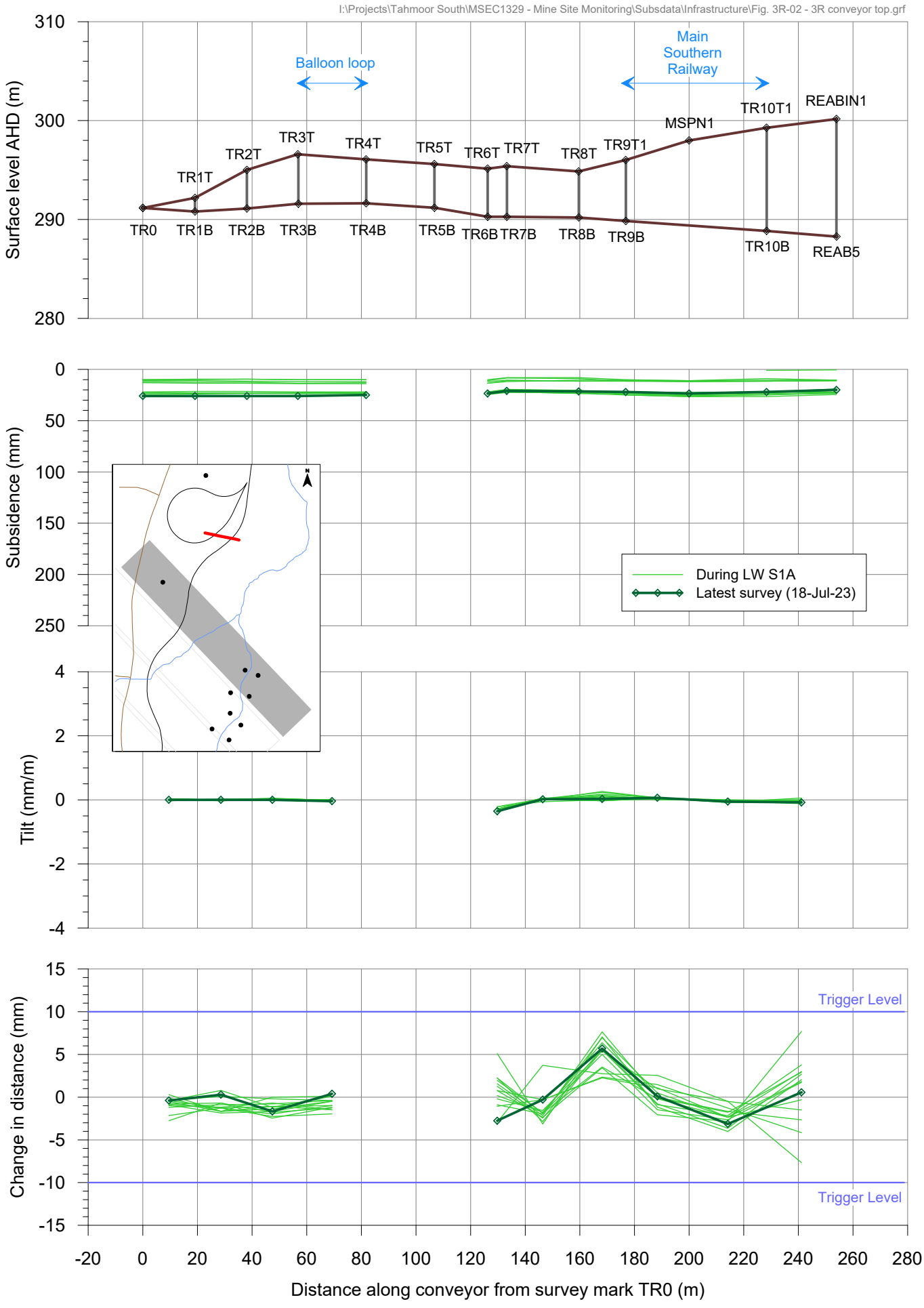


Fig. 2A-01-R38

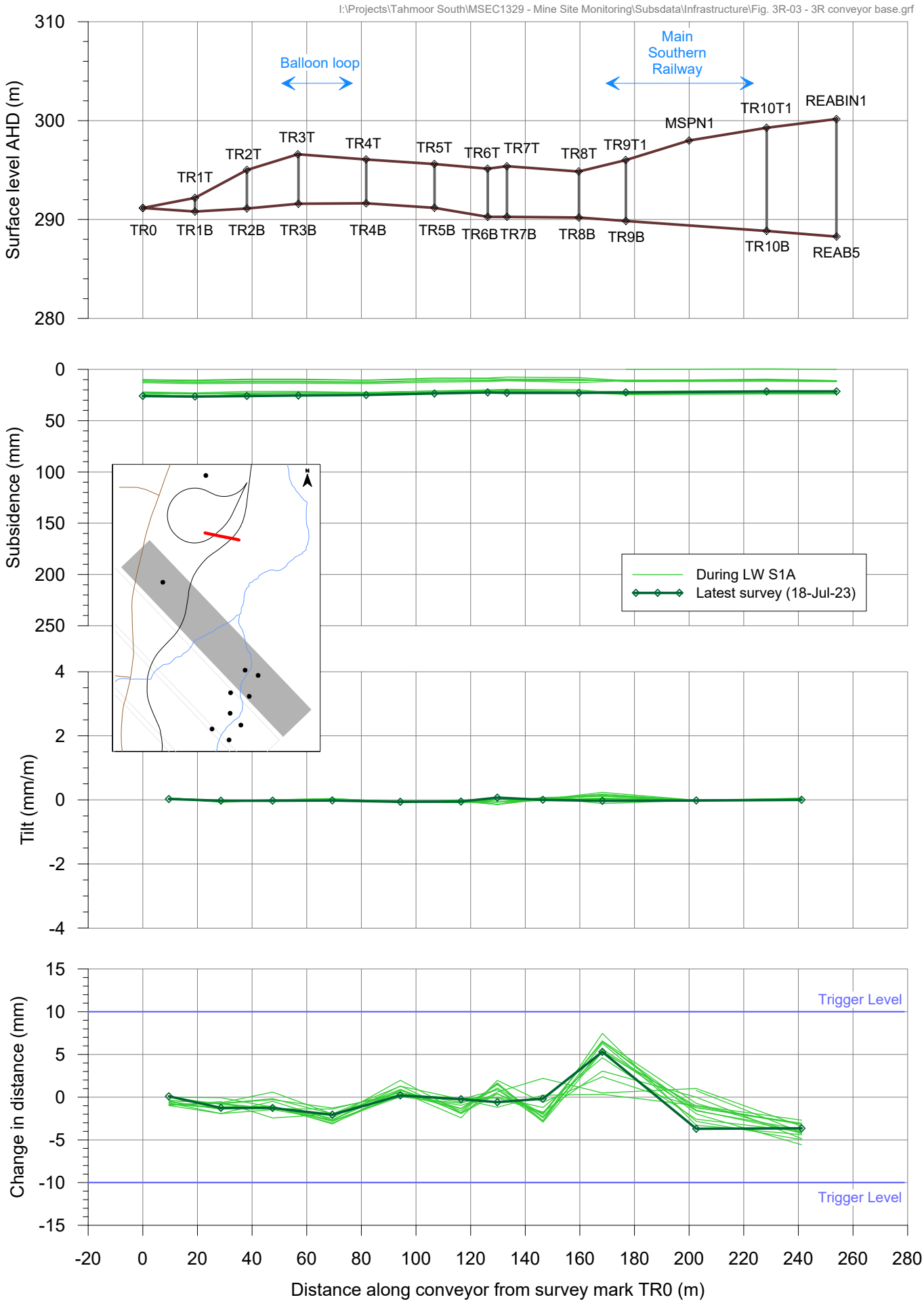
Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at top of 3R conveyor



msec

Fig. 3R-02-R38

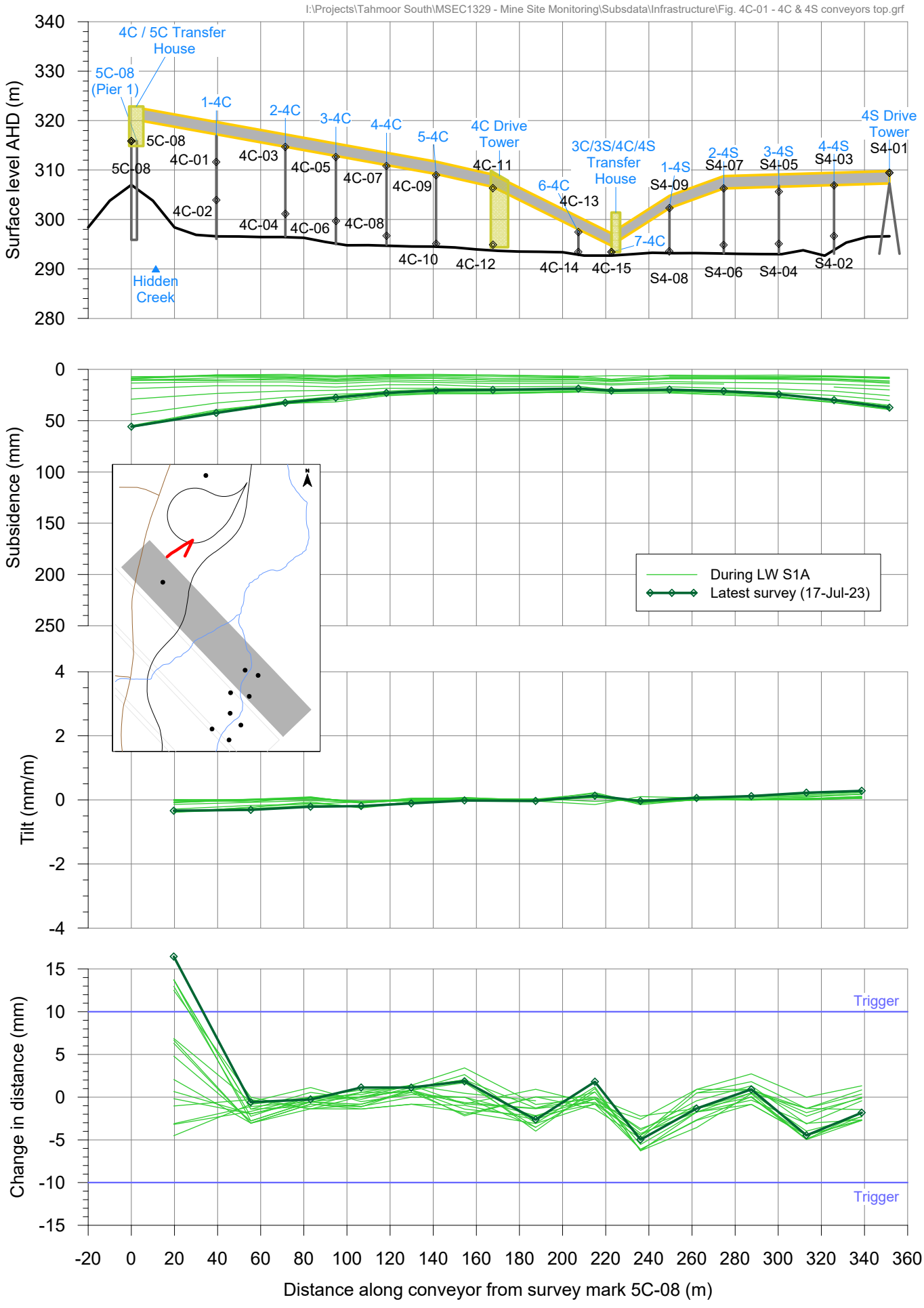
Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at base of 3R conveyor



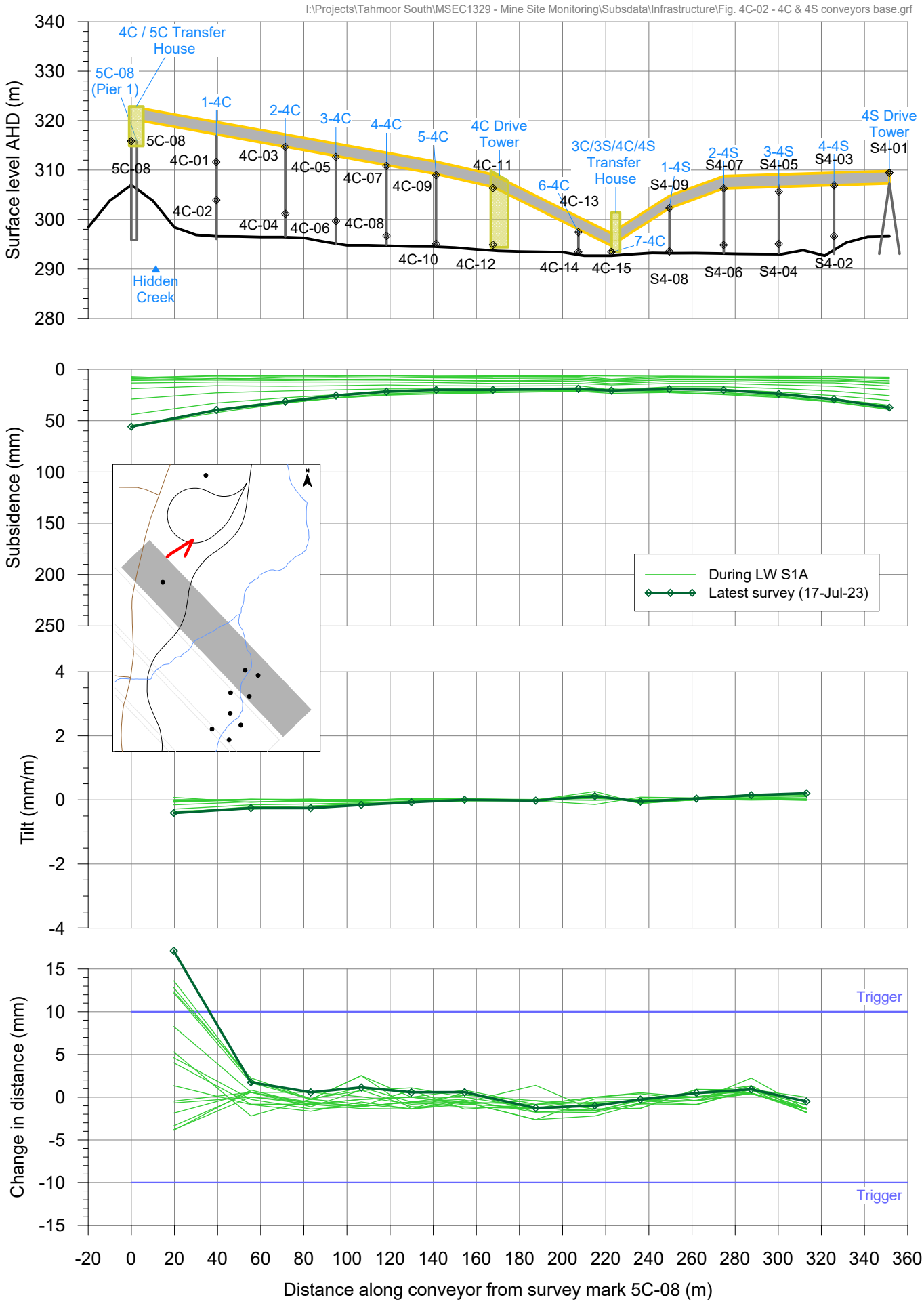
msec

Fig. 3R-03-R38

Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at top of 4C & 4S conveyors

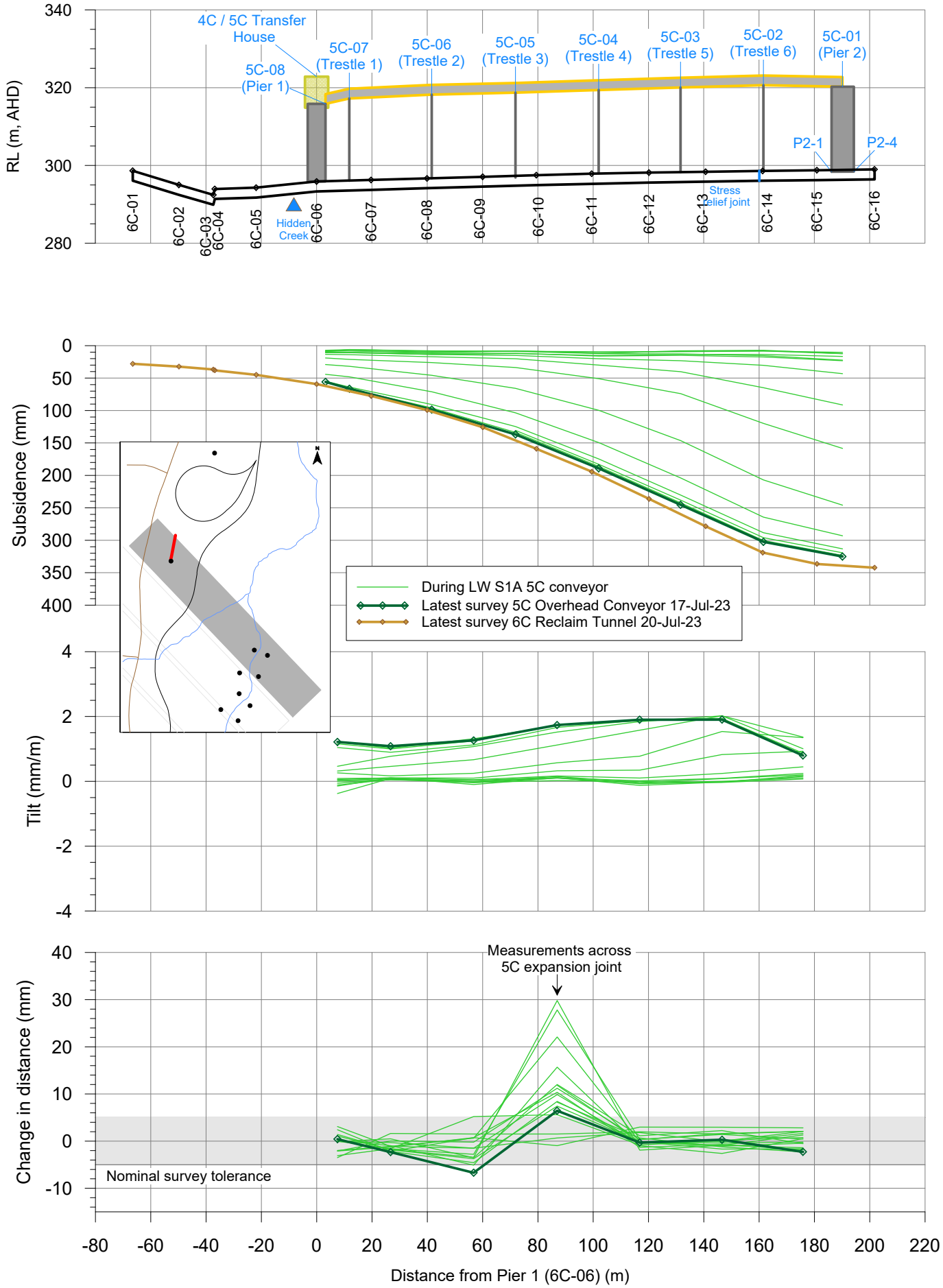


Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at base of 4C & 4S conveyors



Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at 5C conveyor

I:\Projects\Tahmoor South\MSEC1329 - Mine Site Monitoring\Subsdata\Infrastructure\Fig. 5C-01 - 5C conveyor.grf

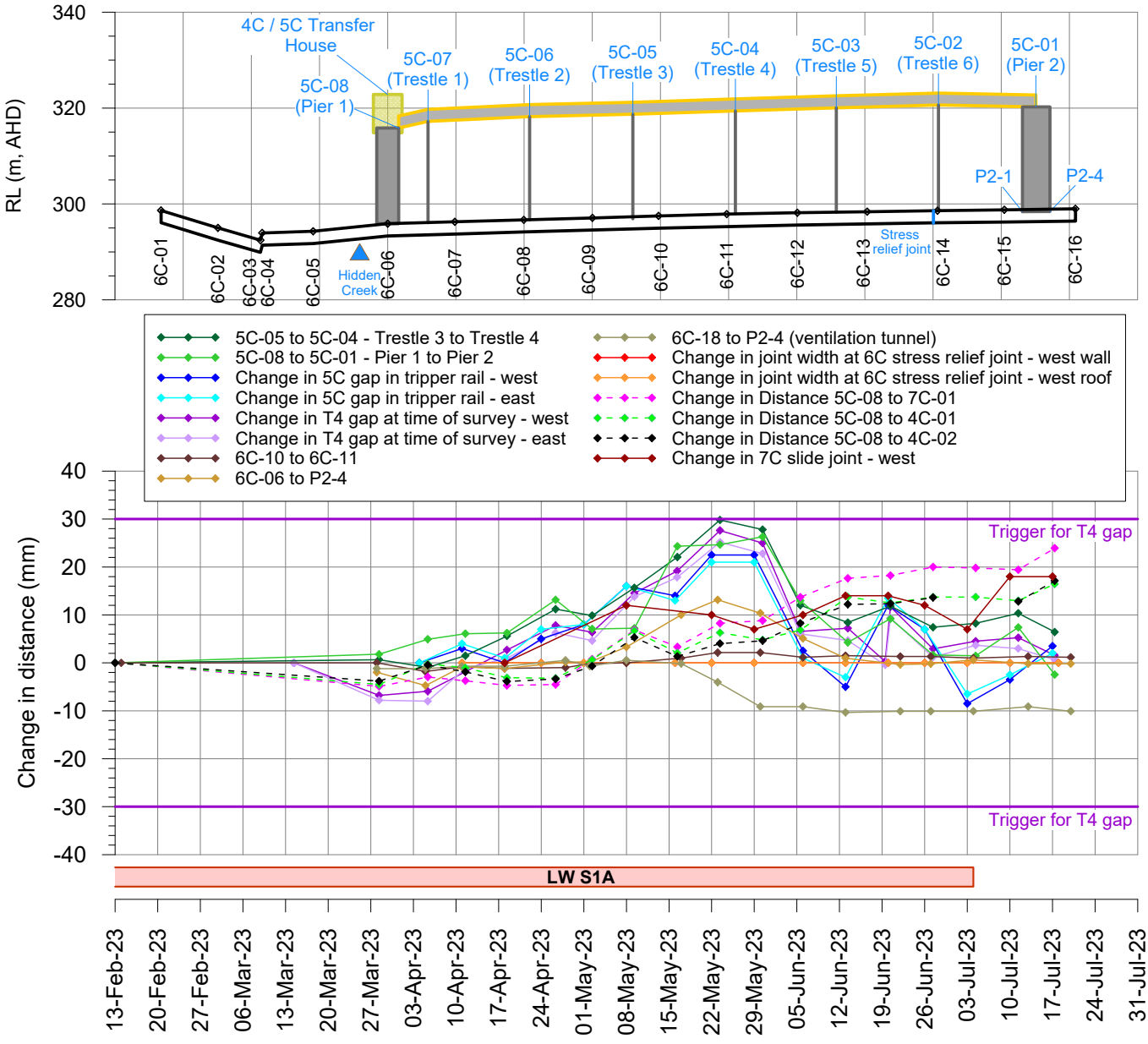


msec

Fig. 5C-01-R38

Tahmoor South LW S1A - Tahmoor Mine Site
Changes in distance at 5C conveyor

I:\Projects\Tahmoor South\MSEC1329 - Mine Site Monitoring\Subsdata\Infrastructure\Fig. 5C-02 - 5C conveyor changes in distance.grf

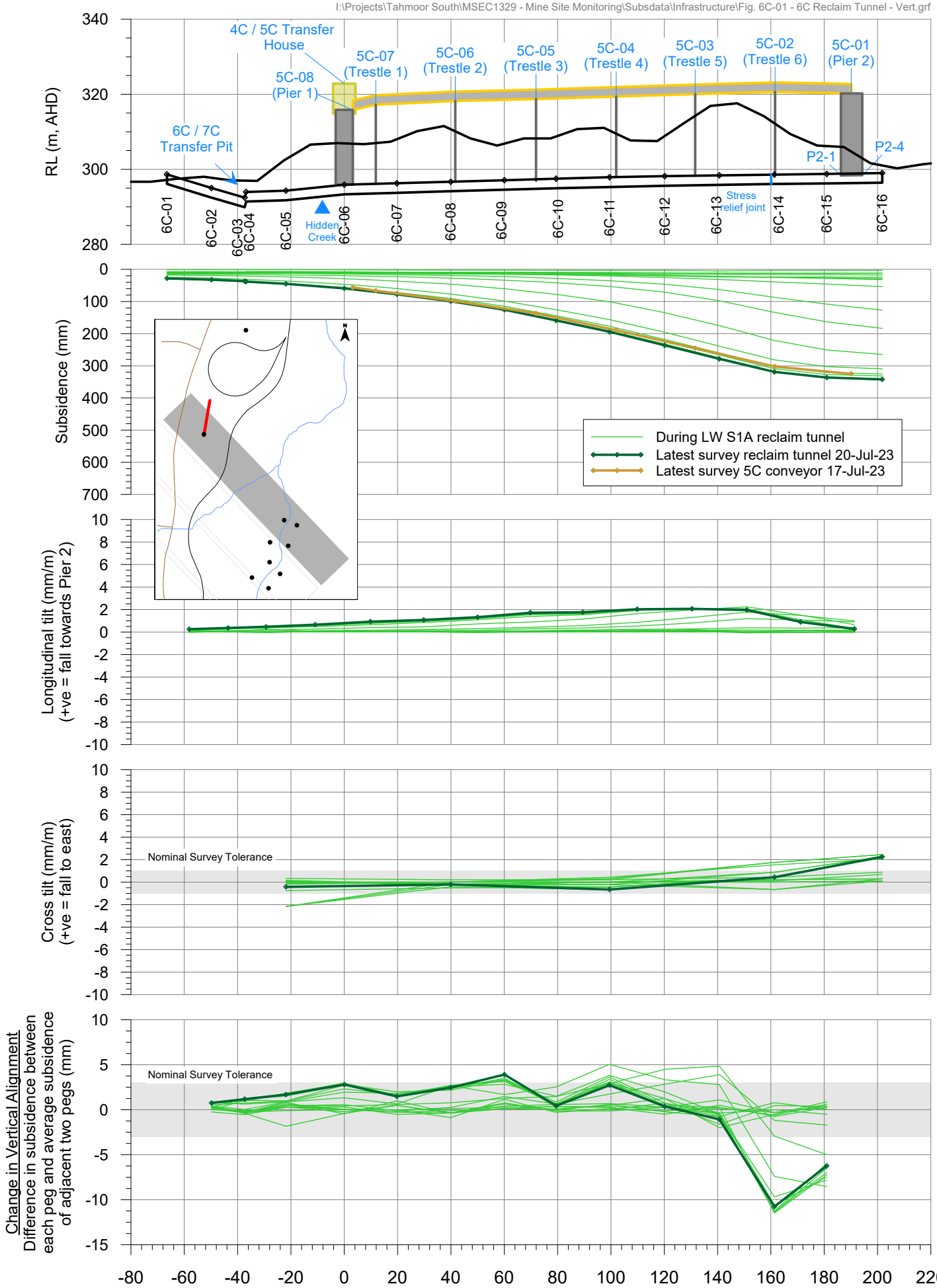


msec

Fig. 5C-02-R38

Tahmoor South LW S1A - Conveyor 6C Reclaim Tunnel
Incremental subsidence, tilt and changes in vertical alignment

I:\Projects\Tahmoor South\MSEC1329 - Mine Site Monitoring\Subsdata\Infrastructure\Fig. 6C-01 - 6C Reclaim Tunnel - Vert.grf

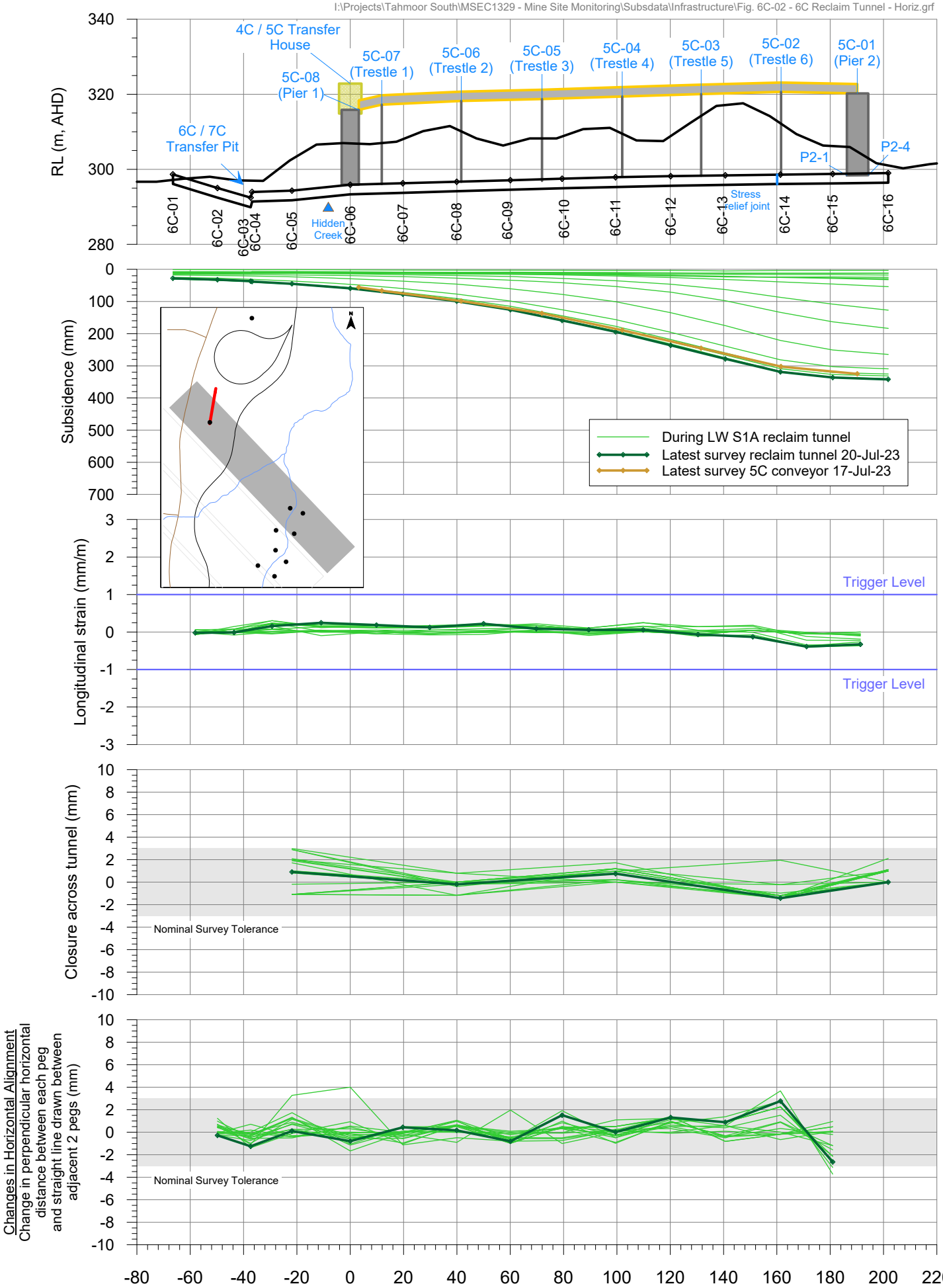


msec

Fig. 6C-01-R38

Tahmoor South LW S1A - Conveyor 6C Reclaim Tunnel
Observed incremental differential horizontal movements

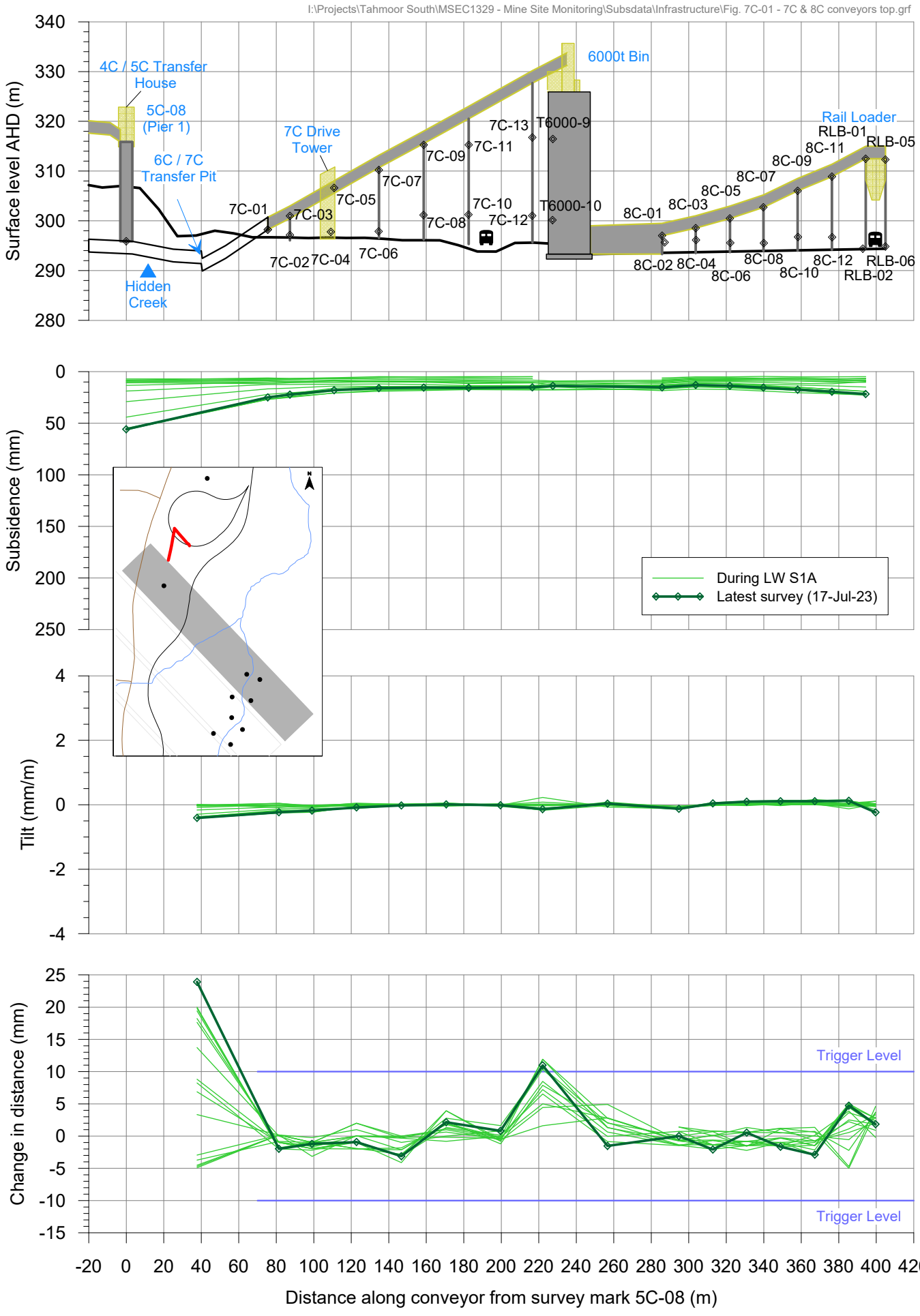
I:\Projects\Tahmoor South\MSEC1329 - Mine Site Monitoring\Subsdata\Infrastructure\Fig. 6C-02 - 6C Reclaim Tunnel - Horiz.grf



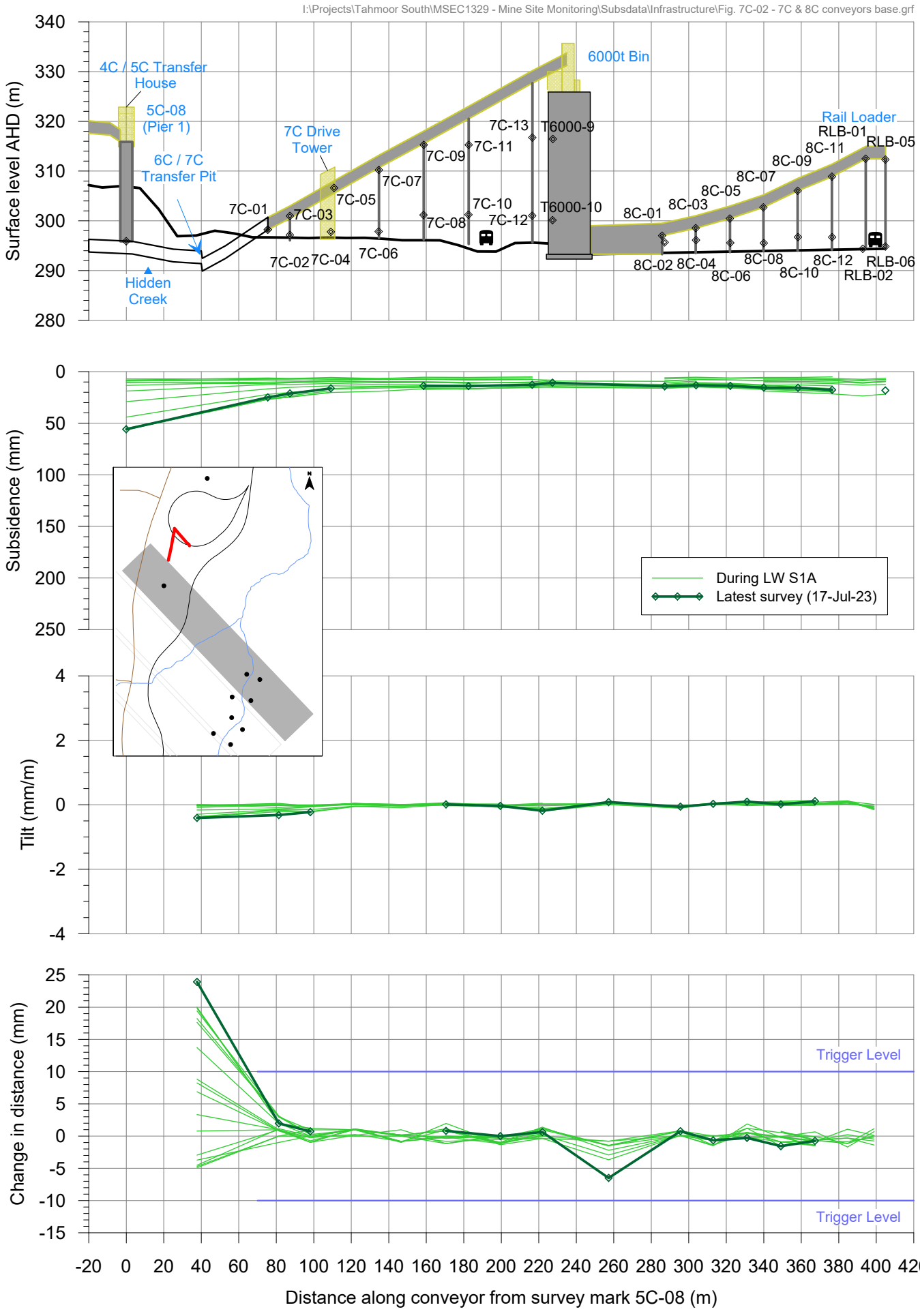
msec

Fig. 6C-02-R38

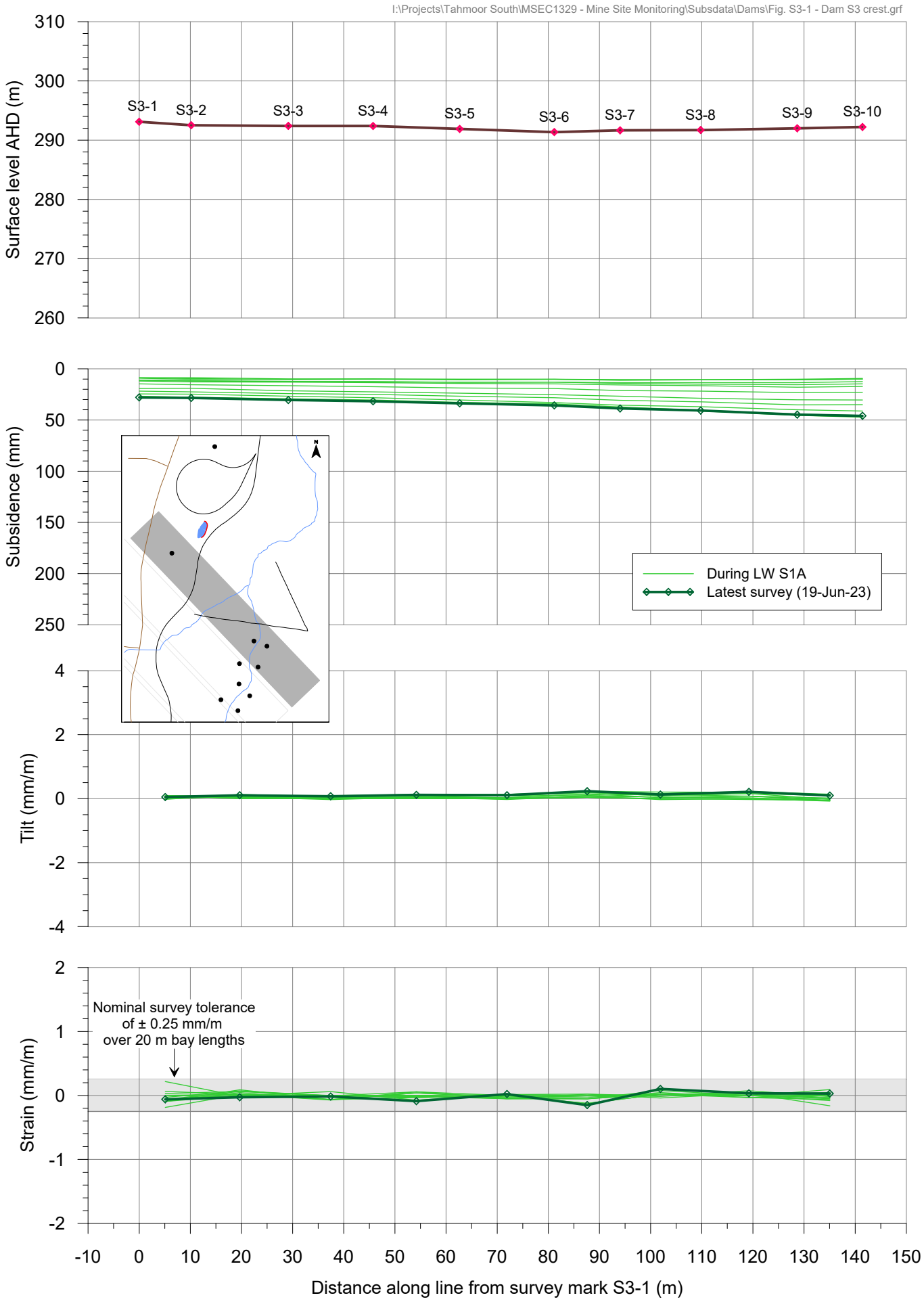
Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at top of 7C & 8C conveyors



Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at base of 7C & 8C conveyors



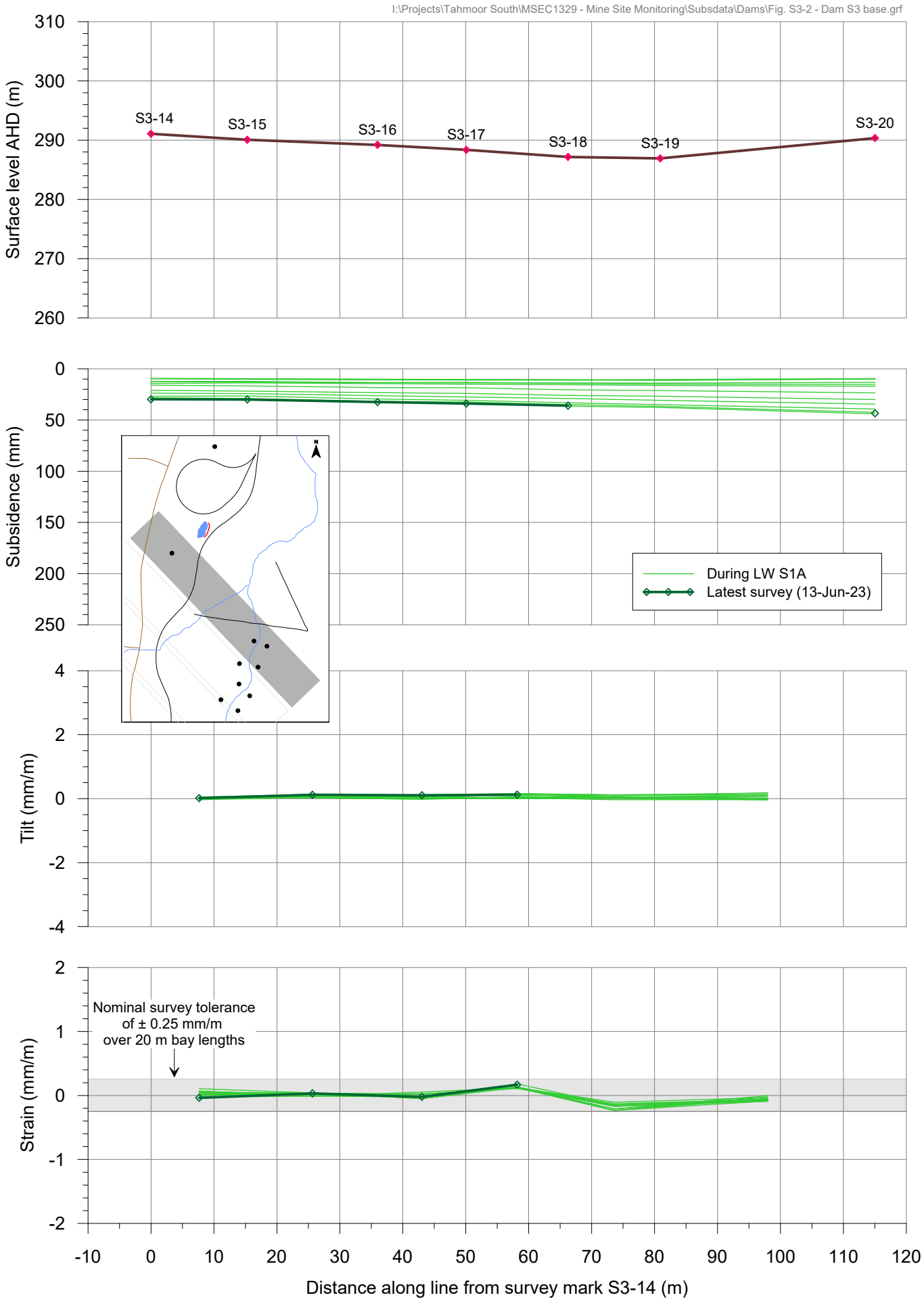
Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles along crest of Dams S2 and S3



msec

Fig. S3-1-R38

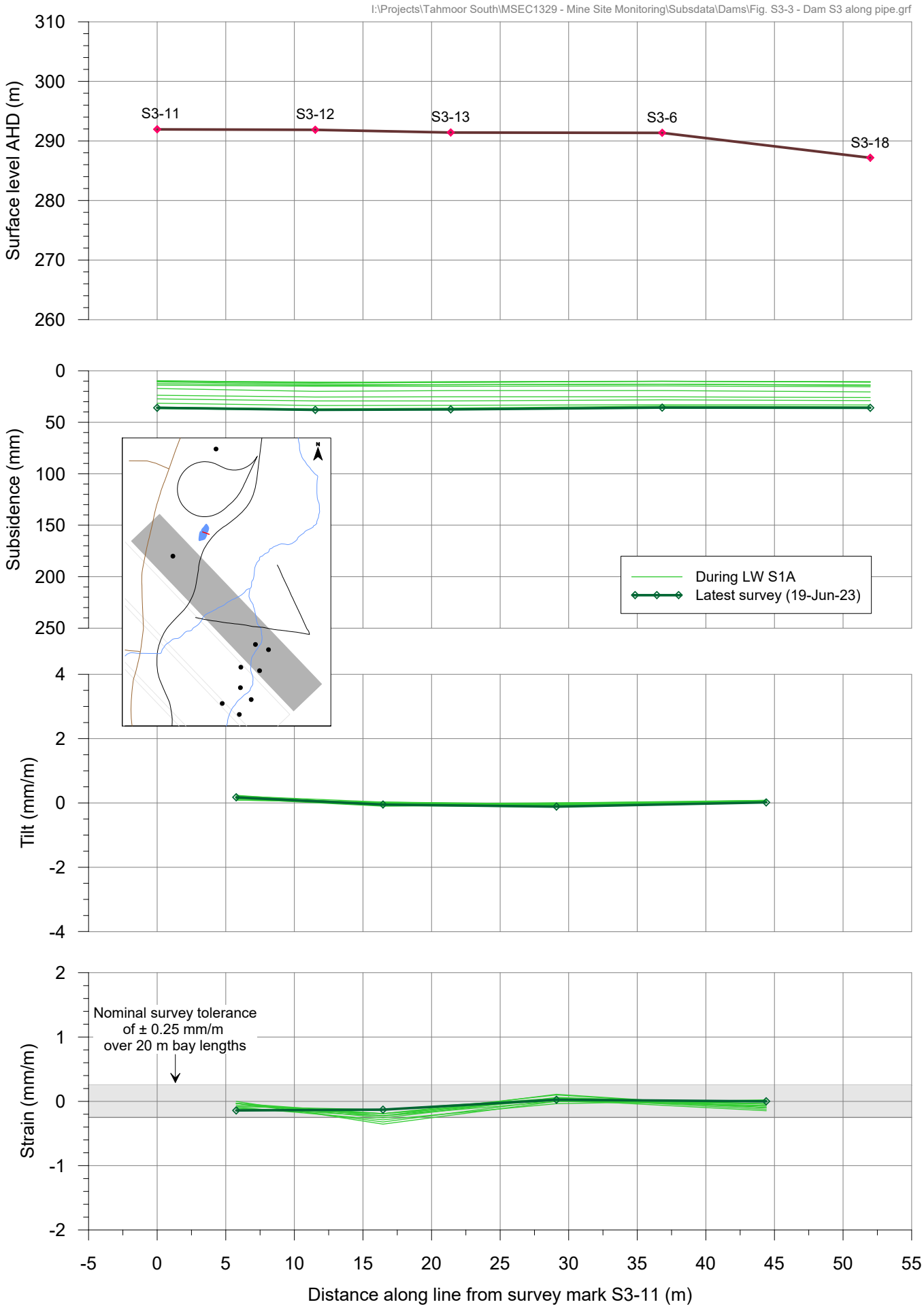
Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles along base of Dams S2 and S3



msec

Fig. S3-2-R38

Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles along pipe between Dams S2 and S3

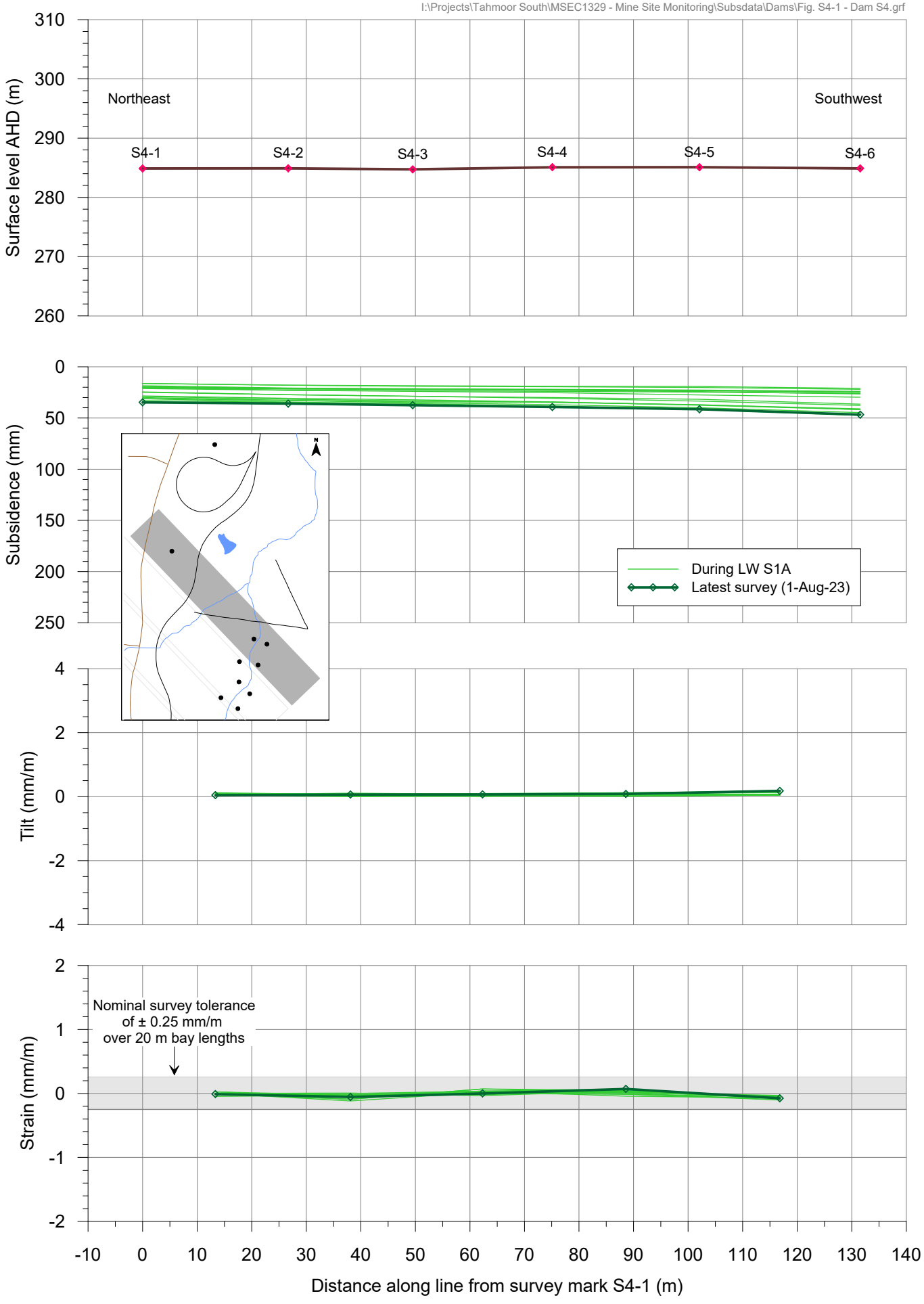


msec

Fig. S3-3-R38

Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles at Dam S4

I:\Projects\Tahmoor South\MSEC1329 - Mine Site Monitoring\Subsdata\Dams\Fig. S4-1 - Dam S4.grf

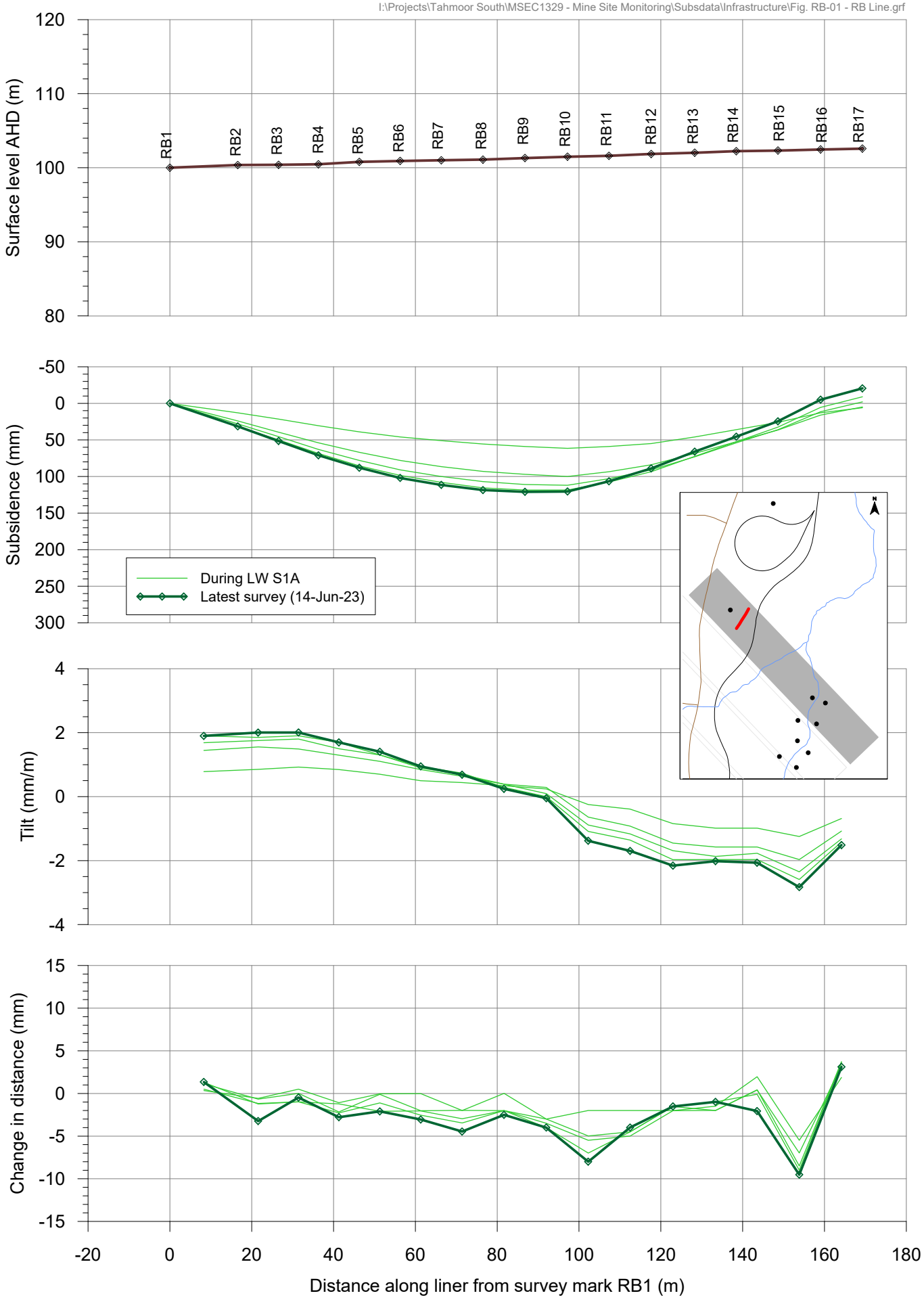


msec

Fig. S4-1-R38

Tahmoor South LW S1A - Tahmoor Mine Site
Incremental subsidence profiles along RB line

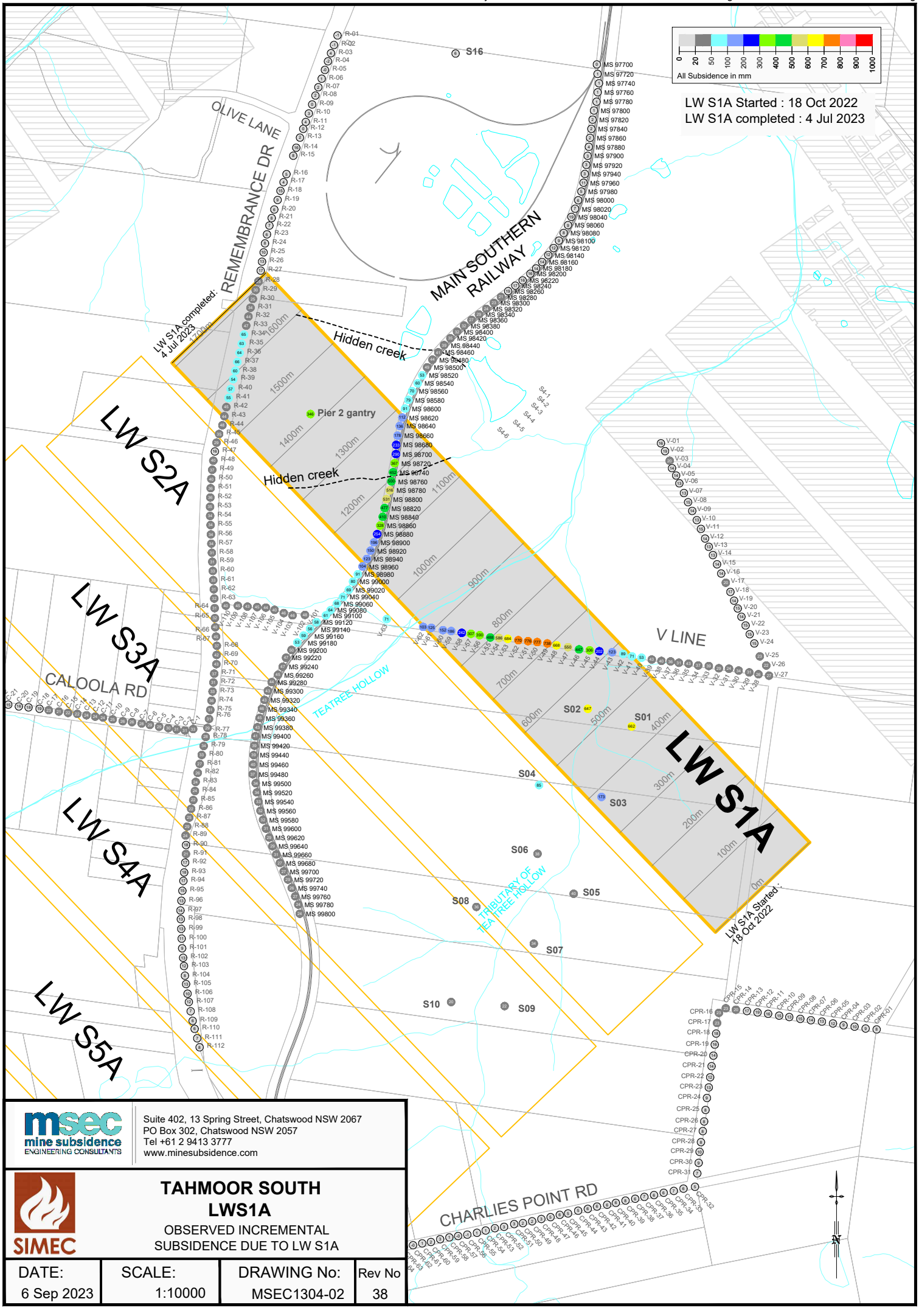
I:\Projects\Tahmoor South\MSEC1329 - Mine Site Monitoring\Subsdata\Infrastructure\Fig. RB-01 - RB Line.grf



msec

Fig. RB-01-R38

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\AcadData\MSEC1304-02 Inc Subs.dwg



msec mine subsidence ENGINEERING CONSULTANTS

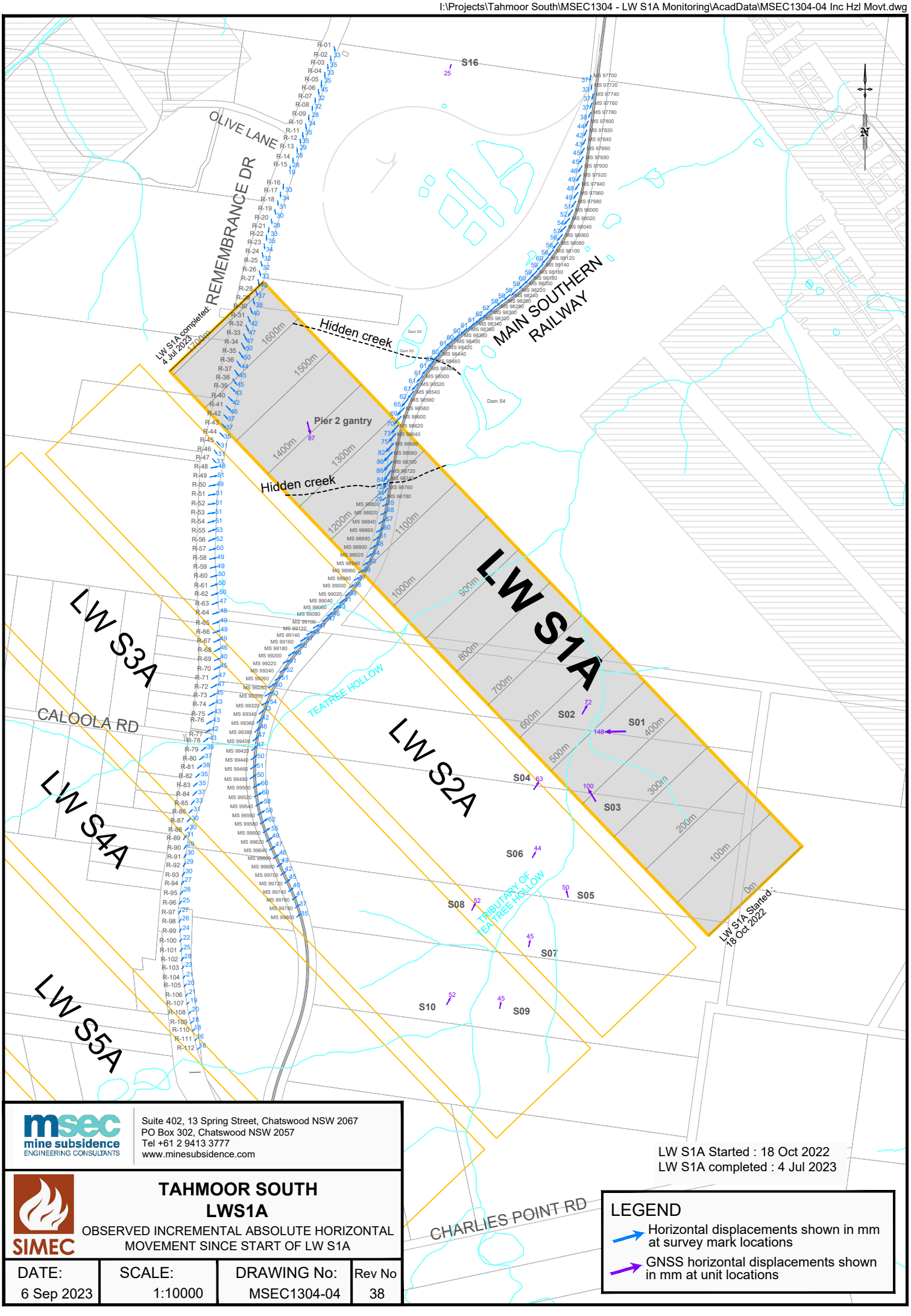
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

TAHMOOR SOUTH
LWS1A
OBSERVED INCREMENTAL SUBSIDENCE DUE TO LW S1A

DATE:	SCALE:	DRAWING No:	Rev No
6 Sep 2023	1:10000	MSEC1304-02	38

I:\Projects\Tahmoor South\MSEC1304 - LW S1A Monitoring\AcadData\MSEC1304-04 Inc Hzl Movt.dwg



msec mine subsidence ENGINEERING CONSULTANTS

Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

TAHMOOR SOUTH
LWS1A

OBSERVED INCREMENTAL ABSOLUTE HORIZONTAL MOVEMENT SINCE START OF LW S1A

DATE:	SCALE:	DRAWING No:	Rev No
6 Sep 2023	1:10000	MSEC1304-04	38

LW S1A Started : 18 Oct 2022
LW S1A completed : 4 Jul 2023

LEGEND

Horizontal displacements shown in mm at survey mark locations

GNSS horizontal displacements shown in mm at unit locations

Appendix B – Surface Water Monitoring Report

REPORT

TAHMOOR COAL PTY LTD
ABN: 97076663968

Tahmoor South Domain

Surface Water Review
1 January to 30 June 2023

121171-16R006-rev0
OCTOBER 2023

TAILINGS.WATER.WASTE.

Document Control

Project Name:	Tahmoor South Domain Surface Water Review
Document Title:	Surface Water Review 1 January to 30 June 2023
File Location:	N:\Synergy\Projects\121\121171 1809 Tahmoor (SIMEC) Surface Water Assistance\16 Quarterly SW and GW Investigation\Documents\R006 (SD)\Text\121171-16R006-rev0.docx
Document Number:	121171-16R006-rev0.docx

Revision History

Revision	Issue	Issue Date	Prepared by	Reviewed by
B	Draft	25 September 2023	Makaela McGrath / Camilla West	Nicola Logan
0	Final	10 October 2023	Makaela McGrath	Camilla West / Tahmoor Coal

Issue Register

Distribution List	Date
Tahmoor Coal Pty Ltd	10 October 2023

ATC Williams Company Details

Prepared By:	Makaela McGrath / Camilla West
Approved By:	Nicola Logan
Address:	16-20 Edmondstone St, Newmarket QLD 4051
Email:	nicolal@atcwilliams.com.au

CONTENTS

APPENDICES

TABLES

DIAGRAMS

MAPS

1 INTRODUCTION

1.1 Background

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates Tahmoor Mine, an underground coking coal mine. The mine surface operations are located south of Tahmoor NSW (within the Greater Sydney Basin) approximately 80 km southwest of Sydney. Tahmoor Mine is located within the Wollondilly Shire Council (WSC) Local Government Area (LGA). Underground workings extend north under the town of Tahmoor and Picton, with two ventilation shafts being located on the outskirts of Tahmoor.

The Tahmoor South Domain (Tahmoor South) is located south of the Bargo River and east of Remembrance Driveway and the township of Bargo. Mining of the six Longwalls (LWs) S1A-S6A within Tahmoor South was approved on 23 April 2021 in accordance with SSD 8445. The location of LWs S1A-S6A and the associated Study Area are illustrated in **Map 1**.

Mining of Longwall (LW) S1A commenced on 18 October 2022 and was completed on 4 July 2023. Mining of LW S2A commenced on the 2 August 2023 and is currently in progress.

In accordance with the *Tahmoor Water Management Plan - Tahmoor South Domain – Longwalls South S1A-S6A* (WMP), Tahmoor Coal are required to implement a monitoring program that includes groundwater, surface water and subsidence.

To support the monitoring program, Tahmoor Coal has developed a comprehensive rainfall, surface water and groundwater monitoring network within and adjacent to Tahmoor South. The surface water monitoring network comprises water level, streamflow and water quality monitoring sites in addition to visual inspection sites. The locations of the relevant monitoring sites are shown in **Map 4** to **Map 6**.

Tahmoor Coal engaged ATC Williams Pty Ltd (ATCW) to undertake a review and analysis of surface water monitoring data recorded at sites within and adjacent to the Tahmoor South for the period of 1 January 2023 to 30 June 2023. The groundwater and subsidence review and analysis were undertaken by independent specialists, with relevant detail summarised in this report.

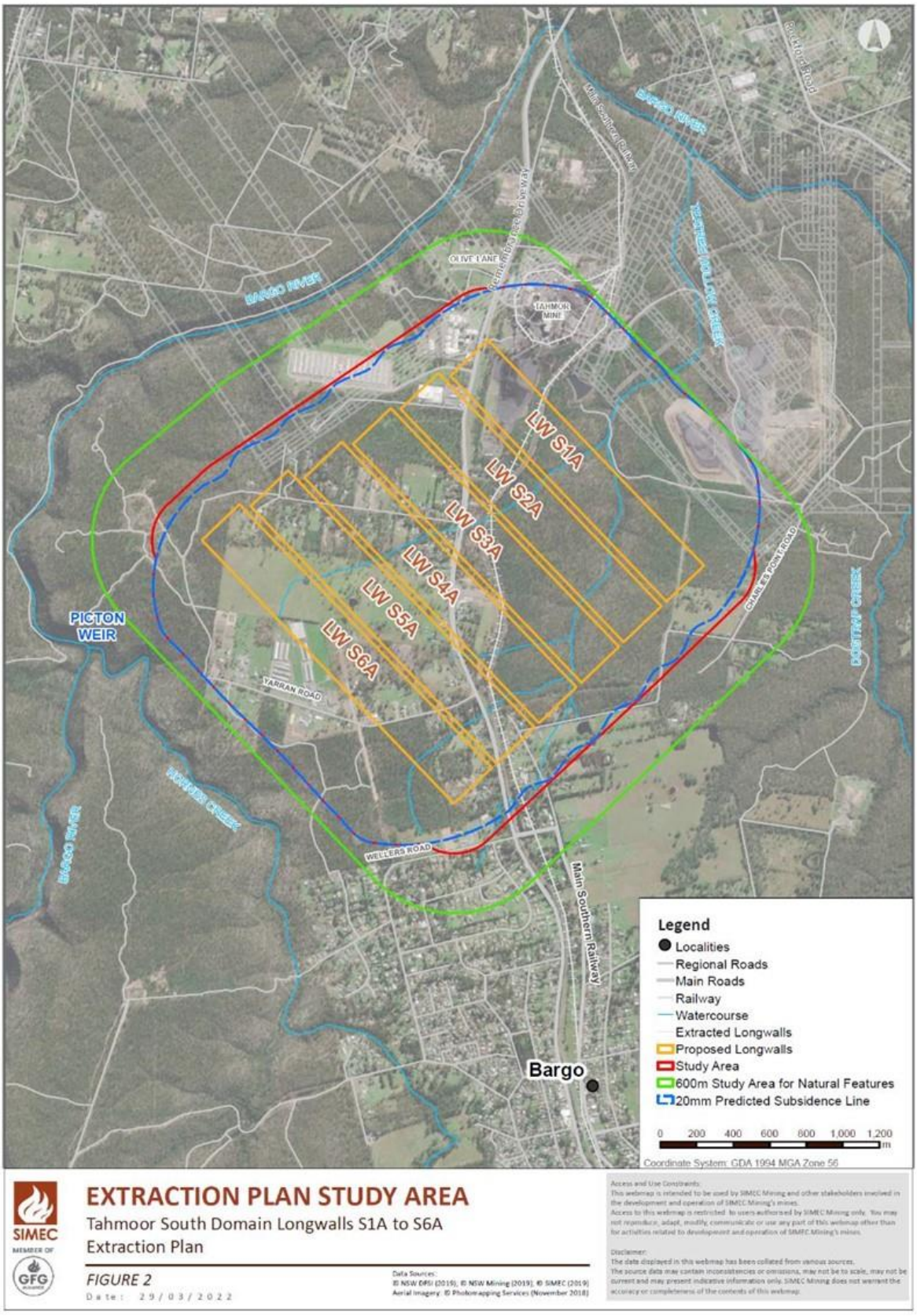
1.2 Scope and Report Purpose

In accordance with the WMP, a Trigger Action Response Plan (TARP) is required to be implemented, including an assessment of surface water monitoring data. The purpose of this report is to present:

- review and interpretation of monitoring data for the period of 1 January to 30 June 2023 - referred to as the review period herein;
- assessment against the performance measures and performance indicators for surface water; and
- recommendations in relation to ongoing monitoring and/or corrective actions.

This report predominantly presents and interprets surface water monitoring data recorded in the vicinity of LW S1A-S6A.

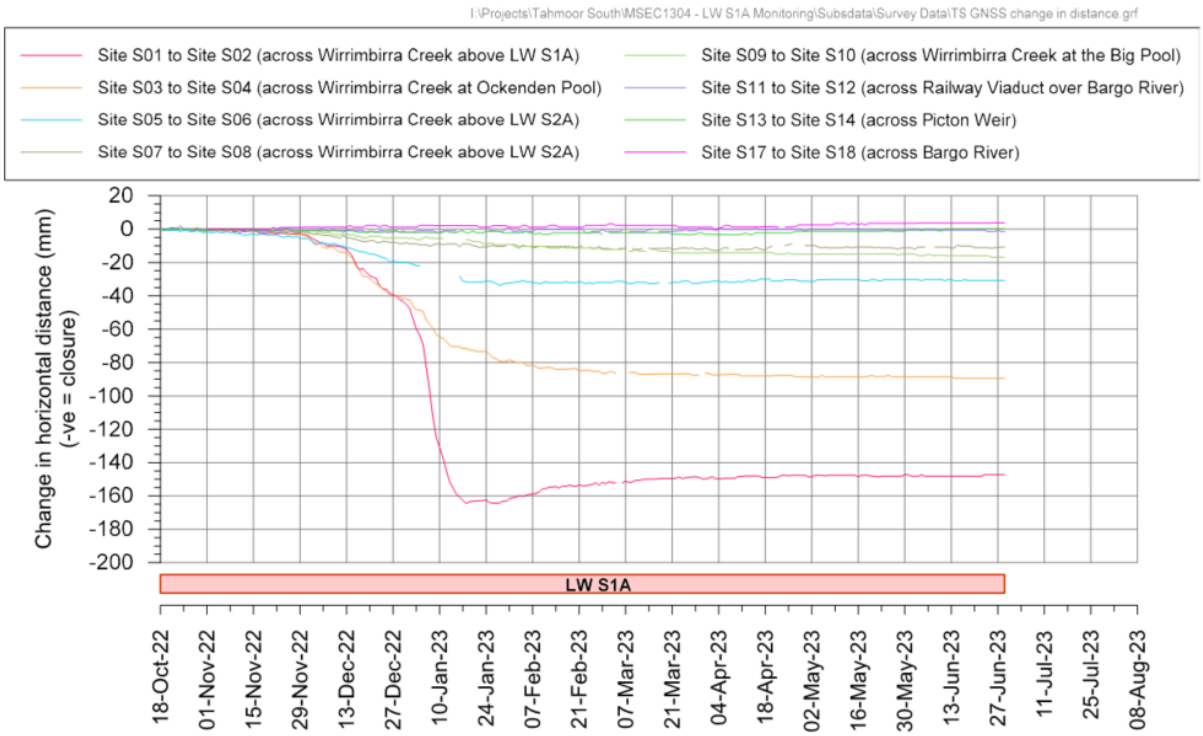
MAP 1: TAHMOOR SOUTH MINING AREA



2 SUMMARY OF MONITORED SUBSIDENCE MOVEMENTS

Tahmoor Coal has installed ground survey marks above and adjacent to LW S1A – S6A with monitoring of subsidence movements undertaken at key locations within and adjacent to Tahmoor South (refer **Map 2**). The subsidence monitoring is detailed in monthly subsidence monitoring reports prepared by Mine Subsidence Engineering Consultants (MSEC) and summarised below. Changes in horizontal distances calculated between GNSS[1] units located at key locations associated with Tahmoor South are presented in **Diagram 1**.

DIAGRAM 1: OBSERVED CHANGES IN HORIZONTAL DISTANCES BETWEEN GNSS UNITS (SOURCE: MSEC, 2023)

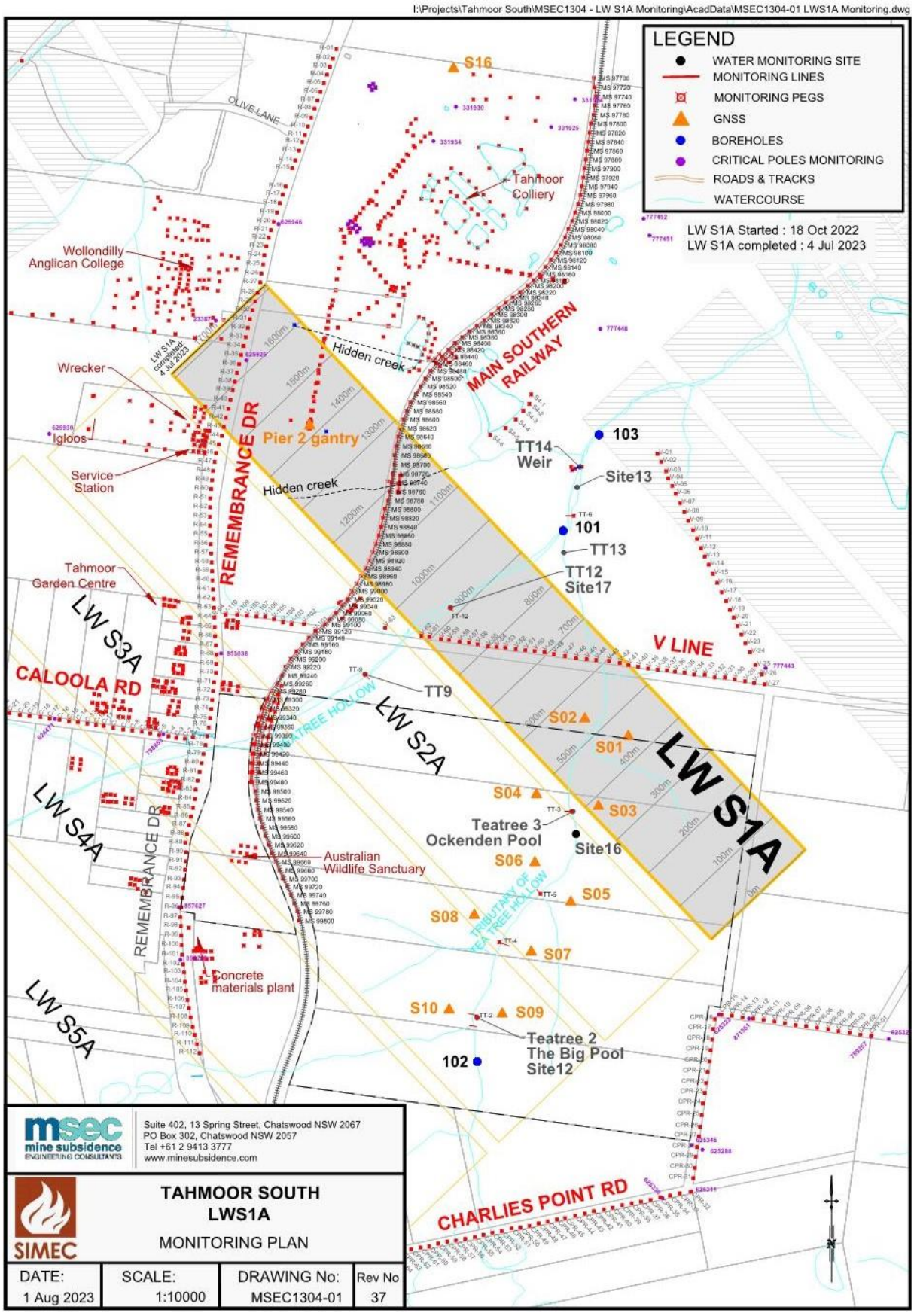


From the commencement of LW S1A to 30 June 2023, the following was recorded (MSEC, 2023):

- Greater than 20 millimetres (mm) closure has developed at sites in Teatree Hollow tributary (Wirrimbirra Creek) overlying LW S1A and LW S2A.
- Approximately 145 mm closure was recorded at Teatree Hollow tributary above LW S1A (Site S01 to Site S02) as of 30 June 2023.
- Approximately 90 mm closure was recorded at pool TT3 (Ockenden Pool) as of 30 June 2023 (Site S03 to Site S04).
- Approximately 30 mm closure was recorded at pool TT5 as of 30 June 2023 (Site S05 to Site S06).
- Less than 20 mm closure was recorded at upstream sites across Teatree Hollow tributary including at pool TT2 (Site S09 to Site S10).
- Negligible change in horizontal distance has been recorded at sites across the Bargo River.

[1] Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure absolute horizontal and vertical positions at a location in real time.

MAP 2: GNSS MONITORING LOCATIONS – TAHMOOR SOUTH (MSEC 2023)



3 SUMMARY OF GROUNDWATER LEVEL TRENDS

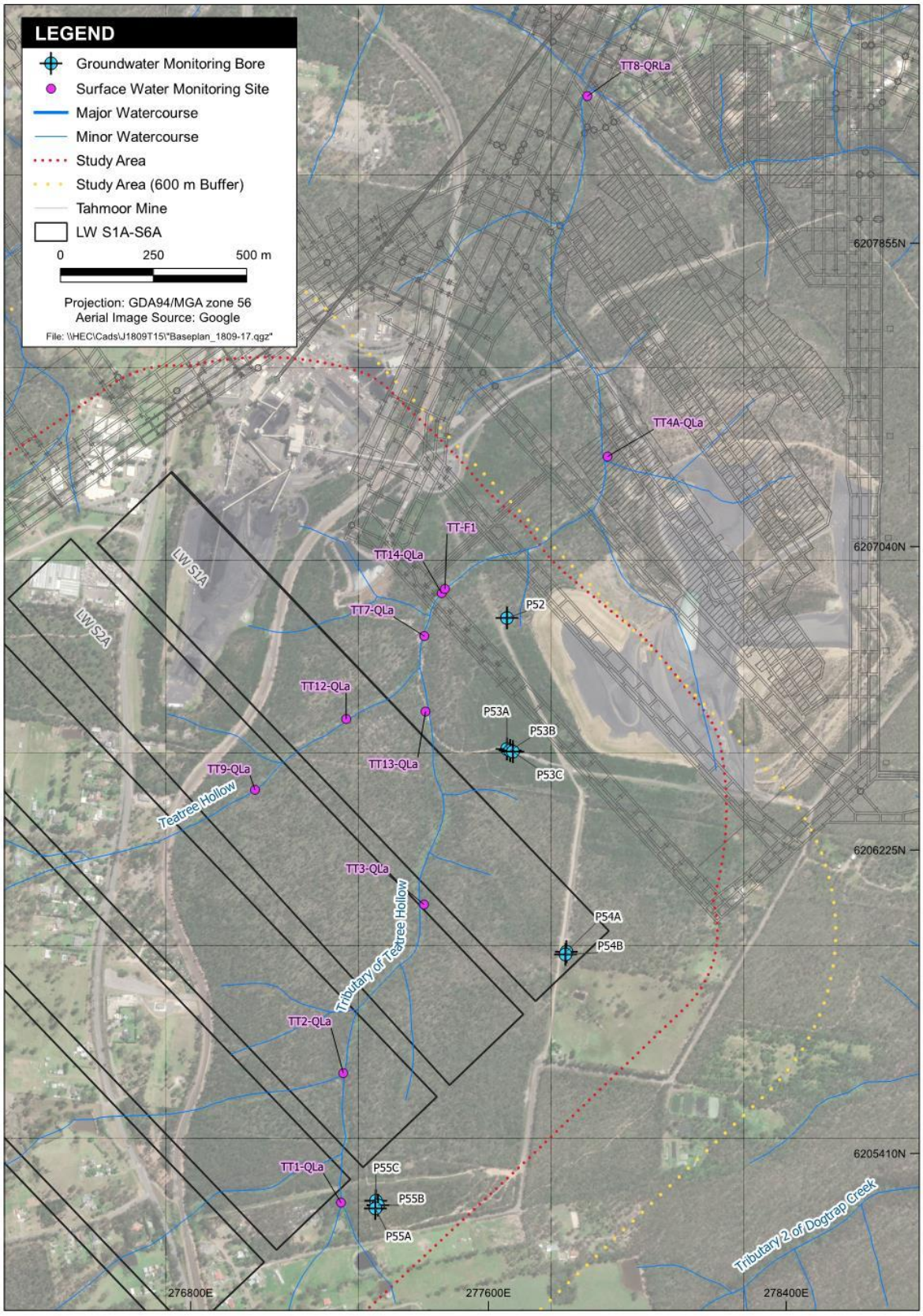
Detailed discussion of groundwater monitoring data recorded within and adjacent to the Study Area is presented in SLR (2023).

Based on SLR (2023), groundwater levels were reviewed to assess the potential for baseflow contribution and surface water-groundwater interaction within the Study Area. The following presents a summary of groundwater level trends recorded during the review period at groundwater monitoring bores in close proximity to surface water monitoring sites within the Study Area. The groundwater monitoring bore locations are shown in **Map 3**. The monitoring bores referenced are shallow open standpipe bores where 'C' denotes the lowest elevation sensor and 'A' denotes the highest elevation sensor in the open standpipe.

- Monitoring Bore P55A-C
  - Monitoring bore P55A-C is located approximately 100 m to the east of monitoring site TT1-QLa in Teatree Hollow tributary.
  - A TARP Level 1 exceedance in relation to groundwater level decline was reported at P55C in June 2023.
  - The manual water level measurements recorded at P55A indicate that the water level remained relatively consistent for the duration of the review period (Normal Condition).
  - The maximum groundwater level recorded at P55A during the review period was approximately 21 m below the bed elevation of Teetree Hollow tributary at TT1-QLa.
  - The groundwater level decline recorded at P55C is unable to be definitively attributed to depressurisation associated with mining of LWS1A, with further monitoring required to confirm.
  - As the groundwater level recorded at P55A remained relatively steady for the duration of the review period, it is inferred that negligible change in baseflow contribution to Teatree Hollow tributary in the vicinity of TT1-QLa occurred during the review period.
- Monitoring Bore P54A-B
  - Monitoring bore P54A-B is located approximately 400 m to the south-east of monitoring site TT3-QLa in Teatree Hollow tributary.
  - From February 2023, the P54A-B was recorded as dry.
  - The groundwater level recorded at P54A in January 2023 was approximately 6 m below the bed elevation of Teetree Hollow tributary at TT3-QLa.
  - There is insufficient monitoring data to assess groundwater-surface water connectivity in the vicinity of P54A-B, however, if the groundwater system was contributing baseflow to Teatree Hollow tributary within the vicinity of P54A-B, it may be inferred that a decline in baseflow contribution has occurred during the review period based on the decline in groundwater level recorded at P54A-B.
- Monitoring Bore P53A-C
  - Monitoring bore P53A-C is located approximately 250 m to the south-east of monitoring site TT13-QLa in Teatree Hollow tributary.
  - The groundwater level recorded at P53C declined by approximately 5 m from January to end June 2023.
  - Based on the manual water level measurements for P53A, a decline of approximately 3 m was recorded from January to end June 2023.
  - The groundwater level decline did not result in an exceedance of a TARP level during the review period.
  - The maximum groundwater level recorded at P53A during the review period was approximately 10 m below the bed elevation of Teetree Hollow tributary at TT13-QLa.
  - If the groundwater system was contributing baseflow to Teatree Hollow tributary in the vicinity of P53A-C, it may be inferred that a decline in baseflow contribution has occurred during the review period based on the decline in groundwater level recorded at P53A-C.

- Monitoring Bore P52
  - Monitoring bore P52 is located approximately 230 m and 190 m to the east of monitoring sites TT7-QLa and TT14-QLa in Teatree Hollow respectively.
  - The groundwater level recorded at P52 declined slightly by approximately 1 m from January to end June 2023.
  - The groundwater level decline did not result in an exceedance of a TARP level during the review period.
  - The maximum groundwater level recorded at P52 during the review period was approximately 15 m and 13 m below the bed elevation of Teetree Hollow at TT7-QLa and TT14-QLa respectively.
  - If the groundwater system was contributing baseflow to Teatree Hollow in the vicinity of P52, it may be inferred that a slight decline in baseflow contribution has occurred during the review period based on the slight decline in groundwater level recorded at P52.

MAP 3: GROUNDWATER MONITORING BORES PROXIMAL TO TEATREE HOLLOW



4 SURFACE WATER MONITORING PROGRAM

4.1 Overview

Tahmoor Coal has implemented an extensive surface water monitoring program within and adjacent to the Study Area, as detailed in the WMP. The LW S1A-S6A surface water monitoring program includes water level, streamflow and water quality monitoring sites in addition to visual inspection sites. The purpose of the surface water monitoring program is to ensure compliance with regulatory requirements and to enable identification of potential mining related impacts to:

- pool and watercourse physical features and natural behaviour;
- surface water level and streamflow; and
- surface water quality.

The monitoring program aimed to develop a baseline (before) dataset for a range of surface water features and to assess operational and post-mining (after) impacts through the monitoring of reference sites (control) and potential impact sites (impact).

The monitoring sites are characterised as follows:

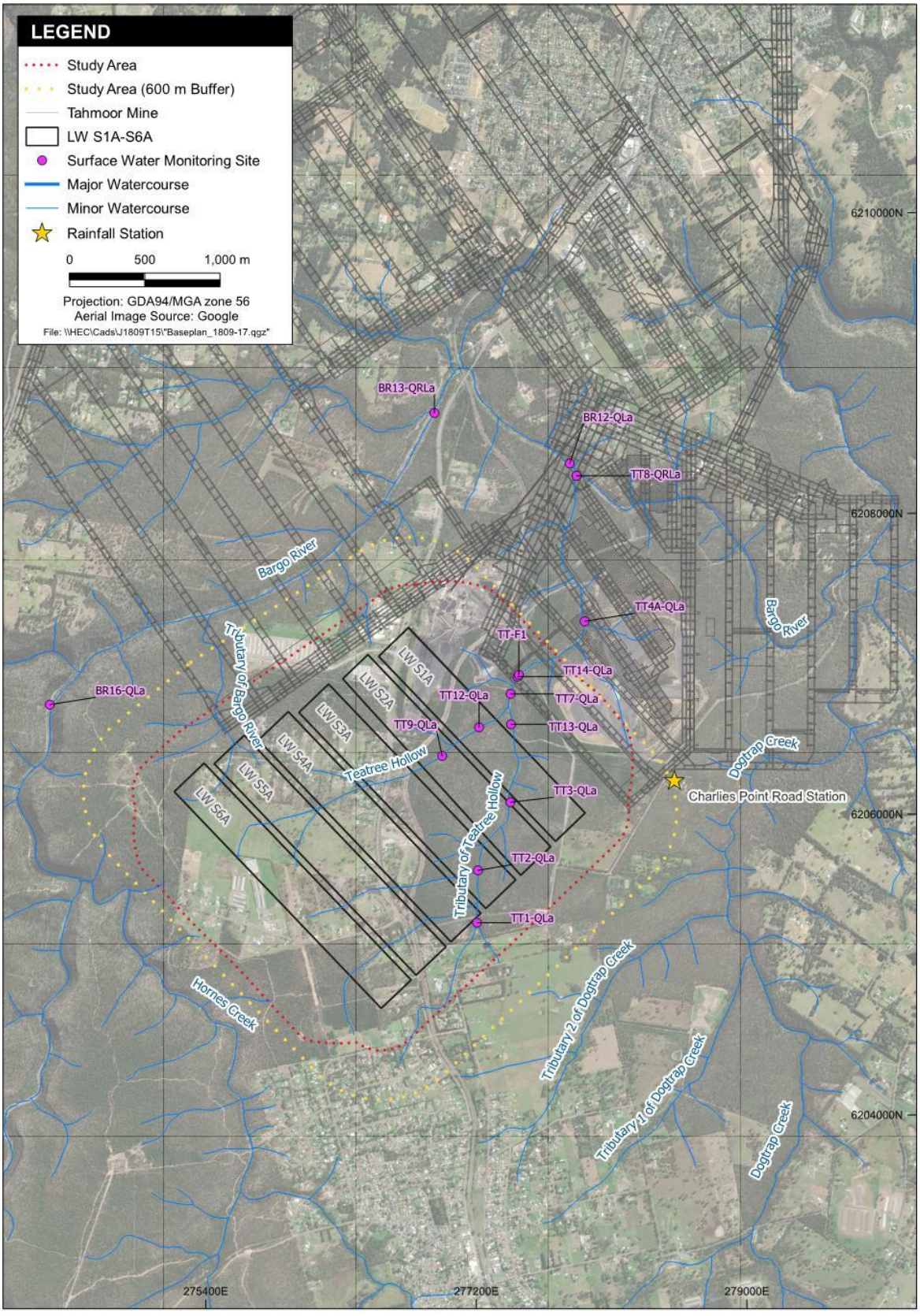
Baseline Site:	Surface water monitoring site that has been monitored for water level and quality prior to the commencement of mining in the Western Domain. Baseline surface water monitoring data was used to derive water quality Site Specific Guideline Values (SSGVs) and water level trigger values.
Reference Site:	Surface water monitoring site that is located upstream of the subsidence impact zone and is considered unlikely to be affected by mining activity. These sites are utilised as benchmarks for observations from potential impact sites.
Potential Impact Site:	Surface water monitoring site located within the potential subsidence impact zone (as defined based on mining induced subsidence predictions), from which a potential effect on surface water level or quality from the site activity may be detected.

4.2 Monitoring Program Summary

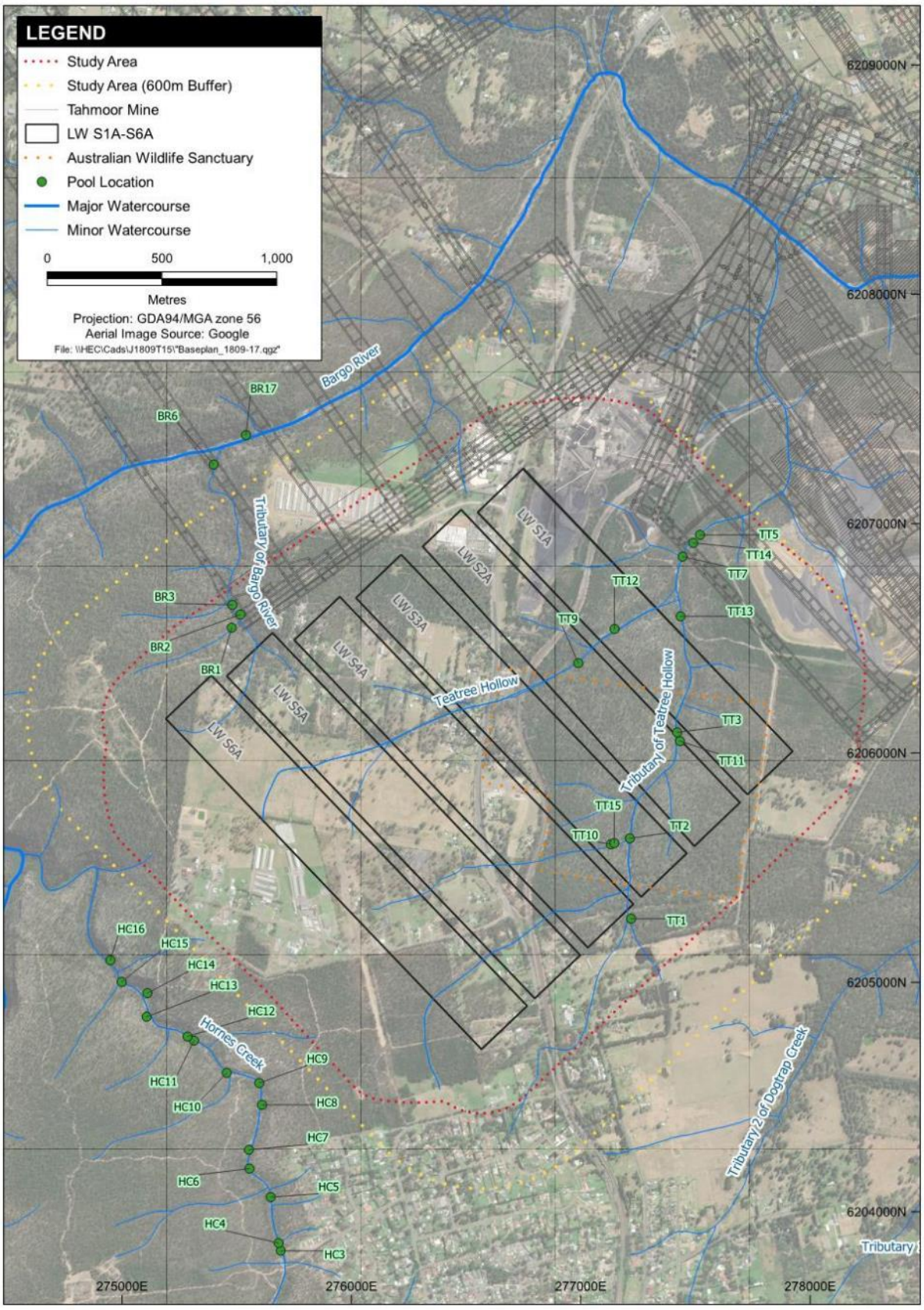
Surface water monitoring sites are located on key watercourses within and adjacent to the Study Area, including Teatree Hollow, Teatree Hollow tributary, Bargo River, Bargo River tributary and Hornes Creek. The locations of the monitoring sites relevant to the Study Area are shown in **Map 4 to Map 6.**

The monitoring site nomenclature is associated with the watercourse and pool number (i.e., TT9 is pool 9 on Teatree Hollow) and the type of monitoring to be implemented: water quality (Q), automated (continuous) water level monitoring (La), streamflow (F), channel morphology (CM), knickpoint (K) and headwater reaches (HW). The surface water monitoring program for LWS1A-S6A is summarised in **Appendix A.**

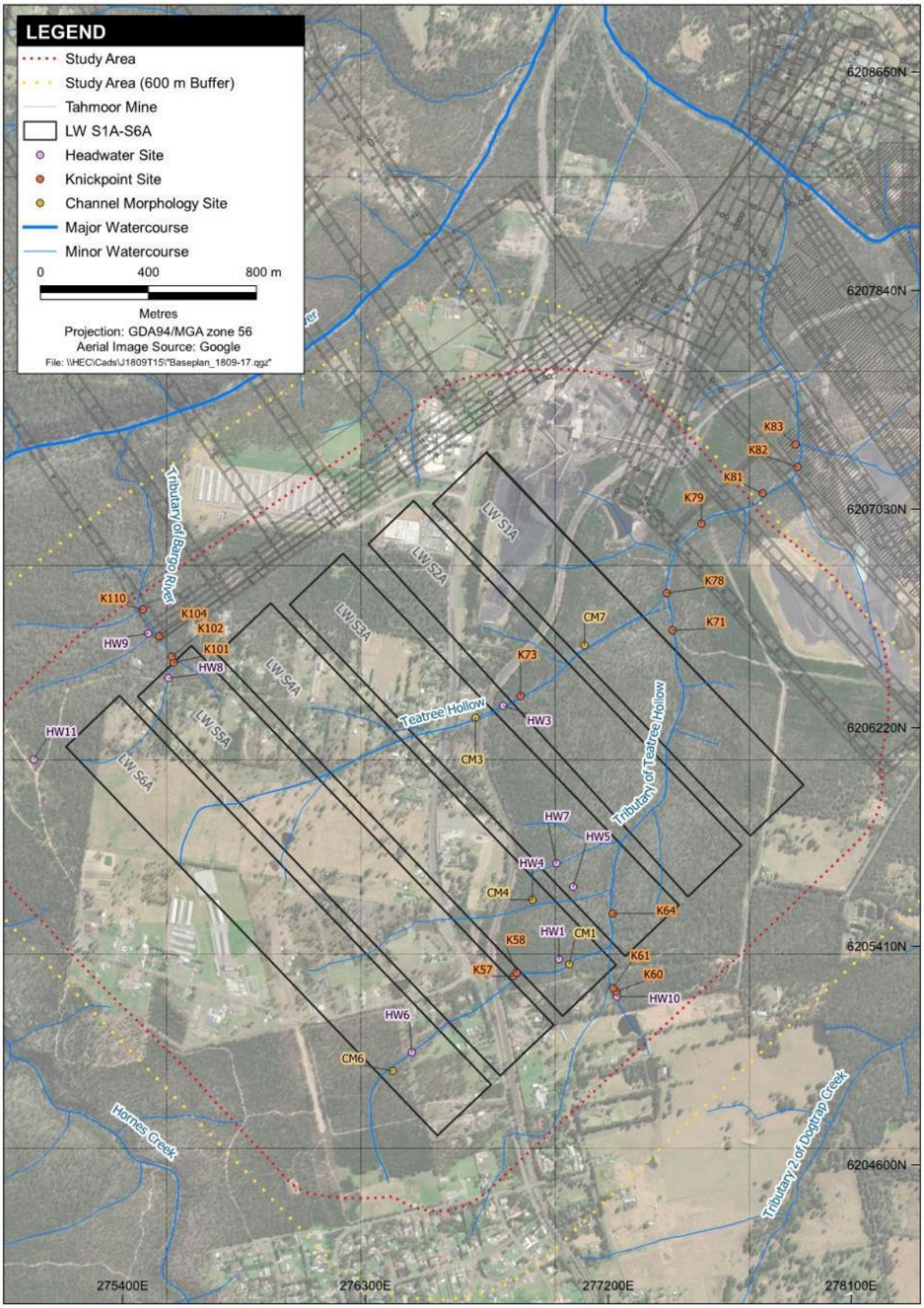
MAP 4: RELEVANT RAINFALL STATIONS, SURFACE WATER MONITORING SITES AND GROUNDWATER MONITORING BORES SPECIFIC TO LWS1A-S6A



MAP 5: POOL VISUAL INSPECTION SITES SPECIFIC TO LWS1A-S6A



MAP 6: MORPHOLOGY AND CHANNEL STABILITY MONITORING SITES SPECIFIC TO LWS1A-S6A



5 SURFACE WATER MONITORING DATA REVIEW

The following sections present a summary of the monitoring data for the period of review. The Hornes Creek and Bargo River tributary monitoring sites, in addition to monitoring sites BR17-QLa and BR18-QLa on the Bargo River (refer **Map 4**), are located outside of the subsidence zone associated with mining of LW S1A. As such, review of the monitoring data for these sites has been excluded from the assessment for the current review period.

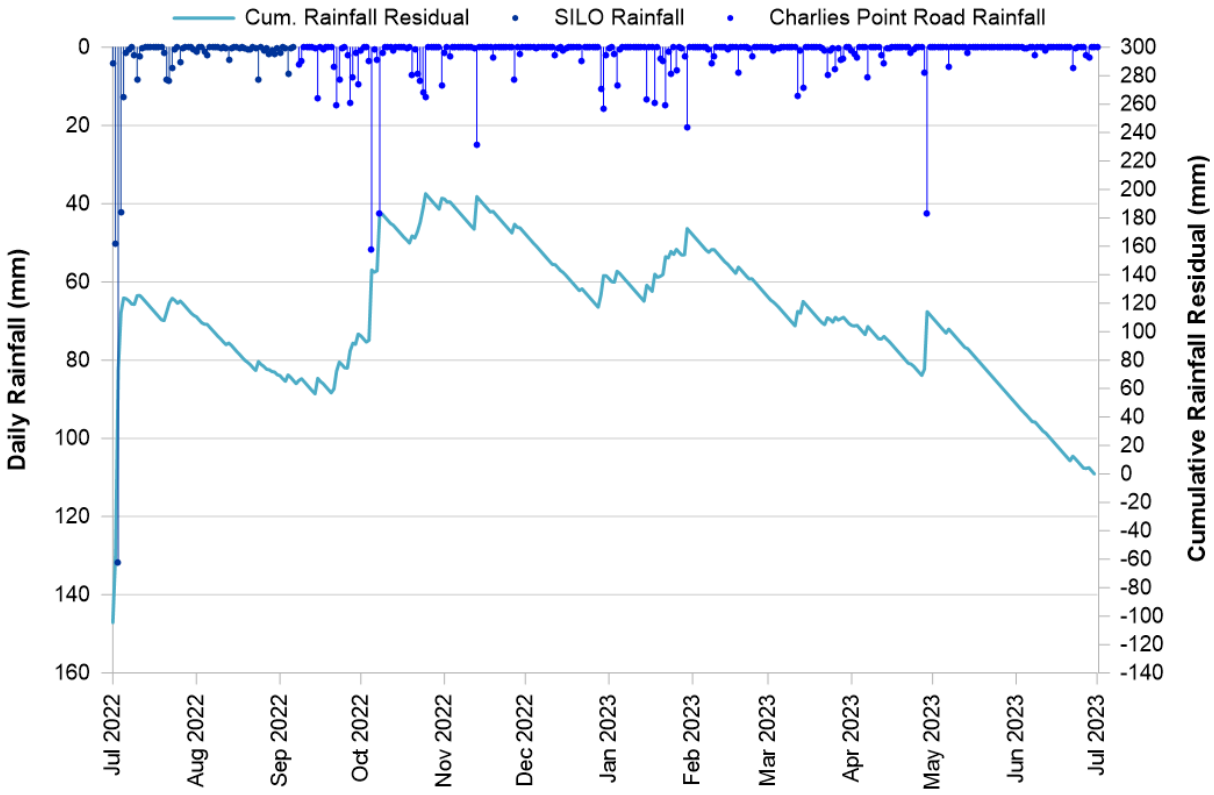
Section 6 presents an assessment of monitoring data against the TARP trigger levels defined in the WMP.

5.1 Rainfall Trends

Diagram 2 presents daily rainfall data recorded at the Tahmoor Coal rainfall station, referred to as "Charlies Point Road", for the period from 8 September 2022 (refer **Map 4** for station location). SILO Point Data, for a location in close proximity to Tahmoor South, is presented for the period 1 July 2022 to 7 September 2022. In addition, the cumulative rainfall residual[2] is presented and has been calculated using both the SILO Point Data and Charlies Point Road daily rainfall. The cumulative rainfall residual was calculated for the period January 2000 to July 2023 to illustrate climatic trends over a long-term period.

The cumulative rainfall residual depicted in **Diagram 2** illustrates an overall declining trend in rainfall from December 2022 to June 2023. This is in comparison to the period of July 2022 to November 2022 where, overall, above average rainfall was recorded.

DIAGRAM 2: DAILY RAINFALL AND CUMULATIVE RAINFALL RESIDUAL



[2] The cumulative rainfall residual is calculated as the cumulative deviation from the average daily rainfall, where positive (upward) slope in the plot indicates periods of above average rainfall and negative (downward) slope indicates periods of below average rainfall.

5.2 Surface Water Level Data

Automated water level data for the full period of record is presented as a series of graphs in **Appendix B**. Note that the cease to flow (CTF) level shown on the automated water level plots refers to the point at which surface water ceases to flow over the pool control (i.e., the lowest point on a rockbar, boulder field or other feature that contains water within the pool / controls surface flow from the pool). In the event that surface flow over the pool control ceases, there may still be leakage from the pool occurring around, through or under the pool control and reporting downstream.

Table 1 presents a summary of the review period water level trends. Note that the water level data recorded at monitoring site TT14-QLa is not summarised in **Table 1,** rather the water level data is converted to streamflow using a rating relationship derived for the low flow gauging weir at TT-F1 (refer **Map 4** for location). Streamflow records for TT-F1, derived based on TT14-QLa water level data, are presented in **Section 5.3**.

TABLE 1: SUMMARY OF WATER LEVEL TRENDS - 1 JANUARY TO 30 JUNE 2023

Monitoring Site	Classification	Summary of Water Level Trends	Appendix B - Graph Reference
Teatree Hollow Catchment			
TT1-QLa	Reference Site	The water level trends were consistent with climatic conditions for the duration of the review period.	B1.1
TT2-QLa	Potential Impact Site	The water level was recorded above the CTF level from January to late April 2023. The water level was recorded below the CTF level from late April to the end of June 2023, except for a brief period in early May during and immediately following a rainfall event. From mid-May to end of June 2023, the water level declined by 0.62 m below the CTF level.	B1.2
TT3-QLa	Potential Impact Site	Except for brief periods during and following rainfall, the water level was below the sensor level, or the pool was dry.	B1.3
TT7-QLa	Potential Impact Site	The water level remained above the CTF level and the baseline minimum for the duration of the review period.	B1.4
TT9-QLa	Potential Impact Site	The water level declined intermittently below the CTF level and baseline minimum during periods of negligible rainfall.	B1.5
TT12-QLa	Potential Impact Site	The water level declined below the sensor level in mid-February 2023. For the remainder of the review period, except for a very brief period in May 2023, the water level was below the sensor level, or the pool was dry.	B1.6
TT13-QLa	Potential Impact Site	The water level declined below the CTF level and the baseline minimum from mid-February to late April 2023 and from mid-May to end June 2023. From early March to late April and in June 2023, the water level was below the sensor level, or the pool was dry.	B1.7

Monitoring Site	Classification	Summary of Water Level Trends	Appendix B - Graph Reference
Bargo River			
BR16-QLa	Reference Site	The water level trends were consistent with climatic conditions for the duration of the review period.	B2.1
BR12-QLa	Potential Impact Site	The water level remained above the baseline minimum during for the duration of the review period.	B2.2
BR13-QRLa	Potential Impact Site	The water level remained above the baseline minimum during the entire review period.	B2.3

5.3 Streamflow Data

A streamflow gauging station was constructed on Teatree Hollow at TT-F1 in June 2022 (refer **Map 4** for location). The gauging station comprises a concrete and steel v-notch weir to enable accurate and continuous low flow monitoring.

To derive a baseline water level and streamflow dataset for TT-F1, the water level data recorded at TT14-QLa post construction of the low flow gauging weir was correlated with the water level data recorded at the upstream monitoring site TT7-QLa. The correlation equation was then applied to the baseline water level data recorded at TT7-QLa to derive a baseline water level dataset for TT14-QLa (TT-F1) prior to the weir construction. The baseline water level dataset was then used, in conjunction with the streamflow rating relationship for TT-F1, to derive a baseline streamflow dataset for TT-F1.

The streamflow and rainfall data for the period of record is presented in **Diagram 3**. **Diagram 4** presents the cumulative rainfall and streamflow residual for the period of record.

The streamflow records presented in **Diagram 3** indicate that streamflow at TT-F1 in Teatree Hollow is intermittent, with periods of no flow recorded prior to the commencement of mining of LW S1A. Consistent with below average rainfall, streamflow at TT-F1 in Teatree Hollow was intermittent during the review period.

The comparison of the cumulative rainfall and streamflow residual presented in **Diagram 4** indicates that streamflow trends have been consistent with rainfall trends for the duration of the review period. The rate of streamflow decline recorded during the review period is considered to be consistent with that recorded from April to November 2021, prior to the commencement of mining of LW S1A and consistent with the rate of rainfall decline recorded during these periods.

DIAGRAM 3: TEATREE HOLLOW (TT-F1) STREAMFLOW AND RAINFALL

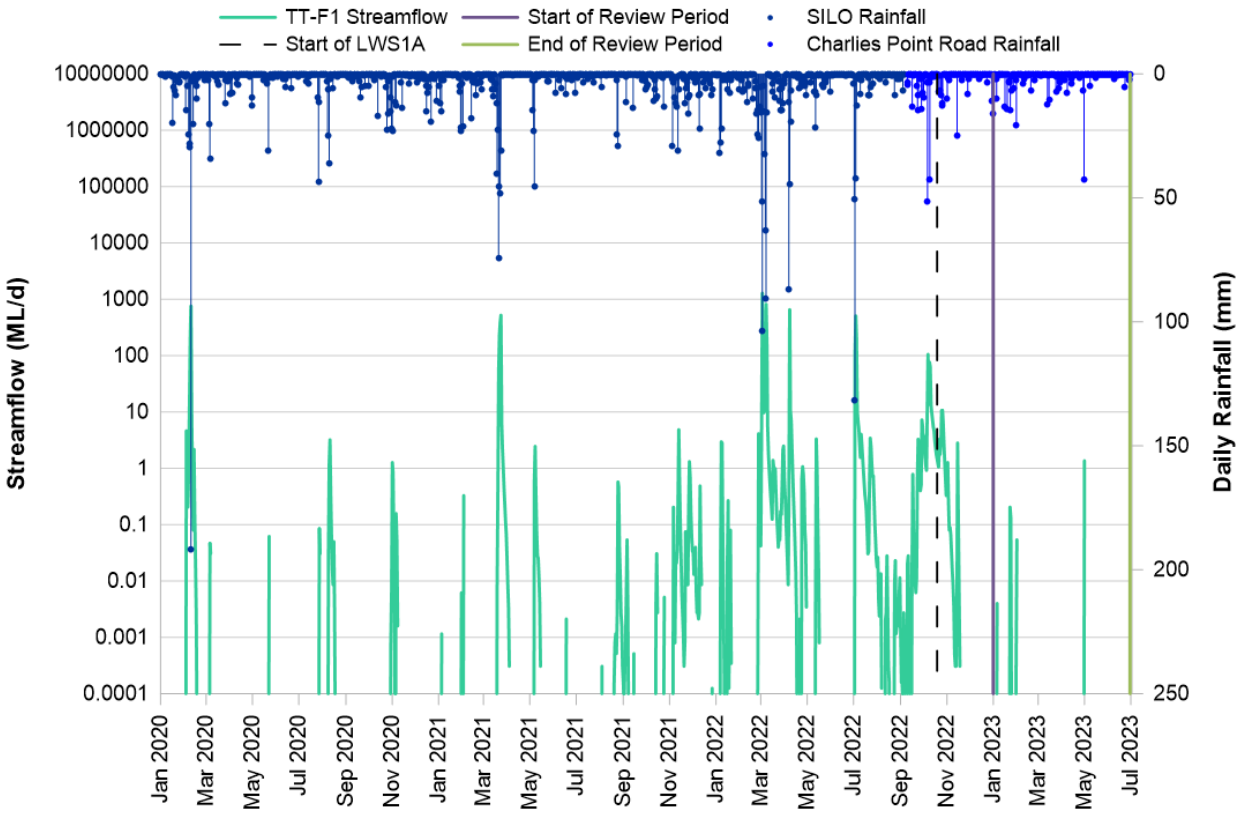
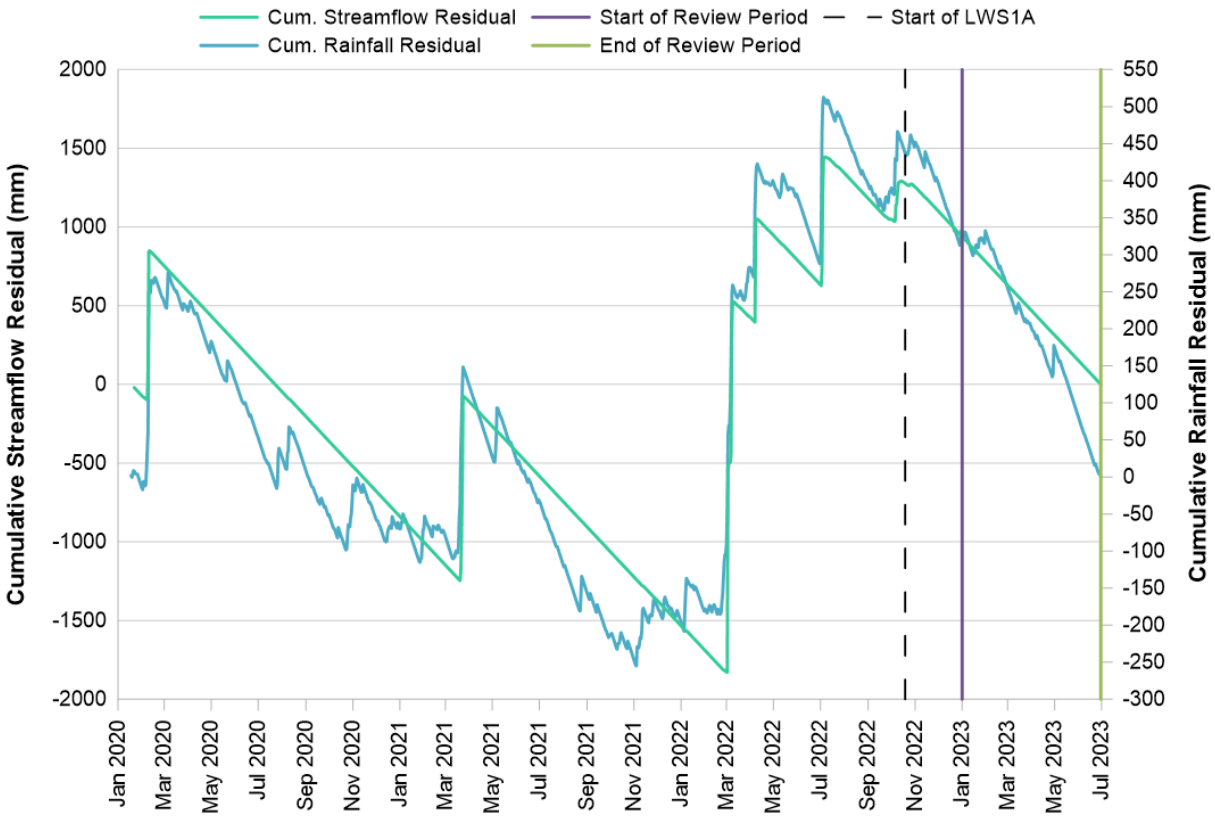


DIAGRAM 4: TEATREE HOLLOW (TT-F1) STREAMFLOW AND RAINFALL



5.4 Surface Water Quality

Water quality monitoring data is presented as a series of graphs in **Appendix C**. **Table 2** presents a summary of the water quality data for the following constituents which are considered to be primary indicators of a potential mining related effect (refer WMP):

- pH;
- Electrical conductivity (EC); and
- Specific dissolved metals: aluminium, copper, iron, manganese, nickel and zinc.

TABLE 2: SUMMARY OF KEY WATER QUALITY CONSTITUENTS – 1 JANUARY TO 30 JUNE 2023

Constituent	Summary of Water Quality	
	Teatree Hollow Catchment TT1-QLa (reference site) TT2-QLa, TT3-QLa, TT7-QLa, TT9-QLa, TT12-QLa, TT13-QLa, TT14-QLa (potential impact sites)	**Bargo River** BR16-QLa (reference site) BR12-QLa, BR13-QRLa (potential impact sites)
Field pH	• Near neutral to slightly acidic pH recorded at the majority of sites • pH recorded during the review period was within the range of baseline values	• Near neutral pH recorded at all sites
Field Electrical Conductivity (EC)	• Field EC values were consistent with baseline values for the majority of sites, with the exception of TT7-QLa in April and June 2023 and TT14-QLa in June 2023 • An increasing trend in EC values was recorded at the majority of the sites during the review period	• Field EC values were consistent with baseline values for the duration of the review period • A slight increasing trend in EC values was recorded at all sites during the review period
Dissolved Aluminium	• Dissolved aluminium concentrations were within the range of baseline concentrations for the duration of the review period (equal to or less than 0.3 mg/L recorded at all sites)	• Dissolved aluminium concentrations were within the range of baseline concentrations for the duration of the review period
Dissolved Copper	• Dissolved copper concentrations were equal to or less than the limit of reporting for the majority of the review period	• Dissolved copper concentrations were equal to or less than the limit of reporting for the duration of the review period
Dissolved Iron	• Dissolved iron concentrations were within the range of baseline concentrations for all sites, with the exception of TT7-QLa in April, May and June 2023 • A historically high concentration of 9.75 mg/L was recorded in June 2023 at TT7-QLa	• Dissolved iron concentrations were within the range of baseline concentrations for the duration of the review period • Dissolved iron concentrations declined from around 1 mg/L in January to less than 0.6 mg/L in June 2023

Constituent	Summary of Water Quality	
	Teatree Hollow Catchment TT1-QLa (reference site) TT2-QLa, TT3-QLa, TT7-QLa, TT9-QLa, TT12-QLa, TT13-QLa, TT14-QLa (potential impact sites)	**Bargo River** BR16-QLa (reference site) BR12-QLa, BR13-QRLa (potential impact sites)
Dissolved Manganese	• Dissolved manganese concentrations recorded at all sites were within the range of baseline values • Slightly elevated (less than 2 mg/L) dissolved manganese concentrations were recorded at TT7-QLa in April and June 2023	• Dissolved manganese concentrations recorded at all sites were within the range of baseline values
Dissolved Nickel	• Dissolved nickel concentrations were within the range of baseline concentrations with the exception of TT7-QLa in April and June 2023 • A historically high concentration of 0.028 mg/L was recorded in June 2023 at TT7-QLa	• Dissolved nickel concentrations were within the range of baseline concentrations for the duration of the review period with the exception of BR12-QLa in February 2023 • A historically high concentration of 0.03 mg/L was recorded in February 2023 at BR12-QLa • For the remainder of the review period, the dissolved nickel concentrations recorded at BR12-QLa were at or less than the limit of reporting
Dissolved Zinc	• Dissolved zinc concentrations were within the range of baseline concentrations with the exception of TT7-QLa in June 2023 • A historically high concentration of 0.15 mg/L was recorded in June 2023 at TT7-QLa	• Dissolved zinc concentrations were within the range of baseline concentrations for the duration of the review period with the exception of BR12-QLa in February 2023 and BR13-QRLa in May 2023 • A historically high concentration of 0.06 mg/L was recorded in February 2023 at BR12-QLa • A historically high concentration of 0.11 mg/L was recorded in May 2023 at BR13-QRLa • For the remainder of the review period, the dissolved zinc concentrations were at or less than the limit of reporting

5.5 Pool Physical Features and Natural Behaviour

Inspections of the physical features and natural behaviour of pools is undertaken on a minimum monthly basis to record visual observations of:

- pool water level and surface flow in the downstream reach (natural behaviour);
- iron staining, gas release and turbidity (physical features); and
- fracturing (physical features).

The visual inspection observations recorded during active mining have been compared to that of the baseline visual inspection records conducted in October 2022 prior to the commencement of mining of LW S1A.

A summary of key visual observations recorded during the review period is presented in **Table 3**.

TABLE 3: SUMMARY OF POOL VISUAL INSPECTION RECORDS – 1 JANUARY TO 30 JUNE 2023

Pool	Classification	Summary of Visual Inspection Records
TT1	Reference Site	• The pool physical features observed during the review period were consistent with that of baseline conditions • In comparison to baseline conditions, a decline in water level was observed at pool TT1 in the latter half of the review period • From late April 2023, surface flow ceased approximately 95 m downstream of pool TT1
TT2	Potential Impact Site	• The pool physical features observed during the review period were consistent with that of baseline conditions • In comparison to baseline conditions, a notable decline in water level was observed at pool TT2 from May 2023 • No mining related fractures were observed • No gas discharge was observed and turbidity was considered consistent with baseline conditions
TT3	Potential Impact Site	• The pool was visually observed as dry on majority of inspection occasions from February to June 2023 • No gas discharge, turbidity or iron staining was observed • No mining related fractures were observed
TT7	Potential Impact Site	• From March to June 2023, a decline in water level was observed at pool TT7 • Iron staining was observed on exposed bedrock at the upstream extent of the pool from late March to end June 2023 • No mining related fractures were observed • No gas discharge was observed and turbidity was considered consistent with baseline conditions
TT9	Potential Impact Site	• In comparison to baseline conditions, a decline in water level was observed at times from March to June 2023 • No gas discharge or iron staining was observed • No development of historical fractures was observed • In comparison to baseline conditions, an increase in turbidity was observed from February to April 2023
TT11	Potential Impact Site	• The pool was visually observed as dry on majority of inspection occasions from February to June 2023 • No gas discharge, turbidity or iron staining was observed • Mining related fractures were initially observed approximately 90 m upstream of pool TT11 in February 2023

Pool	Classification	Summary of Visual Inspection Records
TT12	Potential Impact Site	• The pool was visually observed as dry from March to June 2023 • Mining related fractures were initially observed immediately upstream and downstream of pool TT12 in March 2023 • From April to June 2023, additional cracking was observed, with a total 26 cracks recorded at the end of the review period • The cracks increased in length and width during this period • Iron staining was observed approximately 50 m downstream of pool TT12 in February and March 2023 • No gas discharge was observed or turbidity was observed
TT13	Potential Impact Site	• The pool was visually observed as dry from March to April, a puddle in May and dry in June 2023 • In March 2023, flow re-emergence was observed immediately downstream of the confluence of Teatree Hollow and Teatree Hollow tributary • From April to June 2023, flow re-emergence was observed at the upstream extent of pool TT7 • No gas discharge, turbidity or iron staining was observed • No mining related fractures were observed

5.6 Channel Morphology and Knickpoint Sites

Inspections of the physical features and natural behaviour of channel morphology and knickpoint sites is undertaken on a minimum monthly basis to record visual observations of:

- ponded / flowing water;
- iron staining, gas release and turbidity;
- fracturing or shearing;
- knickpoint development; and
- erosion and sedimentation.

The visual inspection observations recorded during active mining have been compared to that of the baseline visual inspection records conducted in October 2022 prior to the commencement of mining of LW S1A.

A summary of key visual observations recorded during the review period is presented in **Table 4**.

TABLE 4: SUMMARY OF CHANNEL MORPHOLOGY AND KNICKPOINT VISUAL INSPECTION RECORDS – 1 JANUARY TO 30 JUNE 2023

Pool	Classification	Summary of Visual Inspection Records
CM3	Reference Site	• No visual evidence of increased erosion or sedimentation in comparison to baseline conditions • From March to June 2023 (period of visual inspections at CM3), trickle flow was observed downstream of CM3 at times with no flow observed at other times • Iron staining was observed, consistent with baseline conditions • No gas discharge was observed and turbidity was considered consistent with baseline conditions
CM7	Potential Impact Site	• No visual evidence of increased erosion or sedimentation in comparison to baseline conditions • No development of historical fractures was observed • From April to June 2023, ponded water was observed at CM7 however surface flow had ceased • Iron staining was observed, consistent with baseline conditions • No gas discharge was observed and turbidity was considered consistent with baseline conditions
K71, K73, K78, K79	Potential Impact Sites	• No further development of knickpoints K71, K73, K78 and K79 was recorded during the review period

6 SURFACE WATER TRIGGER EXCEEDANCE ASSESSMENT

6.1 Surface Water Trigger Level Summary

The surface water trigger levels exceeding ‘Normal Condition’ for the period of 1 January to 30 June 2023 (the review period) are summarised in **Table 5**.

6.2 Surface Water Trigger Level Assessment

A visual depiction of the Teatree Hollow and Teatree Hollow tributary surface water conditions and physical effects is presented in **Map 7**. The information presented in **Map 7** was predominately collated from the visual inspection records for the review period (BES, 2023a-k).

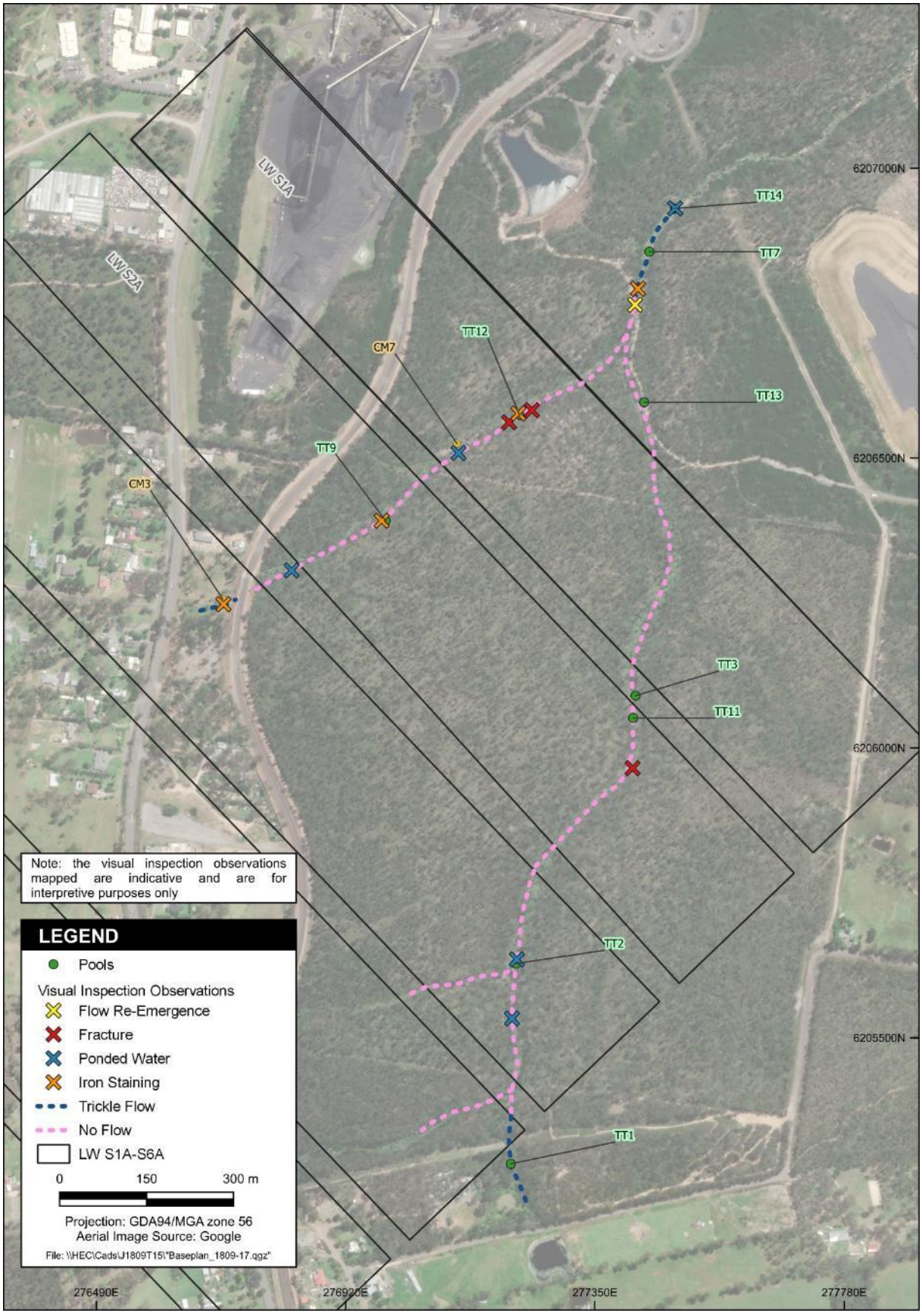
TABLE 5: SURFACE WATER TARP SIGNIFICANCE LEVELS AND ACTIONS – 1 JANUARY TO 30 JUNE 2023

Date	Location(s)	Comment	TARP Significance	Actions
Surface Water Level				
23 May to 30 June 2023	TT2-QLa	The recorded water level declined by greater than 10 centimetres (cm) below the recorded baseline minimum level (for more than one 24-hour period for automated pool water level) and the same did not occur at the reference site(s).	Level 1	• Water level trends for all sites in Teatree Hollow and Teatree Hollow tributary were reviewed with consideration to climatic conditions (refer **Section 6**) • Streamflow data recorded at TT-F1 was reviewed and streamflow reduction assessment conducted (refer **Section 5.3** and **Section 6.2**) • Relevant information was obtained from key specialists necessary to inform assessment (refer **Section 6**)
11 to 17 January 2023	TT3-QLa			
24 February to 13 March, 20 March to 23 March, 20 April to 29 April and 18 to 30 June 2023	TT9-QLa			
18 February to 15 March 2023	TT12-QLa			
7 February to 6 March 2023	TT3-QLa	The recorded water level has declined atypically[3] below the recorded baseline minimum level for less than one month (as a consecutive period) and the same has not occurred at the reference site(s).	Level 2	• Actions as per Level 1 • Monitoring and review of data frequency increased to fortnightly
16 March to 15 April 2023	TT12-QLa			
21 February to 20 March 2023	TT13-QLa			
7 March to 30 June 2023	TT3-QLa	The recorded water level has declined atypically for greater than one month (as a consecutive period) and the same has not occurred at the reference site(s).	Level 3	• Actions as per Level 2 • Detailed investigation undertaken to identify cause of atypical water level decline (refer **Section 6**)
16 April to 30 June 2023	TT12-QLa			
21 March to 30 April, 14 May to 30 June 2023	TT13-QLa			
Physical Features and Natural Pool Behaviour				
February 2023	TT3, TT11	Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs in one month and the same has not occurred at the reference site(s) AND/OR visual observation of fracturing	Level 1	• Visual changes along watercourse were reviewed with consideration to climatic conditions (refer **Section 6**) • Monitoring and review of data frequency increased to fortnightly
March 2023	TT7, TT12, TT13			
April 2023	TT3, TT7, TT11			
May and June 2023	TT2, TT3, TT11			

[3] 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or a change in the slope of the falling limb of the hydrograph or water level recessionary behaviour below the cease to flow level which is inconsistent with baseline conditions and cannot be attributed entirely to climatic conditions.

Date	Location(s)	Comment	TARP Significance	Actions
				• Relevant information was obtained from key specialists necessary to inform assessment (refer **Section 6**)
March April May and June 2023	TT3, TT11 TT12, TT13 TT7	Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for two consecutive months and the same has not occurred at the reference site(s).	Level 2	• Actions as per Level 1 • Detailed investigation undertaken to assess if the change in behaviour is related to mining effects (refer **Section 6**)
May and June 2023	TT12, TT13	Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for three consecutive months and the same has not occurred at the reference site(s) AND the change in behaviour has been investigated and confirmed to be related to mining effects.	Level 3	• Actions as per Level 2
Surface Water Quality				
April, May and June 2023	TT7-QLa	Exceedance of the dissolved iron and dissolved zinc SSGV occurred at a given potential impact site in three consecutive months and the same has not occurred at the reference site(s).	Level 1	• Exceedance of the trigger level during the baseline period was reviewed (refer **Section 6.2.3**) • Water quality trends were reviewed for the watercourse reach (refer **Section 6.2.3**) • Relevant information was obtained from key specialists necessary to inform assessment (refer **Section 6**) • Reasonable and feasible options for remediation were considered where relevant (refer **Section 7.3**)
March, April, May and June 2023	TT7-QLa	Exceedance of the SSGV for electrical conductivity occurred at a given potential impact site in four or five consecutive months and the same has not occurred at the reference site(s).	Level 2	• Actions as per Level 1 • Increased monitoring and review of data frequency was considered (refer **Section 6.2.3**) • The Water Management Plan was reviewed and modifications considered (refer **Section 7.3**).

MAP 7: VISUAL DEPICTION OF SURFACE WATER CHARACTERISTICS AND PHYSICAL EFFECTS (1 JANUARY TO 30 JUNE 2023)

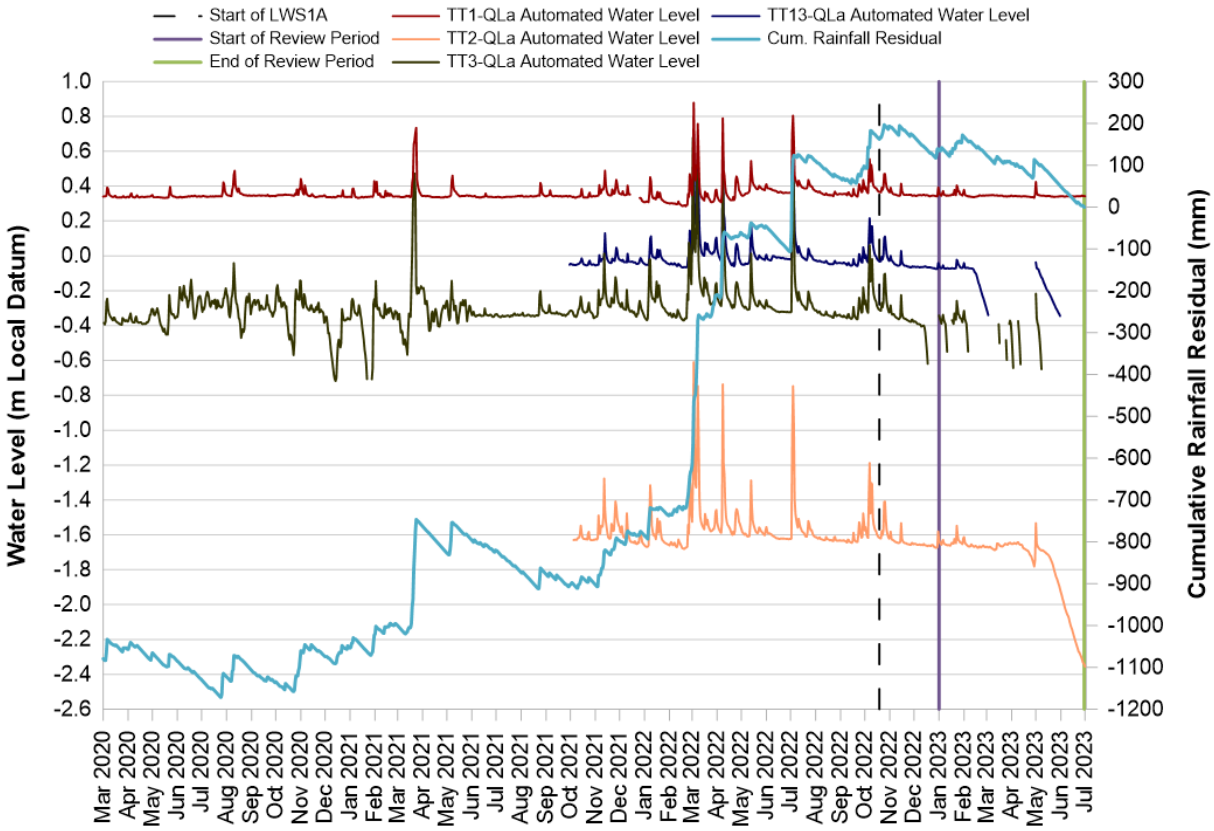


6.2.1 Water Level Assessment

6.2.1.1 Teatree Hollow Tributary

Diagram 5 presents a comparison of the water level records (converted to metres local datum for comparative purposes) for monitoring sites on Teatree Hollow tributary for the period of record. The cumulative rainfall residual is also presented (calculated for the period 1 January 2000 to 30 June 2023).

DIAGRAM 5: TEATREE HOLLOW TRIBUTARY WATER LEVEL COMPARISON



Pool TT1 (Monitoring Site TT1-QLa)

As illustrated in **Diagram 5**, pool TT1 (reference site TT1-QLa) held water for the duration of the review period although the water level was low for the majority of the review period, consistent with below average rainfall conditions. From late April 2023, trickle flow was observed downstream of pool TT1; however, this was reported to cease approximately 95 m downstream of pool TT1 (refer **Map 7**). Accordingly, as of late April 2023, negligible surface flow was present in the upstream reach of Teatree Hollow tributary.

It is noted that the location at which surface flow was reported to cease is over 800 m upstream of LW S1A and, as such, is considered to be outside of the influence of direct mining effects. In addition, and as stated in **Section 3**, as the groundwater level recorded at P55A remained relatively steady for the duration of the review period, it is inferred that negligible change in baseflow contribution to Teatree Hollow tributary in the vicinity of TT1-QLa occurred during the review period.

Pool TT2 (Monitoring Site TT2-QLa)

From late May to the end of June 2023, the water level recorded at pool TT2 (monitoring site TT2-QLa) declined by 0.62 m below the CTF level (refer **Diagram 5**). Accordingly, a Level 1 trigger applies for this period in accordance with the WMP.

As stated in **Section 2**, less than 20 mm closure was recorded at pool TT2 as of June 2023 and no impacts to physical features have been recorded (refer **Table 3**). The decline in water level has occurred

since cessation of surface water flow in the reach of Teatree Hollow tributary between pool TT1 and TT2 (refer **Map 7**).

There is insufficient groundwater monitoring data to assess surface water-groundwater connectivity in the vicinity of pool TT2 (refer **Section 3**). As such, a decline in baseflow contribution to pool TT2 during the review period can be neither confirmed nor discounted.

Based on the monitoring data recorded during the review period, it is considered that the decline in water level is related to the prevailing climatic conditions and unrelated to mining effects associated with LW S1A.

Pool TT11 and Pool TT3 (Monitoring Site TT3-QLa)

As illustrated in **Diagram 5** and stated in **Table 1**, except for brief periods during and following rainfall, the water level was either below the sensor level or Pool TT3 was dry (monitoring site TT3-QLa). The pool was visually observed as dry on the majority of inspection occasions from February to June 2023. Pool TT11 was also visually observed as dry on the majority of inspection occasions from February to June 2023.

In February 2023, mining related fractures were observed upstream of pool TT11 (refer **Map 7**) and surface flow in Teatree Hollow tributary was reported to cease in the vicinity of the fractures. It is noted that fractures have not been observed at pool TT3 itself (refer **Table 3**).

Pool TT3 is a shallow elongated pool with limited storage capacity. As shown in **Diagram 5,** the water level has historically declined below the sensor level at this pool during periods of average or below average rainfall.

There is insufficient monitoring data to assess groundwater-surface water connectivity within the vicinity of pool TT3. However, if the groundwater system was contributing baseflow to Teatree Hollow tributary within the vicinity of pool TT3, it may be inferred, based on the limited groundwater level records for monitoring bore P54A-B, that a decline in baseflow contribution to pool TT3 may have occurred during the review period (refer **Section 3**).

Accordingly, the decline in water level recorded during the review period is considered to be related to the:

- cessation of surface water flow in Teatree Hollow tributary due to mining induced fracturing upstream of pool TT11;
- prevailing climatic conditions;
- potential reduction in baseflow contribution; and
- as of late April 2023, negligible surface water flow reporting from the upstream reach of Teatree Hollow tributary.

Pool TT13 (Monitoring Site TT13-QLa)

As illustrated in **Diagram 5** and stated in **Table 1**, from early March to late April and in June 2023, the water level at pool TT13 (monitoring site TT13-QLa) was below the sensor level or the pool was dry. The pool was visually observed as dry on the majority of inspection occasions from March to June 2023.

Pool TT13 is a shallow elongated pool with limited storage capacity. It is likely that the water level at pool TT13 has historically declined to very low levels during periods of average or below average rainfall, however, there is insufficient baseline data to confirm.

Based on the groundwater level data for monitoring bore P53A-C, located approximately 250 m to the south-east of pool TT13, and assuming the groundwater system was contributing baseflow to Teatree Hollow tributary within the vicinity of pool TT13, it may be inferred that a decline in baseflow contribution has likely occurred during the review period based on the decline in groundwater level recorded at P53A-C (refer **Section 3**).

Accordingly, the decline in water level recorded during the review period is considered to be related to the:

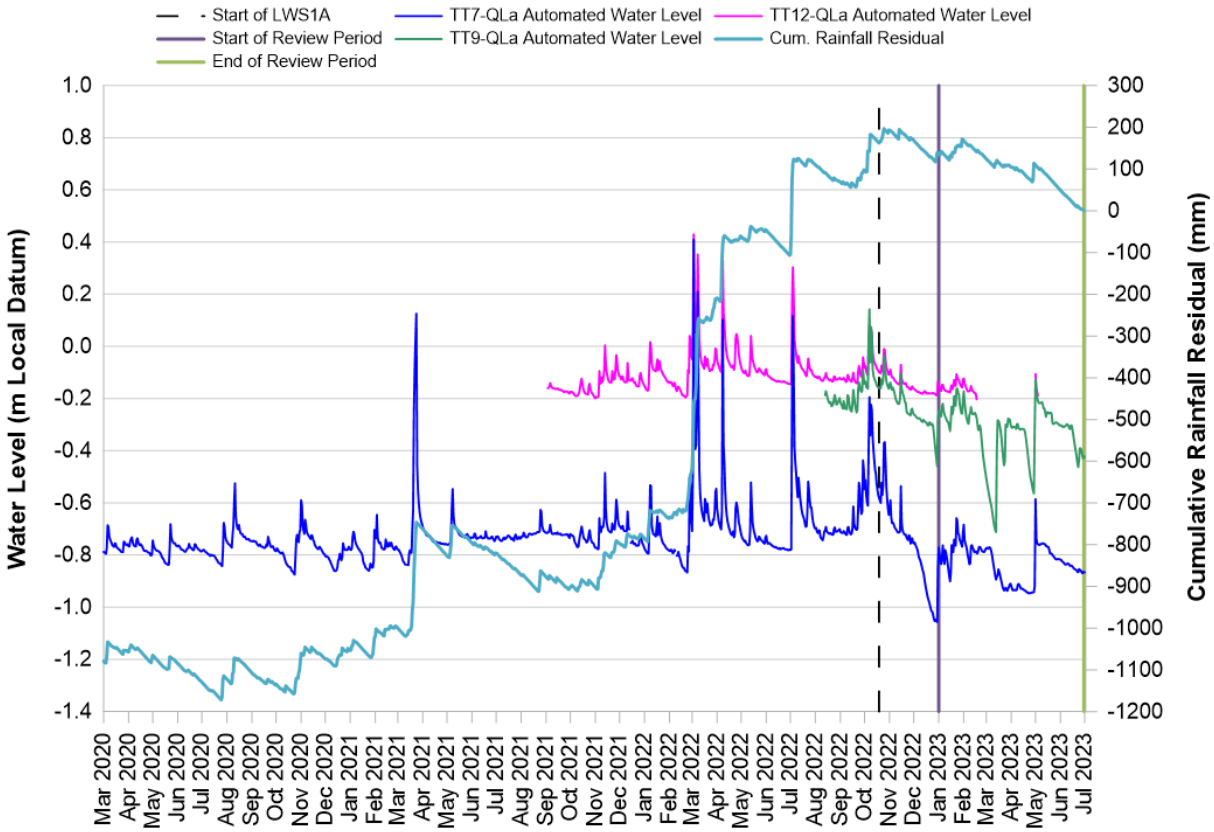
- cessation of surface water flow in Teatree Hollow tributary due to mining induced fracturing upstream of pool TT11;
- prevailing climatic conditions;
- potential reduction in baseflow contribution; and

- as of late April 2023, negligible surface water flow reporting from the upstream reach of Teatree Hollow tributary.

6.2.1.2 Teatree Hollow

Diagram 6 presents a comparison of the water level records (converted to metres local datum for comparative purposes) for monitoring sites on Teatree Hollow for the period of record. The cumulative rainfall residual is also presented (calculated for the period 1 January 2000 to 30 June 2023).

DIAGRAM 6: TEATREE HOLLOW WATER LEVEL COMPARISON



Pool TT9 (Monitoring Site TT9-QLa)

As stated in **Table 1**, the pool TT9 water level declined intermittently below the CTF level and baseline minimum during periods of below average rainfall. It is noted that only two months of baseline data are available for this site prior to the commencement of mining of LW S1A. As such, there is potential that the water level at monitoring site TT9-QLa declined to similar levels historically.

From March to June 2023 (period of visual inspections at CM3), at times trickle flow was observed downstream of CM3 while at other times no surface flow was observed (refer **Map 7**). CM3 is a reference site located approximately 400 m upstream of LW S1A and, as such, is considered to be outside of the influence of direct mining effects.

There is insufficient groundwater monitoring data to assess surface water-groundwater connectivity in the vicinity of pool TT9 (refer **Section 3**). As such, a decline in baseflow contribution to pool TT9 during the review period can be neither confirmed nor discounted.

Based on the monitoring data recorded during the review period, it is considered that the intermittent decline in water level recorded at pool TT9 during the review period is related to the prevailing climatic conditions and unrelated to mining effects associated with LW S1A.

It is recommended that the baseline minimum for pool TT9 is revised to consider the water level data recorded to the cessation of mining of LW S1A (4 July 2023).

Pool TT12 (Monitoring Site TT12-QLa)

As stated in **Table 1** and illustrated in **Diagram 6**, the pool TT12 water level declined below the sensor level in mid-February 2023. For the remainder of the review period, except for a very brief period in May 2023, the water level was below the sensor level, or the pool was dry.

Mining related fractures were initially observed immediately upstream and downstream of pool TT12 in March 2023 (refer **Map 7**). From April to June 2023 (inclusive), additional fracturing was observed, and the length and width of existing fractures increased (refer **Table 3**).

There is insufficient groundwater monitoring data to assess surface water-groundwater connectivity in the vicinity of pool TT12 (refer **Section 3**). As such, a decline in baseflow contribution to pool TT12 during the review period can be neither confirmed nor discounted.

Iron staining was observed approximately 50 m downstream of pool TT12 in February and March 2023 suggesting the re-emergence of flow diverted via upstream fractures.

Accordingly, the decline in water level recorded at pool TT12 during the review period is considered to be related to the:

- cessation of surface water flow in Teatree Hollow due to mining induced fracturing upstream of pool TT12;
- prevailing climatic conditions; and
- as of March 2023, negligible surface water flow reporting from the upstream reach of Teatree Hollow.

Pool TT7 (Monitoring Site TT7-QLa)

As shown in **Diagram 6**, water level declines were recorded at pool TT7 during the review period. However, the water level remained above the baseline minimum during this period (refer **Table 1**). The data shown in **Diagram 6** illustrates that the water level at pool TT7 declined historically during periods of below average rainfall prior to the commencement of mining of LW S1A.

As stated in **Section 3**, if the groundwater system was contributing baseflow to Teatree Hollow in the vicinity of pool TT7, it may be inferred that a slight decline in baseflow contribution has likely occurred during the review period based on the slight decline in groundwater level recorded at monitoring bore P52. It is considered that the slight decline in groundwater level recorded at monitoring bore P52 is consistent with a decline in rainfall recharge during the review period.

As such, it is considered that the decline in water level recorded at pool TT7 during the review period is consistent with historical behaviour and partly related to the prevailing climatic conditions.

As stated in **Table 1** and illustrated in **Map 7**, flow re-emergence was observed upstream of pool TT7 from March to June 2023 (inclusive). It is considered that, despite the prevailing climatic conditions, pool TT7 was, to some extent, supported by surface flow that had been diverted as underflow (subsurface flow) from upstream reaches of Teatree Hollow and Teatree Hollow tributary.

6.2.2 Streamflow Assessment

As noted above and illustrated in **Map 7**, negligible surface flow was present at the upstream reach of Teatree Hollow from March 2023 or the upstream reach of Teatree Hollow tributary from April 2023. The decline in surface water flow occurred at locations upstream of mining related influences and is related to below average rainfall conditions.

Despite mining related impacts recorded at locations in Teatree Hollow and Teatree Hollow tributary overlying LW S1A and the eastern end of LW S2A, the streamflow data presented in **Section 5.3** indicates that streamflow trends recorded at monitoring site TT-F1 in Teatree Hollow have been consistent with rainfall trends for the duration of the review period. The rate of streamflow decline recorded during the review period is considered to be consistent with that recorded from April to November 2021 prior to the commencement of mining of LW S1A and consistent with the rate of rainfall decline recorded during these periods.

Notwithstanding, a streamflow reduction assessment has been conducted for the period from commencement of mining of LW S1A (October 2022) to end June 2023. In accordance with the SSD 8445, the results of this assessment will be presented in the Annual Review and compared to the Water Access Licence (WAL) volumes held by Tahmoor Coal for the Maldon Weir Management Zone

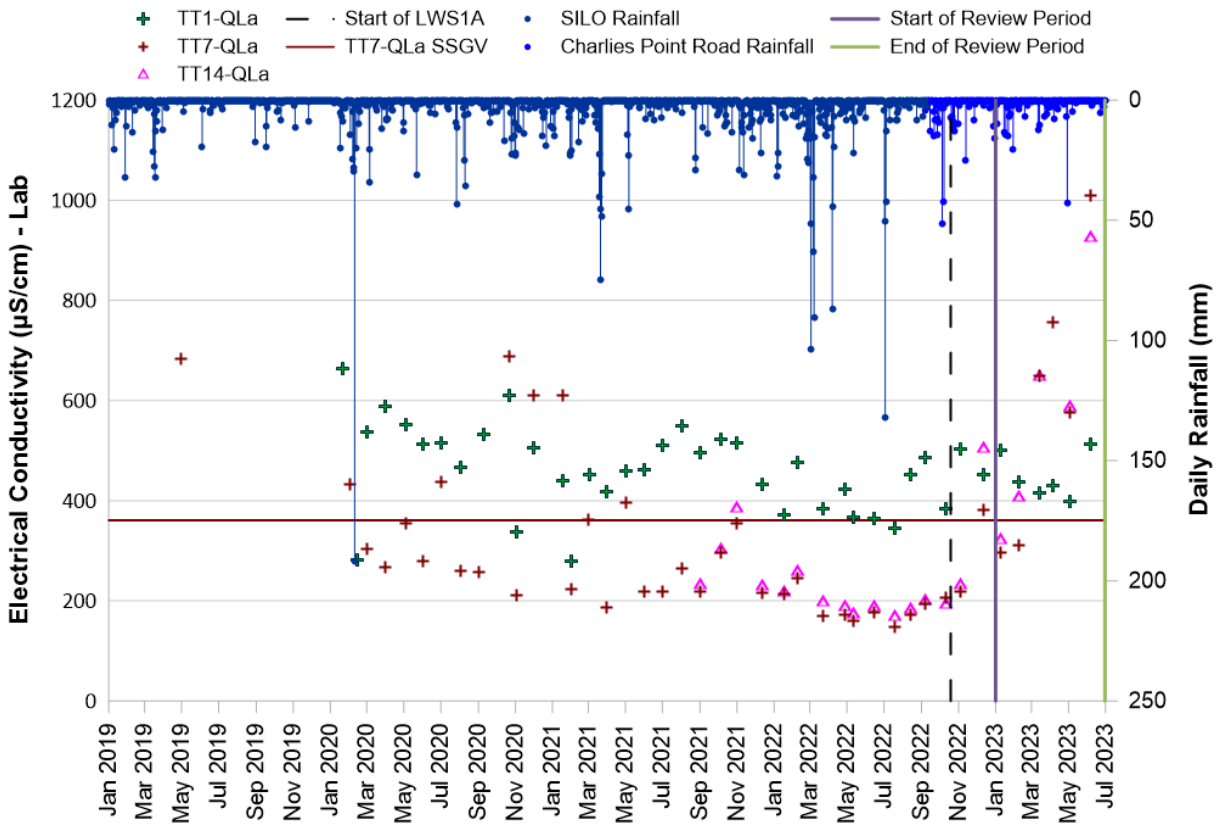
of the Upper Nepean and Upstream Warragamba Water Source (regulated by the *Water Sharing Plan for Greater Metropolitan Region Unregulated River Water Sources)*.

6.2.3 Water Quality Assessment

6.2.3.1 Electrical Conductivity

The field EC values recorded at reference site TT1-QLa and potential impact sites TT7-QLa and TT14-QLa are shown on **Diagram 7**.

DIAGRAM 7: FIELD ELECTRICAL CONDUCTIVITY



The data presented in **Diagram 7** indicates that:

- The TT7-QLa EC SSGV (361 µS/cm) was exceeded for four consecutive months from March to June 2023 (inclusive) i.e., Level 1 trigger for March to May 2023 and Level 2 trigger for March to June 2023.
- EC was also slightly elevated at TT14-QLa during the review period, however, the SSGV was exceeded for less than three consecutive months (normal condition).
- Similarly elevated EC values were not recorded at the upstream reference site (TT1-QLa) from March to June 2023.
- With the exception of June 2023, similarly elevated EC has been recorded historically at TT7-QLa.
- A Level 1 trigger or above for EC (i.e. an exceedance of the SSGV for three consecutive months or greater) was not recorded at TT7-QLa during the baseline monitoring period prior to commencement of mining.

As stated in **Section 6.2.1**, a generally declining trend in water level was recorded at pool TT7 (monitoring site TT7-QLa) from March to June 2023, consistent with below average rainfall conditions.

Despite the prevailing climatic conditions, pool TT7 was, to some extent, considered to be supported by surface flow that had been diverted as underflow from upstream reaches of Teatree Hollow and Teatree Hollow tributary.

Accordingly, the elevated EC values recorded at pool TT7 from March to June 2023 are considered related to the following:

- Evapoconcentration of salinity during periods of below average rainfall and water level decline.
- Interaction of underflow with subsurface geology and re-emergence of elevated EC underflow as surface flow in the vicinity of pool TT7.

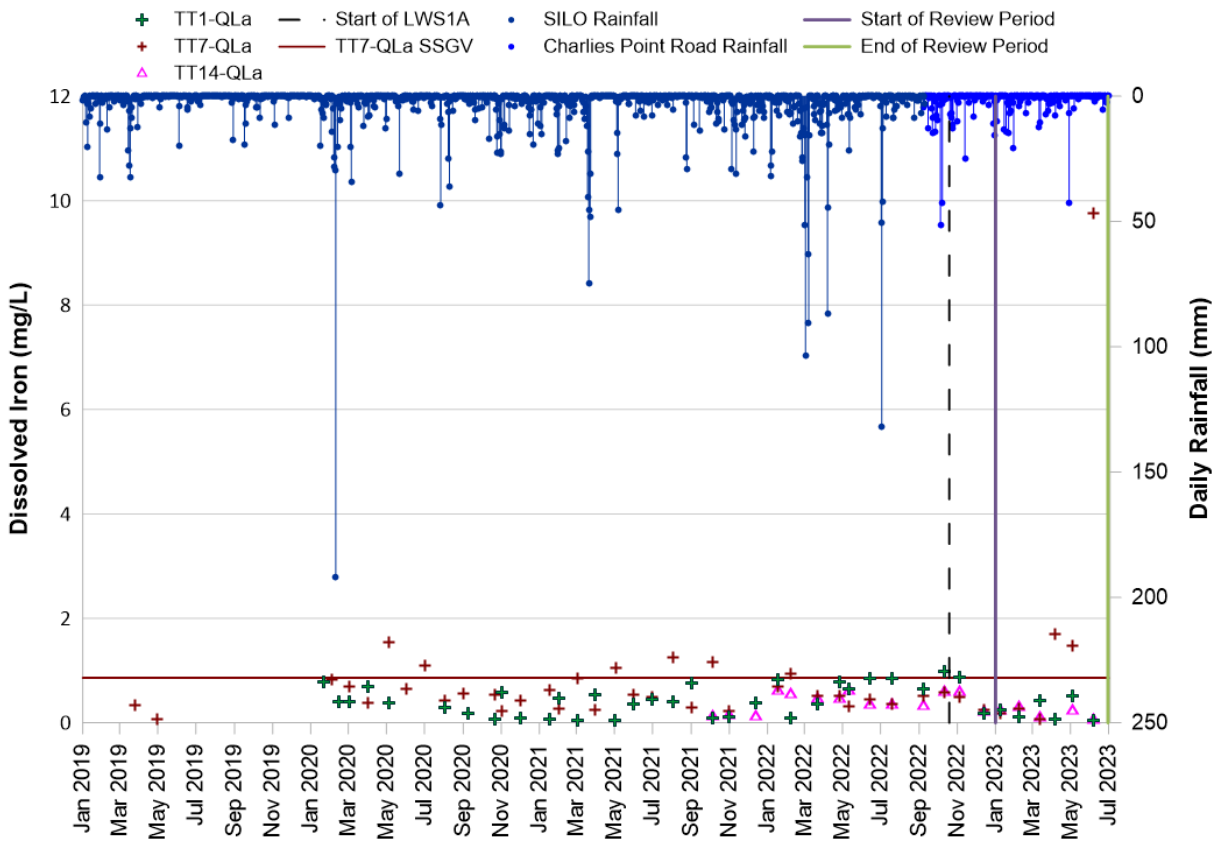
As similarly elevated EC values were recorded at TT7-QLa historically (prior to June 2023) and causation is considered to be confidently identified, the frequency of monitoring was not increased during the review period.

As shown in **Diagram 3** and **Map 7**, negligible surface flow reported to the downstream reach of Teatree Hollow from February 2023. As such, it is considered that the slightly elevated EC values recorded at TT7-QLa and TT14-QLa from March to June 2023 are unlikely to have influenced the water quality of the downstream reach of Teatree Hollow.

6.2.3.2 Dissolved Metals

The dissolved iron concentrations recorded at reference site TT1-QLa and potential impact sites TT7-QLa and TT14-QLa are shown on **Diagram 8**.

DIAGRAM 8: DISSOLVED IRON CONCENTRATIONS



The data presented in **Diagram 8** indicates that:

- The TT7-QLa dissolved iron SSGV (0.86 mg/L) was exceeded for three consecutive months from April to June 2023 (inclusive) i.e., Level 1 trigger for April to June 2023.

- Similarly elevated dissolved iron concentrations were not recorded at the upstream reference site (TT1-QLa) during the corresponding period.
- Similarly elevated dissolved iron concentrations were not recorded at the downstream monitoring site (TT14-QLa) during the corresponding period.
- With the exception of June 2023, similarly elevated dissolved iron concentrations have been recorded historically at TT7-QLa.
- A Level 1 trigger or above for dissolved iron (i.e. an exceedance of the SSGV for three consecutive months or greater) was not recorded at TT7-QLa during the baseline monitoring period prior to commencement of mining.

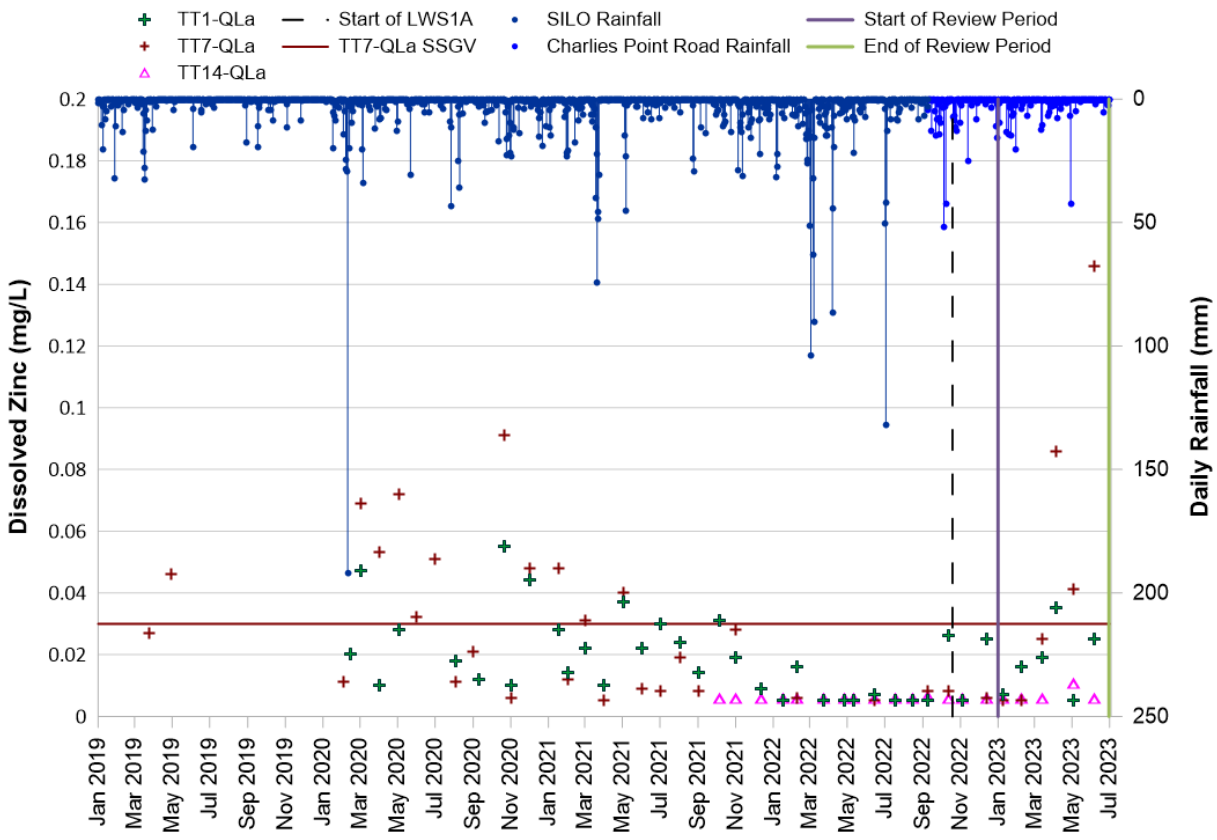
The elevated dissolved iron concentrations recorded at pool TT7 from April to June 2023 are considered related to the interaction of underflow with subsurface geology and re-emergence of elevated dissolved iron underflow as surface flow in the vicinity of pool TT7. As stated in **Table 3** and illustrated in **Map 7**, iron staining was observed on exposed bedrock at the upstream extent of the pool from late March to end June 2023.

As similarly elevated dissolved iron concentrations were recorded at TT7-QLa historically (prior to June 2023) and causation is considered to be confidently identified, the frequency of monitoring was not increased during the review period.

Similarly elevated dissolved iron concentrations were not recorded at the downstream monitoring site (TT14-QLa) during the corresponding period. As such, it is considered that the elevated dissolved iron concentrations recorded at TT7-QLa are unlikely to have influenced the water quality of the downstream reach of Teatree Hollow.

The dissolved zinc concentrations recorded at reference site TT1-QLa and potential impact sites TT7-QLa and TT14-QLa are shown on **Diagram 9**.

DIAGRAM 9: DISSOLVED ZINC CONCENTRATIONS



The data presented in **Diagram 9** indicates that:

- The TT7-QLa dissolved zinc SSGV (0.03 mg/L) was exceeded for three consecutive months from April to June 2023 (inclusive) i.e., Level 1 trigger for April to June 2023.
- The dissolved zinc concentration recorded at the upstream reference site (TT1-QLa) in April 2023 was similar to that recorded in May 2023 at TT7-QLa.
- Similar dissolved zinc concentrations were not recorded at the upstream reference site (TT1-QLa) in June 2023.
- Similarly elevated dissolved zinc concentrations were not recorded at the downstream monitoring site (TT14-QLa) during the corresponding period.
- With the exception of June 2023, similarly elevated dissolved zinc concentrations have been recorded historically at TT7-QLa.
- A Level 1 trigger for dissolved zinc (i.e. an exceedance of the SSGV for three consecutive months) was recorded at TT7-QLa during the baseline monitoring period from March to July 2020 (inclusive).

The elevated dissolved zinc concentrations recorded at pool TT7 from April to June 2023 are likely related to the interaction of underflow with subsurface geology and re-emergence of elevated dissolved zinc underflow as surface flow in the vicinity of pool TT7. It is noted that a Level 1 trigger for dissolved zinc also occurred during the baseline monitoring period prior to the commencement of mining.

As similarly elevated dissolved zinc concentrations were recorded at TT7-QLa historically, the frequency of monitoring was not increased during the review period.

Similarly elevated dissolved zinc concentrations were not recorded at the downstream monitoring site (TT14-QLa) during the corresponding period. As such, it is considered that the elevated dissolved zinc concentrations recorded at TT7-QLa are unlikely to have influenced the water quality of the downstream reach of Teatree Hollow.

7 REVIEW OF SURFACE WATER PERFORMANCE

7.1 Subsidence Impact Performance Measures

The subsidence impact performance measures and performance indicators for natural features defined in the WMP are summarised in **Table 6**. The monitoring results, in conjunction with the TARPs, are used to assess the impacts of mining in Tahmoor South against the subsidence impact performance measures specified in **Table 6**.

TABLE 6: SUBSIDENCE PERFORMANCE MEASURES AND PERFORMANCE INDICATORS FOR SURFACE WATER

Feature	Subsidence Performance Measures	Subsidence Performance Indicators
All watercourses within the Subsidence Area	No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS.	Exceedance of the impact assessment criteria, as defined in the relevant Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure.
Other watercourses	Negligible environmental consequences including beyond those predicted in the EIS, including: • negligible diversion of flows or changes in the natural drainage behaviour of pools; • negligible decline in baseline channel stability; • negligible gas releases and iron staining; and • negligible increase in water turbidity.	The performance measure will be considered to be exceeded if a Level 3 TARP is triggered in relation to water level decline and/or water quality changes and the investigation outcomes indicate a mining related impact based on monitoring data for sites in Hornes Creek and the Bargo River.

7.2 Assessment of Performance

Table 7 summarises the features considered to be directly or indirectly impacted by mining of LW S1A during the review period.

TABLE 7: SUMMARY OF MINING RELATED IMPACTS

Watercourse Feature	Impact Feature	Impact Type
Pool TT3	• Pool water level	Indirect
Pool TT11	• Pool water level	Indirect
Reach of Teatree Hollow tributary*	• Physical (fractures)	Direct
Pool TT12	• Pool water level • Physical (fractures)	Direct
Pool TT13	• Pool water level	Indirect
Pool TT7	• Pool water quality • Iron staining	Indirect

* From pool TT11 to 95 m upstream of pool TT11.

As detailed in the *Tahmoor South Project Environmental Impact Statement* (SIMEC, 2019), where Teatree Hollow and Teatree Hollow tributary are directly mined beneath, subsidence effects were expected to be of sufficient magnitude to result in the buckling of underlying strata and associated surface fracturing at some locations. At these locations it was considered likely that water would be diverted from the watercourse into the underlying dilated strata. The diverted flow would be conveyed via the dilated strata and remerge further downstream in the watercourse as surface flow. As such, although Teatree Hollow and Teatree Hollow tributary were likely to incur localised reductions in pool water level and streamflow associated with fracturing in the vicinity of LW S1-S6A, the net reduction in streamflow conveyed from Teatree Hollow to the Bargo River was expected to be negligible.

Isolated, episodic pulses in salinity, iron, manganese, zinc and nickel were expected to occur in Teatree Hollow due to subsidence induced changes in surface water runoff, underflow and baseflow discharging to these surface water systems.

Accordingly, it is considered that:

- The LW S1A mining related impacts to the watercourse features listed in **Table 7** are consistent with that predicted in the EIS.
- No greater impact than that predicted in the EIS has occurred to watercourses within the Subsidence Area.
- No impacts have occurred to other watercourses.
- No exceedance of the performance measures has occurred.
- No material environmental harm has occurred as a result of mining.

7.3 Impact Response

With respect to the water quality trigger exceedances recorded at TT7-QLa during the review period, there are limited feasible corrective management actions (CMAs) that could be implemented prior to the cessation of subsidence movements associated with mining of LW S1A-S6A. In addition, the water quality effects recorded at pool TT7 are considered immaterial and, as such, CMAs are not considered required at this stage.

Presently, there is negligible indication of a material impact to the water quality of Teatree Hollow, given that:

- There has been negligible surface flow reporting to the downstream reach of Teatree Hollow from February 2023, i.e. limited potential for transport of elevated EC, dissolved iron or dissolved zinc.
- With the exception of June 2023, similarly elevated EC, dissolved iron and dissolved zinc concentrations have been recorded historically at TT7-QLa prior to the commencement of mining in Tahmoor South.
- Similarly elevated dissolved iron and dissolved zinc concentrations were not recorded at the downstream monitoring site (TT14-QLa) during the corresponding period.

Accordingly, it is considered that water quality effects are limited to pool TT7 with negligible indication of material environmental harm to Teatree Hollow.

Direct and indirect mining impacts, in the form of surface fracturing and associated flow diversion, have occurred at several locations in Teatree Hollow and Teatree Hollow tributary, upstream of monitoring site TT-F1. However, there is negligible indication of a non-natural reduction in surface flow reporting to the downstream reach of Teatree Hollow (downstream of TT-F1) i.e. the reduction in surface flow recorded at TT-F1 during the review period is considered consistent with natural (climatic) variability. As such, there is negligible indication of material environmental harm to Teatree Hollow or other watercourses.

Surface water monitoring and data review will continue to be undertaken in accordance with the WMP. It is noted that the WMP was reviewed and revised during the current review period. Specifically, revisions to the monitoring site SSGVs and TARPs were proposed. The proposed revisions to the WMP are currently in review by relevant government agencies and awaiting approval.

In accordance with C12 of SSD 8445 and as detailed in the WMP, a Watercourse Corrective Action Management Plan (WCAMP) will be prepared for watercourses damaged by subsidence impacts. The

WCAMP will be prepared in consultation with relevant government agencies, as defined in the WMP. The WCAMP will be prepared and implemented at the cessation of subsidence movements associated with Tahmoor South mining.

8 SUMMARY AND RECOMMENDATIONS

Review and assessment of surface water monitoring data recorded prior to and during the review period of 1 January to 30 June 2023 has indicated the following:

- Surface Water Level:
  - During the review period, a Level 1 trigger exceedance in relation to pool water level was recorded at monitoring sites TT2-QLa and TT9-QLa. It is considered that the decline in water level at monitoring sites TT2-QLa and TT9-QLa is related to the prevailing climatic conditions and unrelated to mining effects associated with LW S1A.
  - During the review period, a maximum Level 3 trigger exceedance was recorded for monitoring sites TT3-QLa, TT12-QLa and TT13-QLA. It is considered that the decline in water level at the aforementioned monitoring sites is related to the:
    - cessation of surface water flow in Teatree Hollow and Teatree Hollow Tributary due to mining induced fracturing upstream of pools in Teatree Hollow (pool TT11) and a reach of Teatree Hollow Tributary (pool TT12);
    - prevailing climatic conditions; and
    - negligible surface water flow reporting from the upstream reach of Teatree Hollow as of March 2023 and from the upstream reach of Teatree Hollow tributary as of late April 2023.
  - All other monitoring sites were 'normal condition' for the duration of the review period.
- Physical Features and Natural Behaviour of Pools:
  - A level 1 TARP trigger exceedance was reported for pool TT2 during the review period in relation to visually observed anomalous change in water level.
  - During the review period, a maximum Level 2 trigger exceedance was recorded for pools TT3, TT7 and TT11. A visually observed anomalous change in water level was recorded for pools TT3, TT7 and TT11. Additionally, from March to June 2023, iron staining was observed at pool TT7 and mining related fractures were observed upstream of pool TT11 in February 2023.
  - During the review period, a maximum Level 3 trigger exceedance was recorded for pools TT12 and TT13. An anomalous change in water level was recorded for 3 months at pools TT12 and TT13. In addition, fracturing was observed immediately upstream and downstream of pool TT12.
  - All other pools were 'normal condition' for the duration of the review period.
  - All channel morphology sites were 'normal condition' for the duration of the review period.
- Surface Water Quality:
  - Water quality TARP trigger exceedances were recorded for electrical conductivity, dissolved iron and dissolved zinc at monitoring site TT7-QLa. It is considered that the water quality exceedances recorded at monitoring site TT7-QLa were related to the following:
    - Evapoconcentration of salinity during periods of below average rainfall and water level decline.
    - The interaction of underflow with subsurface geology and re-emergence of underflow (with elevated salinity, dissolved iron and dissolved zinc) as surface flow in the vicinity of pool TT7.

Based on the monitoring data for the period 1 January to 30 June 2023, following commencement of mining LW S1A, mining related impacts to the watercourse features are considered consistent with that predicted in the EIS.

8.1 Current Surface Water Monitoring Recommendations

Based on the assessment outcomes contained herein, it is recommended that:

- ongoing review of surface monitoring data is continued to be undertaken in accordance with the WMP; and,
- the baseline minimum for pool TT9 is revised to consider the water level data recorded to the cessation of mining of LW S1A (4 July 2023).

8.2 Previous Surface Water Monitoring Recommendations

Recommendations from the previous review period (18 October to 31 December 2022, ATCW 2023) and the subsequent status/actions are summarised in **TABLE 8**.

TABLE 8: STATUS OF PREVIOUS SURFACE WATER MONITORING PROGRAM RECOMMENDATIONS

Item	Previous Recommendation	Progress of Recommendation
1	Ongoing review of surface monitoring data is continued to be undertaken in accordance with the WMP	Since mining commencement in October 2022, review of surface monitoring data has been undertaken in accordance with the WMP

REFERENCES

BES (2023a). January 2023 Tahmoor South Longwall S1A Monitoring. Report by Brienen Environmental Services prepared for Tahmoor Coal Pty Ltd, January.

BES (2023b). February 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES), February.

BES (2023c). 1 March 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES), March.

BES (2023d). 15 March 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES), March.

BES (2023e). 29 March 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES), March.

BES (2023f). 12 April 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES), April.

BES (2023g). 26 April 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES), April.

BES (2023h). 17 May 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES) May.

BES (2023i). 31 May 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES) May.

BES (2023j). 16 June 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES) June.

BES (2023k). 28 June 2023 Tahmoor South Longwall S1A Monitoring. Prepared for Tahmoor Coal Pty Ltd by Brienen Environment & Safety (BES) June.

ATC Williams Pty Ltd (2023) Tahmoor South Domain, Surface Water Review 18 October to 31 December 2022. Prepared on behalf of Tahmoor Coal Pty Ltd. March 2022. Doc ref: 121171-16R004-rev0.

SIMEC (2019) Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019.

SLR (2023). “Tahmoor South Groundwater Annual Reporting, January to June 2023”. Prepared by SLR Consulting Australia Pty Ltd (SLR) on behalf of Tahmoor Coal, September.

MSEC (2023). “Tahmoor LW S1A Subsidence Monitoring Report, Monitoring Period 24 June to 30 June 2023”. Report Number: MSEC1304, July.

Tahmoor Coal (2023). Tahmoor South Domain – Longwalls South S1A-S6A Water Management Plan, January.

CONDITIONS OF REPORT

1. This report must be read in its entirety.
2. This report has been prepared by ATCW for the purposes stated herein and ATCW's experience, having regard to assumptions that can reasonably be expected to make in accordance with sound professional principles. ATCW does not accept responsibility for the consequences of extrapolation, extension or transference of the findings and recommendations of this report to different sites, cases, or conditions.
3. This document has been prepared based in part on information which was provided to ATCW by the client and/or others and which is not under our control. ATCW does not warrant or guarantee the accuracy of this information. The user of the document is cautioned that fundamental input assumptions upon which the document is based may change with time. It is the user's responsibility to ensure that these assumptions are valid.
4. Unless specifically agreed otherwise in the contract of engagement, ATCW retains Intellectual Property Rights over the contents of the document. The client is granted a licence to use the report for the purposes for which it was commissioned.

.

APPENDICES

APPENDIX A – SUMMARY OF SURFACE WATER MONITORING PROGRAM

Feature	Locations	Monitoring		
		Prior to Mining	During Mining	Post Mining
Streamflow	Streamflow gauging stations: • TT-F1 (Existing) • DT-F1 (Proposed)	Continuous record. Data downloaded prior to the commencement of secondary extraction in relevant catchment.	Continuous record. Data downloaded and reviewed monthly.	Continuous record, data downloaded and reviewed quarterly for 12 months following the completion of relevant mining activities. This period may be extended as per decision by the Environmental Response Group*.
Surface Water Quality	Existing sites: TT1-QLa, TT2-QLa, TT3-QLa, TT7-QLa, TT9-QLa, TT12-QLa, TT13-QLa, TT14-QLa, HC1-QLa, HC3-QLa, HC19-QLa, BR3-QLa, BR6-QLa, BR13-QRLa, BR12-QLa, BR16-QLa, BR17-QLa, BR18-QLa Proposed sites: HC13-QLa, HC16-QLa	Monthly sampling for a minimum of 12 months prior to secondary extraction.	Monthly sampling and analysis.	Monthly sampling and analysis for 12 months following the completion of relevant mining activities. This period may be extended as per decision by the Environmental Response Group.
		Parameters: Field analysis: pH, EC and DO, temperature and ORP. Laboratory analysis for: pH, EC, total dissolved solids, total suspended solids, turbidity, major cations†, sulphate, alkalinity, chloride, dissolved metals‡, total metals≠, total kjeldahl nitrogen, total nitrogen, total phosphorus, total cations and total anions.		
Automated pool water level	Existing sites: TT1-QLa, TT2-QLa, TT3-QLa, TT7-QLa, TT9-QLa, TT12-QLa, TT13-QLa, TT14-QLa, HC1-QLa, HC3-QLa, HC19-QLa, BR3-QLa, BR6-QLa, BR12-QLa, BR13-QRLa, BR16-QLa, BR17-QLa, BR18-QLa Proposed sites: HC13-QLa, HC16-QLa	Continuous record and monthly manual measurements for a minimum of 12 months prior to secondary extraction. Data downloaded prior to the commencement of secondary extraction in relevant catchment.	Continuous record and monthly manual measurements. Data downloaded and reviewed monthly.	Continuous record and monthly manual measurements. Data downloaded and reviewed quarterly for 12 months following the completion of relevant mining activities. This period may be extended as per decision by the Environmental Response Group.

Feature	Locations	Monitoring		
		Prior to Mining	During Mining	Post Mining
Physical features and natural behaviour of pools and reaches	Teatree Hollow, Teatree Hollow tributary and the Bargo River tributary pools and reaches	One observation prior to mining using fixed location photo points.	Observations every month during the active subsidence period (after 200 m of secondary extraction of relevant longwall) for sites within the active subsidence zone^ using fixed location photo points.	Quarterly observations over 12 months for pools that are no longer within the active subsidence zone or as required in accordance with a Watercourse Corrective Action Management Plan.
Morphology and channel stability	Headwater and knickpoint sites in Teatree Hollow, Teatree Hollow tributary and the Bargo River tributary	One observation prior to mining using fixed location photo points. One catchment survey of 10 headwater sites	Observations of knickpoint formation every month during the active subsidence period for sites within the active subsidence zone using fixed location photo points. Annual catchment survey of 10 headwater sites.	One observation of knickpoint formation at sites that are no longer within the active subsidence zone using fixed location photo points. One catchment survey of 10 headwater sites. Post-mining geomorphology survey following completion of mining LW S6A.

APPENDIX B – WATER LEVEL PLOTS

APPENDIX B1 – TEATREE HOLLOW WATER LEVEL PLOTS

DIAGRAM B1.1: MONITORING SITE TT1-QLA WATER LEVEL RECORDS

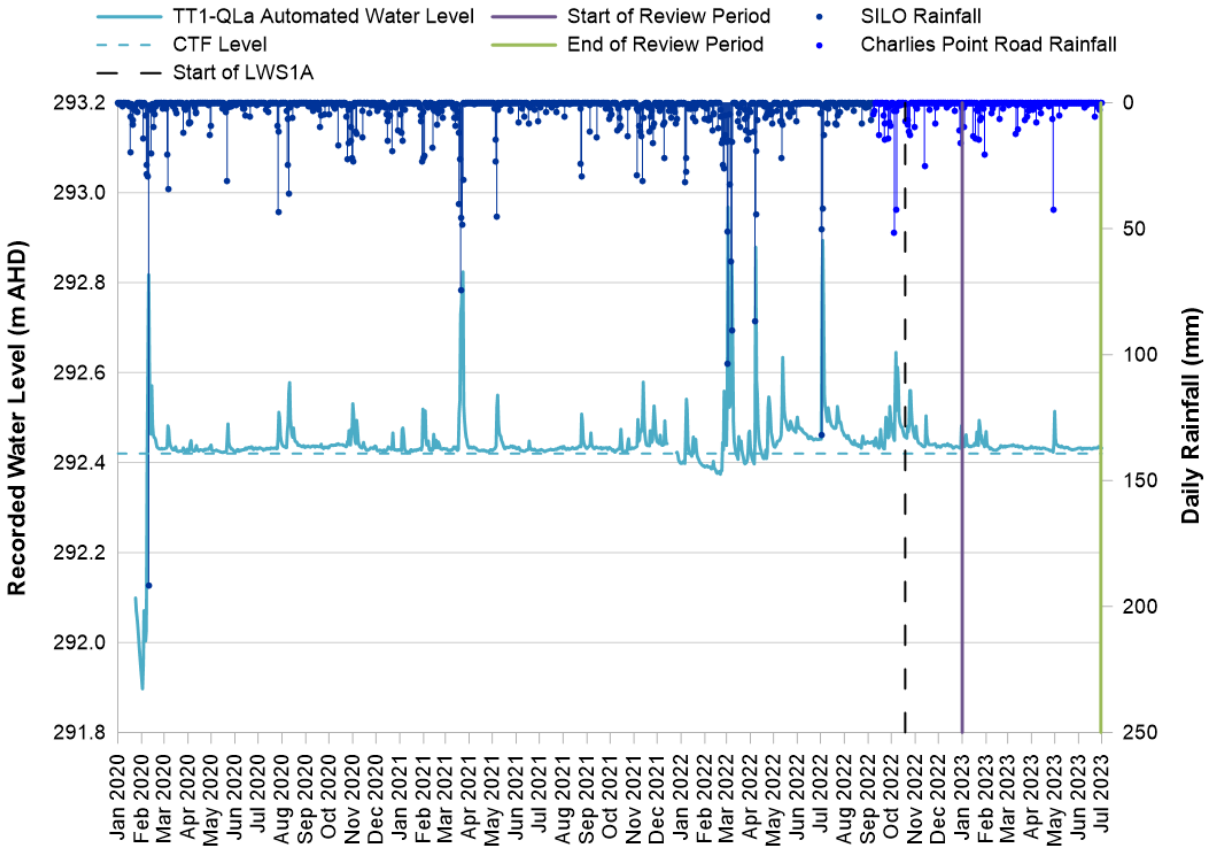


DIAGRAM B1.2: MONITORING SITE TT2-QLA WATER LEVEL RECORDS

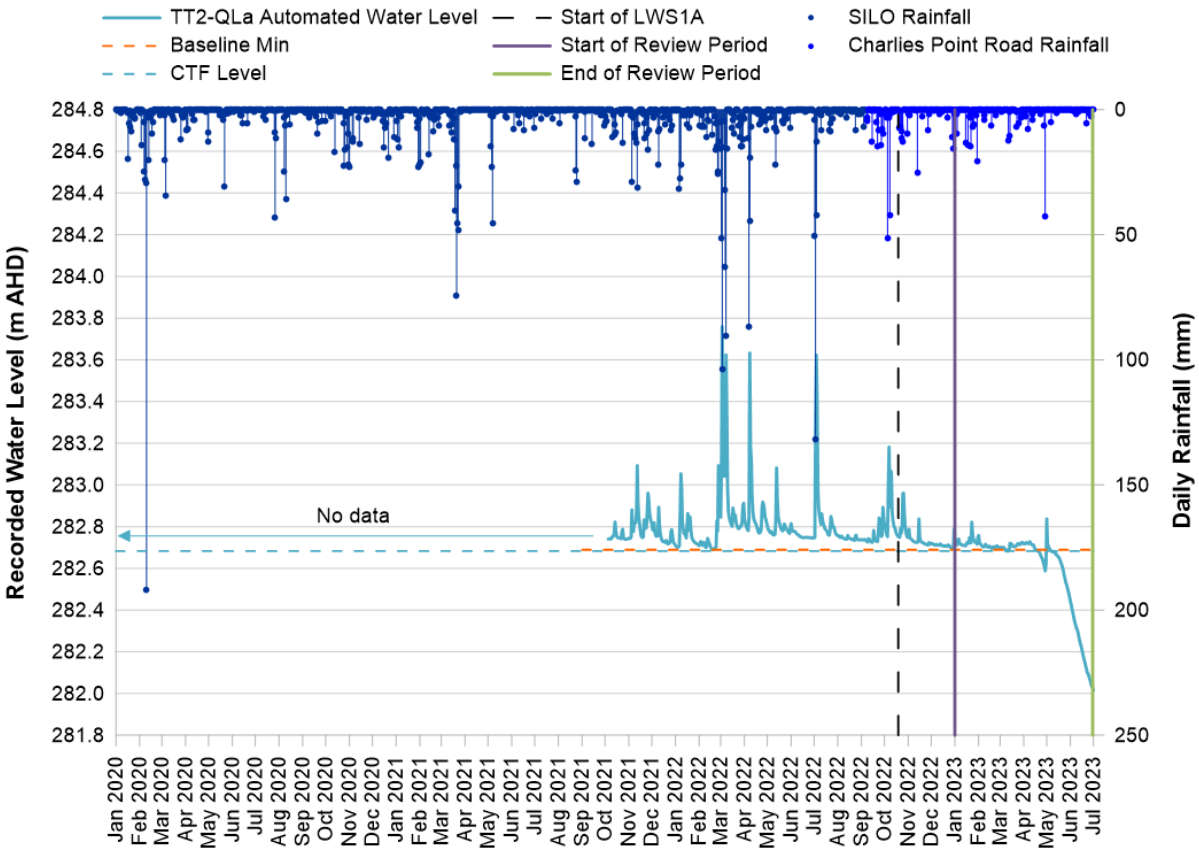


DIAGRAM B1.3: MONITORING SITE TT3-QLA WATER LEVEL RECORDS

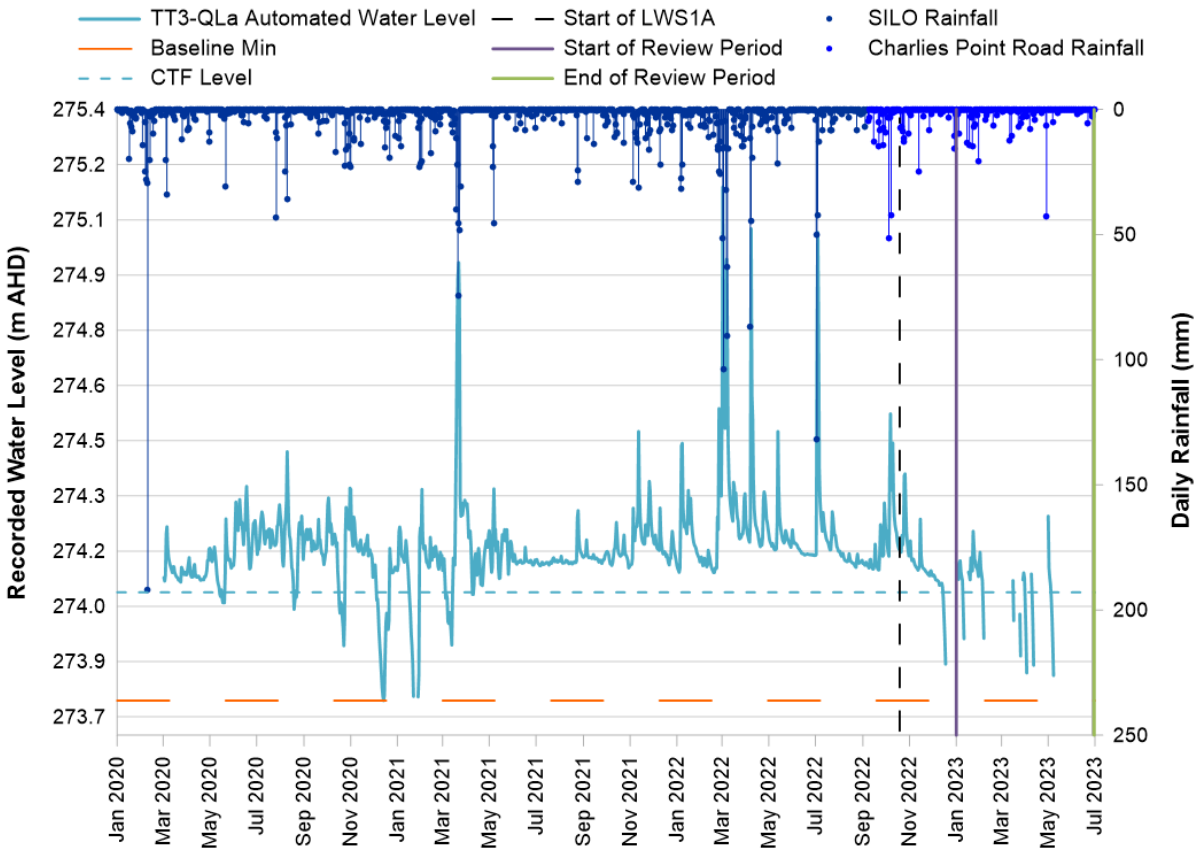


DIAGRAM B1.4: MONITORING SITE TT7-QLA WATER LEVEL RECORDS

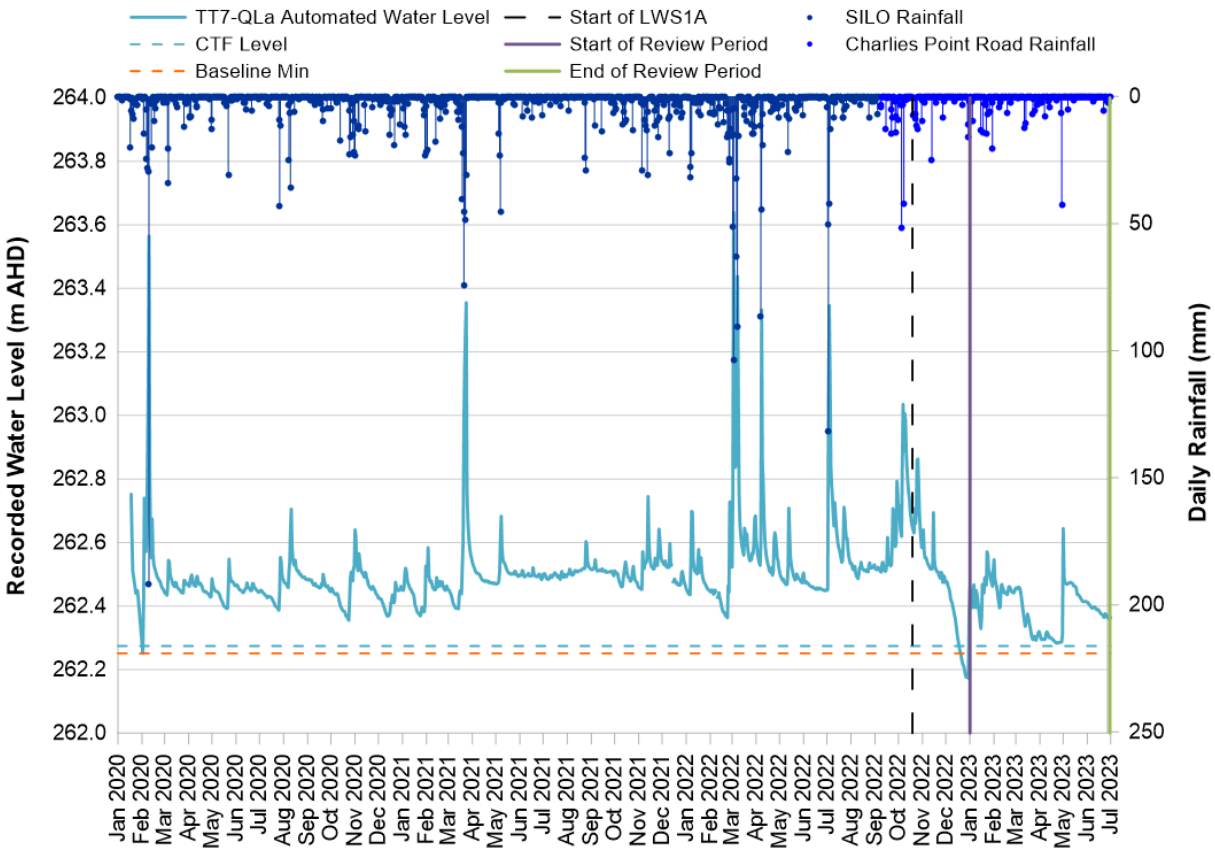


DIAGRAM B1.5: MONITORING SITE TT9-QLA WATER LEVEL RECORDS

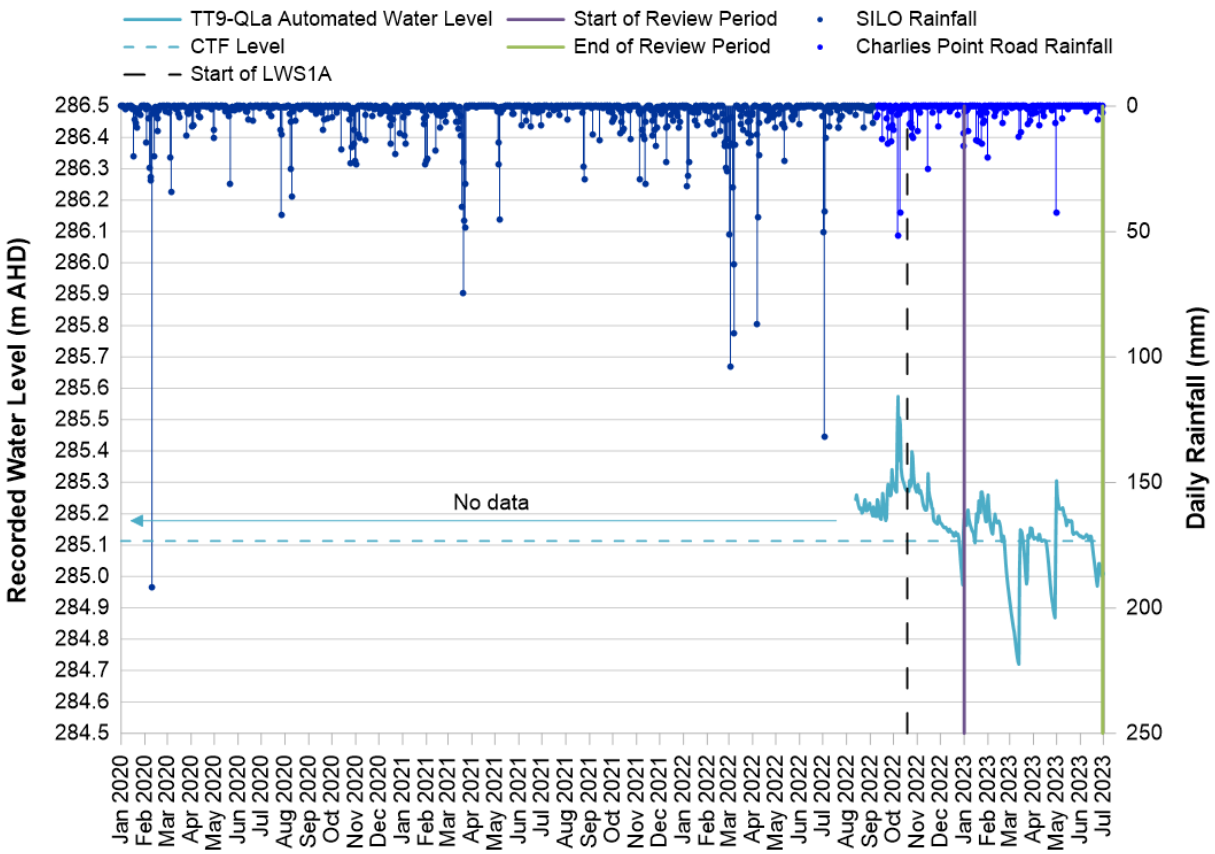


DIAGRAM B1.6: MONITORING SITE TT12-QLA WATER LEVEL RECORDS

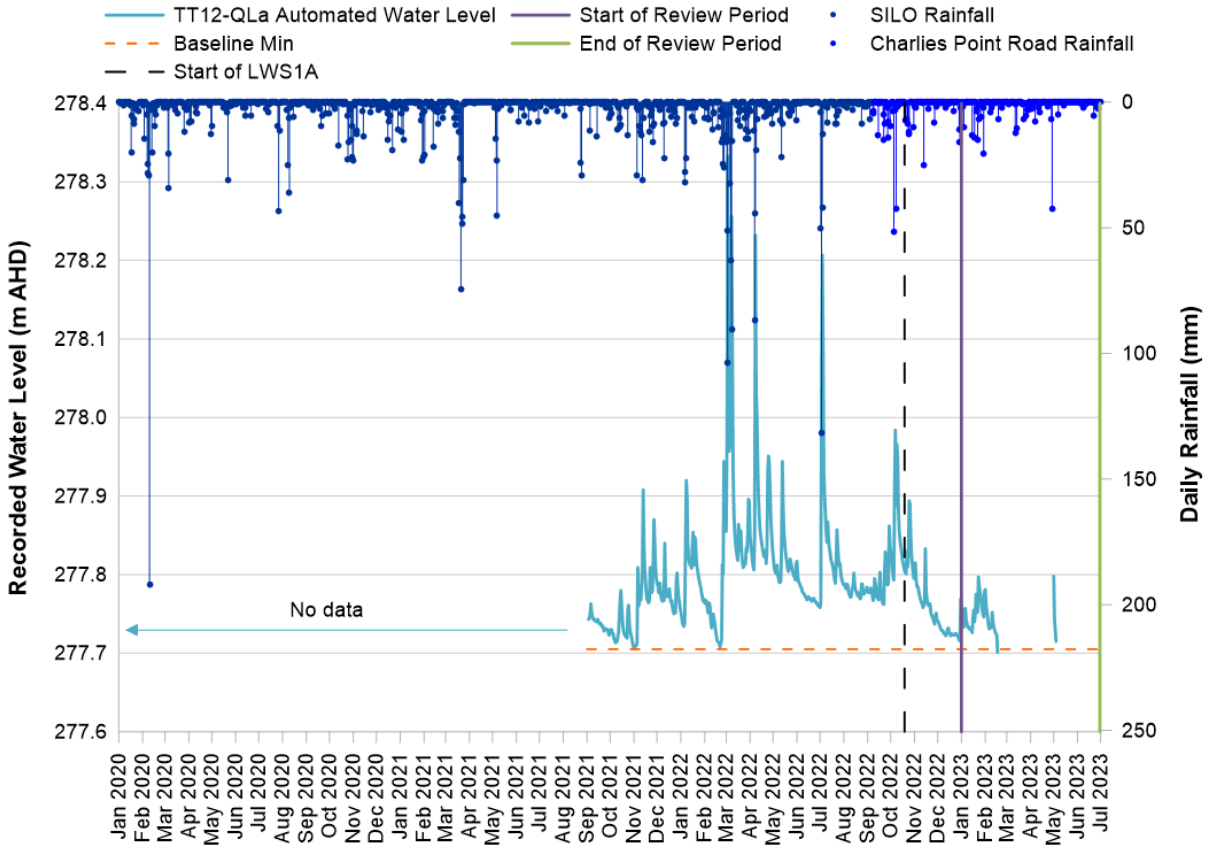
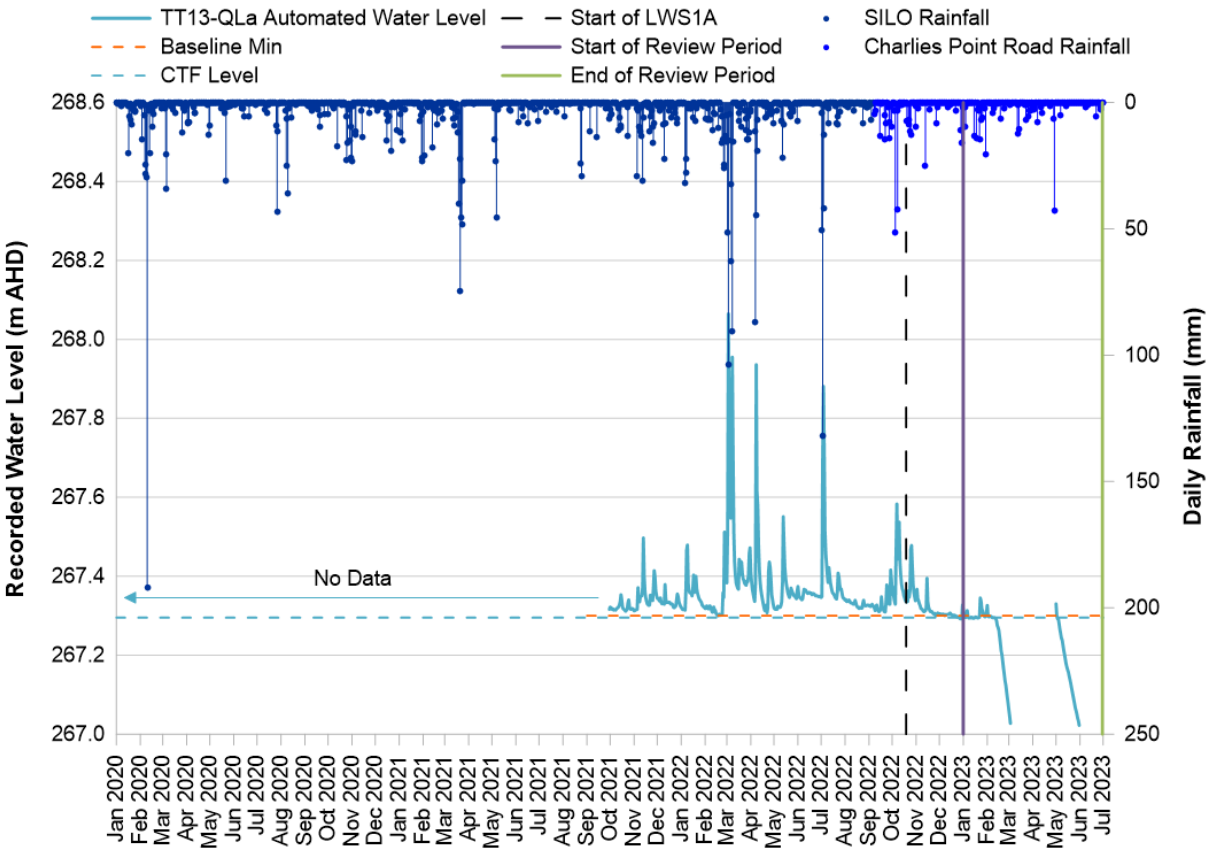


DIAGRAM B1.7: MONITORING SITE TT13-QLA WATER LEVEL RECORDS



APPENDIX B2 – BARGO RIVER WATER LEVEL PLOTS

DIAGRAM B2.1: MONITORING SITE BR12-QLA WATER LEVEL RECORDS

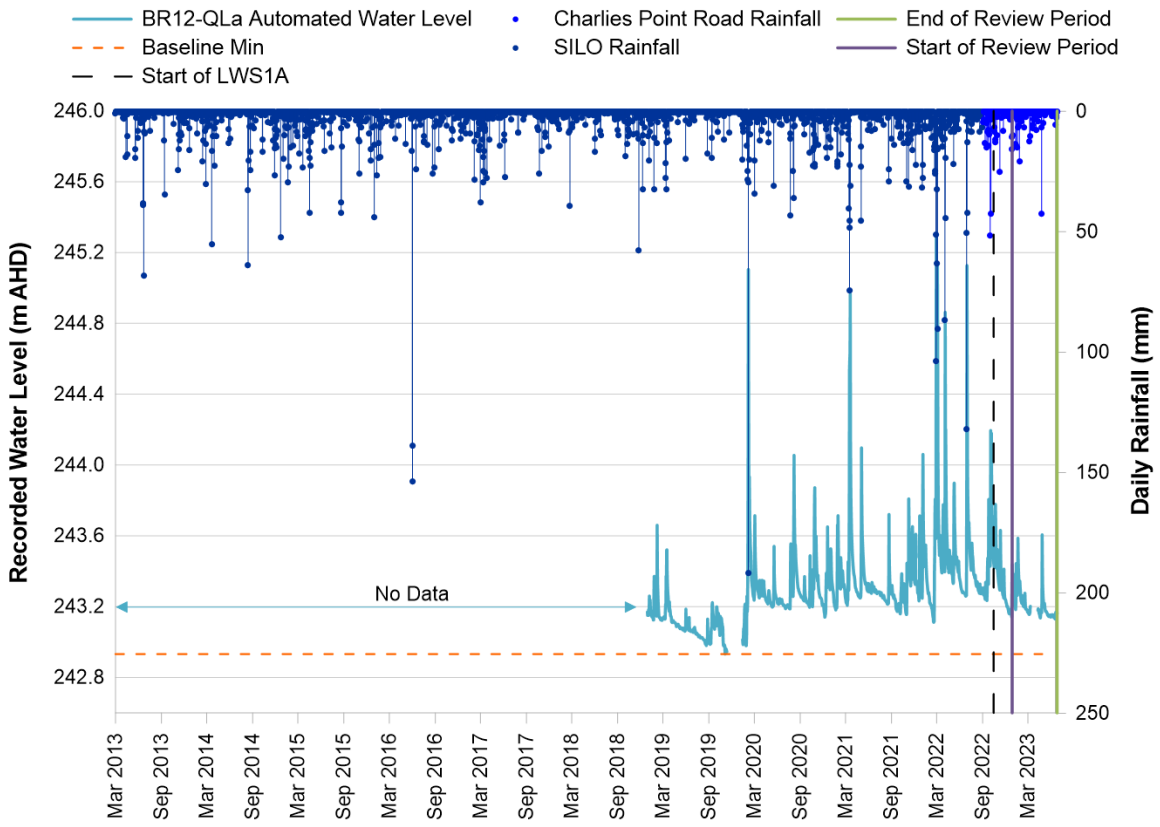


DIAGRAM B2.2: MONITORING SITE BR13-QLA WATER LEVEL RECORDS

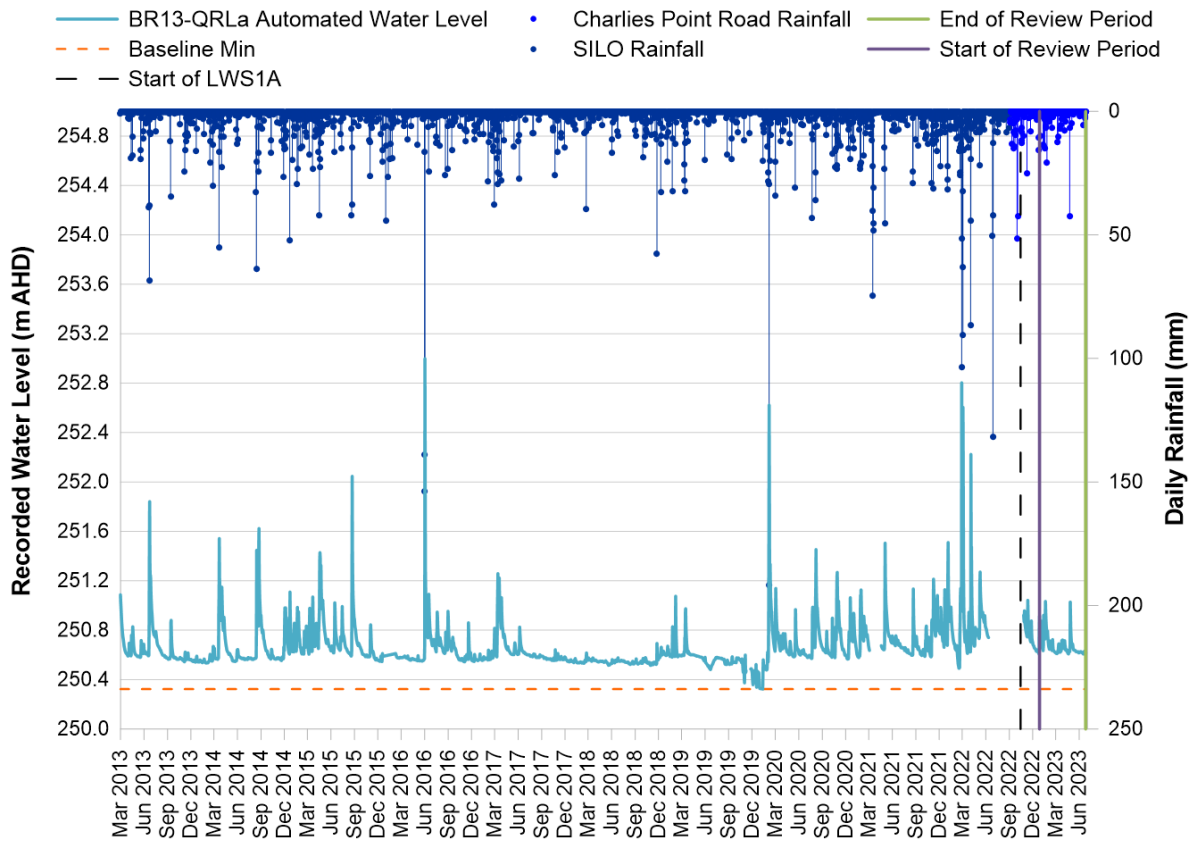
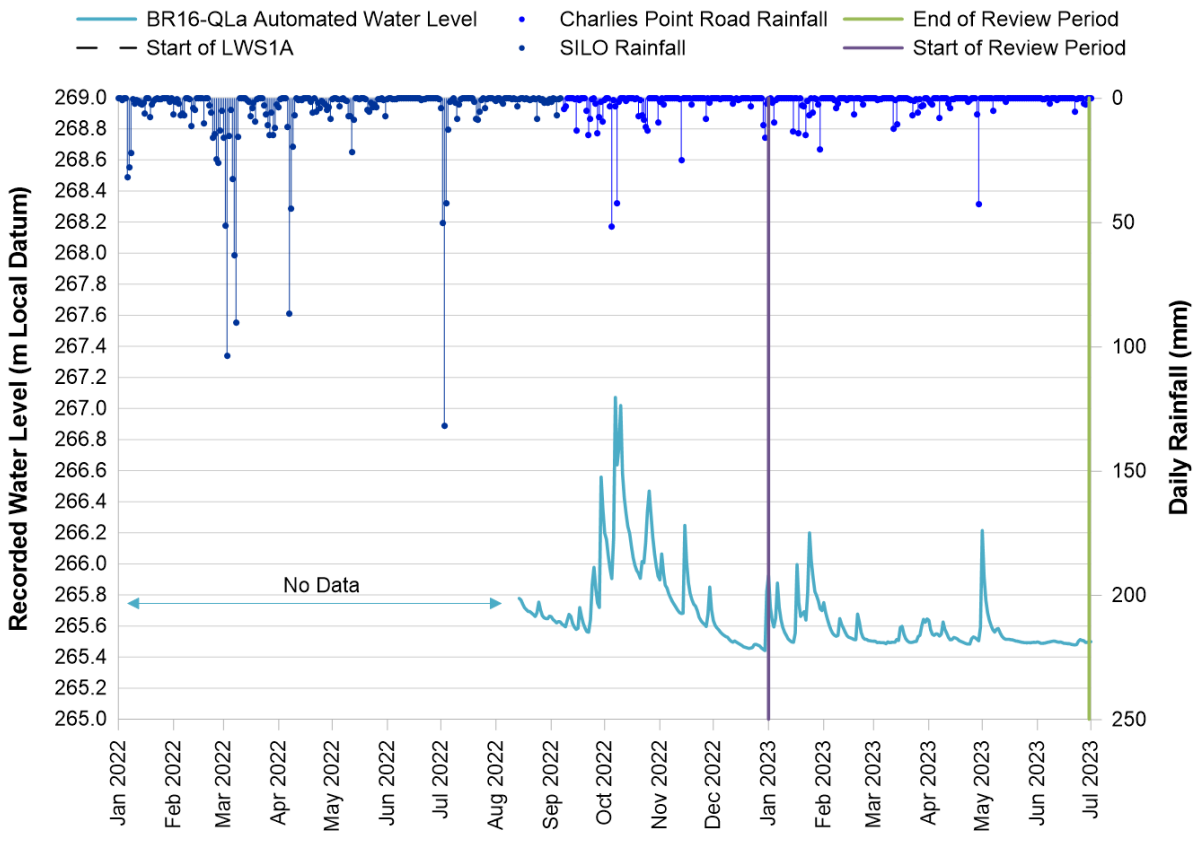


DIAGRAM B2.3: MONITORING SITE BR16-QLA WATER LEVEL RECORDS

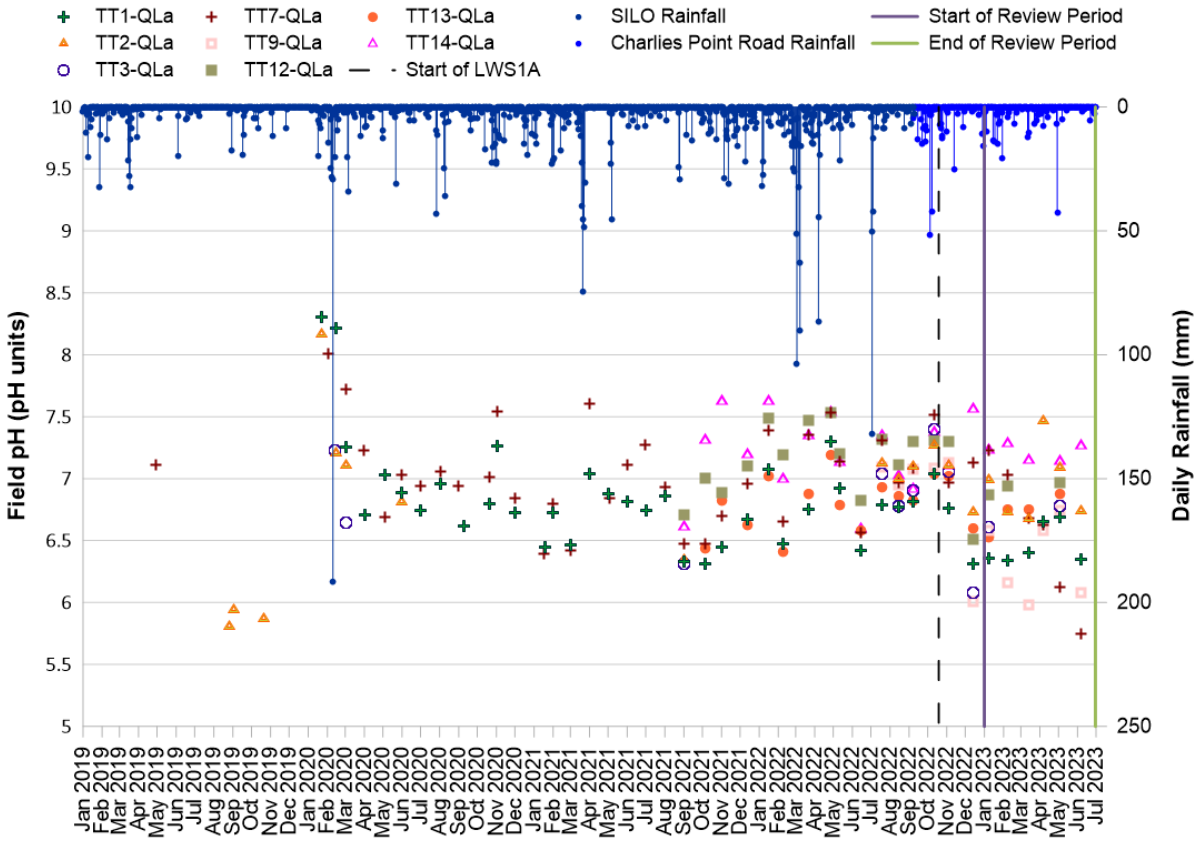


APPENDIX C –WATER QUALITY PLOTS [4]

[4] When the recorded value was below the limit of reporting, the value has been plotted at the limit of reporting in the following plots.

APPENDIX C1 – TEATREE HOLLOW WATER QUALITY PLOTS

DIAGRAM C1.1: FIELD AND LABORATORY PH RECORDS



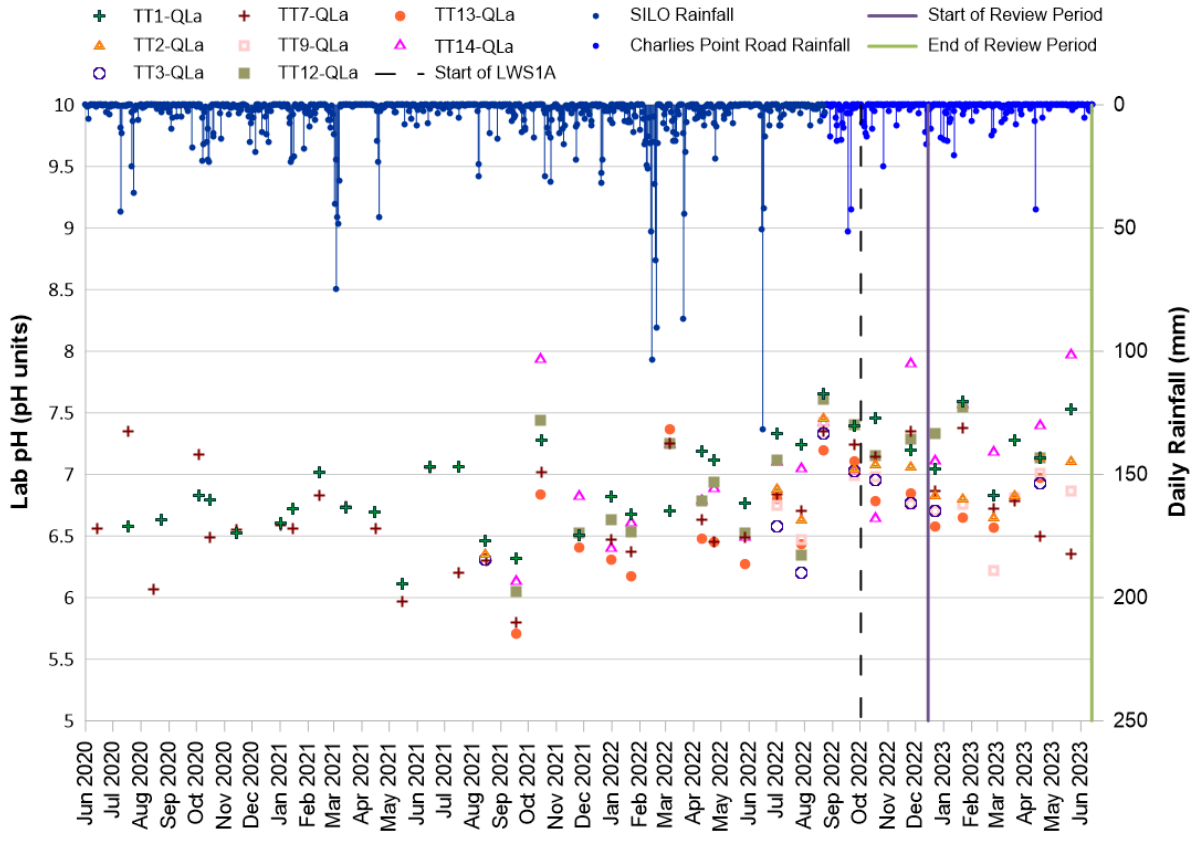
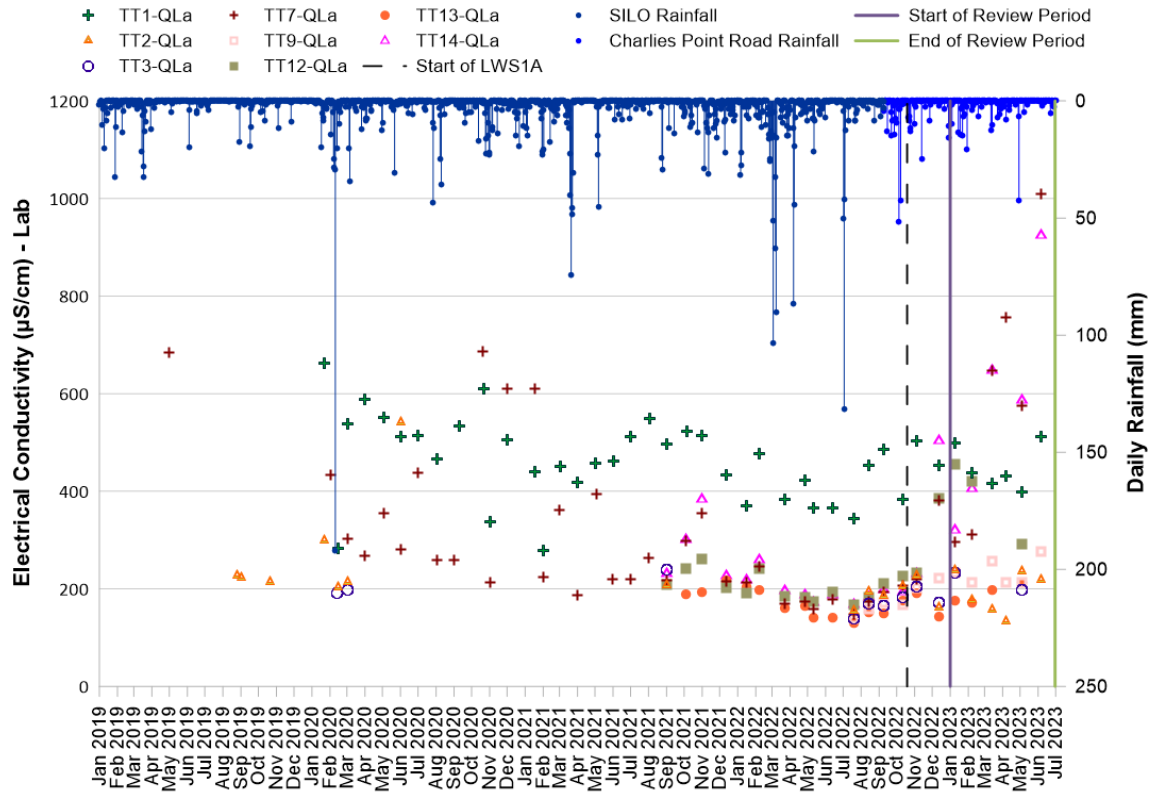


DIAGRAM C1.2: FIELD AND LABORATORY ELECTRICAL CONDUCTIVITY RECORDS



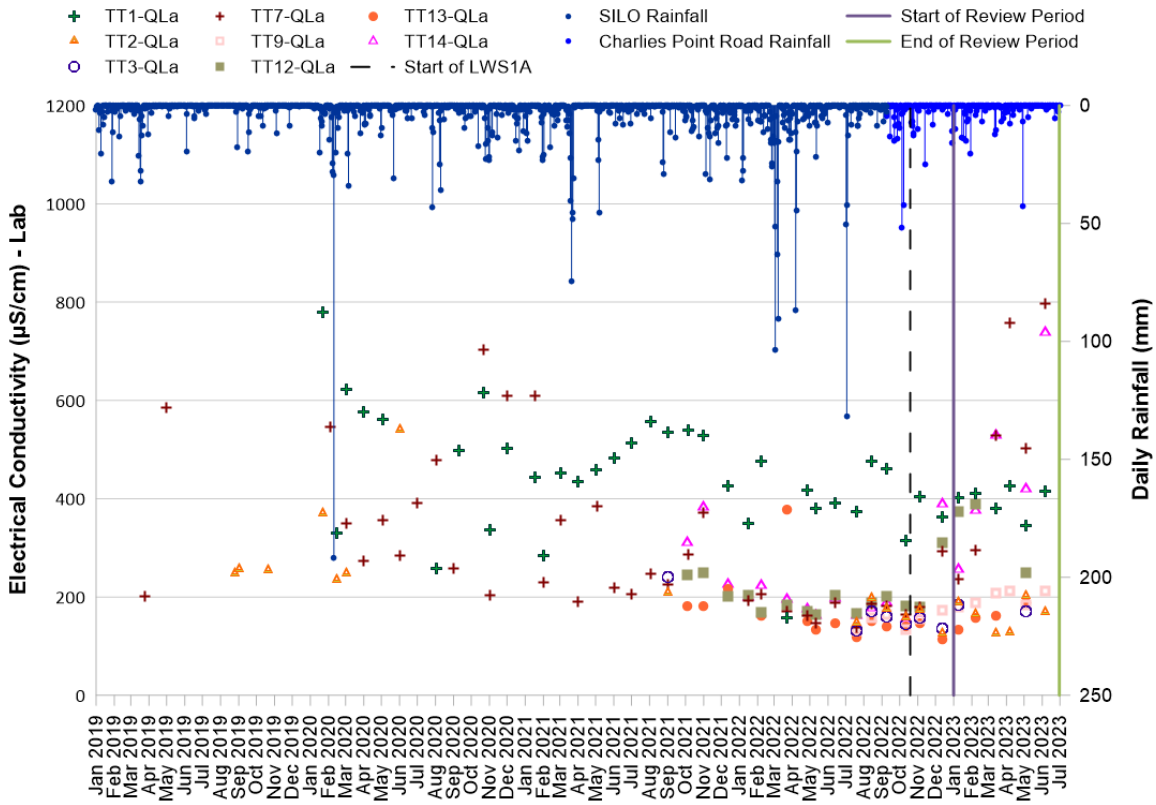


DIAGRAM C1.3: DISSOLVED ALUMINIUM RECORDS

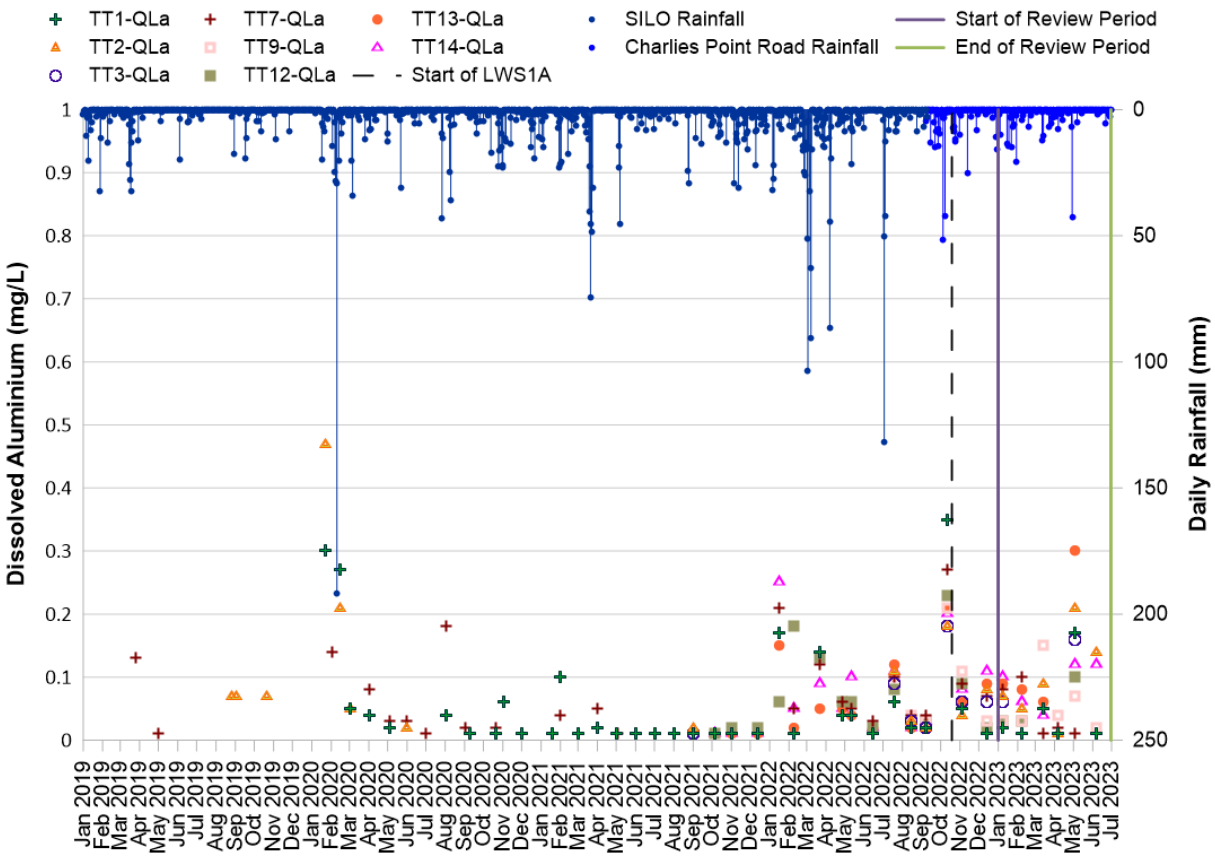


DIAGRAM C1.4: DISSOLVED COPPER RECORDS

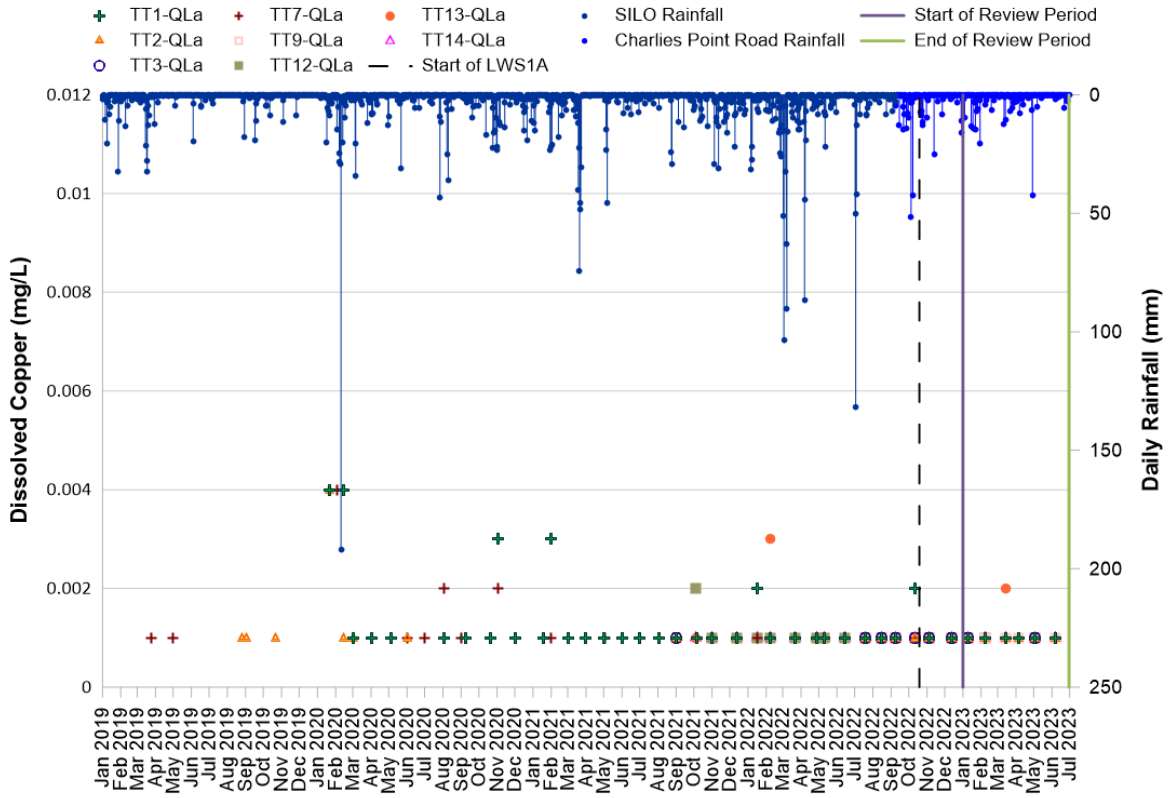


DIAGRAM C1.5: DISSOLVED IRON RECORDS

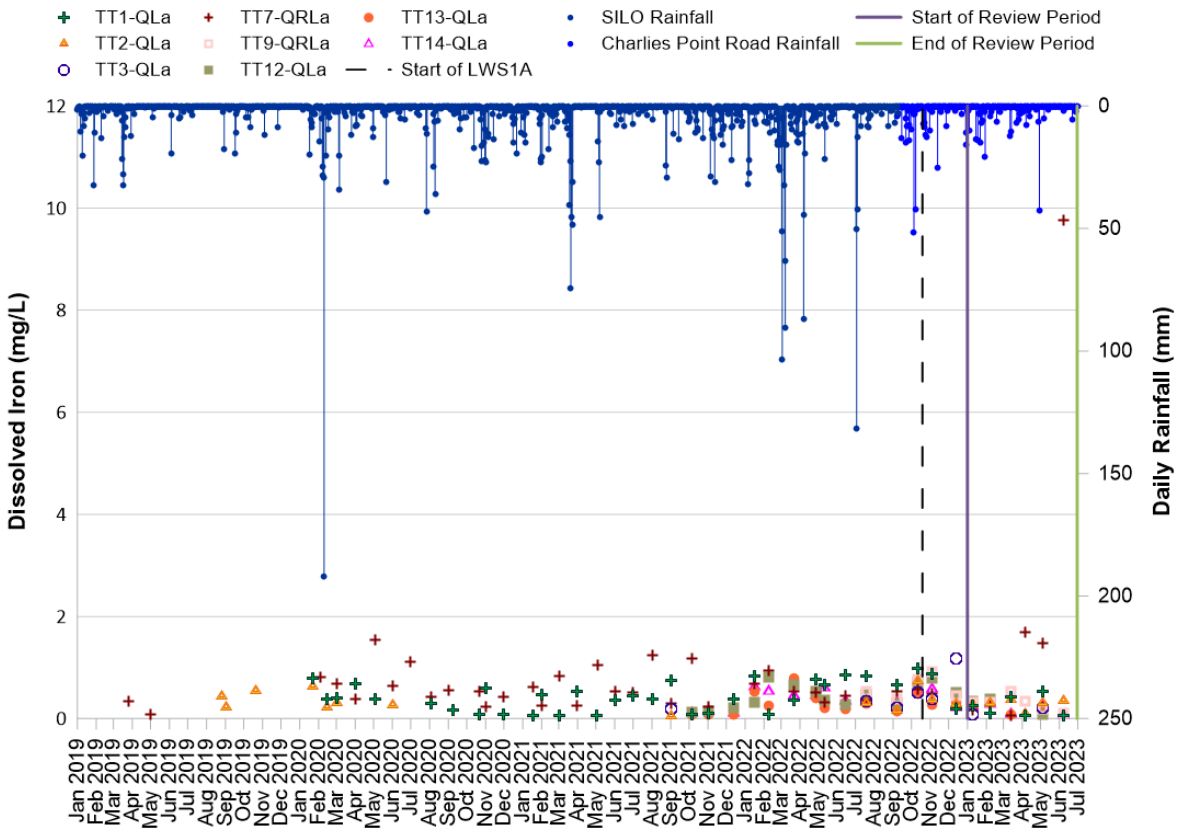


DIAGRAM C1.6: DISSOLVED MANGANESE RECORDS

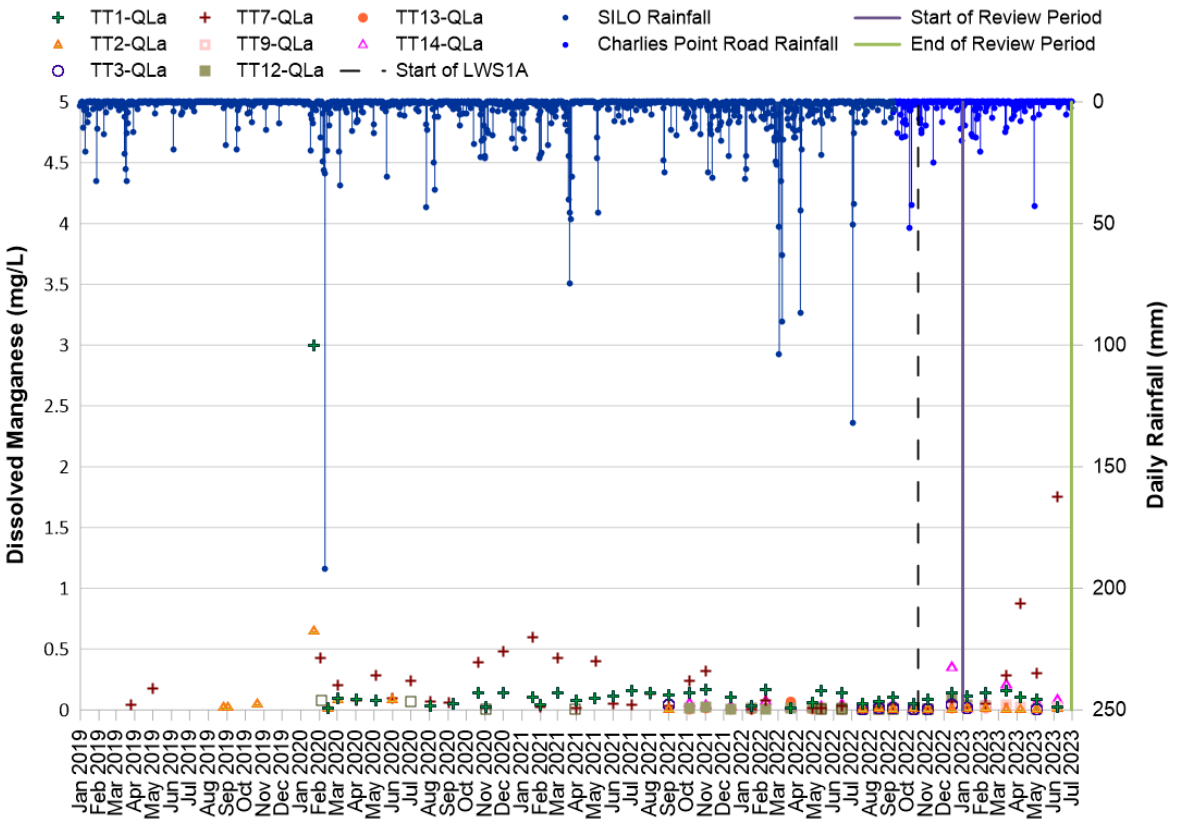


DIAGRAM C1.7: DISSOLVED NICKEL RECORDS

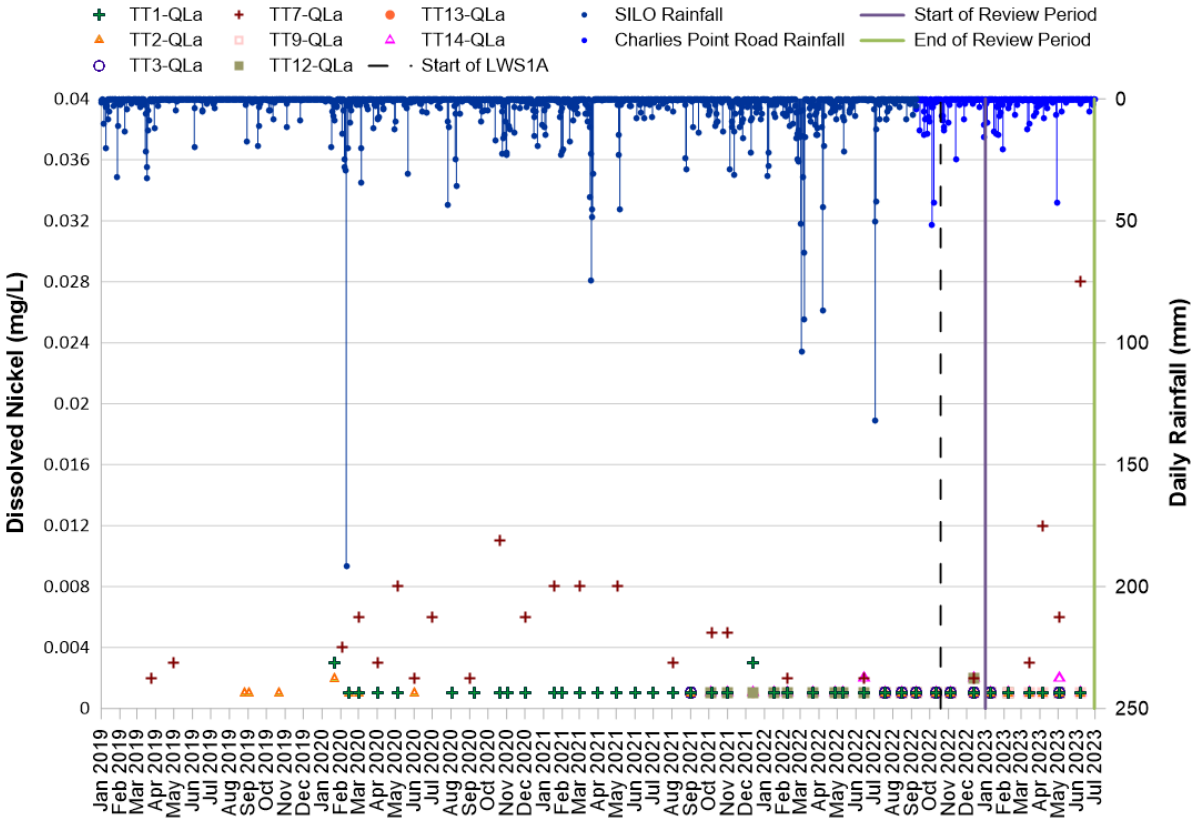
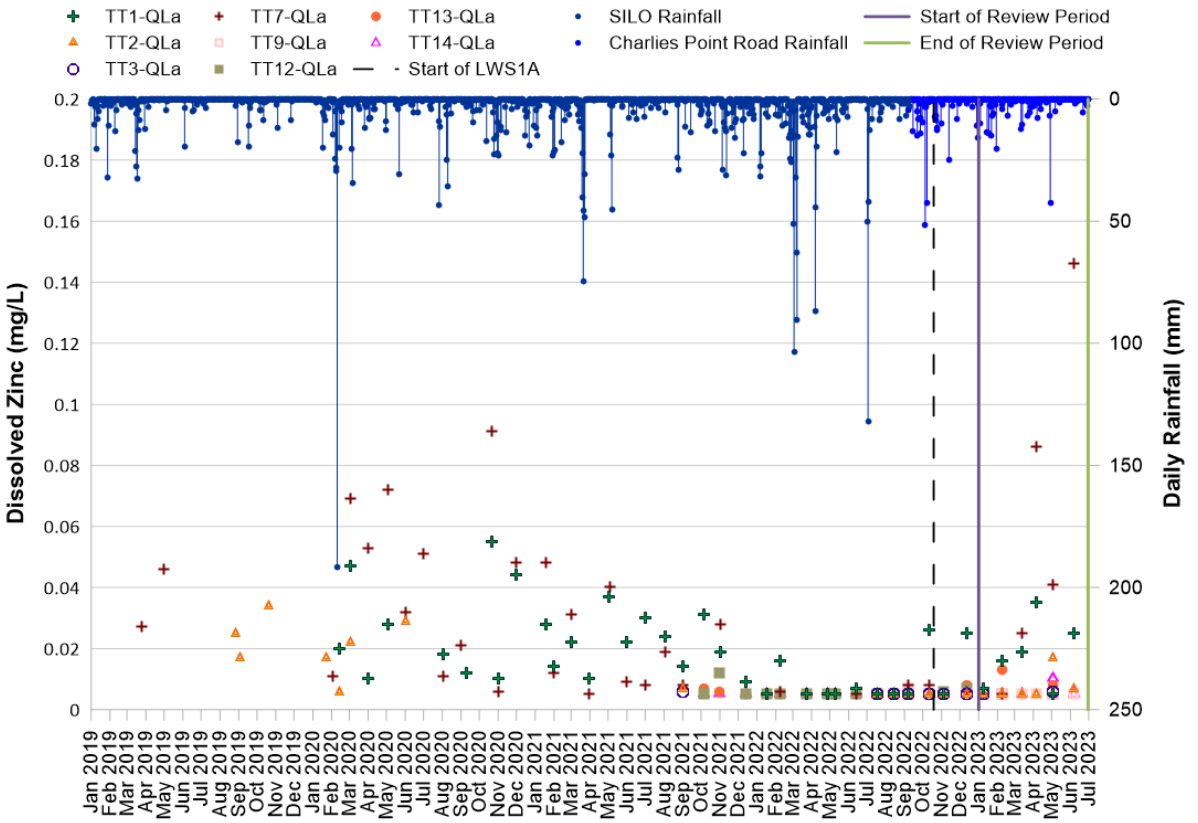
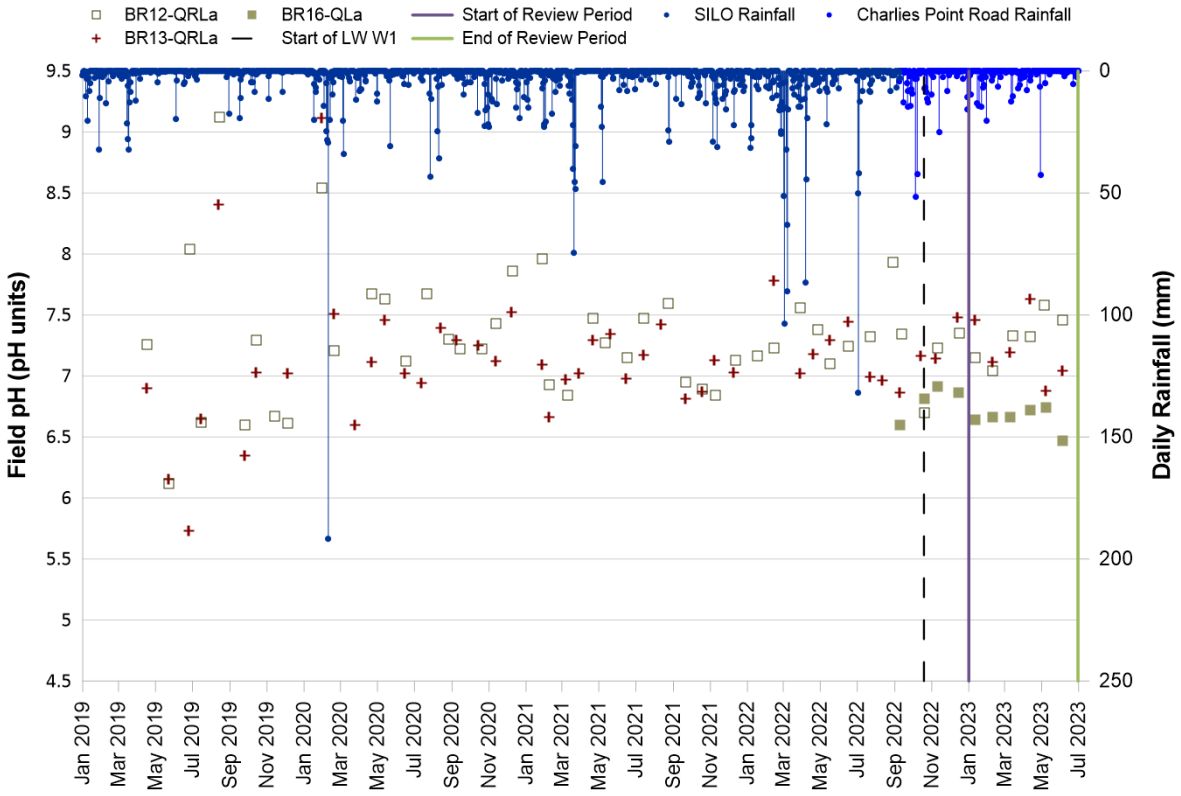


DIAGRAM C1.8: DISSOLVED ZINC RECORDS



APPENDIX C2 – BARGO RIVER WATER QUALITY PLOTS

DIAGRAM C2.1: FIELD AND LABORATORY PH RECORDS



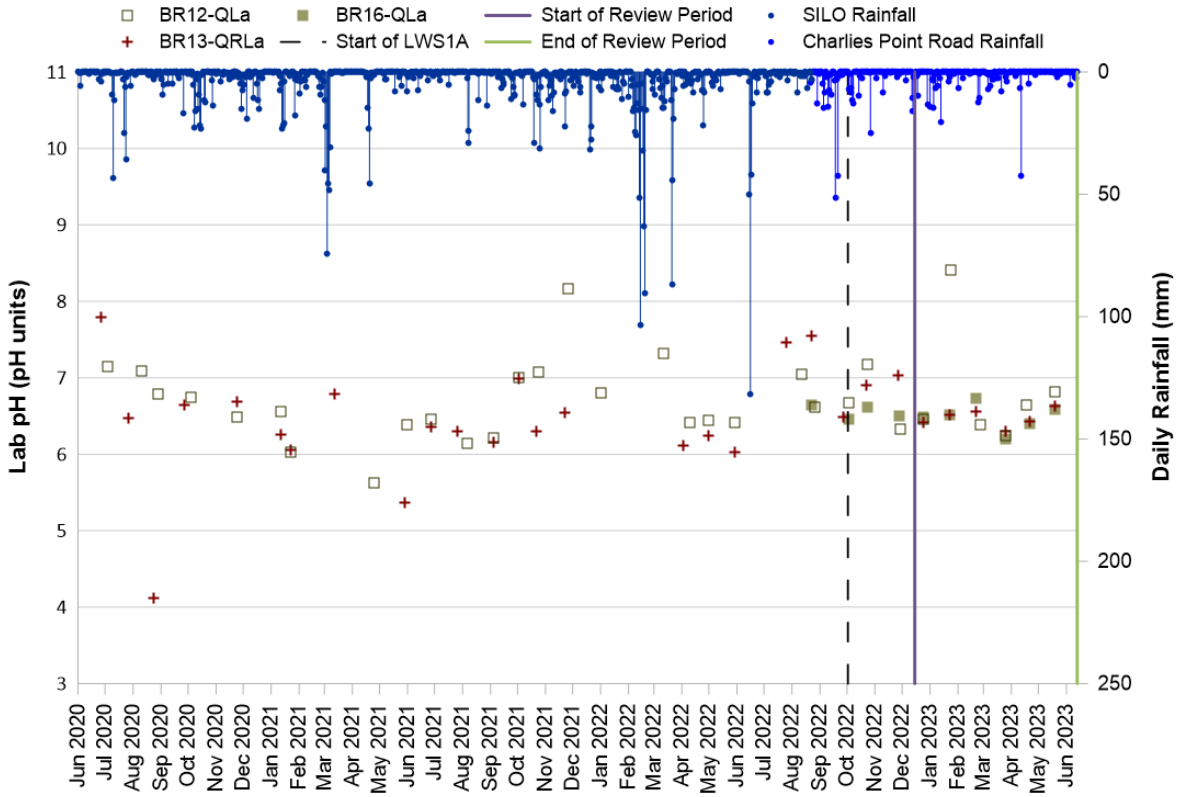
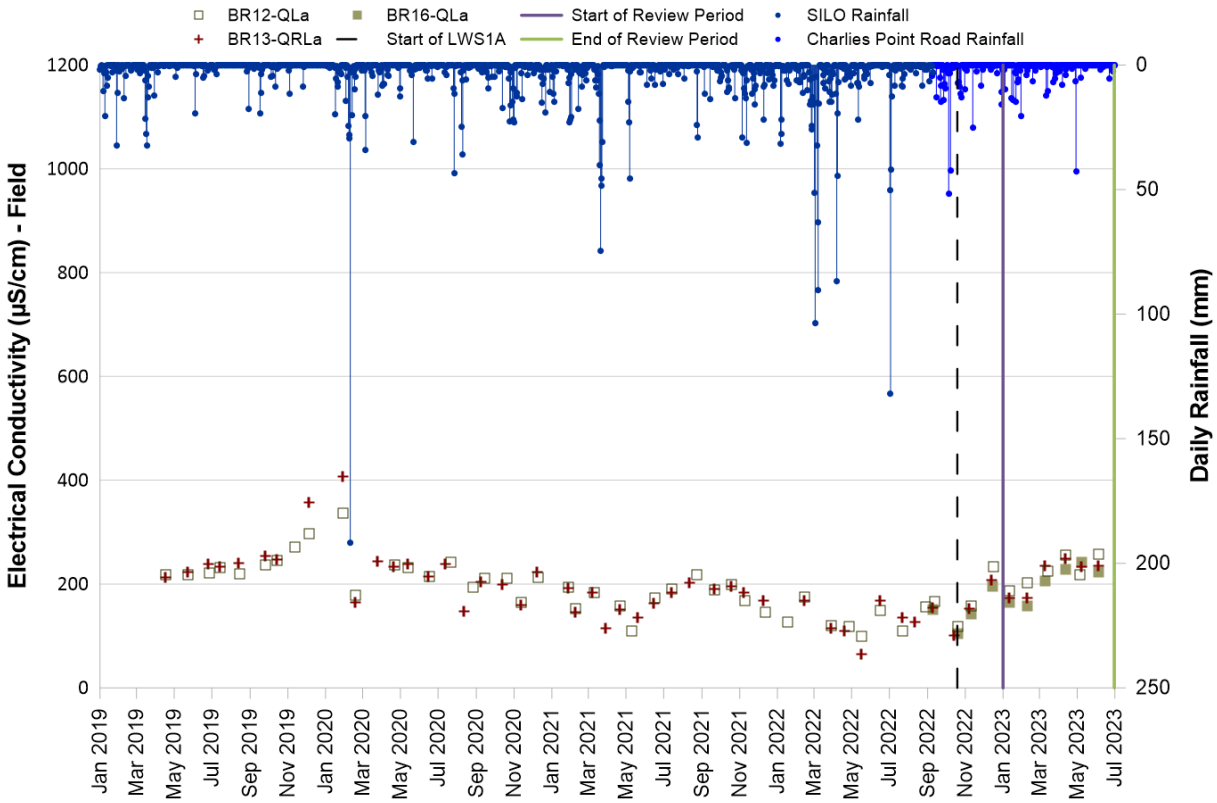


DIAGRAM C2.2: FIELD AND LABORATORY ELECTRICAL CONDUCTIVITY RECORDS



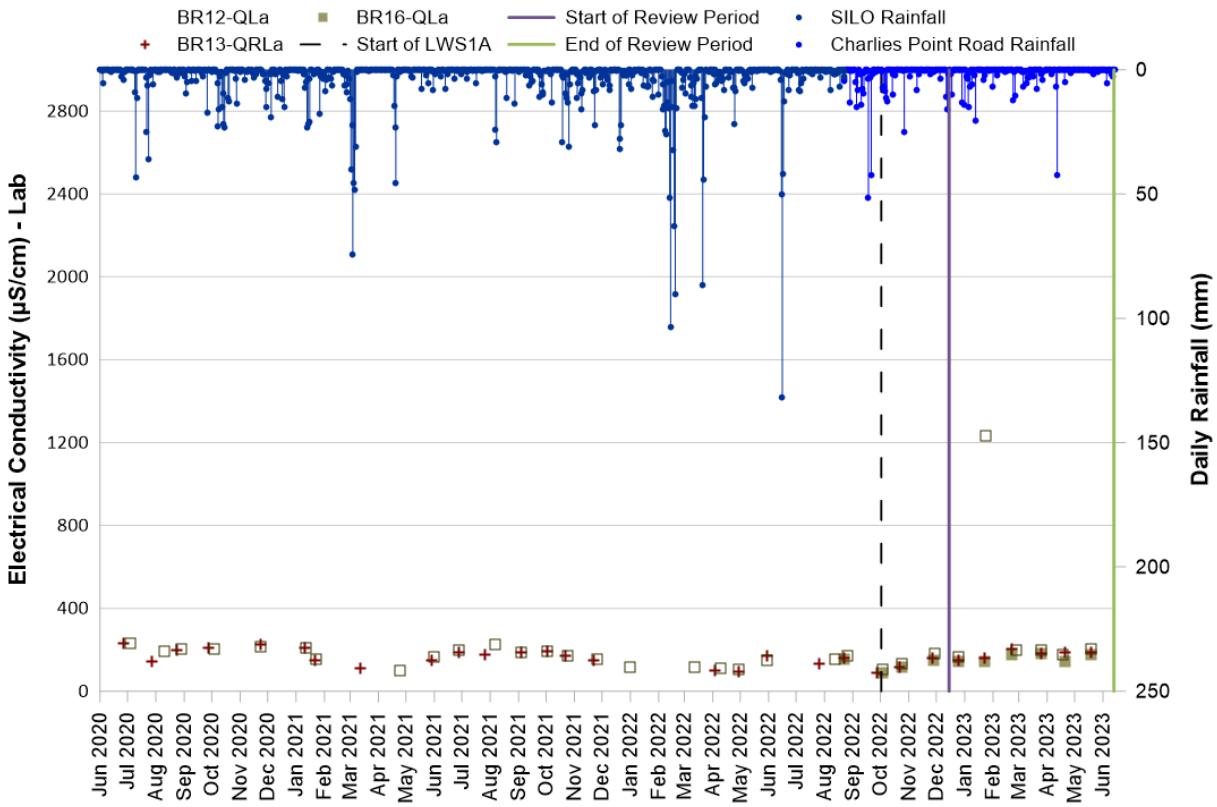


DIAGRAM C2.3: DISSOLVED ALUMINIUM RECORDS

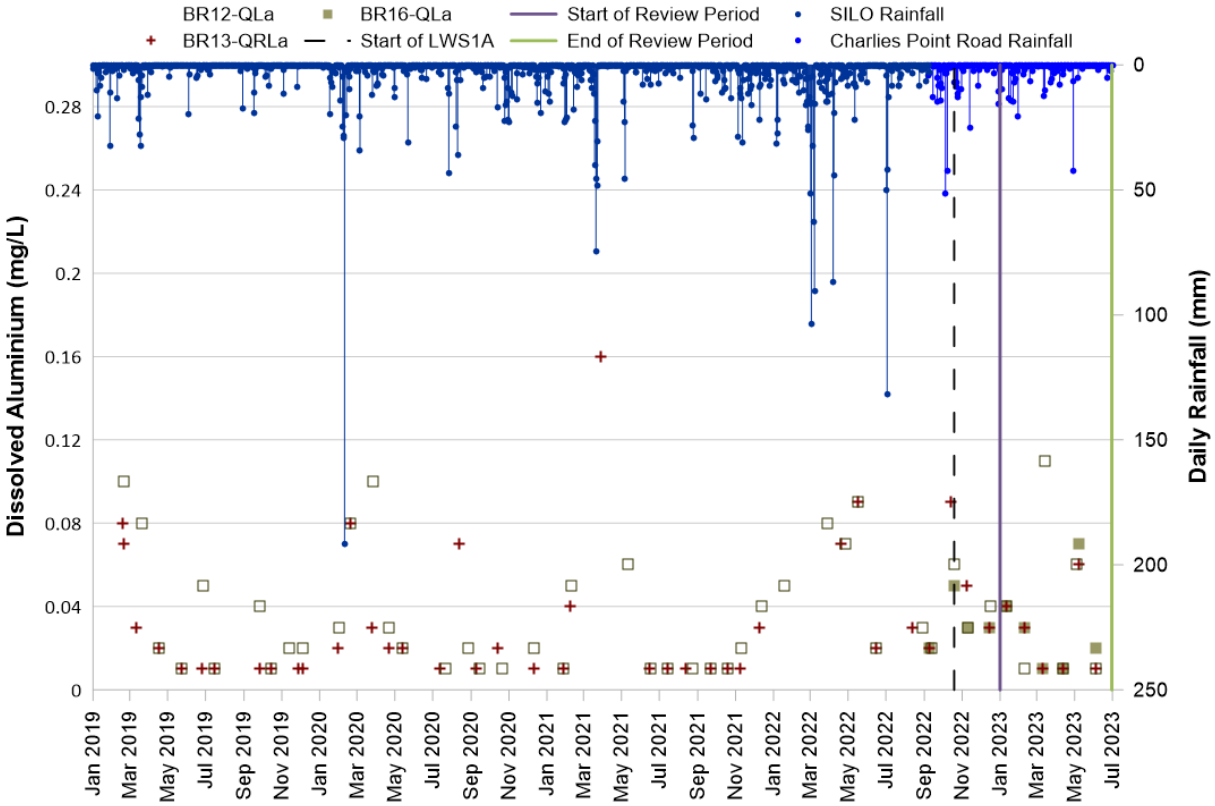


DIAGRAM C2.4: DISSOLVED COPPER RECORDS

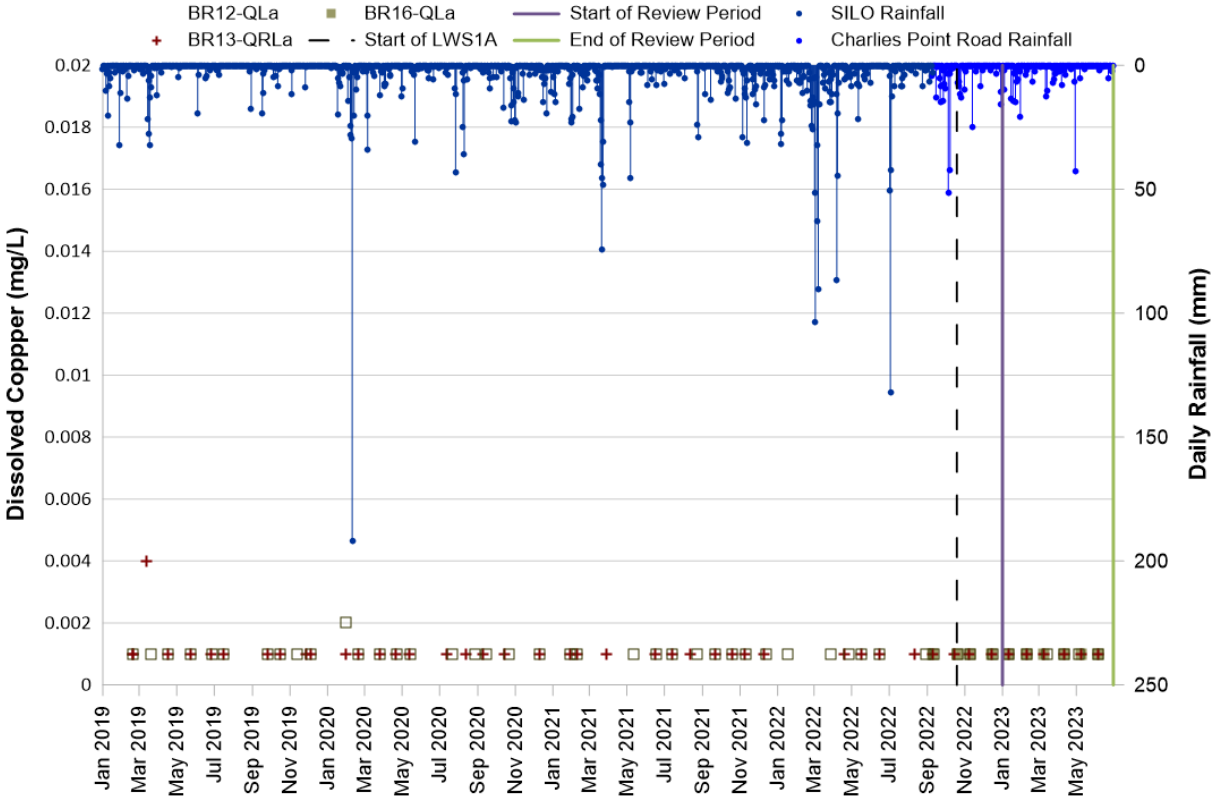


DIAGRAM C2.5: DISSOLVED IRON RECORDS

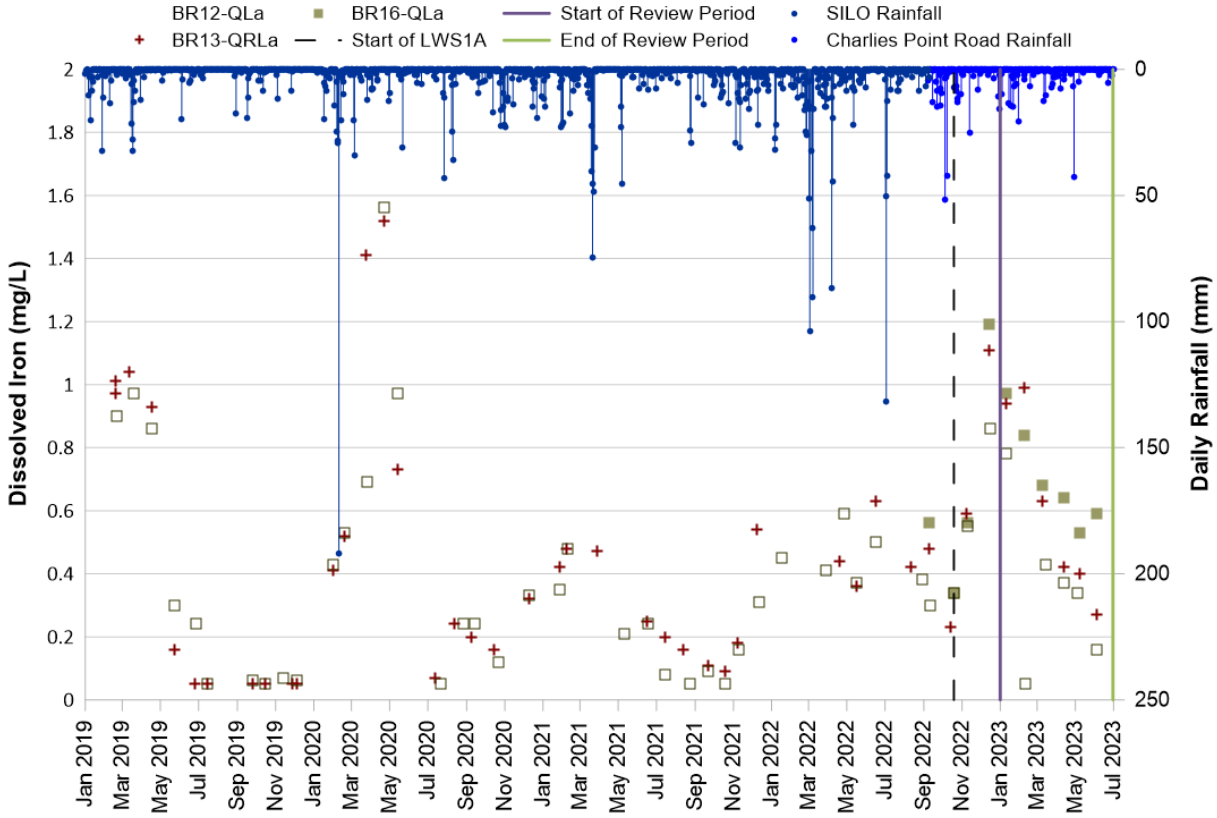


DIAGRAM C2.6: DISSOLVED MANGANESE RECORDS

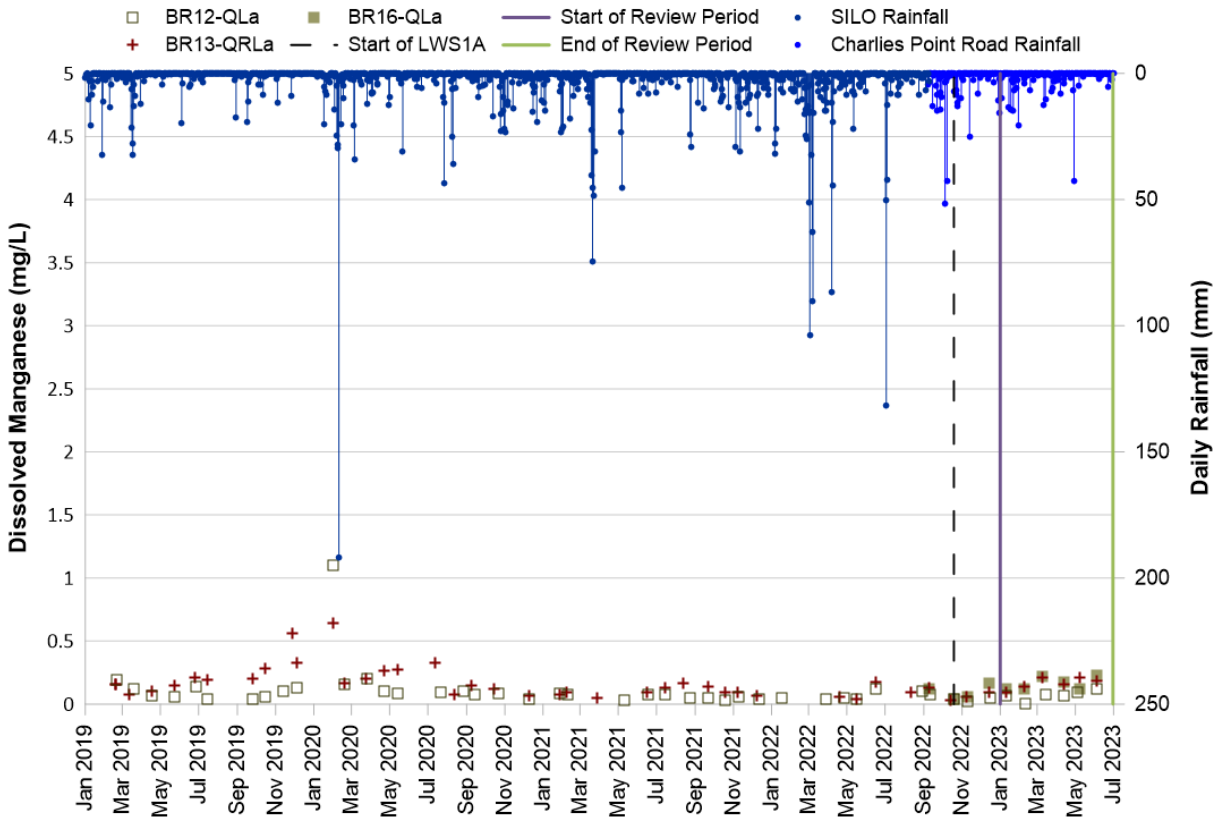


DIAGRAM C2.7: DISSOLVED NICKEL RECORDS

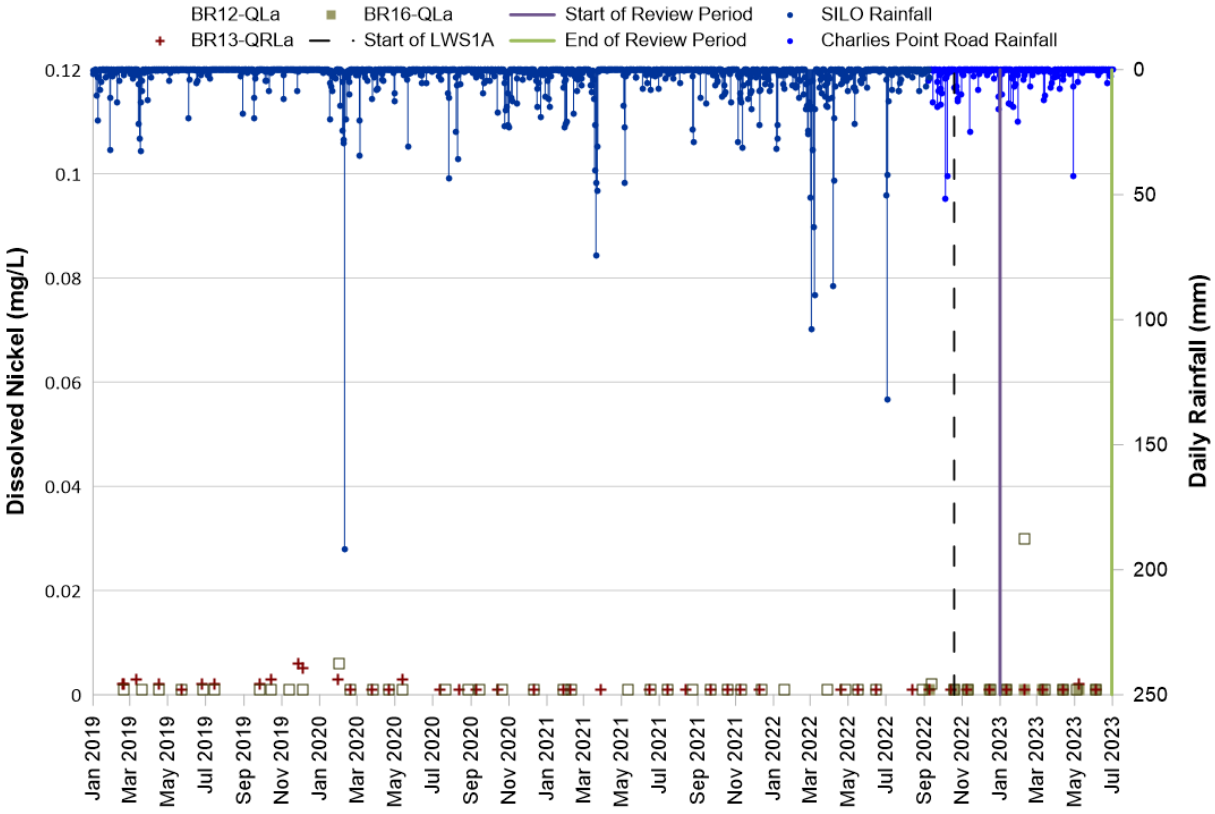
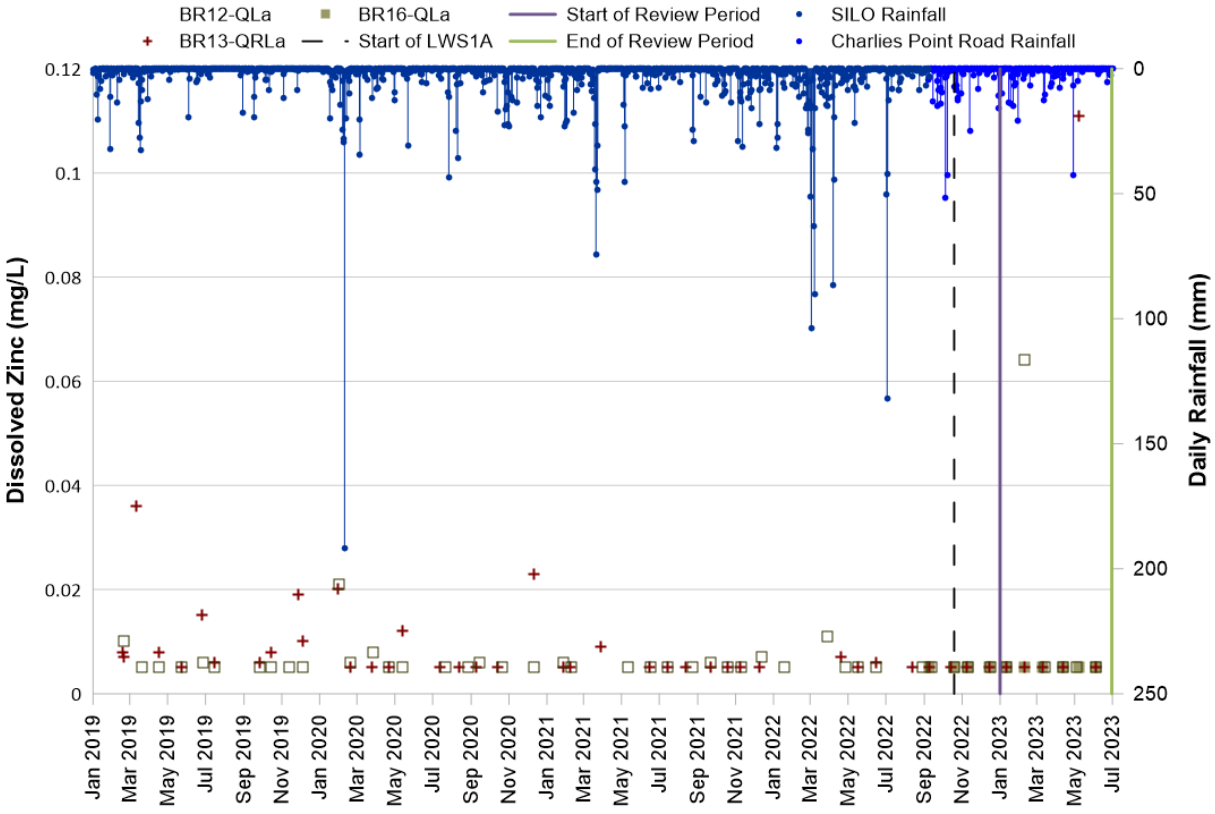


DIAGRAM C2.8: DISSOLVED ZINC RECORDS



Appendix C – Creek Monitoring Reports

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

SIMEC Mining – Tahmoor Coking Coal
Remembrance Driveway
TAHMOOR NSW 2573

Attention: April Hudson

RE: 15 March 2023 Tahmoor South Longwall S1A Monitoring:

April,

Please find discussed below observations in Teatree Hollow at the following pool sites, TT2, TT3, TT5, TT7, TT9, TT11, TT12, TT13, TT14, and CM7 from surveys conducted on the 1st of March 2023. Sediment knickpoints K71, K73, K78 and K79 were also inspected.

Pool TT2,

Visual inspections within the Longwall S1A active subsidence area at site TT2 on 15 March 2023 as shown in **Figure 1**, identified that the hydraulic control on the downstream end of the pool was 1000 mm Wide x 17 mm deep with water flowing over the hydraulic control. There were no new changes or fractures, no gas discharge and the water level is consistent with the recent rainfall totals.

At site TT2, there was no observed impact to pool water level, overland connected flow, iron staining, gas release or turbidity as compared with baseline conditions conducted in September 2022. TT2 was therefore within TARP Level Normal Condition.

Stream Section Between TT2 and TT3.

23.6 mmm of rain fell at the Charlies Pt Rod rain gauge between 18:00 on the 12th of March 2023 and 16:00 on the 14th of March 2023. Teatree Hollow Tributary between TT2 and TT3 was now flowing as shown in **Figure 1**. Water stopped flowing just past TT3 with flowing water not appearing again until the confluence with Teatree Hollow.

The sediment knick point, identified in the February 2023 inspection, 460 mm wide by 560 deep was submerged. The size of this knickpoint has not increased since the 1 March 2023 inspection.

The cracking identified in the February 2023 report was now submerged.

Pool TT3,

Visual inspections within the Longwall S1A active subsidence area at site TT3 on 15 March 2023 as shown in **Figure 1,** identified that the hydraulic control on the downstream end of the pool was 645 mm wide with 10 mm of water flowing over the

hydraulic control. There were no new fractures, iron staining, gas release or turbidity as compared with baseline conditions.

At site TT3, there was a change in pool water level from 1 March 2023 with the pool no longer being dry. The 23.6 mm of rain most likely had an impact on this pool. TT3 was therefore within TARP Level Normal.

Pool TT7,

Visual inspections within the Longwall S1A active subsidence area at site TT7 on 1 March 2023 as shown in **Figure 2**, identified that the hydraulic control on the downstream end of the pool was 980 mm Wide with water not flowing over the hydraulic control. No fractures, no gas discharge and the water level is inconsistent with the recent rainfall totals.

At site TT7, there was an observed impact to pool water level. No overland connected flow, iron staining, gas release or turbidity had changed as compared with baseline conditions conducted in September 2022. TT7 was therefore within TARP Level 1.

Pool TT9,

Visual inspections within the Longwall S1A active subsidence area at site TT9 on 1 March 2023 as shown in **Figure 1**, identified that the hydraulic control on the downstream end of the pool was 650mm wide with 130 mm of water flowing over the hydraulic control. There were no new changes or fractures and no gas discharge. The water level was consistent with the low flow detected at CM3 approximately 300 metres upstream.

At site TT9, there was a change in pool water level that was not seen in the baseline conditions of September 2022 or later but was consistent with the flow upstream at CM3. There were no observed, overland connected flow, iron staining, or gas release. Turbidity has increased as compared with baseline conditions conducted in August 2022 but consistent with the inspection on 8 February 2023. This will continue to be monitored as the longwall approaches. TT9 was therefore within TARP Normal Condition.

Pool TT11

Visual inspections within the Longwall S1A active subsidence area at site TT11 on 15 March 2023 as shown in **Figure 1,** identified that the hydraulic control on the downstream end of the pool was 3500 mm wide with water flowing around the hydraulic control. It does not appear the water level flowing around the weir was caused by cracking but more the age and the engineering of the weir. There were no new fractures, iron staining, gas release or turbidity as compared with baseline conditions. The water level was not consistent with the recent rainfall totals.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

At site TT11, there was a change in pool water level from 1 March 2023 with the pool no longer being dry. The 23.6 mm of rain most likely had an impact on this pool. TT3 was therefore within TARP Level Normal.

Pool TT12,

Visual inspections within the Longwall S1A active subsidence area at site TT12 on 1 March 2023 as shown in **Figure 2**, identified that pool was dry. There was fracturing both upstream and downstream of the pool. As the pool was dry there was no gas discharge noted. The water level is inconsistent with the upstream pool at TT9 with flow stopping approximately 100 metres upstream of TT12.

At site TT12, there was an observed impact to pool water level, TT12 was therefore within TARP Level 1.

Downstream TT12

Approximately 50 metres downstream of TT12 the iron staining identified in the 1 March 2023 survey was still evident. The 15 cracks identified in the 1 March 2023 report had lengthened and widened. During this inspection and additional 7 cracks were identified. This area is currently assessed as being within TARP Level 1.

Pool TT13

Visual inspections within the Longwall S1A active subsidence area at site TT13 on 15 March 2023 as shown in **Figure 2,** identified that the hydraulic control on the downstream end of the pool was 850mm wide and the pool being dry. There were no new changes or fractures and no gas discharge. However, the water level was not consistent with the recent rainfall totals.

At site TT13, there was a change in pool water level that was not seen in the baseline conditions of September 2022 or later. There was evidence of rain ponding above TT13, but water did not flow again until the Teatree Hollow tributary met the Teatree Hollow stream. TT13 was therefore within TARP Level 1.

Channel Morphology CM3

Visual inspections within the Longwall S1A active subsidence area at site CM3 on 15 March 2023 as shown in **Figure 3**, identified that the hydraulic control on the downstream end of the pool was 280mm wide with 25 mm of water flowing over the hydraulic control. No shearing or cracking was identified. No additional iron seeps were noted beyond what was identified the baseline survey. No gas discharge was detected.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

At site CM3, there was no evidence of further development of soft knickpoints as compared with baseline conditions conducted in October 2022. CM3 was therefore within TARP Level Normal Condition.

Channel Morphology CM7

Visual inspections within the Longwall S1A active subsidence area at site CM7 on 15 March 2023 as shown in **Figure 3**, identified that the 8 depressions within the rockbar area were all flowing over their hydraulic control. No further shearing or cracking was identified beyond what was noted in the baseline survey of October 2022. No additional iron seeps were noted beyond what was identified the baseline survey at depression 5 and rockbar 5. No gas discharge was detected. The cracking on the southern side of rockbar 2 that was identified in the November survey showed no sign of increase in size from the last inspection on 1 March 2023.

At site CM7, there was no evidence of further development of soft knickpoints as compared with baseline conditions conducted in October 2022. CM7 was therefore within TARP Level Normal Condition.

Knickpoints TT13-K71, TT9-K73, K78, K79,

Visual inspections within the Longwall S1A active subsidence area at knickpoints TT13-K71, TT9-K73 and K78 on 15 March 2023, as shown in **Figure 3,** did not identify further development growth of the knickpoints since the baseline survey in July and August 2023. K79 is no longer able to be assessed against the TARP due to the weir construction.

The new potential knickpoint discovered during the February inspection is discussed in the heading titled *Stream Section Between TT2 and TT3* and shown in **Figure 3**.

Knickpoints K71, K73 and K78 are therefore within TARP Level Normal Condition.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Figure 1
Tahmoor South S1A WMP5 and WMP6 PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF WATERCOURSES

Tarp Normal
Tarp Level 1
Tarp Level 2
Tarp Level 3

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Figure 2
Tahmoor South S1A WMP5 and WMP6 PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF WATERCOURSES

Tarp Normal
Tarp Level 1
Tarp Level 2
Tarp Level 3

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Figure 3
Tahmoor South S1A
WMP7 CHANNEL STABILITY, SEDIMENTATION AND EROSION

Tarp Normal

Tarp Level 1

Tarp Level 2

15/17 Cemetery Rd
Helensburgh NSW 2508

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

SIMEC Mining – Tahmoor Coking Coal
Remembrance Driveway
TAHMOOR NSW 2573

Attention: April Hudson

RE: 28 June 2023 Tahmoor South Longwall S1A Monitoring:

April,

Please find discussed below observations in Teatree Hollow at the following pool sites, TT1, TT2, TT3, TT5, TT7, TT9, TT11, TT12, TT13, TT14, and CM7 from surveys conducted on the 14 June 2023. Sediment knickpoints K71, K73, K78 and K79 were also inspected.

Pool TT1

On 28 June 2023 visual inspections were conducted outside the Longwall S1A active subsidence area at site TT1 as shown in Figure 1. It was identified that the hydraulic control on the downstream end of the pool was 410 mm wide with 75 mm of water flowing over the hydraulic control. There were no new changes or fractures, no gas discharge and the water level is consistent with the recent rainfall totals.

At site TT1, there was no observed impact to pool water level. There was no overland connected flow, iron staining, gas release or turbidity as compared with baseline conditions conducted in September 2022. TT1 is therefore within TARP Level Normal Condition.

Pool TT2,

On 28 June 2023 visual inspections were conducted within the Longwall S1A active subsidence area at site TT2 as shown in **Figure 1.** It was identified that the hydraulic control on the downstream end of the pool was 1100 mm wide with water not flowing over the hydraulic control. There were no new changes or fractures, no gas discharge and the water level is consistent with the recent rainfall totals.

At site TT2, there was an observed impact to pool water level. Water trickled out of TT1 and along the Teatree Hollow Tributary and dried up approximately 95 metres downstream of TT1. Water reappears at knickpoint K64 but only as a no flowing depression below K64. Water was not flowing into or out of TT2 which is approximately 160 metres downstream of K64.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

There was no overland connected flow, iron staining, gas release or turbidity as compared with baseline conditions conducted in September 2022. TT2 is therefore within TARP Level 1, due to there being no water flowing out of TT2 and the upstream pool TT1 has water flowing in and out.

Stream Section Between TT2 and TT3.

Between 09:00 on 14 June 2023, and 09:00 on 28 June 2023, 7.6 mm of rain was recorded at the Charlies Pt Road rain gauge. The Teatree Hollow Tributary between TT2 and TT3 was not flowing, and even the puddles observed during the 31 May 2023 inspection had evaporated, as depicted in Figure 1. Additionally, water had stopped flowing at the downstream hydraulic control of pool TT2, and water did not appear again until TT7.

The sediment knick point, identified in the February 2023 inspection, 460 mm wide by 560 deep was dry. The size of this knickpoint has not increased since the 1 March 2023 inspection.

The cracking identified in the February 2023 report has not increased in size.

During this inspection, the iron staining identified approximately 250 meters downstream of Pool TT2 on May 17, 2023, was not present.

Pool TT3,

On 28 June 2023 Visual inspections were conducted within the Longwall S1A active subsidence area at site TT3 as shown in **Figure 1**. It was identified that the hydraulic control on the downstream end of the pool was 1200mm wide and the pool was dry. No new fractures, iron staining, gas release, or turbidity were observed as compared to the baseline conditions.

According to the 5 May 2023 inspection of the rock shelter forming the eastern bank of TT11, pool TT3 was holding water at that time. However, currently, the pool is dry. Based on this information, it can be concluded that site TT3 is currently within TARP Level 1.

Pool TT7,

On 28 June 2023 Visual inspections were conducted within the Longwall S1A active subsidence area at site TT7 as shown in **Figure 2**. It was identified that the hydraulic control on the downstream end of the pool was 630 mm wide with water not flowing over the hydraulic control. No fractures, no gas discharge and the water level is inconsistent with the upstream flow at TT9.

At site TT7, there was an observed impact to pool water level. No overland connected flow, gas release or turbidity had changed as compared with baseline conditions conducted in

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

September 2022. Iron staining was identified at the upstream section of the pool which would normally be filled with water. TT7's impact was first noted in the 29 March 2023 inspection and is therefore within TARP Level 2.

Pool TT9,

On 28 June 2023, visual inspections were conducted within the Longwall S1A active subsidence area at site TT9 as shown in **Figure 1**. It was identified that the hydraulic control on the downstream end of the pool was 700 mm wide with 250 mm of water flowing over the hydraulic control. There were no new changes or fractures observed, and there was no gas discharge. The water level in the pool was consistent with the low flow that was detected at CM3, which is approximately 300 meters upstream.

There was a change in the water level of the pool at site TT9 that was not observed in the baseline conditions of September 2022. However, this change was consistent with the flow upstream at CM3. There were no signs of overland connected flow, iron staining, or gas release observed during the inspection.

While the turbidity had increased compared to the baseline conditions conducted in August 2022, it has not changed since the last inspection of 14 June 2023. These factors indicate that the site is currently within TARP Normal Condition.

Pool TT11

On 28 June 2023, visual inspections were conducted within the Longwall S1A active subsidence area at site TT11, as shown in Figure 1. It was identified that the hydraulic control on the downstream end of the pool was 3500 mm wide, and the pool was dry. No new fractures, iron staining, gas release, or turbidity were observed as compared to the baseline conditions.

According to the 5 May 2023 inspection of the rock shelter forming the eastern bank of TT11, the pool at site TT11 was holding water at that time. However, currently, the pool is dry. Based on this information, it can be concluded that site TT11 is currently within TARP Level 1.

Pool TT12,

On 28 June 2023, visual inspections were conducted within the Longwall S1A active subsidence area at site TT12, as shown in Figure 2. It was observed that the pool was dry, and there was fracturing both upstream and downstream of the pool. Since the pool was dry, no gas discharge was noted during the inspection.

Based on the observation of a 3-month impact to the pool water level and the investigation and confirmation of the change in behaviour being related to mining effects at site TT12, it can be concluded that the site is currently assessed as being within TARP Level 3.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Downstream TT12

During the inspection, it was observed that the iron staining identified in the 1 March 2023 survey was still evident approximately 50 meters downstream of TT12. The number of cracks in the area has remained steady at 26. During this inspection, it was observed that the length and width of the cracks have increased.

Based on the consecutive observation of the lengthening and widening of the previous cracks over a three-month period, and the confirmation that these changes are related to mining effects, the area is currently assessed as being within TARP Level 3.

Pool TT13

Visual inspections were conducted on 28 June 2023 within the Longwall S1A active subsidence area at site TT13, as shown in Figure 2. The inspection revealed that the hydraulic control was 850mm wide and the pool completely dry. No new changes or fractures were observed during the inspection, and no gas discharge was noted at the site.

Based on the observation of a 3-month impact to the pool water level and the investigation and confirmation of the change in behaviour being related to mining effects at site TT13, it can be concluded that the site is currently assessed as being within TARP Level 3.

Channel Morphology CM3

On 28 June 2023, visual inspections were conducted within the Longwall S1A active subsidence area at site CM3, as shown in Figure 3. The inspection revealed that the hydraulic control on the downstream end of the pool was 600 mm wide, and there was no water flowing over the hydraulic control. The pool had been reduced to a small puddle, and no shearing or cracking was identified. Furthermore, no additional iron seeps were noted beyond what was identified in the baseline survey, and no gas discharge was detected during the inspection.

Based on the inspection conducted on 28 June 2023, it was observed that there was no evidence of further development of soft knickpoints at site CM3 as compared with the baseline conditions conducted in October 2022. Therefore, it can be concluded that site CM3 is currently within TARP Level Normal Condition.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Channel Morphology CM7

On 28 June 2023, visual inspections were conducted within the Longwall S1A active subsidence area at site CM7, as shown in Figure 3. It was observed that the 8 depressions within the rockbar area were not flowing over their hydraulic control and no water was visible from depression 8 all the way to TT7. No further shearing or cracking was identified beyond what was noted in the baseline survey conducted in October 2022. Moreover, no additional iron seeps were noted beyond what was identified in the baseline survey at depression 5 and rockbar 5, and no gas discharge was detected during the inspection.

It was also noted that the cracking on the southern side of rockbar 2, which was identified in the November survey, showed no sign of an increase in size from the last inspection conducted on 14 June 2023.

At site CM7, there was no evidence of further development of soft knickpoints, or increased erosion compared to the baseline conditions observed in October 2022. Therefore, CM7 is currently assessed as being within TARP Level Normal Condition.

Knickpoints TT13-K71, TT9-K73, K78, K79,

Visual inspections conducted on 28 June, 2023, within the Longwall S1A active subsidence area at knickpoints TT13-K71, TT9-K73, and K78, as shown in Figure 3, did not identify any further growth or development of the knickpoints since the baseline survey conducted in July and August 2022. However, K79 cannot be assessed against the TARP due to the weir construction.

The new potential knickpoint discovered during the February inspection is discussed in the heading titled *Stream Section Between TT2 and TT3* and shown in **Figure 3**.

Knickpoints K71, K73 and K78 are therefore within TARP Level Normal Condition.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Figure 1
Tahmoor South S1A WMP5 and WMP6 PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF WATERCOURSES

Tarp Normal
Tarp Level 1
Tarp Level 2
Tarp Level 3

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Figure 2
Tahmoor South S1A
WMP5 and WMP6
PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF WATERCOURSES

Tarp Normal

Tarp Level 1

Tarp Level 2

Tarp Level 3

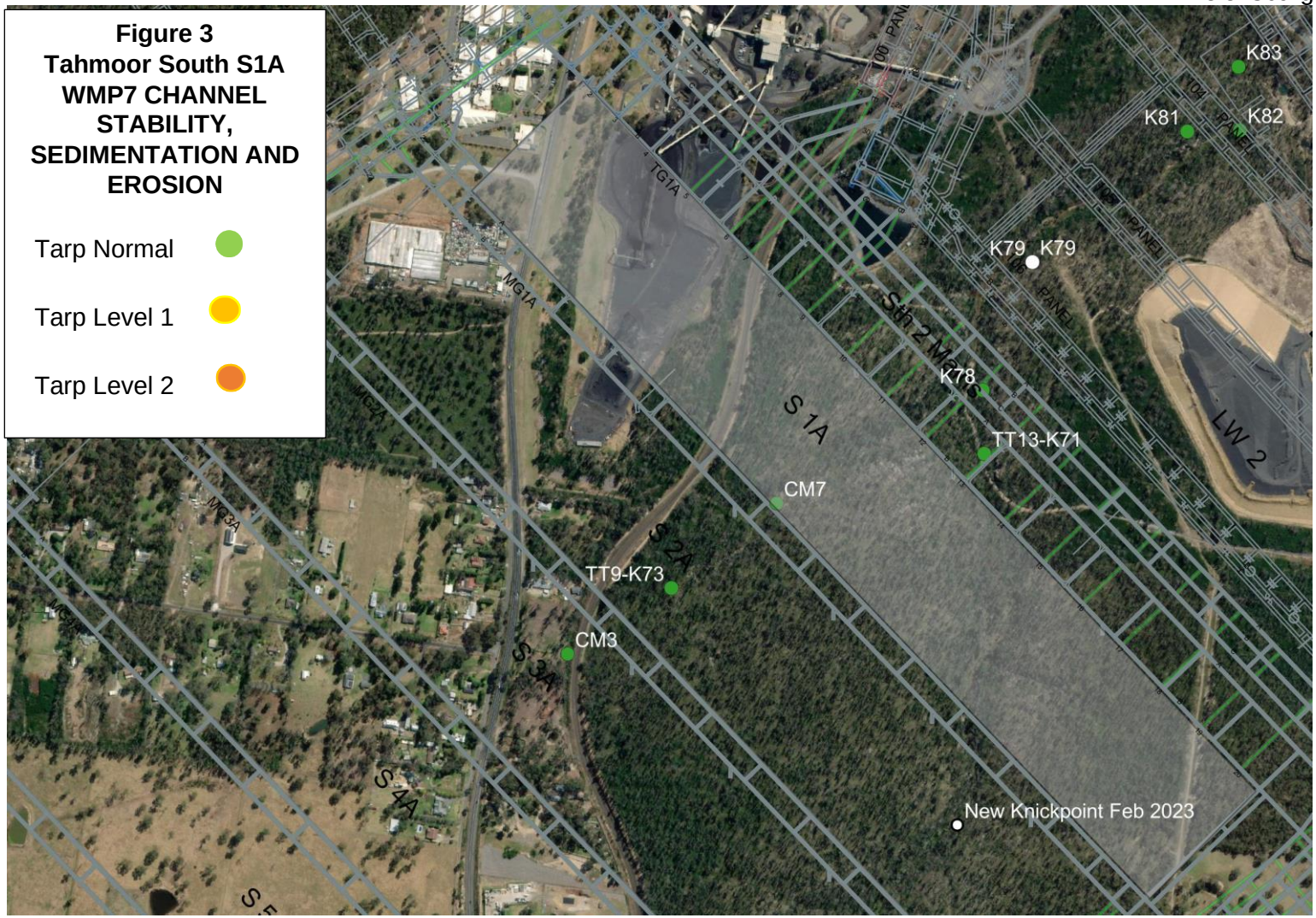
Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Figure 3
Tahmoor South S1A
WMP7 CHANNEL STABILITY, SEDIMENTATION AND EROSION

Tarp Normal

Tarp Level 1

Tarp Level 2



Teatree Hollow – TT1

Upstream 18/08/2022

Upstream 28/06/2023

Downstream 18/08/2022

Downstream 28/06/2023

Teatree Hollow – TT2

Upstream 6/02/2013

Upstream 28/06/2023

Downstream 6/02/2013

Downstream 28/06/2023

Teatree Hollow – TT3

Upstream 6/02/2013

Upstream 28/06/2023

Downstream 6/02/2013

Downstream 28/06/2023

Teatree Hollow – TT5

Upstream 08/02/2022

Upstream 28/06/2023

Downstream 08/02/2022

Downstream 28/06/2023

Additional 08/02/2022

Additional Iron Staining 28/06/2023

Teatree Hollow – TT7

Upstream 6/02/2013

Upstream 28/06/2023

Downstream 6/02/2013

Downstream 28/06/2023

Additional Iron Staining 12/04/2023

Additional Iron Staining 28/06/2023

Teatree Hollow – TT9

Upstream 6/02/2013

Upstream 28/06/2023

Downstream 6/02/2013

Downstream 28/06/2023

Additional Photo Cracking upstream 08/02/2023

Additional Photo Cracking upstream 28/06/2023

Teatree Hollow – TT11

Upstream 6/02/2013

Upstream 28/06/2023

Downstream 6/02/2013

Downstream 28/06/2023

Teatree Hollow – TT12 Upstream Cracking

Crack 15 29/03/2023

Crack 15 28/06/2023

Teatree Hollow – TT12

Upstream 10/08/2022

Upstream 28/06/2023

Downstream 10/08/2022

Downstream 28/06/2023

Downstream Knick point 10/08/2022

Downstream Knick point 28/06/2023

Additional photo Iron Staining 10/08/2022

Additional photo Iron Staining 28/06/2023

Teatree Hollow – TT12 Downstream Cracking

Crack 1 01/03/2023

Crack 1 28/06/2023

Crack 2 01/03/2023

Crack 2 28/06/2023

Crack 3 01/03/2023

Crack 3 28/06/2023

Crack 4 01/03/2023

Crack 4 28/06/2023

Crack 5 01/03/2023

Crack 5 28/06/2023

Crack 6 01/03/2023

Crack 6 28/06/2023

Crack 7 01/03/2023

Crack 7 28/06/2023

Crack 8 01/03/2023

Crack 8 28/06/2023

Crack 9 01/03/2023

Crack 9 28/06/2023

Crack 10 01/03/2023

Crack 10 28/06/2023

Crack 11 01/03/2023

Crack 11 28/06/2023

Crack 12 01/03/2023

Crack 12 28/06/2023

Crack 13 01/03/2023

Crack 13 28/06/2023

Crack 14 01/03/2023

Crack 14 28/06/2023

Crack 15 01/03/2023

Crack 15 28/06/2023

Crack 16 15/03/2023

Crack 16 28/06/2023

Crack 17 15/03/2023

Crack 17 28/06/2023

Crack 18 15/03/2023

Crack 18 28/06/2023

Crack 19 15/03/2023

Crack 19 28/06/2023

Crack 20 15/03/2023

Crack 20 28/06/2023

Crack 21 15/03/2023

Crack 21 28/06/2023

Crack 22 15/03/2023

Crack 22 28/06/2023

Crack 23 29/03/2023

Crack 23 28/06/2023

Crack 24 26/04/2023

Crack 24 28/06/2023

Crack 25 26/04/2023

Crack 25 28/06/2023

Crack 26 18/05/2023

Crack 26 28/06/2023

Teatree Hollow – TT12 Downstream

Iron Staining 1 01/03/2023

Iron Staining 1 28/06/2023

Iron Staining 2 01/03/2023

Iron Staining 2 28/06/2023

Iron Staining 3 01/03/2023

Iron Staining 3 28/06/2023

Iron Staining 4 01/03/2023

Iron Staining 4 28/06/2023

Iron Staining 5 01/03/2023

Iron Staining 5 28/06/2023

Iron Staining 6 01/03/2023

Iron Staining 6 28/06/2023

Iron Staining 7 01/03/2023

Iron Staining 7 28/06/2023

Iron Staining 8 01/03/2023

Iron Staining 8 28/06/2023

Iron Staining 9 01/03/2023

Iron Staining 9 28/06/2023

Teatree Hollow – TT13

Upstream 10/08/2022

Upstream 28/06/2023

Downstream 10/08/2022

Downstream 28/06/2023

Teatree Hollow – TT14

Upstream 6/02/2013

Upstream 28/06/2023

Downstream 10/08/2022

Downstream 28/06/2023

Additional Photo Iron Staining 08/02/2023

Additional Photo Iron Staining 28/06/2023

Additional photo 2 Iron Staining 08/02/2023

Additional photo 2 Iron Staining 28/06/2023

Teatree Hollow /CM3

Upstream 27/10/2022

Upstream 28/06/2023

Downstream 27/10/2022

Downstream 28/06/2023

Teatree Hollow /CM7

Pool 1 Up 27/10/2022

Depression 1 Up 28/06/2023

Depression 1 Down 27/10/2022

Depression 1 Down 28/06/2023

Depression 2 Up 27/10/2022

Depression 2 Up 28/06/2023

Depression 2 Down 27/10/2022

Depression 2 Down 28/06/2023

Depression 3 Up 27/10/2022

Depression 3 Up 28/06/2023

Depression 3 Down 27/10/2022

Depression 3 Down 28/06/2023

Depression 4 Up 27/10/2022

Depression 4 Up 28/06/2023

Depression 4 Down 27/10/2022

Depression 4 Down 28/06/2023

Depression 5 Up 27/10/2022

Depression 5 Up 28/06/2023

Depression 5 Down 27/10/2022

Depression 5 Down 28/06/2023

Depression 6 Up 27/10/2022

Depression 6 Up 28/06/2023

Depression 6 Down 19/10/2022

Depression 6 Down 28/06/2023

Depression 7 Up 19/10/2022

Depression 7 Up 28/06/2023

Depression 7 Down 19/10/2022

Depression 7 Down 28/06/2023

Depression 8 Up 27/10/2022

Depression 8 Up 28/06/2023

South Rockbank looking south at Depression 7
19/10/2022

South Rockbank looking south at Depression 7
28/06/2023

South Rockbank flowing into Depression 5
19/10/2022

South Rockbank flowing into Depression 5
28/06/2023

Weathering, cracking on North bank of Rockbar 2
19/10/2022

Weathering, cracking on North bank of Rockbar 2
28/06/2023

Joint on north rockbank at rockbar 2 Depression 3 Looking north 19/10/2022

Joint on north rockbank at rockbar 2 Depression 3 Looking north 28/06/2023

Cracking on South bank of Rockbar 2 15/11/2022

Cracking on South bank of Rockbar 2 28/06/2023

Knickpoint – K73

Upstream 18/08/2022

Upstream 28/06/2023

Downstream 18/08/2022

Downstream 28/06/2023

Knickpoint – K78

Upstream 27/07/2022

Upstream 28/06/2023

Downstream 27/07/2022

Downstream 28/06/2023

Appendix D – Groundwater Monitoring Report

Six-Monthly Groundwater Monitoring: January – June 2023

Tahmoor South Domain

Tahmoor Coal Pty Ltd

2975 Remembrance Driveway, Bargo NSW 2574

Prepared by:

SLR Consulting Australia Pty Ltd

Level 11, 176 Wellington Parade, East Melbourne, VIC, Australia, 3002

SLR Project No.: 640.30614.00000

1 October 2023

Revision: 2.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	26 September 2023	K Selvaratnam/S Hulbert	KJ Wallis	KJ Wallis
2.0	1 October 2023	K Selvaratnam/S Hulbert	S Hulbert	S Hulbert

Basis of Report

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Tahmoor Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Table of Contents

Tables in Text

Figures in Text

Appendices

Acronyms and Abbreviations

Al	Aluminium
As	Arsenic
BHCS	Bald Hill Claystone
Ba	Barium
BGSS	Bulgo Sandstone
BUCO	Bulli Coal Seam
CCL	Consolidated Coal Lease
Cu	Copper
EC	Electrical Conductivity
Filt	Filtered
HBSS	Hawkesbury Sandstone
Fe	Iron
Pb	Lead
Li	Lithium
LW	Longwall
Mn	Manganese
ML	Mining Lease
Ni	Nickel
pH	Potential of Hydrogen
Se	Selenium
SSD	State Significant Development
Sr	Strontium
TDS	Total Dissolved Solids
TARP	Trigger Action Response Plan
VWP	Vibrating Wire Piezometer
WWCO	Wongawilli Coal Seam
WBCS	Wombarra Claystone
WMP	Water Management Plan
WWFM	Wianamatta Form
Zn	Zinc

1.0 Introduction

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) was engaged by Tahmoor Coal Pty Ltd (Tahmoor Coal) to undertake a review of groundwater data, which has been collected by Consulting Earth Scientists Pty Ltd (CES), for the Tahmoor South Domain (Tahmoor South) of the Tahmoor Coal Mine (Tahmoor Mine) between 1st January 2023 and 30th June 2023.

Tahmoor Mine, located approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW), is an underground mine extracting from the Bulli Coal Seam via longwall mining.

Mining at Tahmoor South commenced on 18 October 2022. The Tahmoor South mining area is within Consolidated Coal Lease (CCL) 716 and CCL 747. Tahmoor South comprises 12 longwalls which includes the 'A series' panel of six longwalls and the 'B series' panel of six longwalls. Tahmoor Coal is currently mining the Tahmoor South A series panel of longwalls, which includes longwall (LW) South 1A to South 6A (S1A – S6A). LW S1A – S6A are orientated north-west to south-east.

1.2 Trigger Action Response Plan

In accordance with Condition E5 (f) of the Development Consent (SDD 8445) (the Consent), in the event that performance measures (in the form of pre-defined triggers) are considered to have been exceeded or are likely to be exceeded, a response will be undertaken in accordance with the Trigger Action Response Plans (TARPs) (SLR, 2022).

TARPs for Tahmoor South were established in the Tahmoor South Water Management Plan (WMP) (Tahmoor Coal, 2022) to manage and protect surface water and groundwater within the vicinity of Tahmoor South.

Six TARPs (WMP8 – WMP13) address various components of the groundwater system, and these are presented in Appendix A. Tahmoor South groundwater monitoring sites are captured in the following TARPs:

- WMP8 Shallow Groundwater Level (Open Standpipes and Private Bores);
- WMP9 Shallow Groundwater Pressure (VWP Sensors <200 m Depth);
- WMP10 Groundwater Pressure Deep (VWP Sensor >200 m Depth, excluding monitoring the Bulli Coal Seam);
- WMP11 Groundwater Quality (Open Standpipes and Private Bores);
- WMP12 Groundwater-Surface Water Interaction; and
- WMP13 Groundwater Monitoring Bores for Thirlmere Lakes.

Each TARP has four levels of triggers which range from "Normal Conditions", where the environment is behaving or performing within normal or expected levels, to "Level 1" (L1), "Level 1" (L2) and "Level 3" (L3), where there is an escalating risk to the environment via deviation from baseline or expected conditions (SLR, 2022).

Groundwater level triggers and groundwater quality triggers are discussed in Appendix A and presented in Appendix B.

1.3 Trigger Action Response Plan Amendments

The Water Management Plan, in accordance with Condition E7 (b-e) of the Consent, will be reviewed within three months of the submission of an Annual Review under Condition E13. In light of this review, amendments were proposed to the original TARPs. These are detailed in the 2022 Annual Review documentation.

Recent correspondence from the New South Wales (NSW) Department of Environment (DPE) (REF: OUT23/14318) has considered the proposed amendments and all pertinent here have been accepted, excluding the proposed change to WMP10. Consequently, this six-monthly review reports against the updated TARPs, with some additional discussion included relevant to the ongoing review of WMP10.

1.4 Report Objective

This report assesses the Tahmoor South groundwater monitoring data against the triggers of TARP WMP8 – WMP13 for the reporting period from 1 January 2023 to 30 June 2023 (inclusive).

This report includes:

- A summary of TARP exceedances during the reporting period,
- A summary of trigger exceedances over time including the identification of breaches of triggers that remain within normal condition in this reporting period,
- An outline of potential factors influencing exceedances during the reporting period, and
- Recommendations of relevant actions and responses to be undertaken, in alignment with the TARPs.

The information in this six-monthly report will inform subsequent monthly reports and the overarching Annual Review.

2.0 Monitoring Period Summary

2.1 Mine Operation

Mining at LW S1A was undertaken at Tahmoor South during the reporting period, with bolt up of LW 1A commencing on 12 June 2023 and broke chain on 4 July 2023.

Extraction chainage over the reporting period is summarised in Table 1. The extraction void progressed to 1702.5m as of 29 June 2023. The extraction void progression as of 4 July 2023 (1705.5 m) is shown in Figure 1.

Table 1 LW S1A Extraction Void Progression

Date	Extraction Void Progression (m)
6 February 2023	910.5
6 March 2023	1097.5
2 April 2023	1232.5
1 May 2023	1433.5
1 June 2023	1648.5
29 June 2023	1702.5
4 July 2023	1,705.5

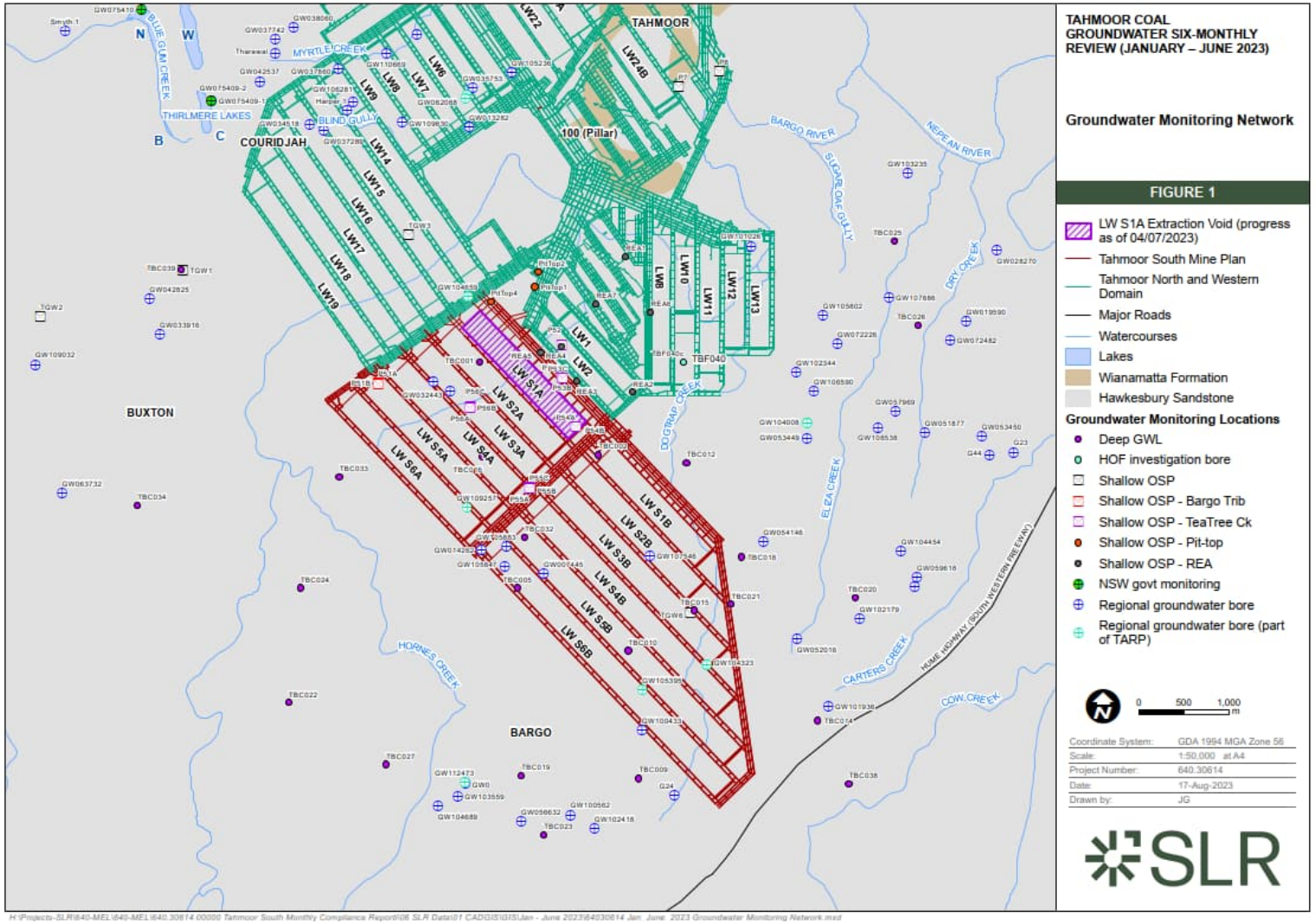


Figure 1 Tahmoor Mine Groundwater Monitoring Network

2.2 Rainfall Analysis

Rainfall over the past 12 months, in comparison to the long-term average (i.e., January 1900 – present) is shown in Table 2. The SILO climate record for the location 0.05° x 0.05° tile centred on a location within proximity of Tahmoor Mine (latitude: -34.25, longitude: 150.60) has been used for this assessment to understand long-term rainfall trends (Queensland Government, 2023).

January 2023 and April 2023 were particularly wet months, where above average rainfall observed with a total monthly total rainfall of 147.4mm and 101.9mm respectively. Comparatively, the remainder of the reporting period was relatively dry with below average rainfall observed. May and June 2023 were particularly dry conditions with a total monthly rainfall of 10.3mm and 16.8mm respectively.

Table 2 Monthly Rainfall vs Long-Term Average Rainfall

SILO (-34.25, 150.60)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Long-term average rainfall (mm)	84.6	113.7	98.9	69.5	53.6	63.3	40.2	47.3	44.2	64.2	79.9	66.2
January – June 2023 monthly rainfall (mm)	147.4	32.9	54.7	101.9	10.3	16.8	-	-	-	-	-	-

Long-term monthly average rainfall, potential evaporation and estimated actual evapotranspiration is presented in Table 2. Excluding the month of June, the evaporation and evapotranspiration are, on average, higher than rainfall.

The historical record of monthly rainfall and the calculated trend in rainfall, using the cumulative residual departure from mean method, is presented in Figure 3 where a positive gradient indicates above average rainfall, whilst a declining trend represents below average. During the reporting period, there have been below average rainfall conditions.

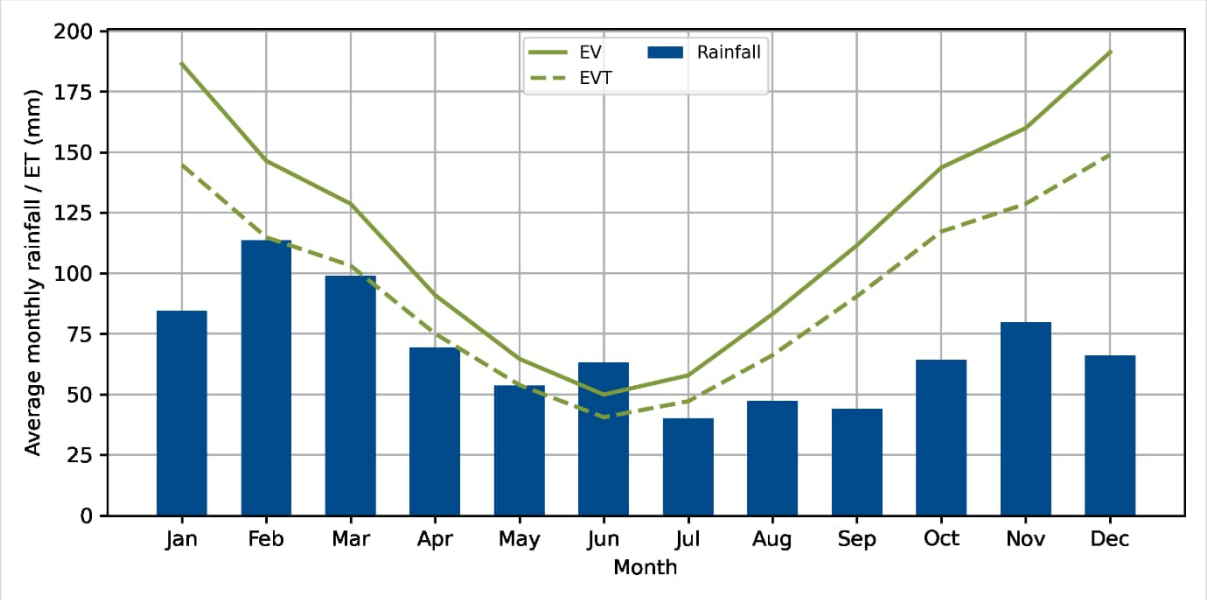


Figure 2 Average Monthly Rainfall, Evaporation and Evapotranspiration

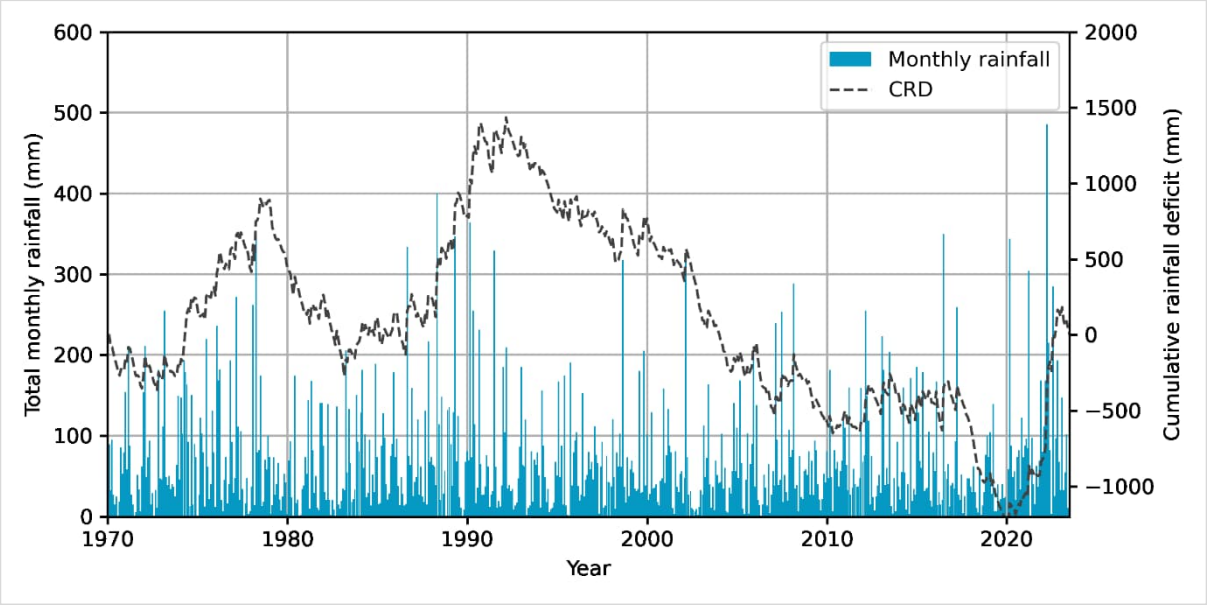


Figure 3 Cumulative Residual Departure and Total Monthly Rainfall

2.3 Monitoring Network Status

The Tahmoor South groundwater monitoring network is shown on Figure 1.

An update on the status of the groundwater monitoring network, and associated data availability, during the reporting period includes:

- P54: groundwater quality and water level logger data were not provided as the bore was observed as being dry since February 2023.
- P53C – groundwater level logger data was not provided for 21 January – 9 May 2023 as the logger was corrupted (presumed malfunction or download error) during this time. Groundwater level logger data for P53C was provided from 10 May 2023 onwards.
- GW062068: groundwater quality and manual dip (level) data were not provided in March, April, May and June 2023 as the bore was inaccessible, due to private landholder infrastructure, during this portion of the reporting period. Access to GW062068 has not been feasible since March 2023 due to bore infrastructure issues. These issues are unable to be resolved and therefore GW062068 was permanently removed from the ongoing monitoring regime in June 2023.
- GW104008: groundwater quality and manual dip (level) data was not provided in May 2023 as the pump was not operational (limited accessibility). The pump was confirmed to be operational in June 2023.
- TBC018 (WWCO-432m): data was not available for download throughout the reporting period.
- TBC026 (ECSL-460m): data was not available for download in January, February, March and April 2023.
- TBC032 (all sensors): data was not available for download in mid-late June 2023.
- TBC09 (BUSM-381m), TBC018 (WBCS-377m). TBC020 (WBCS-397m) and TBC020 (WO-439m): while monitoring data was available for download during the reporting period, drawdown at these locations was not calculated. The historical groundwater level, upon which the drawdown calculation is based upon, is not available for these locations.

- TBC024 (BHCS-168m), TBC032 (HBSS-95m) and TBC034 (BHCS-176m): while monitoring data was available for download during the reporting period, the data appears to be erroneous.

2.4 Site Matters

General site matter noted for the reporting period include:

- Fracturing was observed upstream of Teatree Hollow pool site TT3 on 8 February 2023.
- Fracturing was observed upstream of Teatree Hollow pool site TT12 on 1 March 2023.

2.5 General Groundwater Conditions Summary

2.5.1 Shallow OSP Bores

Groundwater depressurisation has been observed in the deepest Open Standpipes at P55 (P55C) and P56 (P56C). Groundwater elevation at P55C and P56C have been reduced since November 2022 and December 2022, respectively. This groundwater depressurisation in the deeper bores could be due to an ongoing mining effect (LWS1A progression). However, the nested shallower bores (P55A&B and P56A&B are stable with no declining water trends present at all. Additionally, given the relative stability of the water level in P55C since an initial decline in November (i.e., no ongoing declining trend) this cannot definitively be attributed to extraction activities. It is suggested to continue to review the trends in this bore and the associated nested bores in coming months to better understand the trends.

Numerous sites (P51B, P53A, P53B, P53C, and REA4) are showing some consistent decline in water levels since approximately April 2023, although not yet triggering TARP WMP8.

2.5.2 Groundwater – Surface Water Connectivity

Groundwater monitoring is undertaken within nearby vicinity of surface watering at multiple locations to assist with the review of groundwater – surface water interaction. Namely to assist with defining if surface flow changes identified are attributable to baseflow loss due to groundwater depressurisation resultant from mining activities.

Monitoring bores P55A-C are associated with surface water monitoring site TT1-QRLa and together they can be considered when reviewing the surface water – groundwater connectivity TARP (WMP12). TT1-QLa is located approximately 100 m to the west of monitoring bores P55A-C in the Teatree Hollow tributary. Groundwater level at monitoring bore P55C was noted to exhibit groundwater depressurisation, however this was unable to be definitely attributed to mining of LW S1A (refer Section 4.3). A comparison of groundwater level recorded at P55A (shallowest bore in the series) with water levels at TT1-QRLa inferred that negligible change in baseflow contributions to Teatree Hollow tributary in the vicinity of TT1-QLa have occurred during the review period. Therefore, it was concluded that there was no apparent correlation at this point in time between the apparent decline in groundwater level at P55C and the nearby surface water gauging station.

2.5.3 Private Bores

Fluctuations in groundwater levels across the suite of private bores monitored are observed, however this is no identifiable trend and no indication of impact from extraction activities.

2.5.4 Shallow VWPs (sensors <200 metres)

Shallow VWPs are showing variation in responses since commencement of extraction. TBC009 (HBSS – 30m) has experienced a small steady decline of approximately 2 metres since November 2022, however the deeper sensors are remaining relatively stable. TBC018 is also showing approximately 2 metres drawdown in the three shallowest sensors (70m, 117m, 164m),

approximately 1.5 metres decline in the sensor at 179 m and has remained stable in the deepest sensor at 198 m. TBC027 is showing some small steady decline, ranging between 0.5 metres to 1.5 metres across all depth sensors, although there is no apparent relationship in the depressurisation incurred and the depth profile. TBC032 is the closest VWP to current extraction activities and is showing depressurisation of up to 12 metres in the deepest sensor (200m). The shallower sensors are all showing some minor trends in depressurisation ranging between 1 and 7 metres. TBC034 remains stable and TBC039 has observed an increase in water level.

2.5.5 Deep VWPs (sensors >200metres)

The deep VWPs overall are showing some depressurisation but this is not consistent spatially or across depth profiles at individual sites.

TBC009 is showing maximum depressurisation of 8 metres between December 2022 and May 2023 at sensor depth 357m, however a recovery of 1 metre was observed subsequently. Approximately 2 meters of drawdown was observed in the sensors above and below (343 m and 392 m) between November 2022 and Feb 2023 after which point the levels have stabilised. TBC018 has observed steady drawdown to a maximum of two metres since November 2022, with less drawdown followed by stabilisation and some recovery in the deeper sensors. TBC020 has shown fluctuation across all sensors, the lowest three sensors have observed no overall drawdown. The shallowest sensor (211m) observed total drawdown of approximately 2 metres by June 2023, though fluctuated to a maximum of 7 metres drawdown over the reporting period. TBC026 has shown significant fluctuations in water levels and with some overall drawdown occurring, but also an increase above baseline conditions in the deepest sensor (440m). TBC032 is the closest VWP to current extraction activities and has observed relatively steady drawdown over time, with the shallowest sensor showing the highest drawdown, which decreases with depth (220m sensor – 12.5 metres drawdown, 237m sensor – 2.5 metres drawdown, 294 metre sensor – 2 metres drawdown). TBC039is not showing any clear response to mining with water levels stable, increasing above baseline conditions or some drawdown and stabilisation.

2.5.6 Electrical Conductivity (salinity) and pH

The pH and EC across all bores show some level of fluctuation with no apparent trends across the full record.

2.5.7 Metals

Metals across all bores have shown fluctuation over the reporting period. Elevated dissolved barium, strontium and manganese levels were recorded during the reporting period at a number of groundwater monitoring sites. Analysis indicates that this is unlikely attributable to mining with sporadic spatial and depth profile distribution. Ongoing monitoring will be used to reassess baseline conditions and triggers.

3.0 TARP Assessment

As detailed in Section 1.2, the groundwater level triggers and groundwater quality triggers are discussed in Appendix A and presented in Appendix B.

Two classes of data assessment are reported:

- Breach: a trigger breach is noted when an observed data point is outside of the defined trigger level. Breaches are reported to provide site context and inform where exceedances may occur in the future.

  An example of a breach for groundwater levels as detailed in WMP8, is where a groundwater level is reported with greater than 2 m water level reduction for a particular month for a period less than 6 consecutive months.

An example for groundwater quality is where the measured concentration exceeds the defined trigger level but for a period of less than 3 consecutive months.

- Exceedance: An exceedance occurs when the TARP level has been exceeded.

  Using the same example above, an exceedance would be when the groundwater level is reported with greater than 2 m water level reduction for a particular month for a period of 6 months or more consecutively.

Pertaining to water quality, the criteria for a TARP Level 1 in WMP11 detailed below (Tahmoor Coal, 2022) where both criteria must be met for an exceedance, and a trigger breach occurs where only one criterion is met, or criteria are only partially met:

- Criteria 1: Observed salinity and/or metal or pH outside of defined trigger levels for 3 consecutive months or more. The effect does not persist after a significant rainfall recharge event.

  AND

- Criteria 2: A similar trend or response is noted at other monitored bores or private bores.

3.1 TARP Exceedance Summary

An assessment of groundwater monitoring data against the TARPs, for all relevant monitoring locations, are presented in Appendix C (groundwater level triggers) and Appendix D (groundwater quality triggers). A complete list of TARP exceedances active as of 30 June 2023 are summarised in Table 3 and Table 4.

During the reporting period, the defined groundwater quality trigger levels were breached for numerous parameters for more than three consecutive months (fulfilling the first element of the TARP criteria). The water quality parameters that breached the groundwater quality trigger levels are provided in Table 4. Of these parameters, only barium, manganese, and strontium show similar trends at other monitored bores. Consequently, only barium, manganese, and strontium (bolded in Table 3) show exceedances are considered to be a TARP (WMP11) Level 1 active at 30 June 2023.

A TARP (WMP8) Level 1 exceedance for groundwater level occurred at P55C and P56C (as shown in Table 2) as of 30 June 2023.

A summary of TARP exceedances active as of 30 June 2023 are presented on Figure 4.

Groundwater level exceedances occurred south and south-west of LW S1A while groundwater quality exceedances occurred north-east, south and south-west of LW S1A.

Table 3 Active June 2023 Trigger Exceedances – WMP 18, WMP12

Exceedance Site	Exceedance Parameter	Exceedance Level	TARP
P55C	Groundwater level	1	WMP8, WMP12
P56C	Groundwater level	1	WMP8

Table 4 Active June 2023 Trigger Breaches and Exceedances – WMP 11

Exceedance Site	Breach Parameter (Criterion 1 met)	Exceedance Parameter (Criteria 1 and 2 met)	Exceedance Level	TARP
P51B	As		1	WMP11
P53A		Sr, Ba	1	WMP11
P53C	Li	Sr, Ba	1	WMP11
P55B		Ba	1	WMP11

Exceedance Site	Breach Parameter (Criterion 1 met)	Exceedance Parameter (Criteria 1 and 2 met)	Exceedance Level	TARP
P55C	Zn	Mn	1	WMP11
P56B	Al		1	WMP11
P56C		Mn	1	WMP11
REA4	Zn, Ni, Li,	Mn, Sr, Ba	1	WMP11
GW109257		Sr	1	WMP11
GW104323	Fe		1	WMP11

Note: for water quality exceedances (WMP11) those bolded are the only parameters that fulfil both criteria 1 and 2 of the TARP.

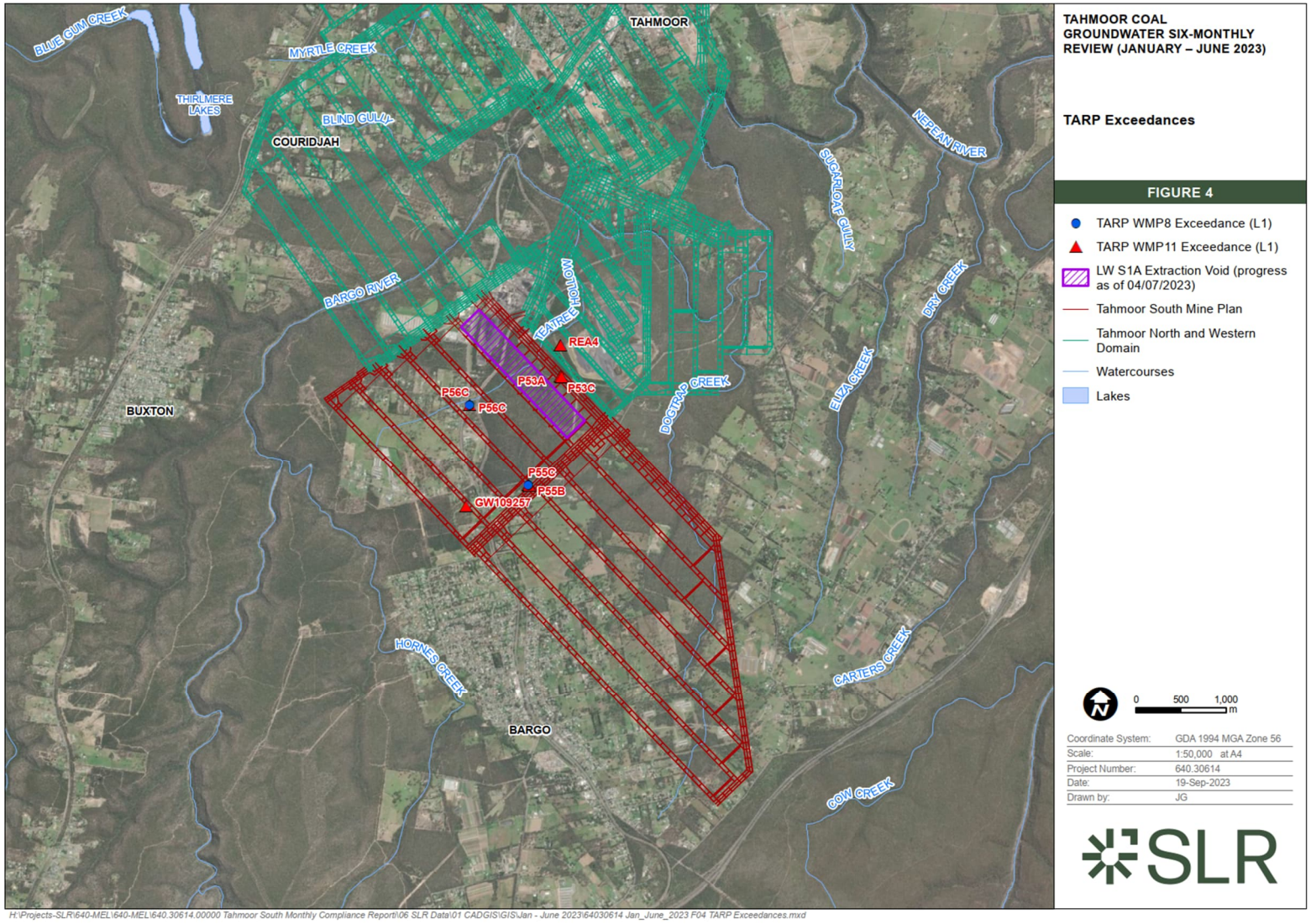


Figure 4 TARP Exceedances

3.2 Trigger Breaches and Exceedances

Plots presenting the groundwater monitoring data against the TARP trigger levels for all relevant monitoring locations, are presented in Appendix C (groundwater level triggers) Appendix D (groundwater quality triggers).

3.2.1 Water Levels (TARP WMP8, WMP9, WMP10, WMP12, WMP13)

A summary of groundwater level trigger breaches for the reported period is presented in Table 6 where the performance of each bore against each trigger is:

- Within normal conditions (indicated by a blank cell);
- Indicated as "B", meaning that the trigger was breached in that month but is not yet considered an exceedance; or
- Indicated as "L" and highlighted, meaning that trigger was breached in that month and as is now considered as an exceedance.

3.2.1.1 WMP10 TARP Review

As discussed in Section 1.3, amendments to WMP10 are still under review and discussion with NSW DPE. A summary of the proposed changes is provided in Table 5.

Table 5 Proposed WMP10 TARP Amendments

Proposed Changes	Reasoning
Normal Conditions – update wording to reflect that within 30 metres of modelled drawdown is considered 'normal conditions', or if drawdown exceeds modelled impacts by greater than 30 metres for a period of less than three months. Level 1 – Observed drawdown exceeds the modelled predicted drawdown, by greater than 30 metres for more than three consecutive months. Level 2 – Observed drawdown exceeds the modelled predicted drawdown, by greater than 30 metres for more than six consecutive months. Level 3 – Observed drawdown exceeds the modelled predicted drawdown, by greater than 30 metres for more than twelve consecutive months.	The current trigger levels have NO level of variation below modelled drawdown which is too sensitive. The revision also adds a temporal scale in order to determine trends rather than triggers from isolated fluctuations. For example: Level 1: initially stated '*within 30 metres of predicted drawdown for a period of less than six months*. If exceedance beyond model drawdown is by 2 cm for one month this would trigger Level 1. However, this is considered to be within the bounds of the model accuracy and not representative of a trend and therefore does not warrant a trigger. The Independent Expert Advisory Panel for Mining (IAPUM) feedback stated: *"For the trigger level wording:* *- the normal condition should be more clearly stated as 'observed levels are within (some measurable value – 10m?) of predicted impacts',* *- for each of the levels 1, 2 and 3 start with the words observed drawdown exceeds….' "* The 'normal' condition should allow for some reasonable variation from predicted impacts (not 'does not exceed' as is current). It is believed, in consideration of the overall level of predicted depressurisation, 30 metres beyond model predictions may be cause for review. Historically, the 30 metres has proven to be a successful and reasonable measure when utilised in the Western Domain WMP and TARPs. Within 30 metres of the modelled predicted drawdown should be considered 'normal conditions'. Given the point accuracy of the groundwater model at each point, using a value of less than 30 metres

Proposed Changes	Reasoning
	here is considered unreasonable, with review undertaken at the model review every three years. Additionally, if predicted impacts are exceeded by greater than 30 metres but for a period of less than 3 months, this is not considered representative of a trend and is still within 'normal conditions'. To enact various TARP Levels, the temporal scale over which we observe this variation from modelled drawdown will be instated. This is a logical and realistic approach to identify potential exceedances in impact via extraction to the groundwater system. Wording edited from 'for a period of' to 'consecutive months' for consistency and clarity across the TARPs.

Feedback from DPE indicated that the additional of the temporal scale was accepted.

Question over the suitability of the 30-metre groundwater level drawdown criteria has been raised, noting the preliminary IAPUM feedback indicated 10 metres. If the criteria were edited to reflect this, a Level 1 criteria would then be described as:

- Level 1 – Observed drawdown exceeds the modelled predicted drawdown, by greater than 10 metres for more than three consecutive months.

Only TBC032 (BGSS – 200m) has exceeded modelled predicted drawdown by greater than 10 metres, however, this has only occurred for a period of three months, not greater.

Consequently, whichever version of the TARPs are reported against, the findings of the subsequent sections are the same.

Table 6 Groundwater Level Trigger Summary (TARP WMP8, WMP9, WMP10, WMP12, WMP13) Jan – June 2023

Bore	Type	TARP WMP	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023
P51A	Shallow Open Standpipe	8, 12						
P51B	Shallow Open Standpipe	8, 12					B1	B1
P52	Shallow Open Standpipe	8, 12						
P53A	Shallow Open Standpipe	8, 12					B1	B1
P53B	Shallow Open Standpipe	8, 12				B1	B1	B1
P53C	Shallow Open Standpipe	8, 12				B2	B2	B2
P54A	Shallow Open Standpipe	8, 12		^	^	^	^	^
P54B	Shallow Open Standpipe	8, 12	B1	^	^	^	^	^
P54C	Shallow Open Standpipe	8, 12	B1	^	^	^	^	^
P55A	Shallow Open Standpipe	8, 12						
P55B	Shallow Open Standpipe	8, 12		B1			B1	B1
P55C	Shallow Open Standpipe	8, 12	B2	B2	B1	B3	B3	L1, B3
P56A	Shallow Open Standpipe	8						
P56B	Shallow Open Standpipe	8						
P56C	Shallow Open Standpipe	8	B1	B1	B1	B2	B3	L1, B3
REA4	Shallow Open Standpipe	8, 12	B1					
~~GW062068~~ [1]	~~Private Bore~~	~~8, 13~~			~~#ND~~	~~#ND~~	~~#ND~~	~~#ND~~
GW104008	Private Bore	8					B1	
GW104323	Private Bore	8						
GW104659	Private Bore	8, 13	B1*			B1	B1	B1
GW105395	Private Bore	8				B1		
GW109257	Private Bore	8					B1	
GW112473	Private Bore	8		B1		B1	B1	B1

Bore	Type	TARP WMP	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023
TBC09 (HBSS-30m)	Shallow VWP	9						
TBC09 (HBSS-75m)	Shallow VWP	9						
TBC09 (BHCS-182m)	Shallow VWP	9						
TBC09 (BGSS-192m)	Shallow VWP	9						
TBC018 (WWFM/HBSS-70m)	Shallow VWP	9						
TBC018 (WWFM/HBSS-117m)	Shallow VWP	9						
TBC018 (HBSS lower-164m)	Shallow VWP	9						
TBC018 (BHCS-179m)	Shallow VWP	9						
TBC018 (BGSS-198m)	Shallow VWP	9						
TBC024 (HBSS-117m)	Shallow VWP	9						
TBC024 (HBSS-139m)	Shallow VWP	9	B3*					
TBC024 (BHCS-168m)	Shallow VWP	9	B3*	B3*	B3*	B3*	B3*	B3*
TBC024 (BGSS-185m)	Shallow VWP	9						
TBC027 (HBSS-95m)	Shallow VWP	9						
TBC027 (HBSS-132m)	Shallow VWP	9						
TBC027 (HBSS-169m)	Shallow VWP	9						
TBC027 (BHCS-181m)	Shallow VWP	9						
TBC027 (BGSS-198m)	Shallow VWP	9						
TBC032 (HBSS-95m)	Shallow VWP	9	B3				B3*	B1
TBC032 (HBSS-131m)	Shallow VWP	9	B3	B2	B3	B2	B3	B3
TBC032 (HBSS-168m)	Shallow VWP	9						
TBC032 (BHCS-181m)	Shallow VWP	9	B1	B1	B1	B1	B1	B1

Bore	Type	TARP WMP	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023
TBC032 (BGSS-200m)	Shallow VWP	9	B1	B1	B1	B1	B1	B1
TBC034 (HBSS-65m)	Shallow VWP	9					B1*	
TBC034 (HBSS-113m)	Shallow VWP	9						
TBC034 (HBSS-161m)	Shallow VWP	9						
TBC034 (BHCS-176m)	Shallow VWP	9	B3*	B3*	B3*	B3*	B3*	B3*
TBC034 (BGSS-196m)	Shallow VWP	9						
TBC039 (HBSS-65m)	Shallow VWP	9, 13						
TBC09 (BGSS-332m)	Deep VWP	10						
TBC09 (BGSS-343m)	Deep VWP	10						
TBC09 (SBSS-357m)	Deep VWP	10						
TBC09 (BUSM-381m)	Deep VWP	10	~NC	~NC	~NC	~NC	~NC	~NC
TBC09 (WWCO-391m)	Deep VWP	10						
TBC09 (WWCO-397m)	Deep VWP	10						
TBC018 (BGSS-282m)	Deep VWP	10						
TBC018 (BGSS-366m)	Deep VWP	10						
TBC018 (WBCS-377m)	Deep VWP	10	~NC	~NC	~NC	~NC	~NC	~NC
TBC018 (BUSM-404m)	Deep VWP	10						
TBC018 (WWCO-432m)	Deep VWP	10			#ND	#ND	#ND	#ND
TBC020 (BGSS-211m)	Deep VWP	10						
TBC020 (BGSS-293m)	Deep VWP	10						
TBC020 (BGSS-375m)	Deep VWP	10						
TBC020 (WBCS-397m)	Deep VWP	10	~NC	~NC	~NC	~NC	~NC	~NC
TBC020 (BGSS-411m)	Deep VWP	10						
TBC020 (WO-434m)	Deep VWP	10						

Bore	Type	TARP WMP	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023
TBC020 (WO-439m)	Deep VWP	10	~NC	~NC	~NC	~NC	~NC	~NC
TBC026 (BGSS-211m)	Deep VWP	10						
TBC026 (BGSS-278m)	Deep VWP	10						
TBC026 (BGSS-344m)	Deep VWP	10						
TBC026 (WBCS-409m)	Deep VWP	10						
TBC026 (BUSM-432m)	Deep VWP	10						
TBC026 (ECSL-440m)	Deep VWP	10						
TBC026 (ECSL-460m)	Deep VWP	10	#ND	#ND	#ND	#ND		
TBC032 (BGSS-200m)	Deep VWP	10						
TBC032 (BGSS-237m)	Deep VWP	10						
TBC032 (BGSS-294m)	Deep VWP	10						
TBC039 (BGSS-243m)	Deep VWP	10						
TBC039 (BGSS-299m)	Deep VWP	10						
TBC039 (SBSS-354m)	Deep VWP	10						
TBC039 (BUSM-375m)	Deep VWP	10						
TBC039 (WWCO-402m)	Deep VWP	10						

[1] Monitoring site GW062068 removed from the groundwater monitoring program due to infrastructure issues that render the bore unsuitable for ongoing monitoring.

^ Bore was observed as dry during the reporting period.

* Logger data appears erroneous therefore not considered to be an exceedance.

~ Not calculated (NC) as the historical groundwater level, upon which the drawdown calculation is based upon, is not available.

No data (ND) available for the reporting period.

3.2.2 Water Quality (TARP WMP11 and WMP13)

A summary of groundwater quality trigger breaches and exceedances in this reporting period is presented in Table 7 where the performance of each bore against each trigger is:

- Within normal conditions (indicated by a blank cell);
- Indicated as "B", meaning that the trigger was breached in the current reporting period but is not yet considered an exceedance; or
- Indicated as "L" and shaded in green, meaning that trigger was breached in the current reporting period for the third time or more and complies with Criteria 1 and 2 of TARP Level 1 in WMP11.

During the reporting period, the defined groundwater quality trigger levels were breached for numerous parameters for more than three months. However, of these parameters, only barium, lithium, manganese, and strontium appear to be showing similar trends across multiple observation points. Consequently, only barium, manganese and strontium (bolded in Table 5) comply with Criteria 1 and 2 and are considered to be an exceedance in agreement with TARP (WMP11) Level 1 for the 1 January to 30 June 2023 period. This is discussed in greater detail below (Sections 4.2.1, 4.2.2, and 4.2.3).

Table 7 Groundwater Quality Trigger Summary (TARP WMP11 and WMP13) – January - June 2023

Bore	TARP WMP	Month	pH Upper	pH Lower	EC	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Sr	Li	Ba	Se
P51A	11	Jan-23				B1	B1						B1			B1	
P51A	11	Feb-23															
P51A	11	Mar-23			B1												
P51A	11	Apr-23															
P51A	11	May-23															
P51A	11	Jun-23		B1													
P51B	11	Jan-23						B1									
P51B	11	Feb-23										B1	L1				
P51B	11	Mar-23										B1	L1				
P51B	11	Apr-23										L1	L1				
P51B	11	May-23											L1				
P51B	11	Jun-23				B1	B1	B1	B1	B1			L1				
P52	11	Jan-23						B1	B1			B1	B1				
P52	11	Feb-23				B1	B1	B2	B2			B2	L1				
P52	11	Mar-23			B1												
P52	11	Apr-23															
P52	11	May-23									B1		B1	B1			
P52	11	Jun-23				B1		B1	B1				B1				
P53A	11	Jan-23				L1		B1	B1			B1	L1			L1	
P53A	11	Feb-23											L1	B1		L1	
P53A	11	Mar-23			B1									B1			
P53A	11	Apr-23												B1		B1	
P53A	11	May-23			B1	B1	B1						B1	L1		B2	

Bore	TARP WMP	Month	pH Upper	pH Lower	EC	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Sr	Li	Ba	Se
P53A	11	Jun-23			B1	B1	B1	B1	B1			B1	B1	**L1**		**L1**	
P53B	11	Jan-23	B1					B1	B1			B1	B1		L1		
P53B	11	Feb-23													L1		
P53B	11	Mar-23															
P53B	11	Apr-23															
P53B	11	May-23												B1			
P53B	11	Jun-23						B1				B1			B1		
P53C	11	Jan-23										B1		B1	B1	B1	
P53C	11	Feb-23										B1		B2	B2	B2	
P53C	11	Mar-23												L1	L1	L1	
P53C	11	Apr-23												L1	L1	L1	
P53C	11	May-23						B1						L1	L1	L1	
P53C	11	Jun-23								B1		B1		**L1**	L1	**L1**	
P54A	11	Jan-23	B1		B1					L1			B1	B1	B1		
P54A	11	Feb-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54A	11	Mar-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54A	11	Apr-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54A	11	May-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54A	11	Jun-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54B	11	Jan-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54B	11	Feb-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54B	11	Mar-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54B	11	Apr-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54B	11	May-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P54B	11	Jun-23	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^
P55A	11	Jan-23	B1									B1	B1	B1	B1		
P55A	11	Feb-23										L1					
P55A	11	Mar-23			B1												
P55A	11	Apr-23								B1							
P55A	11	May-23			B1					B2							
P55A	11	Jun-23											B1				
P55B	11	Jan-23				L1				L1		B1				B1	
P55B	11	Feb-23				L1				L1		L1	B1				
P55B	11	Mar-23				L1				L1		L1				B1	
P55B	11	Apr-23								L1		L1					
P55B	11	May-23				B1				L1						L1	
P55B	11	Jun-23				B1		B1	B1			B1	B1			**L1**	
P55C	11	Jan-23					B1			L1		B1					
P55C	11	Feb-23			B1	B1	B2			L1		B2					
P55C	11	Mar-23			B1		L1			L1							

Bore	TARP WMP	Month	pH Upper	pH Lower	EC	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Sr	Li	Ba	Se
P55C	11	Apr-23					L1			L1		B1					
P55C	11	May-23		B1			L1			L1							
P55C	11	Jun-23				B1	**L1**	B1	B1	L1		B1	B1				
P56A	11	Jan-23				B1	B1		B1			B1					
P56A	11	Feb-23															
P56A	11	Mar-23							B1	B1		B1					
P56A	11	Apr-23				B1											
P56A	11	May-23		B1													
P56A	11	Jun-23							B1	B1	B1	B1					
P56B	11	Jan-23				B1				B1		L1					
P56B	11	Feb-23										L1					
P56B	11	Mar-23			B1							L1					
P56B	11	Apr-23						B1				L1					
P56B	11	May-23		B1								L1	B1				
P56B	11	Jun-23						B1		B1	B1	L1	B1				
P56C	11	Jan-23				L1	L1			B1	B1	B1	B1				
P56C	11	Feb-23		B1		L1	L1										
P56C	11	Mar-23		B2		L1	L1										
P56C	11	Apr-23		L1*			L1										
P56C	11	May-23		L1			L1			B1	B1						
P56C	11	Jun-23				B1	**L1**			B1	B1	B1	B1				
REA4	11	Jan-23				B1	B1	B1	B1	L1		B1		L1	L1	L1	
REA4	11	Feb-23					B2			L1	L1			L1	L1	L1	
REA4	11	Mar-23				B1	L1			L1	L1			L1	L1	L1	
REA4	11	Apr-23				L1	L1			L1	L1			L1	L1	L1	
REA4	11	May-23					L1			L1	L1			L1	L1	L1	
REA4	11	Jun-23				B1	**L1**		B1	L1	L1	B1		**L1**	L1	**L1**	
GW062068	11, 13	Jan-23					B1		B1	B1		B1	B1	B1	B1	B1	
GW062068	11, 13	Feb-23				B1	B1		B2			B2			B2	L1	
GW062068	11, 13	Mar-23	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW062068	11, 13	Apr-23	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW062068	11, 13	May-23	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW062068	11, 13	Jun-23	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW104008	11	Jan-23				B1							L1		B1		
GW104008	11	Feb-23				#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW104008	11	Mar-23				L1					LI			B1	L1	B1	
GW104008	11	Apr-23						B1						L1		L1	
GW104008	11	May-23	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW104008	11	Jun-23				B1			B1		B1	B1			B1	B1	
GW104323	11	Jan-23				B1								B1	B1		

Bore	TARP WMP	Month	pH Upper	pH Lower	EC	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Sr	Li	Ba	Se
GW104323	11, 13	Feb-23				L1	B1							B2	L1		
GW104323	11	Mar-23				L1								L1	L1		
GW104323	11	Apr-23							L1					L1	L1	B1	
GW104323	11	May-23				L1						B1			L1		
GW104323	11	Jun-23				L1											
GW104659	11, 13	Jan-23					B1		L1						L1	B1	
GW104659	11	Feb-23	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW104659	11, 13	Mar-23			B1		B1							B2	L1	L1	
GW104659	11, 13	Apr-23													L1		
GW104659	11, 13	May-23					B1					B1		B1	L1		
GW104659	11, 13	Jun-23															
GW105395	11	Jan-23				B1			L1	B1					L1	L1	
GW105395	11, 13	Feb-23				B2	B2			B1						L1	
GW105395	11	Mar-23								B1					B1	L1	
GW105395	11	Apr-23															
GW105395	11	May-23					B1					B1		B1	B1	B1	
GW105395	11	Jun-23				B1	B1			B1					B1	B1	
GW109257	11	Jan-23					B1					B1		B1	B1	B1	
GW109257	11	Feb-23				#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW109257	11	Mar-23			B1	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND	#ND
GW109257	11	Apr-23												L1		L1	
GW109257	11	May-23					B1		B1	B1	B1			L1	B1	B1	
GW109257	11	Jun-23								B1		B1		**L1**	B1	B1	
GW112473	11	Jan-23				B1	B1				B1			B1	B1		
GW112473	11	Feb-23				L1	L1				L1			L1	L1		
GW112473	11	Mar-23			B1	L1	L1				L1			L1	L1	B1	
GW112473	11	Apr-23			B1	L1	L1			B1	L1			L1		B1	
GW112473	11	May-23		B1	B1		L1		B1	B1	L1			L1	B1	L1	
GW112473	11	Jun-23		B1					B1								

No data (ND) available for the reporting period.
^ Bore was observed as dry during the reporting period.
Green shading indicates that the bore and analyte comply with Criteria 1 of TARP Level 1 in WMP11.
Bolded text indicates that the bore and analyte comply with Criteria 1 and 2 of TARP Level 1 in WMP11.

3.2.3 Groundwater – Surface Water Interactions (TARP WMP12 and WMP13)

WMP12 pertains specifically to the monitoring of potential impacts on groundwater – surface water interactions, whilst WMP13 is pertinent to monitoring for a potential impact on Thirlmere Lakes. Triggering of WMP8 is required to enact WMP12 and triggering of WMP8 and WMP11 is required to enact WMP13.

Regarding WMP12, a triggering of WMP8 occurred during the reporting period. As of 30 June 2023, a TARP (WMP8) Level 1 exceedance for groundwater level occurred at Bore P55C (which is associated with surface water monitoring site TT1-QRLa). An extended discussion of the P55C exceedance is provided in Section 4.1.1, and specifically pertaining to TARP WMP12 in Section 4.3.

Regarding WMP13 (Groundwater Monitoring Bores for Thirlmere Lakes), a triggering of WMP11 occurred during the reporting period. For bore GW104659 (which is associated with WMP13), the concentration of lithium is greater than the groundwater quality trigger level (Level 1) in March, April and May 2023. However, to enact WMP13, a minimum of two early warning bores are required to exceed the trigger level for either groundwater quality or groundwater level. As of June 2023, there are no active exceedances associated with the WMP13 bores.

4.0 Potential Influences

4.1 TARP WMP8

The potential influences driving the observed exceedances at P55C and P56C, as listed in Table 3, are discussed in this section. The spatial distribution of observed groundwater levels above the trigger level, and the identified TARP Level 1 exceedances, at the P55 and P56 sites are shown in Figure 5.

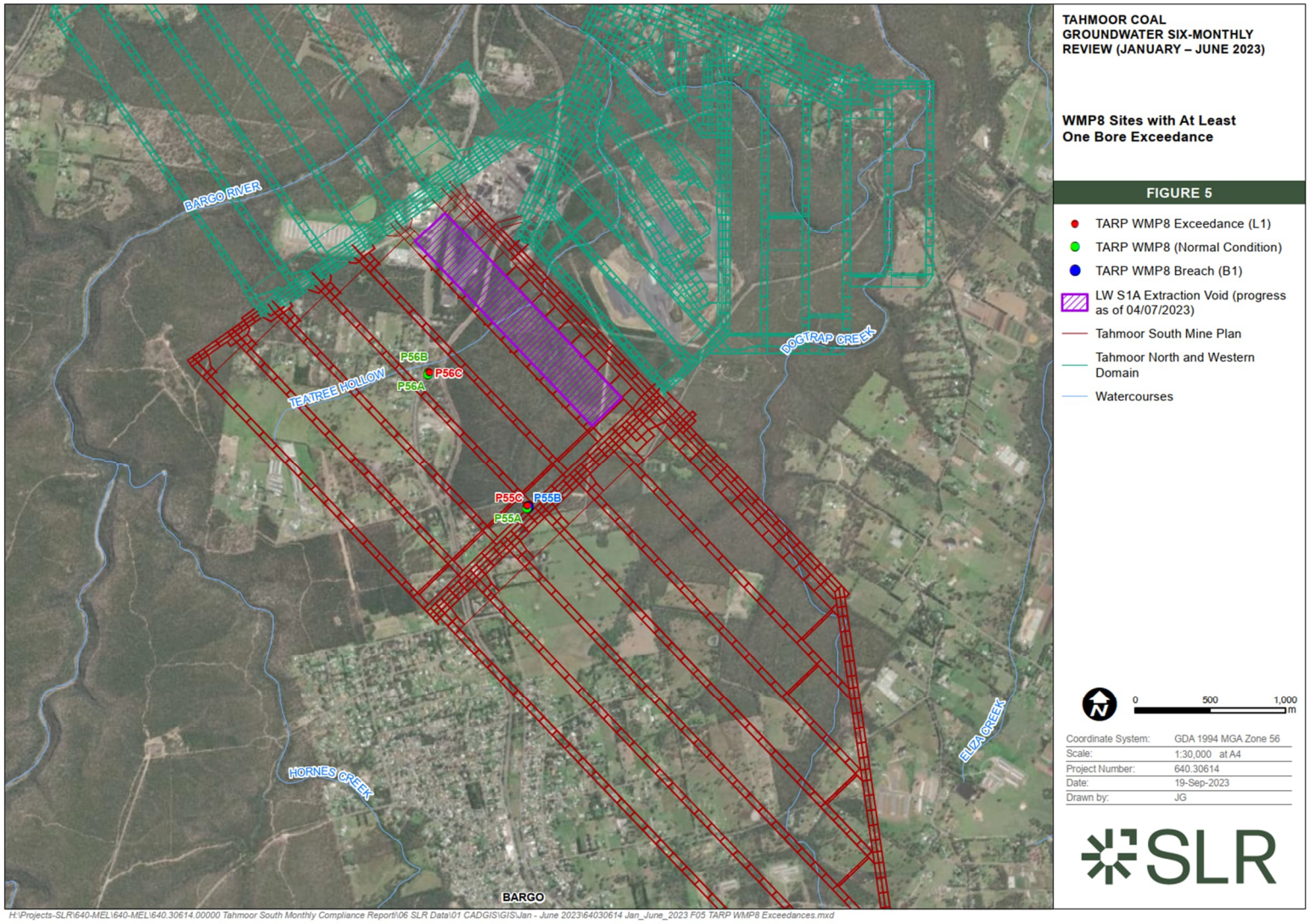


Figure 5 Sites with at least one TARP WMP8 Exceedance

4.1.1 P55C

As of 30 June 2023, a TARP Level 1 exceedance of the trigger level occurred at P55C. This observed exceedance is presented in Figure 6.

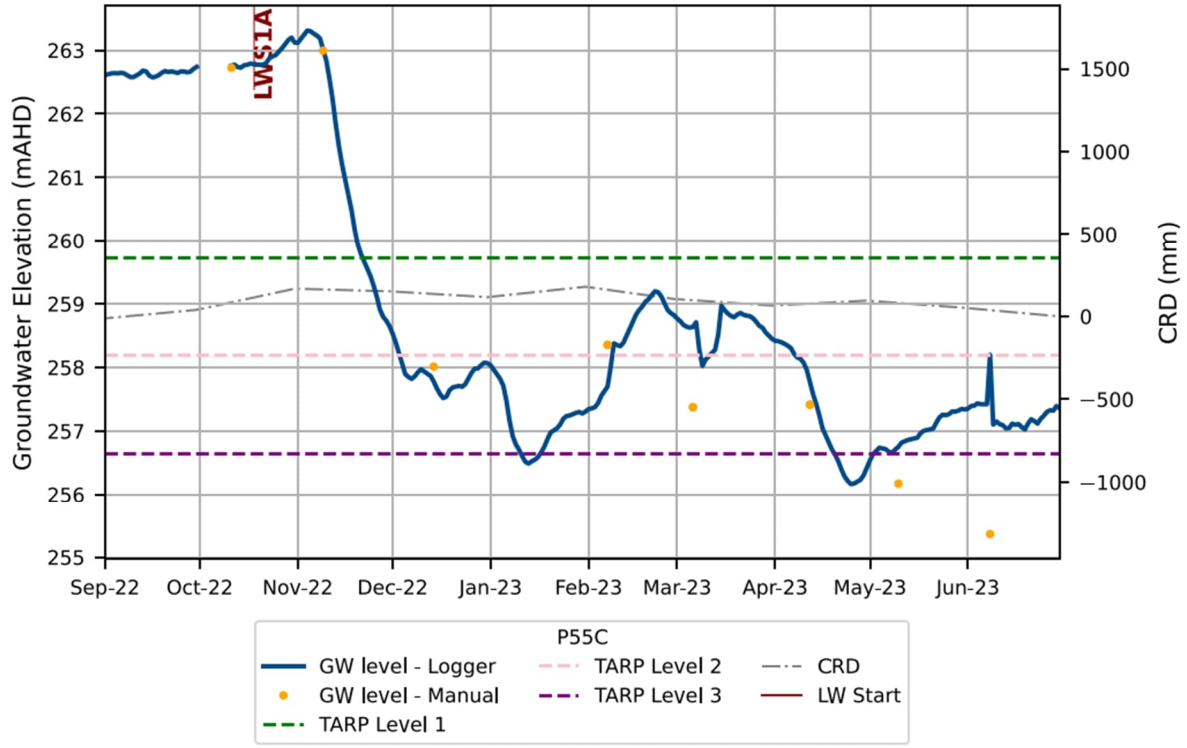


Figure 6 TARP WMP8 Level 1 Exceedance – P55C

At P55C, the groundwater elevation was lower than the TARP L1 trigger level in all monitoring rounds since November 2022. Over the reporting period, the groundwater elevation has fluctuated by approximately 5 m with groundwater levels decreasing to below the TARP L3 trigger level in April 2023 before slightly increasing to below the TARP L2 trigger level in May and June 2023.

The groundwater elevation at P55A has remained relatively steady, and above the TARP L1 trigger level, throughout the reporting period. The groundwater elevation at P55B has fluctuated around the TARP L1 trigger level throughout the period, with the groundwater elevation decreasing to below the TAPR L1 trigger level in May and June 2023.

With the exceedance at Site P55 only occurring in the deepest bore (P55C), this groundwater depressurisation in the deeper bore could be due to an ongoing mining effect (LWS1A progression). However, given the relative stability of this water level (i.e., no ongoing declining trend) this cannot definitively be attributed to extraction activities. It is suggested to continue to review the trends in this bore and the associated nested bores in coming months to better understand the trends.

4.1.2 P56C

As of 30 June 2023, a TARP Level 1 exceedance of the trigger level occurred at P56C. This observed exceedance is presented in Figure 7.

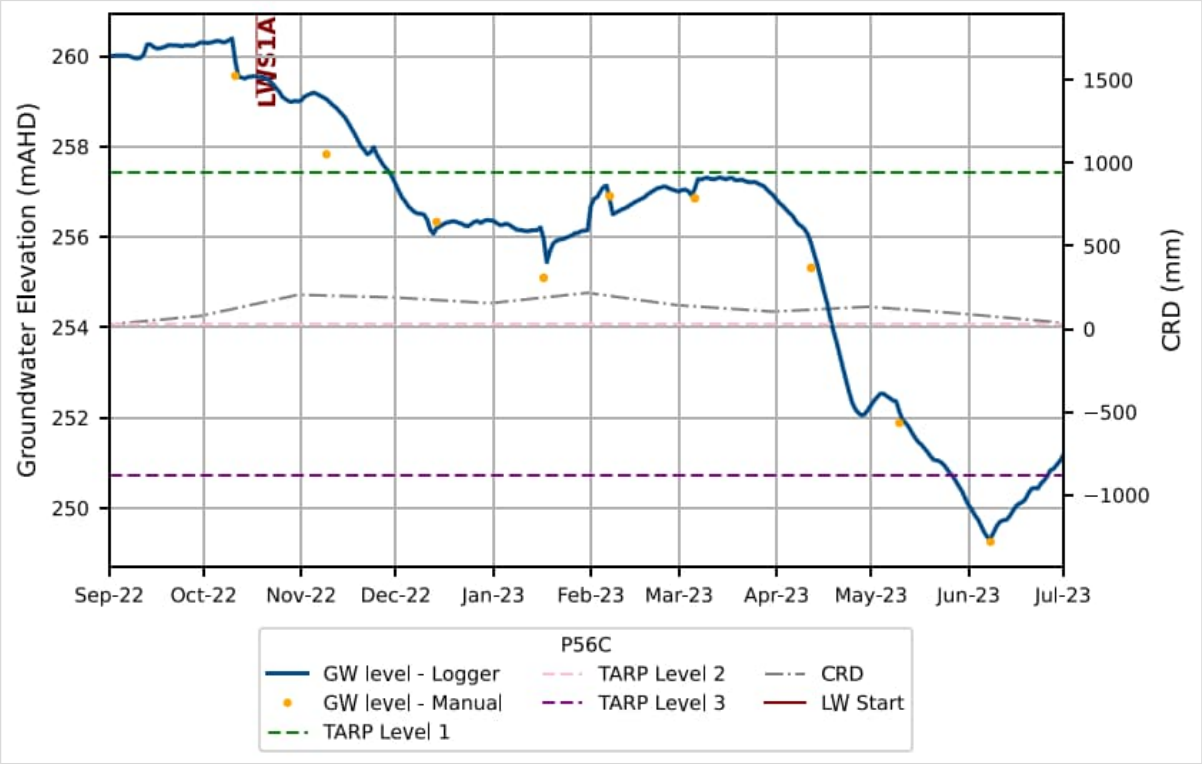


Figure 7 TARP WMP8 Level 1 Exceedance – P56C

At P56C, the groundwater elevation was lower than the TARP L1 trigger level in all monitoring rounds since December 2022. Over the reporting period, the groundwater elevation has overall decreased by approximately 6 m with groundwater levels decreasing to below the TARP L2 trigger level in April 2023 and further decreasing to below the TARP L3 trigger level in June 2023.

The groundwater elevation at P56A has remained relatively steady, and above the TARP L1 trigger level, throughout the reporting period. The groundwater elevation at P56B has been generally steady, except for short-term spike in early 2023, and has remained above the TARP L1 trigger level throughout the reporting period. Consequently, the exceedance at Site P56 only occurring in the deepest bore (P56C).

The relatively steady decline at this site this groundwater depressurisation in the deeper bore could be due to an ongoing mining effect (LWS1A progression).

4.2 TARP WMP11

The potential influences driving the observed exceedances at P53A, P53C, P55B, P55C, P56C, REA4 and GW109257P51B, as listed in Table 4, are discussed in this section. During the reporting period, TARP Level 1 exceedances were observed for the parameters of barium, strontium and manganese.

4.2.1 Barium

As of 30 June 2023, a TARP Level 1 exceedance of the barium trigger level occurred at P53A, P53C, P55B, REA4. Each of these observed exceedances are presented in Figure 8 and discussed in Table 8. The spatial distribution of observed barium concentrations above the trigger level, and the identified TARP Level 1 exceedances, are shown in Figure 9.

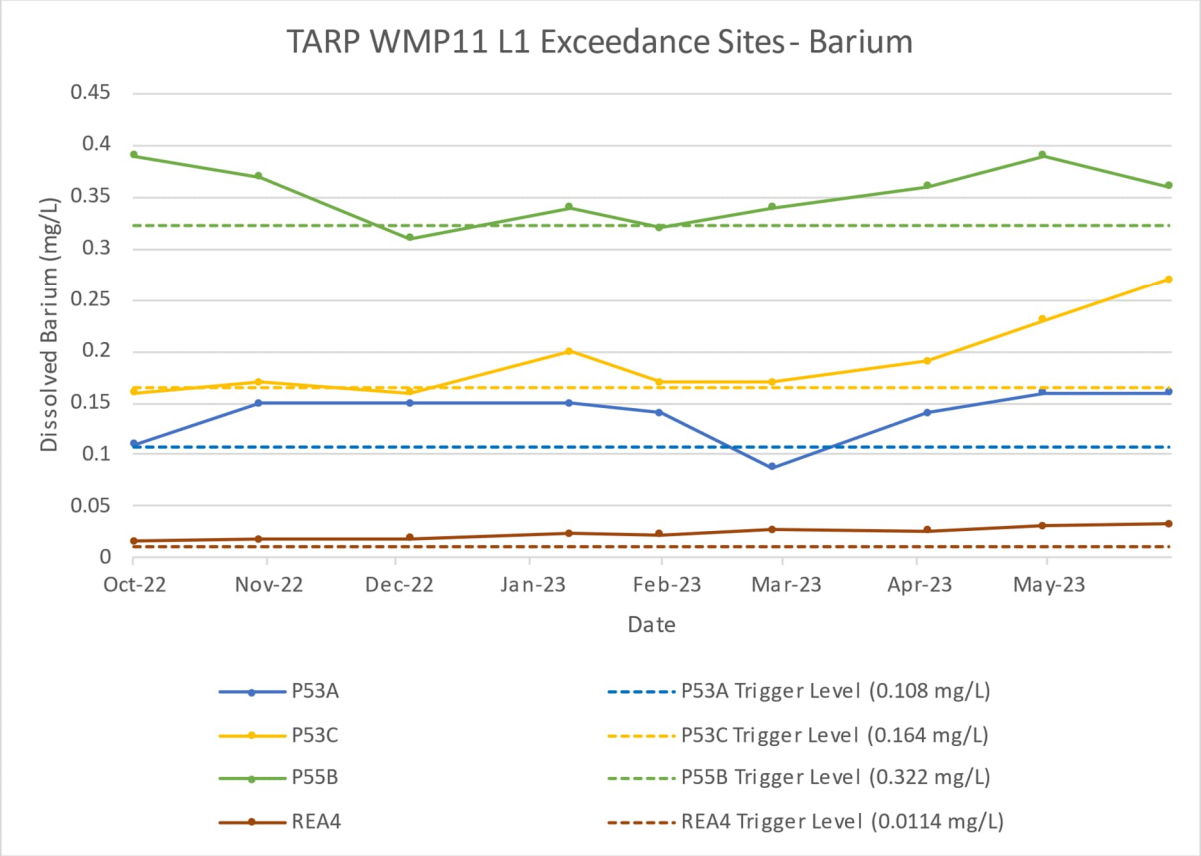


Figure 8 TARP WMP11 Level 1 Exceedance – Barium

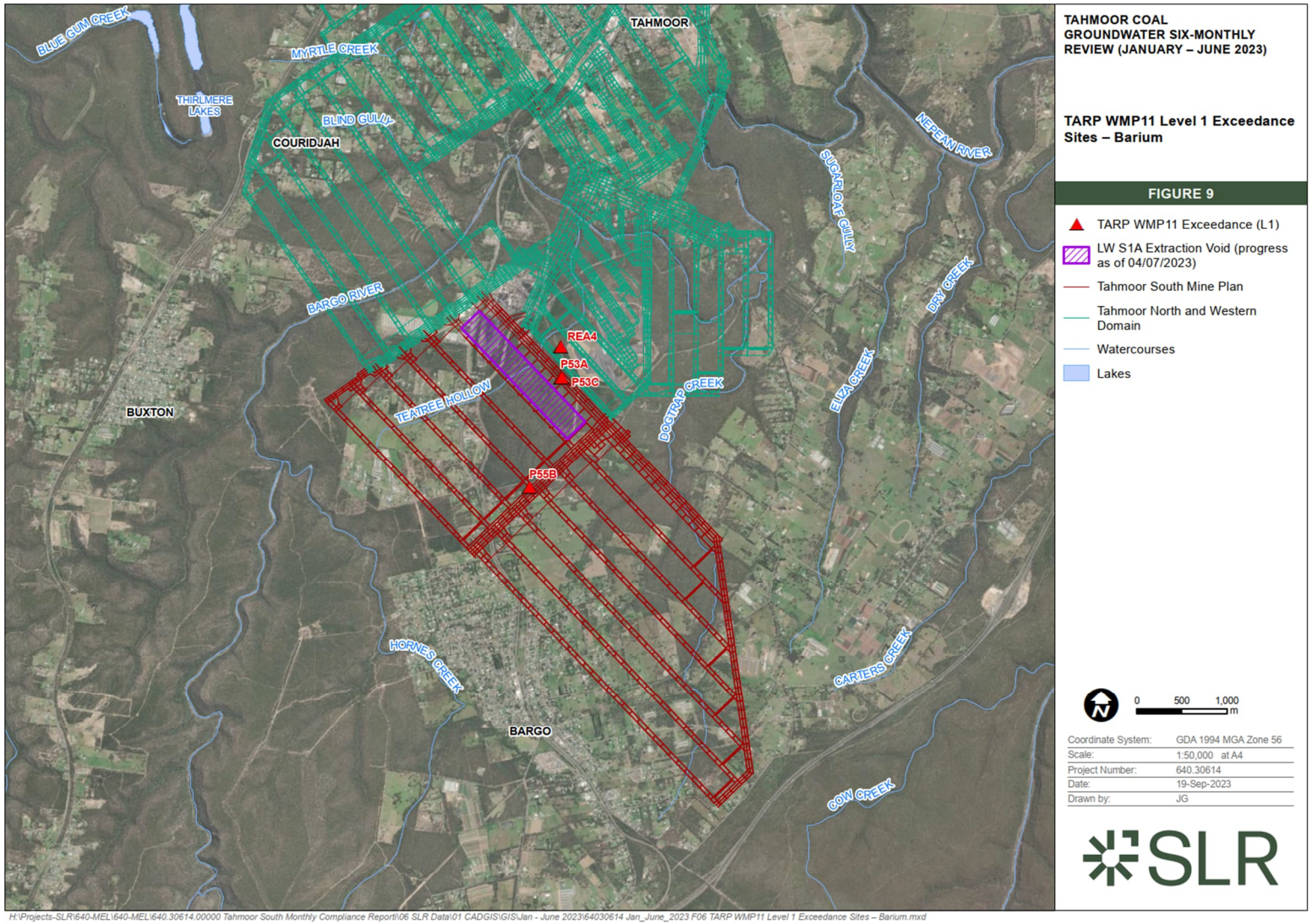
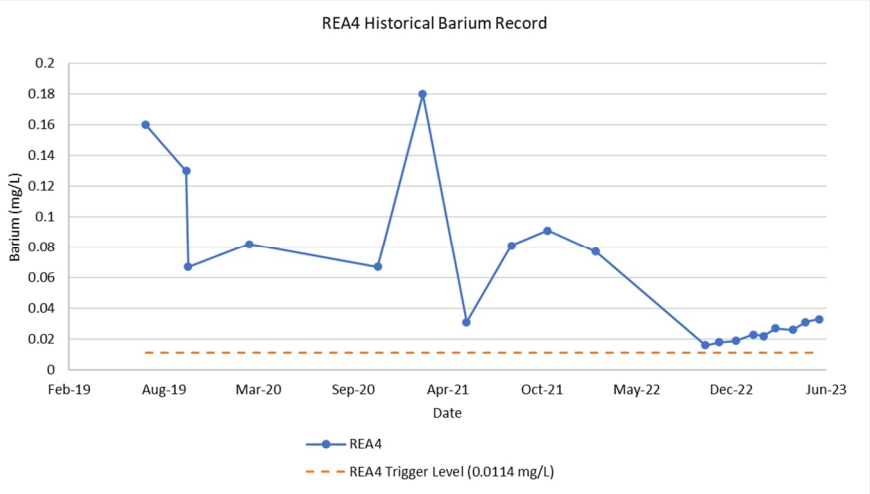
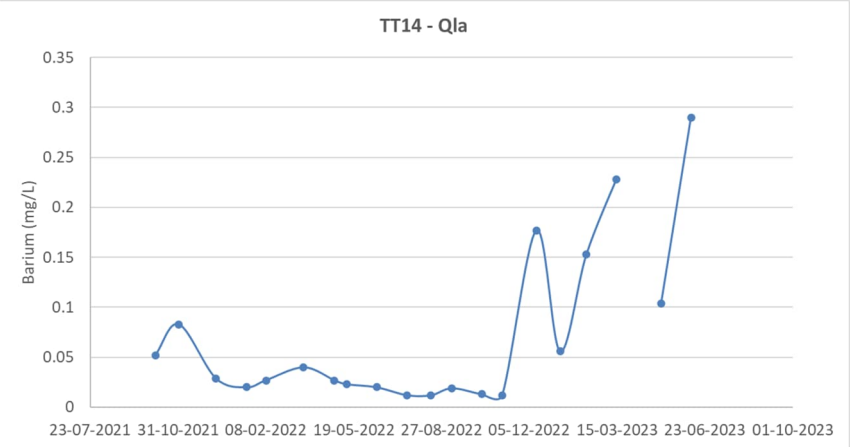


Figure 9 TARP WMP11 Level 1 Exceedance Sites – Barium

Table 8 Groundwater Quality Exceedance Discussion – Barium

Site	Discussion
P53	At P53A, the concentration of barium was higher than the trigger level in all monitoring rounds since October 2022, except in March 2023. Over the reporting period, the concentration of barium was relatively steady in January and February then sharply decreased in March before steadily increasing for the remainder of the reporting period. The concentration of barium at P53B has remained below the trigger level for barium in all monitoring rounds since October 2022. However, during this time, it is noted that the concentration of barium was generally increasing until April 2023 where the concentration of barium seemed to stabilise before decreasing in June 2023. At P53C, the concentration of barium was higher than the trigger level for barium in all monitoring rounds since November 2022, except in December 2022. Over the reporting period, the concentration of barium fluctuated near the trigger level concentration in January, February and March, before steadily increasing for the remainder of the reporting period. The increase in the concentration of dissolved barium at P53A and P53C appear to be related to the natural fluctuation in groundwater quality, and rising trend, at the P53 site. Over the reporting period, the extraction void progressed in the direction away from the P53 site. While the P53 site is located within proximity to LW S1A extraction void, additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. It is recommended the trigger for P53A and P53C be updated.
P55	The concentration of barium at P55A has remained below the trigger level for barium in all monitoring rounds since October 2022. However, during this time, it is noted that the concentration of barium was generally increasing and almost reached the trigger level in May and June 2023. At P55B, the concentration of barium was higher than the trigger level for barium in all monitoring rounds since November 2022, except in December 2022 and February 2023. Over the reporting period, the concentration of barium fluctuated near the trigger level concentration in January and February, before steadily increasing for the remainder of the reporting period. The concentration of barium at P55C has remained below the trigger level for barium in all monitoring rounds since October 2022 and been generally consistent since December 2022. The increase in the concentration of dissolved barium at P55B appear to be related to the natural fluctuation in groundwater quality. The P55 site is located south-west of the LW S1A extraction void. Additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. It is recommended that the trigger for P55B be updated.
REA4	At REA4, the concentration of barium was higher than the trigger level for barium in all monitoring rounds since November 2022. The concentration of barium has been increasing over the reporting period in small increments. REA4 is considered a nested site with the nearby P52. At P52, the concentration of barium has fluctuated but remained below the P52 trigger level throughout the reporting period. It is noted that the barium trigger is particularly low (0.0114 mg/L) when compared to both P52 (0.31 mg/L) and the other bores. This trigger was devised on two monitoring rounds associated with the Tahmoor South monitoring regime. However, at this specific site additional monitoring data has been made available and is presented in the following figure. It is recommended the trigger for REA4 be updated.

Site	Discussion
	 Of interest, the nearby surface water site (TT14-Qla) also shows natural fluctuations in barium across the baseline monitoring period as shown on the below plot where barium concentrations range between 0.012 - 0.29 mg/L. These are believed to be within the natural fluctuations and concentrations expected for barium in the region.  The increase in the concentration of dissolved barium at REA4 appear to be related to the natural fluctuation in groundwater quality. Additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. A revision to the trigger is recommended to be more commensurate with the natural fluctuations and other local sites.

4.2.2 Strontium

As of 30 June 2023, TARP Level 1 exceedances of the strontium trigger level occurred at P53A, P53C, REA4 and GW109257. Each of these observed exceedances are presented in Figure 10 and Figure 11 and discussed in Table 9. The spatial distribution of observed strontium concentrations above the trigger level, and the identified TARP Level 1 exceedances, are shown in Figure 12.

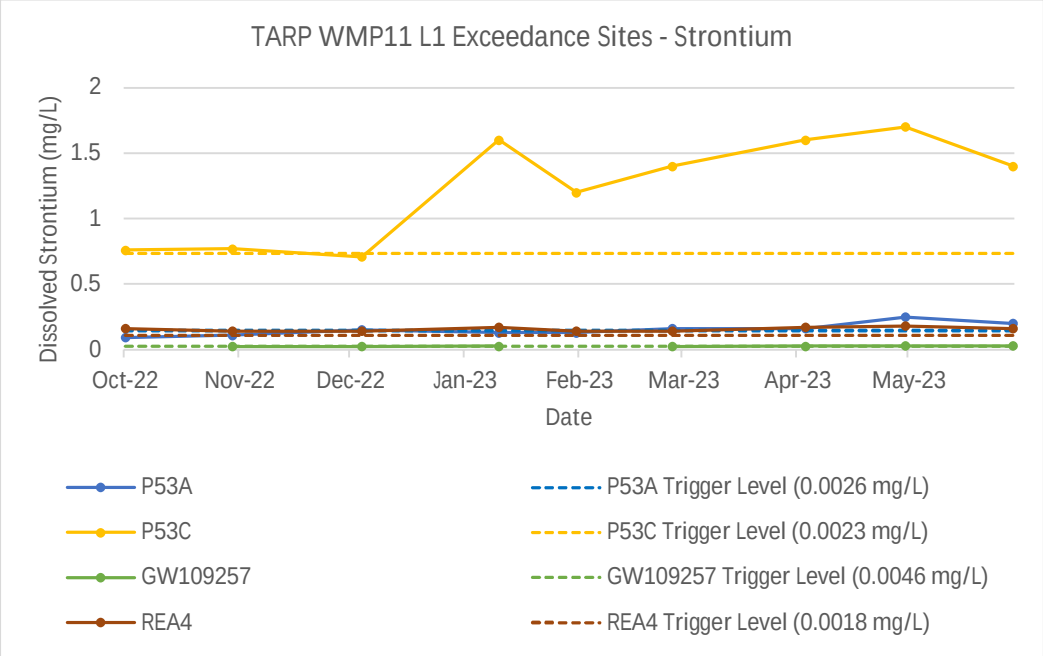


Figure 10 TARP WMP11 Level 1 Exceedance – Strontium

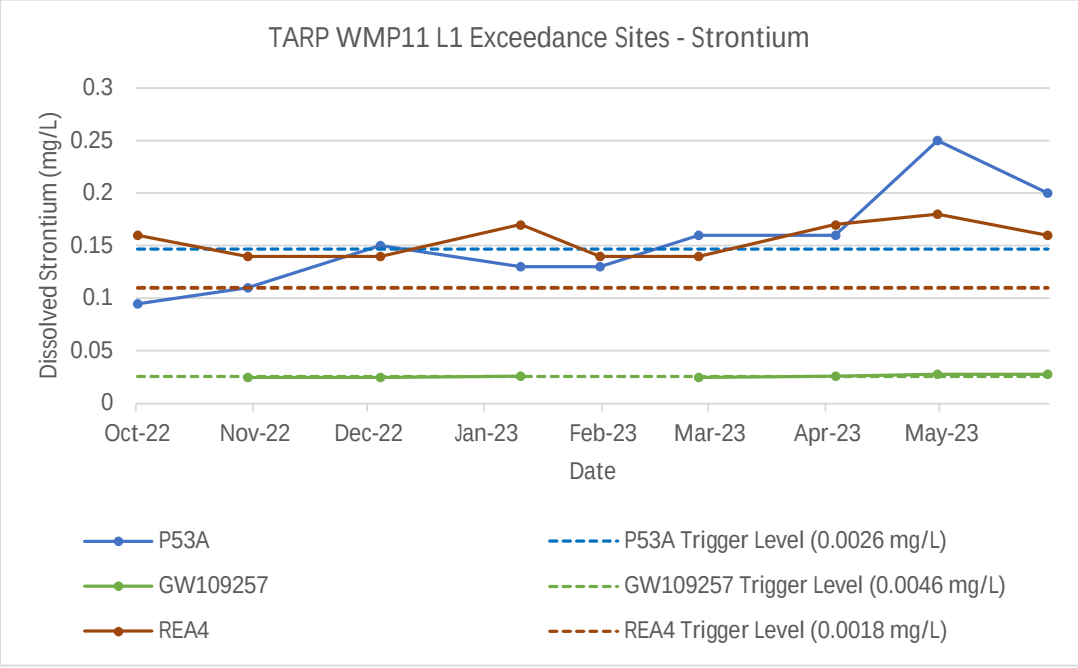


Figure 11 TARP WMP11 Level 1 Exceedance – Strontium (excluding P53C)

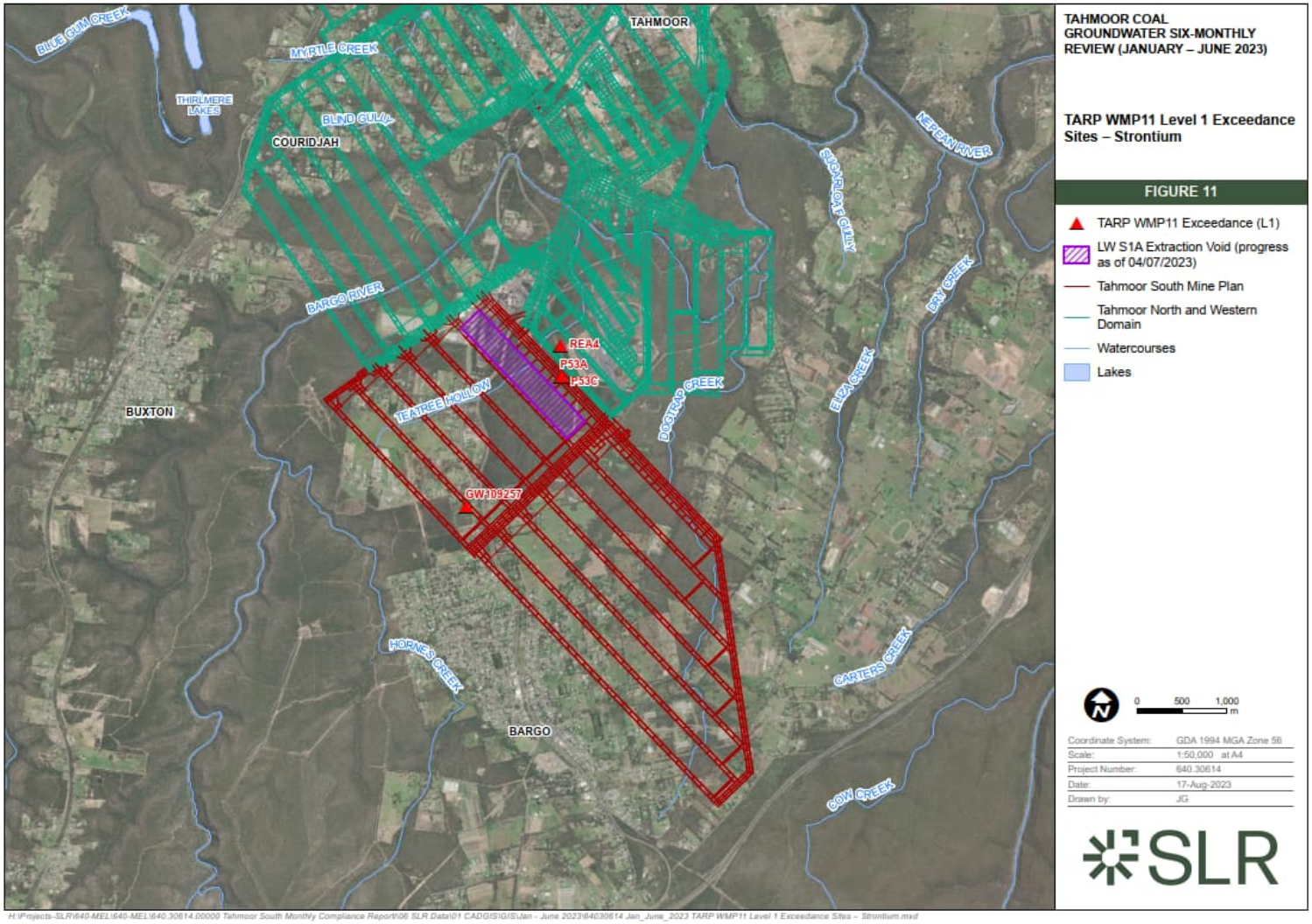


Figure 12 TARP WMP11 Level 1 Exceedance Sites – Strontium

Table 9 Groundwater Quality Exceedance Discussion – Strontium

Site	Discussion
P53	At P53A, the concentration of strontium has fluctuated around the trigger level since October 2022, and has overall increased over the reporting period. The concentration of strontium at P53B was higher than the trigger level in May 2023 only. Over the reporting period, the concentration of strontium has fluctuated, with a period of increasing concentration from February to May 2023 before decreasing in June 2023. At P53C, the concentration of strontium was higher than the trigger level in all monitoring rounds since December 2022. Over the reporting period, the concentration of strontium was generally increasing until May 2023, when the concentration began to decrease. It appears that the trend of elevated strontium concentrations is correlated with similar trends in the strontium concentrations at Site P53. The increase in the concentration of dissolved strontium at P53A and P53C appear to be related to the natural fluctuation in groundwater quality, and rising trend, at the P53 site. Over the reporting period, the extraction void progressed in the direction away from the P53 site. While the P53 site is located within proximity to LW S1A extraction void, additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. Upon further monitoring and review, a revision of the baseline trigger is recommended.
REA4	At REA4, the concentration of strontium was higher than the trigger level in all monitoring rounds since October 2022. The concentration of strontium has fluctuated over the reporting period. REA4 is considered a nested site with the nearby P52. At P52, the concentration of strontium has fluctuated but remained below the P52 trigger level in all months of the reporting period, except in May 2023. It appears that the trend of elevated strontium concentrations is correlated with similar trends in the barium concentrations at REA4. The increase in the concentration of dissolved strontium at REA4 appear to be related to the natural fluctuation in groundwater quality. The REA4 site is located north of the P53 site, where similar trends in the barium concentration were observed. Additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. Upon further monitoring and review a revision of the baseline trigger is recommended.
GW109257	At GW109257, the concentration of strontium was higher than the trigger level for strontium in January, April, May and June 2023. Over the reporting period, the concentration of strontium has fluctuated before increasing from March 2023. The increase in the concentration of dissolved strontium at GW109257 appear to be related to the natural fluctuation in groundwater quality at this site. The GW109257 bore is not within proximity to LW S1A extraction void. Similar trends have not been observed in other bores within a similar distance to LWS1A as GW109257. Additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. Upon further monitoring and review a revision of the baseline trigger is recommended.

4.2.3 Manganese

As of 30 June 2023, TARP Level 1 exceedances of the manganese trigger level occurred at P55C, P56C and REA4. Each of these observed exceedances are presented in Figure 13 and discussed in Table 10. The spatial distribution of observed manganese concentrations above the trigger level, and the identified TARP Level 1 exceedances, are shown in Figure 14.

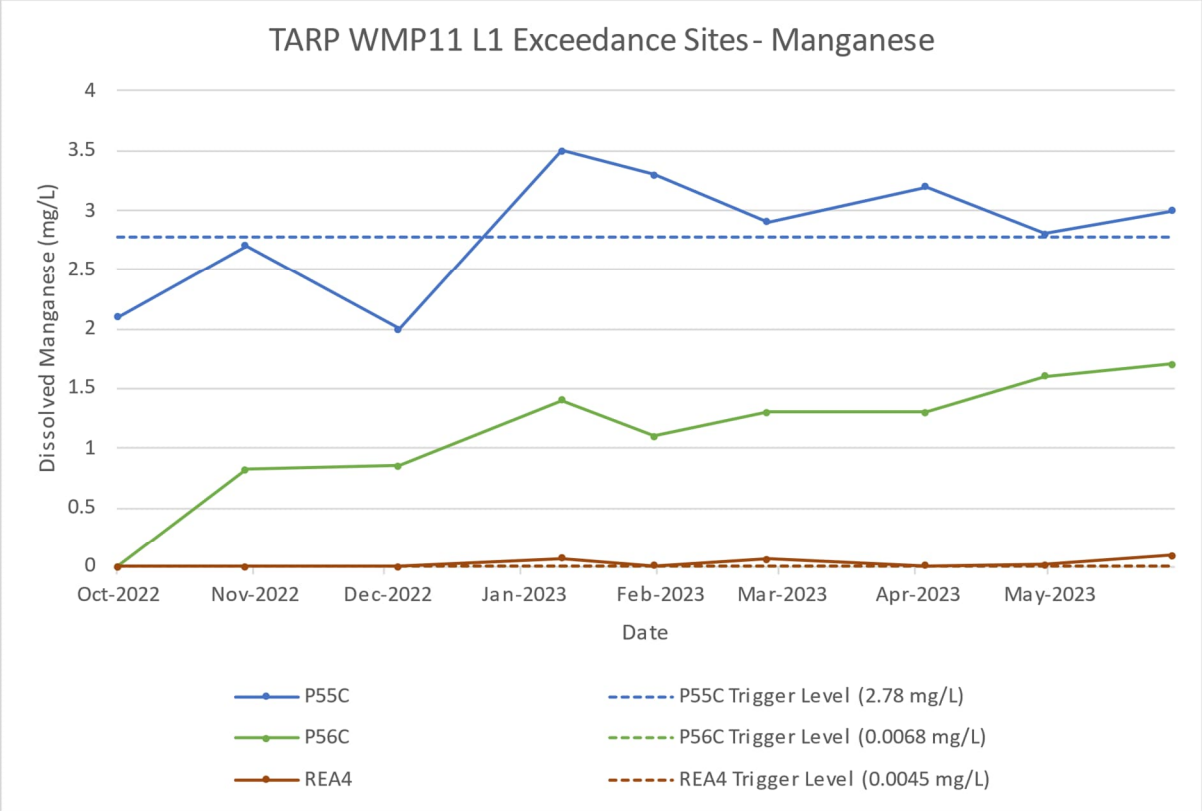


Figure 13 TARP WMP11 Level 1 Exceedance – Manganese

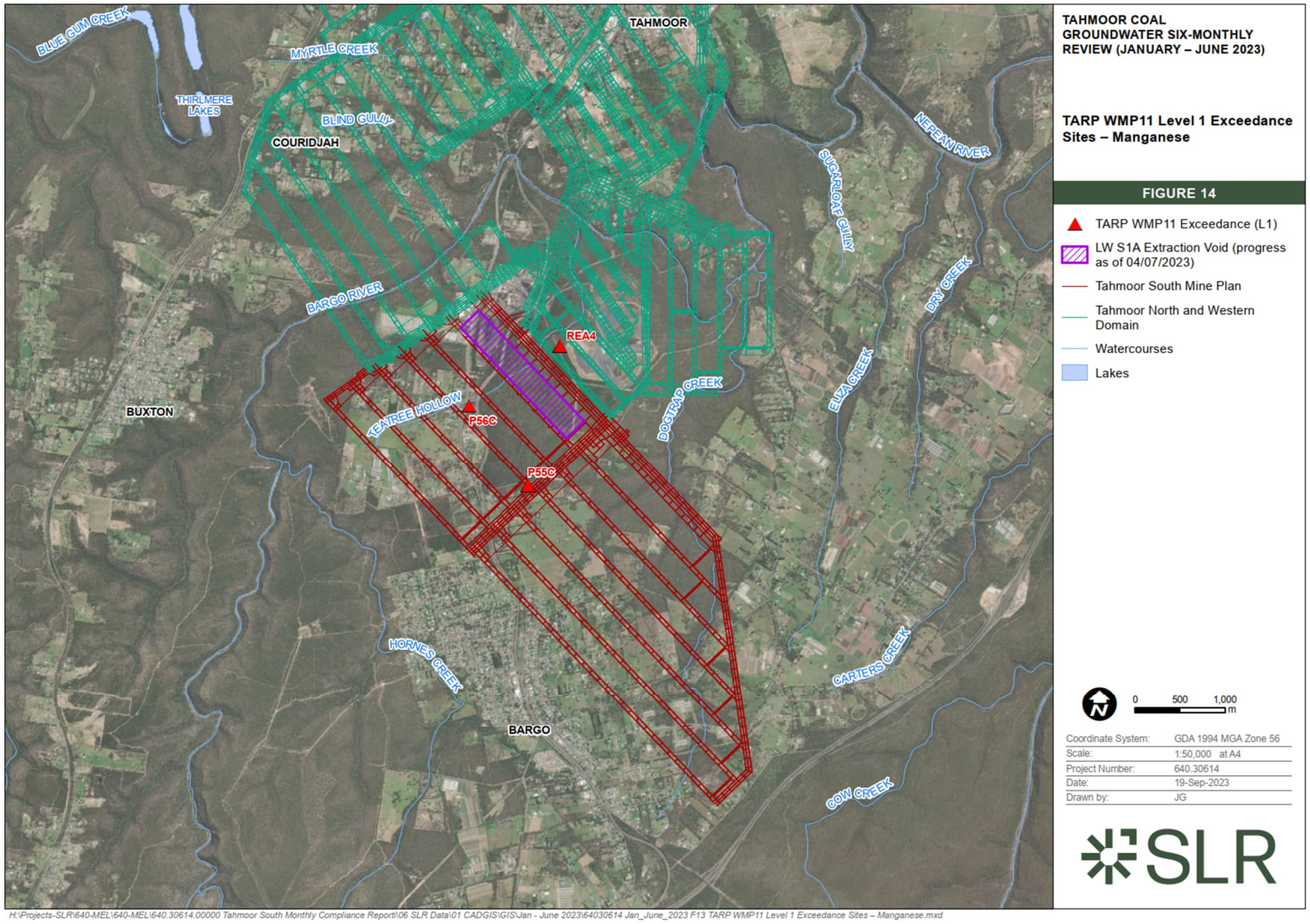


Figure 14 TARP WMP11 Level 1 Exceedance Sites – Manganese

Table 10 Groundwater Quality Exceedance Discussion – Manganese

Site	Discussion
P55	At P55C, the concentration of manganese was higher than the trigger level in all monitoring rounds since January 2023. Over the reporting period, the concentration of manganese has been generally increasing since December 2022. The concentration of manganese at P55A and P55B has remained below the trigger level in all monitoring rounds since October 2022. The increase in the concentration of dissolved manganese at P55C appear to be related to the natural fluctuation in groundwater quality. The P55 site is located south of the LW S1A extraction void. Additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. Upon further monitoring and review, a revision of the baseline trigger is recommended.
P56	At P56C, the concentration of manganese was higher than the trigger level for manganese in all monitoring rounds since October 2022 and has been generally increasing over the reporting period. The concentration of manganese at P56A has remained below the trigger level for manganese in all monitoring rounds since November 2022, except in January 2023. The concentration of manganese at P56B has remained below the trigger level for manganese in all monitoring rounds since October 2022, with the manganese concentrations relatively steady over the reporting period. The trigger levels for P56A, P56B and P56C are 0.122 mg/L, 1.67 mg/L, and 0.07 mg/L, developed on baseline pre-mining observations. This significant variation could be indicative of the highly variable natural manganese concentrations in local groundwater. The increase in the concentration of dissolved manganese at P56C appear to be related to the natural fluctuation in groundwater quality. The P56 site is located east of the LW S1A extraction void. Additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. Upon further monitoring and review, a revision of the baseline trigger is recommended.
REA4	At REA4, the concentration of manganese was higher than the trigger level for manganese in all monitoring rounds since December 2022. Generally, the concentration of barium has been increasing over the reporting period. REA4 is nested with site P52. At P52, the concentration of barium has remained below the P52 trigger level throughout the reporting period, except in November 2022 and February 2023. The increase in the concentration of dissolved manganese at REA4 appear to be related to the natural fluctuation in groundwater quality. Additional monitoring is required to ascertain if variability in water quality can be attributable to extraction activities. Upon further monitoring and review, a revision of the baseline trigger is recommended.

4.2.4 WMP11 Trigger Levels

While TARP L1 exceedances have been observed over the reporting period for barium, strontium and manganese, the concentrations of these dissolved metals have not significantly increased since the commencement of mining. The exception to this trend is the strontium concentration at P53C, which has continued to increase since October 2022.

The spatial distribution of the bores showing trends in barium, manganese, and strontium are inconsistent with a response to mining, with bores spatially disparate from extraction activities showing this trend. For example, bores located at a similar distance (or closer) to extraction are not showing similar trends and hence the trends are not easily attributable to mining activities. Additionally, nested sites are not showing consistent trends in barium, manganese, and strontium.

Furthermore, SLR understands that observed concentrations of the dissolved metals barium, strontium and manganese in groundwater is generally consistent with the observed pre-mining concentrations of these dissolved metals in surface water (pers.coms. ACT Williams, Sept 2023).

Therefore, it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period.

Given that extraction at LW S1A commenced less than one year ago (i.e., October 2022), it is likely to be too early in the monitoring period to conclude that TARP exceedances related to groundwater quality are conclusively mining related. As such, it is more likely, that TARP exceedances related to groundwater quality are representative of natural fluctuations in water quality.

Groundwater trigger levels were calculated using a short baseline period which could result in a conservative trigger level for barium, strontium and manganese. In the 2022 Annual Review (SLR, 2023), a review the baseline data in conjunction with the additional data collected over 2023 was recommended, and to consider incorporating the additional data points into the 'baseline' period with a recalculation of the triggers to capture the natural variability of the system.

While the observed groundwater quality trends for barium, strontium and manganese have not been found to be attributable to mining activities in this reporting period, it is noted that a full 12-month period of monitoring data is yet to be collected. As such, climatic drivers and seasonality have not been fully reflected in the monitoring data.

It is recommended that a revision of the trigger levels for dissolved metals, specifically barium, strontium and manganese, is undertaken once the October 2023 monitoring data has been reviewed. This would allow a full 12-month period of monitoring data to be included into 'baseline' period from which trigger values can be recalculated, and therefore capture the natural variability of the system.

4.3 TARP WMP12

P55C is associated with surface water monitoring site TT1-QRLa and the two can be considered together when reviewing the surface water – groundwater connectivity TARP (WMP12). The water level plot for TT1-QRLa is provided in Figure 15, and the groundwater hydrograph reproduced again here for context in Figure 16.

The cease to flow level at this SW site is 292.42 mAHD, and the baseline minimum is 291.897 mAHD. The groundwater elevation range recorded at P55C (the deepest of the nested bores at P55) is 256 mAHD to 265 mAHD.

There is no apparent correlation at this point in time between the apparent decline in groundwater level and trigger breach at P55C and the nearby surface water gauging station.

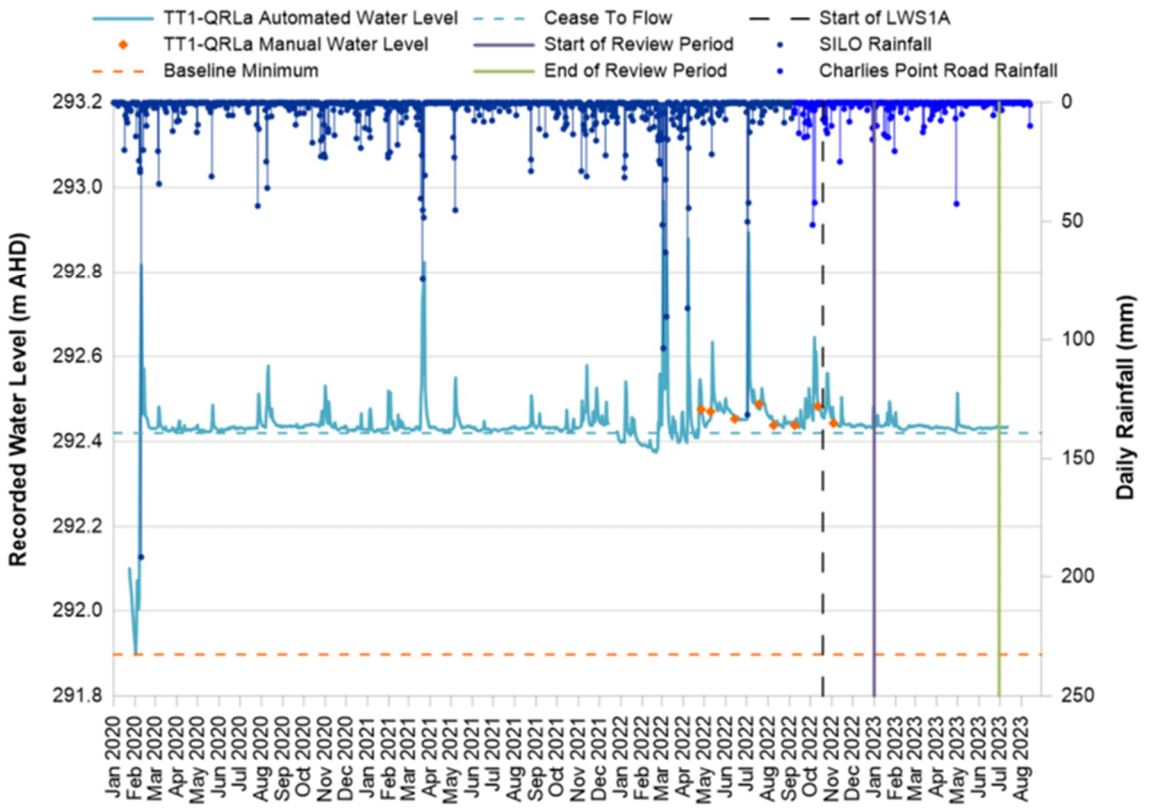


Figure 15 Recorded Water Level and daily rainfall for TT1-QRLa

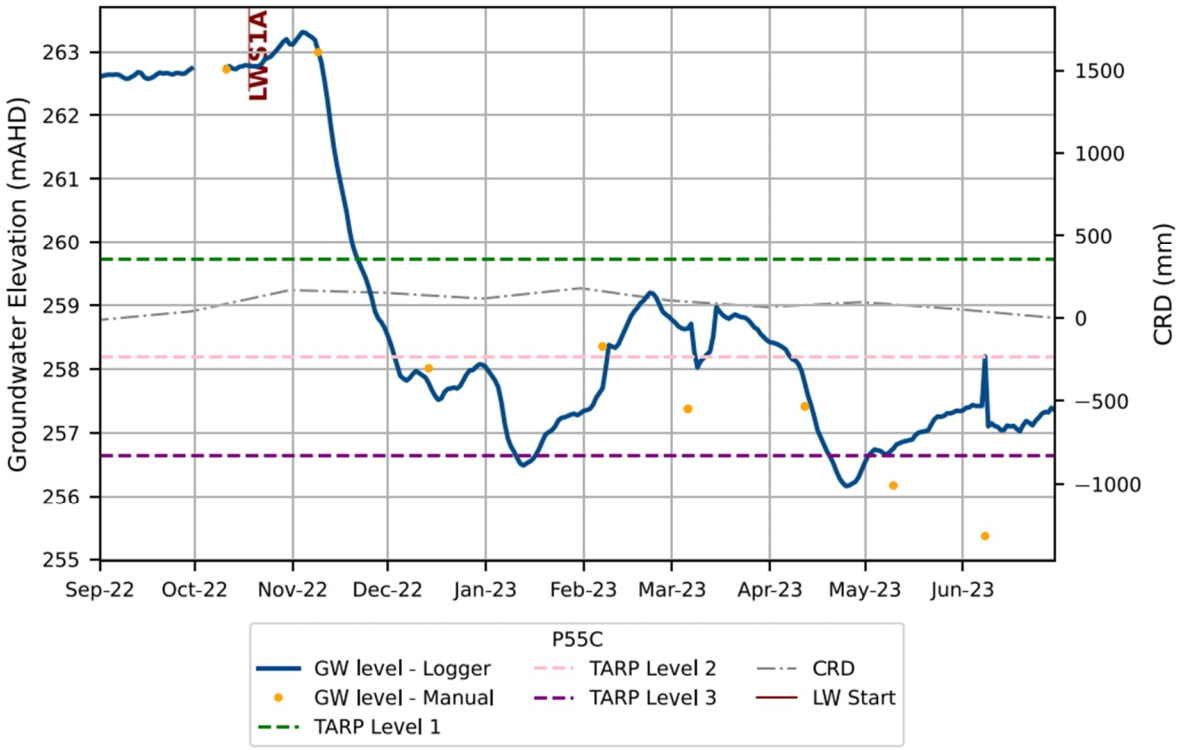


Figure 16 Groundwater Elevation at P55C

5.0 Mine Inflows

Since 2009, observed inflows to Tahmoor Mine have ranged from approximately 2 to 7 ML/d. In October 2022, the Western Domain blocks were sealed. Since this time, the average groundwater inflow from Tahmoor underground workings is reported as 2.3 ML/d.

The cumulative groundwater inflows, as calculated from the mine water balance and pump-out records is presented in Figure 17.

The reporting period occurs within the water year 2022-23. As of 30 June 2023, the cumulative groundwater make for water year 2022-23 is 1,068 ML, which remains below the groundwater entitlement of 1,642 ML/y (Figure 17).

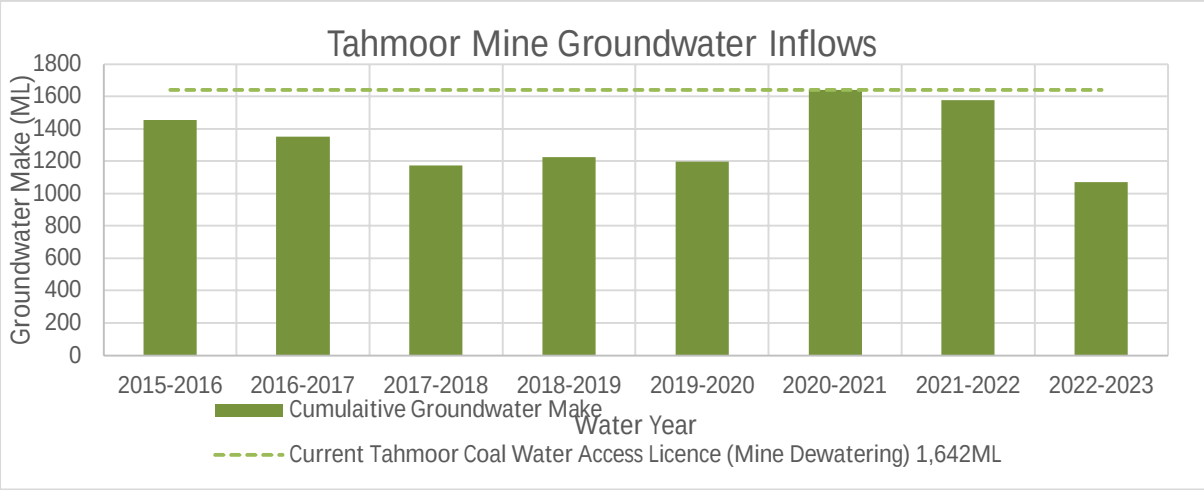


Figure 17 Tahmoor Mine Groundwater Inflows

6.0 Action and Response

Table 12, Table 12 and Table 13 summarise the Actions and Responses in line with each relevant TARP that has been triggered.

Table 11 Actions and Responses for Level 1 TARP Triggers for WMP8 (Shallow Groundwater Levels)

Action / Response from TARP WMP8	Tahmoor Coal response
Actions	
Continue monitoring and review of data as per monitoring program.	Monthly monitoring and review of data is ongoing according to the monitoring program.
Undertake an investigation to assess cause and determine if mining related.	An investigation to assess cause of the water level decline at P55C and P56C is provided in Section 4. For both bores, groundwater depressurisation could be due to ongoing mining effect. However, at P55C, the relative stability of this water level cannot definitely be attributed to extraction activities.
Undertake investigation to determine if the decline will impact the long-term viability of the affected water supply works.	Current drawdown associated with exceedances is localised, and only observed in the deepest of the nested sites. Consequently, there no indication that regional aquifer

Action / Response from TARP WMP8	Tahmoor Coal response
	drawdown is occurring of that any impact would be observed in existing water supply works.
Discuss findings and obtain other relevant information from key specialists (e.g., subsidence monitoring results, surface water level results).	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 4).
The investigation will be commenced/completed as efficiently as practicable. If the changes have been confirmed to be related to mining effects: For Open Standpipe Monitoring Bores: For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	For both bores, groundwater depressurisation could be due to ongoing mining effect, however this has not been confirmed based on the current data.
Responses	
Report trigger exceedance to DPE and key stakeholders.	Notification of this exceedance to DPE is completed as part of this report.
Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.

Table 12 Actions and Responses for Level 1 TARP Triggers for WMP11 (Groundwater Quality)

Action / Response from TARP WMP11	Tahmoor Coal response
Actions	
Continue monitoring and review of data as per monitoring program.	Monthly monitoring and review of data is ongoing according to the monitoring program.
Undertake an investigation to assess cause and determine if mining related.	An investigation to assess cause of the groundwater quality decline is provided in Section 4. It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality.
Undertake investigation to determine if the change in quality will impact the long-term viability of the affected water supply works.	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality. Therefore, long-term impacts are unlikely to occur at this stage.
Discuss findings and obtain other relevant information from key specialists (e.g., subsidence monitoring results, surface water level results).	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 4).
If the changes have been confirmed to be related to mining effects: For Private Bores: • Initiate negotiations with impacted landholders as soon as practicable. Consider all reasonable and feasible options for remediation as relevant. This could include potential for implementation of make-good provisions as per Section	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality.

Action / Response from TARP WMP11	Tahmoor Coal response
6.2.1.4 of the Water Management Plan for affected private bore owners (e.g., provision of access to an alternative source of water).	
If the changes have been confirmed to be related to mining effects: For Open Standpipe Monitoring Bores: • For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality. None of the bores specified in WMP13 were triggered within the reporting period.
Responses	
Report trigger exceedance to DPE and key stakeholders.	Notification of this exceedance to DPE is completed as part of this report.
Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.
If the changes have been confirmed to be related to mining effects: For Private Bores: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g., provision of access to an alternative source of water as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.	It was determined that it is unlikely that extraction at LW S1A is influencing the elevated concentrations of barium, strontium and manganese during the reporting period, and are likely representative of natural fluctuations in water quality.

Table 13 Actions and Responses for Level 1 TARP Triggers for WMP12 (Groundwater – Surface Water Interaction)

Action / Response from TARP WMP12	Tahmoor Coal response
Actions	
Continue monitoring and review of data as per monitoring program.	Monthly monitoring and review of data is ongoing according to the monitoring program.
Undertake an investigation to assess cause and determine if mining related.	An investigation to review if the trigger at WMP8 is indicative of groundwater – surface water interaction changes (WMP12) has been undertaken in Section 4.3. TARP WMP12 has been initiated for P55C due to TARP triggers at both P55C (WMP8) and changes observed at the relevant surface water site TT1-QRLa. Further detailed investigation into the site-specific groundwater surface water relationship is required. Given no trigger is breached in the shallow groundwater bore (P55a or P55b), there is unlikely to be a direct relationship between groundwater drawdown and surface water changes. It was determined that it is unlikely that extraction at LW S1A is influencing groundwater – surface water interactions during the reporting period.

Action / Response from TARP WMP12	Tahmoor Coal response
Discuss findings and obtain other relevant information from key specialists (e.g., subsidence monitoring results, surface water level results).	Relevant information was obtained from key specialists necessary to inform assessment (refer Section 4.3).
Responses	
Report trigger exceedance to DPE and key stakeholders.	Notification of this exceedance to DPE is completed as part of this report.
Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review	Completed as part of this report.
If the changes have been confirmed to be related to mining effects: For Private Bores: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g., provision of access to an alternative source of water as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.	It was determined that it is unlikely that extraction at LW S1A is currently impacting groundwater – surface water interactions, with shallowest groundwater levels currently unimpacted by longwall extraction.

7.0 Recommendations

Based on the TARP assessment and discussion of potential influences driving the observed exceedances in the reporting period, of the following recommendations are made:

- Revise the trigger levels for dissolved metals, specifically barium, strontium and manganese, by including the 12-month period of monitoring data from October 2022 to October 2023 in the 'baseline' period from which trigger values can be recalculated, such that the trigger levels capture the natural variability of the system.
- Remove monitoring site GW062068 from the groundwater monitoring program due to infrastructure issues that render the bore unsuitable for ongoing monitoring.
- Establish the historical groundwater level for VWPs TBC09 (BUSM-381m), TBC018 (WBCS-377m). TBC020 (WBCS-397m) and TBC020 (WO-439m) so that drawdown at these locations can be calculated.
- Review the configuration of all VWPs in the monitoring network as it appears there are potential issues of channels duplicating data (particularly at Site TBC024) and misalignment between the understanding of installed/labelled sensor depth and the sensor depth as per the data download.
- Following a review of the VWP configuration, consider removing VWPs TBC024 (BHCS-168m), TBC032 (in particular, HBSS-95m) and TBC034 (BHCS-176m) from the monitoring regime as data appears to be erroneous due to faulty loggers.
- Continue the monitoring program, and the reporting of groundwater level and quality data in monthly groundwater monitoring reporting.

- Once groundwater level data become available at the Thirlmere Lakes bores, assess groundwater levels against WMP13 to confirm that no groundwater level exceedances occurred following the commencement of LW S1A.

The following actions from the 2022 Tahmoor South Annual Review (SLR, 2023) are also recommended:

- Install and commence monitoring at P50, in order to replace P51 as an early warning bore in WMP13.
    - This is currently in the works with land access negotiations underway.
- In the next Six-Monthly Subsidence Impact Report, review the baseline data in conjunction with the additional data collected to that point. If no impact from mining has been identified, consider incorporating the additional data points into the 'baseline' period and recalculate the triggers to capture natural variability of the system.
    - Review of the data in this six-monthly has indicated that fluctuations noted are not attributable to mining and consequently can be used as additional baseline data for recalculation of triggers. SLR will undertake a review of current triggers and review prior to the submission of the next six-monthly report.

8.0 References

SLR, 2023. *Tahmoor South Groundwater Reporting October – December 2022*. SLR Report: 640.30614.00000-R01-v2.0.

SLR, 2022. *Extraction Plan Groundwater Technical Report*. Prepared for Tahmoor Coal, October 2022. SLR Report: 610.30637.00000-R01

Queensland Government, 2023. SILO Long Paddock. Available at https://www.longpaddock.qld.gov.au/

Tahmoor Coal Pty Ltd, 2022. *Water Management Plan – Tahmoor South Domain – Longwalls South 1A-South 6A*. May 18,2022. Report: TAH-HSEC-00361.

Appendix A TARP WMP8 – WMP13 (Tahmoor Coal, 2022)

Six-Monthly Groundwater Monitoring: January – June 2023

Tahmoor South Domain

Tahmoor Coal Pty Ltd

SLR Project No.: 640.30614.00000

1 October 2023

WATER MANAGEMENT PLAN TARP – WMP8 SHALLOW GROUNDWATER LEVEL (OPEN STANDPIPES AND PRIVATE BORES)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. This TARP supports TARP WMP13, where groundwater levels as they pertain to groundwater dependent ecosystems (GDEs) (Thirlmere Lakes) are covered. **Assessment Criteria** Bore specific trigger values based on baselines data for each reporting level.	**Locations** **Open standpipes** Existing sites: P51a, P51b, P52, REA4, P53a, P53b, P53c, P54a, P54b, P55a, P55b, P55c, P56a, P56b, P56c Proposed sites: P50a, P50b, P50c, P57a, P57b **Private bores** GW109257, GW104008, GW112473, GW104659, GW062068, GW105395, GW104323 All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** Monthly manual measurements of water level. **During Mining** Monthly manual measurements of water level. **Post-mining** Quarterly manual measurements of water level for 12 months following the completion of LW S6A, or as required in accordance with a Rehabilitation Management Plan.	**Normal Condition**		
		• Groundwater level remains consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two meters.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Greater than 2 m water level reduction[1] for a period of 6 months following the commencement of extraction.	For Private Bores and Open Standpipe Monitoring Bores • *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Undertake investigation to demonstrate if the decline will impact the long-term viability of the affected water supply works. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results). The investigation will be commenced/completed as efficiently as practicable. If the changes have been confirmed to be related to mining effects: For Private Bores: • Initiate negotiations with impacts landowners as soon as practicable. Consider all reasonable and feasible options for remediation as relevant (e.g. extending the depth of the bore, establishment of additional bores, etc - as per Section 6.2.1.4 of the Water Management Plan. " For Open Standpipe Monitoring Bores • For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	For Private Bores and Open Standpipe Monitoring Bores • Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. If the changes have been confirmed to be related to mining effects: For Private Bores: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access (finalise negotiations and implement the agreed "make-good" arrangements) • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Water level declines below the average between the 'maximum modelled drawdown' (Level 3 trigger) and the '2 m drawdown' (Level 1 trigger)[1] for a period of greater than 6 months following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	For Private Bores and Open Standpipe Monitoring Bores • *Actions as stated in Level 1.* • Consider increasing monitoring and review of data at sites where Level 2 has been reached, subject to land access. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). • Compare against base case and deterministic model scenarios[2]. • Review Water Management Plan and modify if necessary. For Private Bores: • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.	For Private Bores and Open Standpipe Monitoring Bores • *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan. For Private Bores: • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access.
		Level 3		
		• Water level reduction greater than the maximum modelled drawdown[1] for a period of 6 months following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	For Private Bores and Open Standpipe Monitoring Bores • *Actions as stated in Level 2.* • Increase monitoring and review of data frequency for sites where Level 3 has been reached, subject to land access. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate).	For Private Bores and Open Standpipe Monitoring Bores • *Responses as stated in Level 2.* For Private Bores: • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access.

Notes:
[1] Level 1, 2 and 3 triggers for water level reduction is provided in Table 6-3 in Appendix E of the Water Management Plan.
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

WATER MANAGEMENT PLAN TARP – WMP9 SHALLOW GROUNDWATER PRESSURE (VWP SENSORS < 200 M DEPTH)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on baselines data for each reporting level.	**Locations** TBC032, TBC033, TBC009, TBC018 Monitoring of all VWP < 200 m depth intakes. Reference Sites: TBC024, TBC027, TBC034, TBC038 All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** VWPs sensors take pressure readings hourly. The system is now telemetered so data is streamed continuously and can be accessed at any point in time. **During Mining** VWPs sensors take pressure readings hourly. The system is now telemetered so data is streamed continuously and can be accessed at any point in time. **Post-mining** Monitoring of data (streamed continuously) for 12 months following the completion of LW S6A.	**Normal Condition**		
		• No observable mining induced change at VWP intakes. • Greater than 5 m water level reduction in VWP intakes[1] following the commencement of extraction for a period of less than six months	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Greater than 5 m water level reduction in VWP intakes[1] following the commencement of extraction for a period of greater than six months.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related, commence/complete as soon as practicable. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Water level declines below the calculated Level 2 trigger – being the average of Level 1 (the '5 m drawdown'[1]) and Level 3 (the 'maximum modelled drawdown') – following the commencement of extraction for a period of greater than six months.. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• *Actions as stated in Level 1.* • Review deeper VWP data at monitored sites. Determine whether additional review of data is required. Determine if review of additional existing VWP sites is required. Reasons for not increasing frequency of data review could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). • Compare against base case and deterministic model scenarios[2]. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Water level reduction greater than the maximum modelled drawdown[1] following the commencement of extraction for a period of greater than six months. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• *Actions as stated in Level 2.* • Increase review of data frequency for sites where Level 3 has been reached. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). Commence/complete as soon as practicable • Undertake investigative to review model results in conjunction with field data.	• *Responses as stated in Level 2.*

Notes:
[1] Level 1, 2 and 3 triggers for water level reduction is provided in Table 6-4 in Appendix E of the Water Management Plan).
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

WATER MANAGEMENT PLAN TARP – WMP10 GROUNDWATER LEVEL / PRESSURE DEEP VWPS (> 200 M DEPTH EXCLUDING MONITORING THE BULLI COAL SEAM)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on modelled data for each reporting level. Model layers utilised to define predicted drawdown for each VWP logger provided in Table below.	**Locations** TBC009, TBC0018, TBC020, TBC026, TBC032, TBC033, TBC039 Reference sites: TBC024, TBC027, TBC034, TBC038 Monitoring of all VWP > 200 m depth intakes excluding those monitoring the Bulli Coal Seam. All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** VWPs sensors take pressure readings hourly. The system is now telemetered so data is streamed continuously and can be accessed at any point in time. **During Mining** VWPs sensors take pressure readings hourly. The system is now telemetered so data is streamed continuously and can be accessed at any point in time. **Post-mining** Monitoring of data (streamed continuously) for 12 months following the completion of LW S6A.	**Normal Condition**		
		• ~~Recorded data within (do not exceed) modelled impacts (predicted drawdown)~~Observed data does not exceed modelled impacts predicted drawdown by greater than 30 metres[1]. • Observed drawdown ~~is within 30 m of~~ exceeds the modelled predicted drawdown[1], by greater than 30 metres for ~~a period less than 6 months.~~of less than three consecutive months	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Observed drawdown ~~is within 30 m of~~ exceeds the modelled predicted drawdown[1], by greater than 30 metres for ~~a period less than 6 months.~~greater than three consecutive months.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related, to be commenced/completed as soon as practicable. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Observed drawdown is exceeds modelled predicted drawdown[1], by ~~less~~ more than 30 metres ~~for a period of~~ greater than 6 consecutive months. • ~~Observed drawdown exceeds modelled predicted drawdown[1] by greater than 30 m, for a period of 6 to 12 months.~~	• *Actions as stated in Level 1.* • Determine suitability of increasing frequency of data review at sites where Level 2 has been reached. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). • Review data in conjunction with VWP data from additional existing VWP sites. • Compare against base case and deterministic model scenarios[2]. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Inclusion of more regional VWPs into data review to determine likely extent and depth of depressurisation. • Advise DPE and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Observed drawdown exceeds modelled predicted drawdown[1] by 30 m, for ~~a period of~~ 12 consecutive months or more.	• *Actions as stated in Level 2.* • Increase review of data frequency for sites where Level 3 has been reached. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). To be commenced/completed as soon as practicable. • Review base case and deterministic model scenarios[2] in conjunction with water pressure data and report findings.	• *Responses as stated in Level 2.*

Notes:
[1] Predicted drawdown refers to the drawdown as generated by the groundwater model and varies over time as extraction progresses. Observed drawdown will be plotted on a monthly basis against the predicted drawdown to determine if a trigger has occurred. Therefore, as the predicted drawdown will be constantly changing according to extraction progression, it is not possible to set a specific trigger limit.
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

Sensor	Model Layer	Model Geology		Sensor	Model Layer	Model Geology
TBC09_322	8	BUSS Mid		TBC26_344	8	BUSS Mid
TBC09_343	8	BUSS Mid		TBC26_409	13	WBCS
TBC09_357	12	SBSS Lower		TBC26_432	15	Bulli Seam
TBC09_381	10	SPCS		TBC26_440	16	Eckersley
TBC09_391	15	Bulli Seam		TBC26_460	16	Eckersley
TBC09_397	17	Wongawilli		TBC32_200	8	BUSS Mid
TBC18_282	8	BUSS Mid		TBC32_237	8	BUSS Mid
TBC18_366	8	BUSS Mid		TBC32_257	8	BUSS Mid
TBC18_377	13	WBCS		TBC32_294	8	BUSS Mid

TBC18_404	15	Bulli Seam		TBC32_314	8	BUSS Mid
TBC18_426	17	Wongawilli		TBC33_247	8	BUSS Mid
TBC18_432	17	Wongawilli		TBC33_306	8	BUSS Mid
TBC20_211	8	BUSS Mid		TBC33_363	11	SBSS Upper
TBC20_293	8	BUSS Mid		TBC33_384	16	Eckersley
TBC20_375	8	BUSS Mid		TBC33_408	16	Eckersley
TBC20_397	13	WBCS		TBC39_243	8	BUSS Mid
TBC20_411	7	BUSS Upper		TBC39_299	8	BUSS Mid
TBC20_434	17	Wongawilli		TBC39_354	11	SBSS Upper
TBC20_439	4	HBSS Mid		TBC39_375	16	Eckersley
TBC26_211	8	BUSS Mid		TBC39_402	16	Eckersley
TBC26_278	8	BUSS Mid				

WATER MANAGEMENT PLAN TARP – WMP11 GROUNDWATER QUALITY (OPEN STANDPIPES AND PRIVATE BORES)

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8"><u>Performance Measure Feature</u>
No performance measure relevant.

<u>TARP Objective</u>
This TARP defines levels of deviation in groundwater level from ‘normal’ or baseline conditions and the actions to be implemented in response to each level deviation.
This TARP supports TARP WMP13, where groundwater quality as it pertains to groundwater dependent ecosystems (GDEs) (Thirlmere Lakes) is covered.

<u>Assessment Criteria</u>
Bore specific trigger values based on baselines data for each reporting level.</td><td rowspan="8"><u>Locations</u>
Open standpipes
Existing sites:
P51a, P51b, P52, REA4, P53a, P53b, P53c, P54a, P54b, P55a, P55b, P55c, P56a, P56b, P56c

Proposed sites:
P50a, P50b, P50c, P57a, P57b

Private bores
GW109257, GW104008, GW112473, GW104659, GW062068, GW105395, GW104323

All monitoring locations are shown in Figure 23 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Monthly water quality sampling.

During Mining
Monthly water quality sampling

Post-mining
Quarterly water quality sampling.

Water Quality sample parameters:
<table><tr><th>Field Parameters</th></tr><tr><td>PH
EC
TDS
DO
ORP</td></tr><tr><th>Laboratory Analysis</th></tr><tr><td>Total alkalinity as CaCO3, HCO3, CO3, DOC
Dissolved Major Cations (Ca, K, Na, Mg, F, Cl, SO4)
Dissolved Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Nitrogen
Total Phosphorus
Ionic Balance (Total Anions and Total Cations)</td></tr></table></td><td colspan="3">Normal Condition</td></tr>
<tr><td>• No observable changes in salinity, pH or metals outside of the baseline variability.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 1</td></tr>
<tr><td>• Observed salinity and/or metals or pH outside of defined trigger levels[1] for ~~less than~~ ~~3~~3 consecutive months or ~~less~~more. The effect does not persist after a significant rainfall recharge event.
AND
• A similar trend or response is noted at other monitored bores or private groundwater bores.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Actions as required for Normal Condition.
• Undertake an investigation to assess cause and determine if mining related.
• Undertake investigation to demonstrate if the change in quality will impact the long-term viability of the affected water supply works.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).
If the changes have been confirmed to be related to mining effects:
For Private Bores:
• Initiate negotiations with impacted landholders as soon as practicable. Consider all reasonable and feasible options for remediation as relevant. This could include potential for implementation of make-good provisions as per Section 6.2.1.4 of the Water Management Plan for affected private bore owners (e.g. provision of access to an alternative source of water).
For Open Standpipe Monitoring Bores
• For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Report trigger exceedance to DPE and key stakeholders.
• Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
If the changes have been confirmed to be related to mining effects:
For Private Bores:
• Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. provision of access to an alternative source of water as detailed in Section 6.2.1.4 of the Water Management Plan).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• Observed salinity and/or metals or pH outside of defined trigger levels[1] , for 3 consecutive months or ~~less~~more. The effect persists after a significant rainfall recharge event.
AND
• The change in water quality is determined not to be controlled by climatic or external anthropogenic factors.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Actions as stated in Level 1.
• Consider increasing monitoring and review of data at sites where Level 2 has been reached, subject to land access. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water quality change).
• Review Water Management Plan and modify if necessary.
For Private Bores:
• Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Responses as stated in Level 1.
• Advise DPE and key stakeholders of any required amendments to Water Management Plan.
For Private Bores:
• Provide findings of CMA review to DPE and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Observed salinity and/or metals or pH outside of defined trigger levels[1] , for greater than ~~6~~3 consecutive months.
AND
• The change in water quality is determined not to be controlled by climatic or external anthropogenic factors.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Actions as stated in Level 2.
• Increase monitoring and review of data frequency for sites where Level 3 has been reached, subject to land access.
• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate).
• Undertake investigative report to demonstrate if the water quality change will impact the long-term viability of any affected water supply works.</td><td>For Private Bores and Open Standpipe Monitoring Bores
• Responses as stated in Level 2.
For Private Bores:
If ascertained impact is due to mining activities and has potential to impact long-term viability of supply for private groundwater bores:
• Develop a Rehabilitation Management Plan in consultation with DPE and landowner.
• Implement Rehabilitation Management Plan, subject to land access.</td></tr>
<tr><td colspan="5">Notes:
[1] Defined trigger levels for groundwater quality are listed in Table 6-5 of Appendix E of the Water Management Plan.</td></tr>
</table>

WATER MANAGEMENT PLAN TARP – WMP12 GROUNDWATER - SURFACE WATER INTERACTION

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in surface water - groundwater interactions from 'normal' conditions and the actions to be implemented in response to each level deviation. The instigation of this TARP will be dictated by triggers exceedances in pertinent groundwater or surface water sites requiring further investigation of groundwater – surface water interactions. Where groundwater – surface water connectivity indicates in a gaining stream, there is potential for groundwater supporting riparian vegetation. Consequently, Riparian vegetation in these situations could be a Groundwater Dependent Ecosystem (GDE), and the pertinent Performance Measure applicable: Negligible impacts including: • Negligible change in groundwater levels; and • Negligible change in groundwater quality. Riparian GDEs are addressed through the Riparian Vegetation TARP (BMP3). Consultation through the ERG will link this TARP (WMP12) to BMP3 via actions in BMP3 to consider groundwater – surface water relationships when pertinent. **Assessment Criteria** Bore specific trigger values based on baselines data for each reporting level. For this TARP, the aligned groundwater and surface water sites would be considered collectively to interpret potential changes/impacts to groundwater – surface water interaction.	**Locations** **Open standpipes** P51a, P51b, P52, REA4, P53a, P53b, P53c P54a, P54b, P54c, P55a, P55b, P55c The aligned surface water and groundwater sites are as follows: • P51a, P51b with surface water site BR2-Qla • P52, REA4 with surface water site-TT14-QLa • P53a, P53b, P53c with surface water site-TT14-Qla • P54a, P54b, P54c with surface water site TT3-QLa • P55a, P55b, P55c with surface water site TT1-QRLa All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** Monthly manual measurements of water level and water quality. **During Mining** Monthly manual measurements of water level and water quality. **Post-mining** Quarterly manual measurements of water level for 12 months following the completion of LW S6A, or as required in accordance with a Rehabilitation Management Plan.	**Normal Condition**		
		• Observed (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent with baseline variability and/pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Observed (or inferred where not immediately neighbouring a surface water site) groundwater levels at surface water monitoring site decline below Level 1 (in TARP WMP8) following the commencement of extraction.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results).	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. If the changes have been confirmed to be related to mining effects: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Observed (or inferred where not immediately neighbouring a surface water site) groundwater levels at aligned surface water monitoring site decline below Level 2 (in TARP WMP8) following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factor.	• *Actions as stated in Level 1.* • Increase frequency of data review to fortnightly at sites where Level 2 has been reached, subject to land access. Reasons for not increasing frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). • Compare against base case and deterministic model scenarios[1]. • Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline. • Review surface water data to assess for surface water level decline at relevant site. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Water Management Plan, including reporting on relationship of observations to baseline and deterministic model scenarios, as necessary.
		Level 3		
		• Inferred groundwater levels at surface water monitoring site decline below Level 3 (in TARP WMP8) following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factor.	• *Actions as stated in Level 2.* • Increase frequency of data review for sites where Level 3 has been reached, subject to land access. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). Report to be commenced and completed as soon as practicable.	• *Responses as stated in Level 2.* • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access.

Notes:
[1] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

WATER MANAGEMENT PLAN TARP – WMP13 GROUNDWATER BORES MONITORING FOR THIRLMERE LAKES

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature GDEs including Thirlmere Lakes[1]. **Performance Measure** Negligible impacts including: • Negligible change in groundwater levels; and • Negligible change in groundwater quality. **Performance Indicator** The performance measure will be considered to be exceeded if the groundwater levels or groundwater quality decline below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction, and the investigation outcomes indicate a mining related impact based on monitoring data for the Thirlmere Lakes. **TARP Objective** This TARP defines levels of deviation at Thirlmere Lakes from 'normal' conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on baselines data for each reporting level.	**Locations** **"Early warning" bores** Existing sites: ~~P51a, P51b~~, GW062068, GW104659, TBC039 (sensor at 65 metres in Hawkesbury Sandstone (HBSS)) Proposed sites: P50a, P50b, P50c **Thirlmere Lakes bores (not trigger bores)** Existing sites: GW075409–1, GW075409–2, GW075410, GW075411 (paired with gauging station 212066) ~~Proposed sites:~~ ~~P50a, P50b, P50c~~ All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency (for "early warning" bores)** **Pre-mining** Monthly manual measurements of water level and water quality. **During Mining** Monthly manual measurements of water level and water quality. **Post-mining** Quarterly manual measurements of water level for 12 months following the completion of LW S6A, or as required in accordance with a Rehabilitation Management Plan. Water Quality sample parameters: **Field Parameters** PH EC TDS DO ORP **Laboratory Analysis** Total alkalinity as CaCO3, HCO3, CO3, DOC Dissolved Major Cations (Ca, K, Na, Mg, F, Cl, SO4) Dissolved Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe) Total Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe) Total Nitrogen Total Phosphorus Ionic Balance (Total Anions and Total Cations)	**Normal Condition**		
		• Groundwater levels and quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge events.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Level 1 trigger of TARP WMP8 for a minimum of two "early warning" bores. OR • Level 1 trigger of TARP WMP11 for a minimum of two "early warning" bores.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level results). If the changes have been confirmed to be related to mining effects: • Consider all reasonable and feasible options for remediation as relevant (e.g. extending the depth of the bore, establishment of additional bores). This could include potential for implementation of make-good provisions as per Section 6.2.1.4 of the Water Management Plan for affected private bore owners. • For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. If the changes have been confirmed to be related to mining effects: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Level 2 trigger of TARP~~s~~ WMP8 for a minimum of three bores (~~(~~"early warning" bores ~~and Thirlmere Lakes bores)~~ OR • Level 2 trigger of TARP~~s~~ WMP11 for a minimum of three bores ("early warning" bores and Thirlmere Lakes bores).	• *Actions as stated in Level 1.* If the changes have been confirmed to be related to mining effects: • Consider increasing monitoring and review of data at sites where Level 2 has been reached, subject to land access. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). Review Thirlmere Lakes monitoring bore data • Compare against base case and deterministic model scenarios[2]. • Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline. • Review surface water data to assess for surface water level decline at relevant site. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Water Management Plan and modify if necessary. • Undertake an investigation to determine if an exceedance of the performance measure is likely. To be commenced/completed as soon as practicable.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Water Management Plan. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days.
		Exceeds Performance Measure		
		• Level 3 trigger of TARPs WMP8 for a minimum of four bores (~~(~~"early warning" bores ~~and Thirlmere Lakes bores~~) OR • Level 3 trigger of TARPs WMP11 for a minimum of four bores ("early warning" bores and Thirlmere Lakes bores). AND • Review of Thirlmere Lakes bores indicated potential impacts resulting from extraction	• *Actions as stated in Level 2.* If the changes have been confirmed to be related to mining effects: • Increase monitoring and review of data frequency for sites where Level 3 has been reached, subject to land access. • Investigate reasons for the performance measure exceedance. To be commenced/completed as soon as practicable. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan.	• *Responses as stated in Level 2.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE) describing remediation options and any preferred remediation measures or other course of action. • Implement any reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project). • Update numerical groundwater model and re-run predictive scenarios to determine the likely extent and depth of depressurisation in the vicinity of Thirlmere Lakes, and to determine whether any additional management actions are required such as modifying the mine plan

Notes:
[1] It is noted that the only Groundwater Dependent Ecosystem (GDE) pertinent to the Tahmoor South Project is that of Thirlmere Lakes[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

Appendix B TARP WMP8 – WMP13 Triggers (Tahmoor Coal, 2022)

Six-Monthly Groundwater Monitoring: January – June 2023

Tahmoor South Domain

Tahmoor Coal Pty Ltd

SLR Project No.: 640.30614.00000

1 October 2023

B.1 WMP8, WMP9, WMP10, WMP13 Groundwater Level

Table 14 Summary of Groundwater Level Triggers

Bore	Type	TARP Reference Level	TARP Level 1	TARP Level 2	TARP Level 3
P51A	Shallow Open Standpipe	298.3	296.3	292.4	288.5
P51B	Shallow Open Standpipe	299.5	297.5	293.6	289.7
P52	Shallow Open Standpipe	248.7	246.7	244.6	242.5
P53A	Shallow Open Standpipe	257.8	255.8	253.7	251.6
P53B	Shallow Open Standpipe	257.8	255.8	253.7	251.6
P53C	Shallow Open Standpipe	255.6	253.6	251.4	249.1
P54A	Shallow Open Standpipe	262.7	260.7	259.0	257.4
P54B	Shallow Open Standpipe	261.9	259.9	258.2	256.6
P55A	Shallow Open Standpipe	273.1	271.1	269.7	268.2
P55B	Shallow Open Standpipe	268.0	266.0	264.4	262.9
P55C	Shallow Open Standpipe	261.7	259.7	258.2	256.6
P56A	Shallow Open Standpipe	290.2	288.2	284.8	281.4
P56B	Shallow Open Standpipe	280.9	278.9	275.5	272.1
P56C	Shallow Open Standpipe	259.4	257.4	254.1	250.7
REA4	Shallow Open Standpipe	250.3	248.3	246.2	244.1
GW062068	Private Bore	276.0	274.0	270.5	267.1
GW104008	Private Bore	236.7	234.7	234.0	233.2
GW104323	Private Bore	258.9	256.9	256.8	256.8
GW104659	Private Bore	251.8	249.8	243.6	237.4
GW105395	Private Bore	324.1	322.1	Modelled drawdown is equal to 2 m	Modelled drawdown is equal to 2 m
GW109257	Private Bore	282.9	280.9	278.9	276.9
GW112473	Private Bore	319.1	317.1	Modelled drawdown is equal to 1 m	Modelled drawdown is equal to 1 m
TNC036 (HBSS-65m)	Shallow VWP	-	204.5	-	-

Bore	Type	TARP Reference Level	TARP Level 1	TARP Level 2	TARP Level 3
TNC036 (HBSS-97m)	Shallow VWP	-	191.3	185.7	180.0
TNC036 (BGSS-169m)	Shallow VWP	-	192.5	135.7	79.0
TNC040 (WMFM-27m)	Shallow VWP	-	203.3	198.2	193.1
TNC040 (HBSS-65m)	Shallow VWP	-	182.1	175.8	169.5
TNC043 (HBSS-65m)	Shallow VWP	-	153.7	152.50	151.3
TNC043 (HBSS-111.5m)	Shallow VWP	-	150.6	148.50	146.5
TBC09 (HBSS-30m)	Shallow VWP	287.6	321.8	321.6	321.5
TBC09 (HBSS-75m)	Shallow VWP	309.4	304.4	304.2	304.1
TBC09 (BHCS-182m)	Shallow VWP	293.0	288.0	287.4	286.8
TBC09 (BGSS-192m)	Shallow VWP	290.4	285.4	285.2	285.0
TBC018 (WWFM/HBSS-70m)	Shallow VWP	250.5	245.5	245.2	244.8
TBC018 (WWFM/HBSS-117m)	Shallow VWP	251.9	246.9	246.6	246.2
TBC018 (HBSS lower-164m)	Shallow VWP	250.7	245.7	245.4	245.1
TBC018 (BHCS-179m)	Shallow VWP	248.5	243.5	243.1	242.8
TBC018 (BGSS-198m)	Shallow VWP	244.7	239.7	237.8	236.0
TBC024 (HBSS-117m)	Shallow VWP	287.6	282.6	-	-
TBC024 (HBSS-139m)	Shallow VWP	287.0	282.0	281.5	281.0
TBC024 (BHCS-168m)	Shallow VWP	289.5	284.5	283.6	282.8
TBC024 (BGSS-185m)	Shallow VWP	289.3	284.3	282.3	280.3
TBC027 (HBSS-95m)	Shallow VWP	320.1	315.1	-	-
TBC027 (HBSS-132m)	Shallow VWP	312.8	307.8	307.6	307.3
TBC027 (HBSS-169m)	Shallow VWP	312.2	307.2	307	306.8
TBC027 (BHCS-181m)	Shallow VWP	310.7	305.7	305.5	305.3
TBC027 (BGSS-198m)	Shallow VWP	310.3	305.3	305.1	304.9
TBC032 (HBSS-95m)	Shallow VWP	262.3	257.3	256.7	256.2
TBC032 (HBSS-131m)	Shallow VWP	255.0	250	249.3	248.6
TBC032 (HBSS-168m)	Shallow VWP	266.9	261.9	261.1	260.4
TBC032 (BHCS-181m)	Shallow VWP	242.8	237.8	228.7	219.5
TBC032 (BGSS-200m)	Shallow VWP	243.8	238.8	208.7	178.7
TBC034 (HBSS-65m)	Shallow VWP	371.8	366.8	-	-
TBC034 (HBSS-113m)	Shallow VWP	368.0	363.0	362.7	362.3
TBC034 (HBSS-161m)	Shallow VWP	358.4	353.4	353.1	352.8
TBC034 (BHCS-176m)	Shallow VWP	354.9	349.9	349.4	348.9
TBC034 (BGSS-196m)	Shallow VWP	358.3	353.3	352.1	350.9
TBC039 (HBSS-65m)	Shallow VWP	313.5	308.7	-	-
TBC09 (BGSS-332m)	Deep VWP	-	N/A	N/A	N/A

Bore	Type	TARP Reference Level	TARP Level 1	TARP Level 2	TARP Level 3
TBC09 (BGSS-343m)	Deep VWP	-	N/A	N/A	N/A
TBC09 (SBSS-357m)	Deep VWP	-	N/A	N/A	N/A
TBC09 (BUSM-381m)	Deep VWP	-	N/A	N/A	N/A
TBC09 (WWCO-391m)	Deep VWP	-	N/A	N/A	N/A
TBC09 (WWCO-397m)	Deep VWP	-	N/A	N/A	N/A
TBC018 (BGSS-282m)	Deep VWP	-	N/A	N/A	N/A
TBC018 (BGSS-366m)	Deep VWP	-	N/A	N/A	N/A
TBC018 (WBCS-377m)	Deep VWP	-	N/A	N/A	N/A
TBC018 (BUSM-404m)	Deep VWP	-	N/A	N/A	N/A
TBC018 (WO-432m)	Deep VWP	-	N/A	N/A	N/A
TBC020 (BGSS-211m)	Deep VWP	-	N/A	N/A	N/A
TBC020 (BGSS-293m)	Deep VWP	-	N/A	N/A	N/A
TBC020 (BGSS-375m)	Deep VWP	-	N/A	N/A	N/A
TBC020 (WBCS-397m)	Deep VWP	-	N/A	N/A	N/A
TBC020 (BGSS-411m)	Deep VWP	-	N/A	N/A	N/A
TBC020 (WO-434m)	Deep VWP	-	N/A	N/A	N/A
TBC020 (WO-439m)	Deep VWP	-	N/A	N/A	N/A
TBC026 (BGSS-211m)	Deep VWP	-	N/A	N/A	N/A
TBC026 (BGSS-278m)	Deep VWP	-	N/A	N/A	N/A
TBC026 (BGSS-344m)	Deep VWP	-	N/A	N/A	N/A
TBC026 (WBCS-409m)	Deep VWP	-	N/A	N/A	N/A
TBC026 (BUSM-432m)	Deep VWP	-	N/A	N/A	N/A
TBC026 (ECSL-440m)	Deep VWP	-	N/A	N/A	N/A
TBC026 (ECSL-460m)	Deep VWP	-	N/A	N/A	N/A
TBC032 (BGSS-200m)	Deep VWP	-	N/A	N/A	N/A
TBC032 (BGSS-237m)	Deep VWP	-	N/A	N/A	N/A
TBC032 (BGSS-294m)	Deep VWP	-	N/A	N/A	N/A
TBC039 (BGSS-243m)	Deep VWP	-	N/A	N/A	N/A
TBC039 (BGSS-299m)	Deep VWP	-	N/A	N/A	N/A
TBC039 (SBSS-354m)	Deep VWP	-	N/A	N/A	N/A
TBC039 (BUSM-375m)	Deep VWP	-	N/A	N/A	N/A
TBC039 (WWCO-402m)	Deep VWP	-	N/A	N/A	N/A

"-" not defined

"N/A" not applicable; a specific trigger limit is not set as predicted drawdown constantly changes with extraction progression.

B.2 WMP11 Groundwater Quality

Table 15 Summary of Groundwater Quality Triggers

Bore	pH Upper	pH Lower	EC	Fe Filt (mg/L)	Mn Filt (mg/L)	Cu Filt (mg/L)	Pb Filt (mg/L)	Zn Filt (mg/L)	Ni Filt (mg/L)	Al Filt (mg/L)	As Filt (mg/L)	Sr Filt (mg/L)	Li Filt (mg/L)	Ba Filt (mg/L)	Se Filt (mg/L)
GW109257	7.590	3.250	927.000	0.382	0.001	0.190	0.007	1.852	0.007	1.404	0.025	0.001	0.005	0.025	0.115
GW104008	7.110	4.590	1983.000	0.016	0.001	0.160	0.001	32.600	0.066	2.100	0.018	0.001	0.001	0.097	0.017
GW112473	6.620	4.620	574.000	0.564	0.001	0.126	0.003	9.120	0.005	1.080	0.014	0.004	0.001	0.014	0.056
GW104659	7.050	4.320	685.000	0.014	0.001	0.152	0.009	28.600	0.015	1.660	0.010	0.001	0.001	0.028	0.038
GW062068	6.100	2.590	2070.000	7.520	0.002	0.218	0.030	0.090	0.011	2.980	0.024	0.015	0.001	0.019	0.142
GW105395	8.240	4.660	4635.000	0.014	0.001	0.081	0.001	37.800	0.077	1.880	0.040	0.001	0.001	0.176	0.038
GW104323	6.950	2.760	1541.000	3.320	0.002	0.290	2.320	0.068	0.010	2.660	0.069	0.182	0.001	0.013	4.540
P51A	12.660	5.230	299.000	0.466	0.002	0.284	0.031	0.026	0.204	0.135	0.014	0.001	0.005	1.866	0.051
P51B	12.790	7.820	3971.000	3.380	0.003	0.620	0.005	0.032	0.762	0.084	0.013	0.001	0.005	3.500	0.022
P52	7.240	4.690	1450.000	0.016	0.001	0.310	0.002	58.600	0.018	4.040	0.045	0.001	0.003	0.062	0.324
P53A	9.200	5.150	896.000	0.014	0.001	0.108	0.001	17.268	0.040	2.000	0.019	0.001	0.003	0.138	0.064
P53B	8.370	5.560	1848.000	0.014	0.001	0.194	0.001	11.908	0.474	2.252	0.013	0.001	0.003	0.652	0.039
P53C	8.460	5.650	1879.000	0.014	0.011	0.164	0.001	27.000	0.014	2.400	0.040	0.001	0.002	0.716	0.143
P54A	7.620	5.000	1951.000	4.001	0.003	0.568	0.400	33.800	0.067	3.100	0.043	0.400	0.400	0.310	0.024
P54B	7.370	5.180	2182.000	0.025	0.002	0.273	0.001	35.460	0.079	2.964	0.040	0.001	0.004	0.493	0.043
P55A	8.070	4.260	1822.000	0.024	0.003	0.351	0.001	37.400	0.020	3.900	0.062	0.001	0.002	0.372	0.221
P55B	8.350	5.110	1699.000	0.011	0.005	0.322	0.001	27.600	0.087	5.680	0.232	0.001	0.002	0.278	0.126
P55C	8.420	5.090	2663.000	0.014	0.001	0.296	0.001	38.000	0.256	2.780	0.141	0.001	0.002	0.644	0.007
P56A	8.500	4.540	1560.000	0.682	0.001	0.170	0.008	0.026	0.021	0.122	0.011	0.007	0.005	0.154	0.037
P56B	11.870	7.060	1526.000	0.016	0.001	0.254	0.001	0.076	0.830	1.676	0.032	0.001	0.005	1.036	0.005

Bore	pH Upper	pH Lower	EC	Fe Filt (mg/L)	Mn Filt (mg/L)	Cu Filt (mg/L)	Pb Filt (mg/L)	Zn Filt (mg/L)	Ni Filt (mg/L)	Al Filt (mg/L)	As Filt (mg/L)	Sr Filt (mg/L)	Li Filt (mg/L)	Ba Filt (mg/L)	Se Filt (mg/L)
P56C	12.190	7.360	3520.000	0.142	0.001	0.640	0.001	0.064	0.481	0.007	0.001	0.001	0.005	1.458	0.003
REA4	8.010	4.200	1126.000	0.040	0.002	0.011	0.003	0.050	0.005	0.005	0.002	0.002	0.002	0.110	0.058

B.3 WMP12 Groundwater-Surface Water Interaction

Refer to Table 14 for the relevant bores, as per Appendix A.

Appendix C Hydrographs – Groundwater Level TARPs

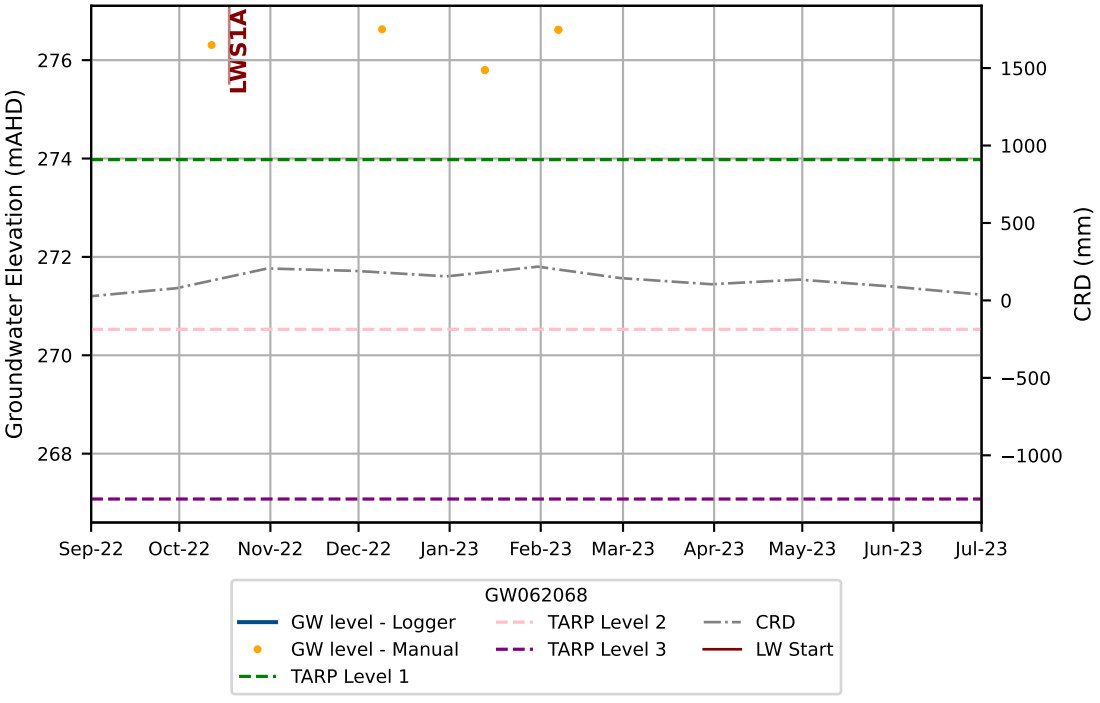
Six-Monthly Groundwater Monitoring: January – June 2023

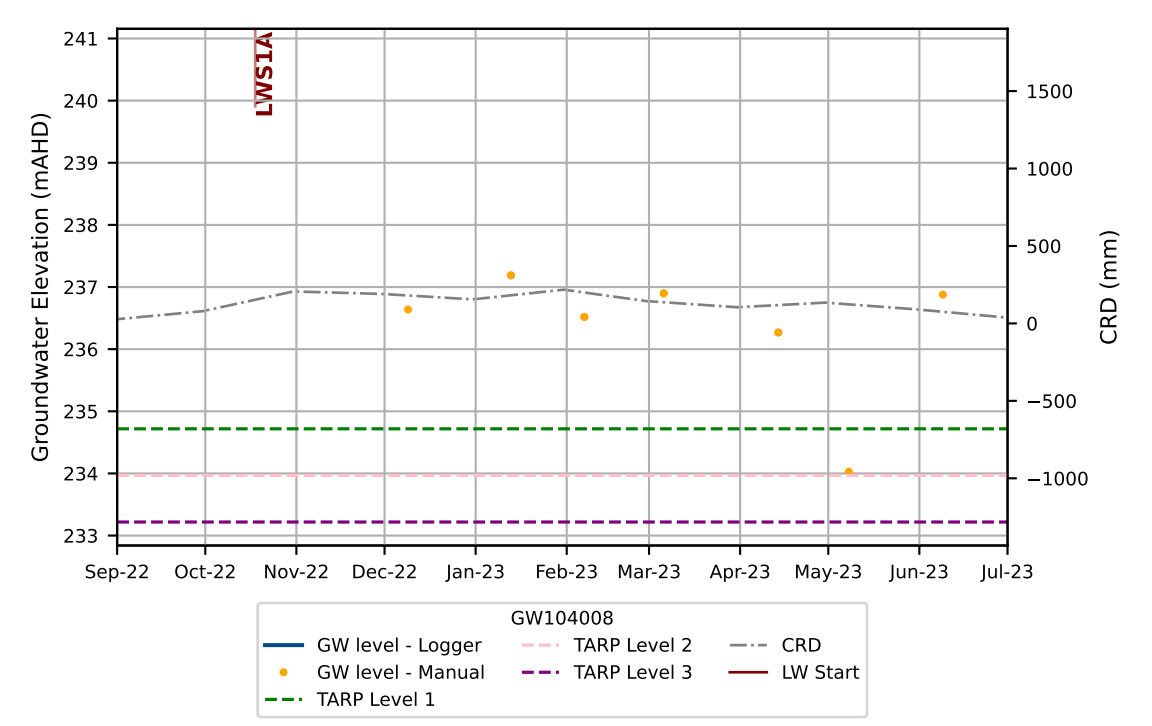
Tahmoor South Domain

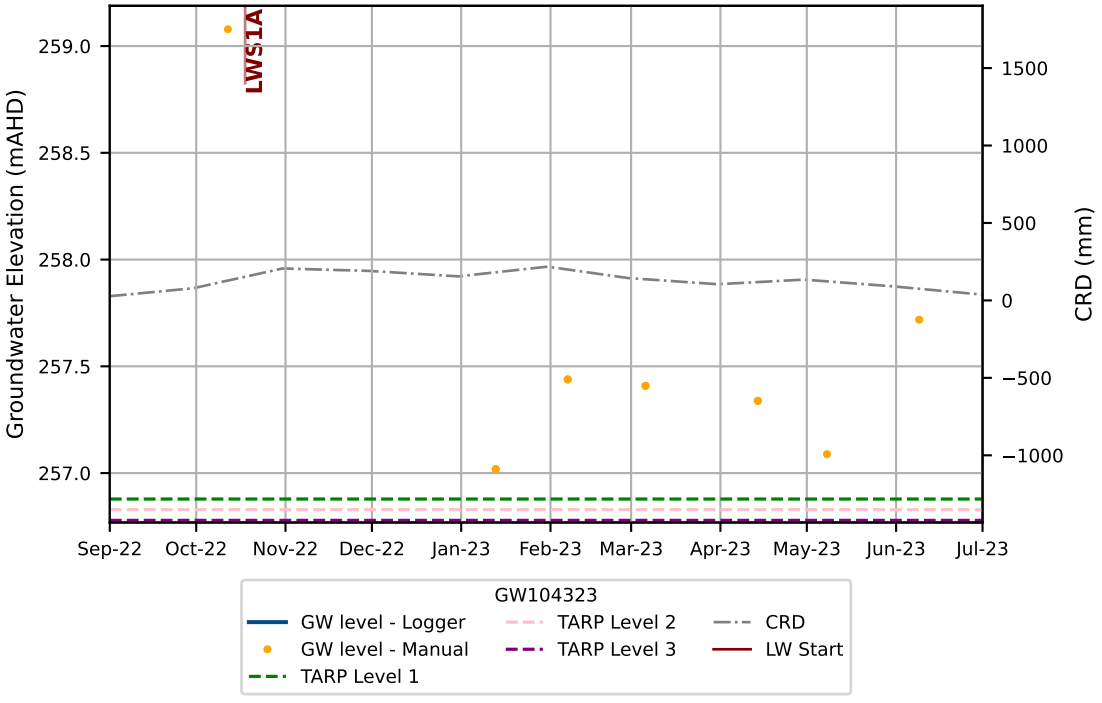
Tahmoor Coal Pty Ltd

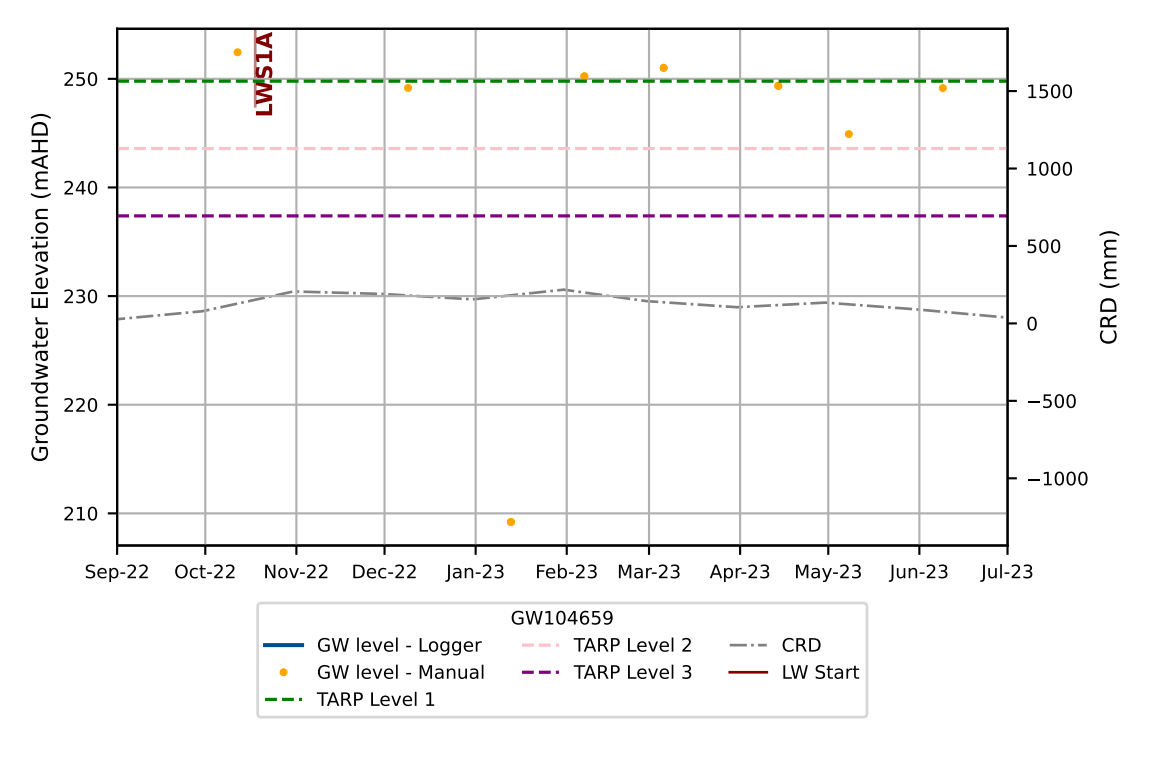
SLR Project No.: 640.30614.00000

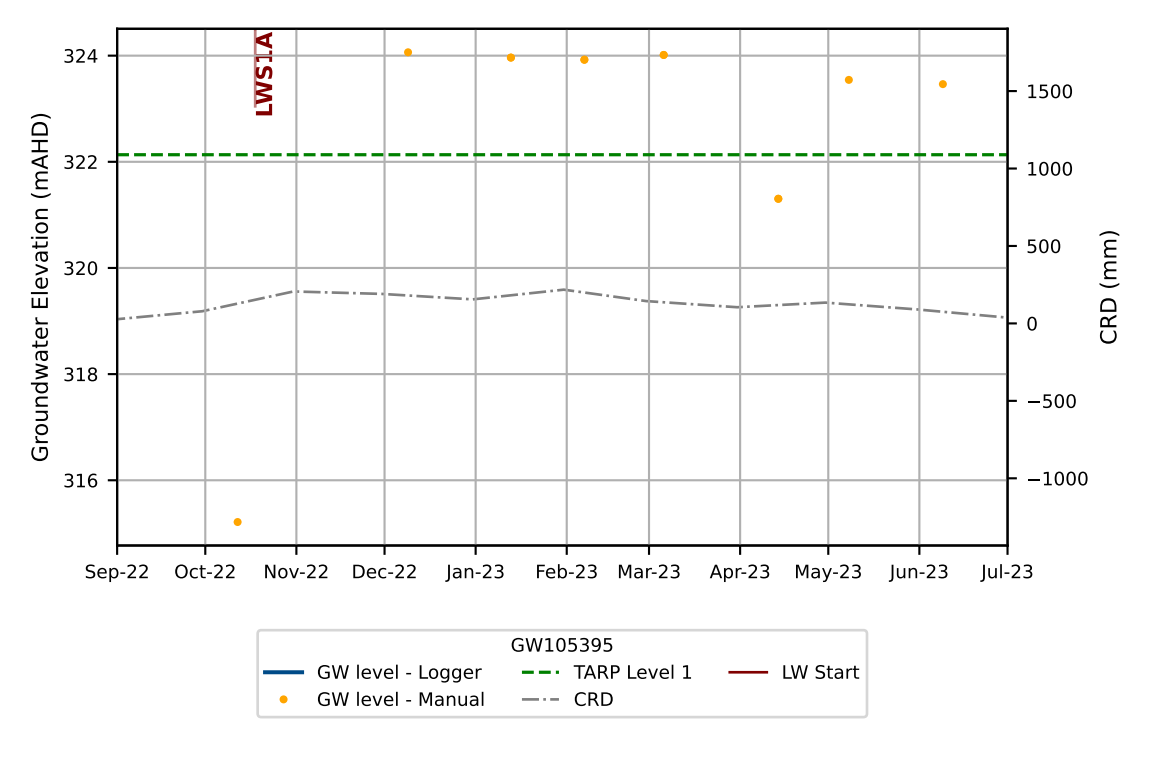
1 October 2023

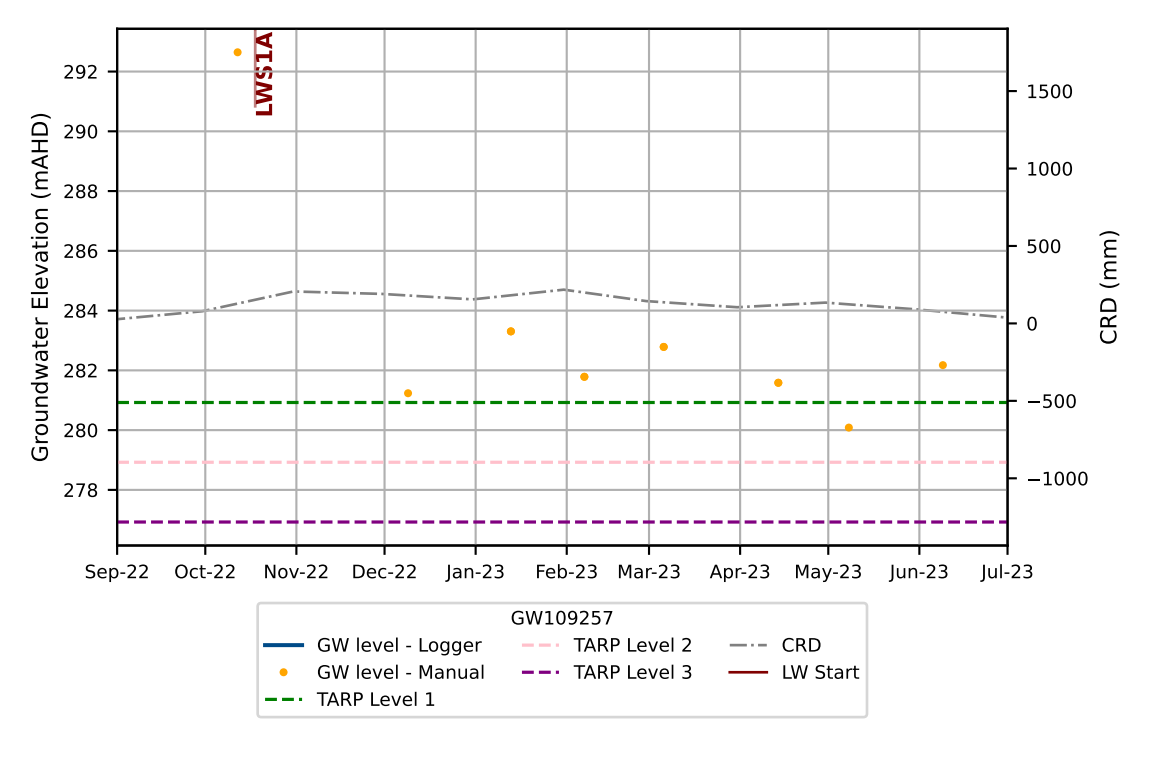

LW S1A
Groundwater Elevation (mAHD)
276
274
272
270
268
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

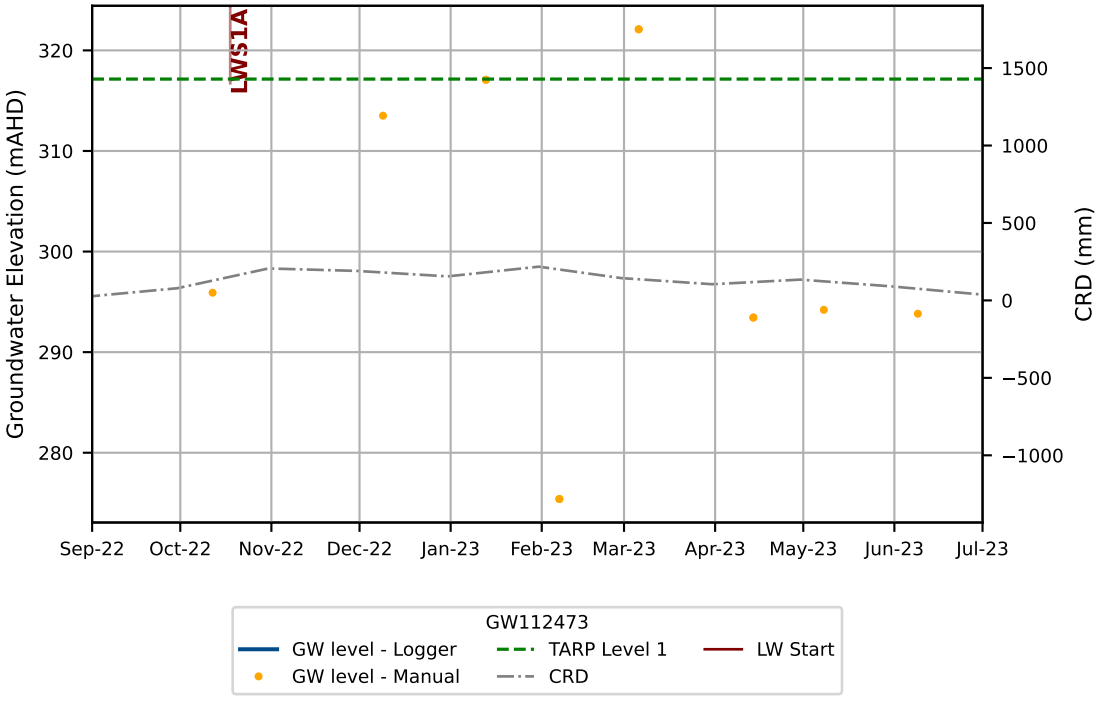

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
241
240
239
238
237
236
235
234
233
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

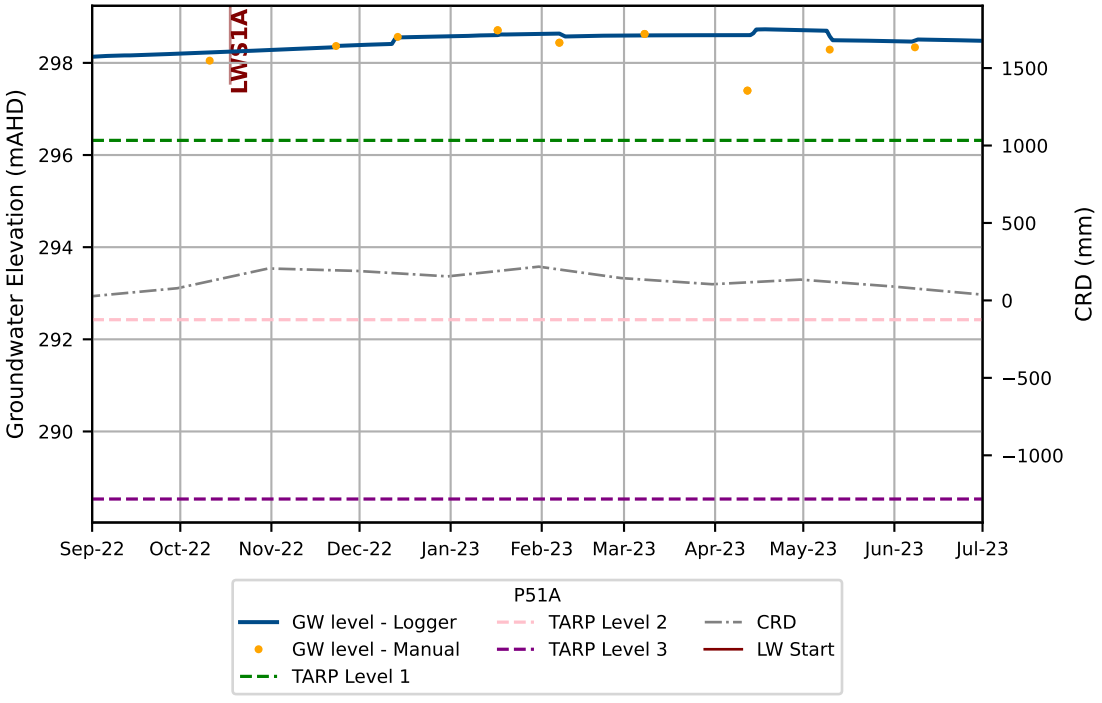

LWS1A
Groundwater Elevation (mAHD)
259.0
258.5
258.0
257.5
257.0
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

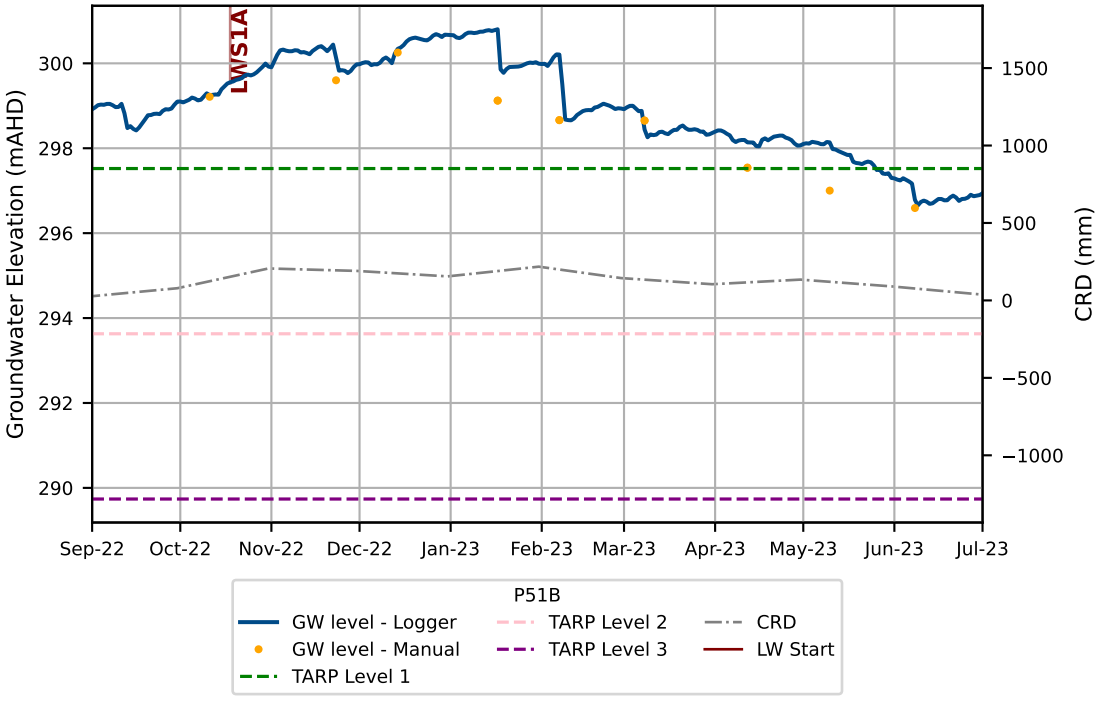

LW51A
Groundwater Elevation (mAHD)
CRD (mm)
250
240
230
220
210
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

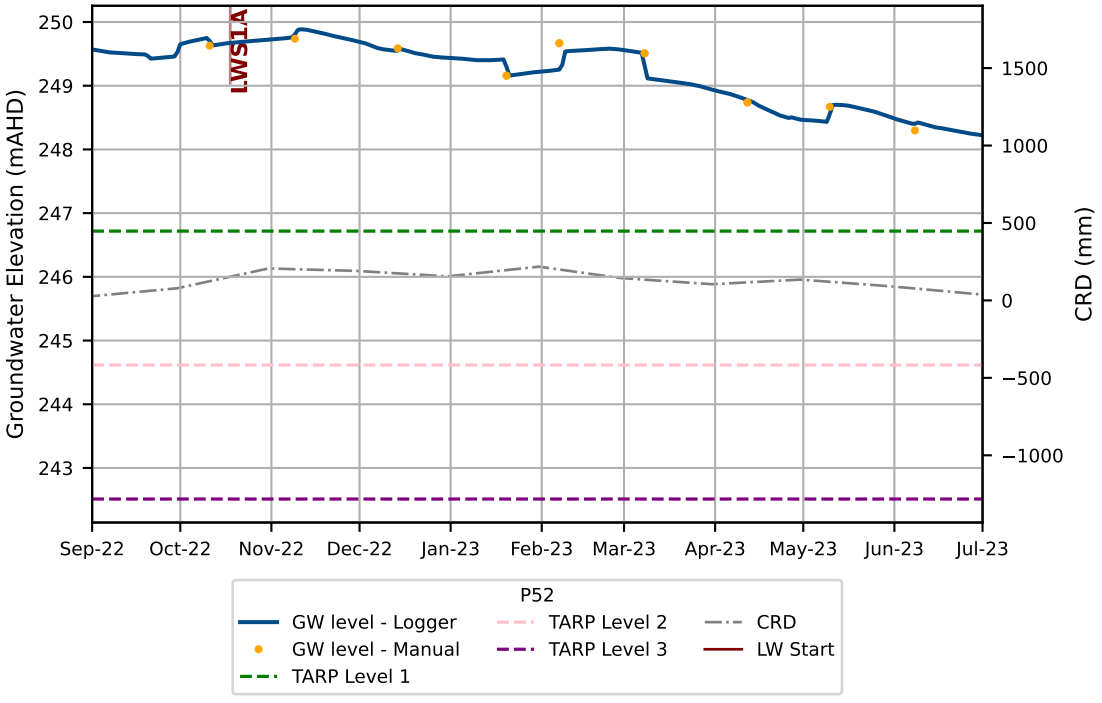

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
324
322
320
318
316
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
GW level - Logger
GW level - Manual
TARP Level 1
CRD
LW Start

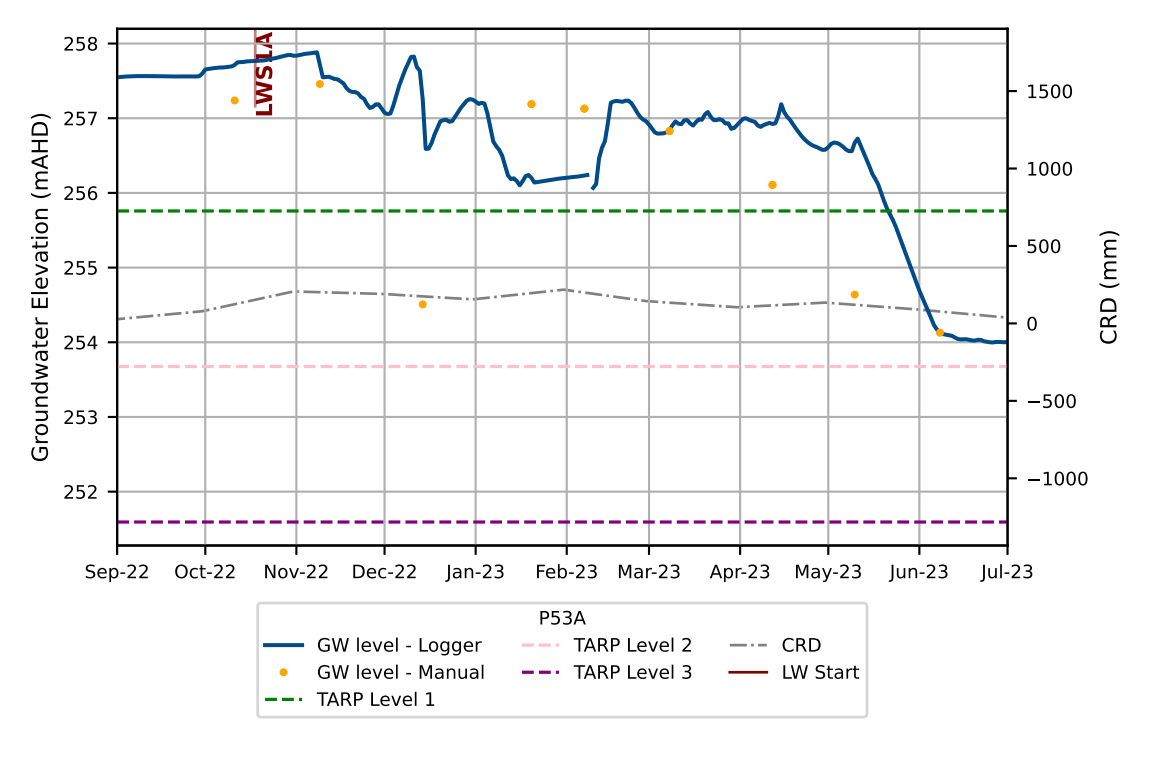

Groundwater Elevation (mAHD)
292
290
288
286
284
282
280
278
CRD (mm)
1500
1000
500
0
−500
−1000
LWS1A
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

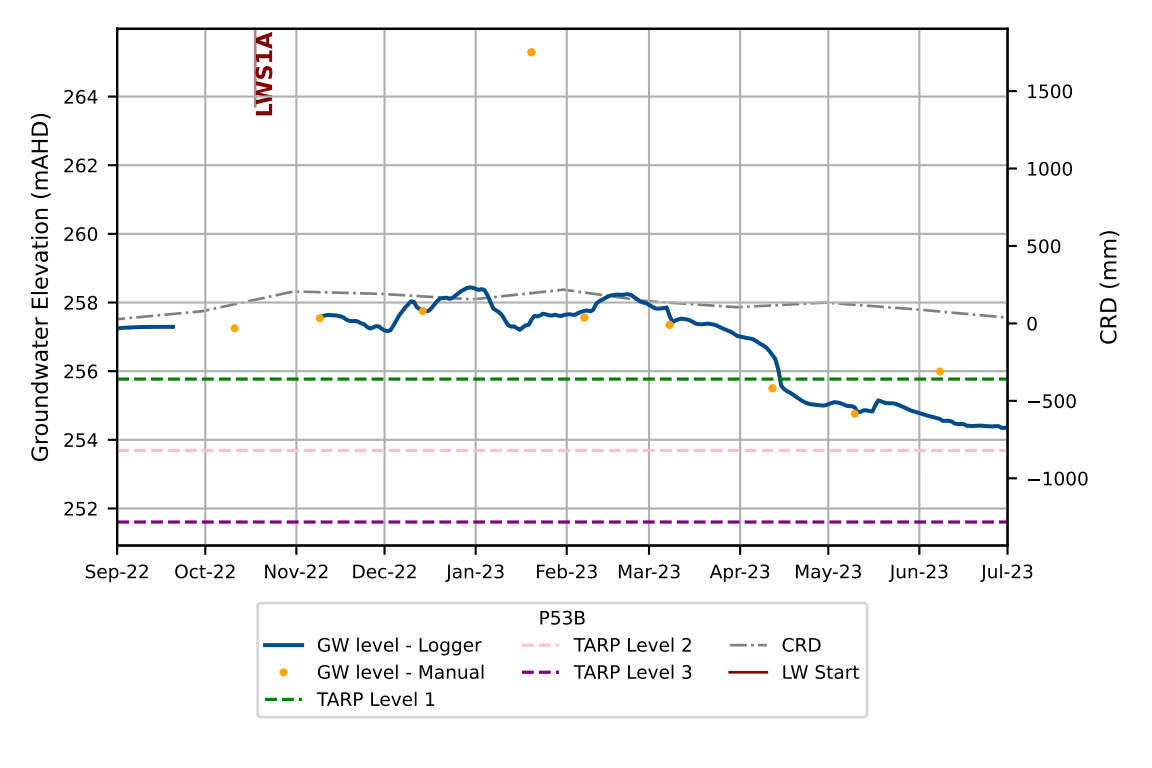

LW STA
Groundwater Elevation (mAHD)
320
310
300
290
280
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
GW level - Logger
GW level - Manual
TARP Level 1
CRD
LW Start

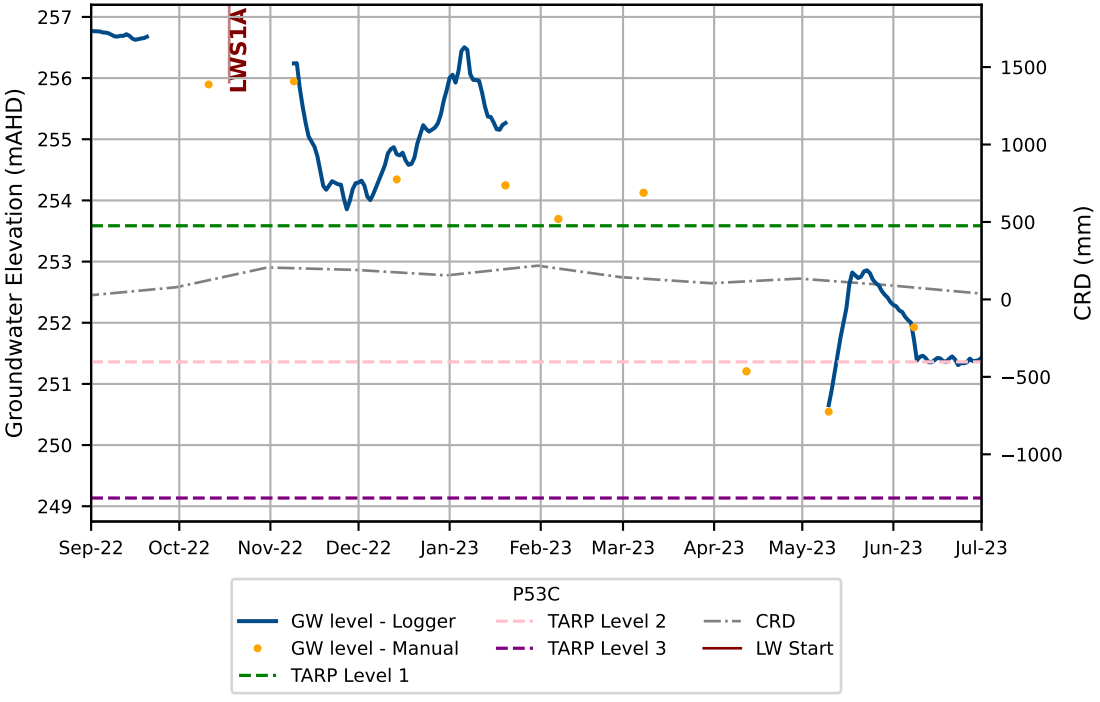

LW51A
Groundwater Elevation (mAHD)
CRD (mm)
298
296
294
292
290
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

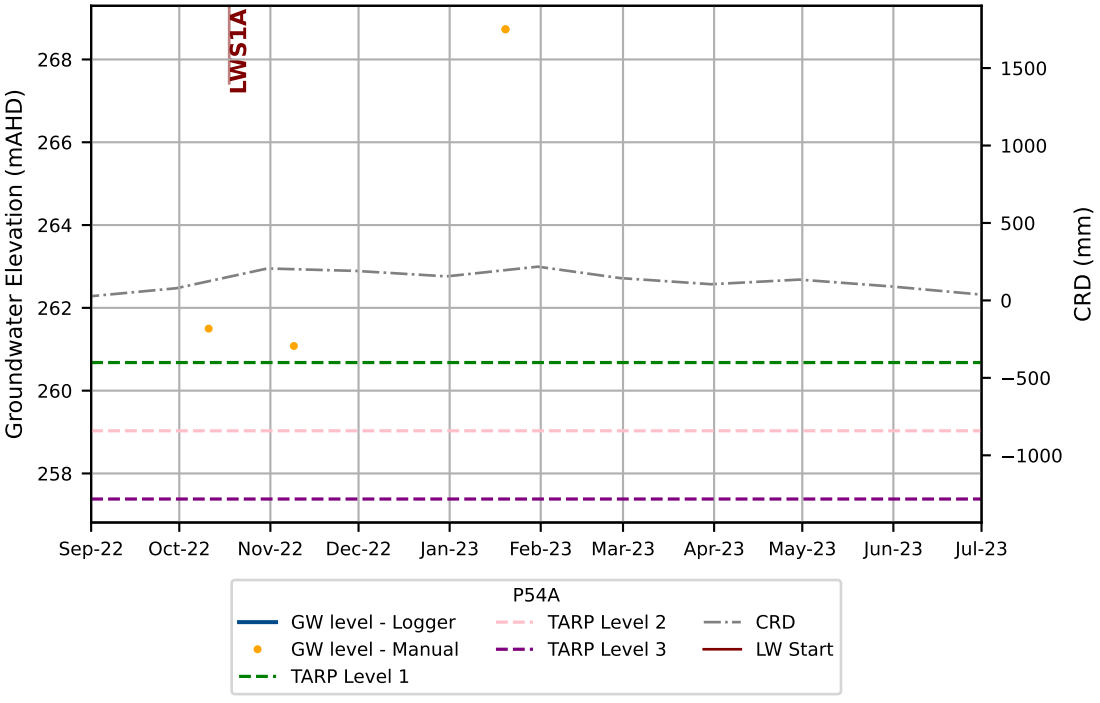

LW51A
Groundwater Elevation (mAHD)
CRD (mm)
300
298
296
294
292
290
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

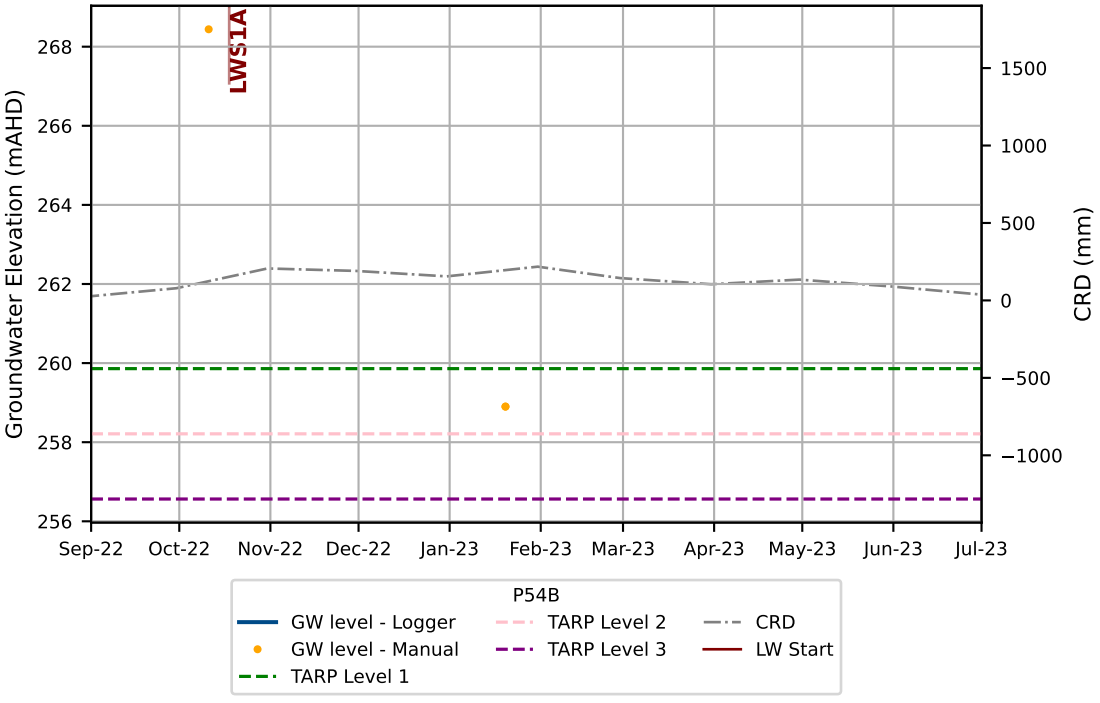

Groundwater Elevation (mAHD)
CRD (mm)
LWS1A
250
249
248
247
246
245
244
243
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

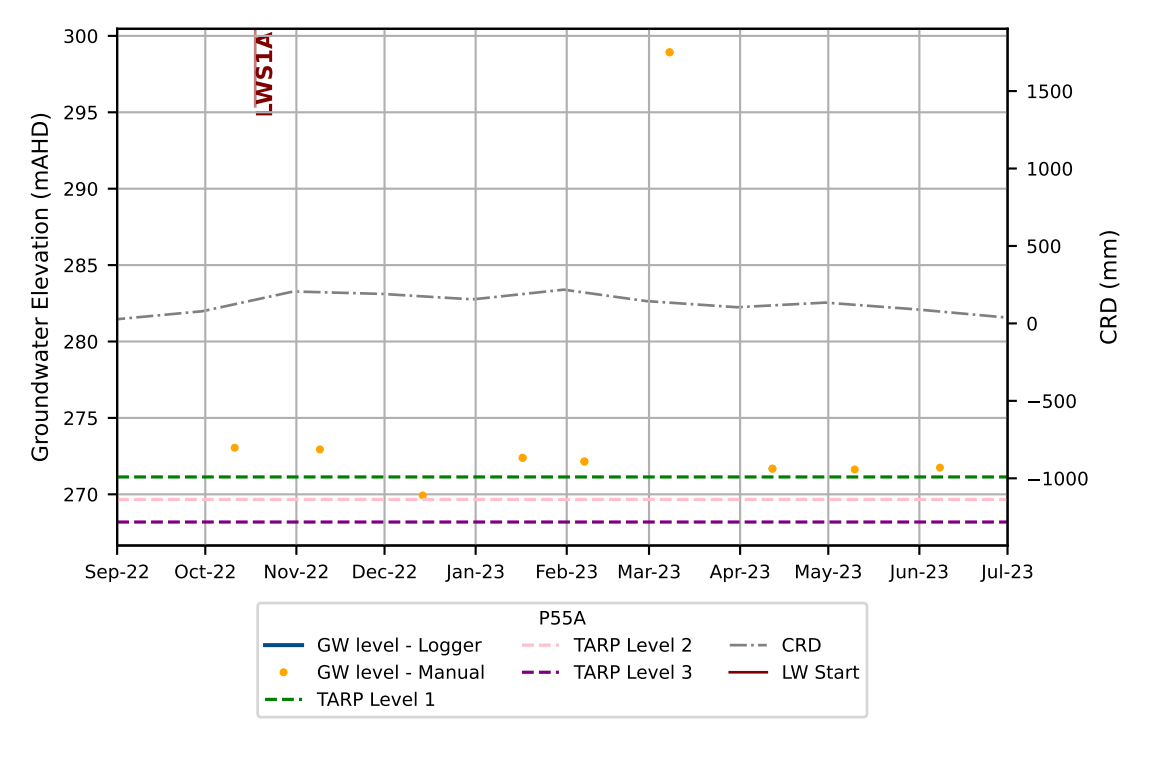

Groundwater Elevation (mAHD)
CRD (mm)
LWSTA
258
257
256
255
254
253
252
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

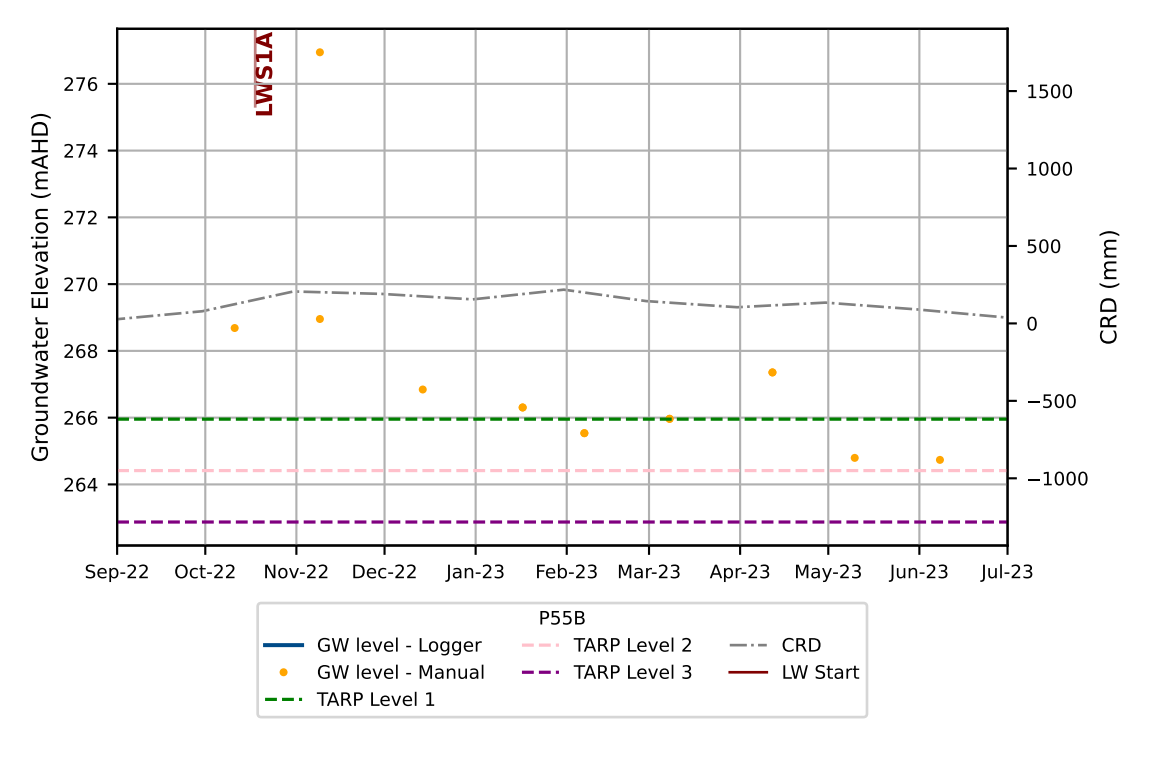

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
264
262
260
258
256
254
252
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

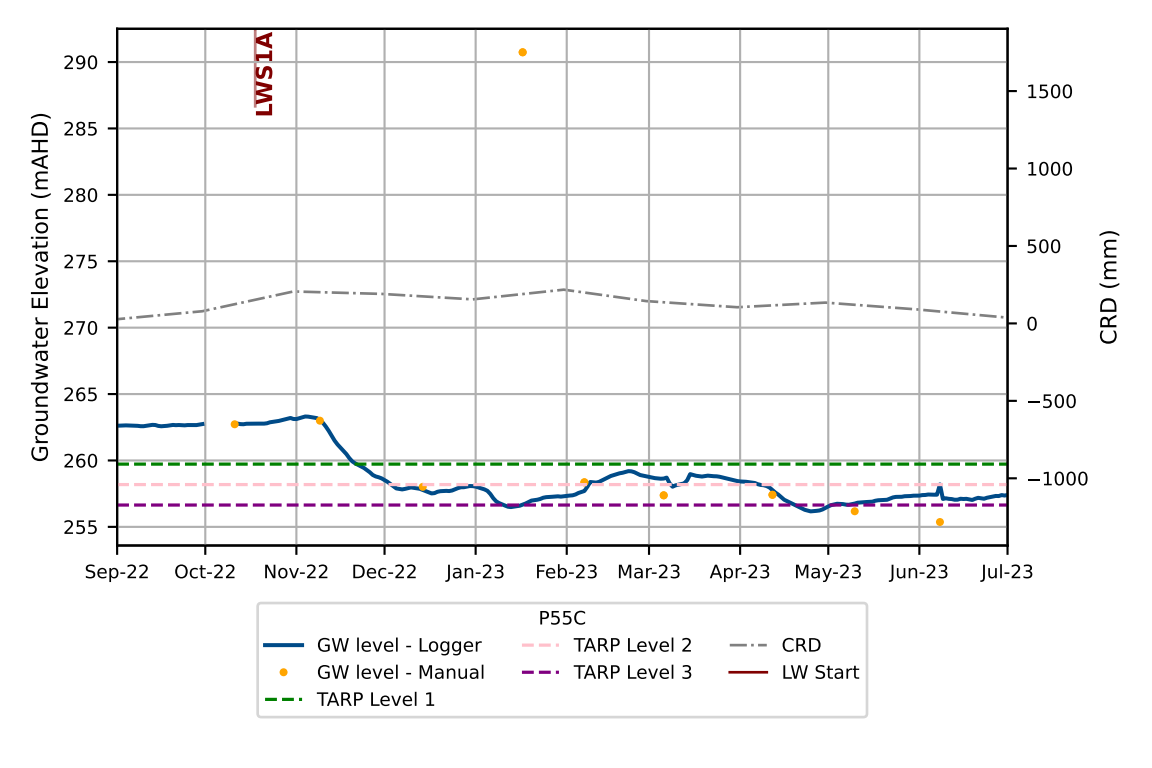

Groundwater Elevation (mAHD)
CRD (mm)
257
256
255
254
253
252
251
250
249
1500
1000
500
0
−500
−1000
LWS1
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

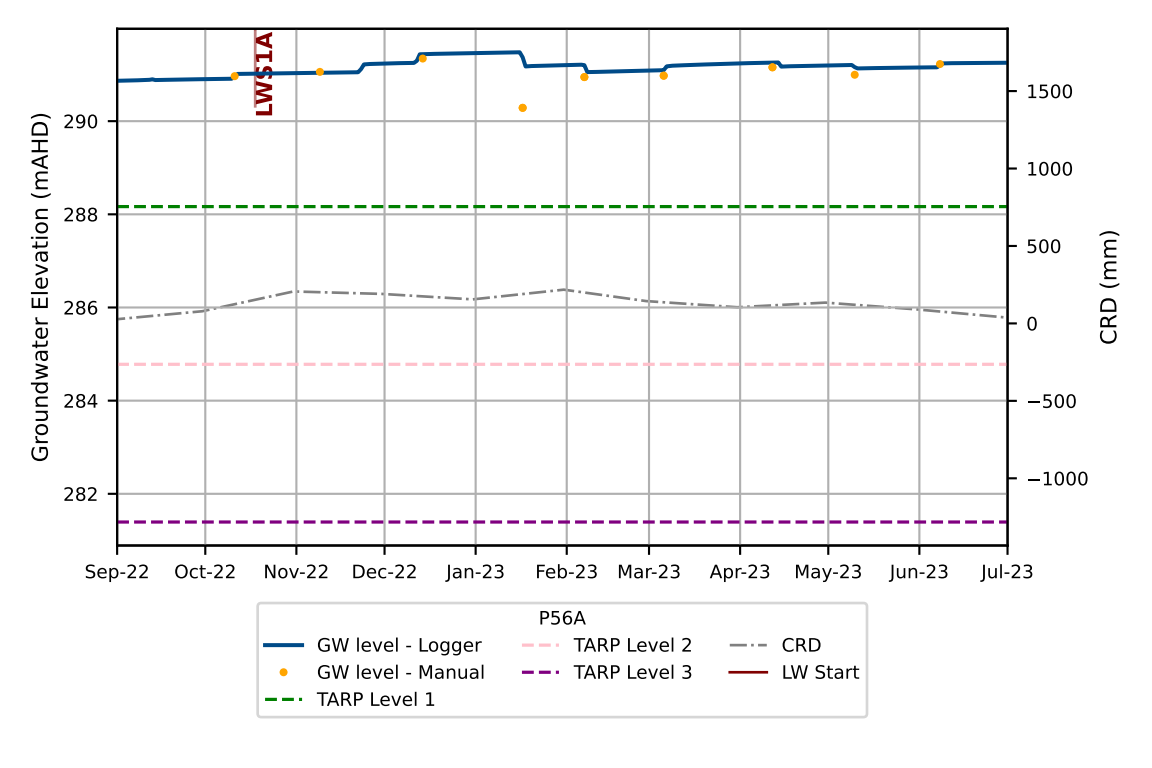

LWS1A
Groundwater Elevation (mAHD)
268
266
264
262
260
258
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54A
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

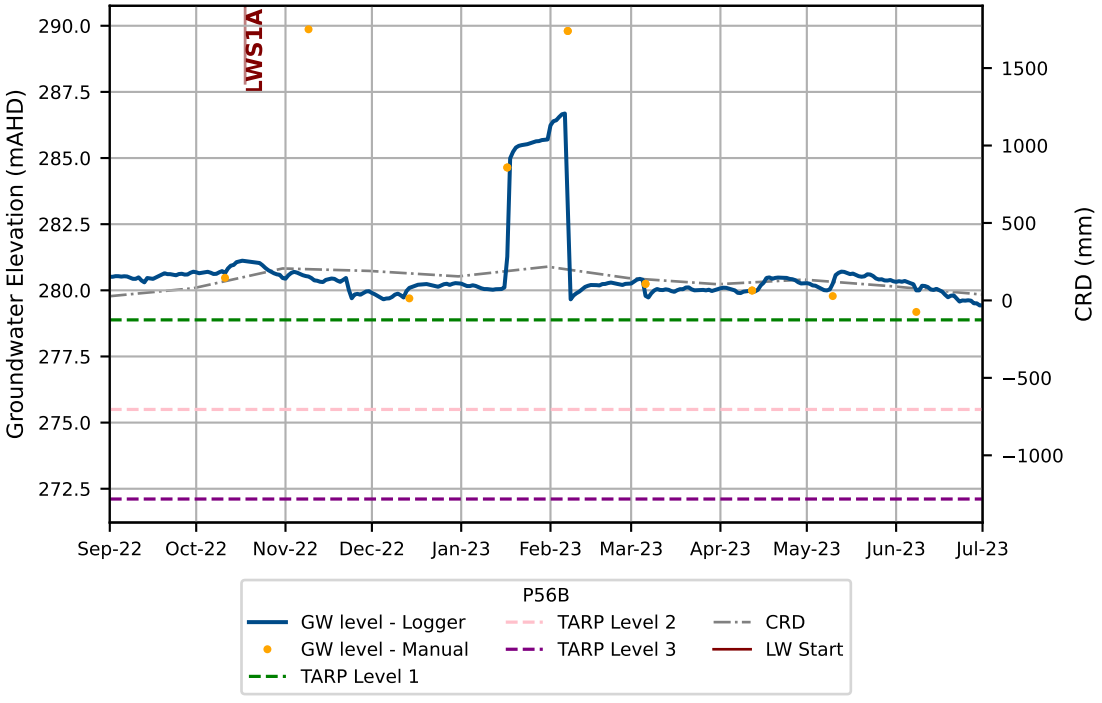

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
268
266
264
262
260
258
256
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

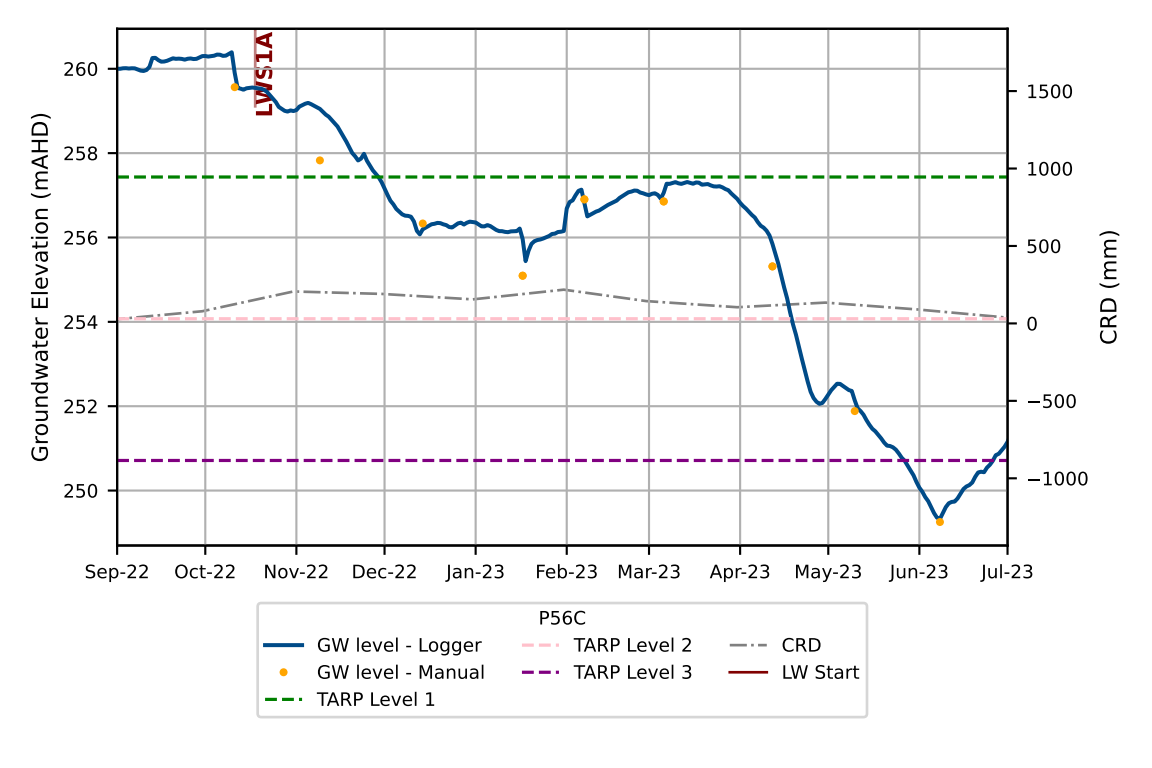

LW S1A
Groundwater Elevation (mAHD)
CRD (mm)
300
295
290
285
280
275
270
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

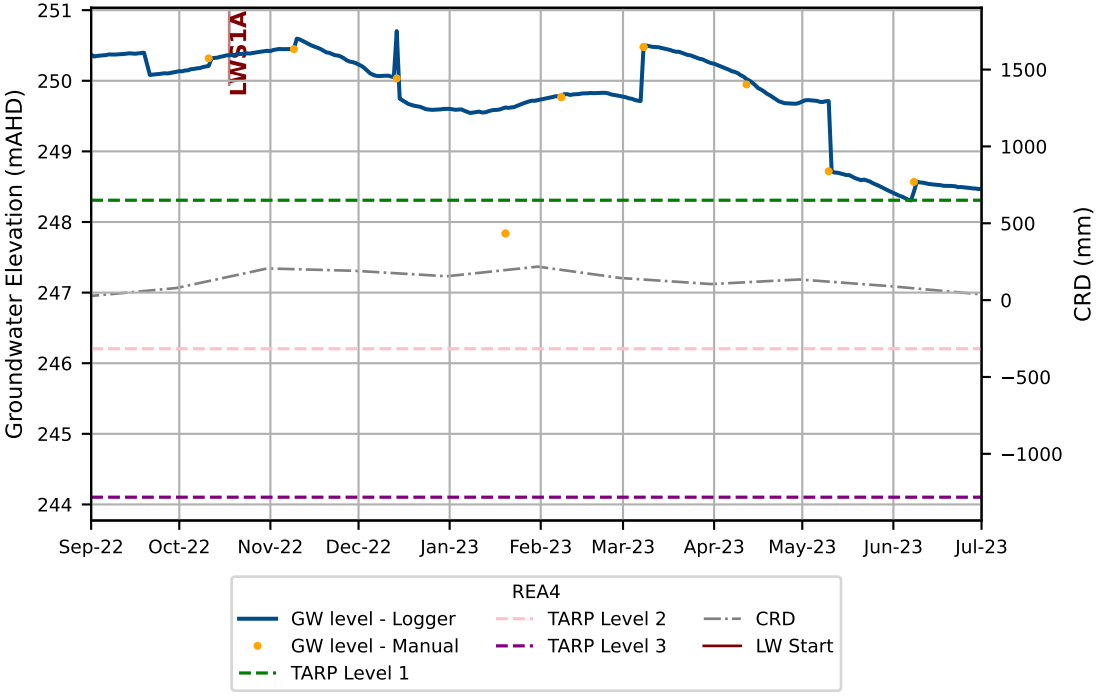

LWS1A
Groundwater Elevation (mAHD)
276
274
272
270
268
266
264
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

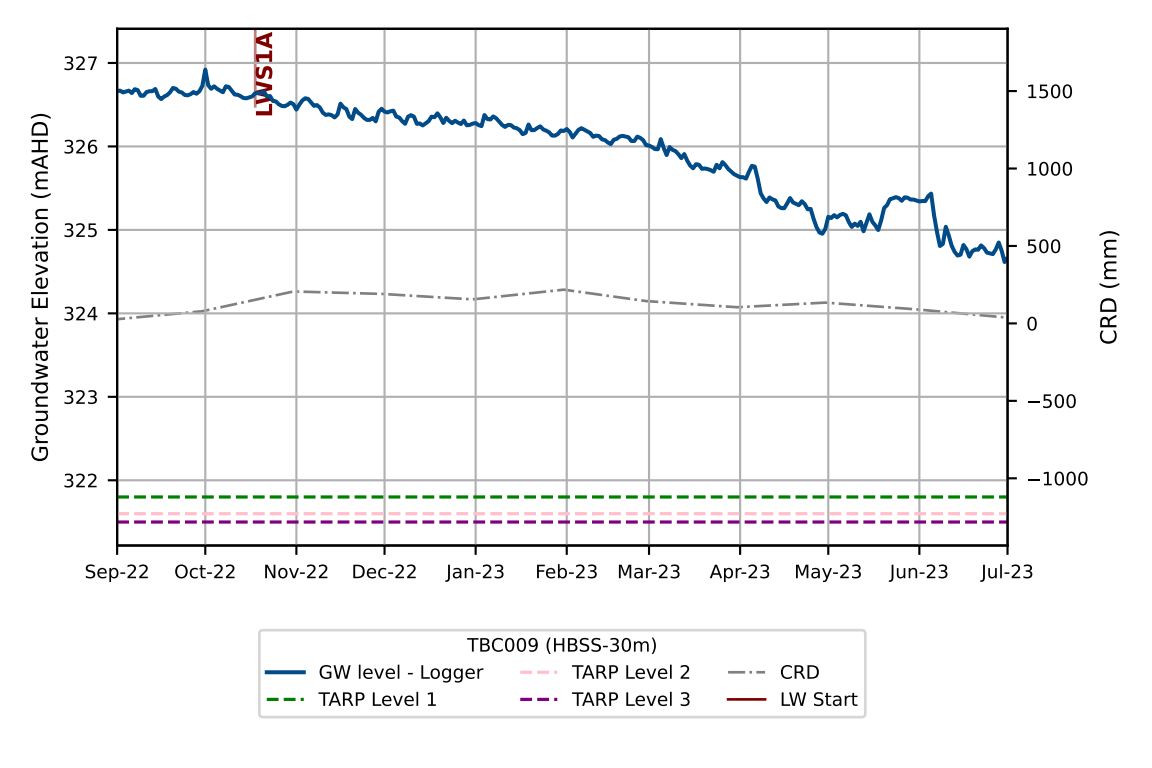

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
290
285
280
275
270
265
260
255
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

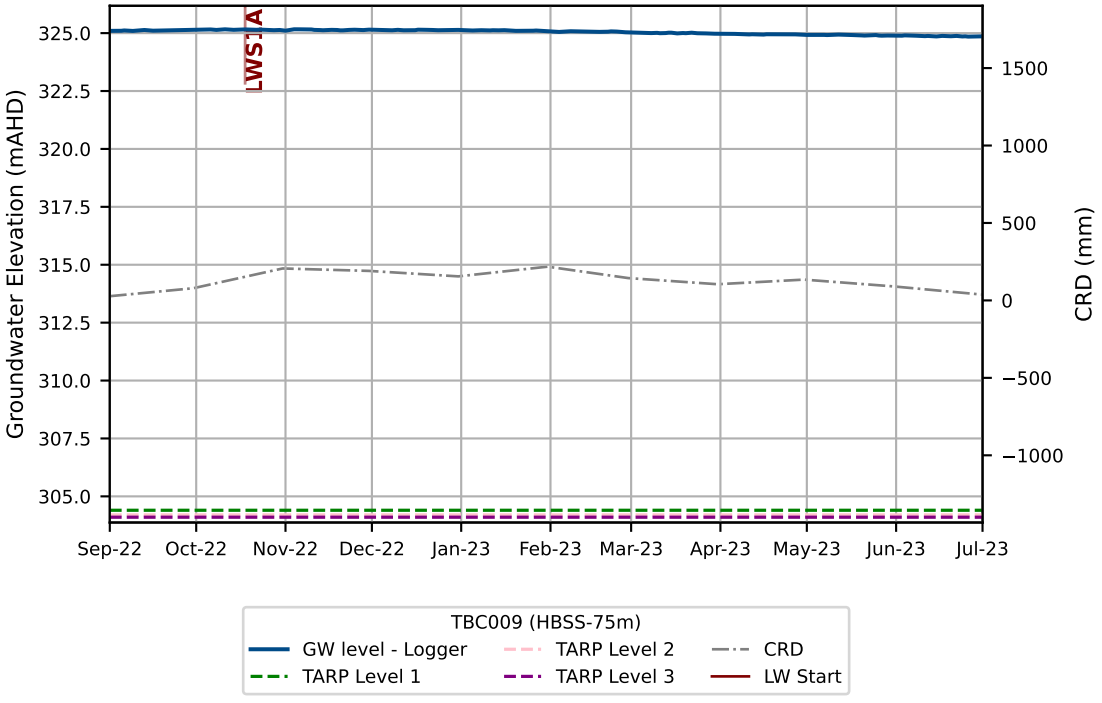

LW51A
Groundwater Elevation (mAHD)
290
288
286
284
282
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

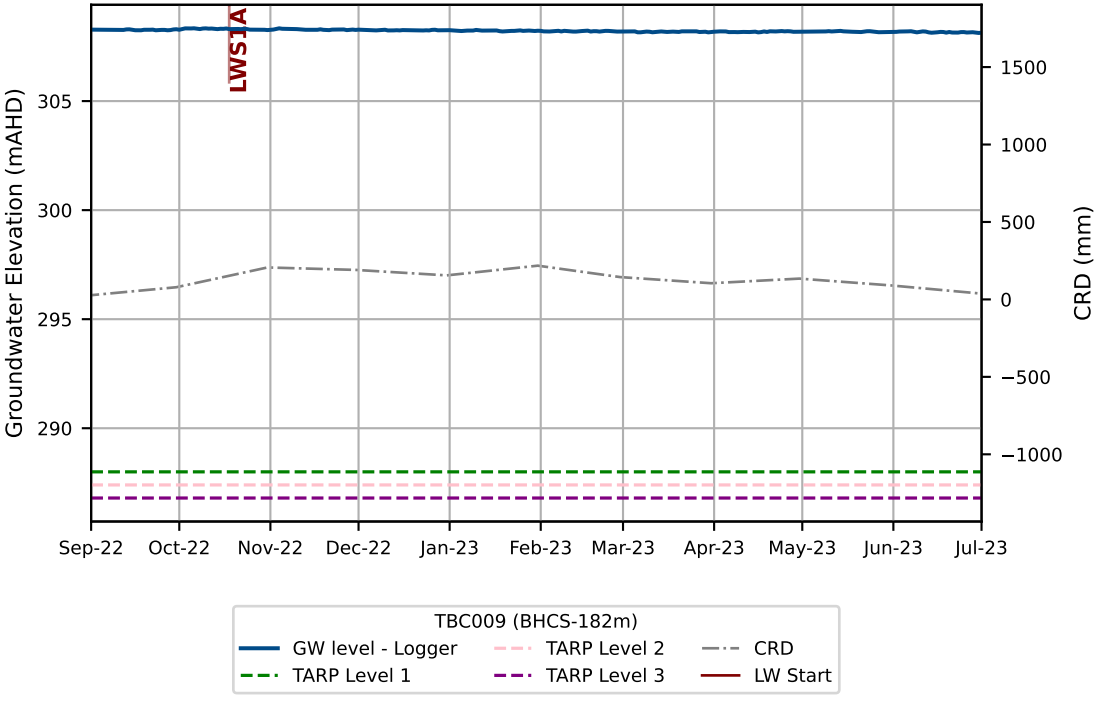

LWS1A
Groundwater Elevation (mAHD)
290.0
287.5
285.0
282.5
280.0
277.5
275.0
272.5
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

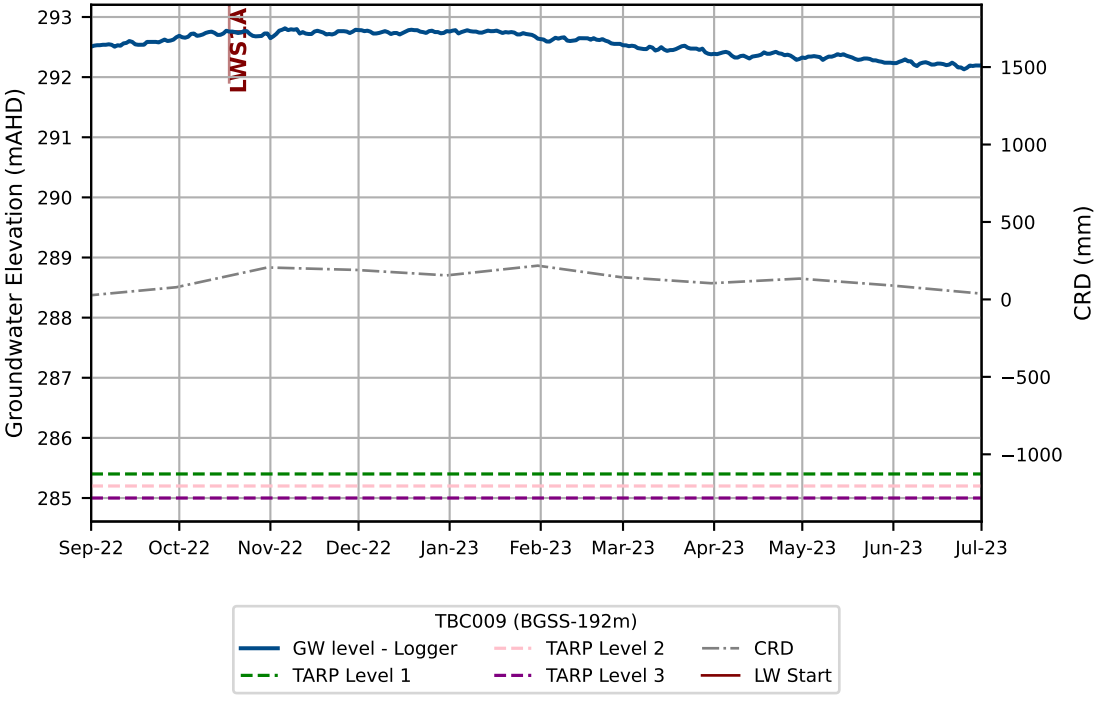

LW S1A
Groundwater Elevation (mAHD)
CRD (mm)
260
258
256
254
252
250
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

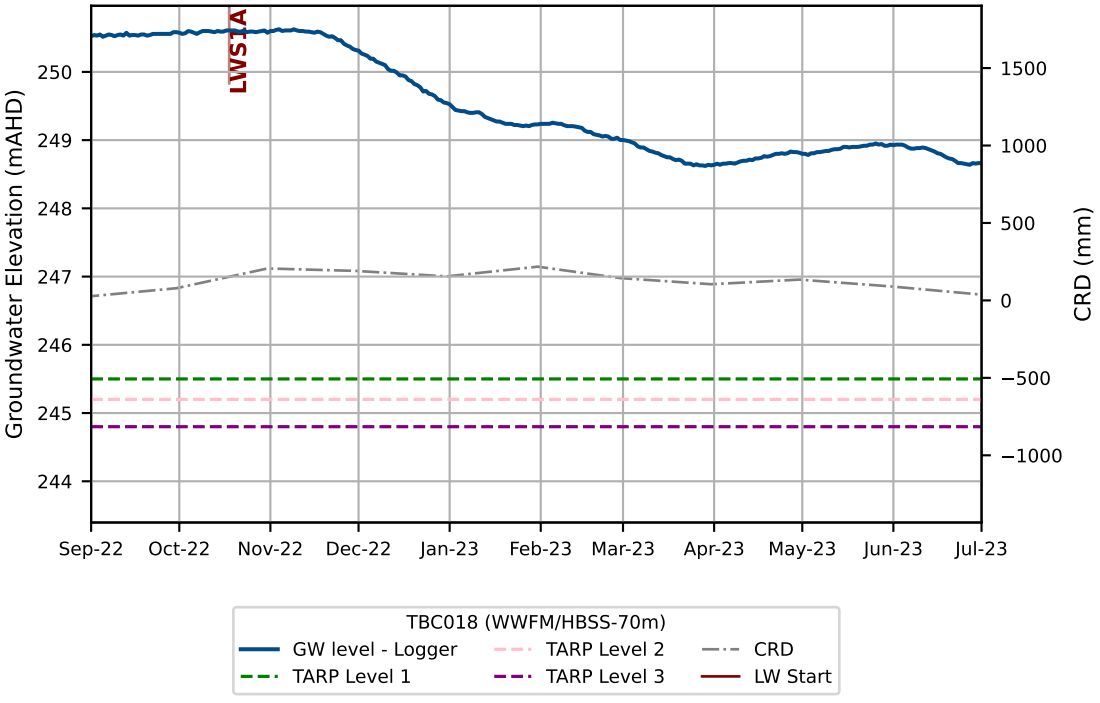

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
251
250
249
248
247
246
245
244
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
GW level - Logger
GW level - Manual
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

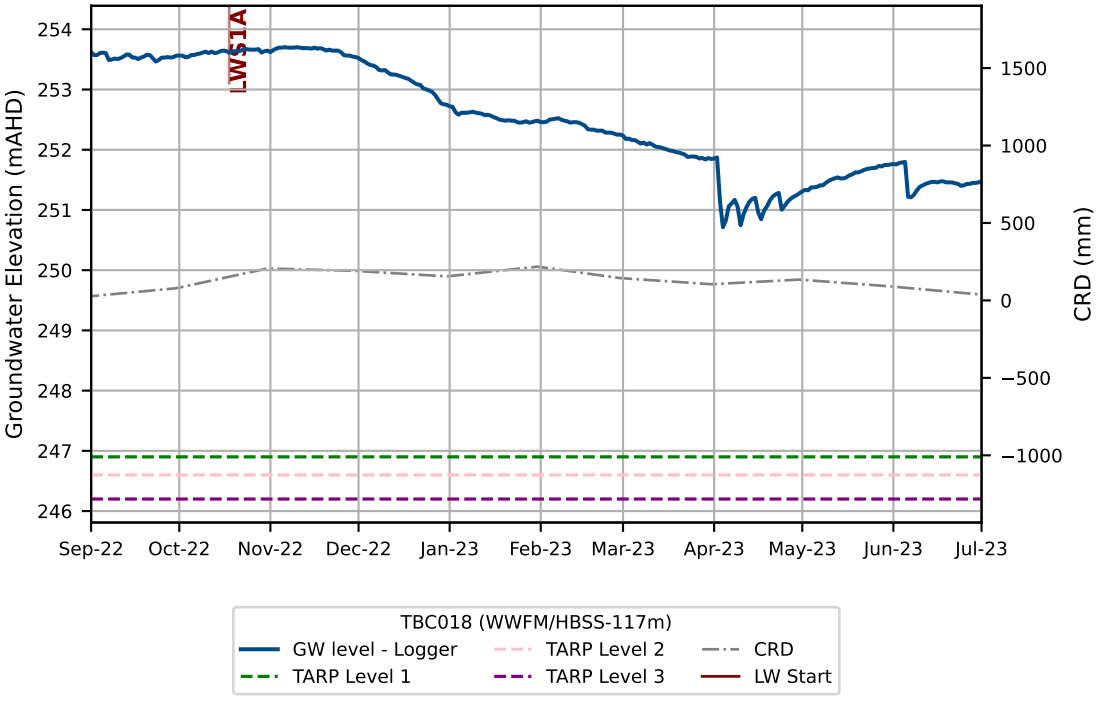

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
327
326
325
324
323
322
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (HBSS-30m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

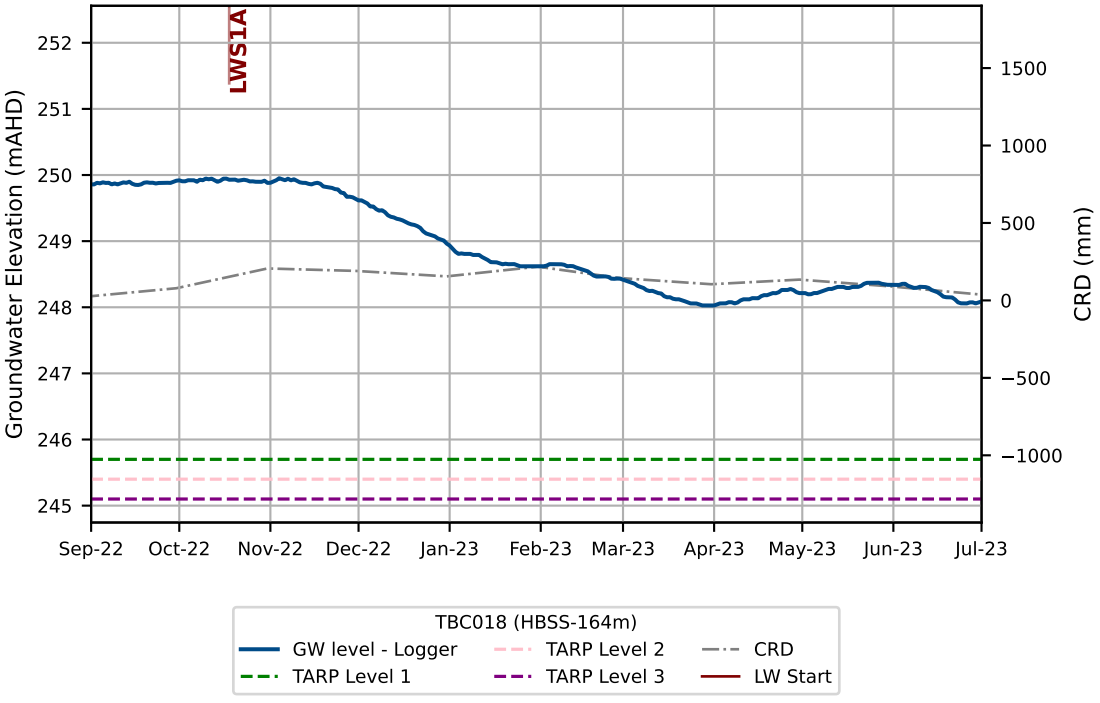

LWSTA
Groundwater Elevation (mAHD)
325.0
322.5
320.0
317.5
315.0
312.5
310.0
307.5
305.0
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (HBSS-75m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

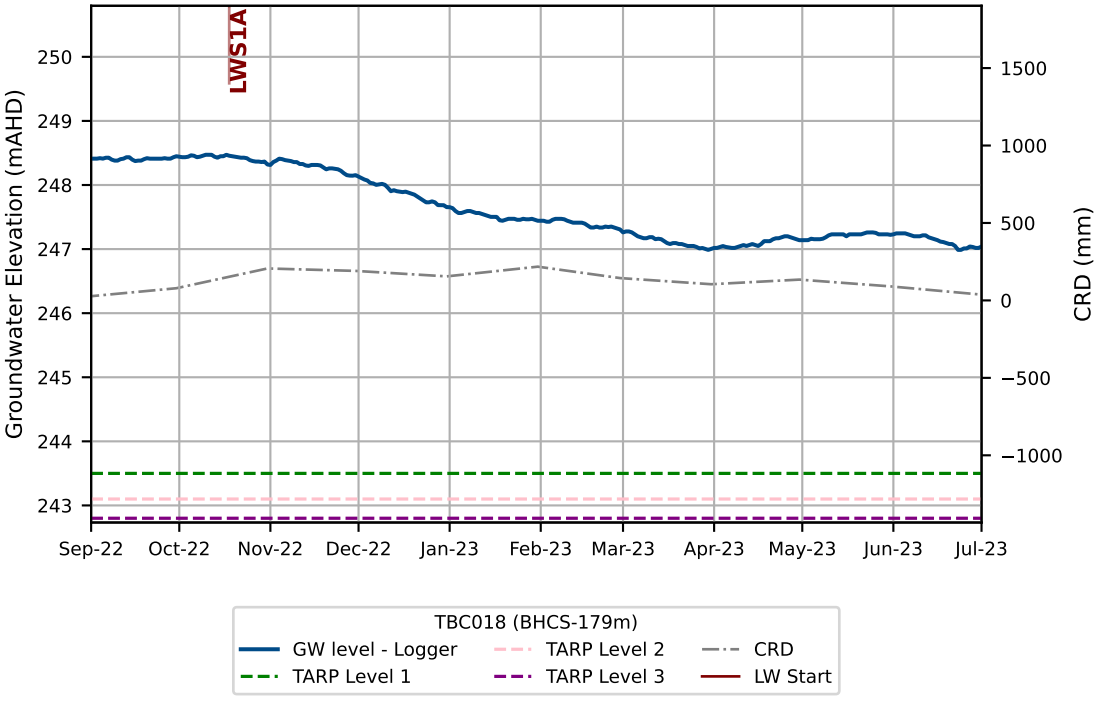

LWS1A
Groundwater Elevation (mAHD)
305
300
295
290
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (BHCS-182m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

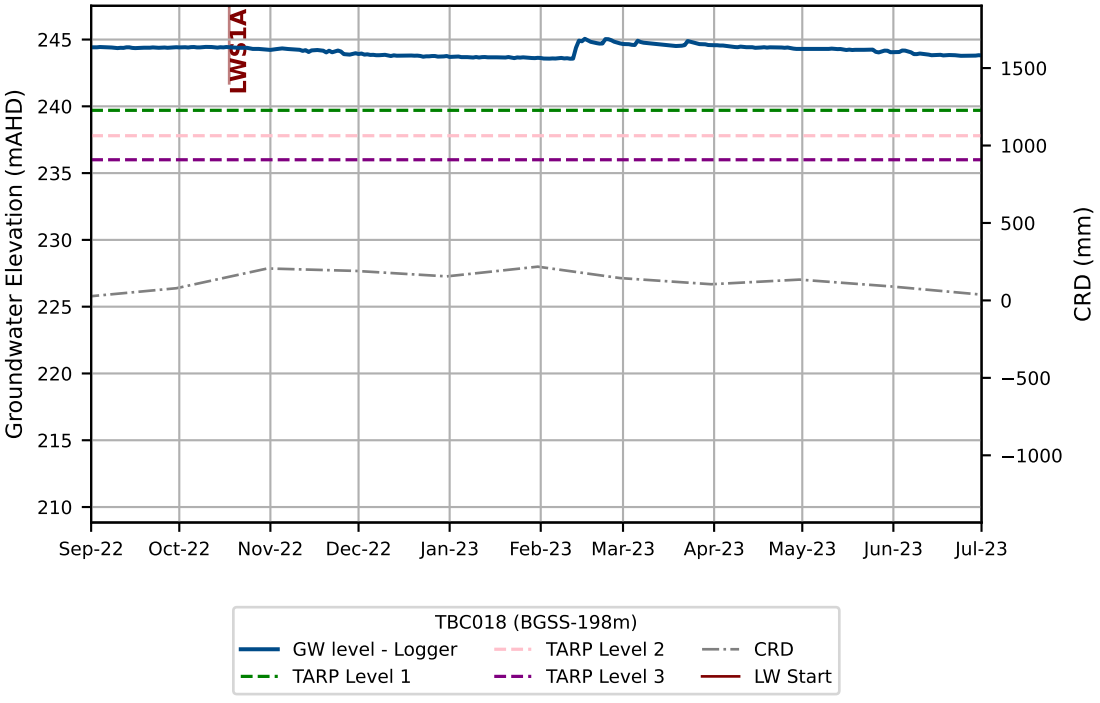

LWSTA
Groundwater Elevation (mAHD)
CRD (mm)
293
292
291
290
289
288
287
286
285
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (BGSS-192m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

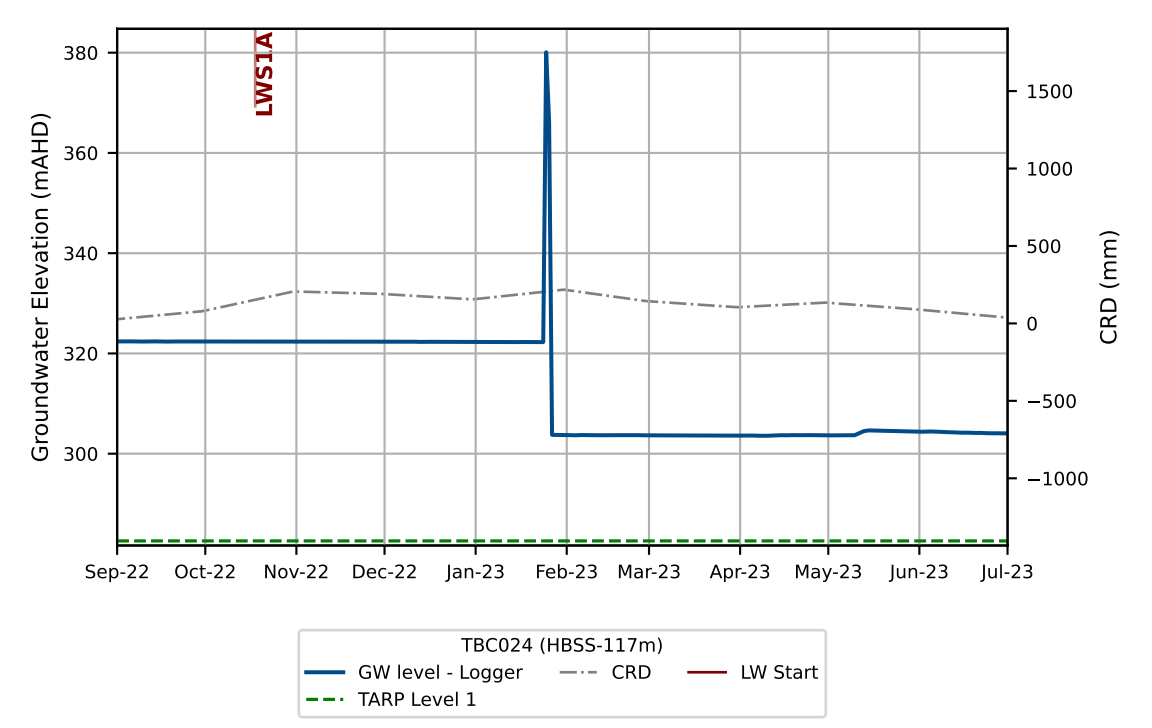

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
250
249
248
247
246
245
244
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (WWFM/HBSS-70m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

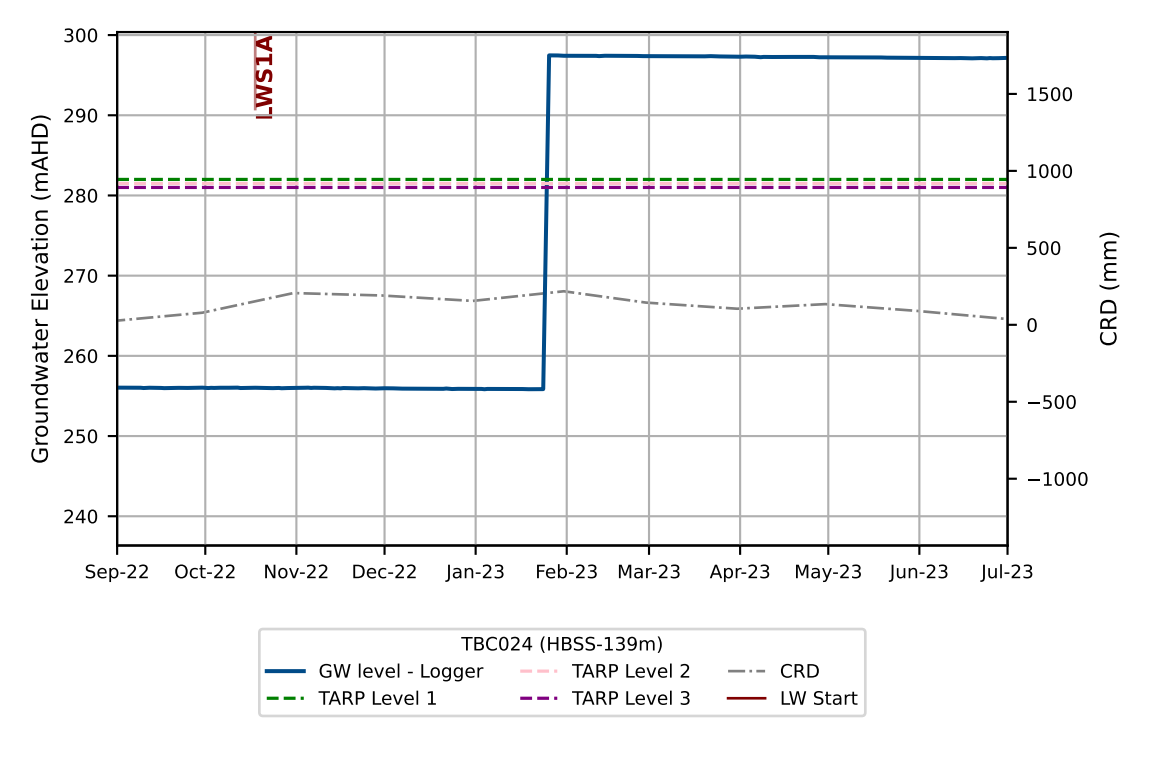

LW S1A
Groundwater Elevation (mAHD)
CRD (mm)
254
253
252
251
250
249
248
247
246
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (WWFM/HBSS-117m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

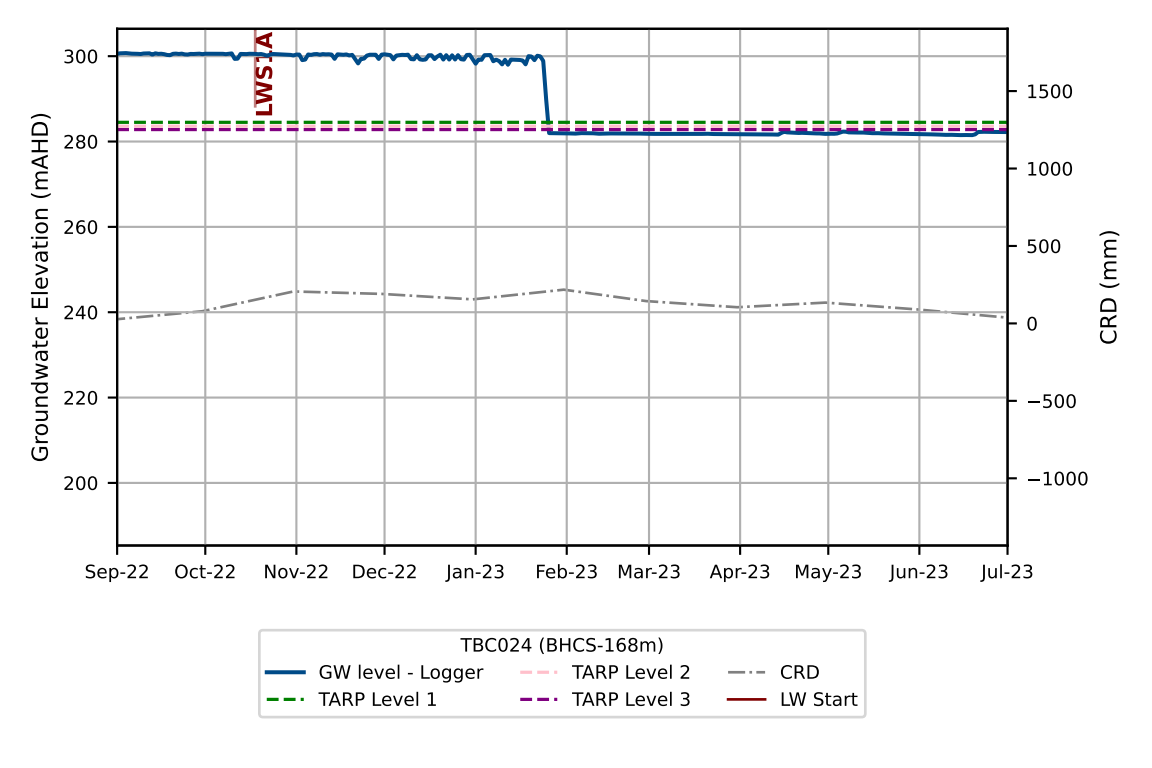

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
252
251
250
249
248
247
246
245
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (HBSS-164m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

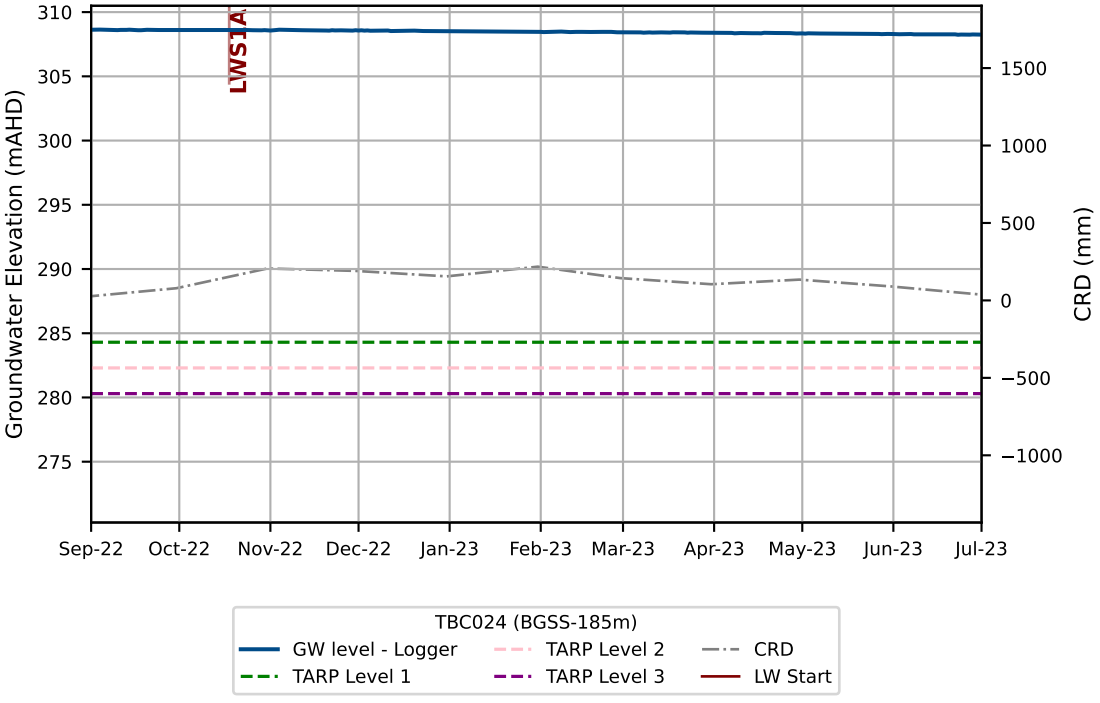

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
250
249
248
247
246
245
244
243
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (BHCS-179m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

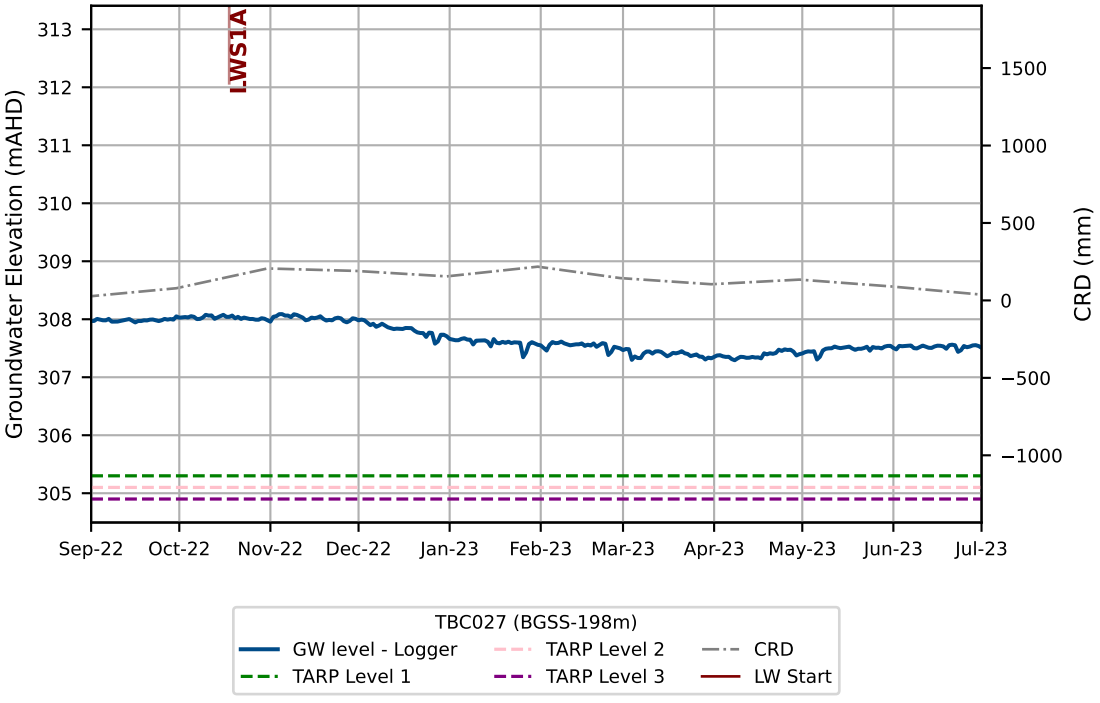

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
245
240
235
230
225
220
215
210
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (BGSS-198m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

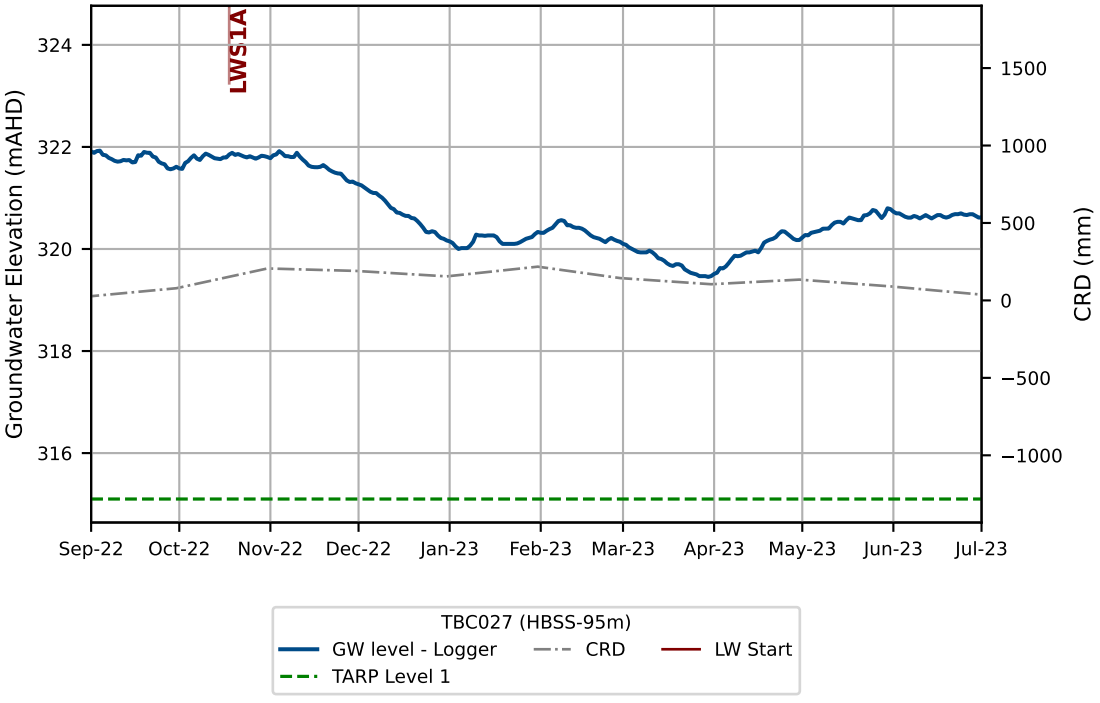

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
380
360
340
320
300
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC024 (HBSS-117m)
GW level - Logger
CRD
LW Start
TARP Level 1

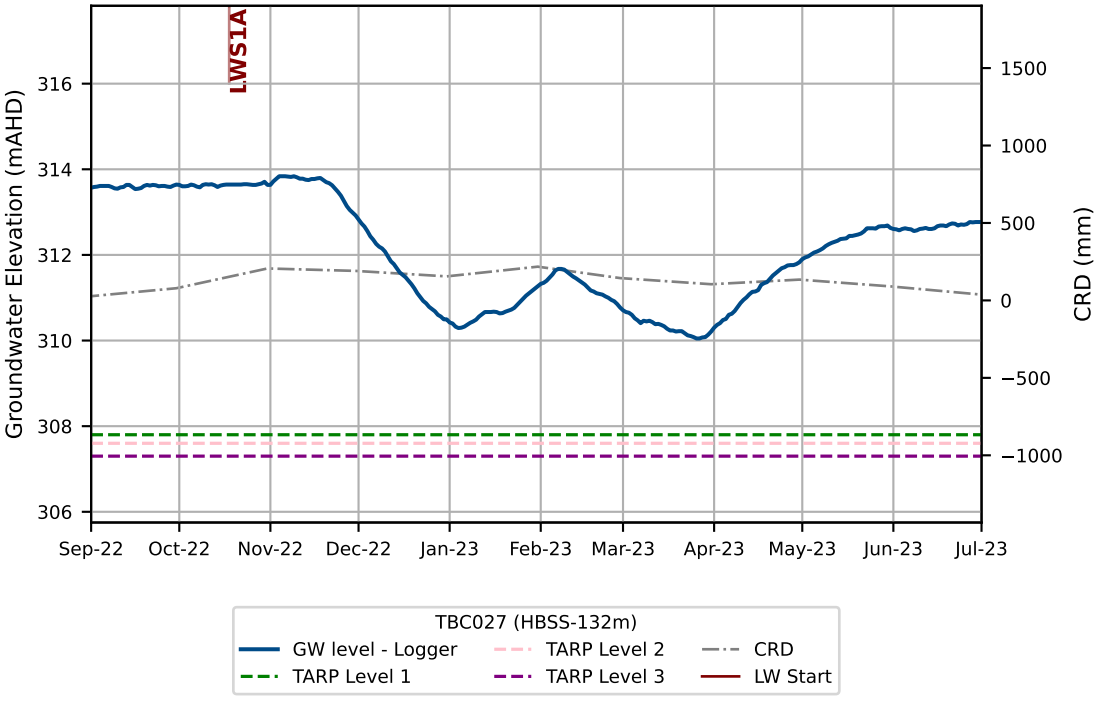

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
300
290
280
270
260
250
240
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC024 (HBSS-139m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

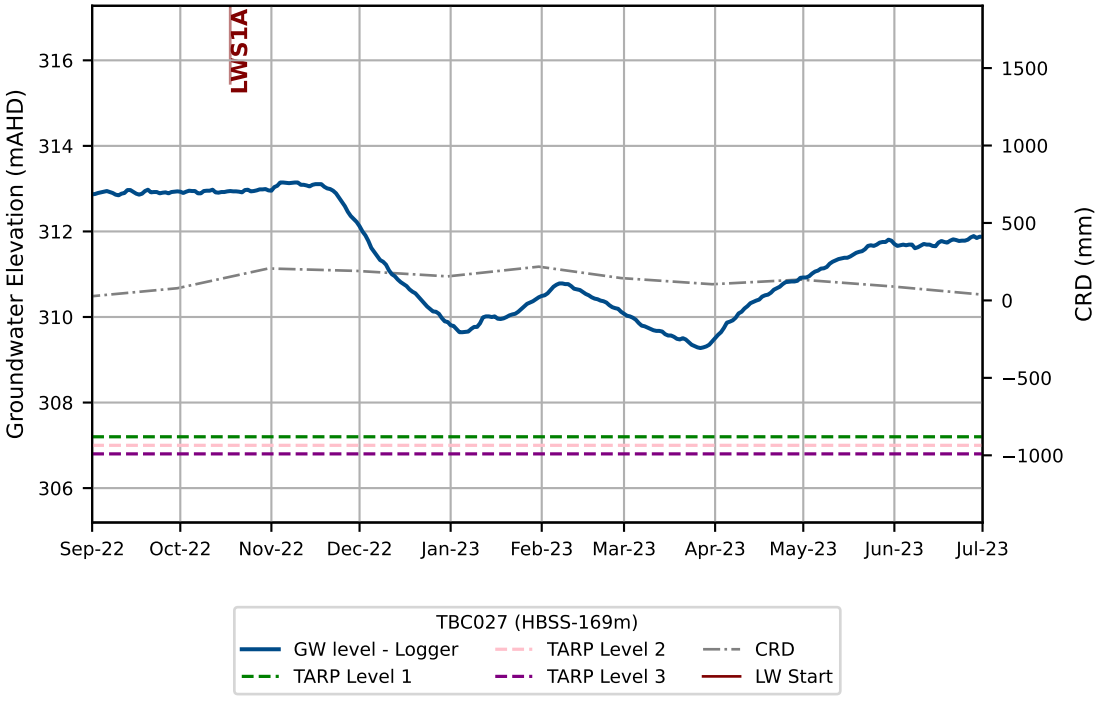

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
300
280
260
240
220
200
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC024 (BHCS-168m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

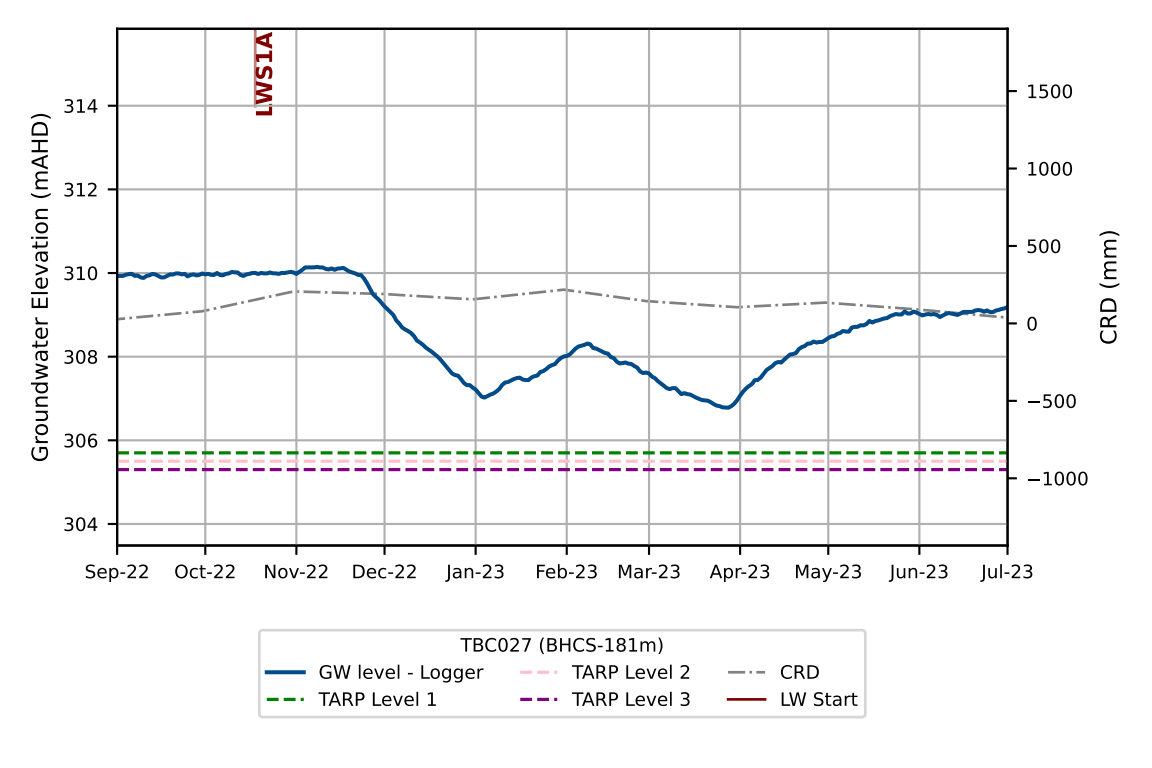

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
310
305
300
295
290
285
280
275
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC024 (BGSS-185m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

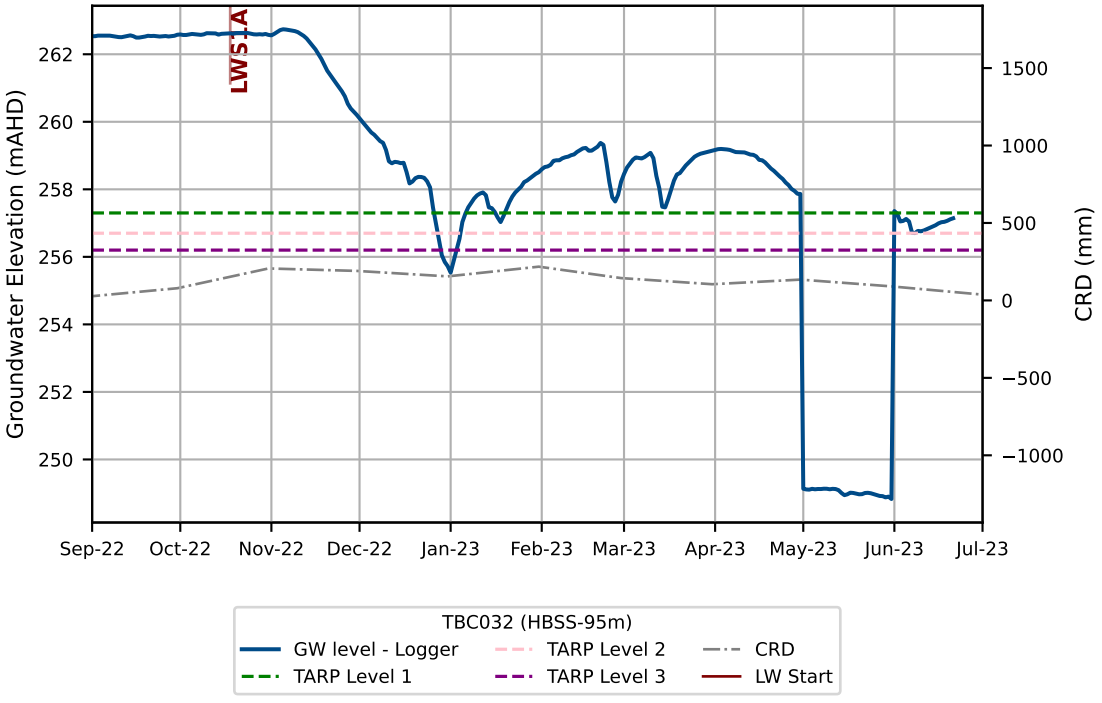

LWS1A
Groundwater Elevation (mAHD)
313
312
311
310
309
308
307
306
305
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC027 (BGSS-198m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

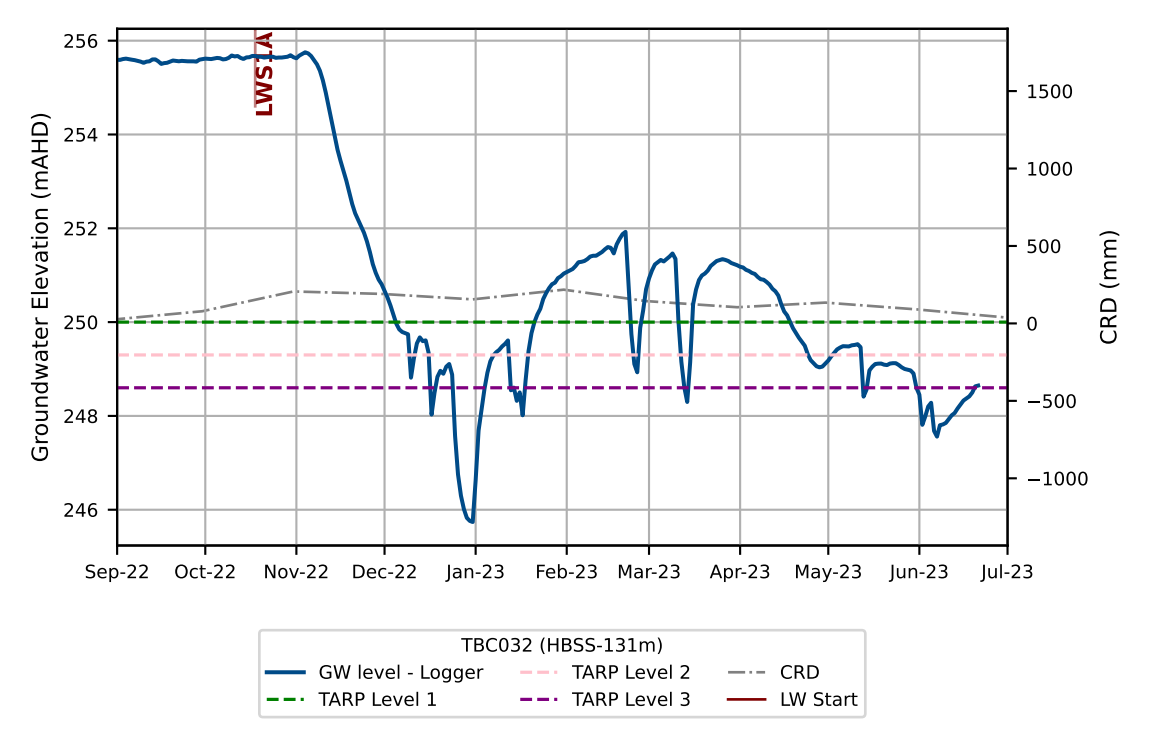

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
324
322
320
318
316
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC027 (HBSS-95m)
GW level - Logger
CRD
LW Start
TARP Level 1

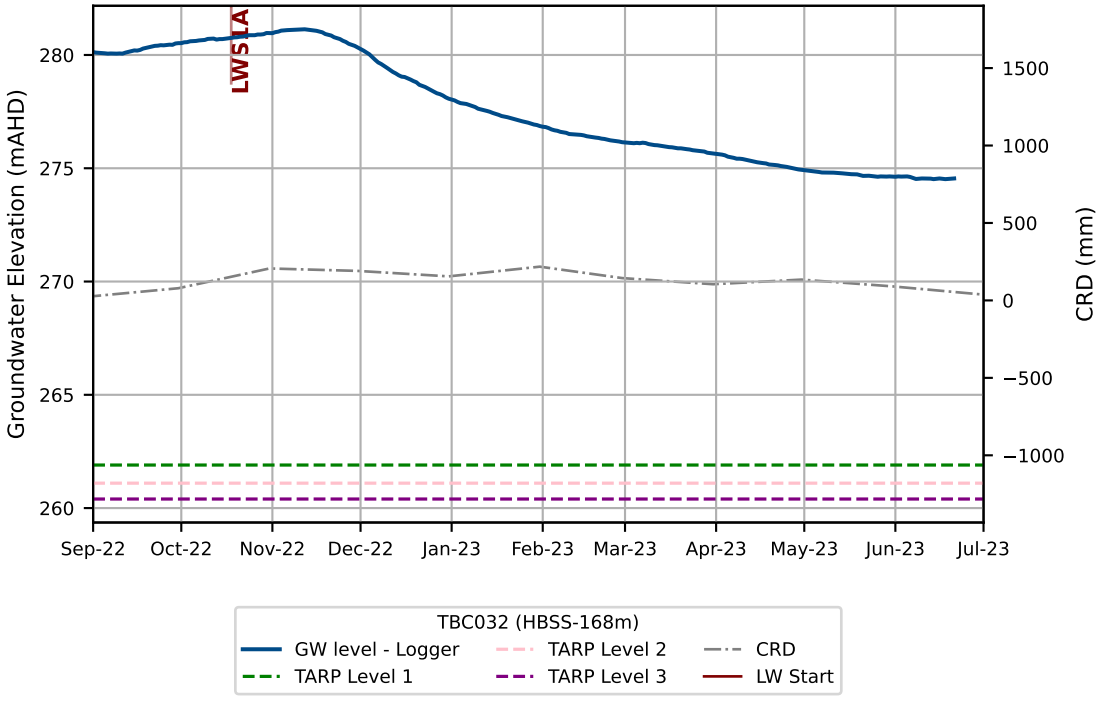

LWS1A
Groundwater Elevation (mAHD)
316
314
312
310
308
306
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC027 (HBSS-132m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

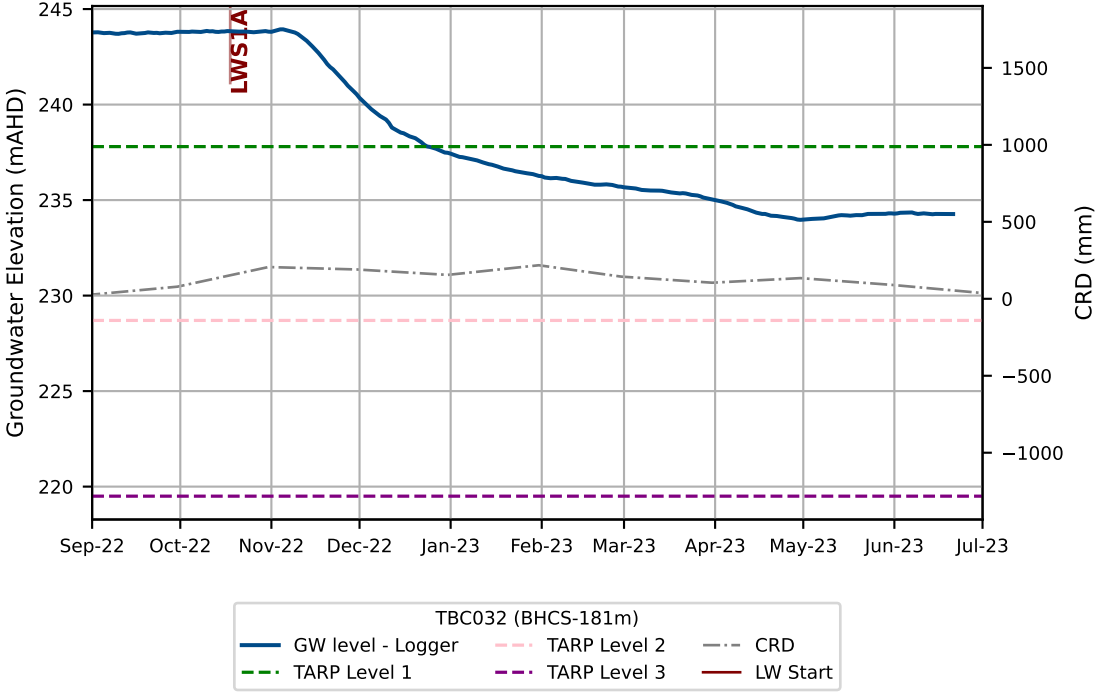

LWS1A
Groundwater Elevation (mAHD)
316
314
312
310
308
306
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC027 (HBSS-169m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

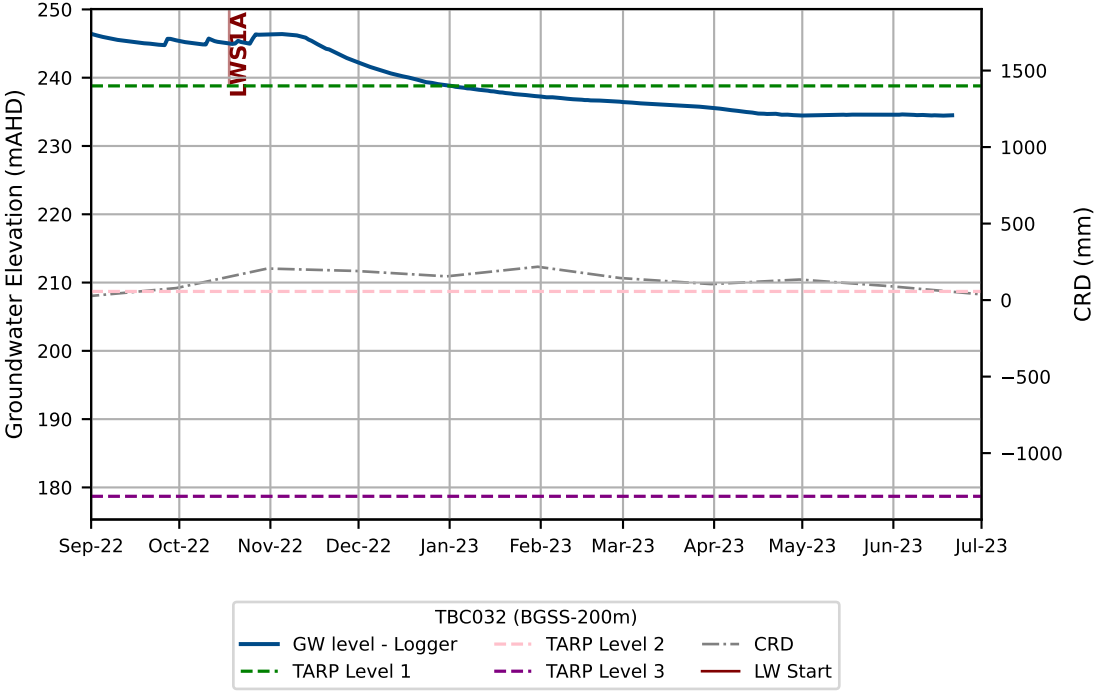

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
314
312
310
308
306
304
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC027 (BHCS-181m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

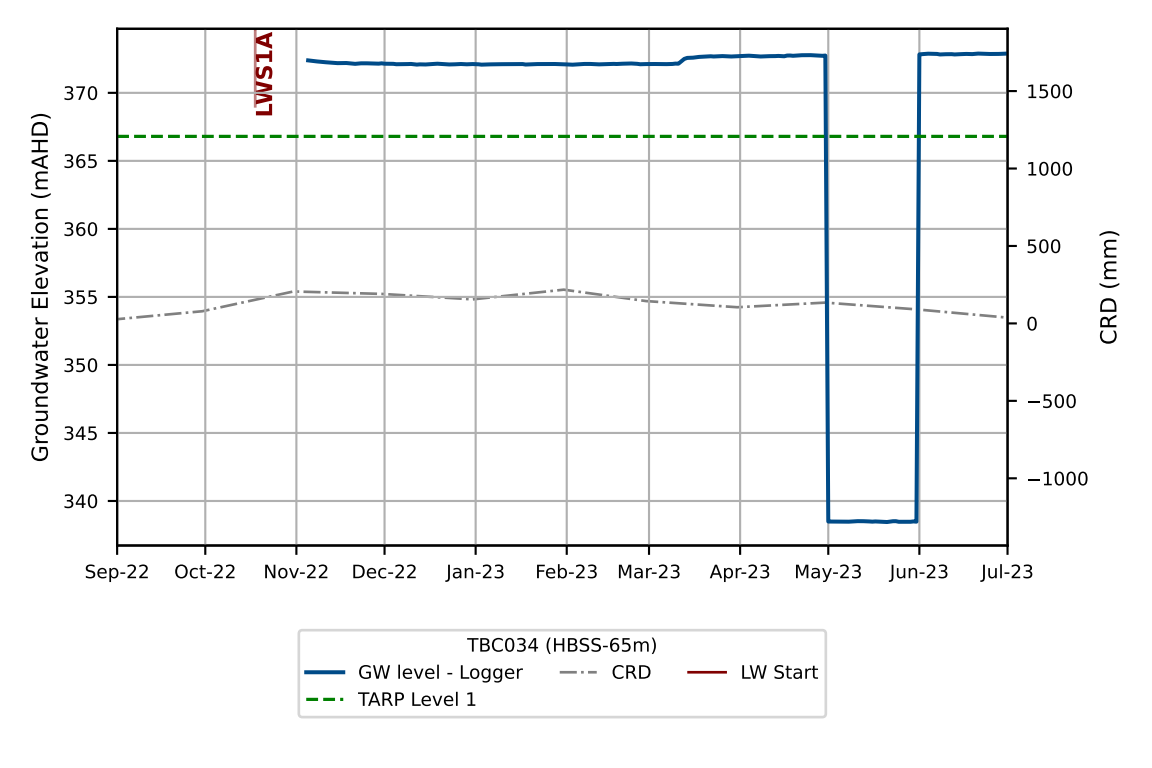

LWST A
Groundwater Elevation (mAHD)
CRD (mm)
262
260
258
256
254
252
250
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (HBSS-95m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

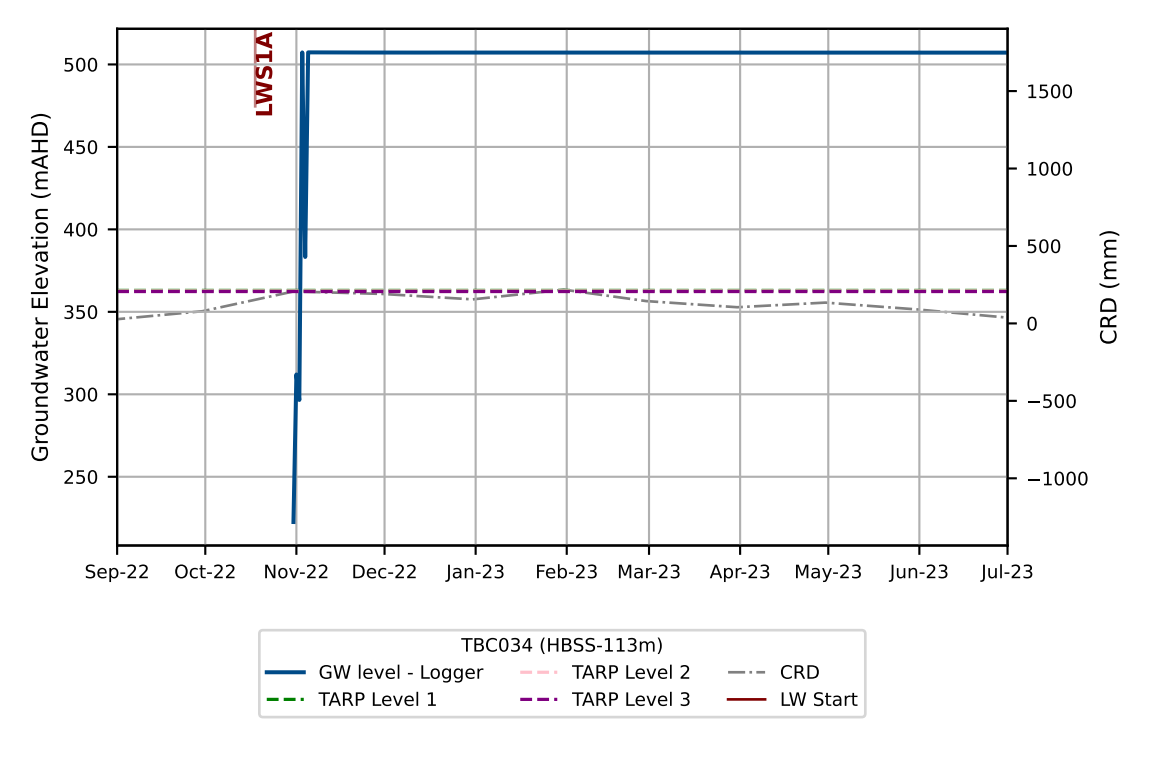

Groundwater Elevation (mAHD)
CRD (mm)
LWST
256
254
252
250
248
246
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (HBSS-131m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

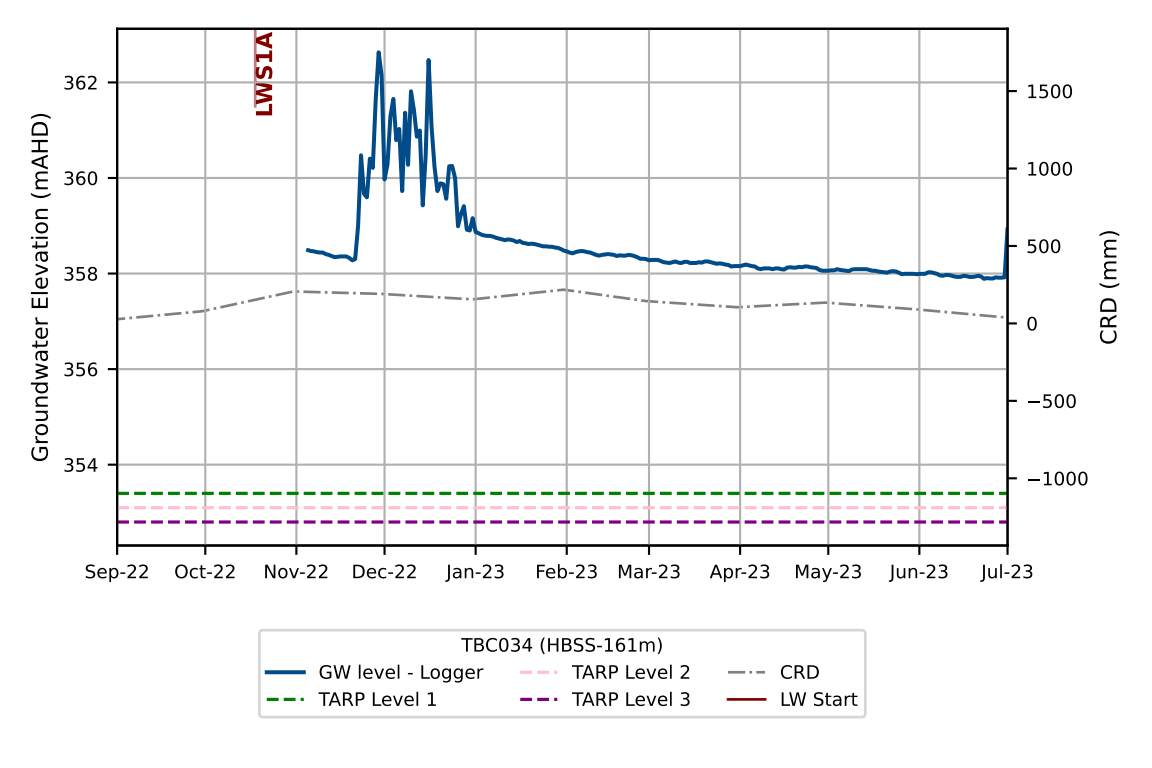

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
280
275
270
265
260
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (HBSS-168m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

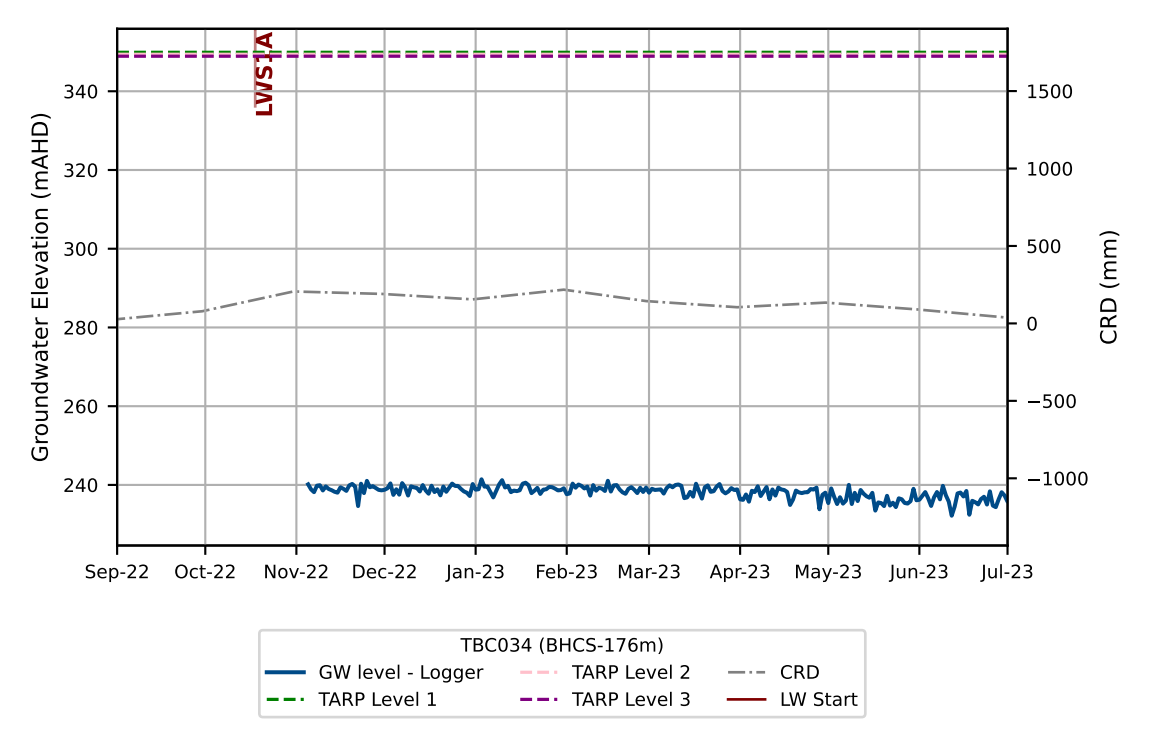

LWSTA
Groundwater Elevation (mAHD)
CRD (mm)
245
240
235
230
225
220
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (BHCS-181m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

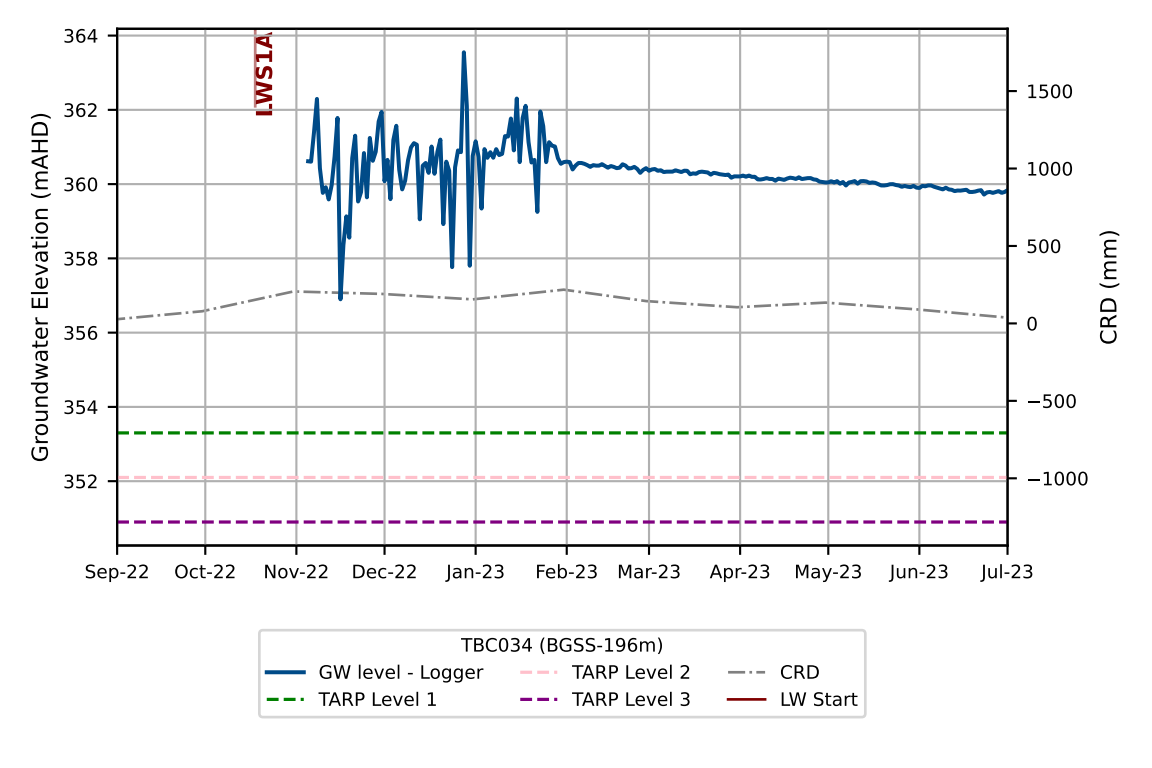

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
250
240
230
220
210
200
190
180
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (BGSS-200m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

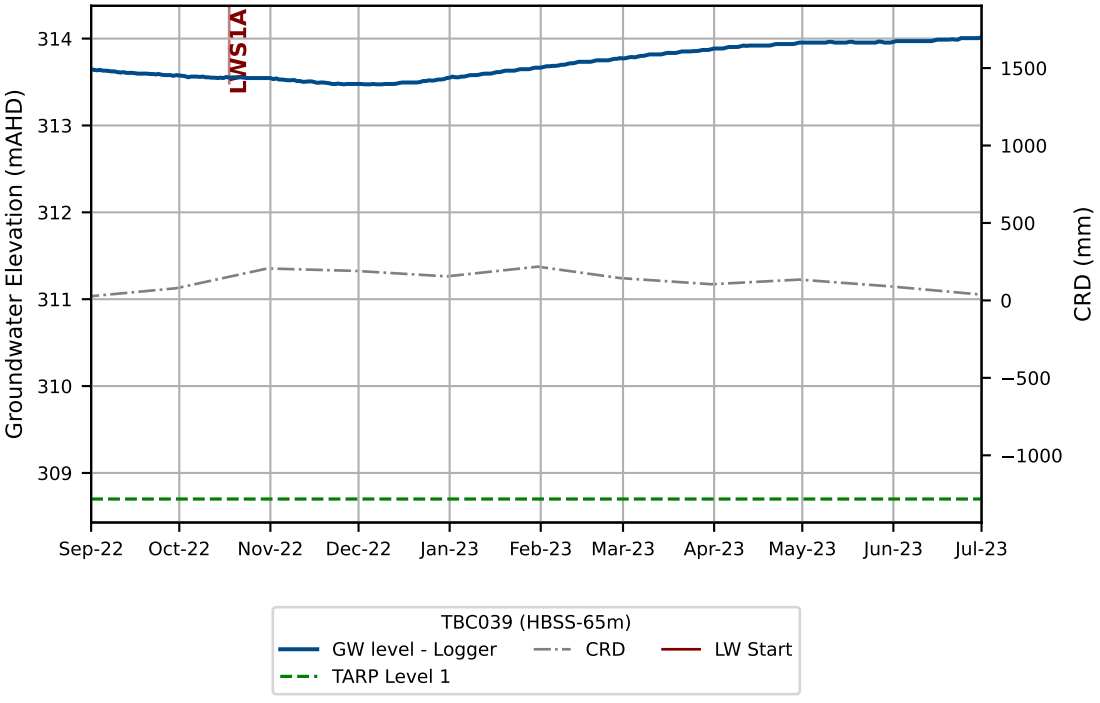

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
370
365
360
355
350
345
340
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC034 (HBSS-65m)
GW level - Logger
CRD
LW Start
TARP Level 1

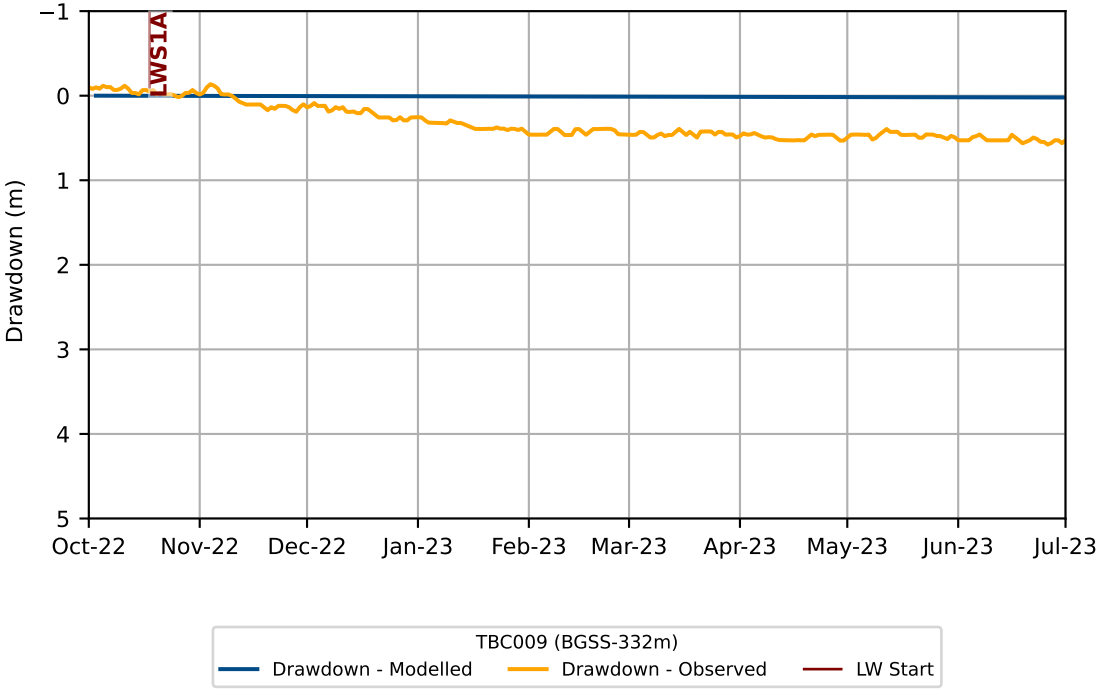

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
500
450
400
350
300
250
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC034 (HBSS-113m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

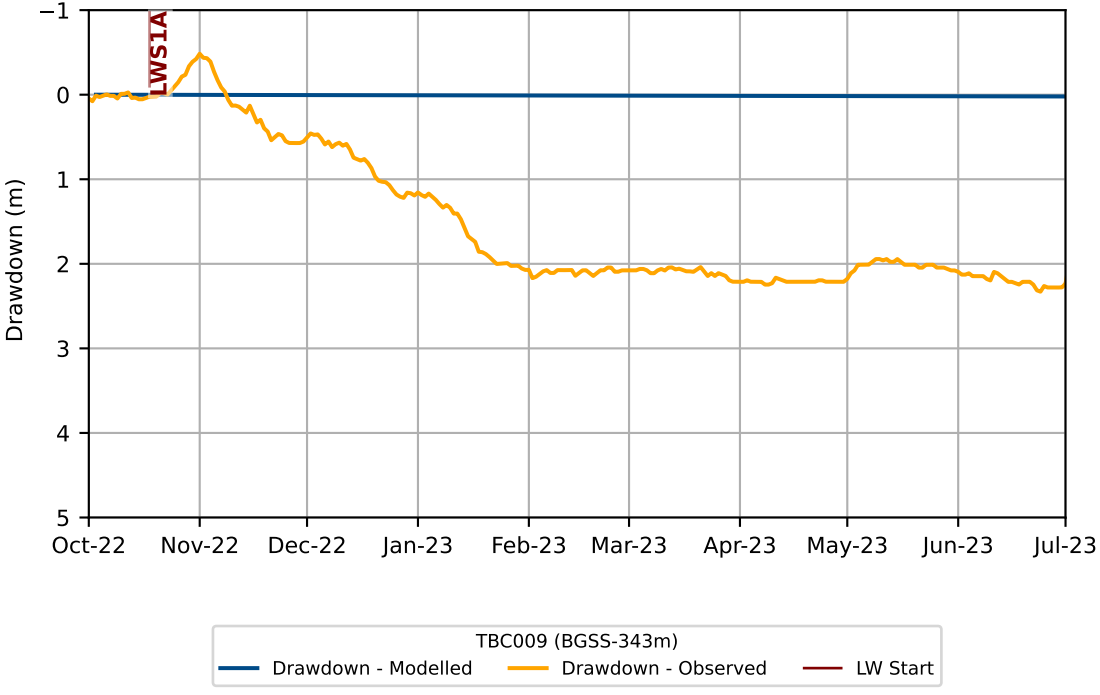

LWS1A
Groundwater Elevation (mAHD)
362
360
358
356
354
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC034 (HBSS-161m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

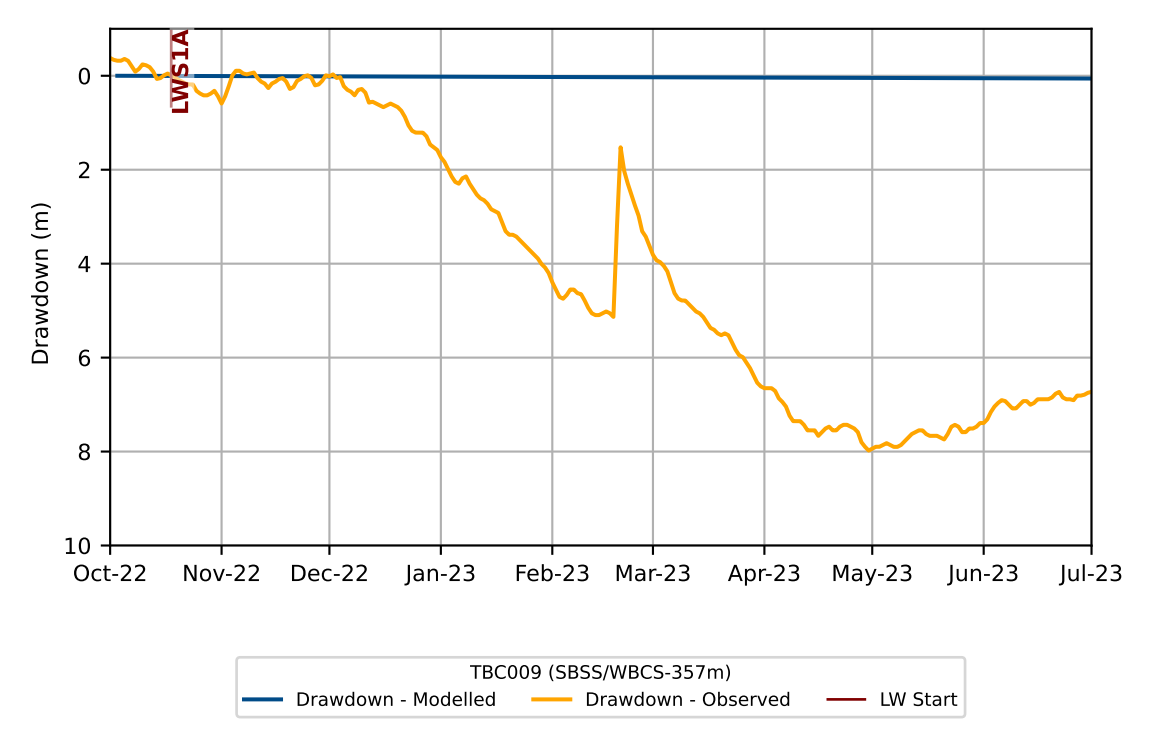

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
340
320
300
280
260
240
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC034 (BHCS-176m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

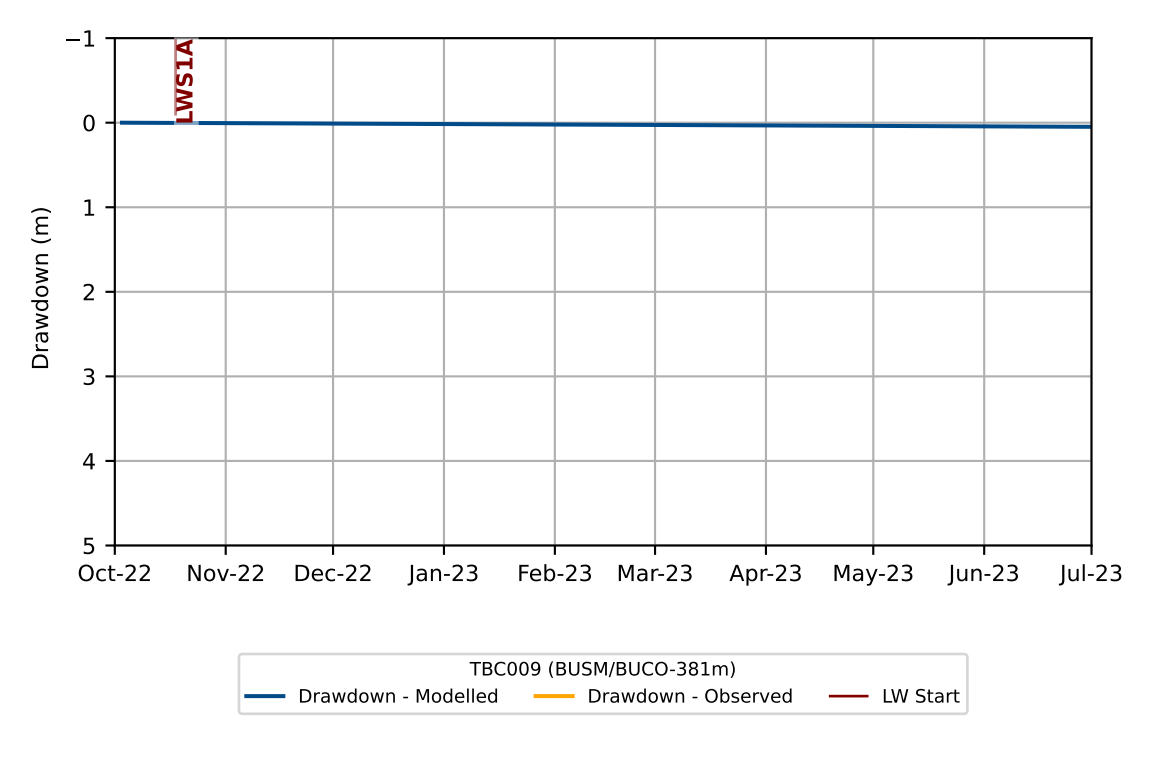

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
364
362
360
358
356
354
352
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC034 (BGSS-196m)
GW level - Logger
TARP Level 1
TARP Level 2
TARP Level 3
CRD
LW Start

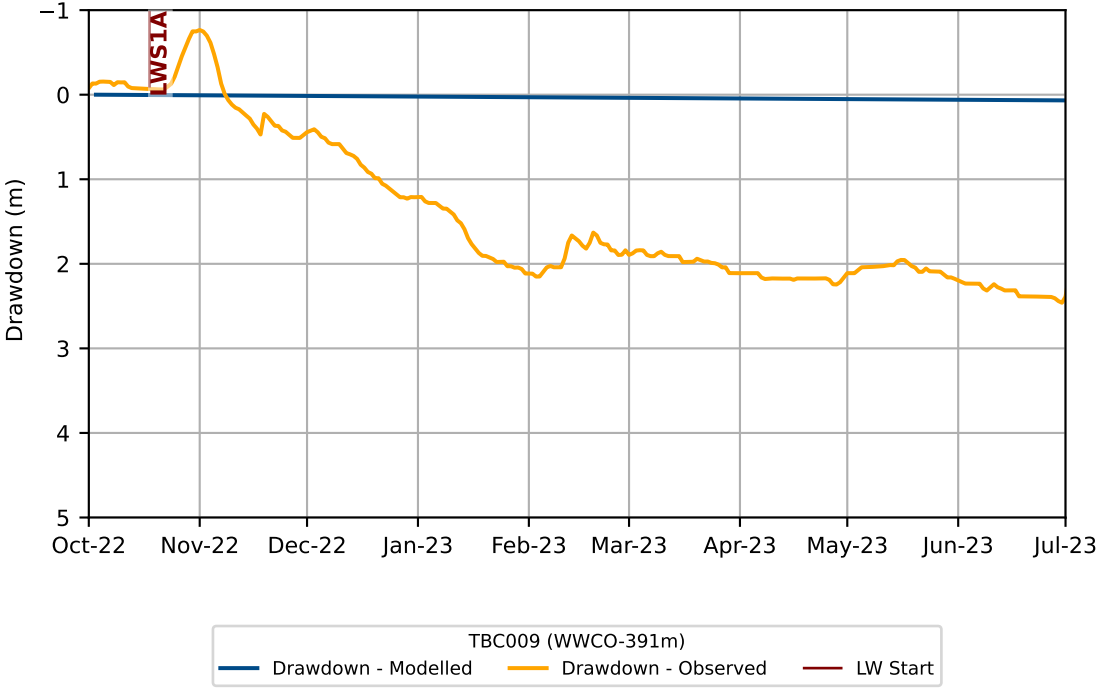

LWS1A
Groundwater Elevation (mAHD)
CRD (mm)
314
313
312
311
310
309
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC039 (HBSS-65m)
GW level - Logger
CRD
LW Start
TARP Level 1

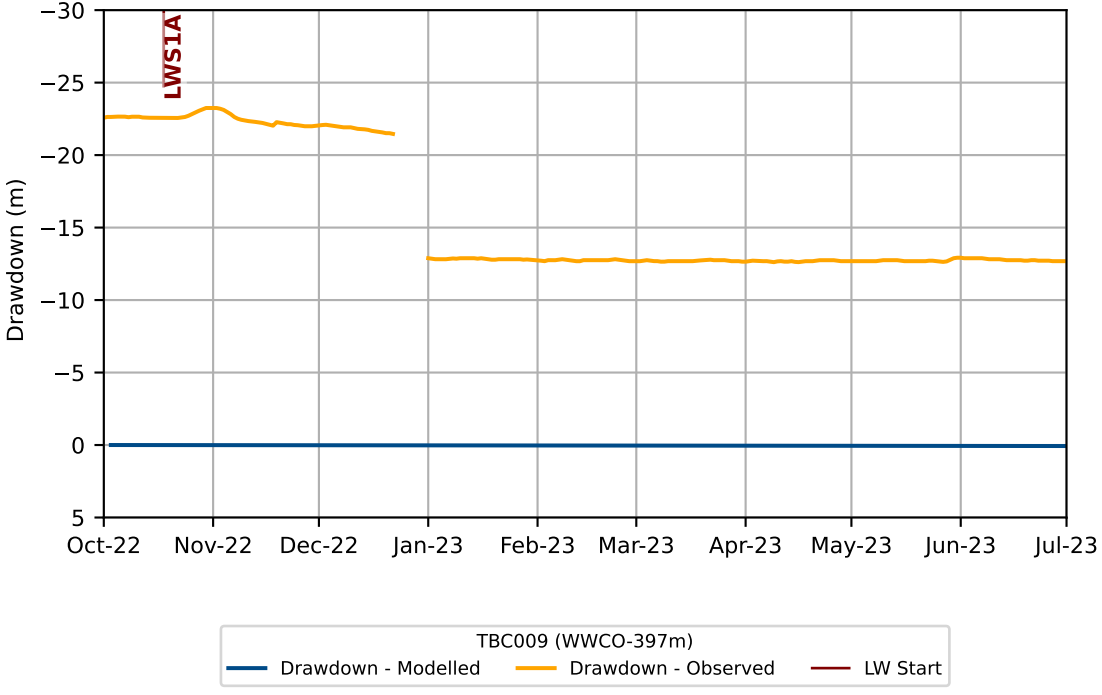

LW1A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (BGSS-332m)
Drawdown - Modelled
Drawdown - Observed
LW Start

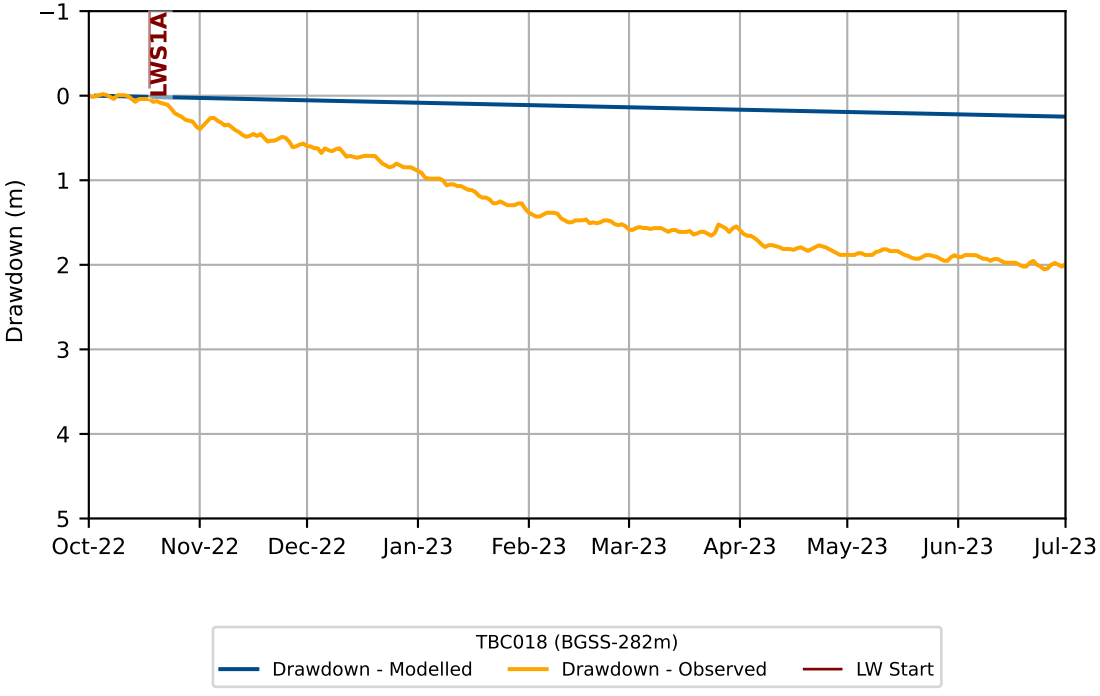

LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (BGSS-343m)
Drawdown - Modelled
Drawdown - Observed
LW Start

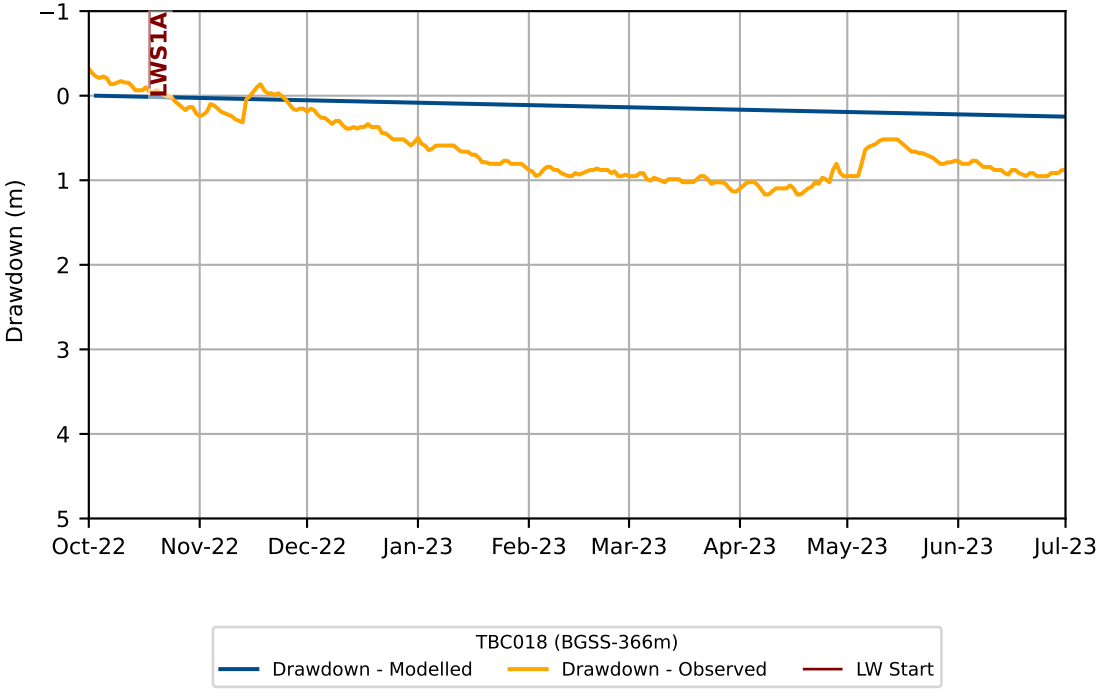

LW S1A
Drawdown (m)
0
2
4
6
8
10
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (SBSS/WBCS-357m)
Drawdown - Modelled
Drawdown - Observed
LW Start

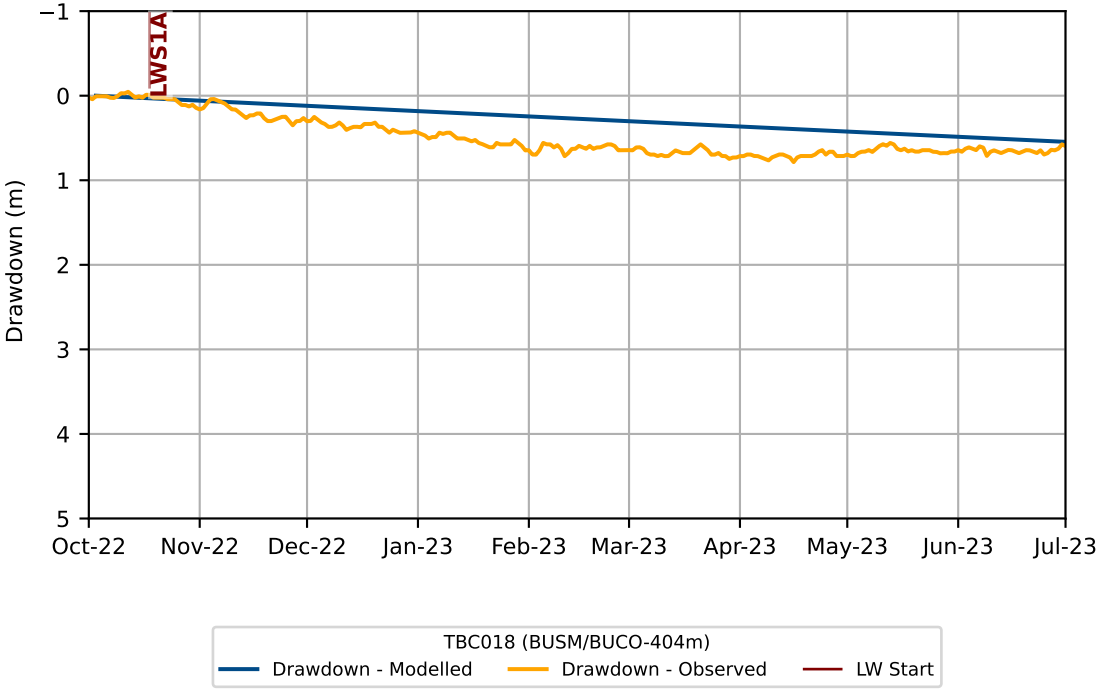

LW1A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (BUSM/BUCO-381m)
Drawdown - Modelled
Drawdown - Observed
LW Start

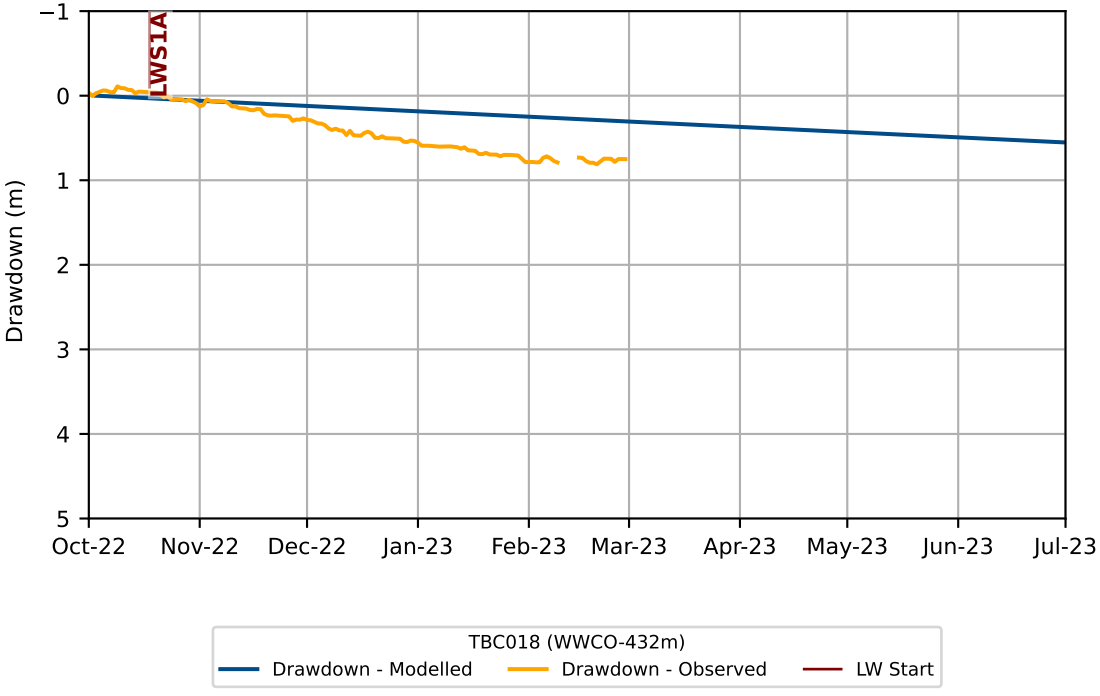

LW51A
Drawdown (m)
−1
0
1
2
3
4
5
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (WWCO-391m)
Drawdown - Modelled
Drawdown - Observed
LW Start

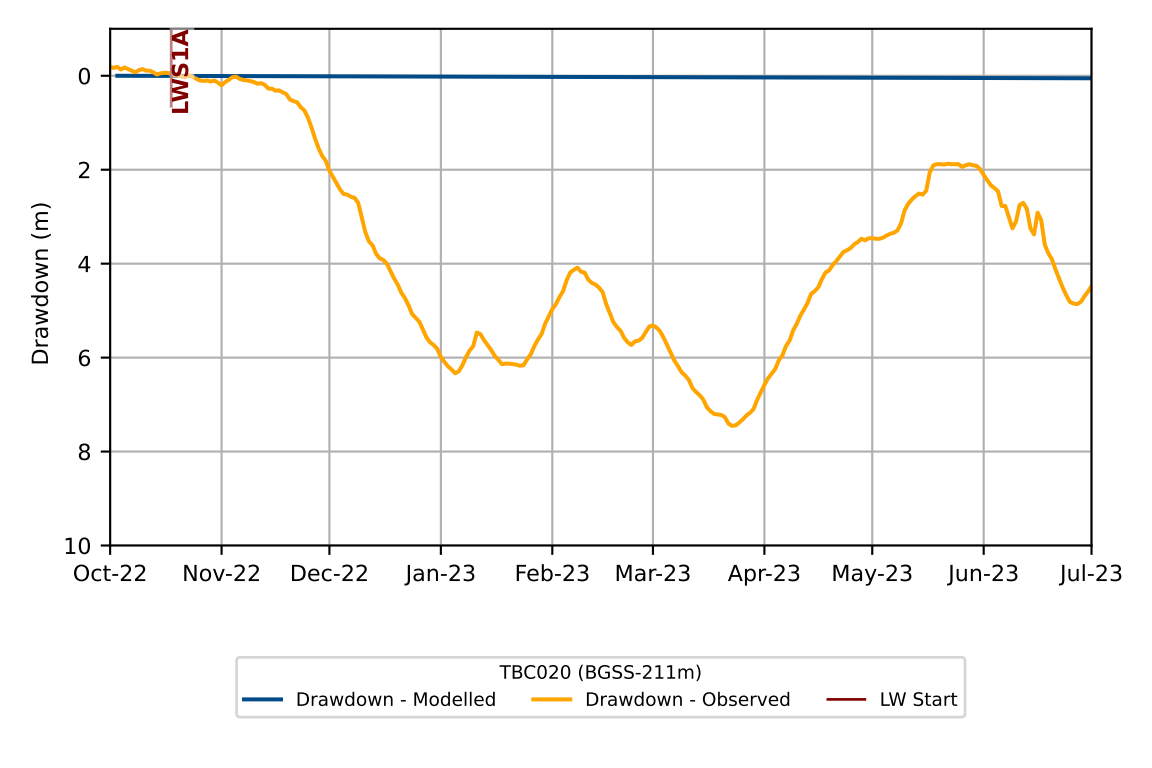

LWS1A
Drawdown (m)
−30
−25
−20
−15
−10
−5
0
5
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC009 (WWCO-397m)
Drawdown - Modelled
Drawdown - Observed
LW Start

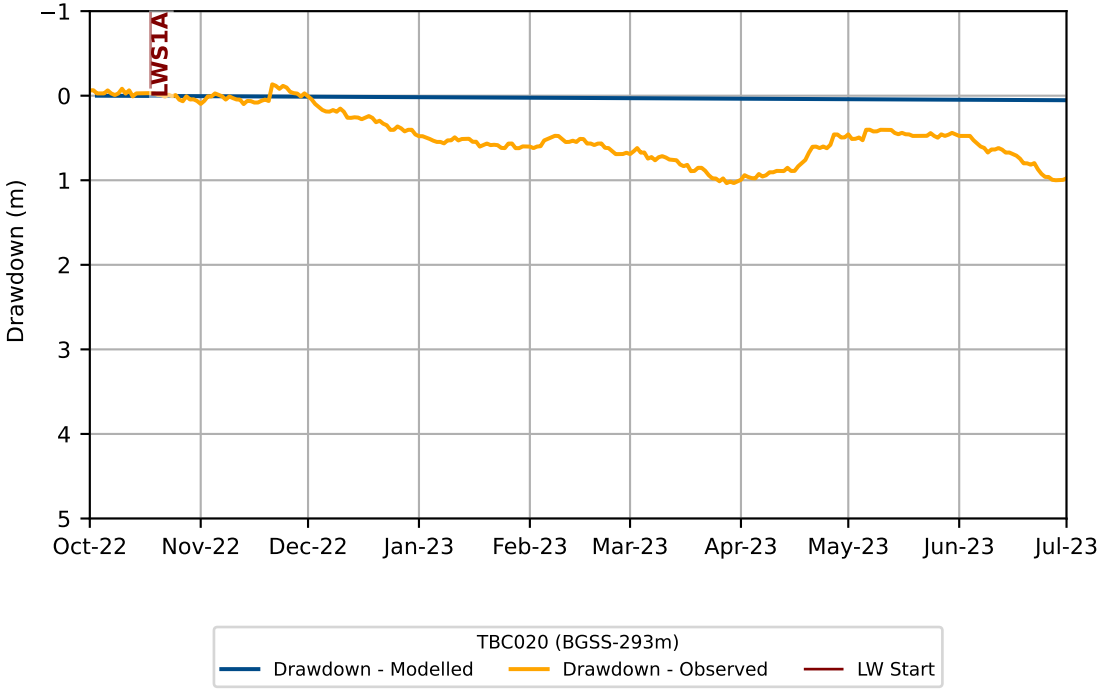

LWS1A
Drawdown (m)
−1
0
1
2
3
4
5
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (BGSS-282m)
Drawdown - Modelled
Drawdown - Observed
LW Start

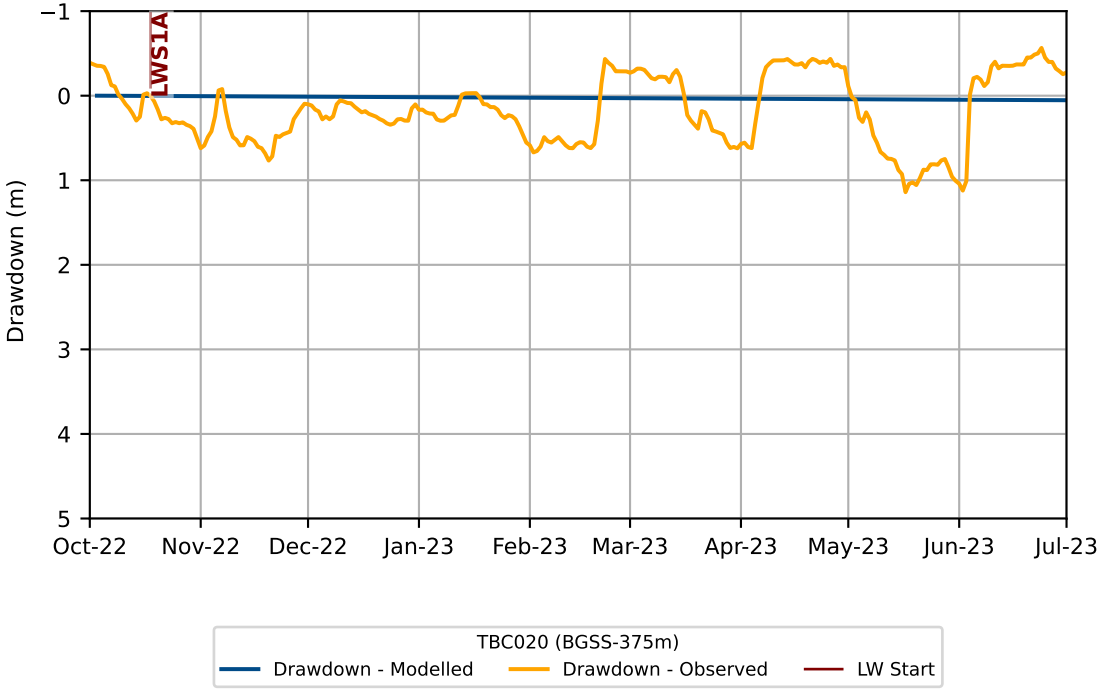

LWS1A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (BGSS-366m)
Drawdown - Modelled
Drawdown - Observed
LW Start

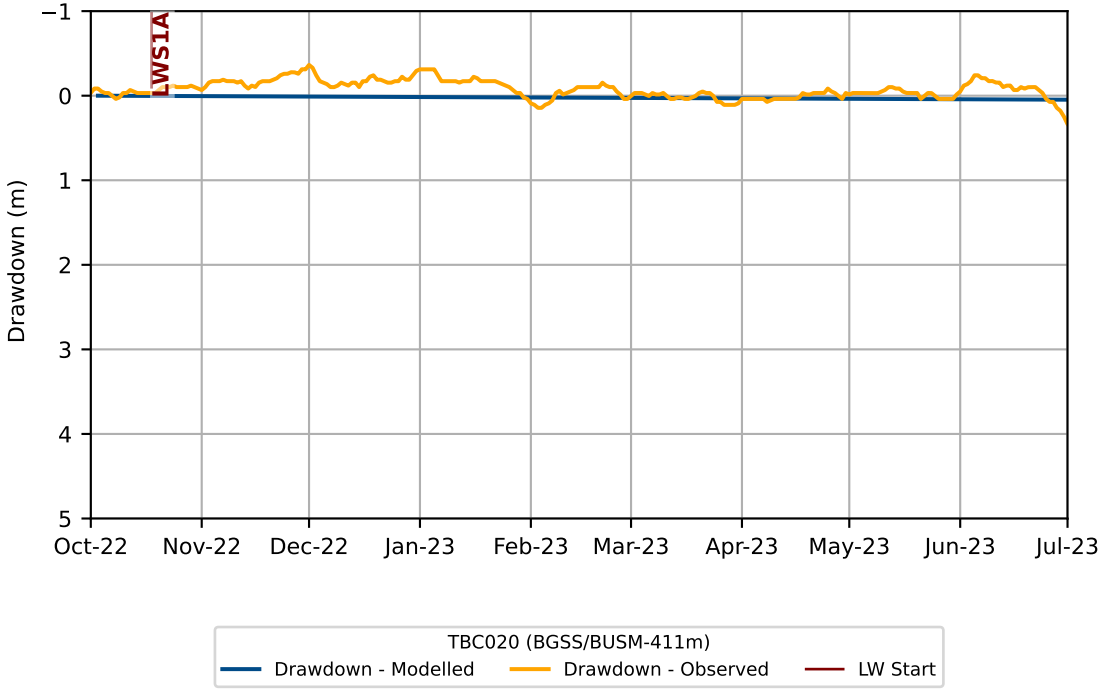

LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (BUSM/BUCO-404m)
Drawdown - Modelled
Drawdown - Observed
LW Start

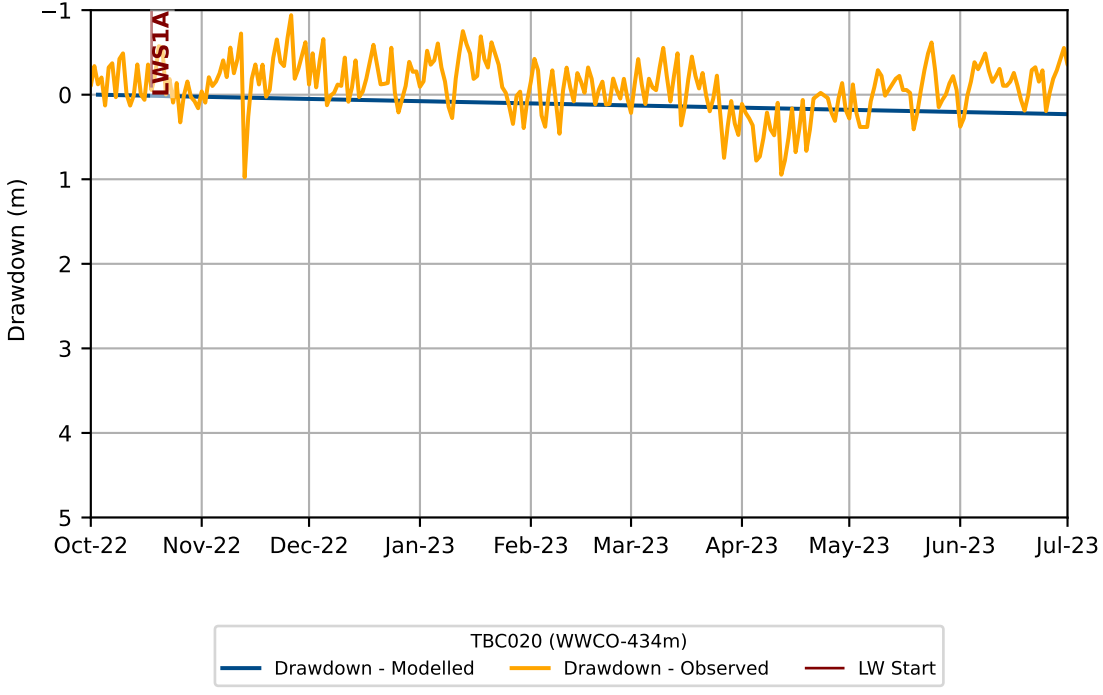

LWS1A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC018 (WWCO-432m)
Drawdown - Modelled
Drawdown - Observed
LW Start

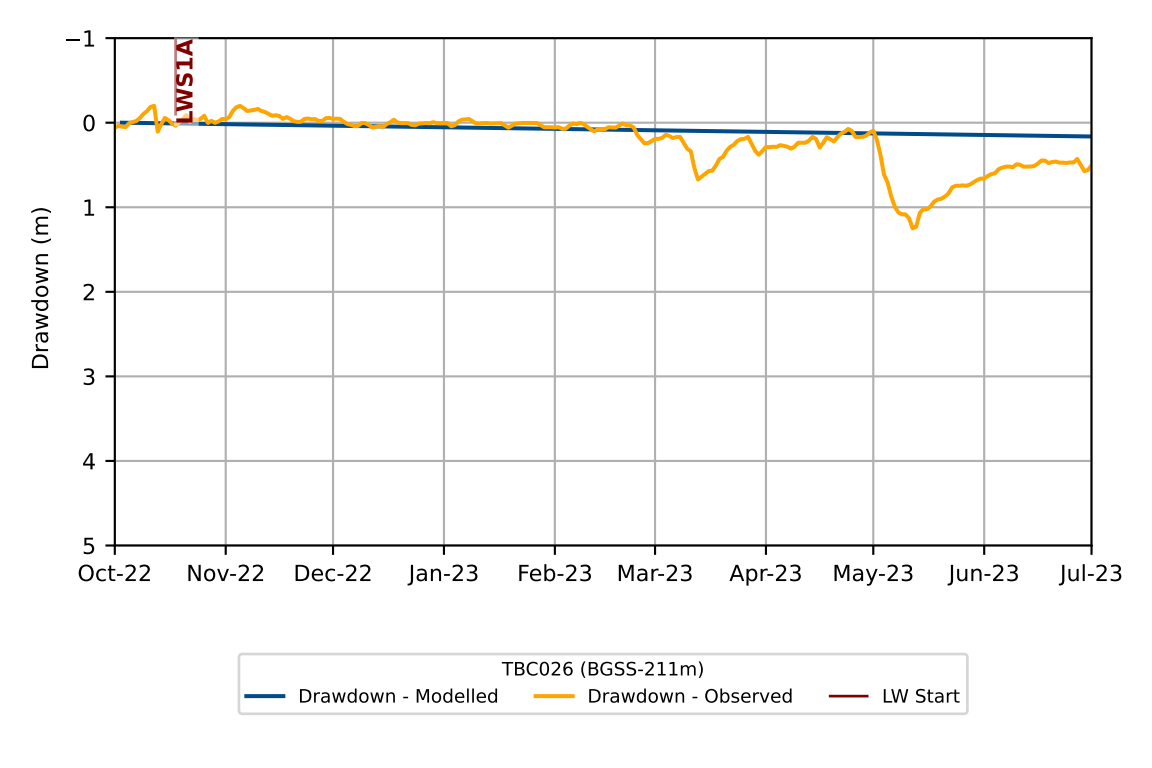

LWS1A
Drawdown (m)
0
2
4
6
8
10
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC020 (BGSS-211m)
Drawdown - Modelled
Drawdown - Observed
LW Start

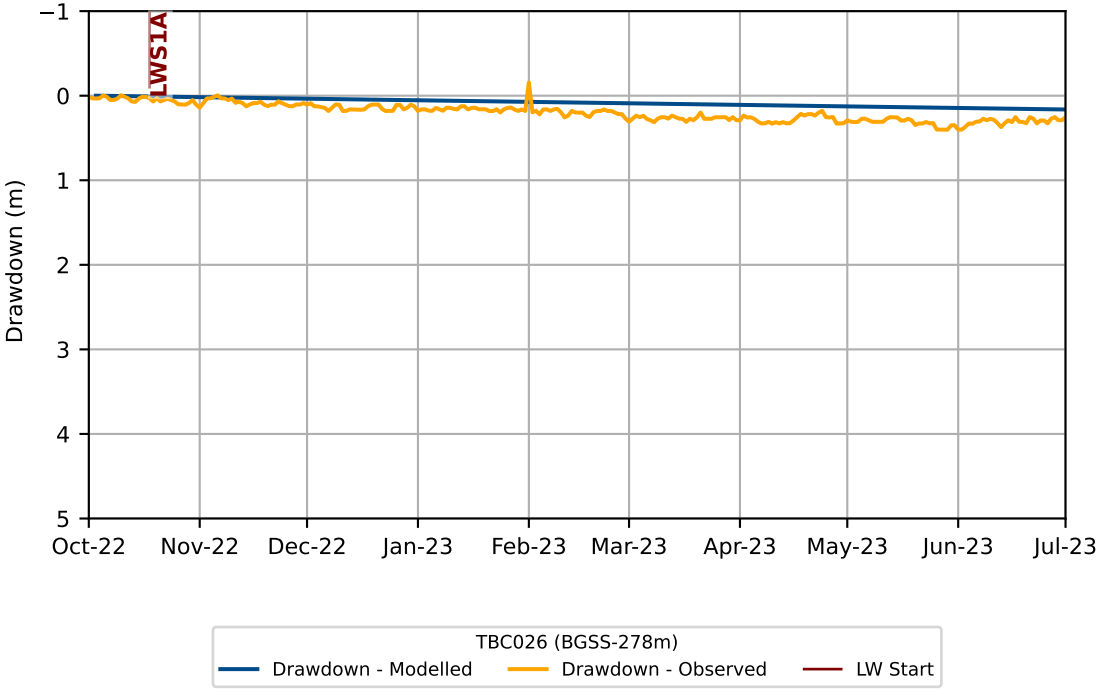

LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC020 (BGSS-293m)
Drawdown - Modelled
Drawdown - Observed
LW Start

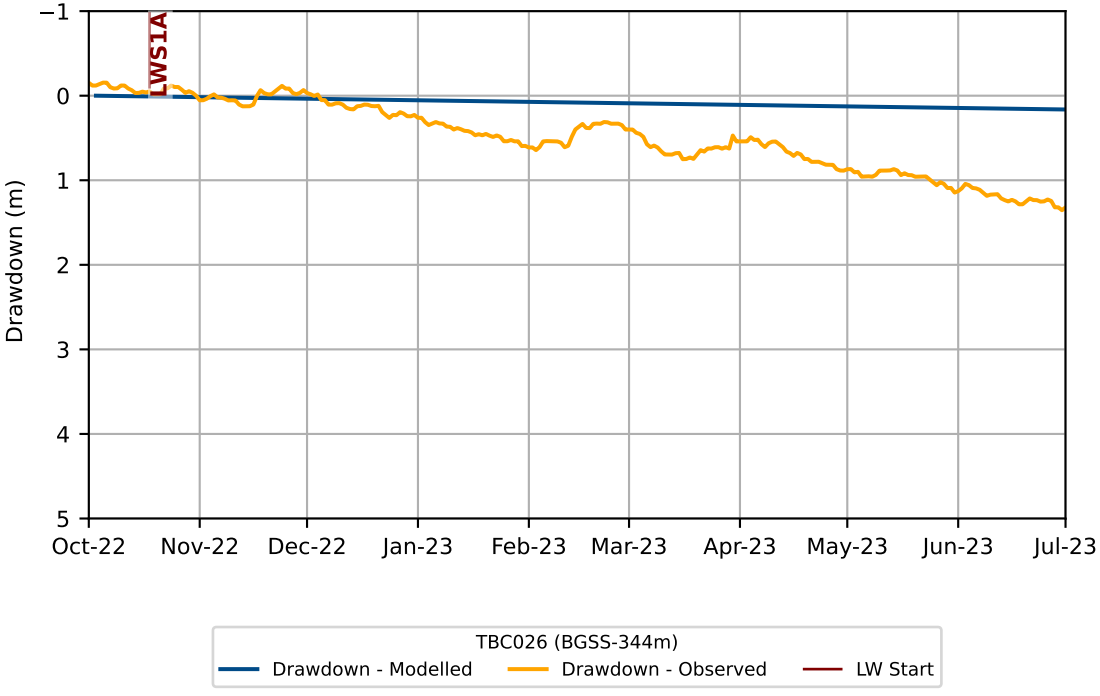

LWS1A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC020 (BGSS-375m)
Drawdown - Modelled
Drawdown - Observed
LW Start

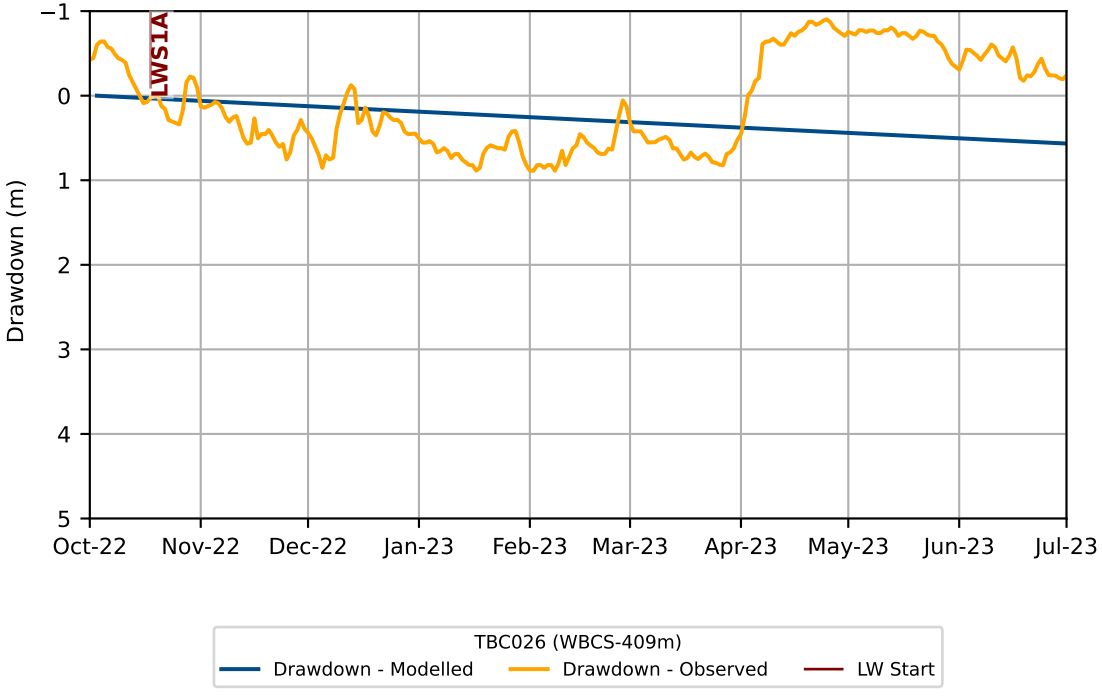

LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC020 (BGSS/BUSM-411m)
Drawdown - Modelled
Drawdown - Observed
LW Start

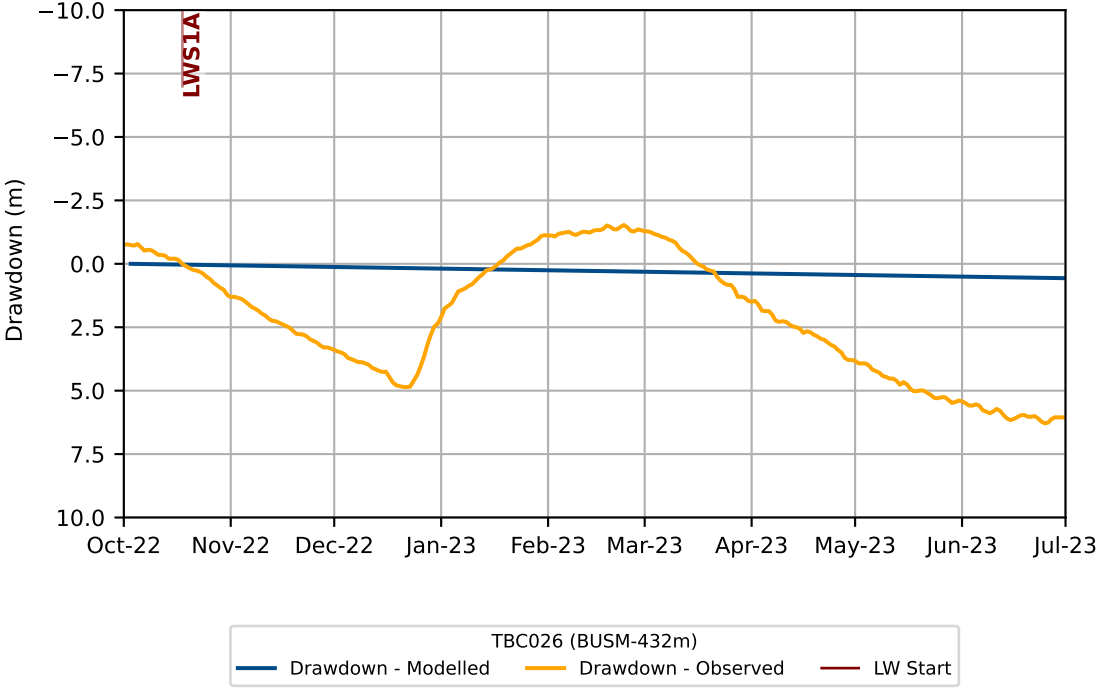

LW S1A
Drawdown (m)
−1
0
1
2
3
4
5
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC020 (WWCO-434m)
Drawdown - Modelled
Drawdown - Observed
LW Start

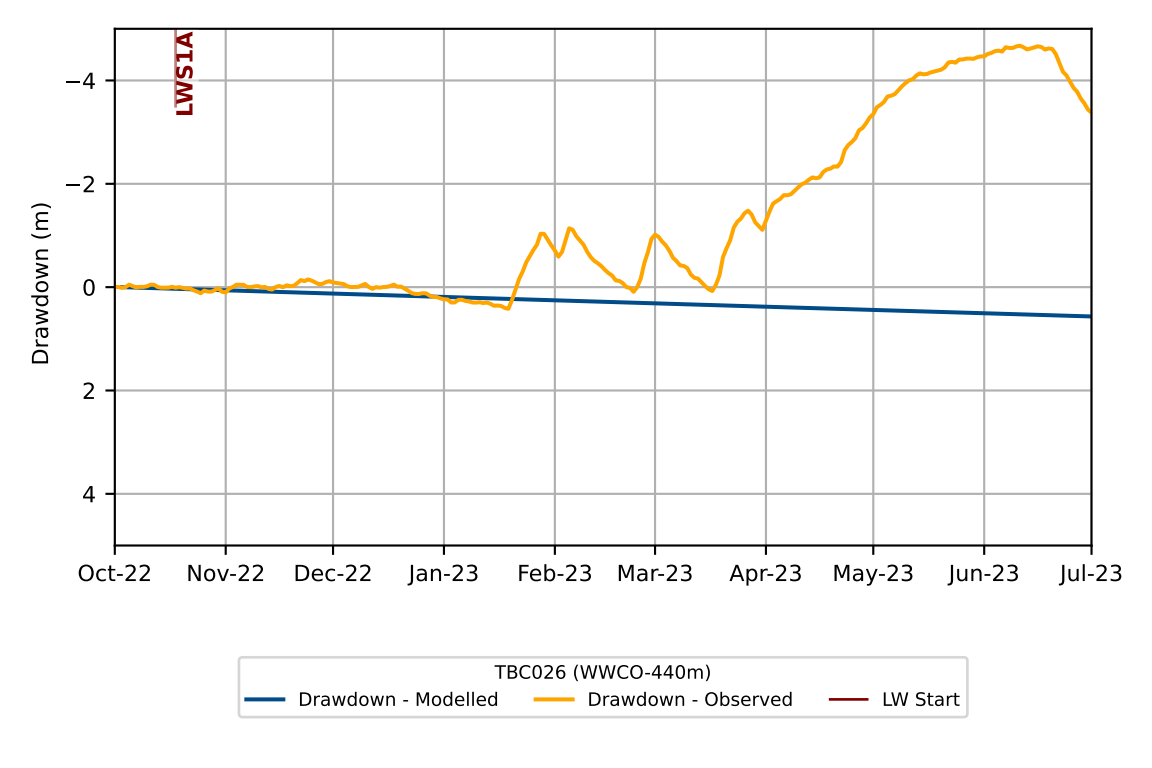

LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC026 (BGSS-211m)
Drawdown - Modelled
Drawdown - Observed
LW Start

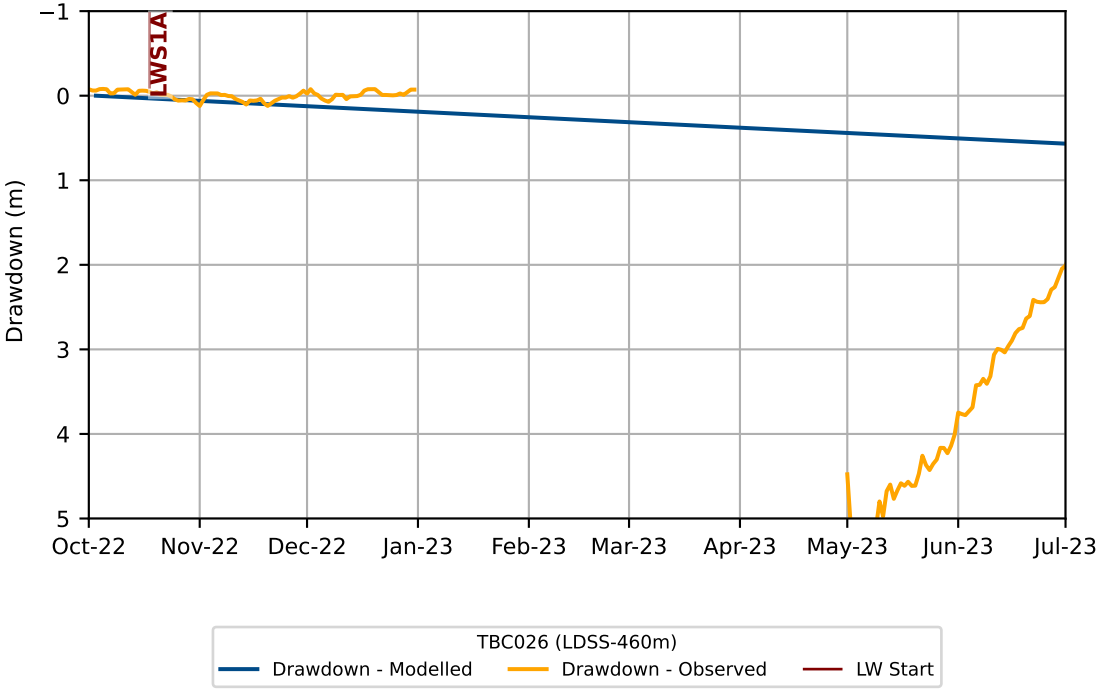

LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC026 (BGSS-278m)
Drawdown - Modelled
Drawdown - Observed
LW Start

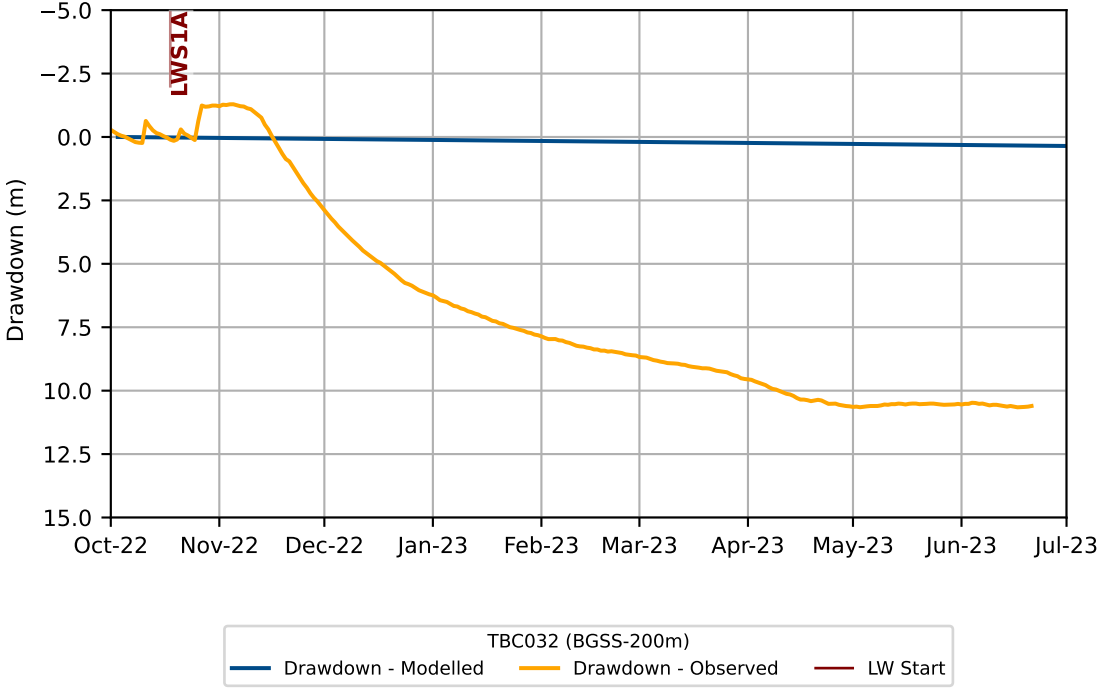

LWS1A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC026 (BGSS-344m)
Drawdown - Modelled
Drawdown - Observed
LW Start

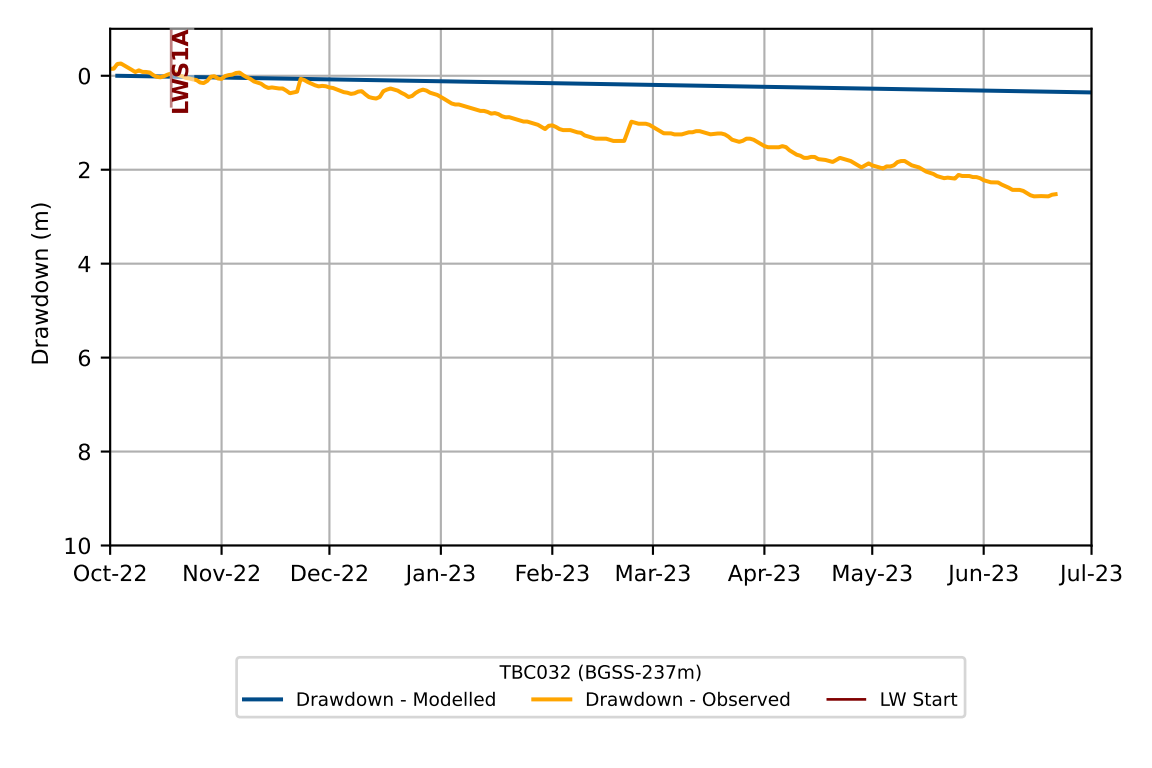

LWS1A
Drawdown (m)
−1
0
1
2
3
4
5
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC026 (WBCS-409m)
Drawdown - Modelled
Drawdown - Observed
LW Start

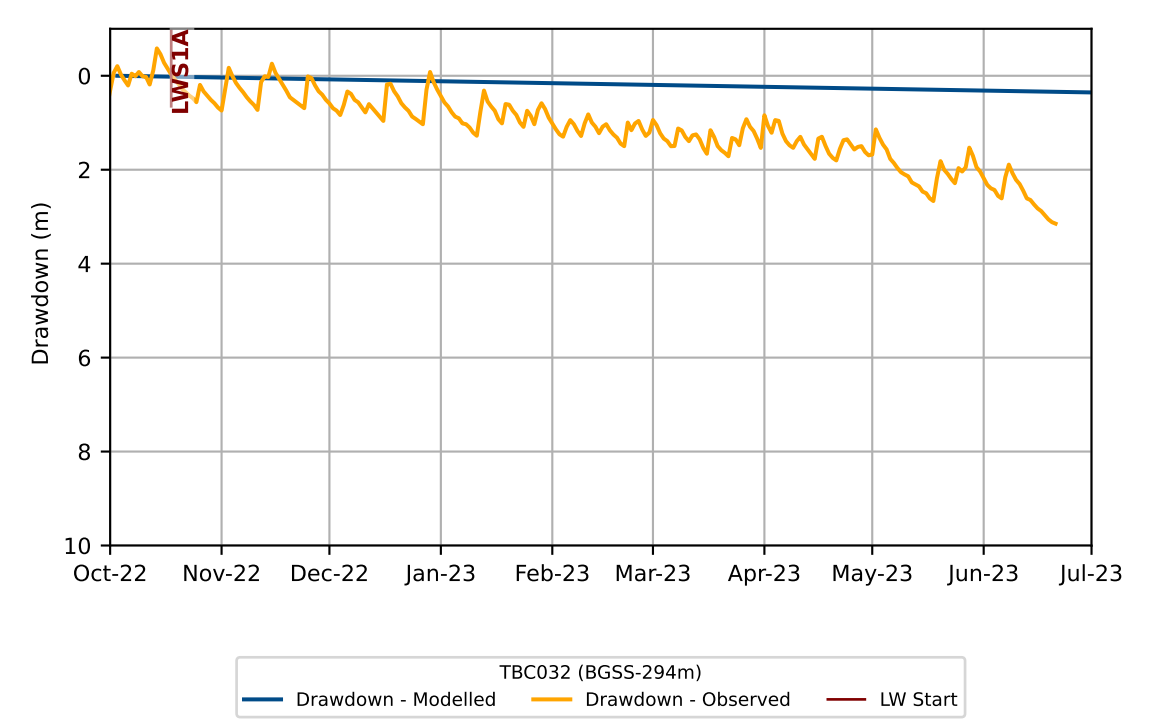

LWS1A
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC026 (BUSM-432m)
Drawdown - Modelled
Drawdown - Observed
LW Start

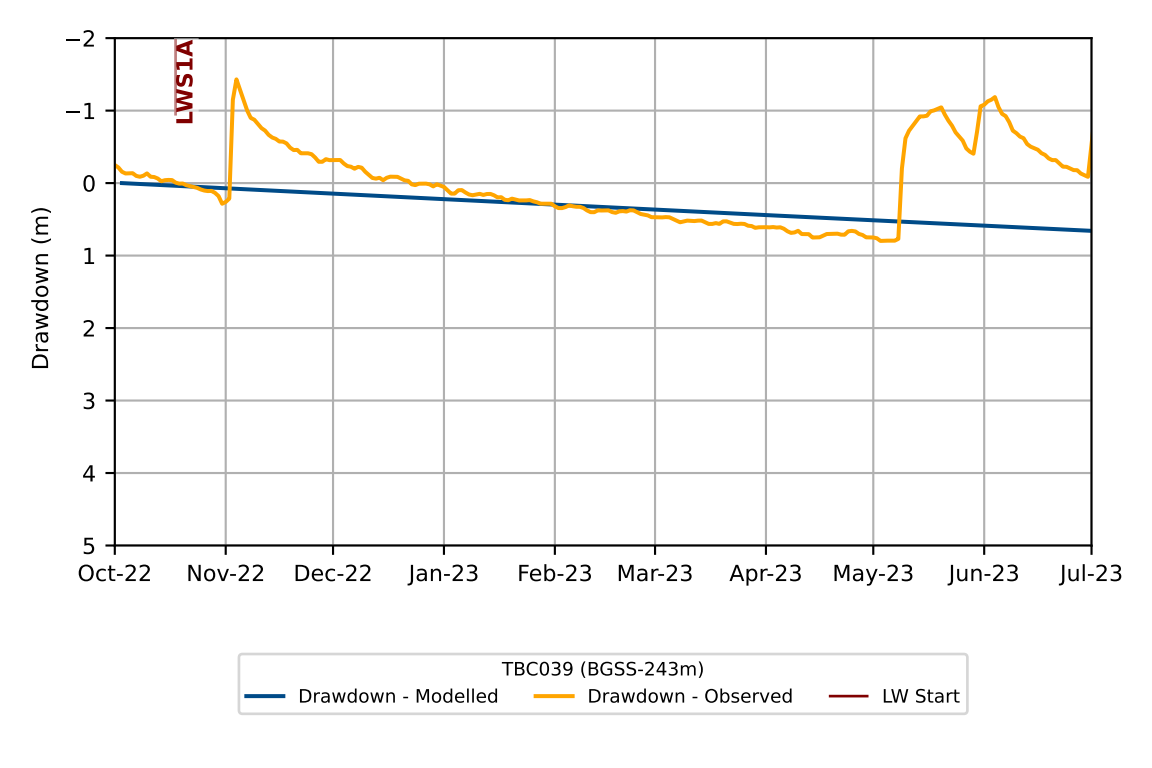

LWS1A
Drawdown (m)
−4
−2
0
2
4
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC026 (WWCO-440m)
Drawdown - Modelled
Drawdown - Observed
LW Start

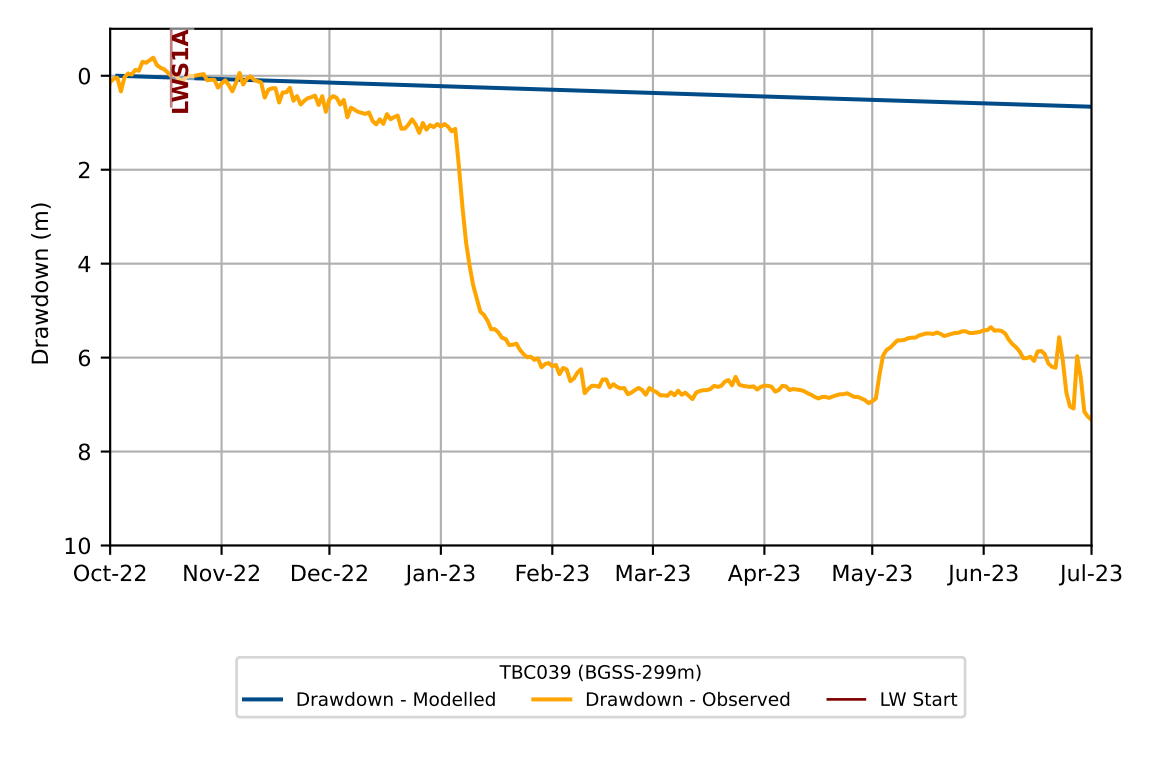

LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC026 (LDSS-460m)
Drawdown - Modelled
Drawdown - Observed
LW Start

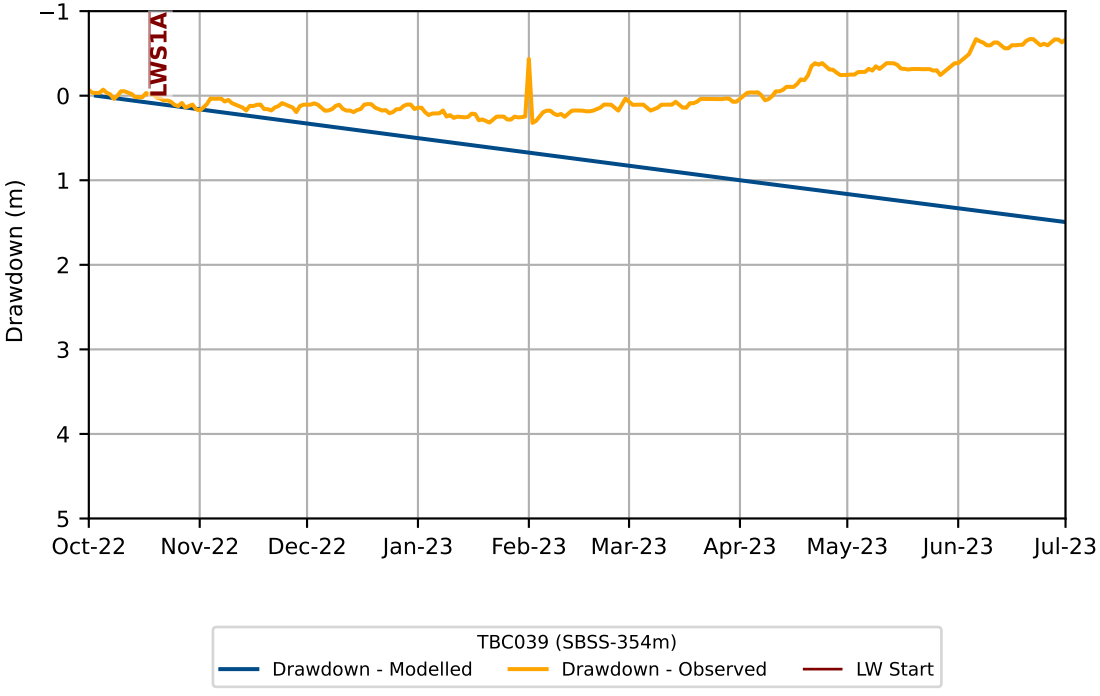

LWS1A
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
12.5
15.0
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (BGSS-200m)
Drawdown - Modelled
Drawdown - Observed
LW Start

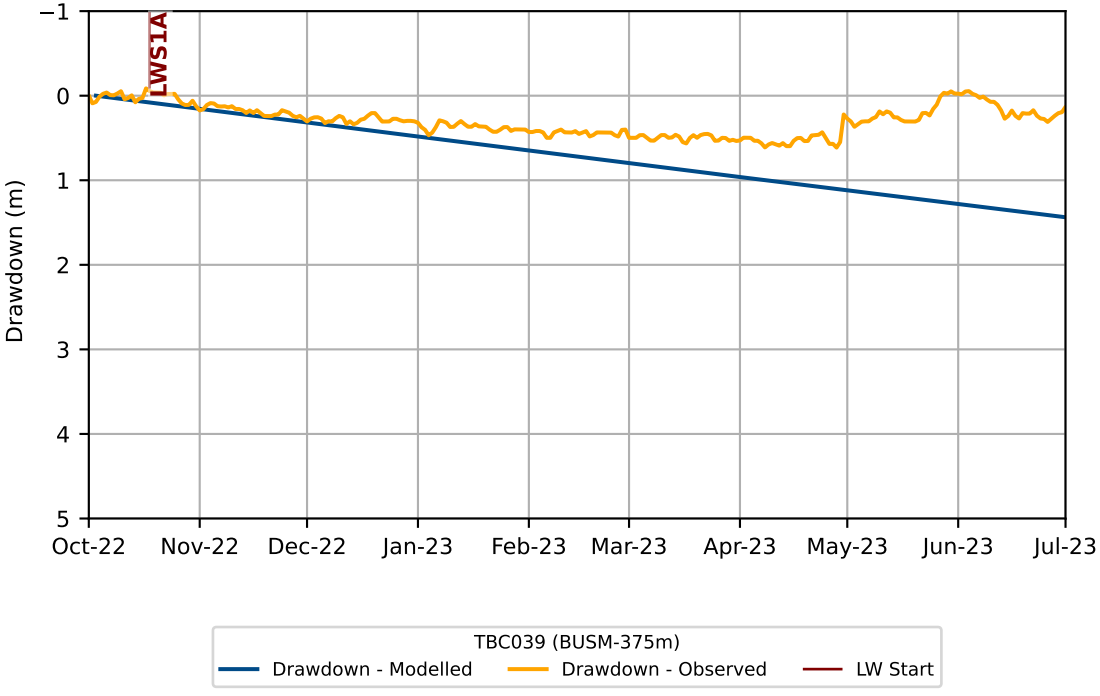

LW51A
Drawdown (m)
0
2
4
6
8
10
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (BGSS-237m)
Drawdown - Modelled
Drawdown - Observed
LW Start

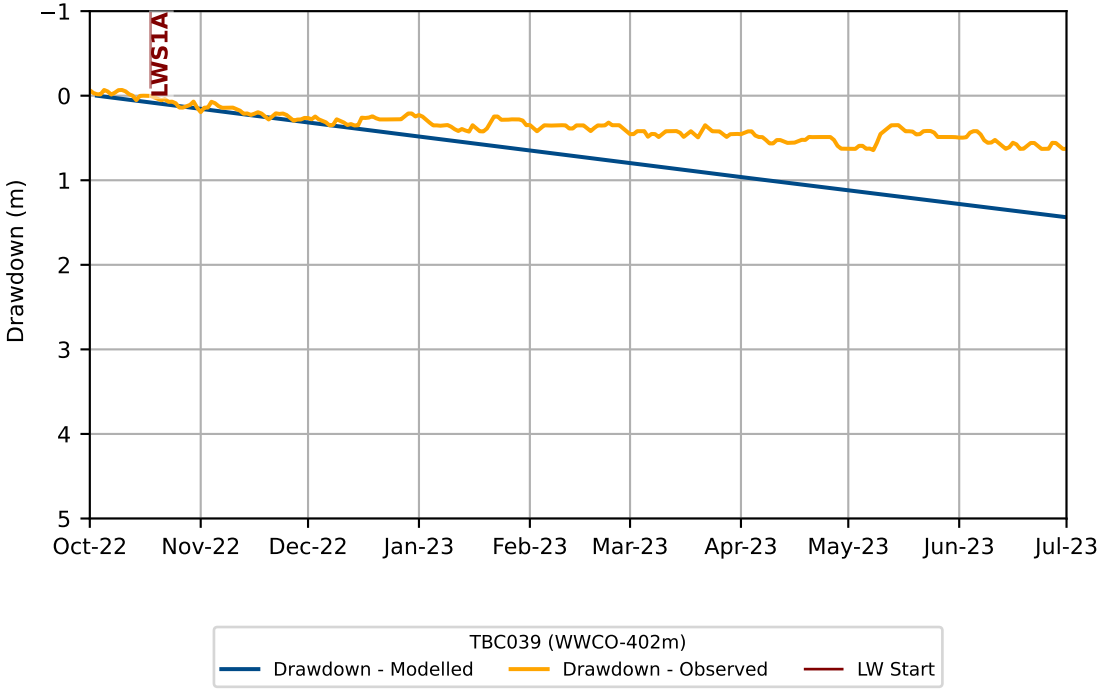

LW51A
Drawdown (m)
0
2
4
6
8
10
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC032 (BGSS-294m)
Drawdown - Modelled
Drawdown - Observed
LW Start


LW51A
Drawdown (m)
−2
−1
0
1
2
3
4
5
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC039 (BGSS-243m)
Drawdown - Modelled
Drawdown - Observed
LW Start


LWS1A
Drawdown (m)
0
2
4
6
8
10
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC039 (BGSS-299m)
Drawdown - Modelled
Drawdown - Observed
LW Start


LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC039 (SBSS-354m)
Drawdown - Modelled
Drawdown - Observed
LW Start


LW51A
Drawdown (m)
−1
0
1
2
3
4
5
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC039 (BUSM-375m)
Drawdown - Modelled
Drawdown - Observed
LW Start


LW51A
−1
0
1
2
3
4
5
Drawdown (m)
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
TBC039 (WWCO-402m)
Drawdown - Modelled
Drawdown - Observed
LW Start

Appendix D Plots – Groundwater Quality TARPs

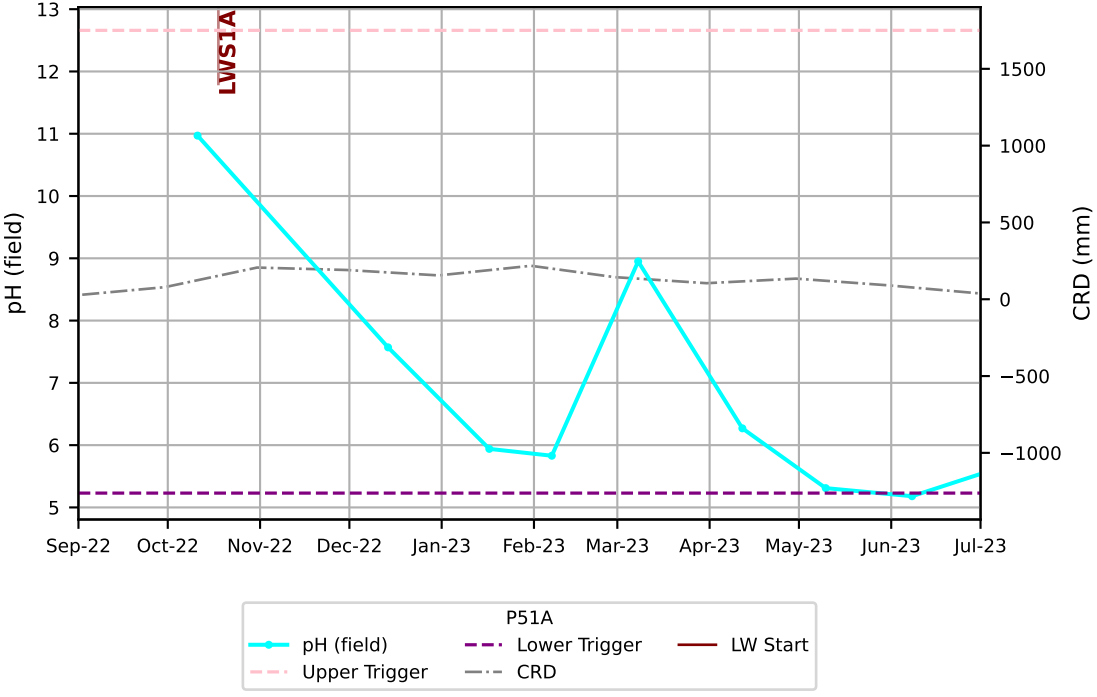
Six-Monthly Groundwater Monitoring: January – June 2023

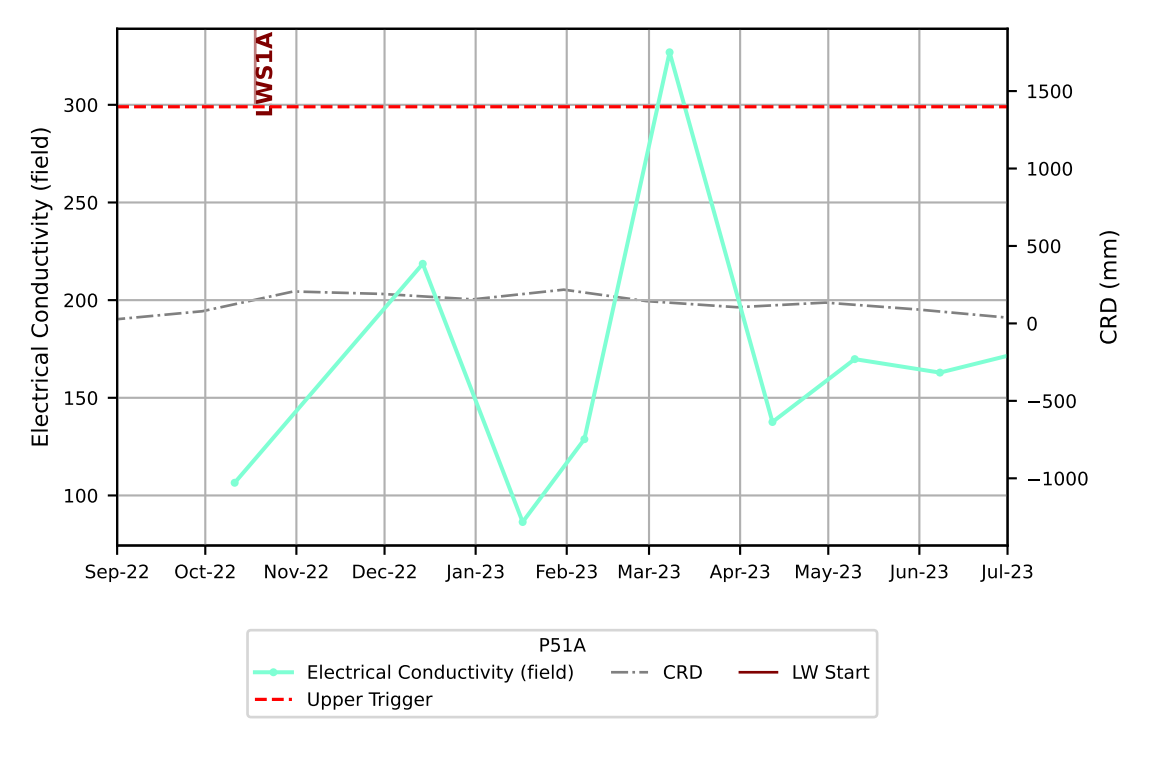
Tahmoor South Domain

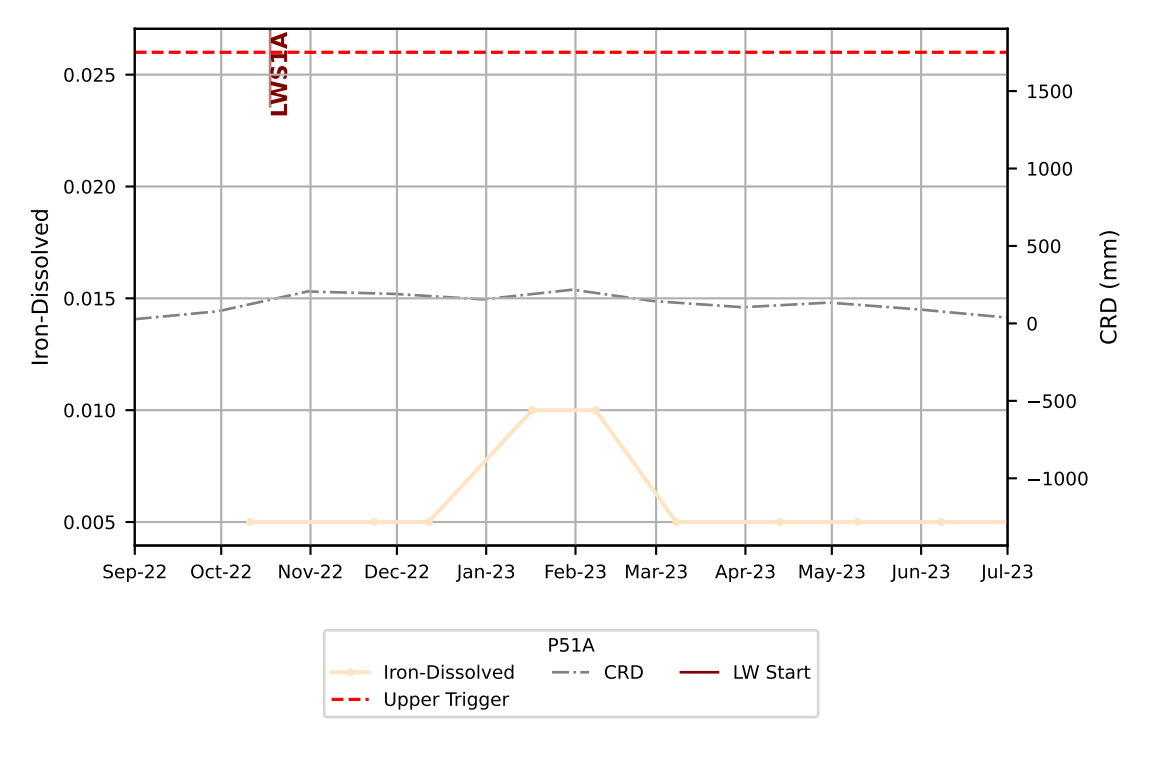
Tahmoor Coal Pty Ltd

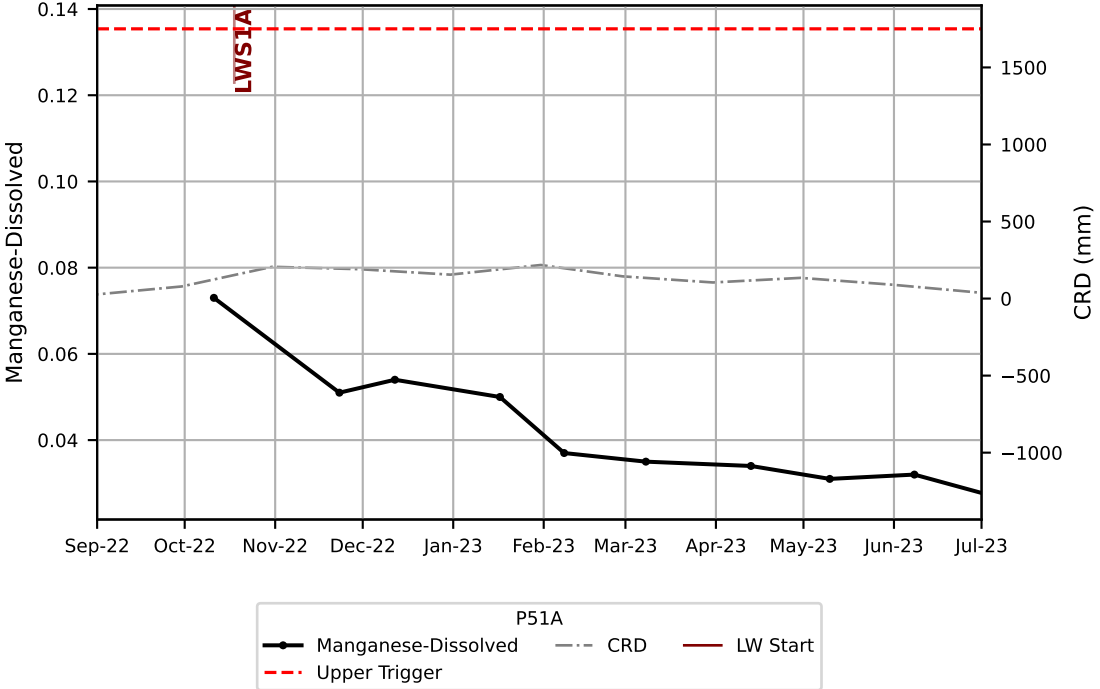
SLR Project No.: 640.30614.00000

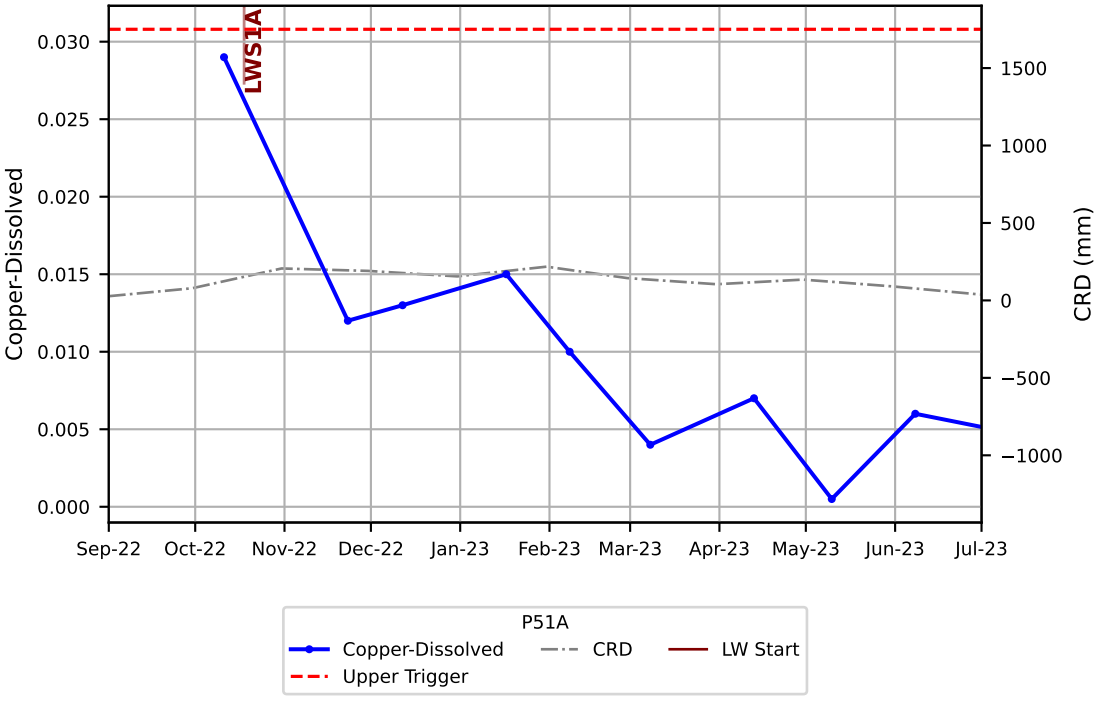
1 October 2023

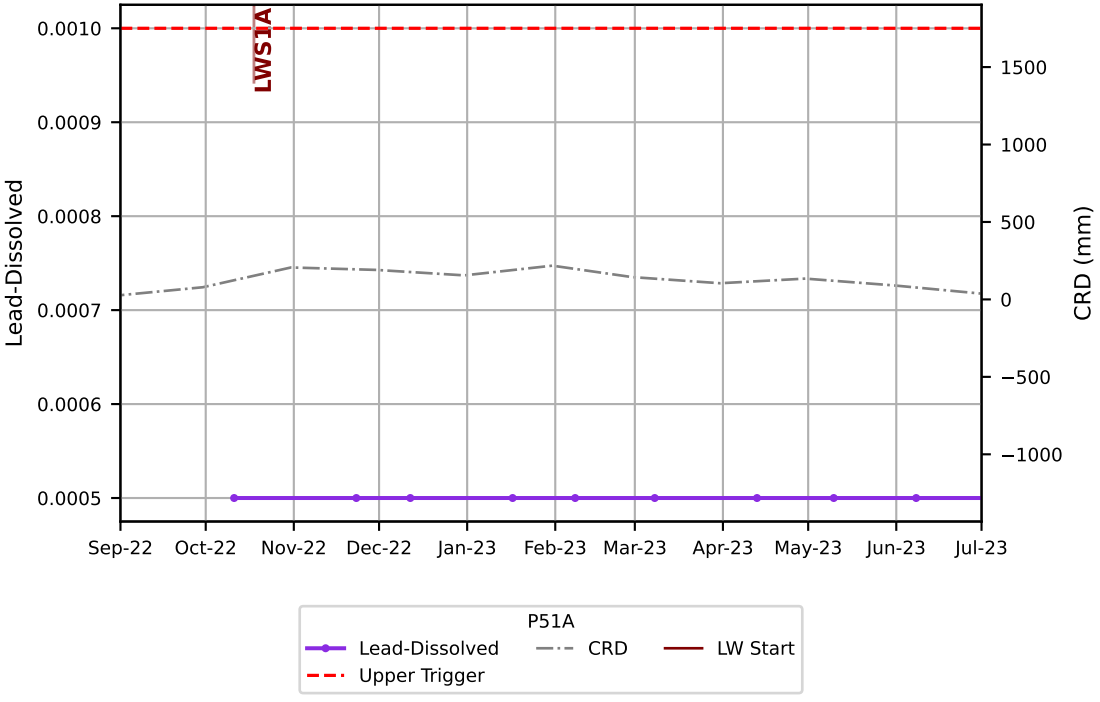

LWS1A
pH (field)
CRD (mm)
13
12
11
10
9
8
7
6
5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

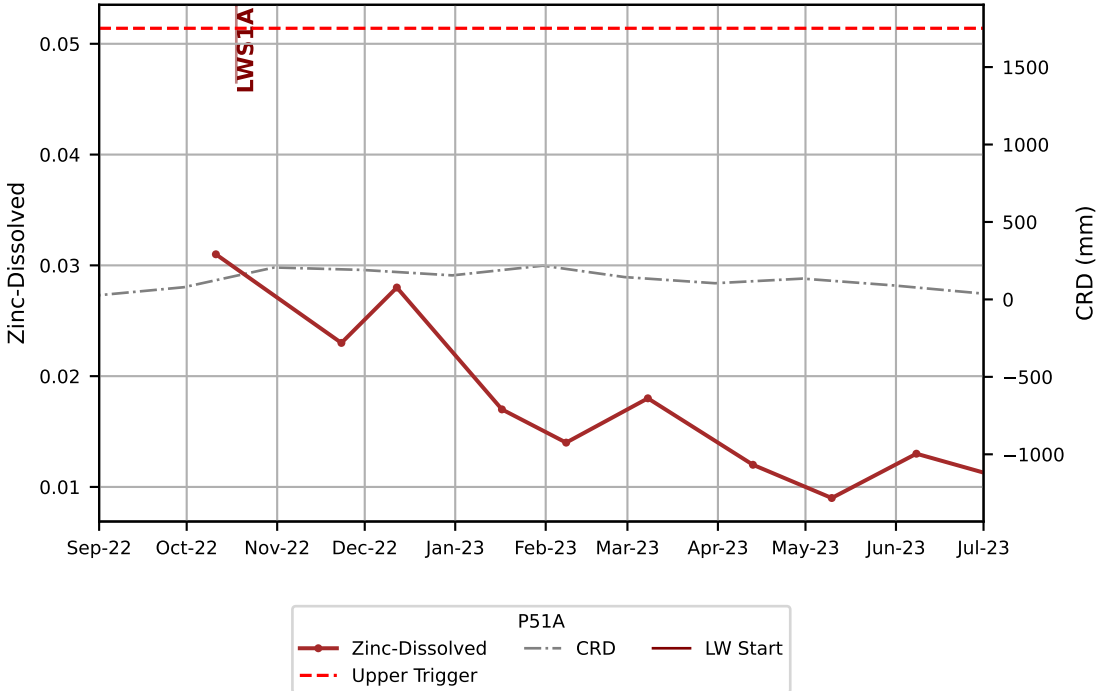

LWS1A
Electrical Conductivity (field)
CRD (mm)
300
250
200
150
100
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

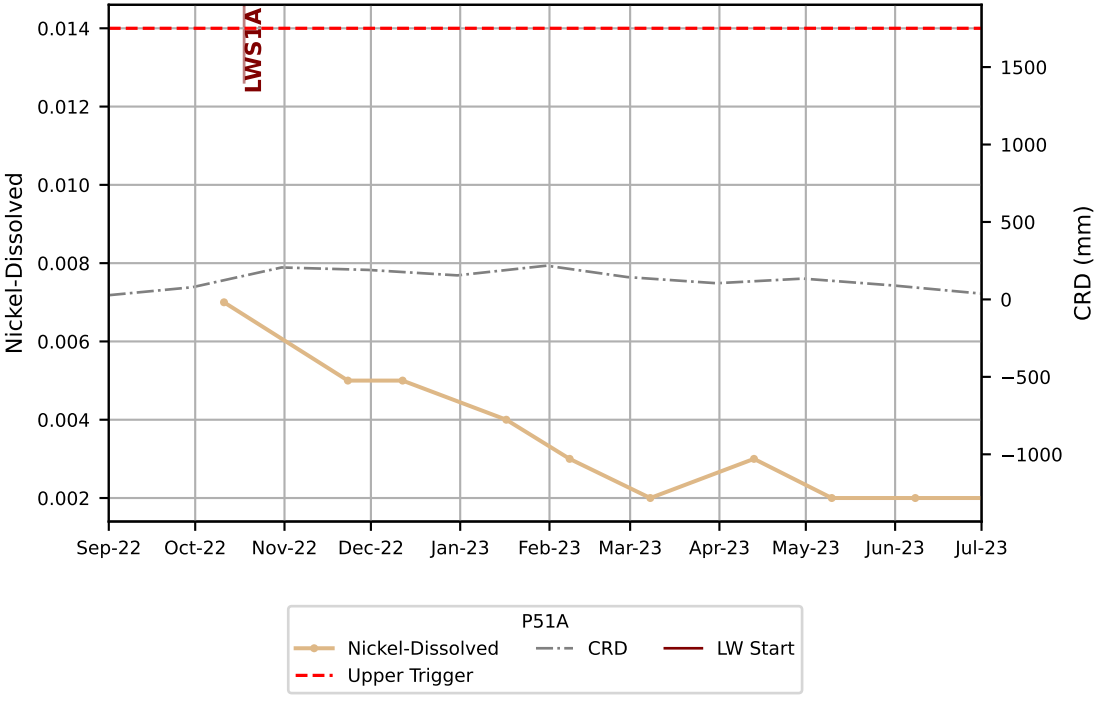

LW S1A
Iron-Dissolved
CRD (mm)
0.025
0.020
0.015
0.010
0.005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Iron-Dissolved
CRD
LW Start
Upper Trigger

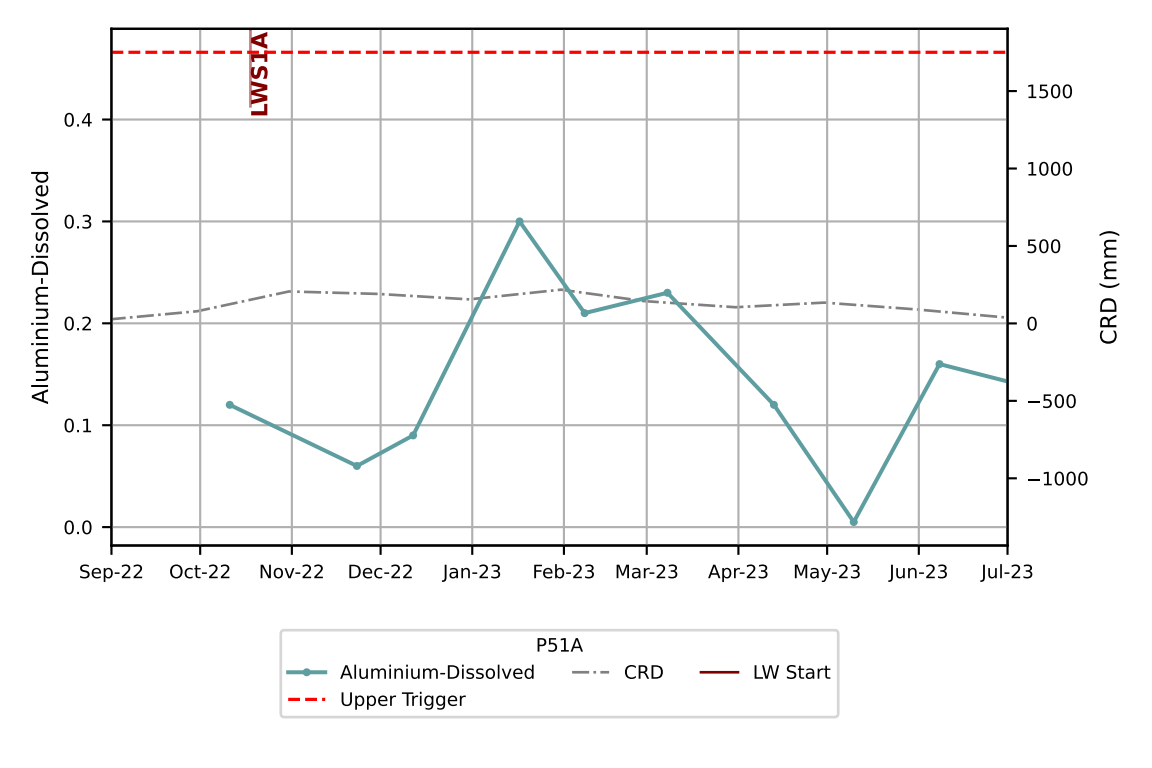

Manganese-Dissolved
CRD (mm)
LWS1A
0.14
0.12
0.10
0.08
0.06
0.04
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Manganese-Dissolved
CRD
LW Start
Upper Trigger

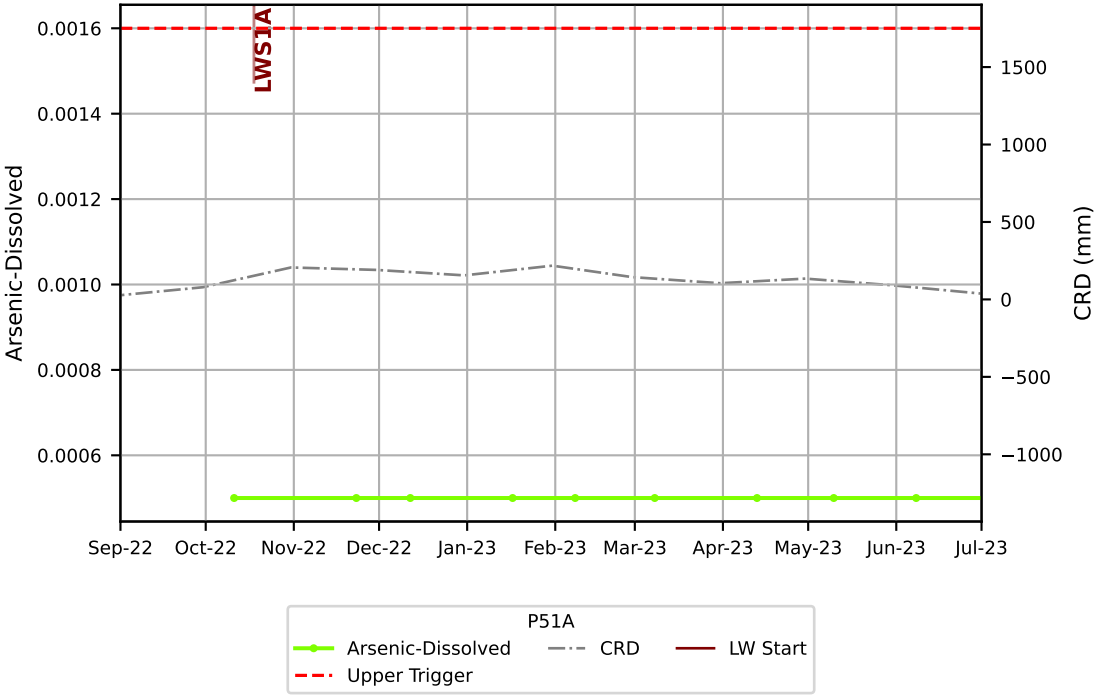

LWS1A
Copper-Dissolved
CRD (mm)
0.030
0.025
0.020
0.015
0.010
0.005
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Copper-Dissolved
CRD
LW Start
Upper Trigger

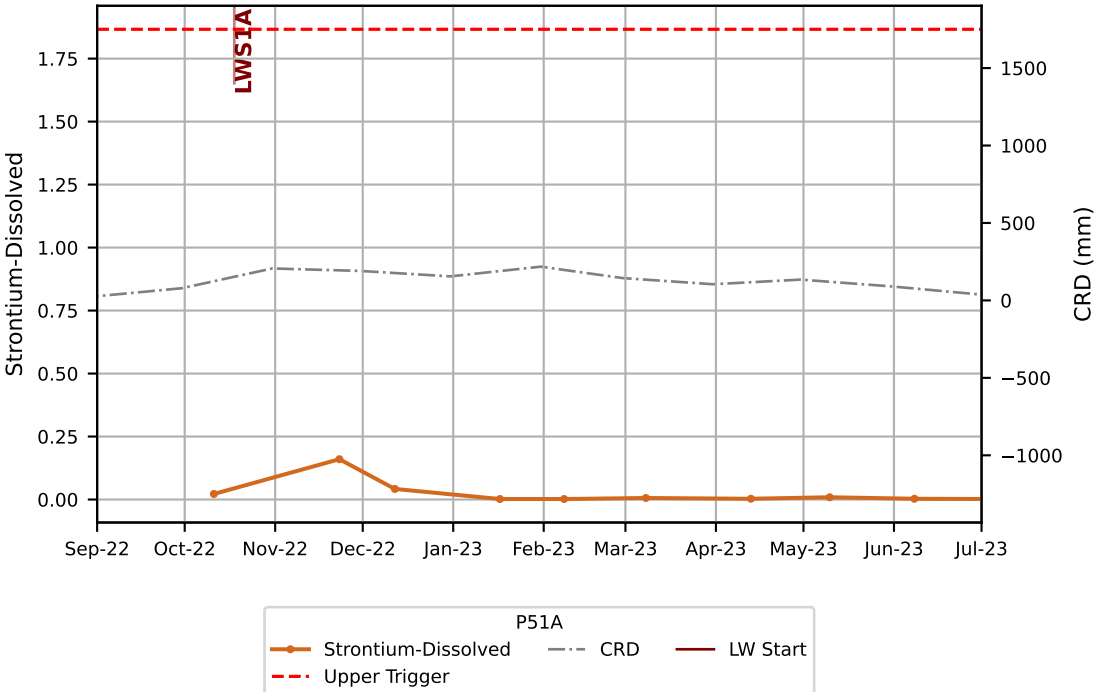

LWS1A
Lead-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Lead-Dissolved
CRD
LW Start
Upper Trigger

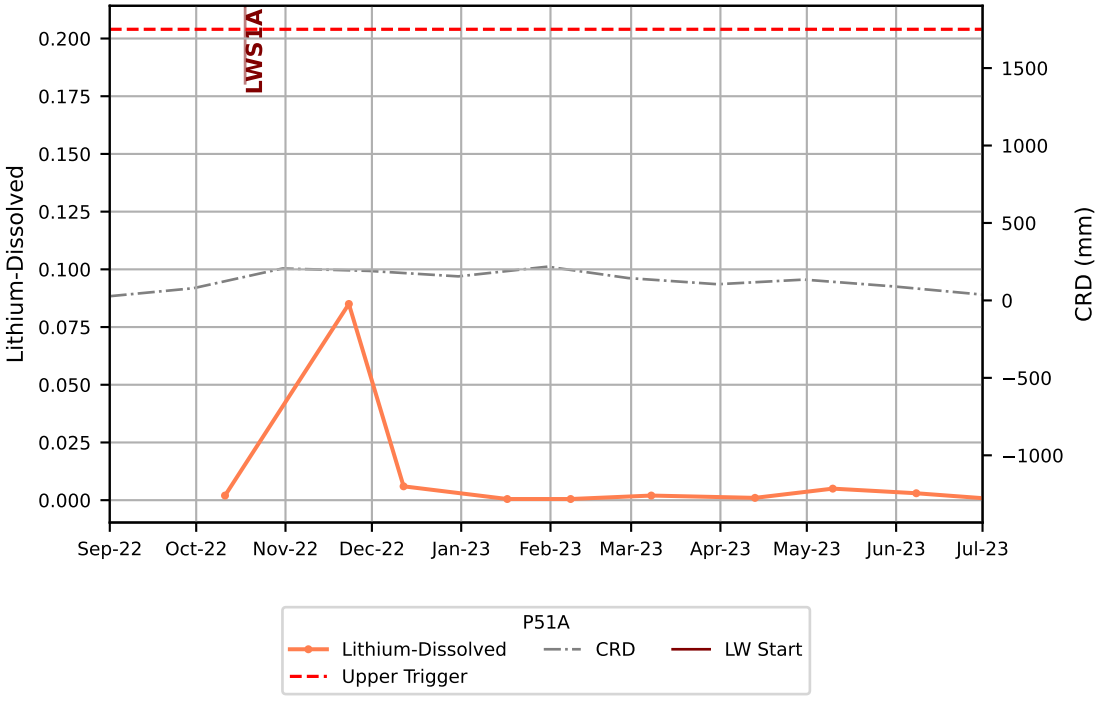

LWS1A
Zinc-Dissolved
CRD (mm)
0.05
0.04
0.03
0.02
0.01
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Zinc-Dissolved
CRD
LW Start
Upper Trigger

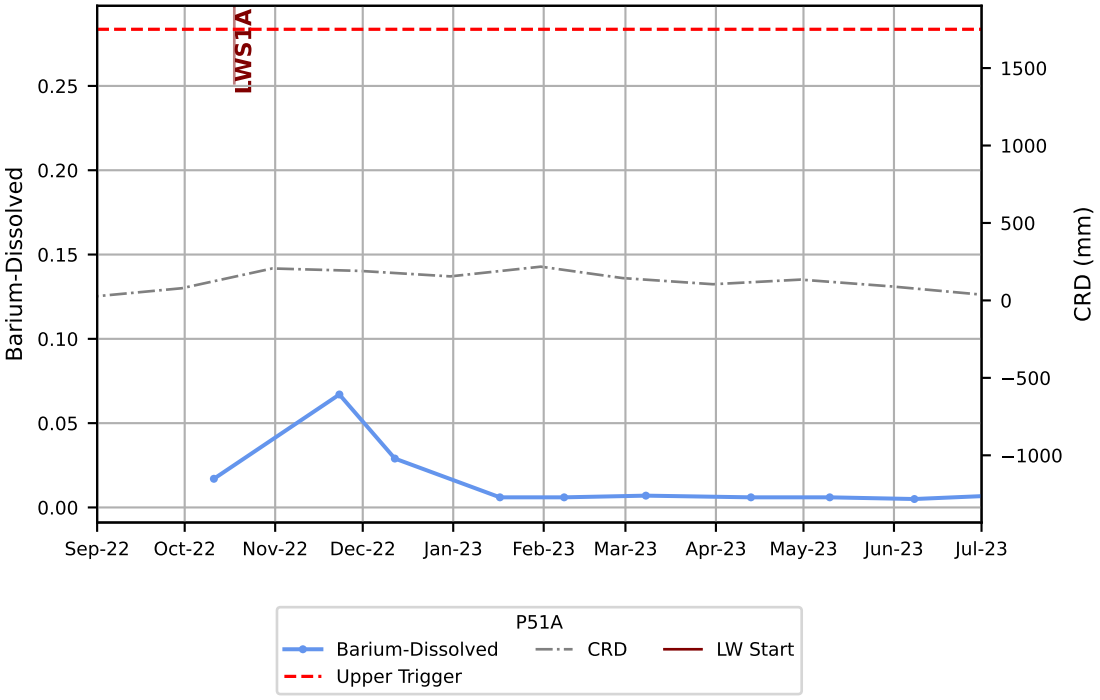

LWS1A
Nickel-Dissolved
CRD (mm)
0.014
0.012
0.010
0.008
0.006
0.004
0.002
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Nickel-Dissolved
CRD
LW Start
Upper Trigger

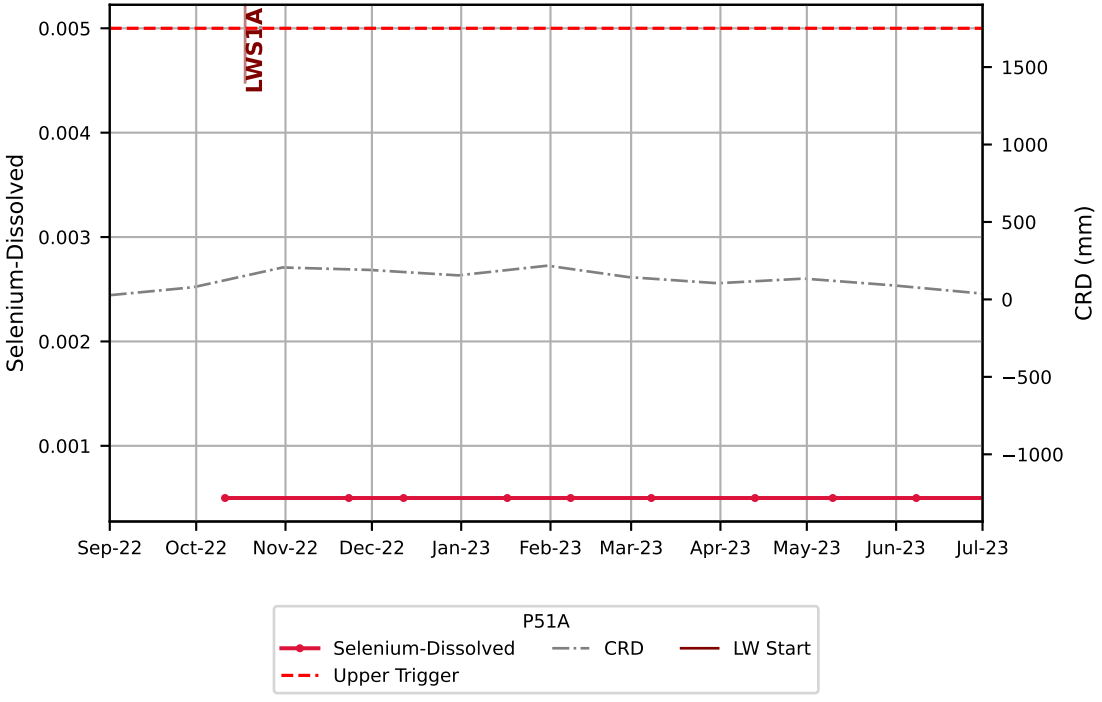

LWS1A
Aluminium-Dissolved
CRD (mm)
0.0
0.1
0.2
0.3
0.4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

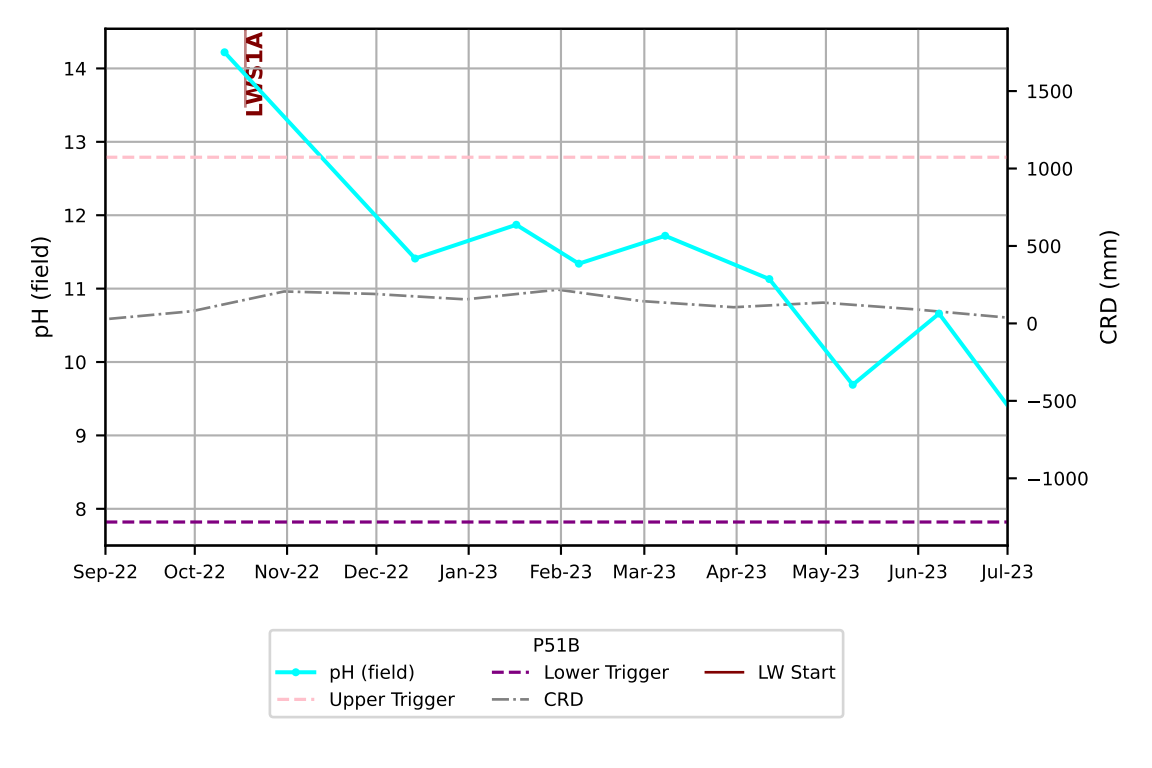

LWS1A
Arsenic-Dissolved
CRD (mm)
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

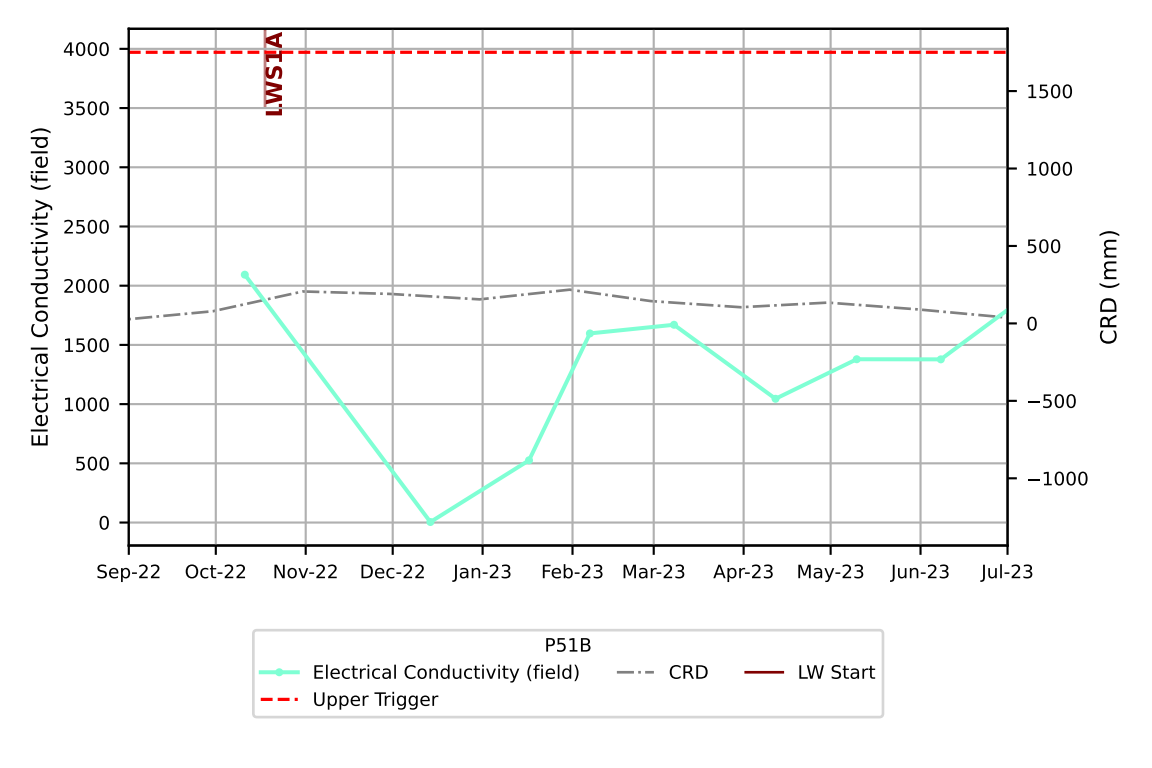

LWS1A
Strontium-Dissolved
CRD (mm)
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Strontium-Dissolved
CRD
LW Start
Upper Trigger

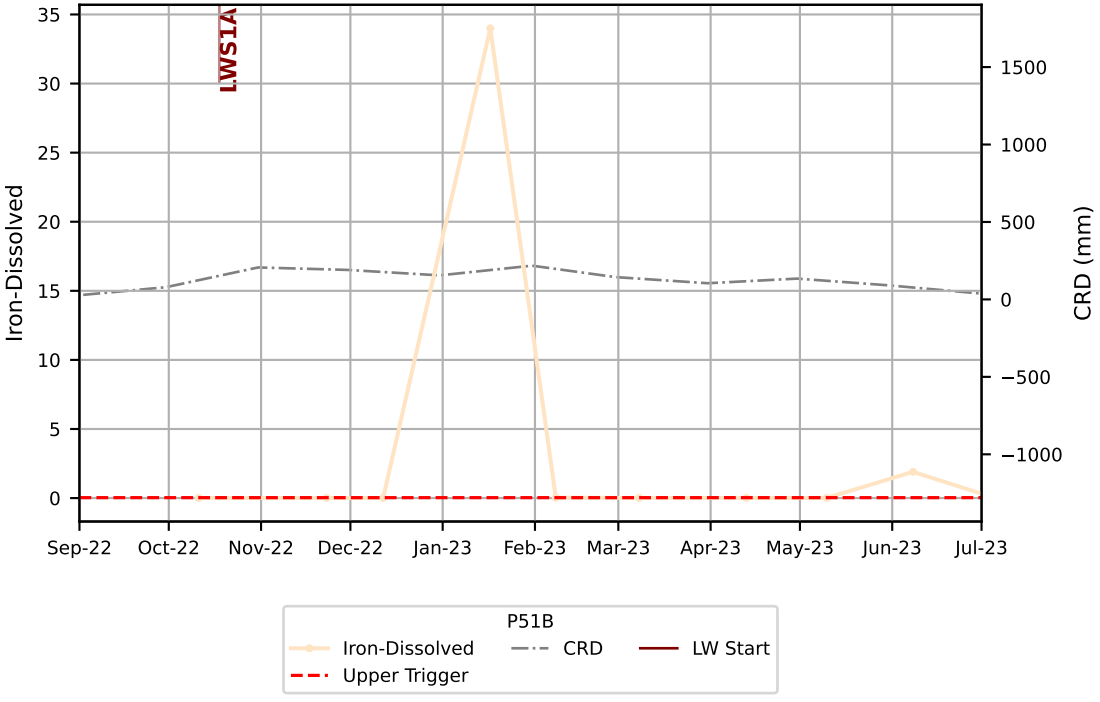

LWS1A
Lithium-Dissolved
CRD (mm)
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Lithium-Dissolved
CRD
LW Start
Upper Trigger

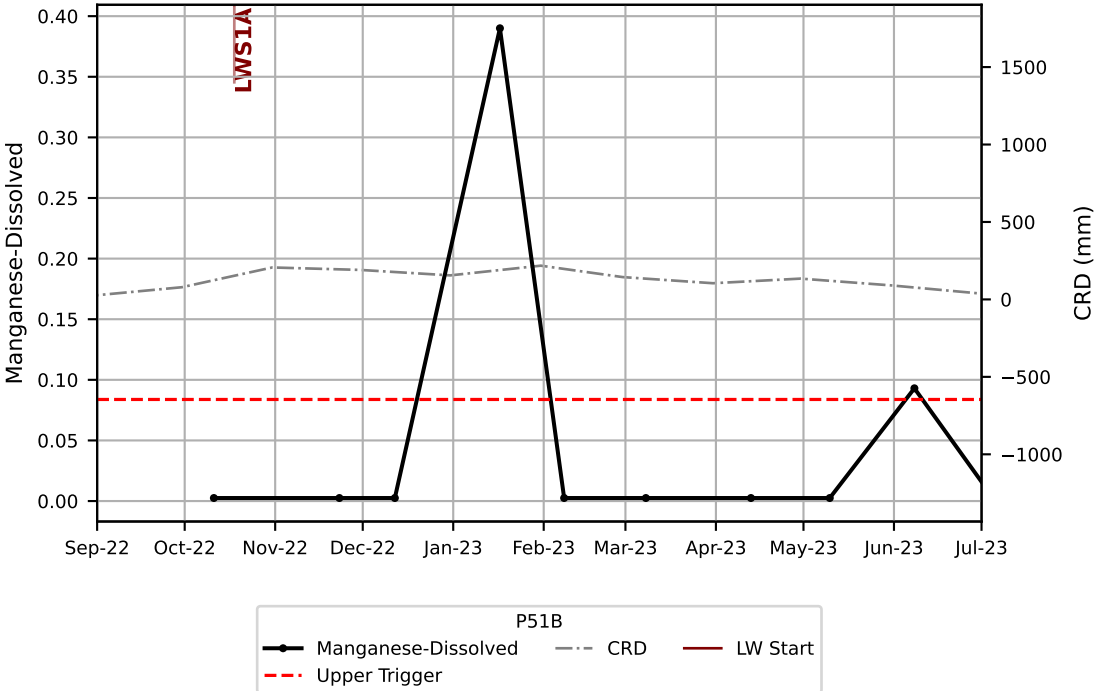

LWS1A
Barium-Dissolved
CRD (mm)
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Barium-Dissolved
CRD
LW Start
Upper Trigger

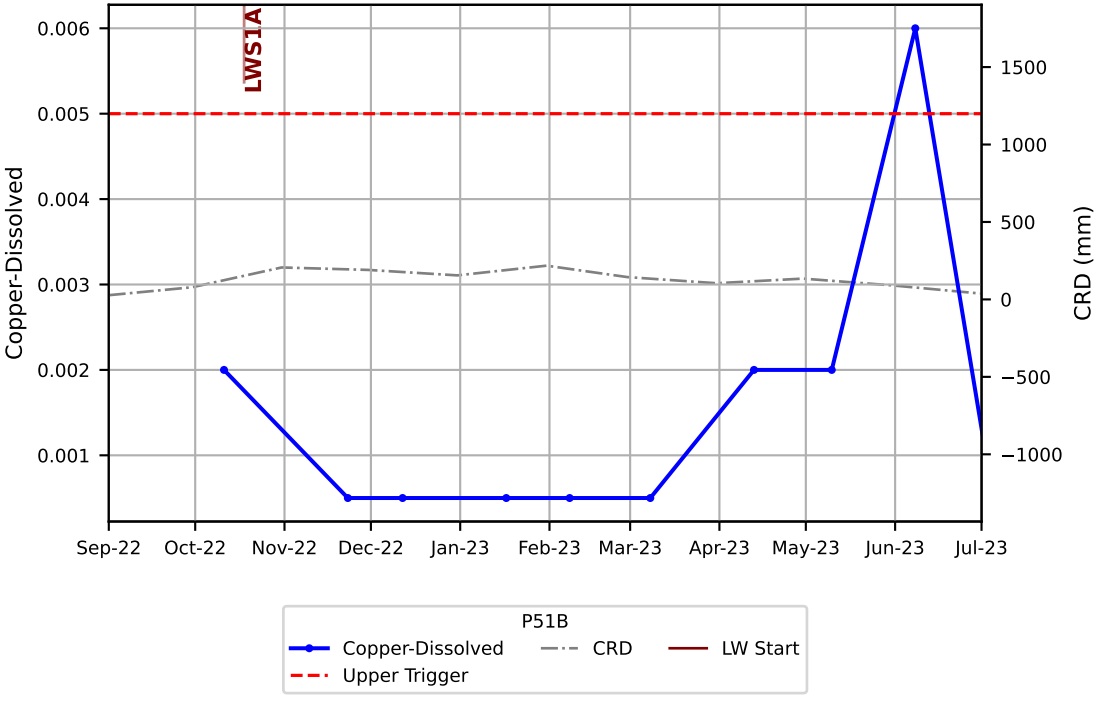

LWS1A
Selenium-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51A
Selenium-Dissolved
CRD
LW Start
Upper Trigger

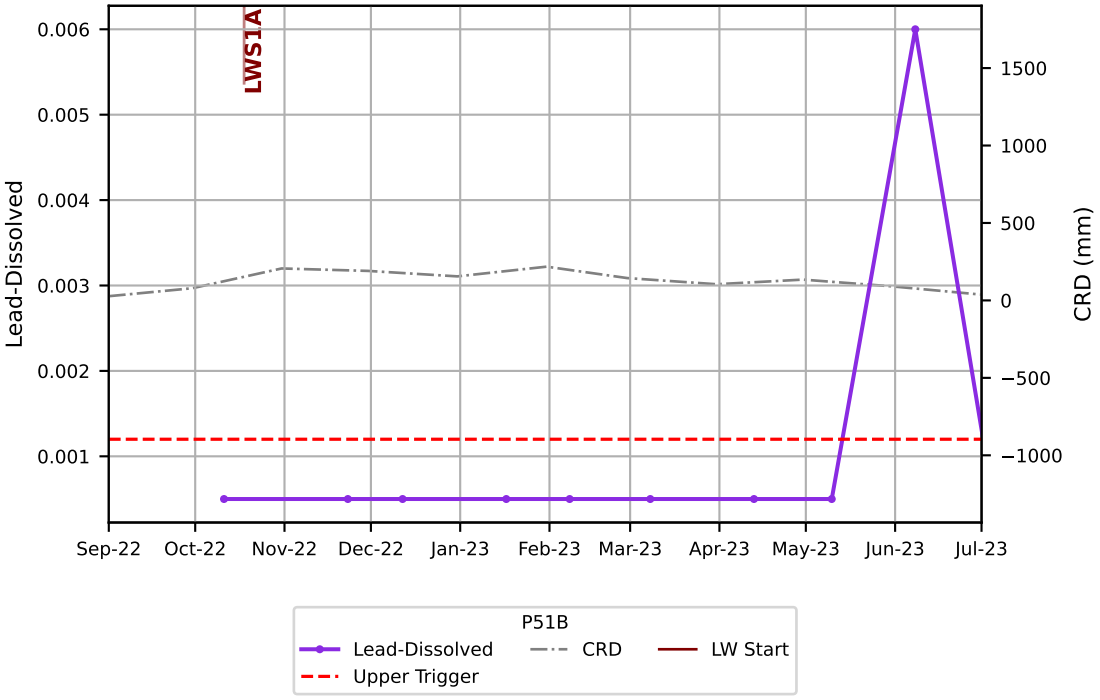

LW S1A
pH (field)
CRD (mm)
14
13
12
11
10
9
8
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

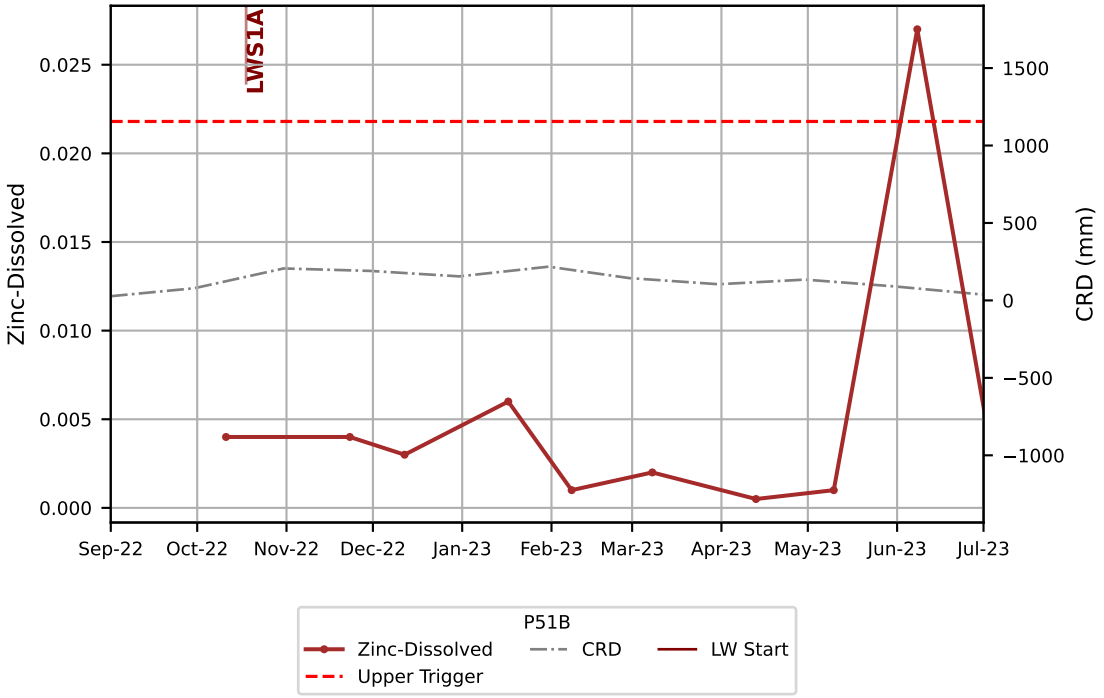

LWS1A
Electrical Conductivity (field)
CRD (mm)
4000
3500
3000
2500
2000
1500
1000
500
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

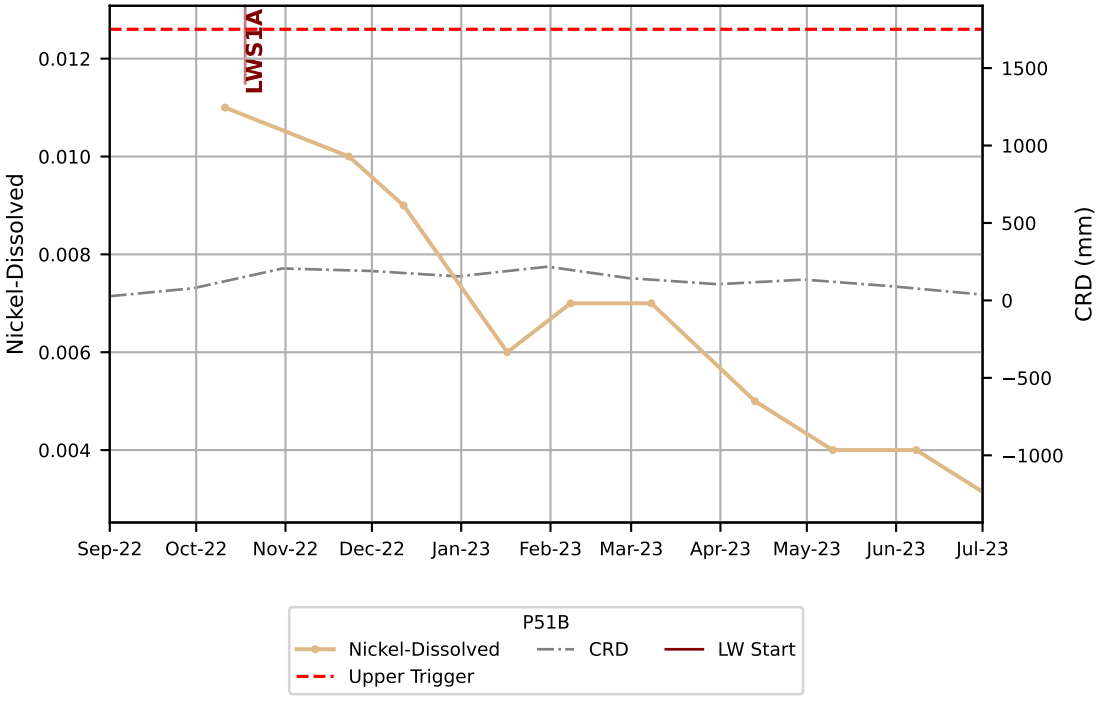

LWS1A
Iron-Dissolved
CRD (mm)
35
30
25
20
15
10
5
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Iron-Dissolved
CRD
LW Start
Upper Trigger

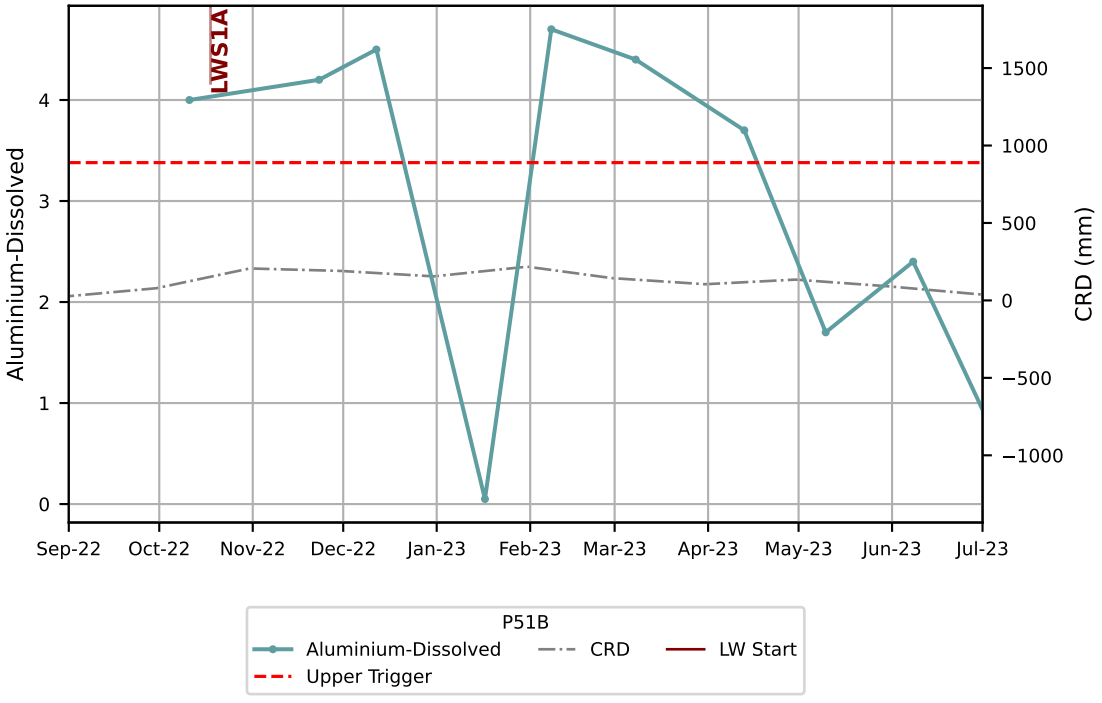

LWS1A
Manganese-Dissolved
CRD (mm)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Manganese-Dissolved
CRD
LW Start
Upper Trigger

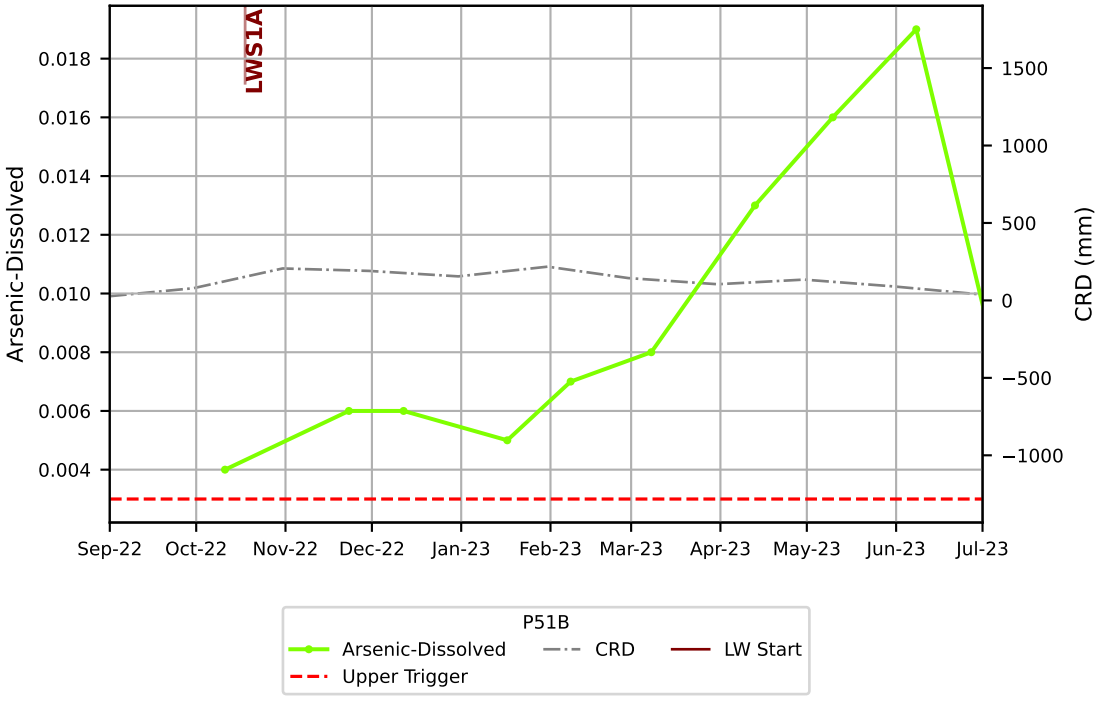

LWS1A
Copper-Dissolved
CRD (mm)
0.006
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Copper-Dissolved
CRD
LW Start
Upper Trigger

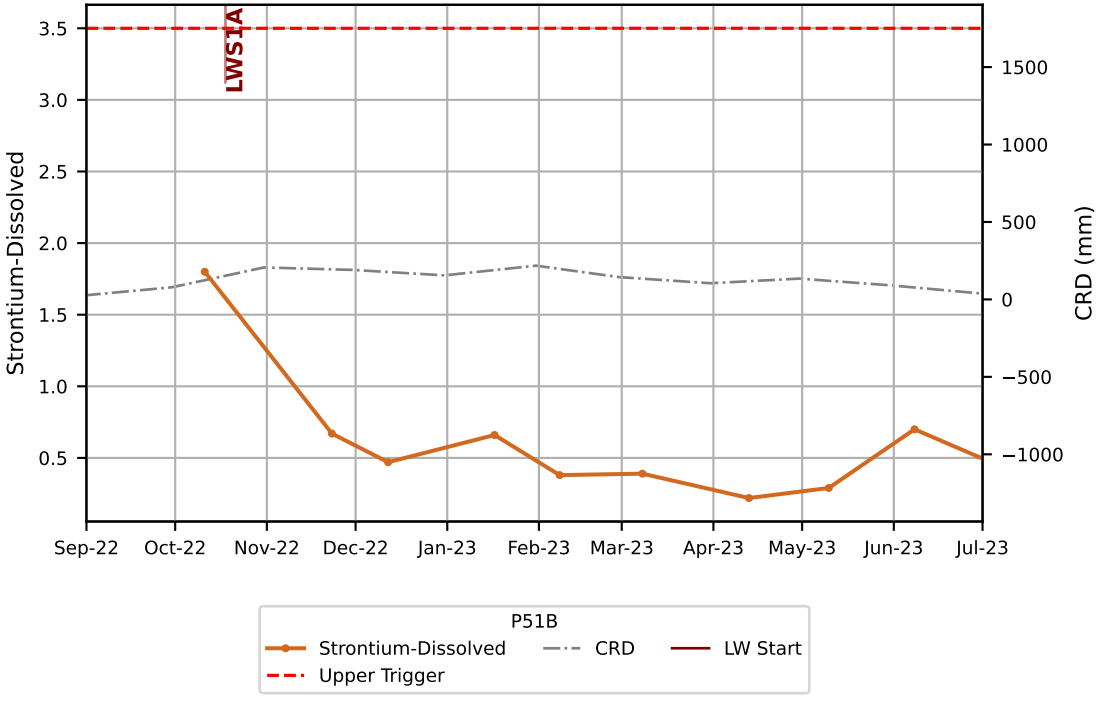

LWS1A
Lead-Dissolved
0.006
0.005
0.004
0.003
0.002
0.001
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Lead-Dissolved
CRD
LW Start
Upper Trigger

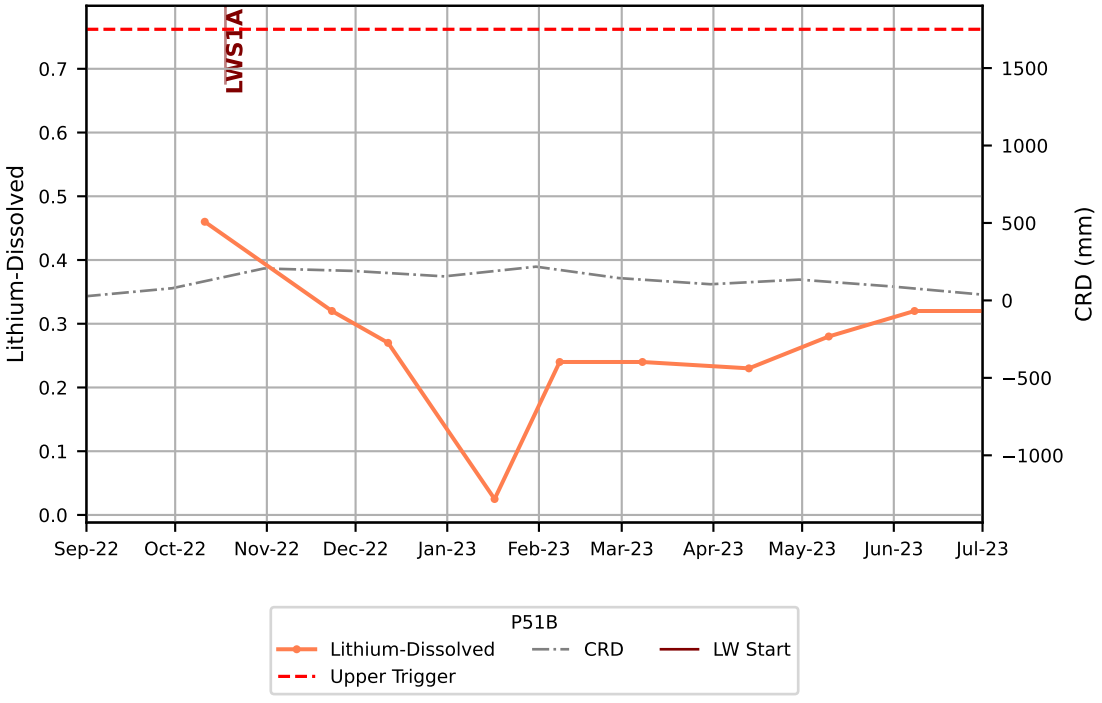

LWS1A
Zinc-Dissolved
CRD (mm)
0.025
0.020
0.015
0.010
0.005
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Zinc-Dissolved
CRD
LW Start
Upper Trigger

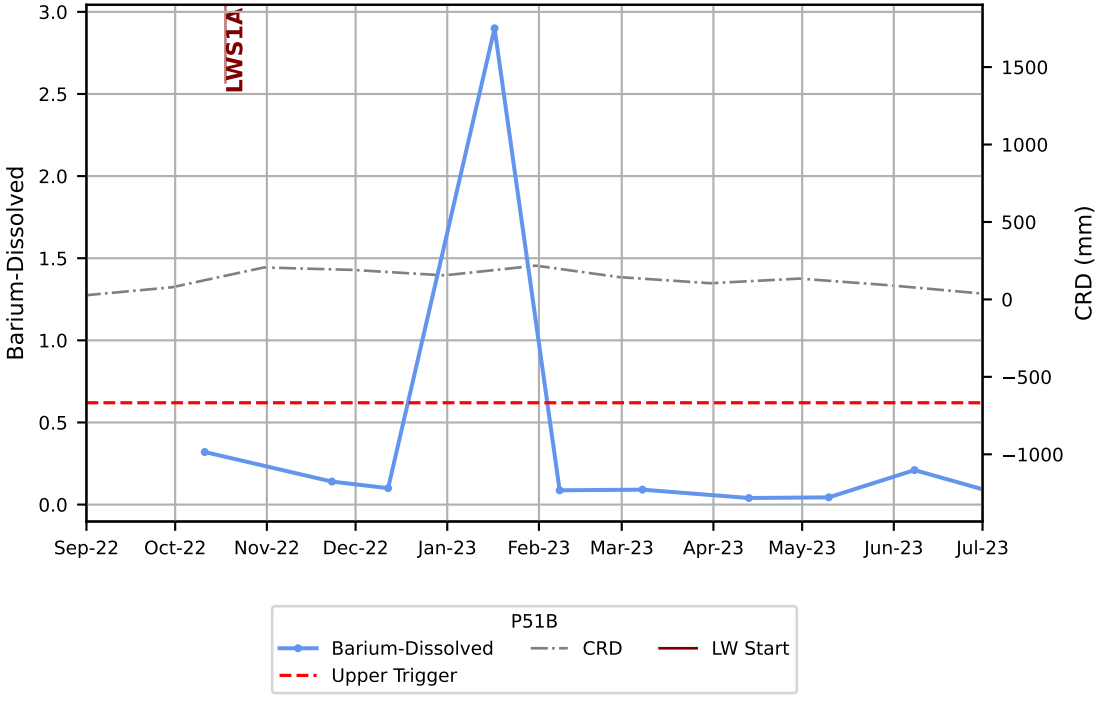

LWS1A
Nickel-Dissolved
CRD (mm)
0.012
0.010
0.008
0.006
0.004
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Nickel-Dissolved
CRD
LW Start
Upper Trigger

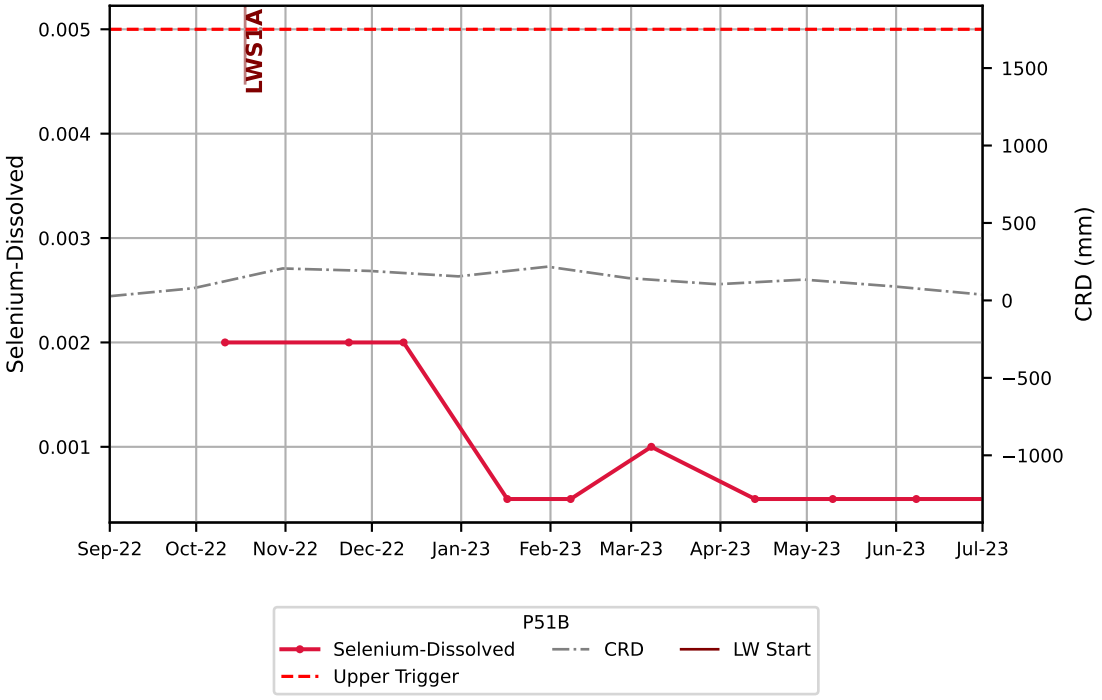

LWS1A
Aluminium-Dissolved
CRD (mm)
0
1
2
3
4
−1000
−500
0
500
1000
1500
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

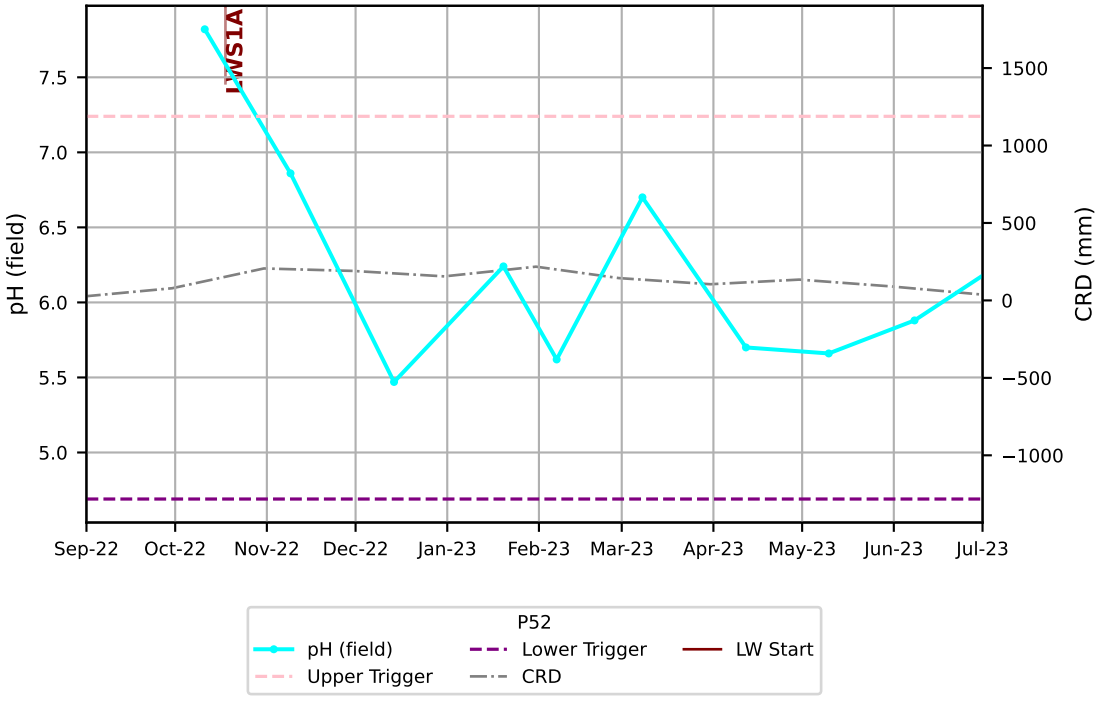

LWS1A
Arsenic-Dissolved
CRD (mm)
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

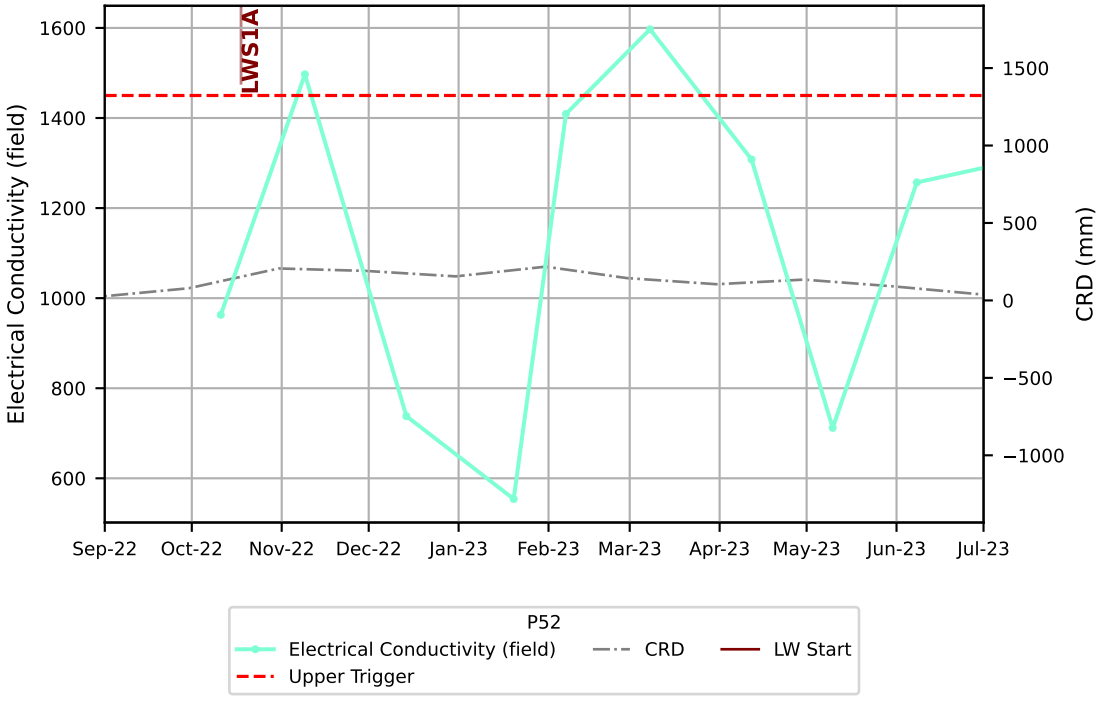

LWS1A
Strontium-Dissolved
CRD (mm)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Strontium-Dissolved
CRD
LW Start
Upper Trigger

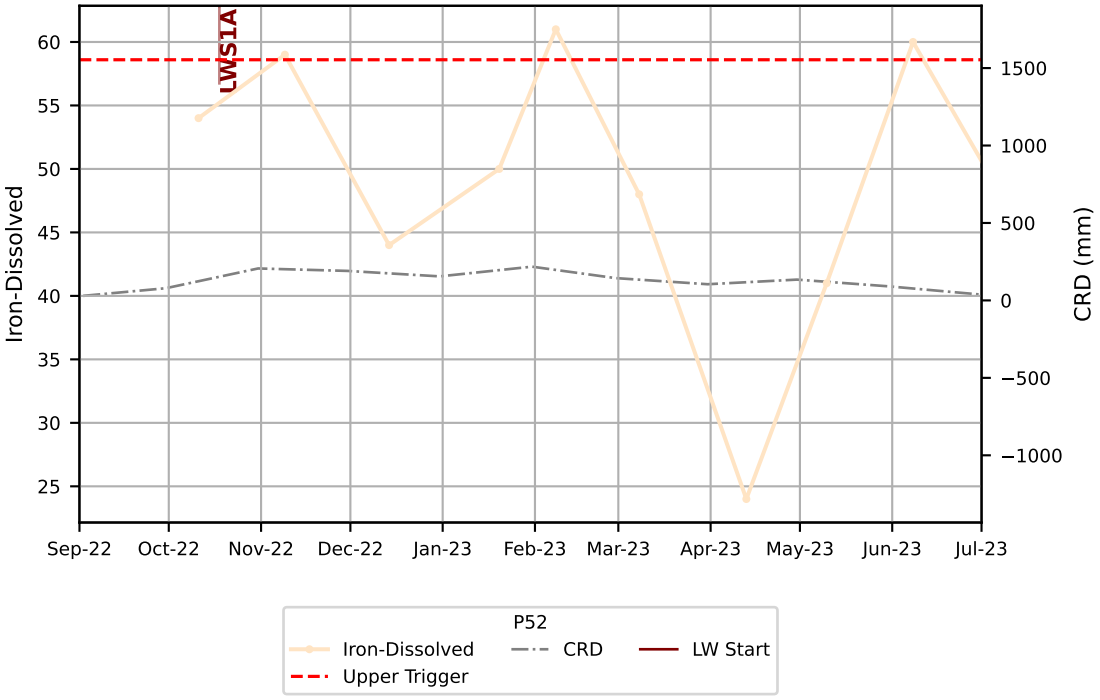

LWSTA
Lithium-Dissolved
CRD (mm)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Lithium-Dissolved
CRD
LW Start
Upper Trigger

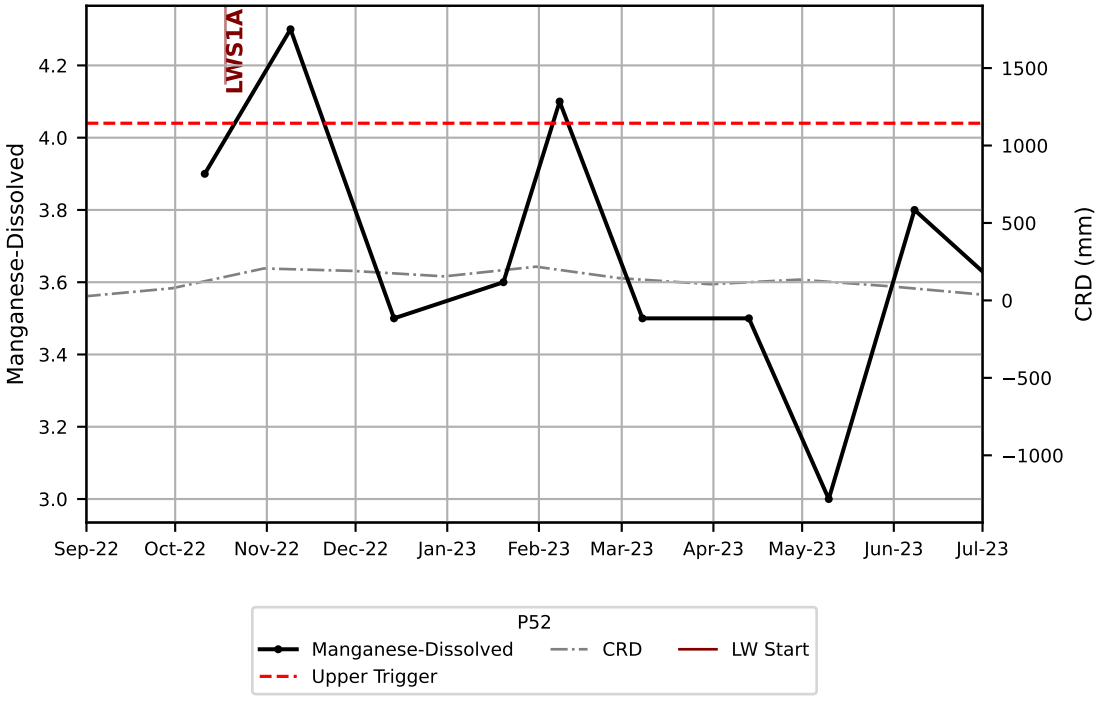

LWS1A
Barium-Dissolved
CRD (mm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Barium-Dissolved
CRD
LW Start
Upper Trigger

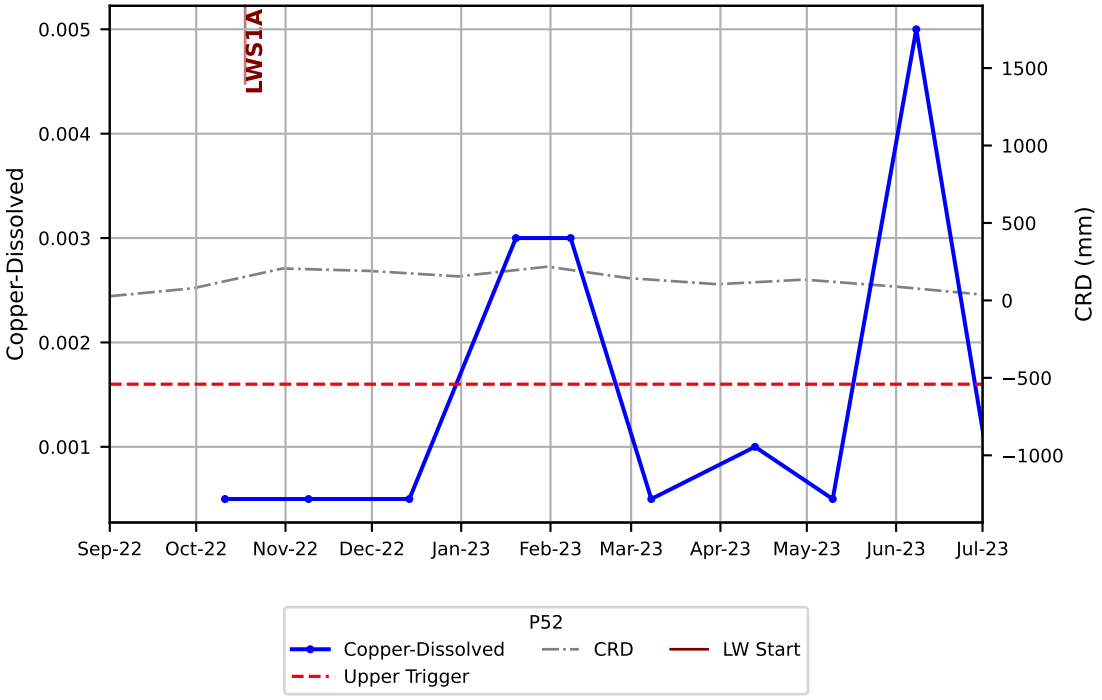

LWS1A
Selenium-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P51B
Selenium-Dissolved
CRD
LW Start
Upper Trigger

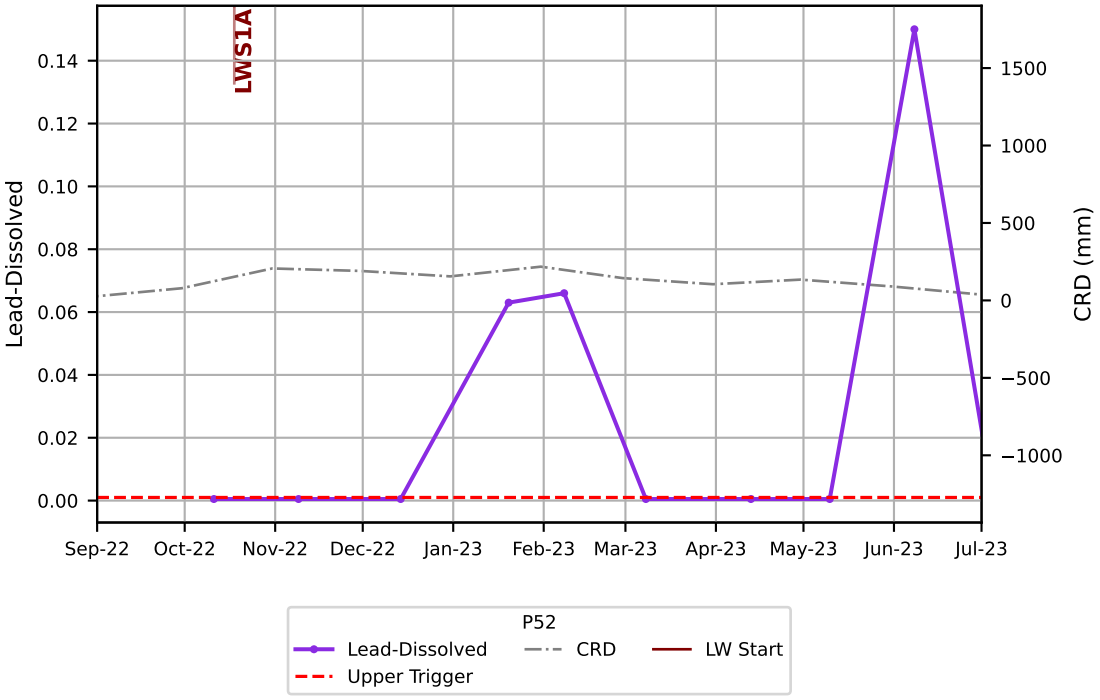

LW S1A
pH (field)
CRD (mm)
7.5
7.0
6.5
6.0
5.5
5.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

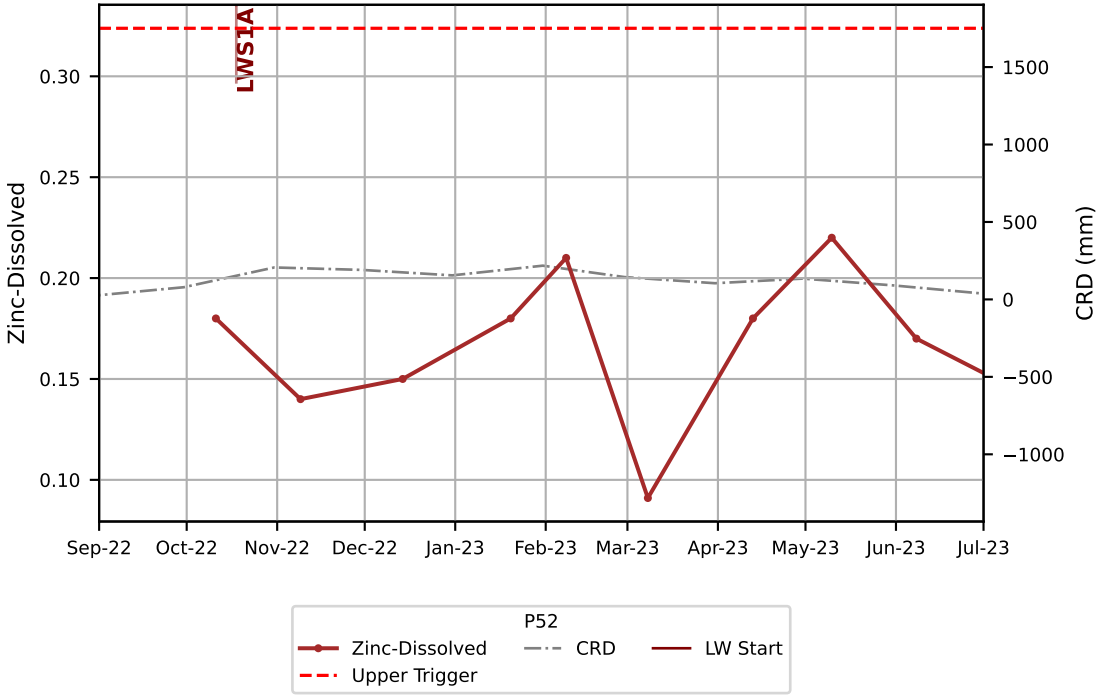

LWS1A
Electrical Conductivity (field)
CRD (mm)
1600
1400
1200
1000
800
600
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

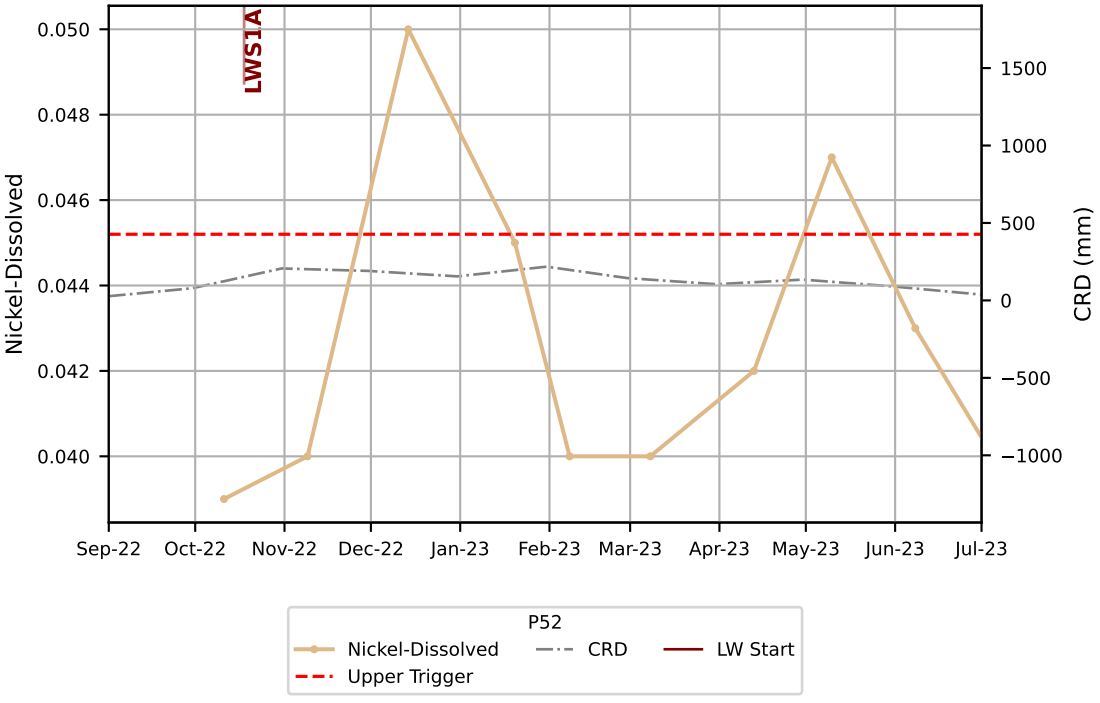

LW S1A
Iron-Dissolved
CRD (mm)
60
55
50
45
40
35
30
25
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Iron-Dissolved
CRD
LW Start
Upper Trigger

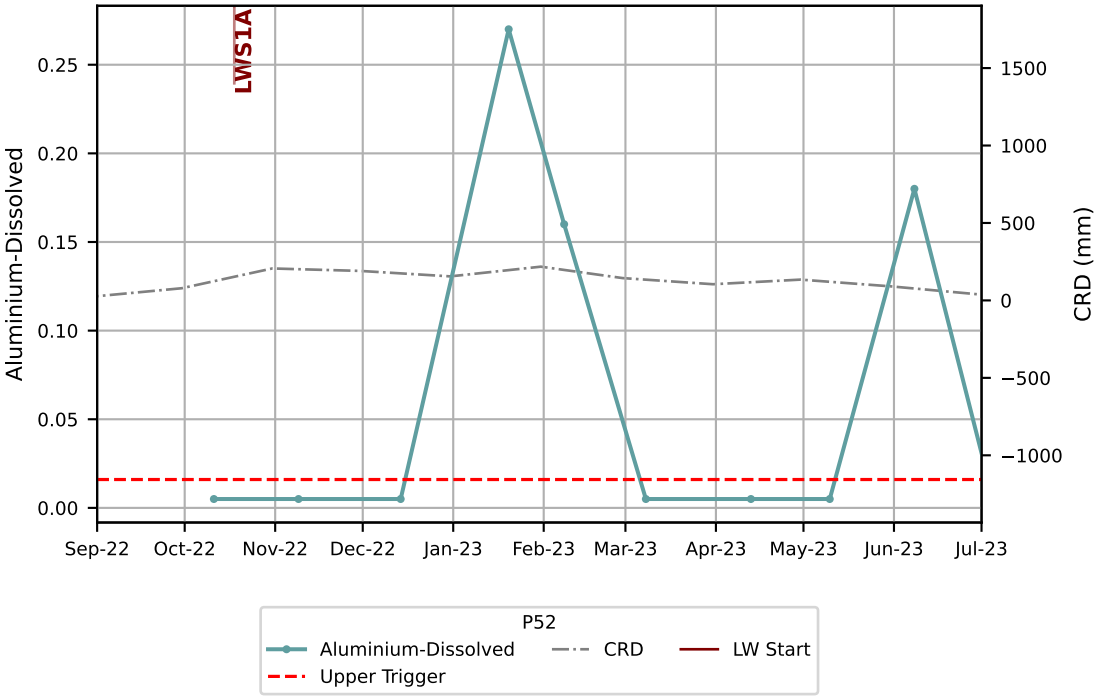

LWS1A
Manganese-Dissolved
CRD (mm)
4.2
4.0
3.8
3.6
3.4
3.2
3.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Manganese-Dissolved
CRD
LW Start
Upper Trigger

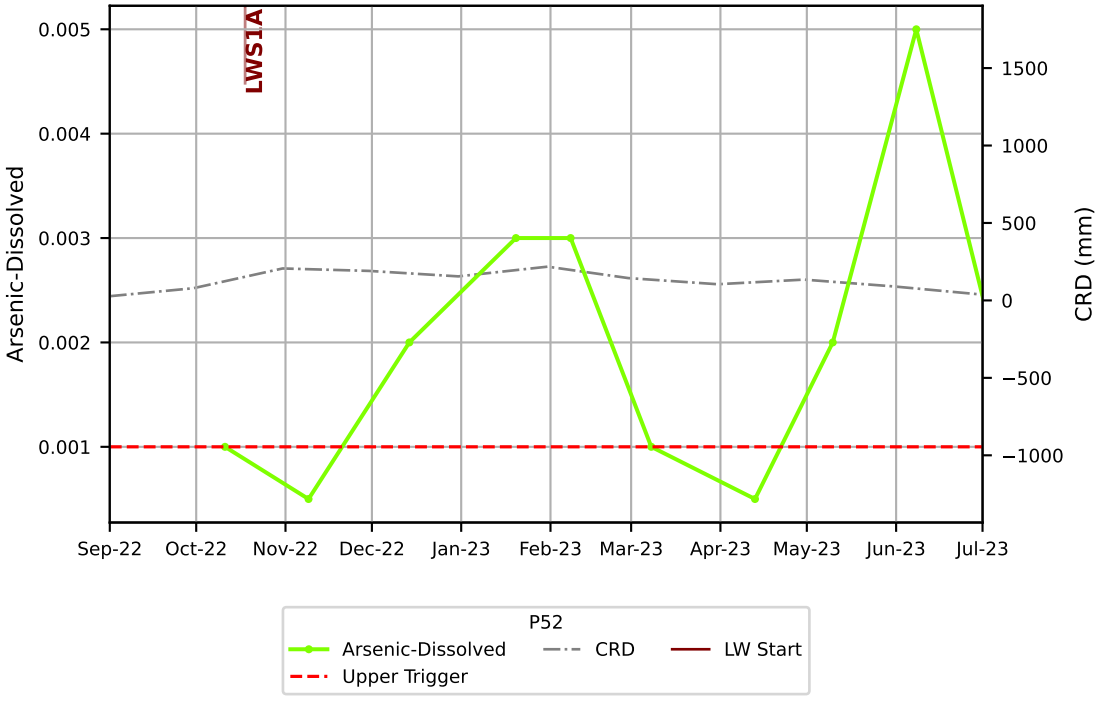

LWS1A
Copper-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Copper-Dissolved
CRD
LW Start
Upper Trigger

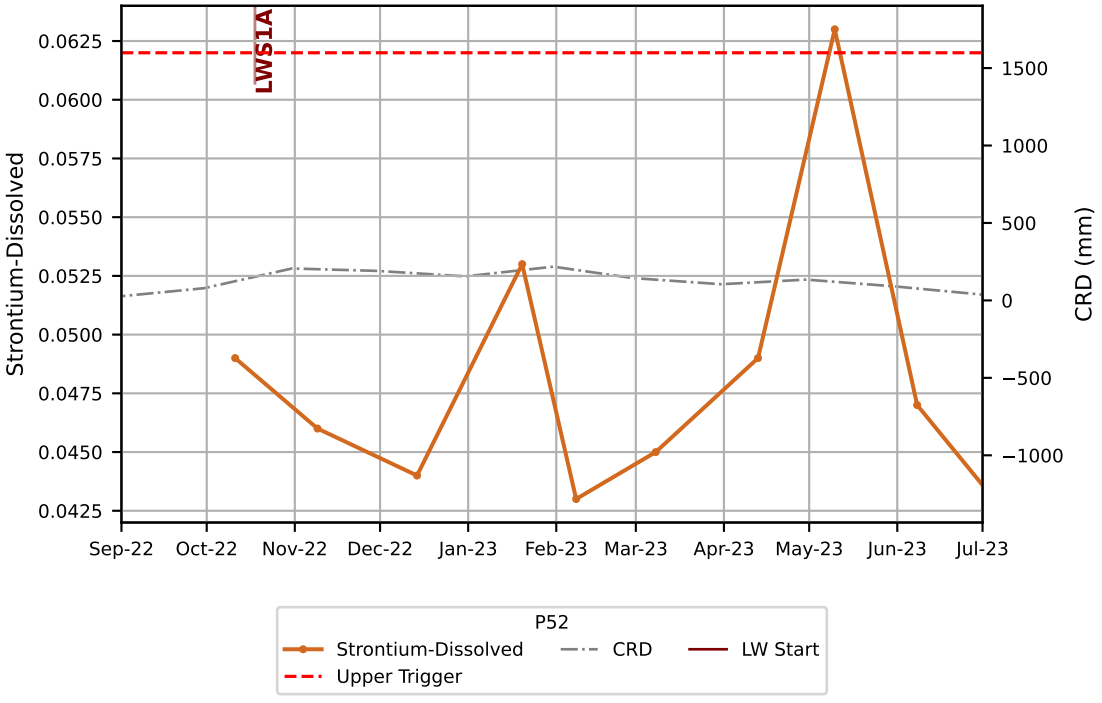

LWS1A
Lead-Dissolved
CRD (mm)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Lead-Dissolved
CRD
LW Start
Upper Trigger

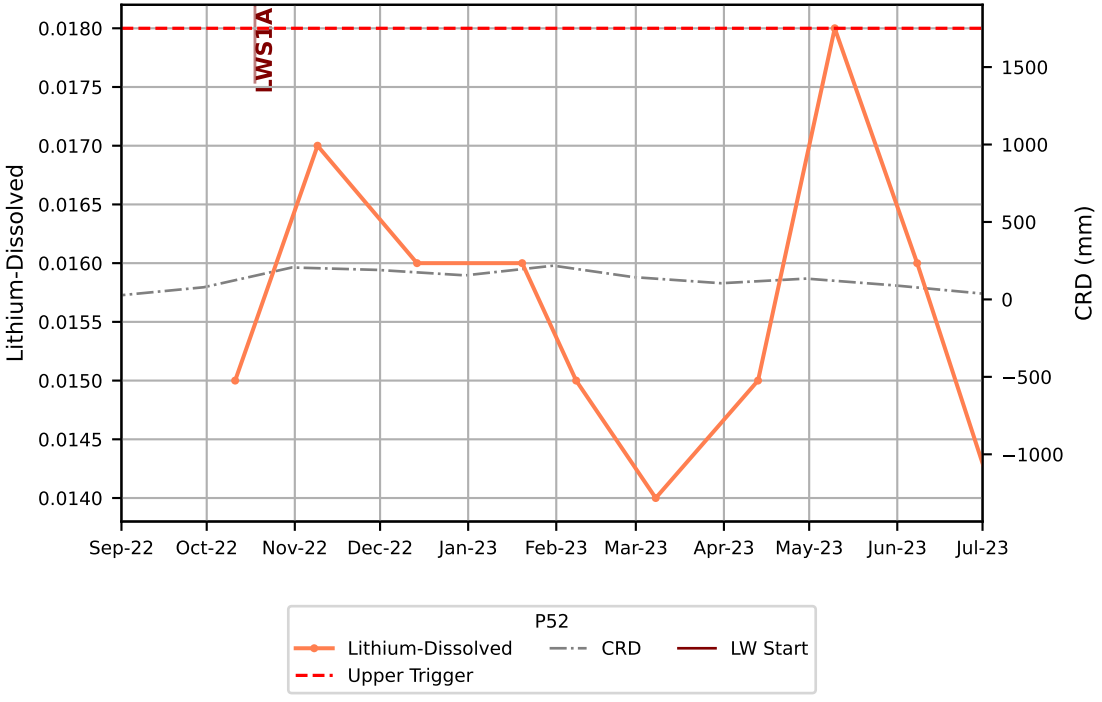

LWS1A
Zinc-Dissolved
CRD (mm)
0.30
0.25
0.20
0.15
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Zinc-Dissolved
CRD
LW Start
Upper Trigger

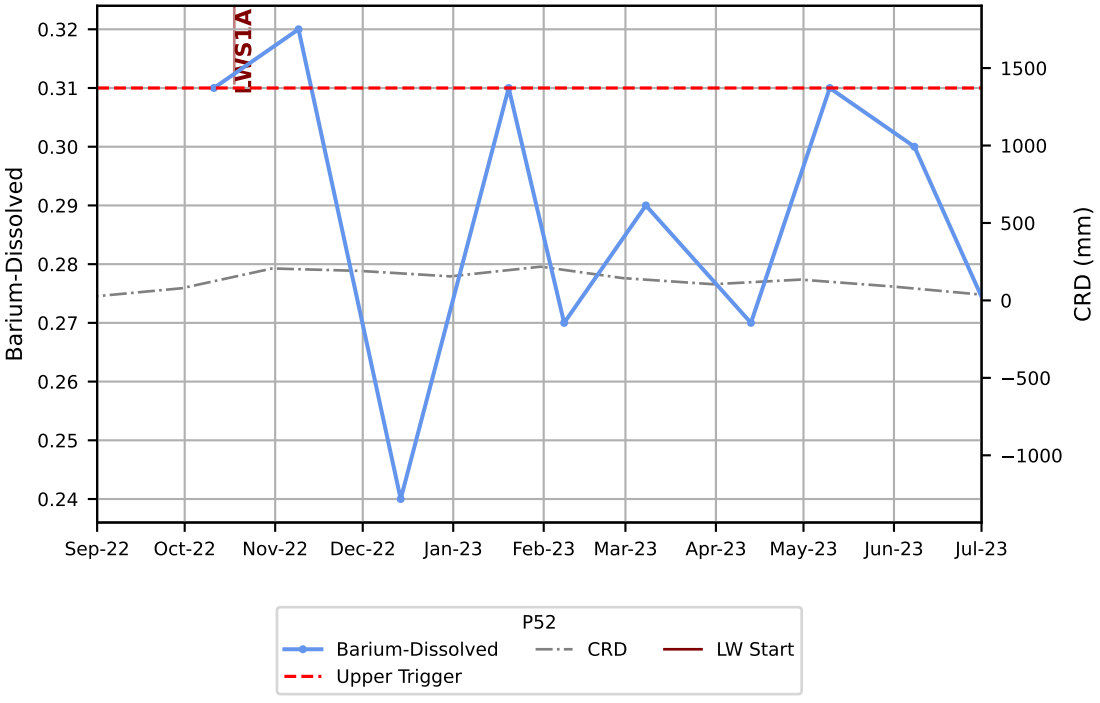

LWS1A
Nickel-Dissolved
CRD (mm)
0.050
0.048
0.046
0.044
0.042
0.040
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Nickel-Dissolved
CRD
LW Start
Upper Trigger

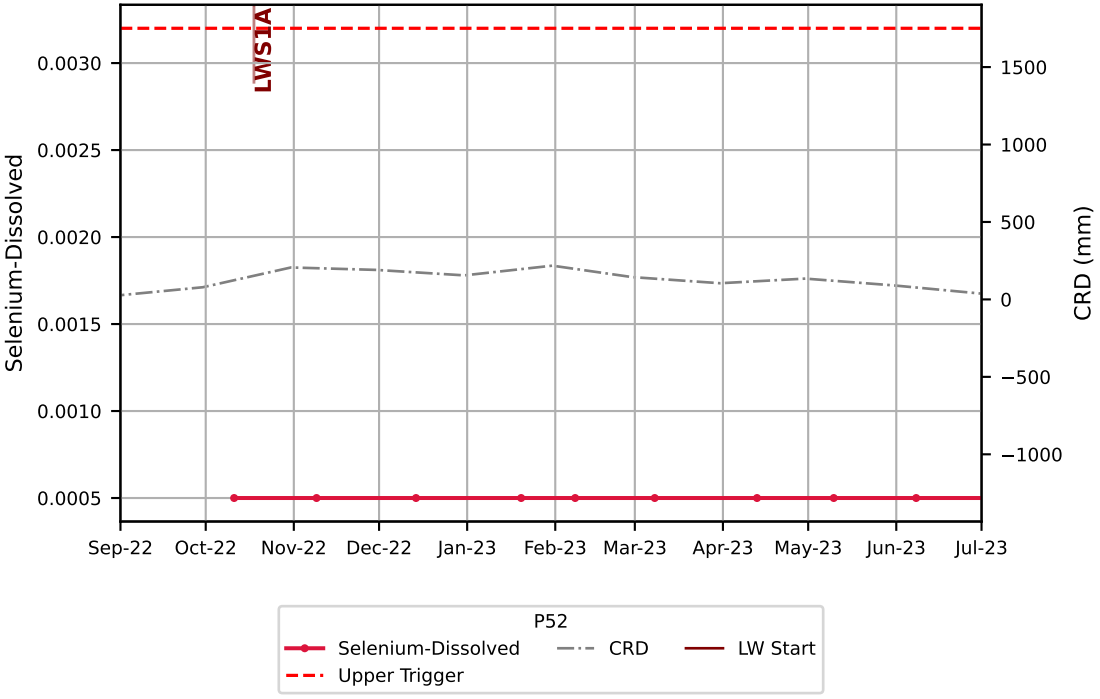

LWS1A
Aluminium-Dissolved
CRD (mm)
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

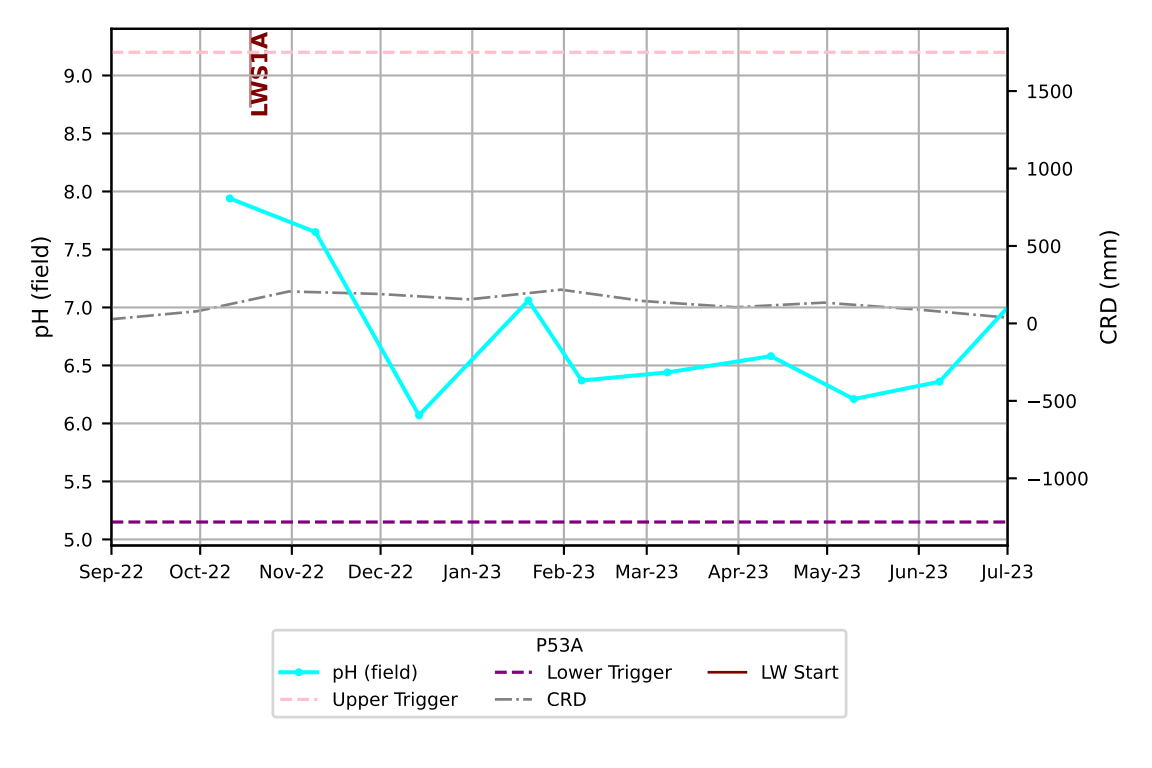

LWS1A
Arsenic-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

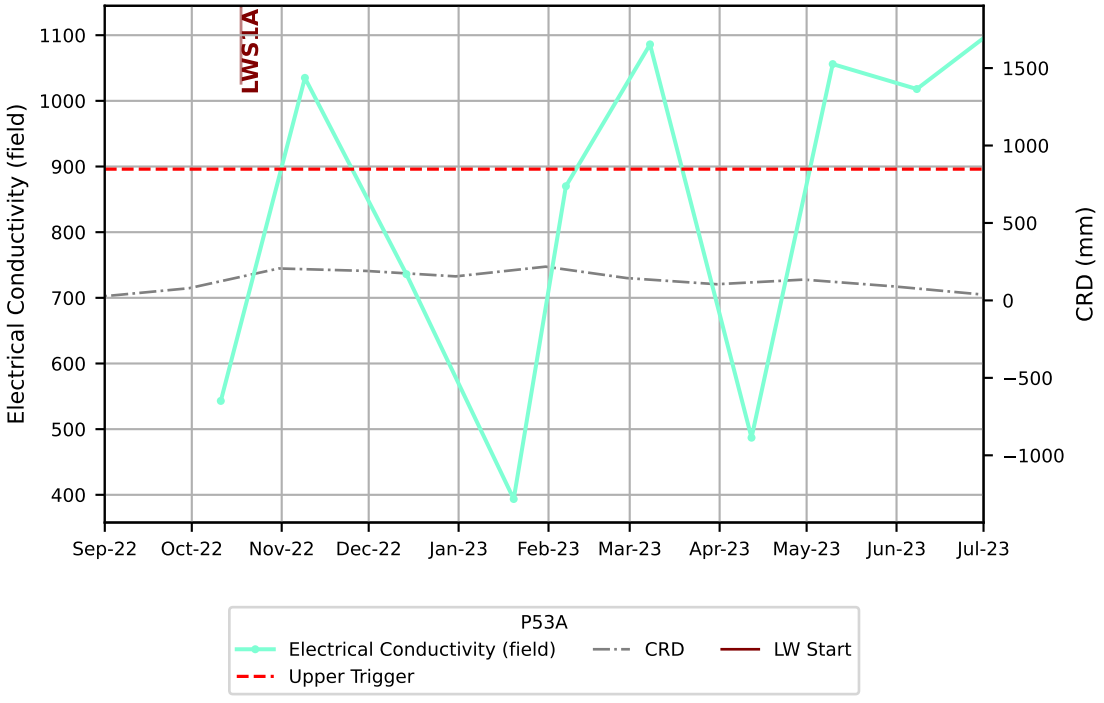

LW S1A
Strontium-Dissolved
CRD (mm)
0.0625
0.0600
0.0575
0.0550
0.0525
0.0500
0.0475
0.0450
0.0425
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Strontium-Dissolved
CRD
LW Start
Upper Trigger

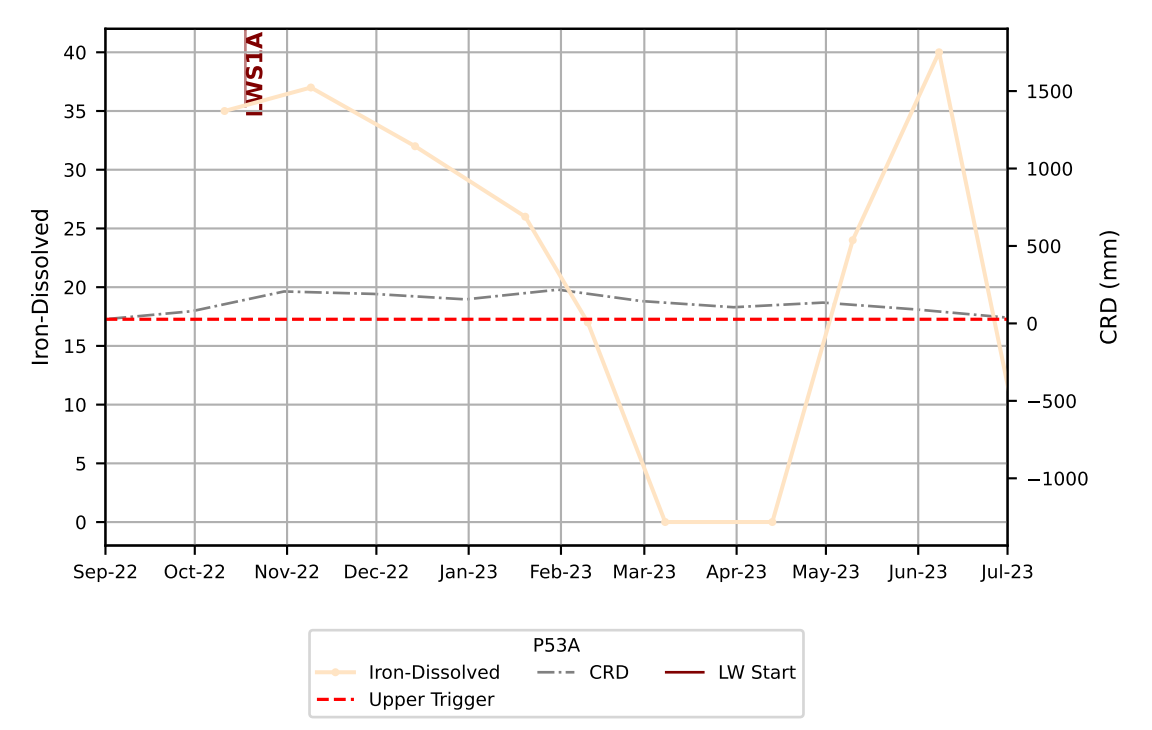

LWS1A
Lithium-Dissolved
CRD (mm)
0.0180
0.0175
0.0170
0.0165
0.0160
0.0155
0.0150
0.0145
0.0140
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Lithium-Dissolved
CRD
LW Start
Upper Trigger

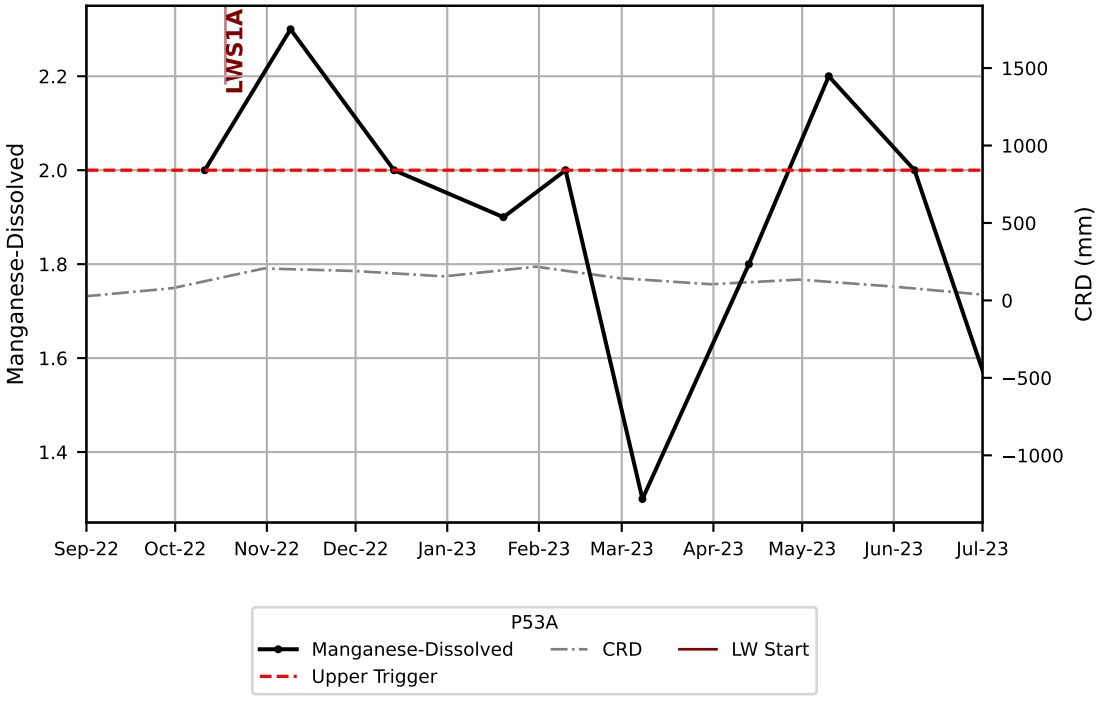

LWS1A
Barium-Dissolved
CRD (mm)
0.32
0.31
0.30
0.29
0.28
0.27
0.26
0.25
0.24
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Barium-Dissolved
CRD
LW Start
Upper Trigger

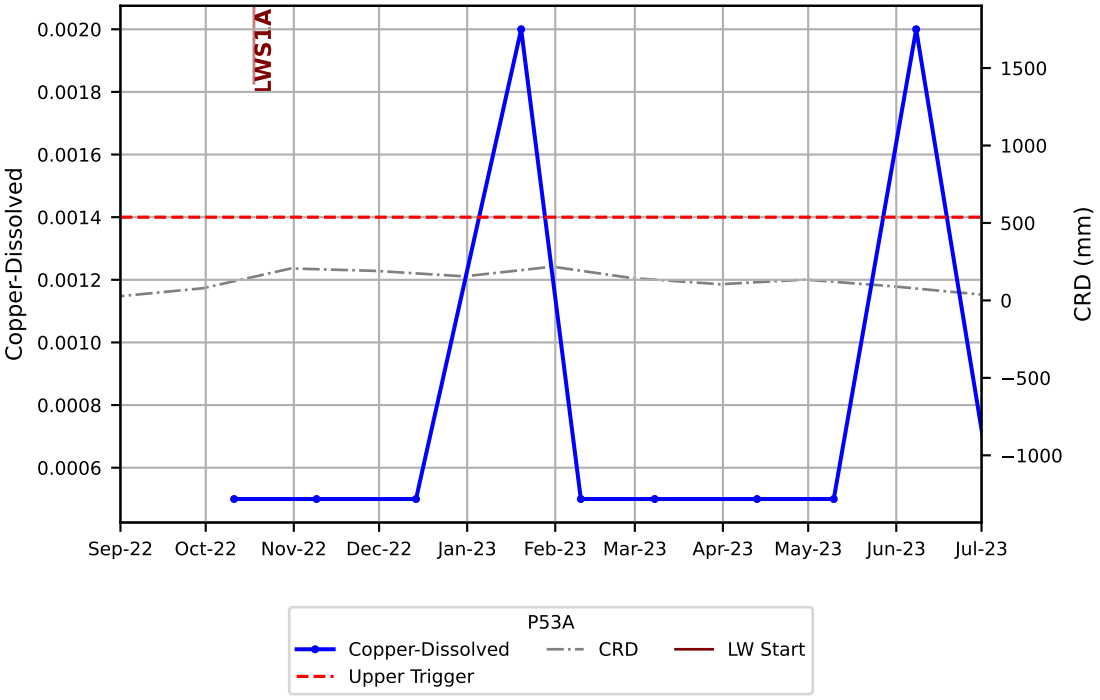

LWS1A
Selenium-Dissolved
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P52
Selenium-Dissolved
CRD
LW Start
Upper Trigger

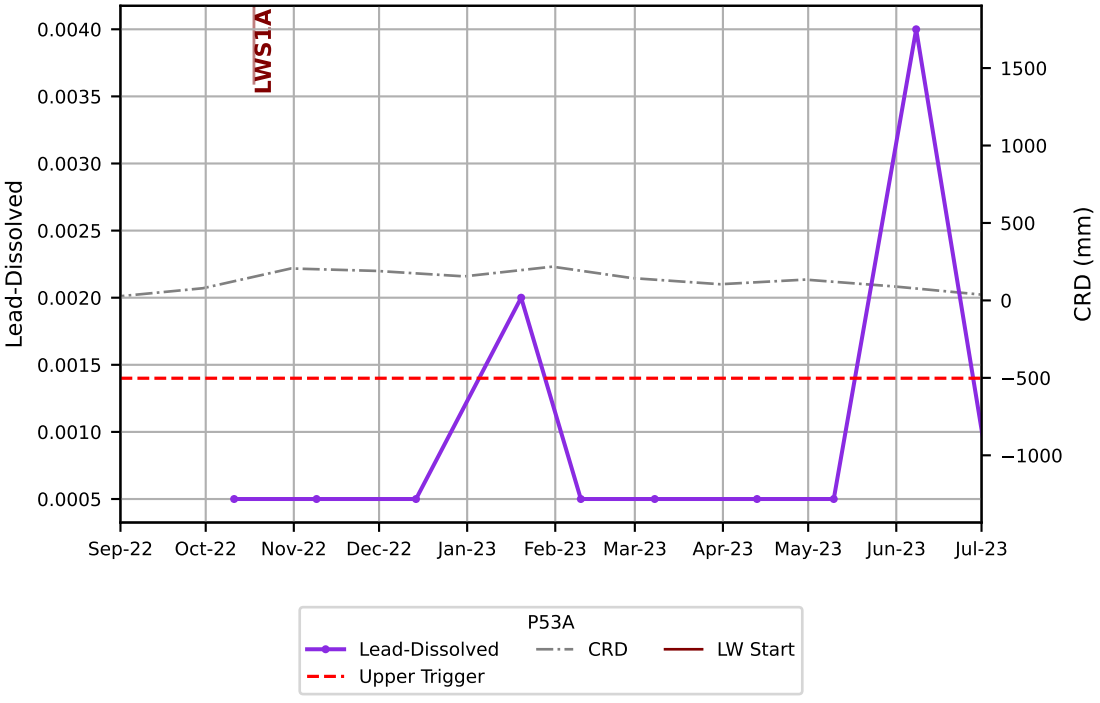

LW51A
pH (field)
CRD (mm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

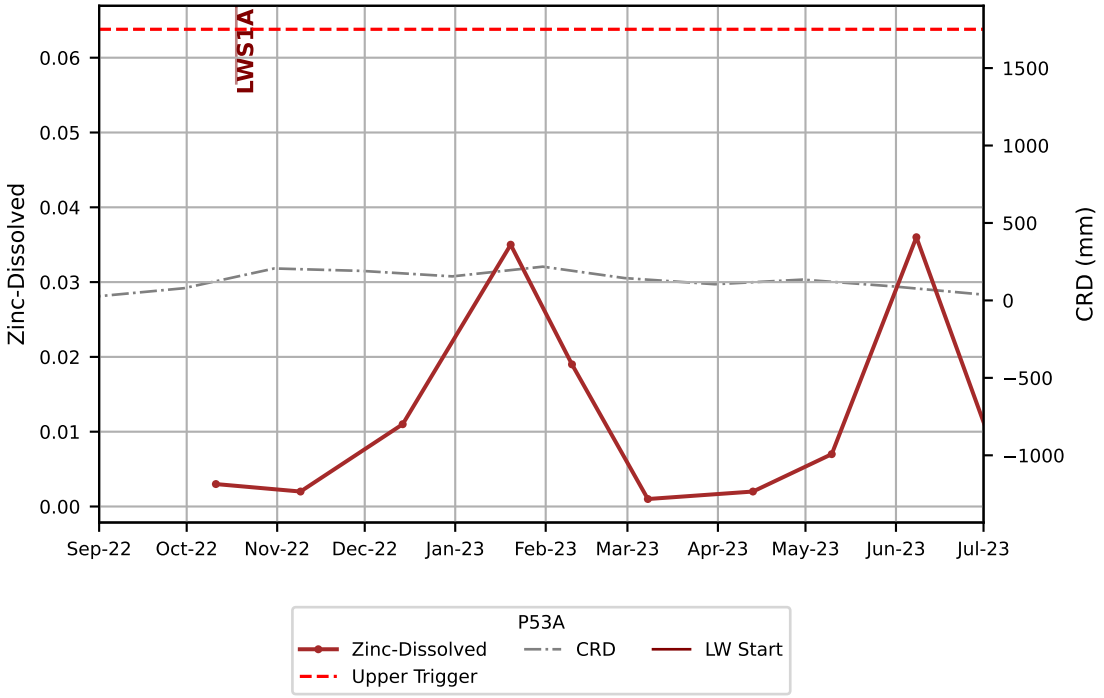

LW51A
Electrical Conductivity (field)
CRD (mm)
1100
1000
900
800
700
600
500
400
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

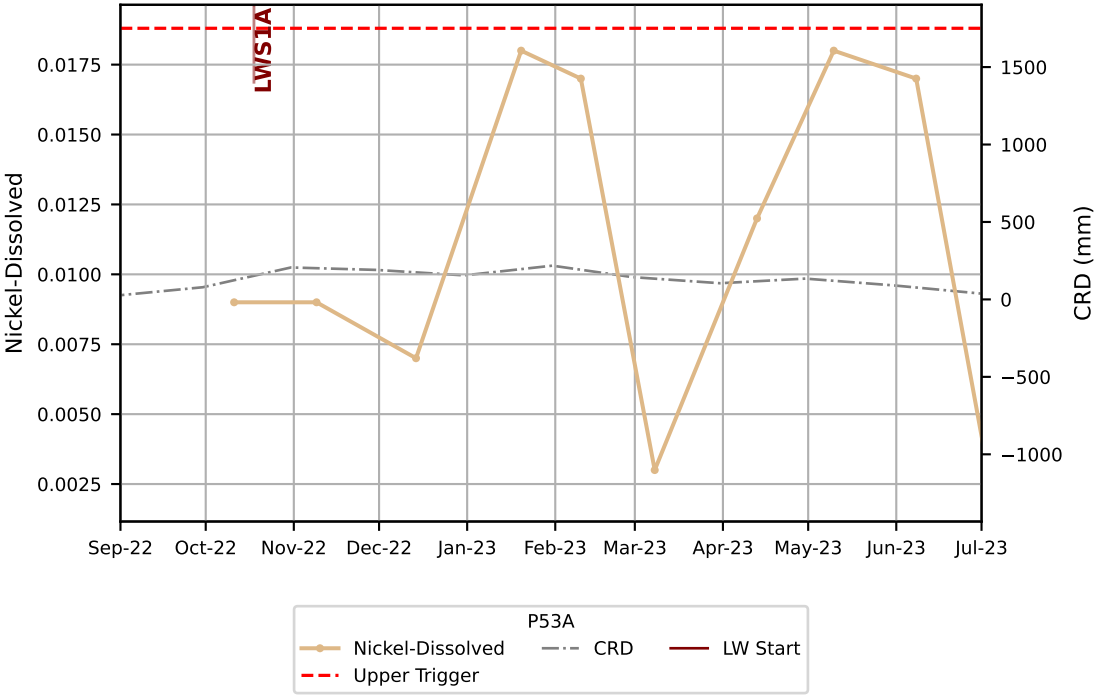

LWS1A
Iron-Dissolved
CRD (mm)
40
35
30
25
20
15
10
5
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Iron-Dissolved
CRD
LW Start
Upper Trigger

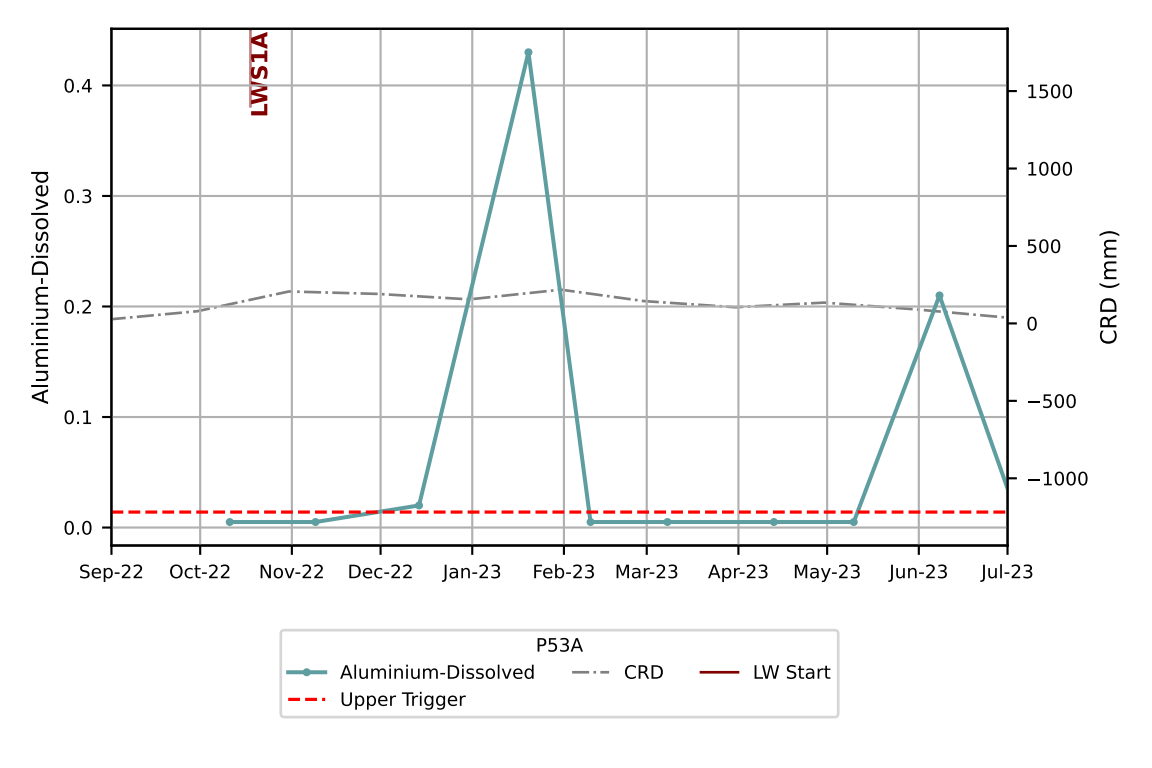

LWS1A
Manganese-Dissolved
CRD (mm)
2.2
2.0
1.8
1.6
1.4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Manganese-Dissolved
CRD
LW Start
Upper Trigger

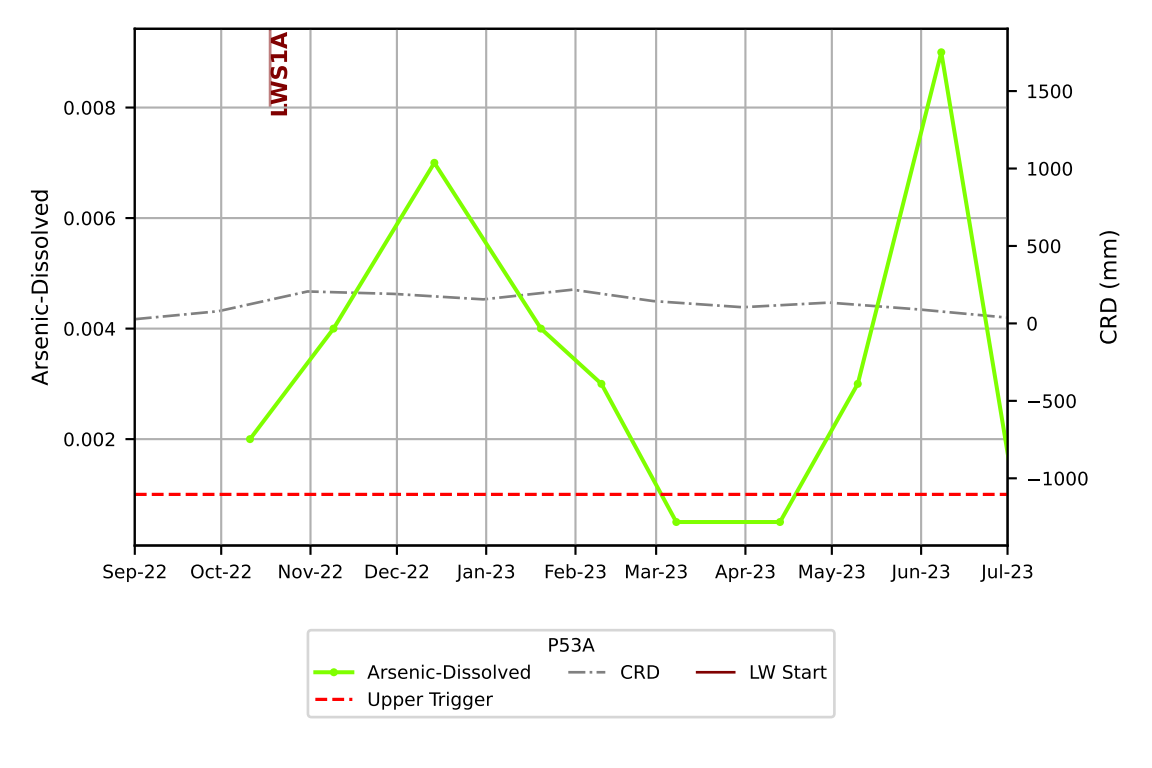

LWS1A
Copper-Dissolved
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Copper-Dissolved
CRD
LW Start
Upper Trigger

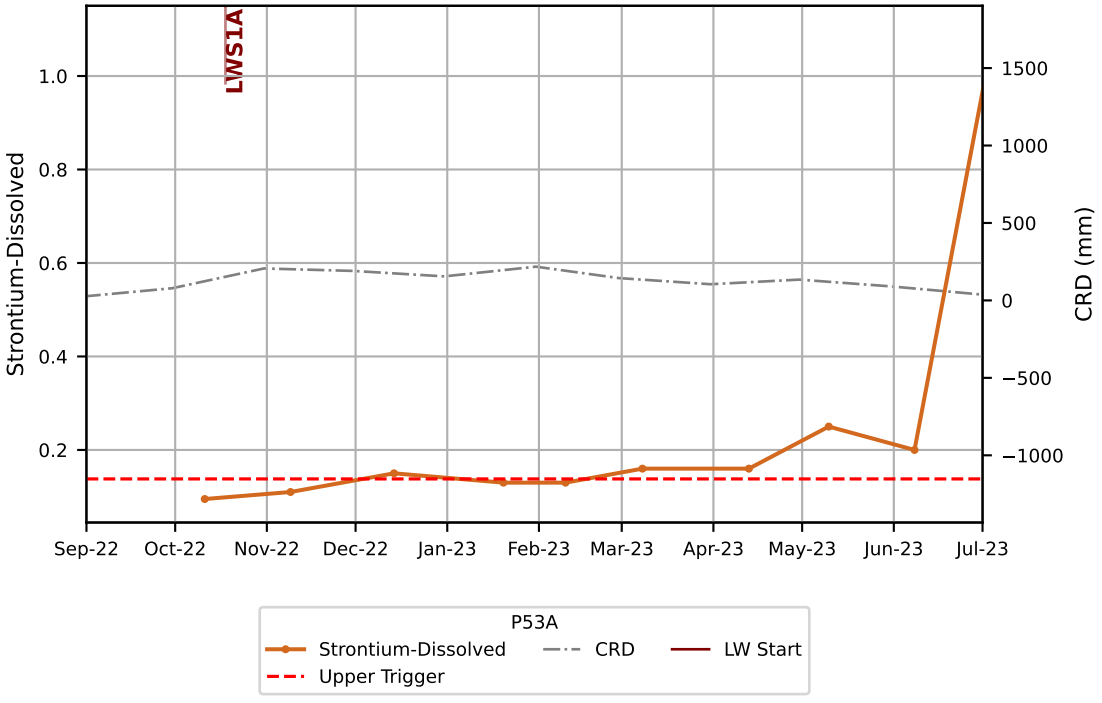

LWS1A
Lead-Dissolved
CRD (mm)
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Lead-Dissolved
CRD
LW Start
Upper Trigger

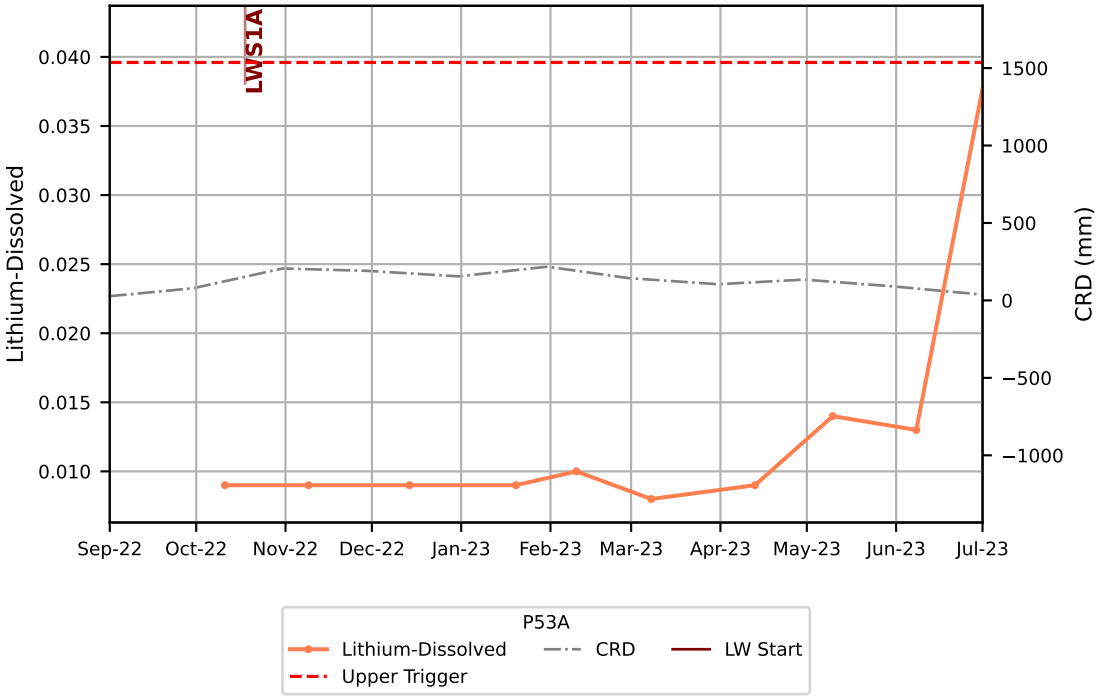

LWS1A
Zinc-Dissolved
CRD (mm)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Zinc-Dissolved
CRD
LW Start
Upper Trigger

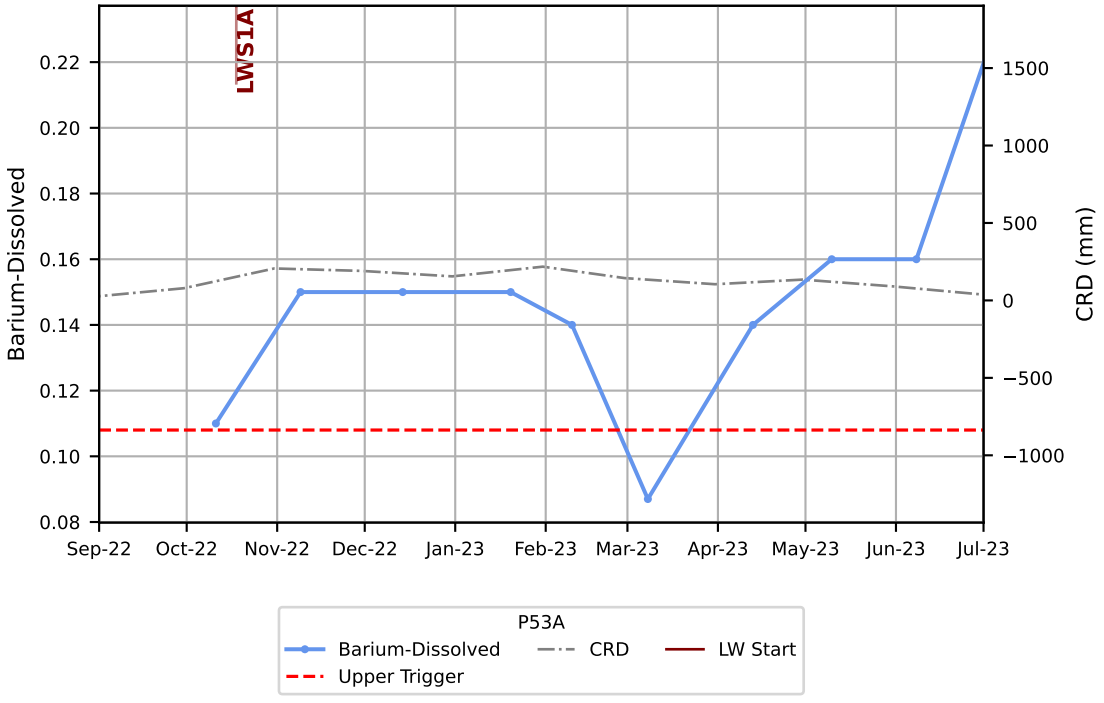

LWS1A
Nickel-Dissolved
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Nickel-Dissolved
CRD
LW Start
Upper Trigger

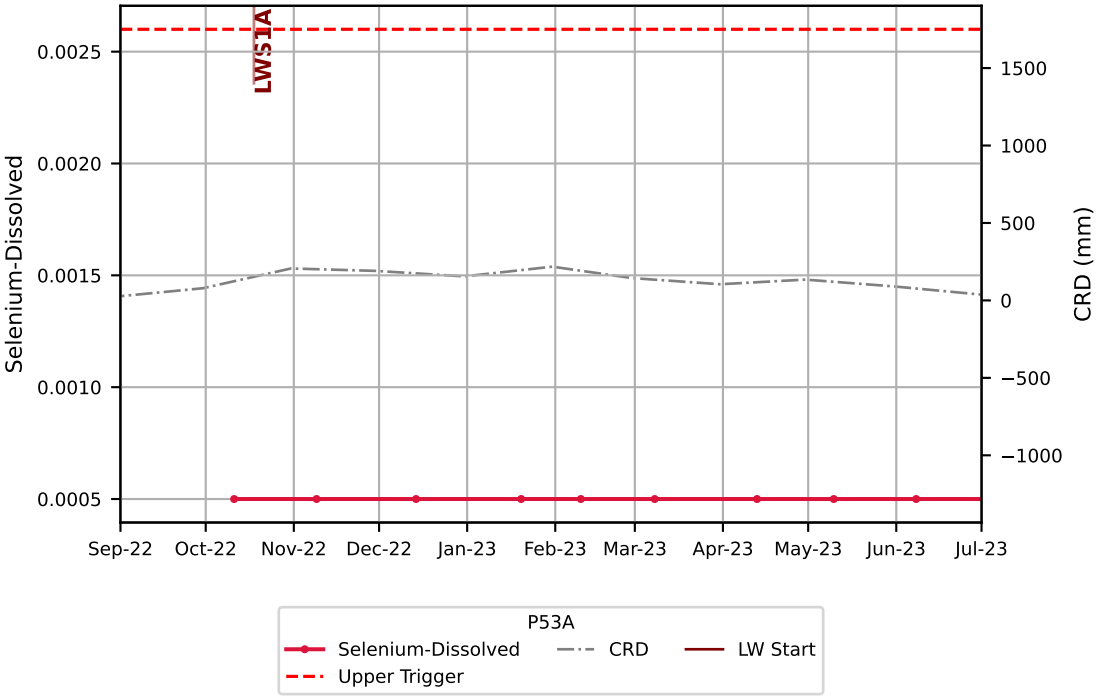

LWS1A
Aluminium-Dissolved
CRD (mm)
0.4
0.3
0.2
0.1
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

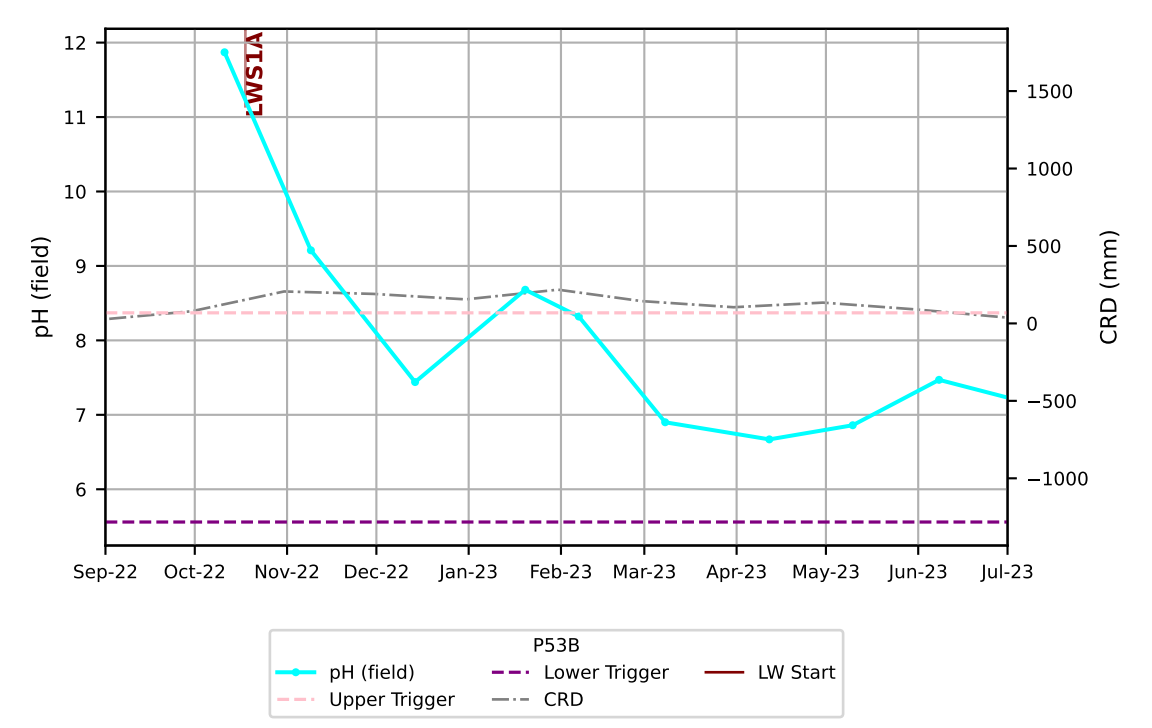

LWS1A
Arsenic-Dissolved
0.008
0.006
0.004
0.002
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

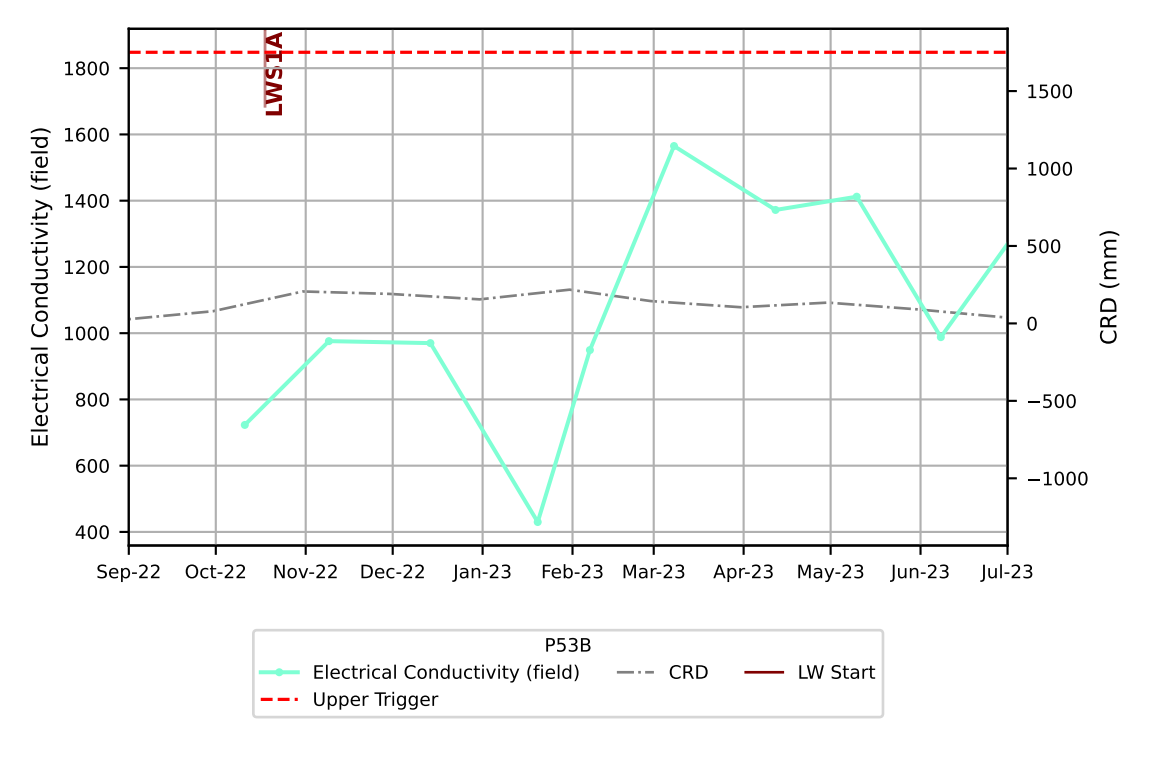

LWS1A
Strontium-Dissolved
CRD (mm)
1.0
0.8
0.6
0.4
0.2
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Strontium-Dissolved
CRD
LW Start
Upper Trigger

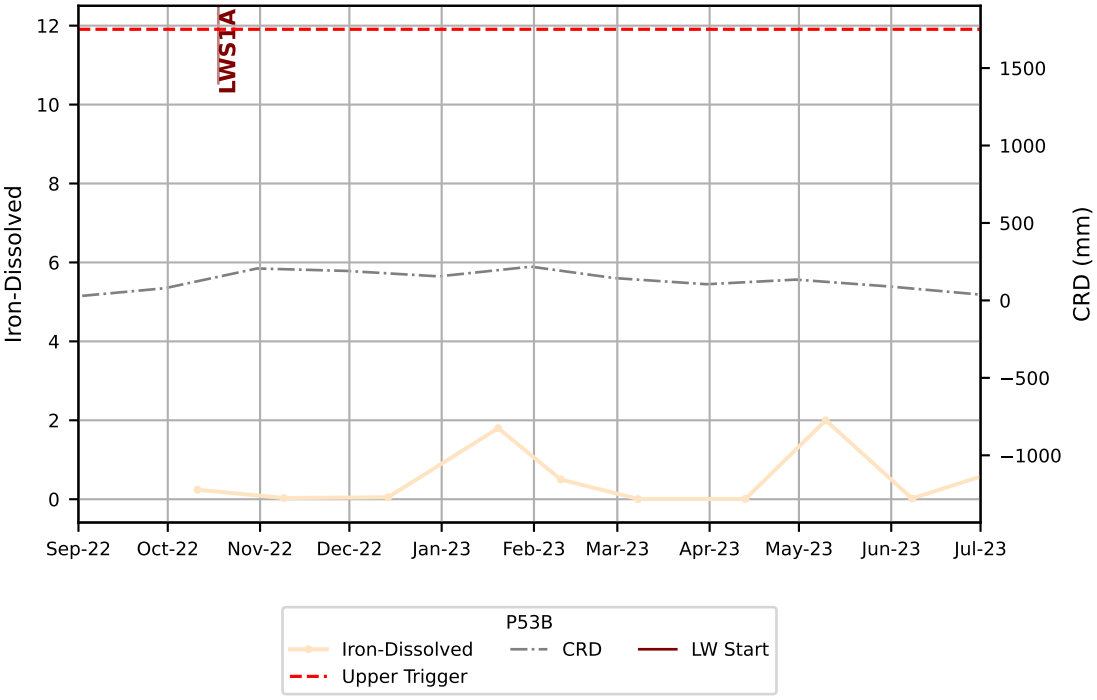

LWS1A
Lithium-Dissolved
0.040
0.035
0.030
0.025
0.020
0.015
0.010
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Lithium-Dissolved
CRD
LW Start
Upper Trigger

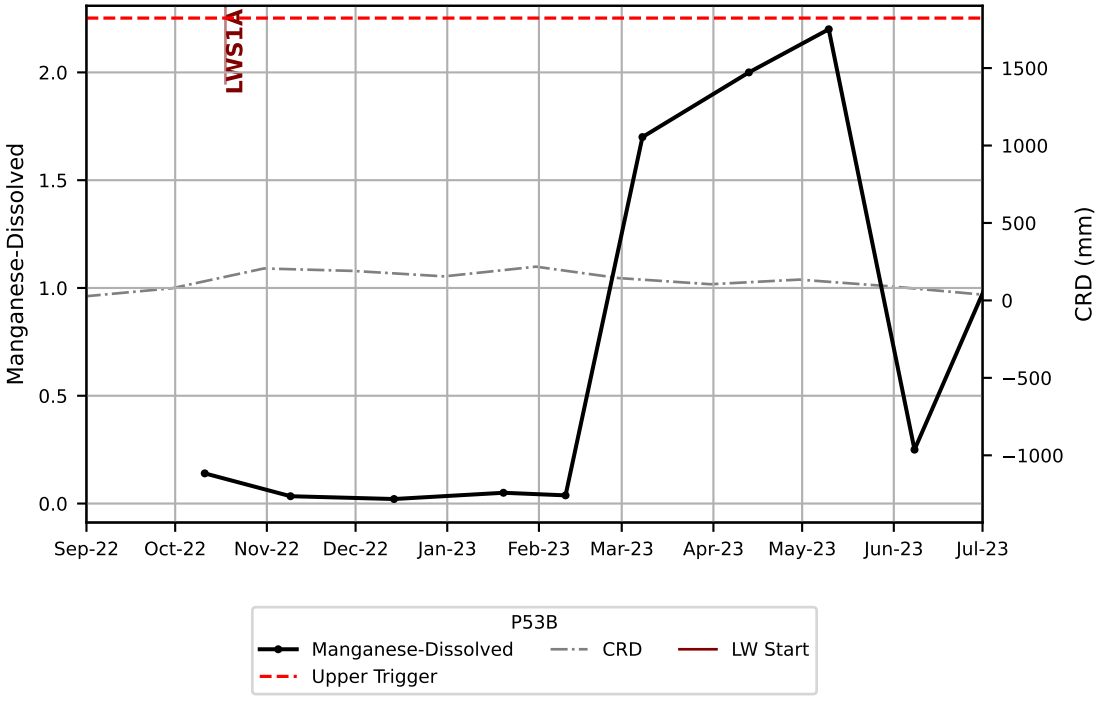

LWS1A
Barium-Dissolved
CRD (mm)
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Barium-Dissolved
CRD
LW Start
Upper Trigger

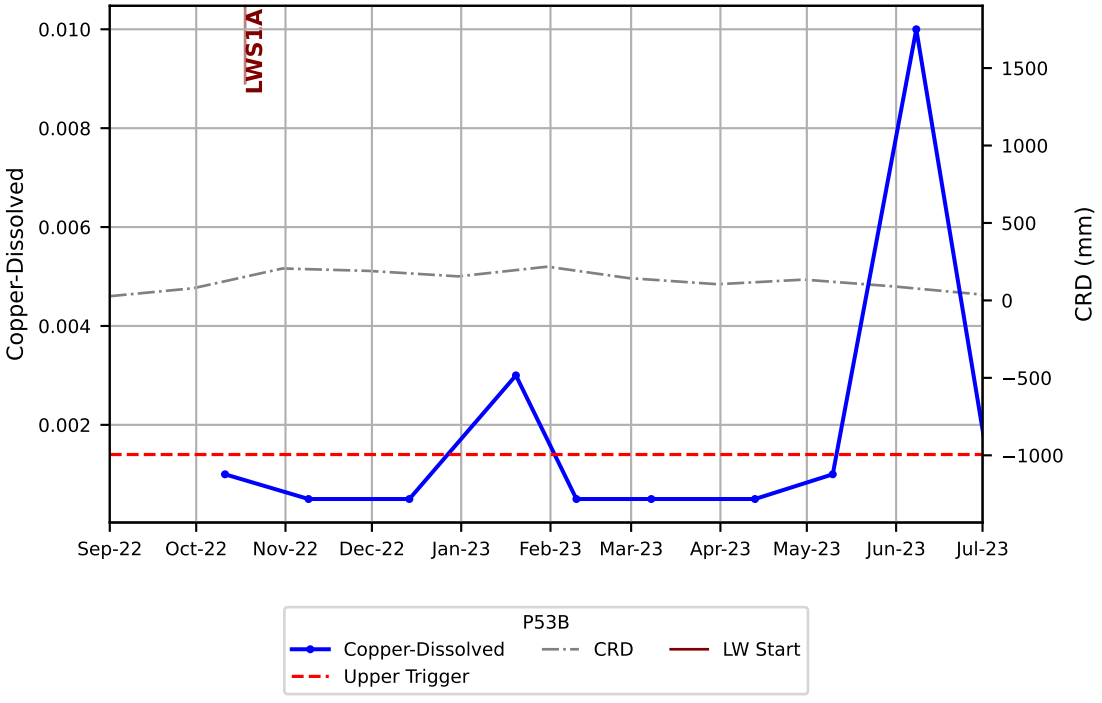

LW S1A
Selenium-Dissolved
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53A
Selenium-Dissolved
CRD
LW Start
Upper Trigger

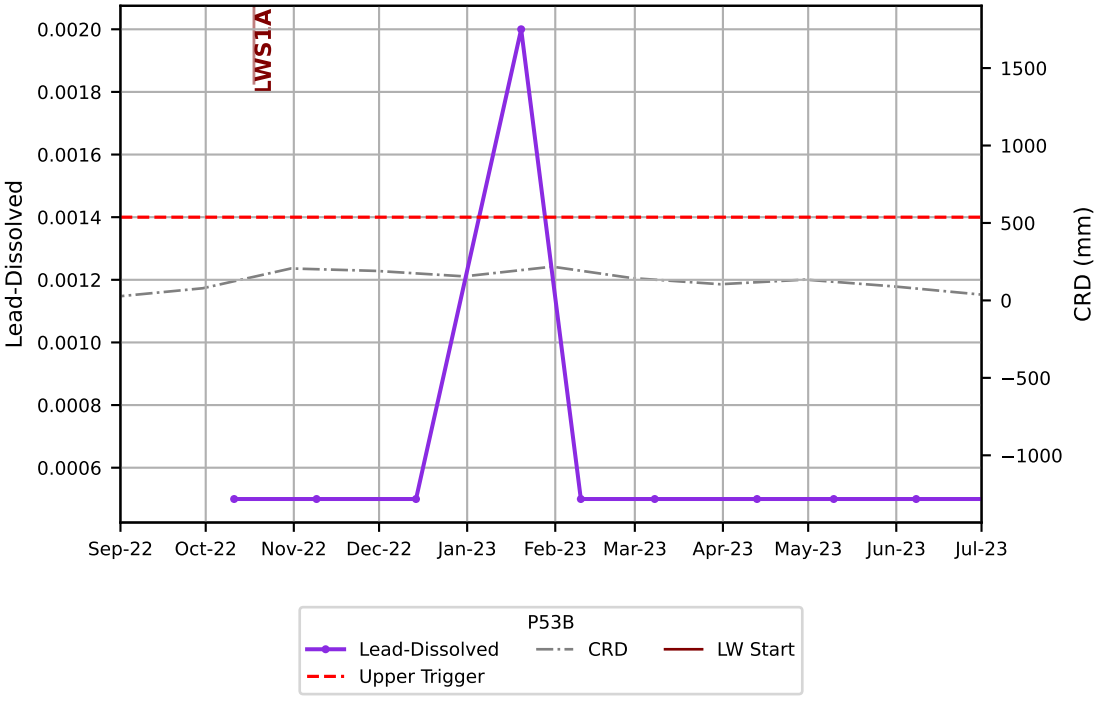

LWS1A
pH (field)
CRD (mm)
12
11
10
9
8
7
6
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

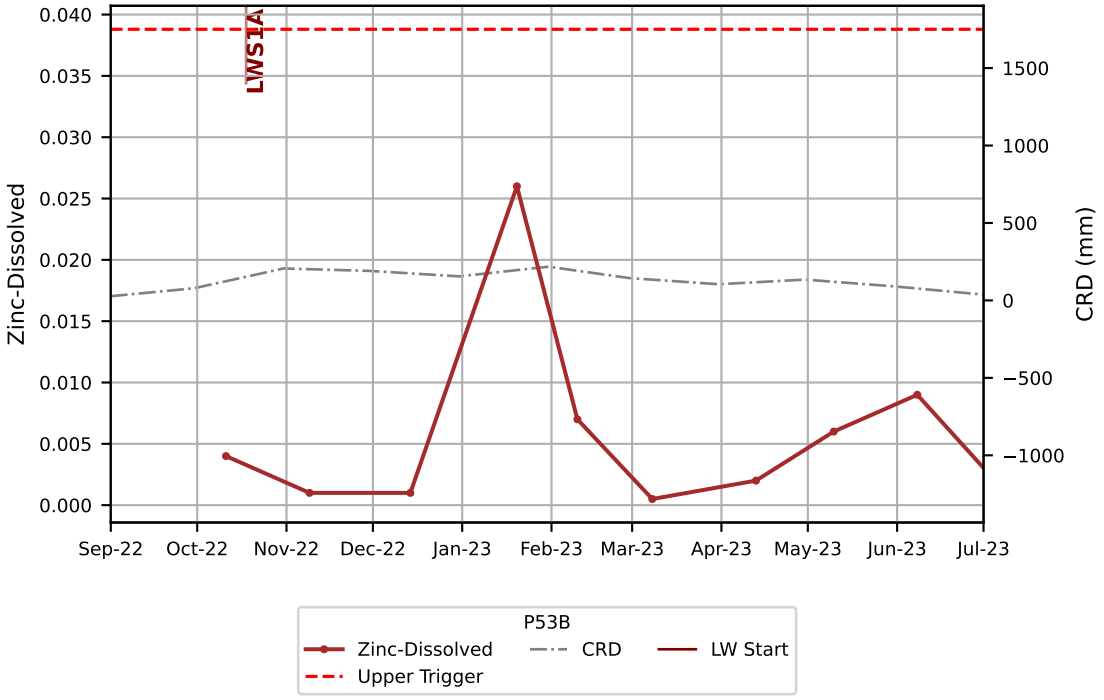

LW1A
Electrical Conductivity (field)
CRD (mm)
1800
1600
1400
1200
1000
800
600
400
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

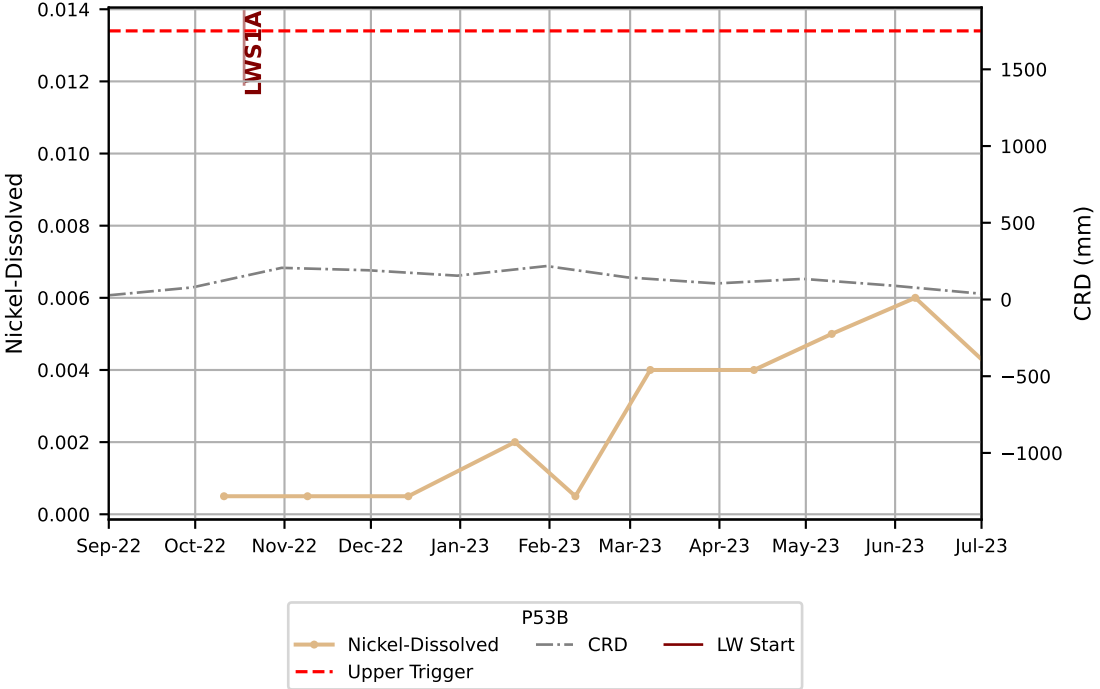

LWS1A
Iron-Dissolved
CRD (mm)
12
10
8
6
4
2
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Iron-Dissolved
CRD
LW Start
Upper Trigger

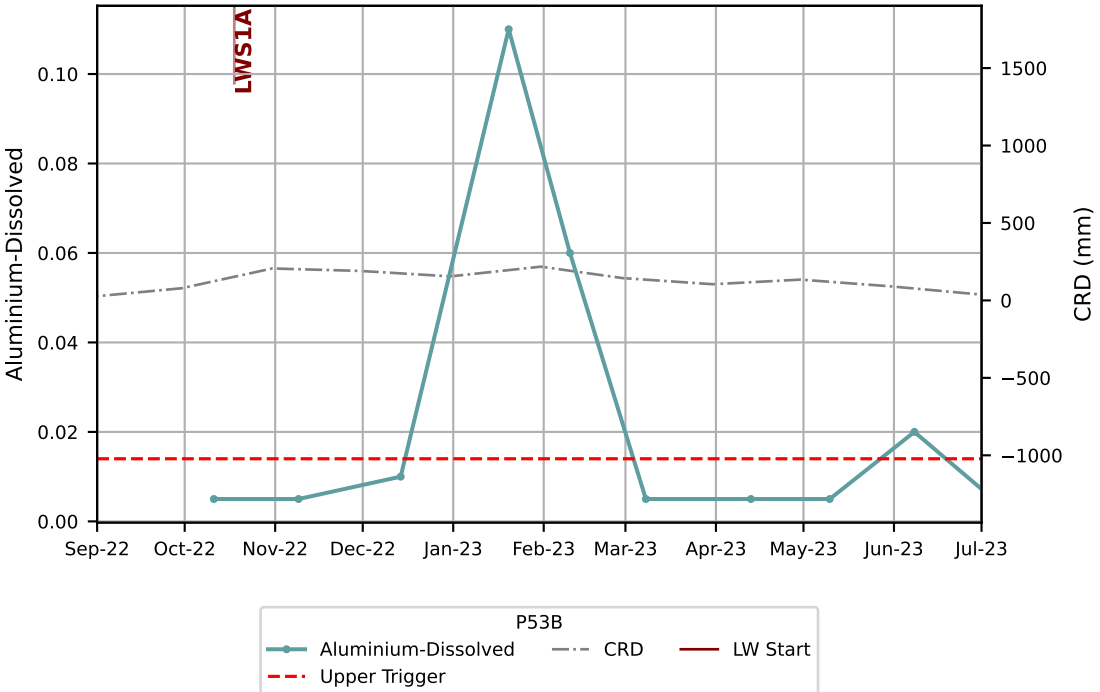

LWS1A
Manganese-Dissolved
CRD (mm)
2.0
1.5
1.0
0.5
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Manganese-Dissolved
CRD
LW Start
Upper Trigger

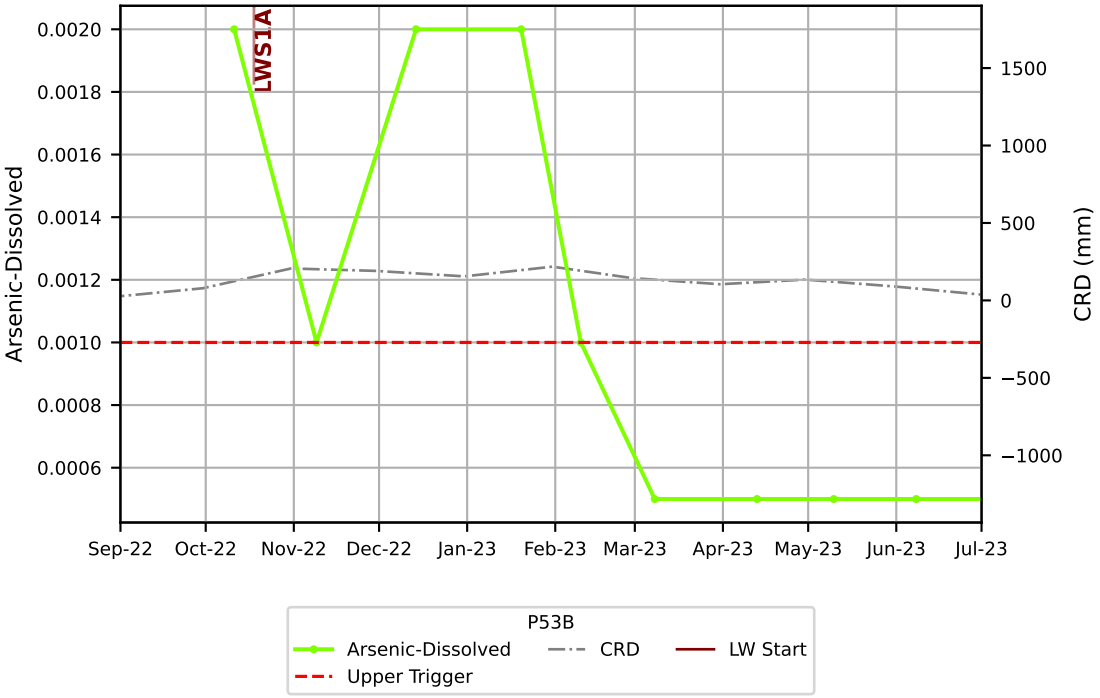

LWS1A
Copper-Dissolved
CRD (mm)
0.010
0.008
0.006
0.004
0.002
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Copper-Dissolved
CRD
LW Start
Upper Trigger

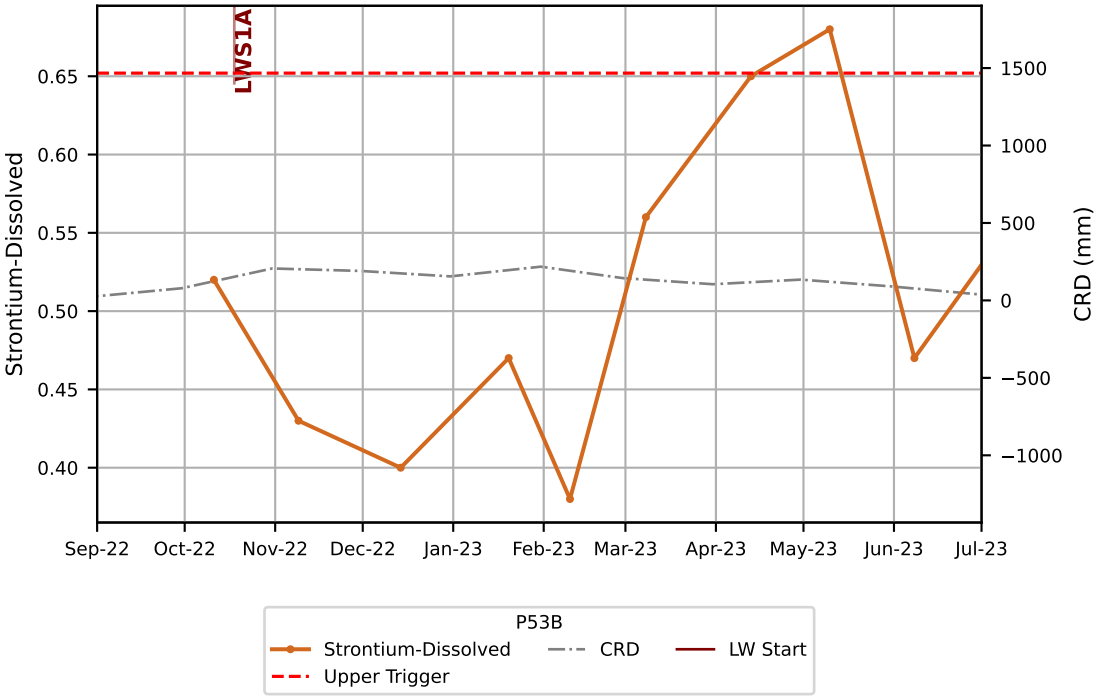

LWS1A
Lead-Dissolved
CRD (mm)
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Lead-Dissolved
CRD
LW Start
Upper Trigger

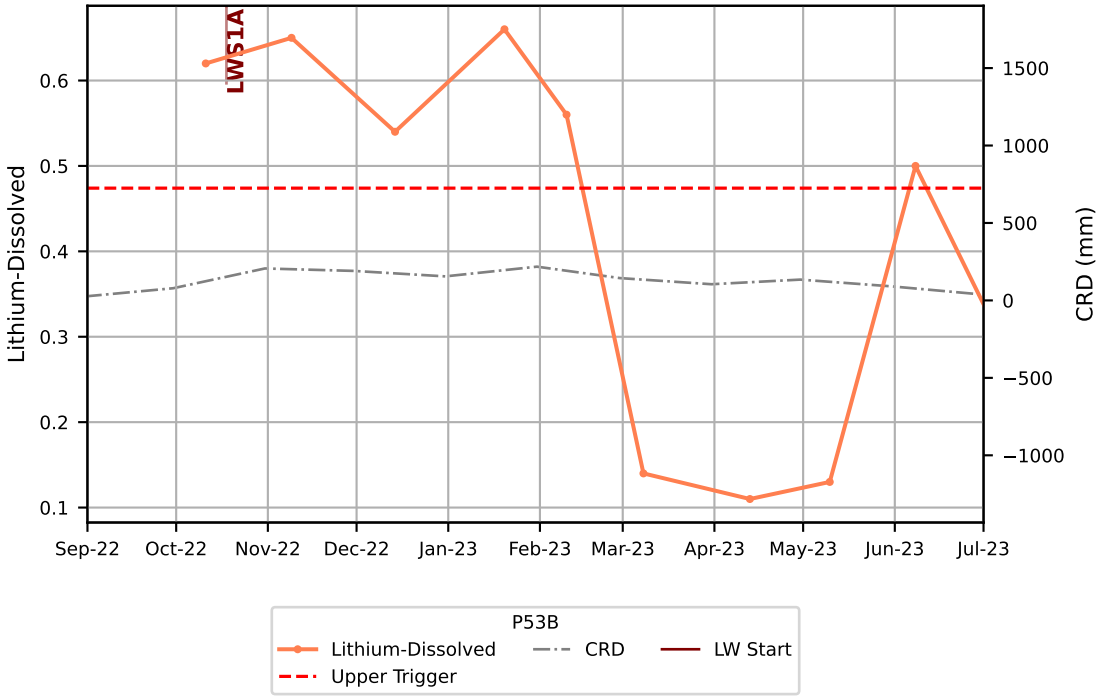

LWS1A
Zinc-Dissolved
CRD (mm)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Zinc-Dissolved
CRD
LW Start
Upper Trigger

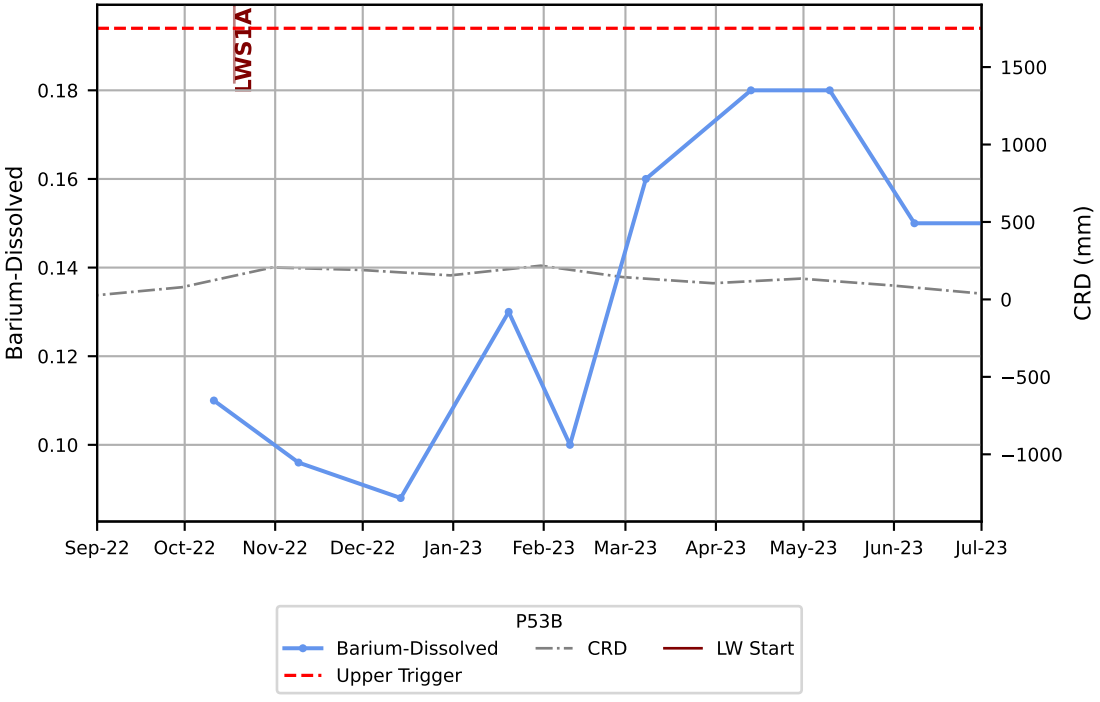

LWS1A
Nickel-Dissolved
CRD (mm)
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Nickel-Dissolved
CRD
LW Start
Upper Trigger

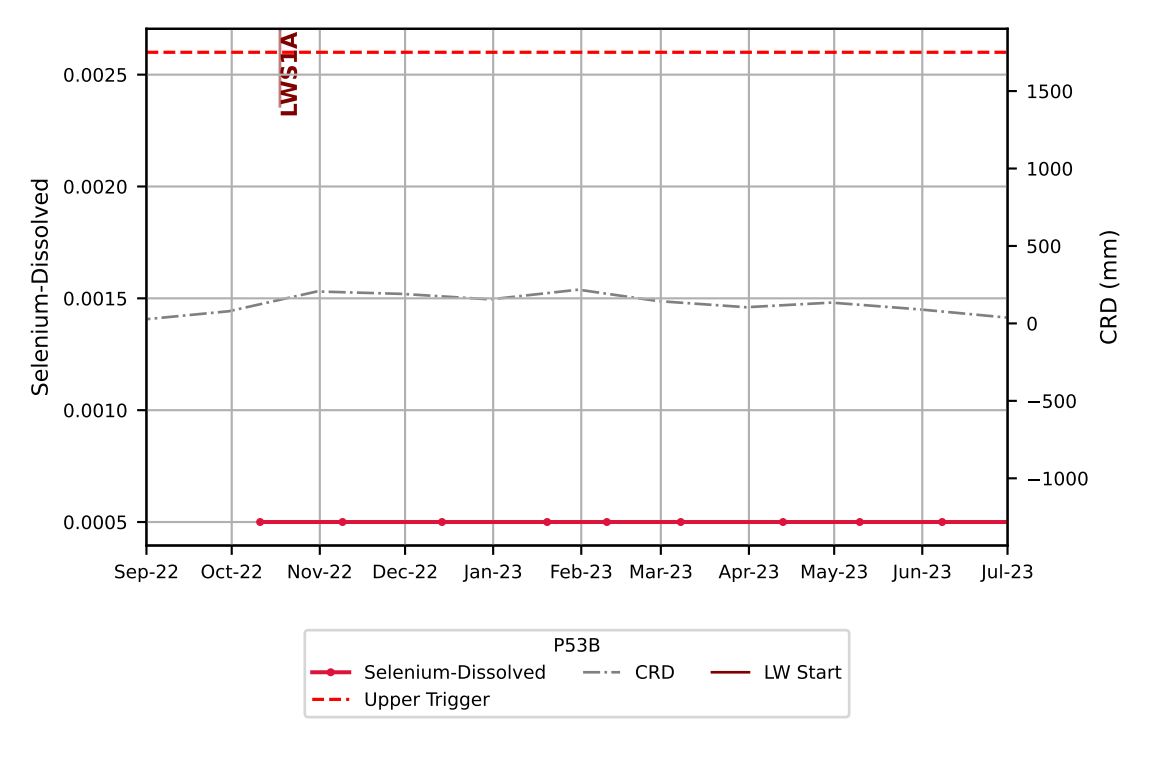

LWS1A
Aluminium-Dissolved
CRD (mm)
0.00
0.02
0.04
0.06
0.08
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

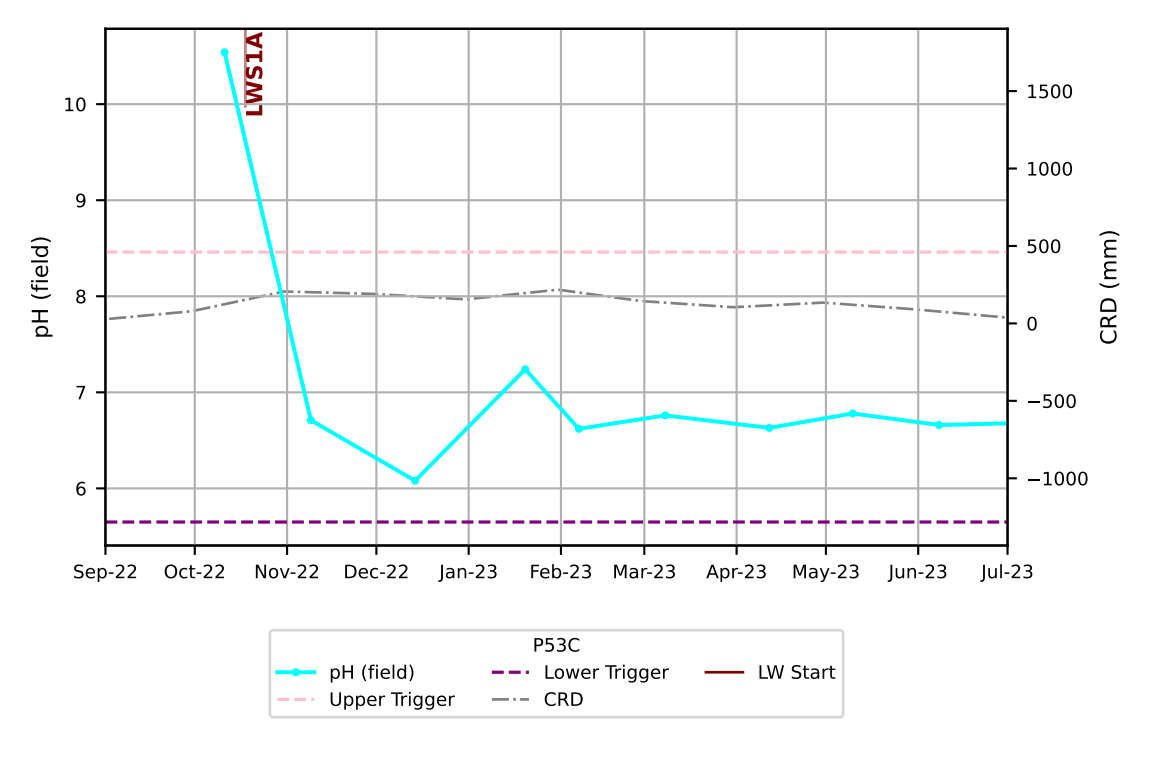

LWS1A
Arsenic-Dissolved
CRD (mm)
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

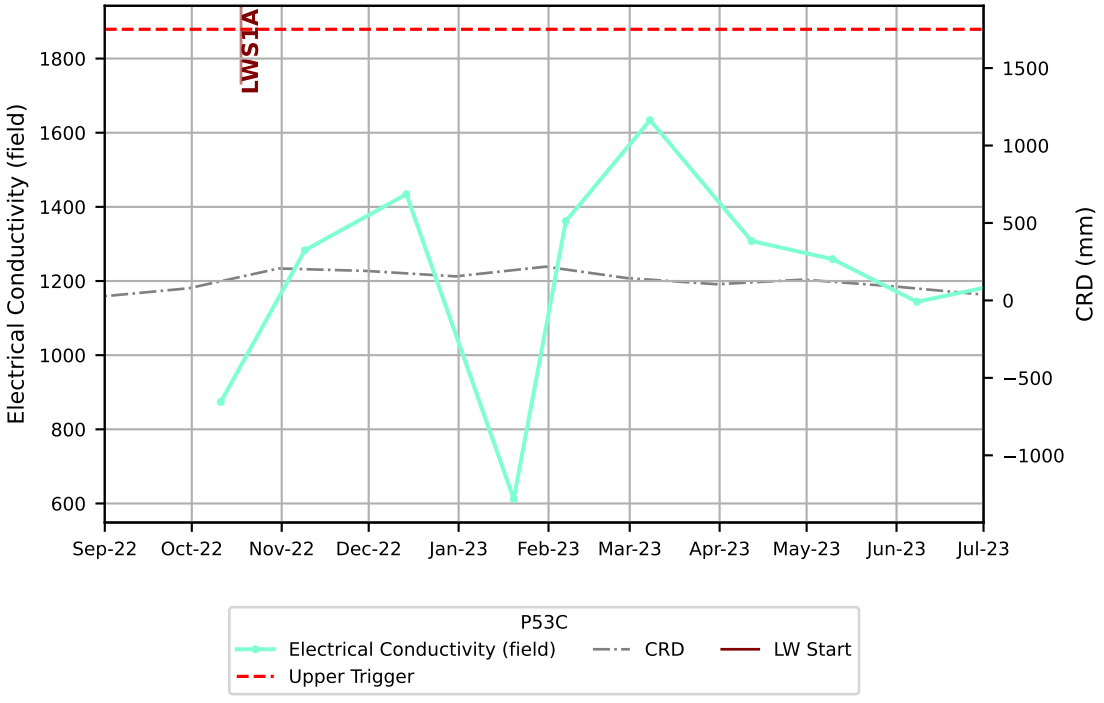

LWS1A
Strontium-Dissolved
0.65
0.60
0.55
0.50
0.45
0.40
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Strontium-Dissolved
CRD
LW Start
Upper Trigger

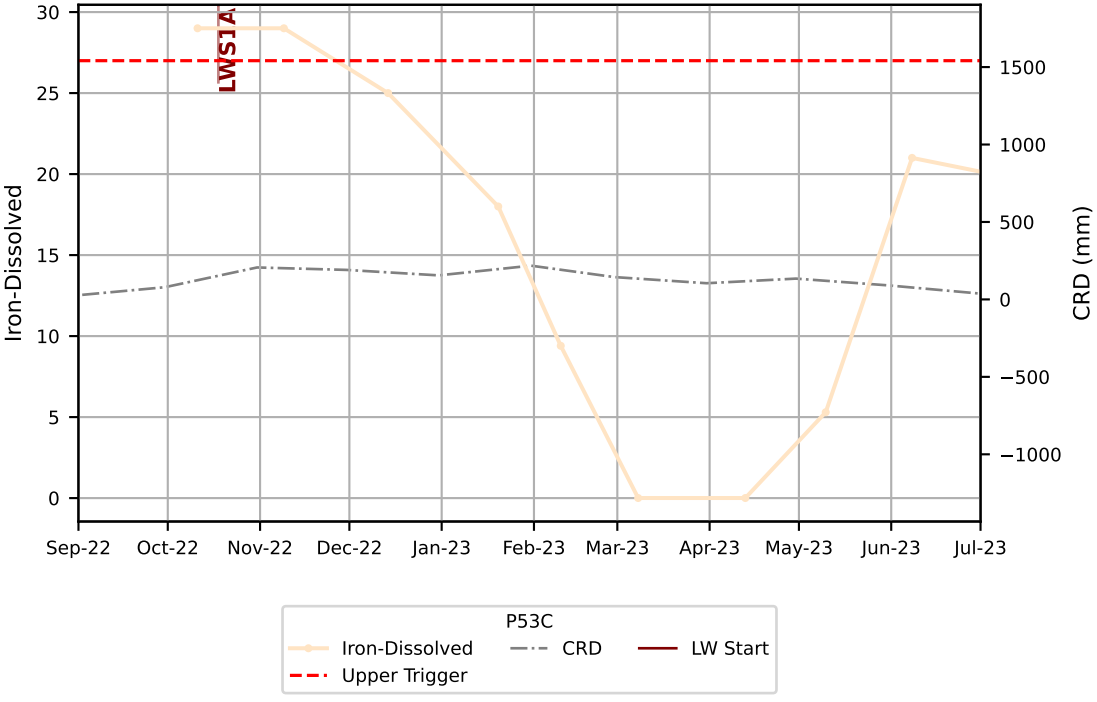

LWS1A
Lithium-Dissolved
CRD (mm)
0.6
0.5
0.4
0.3
0.2
0.1
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Lithium-Dissolved
CRD
LW Start
Upper Trigger

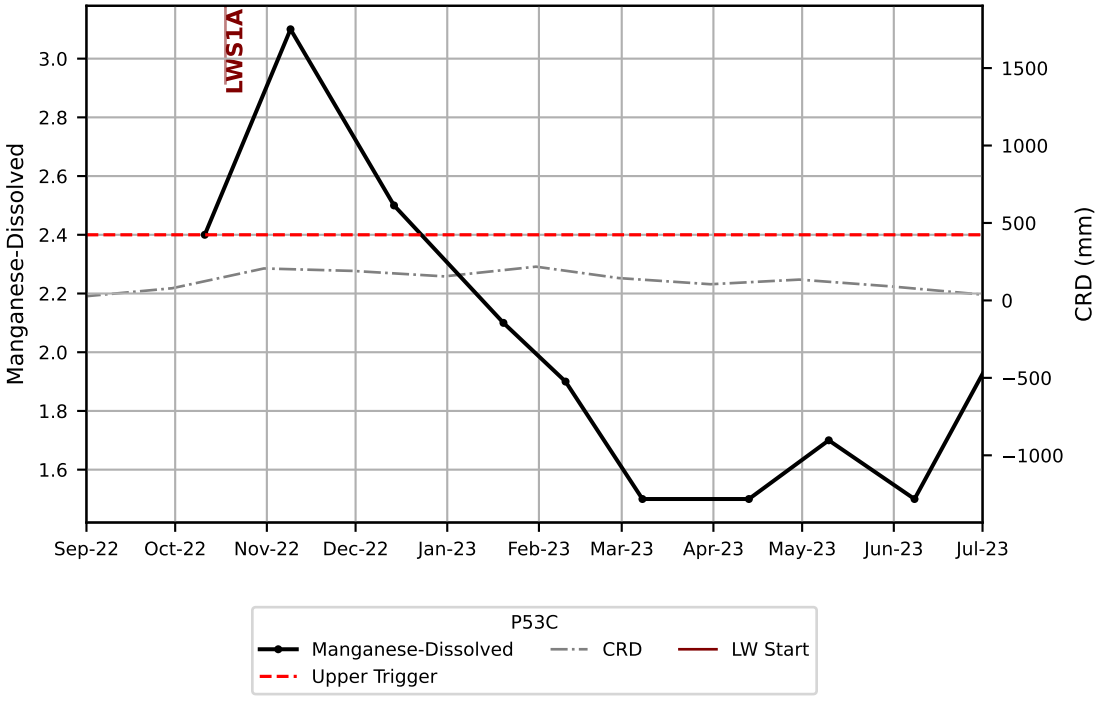

LWS1A
Barium-Dissolved
CRD (mm)
0.18
0.16
0.14
0.12
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Barium-Dissolved
CRD
LW Start
Upper Trigger

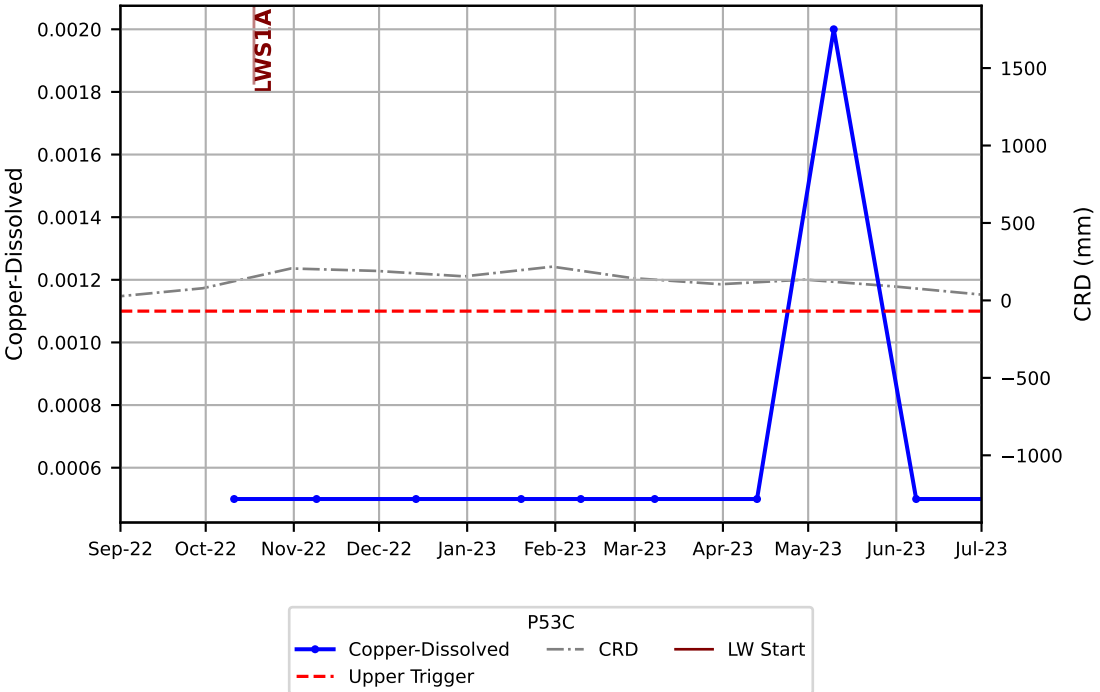

LW51A
Selenium-Dissolved
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53B
Selenium-Dissolved
CRD
LW Start
Upper Trigger

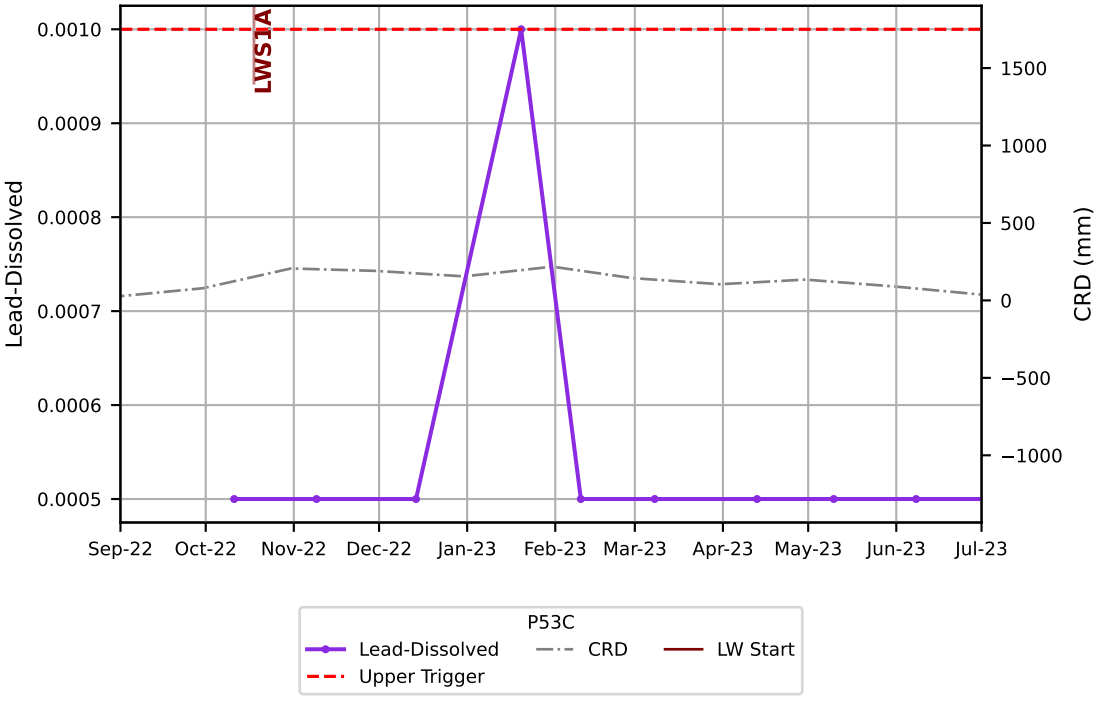

LWS1A
pH (field)
CRD (mm)
10
9
8
7
6
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

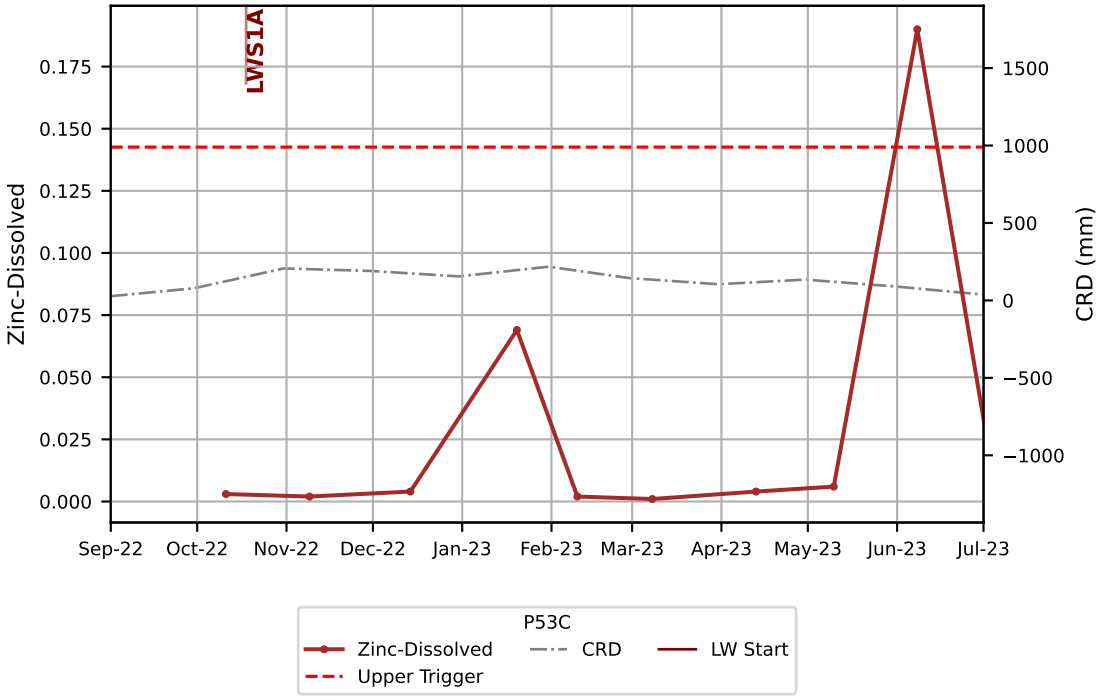

LW S1A
Electrical Conductivity (field)
CRD (mm)
1800
1600
1400
1200
1000
800
600
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

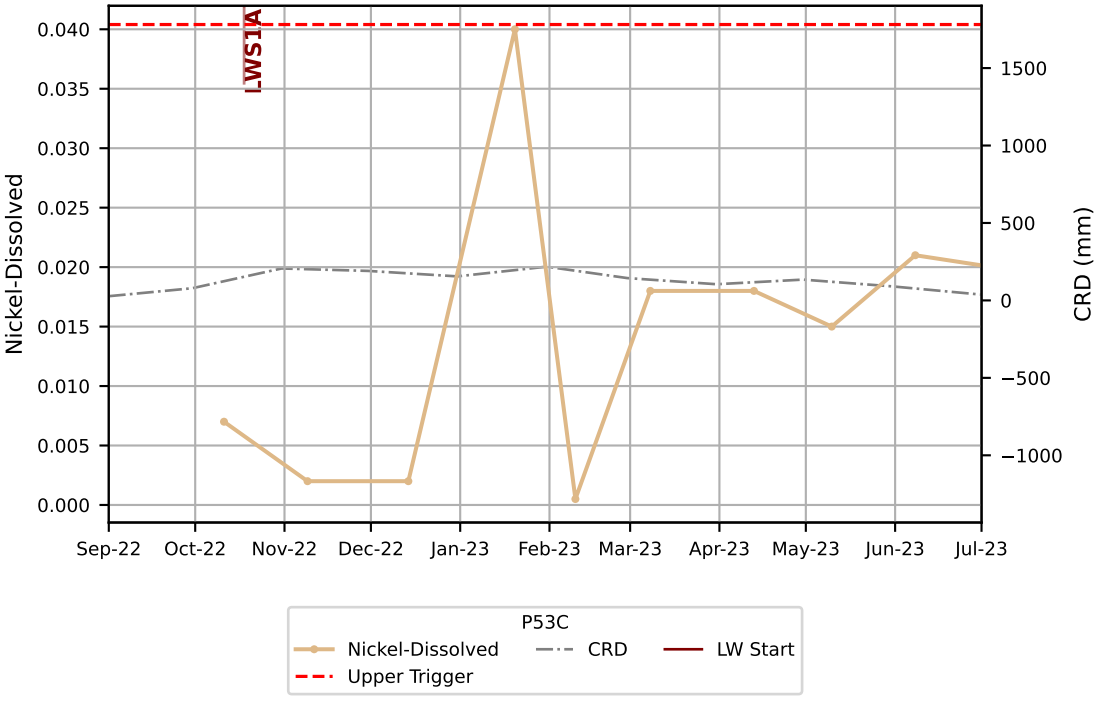

LW S1A
Iron-Dissolved
CRD (mm)
30
25
20
15
10
5
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Iron-Dissolved
CRD
LW Start
Upper Trigger

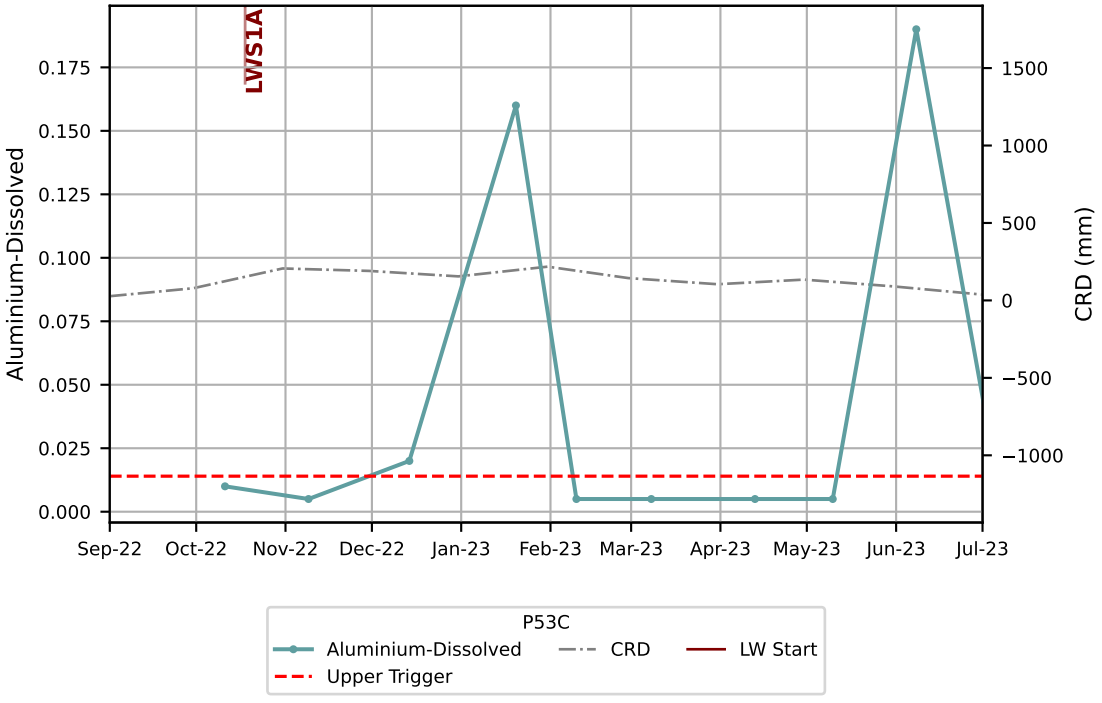

LWS1A
Manganese-Dissolved
CRD (mm)
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Manganese-Dissolved
CRD
LW Start
Upper Trigger

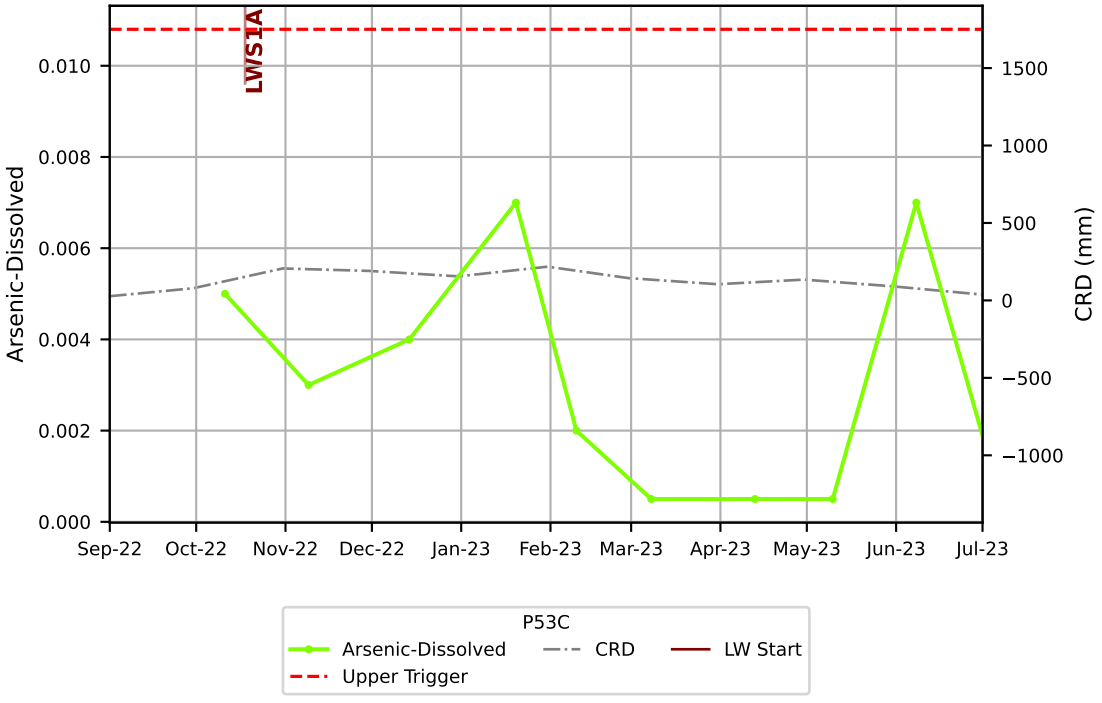

LWS1A
Copper-Dissolved
CRD (mm)
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Copper-Dissolved
CRD
LW Start
Upper Trigger

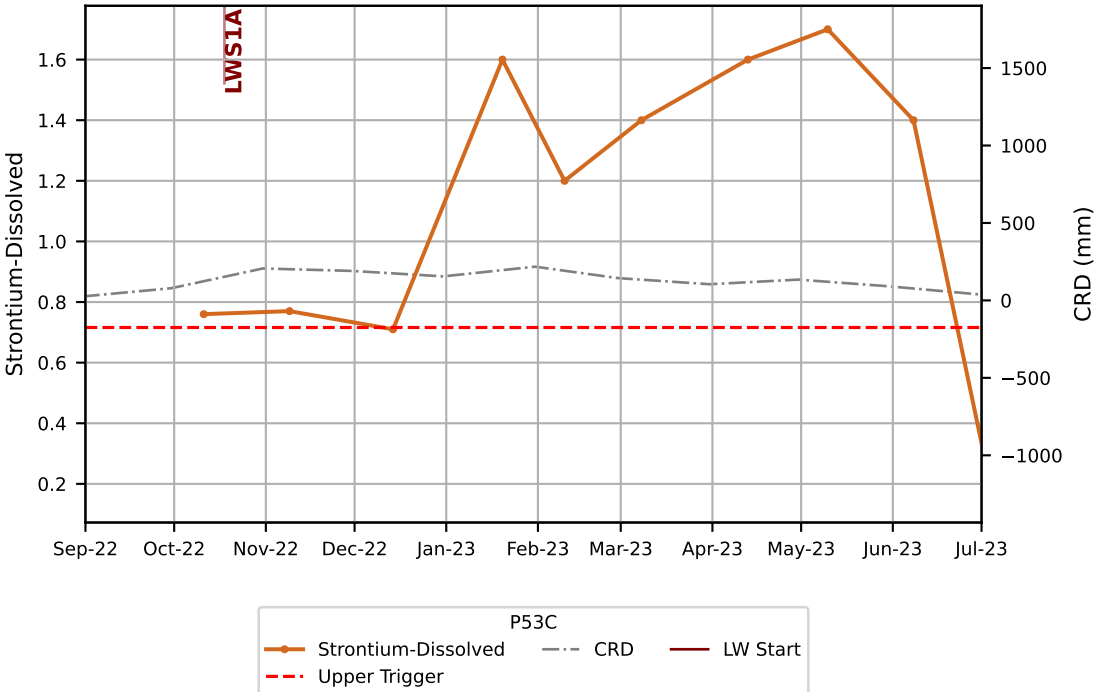

LWS1A
Lead-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Lead-Dissolved
CRD
LW Start
Upper Trigger

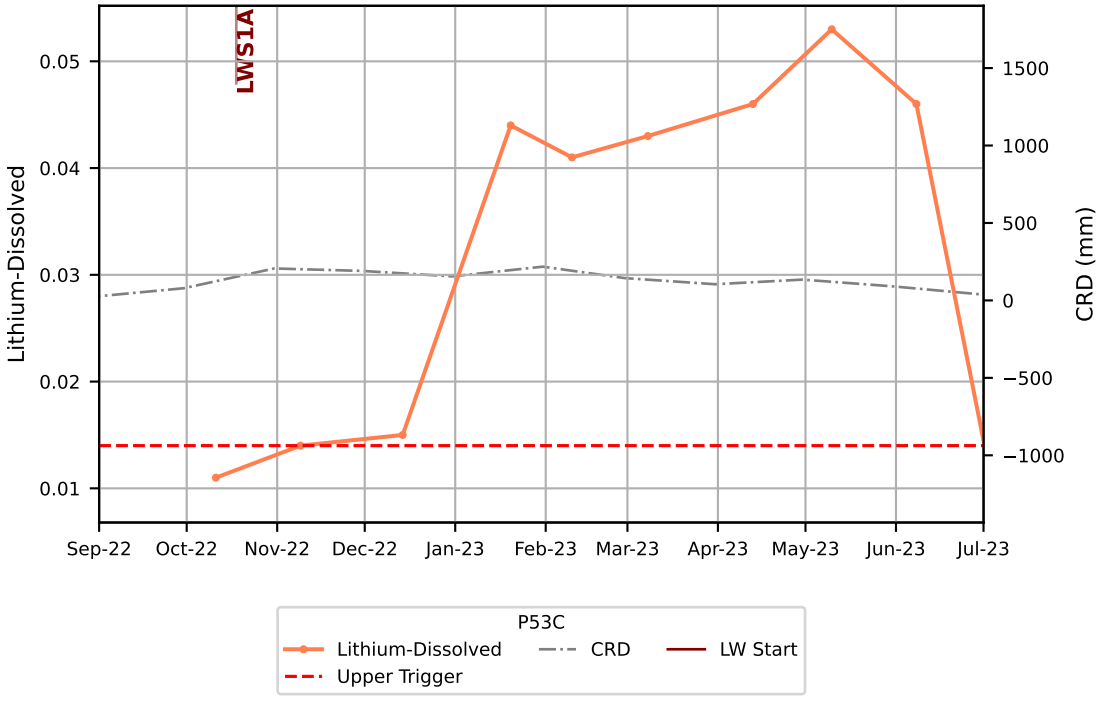

LWS1A
Zinc-Dissolved
CRD (mm)
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Zinc-Dissolved
CRD
LW Start
Upper Trigger

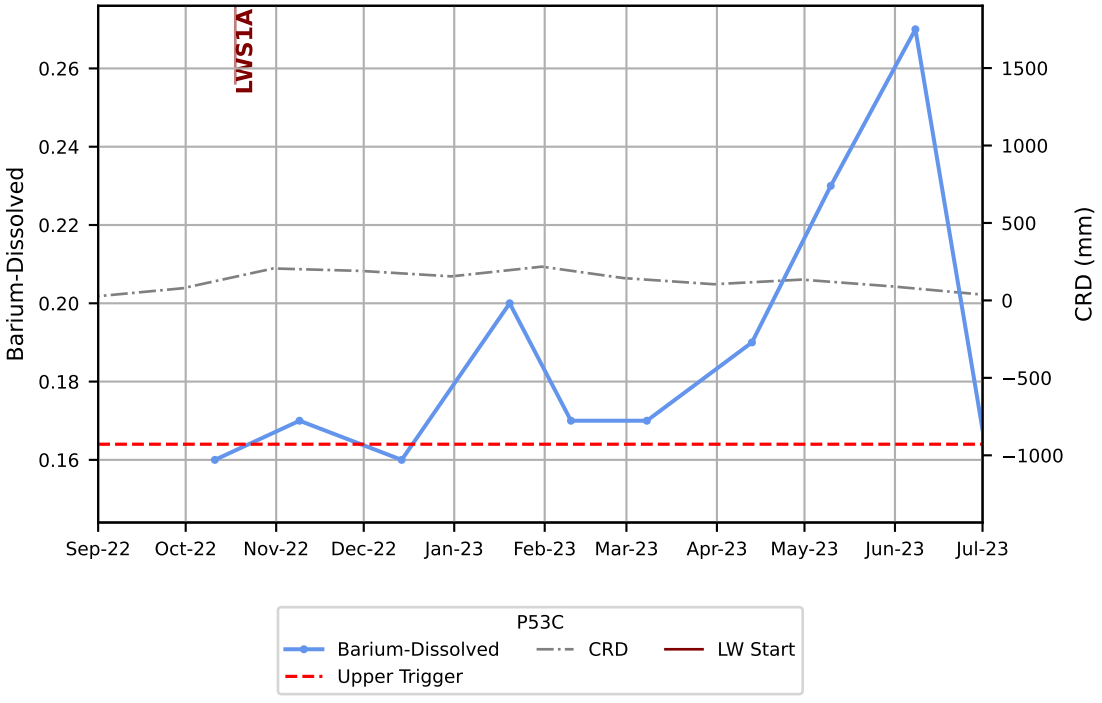

LWS1A
Nickel-Dissolved
CRD (mm)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Nickel-Dissolved
CRD
LW Start
Upper Trigger

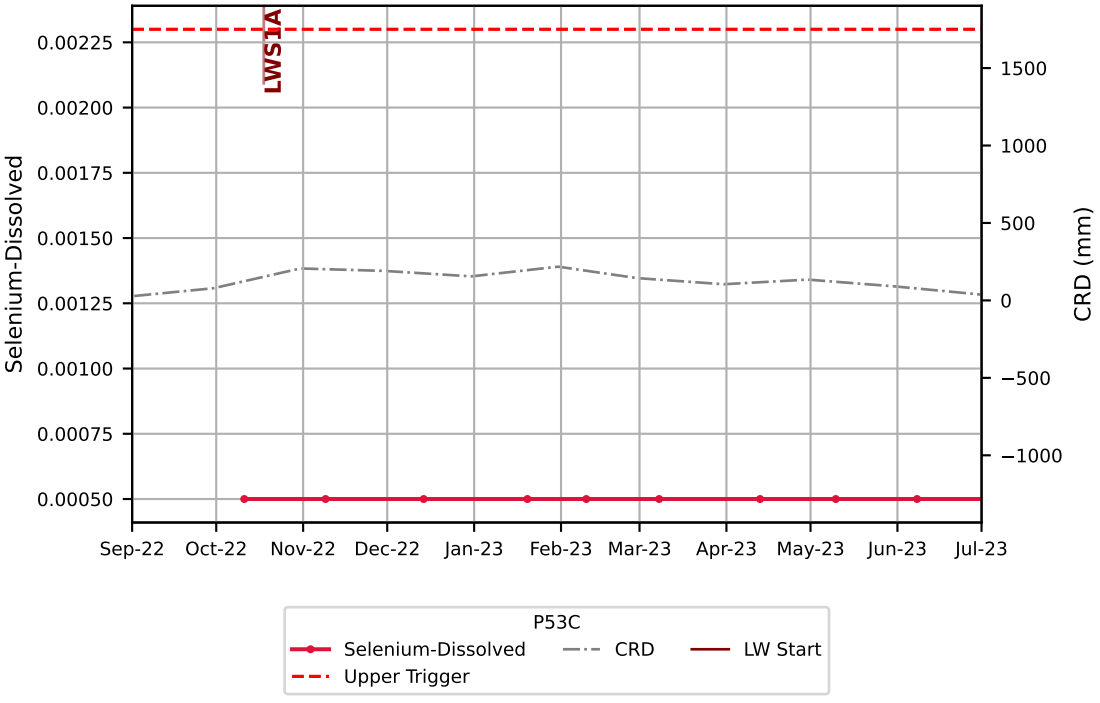

LWS1A
Aluminium-Dissolved
CRD (mm)
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

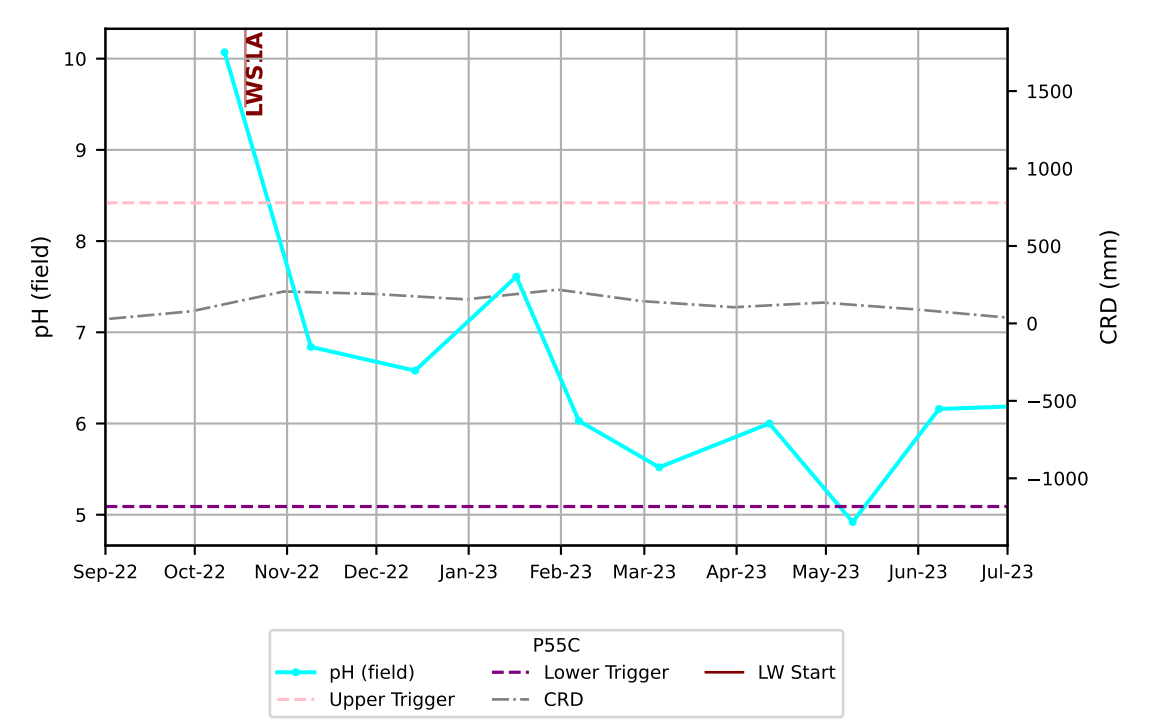

LWS1A
Arsenic-Dissolved
CRD (mm)
0.010
0.008
0.006
0.004
0.002
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

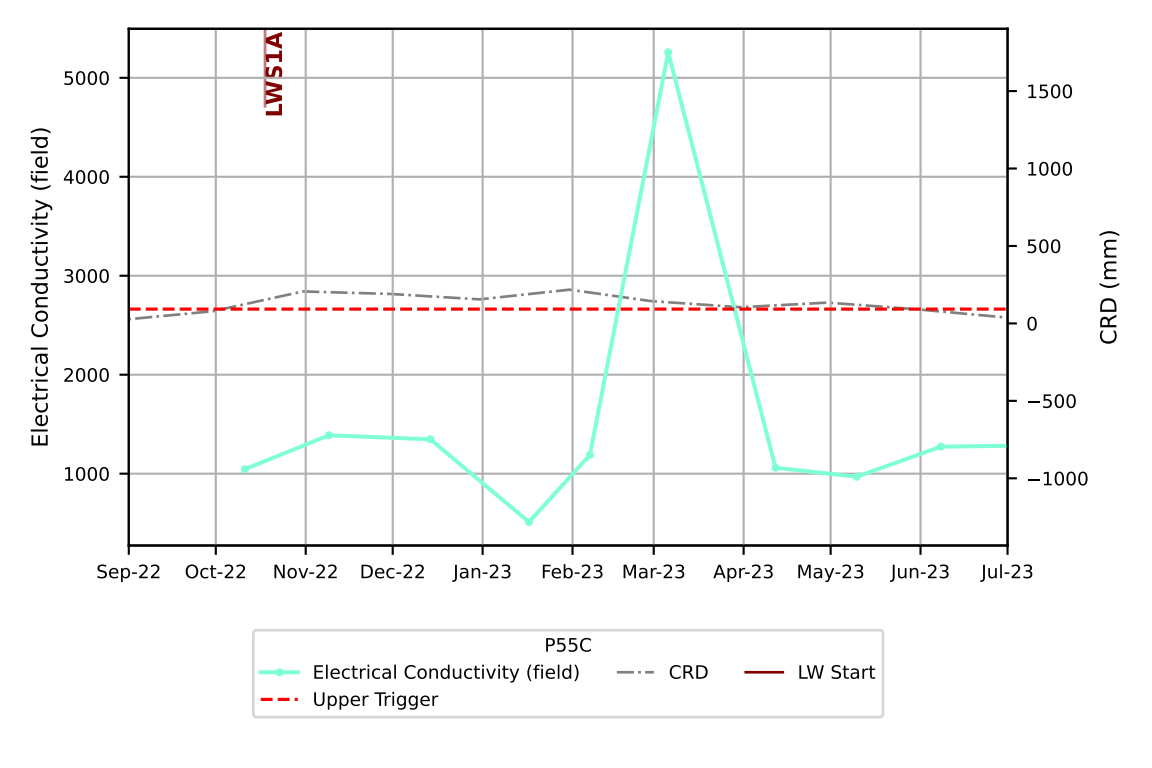

LWS1A
Strontium-Dissolved
CRD (mm)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Strontium-Dissolved
CRD
LW Start
Upper Trigger

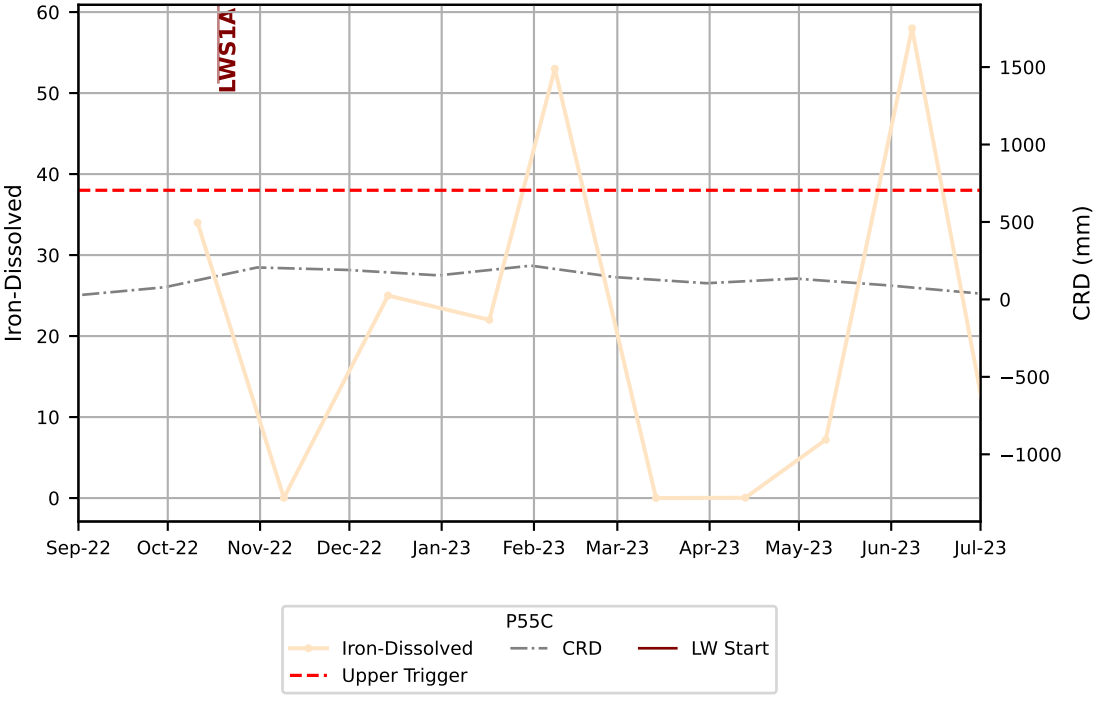

LWS1A
Lithium-Dissolved
CRD (mm)
0.05
0.04
0.03
0.02
0.01
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Lithium-Dissolved
CRD
LW Start
Upper Trigger

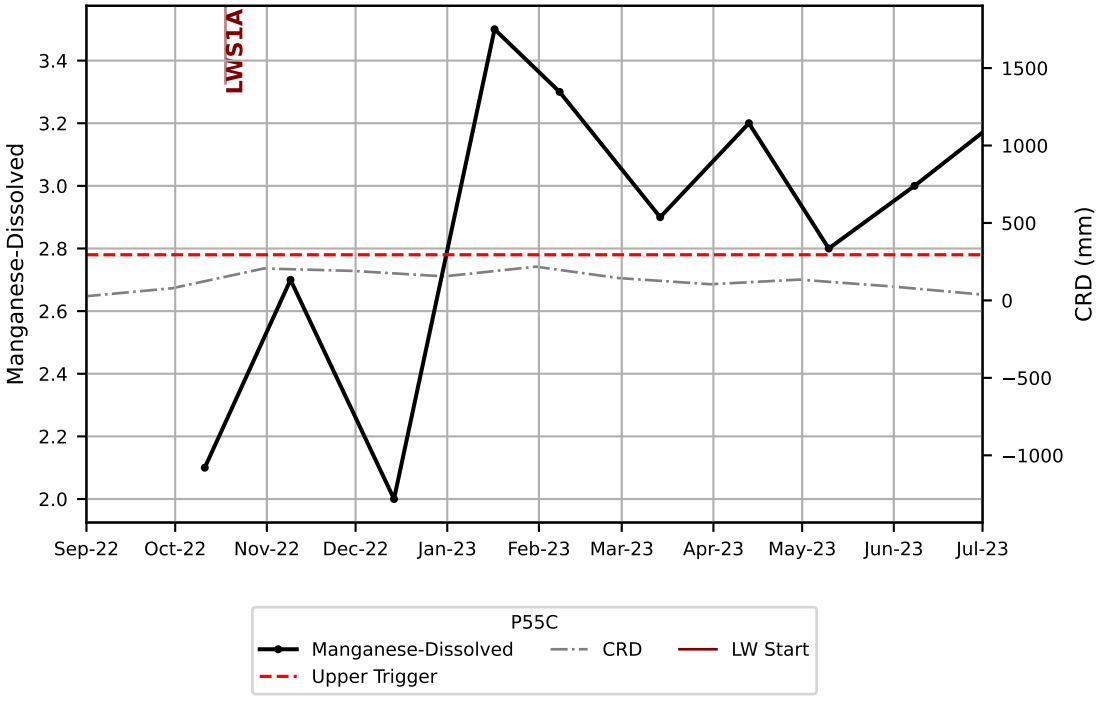

LWS1A
Barium-Dissolved
CRD (mm)
0.26
0.24
0.22
0.20
0.18
0.16
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Barium-Dissolved
CRD
LW Start
Upper Trigger

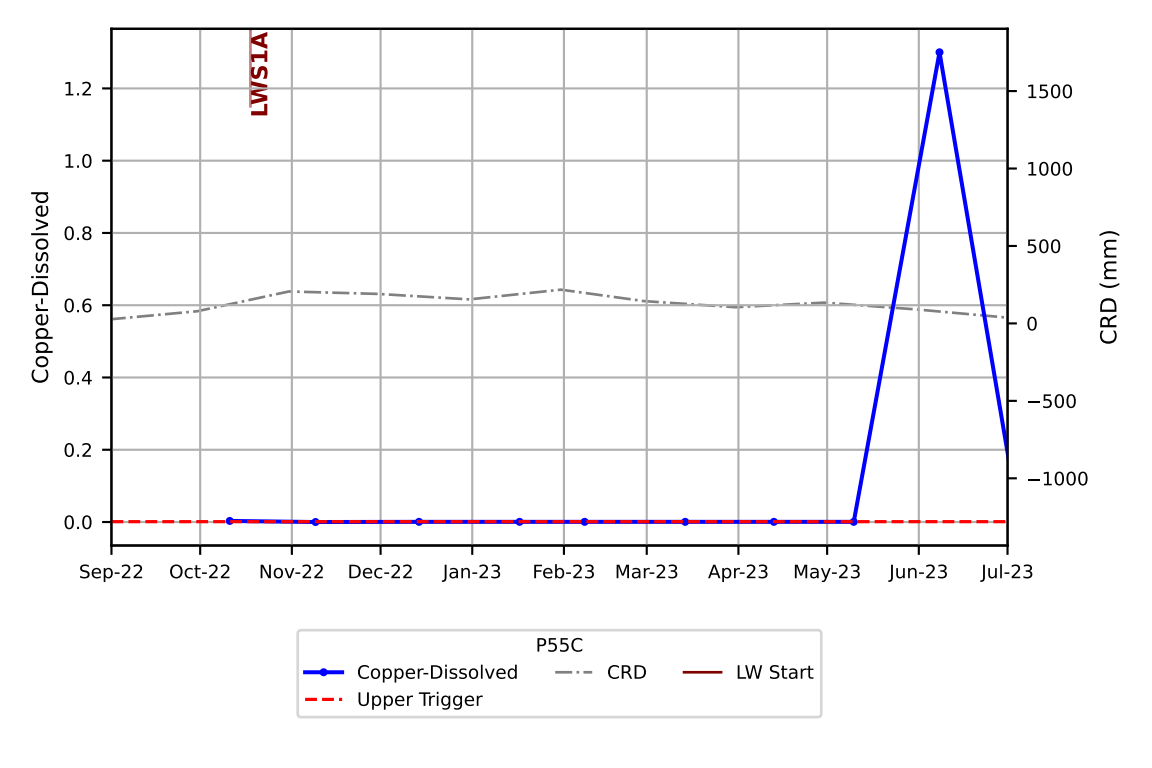

LWS1A
Selenium-Dissolved
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P53C
Selenium-Dissolved
CRD
LW Start
Upper Trigger

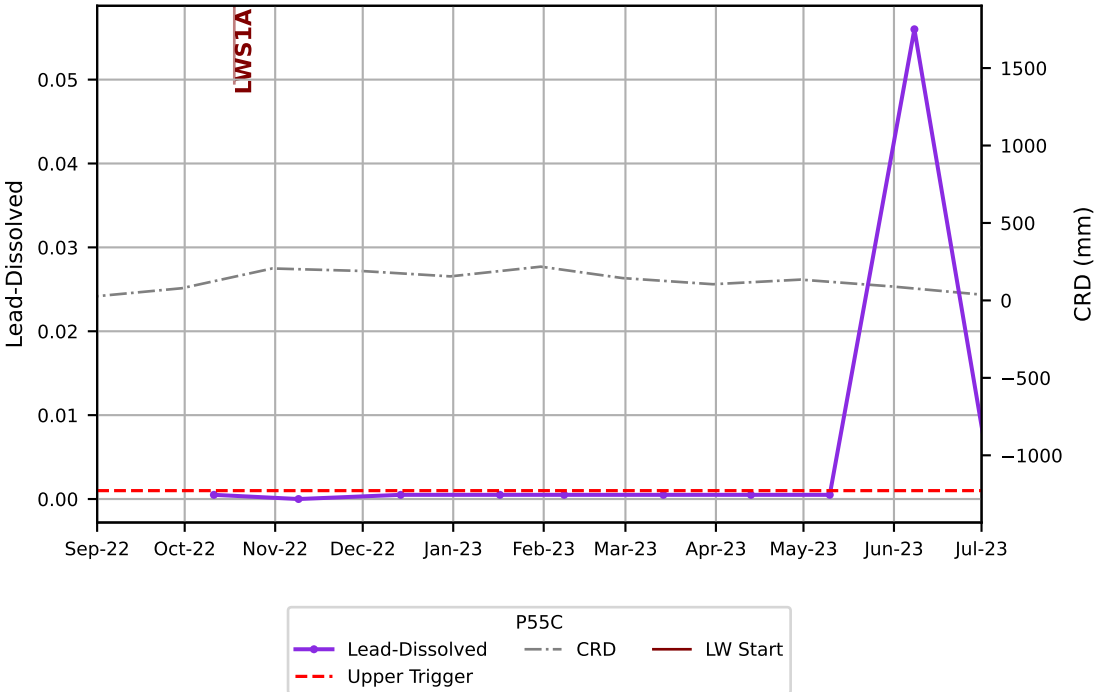

LWS1A
pH (field)
CRD (mm)
10
9
8
7
6
5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

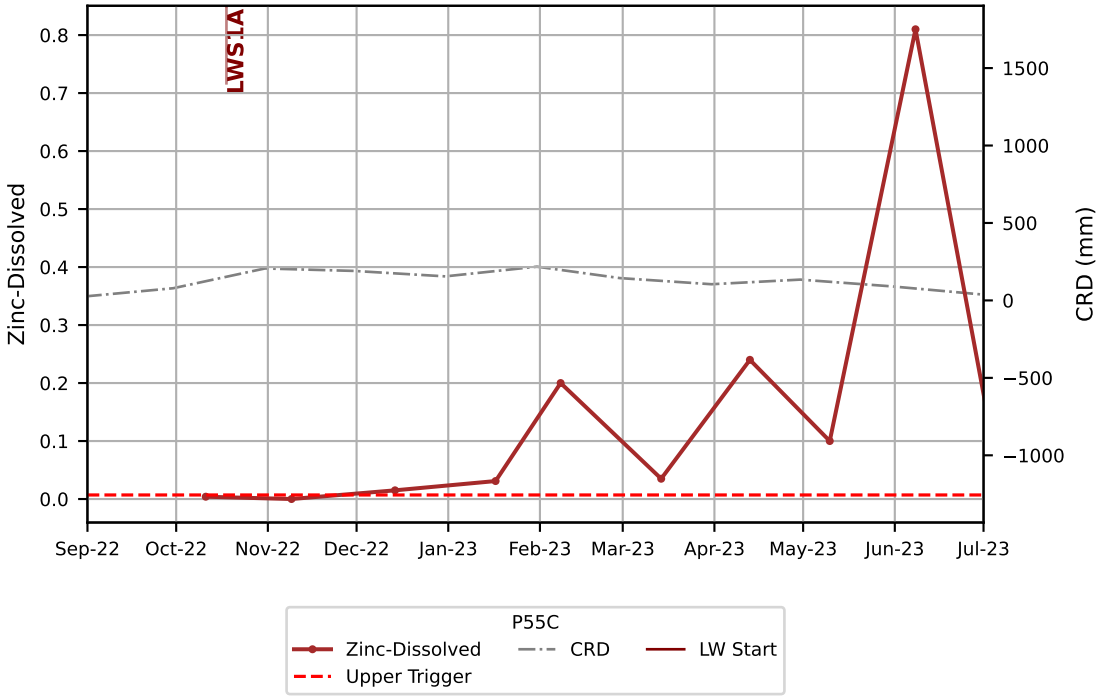

LWS1A
Electrical Conductivity (field)
CRD (mm)
5000
4000
3000
2000
1000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

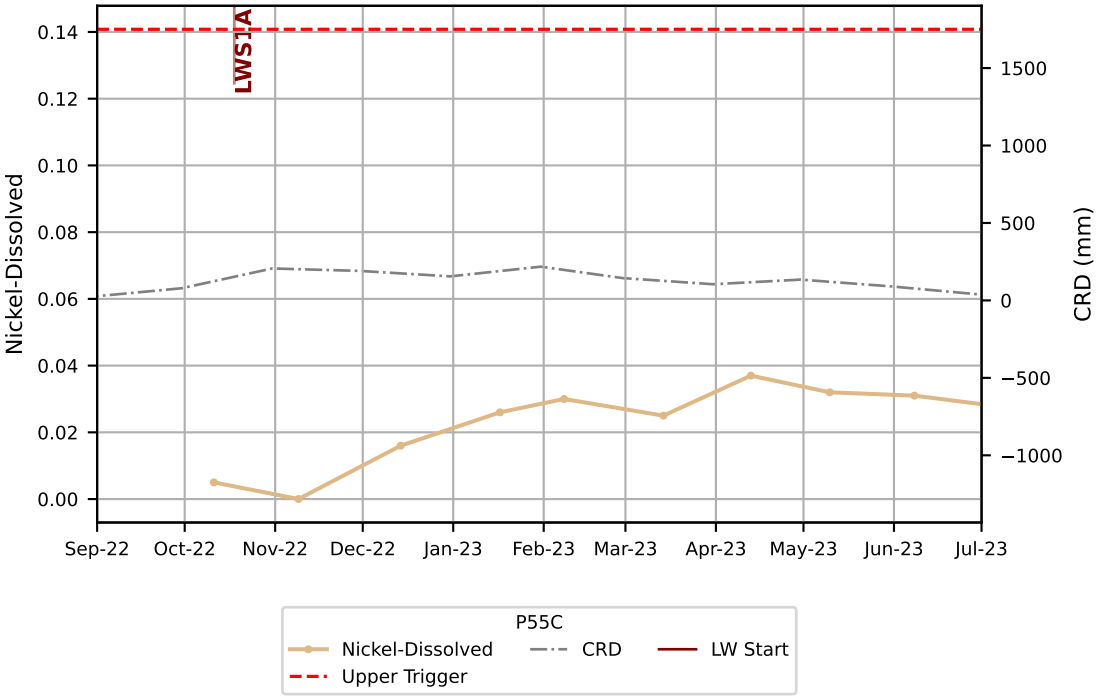

LWS1A
Iron-Dissolved
CRD (mm)
60
50
40
30
20
10
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Iron-Dissolved
CRD
LW Start
Upper Trigger

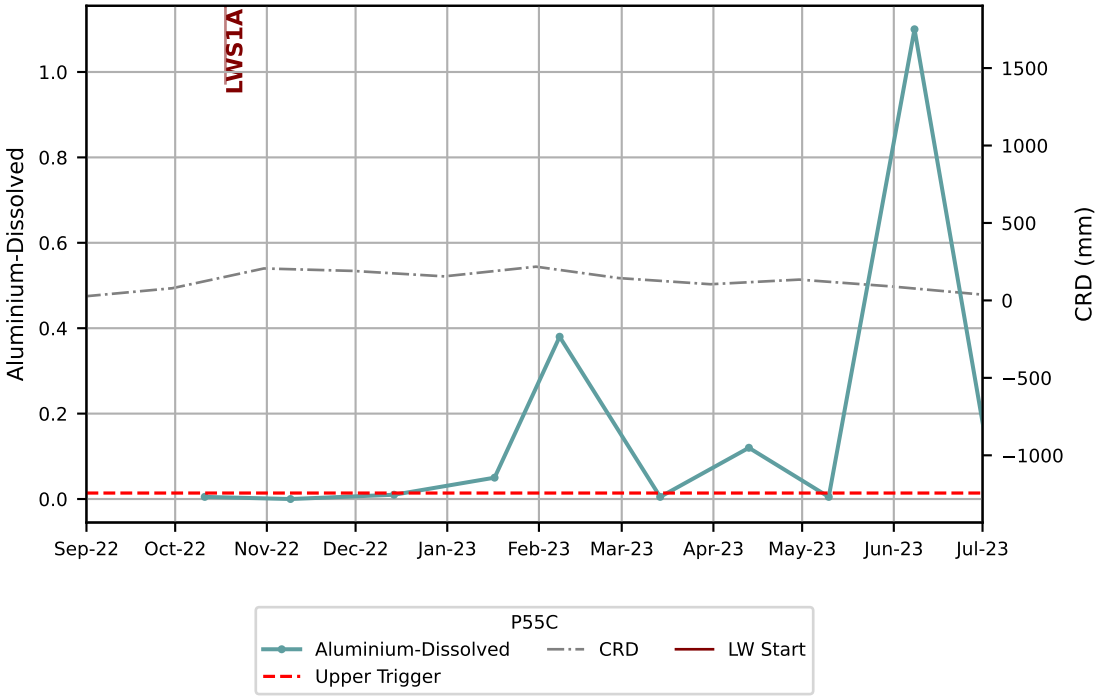

LWS1A
Manganese-Dissolved
CRD (mm)
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Manganese-Dissolved
CRD
LW Start
Upper Trigger

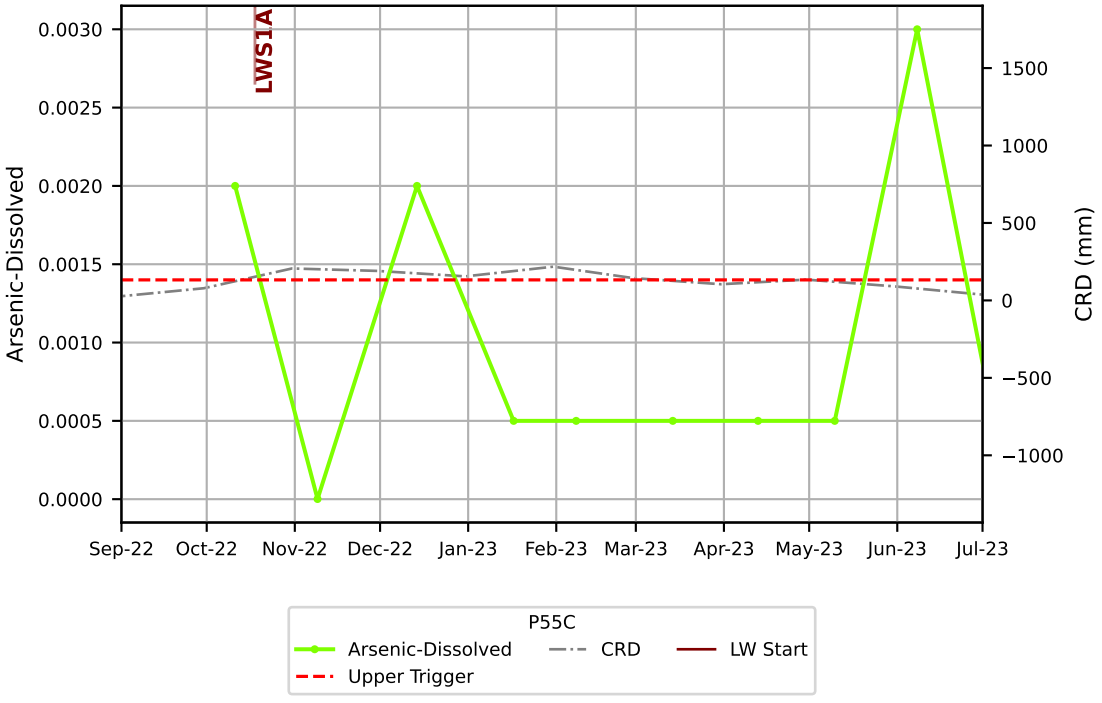

LWS1A
Copper-Dissolved
CRD (mm)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Copper-Dissolved
CRD
LW Start
Upper Trigger

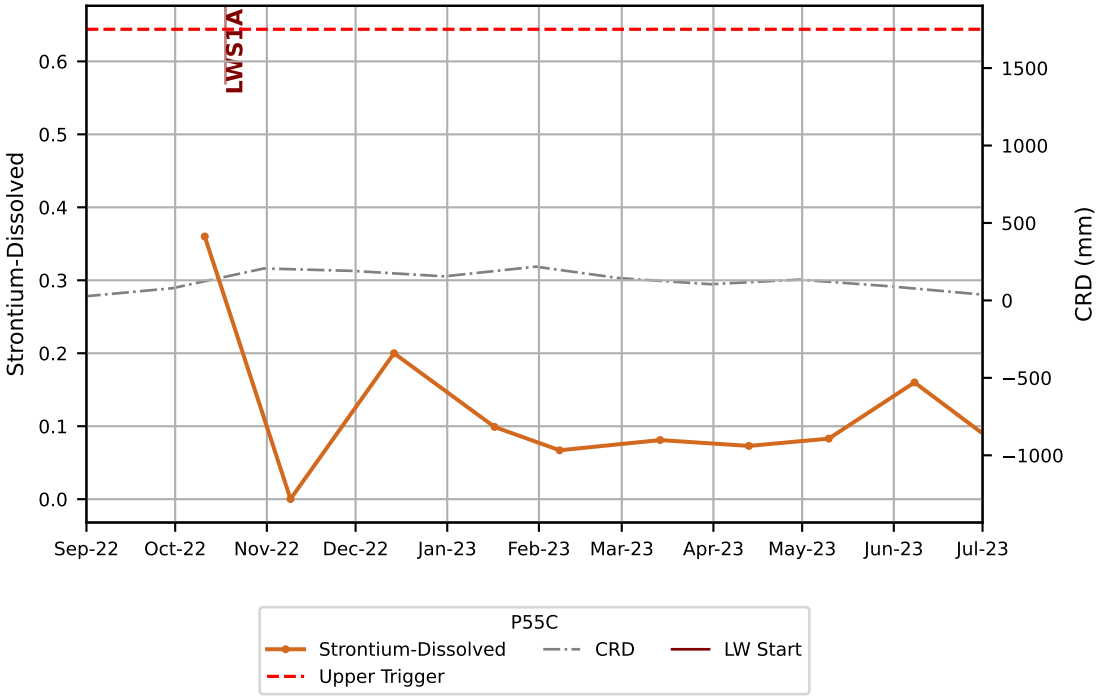

LWS1A
Lead-Dissolved
CRD (mm)
0.05
0.04
0.03
0.02
0.01
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Lead-Dissolved
CRD
LW Start
Upper Trigger

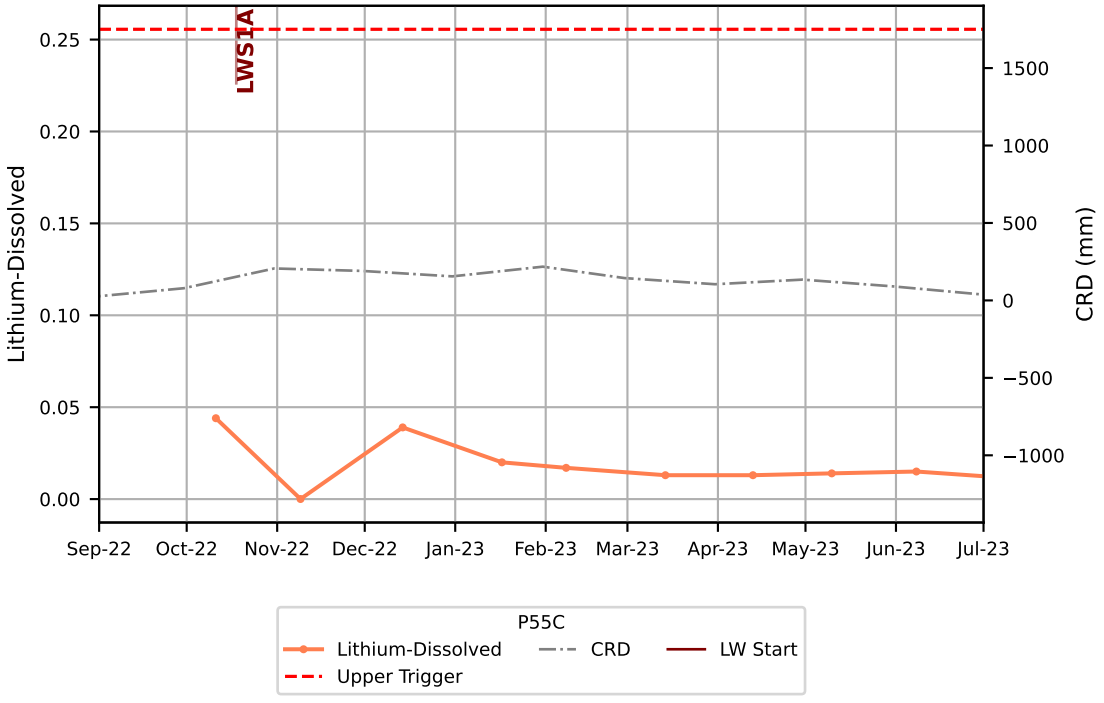

LWS1A
Zinc-Dissolved
CRD (mm)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Zinc-Dissolved
CRD
LW Start
Upper Trigger

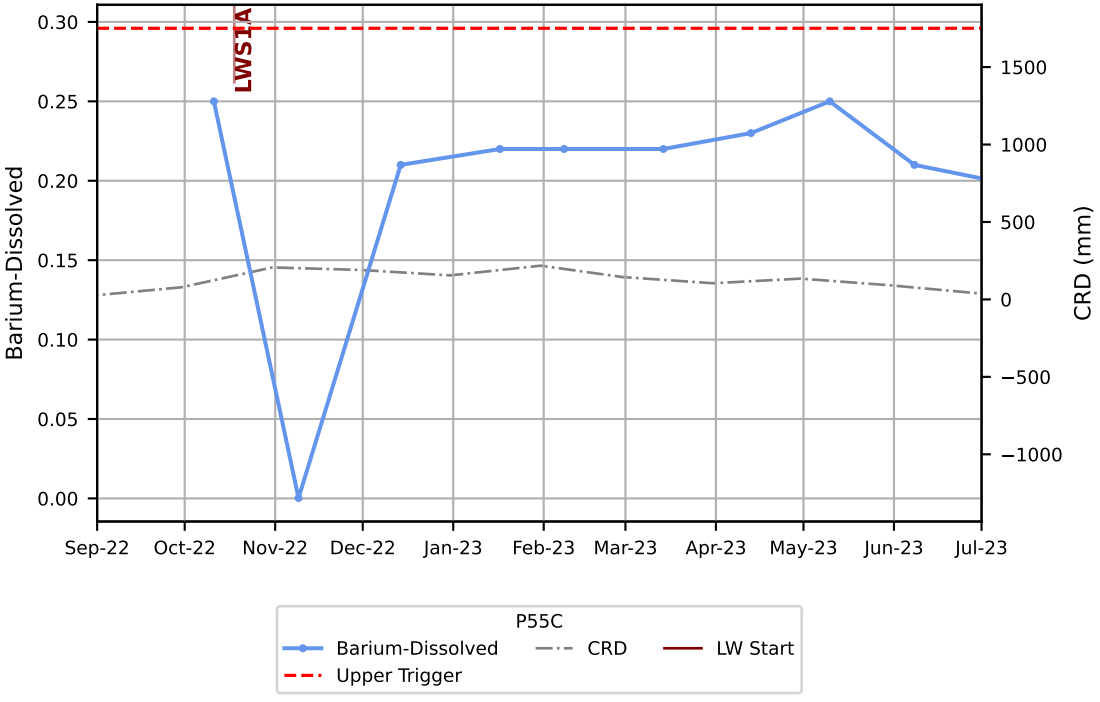

LWS1A
Nickel-Dissolved
CRD (mm)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Nickel-Dissolved
CRD
LW Start
Upper Trigger

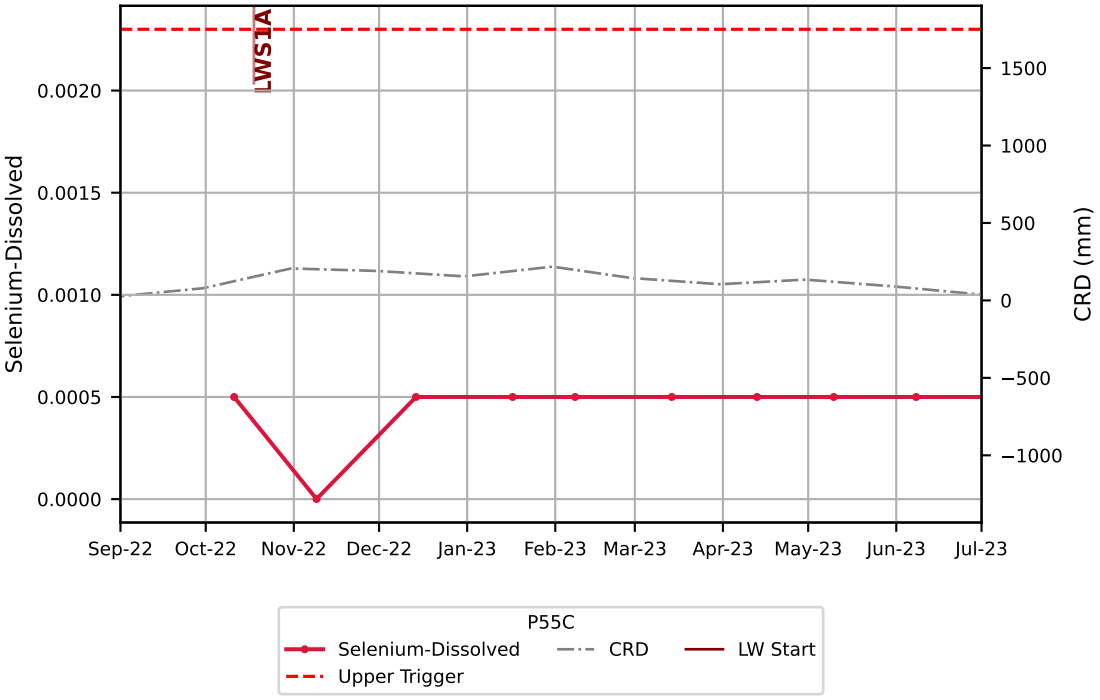

LWS1A
Aluminium-Dissolved
CRD (mm)
1.0
0.8
0.6
0.4
0.2
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

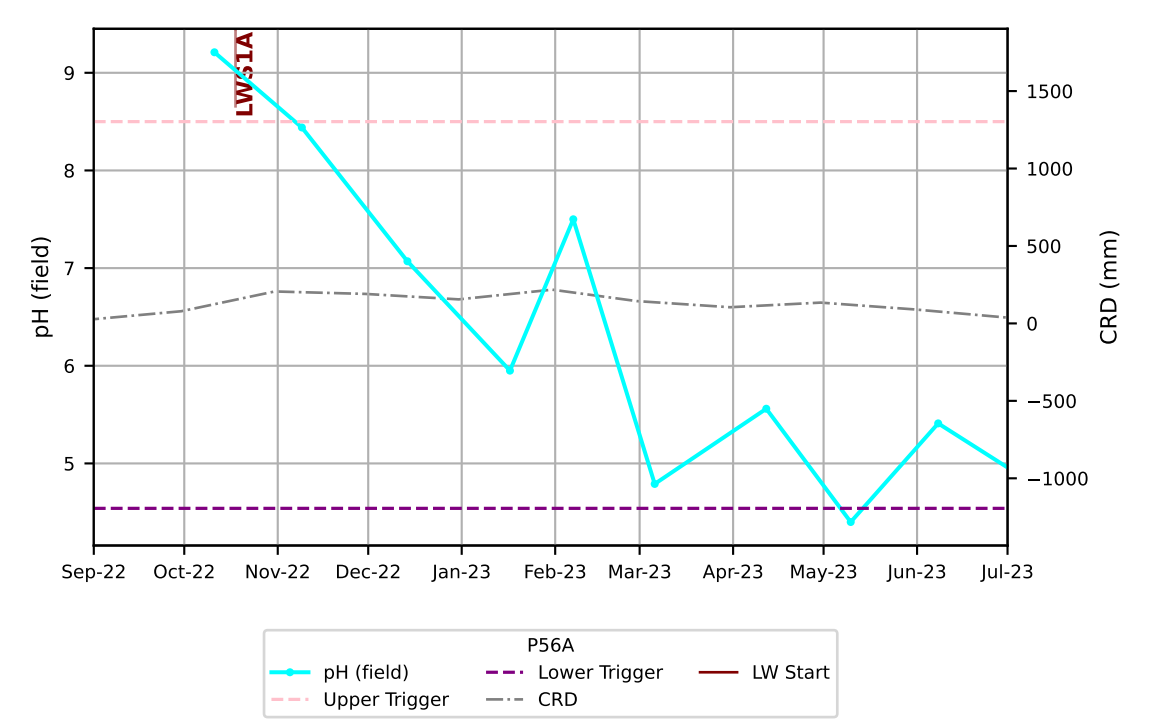

LWS1A
Arsenic-Dissolved
CRD (mm)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

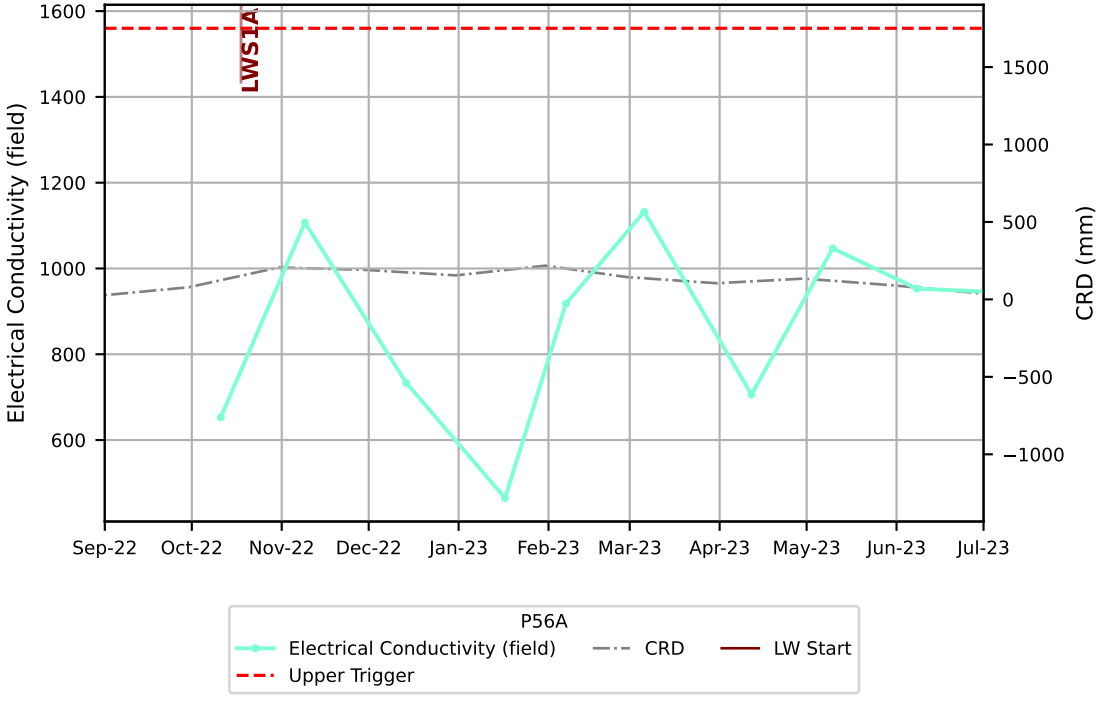

LWSIA
Strontium-Dissolved
CRD (mm)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Strontium-Dissolved
CRD
LW Start
Upper Trigger

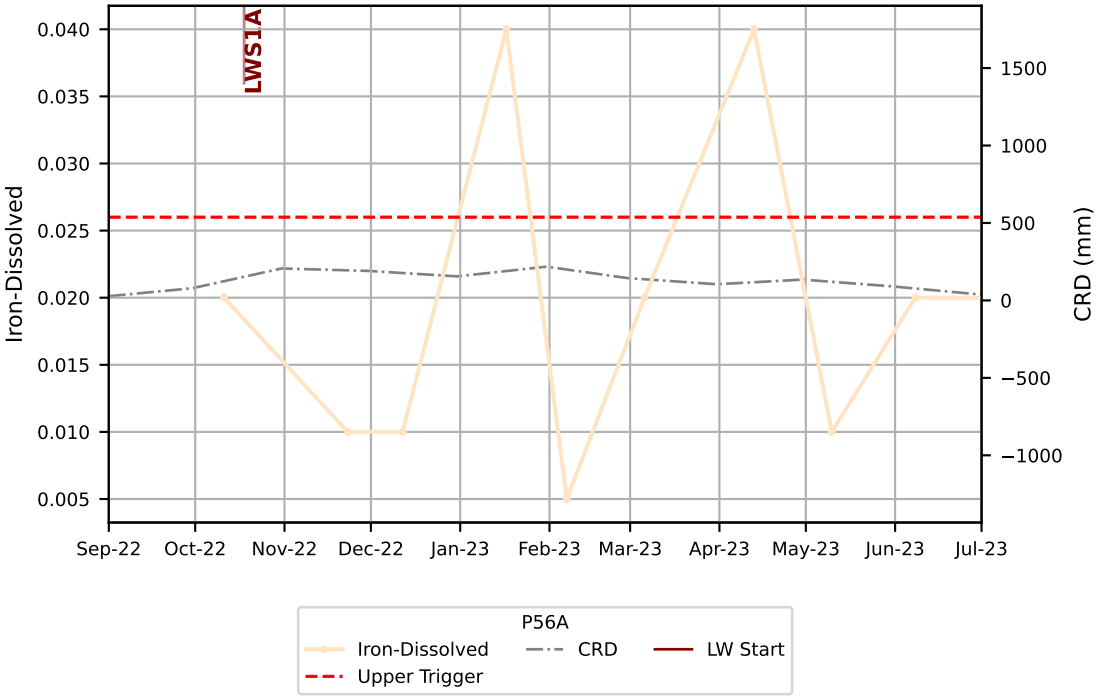

LWS1A
Lithium-Dissolved
CRD (mm)
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Lithium-Dissolved
CRD
LW Start
Upper Trigger

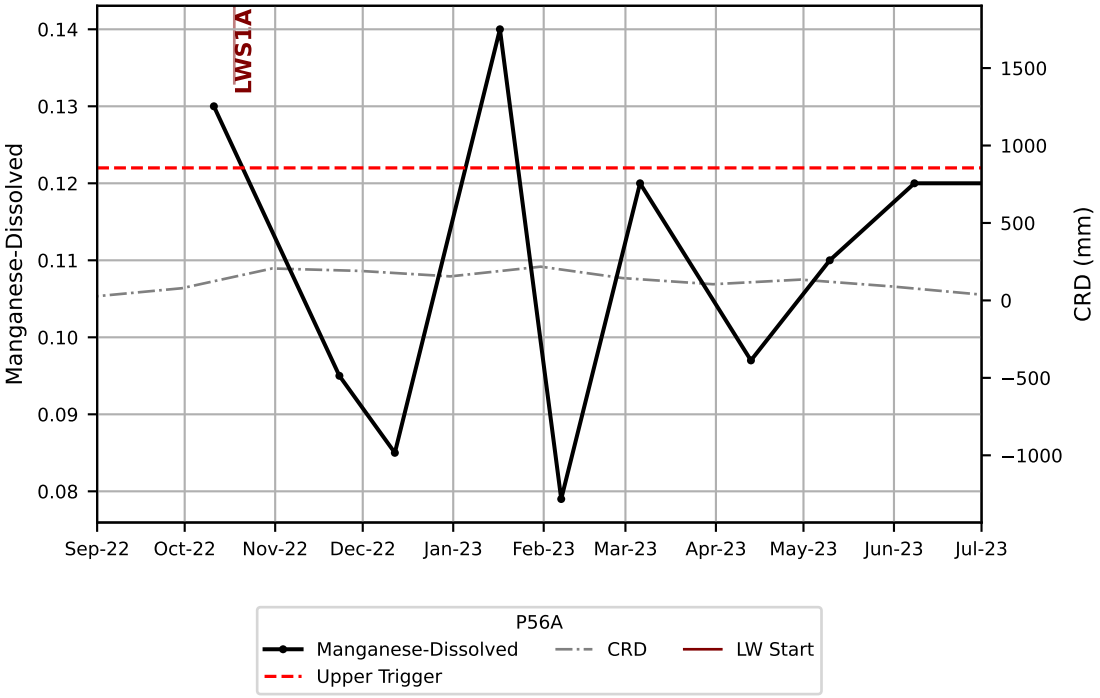

LWS1A
Barium-Dissolved
CRD (mm)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Barium-Dissolved
CRD
LW Start
Upper Trigger

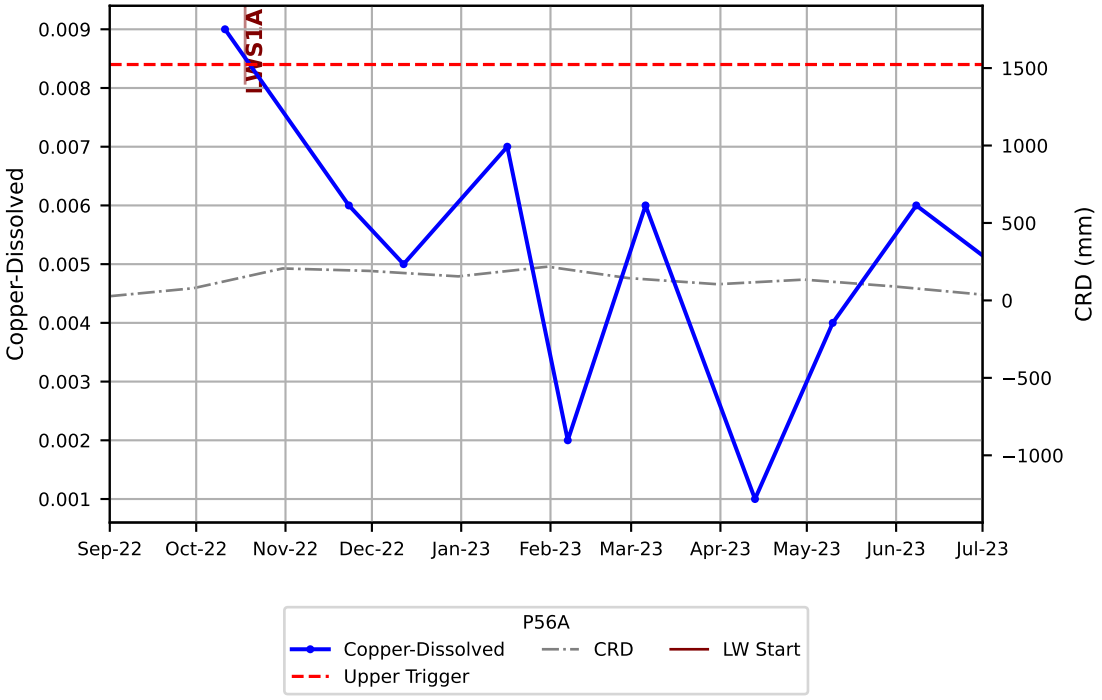

LW1A
Selenium-Dissolved
0.0020
0.0015
0.0010
0.0005
0.0000
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55C
Selenium-Dissolved
CRD
LW Start
Upper Trigger

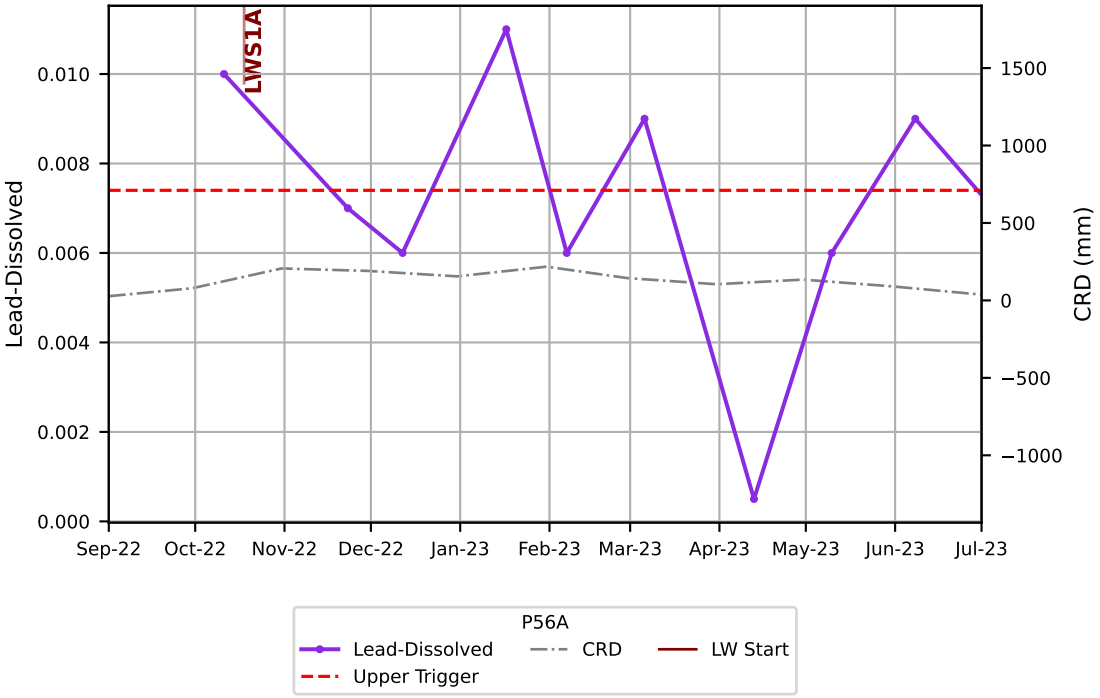

LW51A
pH (field)
CRD (mm)
9
8
7
6
5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

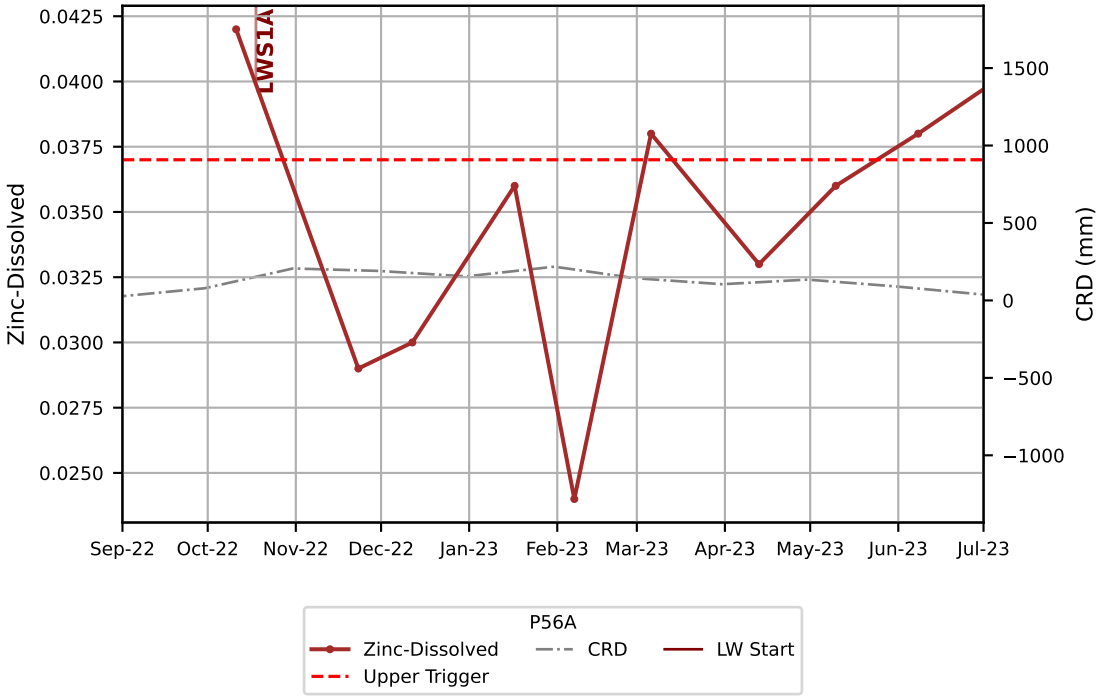

LW1A
Electrical Conductivity (field)
CRD (mm)
1600
1400
1200
1000
800
600
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

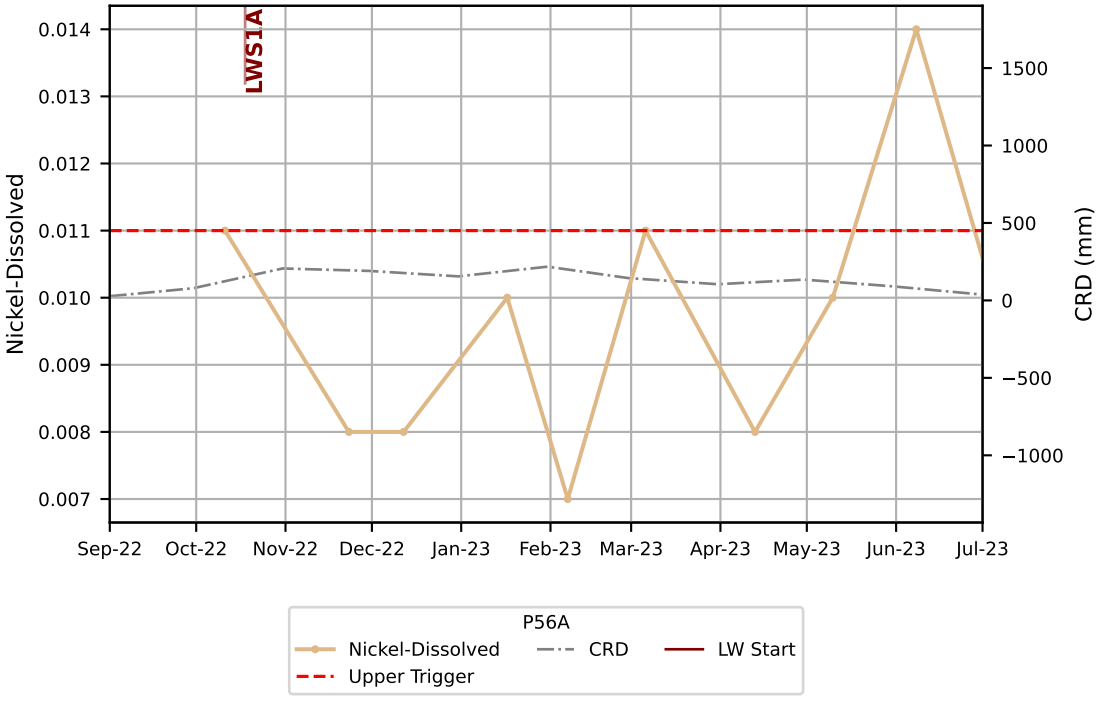

LWS1A
Iron-Dissolved
CRD (mm)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Iron-Dissolved
CRD
LW Start
Upper Trigger

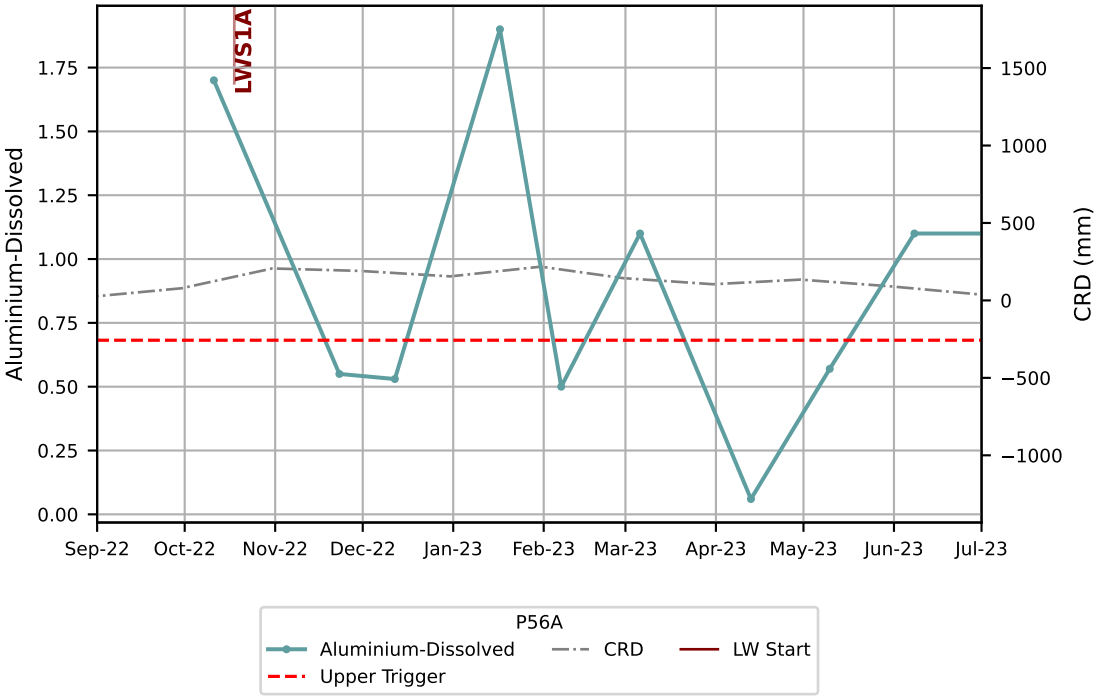

LWS1A
Manganese-Dissolved
CRD (mm)
0.14
0.13
0.12
0.11
0.10
0.09
0.08
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Manganese-Dissolved
CRD
LW Start
Upper Trigger

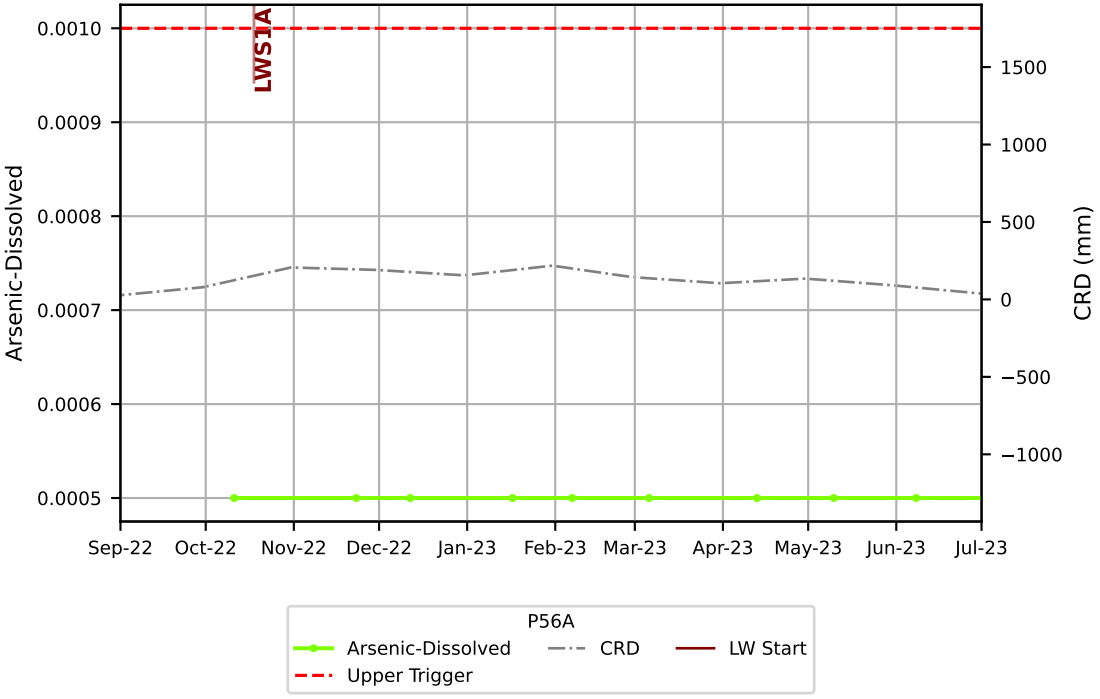

LWS1A
Copper-Dissolved
CRD (mm)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Copper-Dissolved
CRD
LW Start
Upper Trigger

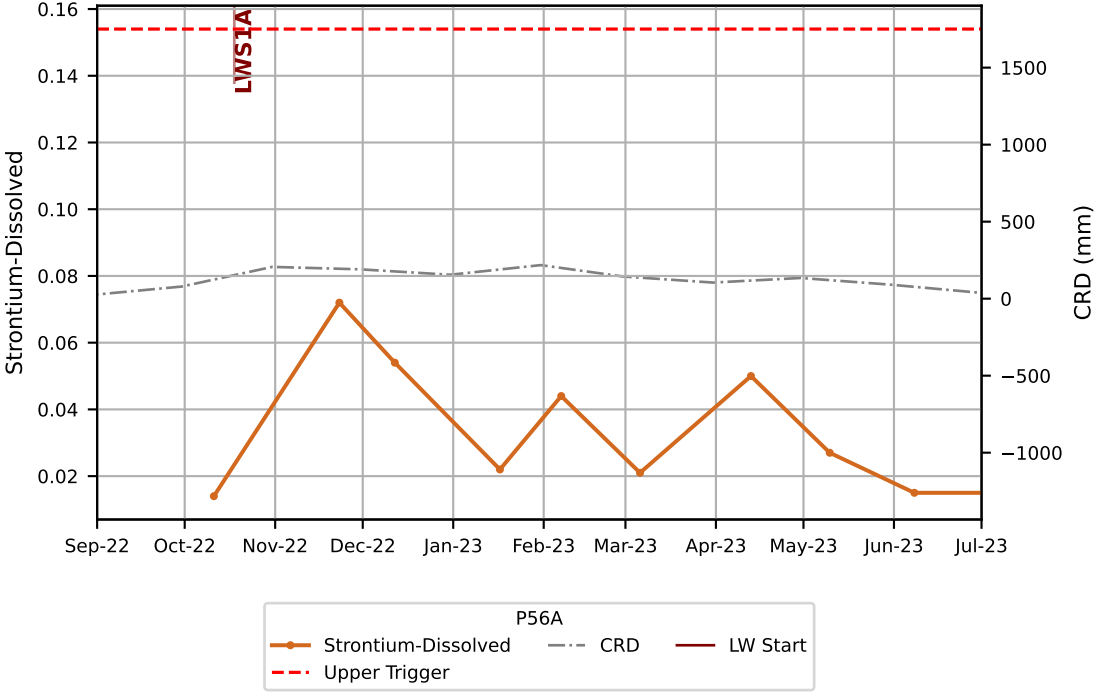

LWS1A
Lead-Dissolved
CRD (mm)
0.000
0.002
0.004
0.006
0.008
0.010
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Lead-Dissolved
CRD
LW Start
Upper Trigger

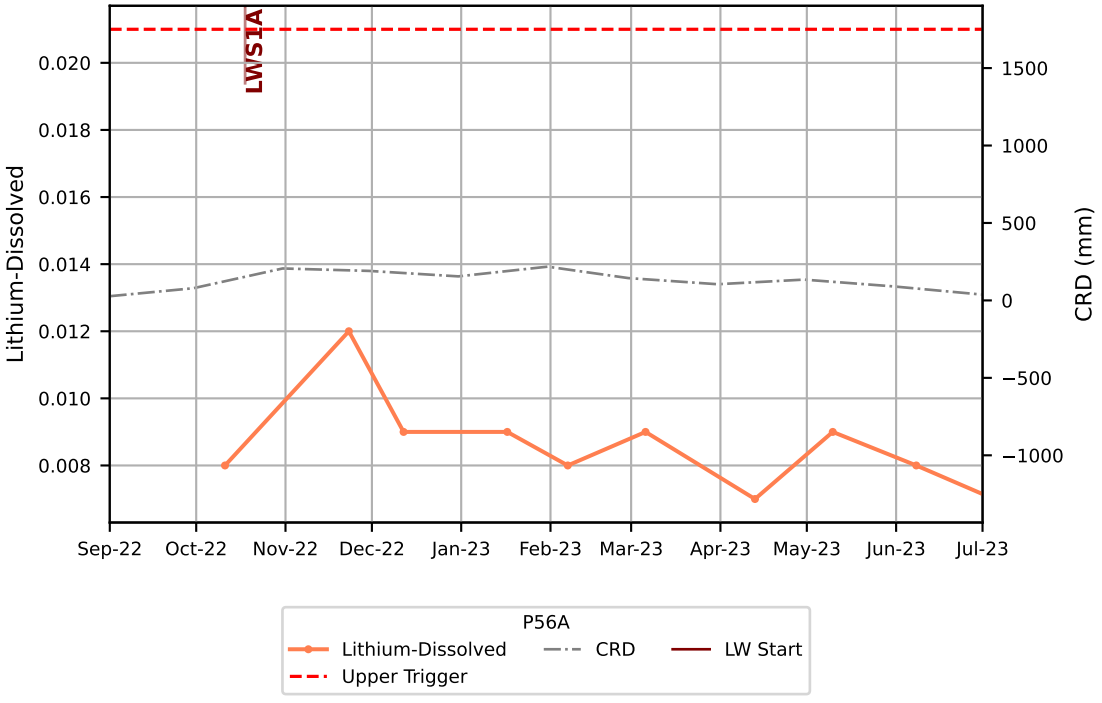

LWS1A
Zinc-Dissolved
CRD (mm)
0.0425
0.0400
0.0375
0.0350
0.0325
0.0300
0.0275
0.0250
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Zinc-Dissolved
CRD
LW Start
Upper Trigger

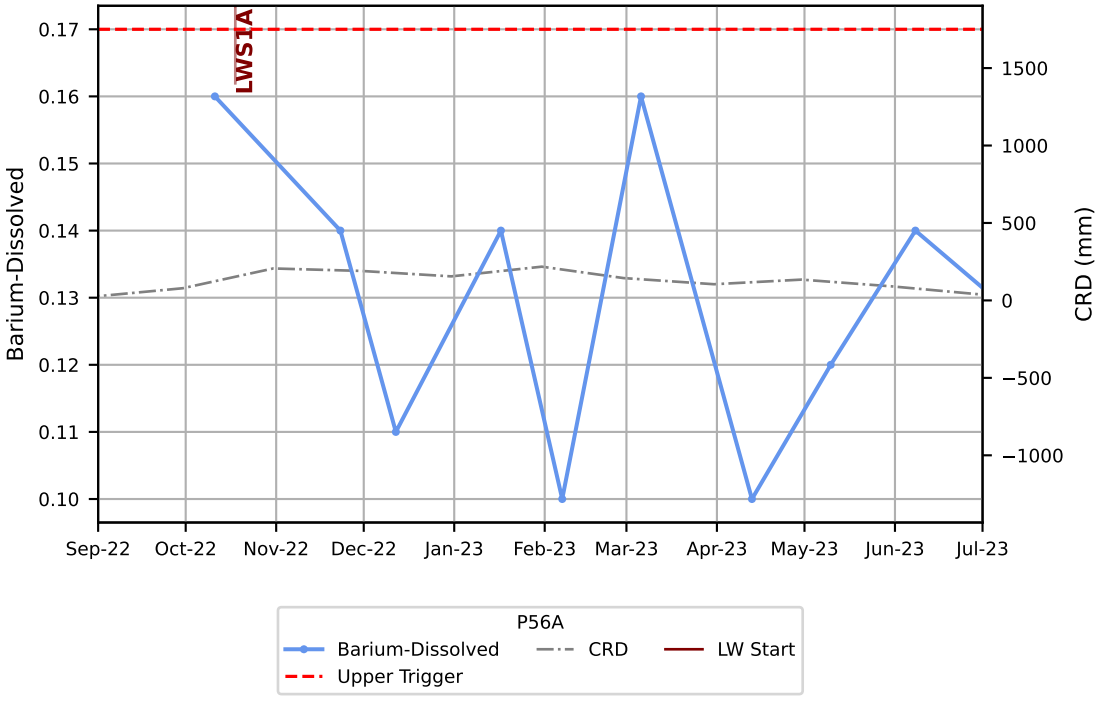

LWS1A
Nickel-Dissolved
CRD (mm)
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Nickel-Dissolved
CRD
LW Start
Upper Trigger

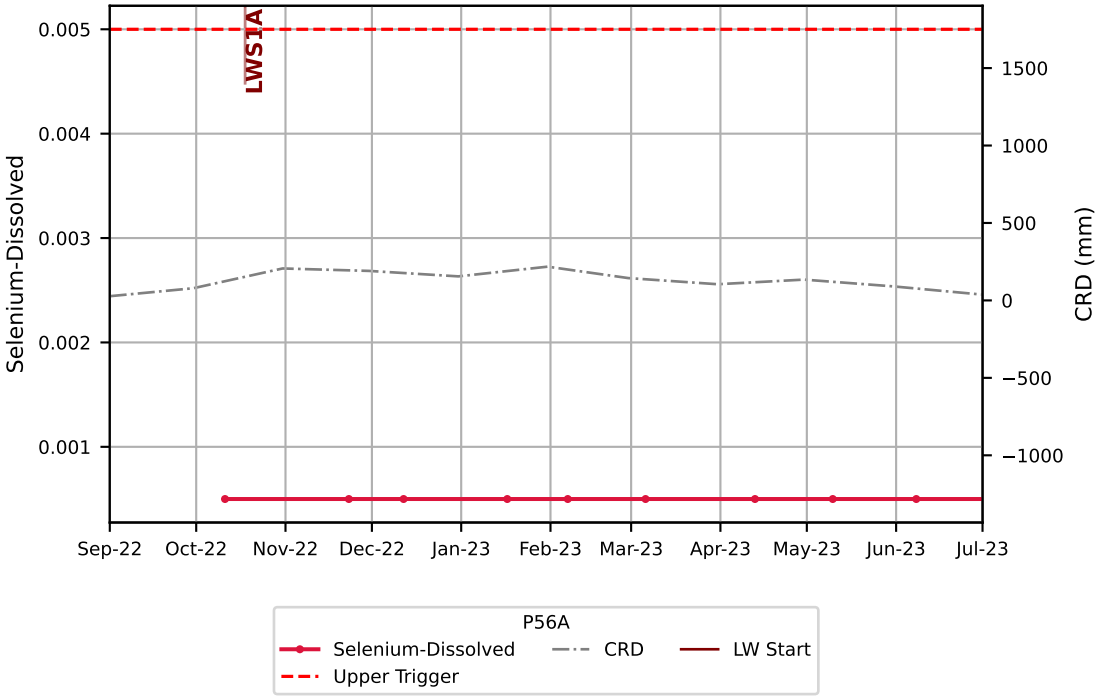

LWS1A
Aluminium-Dissolved
CRD (mm)
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

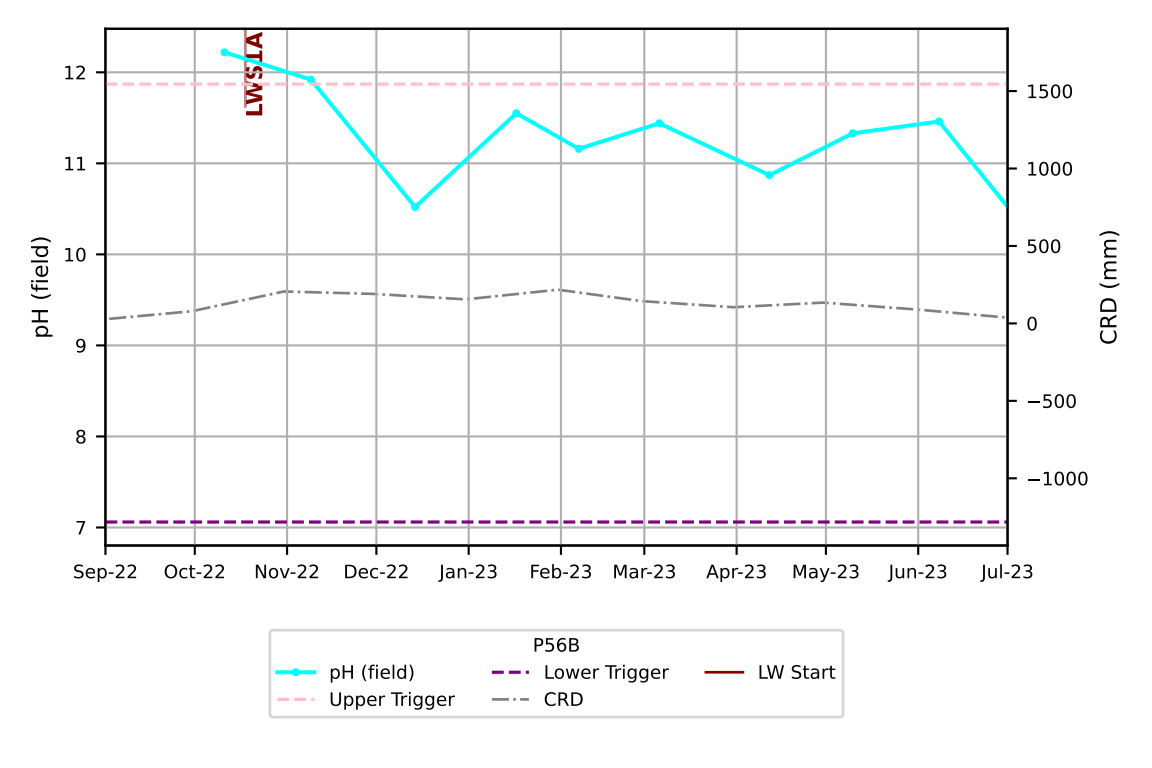

LWS1A
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
Arsenic-Dissolved
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

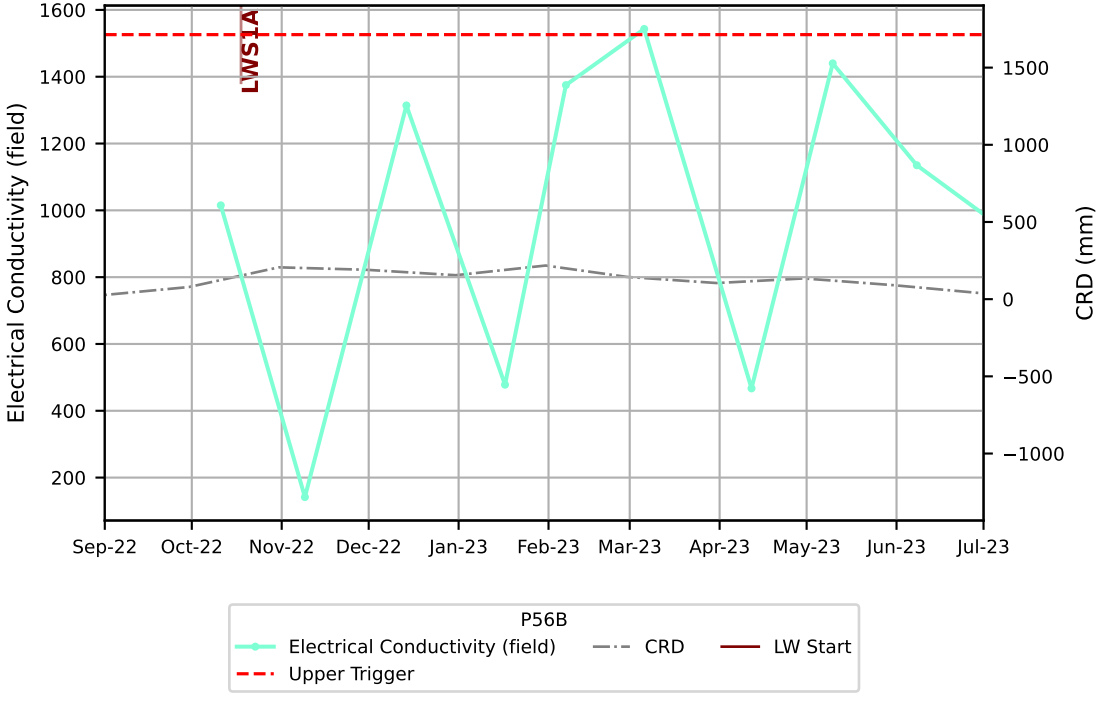

LWS1A
Strontium-Dissolved
CRD (mm)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Strontium-Dissolved
CRD
LW Start
Upper Trigger

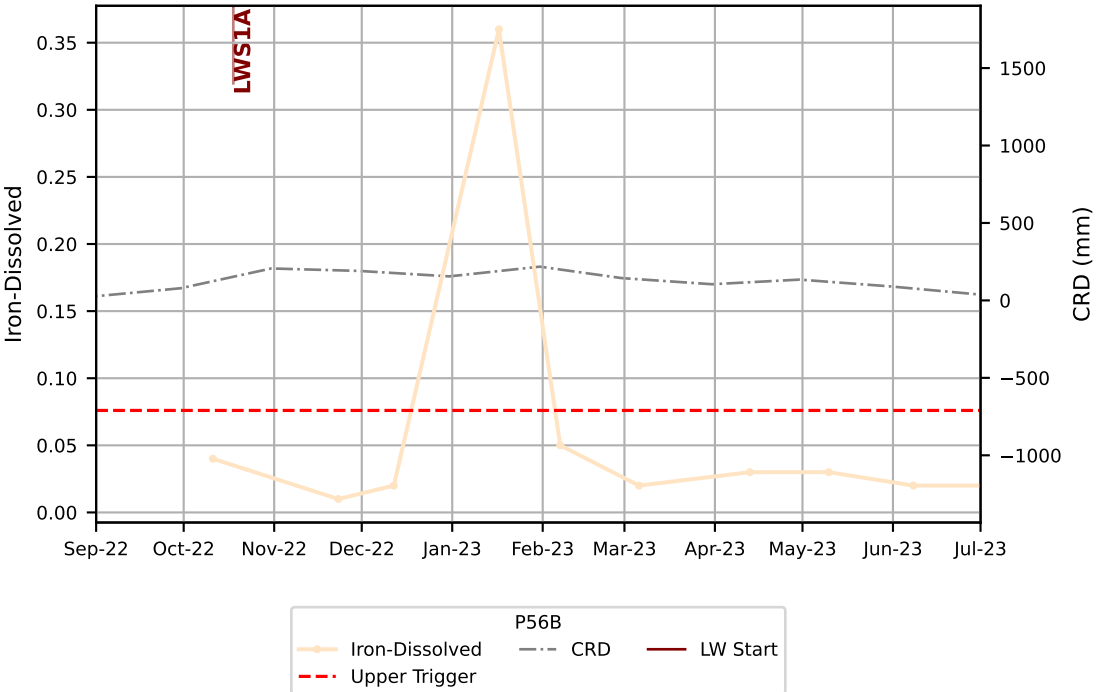

LWS1A
Lithium-Dissolved
0.020
0.018
0.016
0.014
0.012
0.010
0.008
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Lithium-Dissolved
CRD
LW Start
Upper Trigger

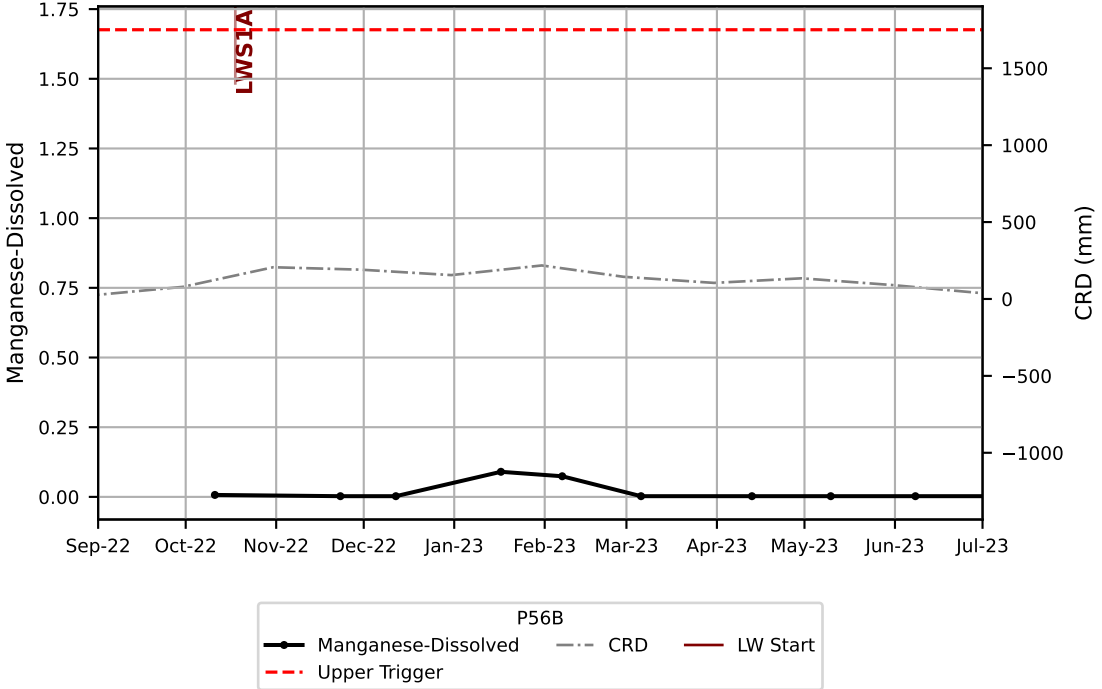

LWS1A
Barium-Dissolved
CRD (mm)
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Barium-Dissolved
CRD
LW Start
Upper Trigger

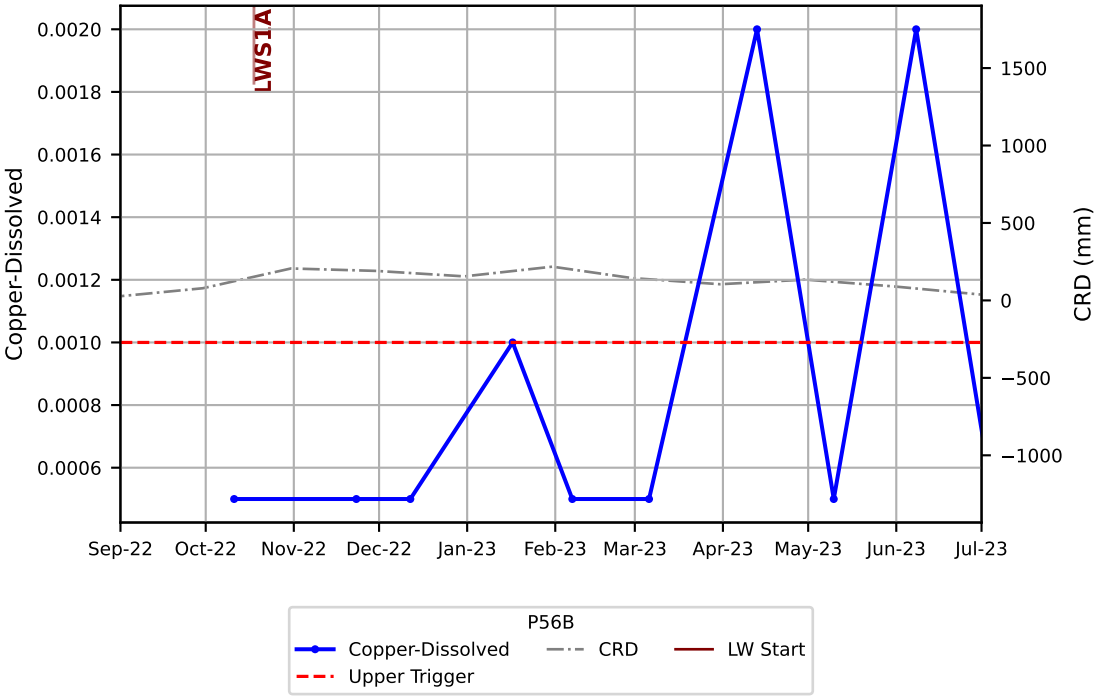

LWS1A
Selenium-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56A
Selenium-Dissolved
CRD
LW Start
Upper Trigger

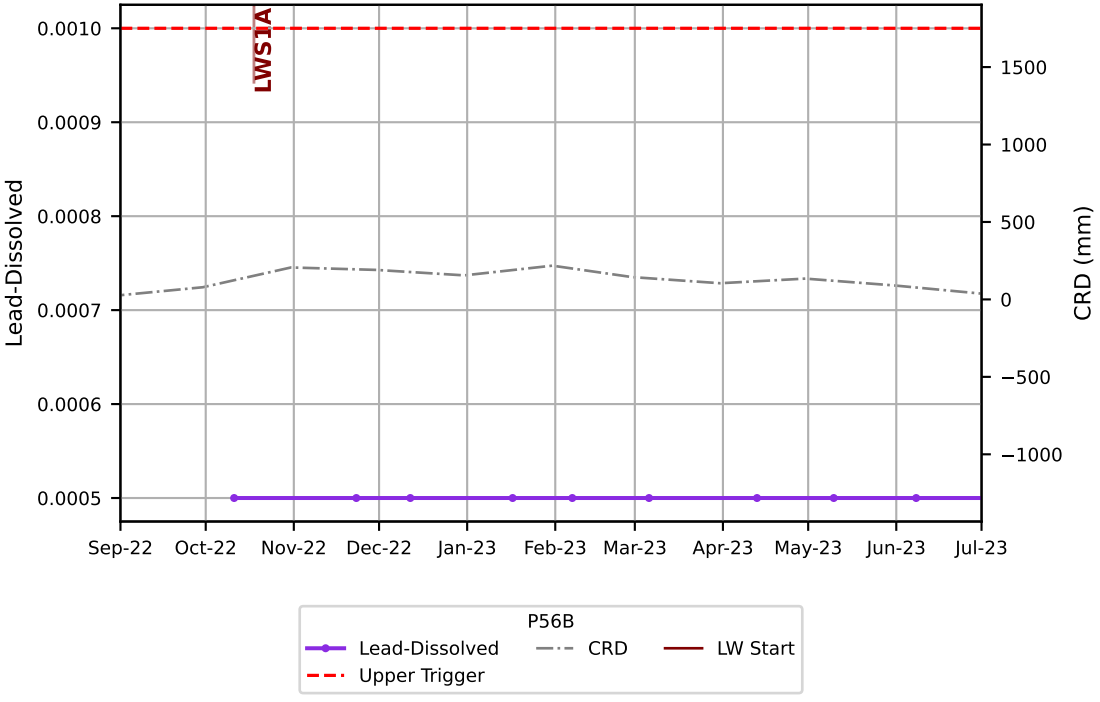

LW Start
pH (field)
CRD (mm)
12
11
10
9
8
7
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

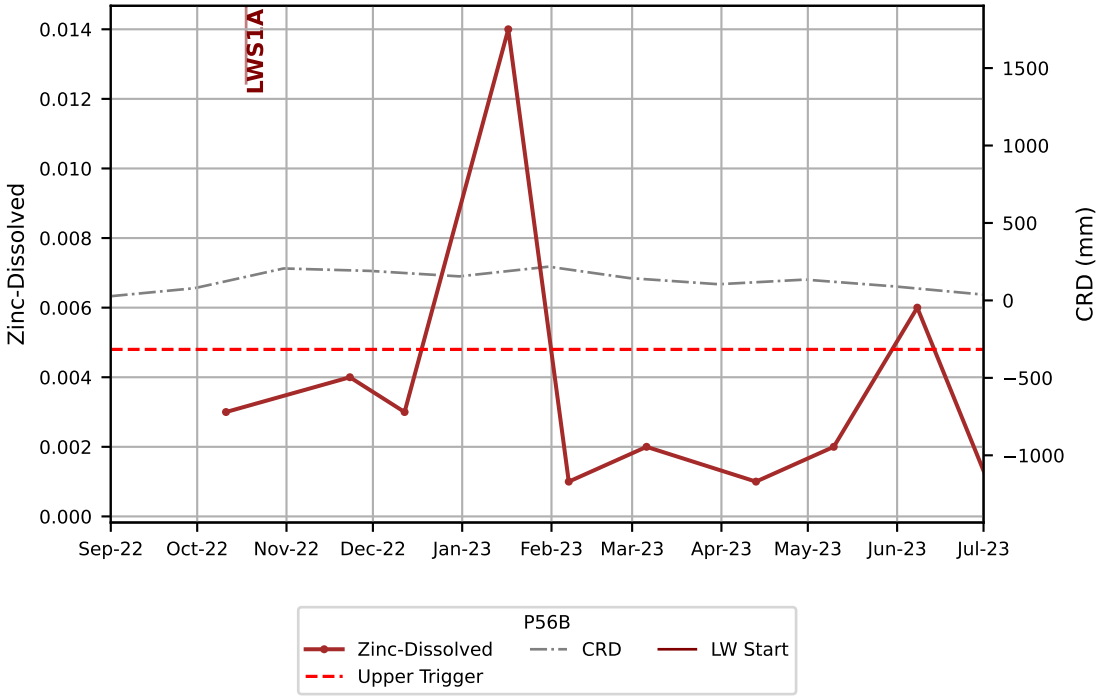

LWS1A
Electrical Conductivity (field)
CRD (mm)
1600
1400
1200
1000
800
600
400
200
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

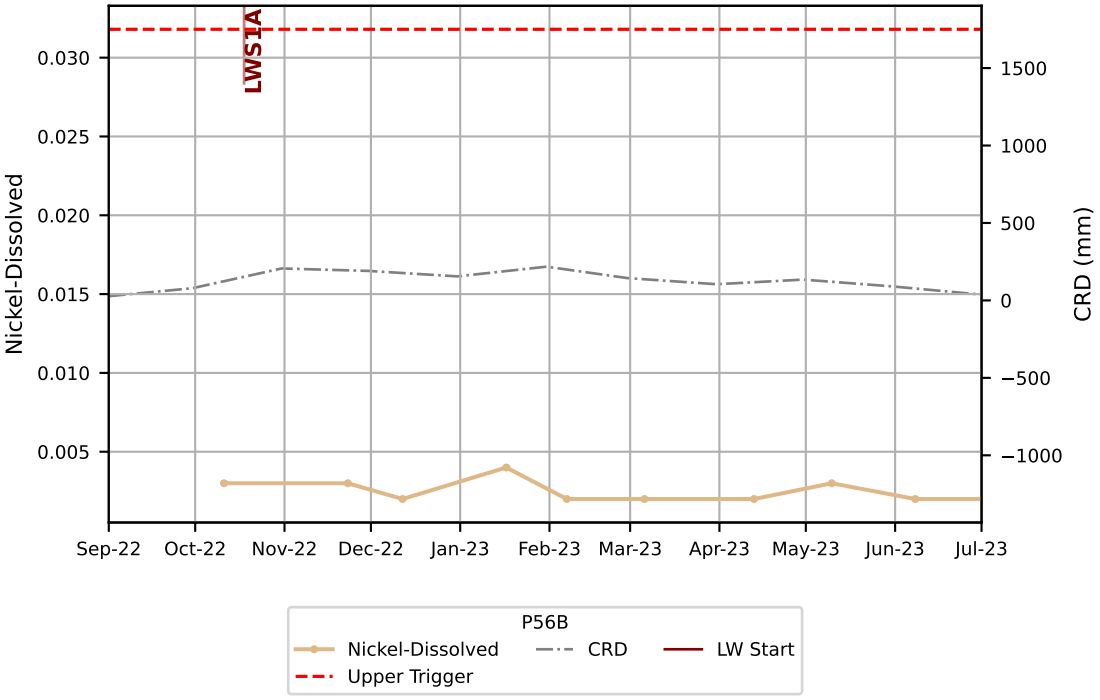

LWS1A
Iron-Dissolved
CRD (mm)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Iron-Dissolved
CRD
LW Start
Upper Trigger

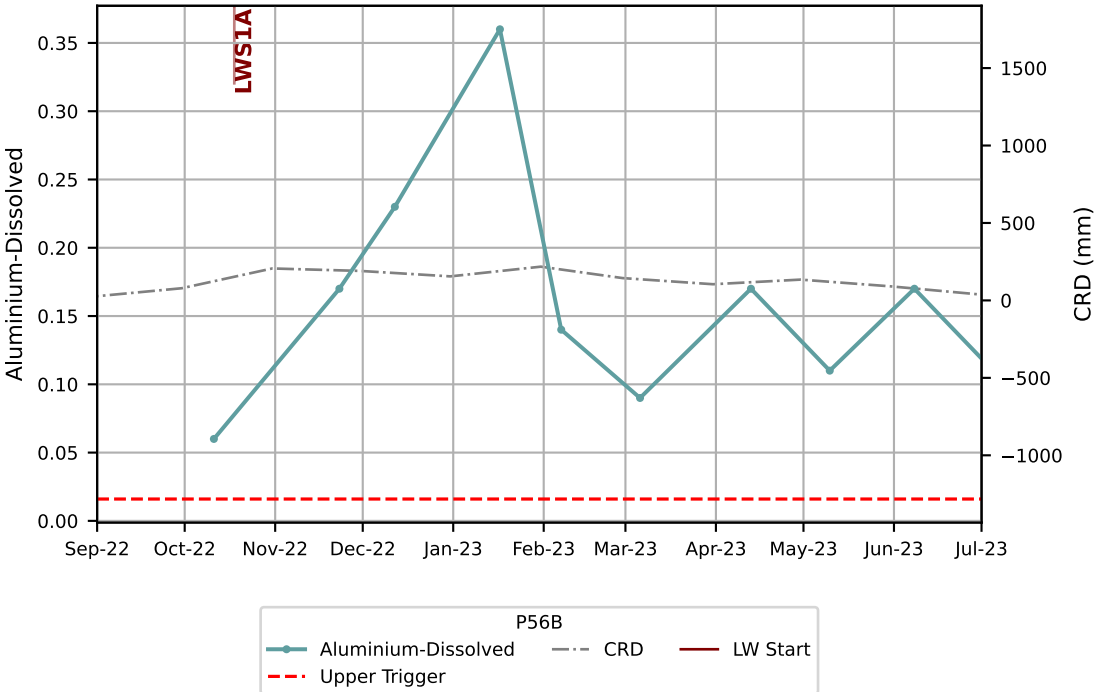

LWS1A
Manganese-Dissolved
CRD (mm)
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Manganese-Dissolved
CRD
LW Start
Upper Trigger

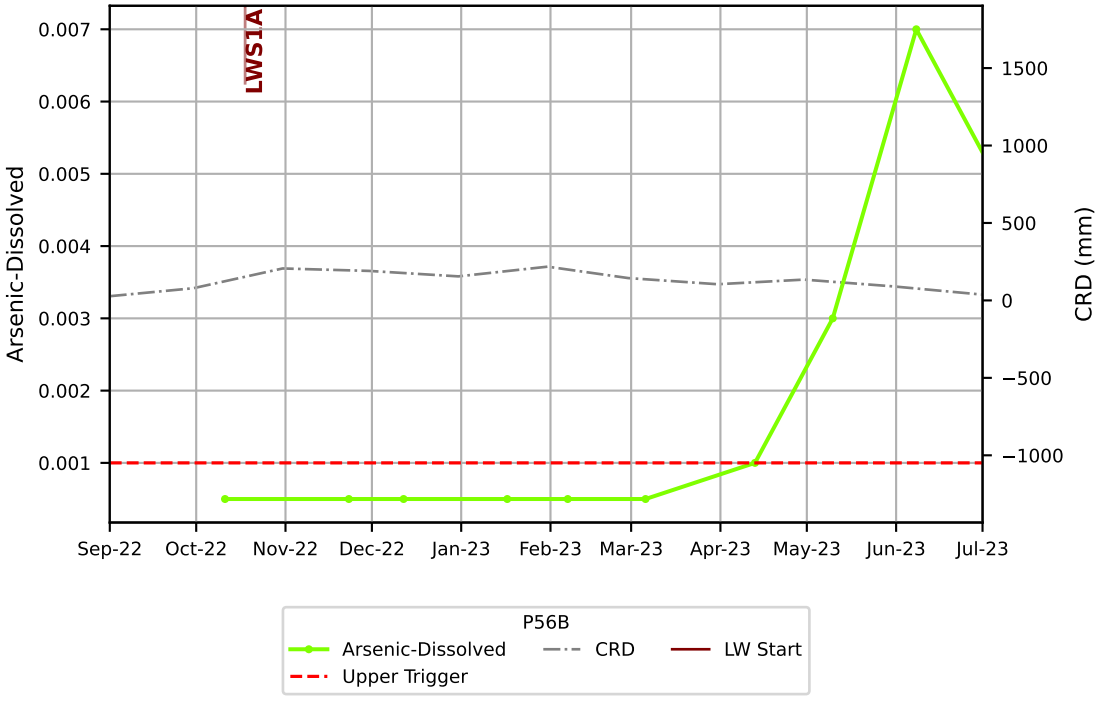

LWS1A
Copper-Dissolved
CRD (mm)
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Copper-Dissolved
CRD
LW Start
Upper Trigger

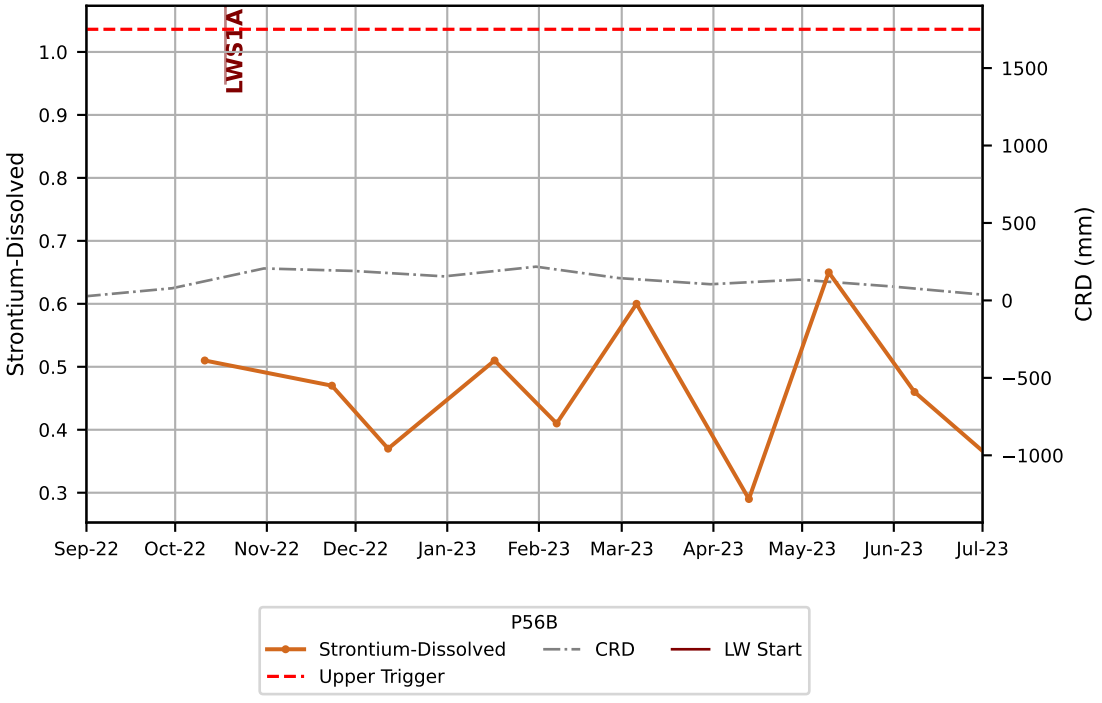

LWS1A
Lead-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Lead-Dissolved
CRD
LW Start
Upper Trigger

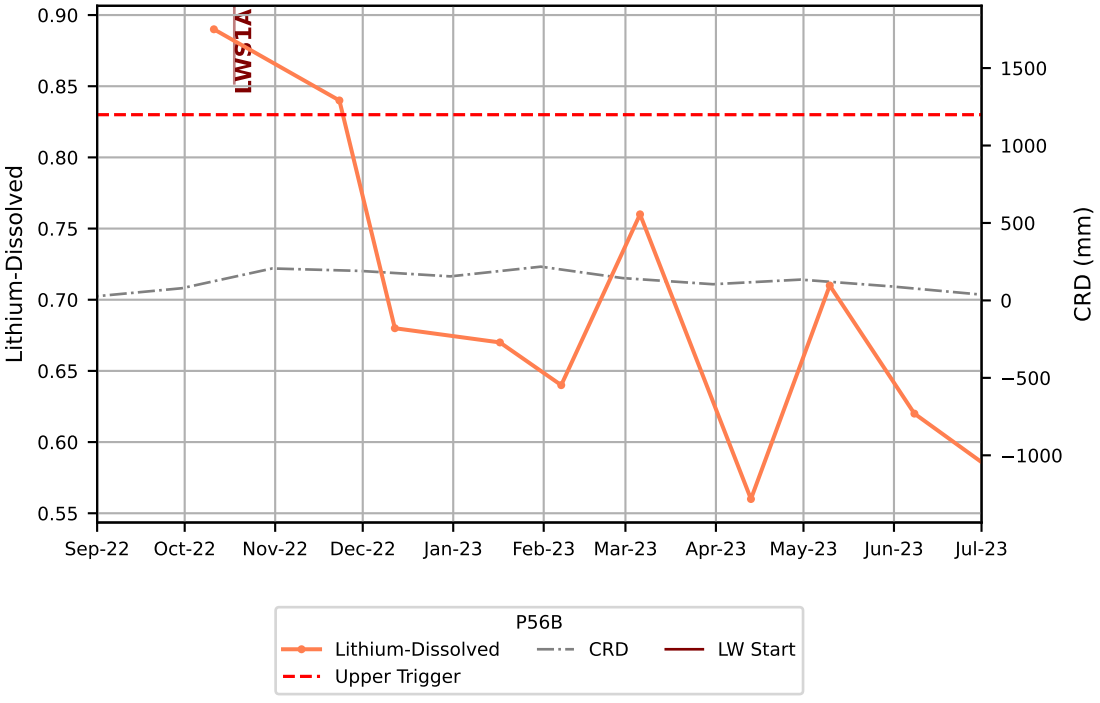

LWS1A
Zinc-Dissolved
CRD (mm)
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Zinc-Dissolved
CRD
LW Start
Upper Trigger

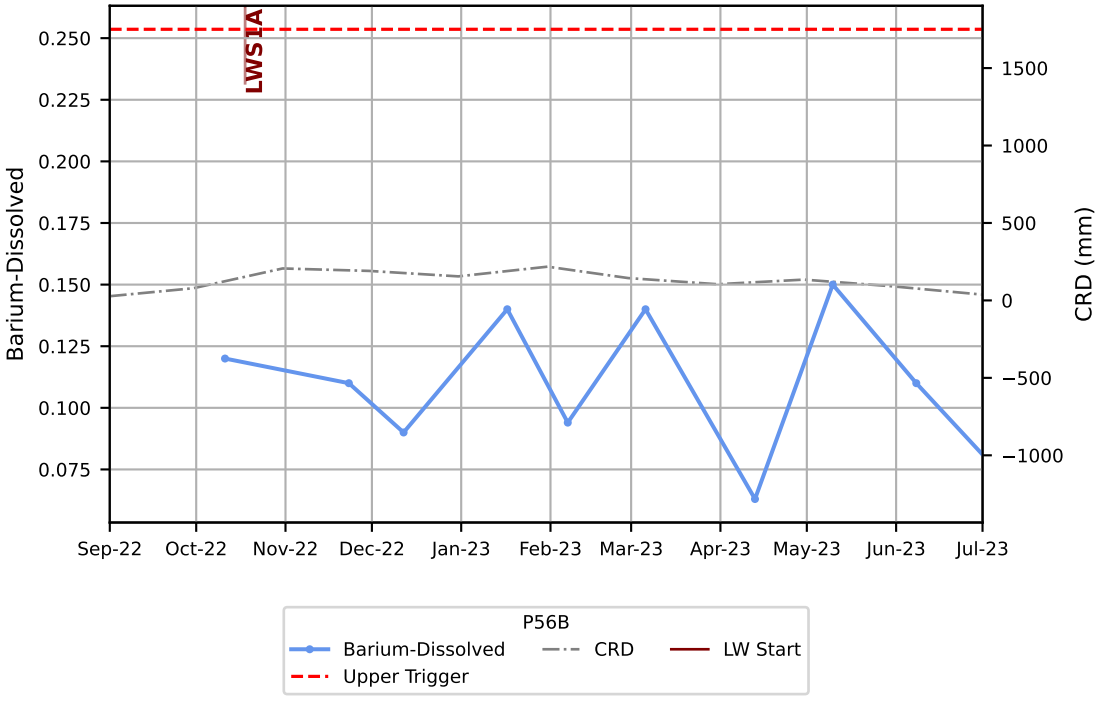

LWS1A
Nickel-Dissolved
0.030
0.025
0.020
0.015
0.010
0.005
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Nickel-Dissolved
CRD
LW Start
Upper Trigger

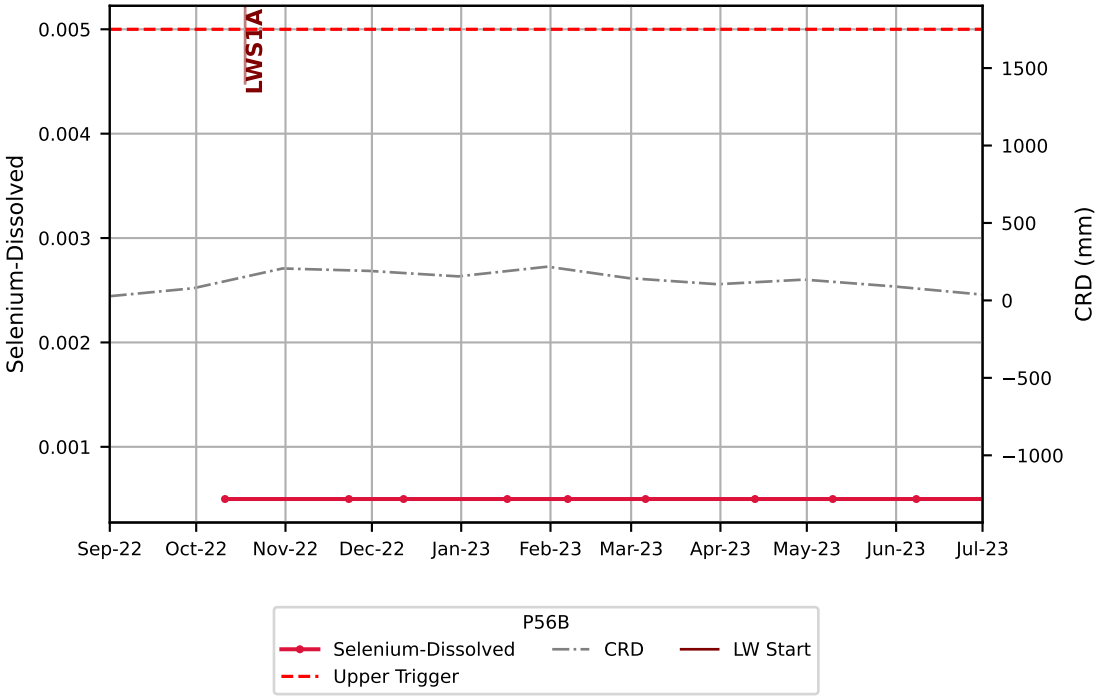

LWS1A
Aluminium-Dissolved
CRD (mm)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

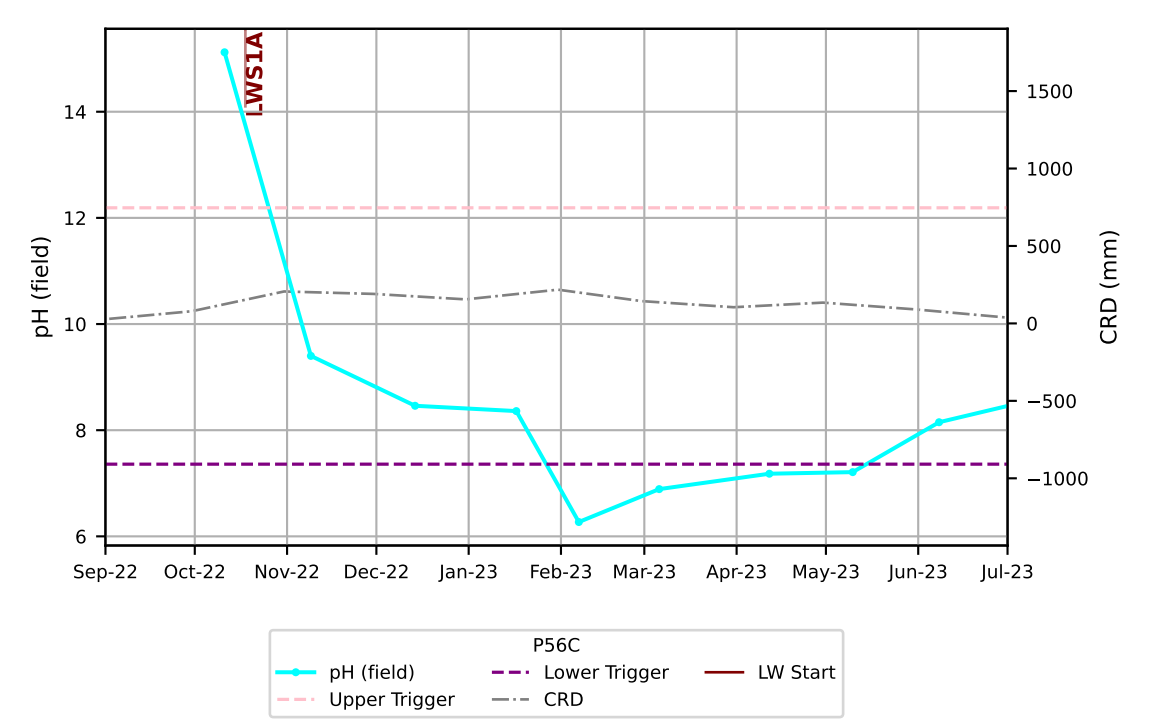

LWS1A
Arsenic-Dissolved
CRD (mm)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

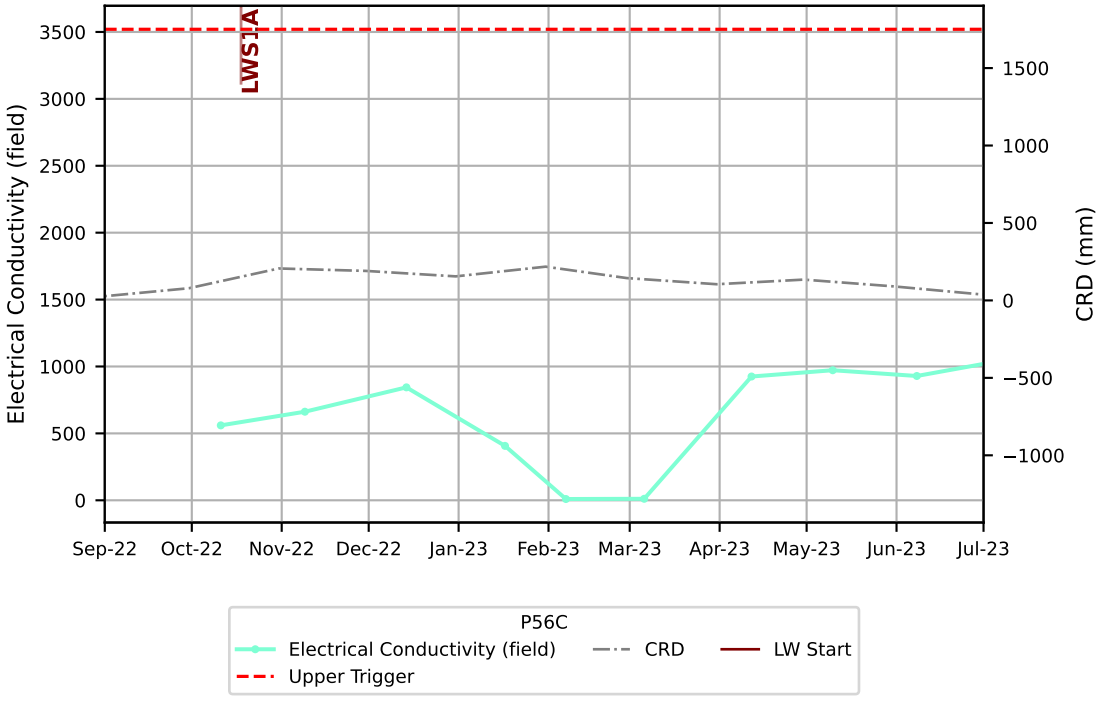

LWSTA
Strontium-Dissolved
CRD (mm)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Strontium-Dissolved
CRD
LW Start
Upper Trigger

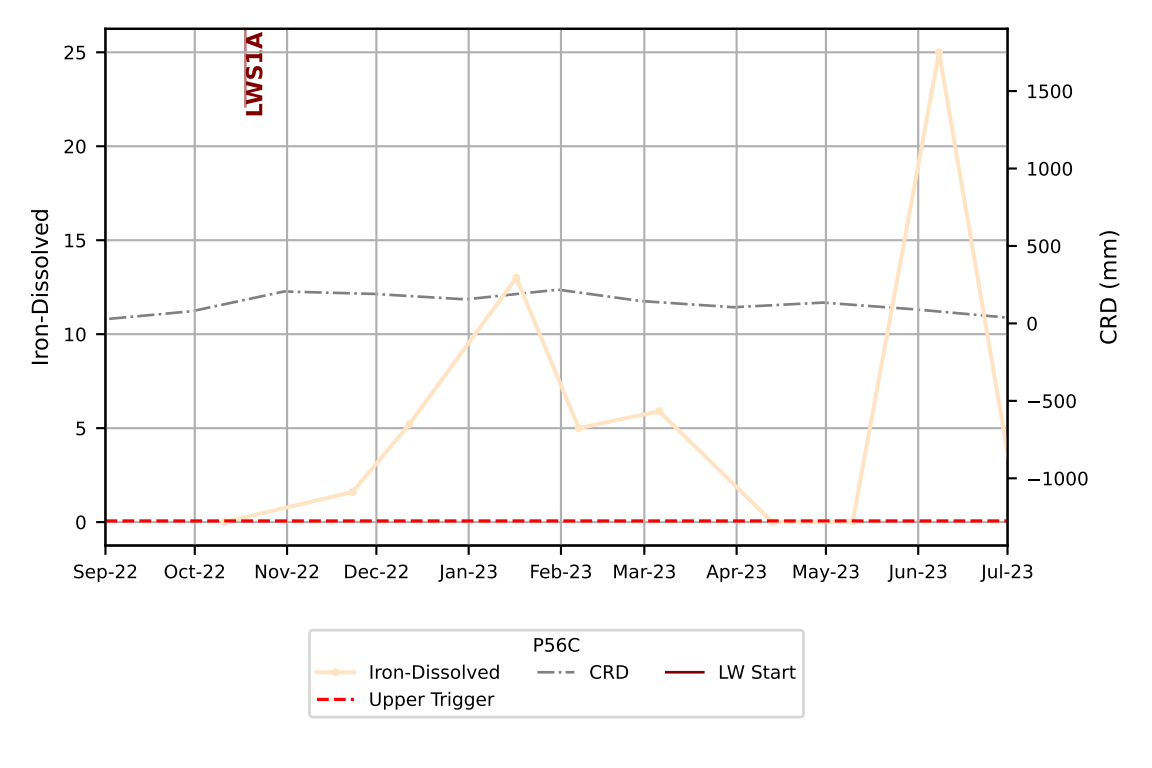

LW1SM1
Lithium-Dissolved
CRD (mm)
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Lithium-Dissolved
CRD
LW Start
Upper Trigger

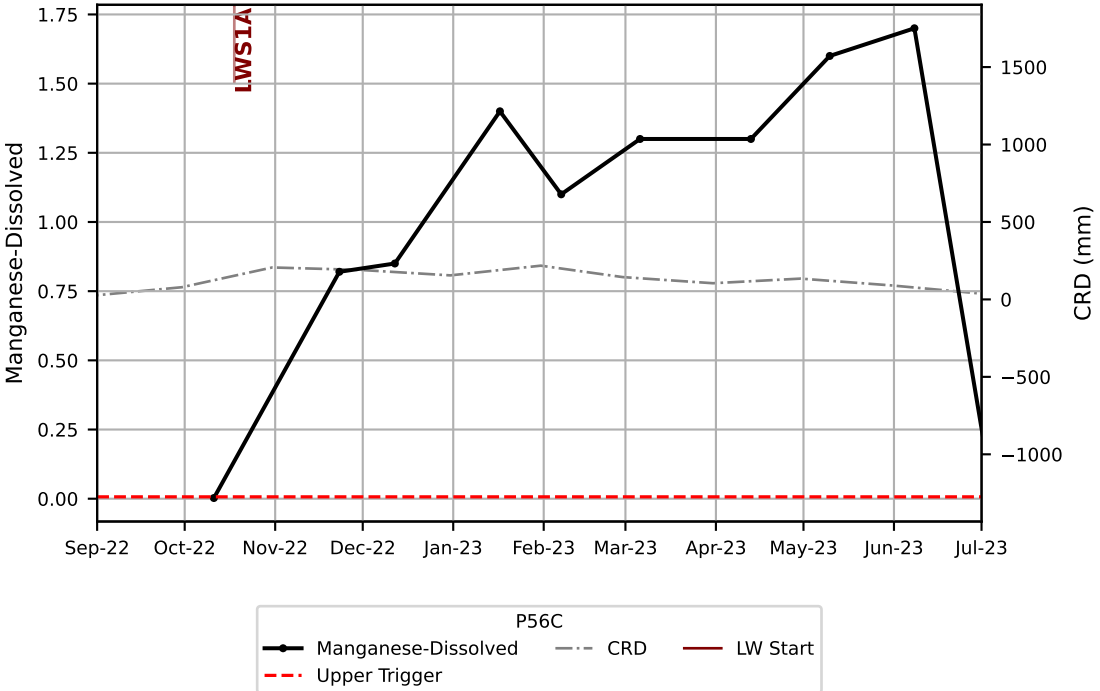

LWS1A
Barium-Dissolved
CRD (mm)
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Barium-Dissolved
CRD
LW Start
Upper Trigger

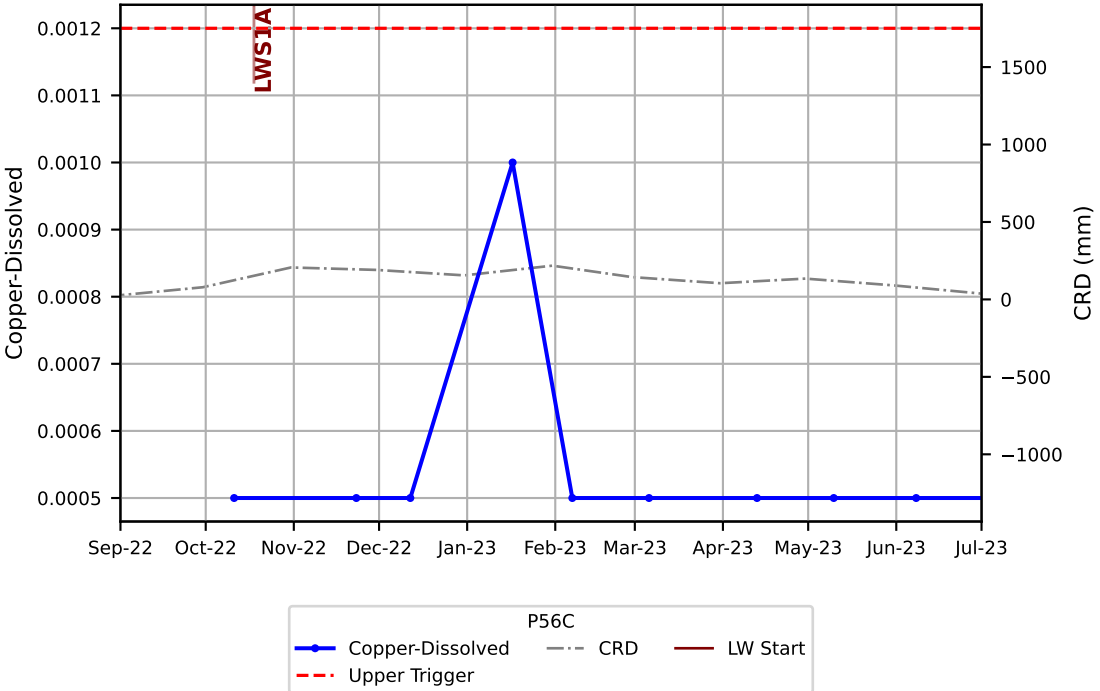

LWS1A
Selenium-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56B
Selenium-Dissolved
CRD
LW Start
Upper Trigger

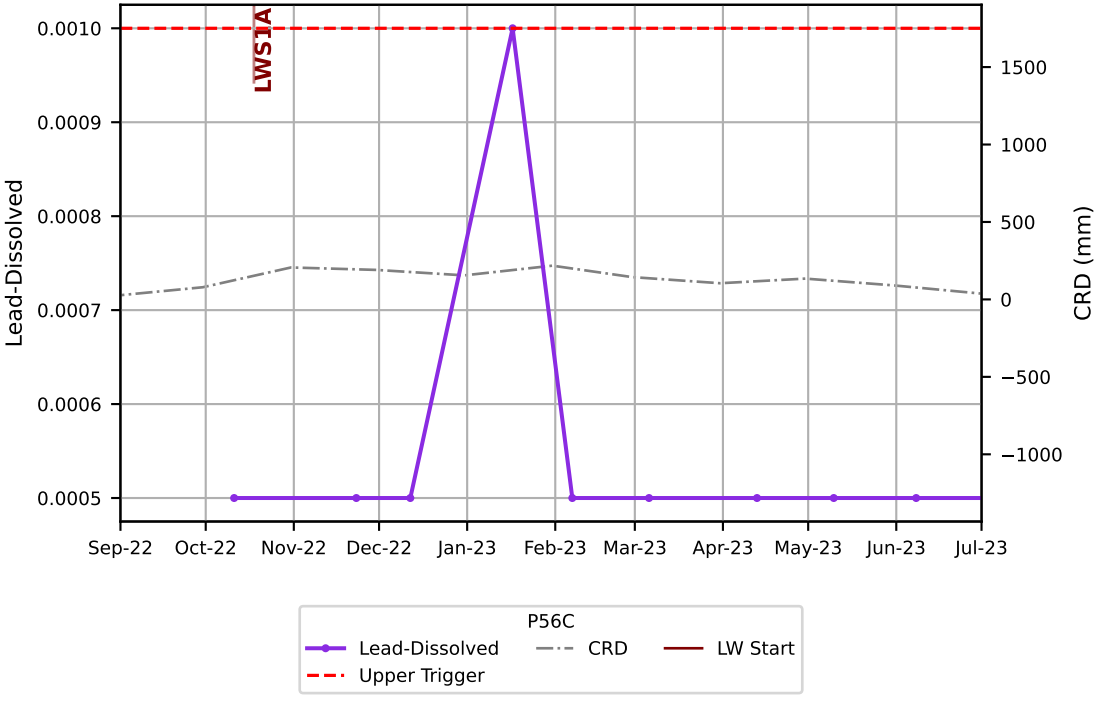

LWS1A
pH (field)
CRD (mm)
14
12
10
8
6
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

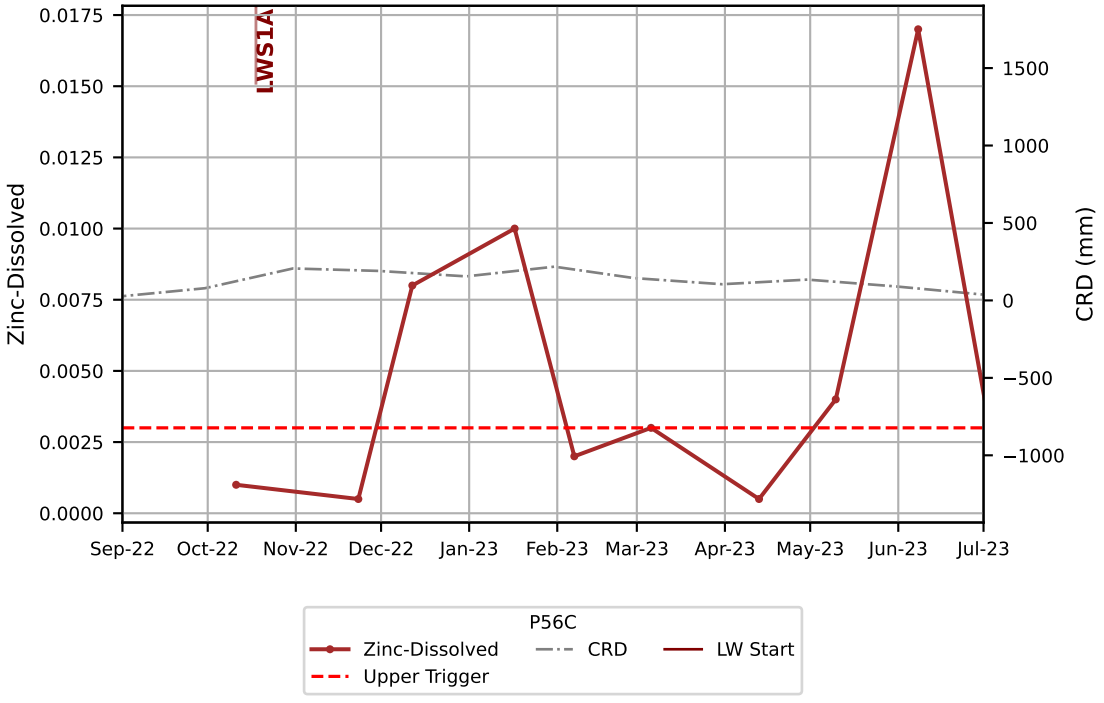

LWS1A
Electrical Conductivity (field)
CRD (mm)
3500
3000
2500
2000
1500
1000
500
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

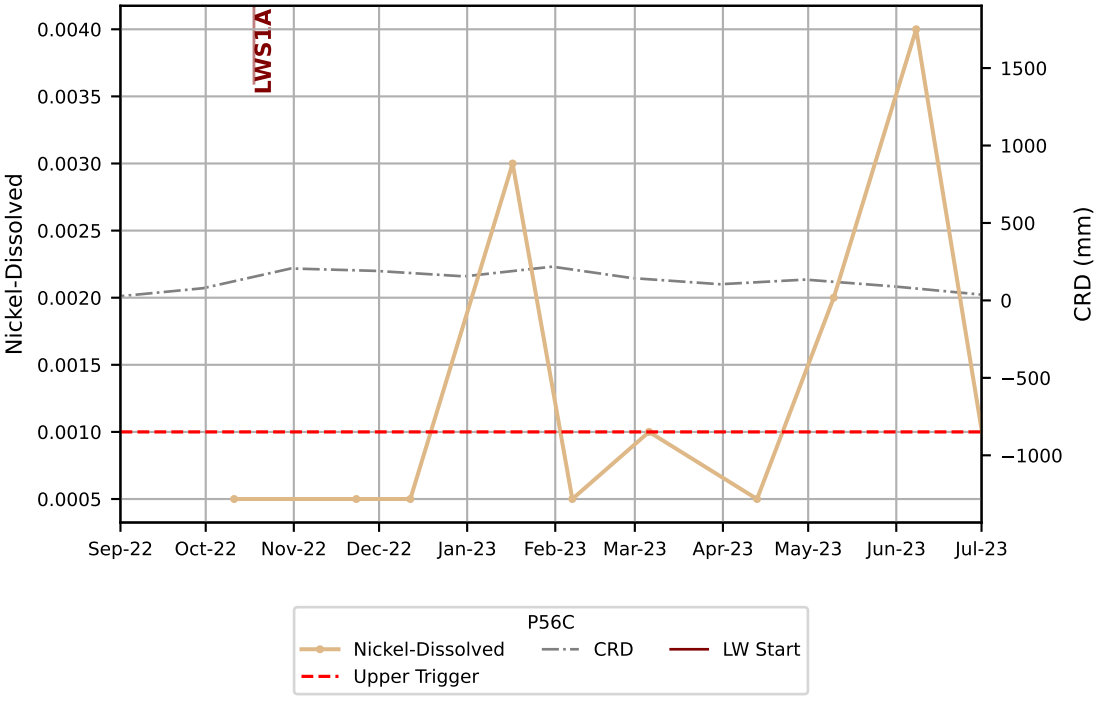

LWS1A
Iron-Dissolved
CRD (mm)
25
20
15
10
5
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Iron-Dissolved
CRD
LW Start
Upper Trigger

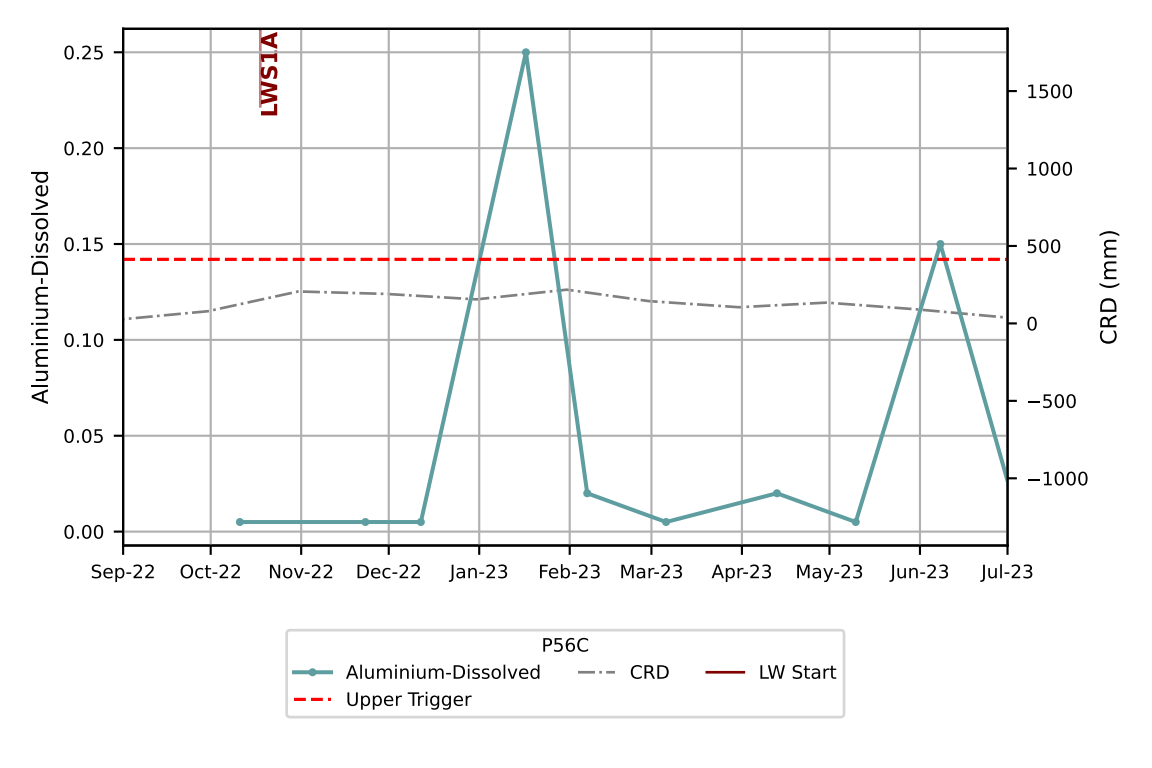

LWS1A
Manganese-Dissolved
CRD (mm)
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Manganese-Dissolved
CRD
LW Start
Upper Trigger

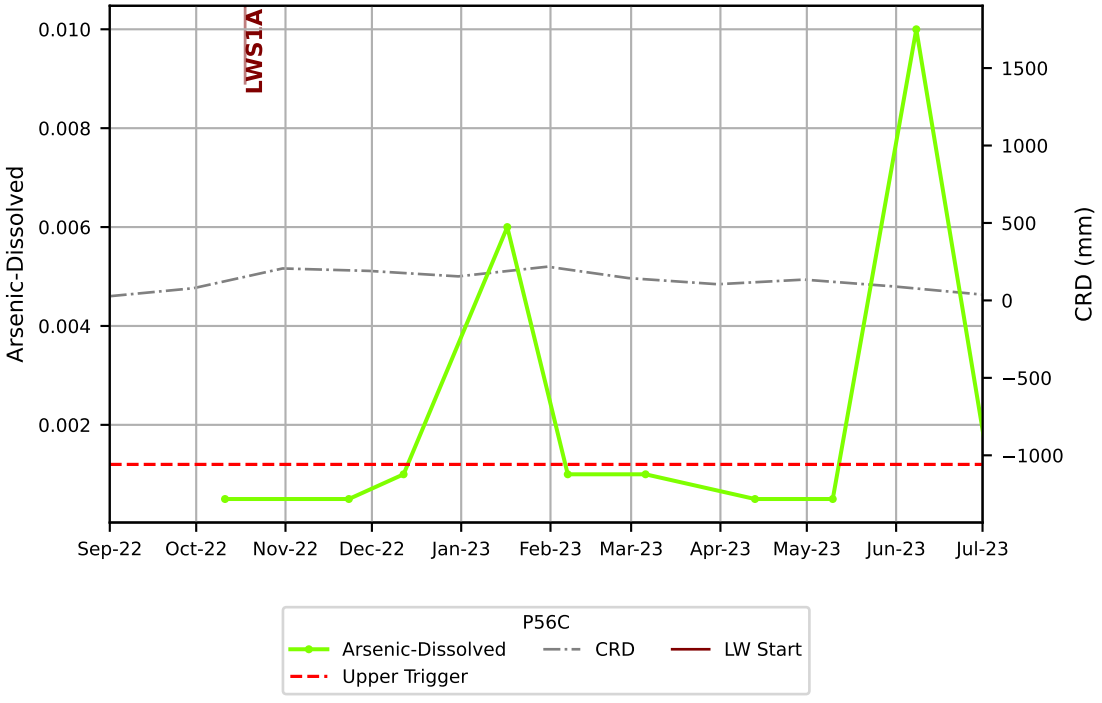

LWS1A
Copper-Dissolved
CRD (mm)
0.0012
0.0011
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Copper-Dissolved
CRD
LW Start
Upper Trigger

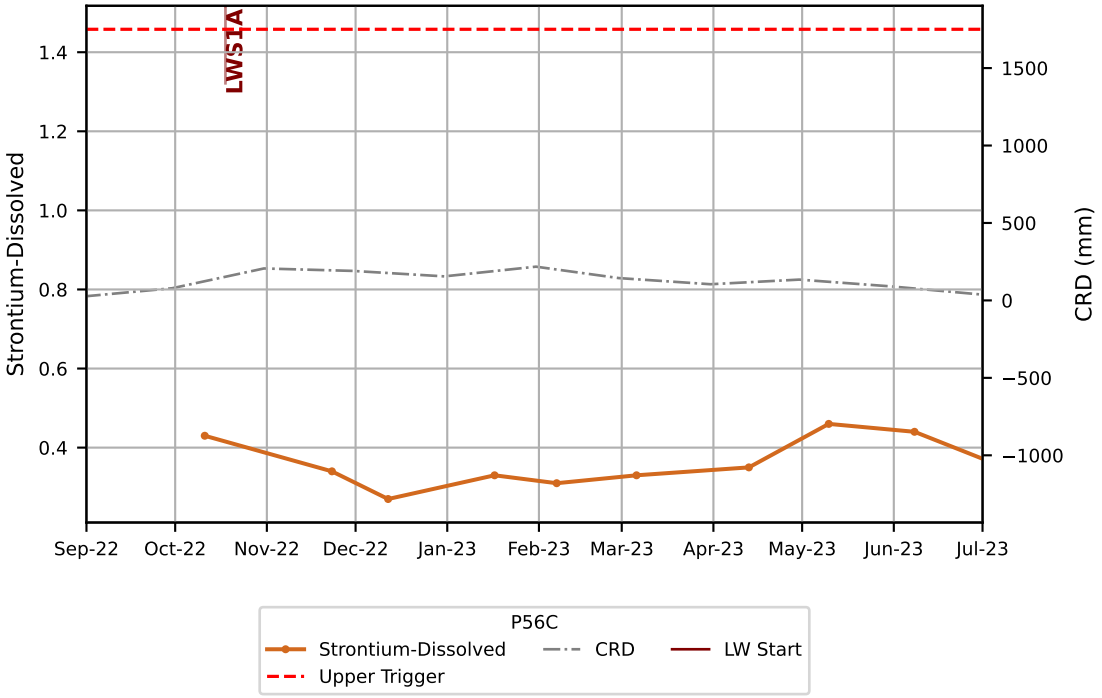

LWS1A
Lead-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Lead-Dissolved
CRD
LW Start
Upper Trigger

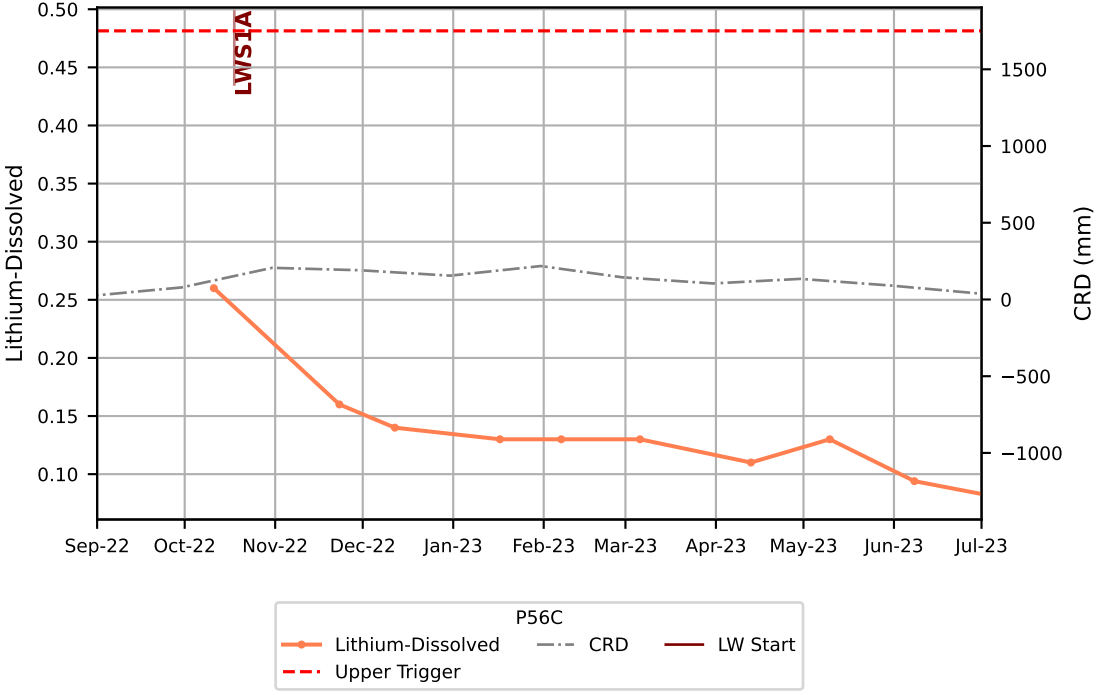

LWS1A
Zinc-Dissolved
CRD (mm)
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Zinc-Dissolved
CRD
LW Start
Upper Trigger

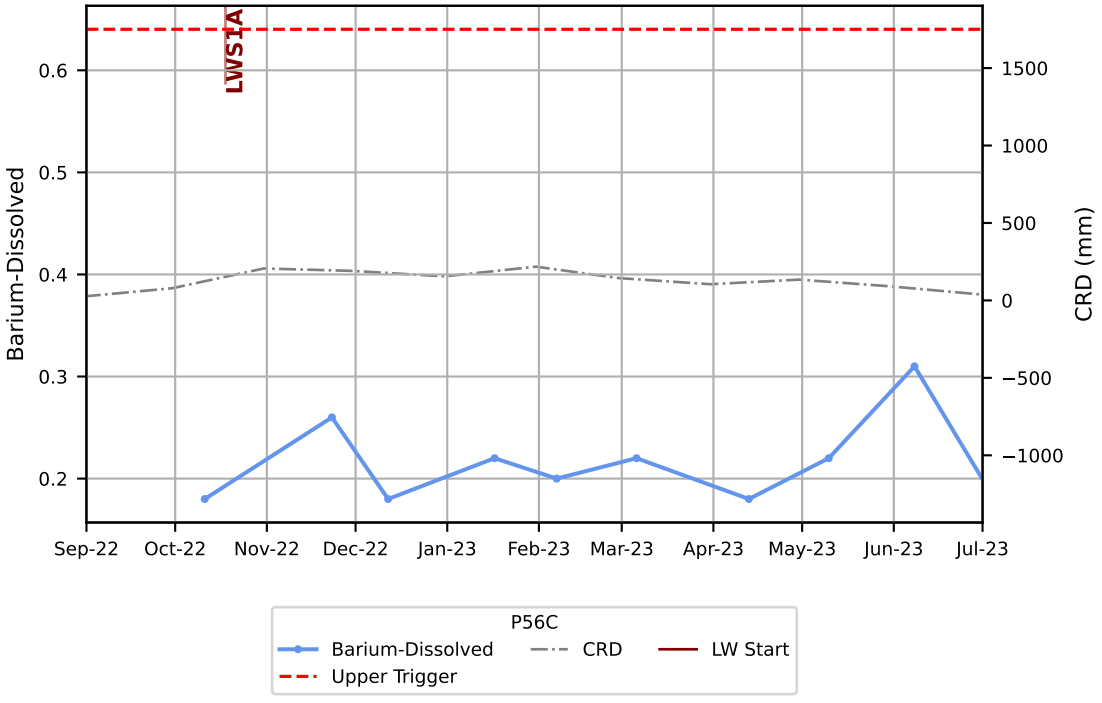

LWS1A
Nickel-Dissolved
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Nickel-Dissolved
CRD
LW Start
Upper Trigger

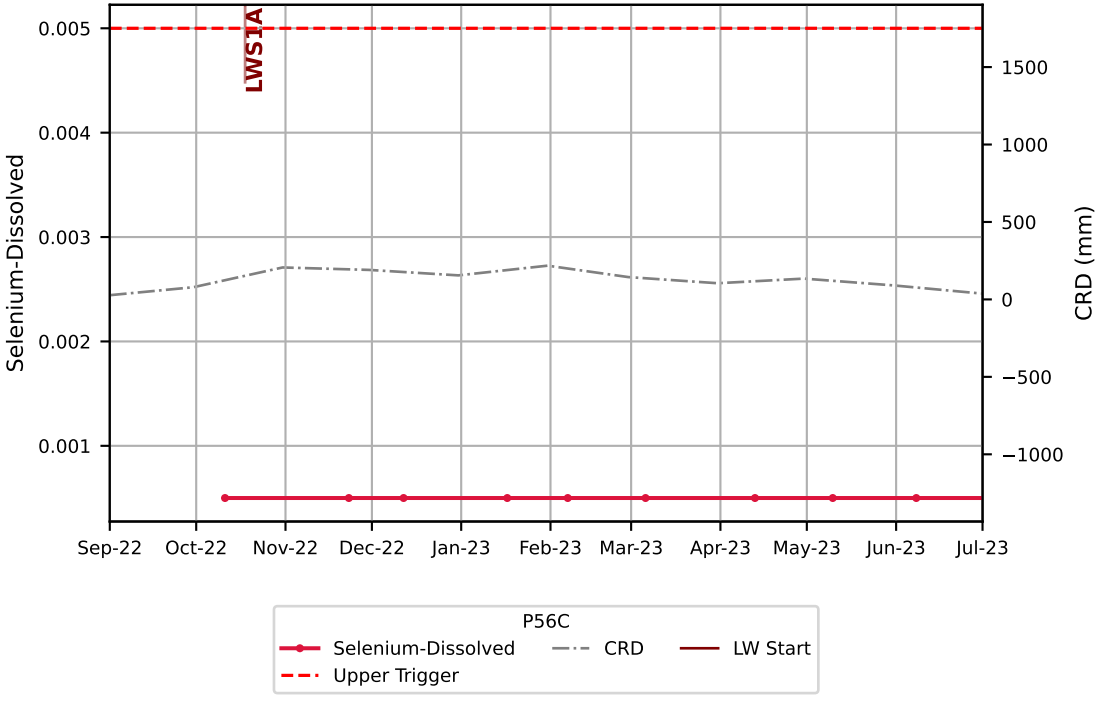

LWS1A
Aluminium-Dissolved
CRD (mm)
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

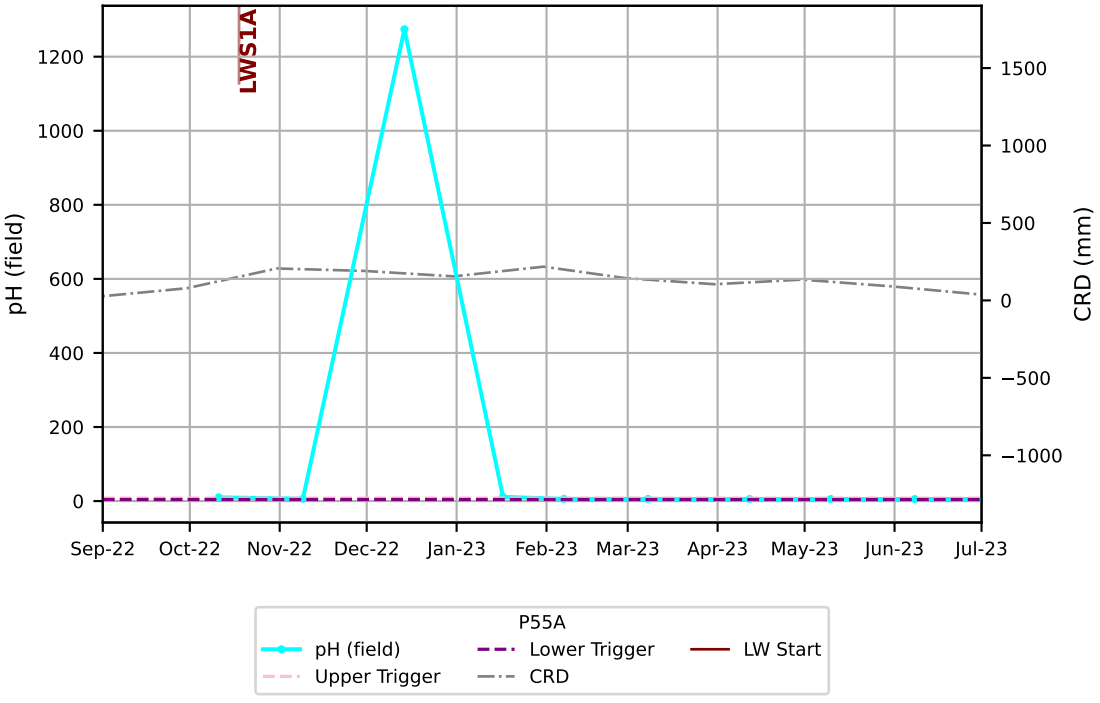

LWS1A
Arsenic-Dissolved
CRD (mm)
0.010
0.008
0.006
0.004
0.002
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

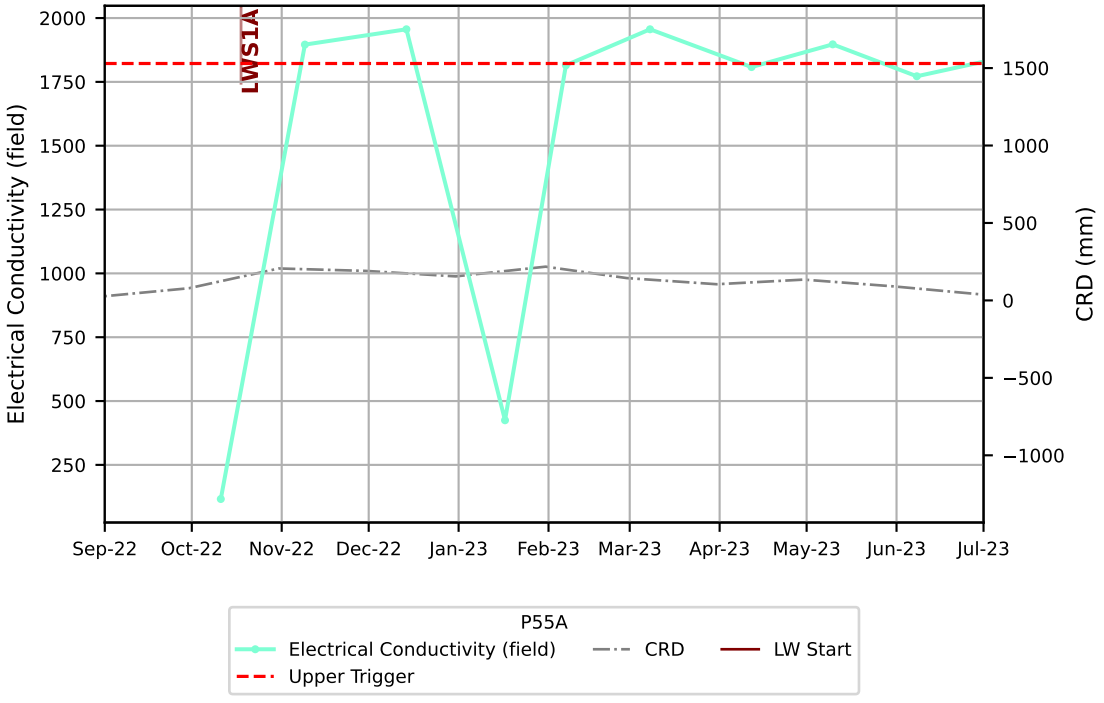

LWSTA
Strontium-Dissolved
CRD (mm)
1.4
1.2
1.0
0.8
0.6
0.4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Strontium-Dissolved
CRD
LW Start
Upper Trigger

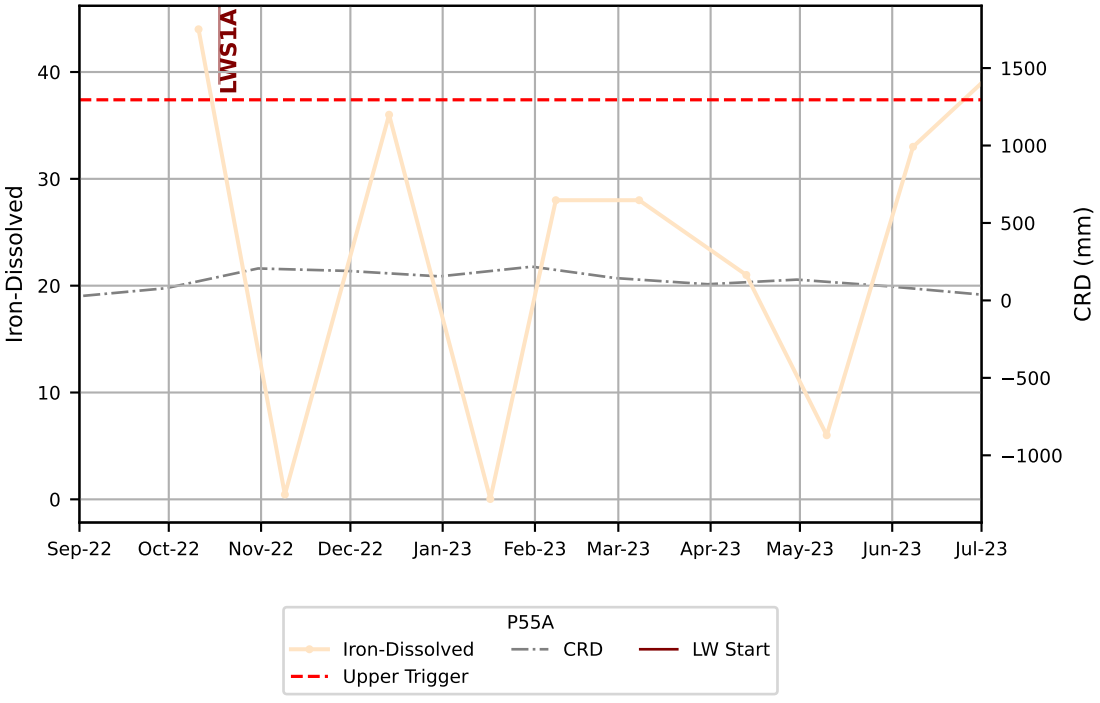

LWS1A
Lithium-Dissolved
CRD (mm)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Lithium-Dissolved
CRD
LW Start
Upper Trigger

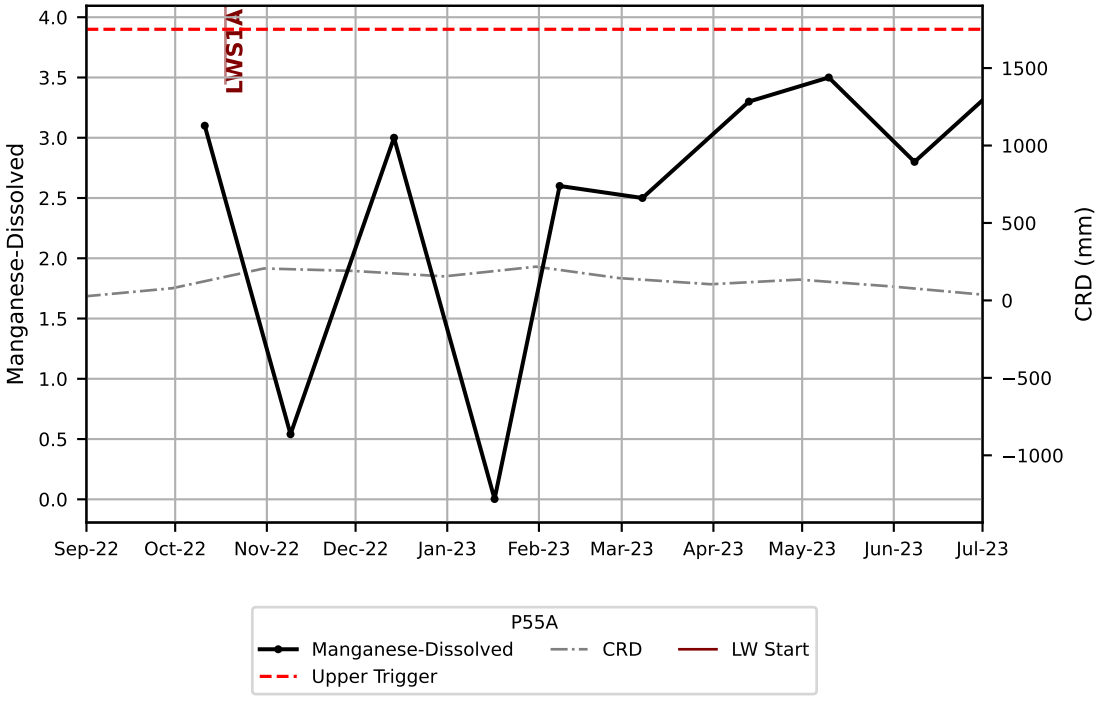

LWSTA
Barium-Dissolved
CRD (mm)
0.6
0.5
0.4
0.3
0.2
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Barium-Dissolved
CRD
LW Start
Upper Trigger

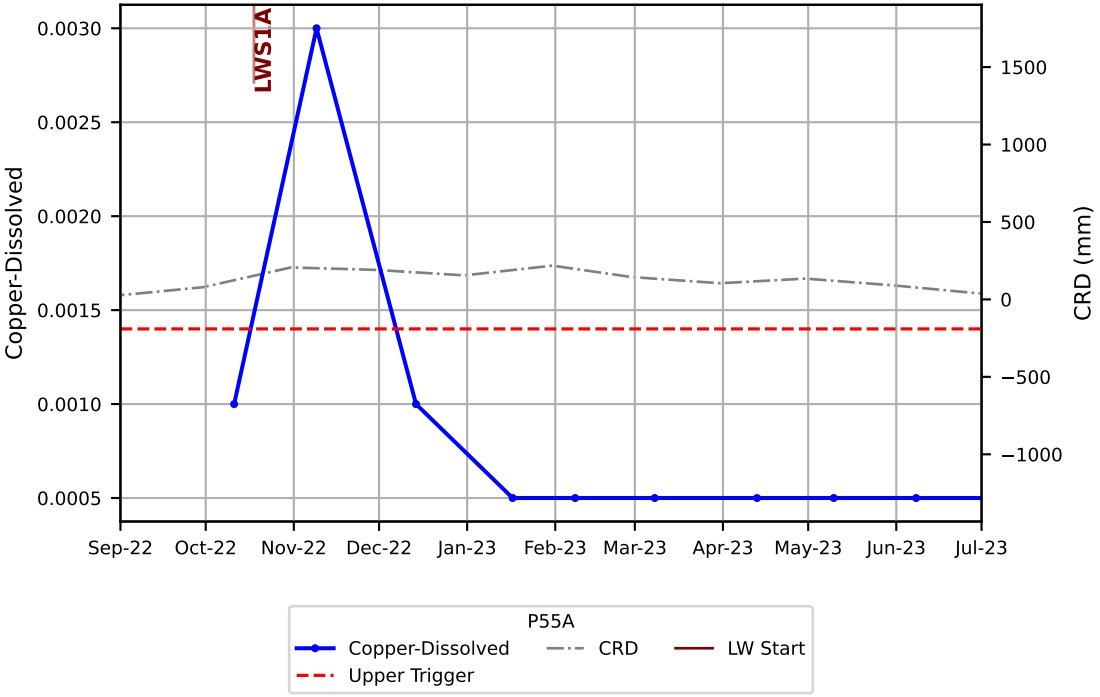

LWS1A
Selenium-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P56C
Selenium-Dissolved
CRD
LW Start
Upper Trigger

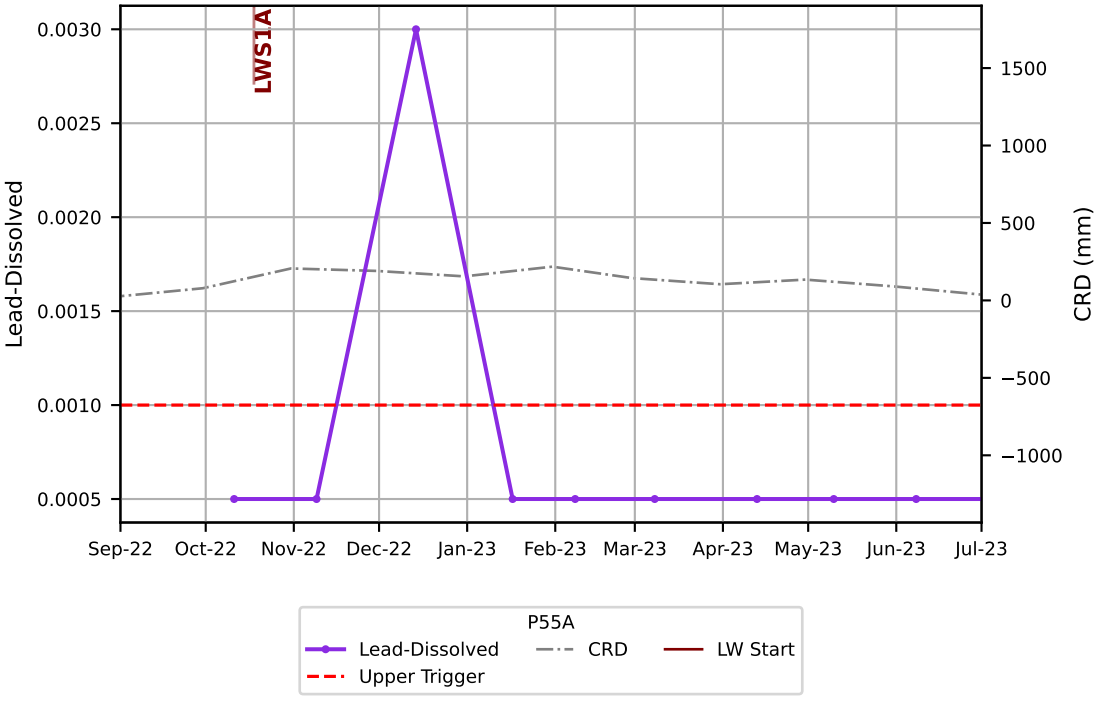

LWS1A
pH (field)
CRD (mm)
1200
1000
800
600
400
200
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

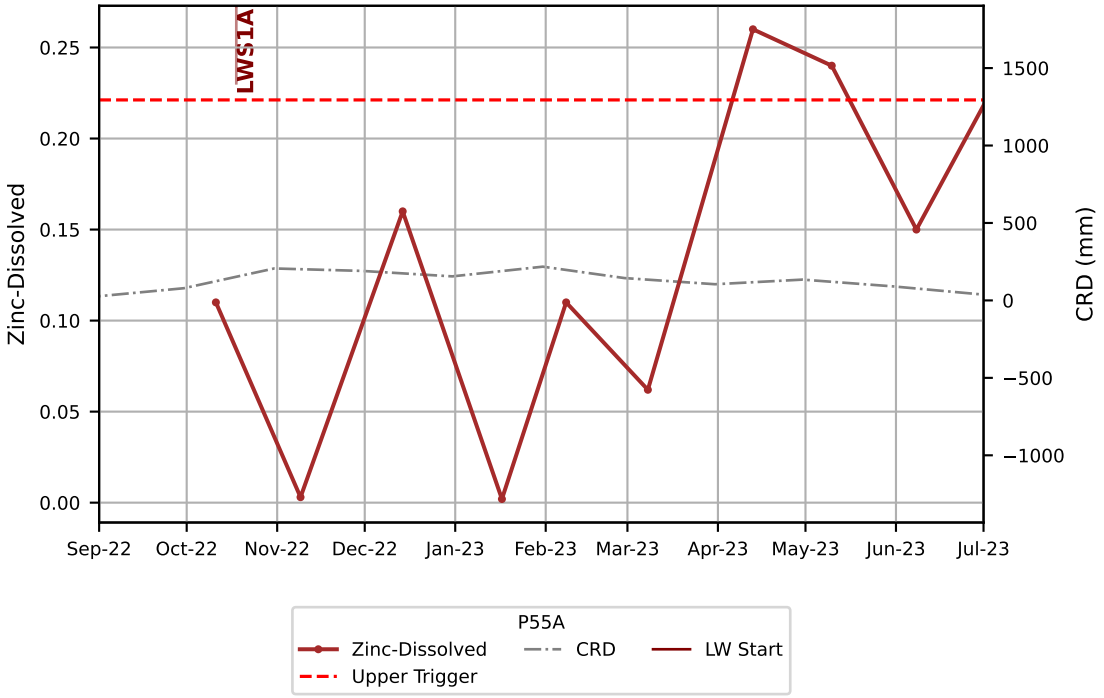

LWS1A
Electrical Conductivity (field)
CRD (mm)
2000
1750
1500
1250
1000
750
500
250
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

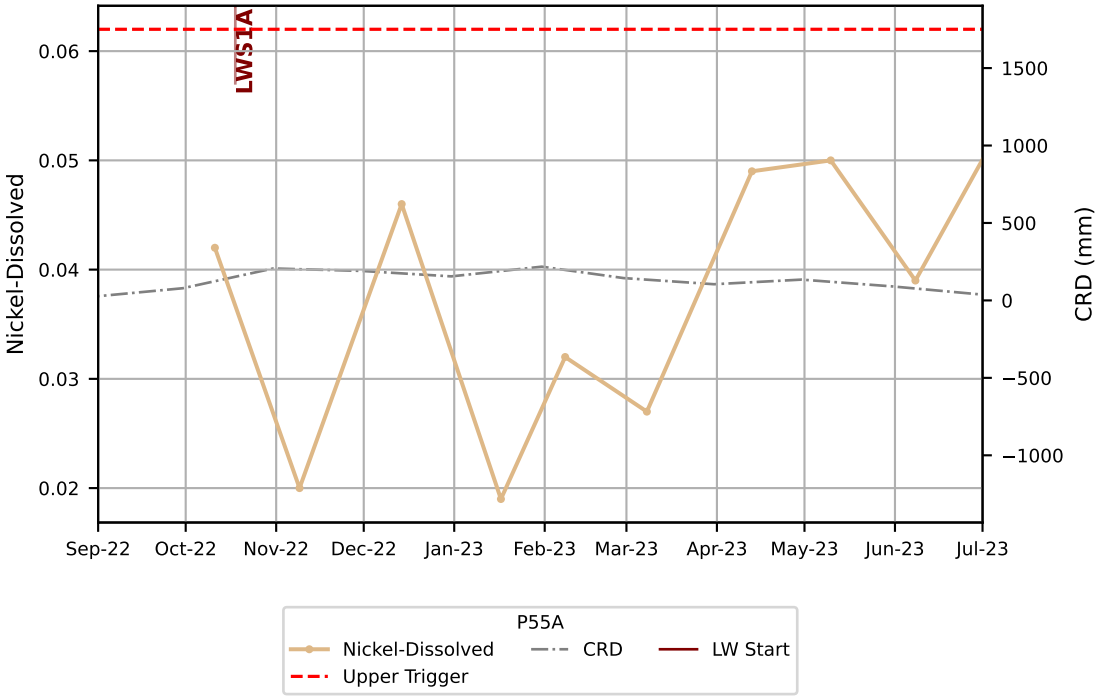

LWS1A
Iron-Dissolved
CRD (mm)
40
30
20
10
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Iron-Dissolved
CRD
LW Start
Upper Trigger

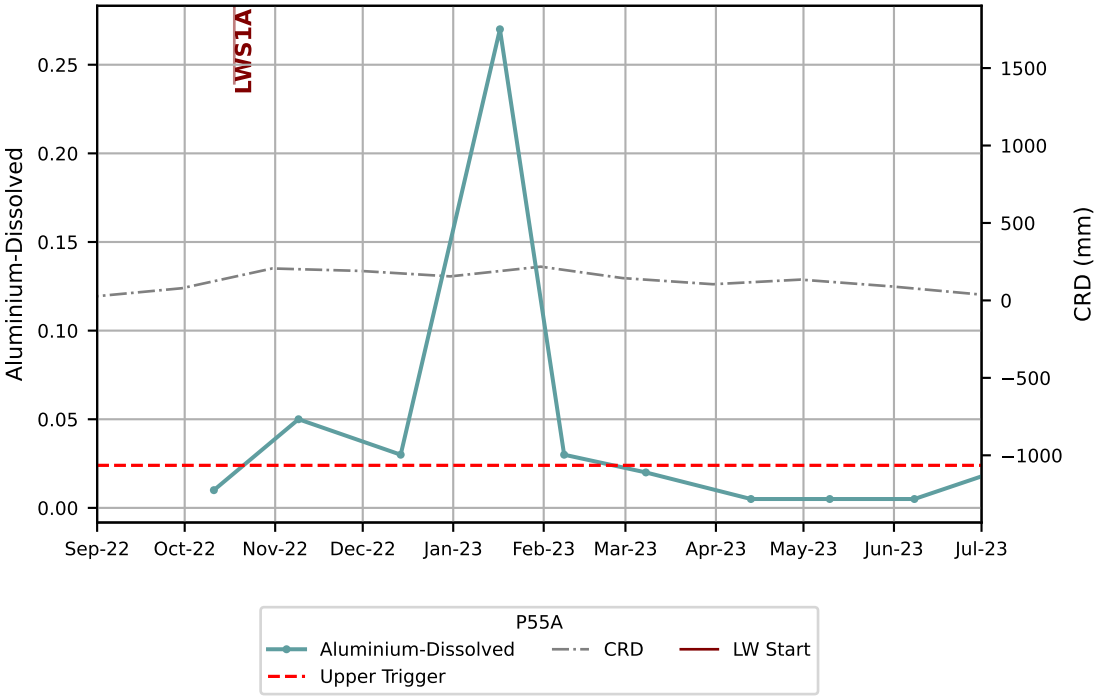

LWSTA
Manganese-Dissolved
CRD (mm)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Manganese-Dissolved
CRD
LW Start
Upper Trigger

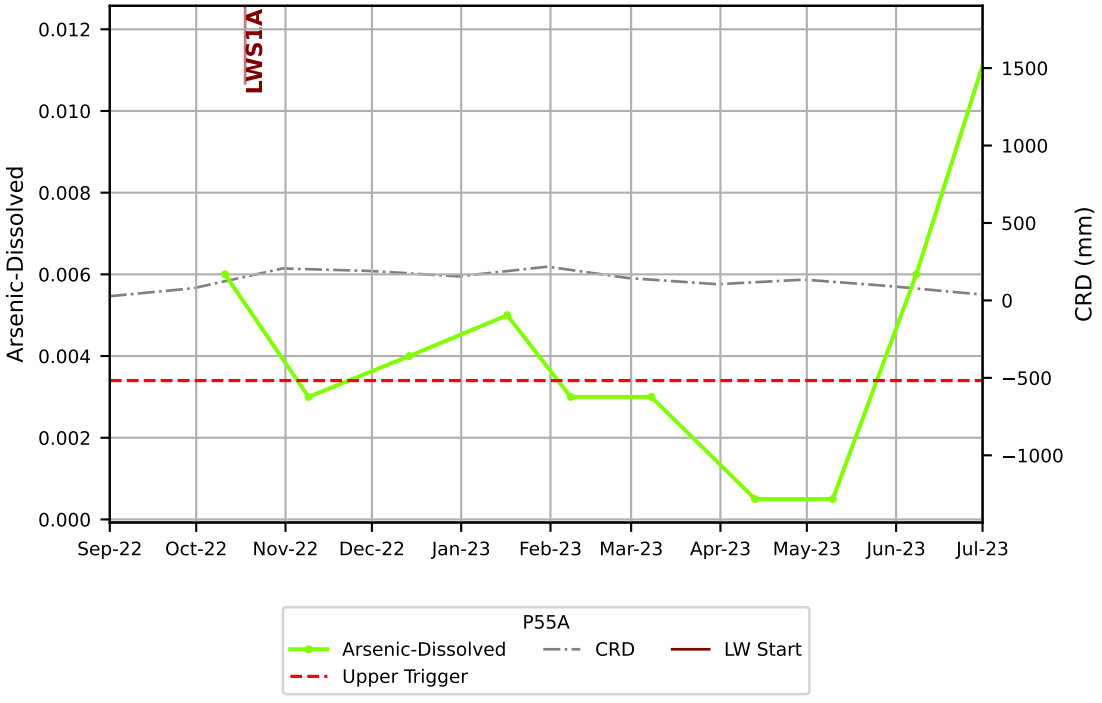

LWS1A
Copper-Dissolved
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Copper-Dissolved
CRD
LW Start
Upper Trigger

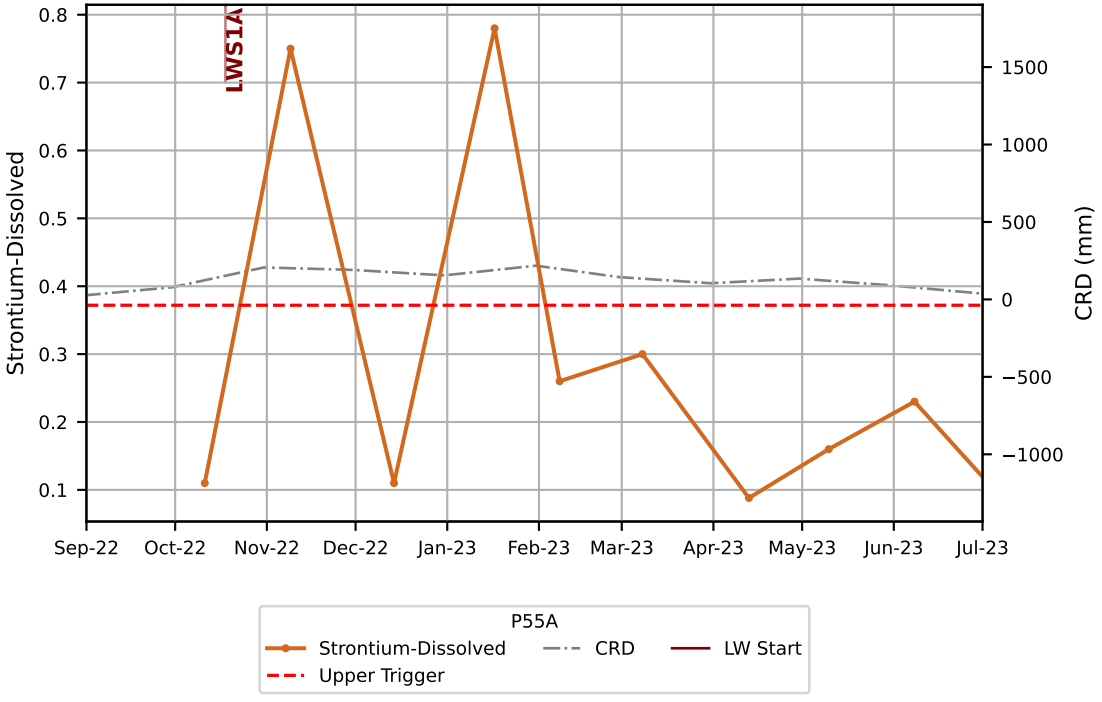

LWS1A
Lead-Dissolved
CRD (mm)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Lead-Dissolved
CRD
LW Start
Upper Trigger

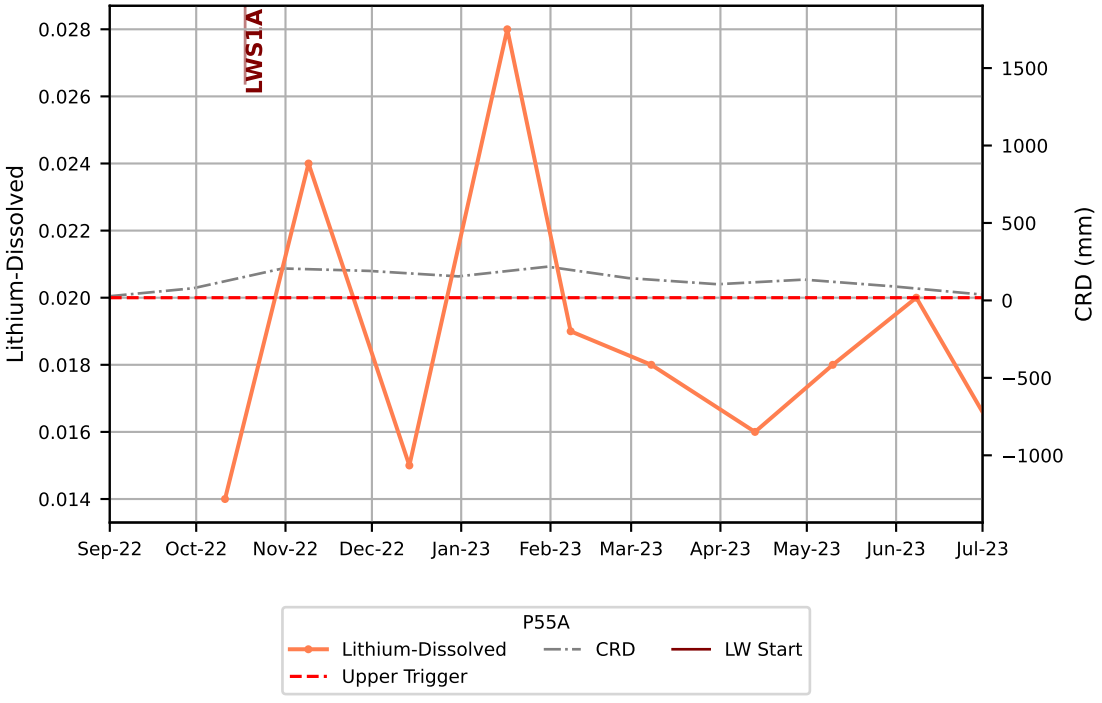

LWS1A
Zinc-Dissolved
CRD (mm)
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Zinc-Dissolved
CRD
LW Start
Upper Trigger

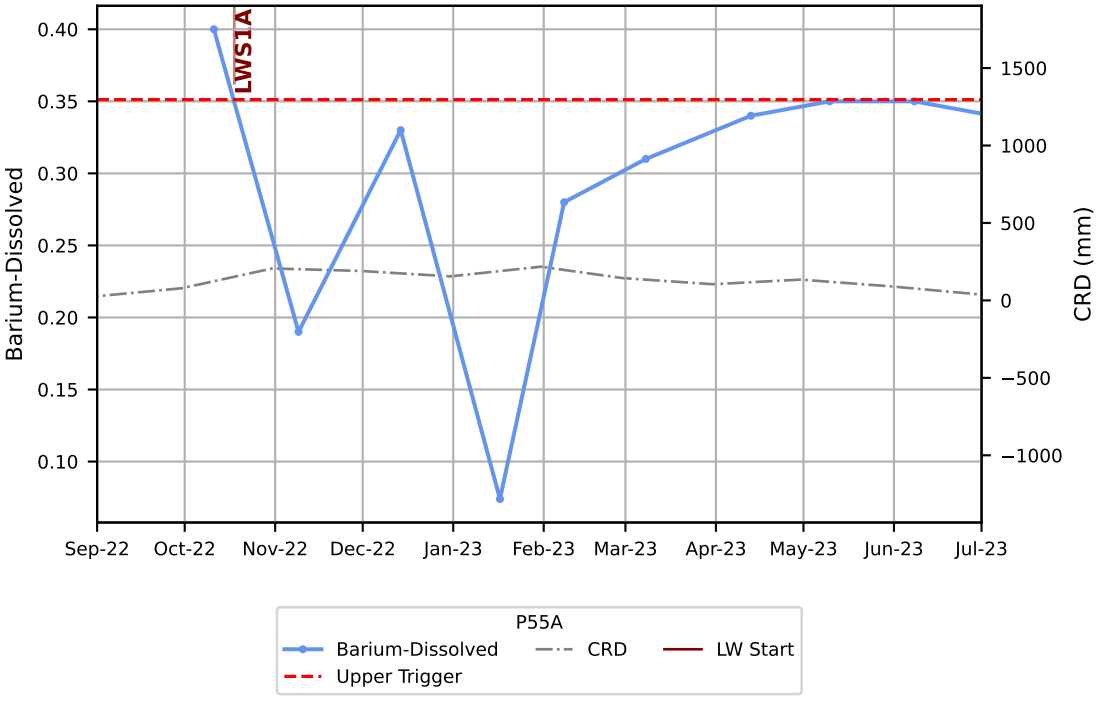

LW51A
Nickel-Dissolved
CRD (mm)
0.06
0.05
0.04
0.03
0.02
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Nickel-Dissolved
CRD
LW Start
Upper Trigger

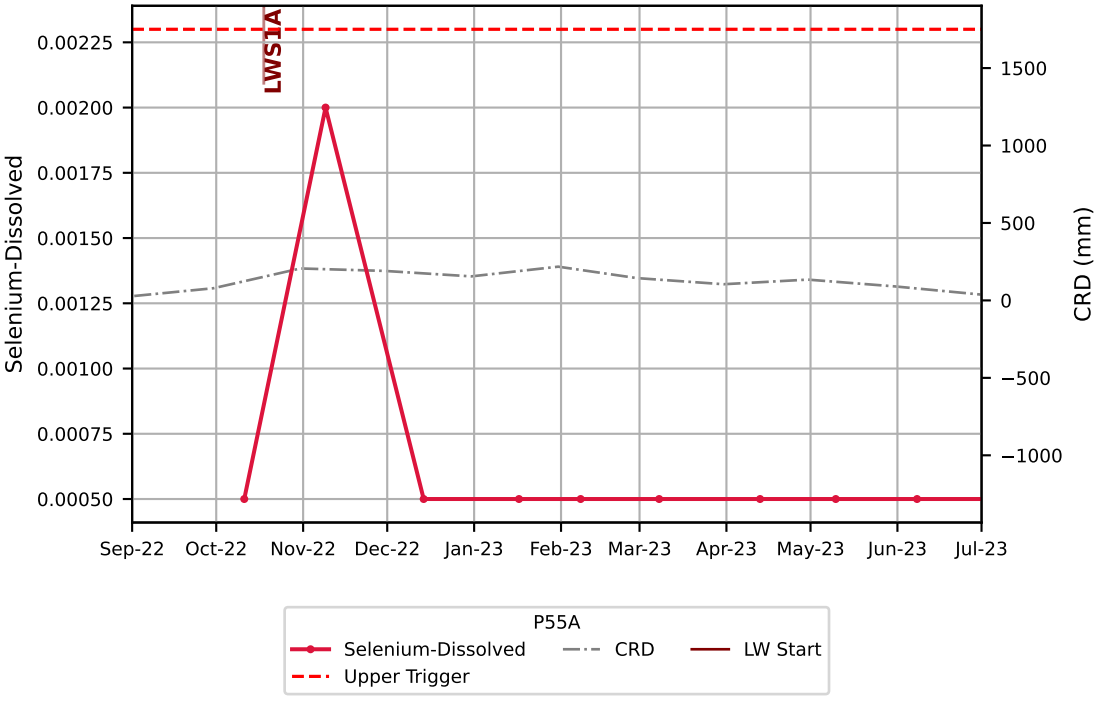

LWS1A
Aluminium-Dissolved
CRD (mm)
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

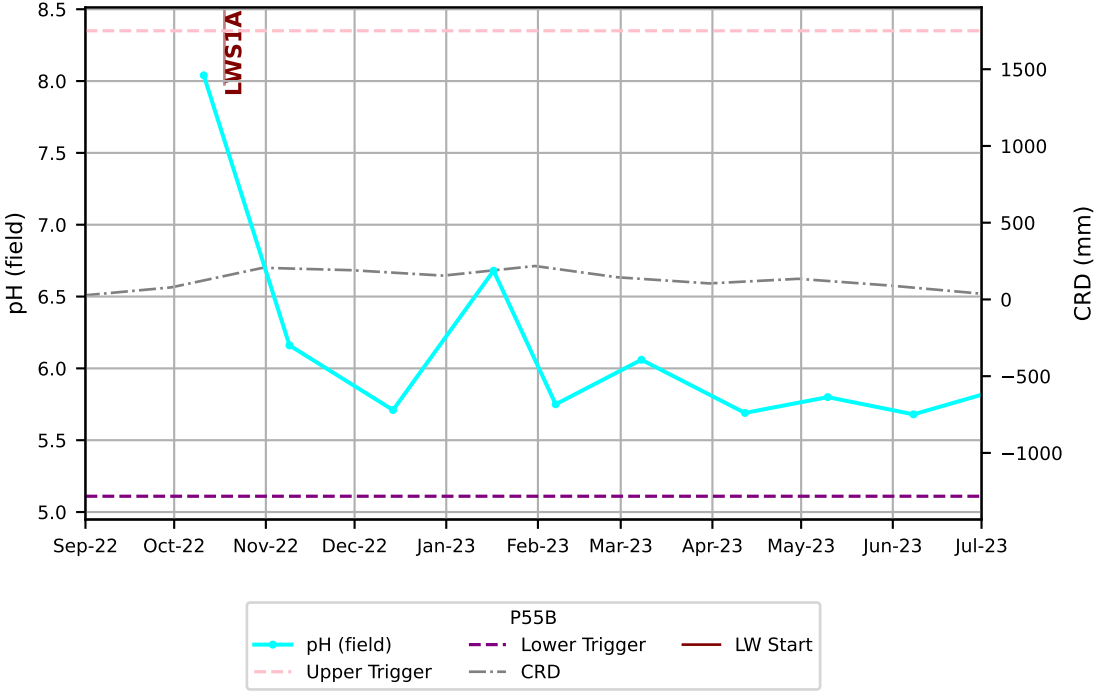

LWS1A
Arsenic-Dissolved
CRD (mm)
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

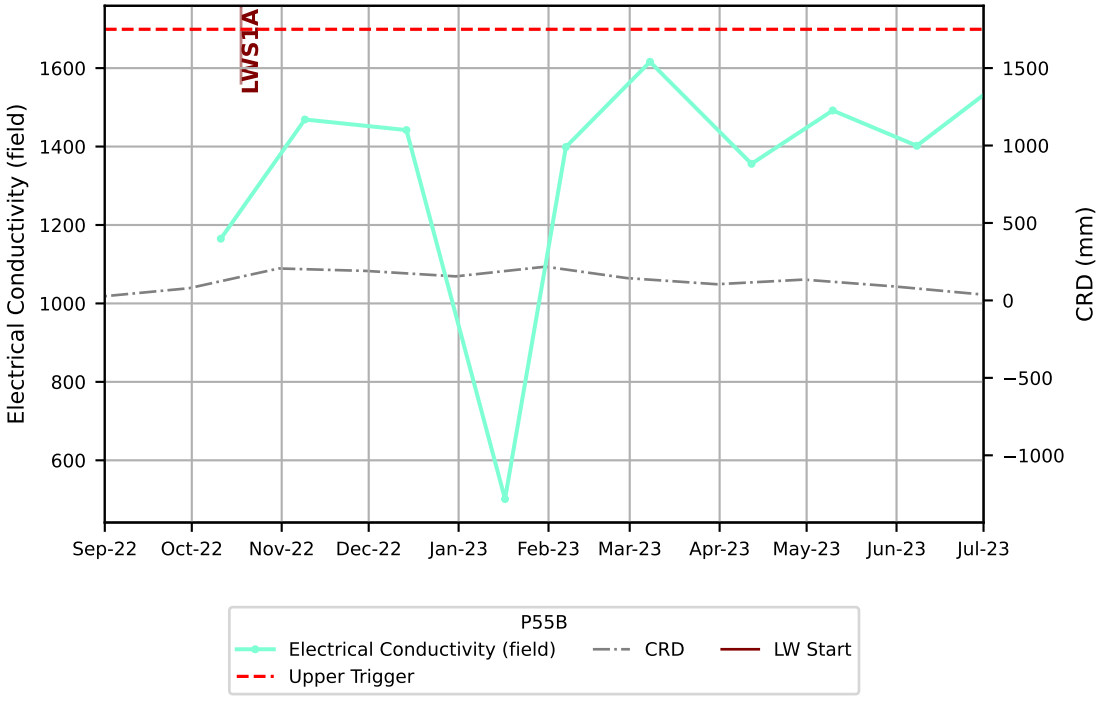

LWS1A
Strontium-Dissolved
CRD (mm)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Strontium-Dissolved
CRD
LW Start
Upper Trigger

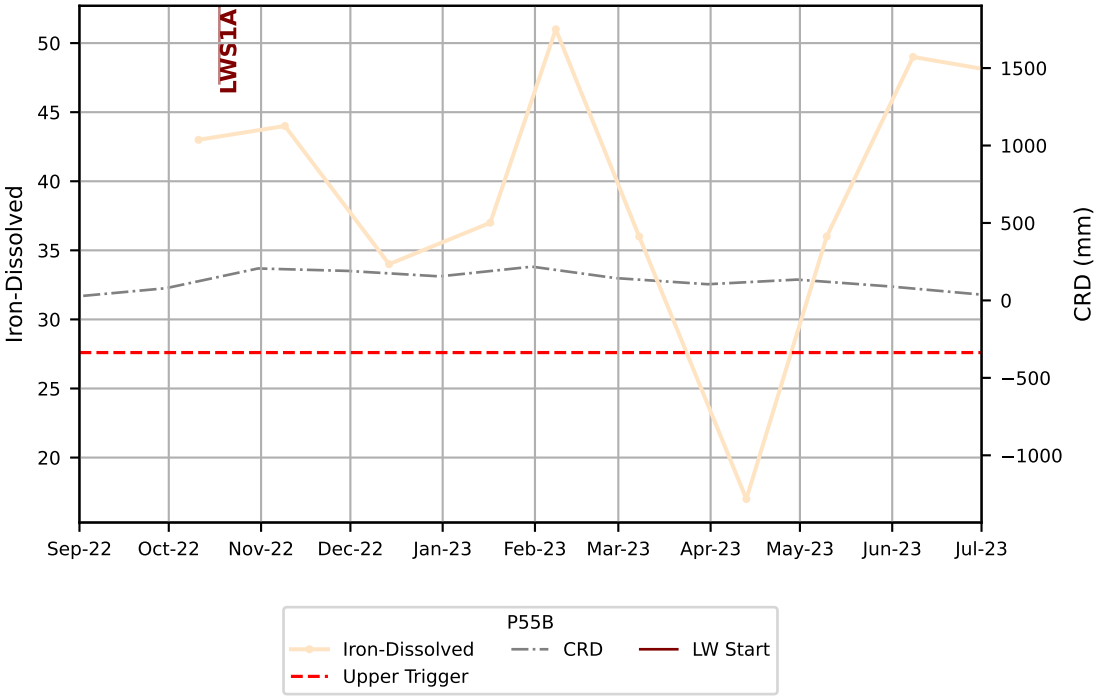

LWS1A
Lithium-Dissolved
CRD (mm)
0.028
0.026
0.024
0.022
0.020
0.018
0.016
0.014
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Lithium-Dissolved
CRD
LW Start
Upper Trigger

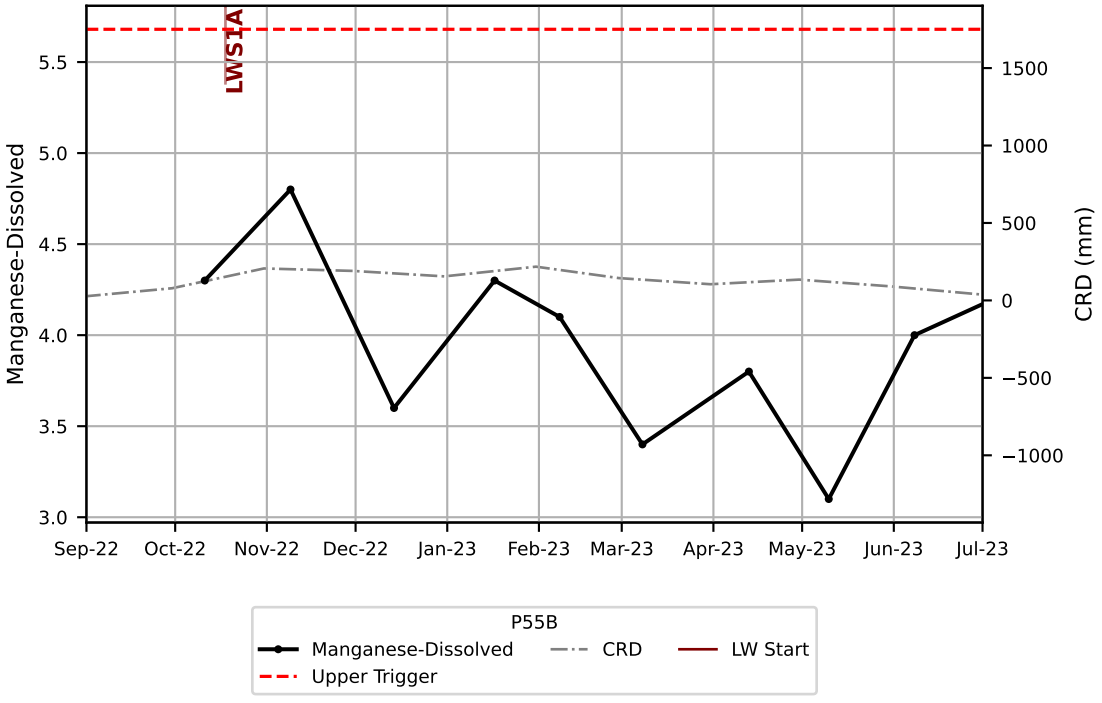

LWS1A
Barium-Dissolved
CRD (mm)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Barium-Dissolved
CRD
LW Start
Upper Trigger

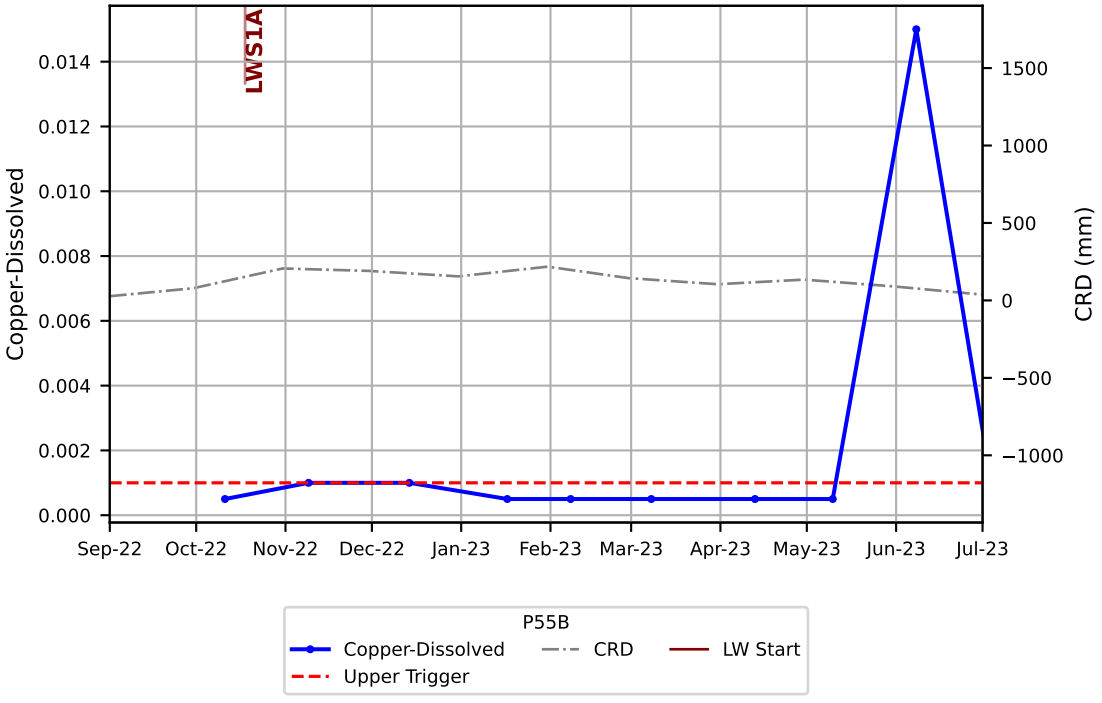

LWSTA
Selenium-Dissolved
CRD (mm)
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55A
Selenium-Dissolved
CRD
LW Start
Upper Trigger

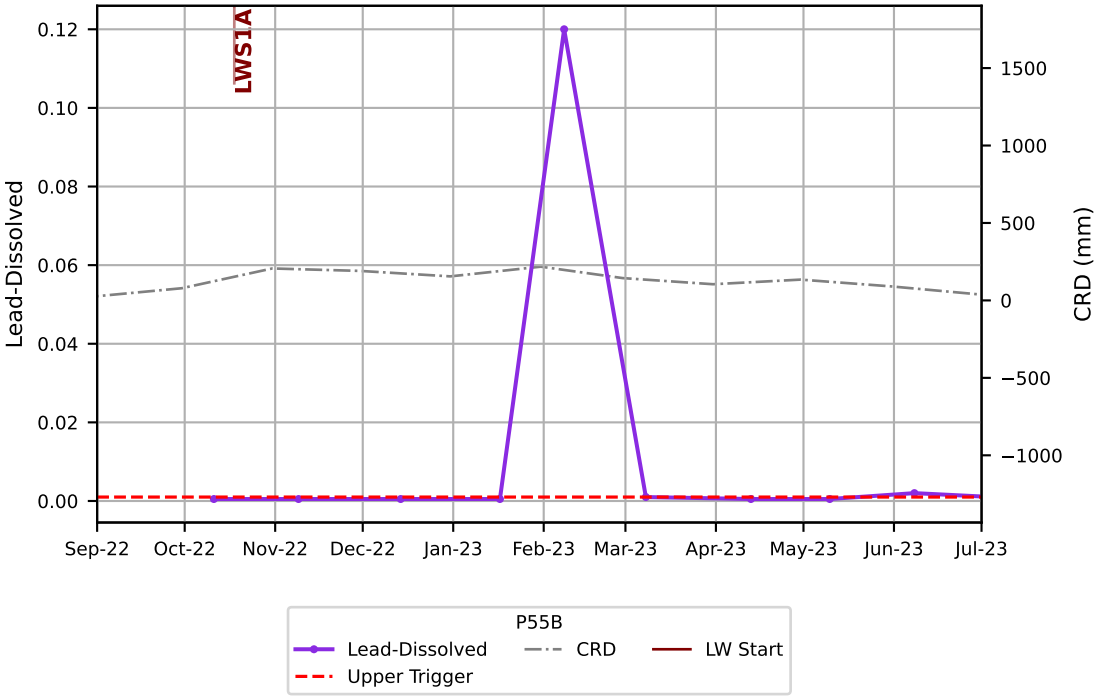

LWS1A
pH (field)
CRD (mm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

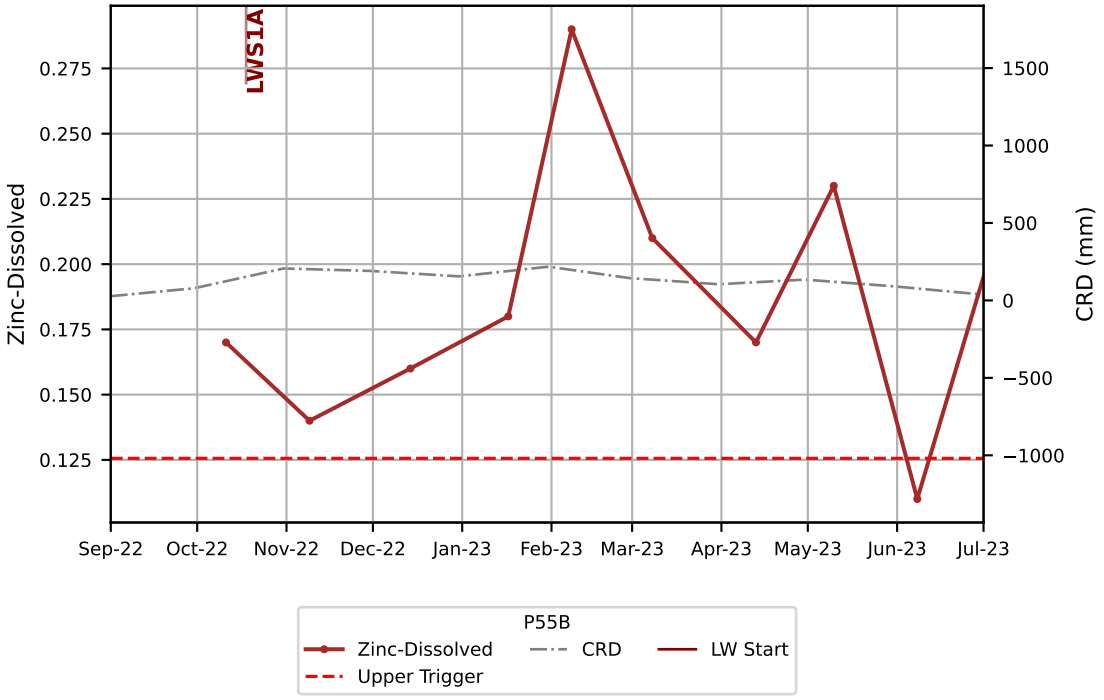

LW51A
Electrical Conductivity (field)
CRD (mm)
1600
1400
1200
1000
800
600
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

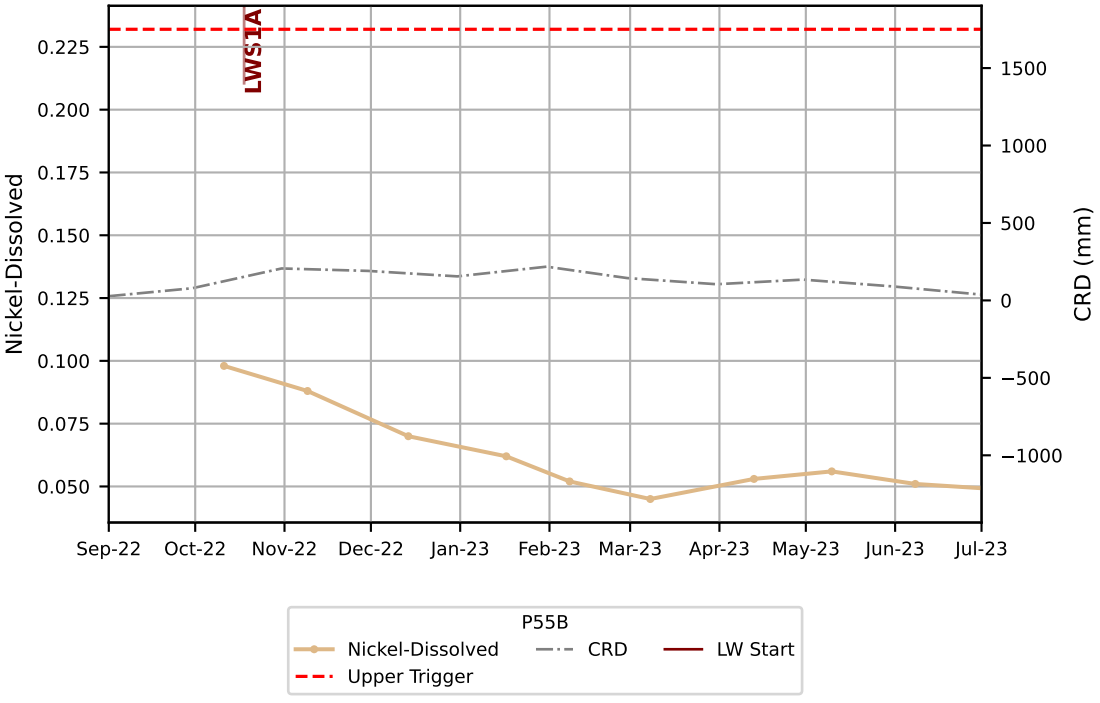

LWS1A
Iron-Dissolved
CRD (mm)
50
45
40
35
30
25
20
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Iron-Dissolved
CRD
LW Start
Upper Trigger

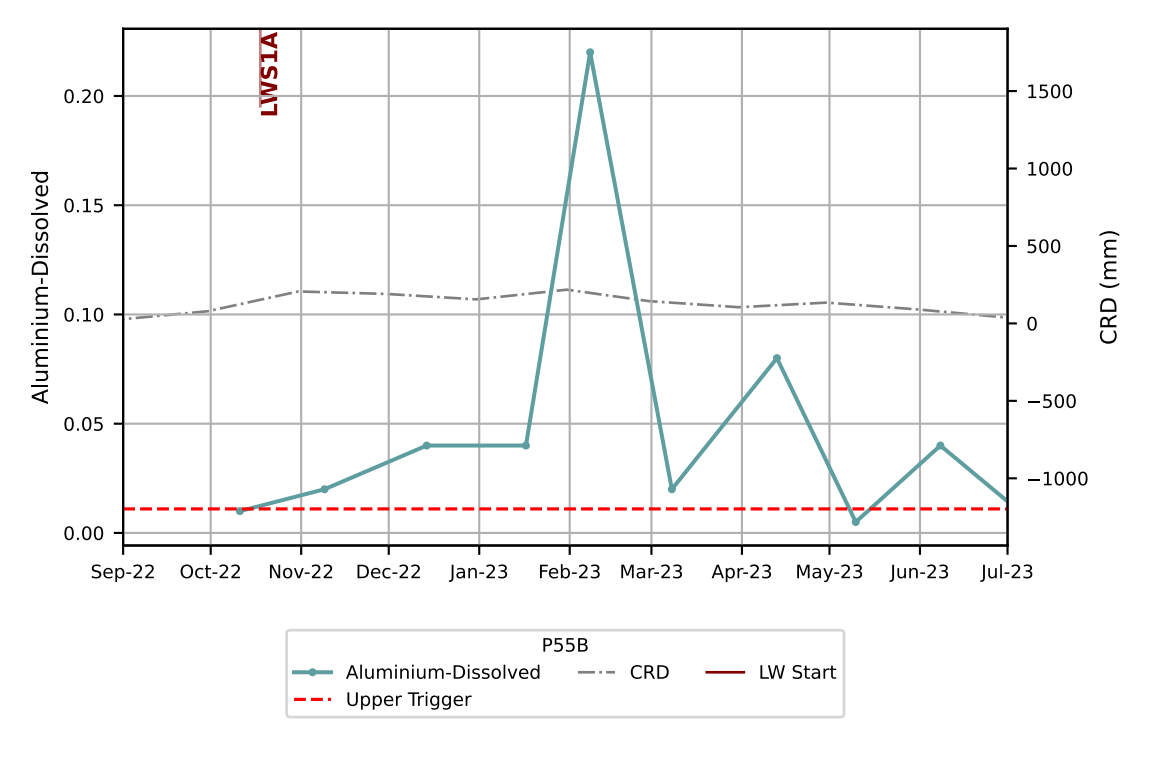

LWSIA
Manganese-Dissolved
CRD (mm)
5.5
5.0
4.5
4.0
3.5
3.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Manganese-Dissolved
CRD
LW Start
Upper Trigger

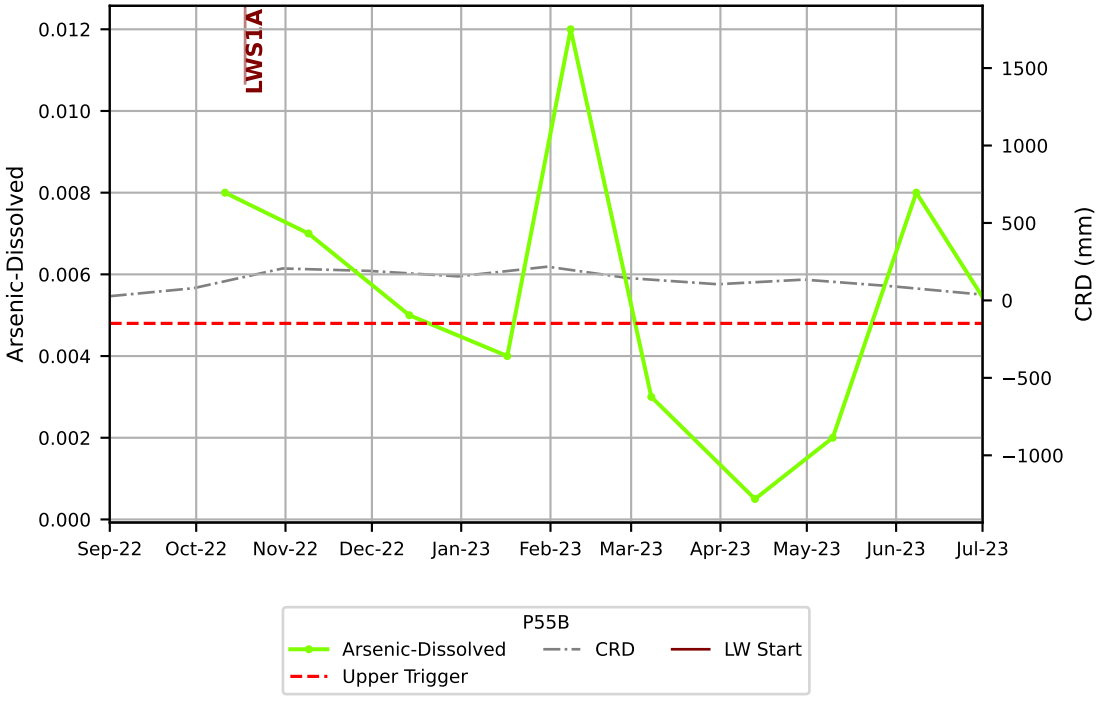

LWS1A
Copper-Dissolved
CRD (mm)
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Copper-Dissolved
CRD
LW Start
Upper Trigger

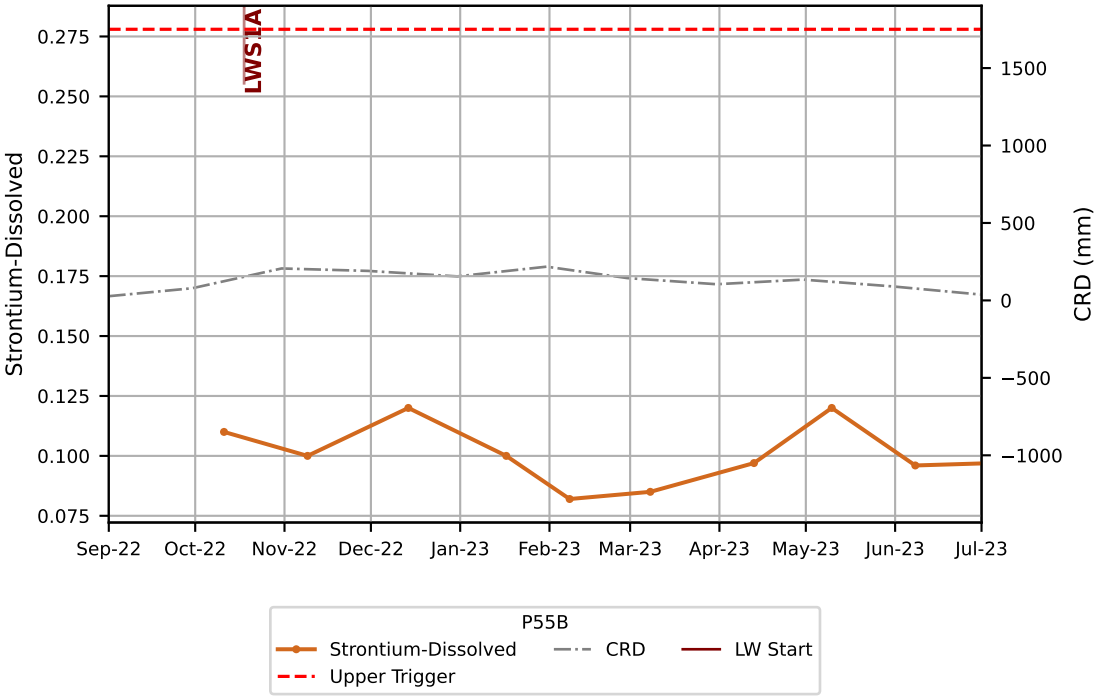

LWS1A
Lead-Dissolved
CRD (mm)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Lead-Dissolved
CRD
LW Start
Upper Trigger

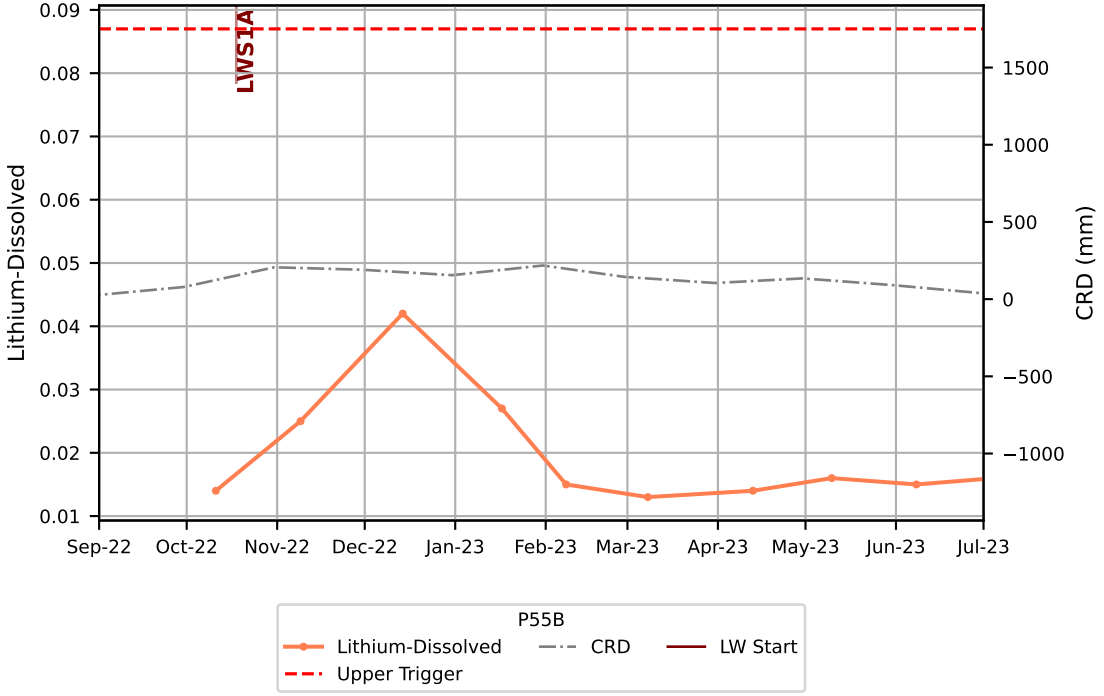

LWS1A
Zinc-Dissolved
CRD (mm)
0.275
0.250
0.225
0.200
0.175
0.150
0.125
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Zinc-Dissolved
CRD
LW Start
Upper Trigger

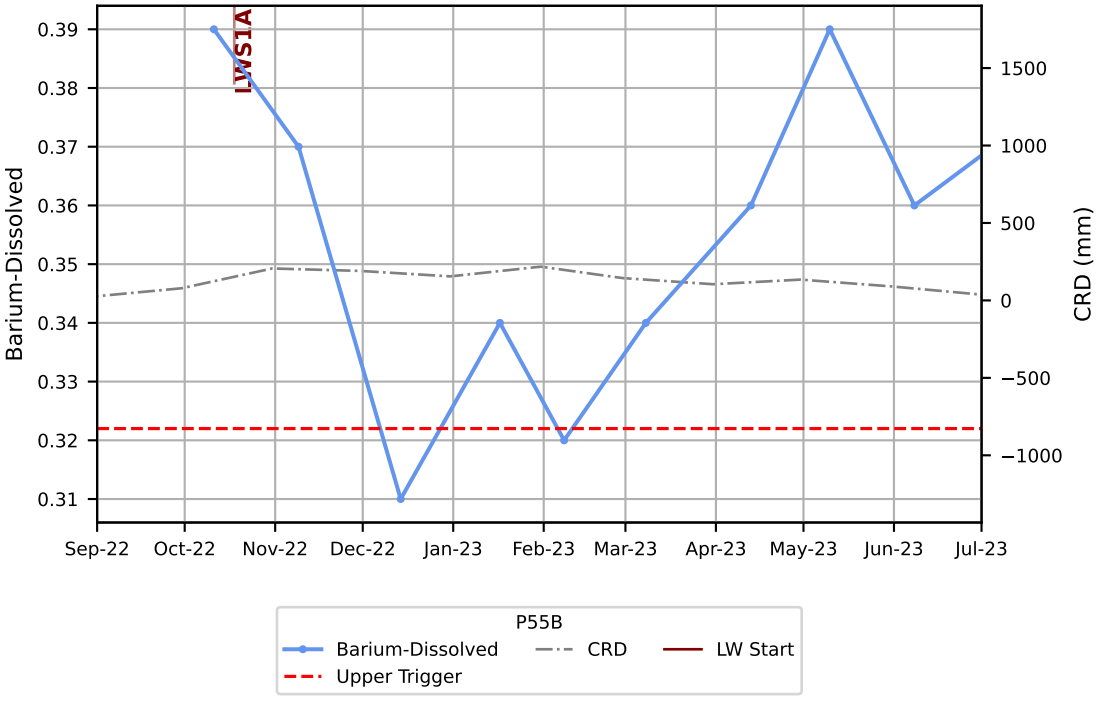

LW51A
Nickel-Dissolved
CRD (mm)
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Nickel-Dissolved
CRD
LW Start
Upper Trigger

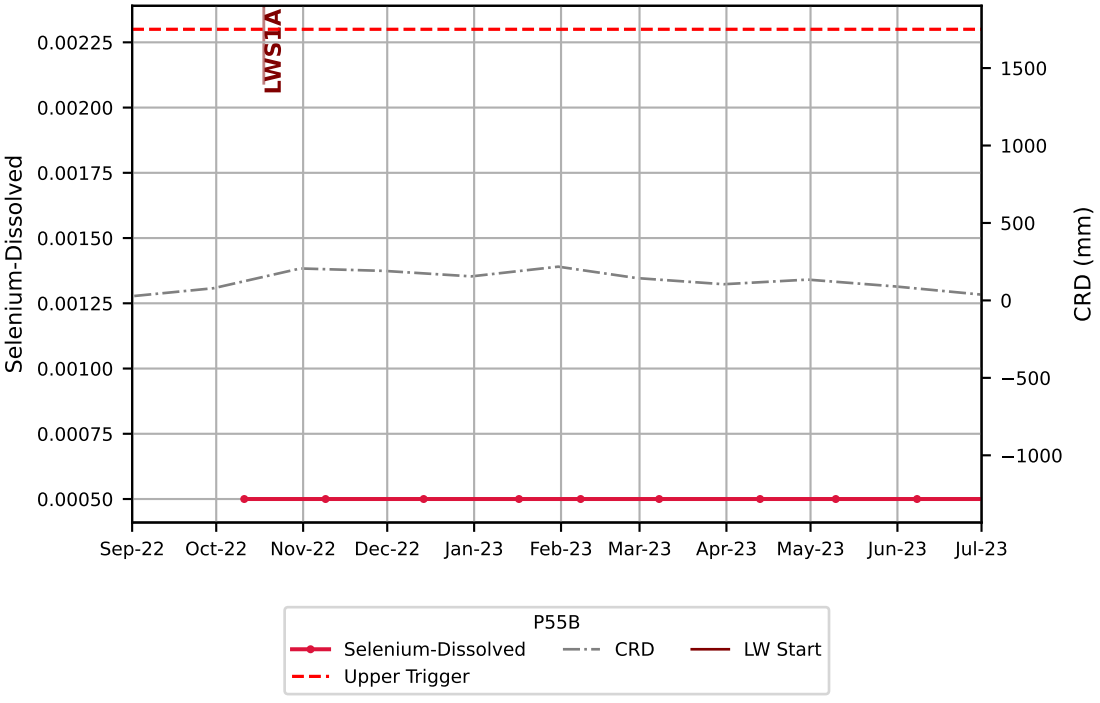

LWS1A
Aluminium-Dissolved
CRD (mm)
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

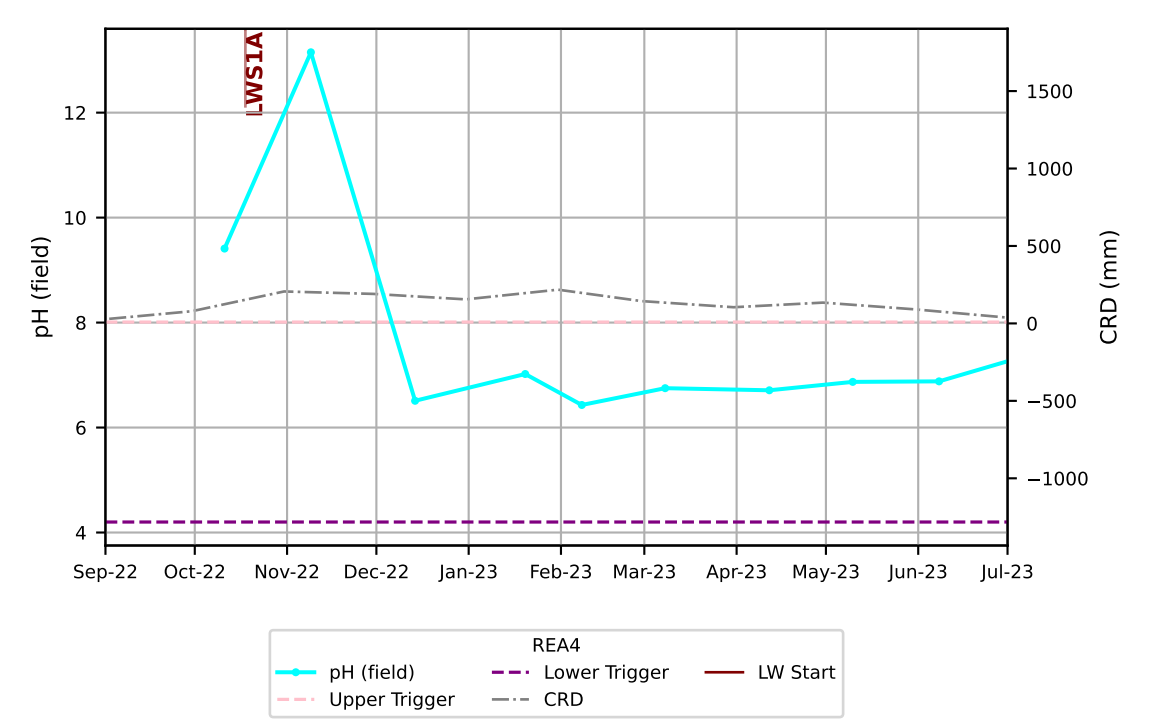

LWS1A
Arsenic-Dissolved
CRD (mm)
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

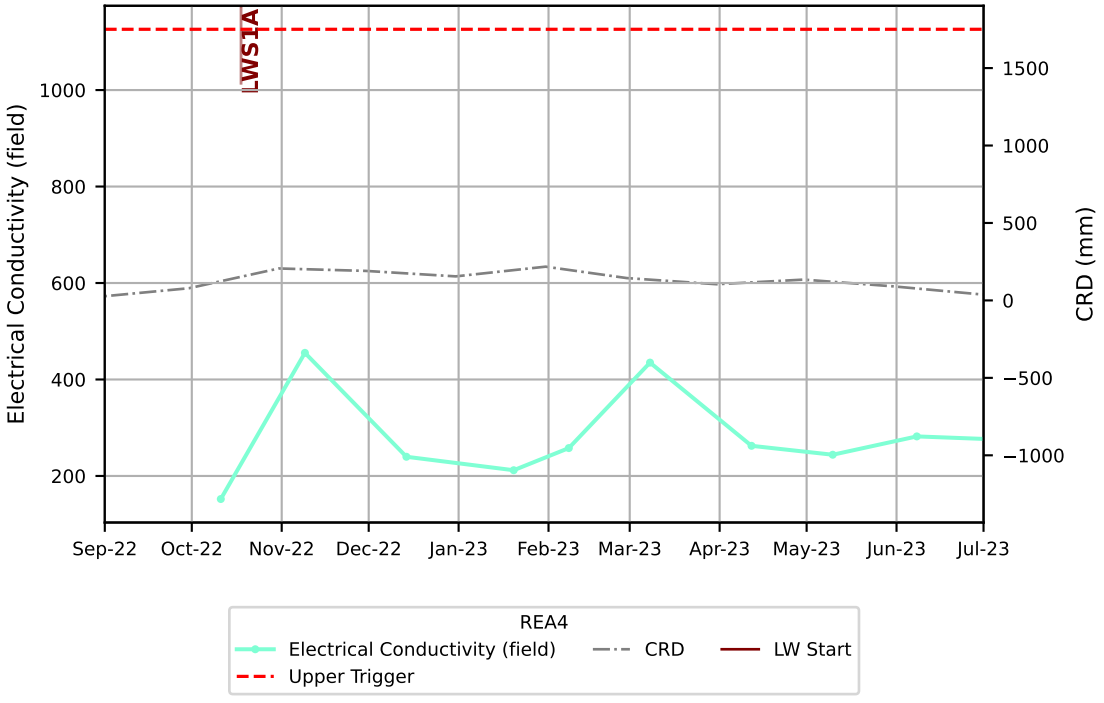

LWSTA
Strontium-Dissolved
CRD (mm)
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Strontium-Dissolved
CRD
LW Start
Upper Trigger

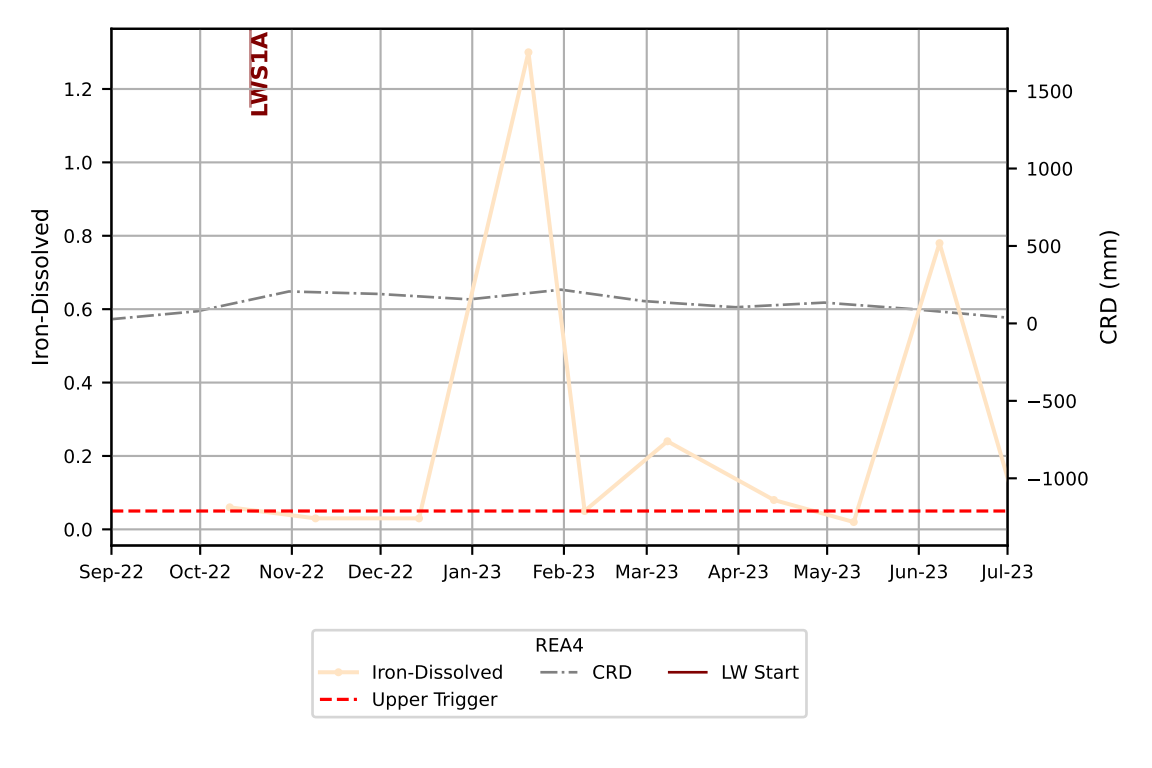

LWS1A
Lithium-Dissolved
CRD (mm)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Lithium-Dissolved
CRD
LW Start
Upper Trigger

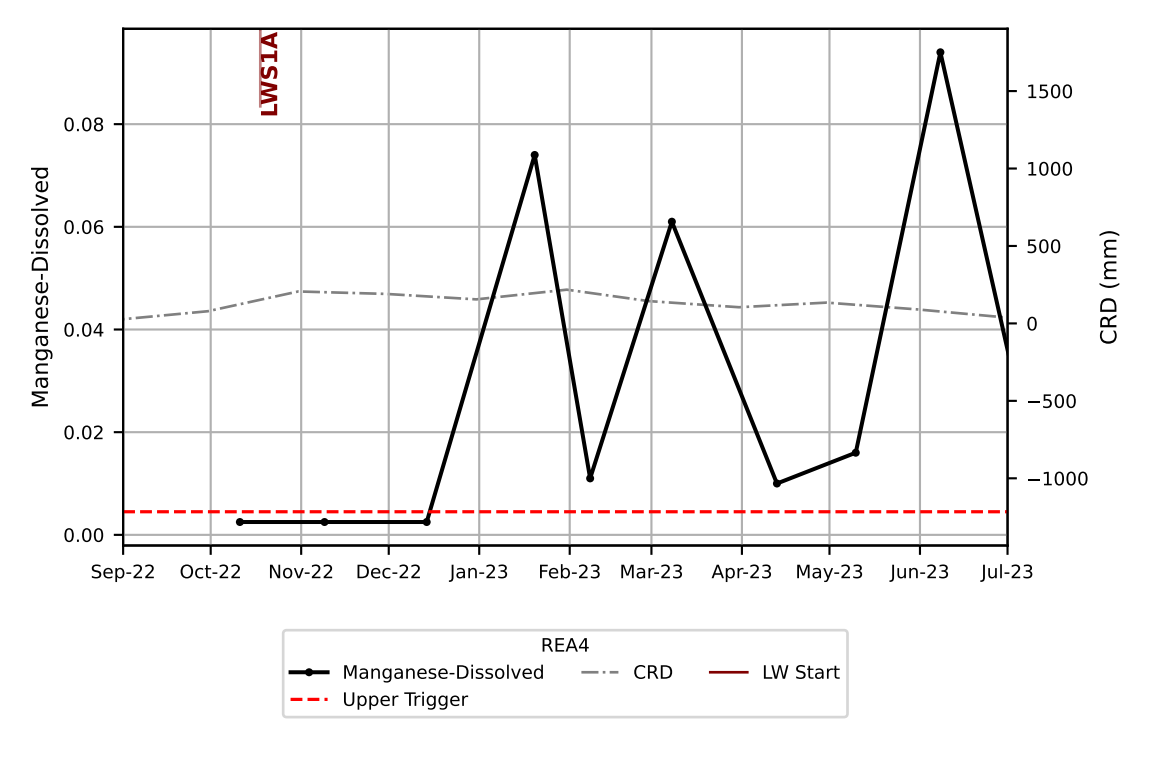

LW S1A
Barium-Dissolved
CRD (mm)
0.39
0.38
0.37
0.36
0.35
0.34
0.33
0.32
0.31
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Barium-Dissolved
CRD
LW Start
Upper Trigger

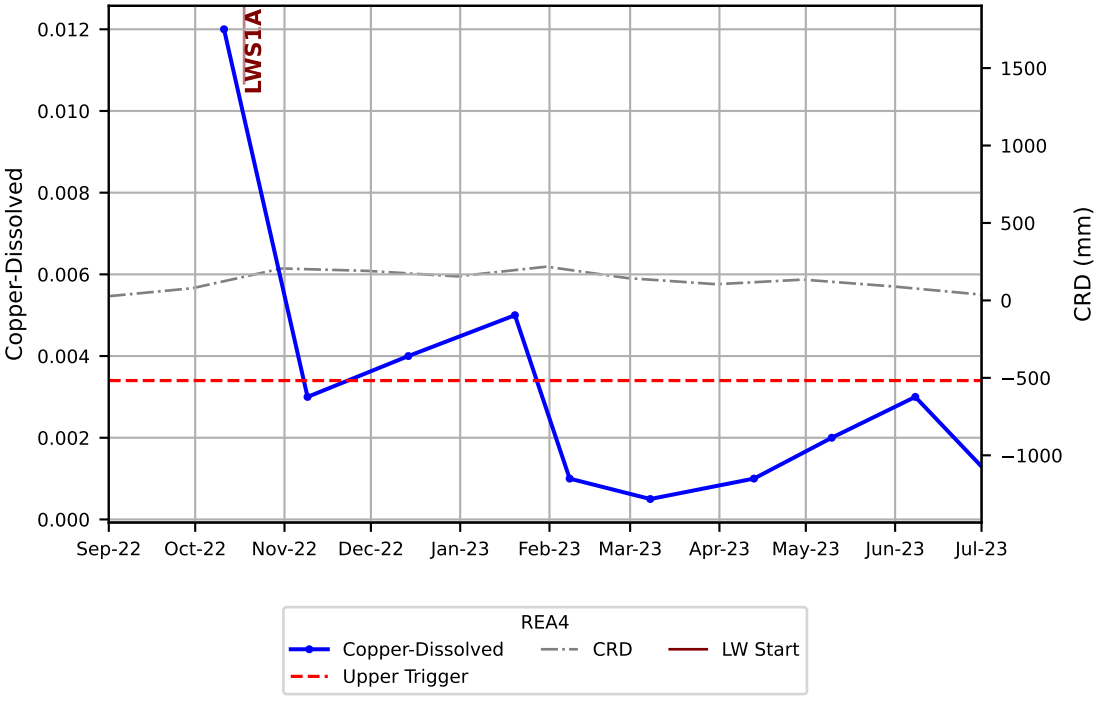

LWS1A
Selenium-Dissolved
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P55B
Selenium-Dissolved
CRD
LW Start
Upper Trigger

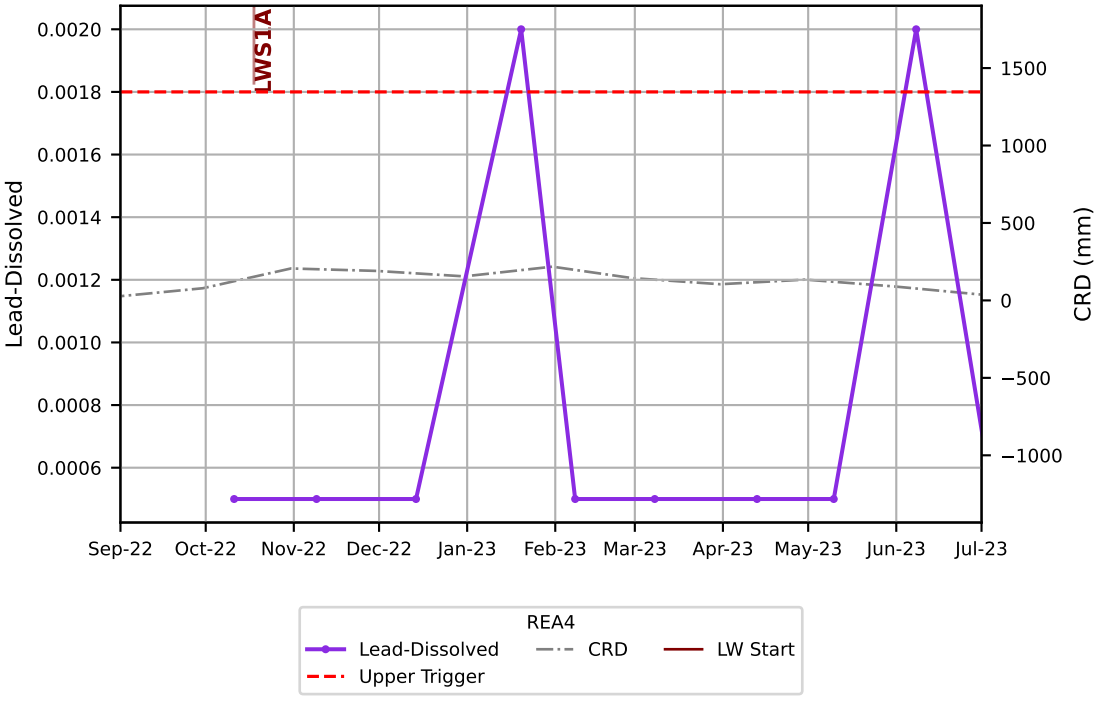

LWS1A
pH (field)
CRD (mm)
12
10
8
6
4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

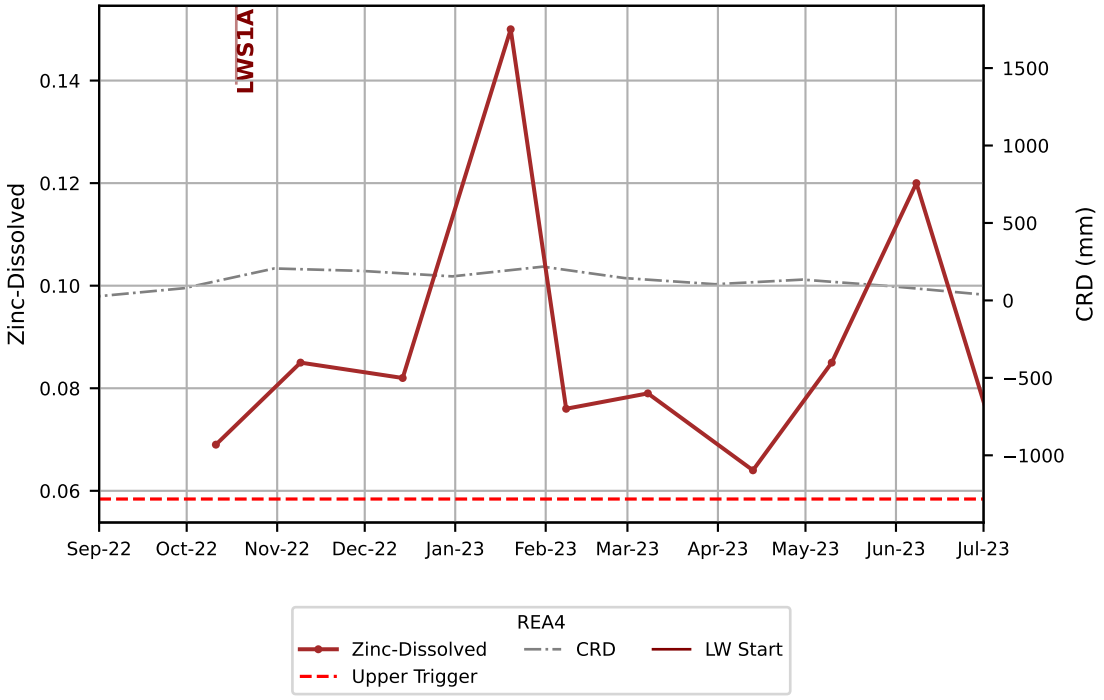

LW1A
Electrical Conductivity (field)
CRD (mm)
1000
800
600
400
200
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

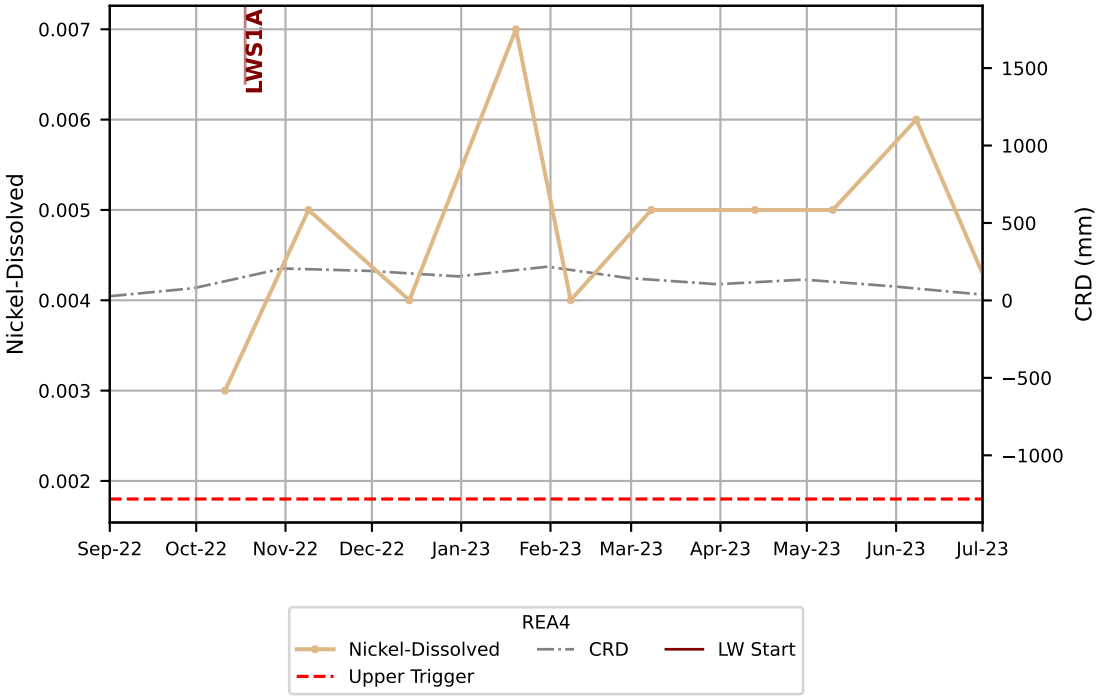

LWS1A
Iron-Dissolved
CRD (mm)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Iron-Dissolved
CRD
LW Start
Upper Trigger

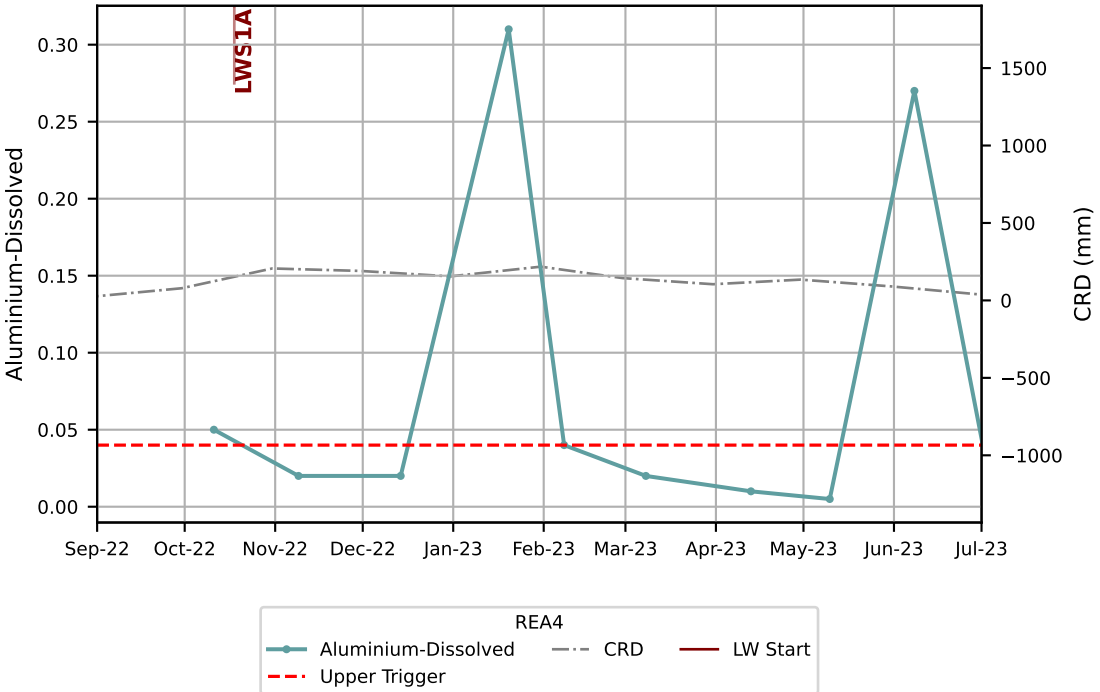

LWS1A
Manganese-Dissolved
CRD (mm)
0.00
0.02
0.04
0.06
0.08
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Manganese-Dissolved
CRD
LW Start
Upper Trigger

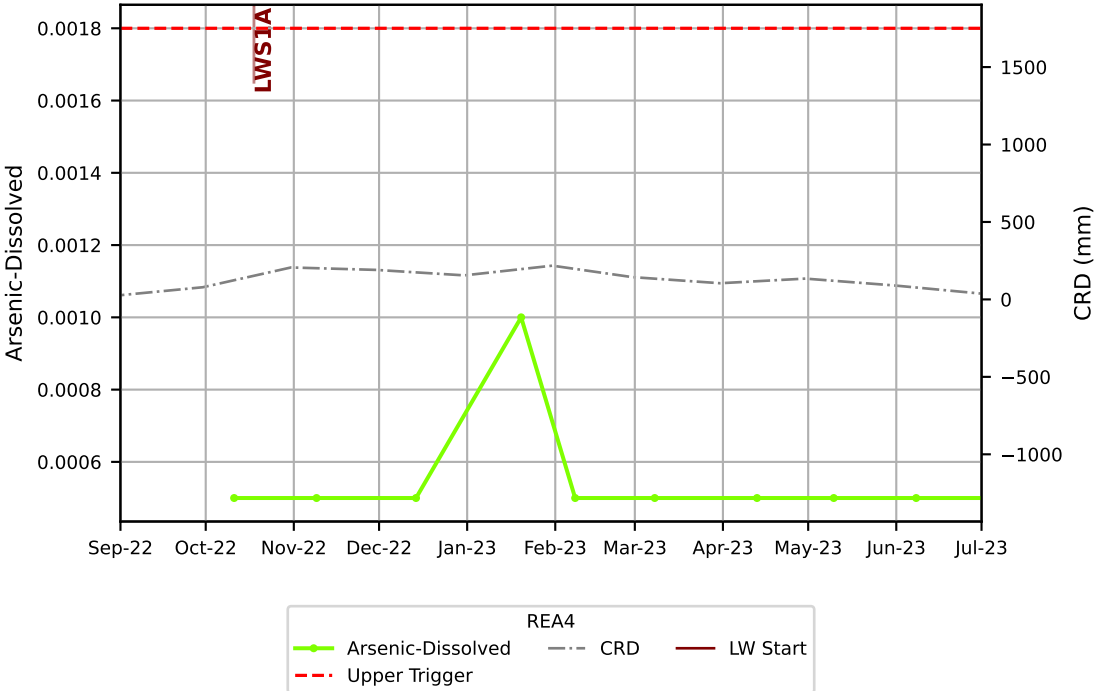

LWS1A
Copper-Dissolved
CRD (mm)
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Copper-Dissolved
CRD
LW Start
Upper Trigger

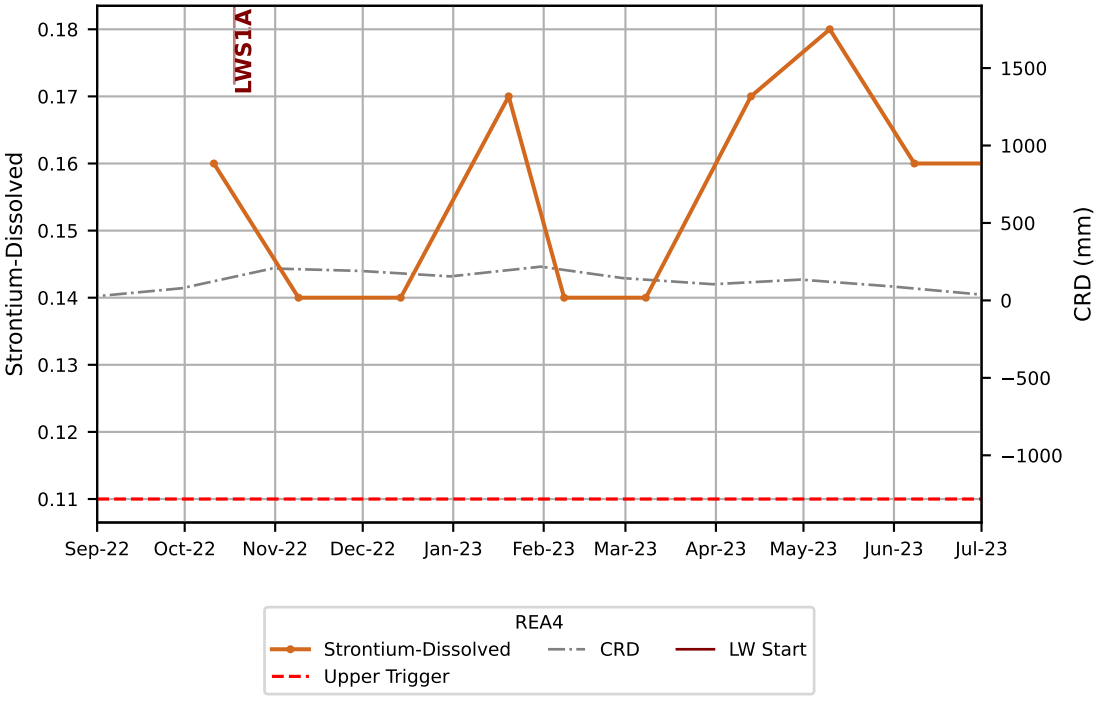

LWS1A
Lead-Dissolved
CRD (mm)
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Lead-Dissolved
CRD
LW Start
Upper Trigger

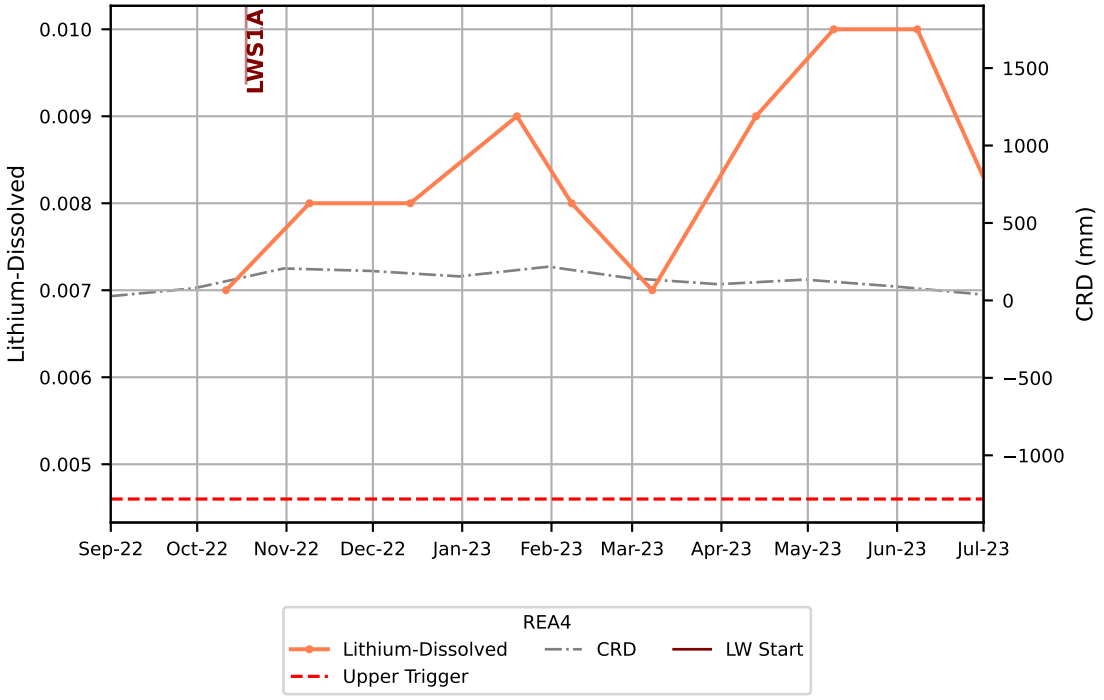

LWS1A
Zinc-Dissolved
CRD (mm)
0.14
0.12
0.10
0.08
0.06
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Zinc-Dissolved
CRD
LW Start
Upper Trigger

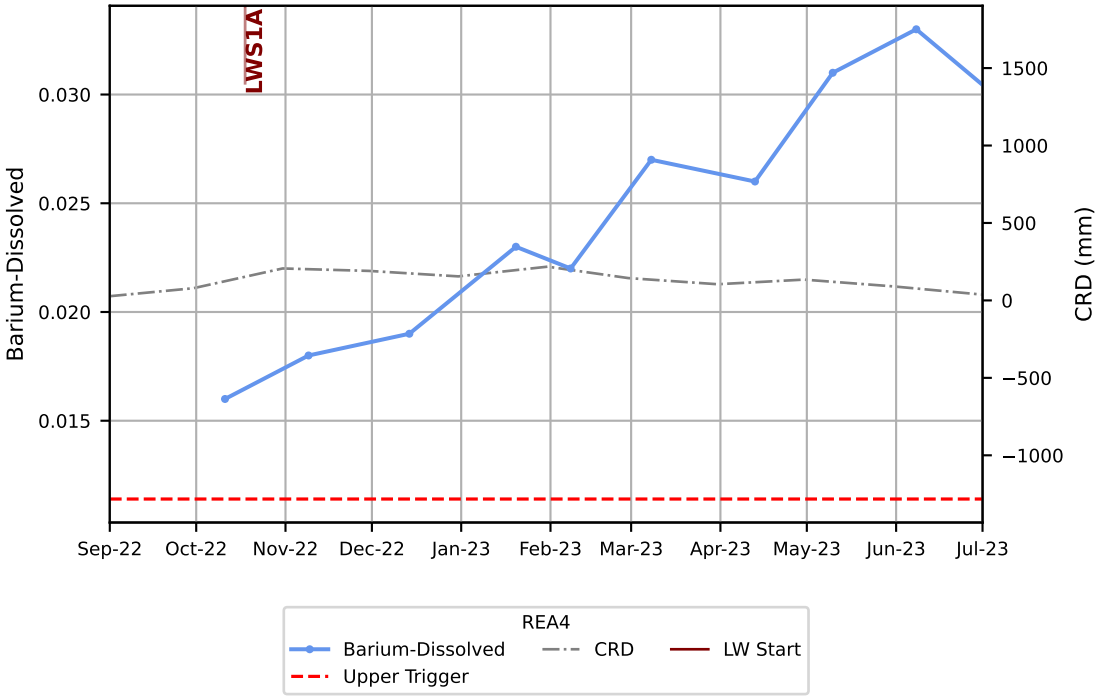

LWS1A
Nickel-Dissolved
CRD (mm)
0.007
0.006
0.005
0.004
0.003
0.002
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Nickel-Dissolved
CRD
LW Start
Upper Trigger

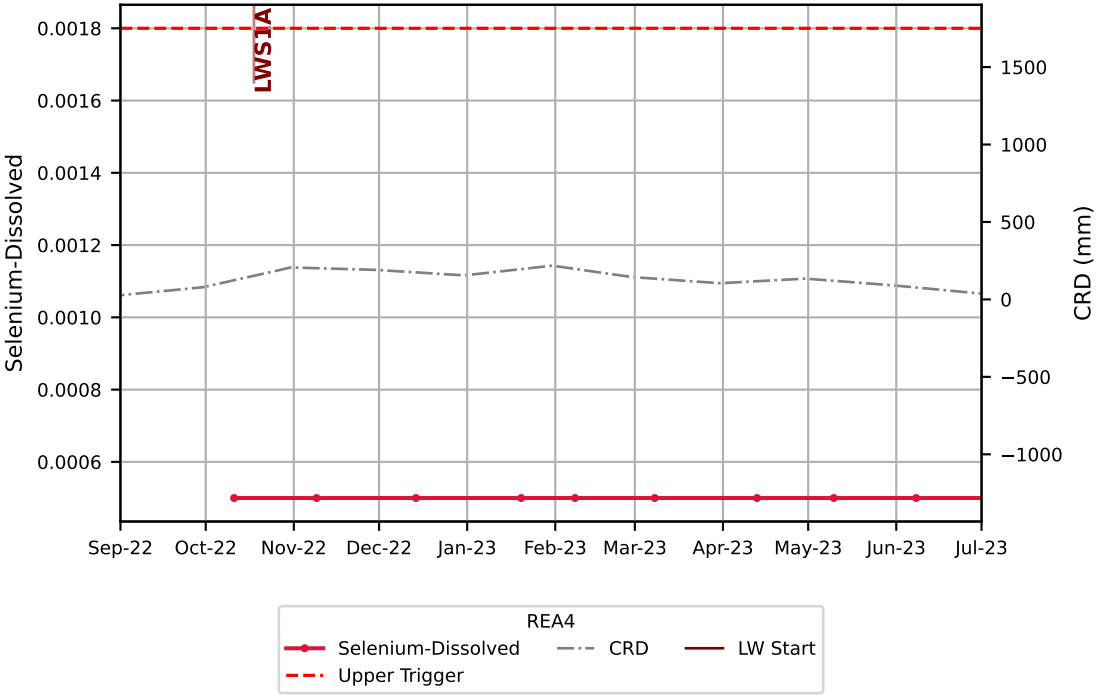

LWS1A
Aluminium-Dissolved
CRD (mm)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

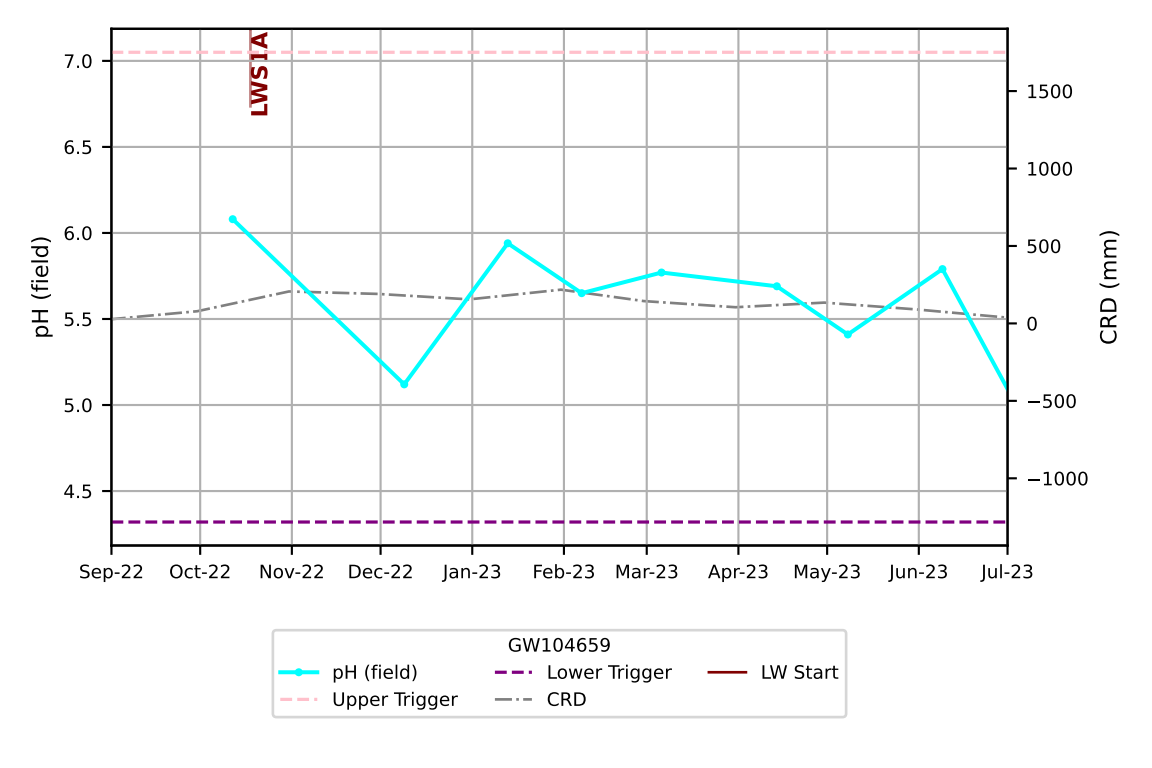

LWS1A
Arsenic-Dissolved
CRD (mm)
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

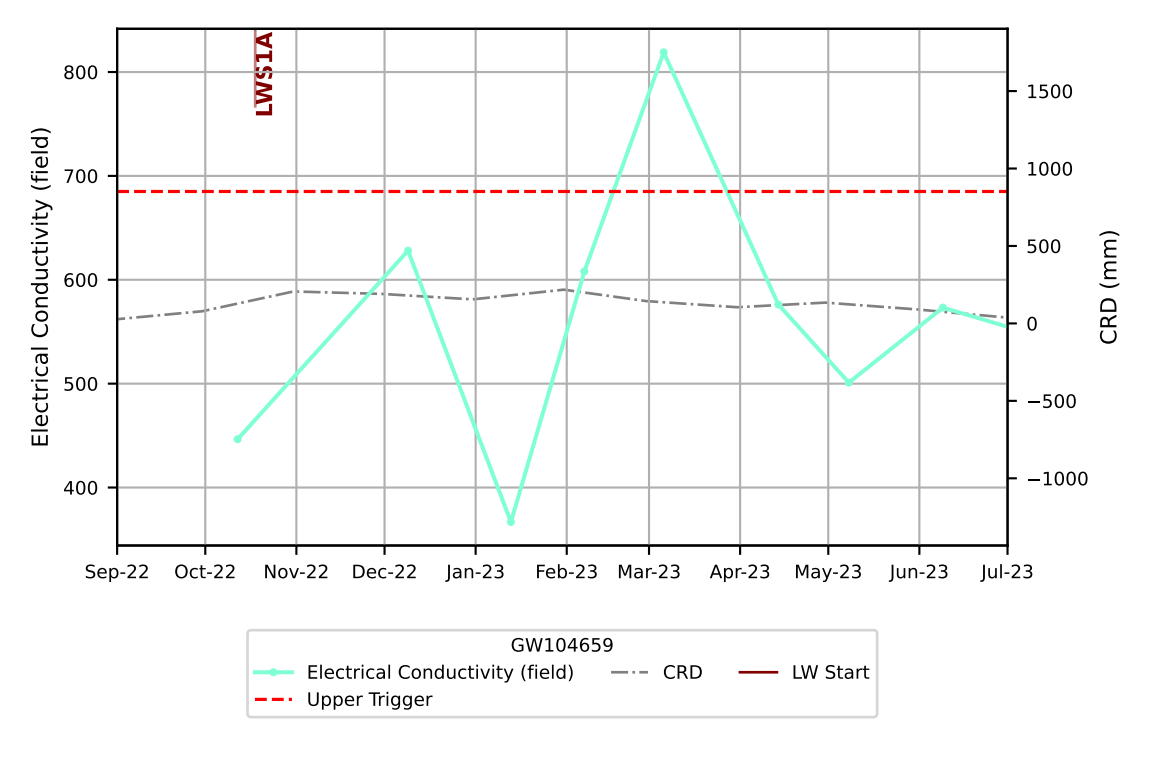

LWS1A
Strontium-Dissolved
CRD (mm)
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Strontium-Dissolved
CRD
LW Start
Upper Trigger

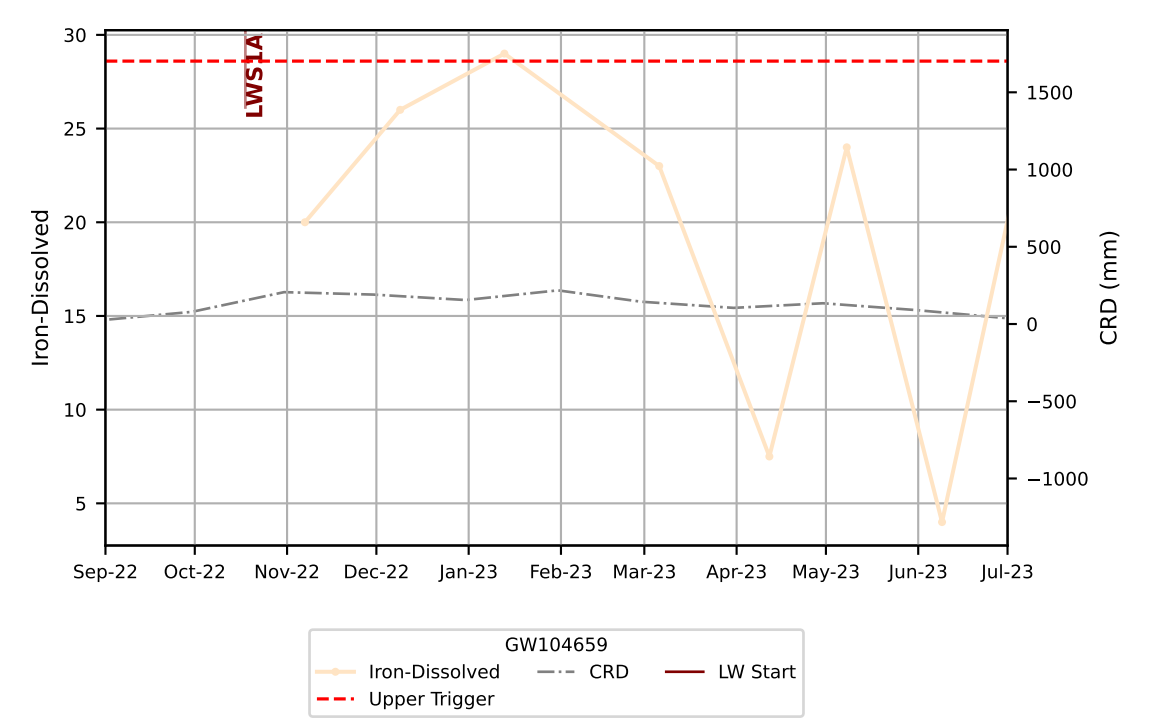

LWS1A
Lithium-Dissolved
CRD (mm)
0.010
0.009
0.008
0.007
0.006
0.005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Lithium-Dissolved
CRD
LW Start
Upper Trigger

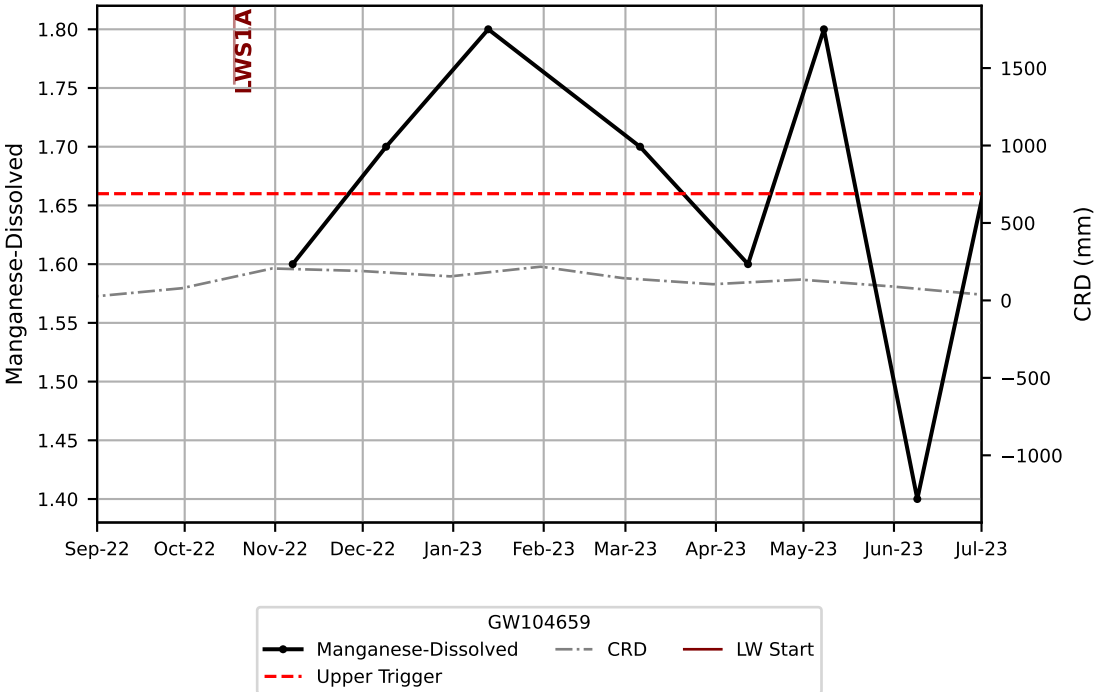

LW S1A
Barium-Dissolved
0.030
0.025
0.020
0.015
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Barium-Dissolved
CRD
LW Start
Upper Trigger

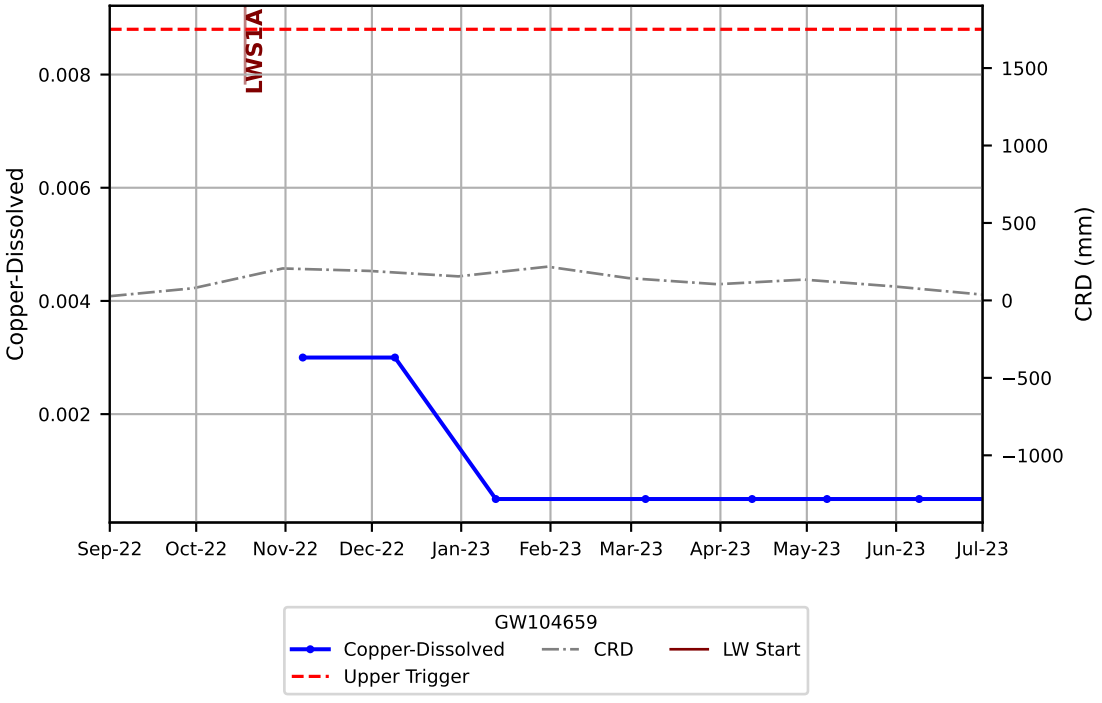

LWS1A
Selenium-Dissolved
CRD (mm)
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
REA4
Selenium-Dissolved
CRD
LW Start
Upper Trigger

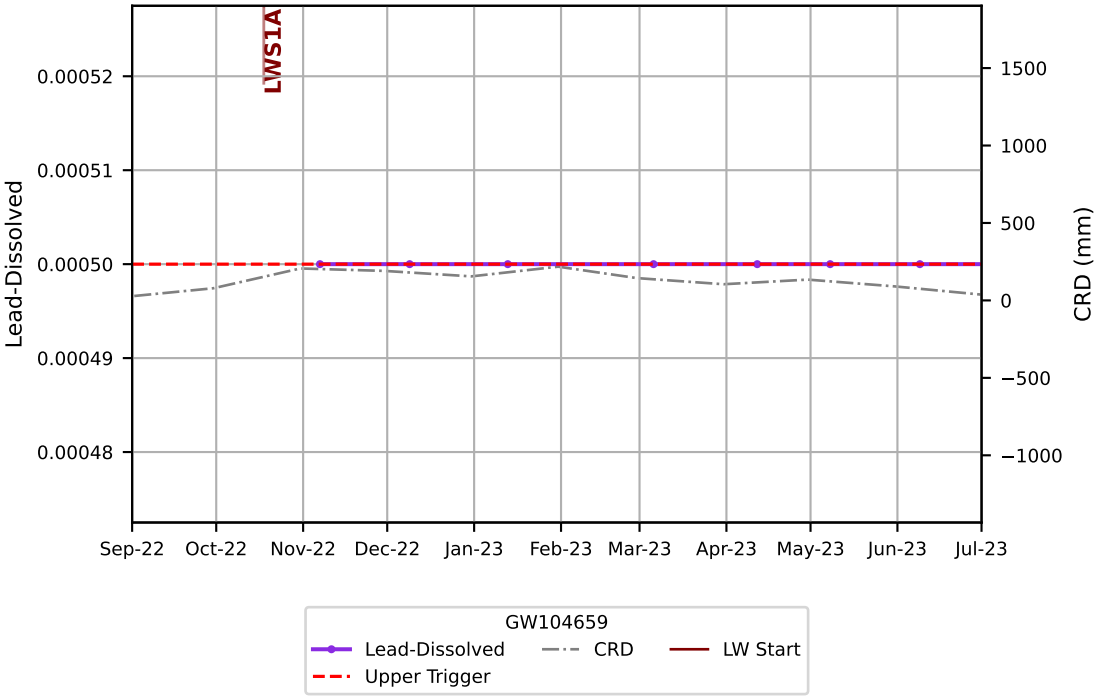

LWS1A
pH (field)
CRD (mm)
7.0
6.5
6.0
5.5
5.0
4.5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

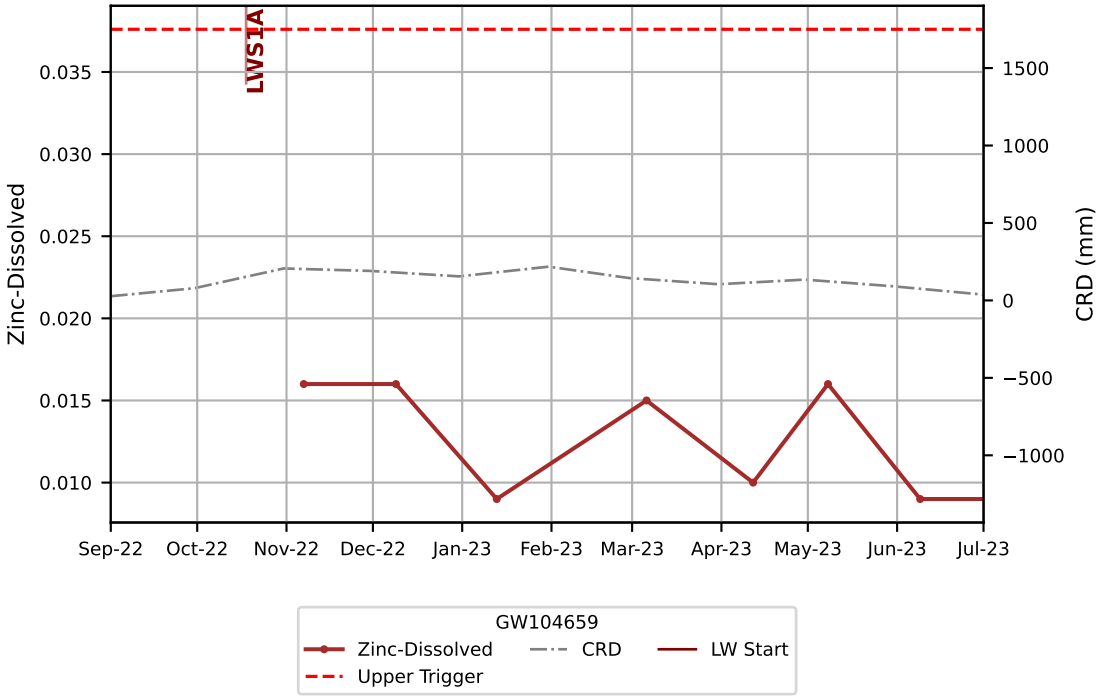

LW S1A
Electrical Conductivity (field)
CRD (mm)
800
700
600
500
400
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

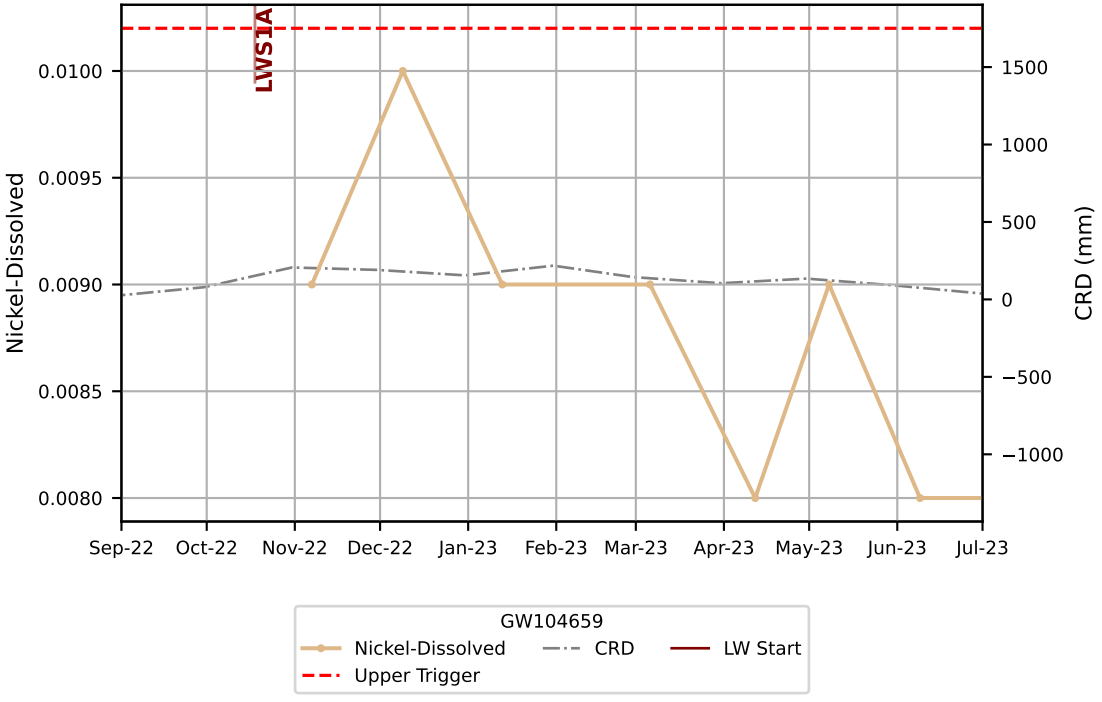

LWS1A
Iron-Dissolved
CRD (mm)
30
25
20
15
10
5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Iron-Dissolved
CRD
LW Start
Upper Trigger

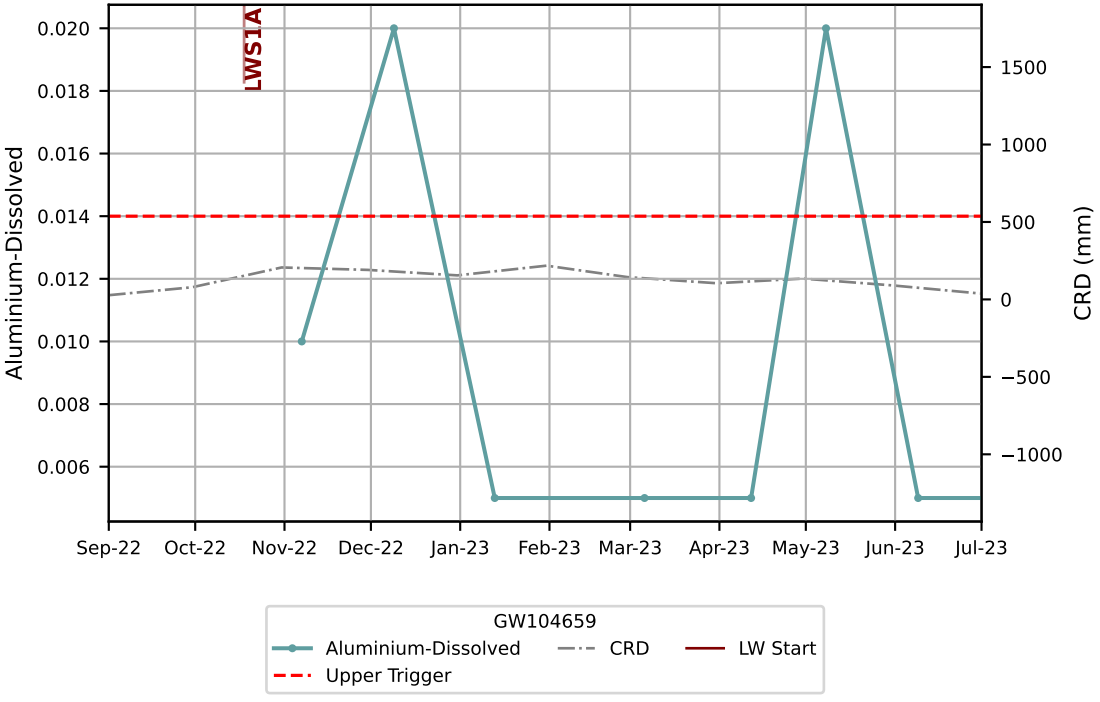

LWS1A
Manganese-Dissolved
CRD (mm)
1.80
1.75
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Manganese-Dissolved
CRD
LW Start
Upper Trigger

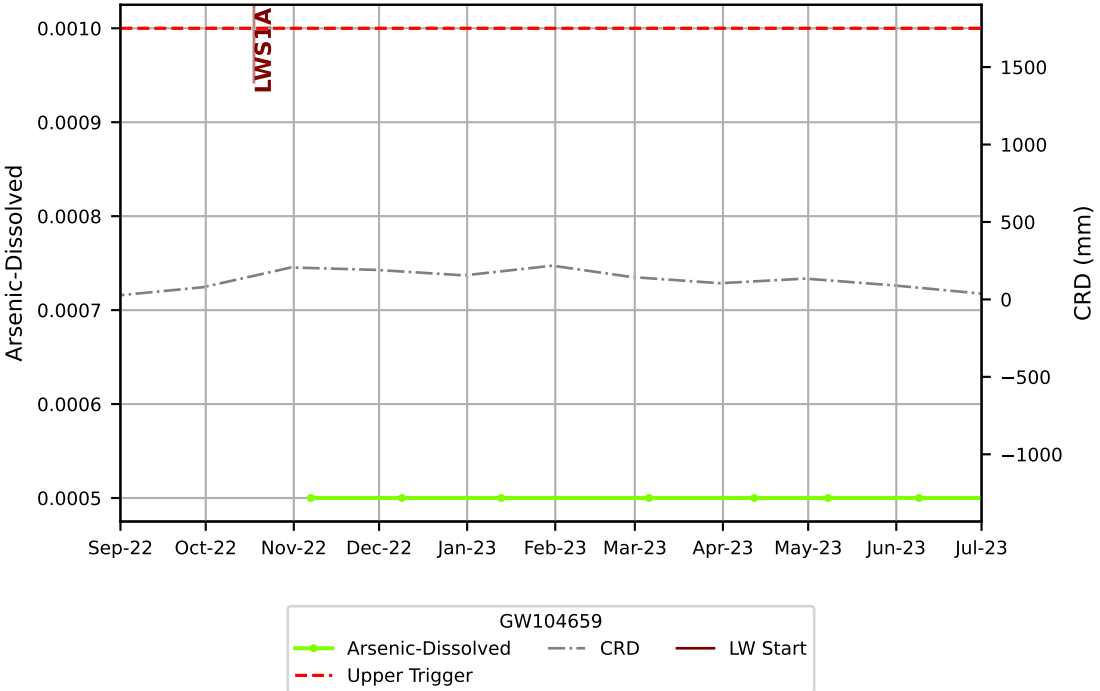

LWS1A
Copper-Dissolved
0.008
0.006
0.004
0.002
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Copper-Dissolved
CRD
LW Start
Upper Trigger

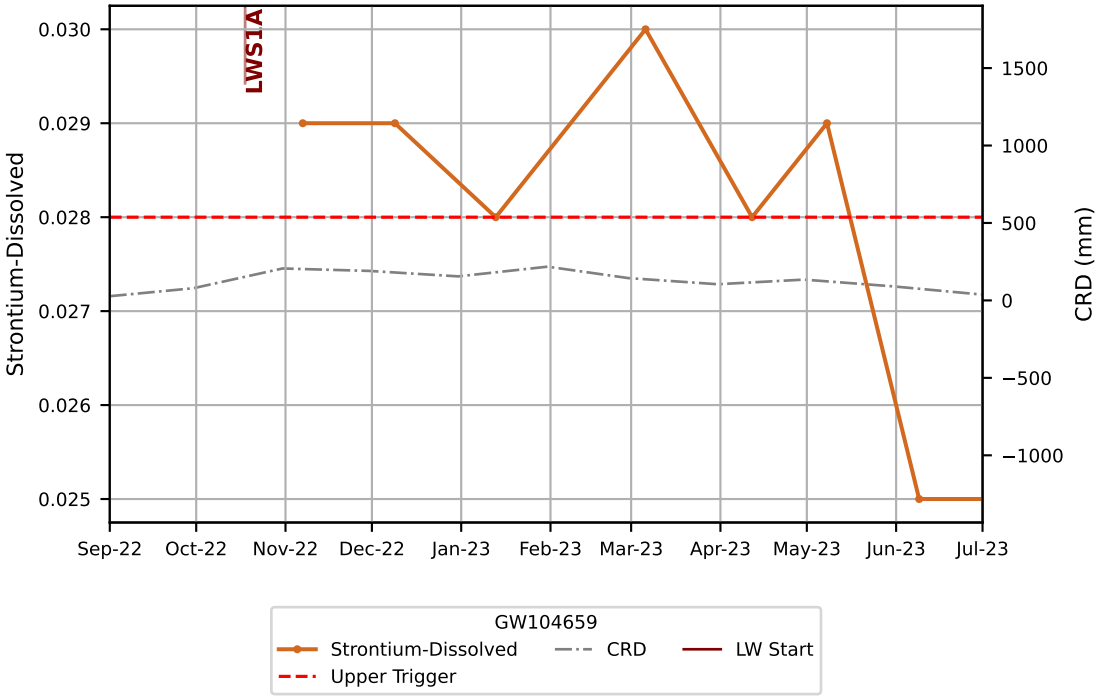

LW51A
Lead-Dissolved
0.00052
0.00051
0.00050
0.00049
0.00048
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Lead-Dissolved
CRD
LW Start
Upper Trigger

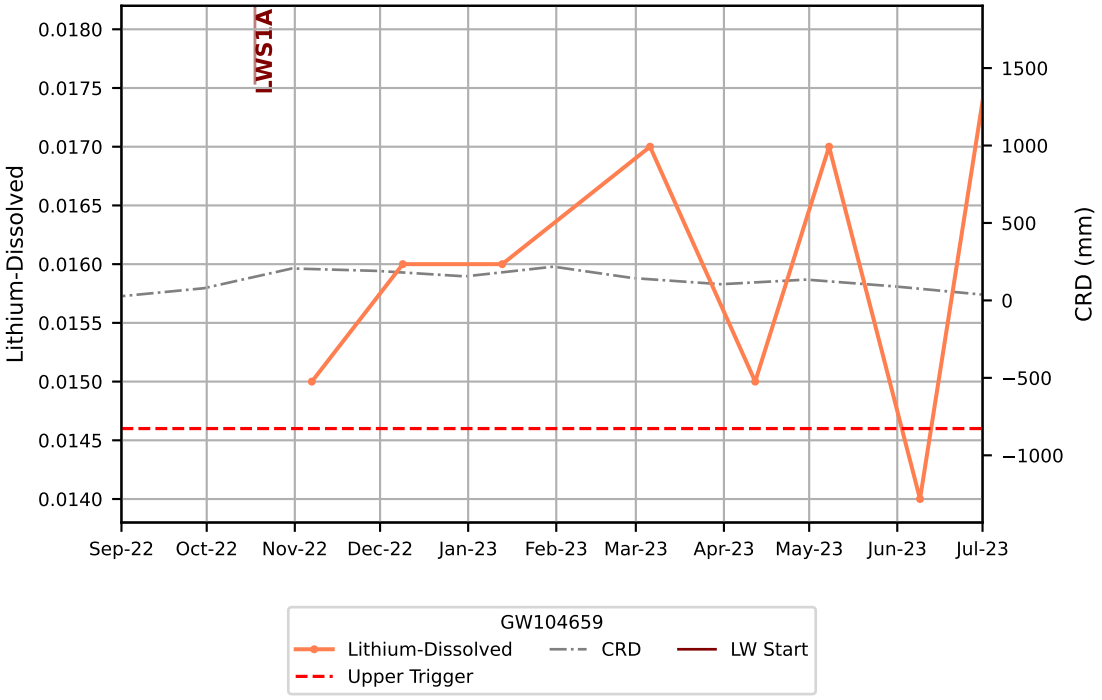

LWS1A
Zinc-Dissolved
CRD (mm)
0.035
0.030
0.025
0.020
0.015
0.010
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Zinc-Dissolved
CRD
LW Start
Upper Trigger

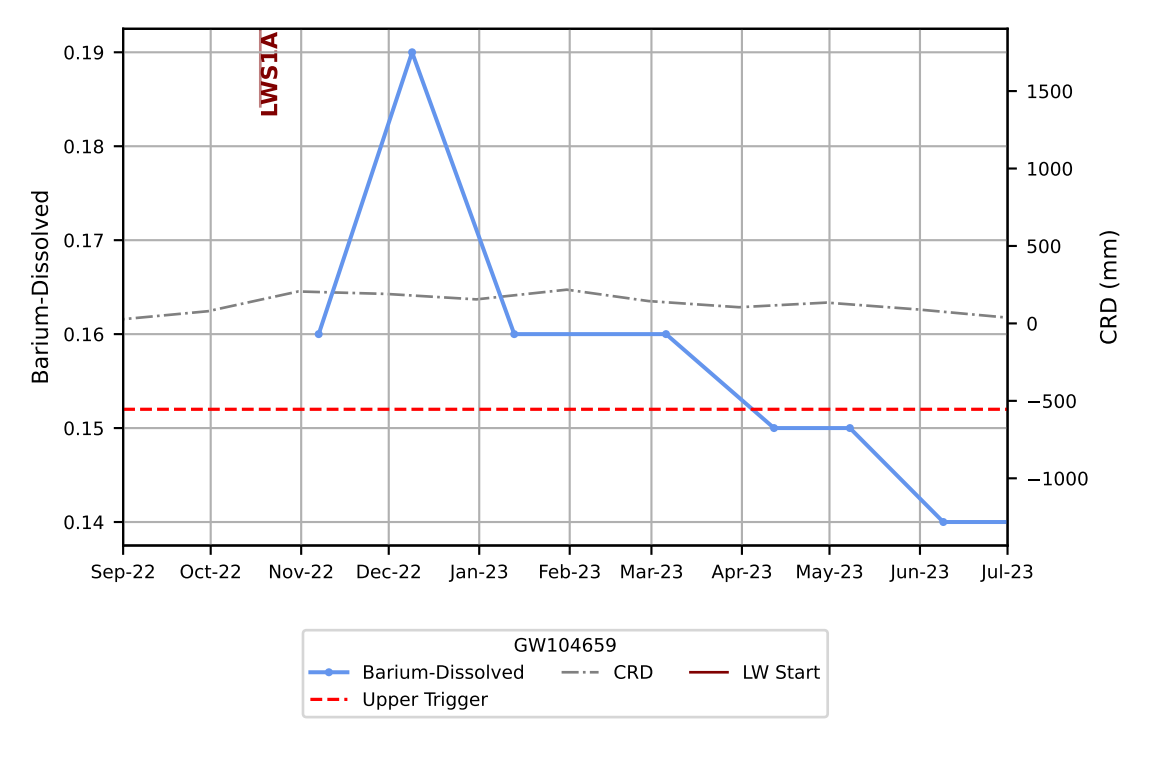

LWS1A
Nickel-Dissolved
0.0100
0.0095
0.0090
0.0085
0.0080
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Nickel-Dissolved
CRD
LW Start
Upper Trigger

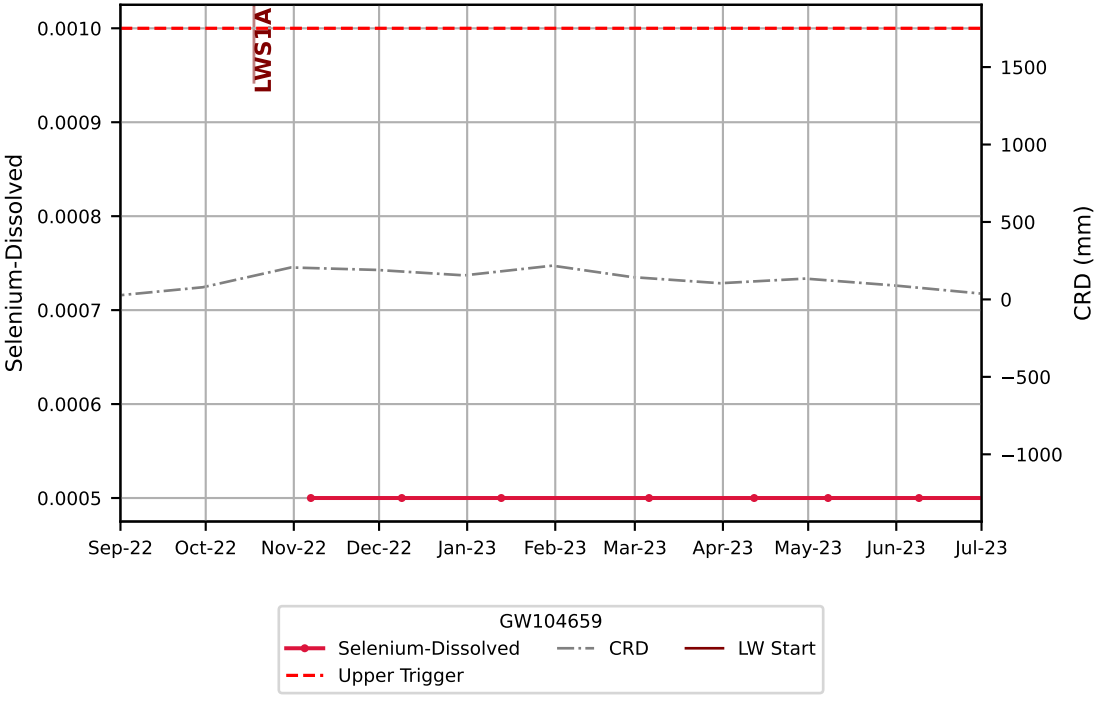

LWS1A
Aluminium-Dissolved
CRD (mm)
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

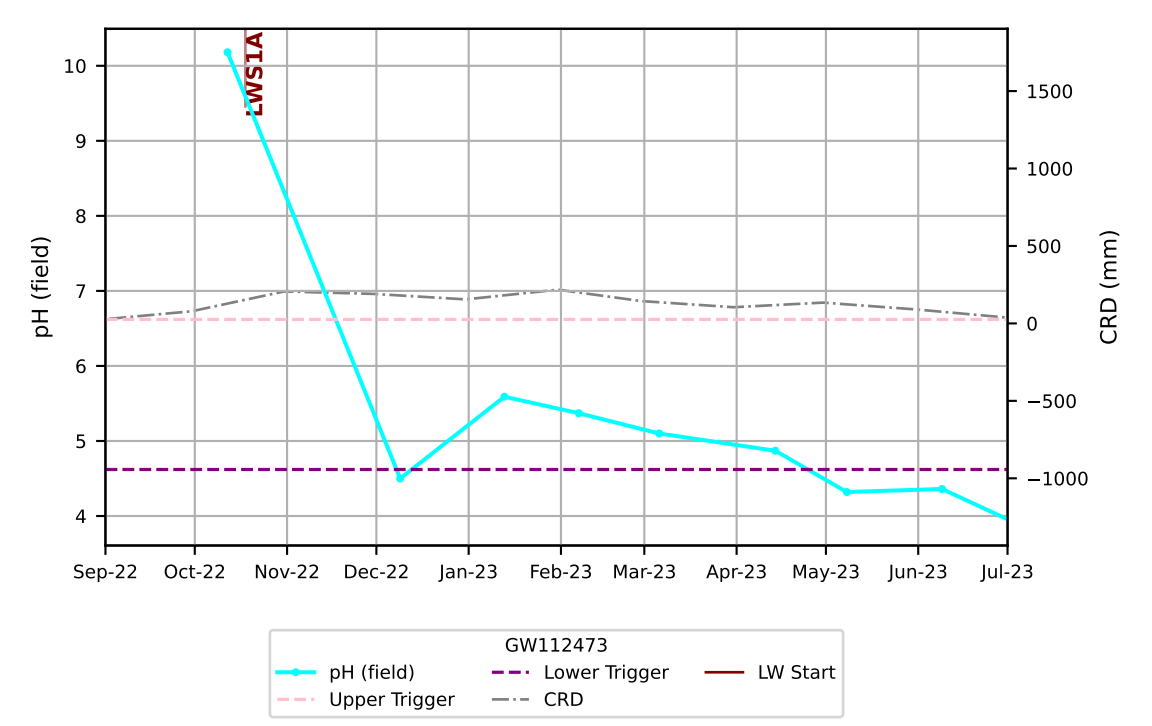

LWS1A
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
Arsenic-Dissolved
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

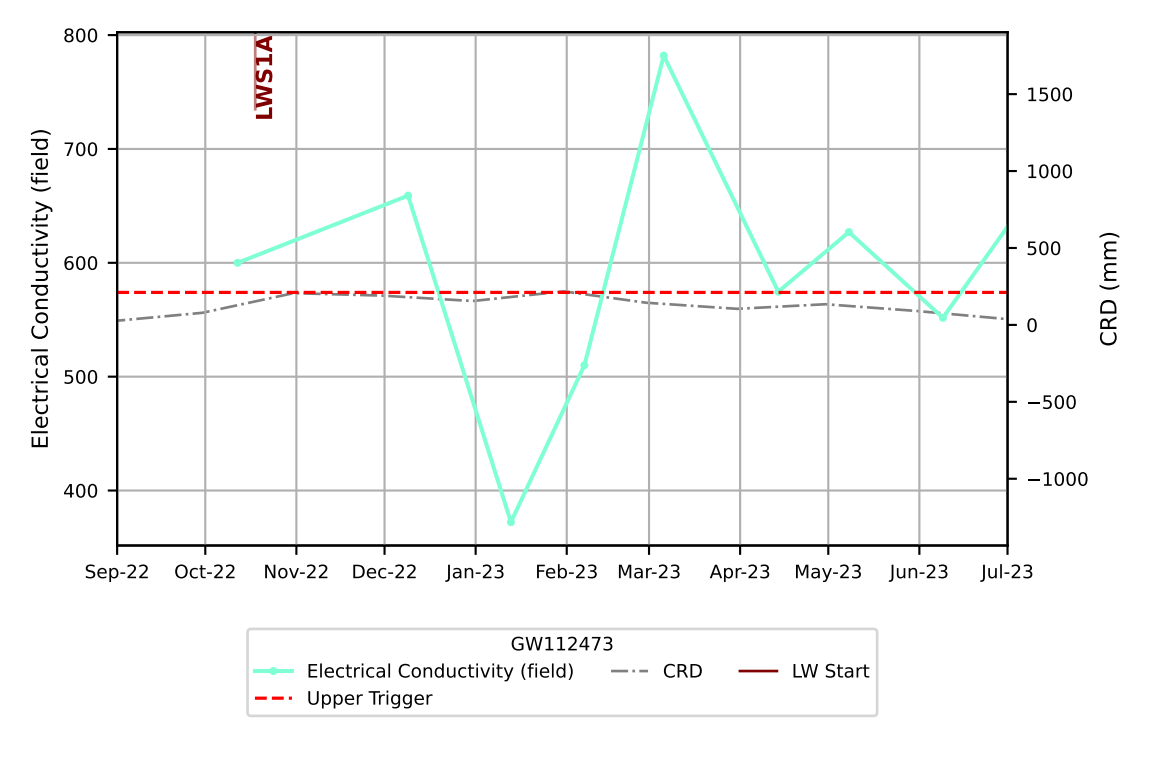

LWS1A
Strontium-Dissolved
CRD (mm)
0.030
0.029
0.028
0.027
0.026
0.025
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Strontium-Dissolved
CRD
LW Start
Upper Trigger

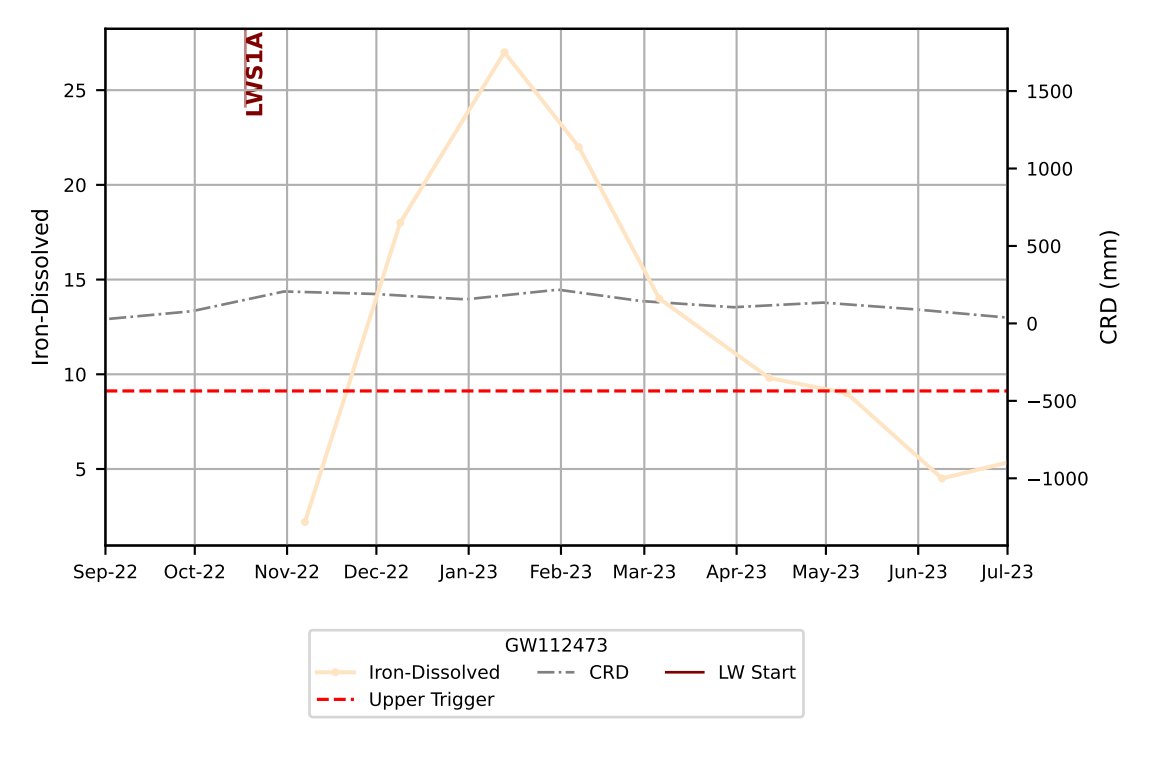

LWS1A
Lithium-Dissolved
CRD (mm)
0.0180
0.0175
0.0170
0.0165
0.0160
0.0155
0.0150
0.0145
0.0140
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Lithium-Dissolved
CRD
LW Start
Upper Trigger

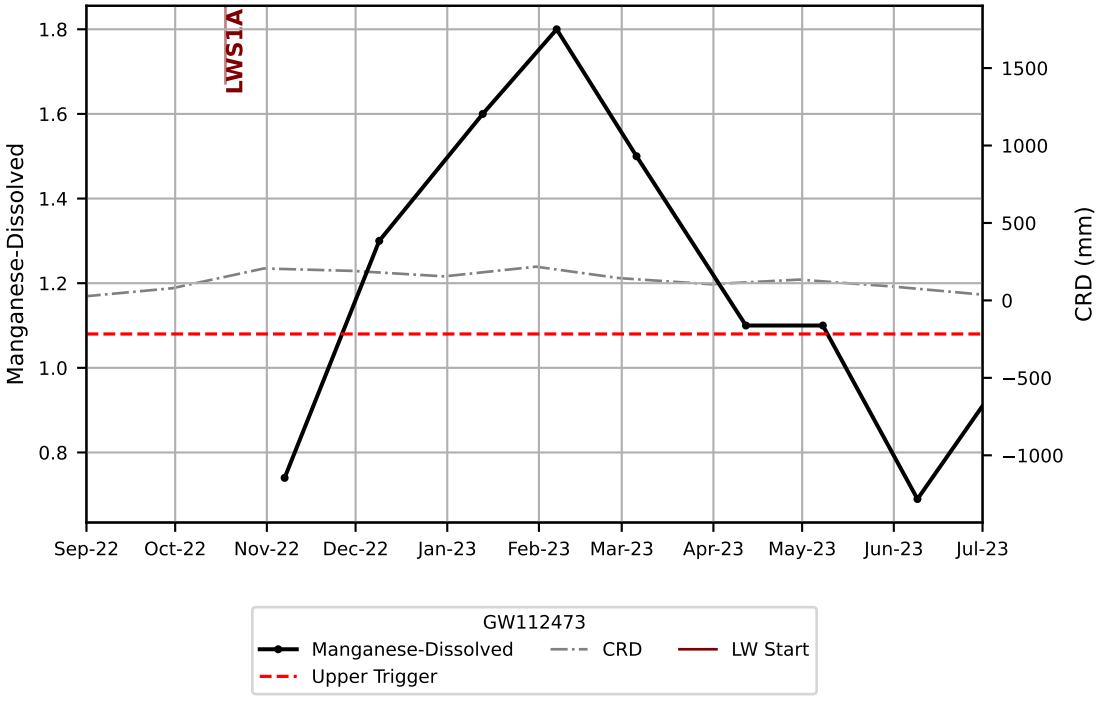

LWS1A
Barium-Dissolved
CRD (mm)
0.19
0.18
0.17
0.16
0.15
0.14
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Barium-Dissolved
CRD
LW Start
Upper Trigger

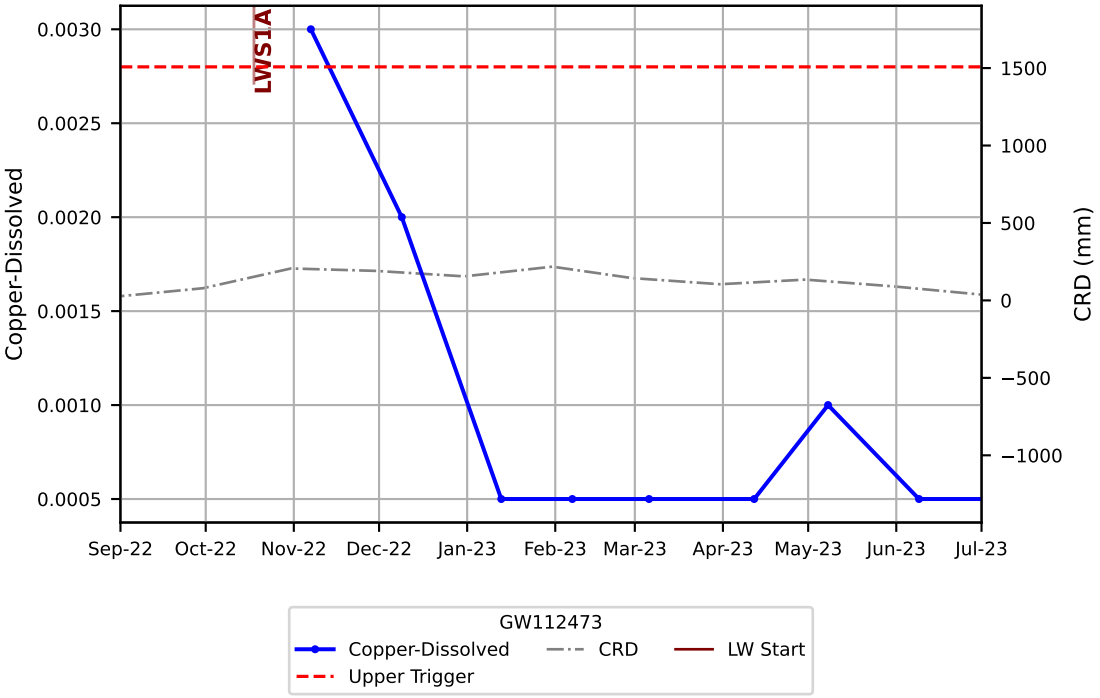

LWS1A
Selenium-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104659
Selenium-Dissolved
CRD
LW Start
Upper Trigger

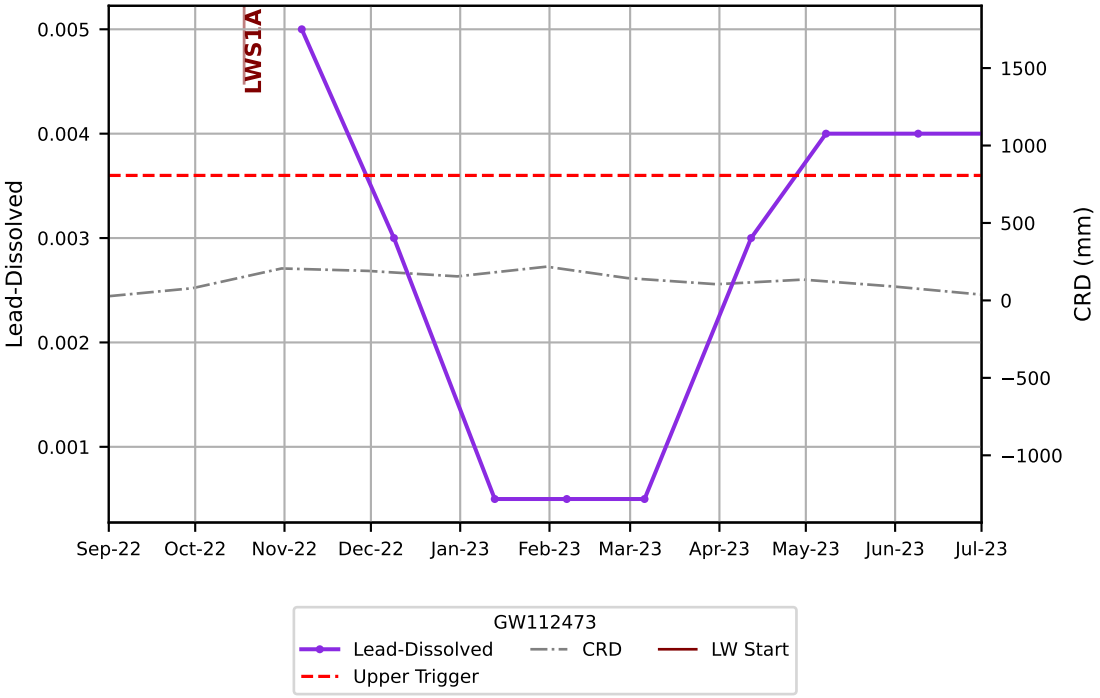

LWS1A
pH (field)
CRD (mm)
10
9
8
7
6
5
4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

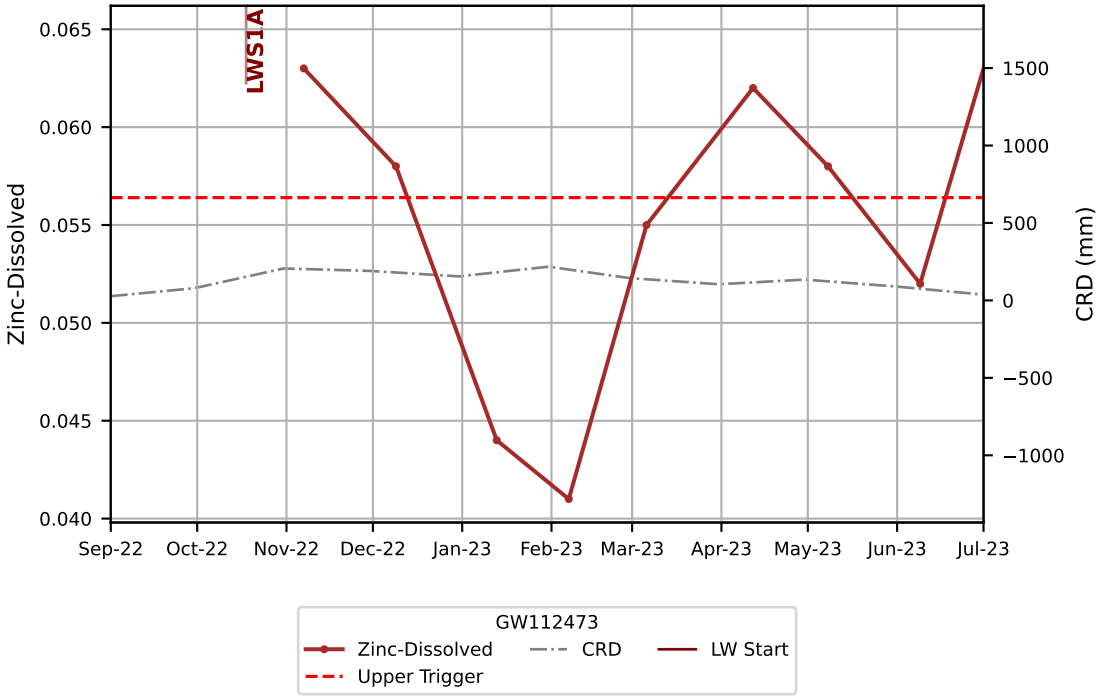

LWS1A
Electrical Conductivity (field)
CRD (mm)
800
700
600
500
400
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

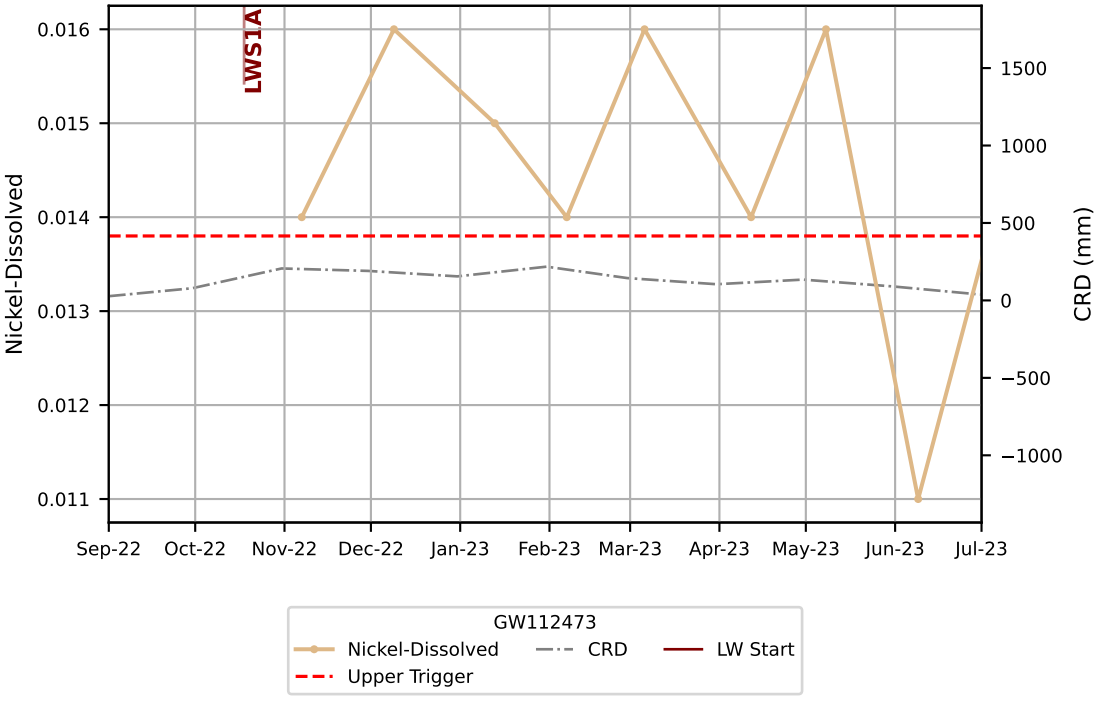

LWS1A
Iron-Dissolved
CRD (mm)
25
20
15
10
5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Iron-Dissolved
CRD
LW Start
Upper Trigger

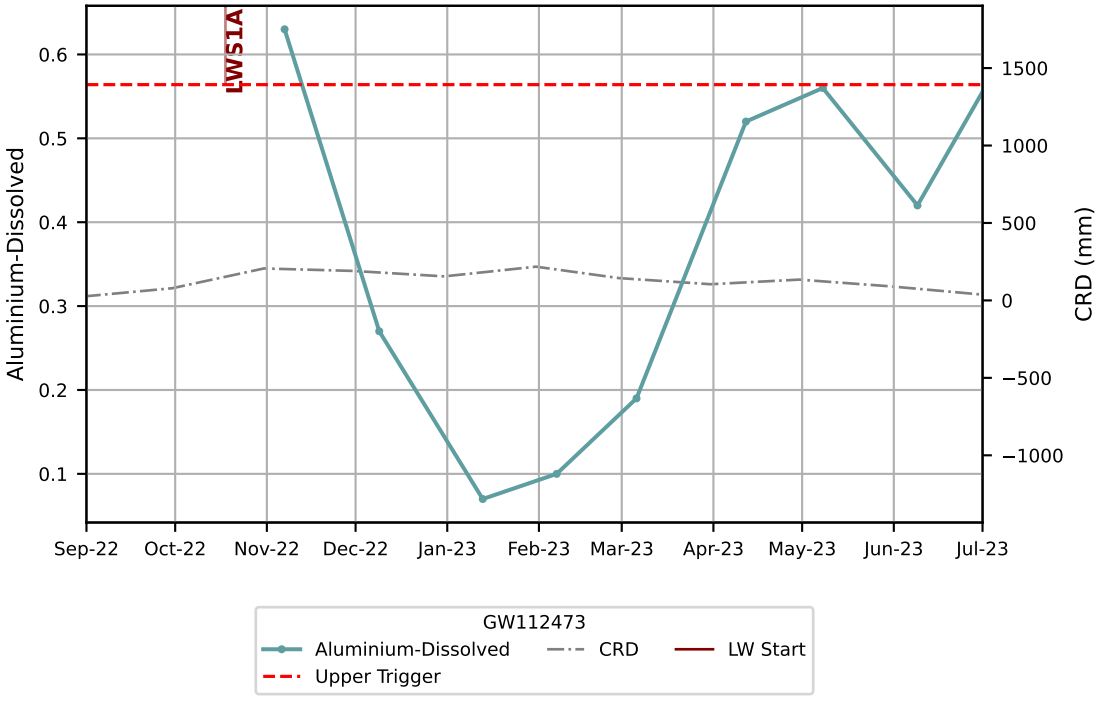

LWS1A
Manganese-Dissolved
CRD (mm)
1.8
1.6
1.4
1.2
1.0
0.8
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Manganese-Dissolved
CRD
LW Start
Upper Trigger

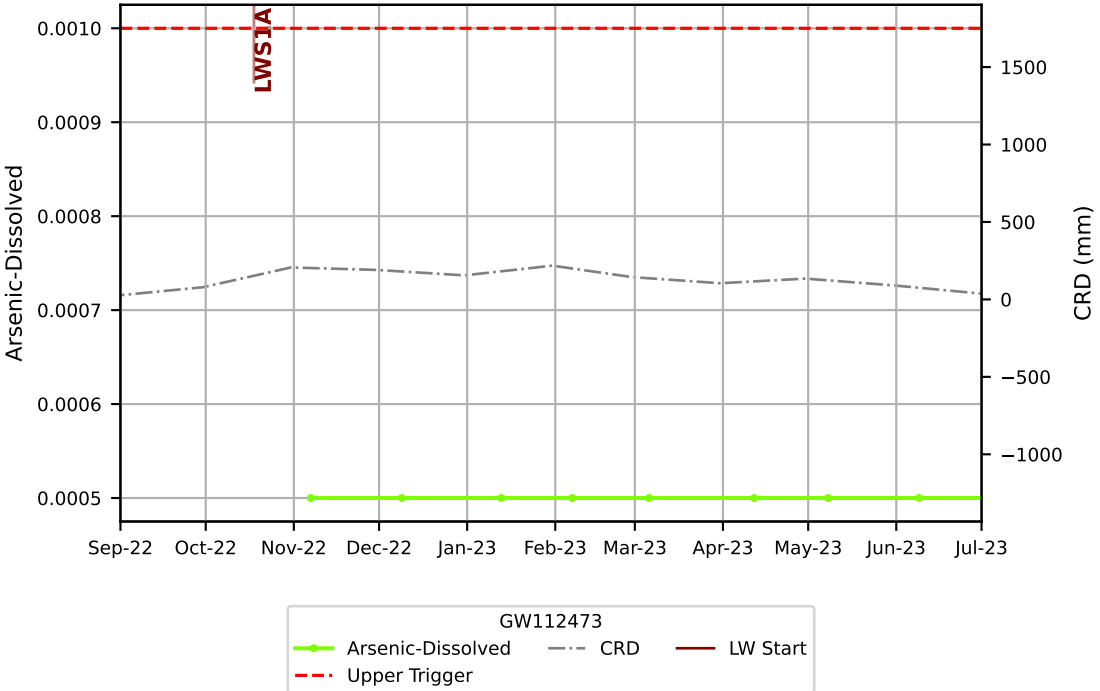

LWS1A
Copper-Dissolved
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Copper-Dissolved
CRD
LW Start
Upper Trigger

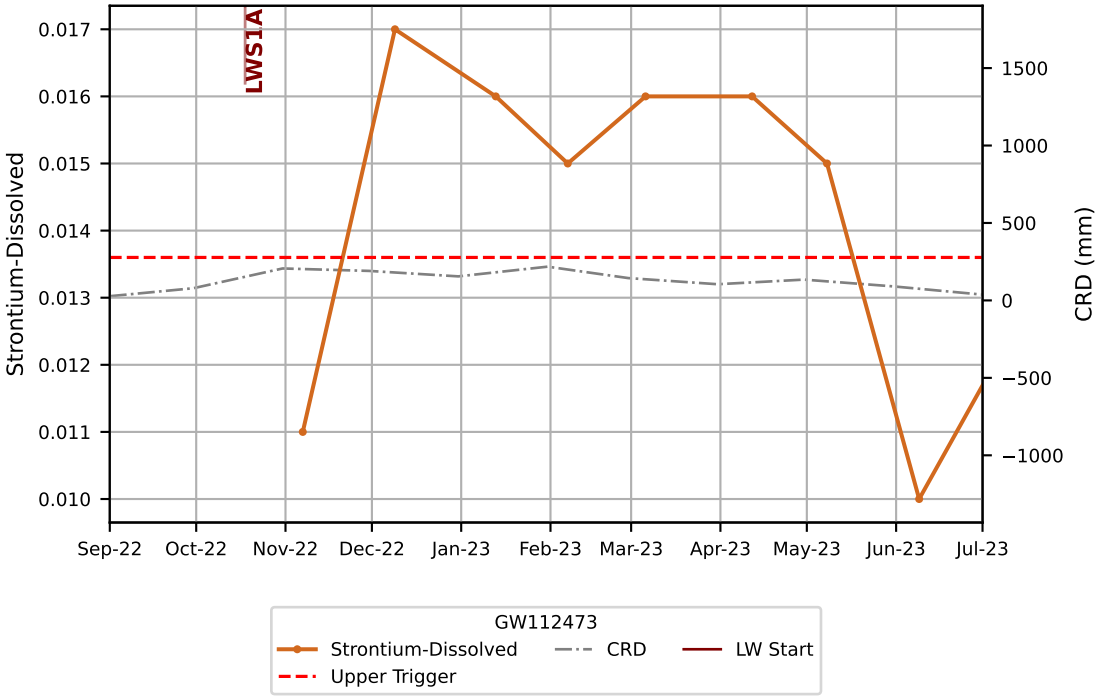

LWS1A
Lead-Dissolved
CRD (mm)
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Lead-Dissolved
CRD
LW Start
Upper Trigger

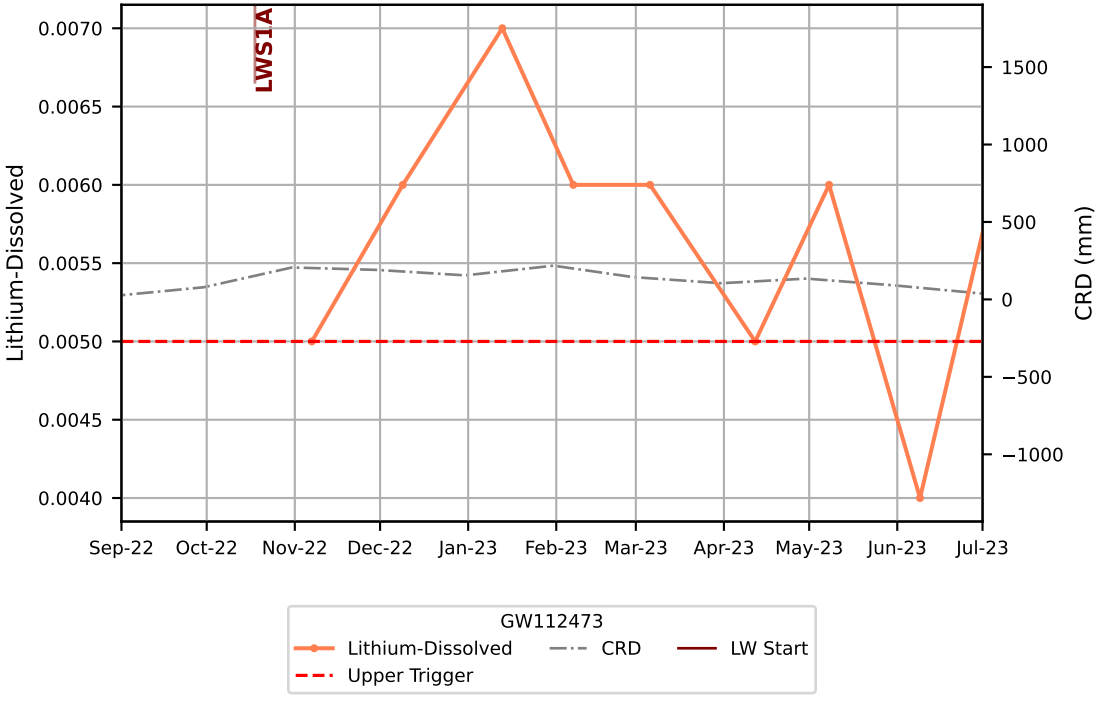

LWS1A
Zinc-Dissolved
CRD (mm)
0.065
0.060
0.055
0.050
0.045
0.040
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Zinc-Dissolved
CRD
LW Start
Upper Trigger

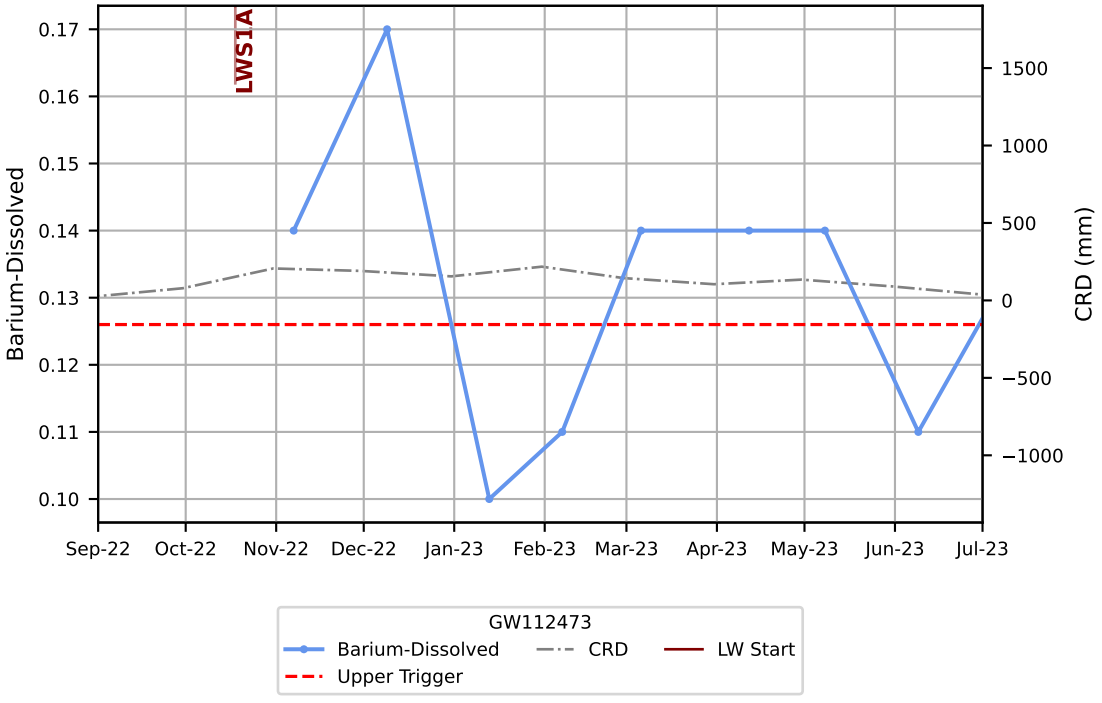

LWS1A
Nickel-Dissolved
CRD (mm)
0.016
0.015
0.014
0.013
0.012
0.011
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Nickel-Dissolved
CRD
LW Start
Upper Trigger

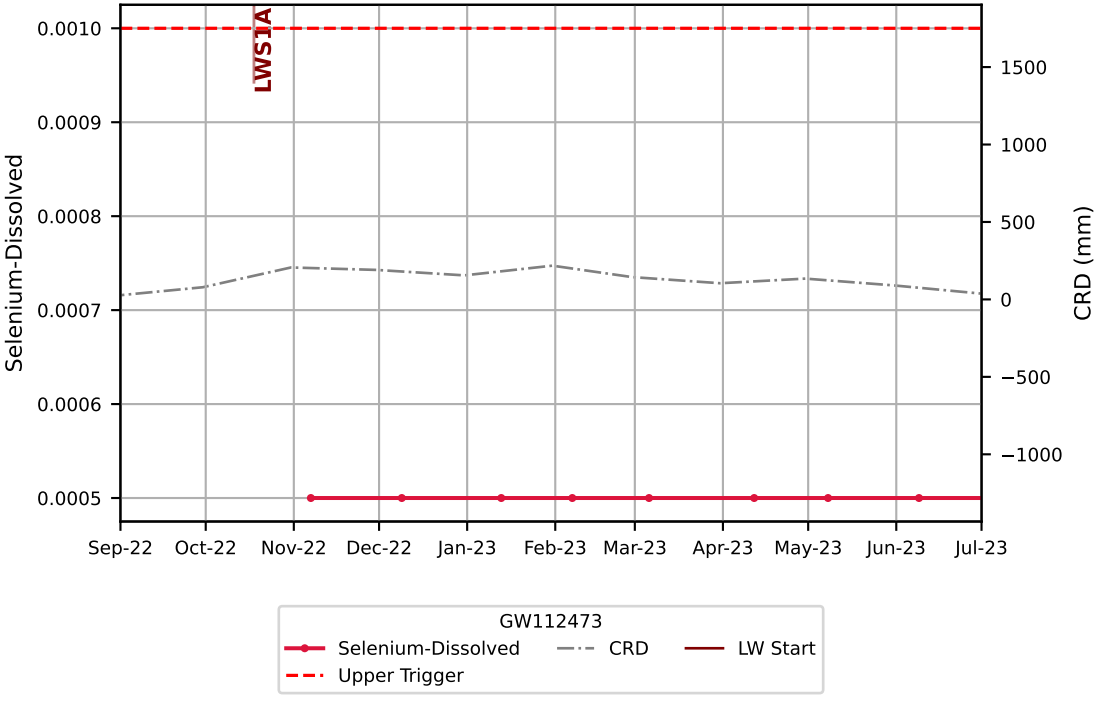

LW1A
Aluminium-Dissolved
CRD (mm)
0.6
0.5
0.4
0.3
0.2
0.1
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

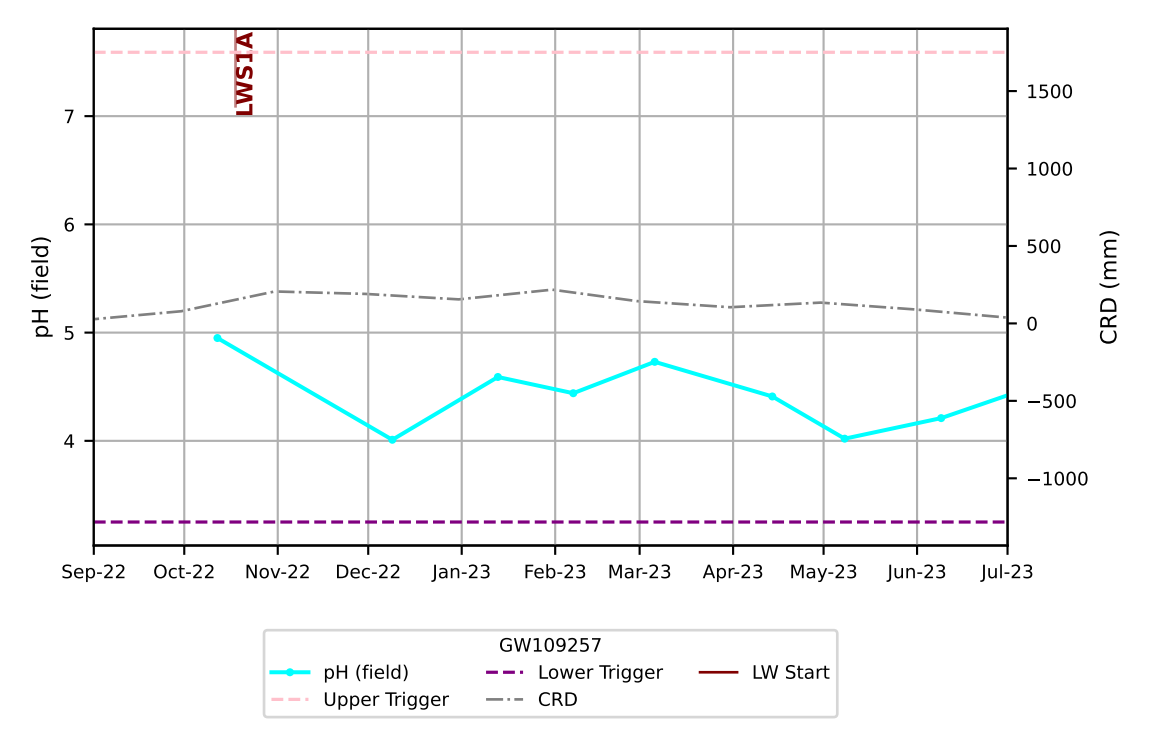

LWS1A
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
Arsenic-Dissolved
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

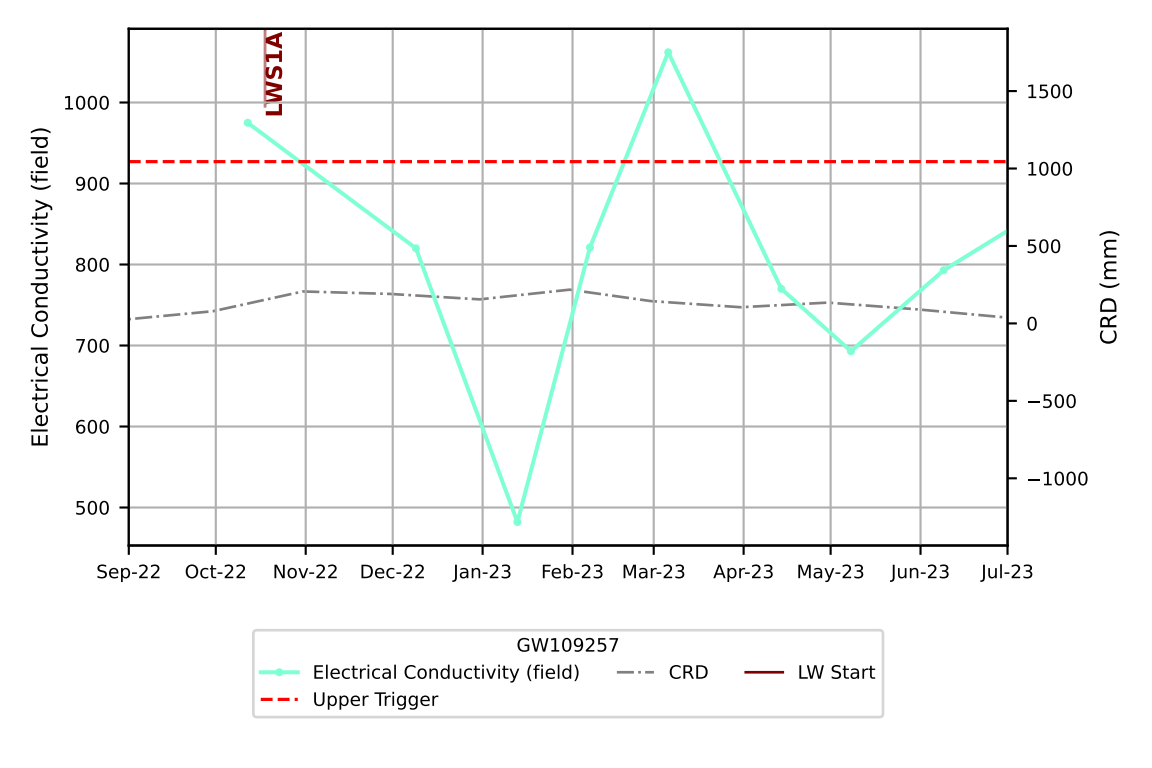

LWS1A
Strontium-Dissolved
CRD (mm)
0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.010
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Strontium-Dissolved
CRD
LW Start
Upper Trigger

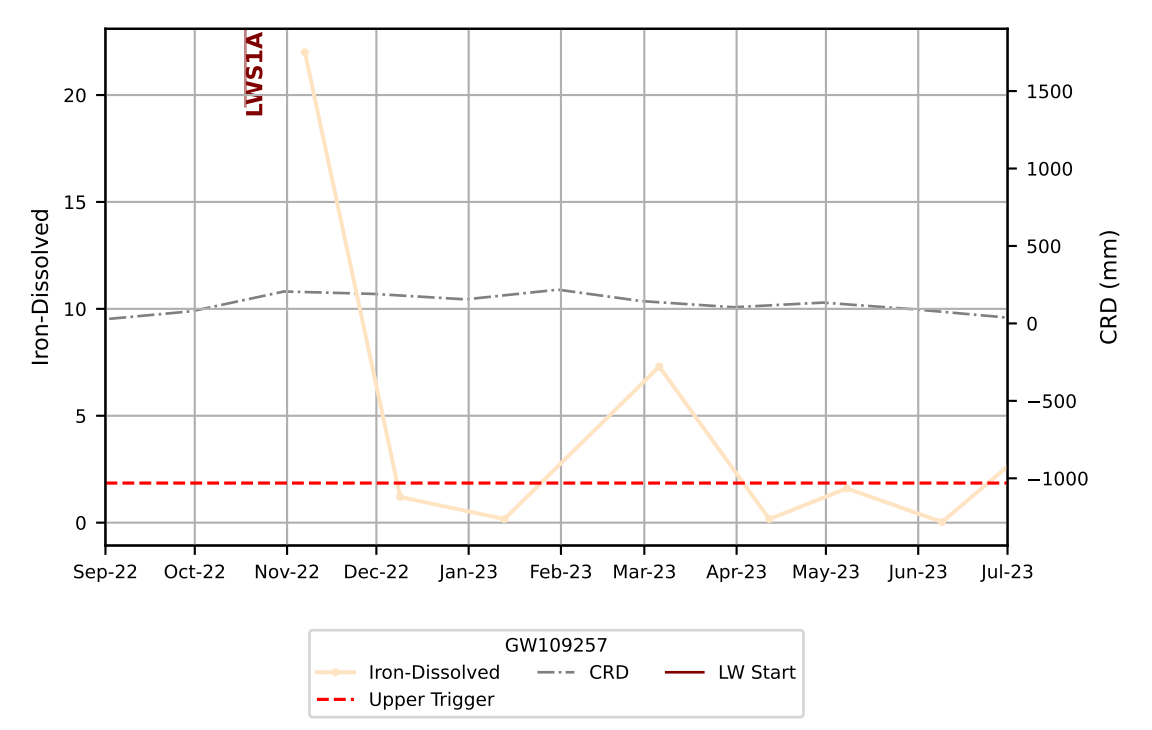

LWS1A
Lithium-Dissolved
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Lithium-Dissolved
CRD
LW Start
Upper Trigger

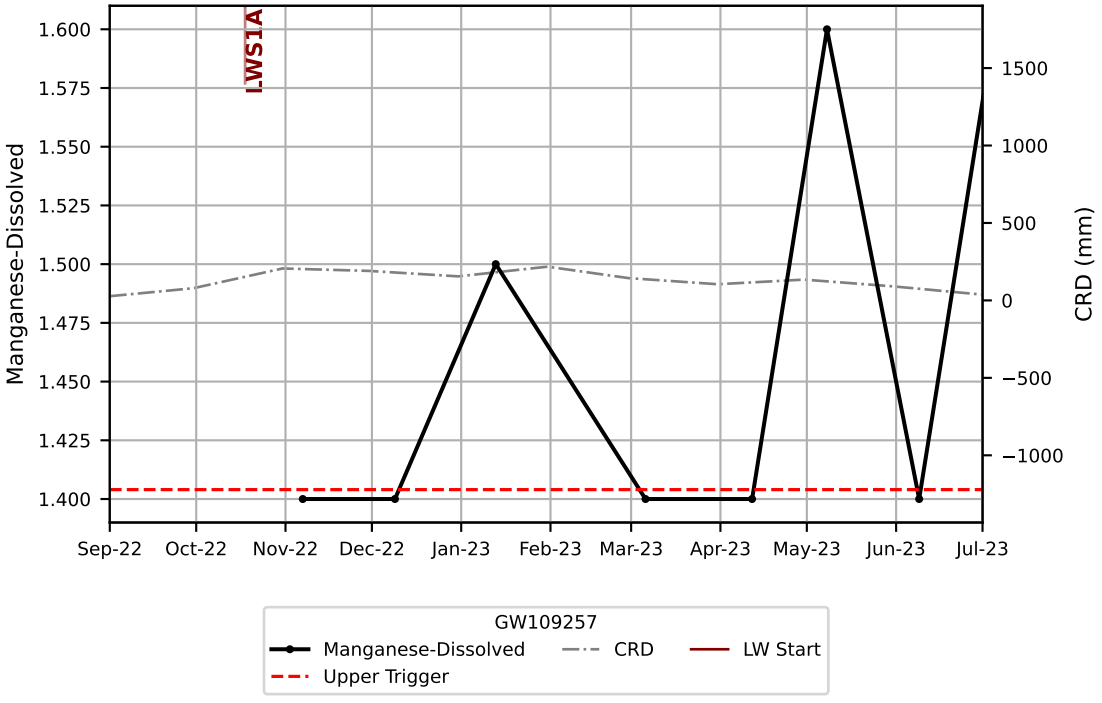

LWS1A
Barium-Dissolved
CRD (mm)
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Barium-Dissolved
CRD
LW Start
Upper Trigger

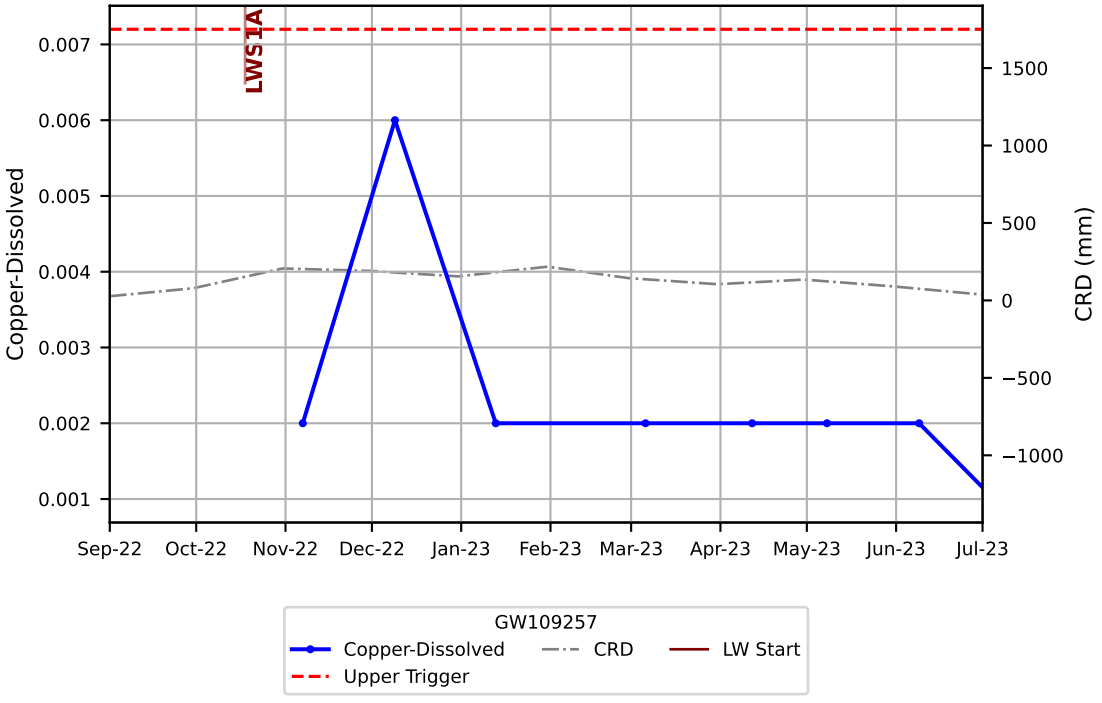

LWS1A
Selenium-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW112473
Selenium-Dissolved
CRD
LW Start
Upper Trigger

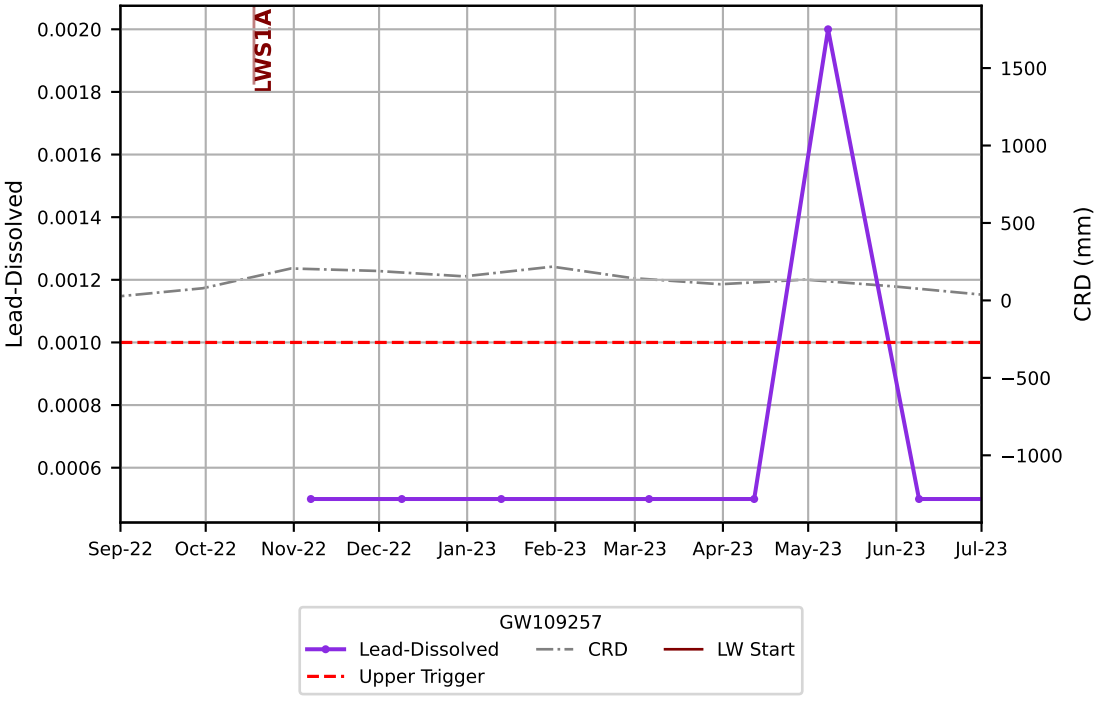

LWS1A
pH (field)
CRD (mm)
7
6
5
4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

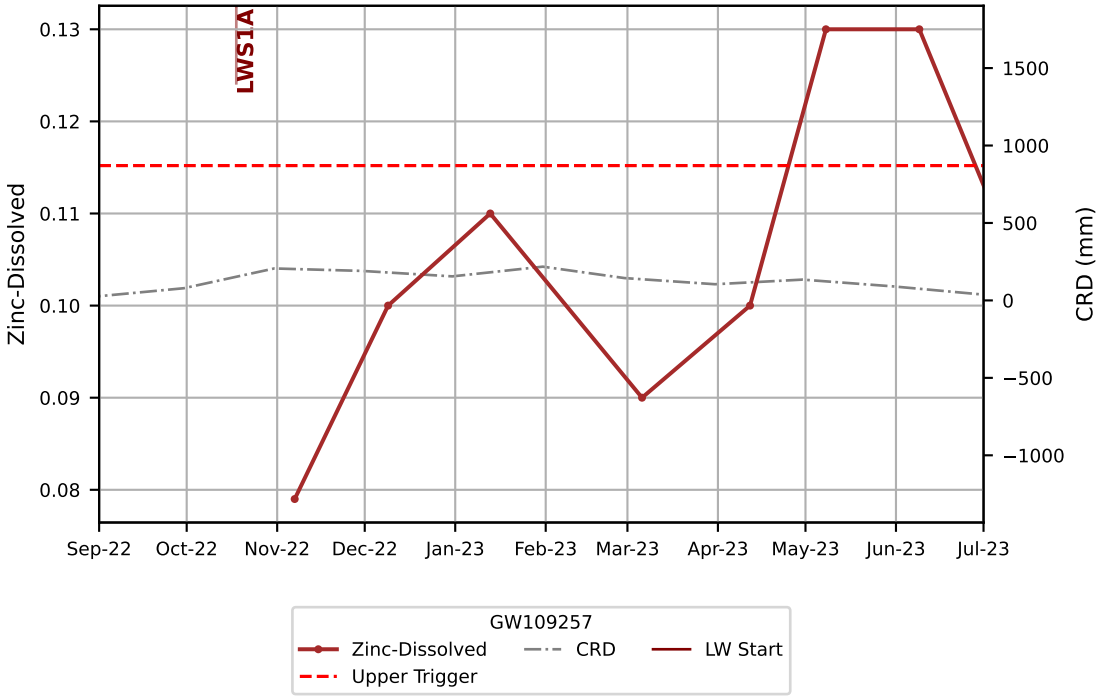

LWS1A
Electrical Conductivity (field)
CRD (mm)
1000
900
800
700
600
500
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

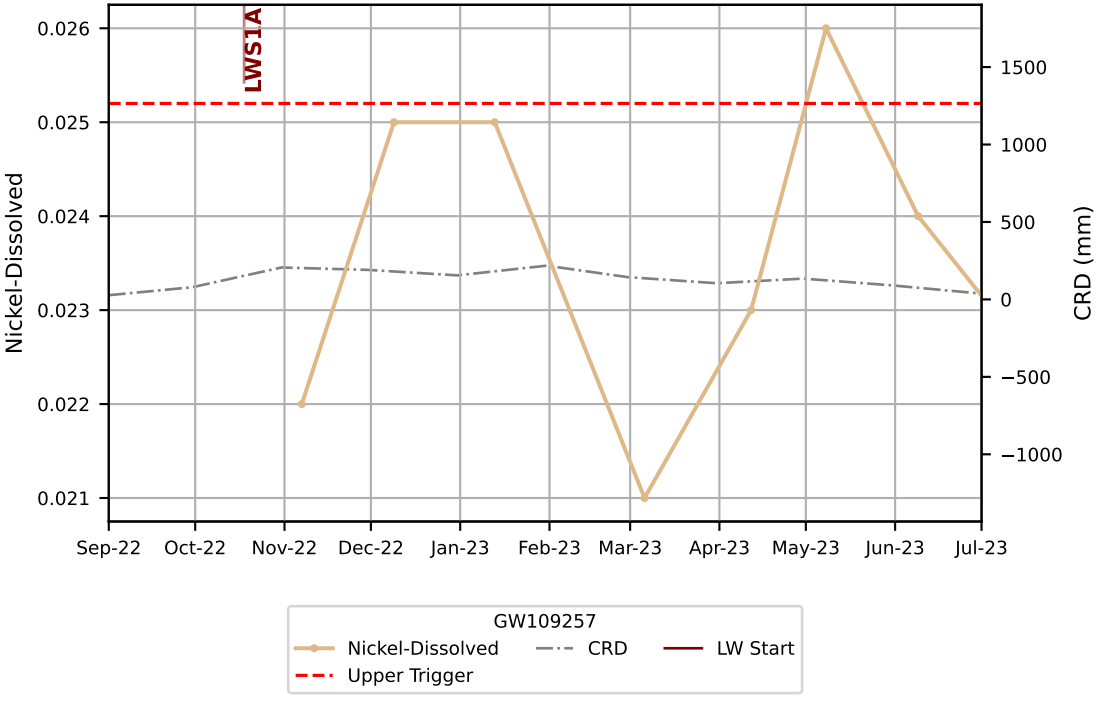

LWS1A
Iron-Dissolved
CRD (mm)
20
15
10
5
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Iron-Dissolved
CRD
LW Start
Upper Trigger

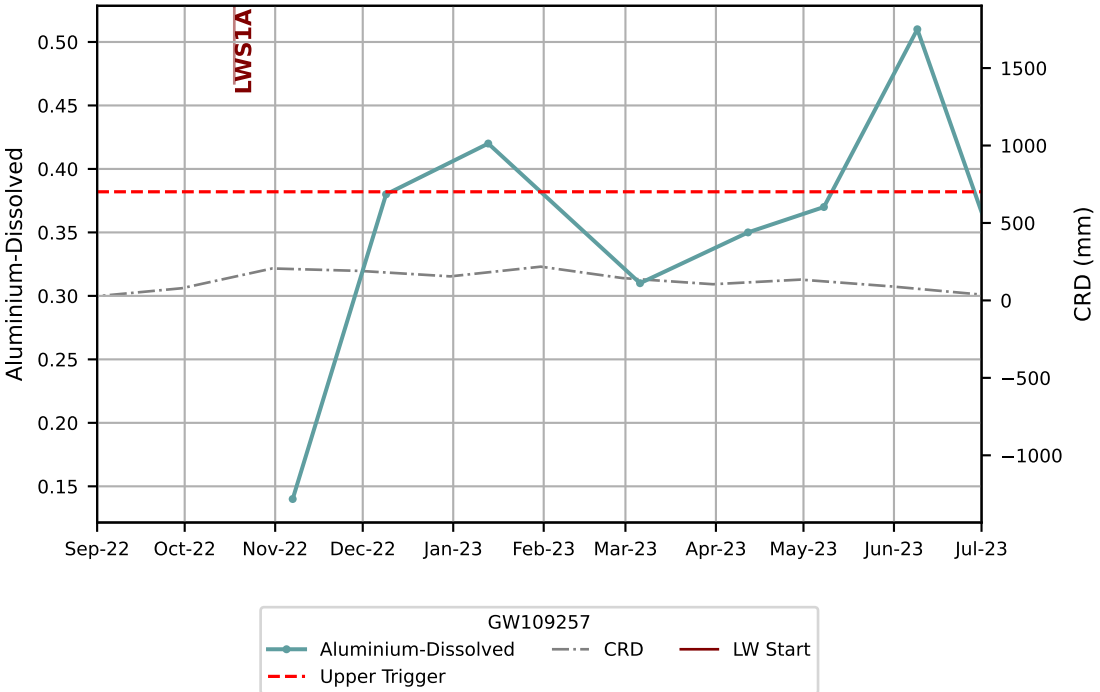

LWS1A
Manganese-Dissolved
CRD (mm)
1.600
1.575
1.550
1.525
1.500
1.475
1.450
1.425
1.400
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Manganese-Dissolved
CRD
LW Start
Upper Trigger

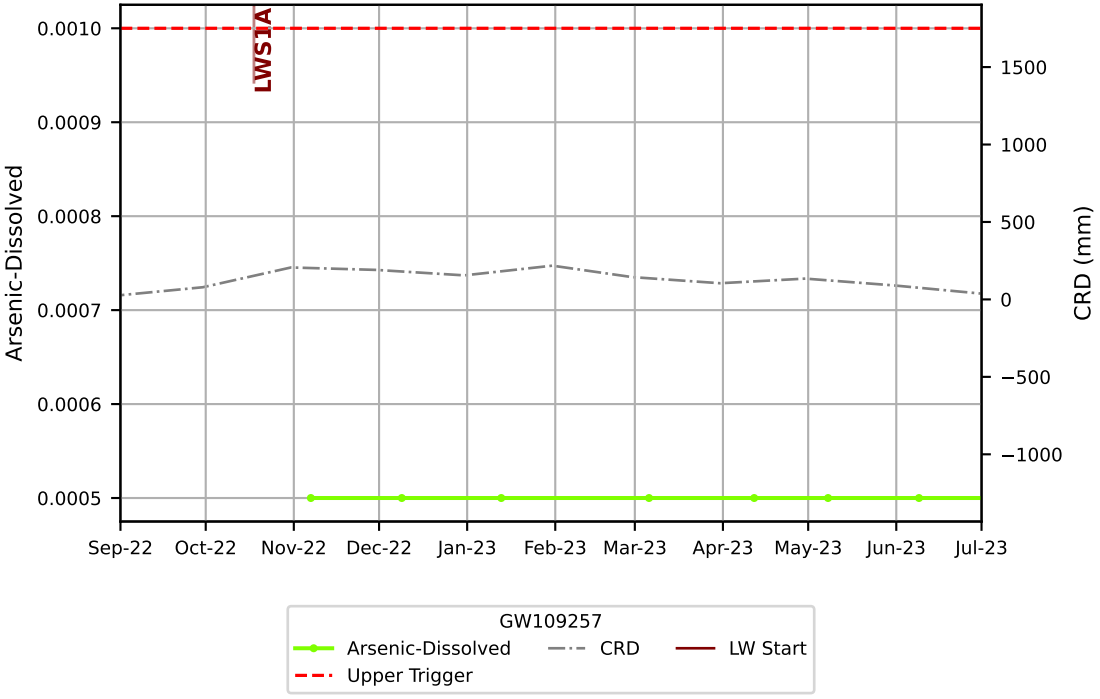

LWS1A
Copper-Dissolved
CRD (mm)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Copper-Dissolved
CRD
LW Start
Upper Trigger

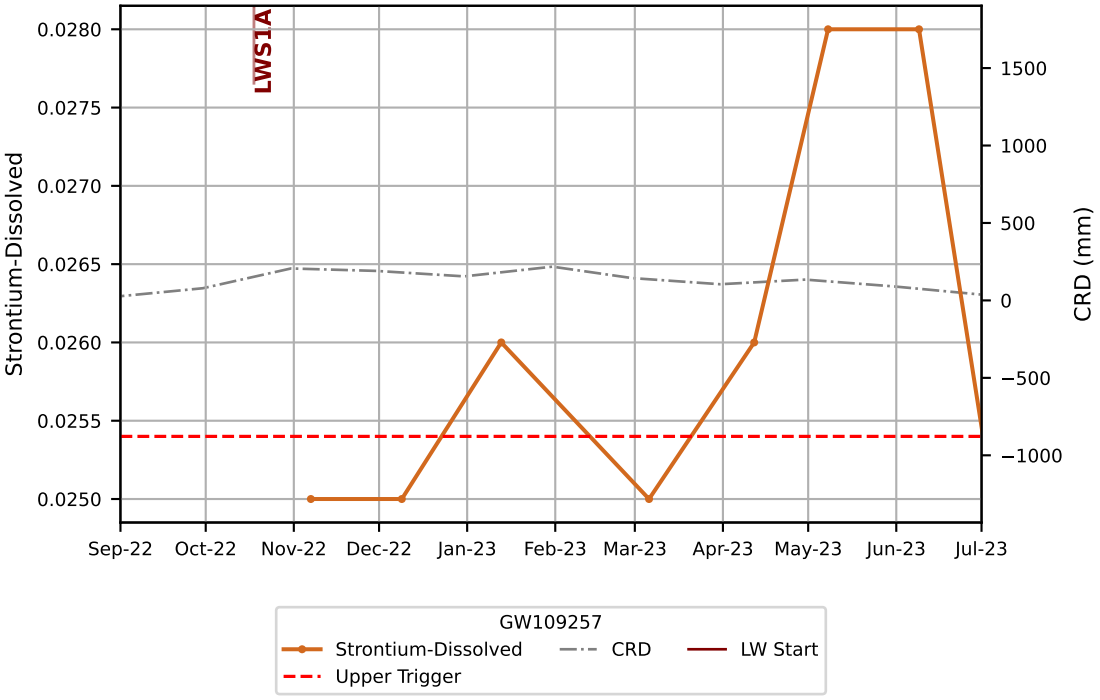

LWS1A
Lead-Dissolved
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Lead-Dissolved
CRD
LW Start
Upper Trigger

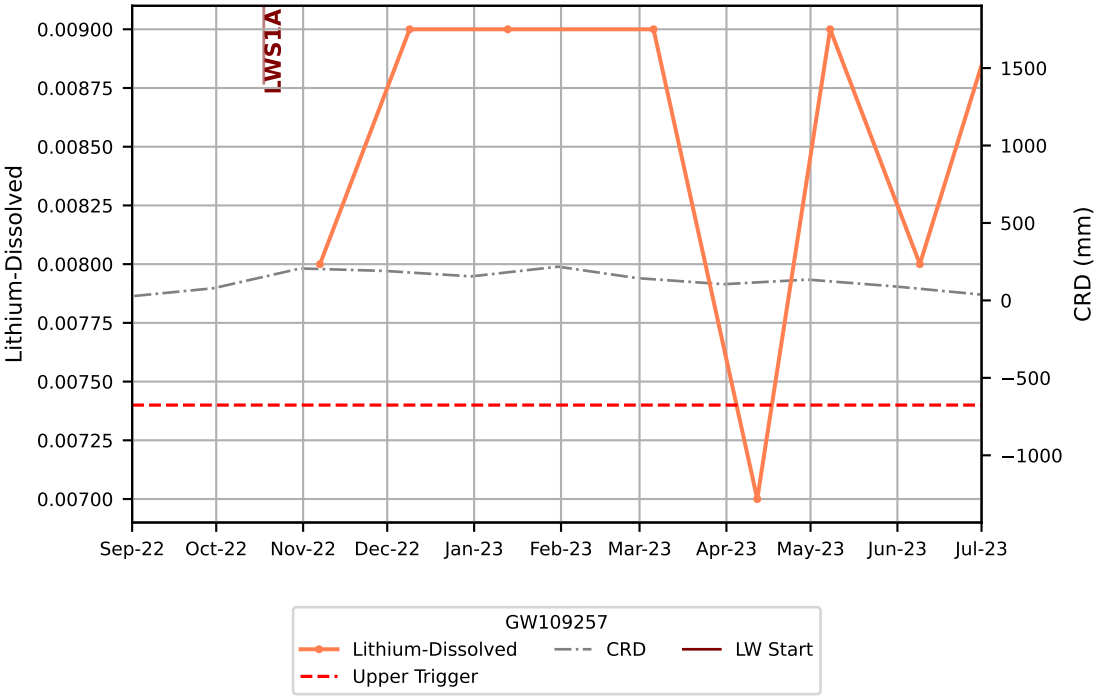

LWS1A
Zinc-Dissolved
CRD (mm)
0.13
0.12
0.11
0.10
0.09
0.08
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Zinc-Dissolved
CRD
LW Start
Upper Trigger

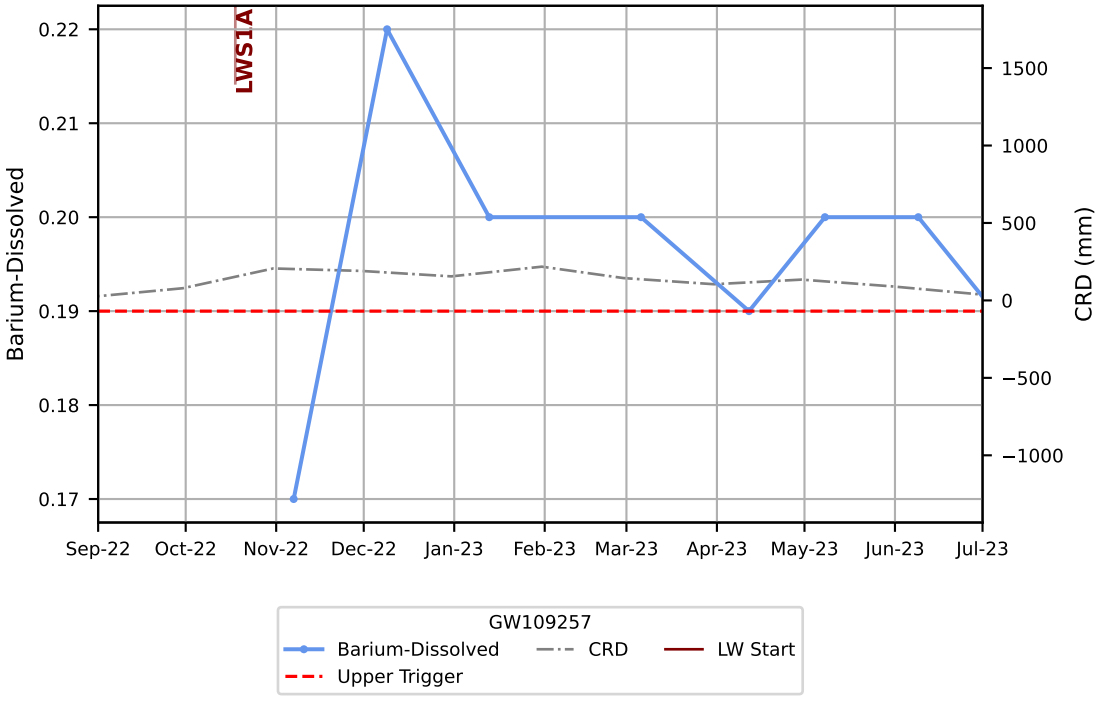

LWS1A
Nickel-Dissolved
CRD (mm)
0.026
0.025
0.024
0.023
0.022
0.021
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Nickel-Dissolved
CRD
LW Start
Upper Trigger

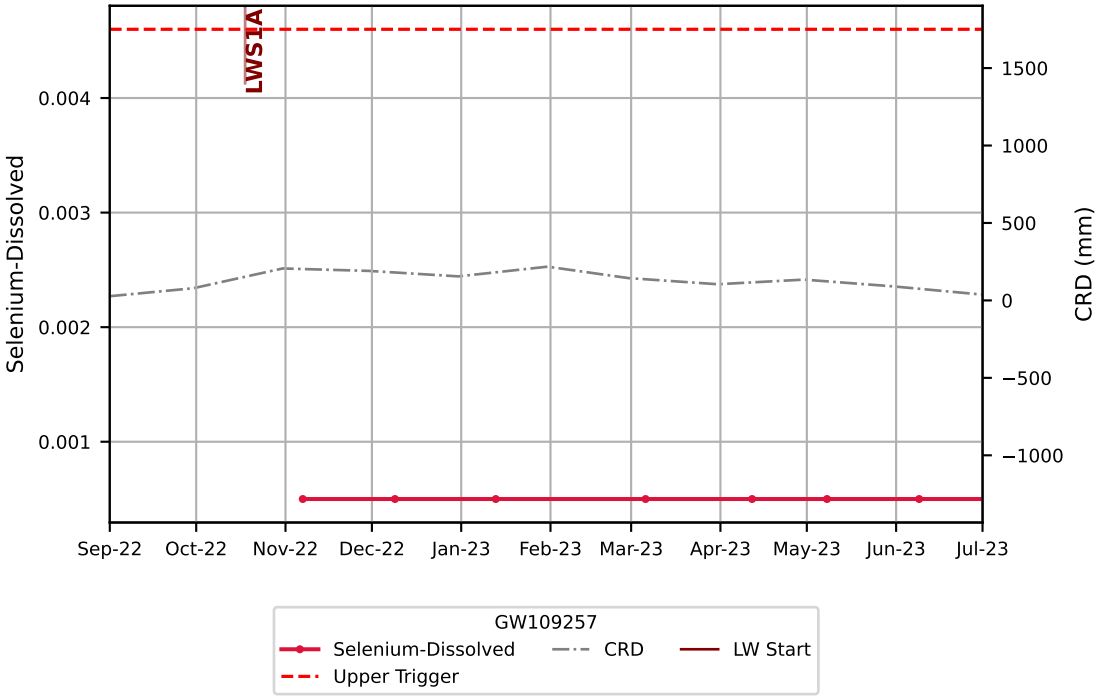

LWS1A
Aluminium-Dissolved
CRD (mm)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

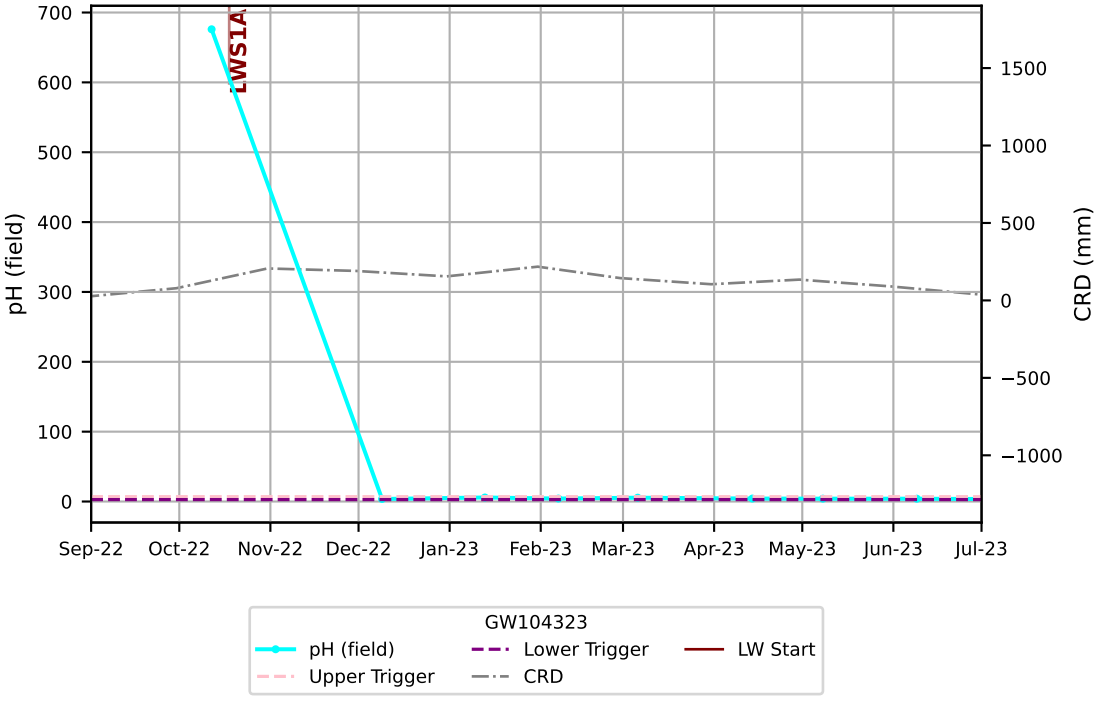

LWS1A
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
Arsenic-Dissolved
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

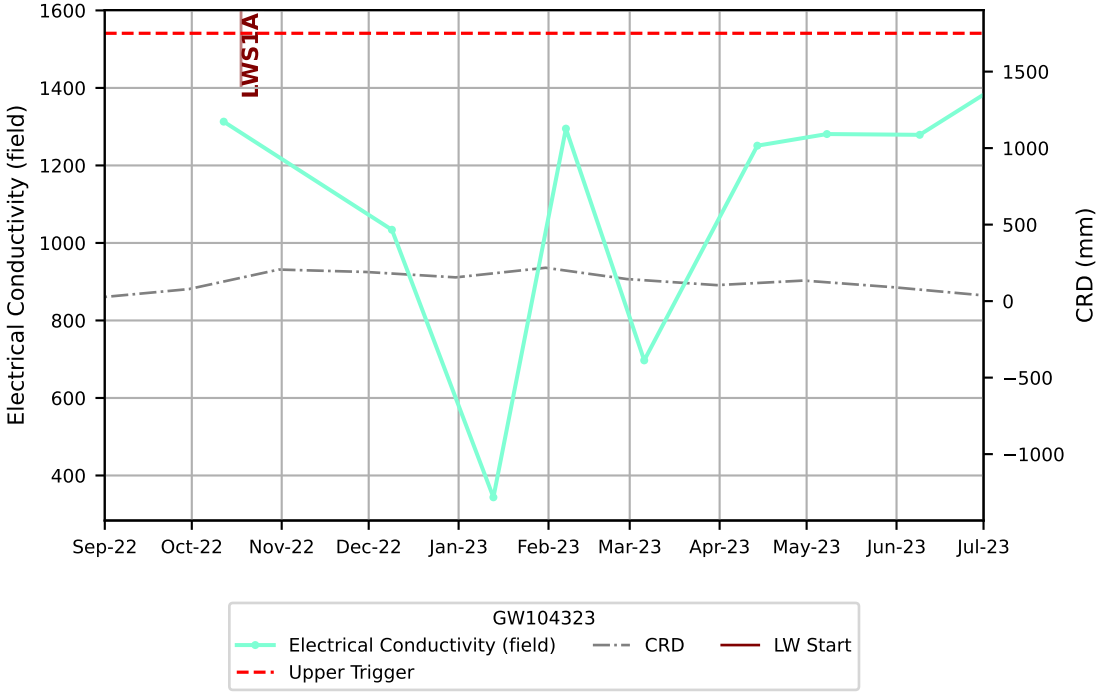

LWS1A
Strontium-Dissolved
0.0280
0.0275
0.0270
0.0265
0.0260
0.0255
0.0250
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Strontium-Dissolved
CRD
LW Start
Upper Trigger

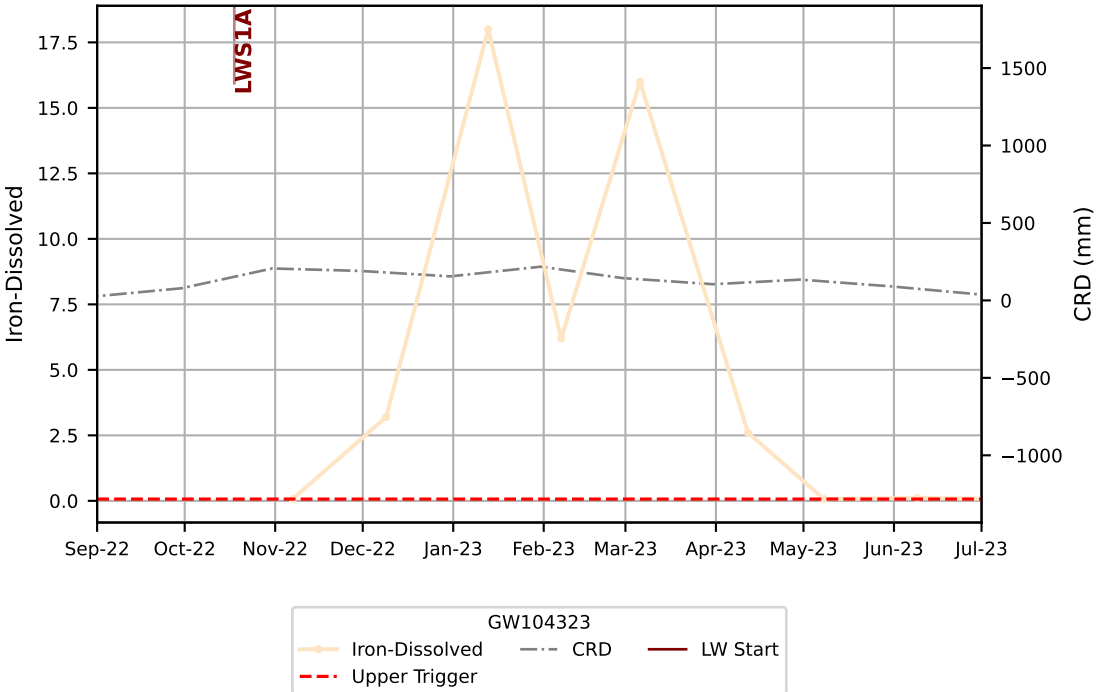

LWS1A
Lithium-Dissolved
CRD (mm)
0.00900
0.00875
0.00850
0.00825
0.00800
0.00775
0.00750
0.00725
0.00700
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Lithium-Dissolved
CRD
LW Start
Upper Trigger

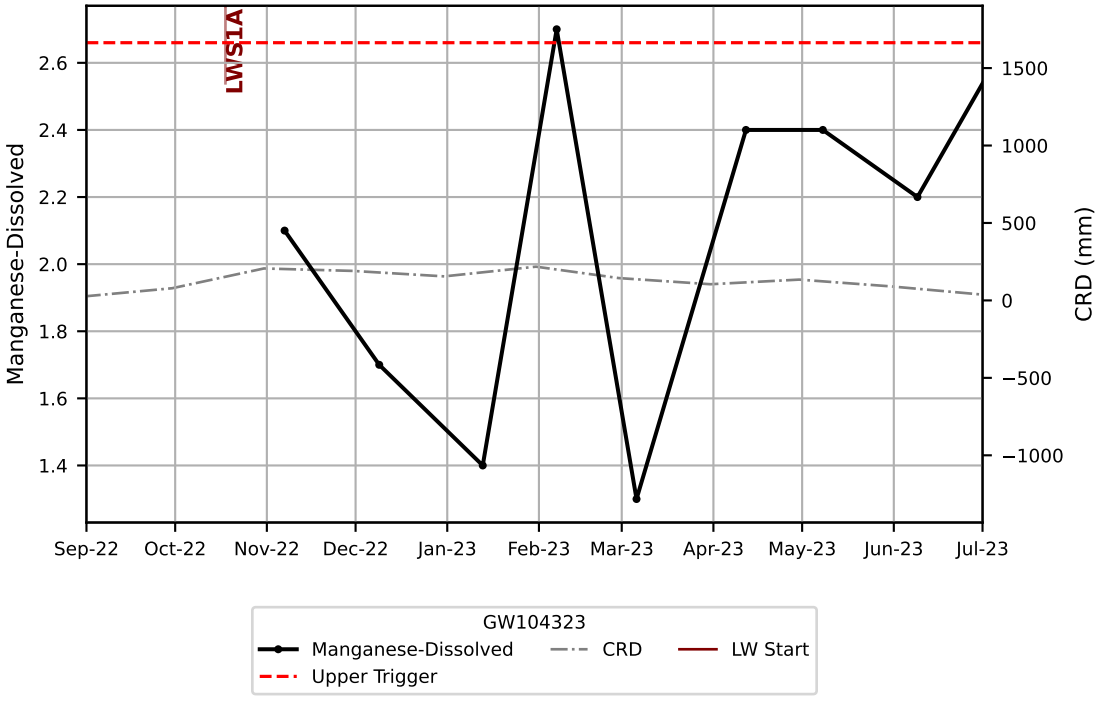

LWS1A
Barium-Dissolved
CRD (mm)
0.22
0.21
0.20
0.19
0.18
0.17
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Barium-Dissolved
CRD
LW Start
Upper Trigger

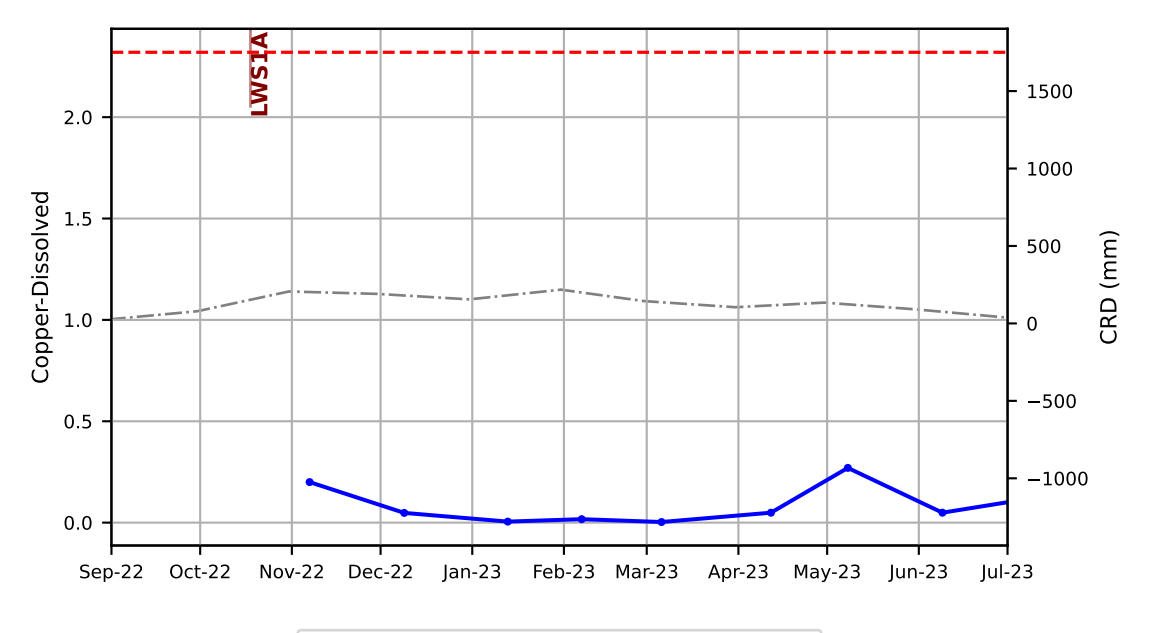

LWS1A
Selenium-Dissolved
CRD (mm)
0.004
0.003
0.002
0.001
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW109257
Selenium-Dissolved
CRD
LW Start
Upper Trigger

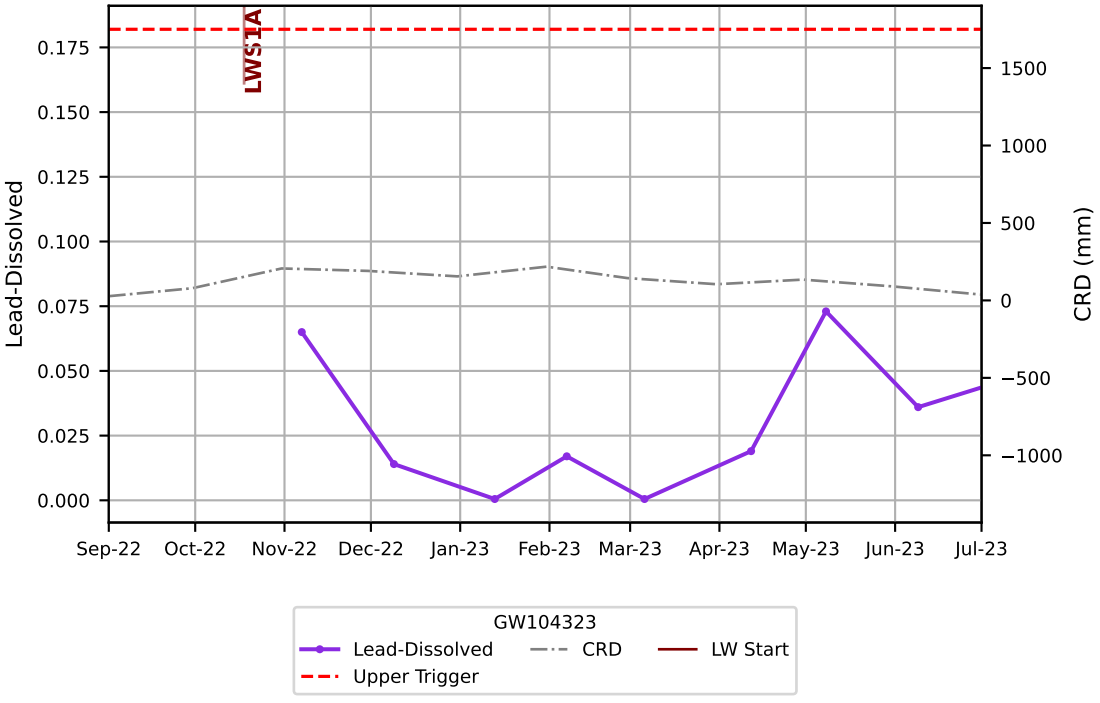

LWS1A
pH (field)
CRD (mm)
700
600
500
400
300
200
100
0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

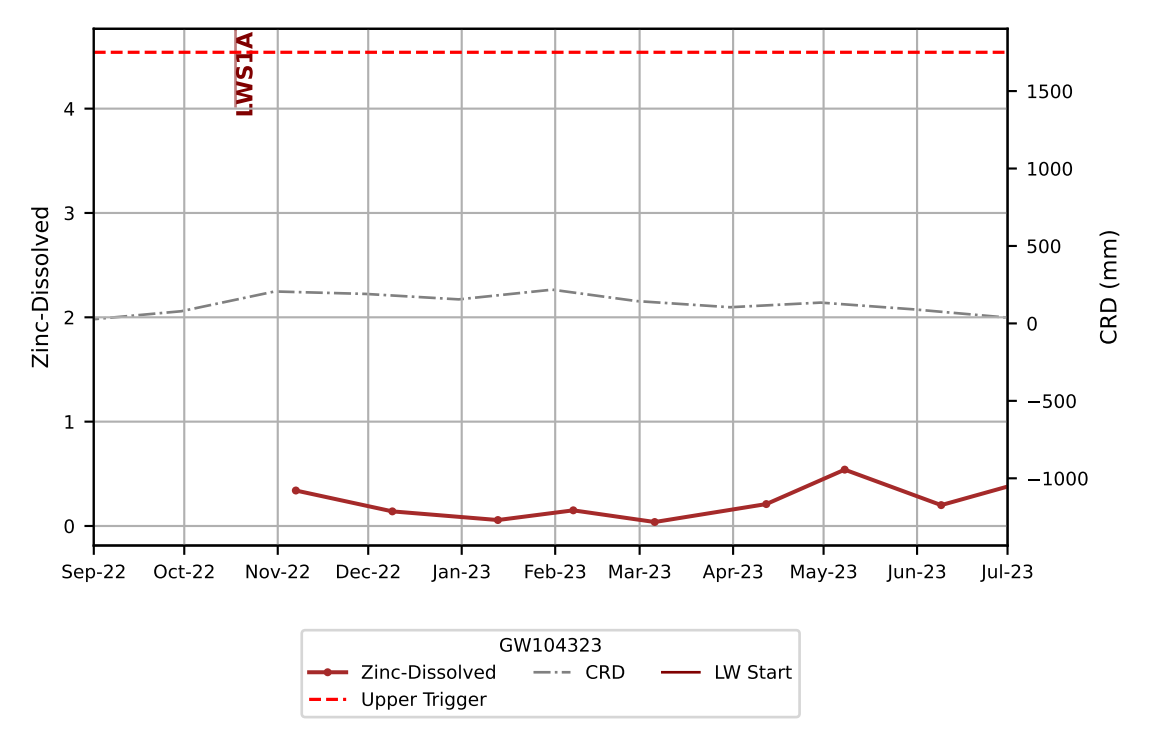

LWS1A
Electrical Conductivity (field)
CRD (mm)
1600
1400
1200
1000
800
600
400
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

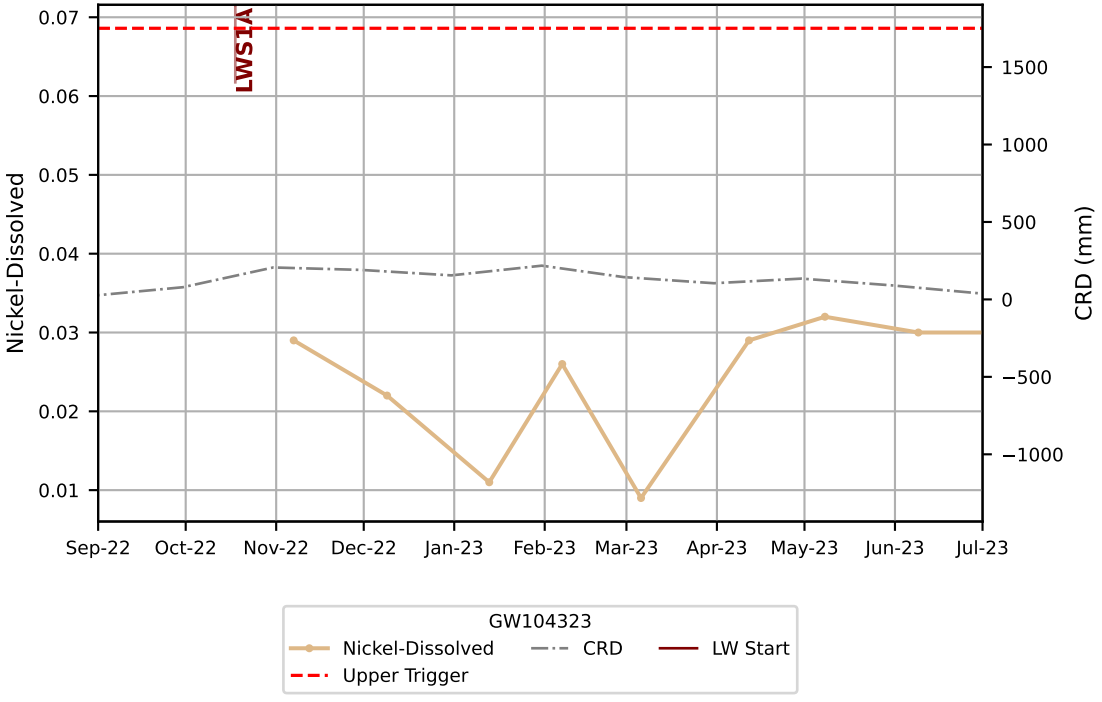

LWS1A
Iron-Dissolved
CRD (mm)
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Iron-Dissolved
CRD
LW Start
Upper Trigger

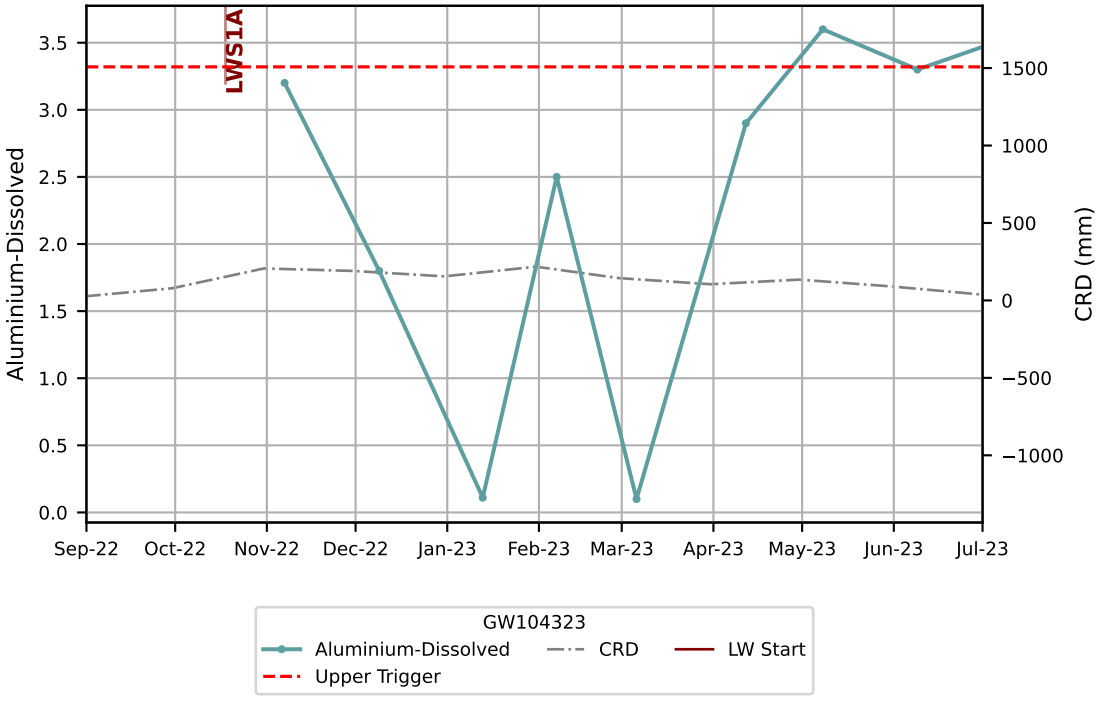

LWS1A
Manganese-Dissolved
CRD (mm)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Manganese-Dissolved
CRD
LW Start
Upper Trigger

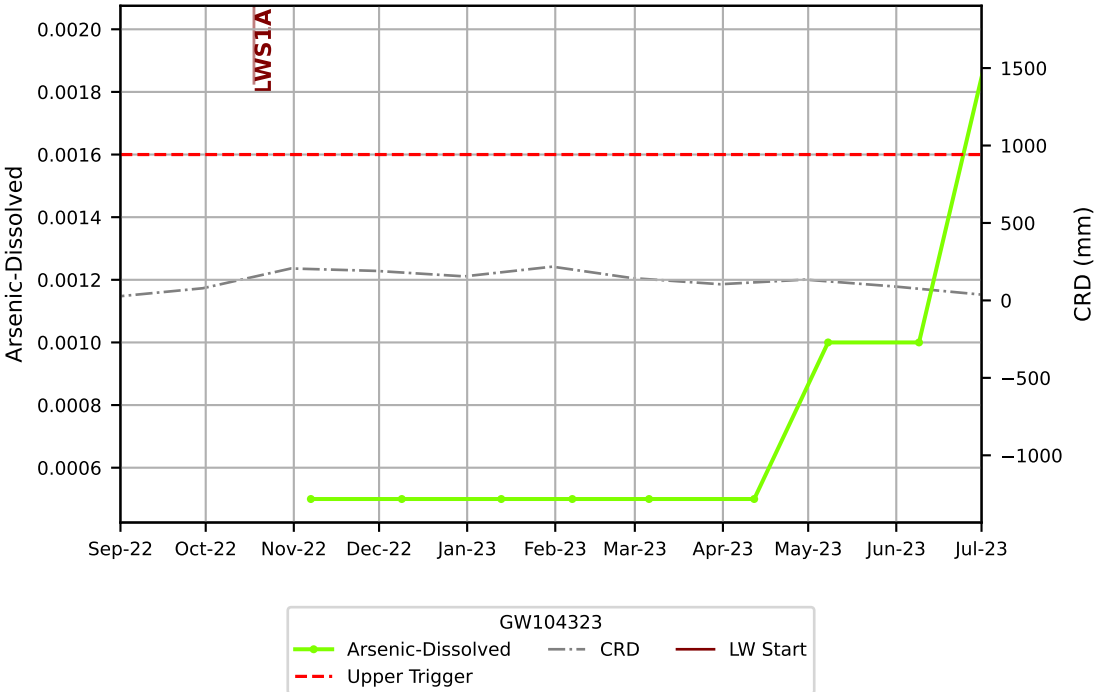

LWSTA
Copper-Dissolved
CRD (mm)
2.0
1.5
1.0
0.5
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Copper-Dissolved
CRD
LW Start
Upper Trigger

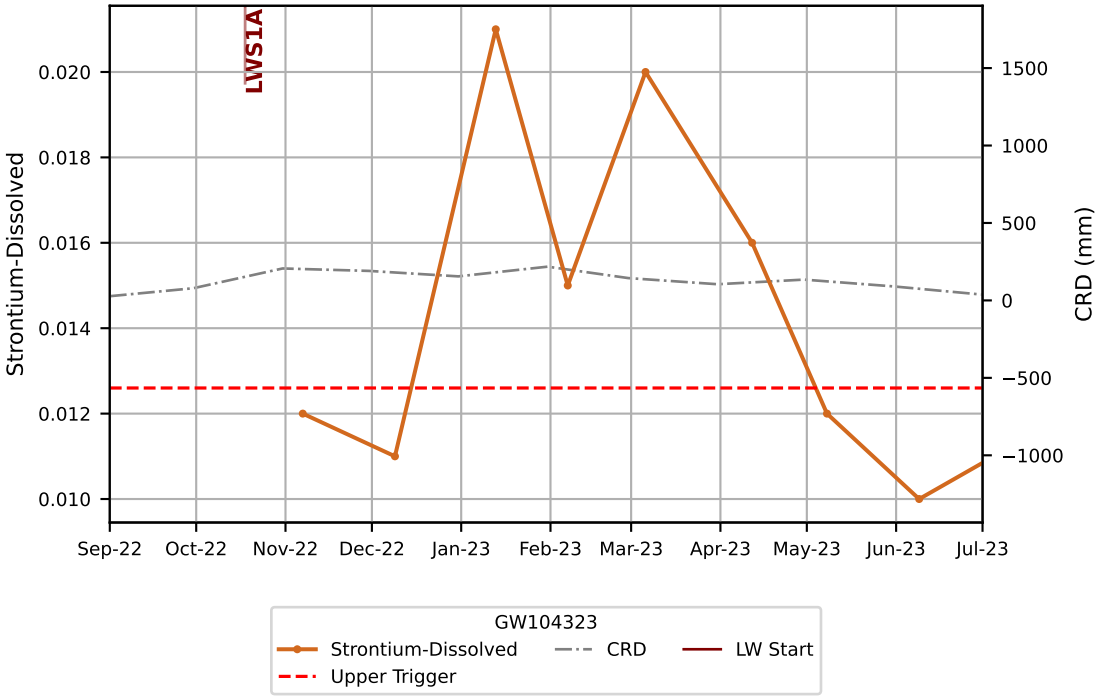

LWS1A
Lead-Dissolved
CRD (mm)
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Lead-Dissolved
CRD
LW Start
Upper Trigger

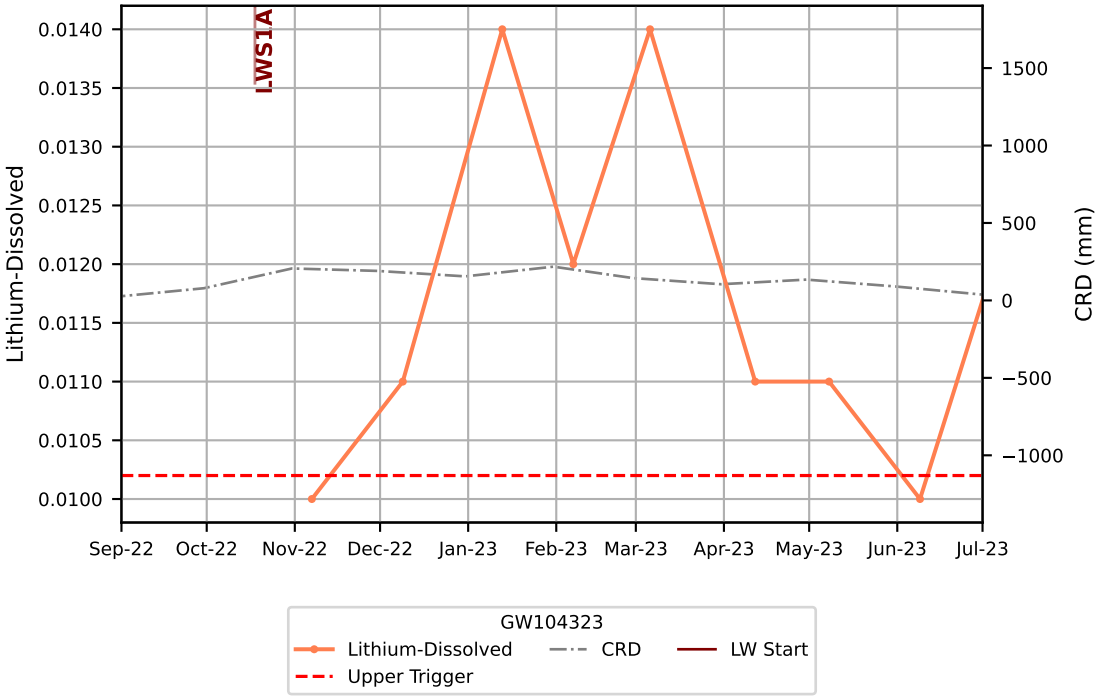

LWS1A
Zinc-Dissolved
CRD (mm)
0
1
2
3
4
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Zinc-Dissolved
CRD
LW Start
Upper Trigger

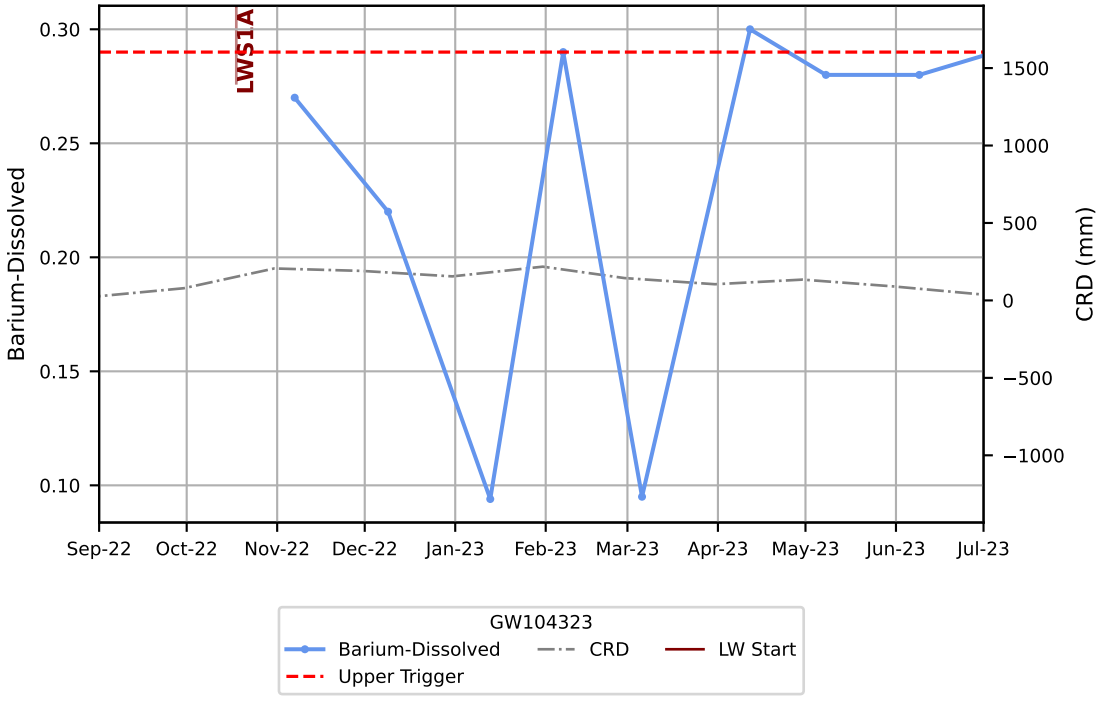

LWS1A
Nickel-Dissolved
CRD (mm)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Nickel-Dissolved
CRD
LW Start
Upper Trigger

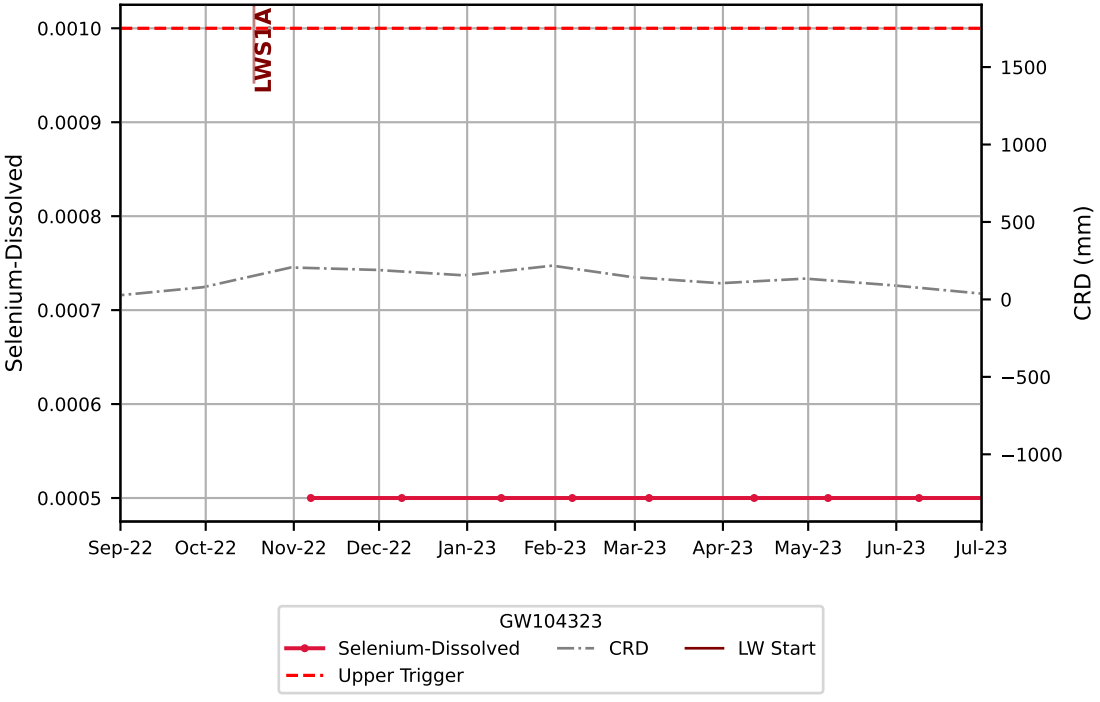

LWS1A
Aluminium-Dissolved
CRD (mm)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

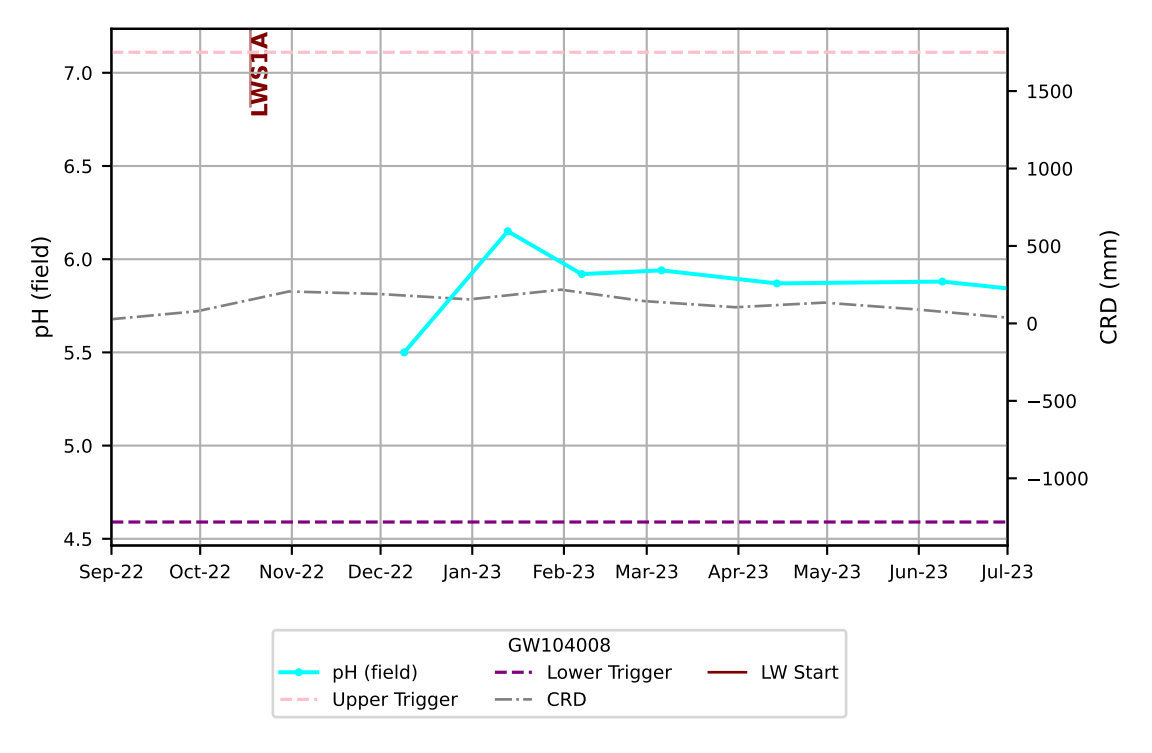

LWS1A
Arsenic-Dissolved
CRD (mm)
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

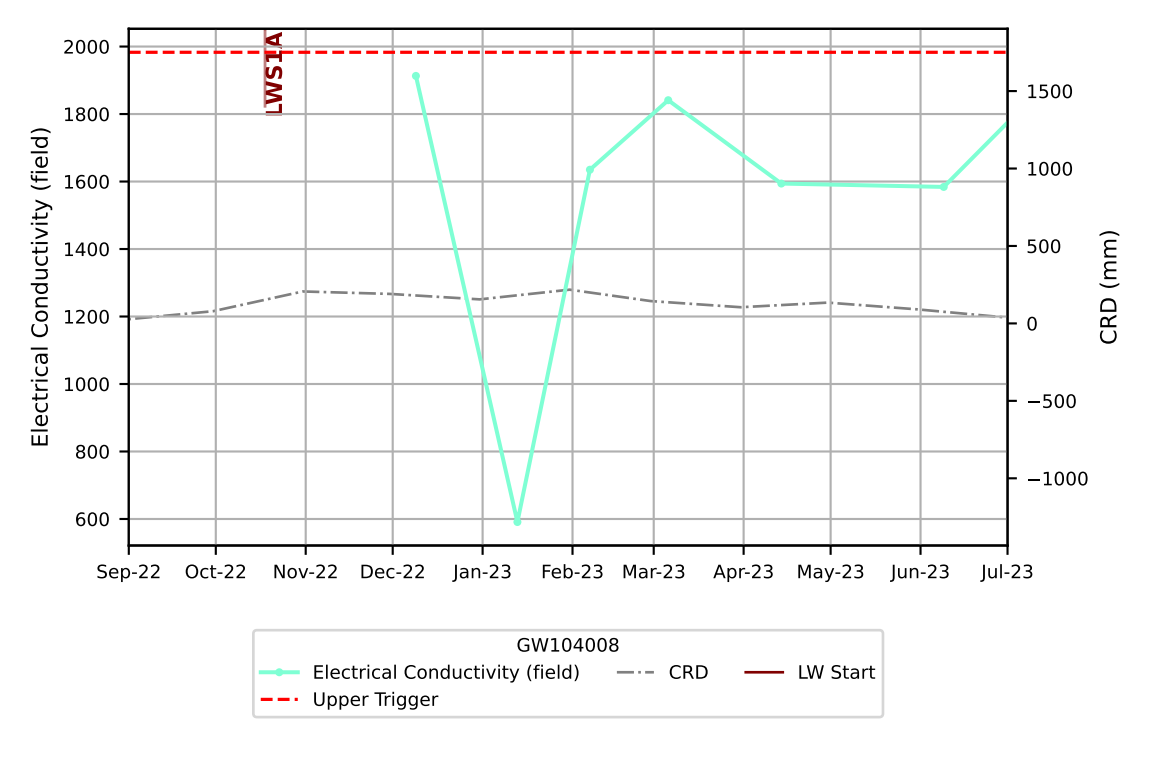

LWS1A
Strontium-Dissolved
0.020
0.018
0.016
0.014
0.012
0.010
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Strontium-Dissolved
CRD
LW Start
Upper Trigger

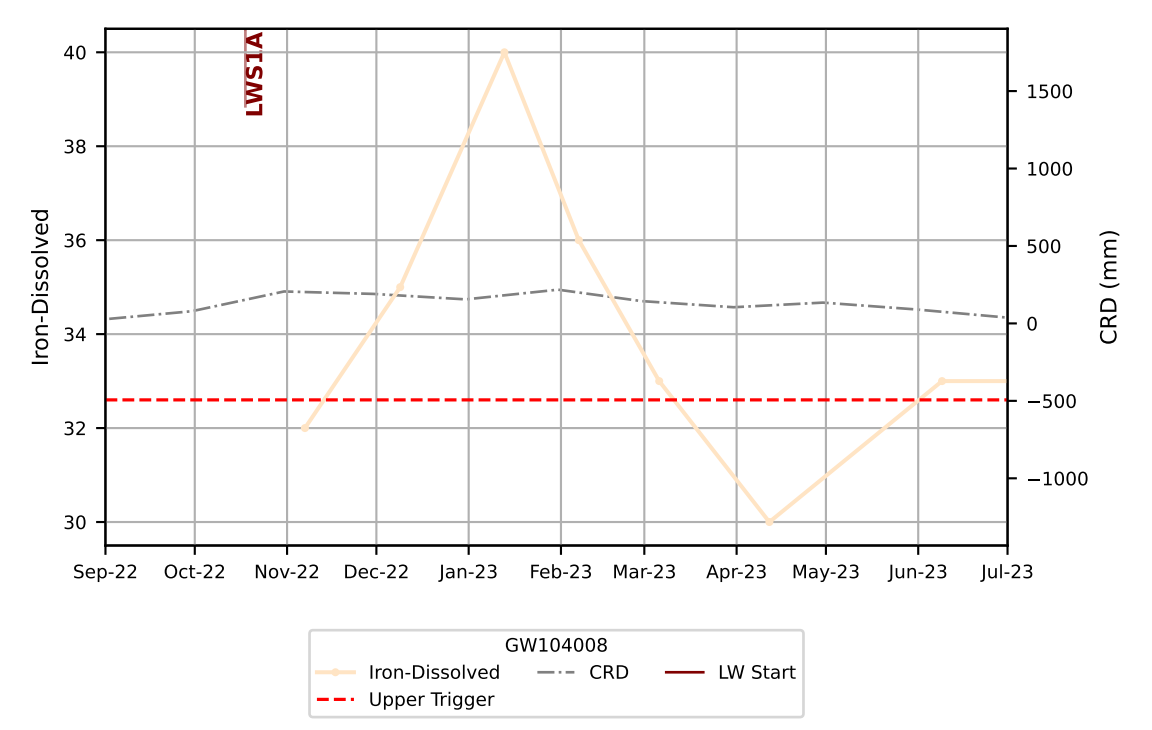

LWS1A
Lithium-Dissolved
0.0140
0.0135
0.0130
0.0125
0.0120
0.0115
0.0110
0.0105
0.0100
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Lithium-Dissolved
CRD
LW Start
Upper Trigger

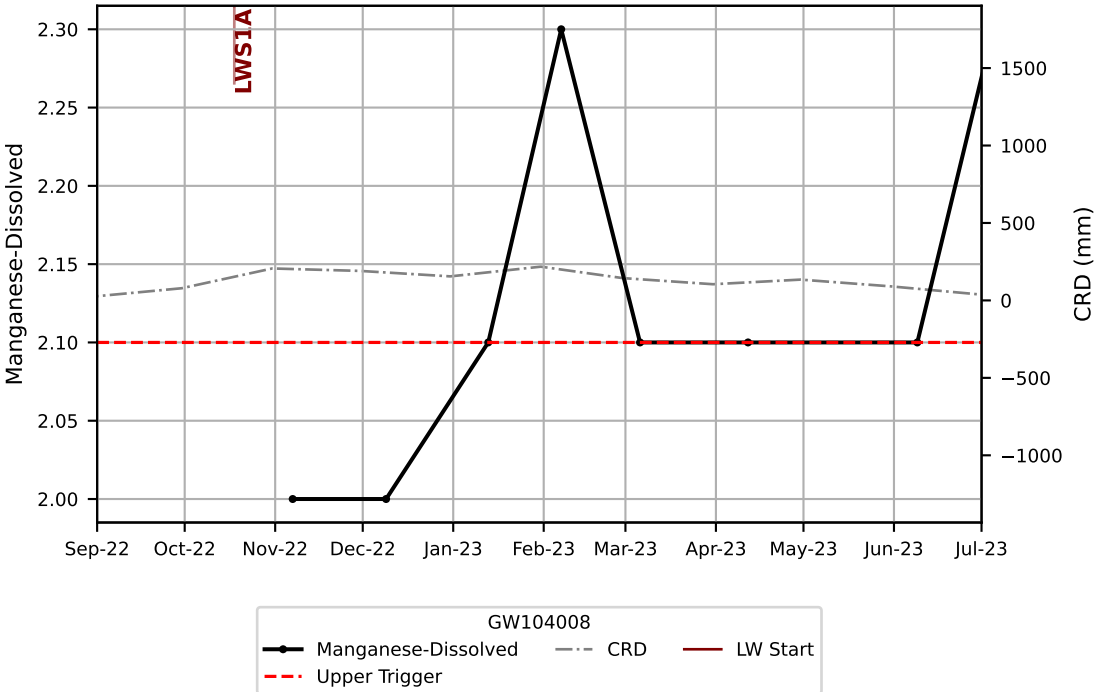

LW S1A
Barium-Dissolved
CRD (mm)
0.30
0.25
0.20
0.15
0.10
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Barium-Dissolved
CRD
LW Start
Upper Trigger

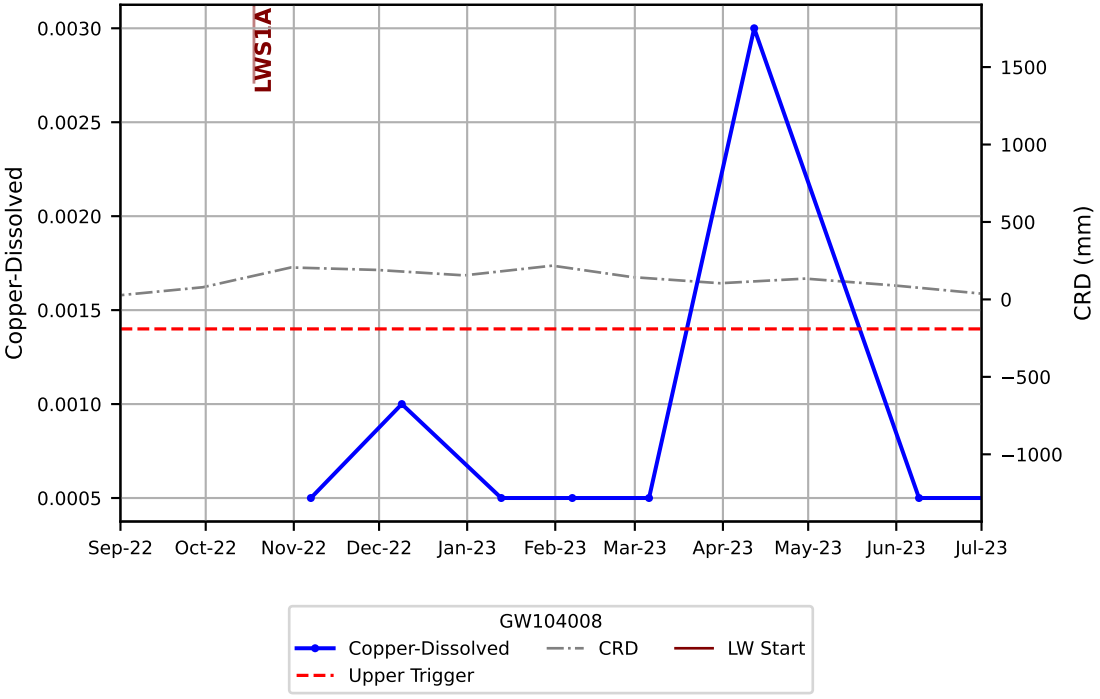

LWS1A
Selenium-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104323
Selenium-Dissolved
CRD
LW Start
Upper Trigger

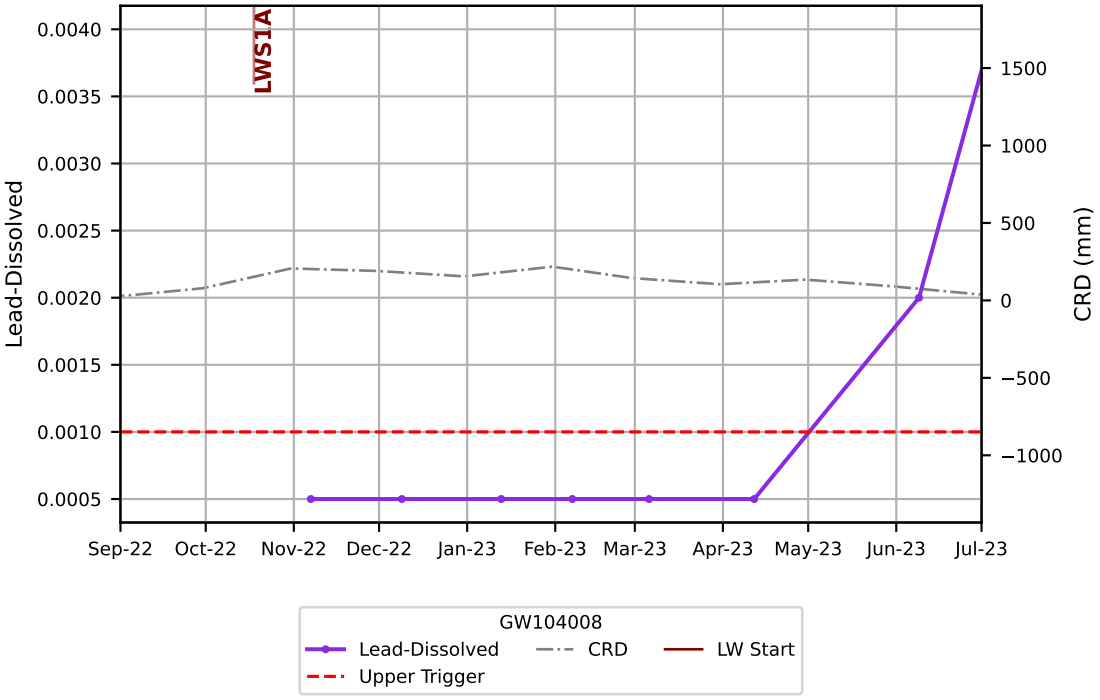

LW51A
pH (field)
CRD (mm)
7.0
6.5
6.0
5.5
5.0
4.5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

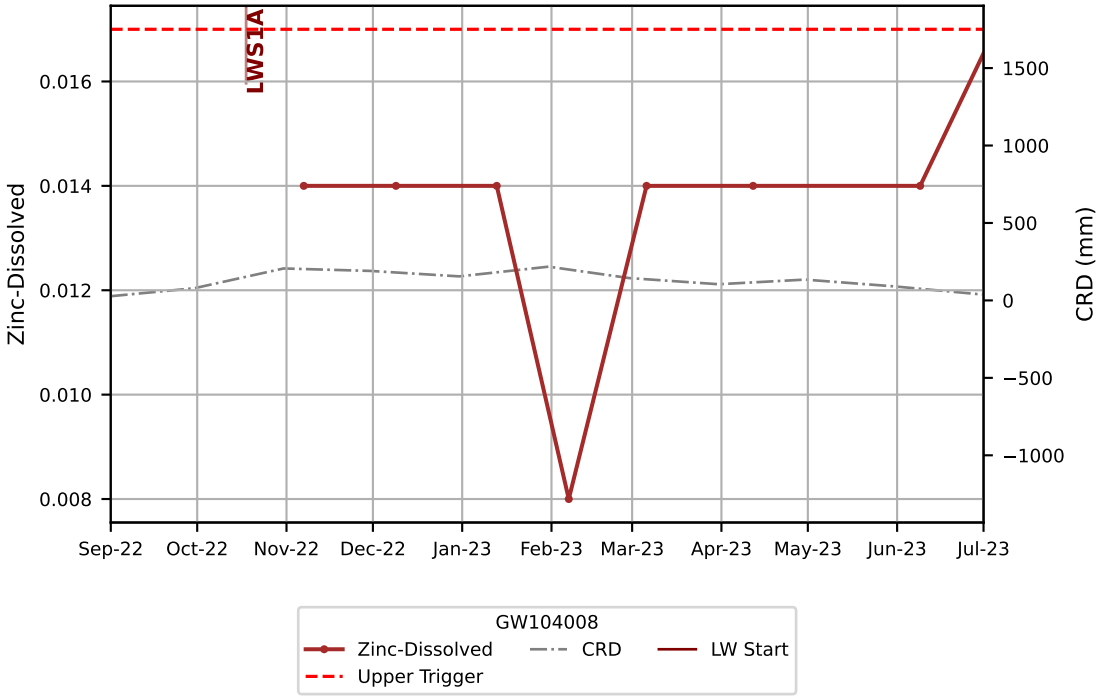

LW1A
Electrical Conductivity (field)
CRD (mm)
2000
1800
1600
1400
1200
1000
800
600
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

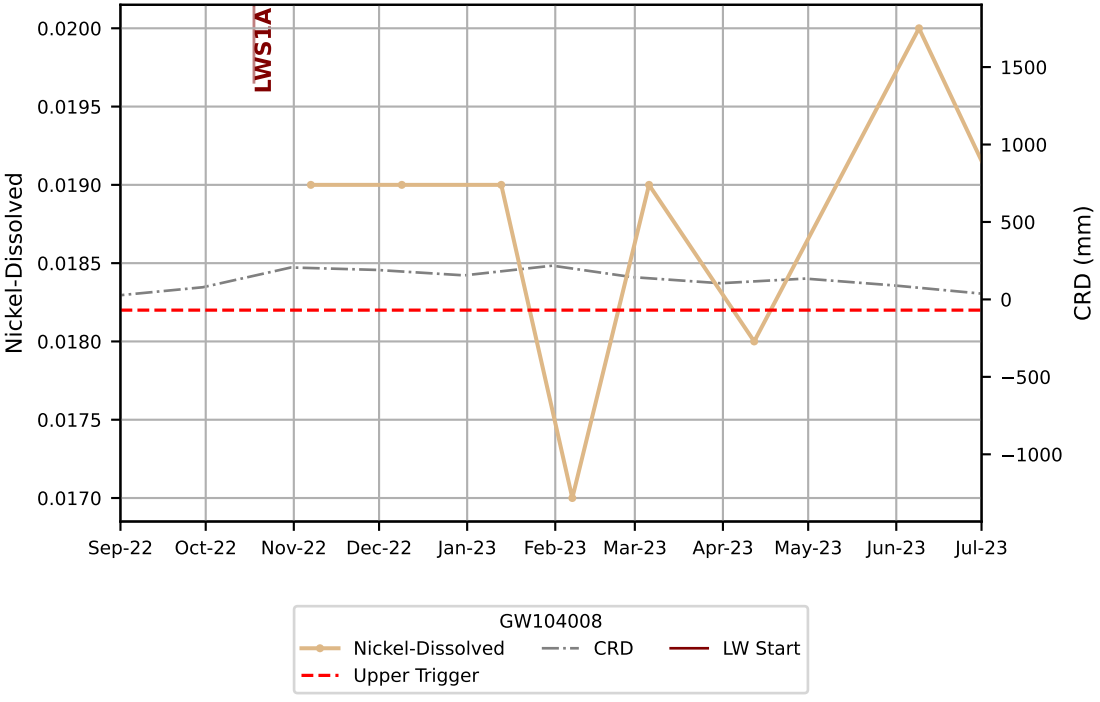

LWS1A
Iron-Dissolved
CRD (mm)
40
38
36
34
32
30
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Iron-Dissolved
CRD
LW Start
Upper Trigger

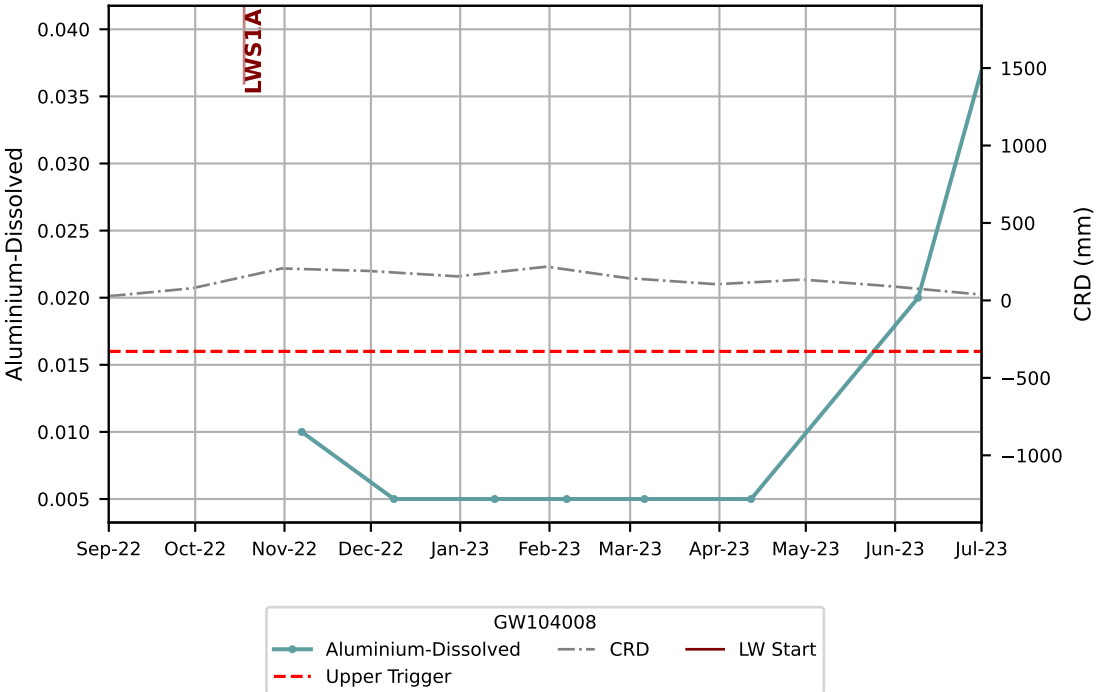

LWS1A
Manganese-Dissolved
CRD (mm)
2.30
2.25
2.20
2.15
2.10
2.05
2.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Manganese-Dissolved
CRD
LW Start
Upper Trigger

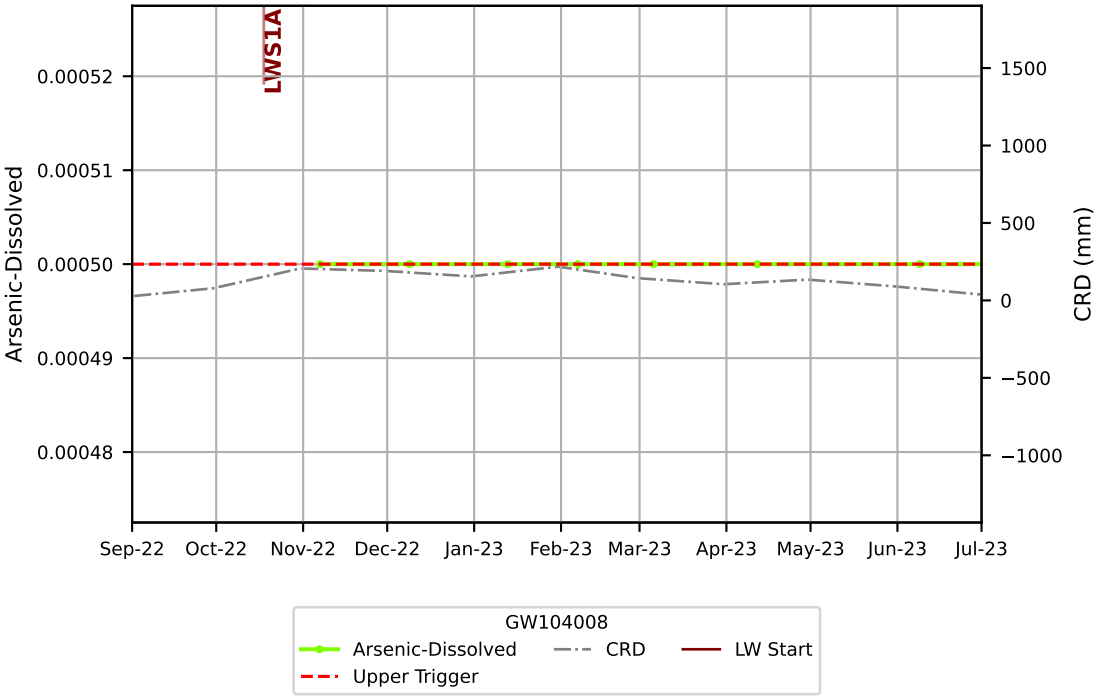

LWS1A
Copper-Dissolved
CRD (mm)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Copper-Dissolved
CRD
LW Start
Upper Trigger

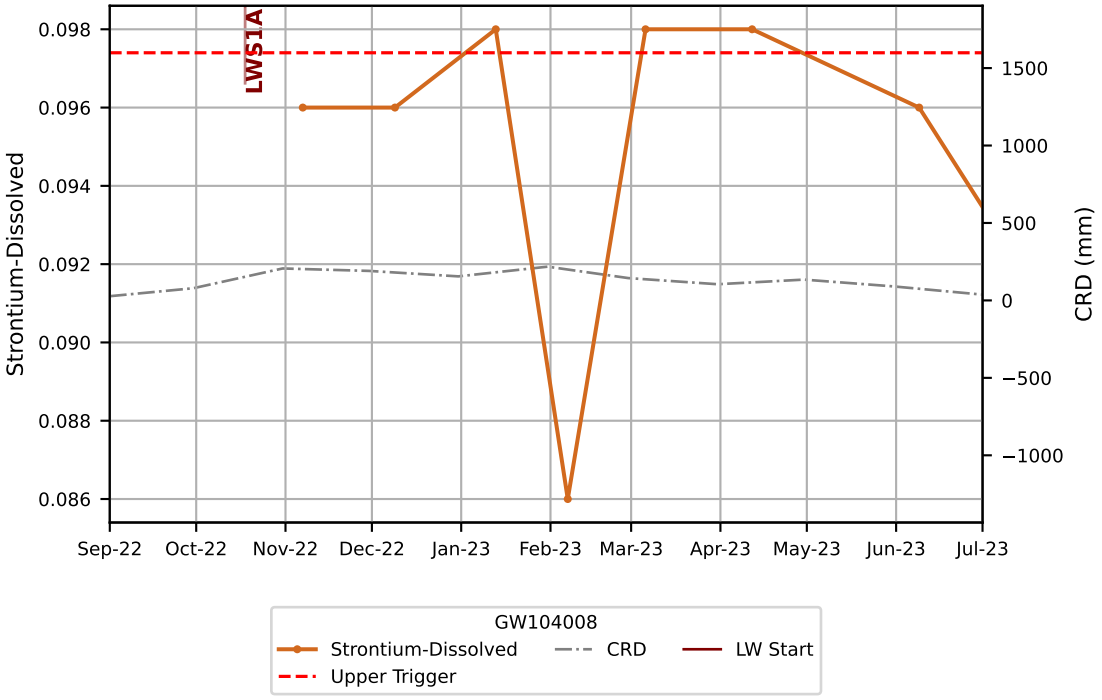

LWS1A
Lead-Dissolved
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Lead-Dissolved
CRD
LW Start
Upper Trigger

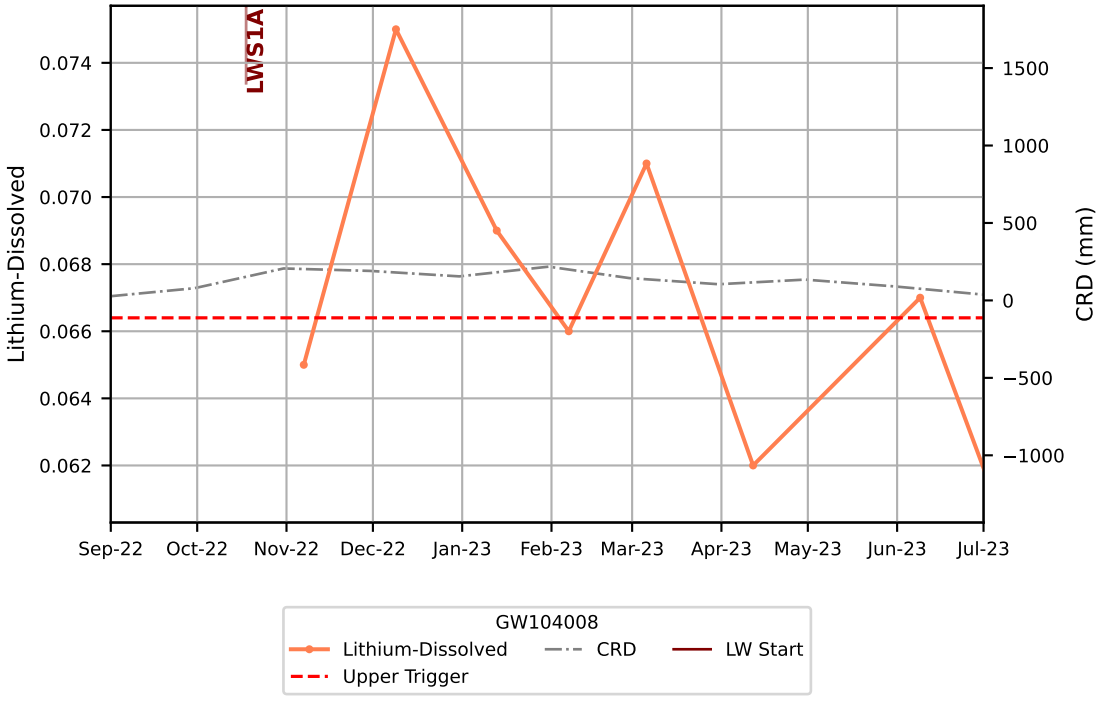

LWS1A
Zinc-Dissolved
0.016
0.014
0.012
0.010
0.008
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Zinc-Dissolved
CRD
LW Start
Upper Trigger

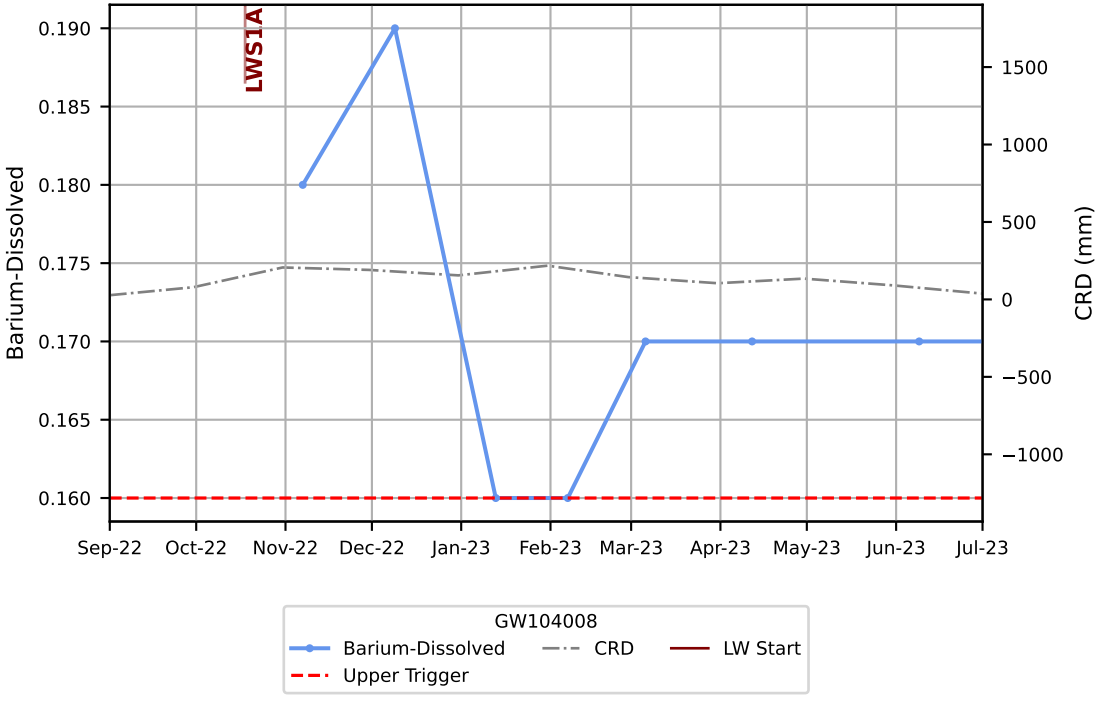

LWS1A
Nickel-Dissolved
CRD (mm)
0.0200
0.0195
0.0190
0.0185
0.0180
0.0175
0.0170
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Nickel-Dissolved
CRD
LW Start
Upper Trigger

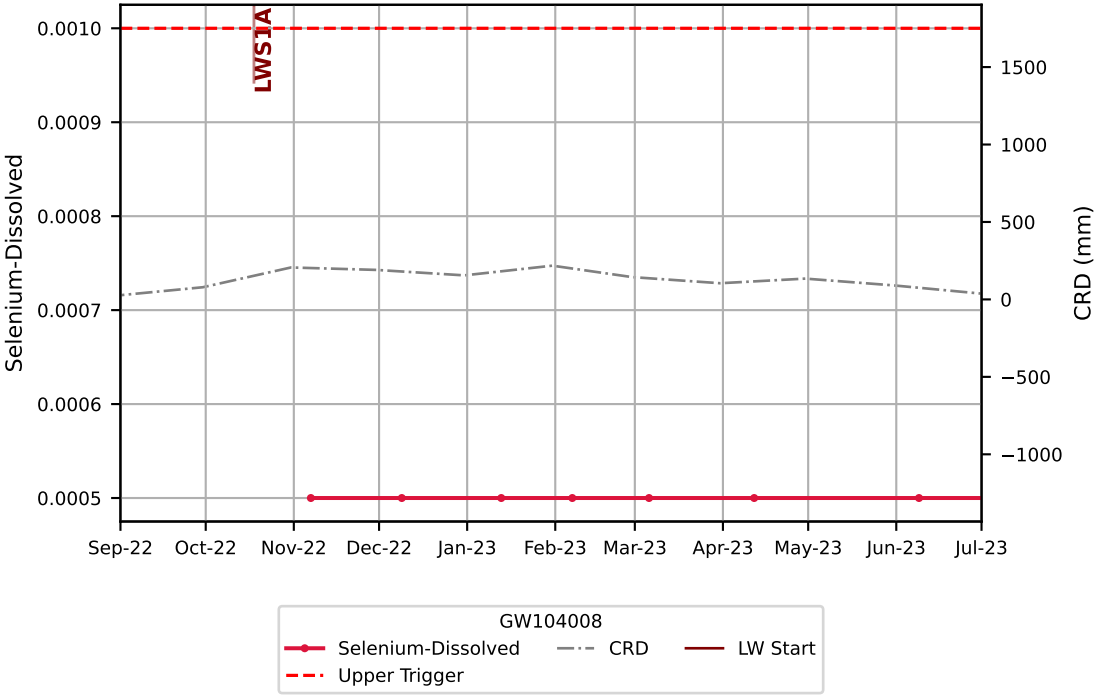

LWS1A
Aluminium-Dissolved
CRD (mm)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

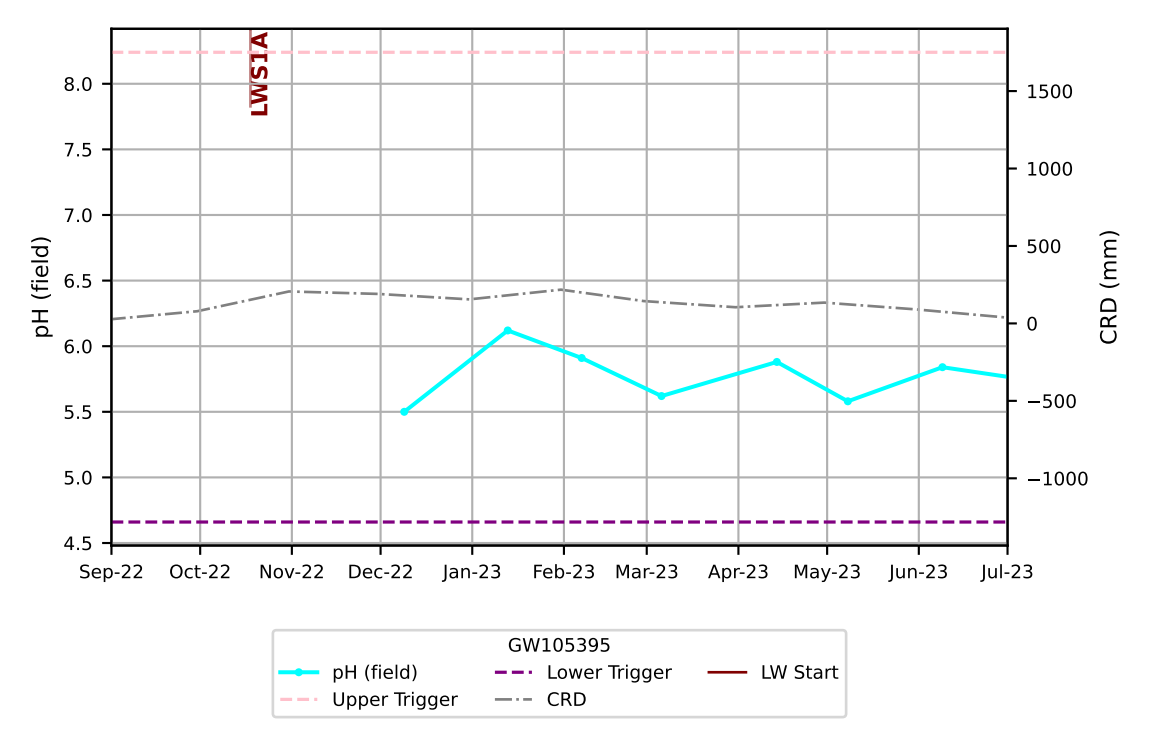

LW51A
Arsenic-Dissolved
CRD (mm)
0.00052
0.00051
0.00050
0.00049
0.00048
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

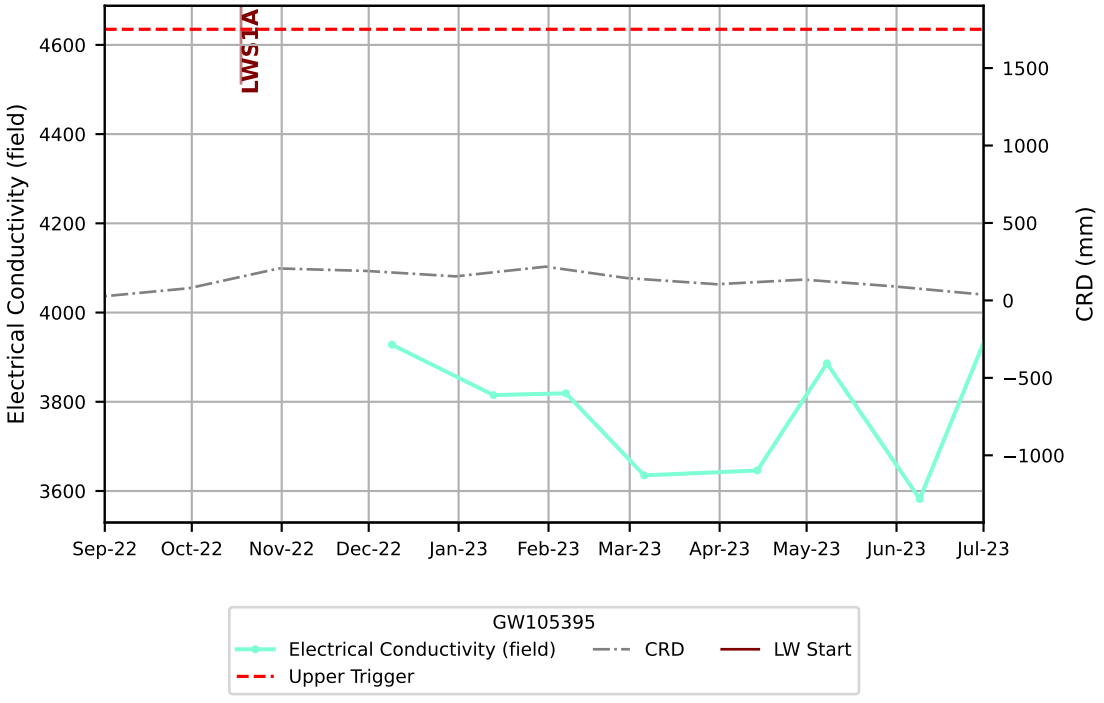

LWS1A
Strontium-Dissolved
CRD (mm)
0.098
0.096
0.094
0.092
0.090
0.088
0.086
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Strontium-Dissolved
CRD
LW Start
Upper Trigger

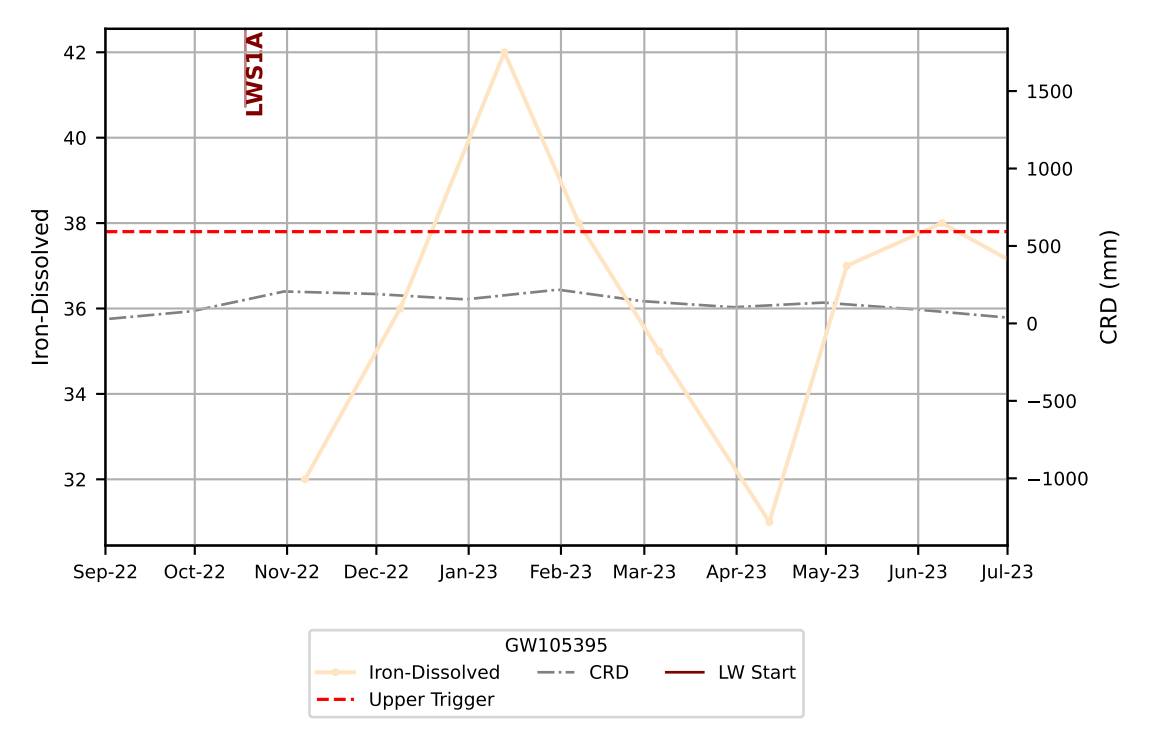

LWS1A
Lithium-Dissolved
CRD (mm)
0.074
0.072
0.070
0.068
0.066
0.064
0.062
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Lithium-Dissolved
CRD
LW Start
Upper Trigger

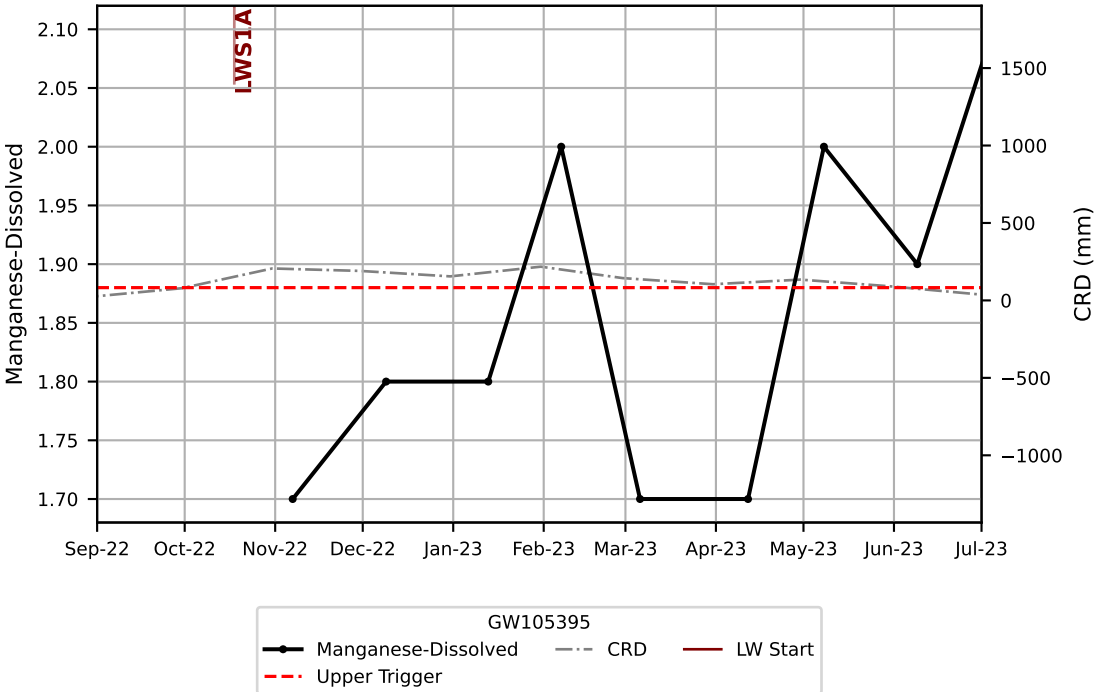

LWS1A
Barium-Dissolved
CRD (mm)
0.190
0.185
0.180
0.175
0.170
0.165
0.160
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Barium-Dissolved
CRD
LW Start
Upper Trigger

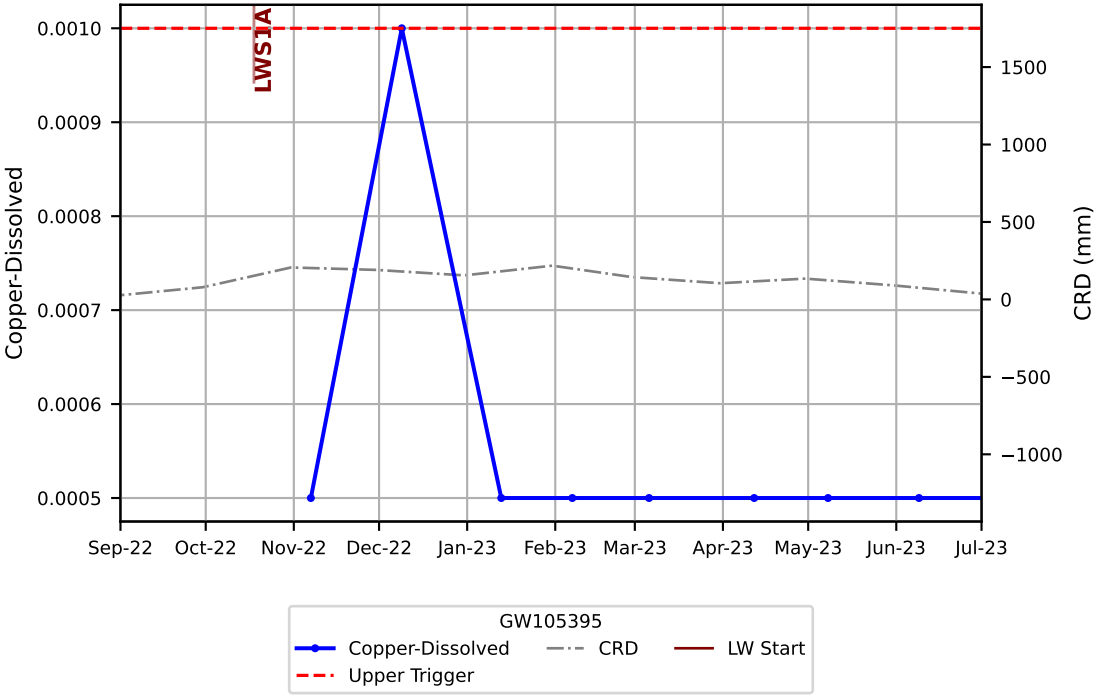

LWS1A
Selenium-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW104008
Selenium-Dissolved
CRD
LW Start
Upper Trigger

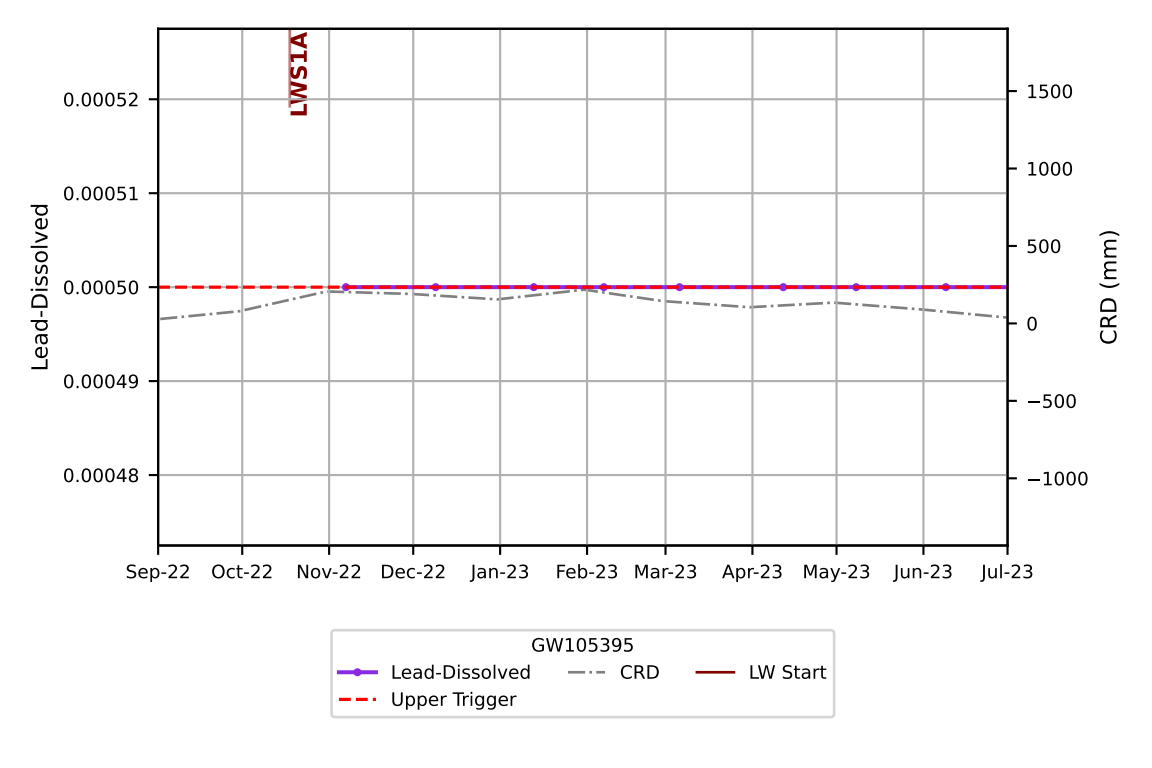

LWS1A
pH (field)
CRD (mm)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

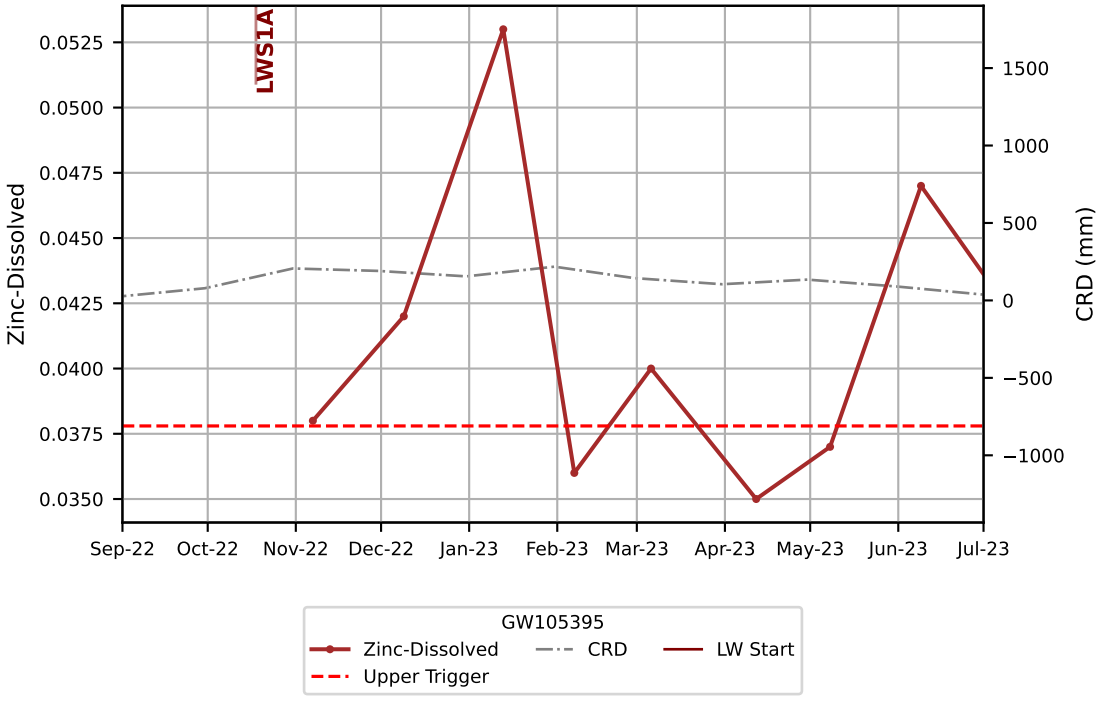

LW1A
Electrical Conductivity (field)
CRD (mm)
4600
4400
4200
4000
3800
3600
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

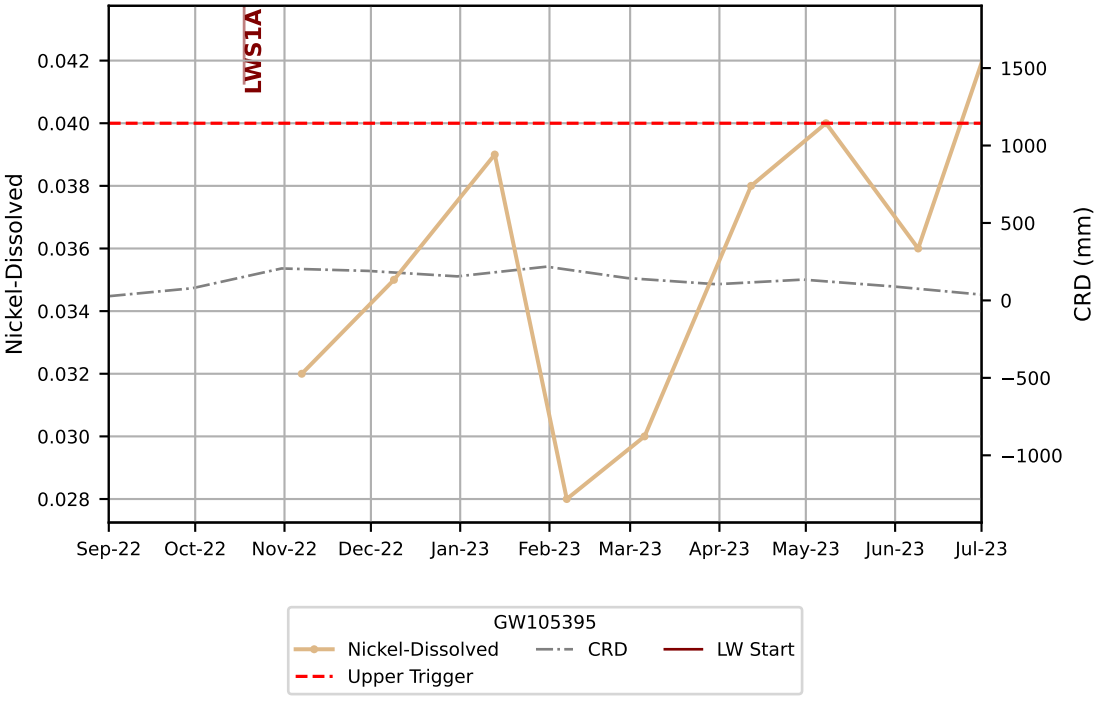

LWS1A
Iron-Dissolved
CRD (mm)
42
40
38
36
34
32
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Iron-Dissolved
CRD
LW Start
Upper Trigger

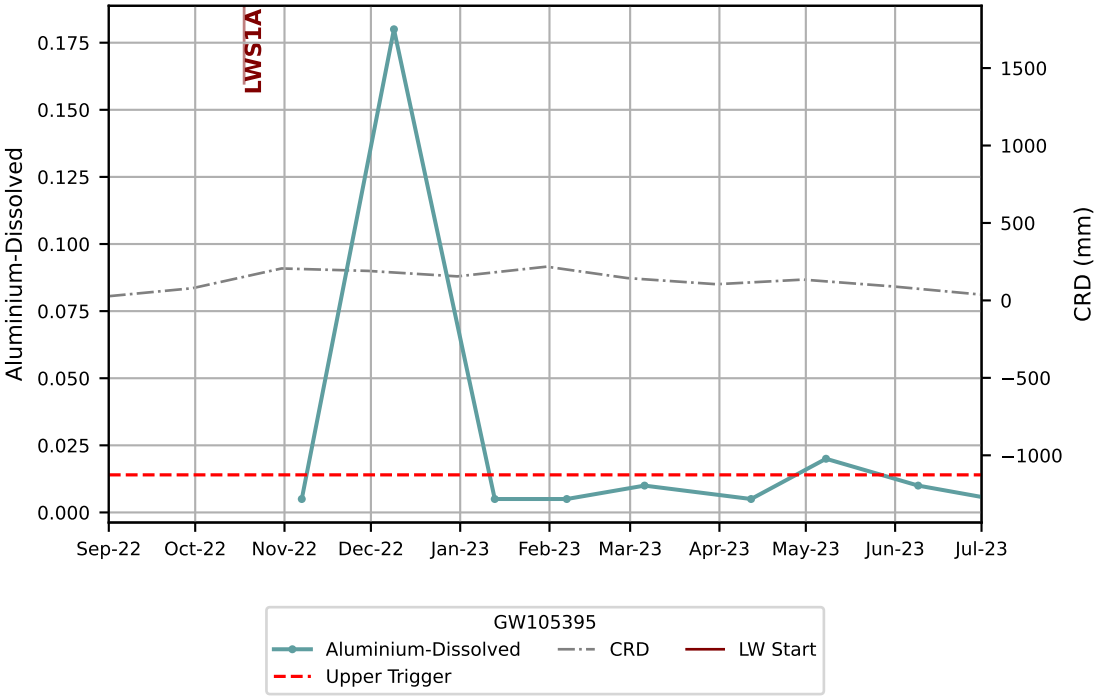

LWS1A
Manganese-Dissolved
CRD (mm)
2.10
2.05
2.00
1.95
1.90
1.85
1.80
1.75
1.70
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Manganese-Dissolved
CRD
LW Start
Upper Trigger

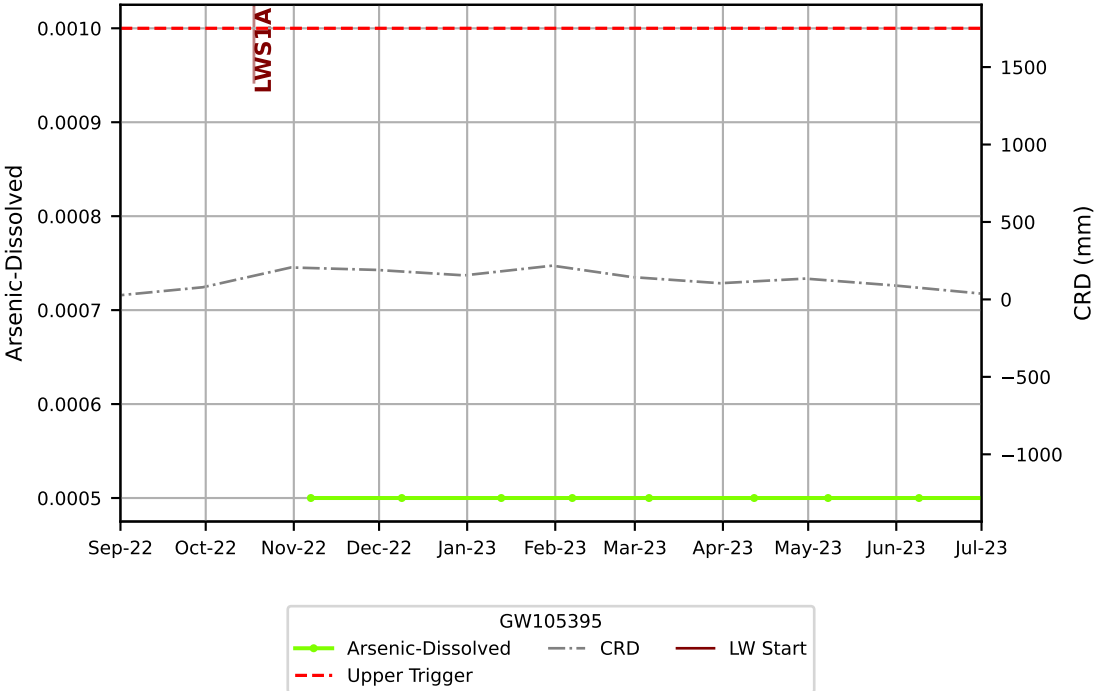

LWS1A
Copper-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Copper-Dissolved
CRD
LW Start
Upper Trigger

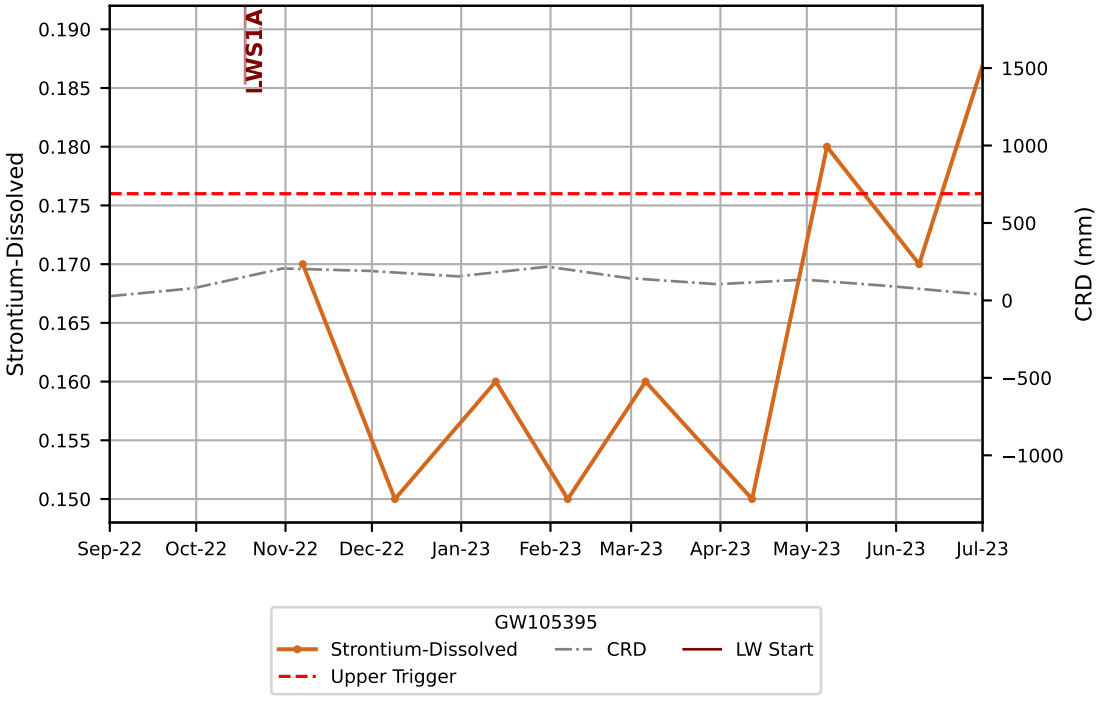

LWS1A
Lead-Dissolved
0.00052
0.00051
0.00050
0.00049
0.00048
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Lead-Dissolved
CRD
LW Start
Upper Trigger

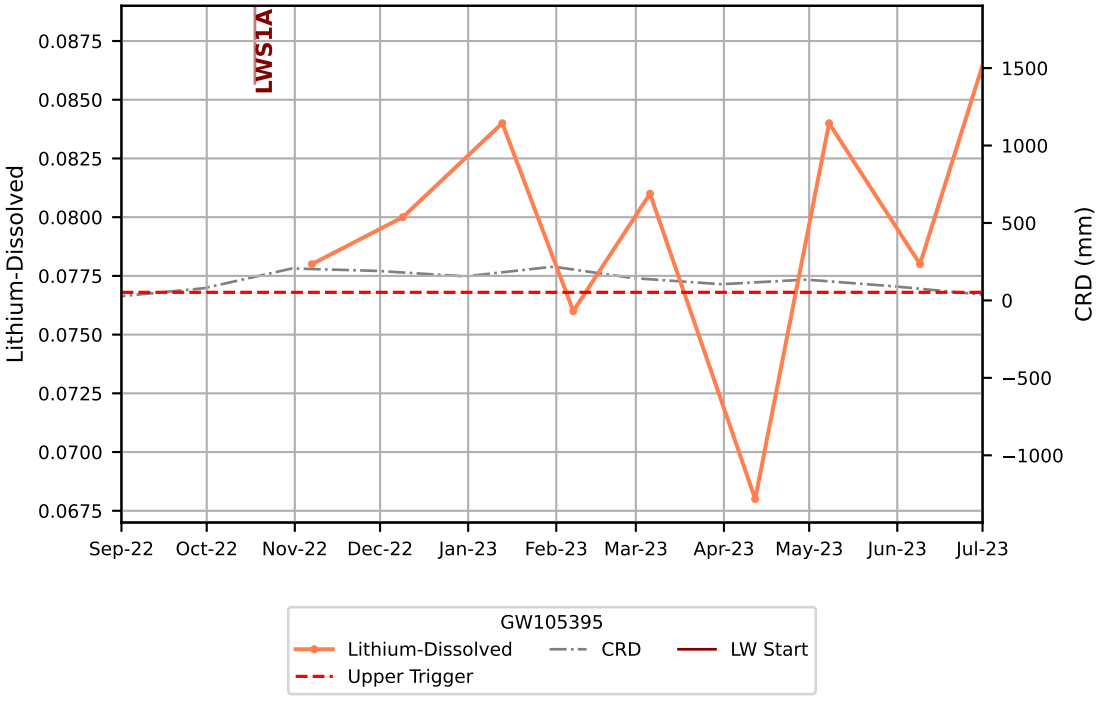

LWS1A
Zinc-Dissolved
CRD (mm)
0.0525
0.0500
0.0475
0.0450
0.0425
0.0400
0.0375
0.0350
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Zinc-Dissolved
CRD
LW Start
Upper Trigger

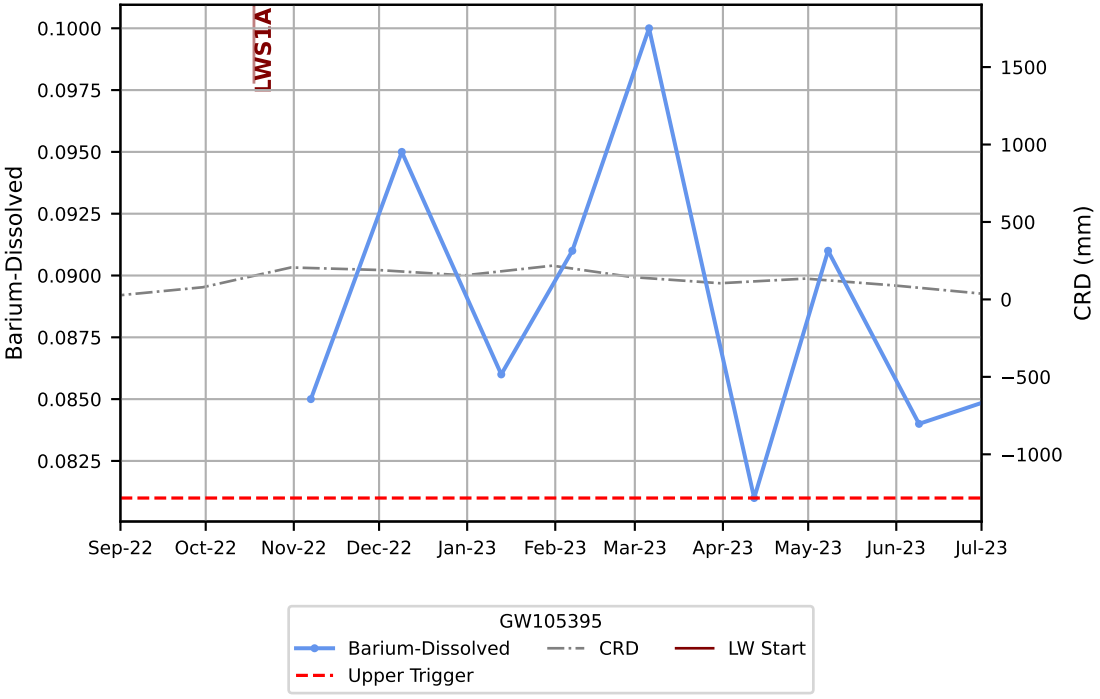

LW51A
Nickel-Dissolved
CRD (mm)
0.042
0.040
0.038
0.036
0.034
0.032
0.030
0.028
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Nickel-Dissolved
CRD
LW Start
Upper Trigger

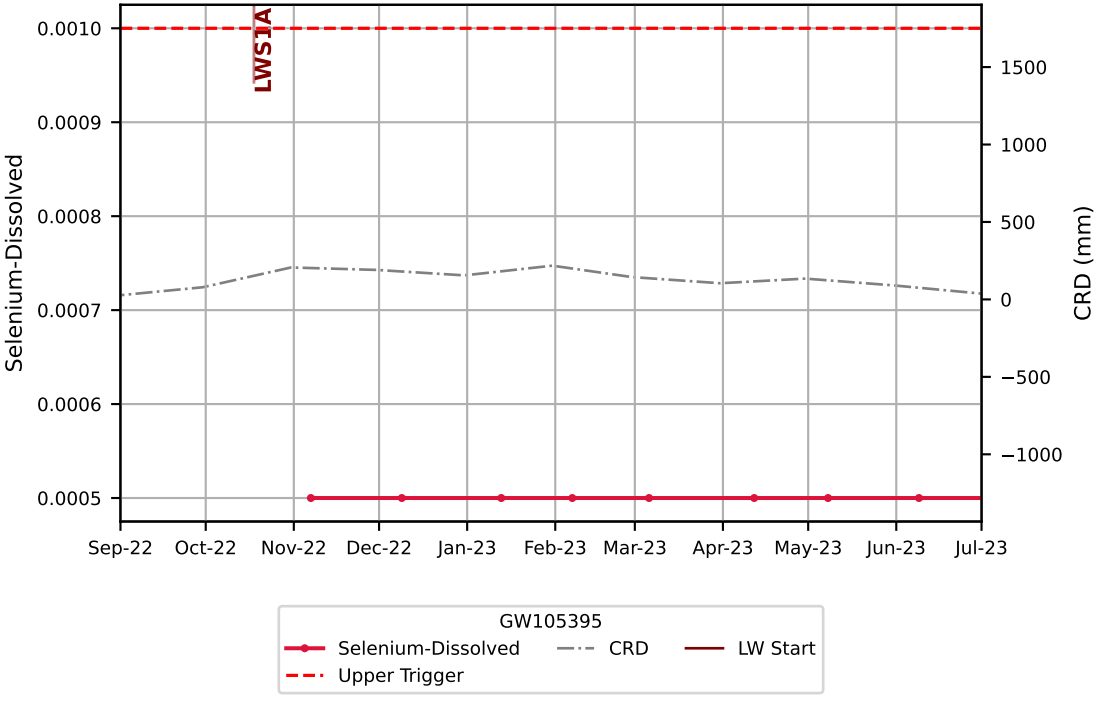

LWS1A
Aluminium-Dissolved
CRD (mm)
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

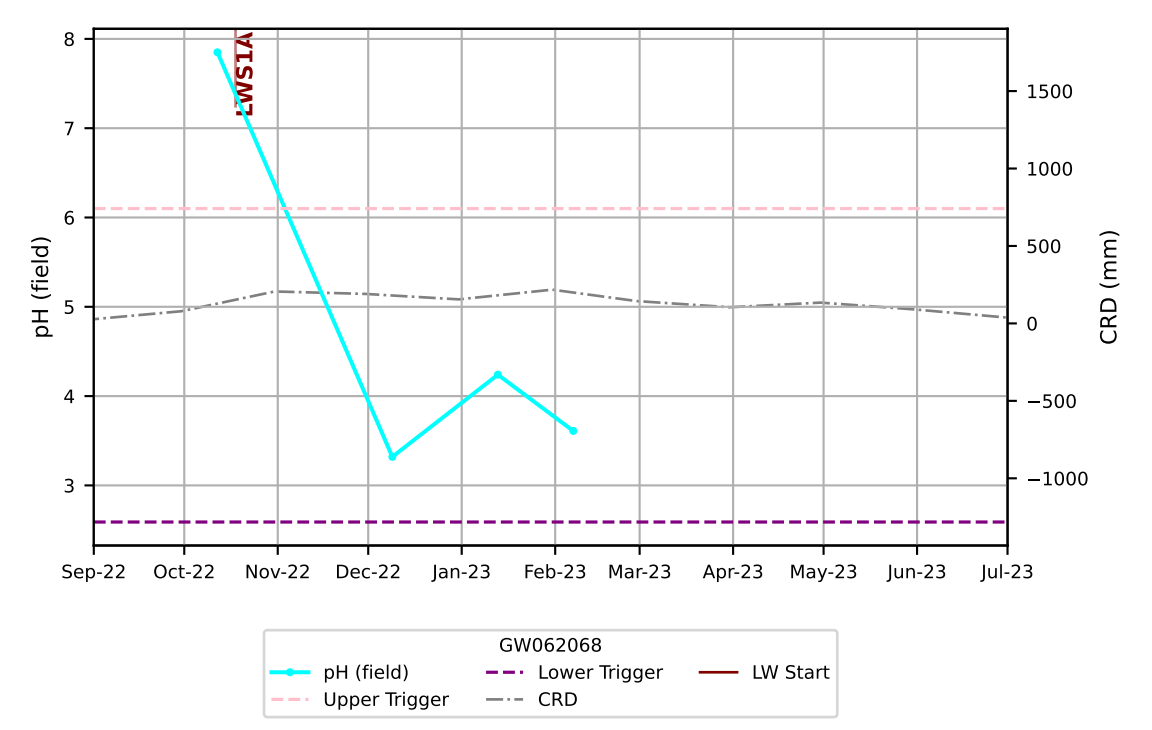

LWS1A
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
Arsenic-Dissolved
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

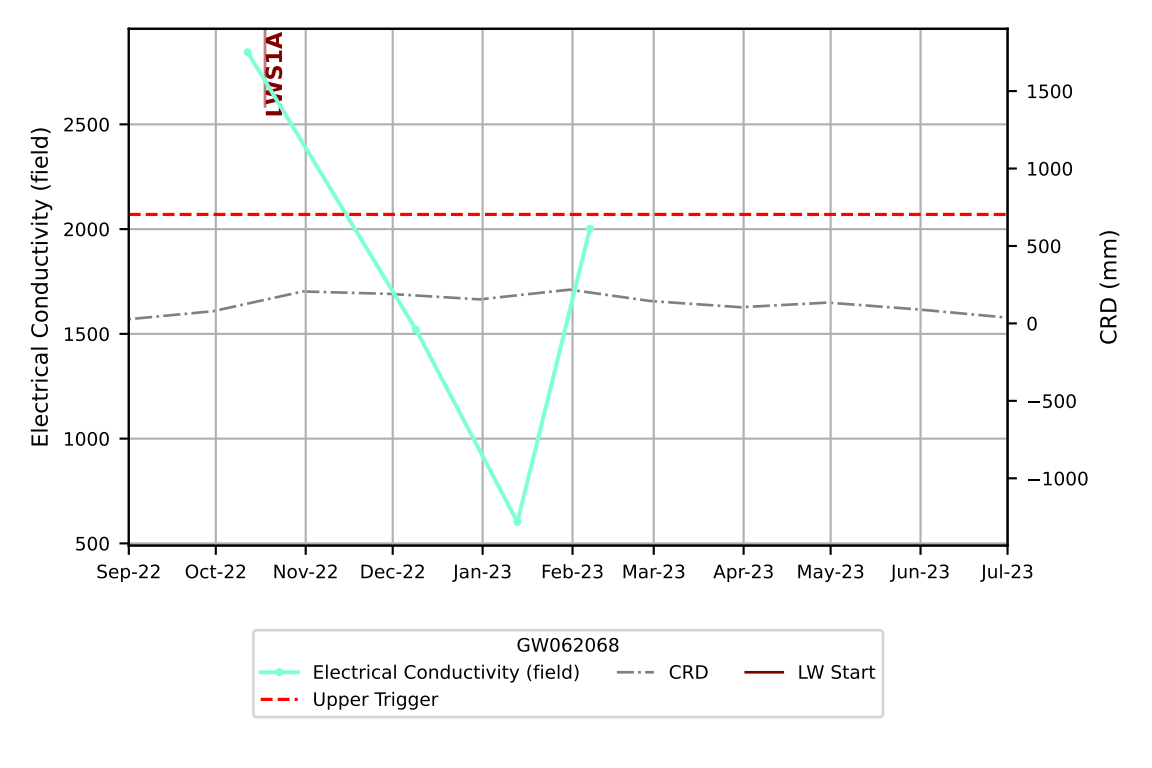

LWS1A
Strontium-Dissolved
CRD (mm)
0.190
0.185
0.180
0.175
0.170
0.165
0.160
0.155
0.150
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Strontium-Dissolved
CRD
LW Start
Upper Trigger

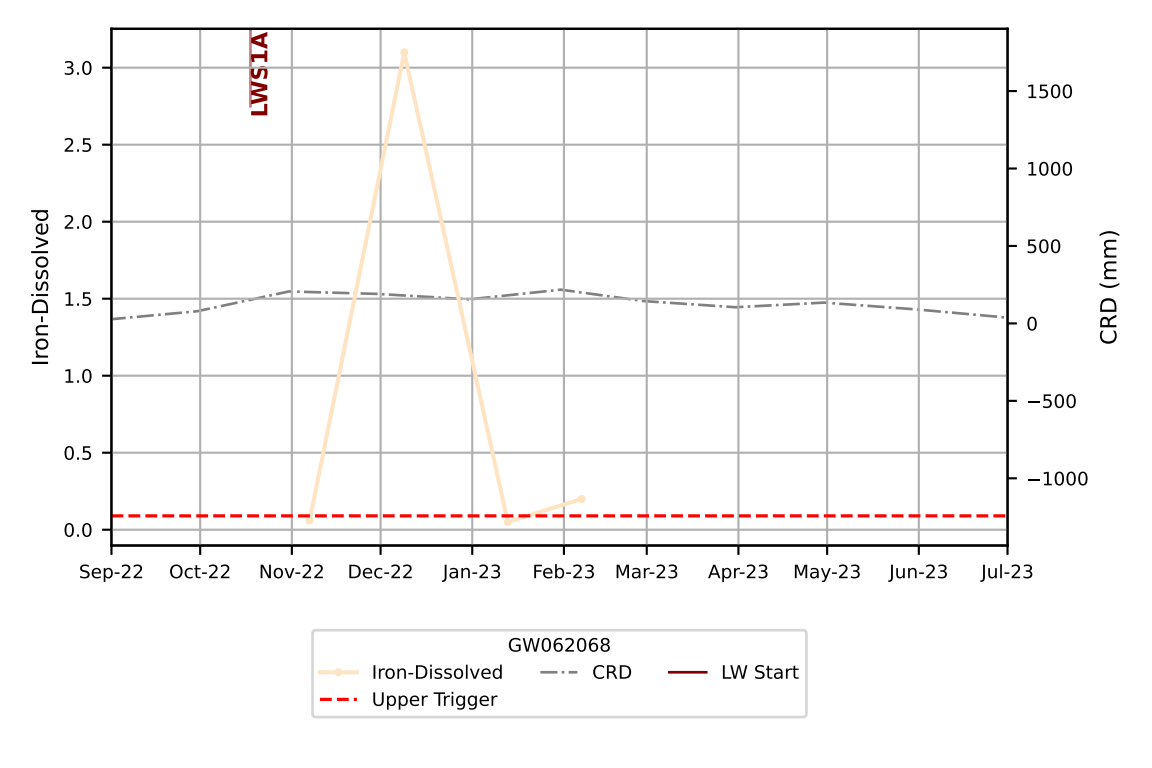

LWS1A
Lithium-Dissolved
CRD (mm)
0.0875
0.0850
0.0825
0.0800
0.0775
0.0750
0.0725
0.0700
0.0675
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Lithium-Dissolved
CRD
LW Start
Upper Trigger

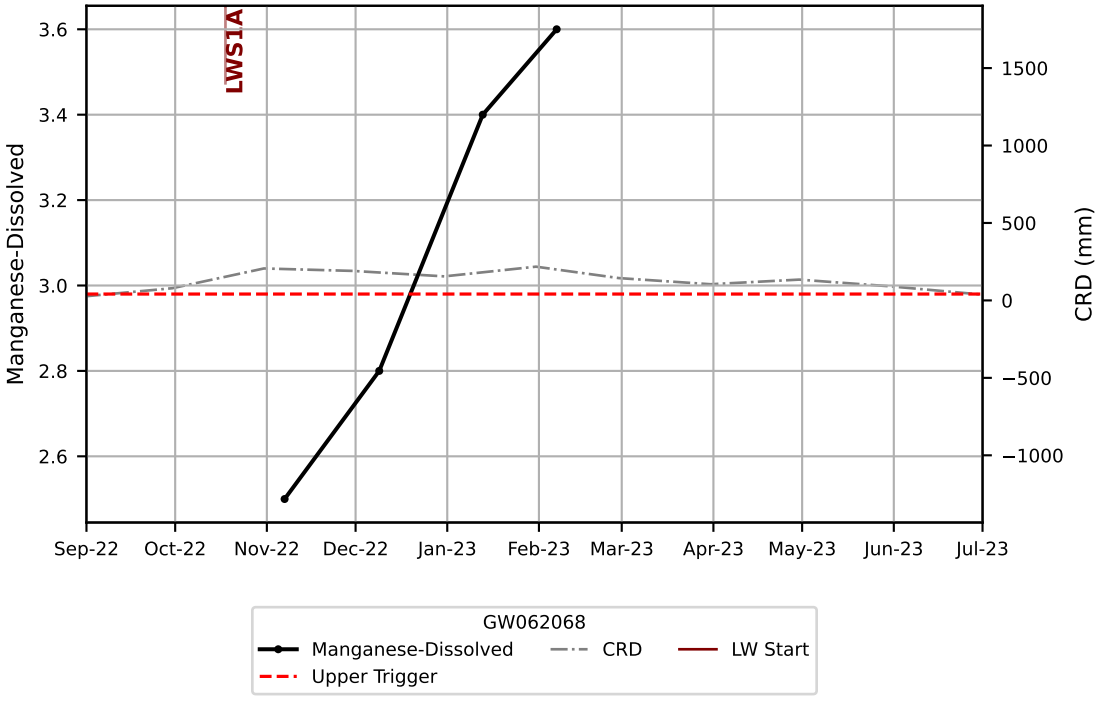

LWS1A
Barium-Dissolved
CRD (mm)
0.1000
0.0975
0.0950
0.0925
0.0900
0.0875
0.0850
0.0825
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Barium-Dissolved
CRD
LW Start
Upper Trigger

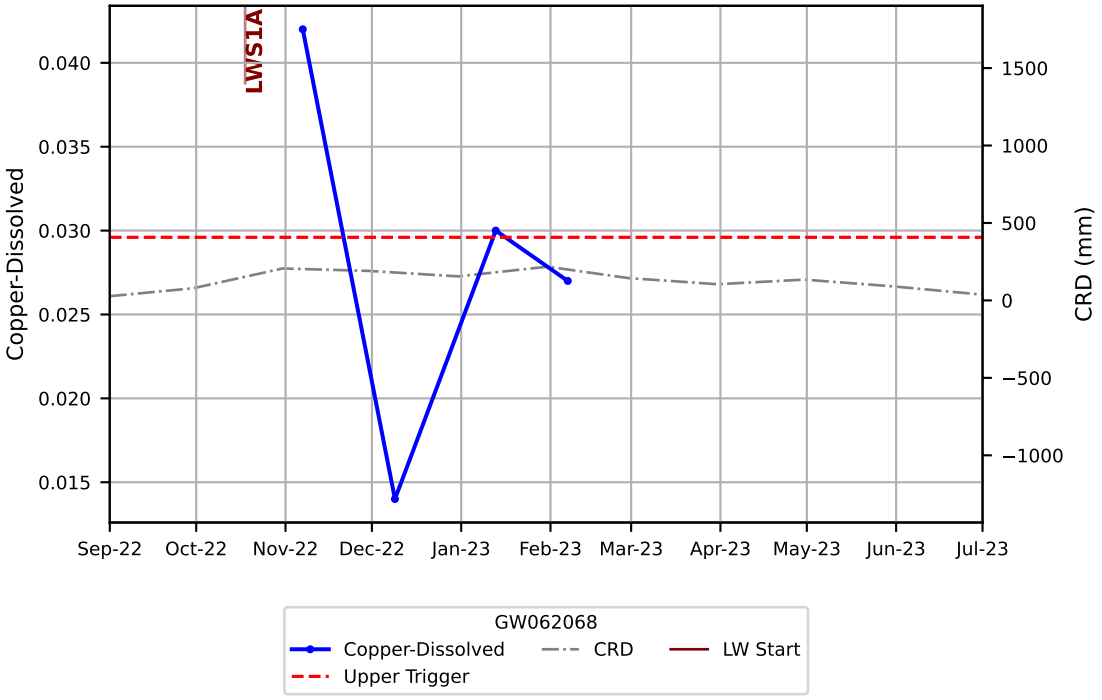

LWS1A
Selenium-Dissolved
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW105395
Selenium-Dissolved
CRD
LW Start
Upper Trigger

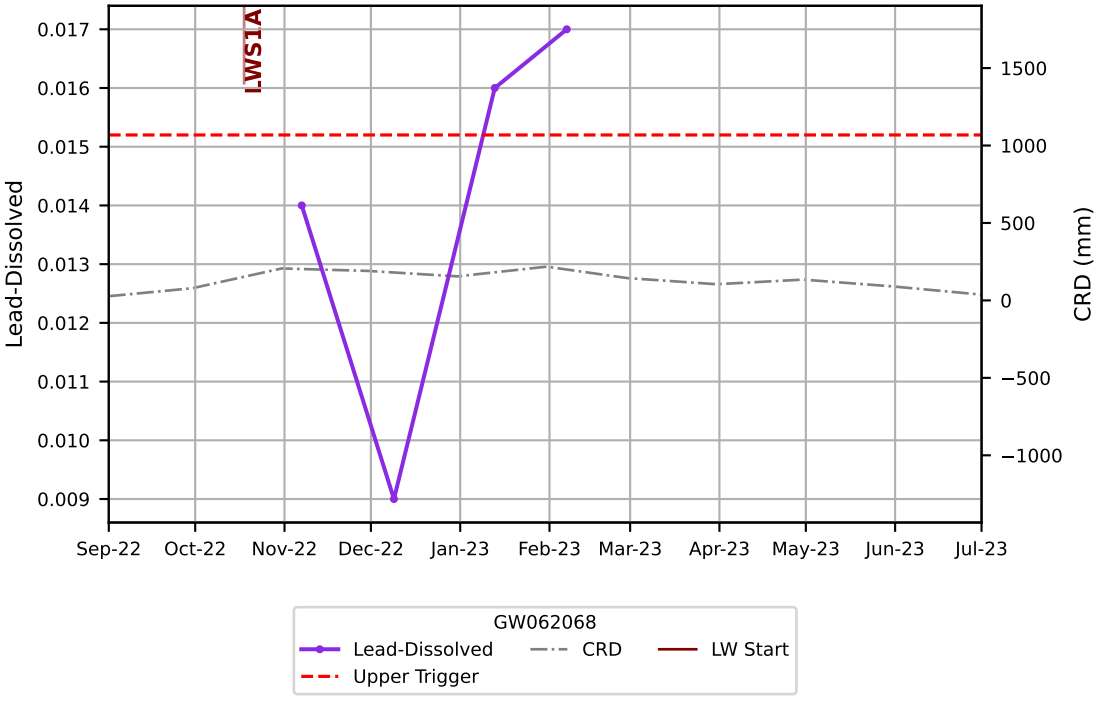

LW1SM1
pH (field)
CRD (mm)
8
7
6
5
4
3
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

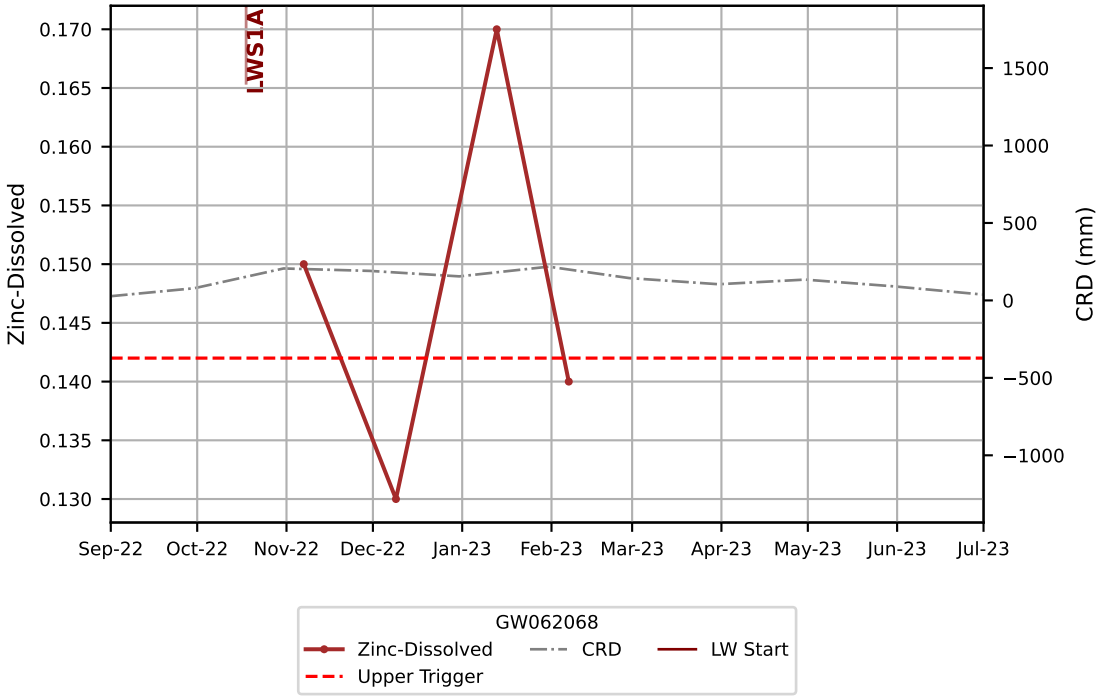

LWS1A
Electrical Conductivity (field)
CRD (mm)
2500
2000
1500
1000
500
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

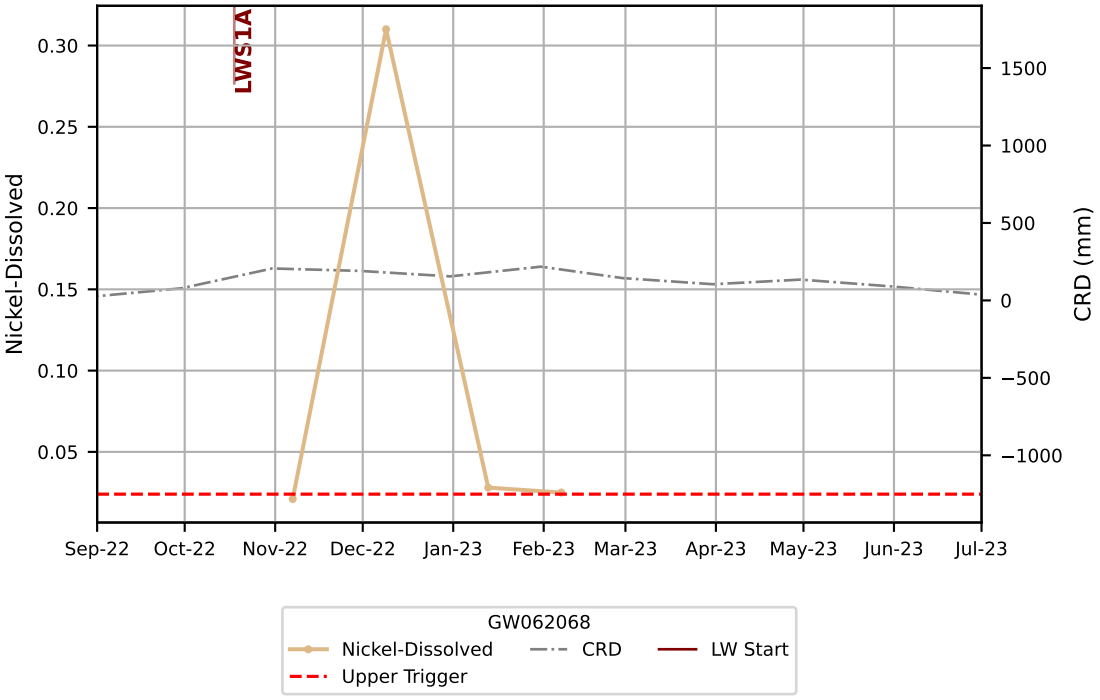

LWS1A
Iron-Dissolved
CRD (mm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Iron-Dissolved
CRD
LW Start
Upper Trigger

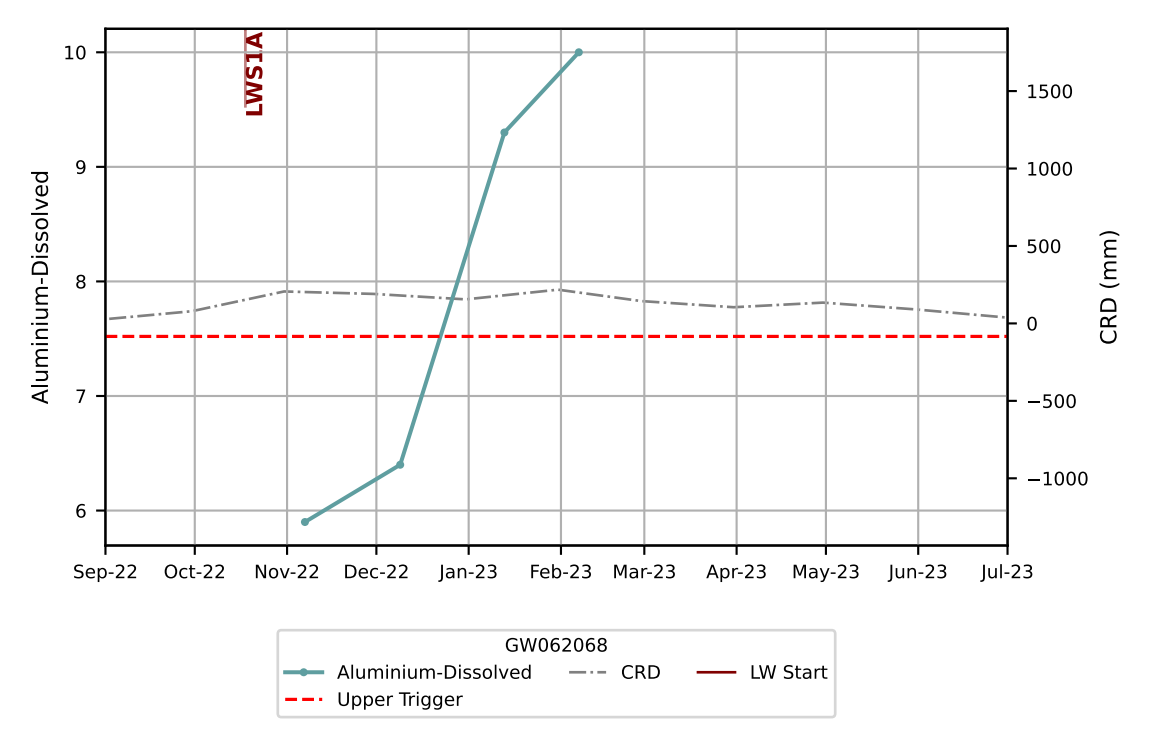

LWS1A
Manganese-Dissolved
CRD (mm)
3.6
3.4
3.2
3.0
2.8
2.6
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Manganese-Dissolved
CRD
LW Start
Upper Trigger

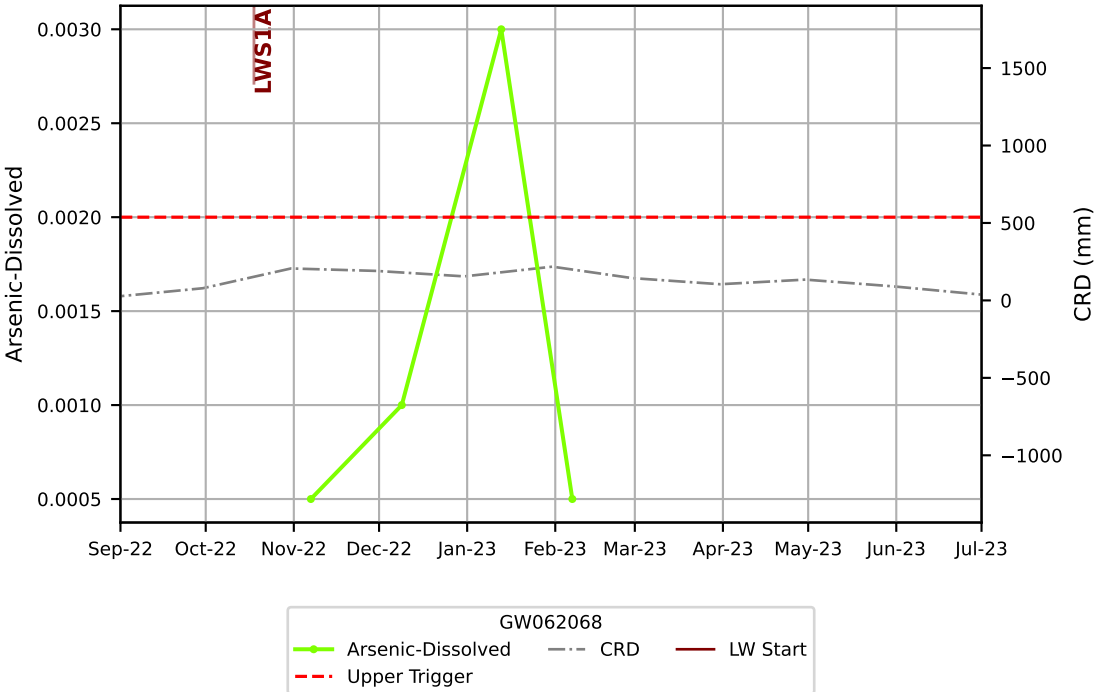

LWS1A
Copper-Dissolved
CRD (mm)
0.040
0.035
0.030
0.025
0.020
0.015
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Copper-Dissolved
CRD
LW Start
Upper Trigger

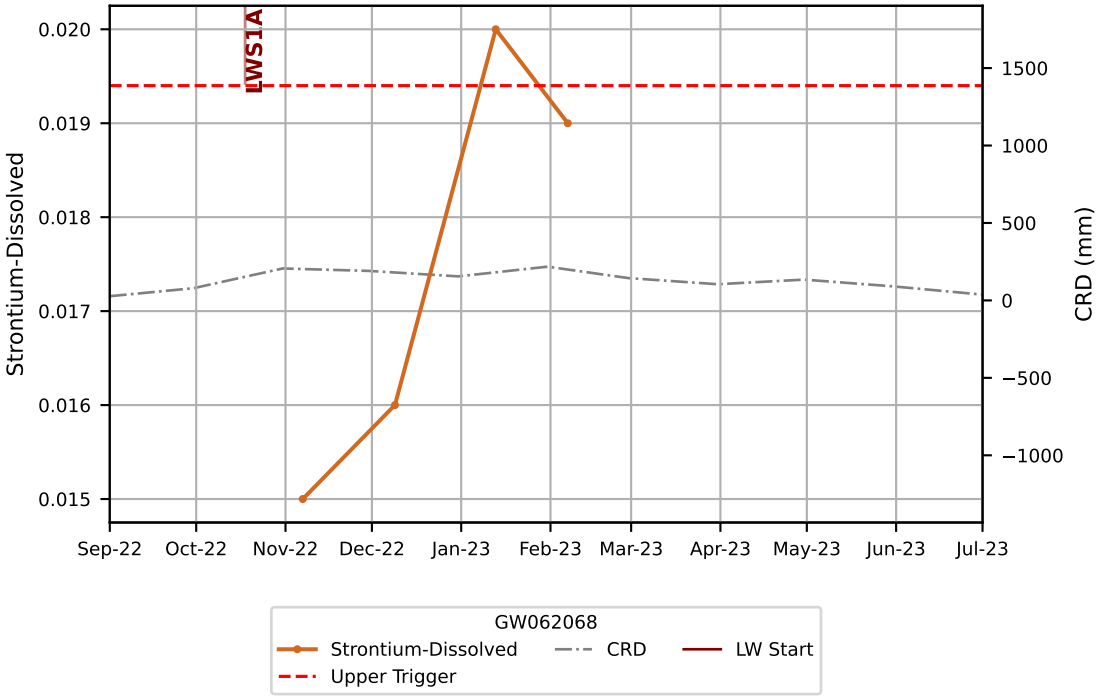

LWS1A
Lead-Dissolved
CRD (mm)
0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Lead-Dissolved
CRD
LW Start
Upper Trigger

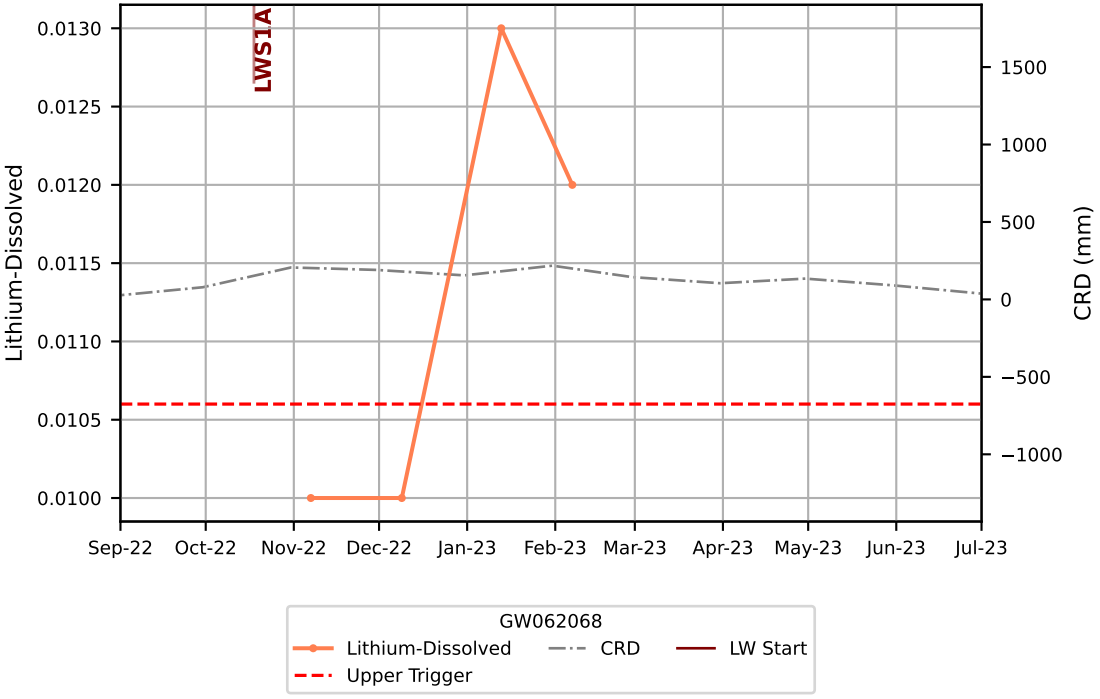

LWS1A
Zinc-Dissolved
CRD (mm)
0.170
0.165
0.160
0.155
0.150
0.145
0.140
0.135
0.130
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Zinc-Dissolved
CRD
LW Start
Upper Trigger

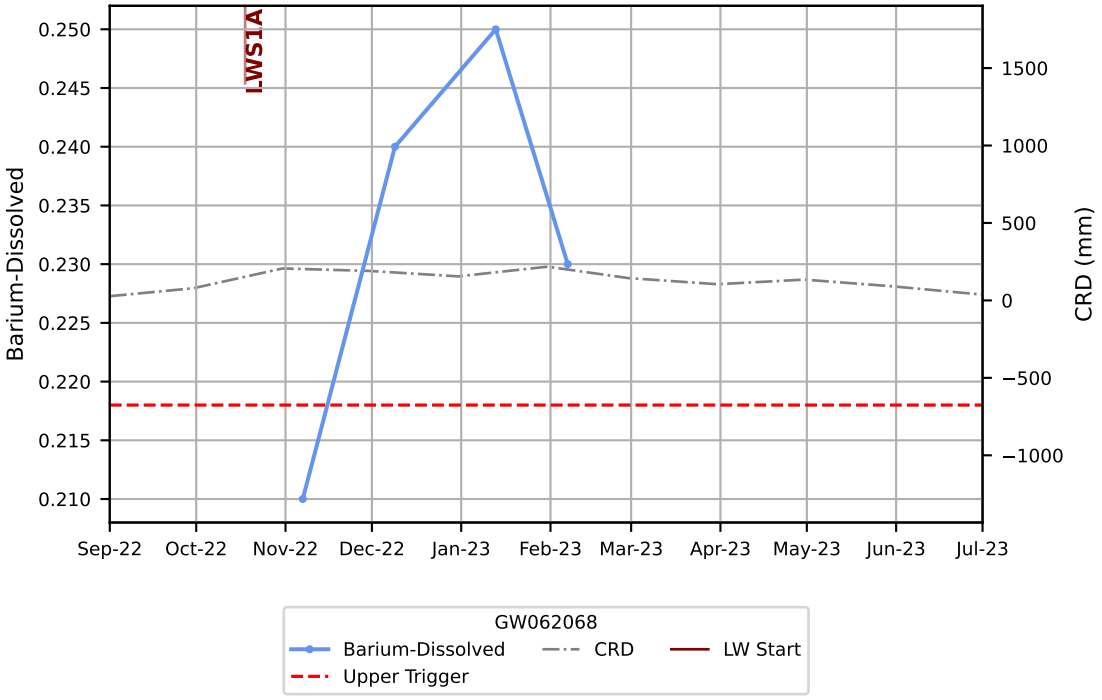

LWS1A
Nickel-Dissolved
0.30
0.25
0.20
0.15
0.10
0.05
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Nickel-Dissolved
CRD
LW Start
Upper Trigger

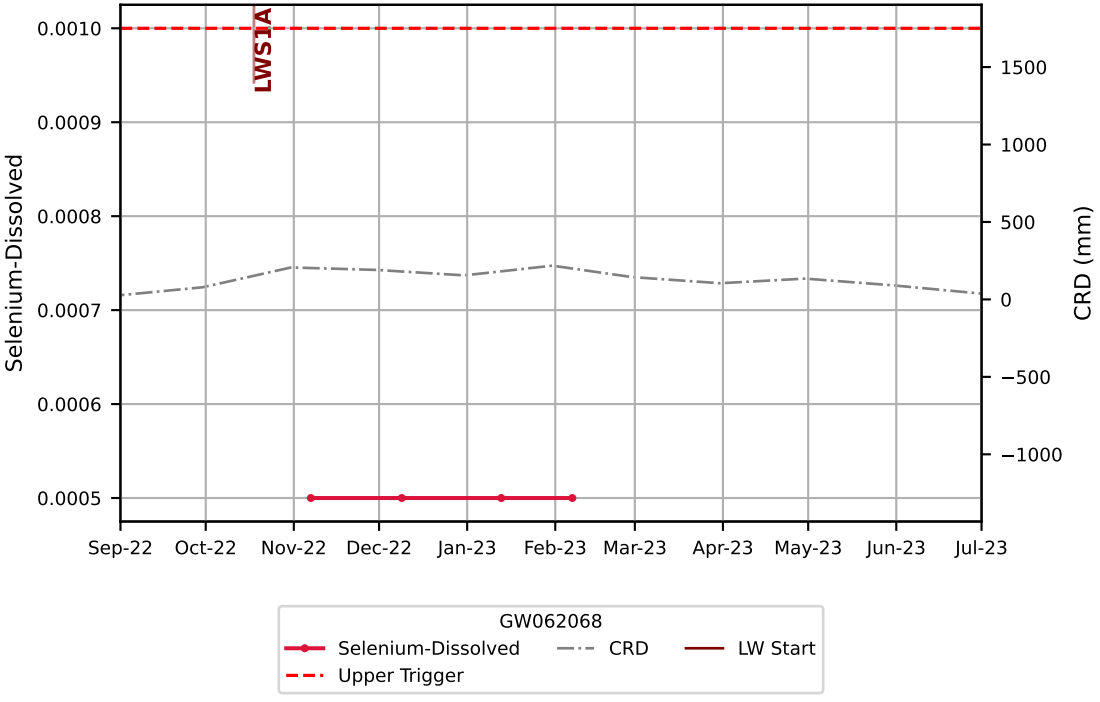

LWS1A
Aluminium-Dissolved
CRD (mm)
10
9
8
7
6
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

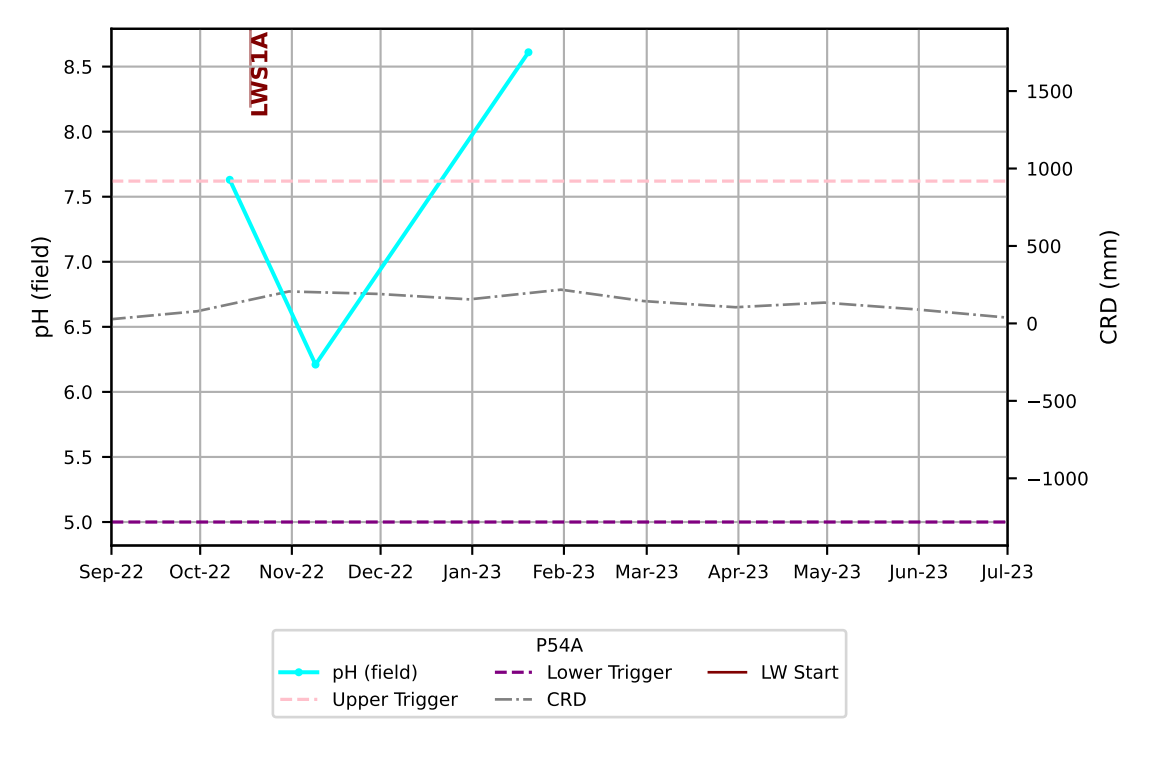

LWS1A
Arsenic-Dissolved
CRD (mm)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

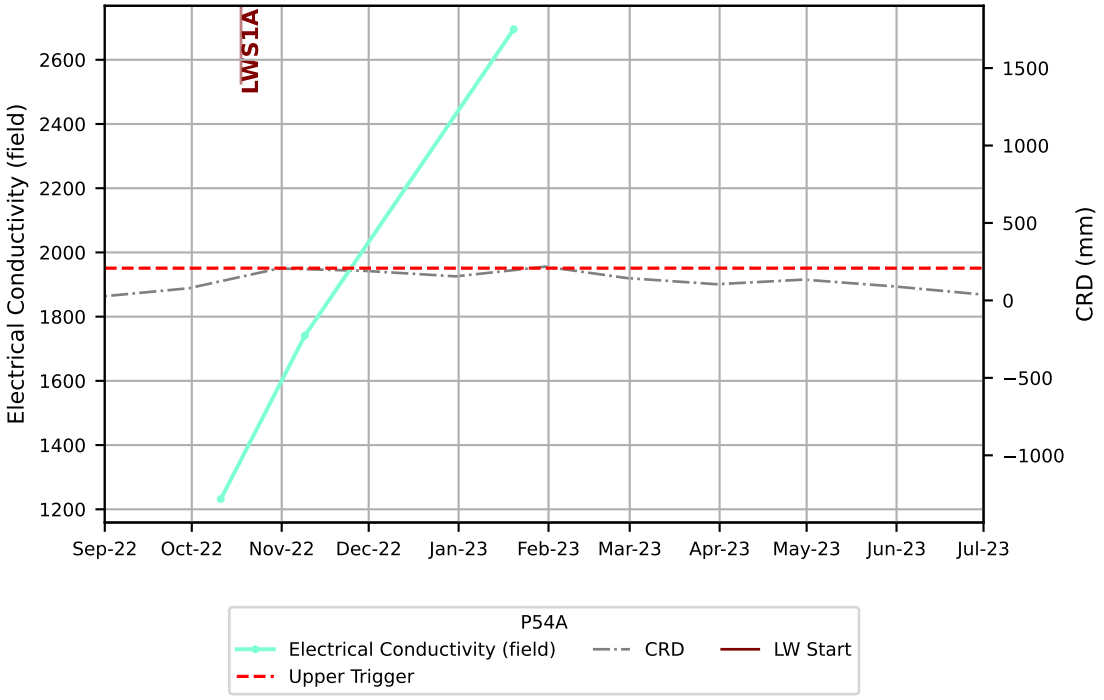

LWS1A
Strontium-Dissolved
0.020
0.019
0.018
0.017
0.016
0.015
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Strontium-Dissolved
CRD
LW Start
Upper Trigger

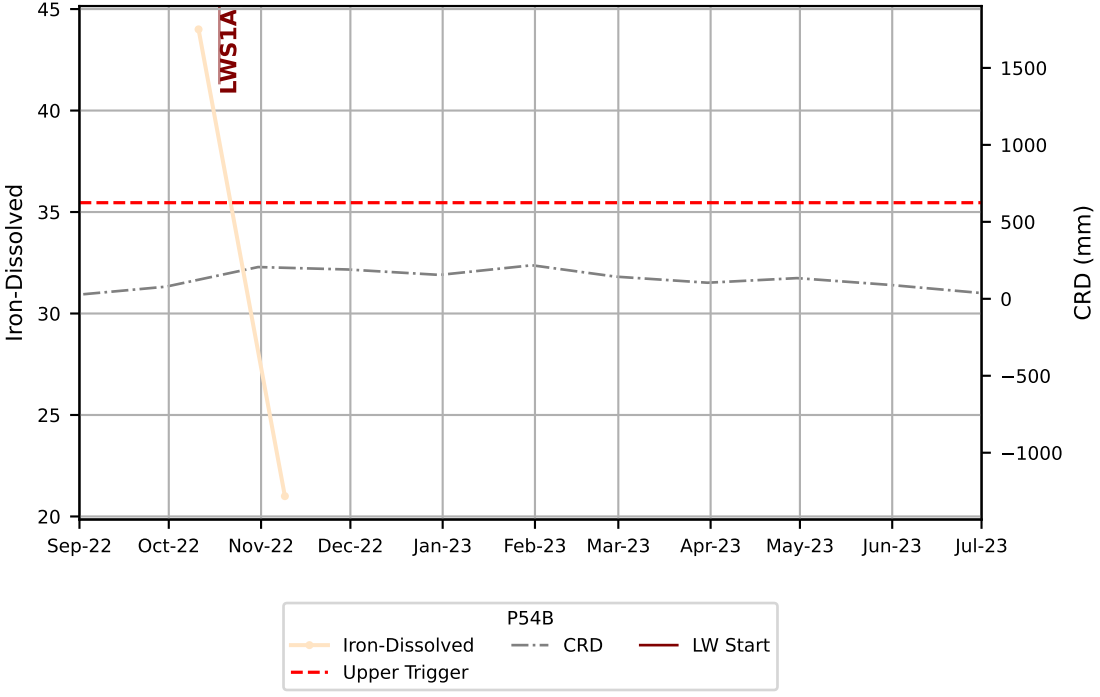

LWS1A
Lithium-Dissolved
0.0130
0.0125
0.0120
0.0115
0.0110
0.0105
0.0100
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Lithium-Dissolved
CRD
LW Start
Upper Trigger

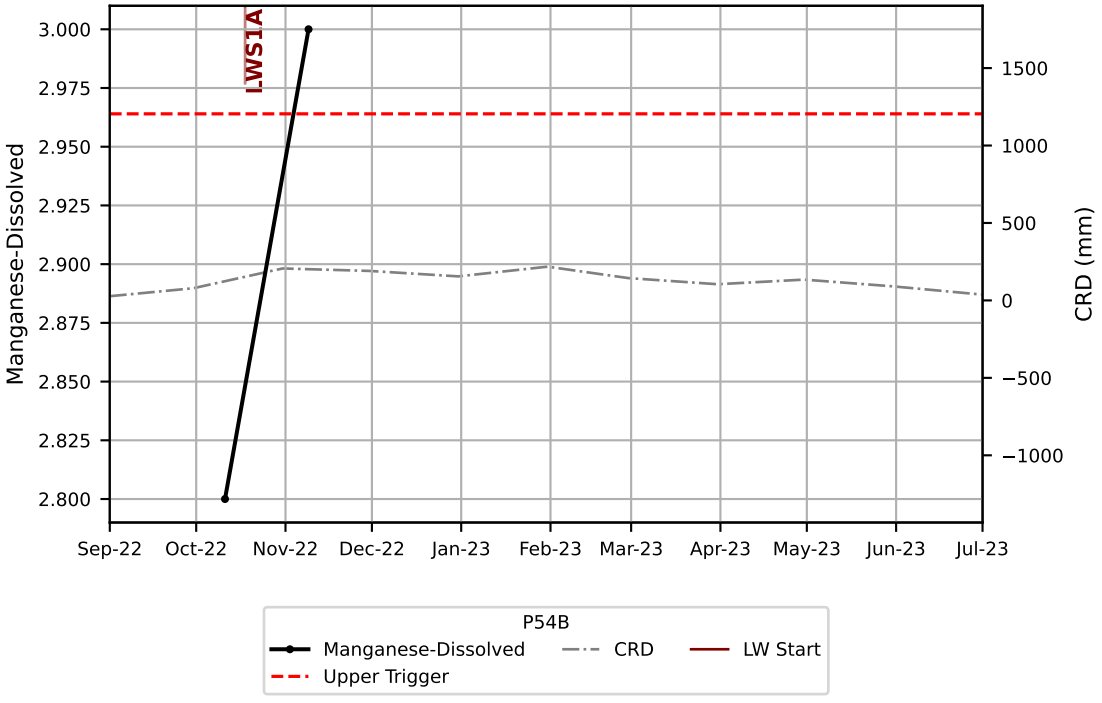

LWS1A
Barium-Dissolved
0.250
0.245
0.240
0.235
0.230
0.225
0.220
0.215
0.210
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Barium-Dissolved
CRD
LW Start
Upper Trigger

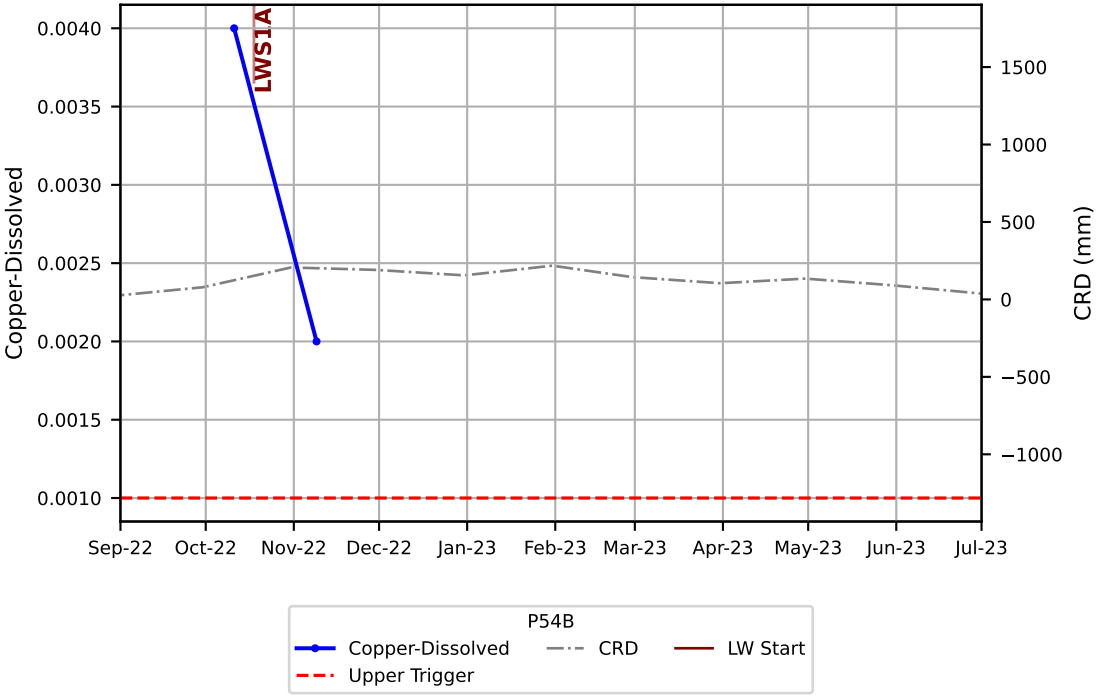

LWS1A
Selenium-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
GW062068
Selenium-Dissolved
CRD
LW Start
Upper Trigger

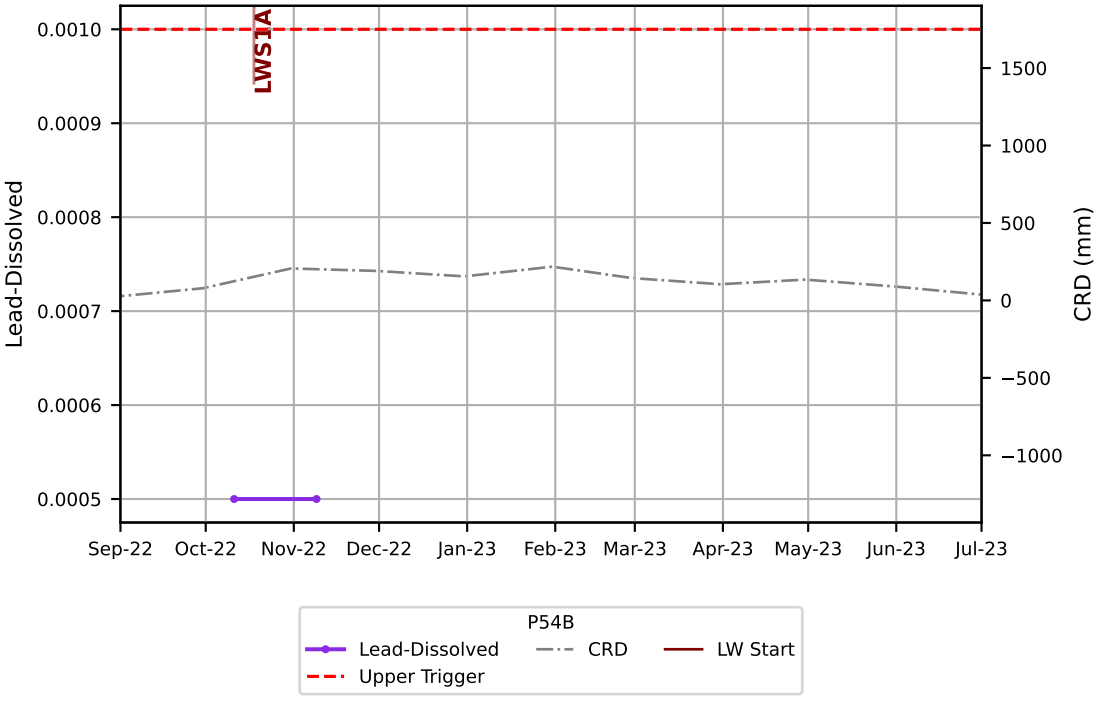

LWS1A
pH (field)
CRD (mm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54A
pH (field)
Upper Trigger
Lower Trigger
CRD
LW Start

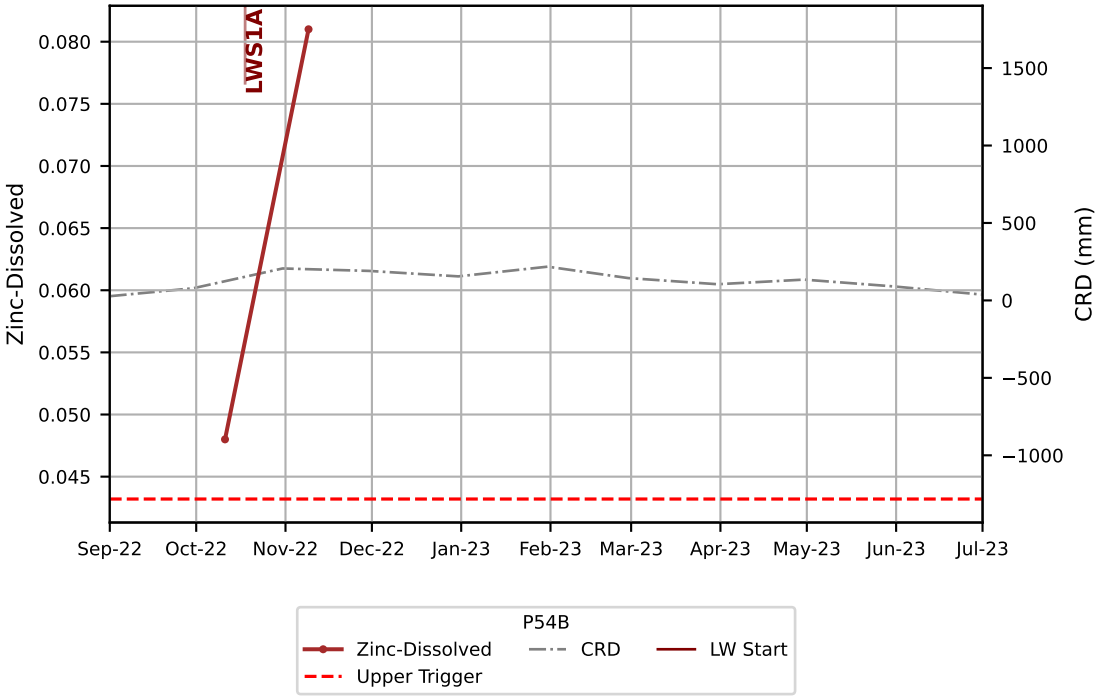

LWS1A
Electrical Conductivity (field)
CRD (mm)
2600
2400
2200
2000
1800
1600
1400
1200
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54A
Electrical Conductivity (field)
CRD
LW Start
Upper Trigger

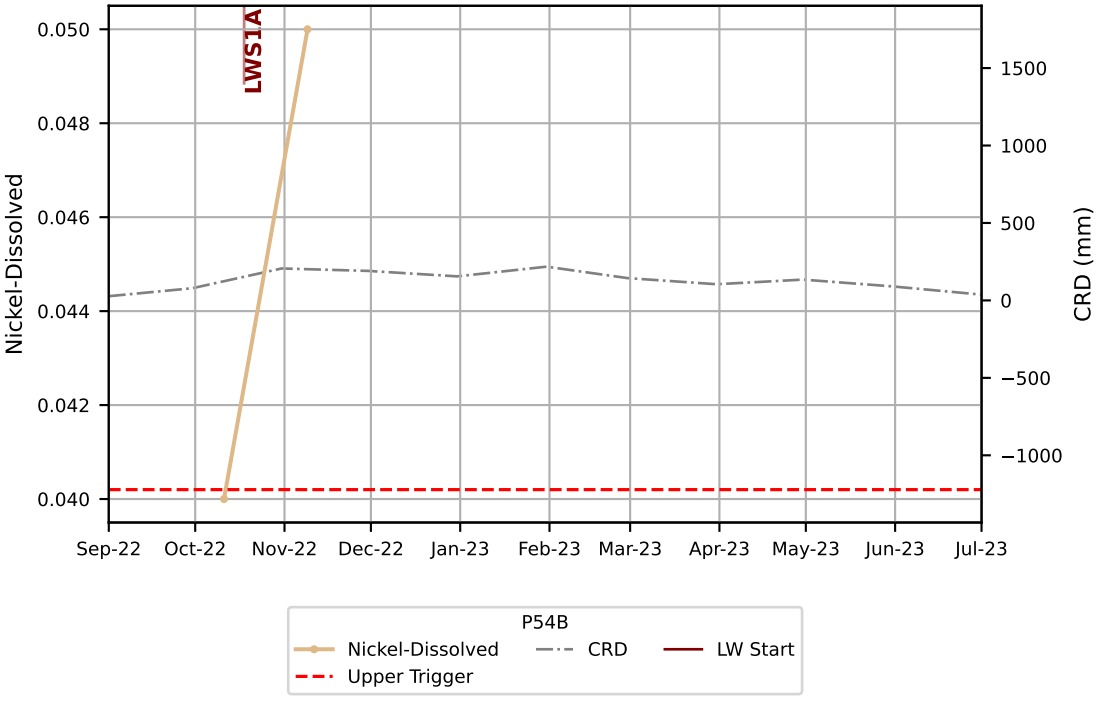

LWS1A
Iron-Dissolved
CRD (mm)
45
40
35
30
25
20
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Iron-Dissolved
CRD
LW Start
Upper Trigger

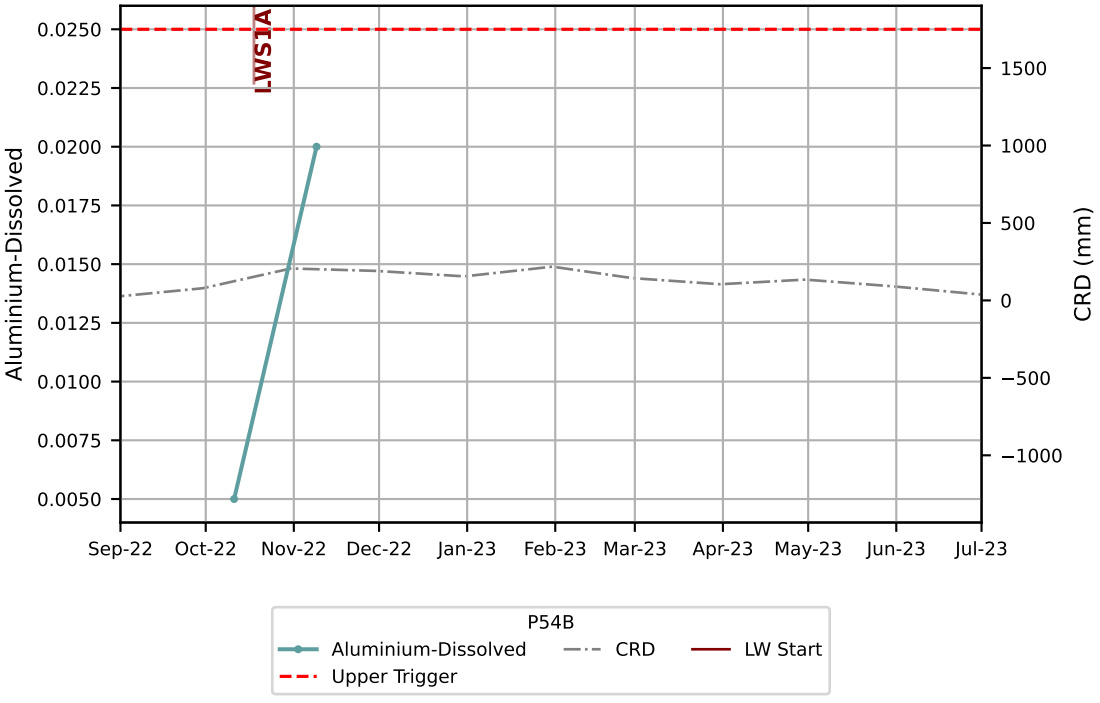

LWS1A
Manganese-Dissolved
3.000
2.975
2.950
2.925
2.900
2.875
2.850
2.825
2.800
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Manganese-Dissolved
CRD
LW Start
Upper Trigger

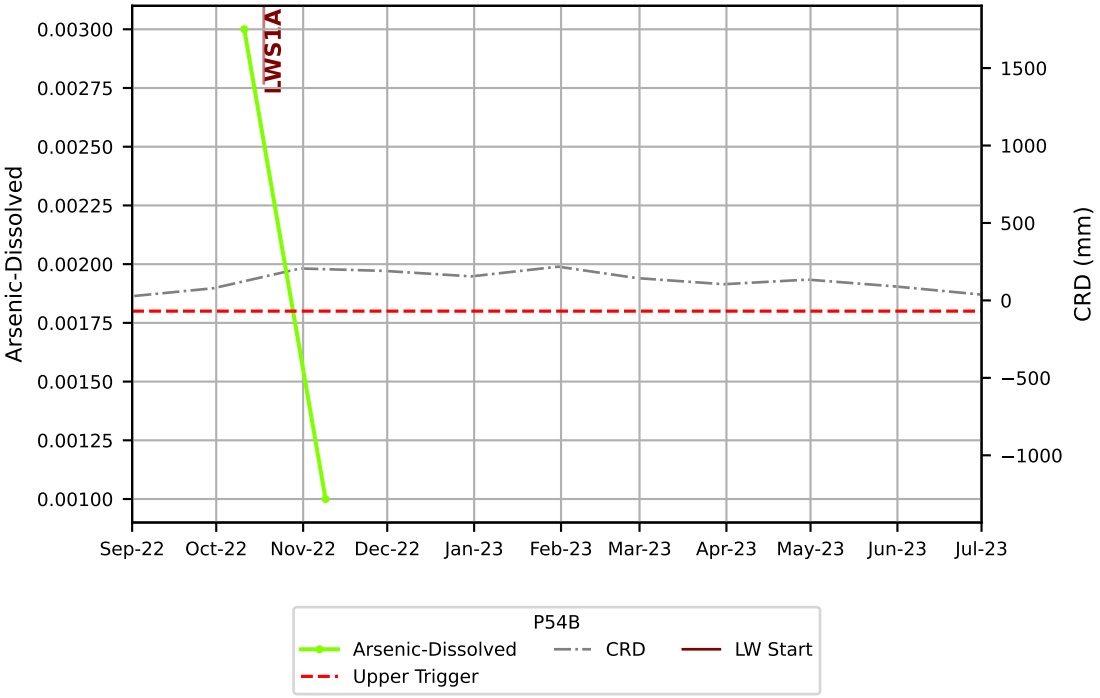

LWS1A
Copper-Dissolved
CRD (mm)
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Copper-Dissolved
CRD
LW Start
Upper Trigger

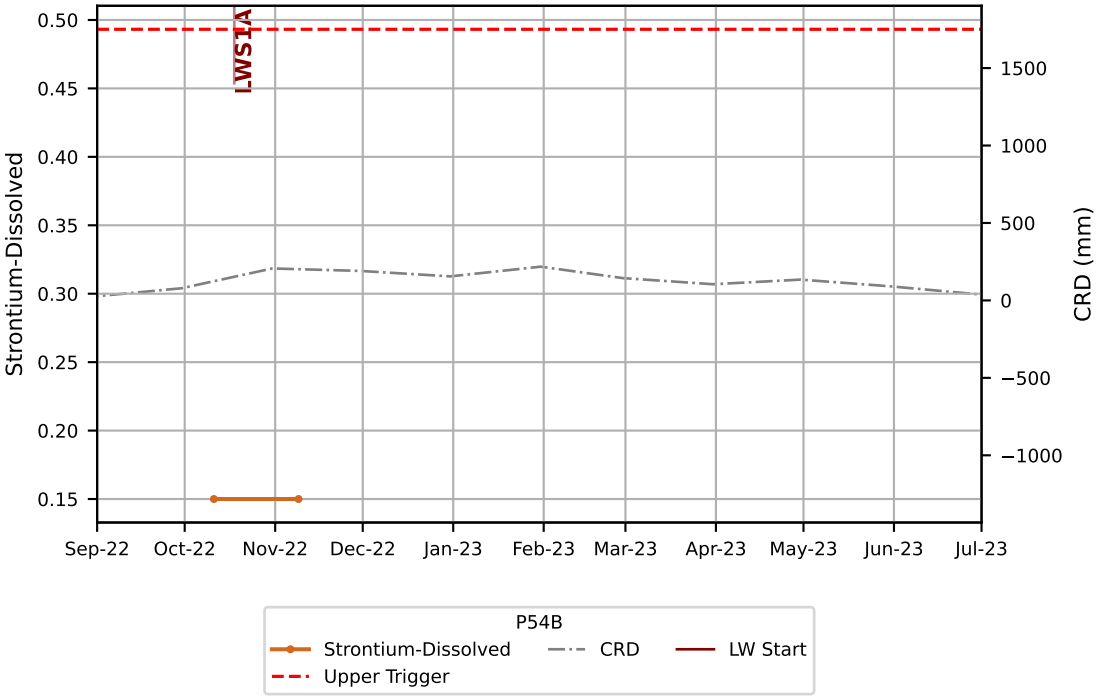

LWS1A
Lead-Dissolved
CRD (mm)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Lead-Dissolved
CRD
LW Start
Upper Trigger

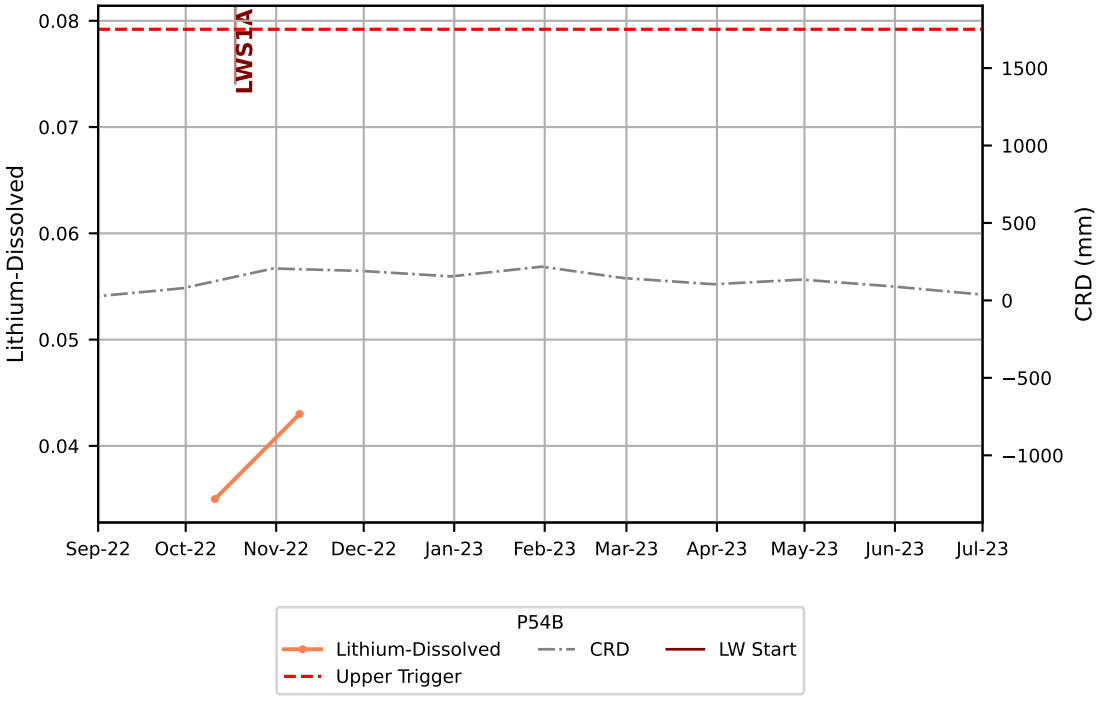

LWS1A
Zinc-Dissolved
CRD (mm)
0.080
0.075
0.070
0.065
0.060
0.055
0.050
0.045
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Zinc-Dissolved
CRD
LW Start
Upper Trigger

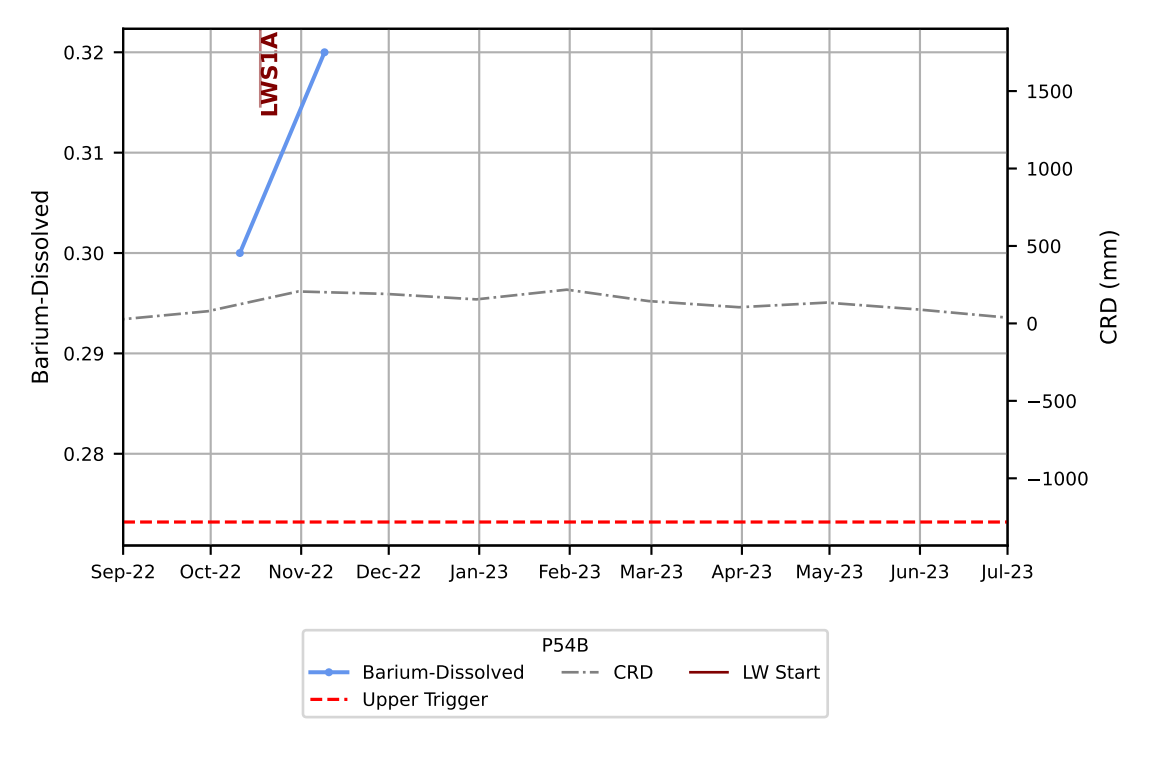

LWS1A
Nickel-Dissolved
CRD (mm)
0.050
0.048
0.046
0.044
0.042
0.040
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Nickel-Dissolved
CRD
LW Start
Upper Trigger

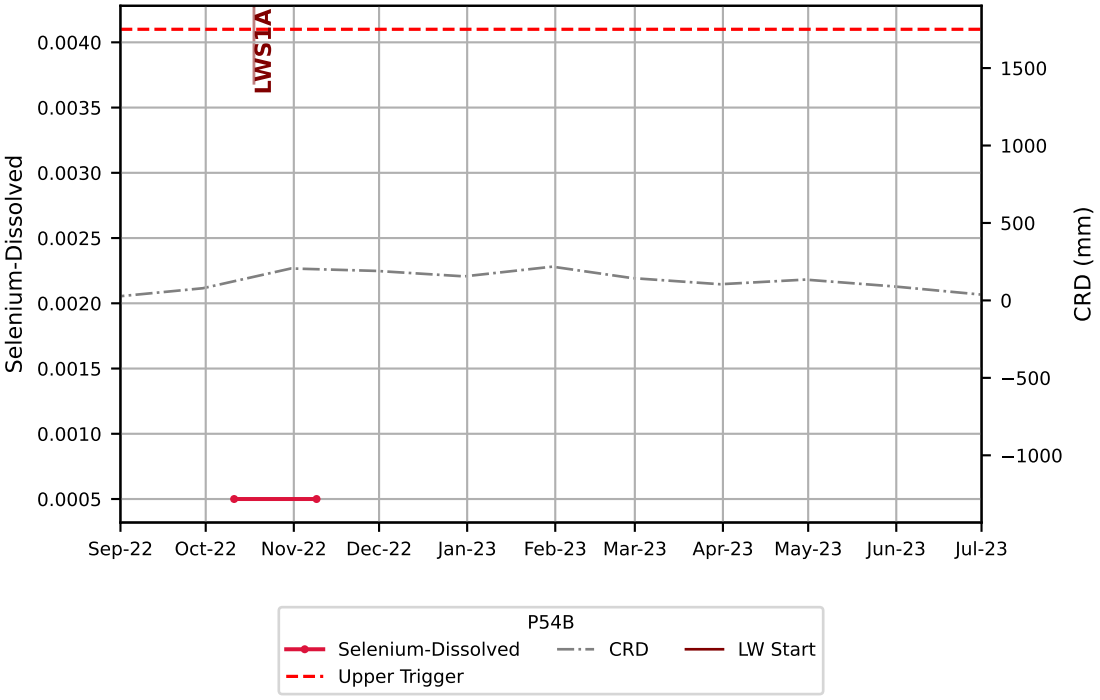

LWS1A
Aluminium-Dissolved
CRD (mm)
0.0250
0.0225
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Aluminium-Dissolved
CRD
LW Start
Upper Trigger

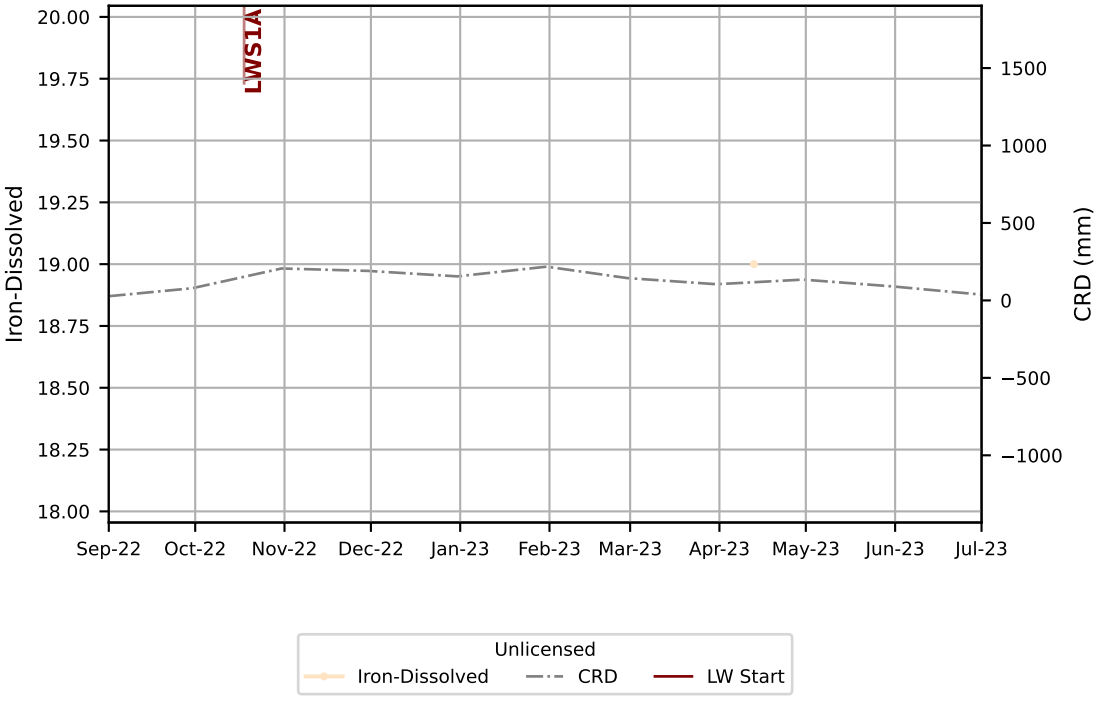

LWS1A
Arsenic-Dissolved
CRD (mm)
0.00300
0.00275
0.00250
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Arsenic-Dissolved
CRD
LW Start
Upper Trigger

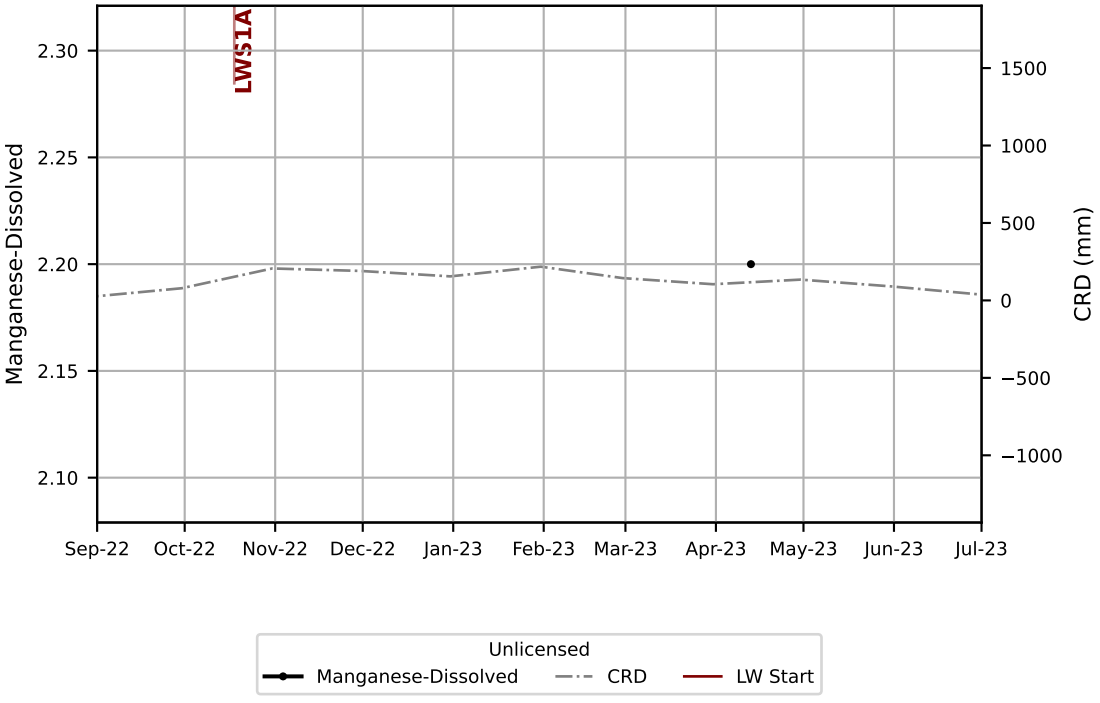

LWS1A
Strontium-Dissolved
CRD (mm)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Strontium-Dissolved
CRD
LW Start
Upper Trigger

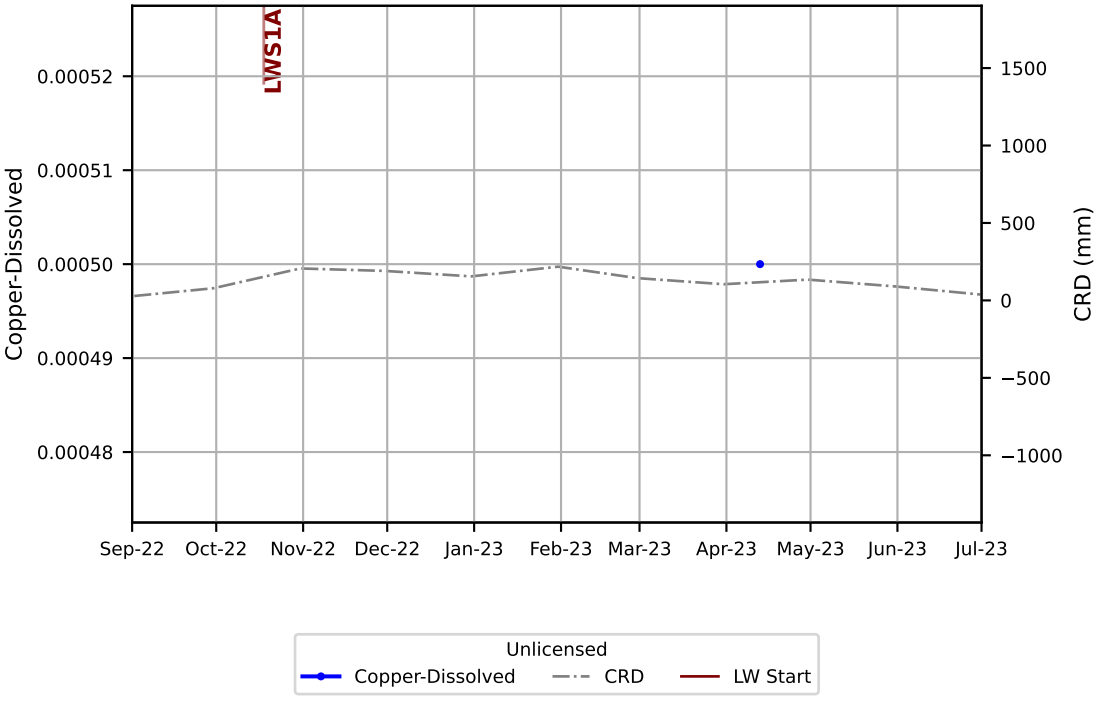

LWS1A
Lithium-Dissolved
CRD (mm)
0.08
0.07
0.06
0.05
0.04
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Lithium-Dissolved
CRD
LW Start
Upper Trigger

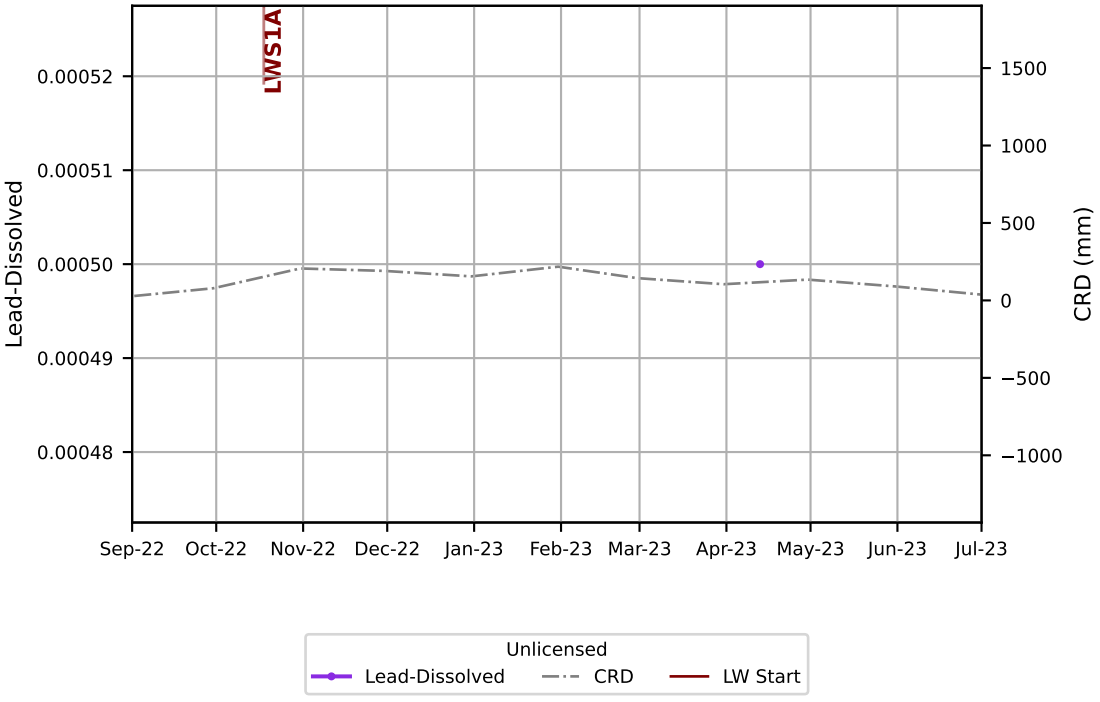

LWS1A
Barium-Dissolved
CRD (mm)
0.32
0.31
0.30
0.29
0.28
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Barium-Dissolved
CRD
LW Start
Upper Trigger

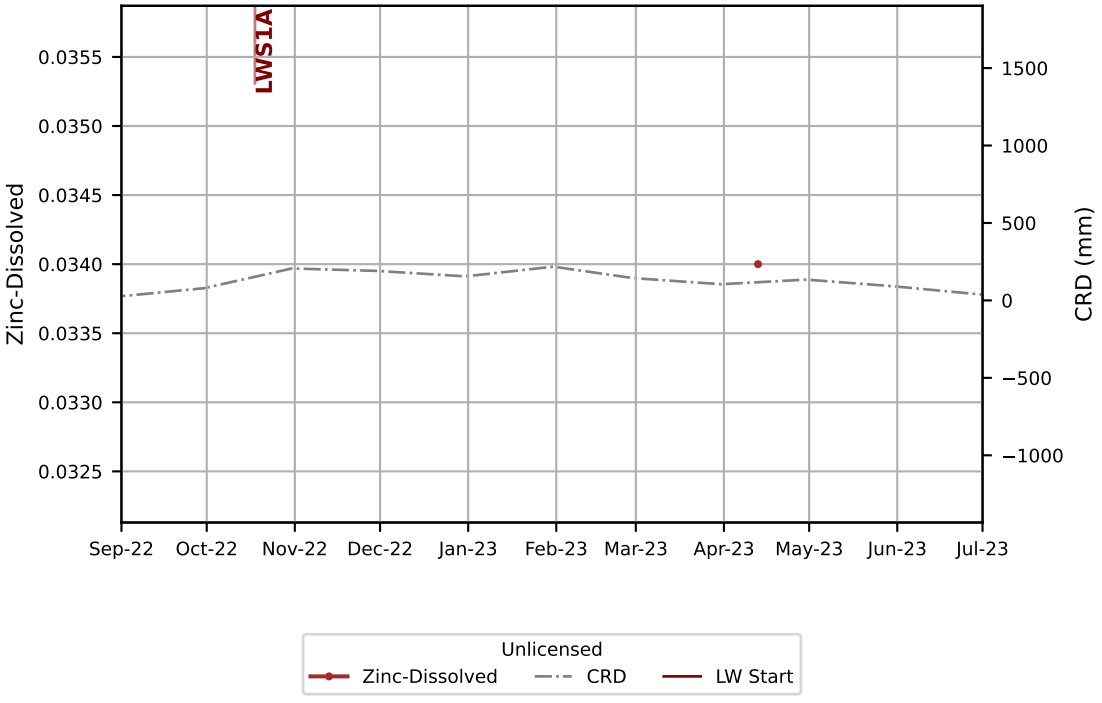

LWS1A
Selenium-Dissolved
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
P54B
Selenium-Dissolved
CRD
LW Start
Upper Trigger

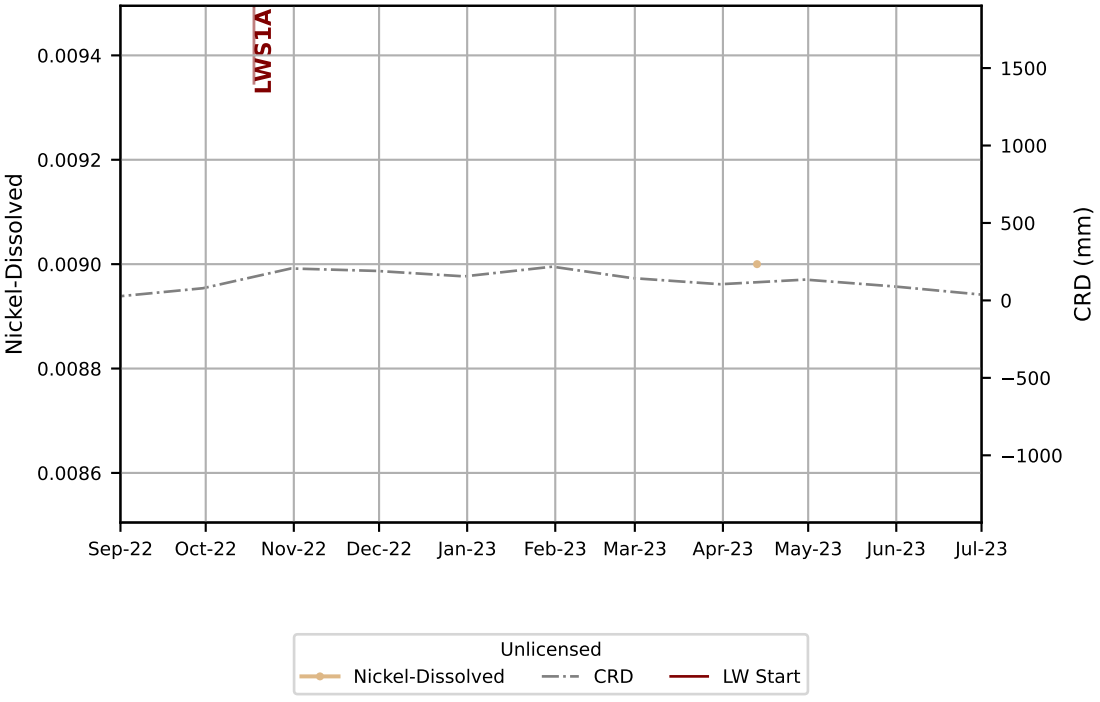

LWSTART
Iron-Dissolved
CRD (mm)
20.00
19.75
19.50
19.25
19.00
18.75
18.50
18.25
18.00
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Iron-Dissolved
CRD
LW Start

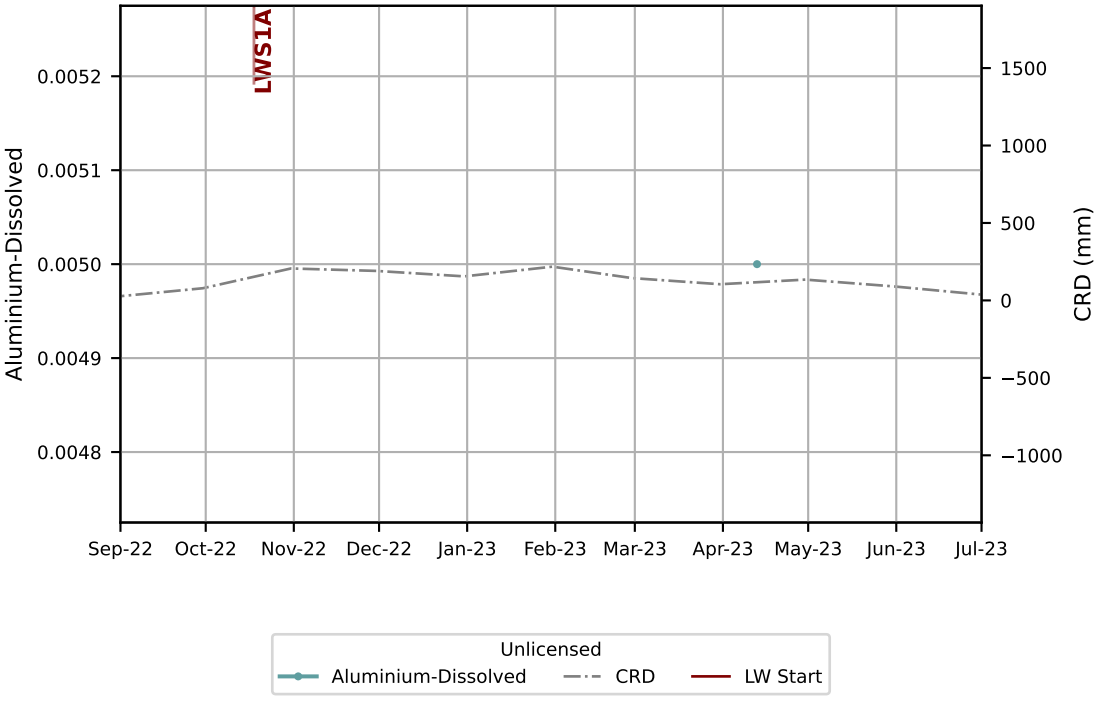

LW S1A
Manganese-Dissolved
2.30
2.25
2.20
2.15
2.10
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Manganese-Dissolved
CRD
LW Start

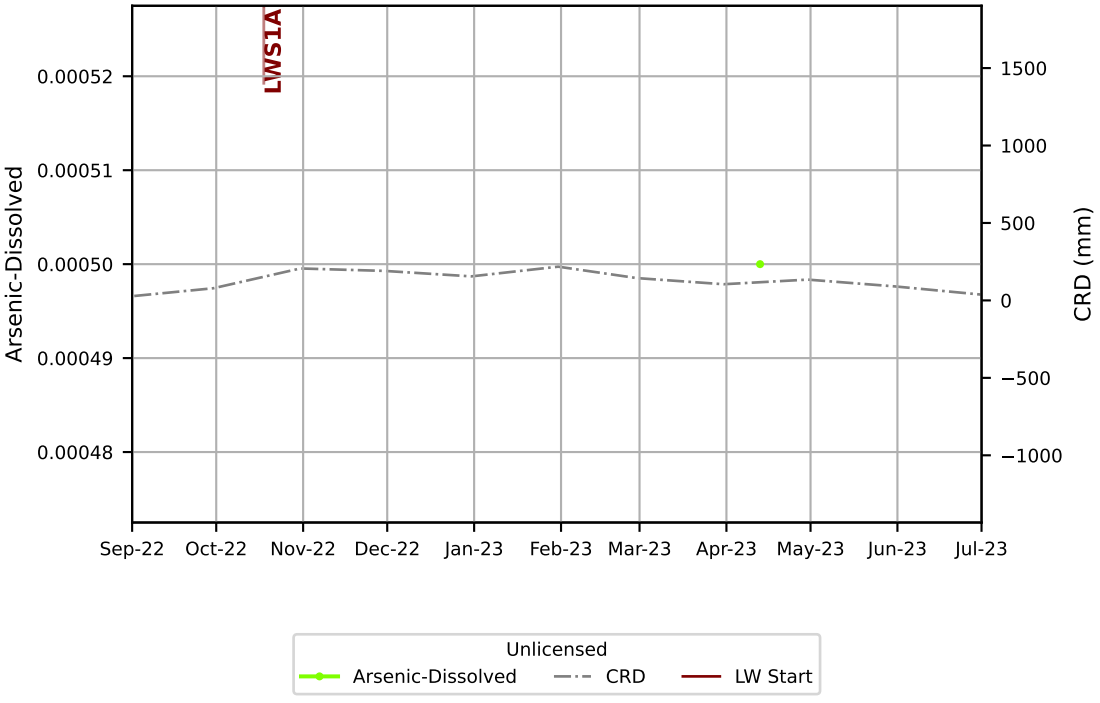

LWS1A
Copper-Dissolved
0.00052
0.00051
0.00050
0.00049
0.00048
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Copper-Dissolved
CRD
LW Start

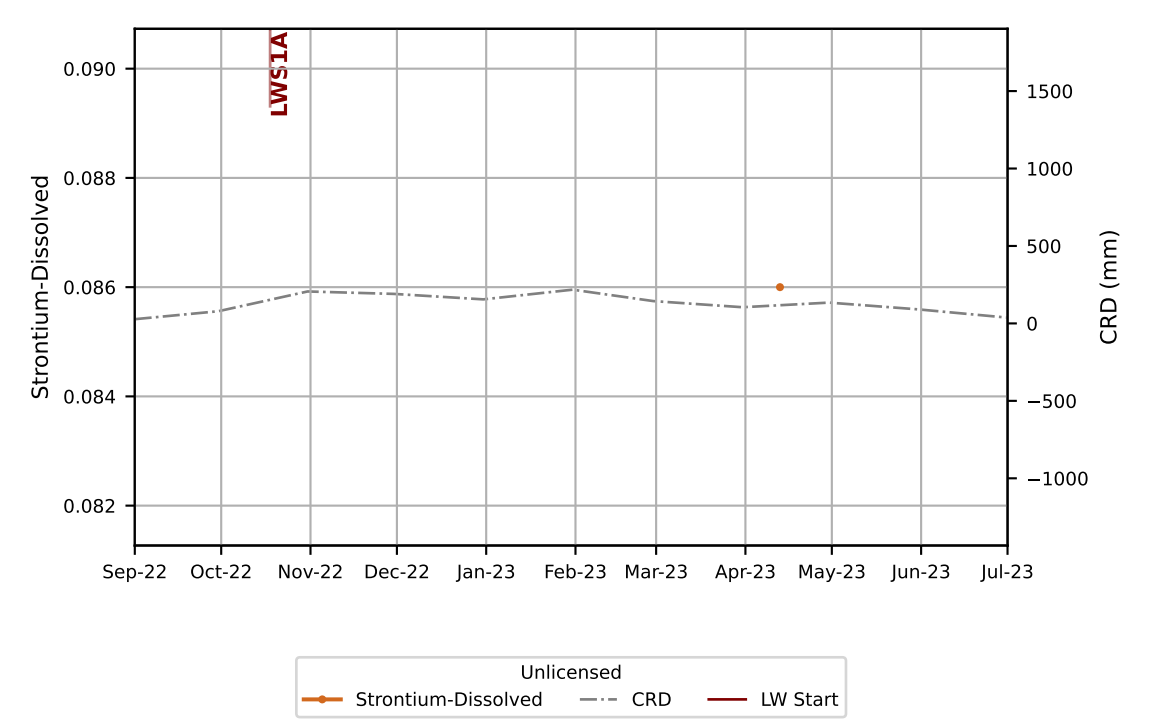

LWS1A
Lead-Dissolved
0.00052
0.00051
0.00050
0.00049
0.00048
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Lead-Dissolved
CRD
LW Start

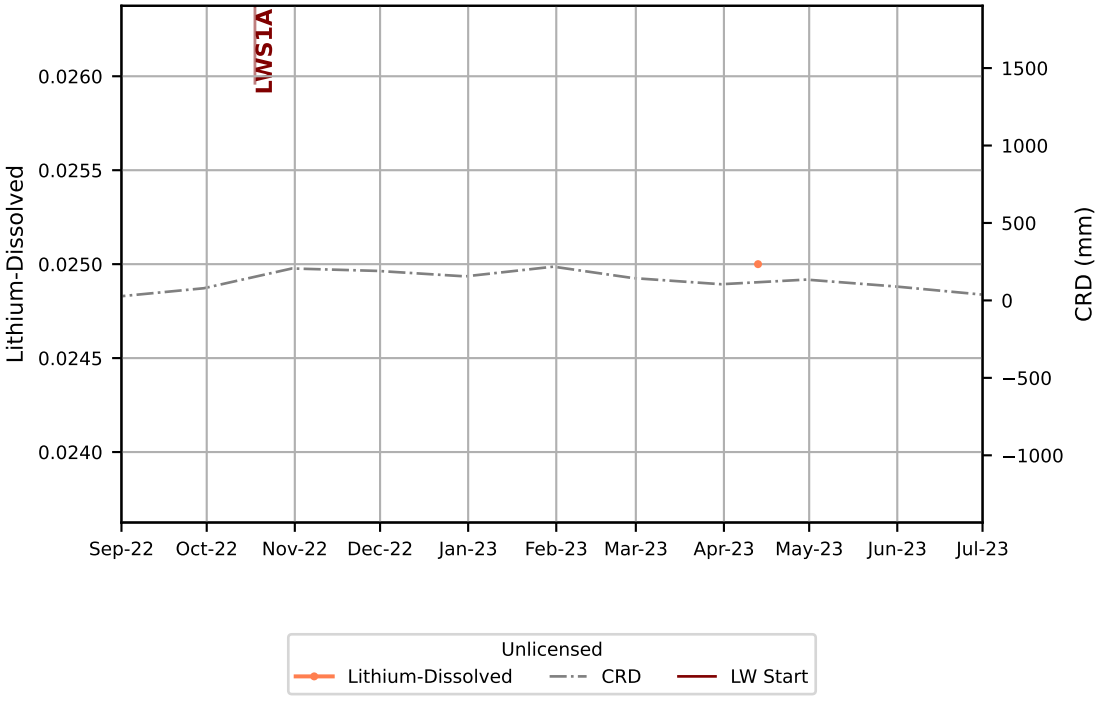

LWS1A
Zinc-Dissolved
0.0355
0.0350
0.0345
0.0340
0.0335
0.0330
0.0325
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Zinc-Dissolved
CRD
LW Start

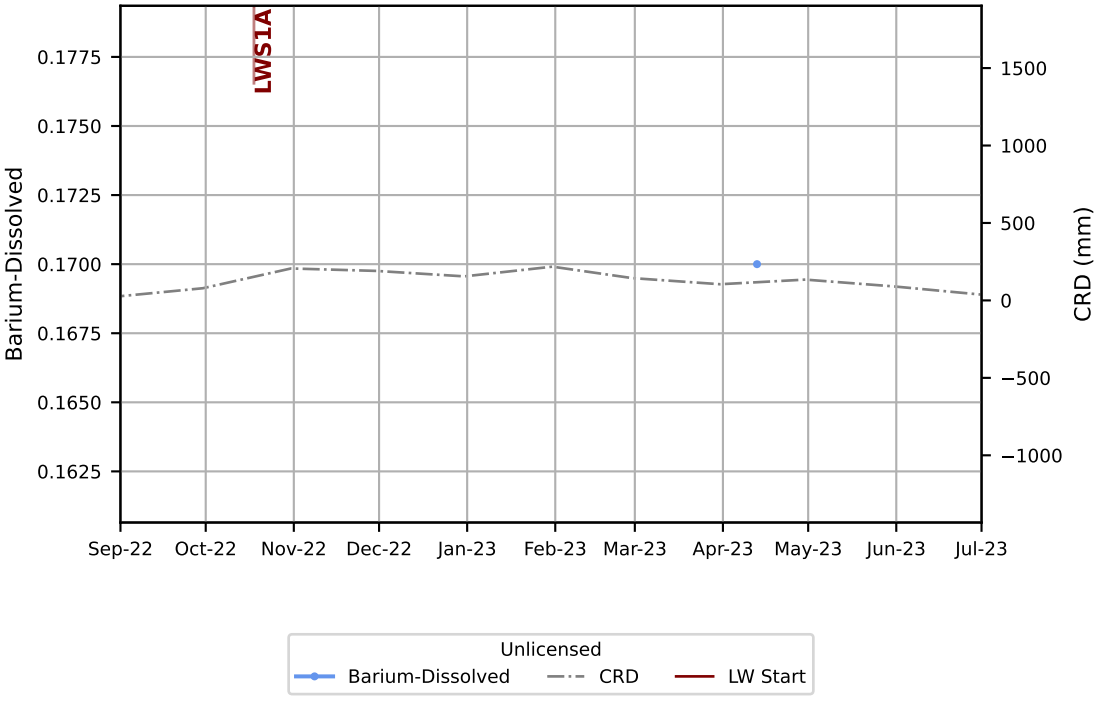

LWS1A
Nickel-Dissolved
0.0094
0.0092
0.0090
0.0088
0.0086
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Nickel-Dissolved
CRD
LW Start

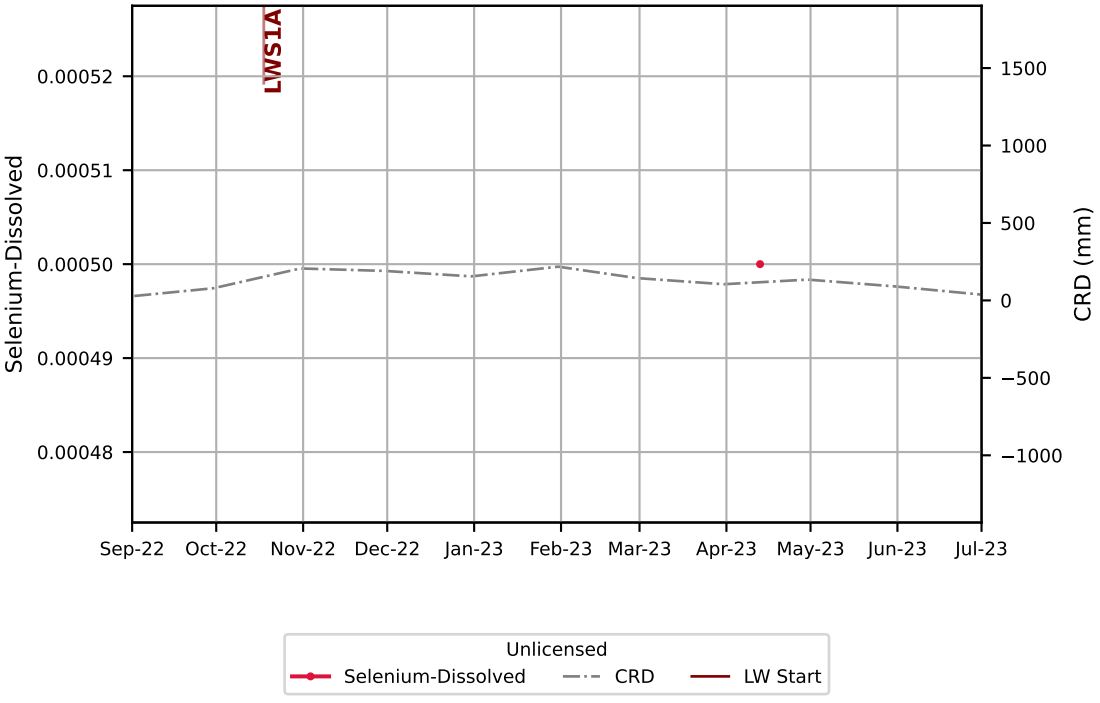

LWS1A
Aluminium-Dissolved
0.0052
0.0051
0.0050
0.0049
0.0048
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Aluminium-Dissolved
CRD
LW Start

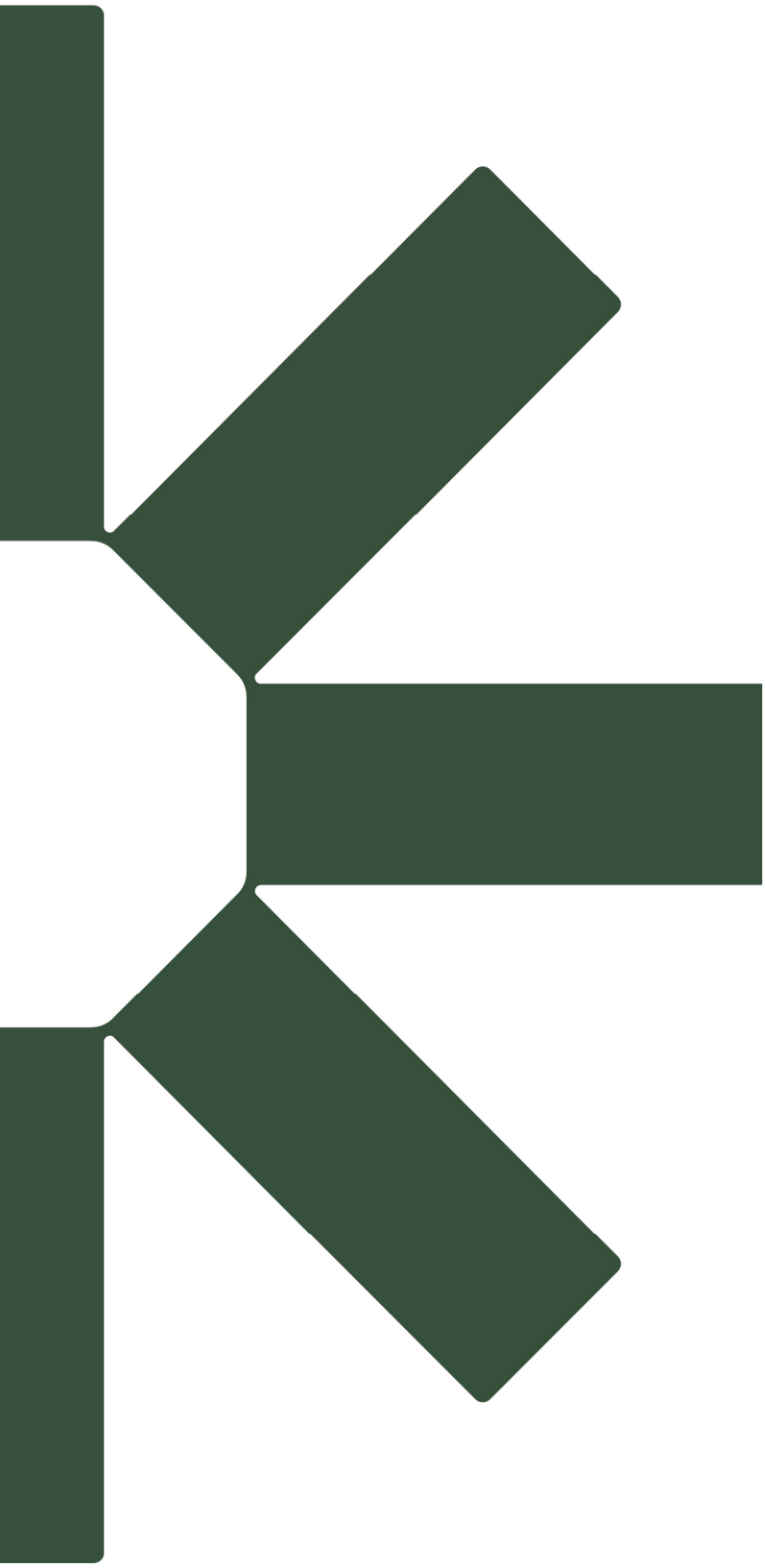

LWS1A
0.00052
0.00051
0.00050
0.00049
0.00048
Arsenic-Dissolved
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Arsenic-Dissolved
CRD
LW Start


LWS1A
Strontium-Dissolved
0.090
0.088
0.086
0.084
0.082
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Strontium-Dissolved
CRD
LW Start


LWS1A
Lithium-Dissolved
0.0260
0.0255
0.0250
0.0245
0.0240
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Lithium-Dissolved
CRD
LW Start


LWS1A
Barium-Dissolved
0.1775
0.1750
0.1725
0.1700
0.1675
0.1650
0.1625
1500
1000
500
0
−500
−1000
CRD (mm)
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Barium-Dissolved
CRD
LW Start


LWS1A
Selenium-Dissolved
0.00052
0.00051
0.00050
0.00049
0.00048
CRD (mm)
1500
1000
500
0
−500
−1000
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Unlicensed
Selenium-Dissolved
CRD
LW Start



Making Sustainability Happen

Appendix E – Heritage Reports

Ground floor 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590
02 9493 9500
www.emmconsulting.com.au

Archaeological Monitoring (July 2023)

27 July 2023

To: April Hudson, SIMEC Mining

From: Dr Alan Williams FRSA FSA FRSN MAACAI MEIANZ

Subject: Teatree Hollow rockshelter 2013.1 (#52-2-4471) - post-longwall monitoring - findings

Dear April,

Background and context

Tahmoor Coal Pty Ltd (Tahmoor Coal) is currently implementing the Tahmoor South Coal Project, near Bargo, which was approved as State Significant Development (SSD-8445) in April 2021. This project includes the southern expansion of underground longwall coal extraction from the existing Tahmoor mine operations, Remembrance Drive, Tahmoor, NSW. Specifically, six longwalls, LWS1A-S6A, are being excavated beneath a relatively unmodified piece of bushland between Remembrance Drive and Charlies Point Road, and within which flows Teatree Hollow Creek. An Extraction Plan for these six longwalls was approved in September 2022.

As part of the Extraction Plan, an heritage management plan (HMP) was developed that provided direction on the management of Aboriginal cultural materials that may interact with the proposed development activities (EMM, 2022). One of the requirements was the ongoing monitoring of a documented rockshelter, Teatree Hollow 2013.1 (AHIMS #52-2-4471), situated on the eastern bank of Teatree Hollow Creek, during the development activities. This site was proactively investigated in advance of the longwall in the event of unexpected impacts, and these activities are reported on in EMM (2023).

This letter provides observations of the rockshelter that was visited following the completion of LWS1A in July 2023 to identify whether the subsidence impacts had occurred.

Results and findings

A site inspection was undertaken by Alan Williams (EMM) and Kirsty Chalker (Cubbitch Barta Native Title Claimants Aboriginal Corporation) on 10 July 2023.[1]

Overall, the rockshelter appeared in a similar condition to when previously visited by these personnel as part of archaeological excavations in November 2022 (Plates 1-5). The site inspection did not identify any observable impacts such as cracks, exfoliation, or collapse, as a result of subsidence or other activities. Further, the floor of the rockshelter showed no evidence of recent rockfall or other moved material that may suggest collapse or movement has occurred.

[1] Tharawal LALC was also invited to participate, but due to existing commitments did not attend the site inspection.

A small patch of the rear wall at the southern end of the site appear to exhibit signs of fresh abrasion (Plate 5), but which may have been the result of animal activity or changing climatic conditions. There is no evidence that this relates to mining activities, nor does it require any form of remediation.

Teatree Hollow Creek that was full at the time of the previous excavations was empty at the time of site inspection (Plates 3 and 4). While not part of the rockshelter site itself, this was noted, since the proximity of the site to the creek provides both a probable reason for its original use in the past, and contributes to its aesthetic significance. SIMEC Mining is currently investigating the changes in creek flow in relation to mining and climatic conditions – the creek being ephemeral and having been subject of several dry months – but is managing this change through Trigger Action Response Plan (TARP) triggers for low flow within the approved LWS1A-S6A Water Management Plan.

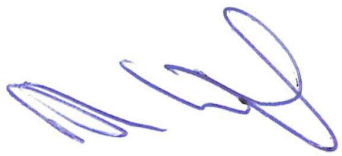
Conclusions and next steps

The site inspection identified no direct subsidence impacts to the site. The drying out of Teatree Hollow Creek has resulted in some indirect impacts to the site's value. Based on this, the following recommendations are proposed:

- Based on the site inspection, no corrective or remedial actions are required for the Teatree Hollow 2013.1 (AHIMS #52-2-4471) following the completion of LWS1A.
- In relation to the water flow regime changes at Teatree Hollow Creek, any corrective actions should be undertaken in accordance with approved Water Management Plan, and consider the association and importance of the creek to Teatree Hollow 2013.1 (AHIMS #52-2-4471). As part of the consultative process for any corrective actions, a copy of plans and proposed actions will be provided to the registered Aboriginal parties for comment prior to finalisation.
- In accordance with the HMP, a further site monitoring inspection of the rockshelter should be undertaken at the completion of LWS2A.

If you have any questions or comments, please contact me on 0438 104 740.

Yours sincerely



Dr Alan Williams FRSA FSA FRSN MAACAI MEIANZ
Technical Lead, Aboriginal Heritage
awilliams@emmconsulting.com.au

References

EMM (2022) Heritage Management Plan – Tahmoor South Domain – Longwalls South 1A – South 6A. *Unpublished report to Tahmoor Coal Pty Limited.*

EMM (2023) Teatree Hollow rockshelter (#52-2-4471) - archaeological excavations - completion of excavations and results. Unpublished report to SIMEC Mining Pty Limited.

This information has been retracted
- For more information contact Tahmoor Coal

SIMEC
Level 28, 88 Phillip Street,
Sydney NSW 2000
Legal entity name goes here ABN: 00 000 000 000

T: +61 (0) 2 0000 0000
E: xxxxxxx.xxxxxxx@simecgfg.com
simec.com

Ground floor 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590
02 9493 9500
www.emmconsulting.com.au

10 October 2023

April Hudson
Approvals Specialist
SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574

Re: Tahmoor South 6C tunnel crack - potential heritage impact

Dear April,

On 29 May 2023, during extraction of LW S1A, two cracks were observed by the structural engineer at the Tahmoor Mine site within the 6C tunnel and vent shaft interface (Plate 4.1 – Plate 4.2). The site continued to be monitored with weekly inspections and on 6 June, four additional cracks were observed (Plate 4.3 - Plate 4.5). An additional crack was detected on 27 June 2023 (Plate 4.6). The site continues to be monitored with weekly inspections.

As the Tahmoor Mine site (Tahmoor Colliery) has been identified as a heritage site as part of the *Heritage Management Plan – Tahmoor South Domain – Longwalls South 1A -South 6A* (2022), impacts to this item must be managed under the Heritage Management Plan Trigger Action Response Plan (TARP).

According to the TARP, this impact is deemed to be a Level 1 trigger:

> Historical heritage site monitoring indicates potential detectable environmental consequences with negligible impacts to the heritage value of the heritage site.

This trigger requires that a qualified archaeologist or heritage architect be consulted in order to determine whether impacts to heritage sites have occurred. This letter responds to this requirement. The desktop assessment has been undertaken by Pamela Chauvel (BA, MA (Research)) who is a qualified archaeologist.

1 Background

Tahmoor Mine Site (also known as Tahmoor Colliery) was identified in the *Macarthur Heritage Study* (1986) and in the *Historical Heritage Assessment: Tahmoor South Project* (HHA) (Niche 2018). However it is not listed on any local or State heritage registers (non-statutory). The HHA assessed the site, which was built in 1972, as having local significance for its role in illustrating the course and pattern of industrial development in Tahmoor.

Subsidence predictions for the existing and proposed longwalls (LW) S1A–S6A prepared by MSEC (2022), assessed the probability of impact from subsidence as 'possible'. The coal conveyor and associated plant and

equipment at Tahmoor Mine site was predicted to subside approximately 1,000 mm over the life of the A series of LW panels at Tahmoor South. Impacts were anticipated to be low and easily managed with careful monitoring. Table 20 in the *LW S1A – S6A Extraction Plan: Heritage Management Plan* (EMM 2022) sets out the subsidence performance indicators:

Site name	Site type	Subsidence Performance Measures	Probability of subsidence impact	Subsidence Performance Indicators
Tahmoor Colliery (Tahmoor Mine Site)	Complex / group	No greater subsidence impacts or loss of heritage values than predicted in the EIS (see HMP Section 4.2.7)	*Possible*	This performance indicator will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items. This performance measure and performance indicator have been incorporated into TARP HMP2 (Historical heritage items).

2 Heritage assessment

It is considered that the hairline cracks (<1 mm) in the concrete within tunnel 6C are minor and, if required, could be repaired in a manner that preserves the heritage value of the mine. The Tahmoor Mine Site is a working site and minor impacts such as hairline cracks are unlikely to affect its heritage values. As the heritage values of the item is not expected to be significantly impacted, this therefore is not considered to be a reportable trigger exceedance under the TARP.

Table 2.1 provides a summary of the seven cracks that have been observed within tunnel 6C.

Table 2.1 Cracks observed within tunnel 6C

Crack ID	Date observed	Dimensions/ notes
Crack A / C1	29/5/2023	<1mm width, increased very marginally on 13/6/2023
Crack B / C2	29/5/2023	<1mm width
Crack C3	6/6/2023	Approaching 1 mm width
Crack C4	6/6/2023	<1mm width
Crack C5	6/6/2023	<1mm width
Crack C6	6/6/2023	<1mm width
Crack C7	27/6/2023	<1mm width

3 Recommendations

1. The site should continue to be monitored and the data reviewed as per the Tahmoor Mine Site Management Plan.

2. At the conclusion of mining of LW S1A – S6A, the cracks within Tunnel 6C should be assessed by a suitably qualified heritage advisor to determine whether remediation is required.

3. If it is determined that remediation of the tunnel is required and/or the impact cannot be repaired at the conclusion of mining of LW S1A – S6A to a level that preserves the heritage values of the site, the TARP requires that the trigger exceedance be reported to DPE and Heritage NSW.

4. The TARP requires that trigger exceedance and investigation outcomes (this letter) be included in the six-monthly Subsidence Impact Report and Annual Review.

4 Closing

If you have any questions, please do not hesitate to contact me.

Yours sincerely

Pamela Chauvel
Senior Archaeologist
pchauvel@emmconsulting.com.au

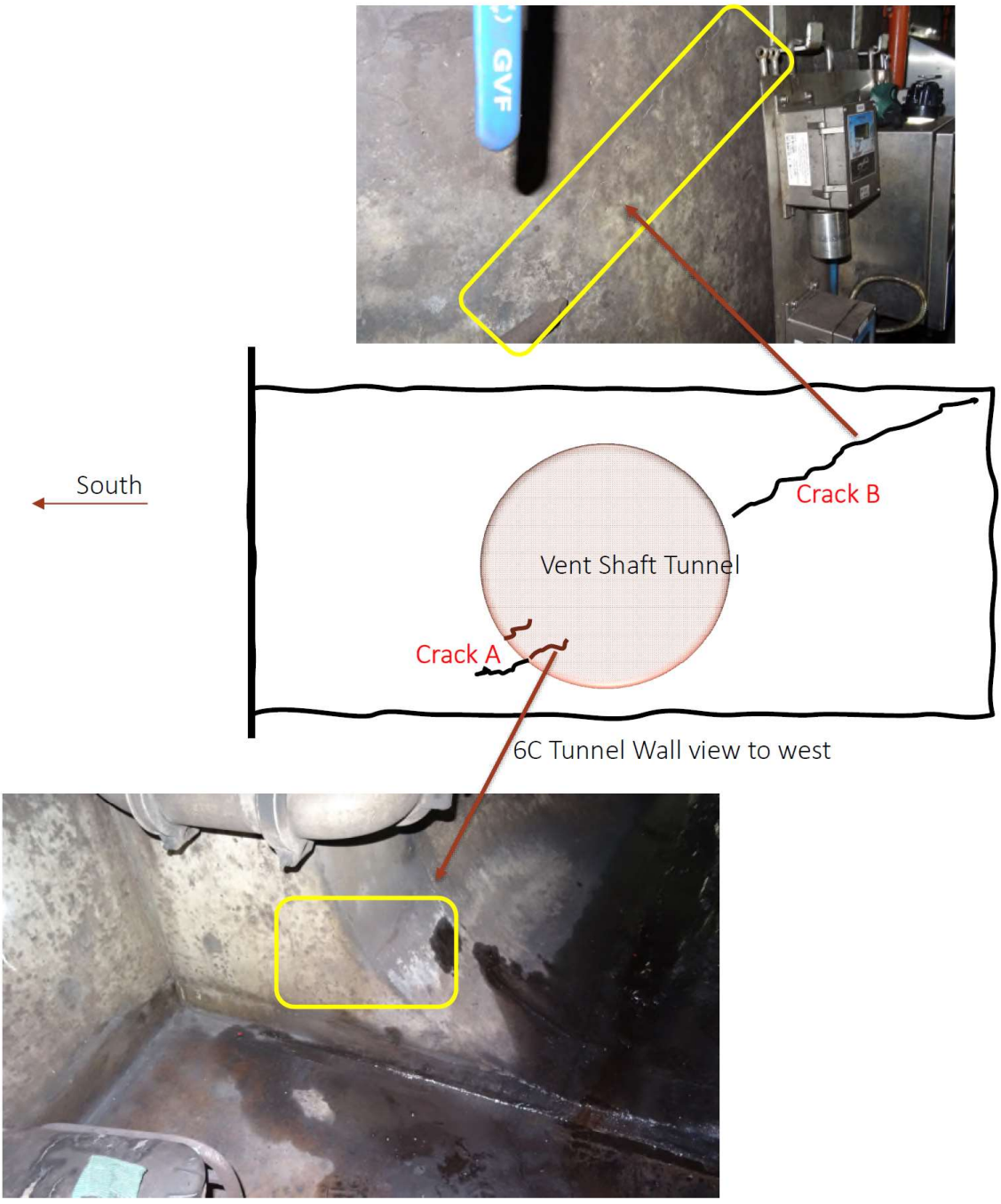


Plate 4.1 **Location of cracks A(C1) and B (C2) within Tunnel 6C (David Talbert 29 May 2023).**

Plate 4.2 Crack B (C2), width <1 mm (David Talbert 29 May 2023).

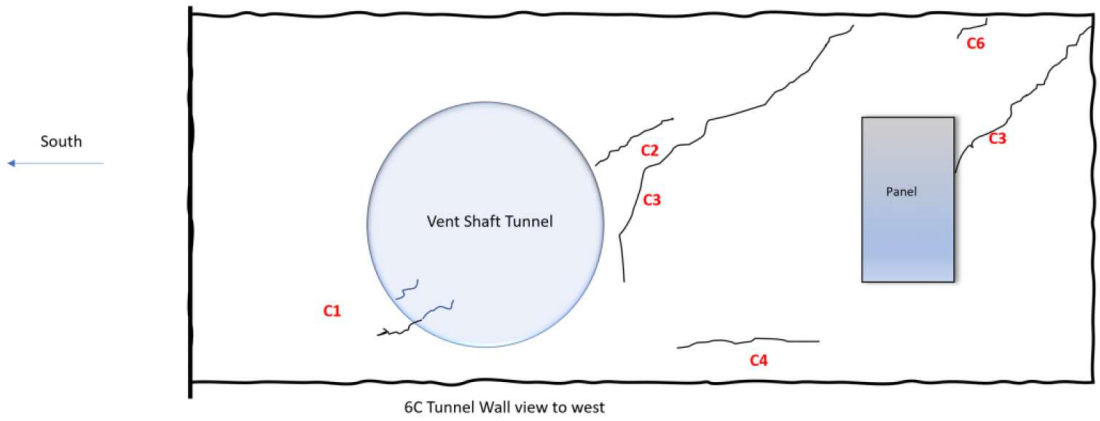
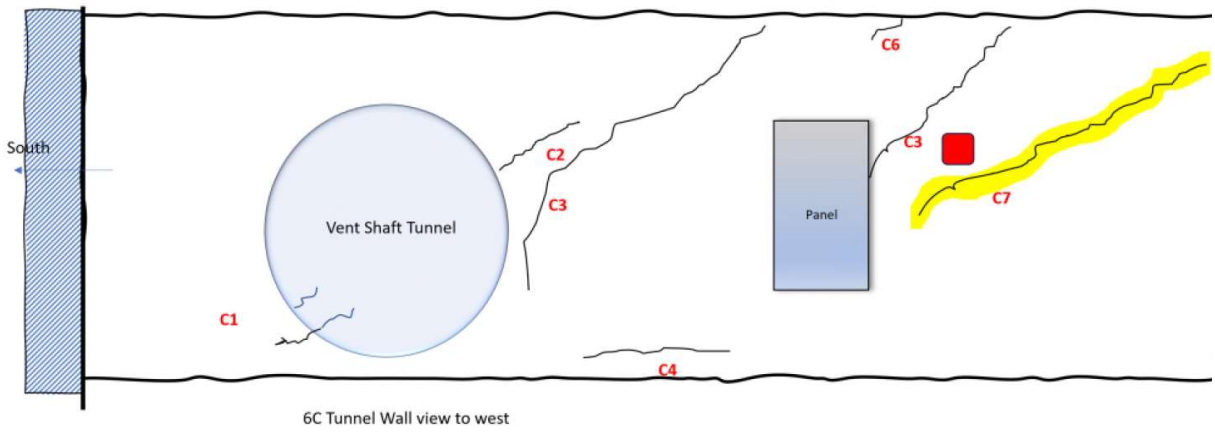


Plate 4.3 **Context for the location of cracks C1, C2 and C3 (David Talbert, 6 June 2023).**

Plate 4.4 Crack C4 (David Talbert, 6 June 2023).

Plate 4.5 Crack C5 (David Talbert, 6 June 2023).



6C Tunnel Wall view to west

Plate 4.6 Location of C7 (David Talbert, 27 June 2023)

Appendix F – Main Southern Rail Monitoring Reports

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 12
During the mining of LW S1A beneath the Main Southern Railway

Reporting Period	12 April 2023 to 18 April 2023	
Length of extraction of LW S1A	1372 m	as at 18 April (LW commenced 18 October 22)
Closest distance of LW S1A face to Railway	57 m	to 98.58 km (LW moving away)
Distance travelled by LW since previous report	85 m	since 11 April 2023
Maximum incremental subsidence along Railway due to LW S1A	361 mm	at 98.80 km on 17 April 2023
Maximum increase in subsidence since previous survey	127 mm	at 98.78 km (11 April to 17 April)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 20 March. Very minor vertical subsidence at this early stage. Minor horizontal movements towards the approaching LW face.
2D ground survey	17 Apr	Weekly	N/A	Subsidence developing above the longwall. Rates of change are increasing. Minor compressive strain developing above the longwall up to 1.5 mm/m between 98.780 km and 98.800 km where maximum subsidence is observed. Compressive strain of 0.9 mm/m and minor bump in subsidence profile 98.740 km to 98.760 km at creek crossing.
Rail creep surveys	17 Apr	Weekly	N/A	Small changes observed.
Long bay length survey	17 Apr	Weekly	N/A	Ground shortening increasing AP2 to ES3. Ground extension increasing ES2 to AP2.
Rail stress	Every 5 mins			Changes in stresses within expectations. Some gauges require some maintenance.
Switch displacements	Every 5 mins			As recommended, adjustments have been completed at ES3-S on the Down Main, both rails.
Track geometry survey	15 and 20 Apr	Weekly		Increasing 14m twist, which exceeds Blue trigger level on both track at 98.8 km. Focussed inspection and additional track geometry survey on 20 Apr. Poor track noted from visual inspections. RMG met on 21 Apr. It was agreed to conduct local resurfacing on 22 Apr and continue with twice weekly trolley surveys in the affected area.
Track centre measurements	17 Apr	Monthly	-	Minor changes observed.
Inspections by Track Certifier	21 Apr	Daily		Poor track noted 98.8 km on 20 Apr at location of maximum observed subsidence. No visible change on 21 Apr and temporary speed restriction is not required at this stage. Local resurfacing planned on 22 Apr. Focussed inspections will continue.
Early warning monitoring				
GNSS monitoring S1 to S15	Continuous		N/A	Rates of change reducing to very low levels.
V-Line along Tahmoor Mine property boundary	12 Apr	Monthly	N/A	Subsidence developing up to 769 mm and valley closure observed across Tributary to Teatree Hollow. Minor changes since previous survey. Survey extent reduced at the eastern end as the longwall has moved away.
Embankment and Culvert at 98.445 km, including Tahmoor Mine Site embankment upstream				
Absolute 3D survey	17 Apr	Weekly	N/A	Very minor changes observed.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Visual inspection	20 Apr	Weekly	N/A	No issues observed. Partial blockage where 0.9 m dia pipe constricts to a 0.6 m dia pipe. It is recommended that the blockage be periodically removed. CCTV inspection on 22 March showed no changes in culvert condition. No issues observed to Tahmoor Mine Site dam embankment. Completion of track baulk installation planned 22 April.
Embankment and Culvert at 98.739 km				
Absolute 3D / relative 3D survey	17 Apr	Abs. Mthly Rel. Weekly	N/A	Subsidence increasing. Small closure across the crest. Compressive strain of 0.8 mm/m 98.740 km to 98.760 km on Up side and 0.4 mm/m on Down side.
Visual inspection	20 Apr	Weekly	N/A	No changes observed.
Embankment and Culvert at 99.035 km				
Absolute 3D / relative 3D survey	17 Apr	Abs. Mthly Rel. Weekly	N/A	Minor subsidence beginning to develop. Very minor closure observed across the culvert.
Visual inspection	20 Apr	Weekly	N/A	No changes observed. Work has been completed to seal gap between brick arch culvert headwall and concrete pipe extension and repair sinkhole.
Embankment and Culvert at 99.338 km				
Absolute 3D / relative 3D survey	17 Apr	Abs. Mthly Rel. Weekly	N/A	Minor changes observed. Minor opening on the Up side 99.30 km to 99.32 km.
Extensometers	Every 15 minutes		N/A	Very minor changes observed.
Inclinometer	18 Apr	Weekly	N/A	Very minor changes observed.
Piezometer	Every 15 minutes		N/A	No water flow through the culvert this week.
Visual inspection	20 Apr	Weekly	N/A	No changes observed.
Cuttings				
Visual inspection	20 Apr	Weekly	N/A	No issues observed. Minor ponding water observed in cess drains.
Coal Conveyor at 98.160 km				
Survey across Railway	17 Apr	Weekly		Measured changes within survey tolerance.
Laser distancemeter	Hourly			Minor changes observed.
Visual inspection	20 Apr	Weekly	N/A	No issues reported.
Bargo River Railway Viaduct at 96.256 km and Remembrance Drive Bridge over Bargo River at 96.385 km				
GNSS units S11 and S12	Continuous		N/A	No measurable movements or change between GNSS units.
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance.
Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance. Some prisms at base of Viaduct that could not be surveyed last month due to water on prisms have been relocated and normalised.
Precision 2D ground survey between ends of Viaduct and Bridge (valley closure)	-	Monthly		Last survey 5 April. Results within survey tolerance.
Gap between deck and northern abutment of Bridge	-	Monthly		Last survey 5 April. Gap measured to close by approximately 9 mm since July in response to increased ambient temperature. More than 100 mm capacity available.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Bargo River Road Overbridge at 96.049 km (Potter's Cutting)				
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance.
Local 3D survey of structure	-	Monthly		Last survey 5 April. Results within survey tolerance.
Crack gauges	4 Apr	Monthly		No changes observed.
Wellers Road Overbridge at 101.162 km				
GNSS unit S15	Continuous		N/A	Very minor movement observed to the north and west.
Local 3D survey of structure	-	-		Last survey 2 March. Very minor movement observed to the north, as per the GNSS unit survey. No measurable change across the bridge span. Next survey planned at end of LW S1A.
Crack gauges	-	-		Measurement planned at end of LW S1A.
Management Actions				
Other management actions since previous report: ● ES3-S on the Down Main, requested that 65 mm of steel be removed from both rails - completed ● Repair of culvert extension at 99.035km completed ● Twice weekly focussed track geometry surveys and inspections in vicinity of 98.8 km				
Any additional and/or outstanding management actions: ● Installation of track baulk at 98.445 km, deferred due to priority resurfacing works at 98.8 km on 22 April and observations of minor subsidence movements and no impacts at this location ● Local resurfacing at 98.8 km.				
Consultation with stakeholders since previous report: ● RMG meeting on 21 April				
Forecast whether continued longwall mining is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW S1A-S6A Management Plan for Longwall Mining beneath and adjacent to the Main Southern Railway, track geometry triggers may be exceeded in the vicinity of 98.8 km this week. While the track condition is poor, the Track Certifier has advised that a temporary speed restriction is not immediately required. Tahmoor Coal will locally resurface the track on 22 April and increase the frequency of track geometry surveys and visual inspections to twice week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.				
Certified by Tahmoor Coal				
Name	Ross Barber			
Position	Project Manager			
Signature	*Ross Baber*			
Date	21 April 2023			

Copy of Report to:
Sladjan Mitic, Area Manager Ingleburn, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Brian Cooper, Manager Maintenance North-South, ARTC;
Peter Haskard, Manager Engineering, Interstate Network, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 13
During the mining of LW S1A beneath the Main Southern Railway

Reporting Period	19 April 2023 to 25 April 2023	
Length of extraction of LW S1A	1428 m	as at 25 April (LW commenced 18 October 22)
Closest distance of LW S1A face to Railway	135 m	to 98.58 km (LW moving away)
Distance travelled by LW since previous report	56 m	since 18 April 2023
Maximum incremental subsidence along Railway due to LW S1A	463 mm	at 98.80 km on 24 April 2023
Maximum increase in subsidence since previous survey	128 mm	at 98.74 km (17 April to 24 April)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	24 Apr	Monthly	N/A	Vertical subsidence increasing. Small horizontal movements towards the LW face. Horizontal misalignment above the longwall at 98.80 km where increased compressive strain and change in vertical alignment is observed.
2D ground survey	24 Apr	Weekly	N/A	Subsidence developing above the longwall at maximum rates of change. Compressive strain of 1.9 mm/m between 98.78 km and 98.80 km where maximum subsidence is observed, with increasing change in vertical alignment. Compressive strain of 1.4 mm/m between 98.74 km and 98.76 km at creek crossing.
Rail creep surveys	24 Apr	Weekly	N/A	Small changes observed.
Long bay length survey	24 Apr	Weekly	N/A	Ground shortening increasing AP2 to ES3. Ground extension increasing ES2 to AP2.
Rail stress	Every 5 mins			Changes in stresses within expectations.
Switch displacements	Every 5 mins			Measurements within tolerances.
Track geometry survey	20, 22, 24 and 27 Apr	Weekly		Increasing 14m twist, which exceeds Blue trigger level on both tracks at 98.80 km, approaching Yellow trigger level on Up Main. Local resurfacing on 22 Apr improved track twist, particularly on Down Main. RRG met on 27 Apr to review latest track geometry data, where it was agreed to conduct manual board surveys to confirm trolley readings and locally resurface the track on 28 Apr. Manual board surveys on 27 Apr correlated well with trolley readings. Twice weekly trolley surveys will continue in the affected area.
Track centre measurements	24 Apr	Monthly	-	Minor changes observed.
Inspections by Track Certifier	27 Apr	Daily		Poor track noted 98.8 km on 20 Apr at location of maximum observed subsidence. No visible change on 21 Apr and temporary speed restriction is not required at this stage. Local resurfacing planned on 22 Apr. Focussed inspections will continue.
Early warning monitoring				
GNSS monitoring S1 to S15	Continuous		N/A	Rates of change reducing to very low levels.
V-Line along Tahmoor Mine property boundary	19 Apr	Monthly	N/A	Subsidence developing up to 769 mm and valley closure observed across Tributary to Teatree Hollow. Minor changes since previous survey.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Embankment and Culvert at 98.445 km, including Tahmoor Mine Site embankment upstream				
Absolute 3D survey	24 Apr	Weekly	N/A	Minor changes observed.
Visual inspection	24 Apr	Weekly	N/A	No issues observed. Partial blockage where 0.9 m dia pipe constricts to a 0.6 m dia pipe was removed on 22 April. No issues observed to Tahmoor Mine Site dam embankment. Completion of track baulk installation planned for 22 April deferred due to priority resurfacing works at 98.8 km.
Embankment and Culvert at 98.739 km				
Absolute 3D / relative 3D survey	24 Apr	Abs. Mthly Rel. Weekly	N/A	Subsidence increasing. Small closure across the crest. Compressive strain of 1.3 mm/m from 98.740 km to 98.760 km on Up side and 0.6 mm/m on Down side.
Visual inspection	24 Apr	Weekly	N/A	No changes observed.
Embankment and Culvert at 99.035 km				
Absolute 3D / relative 3D survey	24 Apr	Abs. Mthly Rel. Weekly	N/A	Minor subsidence beginning to develop. Very minor closure observed across the culvert.
Visual inspection	24 Apr	Weekly	N/A	No changes observed. Work has been completed to seal gap between brick arch culvert headwall and concrete pipe extension and repair sinkhole.
Embankment and Culvert at 99.338 km				
Absolute 3D / relative 3D survey	24 Apr	Abs. Mthly Rel. Weekly	N/A	Minor changes observed. Minor opening on the Up side 99.30 km to 99.32 km.
Extensometers	Every 15 minutes		N/A	Very minor changes observed.
Inclinometer	24 Apr	Weekly	N/A	Very minor changes observed.
Piezometer	Every 15 minutes		N/A	No water flow through the culvert this week.
Visual inspection	24 Apr	Weekly	N/A	No changes observed.
Cuttings				
Visual inspection	24 Apr	Weekly	N/A	No issues observed. Minor ponding water observed in cess drains.
Coal Conveyor at 98.160 km				
Survey across Railway	24 Apr	Weekly		Measured changes within survey tolerance.
Laser distancemeter	Hourly			Minor changes observed.
Visual inspection	24 Apr	Weekly	N/A	No issues reported.
Bargo River Railway Viaduct at 96.256 km and Remembrance Drive Bridge over Bargo River at 96.385 km				
GNSS units S11 and S12	Continuous		N/A	No measurable movements or change between GNSS units.
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance.
Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance. Some prisms at base of Viaduct that could not be surveyed last month due to water on prisms have been relocated and normalised.
Precision 2D ground survey between ends of Viaduct and Bridge (valley closure)	-	Monthly		Last survey 5 April. Results within survey tolerance.
Gap between deck and northern abutment of Bridge	-	Monthly		Last survey 5 April. Gap measured to close by approximately 9 mm since July in response to increased ambient temperature. More than 100 mm capacity available.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Bargo River Road Overbridge at 96.049 km (Potter's Cutting)				
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance.
Local 3D survey of structure	-	Monthly		Last survey 5 April. Results within survey tolerance.
Crack gauges	-	Monthly		Last readings 4 April.
Wellers Road Overbridge at 101.162 km				
GNSS unit S15	Continuous		N/A	Very minor movement observed to the north and west.
Local 3D survey of structure	-	-		Last survey 2 March. Very minor movement observed to the north, as per the GNSS unit survey. No measurable change across the bridge span. Next survey planned at end of LW S1A.
Crack gauges	-	-		Measurement planned at end of LW S1A.
Management Actions				
Other management actions since previous report: ● Partial blockage in culvert at 98.445 km where 0.9 m dia pipe constricts to a 0.6 m dia pipe removed 22 April ● Local resurfacing at 98.8 km on 22 April. ● Twice weekly focussed track geometry surveys and inspections in vicinity of 98.8 km. Manual board surveys on 27 April.				
Any additional and/or outstanding management actions: ● Installation of track baulk at 98.445 km, deferred due to priority resurfacing works at 98.8 km on 22 April and observations of minor subsidence movements and no impacts at this location ● Local resurfacing at 98.8 km planned on 27 April. ● Inspect and correct track geometry exceedances at 98.8 km on the Up Main				
Consultation with stakeholders since previous report: ● RMG meeting on 28 April				
Forecast whether continued longwall mining is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW S1A-S6A Management Plan for Longwall Mining beneath and adjacent to the Main Southern Railway, track geometry triggers may be exceeded in the vicinity of 98.8 km this week. While the track condition is poor, the Track Certifier has advised that a temporary speed restriction is not immediately required. Tahmoor Coal will locally resurface the track on 28 April and has increased the frequency of track geometry surveys and visual inspections to twice a week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.				
Certified by Tahmoor Coal				
Name	Ross Barber			
Position	Project Manager			
Signature	*Ross Barber*			
Date	28 April 2023			

Copy of Report to:
Sladjan Mitic, Area Manager Ingleburn, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Brian Cooper, Manager Maintenance North-South, ARTC;
Peter Haskard, Manager Engineering, Interstate Network, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 14
During the mining of LW S1A beneath the Main Southern Railway

Reporting Period	26 April 2023 to 2 May 2023	
Length of extraction of LW S1A	1445 m	as at 2 May (LW commenced 18 October 22)
Closest distance of LW S1A face to Railway	150 m	to 98.56 km (LW moving away)
Distance travelled by LW since previous report	17 m	since 25 April 2023 LW stopped between 24 and 30 April 2023
Maximum incremental subsidence along Railway due to LW S1A	481 mm	at 98.80 km on 2 May 2023
Maximum increase in subsidence since previous survey	22 mm	at 98.74 km (24 April to 2 May)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 24 April. Horizontal misalignment above the longwall at 98.80 km where increased compressive strain and change in vertical alignment is observed.
2D ground survey	2 May	Weekly	N/A	Subsidence developing above the longwall at maximum rates of change per metre of LW advance but minor changes this week due to limited LW progress. Compressive strain of 2.1 mm/m between 98.78 km and 98.80 km where maximum subsidence is observed, with increasing change in vertical alignment. Compressive strain of 1.5 mm/m between 98.74 km and 98.76 km at creek crossing.
Rail creep surveys	2 May	Weekly	N/A	Small changes observed.
Long bay length survey	2 May	Weekly	N/A	Small changes in ground shortening AP2 to ES3 and ground extension ES2 to AP2 due to limited LW progress.
Rail stress	Every 5 mins			Changes in stresses within expectations.
Switch displacements	Every 5 mins			Measurements within tolerances.
Track geometry survey	28 Apr and 4 May	Weekly		Poor track geometry at 98.800 km due to mining-induced movements. Local resurfacing on 28 April improved track twist on Down Main. Increasing 14m twist, which exceeds Blue trigger level on both tracks at 98.820 km. Blue trigger for Cant Difference from Design exceeded Up Main 98.813 km to 98.845 km following some deterioration after resurfacing. Twice weekly trolley surveys will continue in the affected area, with resurfacing as required.
Track centre measurements	2 May	Monthly	-	Minor changes observed.
Inspections by Track Certifier	2 May	Daily		Poor track noted 98.8 km. Focussed inspections will continue.
Early warning monitoring				
GNSS monitoring S1 to S15	Continuous		N/A	Rates of change reducing to very low levels.
V-Line along Tahmoor Mine property boundary	3 May	Monthly	N/A	Subsidence up to 771 mm and valley closure observed across Tributary to Teatree Hollow. Minor changes since previous survey.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Embankment and Culvert at 98.445 km, including Tahmoor Mine Site embankment upstream				
Absolute 3D survey	2 May	Weekly	N/A	Minor changes observed.
Visual inspection	1 May	Weekly	N/A	No issues observed, though downstream outlet ponded due to temporary high water level in mine site dam. No issues observed to Tahmoor Mine Site dam embankment. Planned track baulk deferred due to priority resurfacing works at 98.8 km.
Embankment and Culvert at 98.739 km				
Absolute 3D / relative 3D survey	2 May	Abs. Mthly Rel. Weekly	N/A	Subsidence increasing. Small closure across the crest. Compressive strain of 1.4 mm/m from 98.740 km to 98.760 km on Up side and 0.6 mm/m on Down side.
Visual inspection	1 May	Weekly	N/A	No changes observed.
Embankment and Culvert at 99.035 km				
Absolute 3D / relative 3D survey	2 May	Abs. Mthly Rel. Weekly	N/A	Minor subsidence developing. Very minor closure observed across the culvert.
Visual inspection	1 May	Weekly	N/A	No changes observed.
Embankment and Culvert at 99.338 km				
Absolute 3D / relative 3D survey	2 May	Abs. Mthly Rel. Weekly	N/A	Minor changes observed. Minor opening on the Up side 99.30 km to 99.32 km.
Extensometers	Every 15 minutes		N/A	Very minor changes observed.
Inclinometer	1 May	Weekly	N/A	Very minor changes observed.
Piezometer	Every 15 minutes		N/A	Water flow detected during rain event on 29-30 April.
Visual inspection	1 May	Weekly	N/A	No changes observed.
Cuttings				
Visual inspection	1 May	Weekly	N/A	No issues observed. Minor ponding water observed in cess drains.
Coal Conveyor at 98.160 km				
Survey across Railway	2 May	Weekly		Measured changes within survey tolerance.
Laser distancemeter	Hourly			Minor changes observed.
Visual inspection	1 May	Weekly	N/A	No issues reported.
Bargo River Railway Viaduct at 96.256 km and Remembrance Drive Bridge over Bargo River at 96.385 km				
GNSS units S11 and S12	Continuous		N/A	No measurable movements or change between GNSS units.
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance.
Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance. Some prisms at base of Viaduct that could not be surveyed last month due to water on prisms have been relocated and normalised.
Precision 2D ground survey between ends of Viaduct and Bridge (valley closure)	-	Monthly		Last survey 5 April. Results within survey tolerance.
Gap between deck and northern abutment of Bridge	-	Monthly		Last survey 5 April. Gap measured to close by approximately 9 mm since July in response to increased ambient temperature. More than 100 mm capacity available.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Bargo River Road Overbridge at 96.049 km (Potter's Cutting)				
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 5 April. Results within survey tolerance.
Local 3D survey of structure	-	Monthly		Last survey 5 April. Results within survey tolerance.
Crack gauges	-	Monthly		Last readings 4 April.
Wellers Road Overbridge at 101.162 km				
GNSS unit S15	Continuous		N/A	Very minor movement observed to the north and west.
Local 3D survey of structure	-	-		Last survey 2 March. Very minor movement observed to the north, as per the GNSS unit survey. No measurable change across the bridge span. Next survey planned at end of LW S1A.
Crack gauges	-	-		Measurement planned at end of LW S1A.
Management Actions				
Other management actions since previous report: ● Local resurfacing at 98.8 km on 28 April and on the 5 May ● Twice weekly focussed track geometry surveys and inspections in vicinity of 98.8 km.				
Any additional and/or outstanding management actions: ● Installation of track baulk at 98.445 km, deferred due to priority resurfacing works at 98.8 km and observations of minor subsidence movements and no impacts at this location				
Consultation with stakeholders since previous report: ● RMG meeting on 5 May				
Forecast whether continued longwall mining is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW S1A-S6A Management Plan for Longwall Mining beneath and adjacent to the Main Southern Railway, track geometry triggers may be exceeded in the vicinity of 98.8 km this week. While the track condition is poor, the Track Certifier has advised that a temporary speed restriction is not required at this stage. Tahmoor Coal has locally resurfaced the track on 28 April and will conduct additional resurfacing as required. The frequency of track geometry surveys and visual inspections has been increased to twice a week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.				
Certified by Tahmoor Coal				
Name	Ross Barber			
Position	Project Manager			
Signature	*Ross Barber*			
Date	5 May 2023			

Copy of Report to:
Sladjan Mitic, Area Manager Ingleburn, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Brian Cooper, Manager Maintenance North-South, ARTC;
Peter Haskard, Manager Engineering, Interstate Network, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 15
During the mining of LW S1A beneath the Main Southern Railway

Reporting Period	3 May 2023 to 9 May 2023	
Length of extraction of LW S1A	1490 m	as at 9 May (LW commenced 18 October 22)
Closest distance of LW S1A face to Railway	195 m	to 98.56 km (LW moving away)
Distance travelled by LW since previous report	45 m	since 2 May 2023
Maximum incremental subsidence along Railway due to LW S1A	499 mm	at 98.80 km on 9 May 2023
Maximum increase in subsidence since previous survey	29 mm	at 98.70 km (2 May to 9 May)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 24 April. Horizontal misalignment above the longwall at 98.80 km where increased compressive strain and change in vertical alignment is observed.
2D ground survey	9 May	Weekly	N/A	Subsidence developing above the longwall with reduced rate of change this week. Compressive strain of 2.2 mm/m between 98.78 km and 98.80 km where maximum subsidence is observed, with increasing change in vertical alignment. Compressive strain of 1.6 mm/m between 98.74 km and 98.76 km at creek crossing.
Rail creep surveys	9 May	Weekly	N/A	Small changes observed. New rail creep at AP2 on the Up Main Up Rail.
Long bay length survey	9 May	Weekly	N/A	Small changes in ground shortening AP2 to ES3 and ground extension ES2 to AP2.
Rail stress	Every 5 mins			Changes in stresses within expectations.
Switch displacements	Every 5 mins			Measurements within tolerances. It is recommended to add at least one weld or 50 mm to ES4-C.
Track geometry survey	5 & 8 May	Weekly		Poor track geometry at 98.800 km due to mining-induced movements. Local resurfacing on 5 May improved track twist on Up Main. Increasing 14m twist, which exceeds Blue trigger level on Down Main at 98.820 km. Blue trigger for Cant Difference from Design exceeded Up Main 98.81 km to 98.845 km following some deterioration after resurfacing. Twice weekly trolley surveys will continue in the affected area, with resurfacing as required.
Track centre measurements	9 May	Monthly	-	Minor changes observed.
Inspections by Track Certifier	9 May	Daily		Poor track noted 98.8 km. Focussed inspections will continue.
Early warning monitoring				
GNSS monitoring S1 to S15	Continuous		N/A	Rates of change reducing to very low levels.
V-Line along Tahmoor Mine property boundary	-	Monthly	N/A	Last survey 3 May. Subsidence up to 771 mm and valley closure observed across Tributary to Teatree Hollow. Minor changes since previous survey.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Embankment and Culvert at 98.445 km, including Tahmoor Mine Site embankment upstream				
Absolute 3D survey	9 May	Weekly	N/A	Minor changes observed.
Visual inspection	5 May	Weekly	N/A	No issues observed. Water levels at downstream outlet reduced as water has been pumped out of mine site dam. No issues observed to Tahmoor Mine Site dam embankment. Planned track baulk deferred due to priority resurfacing works at 98.8 km.
Embankment and Culvert at 98.739 km				
Absolute 3D / relative 3D survey	9 May	Abs. Mthly Rel. Weekly	N/A	Subsidence increasing. Small closure across the crest. Compressive strain of 1.5 mm/m from 98.740 km to 98.760 km on Up side and 0.7 mm/m on Down side.
Visual inspection	5 May	Weekly	N/A	No changes observed.
Embankment and Culvert at 99.035 km				
Absolute 3D / relative 3D survey	9 May	Abs. Mthly Rel. Weekly	N/A	Minor subsidence developing. Very minor closure observed across the culvert.
Visual inspection	5 May	Weekly	N/A	No changes observed.
Embankment and Culvert at 99.338 km				
Absolute 3D / relative 3D survey	9 May	Abs. Mthly Rel. Weekly	N/A	Minor changes observed. Minor opening on the Up side 99.30 km to 99.32 km. Picket at 99.32 km on the Down side crest has tilted away from the track. There is no evidence that the picket has been damaged.
Extensometers	Every 15 minutes		N/A	Minor changes observed.
Inclinometer	8 May	Weekly	N/A	Very minor changes observed.
Piezometer	Every 15 minutes		N/A	No water flow through the culvert this week.
Visual inspection	5 May	Weekly	N/A	No issues observed. Groundwater seepage through culvert walls likely associated with recent rainfall.
Cuttings				
Visual inspection	5 May	Weekly	N/A	No issues observed. Minor ponding water observed in cess drains.
Coal Conveyor at 98.160 km				
Survey across Railway	8 May	Weekly		Measured changes within survey tolerance.
Laser distancemeter	Hourly			Minor changes observed.
Visual inspection	8 May	Weekly	N/A	No issues reported.
Bargo River Railway Viaduct at 96.256 km and Remembrance Drive Bridge over Bargo River at 96.385 km				
GNSS units S11 and S12	Continuous		N/A	No measurable movements or change between GNSS units.
Far-field Absolute 3D survey	4 May	Monthly	N/A	Results within survey tolerance.
Absolute 3D survey	4 May	Monthly	N/A	Results within survey tolerance.
Precision 2D ground survey between ends of Viaduct and Bridge (valley closure)	4 May	Monthly		Results within survey tolerance.
Gap between deck and northern abutment of Bridge	4 May	Monthly		Gap measured to close by approximately 8 mm since July in response to increased ambient temperature. More than 100 mm capacity available.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Bargo River Road Overbridge at 96.049 km (Potter's Cutting)				
Far-field Absolute 3D survey	4 May	Monthly	N/A	Results within survey tolerance.
Local 3D survey of structure	4 May	Monthly		Results within survey tolerance.
Crack gauges	-	Monthly		Last readings 4 April.
Wellers Road Overbridge at 101.162 km				
GNSS unit S15	Continuous		N/A	Very minor movement observed to the north and west.
Local 3D survey of structure	-	-		Last survey 2 March. Very minor movement observed to the north, as per the GNSS unit survey. No measurable change across the bridge span. Next survey planned at end of LW S1A.
Crack gauges	-	-		Measurement planned at end of LW S1A.
Management Actions				
Other management actions since previous report: ● Local resurfacing on the Up Main at 98.8 km on 5 May ● Twice weekly focussed track geometry surveys and inspections in vicinity of 98.8 km				
Any additional and/or outstanding management actions: ● Add at least one weld or 50 mm to ES4-C ● Installation of track baulk at 98.445 km, deferred due to priority resurfacing works at 98.8 km and observations of minor subsidence movements and no impacts at this location				
Consultation with stakeholders since previous report: ● RMG meeting on 12 May				
Forecast whether continued longwall mining is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW S1A-S6A Management Plan for Longwall Mining beneath and adjacent to the Main Southern Railway, track geometry triggers may be exceeded in the vicinity of 98.8 km this week. While the track condition is poor, the Track Certifier has advised that a temporary speed restriction is not required at this stage. Tahmoor Coal has locally resurfaced the track on 5 May and will conduct additional resurfacing as required. The frequency of track geometry surveys and visual inspections has been increased to twice a week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.				
Certified by Tahmoor Coal				
Name	Ross Barber			
Position	Project Manager			
Signature	*Ross Barber*			
Date	12 May 2023			

Copy of Report to:
Sladjan Mitic, Area Manager Ingleburn, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Brian Cooper, Manager Maintenance North-South, ARTC;
Peter Haskard, Manager Engineering, Interstate Network, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 19
During the mining of LW S1A beneath the Main Southern Railway

Reporting Period	31 May 2023 to 6 June 2023	
Length of extraction of LW S1A	1685 m	as at 6 June 2023 (LW commenced 18 October 22)
Closest distance of LW S1A face to Railway	380 m	to 98.54 km (LW moving away)
Distance travelled by LW since previous report	57 m	since 30 May 2023
Maximum incremental subsidence along Railway due to LW S1A	526 mm	at 98.80 km on 5 June 2023
Maximum increase in subsidence since previous survey	10 mm	at 98.66 km (30 May to 5 June)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 30 May. Minor increase this month in horizontal misalignment at 98.80 km where increased compressive strain and change in vertical alignment is observed.
2D ground survey	5 Jun	Weekly	N/A	Rates of change reducing to very low levels. Compressive strain of 2.4 mm/m between 98.78 km and 98.80 km, with change in vertical alignment. Compressive strain of 1.7 mm/m between 98.74 km and 98.76 km at creek crossing. No change this week.
Rail creep surveys	5 Jun	Weekly	N/A	As recommended, AP2 on the Up Main has been extended. No new creep observed.
Long bay length survey	5 Jun	Weekly	N/A	Small changes in ground shortening AP2 to ES3 and ground extension ES2 to AP2. Rates of change reducing.
Rail stress	Every 5 mins			Changes in stresses within expectations.
Switch displacements	Every 5 mins			Measurements within tolerances. As recommended, AP2 on the Up Main has been extended.
Track geometry survey	5 Jun	Weekly		Rates of change reducing to very low levels. Poor track geometry at 98.800 km due to mining-induced movements. Resurfacing on 3 June has improved track condition on both tracks. Previously recorded exceedance of Blue trigger for twist corrected at 98.820 km on Down Main. Cant difference from design exceeds Blue trigger between 98.81 km and 98.845 km on Up Main.
Track centre measurements	5 Jun	Monthly	-	Minor changes observed.
Inspections by Track Certifier	6 Jun	Daily		Poor track noted 98.8 km. Focussed inspections will continue.
Early warning monitoring				
GNSS monitoring S1 to S15	Continuous		N/A	Rates of change reducing to very low levels.
V-Line along Tahmoor Mine property boundary	7 Jun	Monthly	N/A	Subsidence up to 774 mm and valley closure observed across Tributary to Teatree Hollow. Minor changes since previous survey.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Embankment and Culvert at 98.445 km, including Tahmoor Mine Site embankment upstream				
Absolute 3D survey	5 Jun	Weekly	N/A	Minor changes observed.
Visual inspection	5 Jun	Weekly	N/A	No issues observed. RMG has agreed to not install the track baulk over the culvert as previously planned, as the LW face has passed the site by more than 300 m, with no valley closure, upsidence or impacts observed. The culvert will continue to be closely monitored as mining continues. CCTV inspection on 6 June showed no changes in culvert condition. As recommended, 3 branches wedged in culvert were cleared on 3 June to prevent further blockage. Water levels at downstream outlet reduced and no ponding observed. No issues observed to Tahmoor Mine Site dam embankment.
Embankment and Culvert at 98.739 km				
Absolute 3D / relative 3D survey	5 Jun	Abs. Mthly Rel. Weekly	N/A	Minor changes observed. Small closure across the crest. Compressive strain of 1.7 mm/m from 98.740 km to 98.760 km on Up side and 0.7 mm/m on Down side.
Visual inspection	5 Jun	Weekly	N/A	No changes observed. CCTV inspection on 6 June showed no changes in culvert condition.
Embankment and Culvert at 99.035 km				
Absolute 3D / relative 3D survey	5 Jun	Abs. Mthly Rel. Weekly	N/A	Minor changes observed. Very minor closure observed across the culvert.
Visual inspection	5 Jun	Weekly	N/A	No changes observed. CCTV inspection on 6 June showed no changes in culvert condition.
Embankment and Culvert at 99.338 km				
Absolute 3D / relative 3D survey	5 Jun	Abs. Mthly Rel. Weekly	N/A	Minor changes observed. Minor opening on the Up side 99.30 km to 99.32 km. Picket at 99.32 km on the Down side crest has tilted away from the track. There is no evidence that the picket has been damaged.
Extensometers	Every 15 minutes		N/A	Very minor change this week.
Inclinometer	6 Jun	Weekly	N/A	Very minor changes observed.
Piezometer	Every 15 minutes		N/A	No water flow through the culvert this week.
Visual inspection	5 Jun	Weekly	N/A	No issues observed. No groundwater seepage through culvert evident. CCTV inspection on 6 June showed no changes in culvert condition.
Cuttings				
Visual inspection	5 Jun	Weekly	N/A	No issues observed. No ponding water observed in cess drains.
Coal Conveyor at 98.160 km				
Survey across Railway	6 Jun	Weekly		Measured changes within survey tolerance.
Laser distancemeter	Hourly			Minor changes observed.
Visual inspection	2 Jun	Weekly	N/A	No issues reported.
Bargo River Railway Viaduct at 96.256 km and Remembrance Drive Bridge over Bargo River at 96.385 km				
GNSS units S11 and S12	Continuous		N/A	No measurable movements or change between GNSS units.
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 4 May. Results within survey tolerance.
Absolute 3D survey	-	Monthly	N/A	Last survey 4 May. Results within survey tolerance.
Precision 2D ground survey between ends of Viaduct and Bridge (valley closure)	-	Monthly		Last survey 4 May. Results within survey tolerance.
Gap between deck and northern abutment of Bridge	-	Monthly		Last survey 4 May. More than 100 mm capacity available.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Bargo River Road Overbridge at 96.049 km (Potter's Cutting)				
Far-field Absolute 3D survey	-	Monthly	N/A	Last survey 4 May. Results within survey tolerance.
Local 3D survey of structure	-	Monthly		Last survey 4 May. Results within survey tolerance.
Crack gauges	1 Jun	Monthly		No changes observed this month.
Wellers Road Overbridge at 101.162 km				
GNSS unit S15	Continuous		N/A	Very minor movement observed to the north and west.
Local 3D survey of structure	-	-		Last survey 2 March. Very minor movement observed to the north, as per the GNSS unit survey. No measurable change across the bridge span. Next survey planned at end of LW S1A.
Crack gauges	-	-		Measurement planned at end of LW S1A.
Management Actions				
Other management actions since previous report: ● Local resurfacing completed 3 June ● Culvert at 98.445 km cleared 3 June ● Extension of AP2 on the Up Main completed ● CCTV inspection of culverts completed 6 June				
Any additional and/or outstanding management actions: ● Installation of ES5 planned 17 and 24 June				
Consultation with stakeholders since previous report: ● RMG meeting on 9 June				
Forecast whether continued longwall mining is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW S1A-S6A Management Plan for Longwall Mining beneath and adjacent to the Main Southern Railway, no new triggers under this Management Plan are expected to be exceeded in the next week. Rates of change in track geometry have reduced to very low levels in the vicinity of 98.8 km where Blue trigger levels have been exceeded. While the track condition is poor, the Track Certifier has advised that a temporary speed restriction is not required. Resurfacing was completed on 3 June and additional resurfacing will be completed if required. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.				
Certified by Tahmoor Coal				
Name	Ross Barber			
Position	Project Manager			
Signature	*Ross Barber*			
Date	9 June 2023			

Copy of Report to:

Sladjan Mitic, Area Manager Ingleburn, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Brian Cooper, Manager Maintenance North-South, ARTC;
Peter Haskard, Manager Engineering, Interstate Network, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate

Appendix G – Tahmoor Mine Site Monitoring Reports

SIMEC MINING
Tahmoor Coking Coal

Mine Site Inspection Check Sheet (Conveyors)

Site	Tahmoor Coal	Date	6/6/2023
Performed By	D Talbert	Company	Tahmoor

Location	Subsidence Impacts		
item	NO	YES	Comment (if Yes include photo report)
ROM Area and conveyors			
1F -3F Conveyors general	✓		
1F -3F – Slide bearings	✓		
3F to raw coal bins	✓		
4F conveyor general	✓		
4F Tunnel	✓		
5F Conveyor general	✓		
5F – Slide bearings	✓		
Stockpile and Conveyors			
4S Conveyor general	✓		
4S – Slide bearings	✓		
4C Conveyor general	✓		
4C – Slide bearings	✓		
5C Conveyor general		✓	20mm spacers removed from Rail.
5C – Slide bearing T4		✓	closed + 20mm both sides
5C Slide bearing P2	✓		No change
6C Conveyor general	✓		
6C Tunnel Structure		✓	Cracking minor increase in width.
6C Expansion Joint	✓		
7C Conveyor general	✓		
7C – Slide bearings to 6000t bin.	✓		
7C – Slide bearings fox drive	✓		
8C Conveyor general	✓		
8C – Slide bearings to rail loader bin	✓		

Photo Report: Tahmoor Mine Conveyors – as of 06/06/23

5C Conveyor

Rail joint gap has **closed significantly**. 20mm spacer has been removed.

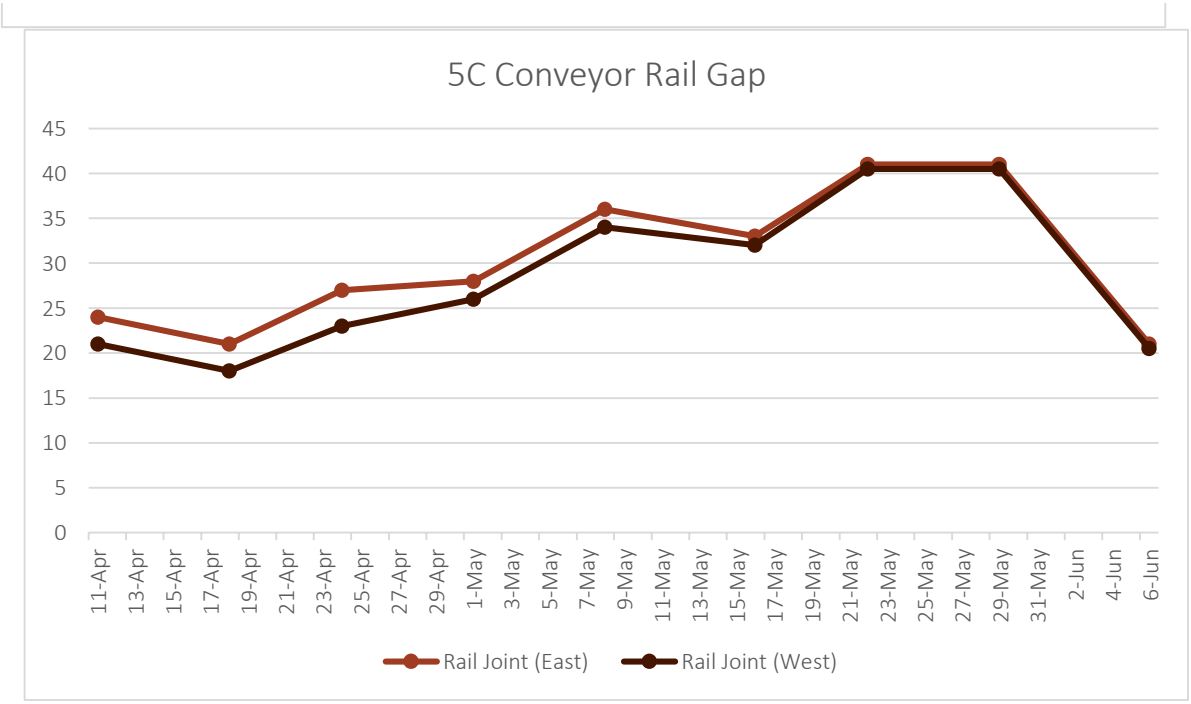


Figure 1: 5C slide joint east showing closure of gap (29/05 vs 06/06)

SIMEC MINING

Site address :

Tahmoor Coal Pty Limited ABN 97 076 663 968

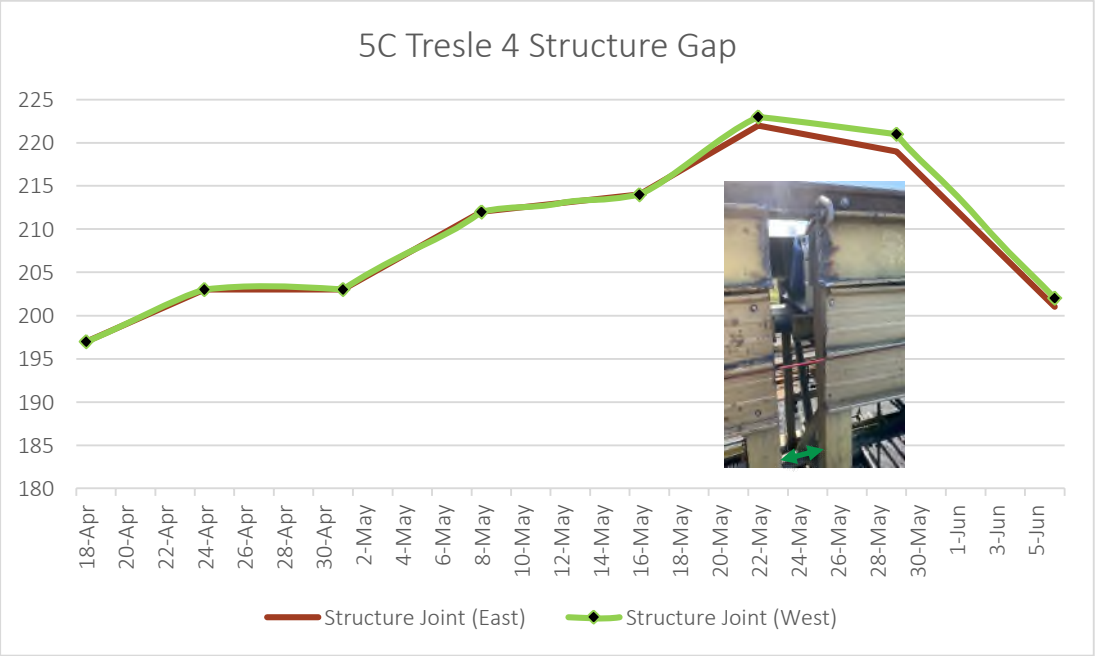
PO box 100, Tahmoor, NSW 2573, Australia

T: +61 (02) 46 400 100

E: contact@simecgfg.com

simecgfg.com

Structure gap at 5C conveyor at slide joint (T4) has **closed** 20mm.



7C Conveyor

No change this week.

8C Conveyor

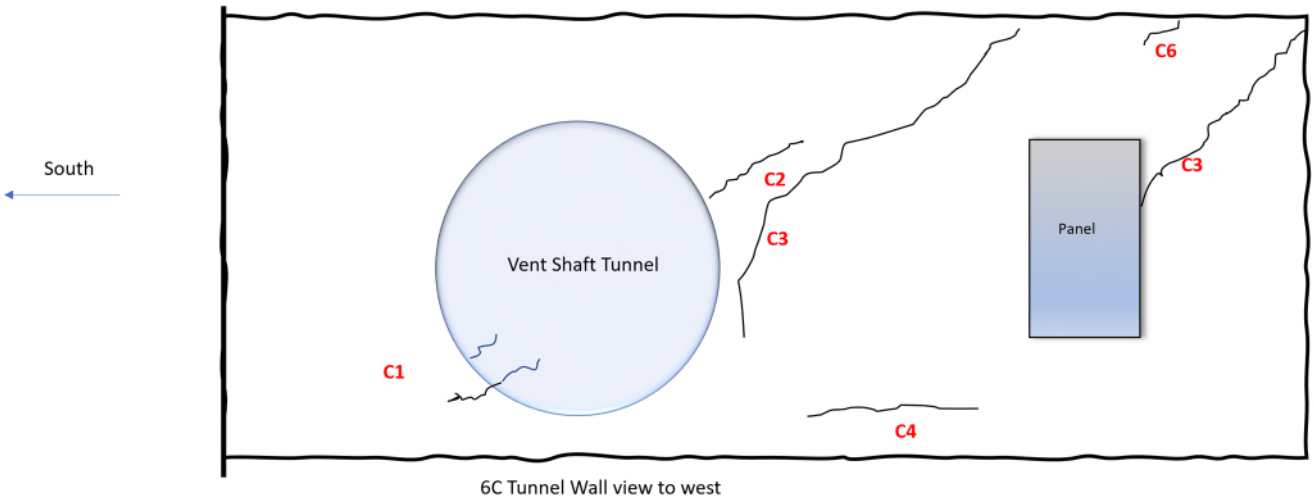
No Change.

4S Conveyor

No change.

6C Tunnel

Cracking is now evident is at least six (6) locations as shown below. Crack width has increased with crack C3 now approaching 1mm. All other cracks are at less than 1mm at this stage. Refer photos below.



6C Tunnel Wall view to west

Photo 1: General location of cracks C1, C2 and C3.

Photo 2: General location of cracks C2 and C3.

Photo 3: General location of cracks C1 and C3.

Photo 4: General location of cracks C4.

Photo 5: General location of crack C5 (Toms crack).

I

Photo 6: General location of crack C6.

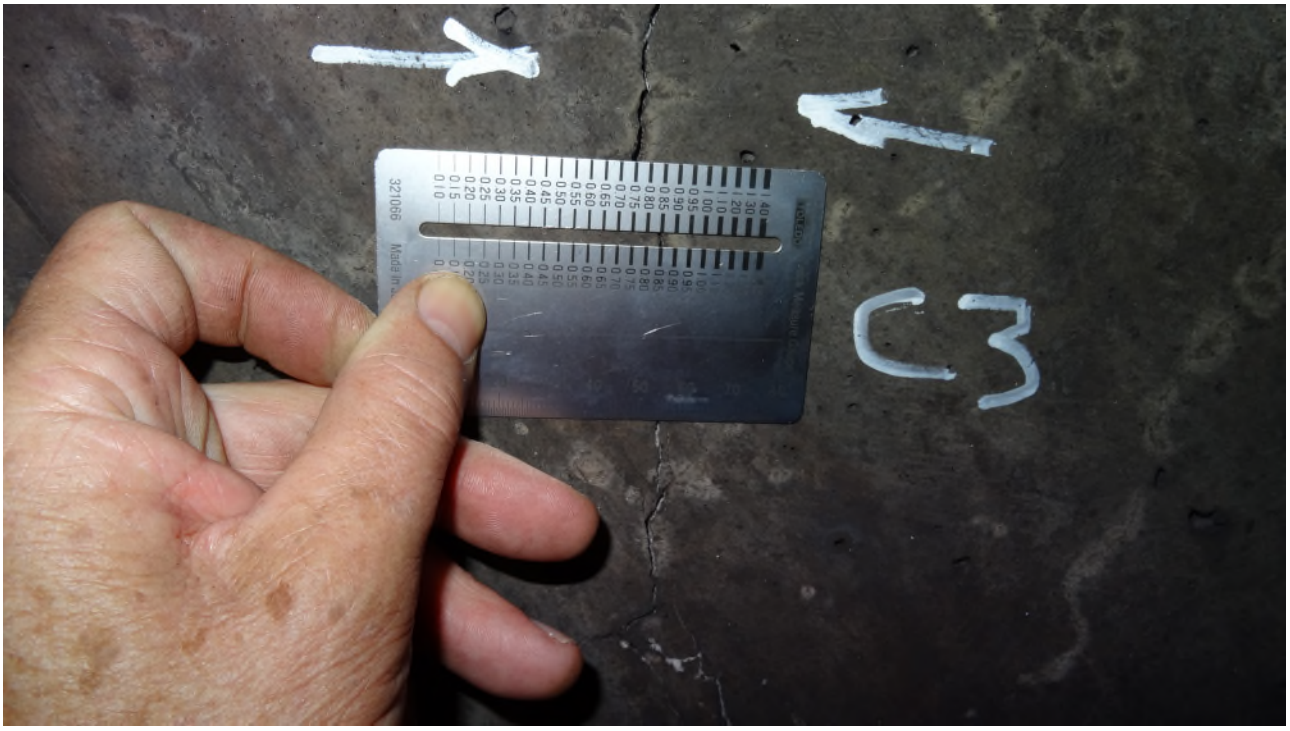


Photo 7: Width of crack C3.

If you require further information, please do not hesitate to contact me 0414 905 565.

David Talbert

Photo Report: Tahmoor Mine Conveyors – as of 27/06/23

5C Conveyor

Rail joint gap has **closed a further 5-7mm**. Measurements indicate the west has closed 2mm more that the east.

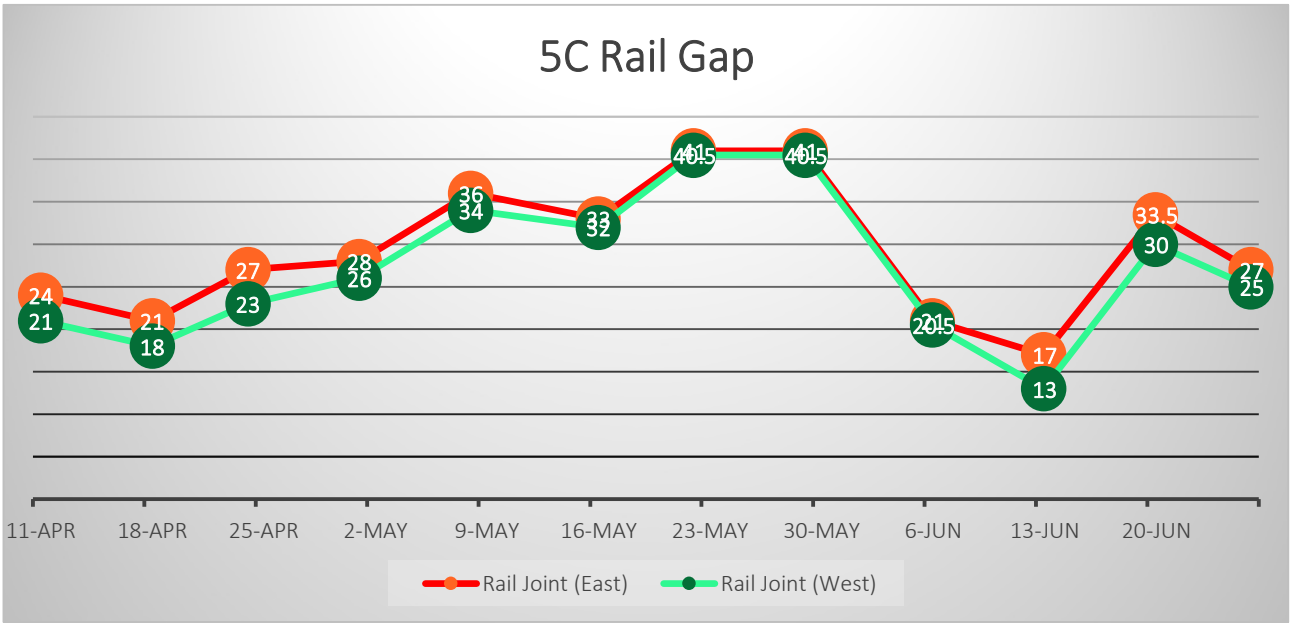
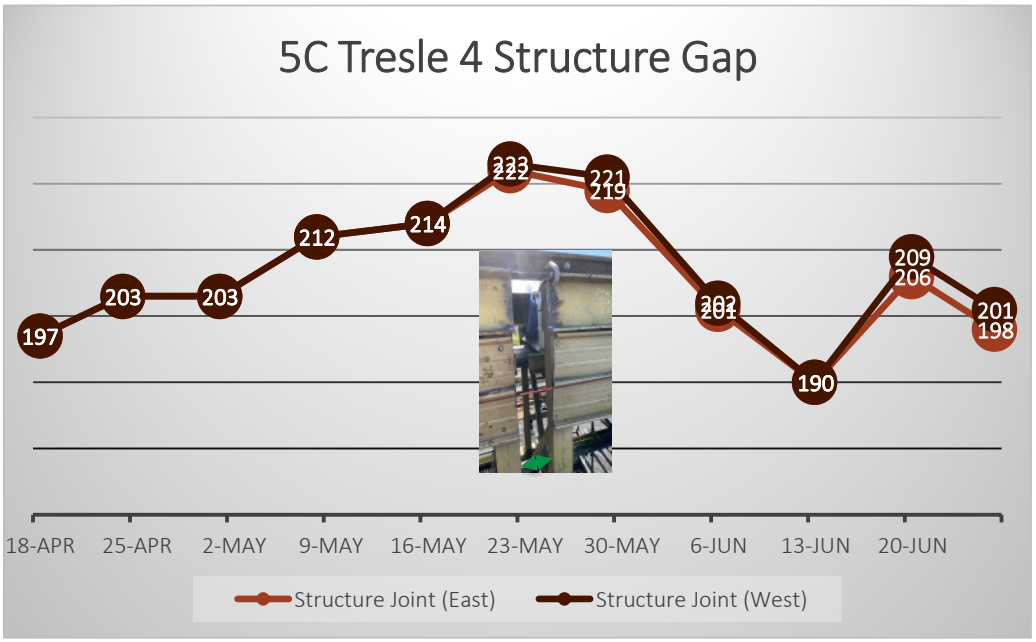


Figure 1 and 2: 5C slide joint east showing variation 13/06 to 27/06.

Structure gap at 5C conveyor at slide joint (T4) has **closed** 8 mm.



7C Conveyor

A meeting of the IMG was held at 9:00am today to review the trigger exceedance at 7C conveyor. The following observations and actions were discussed;

- Inspection of base plates revealed no obvious subsidence related changes.
- Slide joint at 7C conveyor to bins is moving as expected.
- Corrosion noted at crossmember to column base (not related to subsidence).
- Likely movement is temperature related.

Actions:

1) Continue to monitor - DT/AW.
2) Repair corrosion at cross member - Rob Brown
3) JMA to complete inspection of cross member - JMA/DT.
4) Mark and record changes in connection 7C to Bins - DT.

8C Conveyor

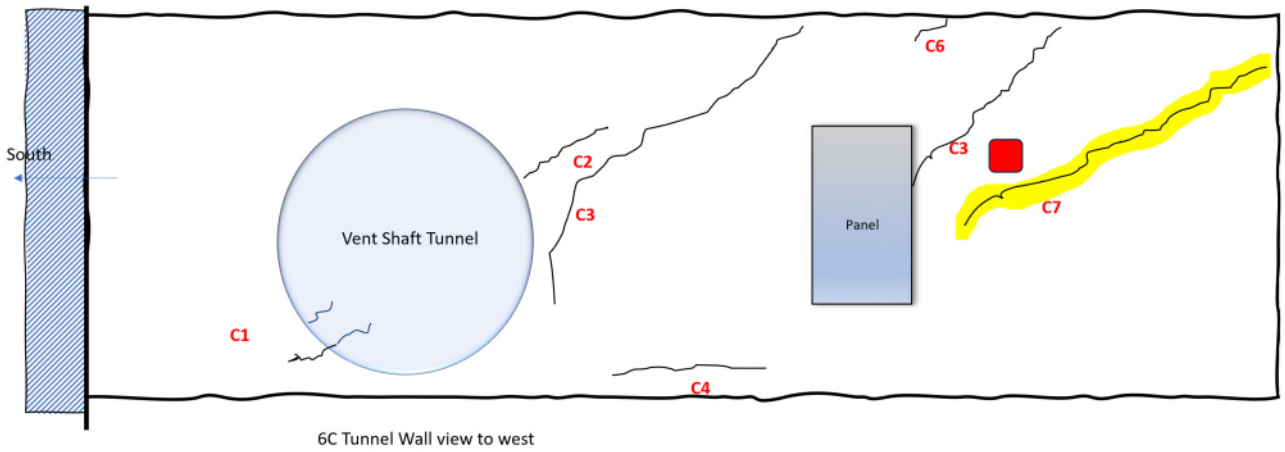
No Change.

4S Conveyor

No change.

6C Tunnel

New crack detected (C7) as shown in figure and photo, currently less than 1mm in width. No noticeable change in existing cracking.



6C Tunnel Wall view to west

Photo 3: Location of new crack (C7).

If you require further information, please do not hesitate to contact me 0414 905 565.

David Talbert

SIMEC MINING
Tahmoor Coking Coal

Mine Site Inspection Check Sheet (Conveyors)

Site	Tahmoor Coal	Date	29/05/23
Performed By	David Talbert	Company	Tahmoor.

Location	Subsidence Impacts		
item	NO	YES	Comment (if Yes include photo report)
ROM Area and conveyors			
1F -3F Conveyors general	✓		
1F -3F – Slide bearings	✓		
3F to raw coal bins	✓		
4F conveyor general	✓		
4F Tunnel	✓		
5F Conveyor general	✓		
5F – Slide bearings	✓		
Stockpile and Conveyors			
4S Conveyor general	✓		
4S – Slide bearings	✓		
4C Conveyor general	✓		
4C – Slide bearings	✓		
5C Conveyor general		✓	Rail joint no change but likely closing
5C – Slide bearing T4		✓	Structure gap closed 2mm both sides
5C Slide bearing P2	✓		
6C Conveyor general	✓		
6C Tunnel Structure		✓	cracking at Vent shaft interface
6C Expansion Joint	✓		
7C Conveyor general	✓		
7C – Slide bearings to 6000t bin.	✓		
7C – Slide bearings fox drive	✓		
8C Conveyor general	✓		
8C – Slide bearings to rail loader bin	✓		

Photo Report: Tahmoor Mine Conveyors – as of 29/05/23

5C Conveyor

Rail joint gap has remained the same and is likely starting to close.

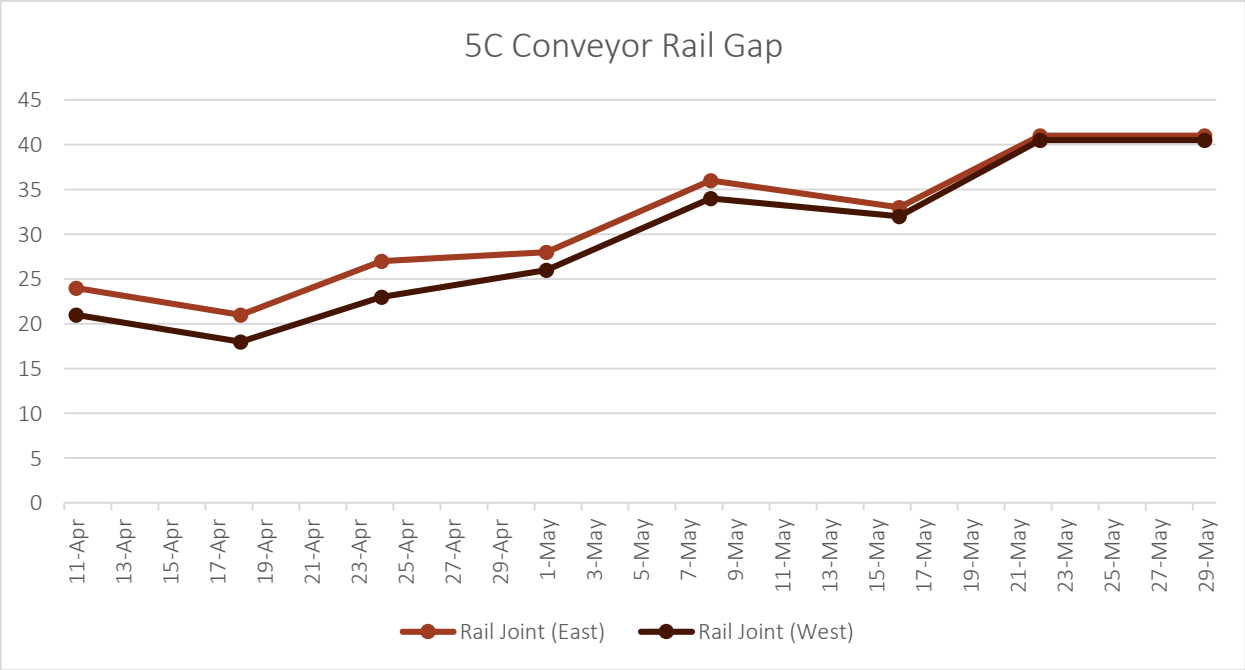
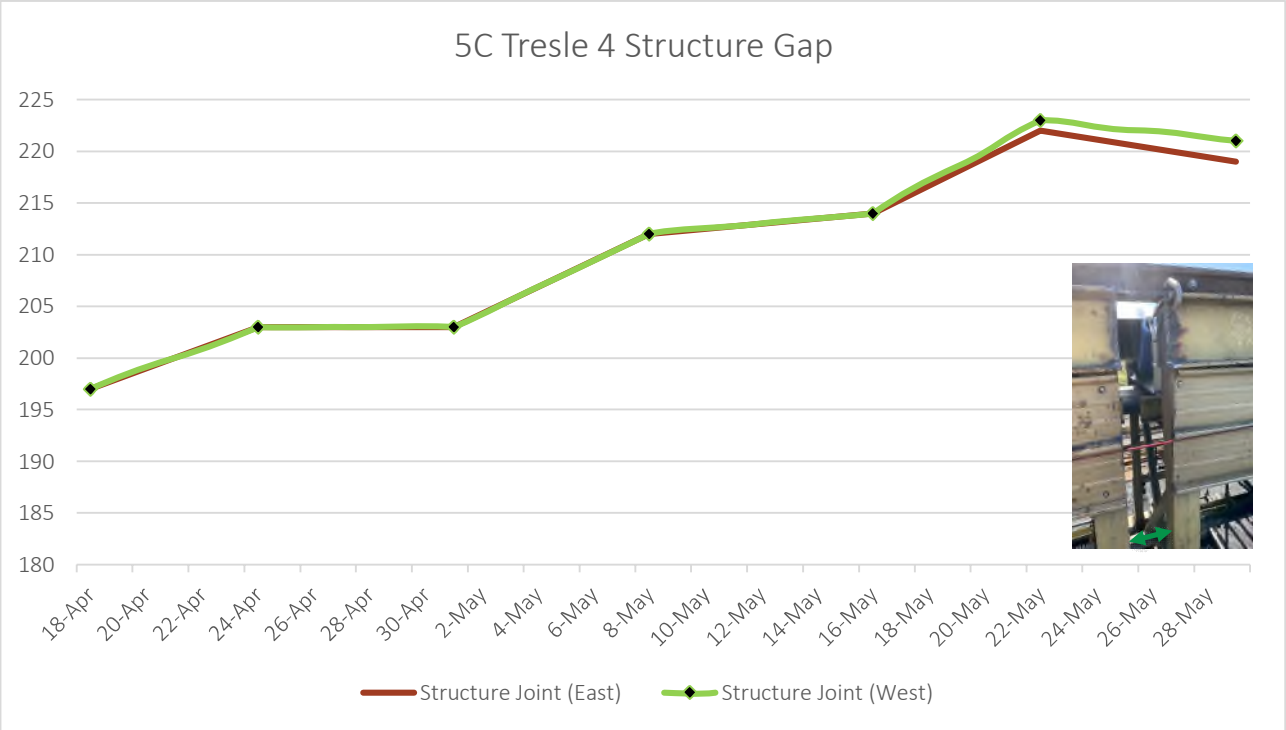


Figure 1: 5C slide joint East with spacer installed (29/05)

Structure gap at 5C conveyor at slide joint (T4) has **closed** 2mm.



7C Conveyor

No change this week.

Figure 2: 7C slide joint west (22/05)

Figure 3: 7C slide joint west (29/05)

8C Conveyor

No Change.

4S Conveyor

No change.

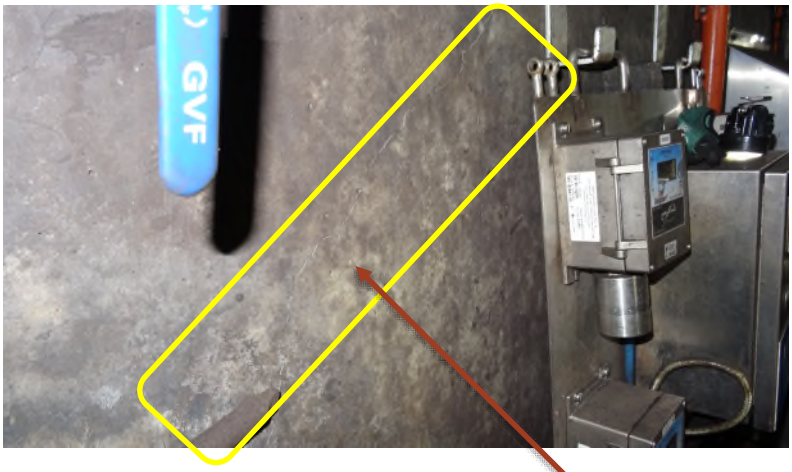
6C Tunnel

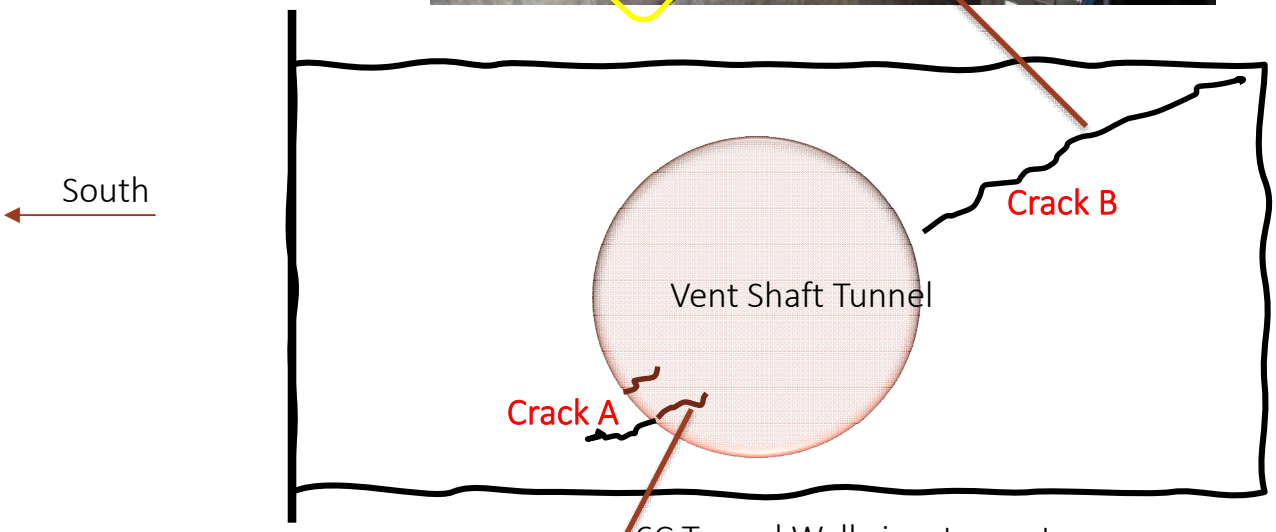
Refer attached report.

If you require further information, please do not hesitate to contact me 0414 905 565.

David Talbert
Mine Subsidence Project Manager

Photo Report: Cracking 6C Tunnel 29/05/23





6C Tunnel Wall view to west

SIMEC MINING

Site address :

Tahmoor Coal Pty Limited ABN 97 076 663 968

PO box 100, Tahmoor, NSW 2573, Australia

T: +61 (02) 46 400 100

E: contact@simecgfg.com

simecgfg.com

Photo 1: Crack A located approximately 7 O'clock along western face extending into the vent shaft tunnel.

Photo 2: evidence of finer cracking above larger crack.

Photo 3: Crack B at edge of vent shaft tunnel extending toward roof.

Photo 4: Crack B extending toward 6C tunnel roof.

Photo 5: Crack B showing crack width <1mm.

If you require further information, please do not hesitate to contact me 0414 905 565.

David Talbert
Mine Subsidence Project Manager

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 14
During the mining of LW S1A beneath the Tahmoor Mine Site

Reporting Period	20 May 2023 to 26 May 2023	
Length of extraction of LW S1A	1588 m	as at 25 May 2023
Closest distance of LW S1A face to Pier 2 on Conveyor 5C	165 m	LW beyond Pier 2 and moving away
Distance travelled by LW since previous report	33 m	Since 18 May 2023
Maximum incremental subsidence within Tahmoor Mine Site	190 mm	at 6C-16A on 23 May 2023
Maximum change in subsidence since previous survey	67 mm	at 5C-01 since 16 May 2023
Safety Incidents	No incidents reported.	
Subsidence impacts reported by Tahmoor Mine Site staff	No subsidence impacts reported.	

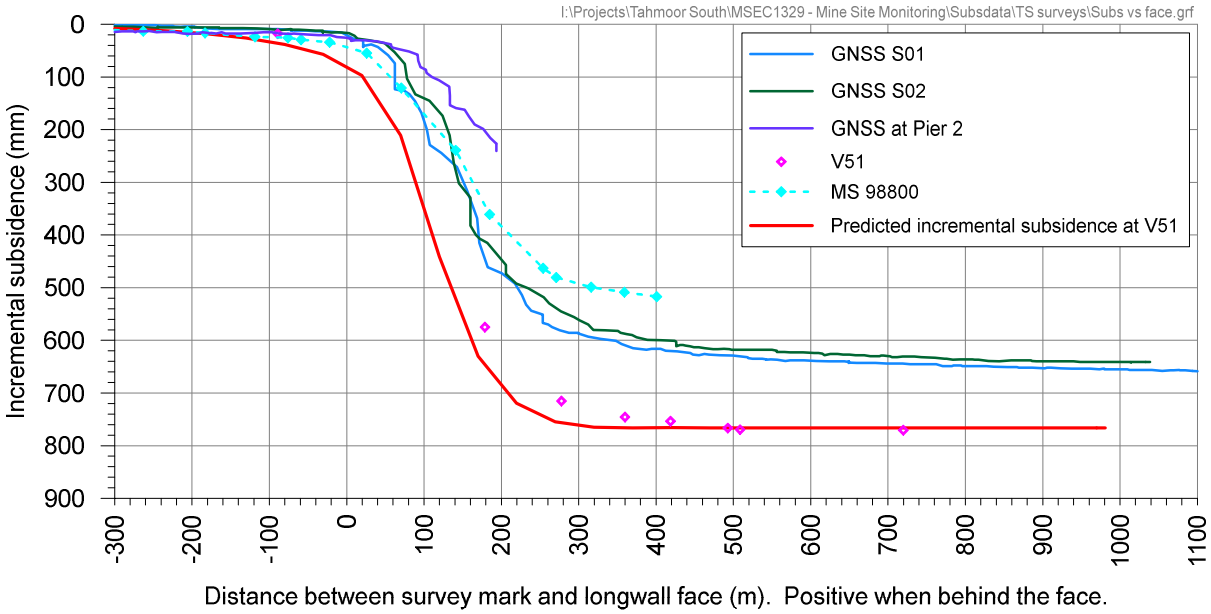
Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
General Mine Site monitoring				
GNSS Unit Gantry at Pier 2	Continuous		N/A	Subsidence increasing, approximately 175 mm in magnitude. Moving south by 90 mm towards the LW face.
GNSS Unit S16 (near Shaft No. 3)	Continuous		N/A	Minor horizontal movement to the south.
V-Line along Tahmoor Mine property boundary	22 May	Monthly	N/A	Subsidence at reduced rates of change.
Main Southern Railway	23 May	Weekly	N/A	Subsidence increasing above the longwall and compressive strain developing at location of maximum subsidence.
Rail Loop	22 May	Weekly	N/A	Very minor changes observed.
Remembrance Drive	22 May	Weekly	N/A	Minor vertical subsidence at this early stage but compressive strain at Pegs R47-R48 and bump growing in subsidence profile at Peg 46. Location is south of Pier 2 and the Stockpile Area.
Visual inspections	26 May	Weekly		No issues observed. Bump developing in southbound travel lane at Peg R46 on Remembrance Drive.
Stockpile Area: Conveyor 5C and Reclaim Tunnel Conveyor 6C				
Reclaim Tunnel survey	23 May	Weekly		Subsidence increasing with fall towards Pier 2. Tilts and strains within survey tolerance. Compressive strain developing at southern end and along ventilation tunnel, as expected.
Conveyor 5C survey	23 May	Weekly	N/A	Subsidence increasing and tilt developing. 30 mm extension across T4 expansion joint between T3 and T4, which correlates well with displacement monitoring at T4 and the measured gap in the tripper rail.
Inclinometer surveys	23 May	Weekly	N/A	Shear observed at 38 m depth in Inclinometer 1, near Pier 2, has blocked passage of sonde. Additional shears at multiple locations increasing. The shear locations are below the depth of the rock anchors. Minor uniform tilt observed along depth of Inclinometer 2, near Pier 1.
Tilt monitoring at Pier 2	Continuous		N/A	Tilts are slightly increasing in magnitude to southeast.
Tilt monitoring at T4	Continuous		N/A	Minor changes in response to stockpile loading.
Displacement monitoring at T4	Continuous			Minor reduction in opening of expansion joint, away from early warning trigger level of 30 mm. Measurements consistent with survey and manual measurements. Approx. 15 mm of change due to temperature. Mine Site Management Group agreed to continue monitoring as the expansion joint has capacity to open up to 90 mm and the joint is expected to close as mining continues.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Stress monitoring at T4	Continuous		N/A	Minor changes in response to stockpile loading as per recommended plan.
Gap in tripper rail	29 May	Weekly	N/A	Rail joint has opened since baseline inspection. No change this week. Current gap remains 10 to 11 mm.
Joint monitoring in Reclaim Tunnel between T5 and T6	29 May	Weekly	N/A	No issues observed. No change to gaps 53 to 57 mm.
Visual inspections	29 May	Weekly	(cracks found in 6C Tunnel)	5C conveyor handrails and floor plate opening. Possible opening of existing joints. Cracks observed at two locations at tunnel and vent shaft interface, one along the western face and one at the edge of the vent shaft. Cracks are less than 1 mm in width. Inspection by structural engineer on 30 May and there are no immediate concerns.
Overhead conveyors				
Conveyor trestle surveys	23 May	Weekly		Minor changes observed along 3R, 4C, 4S, 7C and 8C conveyors.
Laser distancemeter at Conveyor 3R across Railway	Continuous			Minor changes observed.
Visual inspection	29 May	Weekly		4S slide joint has not changed this week. 8C slide joint has not changed this week. 7C conveyor has not changed this week.
Drift				
Drift survey	24 May	Weekly		Closure measured last week between Marks PTL-03 and PTL-04 has reduced this week.
Visual inspection	Daily		N/A	No issues reported.
Winder				
Tiltmeters on Winder	Continuous			Minor changes observed.
Visual inspection	26 May	Weekly	N/A	No issues observed.
Rail Loop				
Long bay length survey	22 May	Weekly		No change in measured distance this week for long bay distance between Pegs BL600 and BL700, which shortened by 11mm on 15 May, exceeding 10mm trigger level. Mine Site and Rail Management Groups met on 19 May. Closure is distributed over bay length, with max. 4mm closure between BL600 and BL620. No bump observed in subsidence profile and site does not coincide with creek crossing or known geological structures. Gradual rates of change observed. No issues with rail stress until summer and it is planned to restress prior to hot temperatures. Focussed inspections will be conducted along track, Rail Loader, Conveyors 4S and 4C and Washery, which are located in this area.
Road culvert survey	22 May	Weekly	N/A	Results within survey tolerance.
Track geometry survey	22 May	Weekly		No issues reported.
Track inspection	Daily		N/A	Daily inspections commenced, no issues reported.
Mine Site Structures				
Tiltmeters on Raw Coal Bins	Continuous			Minor changes observed.
Rail Loader survey	22 May	Weekly		Results within survey tolerance.
Reject Bin survey	23 May	Weekly		Minor changes observed.
Visual inspections	26 May	Weekly		No issues reported.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Overhead crane and monorails				
Crane rail survey	22 May	Weekly		Results within survey tolerance.
Visual inspections	29 May	Weekly		No issues reported.
Shaft No. 3				
Tiltmeters on shaft winder	Continuous			Minor changes observed.
Clearance measurements at 135m depth	24 May	Weekly		Clearances between 240 mm and 340 mm this week, greater than minimum clearance of 180 mm.
Visual inspection	Daily		N/A	No issues reported.
Dams, embankments and site services				
Dam S4 survey	22 May	Weekly	N/A	Minor subsidence and closure observed.
Dam S2 and S3 survey	22 May	Weekly	N/A	Results within survey tolerance.
Visual inspections by building inspector, incl high pressure water pipeline	23 & 24 May	Weekly		No issues observed.
Geotech inspections on mine site	-	Monthly		Last inspection 8 May. No issues observed by geotechnical engineer.
Geotech inspections of Dams S2 and S3 from railway	22 May	Weekly		No issues observed by geotechnical engineer.
Track inspections of Dams S2 and S3 from railway	Daily		N/A	No issues observed by Track Certifier.
Reject Emplacement Area				
Visual inspections	-	Cease		No issues observed. Weekly inspections have ceased as LW face has moved well away from this area.
Management Actions				
Other management actions since previous report: ● Inspection of 6C conveyor by structural engineer on 22 and 30 May				
Any additional and/or outstanding management actions: ● Nil				
IMG meeting since previous report: ● Weekly IMG meeting held 31 May				
Forecast whether continued longwall mining is likely to cause impact on the safety of operations at Tahmoor Mine Site Based on monitoring results to date, and the controls implemented and available under the LW S1A-S6A Management Plan for Longwall Mining beneath and adjacent to the Tahmoor Mine Site, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.				
Certified by Tahmoor Coal				
Name	Ross Barber			
Position	Project Manager			
Signature	*Ross Barber*			
24	31 May 2023			

Copy of Report to:
IMG
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate


I:\Projects\Tahmoor South\MSEC1329 - Mine Site Monitoring\Subsdata\TS surveys\Subs vs face.grf
Incremental subsidence (mm)
0
100
200
300
400
500
600
700
800
900
-300
-200
-100
0
100
200
300
400
500
600
700
800
900
1000
1100
Distance between survey mark and longwall face (m). Positive when behind the face.
GNSS S01
GNSS S02
GNSS at Pier 2
V51
MS 98800
Predicted incremental subsidence at V51

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 20
During the mining of LW S1A beneath the Tahmoor Mine Site

Reporting Period	1 July 2023 to 7 July 2023	
Length of extraction of LW S1A	1706 m	LW completed extraction on 4 July 2023
Closest distance of LW S1A face to Pier 2 on Conveyor 5C		
Distance travelled by LW since previous report	3 m	Since 29 June 2023
Maximum incremental subsidence within Tahmoor Mine Site	347 mm	at 6C-16A on 5 July 2023
Maximum change in subsidence since previous survey	7 mm	at GNSS unit at Pier 2 since 29 June 2023
Safety Incidents	No incidents reported.	
Subsidence impacts reported by Tahmoor Mine Site staff	No subsidence impacts reported.	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
General Mine Site monitoring				
GNSS Unit Gantry at Pier 2	Continuous		N/A	Very minor increase in subsidence for this period, total subsidence is 347mm.
GNSS Unit S16 (near Shaft No. 3)	Continuous		N/A	Minor horizontal movement to the south.
V-Line along Tahmoor Mine property boundary	5 Jul	Monthly	N/A	Subsidence at reduced rates of change.
Main Southern Railway	4 Jul	Weekly	N/A	Rates of change reduced to low levels.
Rail Loop	3 Jul	Weekly	N/A	Very minor changes observed.
Remembrance Drive	3 Jul	Weekly	N/A	Minor vertical subsidence developing with compressive strain at Pegs R47-R48 and bump growing in subsidence profile at Peg 46. Minor changes this week.
Visual inspections	3 Jul	Weekly		No significant change observed this week.
Stockpile Area: Conveyor 5C and Reclaim Tunnel Conveyor 6C				
Reclaim Tunnel survey	4 Jul	Weekly		Minor subsidence continuing.
Conveyor 5C survey	4 Jul	Weekly	N/A	Very minor subsidence and tilt continuing to develop.
Inclinometer surveys	3 Jul	Weekly	N/A	No significant change observed this week.
Tilt monitoring at Pier 2	Continuous		N/A	Minor changes in tilts this week.
Tilt monitoring at T4	Continuous		N/A	Minor changes in response to stockpile loading.
Displacement monitoring at T4	Continuous			Minor opening of expansion joint, returning towards baseline. Measurements consistent with survey and manual measurements.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Stress monitoring at T4	Continuous		N/A	Minor changes in response to stockpile loading as per recommended plan.
Gap in tripper rail	10 Jul	Weekly	N/A	Rail joint has opened 4mm this week likely temperature related.
Joint monitoring in Reclaim Tunnel between T5 and T6	10 Jul	Weekly	N/A	No noticeable change.
Visual inspections	10 Jul	Weekly	(cracks found in 6C Tunnel)	Structure gap across expansion joint has opened slightly this week at T4. No noticeable change in cracking this week.
Overhead conveyors				
Conveyor trestle surveys	4 Jul	Weekly	(change in distance)	The slide joint at the 7C conveyor is moving as expected and the movement is likely temperature related.
Laser distancemeter at Conveyor 3R across Railway	Continuous			Minor changes observed.
Visual inspection	10 Jul	Weekly		4S slide joint has not changed this week. 8C slide joint has not changed this week. 7C slide joint (west) measurements show that the 7C conveyor structure has moved to the south this week consistent with measured ground movements and temperature change.
Drift				
Drift survey	5 Jul	Weekly		Very minor changes across the portal this week.
Visual inspection	Daily		N/A	No issues reported.
Winder				
Tiltmeters on Winder	Continuous			Minor changes observed.
Visual inspection	7 Jul	Weekly	N/A	No issues observed.

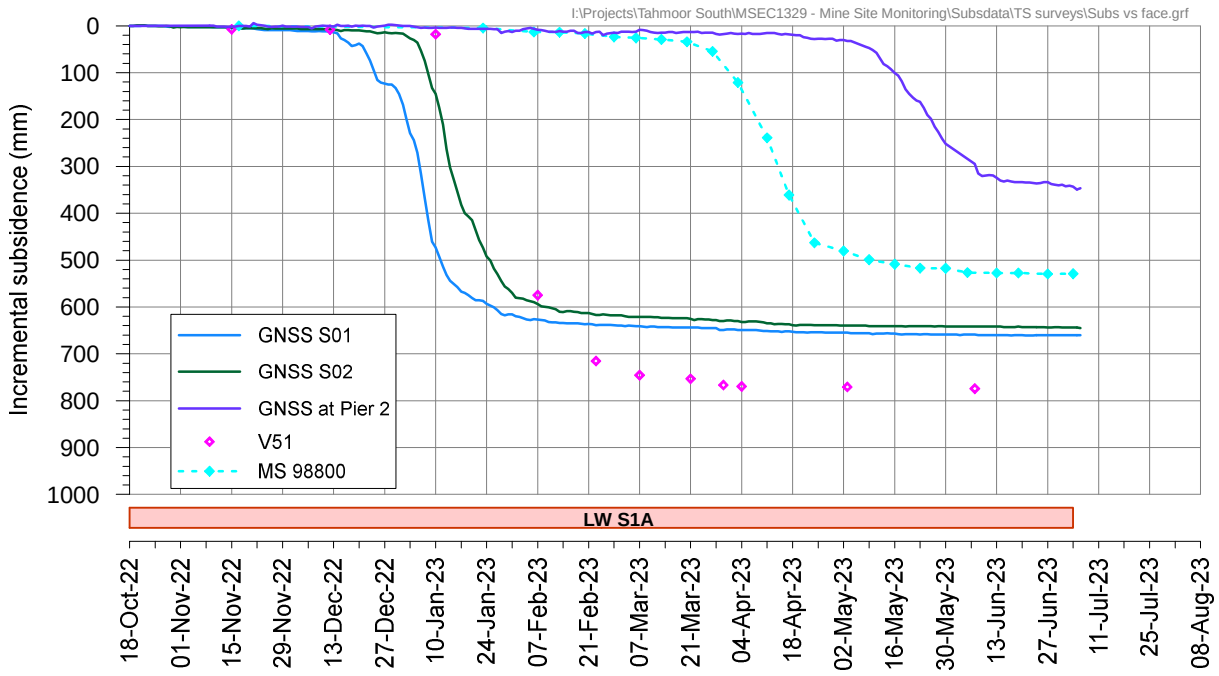
Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Rail Loop				
Long bay length survey	3 Jul	Weekly		Minor (1 mm) increase in measured distance for long bay distance between Pegs BL600 and BL700, with ground shortening at 10mm trigger level. No issues with rail stress until summer and it is planned to restress prior to hot temperatures.
Road culvert survey	3 Jul	Weekly	N/A	Results within survey tolerance.
Track geometry survey	3 Jul	Weekly		No issues reported.
Track inspection	Daily		N/A	No issues reported.
Mine Site Structures				
Tiltmeters on Raw Coal Bins	Continuous			Minor changes observed.
Rail Loader survey	4 Jul	Weekly		Results within survey tolerance.
Reject Bin survey	3 Jul	Weekly		Minor changes observed.
Visual inspections	7 Jul	Weekly		No issues reported.
Overhead crane and monorails				
Crane rail survey	-	Weekly		Last survey 26 June. Awaiting results from survey completed 11 July.
Visual inspections	7 Jul	Weekly		No issues reported.
Shaft No. 3				
Tiltmeters on shaft winder	Continuous			Minor changes observed.
Clearance measurements at 135m depth	11 Jul	Weekly		Clearances between 260 mm and 300 mm this week, greater than minimum clearance of 180 mm.
Visual inspection	Daily		N/A	No issues reported.
Dams, embankments and site services				
Dam S4 survey	-	End of LW	N/A	Final survey at end of LW S1A.
Dam S2 and S3 survey	-	End of LW	N/A	Final survey at end of LW S1A.
Visual inspections by building inspector, incl high pressure water pipeline	6 Jul	Weekly		No issues observed.
Geotech inspections on mine site	-	Monthly		Last inspection June 23. No issues observed by geotechnical engineer.
Geotech inspections of Dams S2 and S3 from railway	5 Jul	Weekly		No issues observed by geotechnical engineer.
Track inspections of Dams S2 and S3 from railway	Daily		N/A	No issues observed by Track Certifier.
Reject Emplacement Area				
Visual inspections	-	Cease		No issues observed. Weekly inspections have ceased as LW face has moved well away from this area.

Management Actions	
Other management actions since previous report: ● Nil	
Any additional and/or outstanding management actions: ● Nil	
IMG meeting since previous report: ● Weekly IMG meeting held 12 July. ● It was agreed by the IMG to seek Mine Management approval to cease weekly general mine site monitoring as of 19 July 2023.	
Forecast whether continued longwall mining is likely to cause impact on the safety of operations at Tahmoor Mine Site Based on monitoring results to date, and the controls implemented and available under the LW S1A-S6A Management Plan for Longwall Mining beneath and adjacent to the Tahmoor Mine Site, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.	
Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	
Date	12 July 2023

Copy of Report to:

IMG

Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate



Appendix H – 3030 Remembrance Drive Monitoring Reports

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 06
3030 Remembrance Driveway, Bargo

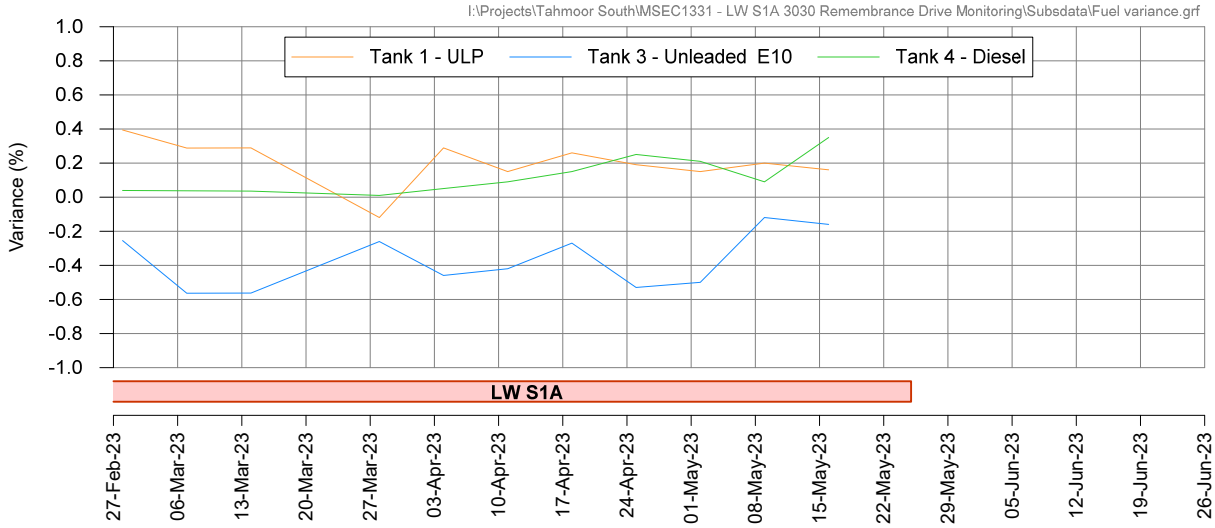
Reporting Period	20 May 2023 to 26 May 2023	
Length of extraction of LW S1A	1588 m	as at 25 May 2023 LW S1A commenced 18 October 2022
Length of extraction remaining of LW S1A	123 m	
Distance travelled by LW since previous report	33 m	Since 18 May 2023
Closest distance of LW S1A face to property	0 m	LW face beneath northeast corner of property
Closest distance of LW S1A face to fuel station	50 m	LW face beyond fuel station and moving away
Maximum incremental subsidence since start of LW S1A	28 mm	At Pegs BP-6, BP-7 and BP-11 on 25 May 2023
Maximum increase in subsidence since previous report	4 mm	At Pegs BP-3 to BP-8, BP-10, BP-11, BP-14 and BP-16 (18 May to 25 May)

Summary of monitoring and inspections

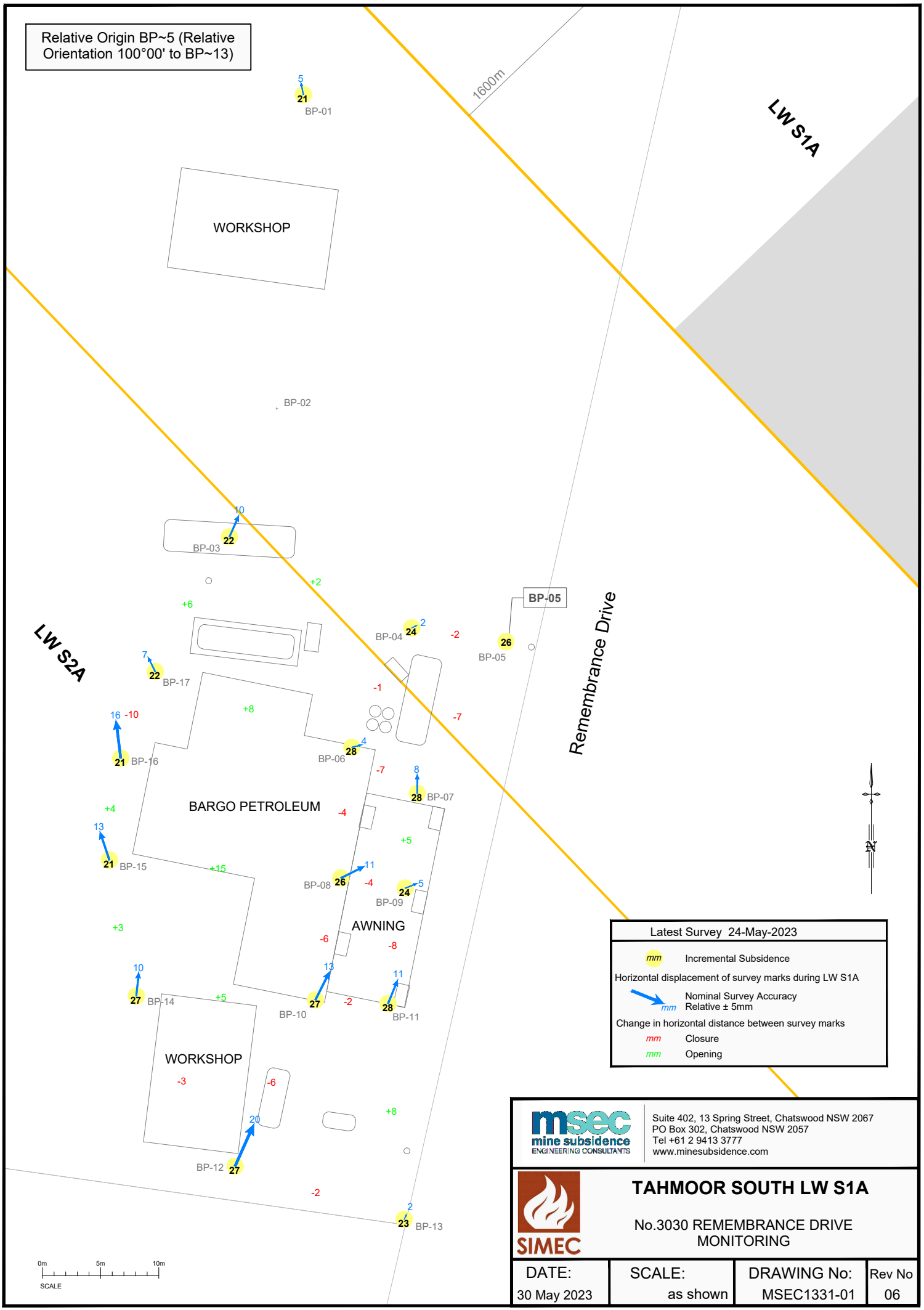
Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Remembrance Driveway				
Ground survey	22 May	Abs. Mthly Rel. Weekly	N/A	Minor changes observed.
Visual inspection	22 May	Weekly	N/A	No issues observed.
Structures				
Local 3D survey	24 May	Weekly	N/A	Minor changes measured.
Visual inspections	25 May	Weekly	N/A	No issues observed.
Fuel tanks and fuel lines				
Fuel balance monitoring	16 May	Weekly	(unlikely to be mining issue)	The buried petrol tanks have passed the fuel balance test. A loss trend is observed for the above-ground diesel tank. The diesel tank has previously failed the test and the owner is investigating. The cause is unlikely to be a mining issue. Surveys around the tank measure very small ground strains, close to survey tolerance.
Pressure testing	-	-	N/A	Last test 21 April. No issues reported.
Groundwater				
Hydrocarbon testing	19 May	Monthly		Concentrations below assessment criteria.
Visual inspections	19 May	Monthly	N/A	No issues reported.
Vehicle hoists				
Alignment survey	-	-	N/A	The motorsports workshop has closed and the tenant has vacated the premises.
Management Actions				
Other management actions since previous report: • Nil				
Any additional and/or outstanding management actions: • Nil				
Consultation with stakeholders since previous report: • Weekly reports issued during the mining of LW S1A				
Forecast whether continued longwall mining is likely to cause impacts on the health and safety of people who may be present at the property due to the extraction of LW S1A Based on monitoring results to date, and the controls implemented and available under the LW S1A Management Plan, no triggers under this Management Plan are expected to be exceeded in the next week.				

Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	*Ross Barber*
30	30 May 2023

Copy of Report to:
Landowner
Bargo Petroleum
Road Tested Spares, Auto Wreckers
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate



I:\Projects\Tahmoor South\MSEC1331 - LW S1A 3030 Remembrance Drive Monitoring\AcadData\MSEC1331-01 No3030 Remembrance Dr.dwg



msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

TAHMOOR SOUTH LW S1A

No.3030 REMEMBRANCE DRIVE MONITORING

DATE:	SCALE:	DRAWING No:	Rev No
30 May 2023	as shown	MSEC1331-01	06

Tahmoor South LW S1A
Incremental subsidence profiles along Remembrance Drive

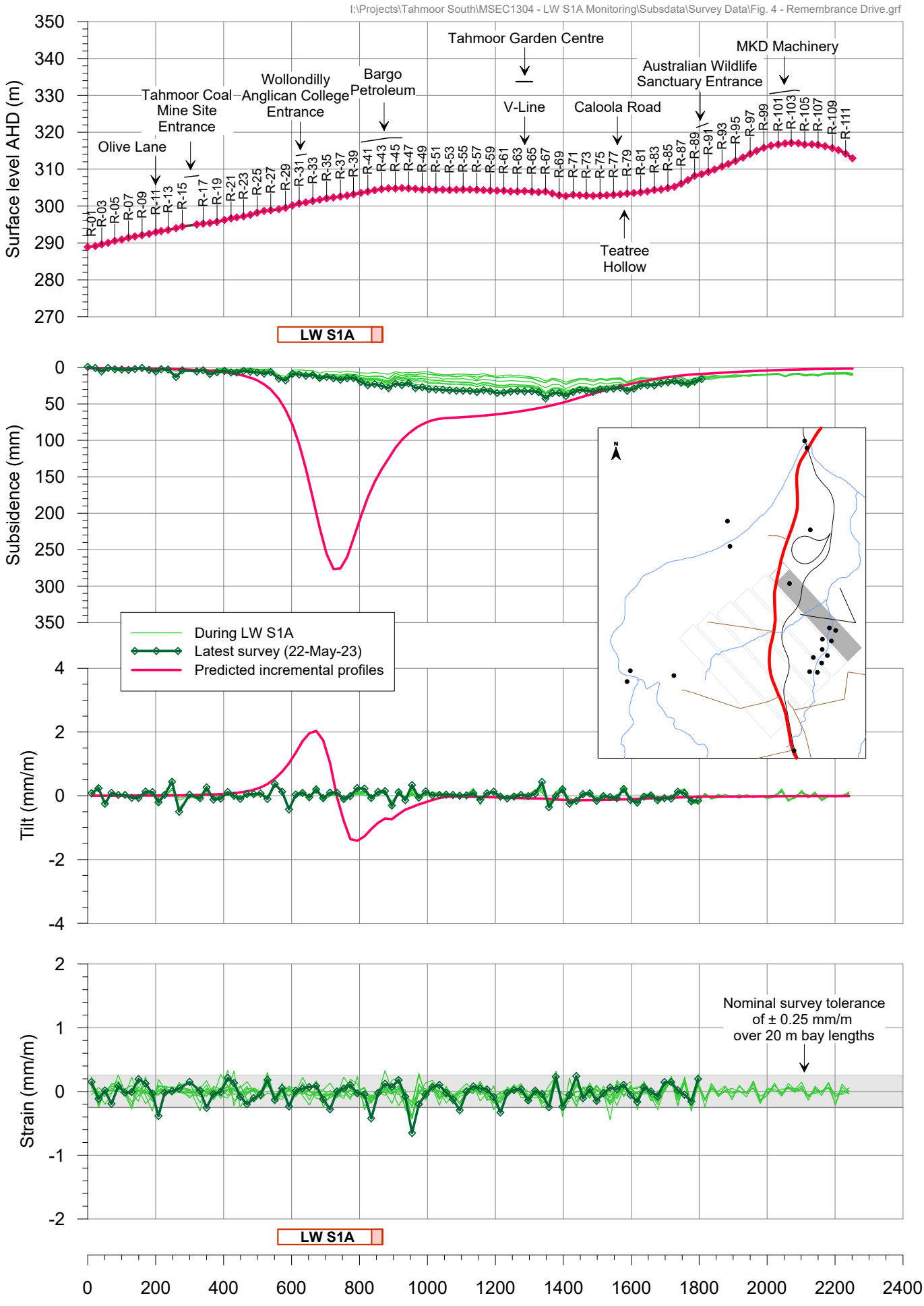


Fig. 4-R28

TAHMOOR COAL: LW S1A

Subsidence Management Status Report No. 13
3030 Remembrance Driveway, Bargo

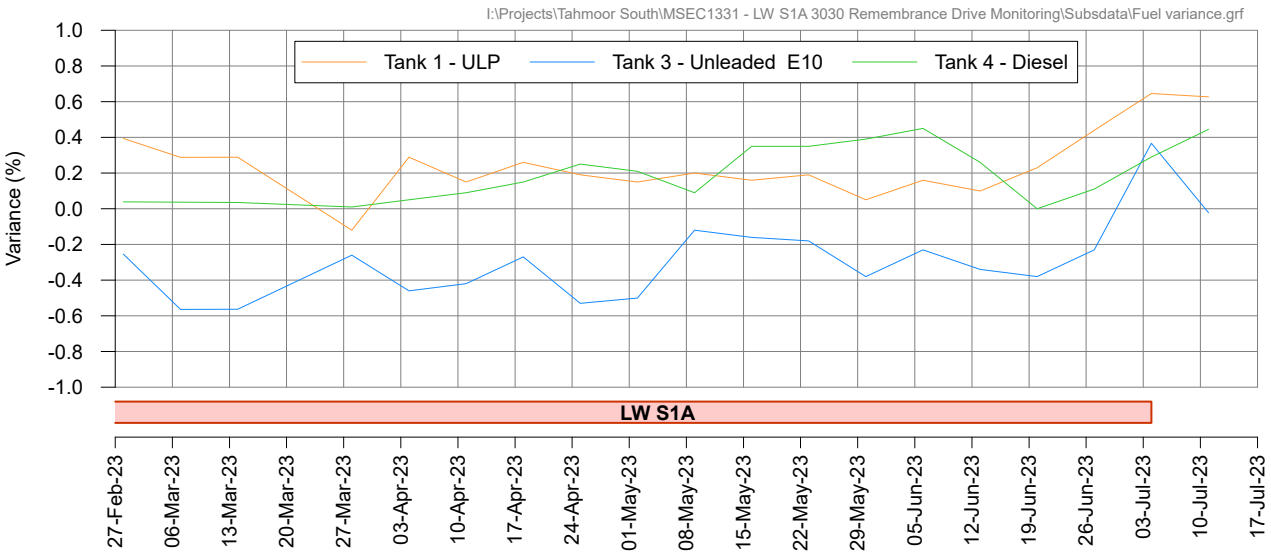
Reporting Period	8 July 2023 to 14 July 2023	
Length of extraction of LW S1A	1706 m	LW S1A completed extraction on 4 July 2023
Length of extraction remaining of LW S1A		
Distance travelled by LW since previous report	-	LW S1A completed extraction on 4 July 2023
Closest distance of LW S1A face to property	-	LW S1A completed extraction on 4 July 2023
Closest distance of LW S1A face to fuel station		
Maximum incremental subsidence since start of LW S1A	37 mm	At Peg BP-5 on 12 July 2023
Maximum increase in subsidence since previous report	3 mm	At Peg BP-7 (5 July to 12 July)

Summary of monitoring and inspections

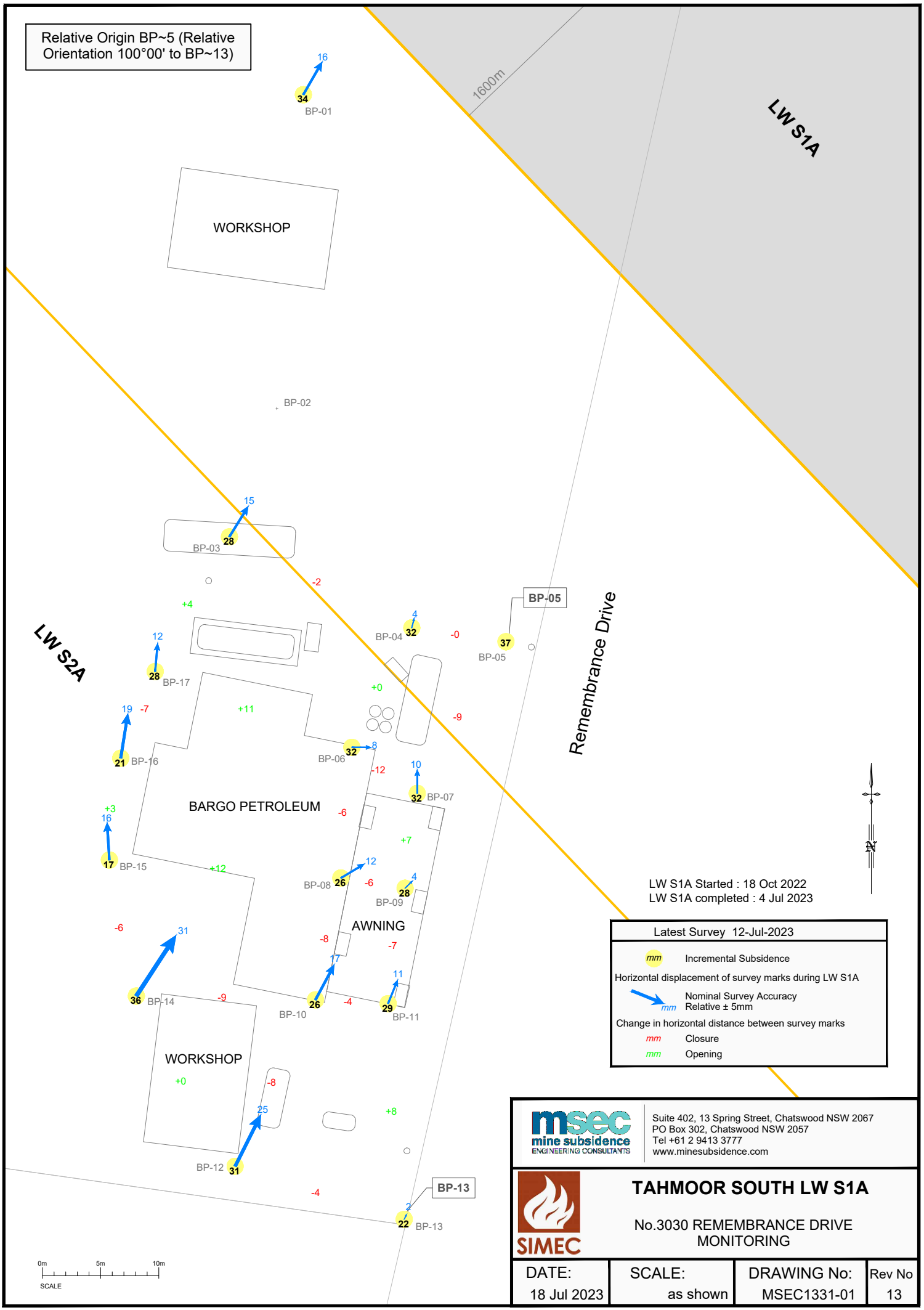
Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Remembrance Driveway				
Ground survey	10 Jul	Abs. Mthly Rel. Weekly	N/A	Gradual development of non-conventional compressive strain along Remembrance Drive between Pegs R47 and R48 and bump in observed subsidence profile at Peg R46. Minor changes observed this week.
Visual inspection	10 Jul	Weekly	N/A	Small bump observed in southbound lane of Remembrance Drive at location of compressive strain between Pegs R47 and R48. A faint bump is visible on the edge line of the northbound lane south of Peg R46. No significant changes observed this week.
Structures				
Local 3D survey	5 Jul	Weekly	N/A	Minor changes measured.
Visual inspections	7 Jul	Weekly	N/A	No issues observed.
Fuel tanks and fuel lines				
Fuel balance monitoring	11 Jul	Weekly	(under investi-gation)	Last report 11 Jul. The buried petrol tanks have passed the fuel balance test during LW S1A. A loss trend had been observed for the above-ground diesel tank between 18 April and 30 May 2023. The result was inconclusive on 6 June, then passed 13 June to 4 July. The latest test on 11 July recorded a loss trend. The cause is unlikely to be a mining issue as surveys around the tank measure very small ground strains, close to survey tolerance. Tahmoor Coal will arrange to pressure test the lines in light of these observations (first attempt on 28 June due to inability to access the pump, which requires additional mechanical support) and is being arranged.
Pressure testing	-	-	N/A	Last test 21 April. No issues reported.
Groundwater				
Hydrocarbon testing	-	Monthly		Last test 21 June. Concentrations below assessment criteria.
Visual inspections	-	Monthly	N/A	Last inspection 21 June. No issues reported.
Vehicle hoists				
Alignment survey	-	-	N/A	The motorsports workshop has closed and the tenant has vacated the premises.

Management Actions	
Other management actions since previous report: ● Nil	
Any additional and/or outstanding management actions: ● Pressure testing of diesel fuel lines	
Consultation with stakeholders since previous report: ● Weekly reports issued during the mining of LW S1A ● Consultation regarding diesel tank	
Forecast whether residual subsidence is likely to cause impacts on the health and safety of people who may be present at the property due to the extraction of LW S1A Based on monitoring results to date, and the controls implemented and available under the LW S1A Management Plan, no triggers under this Management Plan are expected to be exceeded in the next week.	
Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	*Ross Barber*
Date	20 July 2023

Copy of Report to:
Landowner
Bargo Petroleum
Road Tested Spares, Auto Wreckers
Ray Ramage, A/Principal Inspector – Subsidence Engineering, Mine Safety Inspectorate



I:\Projects\Tahmoor South\MSEC1331 - LW S1A 3030 Remembrance Drive Monitoring\AcadData\MSEC1331-01 No3030 Remembrance Dr.dwg



msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

TAHMOOR SOUTH LW S1A

No.3030 REMEMBRANCE DRIVE MONITORING

DATE:	SCALE:	DRAWING No:	Rev No
18 Jul 2023	as shown	MSEC1331-01	13

Tahmoor South LW S1A
Incremental subsidence profiles along Remembrance Drive

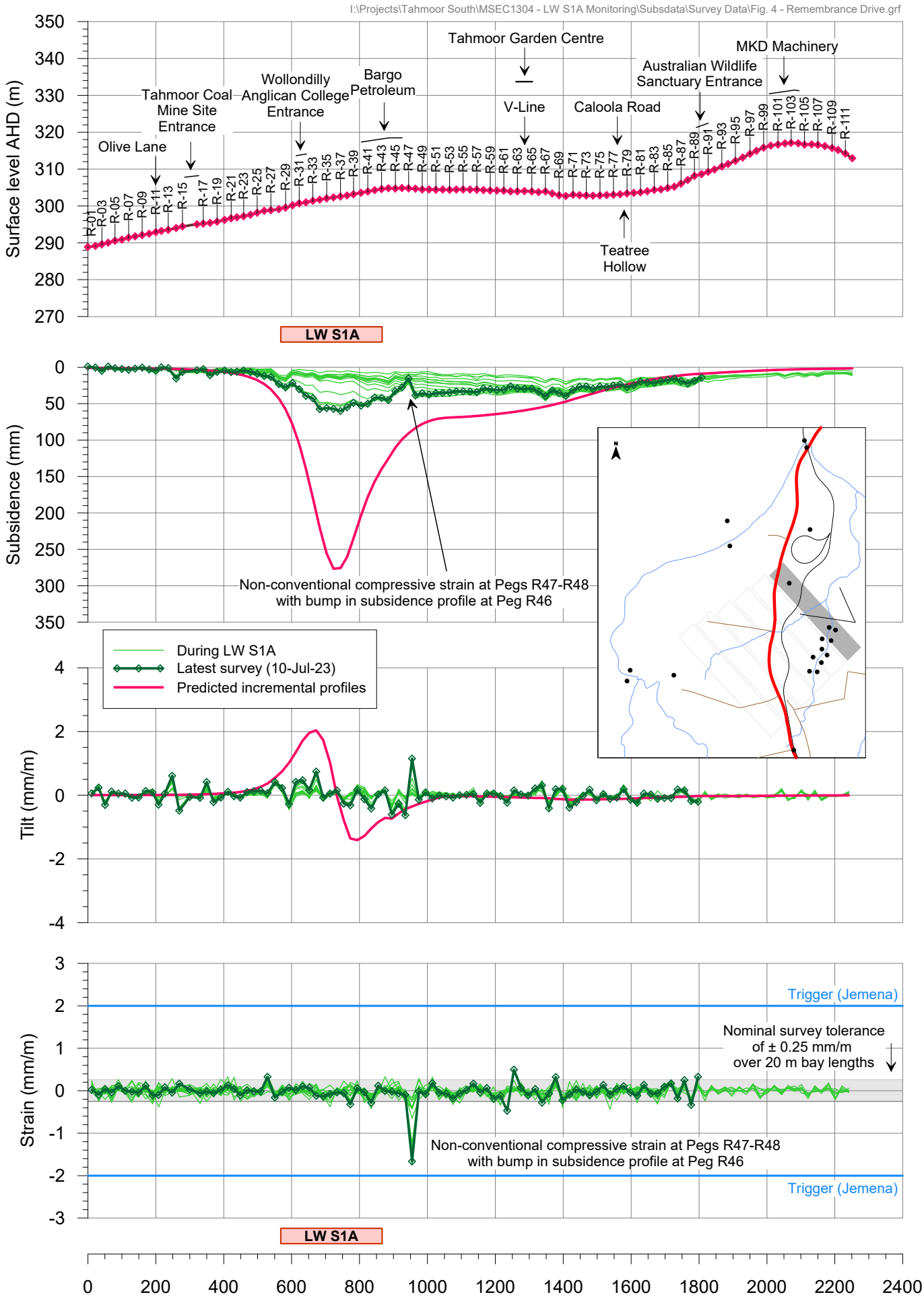


Fig. 4-R35