SOUTH32

END OF PANEL
LANDSCAPE REPORT
DENDROBIUM AREA 3C

DENDROBIUM AREA 3C LONGWALL 21 END OF PANEL LANDSCAPE REPORT

NOVEMBER 2023

EXECUTIVE SUMMARY

This report summarises the observed and measured subsidence effects on landscape features resulting from the extraction of Dendrobium Area 3C (DA3C) Longwall 21. Longwall 21 is the first panel extracted in DA3C. Extraction began on 25 April 2023 and was completed on 6 August 2023. The Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) conducts detailed monitoring and inspections of landscape features including swamps, watercourses, and landscape features within the mining area of DA3C. This monitoring was conducted in accordance with:

- Longwalls 20 and 21 Subsidence Management Plan (SMP) (November 2019) (Note- Longwall 20 is not yet extracted).
- Area 3C Swamp Impact, Monitoring, Management and Contingency Plan (SIMMCP) (August 2020)
- Area 3C Watercourse Impact, Monitoring and Contingency Plan (WIMMCP) (August 2020)

The Watercourse, Swamp and Landscape Trigger Action Response Plans (TARPs) form the basis of the impact assessments in this report.

A total of 36 surface impacts were identified by IMCEFT. During the Longwall 21 monitoring period two swamps recorded shallow groundwater triggers while three swamps recorded soil moisture triggers. During the reporting period swamp groundwater and/or soil moisture triggers were also recorded in swamps in Dendrobium Area 3A and 3B. Swamp triggers will be assessed further in the specialist Surface Water and Shallow Groundwater Assessment of the final EoP Report.

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Abbreviations

AEMR – Annual Environmental Management Report (now called Annual Review (AR))

BCD - Biodiversity and Conservation Division

CMA – Corrective Management Action

DPE - Department of Planning and Environment

EoP – End of Panel

IMCEFT – Illawarra Metallurgical Coal Environmental Field Team

RR – Resources Regulator

SIMMCP – Swamp Impact, Monitoring, Management and Contingency Plan

S32 – South32

SMP – Subsidence Management Plan

TARP – Trigger Action Response Plan

WIMMCP – Watercourse Impact, Monitoring, Management and Contingency Plan

Definitions

Active Mining Area – Within 400m of the active longwall.

1 OVERVIEW OF MONITORING PROGRAM

Landscape monitoring was conducted within the Longwall 21 mining area during baseline (pre-mining), active mining and post-mining periods. Baseline inspections were conducted up until the longwall was within 400m of each feature. During the active mining period (400m from the longwall), inspections increased to weekly until the longwall was at least 400m past the feature. Post-mining inspections continue as outlined in the relevant management plans.

1.1 Surface Monitoring for Longwall 21

IMCEFT and other specialists conducted observations and measurements of surface and shallow groundwater levels, swamp soil moisture, surface water flows, surface water quality and inspections of key landscape features. This monitoring included targeted sites within swamps and watercourses as well as steep slopes, cliff lines and other landscape features.

Landscape Monitoring Summary

In accordance with the Dendrobium Area 3C SMP Approval, landscape monitoring sites and photo points within the active mining area were monitored at monthly intervals. Monitoring photos from Landscape sites are compared to baseline photos at each site. Landscape monitoring sites (and photo points) were monitored before, during and after the Longwall 21 extraction period (Table 1).

Longwall 21 post-mining inspections were undertaken, and impacts were observed at two Landscape monitoring sites.

Table 1: Summary of Landscape monitoring sites associated with Longwall 21.

Site Name	Easting	Northing	Impact Description
LW21_RO1	291766	6194129	Rockfall at step
LW21_RO2	291046	6194265	No Impacts Observed
LW21_FR6F	291938	6194142	No Impacts Observed
LW21_AT1	291433	6194200	No Impacts Observed
LW21_SS1	291205	6194127	No Impacts Observed
LW21_SS2	291315	6194347	No Impacts Observed
LW21_SS3	291232	6194186	Fracture to rock outcrop

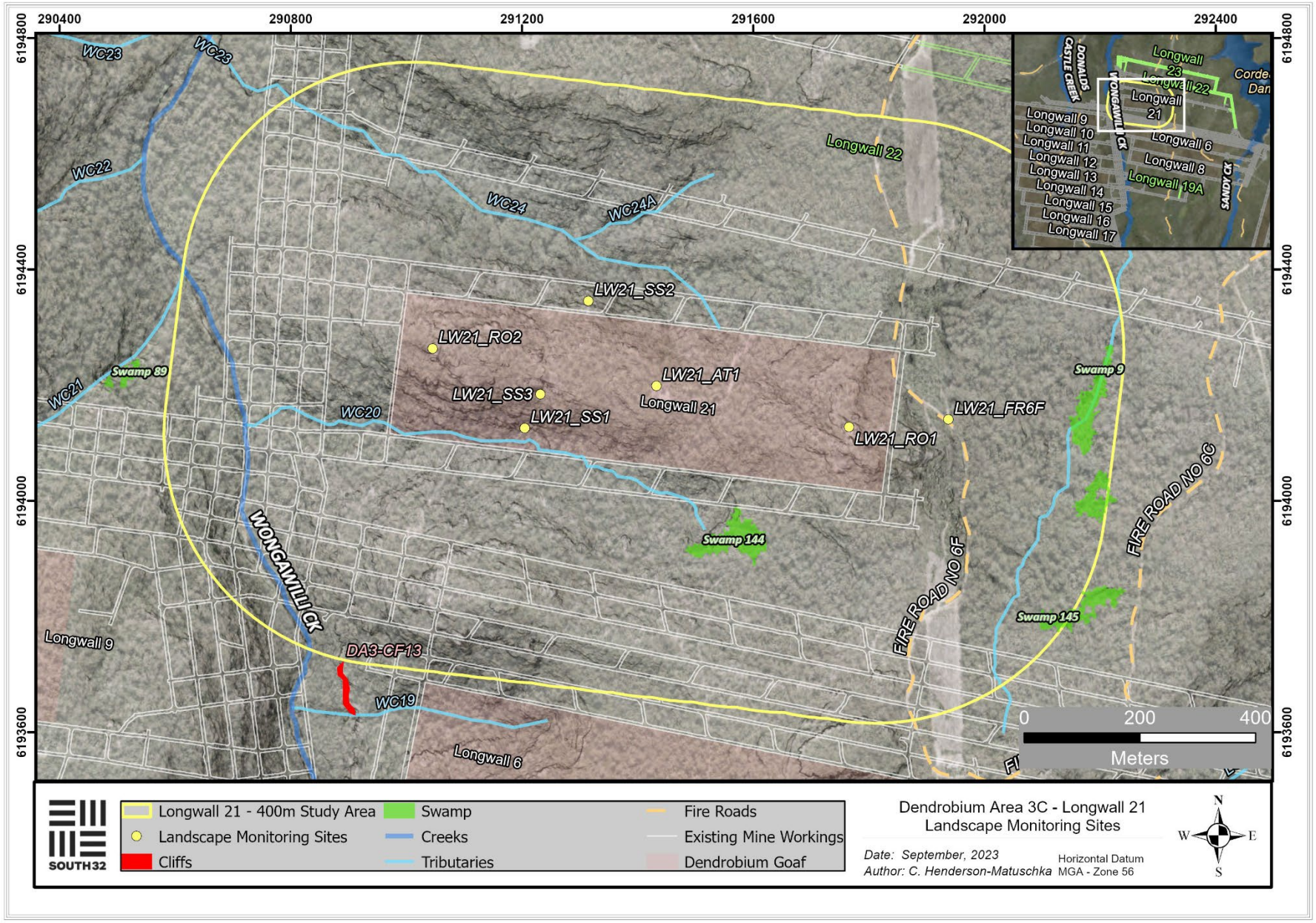


Figure 1: Map showing landscape monitoring sites relevant to Longwall 21.

2 REFERENCE SITE MONITORING

Swamp reference sites are monitored in accordance with the SIMMCP. Photos from reference swamps 22 and 24 are shown below (Photo 1 and Photo 2). Data recorded from reference swamps is compared with data from impact monitoring sites relevant to previously mined and active longwalls. Specialist assessments of swamps, including comparison with reference swamps, will be included in the Terrestrial Ecology Assessment and Surface Water and Shallow Groundwater Assessment, to accompany the Longwall 21 EoP Summary Report.

Photo 1: Reference site *S22_S02*. Taken on 22/06/2023.

Photo 2: Reference site *S24_S01*. Taken on 22/06/2023.

3 TARP OVERVIEW

Table 2: Management plans referred to for Longwall 21 monitoring and reporting.

Aspect	Management Plan
Swamps	Area 3C Swamp Impact, Monitoring, Management and Contingency Plan (August 2020)
Watercourses	Area 3C Watercourse Impact, Monitoring and Contingency Plan (August 2020)
Landscape	Dendrobium Area 3B Subsidence Management Plan (SMP), Volume 2 – Table 1.2 Dendrobium Landscape Impacts, Triggers and Response (November 2012)

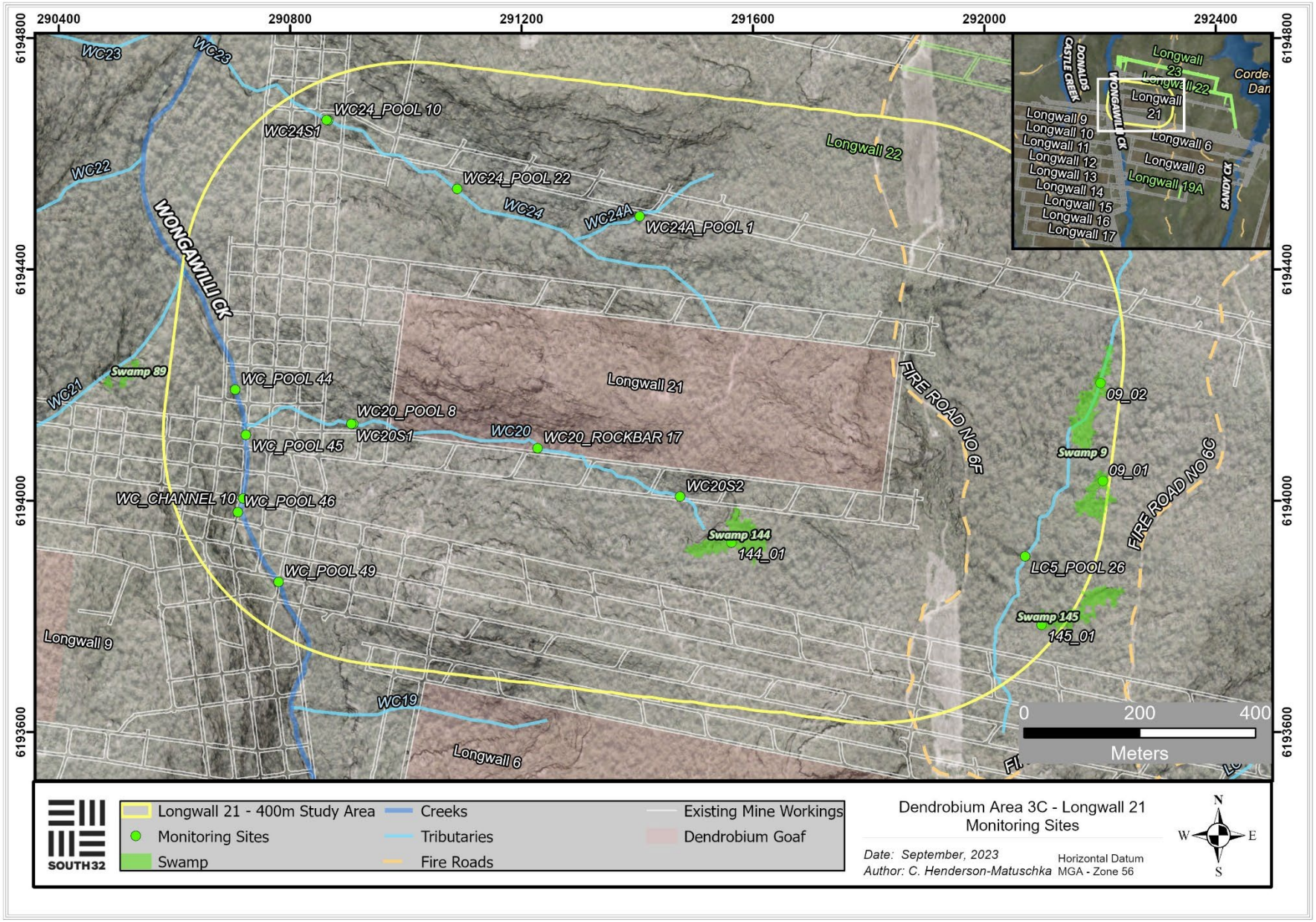


Figure 2: Map showing monitoring sites for the Longwall 21 active mining area

4 SUMMARY OF IMPACTS

During the extraction of Longwall 21, 36 new surface impacts were identified (Table 3, Figure 3). Shallow groundwater and soil moisture triggers were also recorded (Table 3, Figure 3 to Figure 4). These triggers will be further assessed in the Longwall 21 Surface Water and Shallow Groundwater Assessment.

Impacts to Natural Features

Subsidence includes vertical and horizontal movement of the land surface, which can result in surface and subsurface cracking, uplifting, buckling, dilation, and tilting. These impacts can affect watercourse hydrology and morphology, swamp hydrology and ecological function, and other landscape features by means of surface cracking, which can lead to erosion and rockfalls. Potential mine subsidence impacts within Dendrobium Area 3C are discussed in the Longwall 20 and 21 SMP, WIMMCP and SIMMCP.

Landscape features

Fractures and cracking observed during the extraction of Longwall 21 were assessed against the relevant TARP (landscape, swamp, or watercourse) and assigned a trigger value (Level 1, Level 2, Level 3 or Exceeding Prediction where applicable).

Table 3: Summary of impacts and triggers associated with Longwall 21.

Site ID	Eastings	Northings	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_001	291811	6194163	Rock Fracturing	Outcrop	06/06/2023	1	Rock fracturing to a small rock outcrop west of Fire Road 6F.	9/06/2023
DA3C_LW21_002	291766	6194129	Rock Fracturing and Rock Movement	LW21_RO1	06/06/2023	2	Rock fracturing and rock movement to a small rock outcrop at Landscape Monitoring Site LW21_RO1.	9/06/2023
DA3C_LW21_003	291739	6194104	Rock Fracturing and Rockfall	Outcrop and Step	06/06/2023	2	Rock fracturing and rockfall to an outcrop and a step west of Fire Road 6F.	9/06/2023
DA3C_LW21_004	291763	6194057	Rock Fracturing	Outcrop	06/06/2023	2	Rock fracturing on an outcrop west of Fire Road 6F.	9/06/2023
DA3C_LW21_005	291640	6194122	Rock Fracturing	Outcrop	15/06/2023	1	Rock fracture on a rock outcrop northeast of WC20.	19/06/2023

Site ID	Eastings	Northings	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_006	291661	6194107	Rock Fracturing	Outcrop	15/06/2023	1	Rock fracturing on a rock outcrop northeast of WC20.	19/06/2023
DA3C_LW21_007	291680	6194106	Rock Fracturing and Rockfall	Outcrop	15/06/2023	2	Rock fracturing and rock fall on an outcrop northeast of WC20.	19/06/2023
DA3C_LW21_008	291540	6194108	Rock Fracturing and Soil Cracking	Rock Step	19/06/2023	1	Rock fracturing/soil cracking to a rock step and bushland northeast of WC20.	20/06/2023
DA3C_LW21_009	291728	6194052	Rock Fracturing	Rock Step	19/06/2023	1	Rock fracturing to a rock step west of Fire Road 6F.	20/06/2023
DA3C_LW21_010	291772	6194167	Rock Fracturing and Rock Movement/ Displacement	Outcrop	19/06/2023	2	Rock fracturing and associated rock movement/displacement at an outcrop west of Fire Road 6F.	20/06/2023
DA3C_LW21_011	291767	6194198	Rock Fracturing, Rock Displacement and Soil Cracking	Outcrop and Bushland	19/06/2023	1	Soil cracking, rock fracturing and associated rock displacement to an outcrop and bushland west of Fire Road 6F.	20/06/2023
144_01	291562	6193926	Groundwater	Swamp 144	22/06/2023	3	Groundwater recession rate greater than baseline	28/06/2023
S144_01	291562	6193926	Soil Moisture	Swamp 144	27/06/2023	3	Average soil moisture level below the baseline level	28/06/2023
DA3C_LW21_012	291605	6194206	Rock Fracturing	Rock Step	27/06/2023	1	Rock fracturing to rock step west of Fire Road 6F.	28/06/2023
DA3C_LW21_013	291260	6194232	Rock Fracturing	Outcrop	03/07/2023	1	Rock fracturing to rock outcrop west of Fire Road 6F.	04/07/2023
DA3C_LW21_014	291465	6194006	Rock Fracturing	Watercourse	11/07/2023	2	Rock fracturing to rockbar on tributary WC20.	17/07/2023
DA3C_LW21_015	291421	6194021	Rock Fracturing	Watercourse	11/07/2023	2	Rock fracturing to channel on tributary WC20.	17/07/2023
DA3C_LW21_016	291249	6194096	Rockfall	Rock Step	11/07/2023	1	Small rockfall to step north of tributary WC20.	17/07/2023
Swamp 15a	292759	6192014	Groundwater	Swamp	12/07/2023	1	Groundwater trigger at one site in Swamp 15a. (Longwall 19 mining area)	17/07/2023

Site ID	Eastings	Northings	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
Swamp 15a	-	-	Soil Moisture	Swamp	12/07/2023	2	Soil moisture triggers at three sites within Swamp 15a. (Longwall 19 mining area)	17/07/2023
DA3C_LW21_016 (Update)	291249	6194096	Rockfall	Rock Step	26/07/2023	2	Rockfall to step north of tributary WC20.	31/07/2023
DA3C_LW21_017	291184	6194105	Rock Fracturing	Watercourse	26/07/2023	1	Rock fracturing and uplift to WC20_Rockbar 15.	31/07/2023
DA3C_LW21_018	291273	6194190	Rock Fracturing	Rock Outcrop/Ledge	26/07/2023	1	Rock fracturing to rock outcrop/ledge.	31/07/2023
DA3C_LW21_019	291634	6194239	Rock Fracturing	Rock Step	1/08/2023	1	Rock fracturing to rock step west of Fire Road 6F.	2/08/2023
DA3C_LW21_020	291318	6194429	Iron Staining	Watercourse	1/08/2023	1	Iron staining in tributary WC24.	2/08/2023
DA3C_LW21_021	291547	6193965	Iron Staining	Rock Step	1/08/2023	1	Iron staining on the Swamp 144 basal step. Reported under the Watercourse TARP as iron occurs in the general drainage line and headwaters of WC20.	2/08/2023
DA3C_LW21_022	291477	6193846	Rockfall	Rock Step	7/08/2023	1	Rockfall to rock outcrop/step west of Fire Road 6F	9/08/2023
S145_01	292099	6193785	Soil Moisture	Swamp	4/08/2023	3	Soil moisture trigger at one site in Swamp 145	9/08/2023
09_02	292200	6194203	Groundwater	Swamp	4/08/2023	2	Groundwater trigger at one site in Swamp 9	9/08/2023
Swamp 15a (update)	-	-	Soil Moisture	Swamp	11/08/2023	3	Soil moisture trigger recorded two additional sites (total now five) in Swamp 15a. (Longwall 19 mining area).	18/08/2023
S12_04	291475	6193086	Soil Moisture	Swamp	29/08/2023	3	Soil moisture trigger recorded in Swamp 12 (Longwall 19 mining area).	4/09/2023
S150_01	289689	6190240	Soil Moisture	Swamp	29/08/2023	3	Soil moisture trigger recorded in Swamp 150 (Longwall 18 mining area).	4/09/2023
09_01	292205	6194034	Groundwater	Swamp	30/08/2023	3	Groundwater trigger at second site in Swamp 9 (Longwall 21 mining area).	4/09/2023
S09_01	292205	6194034	Soil Moisture	Swamp	30/08/2023	3	Soil moisture trigger recorded in Swamp 9 (Longwall 21 mining area).	4/09/2023

Site ID	Eastings	Northings	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
S09_02	292200	6194203	Soil Moisture	Swamp	30/08/2023	3	Soil moisture trigger recorded in Swamp 9 (Longwall 21 mining area).	4/09/2023
DA3C_LW21_023	291206	6194204	Rock Fracturing	Rock Outcrop	31/08/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	4/09/2023
DA3C_LW21_024	291250	6194199	Rock Fracturing	Rock Outcrop	31/08/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	4/09/2023
DA3C_LW21_025	291112	6194193	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing and rockfall to a rock outcrop north of tributary WC20.	8/09/2023
DA3C_LW21_026	291034	6194170	Rockfall	Rock Outcrop	6/09/2023	1	Small rockfall and fracturing to step north of tributary WC20.	8/09/2023
DA3C_LW21_027	291221	6194124	Rockfall	Rock Outcrop	6/09/2023	2	Rockfall to step north of tributary WC20 at Landscape Monitoring Site *LW21_SS1*.	8/09/2023
DA3C_LW21_028	291287	6194140	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	8/09/2023
DA3C_LW21_029	291222	6194184	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20 at Landscape Monitoring Site *LW21_SS3*.	8/09/2023
DA3C_LW21_030	291566	6194131	Rock Fracturing	Rock Outcrop	12/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	14/09/2023
DA3C_LW21_031	291337	6194140	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_032	291055	6194151	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_033	291033	6194174	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_034	291046	6194236	Rock Movement and Soil Cracking	Rock Outcrop	12/09/2023	2	Rock movement and soil cracking to rock outcrop north of tributary WC20.	14/09/2023
S15b_H1	292517	6192696	Soil Moisture	Swamp	19/09/2023	3	Soil moisture trigger recorded in Swamp 15b (Longwall 19 mining area).	21/09/2023
S34_01	291891	6191892	Soil Moisture	Swamp	27/09/2023	3	Soil moisture trigger recorded in Swamp 34 (Longwall 19 mining area).	28/09/2023
DA3C_LW21_035	290842	6193559	Iron Staining	Bushland	9/10/2023	1	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	11/10/2023
DA3C_LW21_036	290837	6193550	Iron Staining	Bushland	9/10/2023	1	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	11/10/2023

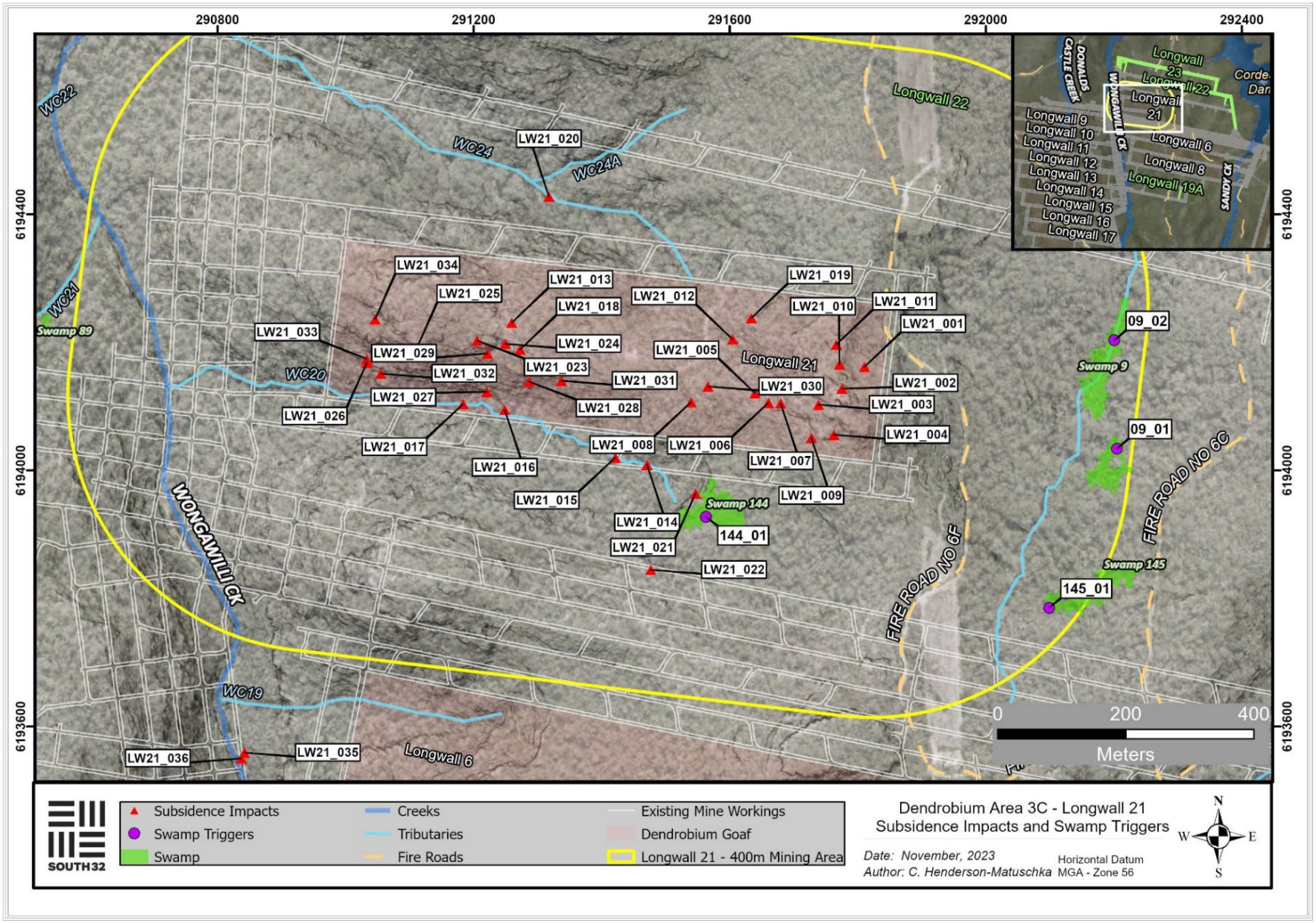


Figure 3: Map showing surface impacts and triggers recorded during the monitoring period of Longwall 21.

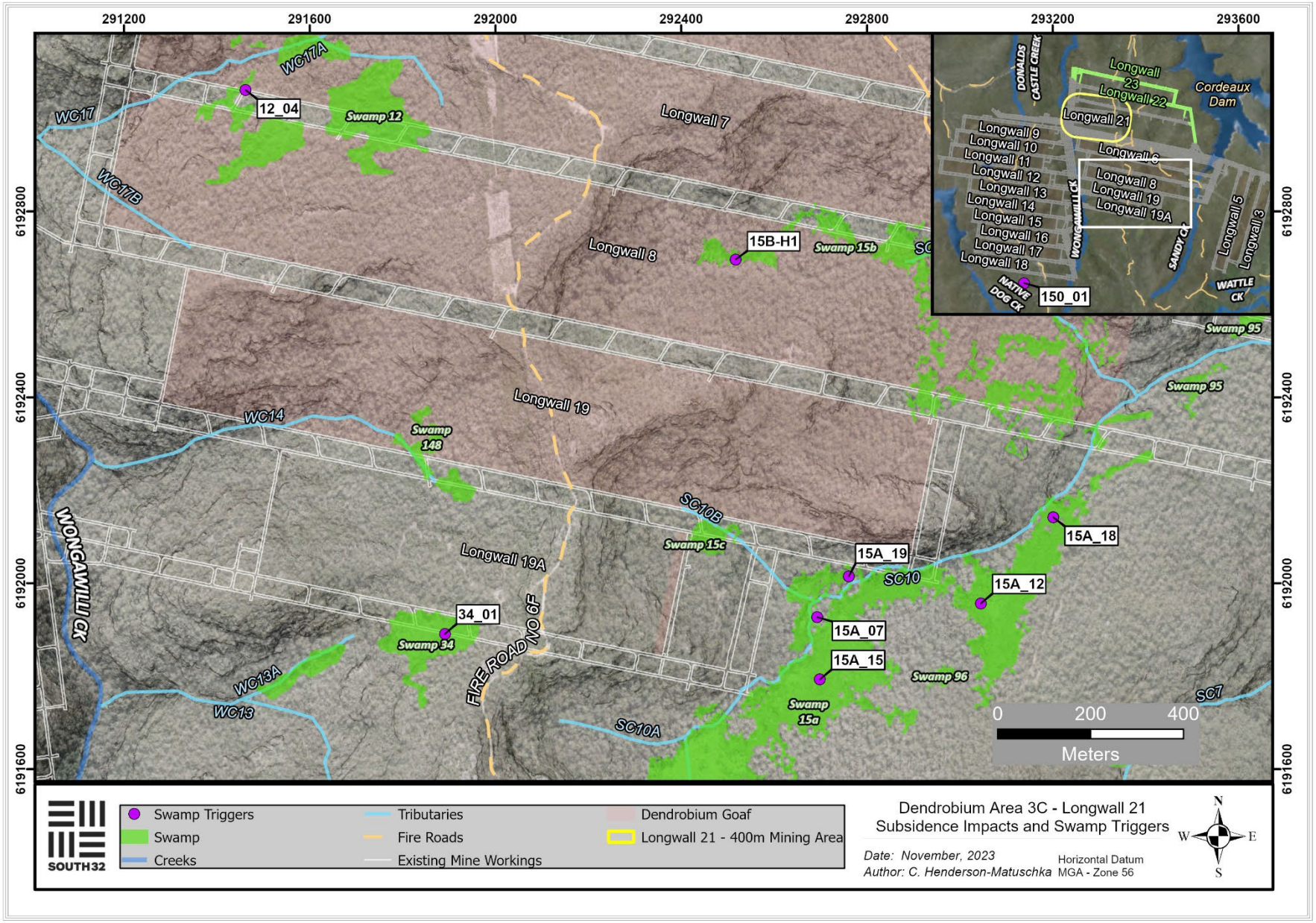


Figure 4: Map showing swamp triggers recorded during the monitoring period of Longwall 21.

5 IMPACTS TO WONGAWILLI CREEK

5.1 Wongawilli Creek

Wongawilli Creek Iron Staining (*DA3B_LW17_031*) (E 290859, N 6193467) (Update)

DA3B_LW17_031 consisted of an increase in iron staining in Wongawilli Creek, initially observed on 2 August 2021. Iron staining has previously been reported in WC17 and WC21, two tributaries in the Wongawilli Creek sub-catchment, following the extraction of Longwalls 7, 9 and 13. Iron staining was also observed during baseline stream mapping of Wongawilli Creek in 2007, prior to mining in Dendrobium Area 3. The influx of iron was evident in most stream features extending from *WC_Pool 50* down to *WC_Pool 20*. The distance between these features is approximately 2.9km. The source of the iron staining was identified as originating from a spring located on the valley slope of Wongawilli Creek, approximately 35m to the east, upslope from *WC_Pool 50*. The hillslope spring was first identified in March 2018. The hillslope spring is not located within any named tributary and was releasing flow into Wongawilli Creek at the time of the initial observations. During an inspection of the hillslope spring on 9/10/2023, the spring was active and discharging into Wongawilli Creek.

During inspections undertaken in September 2023, no iron was evident on Wongawilli Creek upstream of spring at *WC_Pool 53* (Photo 3 and Photo 4). Downstream of *WC_Pool 20* (Photo 9 and Photo 10), isolated sections of iron staining were restricted to shallow sections of pools and rockbars with the deeper pools remaining unaffected. No observable iron was evident at *Wongawilli Creek (FR6)* (Photo 11 and Photo 12) and *WC_Pool 2* (Photo 13 and Photo 14) (Figure 5).

These results will be assessed in further detail in the specialist Surface Water and Shallow Groundwater Assessment of the final EoP Report.

Photo 3: *WC_Pool 53* looking upstream. Taken 11/09/2023.

Photo 4: *WC_Pool 53* looking downstream. Taken 11/09/2023.

Photo 5: *WC_Pool 50* looking upstream. Taken 11/09/2023.

Photo 6: *WC_Pool 50* looking downstream. Taken 11/09/2023.

Photo 7: *WC_Pool 30* looking upstream.
Taken 11/09/2023.

Photo 8: *WC_Pool 30* looking downstream.
Taken 11/09/2023.

Photo 9: *WC_Pool 20* looking upstream.
Taken 11/09/2023.

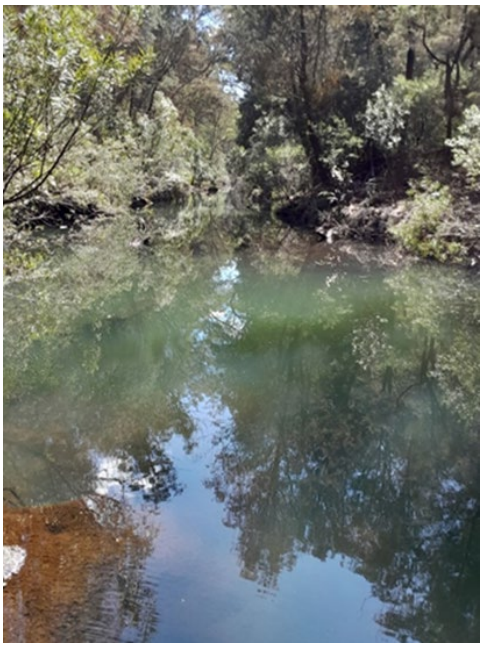


Photo 10: *WC_Pool 20* looking downstream.
Taken 11/09/2023.

Photo 11: *Wongawilli Creek (FR6)* looking upstream. Taken 19/09/2023.

Photo 12: *Wongawilli Creek (FR6)* looking downstream. Taken 19/09/2023.

Photo 13: *WC_Pool 2* looking upstream. Taken 19/09/2023.

Photo 14: *WC_Pool 2* looking upstream. Taken 19/09/2023.

WC_Pool 50 Gas Release (*DA3A_LW19_029*) (E 290816, N 6193699) (Update)

A gas release was initially observed in Wongawilli Creek at *WC_Pool 50* on 18 January 2023 (Figure 5). *DA3A_LW19_029* consisted of a gas release originating from the base of a sandstone step on the western side of the pool (Photo 15). The release was constant for approximately 15 seconds and ceased for approximately one minute, before starting again in a similar interval. A period of approximately 10 minutes was then observed without release. Very light, intermittent bubbling was also observed from the centre of the pool however these were very small and not able to be photographed.

The latest inspection was undertaken on 11 September 2023. During this inspection, one light gas release was reported from the base of the sandstone step on the western side of the pool (Photo 16). This release was

constant for a period of one minute and then ceased for approximately 9 minutes, before starting again in a similar interval. No releases were observed within the centre of pool.

These results will be assessed in further detail in the specialist Surface Water and Shallow Groundwater Assessment of the final EoP Report.

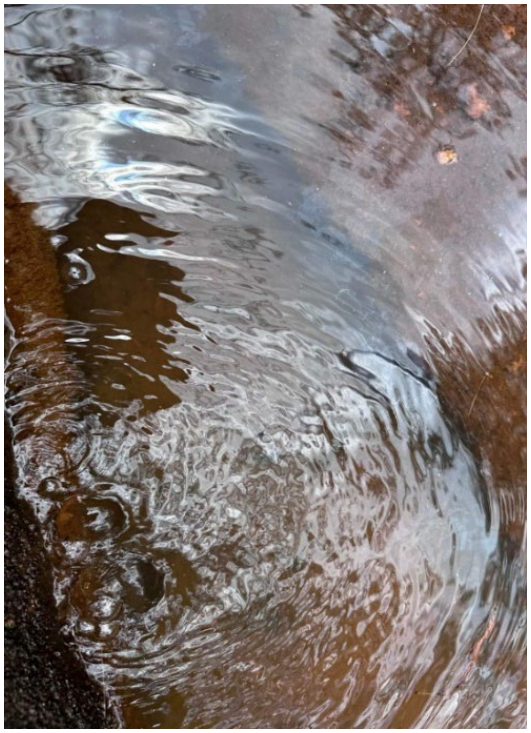


Photo 15: *DA3A_LW19_029,* gas release from base of sandstone ledge on the western side of *WC_Pool 50*, Wongawilli Creek. Taken on 18/01/2023.

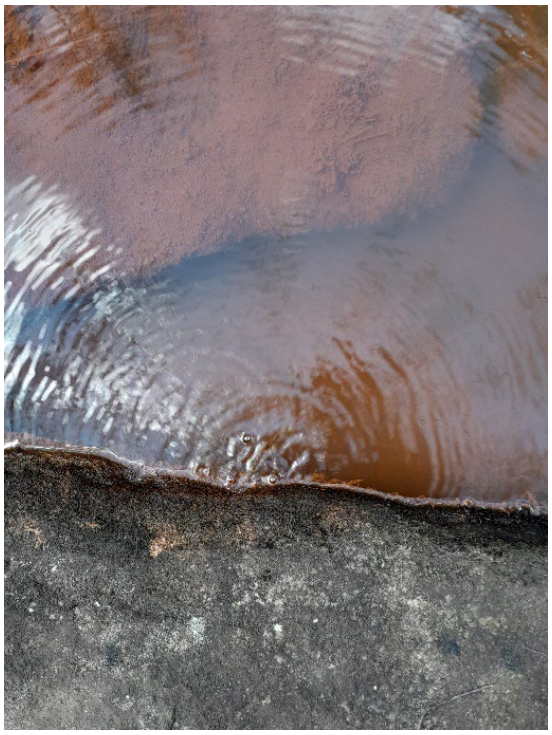


Photo 16: *DA3A_LW19_029,* gas release from base of sandstone ledge on the western side of *WC_Pool 50*, Wongawilli Creek. Taken on 11/09/2023.

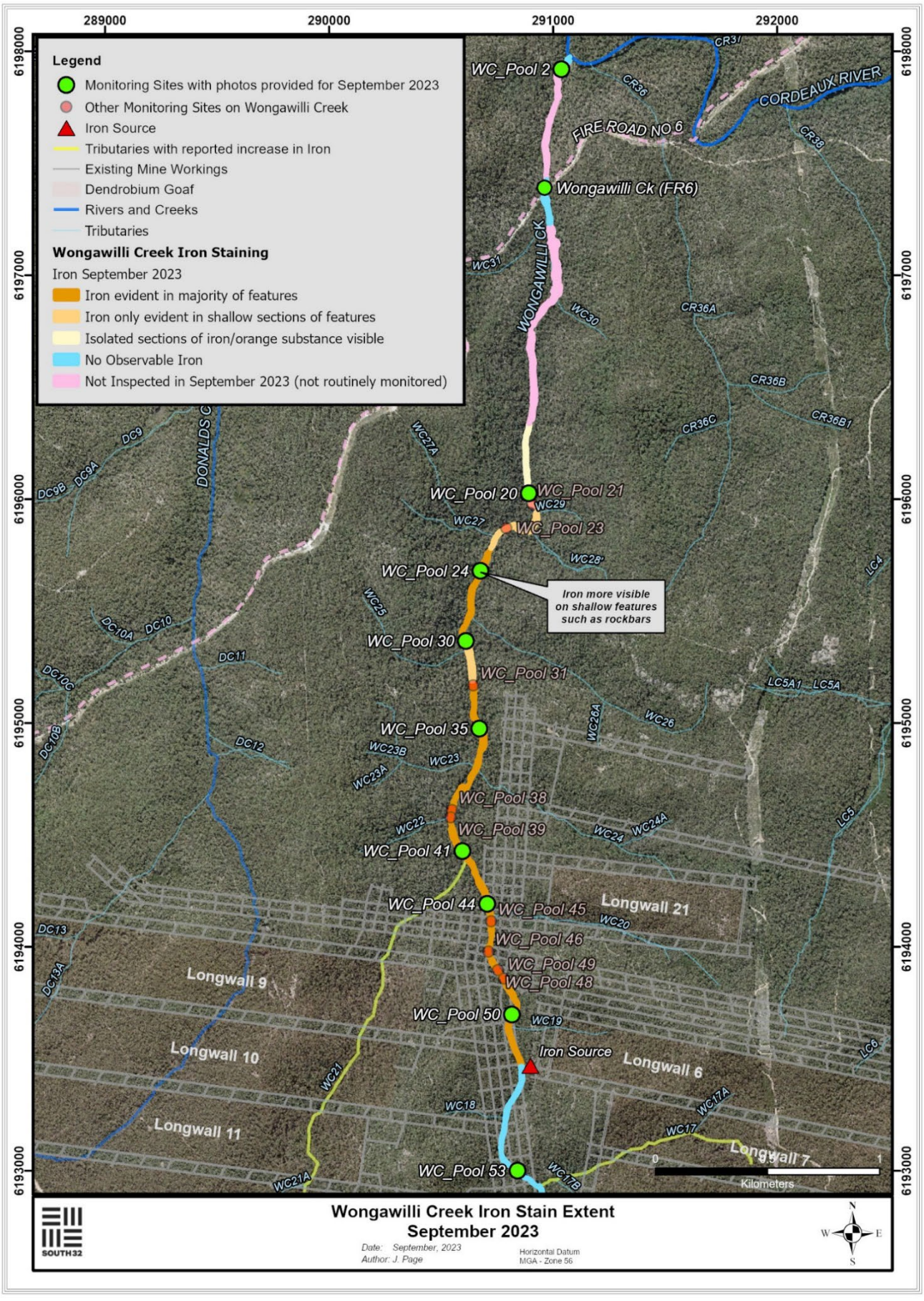


Figure 5: Wongawilli Creek iron stain extent, September 2023.

DA3C_LW21_035 (E 290842, N 6193559)

DA3C_LW21_035 is located upslope approximately 15m east of *WC_Pool 50* on *Wongawilli Creek* and is not associated with any mapped tributary (Figure 3). The impact consists of an iron spring and associated iron staining originating from a rock outcrop with seepage extending westward from an area associated with previous *DA3A* mining operations, specifically Longwall 6. The spring was active during the inspection with both the seepage and iron staining extending to *Wongawilli Creek* (Photo 17 and Photo 18). The iron spring and associated staining is approximately 95m north of a previously identified iron spring reported during the *LW17* monitoring period, specifically *DA3B_LW17_031* and is outside the Longwall 21 mining area.

DA3C_LW21_035 is a Level 1 trigger as per the Dendrobium Watercourse TARP (Table 7), specifically:

- Observable increase in iron staining within the mining area.

Photo 17: *DA3C_LW21_035,* looking upslope, showing source of iron spring & staining.

Photo 18: *DA3C_LW21_035,* looking downslope, showing extent of staining with *Wongawilli Creek* in the background.

DA3C_LW21_036 (E 290837, N 6193550)

DA3C_LW21_036 is located upslope approximately 8m east of *WC_Pool 50* on *Wongawilli Creek* and is not associated with any mapped tributary (Figure 3). The impact consists of an iron spring and associated iron staining originating from a rock outcrop with seepage extending westward from an area associated with previous *DA3A* mining operations, specifically Longwall 6. The spring was active during the inspection with both the seepage and iron staining extending to *Wongawilli Creek* (Photo 19 & Photo 20). This iron spring and associated staining is approximately 85m north of a previously identified iron spring reported during the Longwall 17 monitoring period, specifically *DA3B_LW17_031* and is outside the Longwall 21 mining area.

DA3C_LW21_036 is a Level 1 trigger as per the Dendrobium Watercourse TARP (Table 7), specifically:

- Observable increase in iron staining within the mining area

Photo 19: *DA3C_LW21_036,* looking upslope, showing source of spring and iron staining.

Photo 20: *DA3C_LW21_036,* looking downslope, showing extend of staining with *Wongawilli Creek* in the background.

IMPACTS TO FIRST AND SECOND ORDER STREAMS

5.2 WC20

DA3C_LW21_014 (E 291465, N 6194006)

Impact *DA3C_LW21_014* consists of rock fracturing on tributary WC20 (Figure 3). The fracturing was observed on mapped feature '*WC20_Rockbar 22'* (Photo 20 and Photo 21), with damage to the concrete footing of flow monitoring site *WC20S2* observed directly upstream (Photo 19). The fracturing on the rockbar has a maximum continuous length of 3.45m, a maximum width of 0.06m and a maximum measured depth of 0.57m. There was no surface flow at the site during this inspection and flow diversion is likely.

DA3C_LW21_014 is a Level 2 trigger as per the Dendrobium Watercourse TARP (Table 7), specifically:

- …fracture that results in observable loss of surface water or erosion.

Photo 21: *DA3C_LW21_014*, section of the rock fracturing. Taken on 11/07/2023.

Photo 22: *DA3C_LW21_014*, width of the rock fracture. Taken on 11/07/2023.

Photo 23: *DA3C_LW21_014*, damage to concrete footing of flow monitoring site *WC20S2*. Taken on 11/07/2023.

DA3C_LW21_015 (E 291421, N 6194021)

Impact *DA3C_LW21_015* consists of rock fracturing on tributary WC20 (Figure 3). The fracturing was observed on mapped feature '*WC20_Channel 8'* and has a maximum length of 2.26m, a maximum width of 0.02 and maximum measurable depth of 0.37m (Photo 24 to Photo 26). No surface flow or pooling was observed at the site during this inspection and flow diversion is likely.

DA3C_LW21_015 is a Level 2 trigger as per the Dendrobium Watercourse TARP (Table 7), specifically:

- …fracture that results in observable loss of surface water or erosion.

Photo 24: *DA3C_LW21_015*, section of rock fracturing. Taken on 11/07/2023.

Photo 25: *DA3C_LW21_015*, other section of rock fracturing. Taken on 11/07/2023.

Photo 26: *DA3C_LW21_015,* width of rock fracture. Taken on 11/07/2023.

DA3C_LW21_017 (E 291184, N 6194105)

Impact *DA3C_LW21_017* consists of rock fracturing and uplift to '*WC20_Rockbar 15*' on tributary *WC20* (Figure 3). The fracturing has a maximum length of 2.6m, a maximum width of 0.012m and uplift of 0.02m (Photo 27 to Photo 30). No surface flow was present during the inspection however the impact is not situated in the direct flow path, therefore flow diversion is unlikely to occur.

DA3C_LW21_017 is a Level 1 trigger as per the Dendrobium Watercourse TARP (Table 7), specifically:

- Crack or fracture up to 100mm width at its widest point with no observable loss of surface water or erosion;
- Crack or fracture up to 10m in length with no observable loss of surface water or erosion.

Photo 27: *DA3C_LW21_017*, width of the rock fracture. Taken on 26/07/2023.

Photo 28: *DA3C_LW21_017*, section of rock fracturing. Taken on 26/07/2023.

Photo 29: *DA3C_LW21_017*, section of rock fracturing. Taken on 26/07/2023.

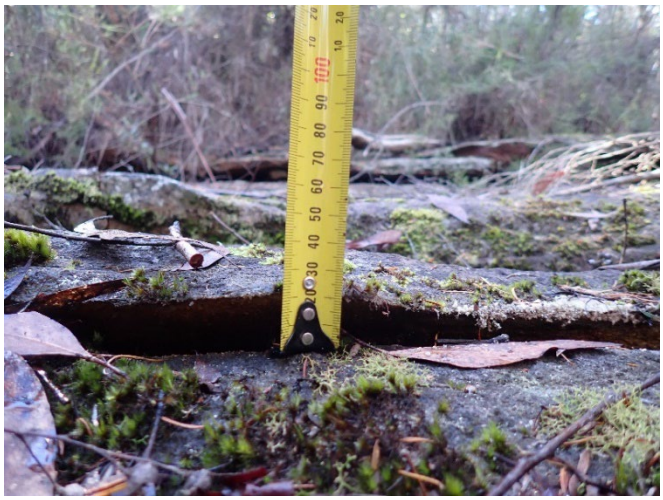


Photo 30: *DA3C_LW21_017*, section of uplift. Taken on 26/07/2023.

DA3C_LW21_021 (E 291547, N 6193965)

DA3C_LW21_021 consists of localised iron staining on the downstream basal step of Swamp 144 and the headwaters of tributary WC20 (Figure 3). The iron staining originates from beneath a large boulder mid-way down the basal step (Photo 31). The iron staining is approximately 2m in length, 1m in width and disappears downslope into bushland. No other surface impacts were observed on or above the basal step.

DA3C_LW21_021 is a Level 1 trigger as per the Dendrobium Watercourse TARP (Table 7), specifically:

- Observable increase in iron staining within the mining area.

Photo 31: *DA3C_LW21_021,* overview of the iron staining.
Taken on 1/08/2023.

5.3 WC24

DA3C_LW21_020 (E 291318, N 6194429)

WC24 is a tributary of Wongawilli Creek that flows westward from DA3C mining operations (Figure 3). The upper reaches of the WC24 sub catchment were mined beneath by Longwall 21. Localised iron staining was observed along a 45m stretch of dry streambed on WC24. The iron staining originates at *WC24_Pool 35* and extends downstream to *WC24_Rockbar 15* (Photo 32 to Photo 35). During the baseline mapping of WC24, no surface water was observed in this part of the tributary. However, the recently recorded iron staining was not present in the baseline mapping. No other surface impacts have been observed in WC24.

DA3C_LW21_020 is a Level 1 trigger as per the Dendrobium Watercourse TARP (Table 7), specifically:

- Observable increase in iron staining within the mining area.

Photo 32: *DA3C_LW21_020,* section of iron staining in *WC24_Pool 35.* Taken on 1/08/2023.

Photo 33: *DA3C_LW21_020,* section of iron staining in *WC24_Channel 18.* Taken on 1/08/2023.

Photo 34: *DA3C_LW21_020,* section of iron staining in *WC24_Channel 18.* Taken on 1/08/2023.

Photo 35: *DA3C_LW21_020,* section of iron staining in *WC24_Rockbar 15.* Taken on 1/08/2023.

6 IMPACTS TO OTHER LANDSCAPE FEATURES

DA3C_LW21_001 (E 291811, N 6194163)

DA3C_LW21_001 is located approximately 80m west of *Fire Road 6F* (Figure 3). The impact consists of rock fracturing to an outcrop. The rock fracturing had a total continuous length of 0.56m, with the piece of rock dislodged from the outcrop. The fracturing has minimal impact to vegetation or ground disturbance (Photo 34).

DA3C_LW21_001 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 36: *DA3C_LW21_001*, showing rock fracture.
Taken on 06/06/2023.

DA3C_LW21_002 (E 291766, N 6194129)

DA3C_LW21_002 is located approximately 140m west of *Fire Road 6F* (Figure 3). The impact consists of multiple large fractures on a rock outcrop at Landscape Monitoring site *LW21_RO1* (Figure 1). The largest fracture has a maximum continuous length of 16m, a maximum width of 0.265m and a maximum measurable depth of 9m (Photo 35 and Photo 36). Rock movement from boulders directly above the fracturing were displaced by 0.26m with exposed soil (Photo 37). Minimal impact to vegetation however moderate ground disturbance to rock outcrop from additional smaller rock fractures (Photo 38 and Photo 39).

DA3A_LW21_002 is a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture between 100mm and 300mm width;
- Crack or fracture between 10m and 50m length.

Photo 37: *DA3C_LW21_002*, showing largest rock fracture in series. Taken on 06/06/2023.

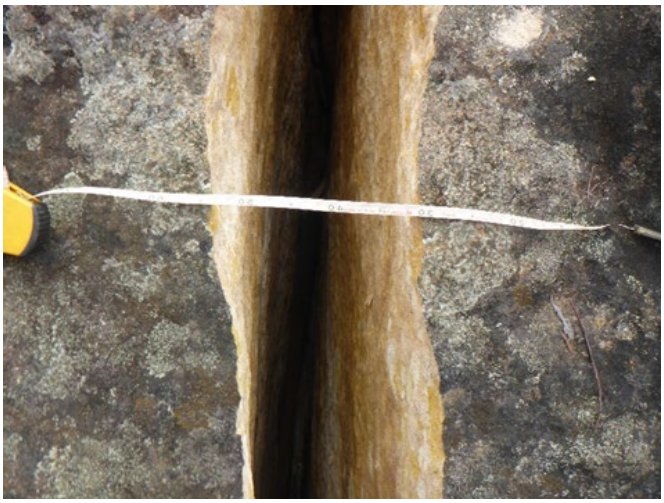


Photo 38: *DA3C_LW21_002*, showing maximum rock fracture width. Taken on 06/06/2023.

Photo 39: *DA3C_LW21_002*, showing rock movement on largest fracture. Taken on 6/06/2023.

Photo 40: *DA3C_LW21_002,* showing rock fracture. Taken on 06/06/2023.

Photo 41: *DA3C_LW21_002,* showing section of rock fracturing. Taken on 06/06/2023.

DA3C_LW21_003 (E 291739, N 6194104)

DA3C_LW21_003 is located approximately 225m west of *Fire Road 6F* (Figure 3). The impact consists of multiple large rock fractures on a rock outcrop and a rockfall from the edge of a step on the same outcrop. The largest rock fracture has a maximum continuous length of 22m, a maximum width of 0.26m and a maximum measurable depth of 3m (Photo 40 and Photo 41). One boulder from the step has dislodged with a rockfall volume of less than 0.1m^3 and an approximate debris area of 0.5m^2 (Photo 42 and Photo 43). The impact has minimal impact to vegetation.

DA3C_LW21_003 is a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture between 100mm and 300mm width;
- Crack or fracture between 10 and 50m length.

Photo 42: *DA3C_LW21_003*, rock fracture on an outcrop. Taken on 06/06//2023.

Photo 43: *DA3C_LW21_003,* width of rock fracture. Taken on 06/06/2023.

Photo 44: *DA3C_LW21_003,* showing rockfall and fragmentation. Taken on 06/06/2023.

Photo 45: *DA3C_LW21_003*, showing rockfall debris. Taken on 06/06/2023.

DA3C_LW21_004 (E 291763, N 6194057)

DA3C_LW21_004 is located approximately 210m west of *Fire Road 6F* (Figure 3). The impact consists of rock fracturing on an outcrop. The rock fracture has a continuous length of approximately 12m, a maximum width of 0.09m and a maximum measurable depth of 2.4m (Photo 44 and Photo 45).

DA3C_LW21_004 is a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture between 100mm and 300mm width;
- Crack or fracture between 10 and 50m length;

Photo 46: *DA3C_LW21_004*, rock fracture on an outcrop. Taken on 06/06/2023.

Photo 47: *DA3C_LW21_004*, rock fracture width. Taken on 06/06/2023.

DA3C_LW21_005 (E 291640, N 6194122)

DA3C_LW21_005 is located approximately 150m northeast of *WC20*, a tributary of *Wongawilli Creek* (Figure 3). The impact consists of a fracture to a rock outcrop (Photo 46 and Photo 47). The rock fracture has a continuous length of 2.1m, a maximum width of 0.05m and a maximum measurable depth of 1.84m. The fracture also resulted in a displacement of small rock fragments.

DA3C_LW21_005 is a Level 1 Trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 48: *DA3C_LW21_005*, fracture to rock outcrop.Taken on 15/06/2023.

Photo 49: *DA3C_LW21_005, showing* width of rock fracture. Taken on 15/06/2023.

DA3C_LW21_006 (E 291661, N 6194107)

DA3C_LW21_006 is located approximately 150m northeast of *WC20*, a tributary of *Wongawilli Creek* (Figure 3). The impact consists of fracturing to a rock outcrop. (Photo 48 and Photo 49). Two intersecting fractures were observed, the longest continuous length measured was 9.0m. The maximum measured width was 0.04m and the maximum measurable depth was 1.12m.

DA3C_LW21_006 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 50: *DA3C_LW21_006*, fracturing to rock outcrop. Taken on 15/06/2023.

Photo 51: DA3C_LW21_006, maximum width of rock fracture. Taken on 15/06/2023.

DA3C_LW21_007 (E 291680, N 6194106)

DA3C_LW21_007 is located approximately 160m northeast of *WC20*, a tributary of *Wongawilli Creek* (Figure 3). The impact consists of two rock fractures and associated rock fall to a rock outcrop (Photo 50). The maximum continuous length of the fractures was 2.74m, with a maximum width of 0.14m (Photo 51). The largest measurable depth was 1.83m. The total volume of the rockfall was less than 0.6m^3 with a total debris area of approximately 3m^2 (Photo 50 and Photo 52).

DA3C_LW21_007 is a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture between 100mm and 300mm width.

Photo 52: *DA3C_LW21_007*, fracturing and rock fall to outcrop. Taken on 15/06/2023.

Photo 53: *DA3C_LW21_007*, maximum width of rock fracture. Taken on 15/06/2023.

Photo 54: *DA3C_LW21_007*, rock fall.
Taken on 15/06/2023.

DA3C_LW21_008 (E 291540, N 6194108)

DA3C_LW21_008 is located approximately 120m northeast of *WC20*, a tributary of *Wongawilli Creek* (Figure 3). The impact consists of a vertical rock fracture at a rock step which then transitions upslope into discontinuous soil cracking (Photo 54 and Photo 55). The impact has a maximum continuous length of 7m, a maximum width of 0.02m and a maximum measurable depth of 0.69m.

DA3C_LW21_008 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

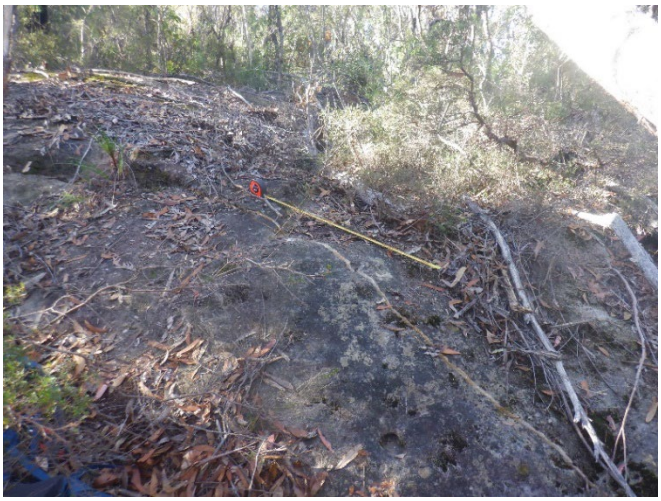


Photo 55: *DA3C_LW21_008*, overview of the rock fracture. Taken on 19/06/2023.

Photo 56: *DA3C_LW21_008*, maximum width of the rock fracture. Taken on 19/06/2023.

Photo 57: *DA3C_LW21_008*, section of the rock fracture. Taken on 19/06/2023.

DA3C_LW21_009 (E 291728, N 6194052)

DA3C_LW21_009 is located approximately 245m west of Fire Road 6F (Figure 3). The impact consists of a rock fracture at a small rock step which disappears upslope into bushland (Photo 56 to Photo 58). The impact has a maximum continuous length of 1.65m, a maximum width of 0.012m and a maximum measurable depth of 0.73m.

DA3C_LW21_009 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 58: *DA3C_LW21_009*, section of the rock fracture. Taken on 19/06/2023.

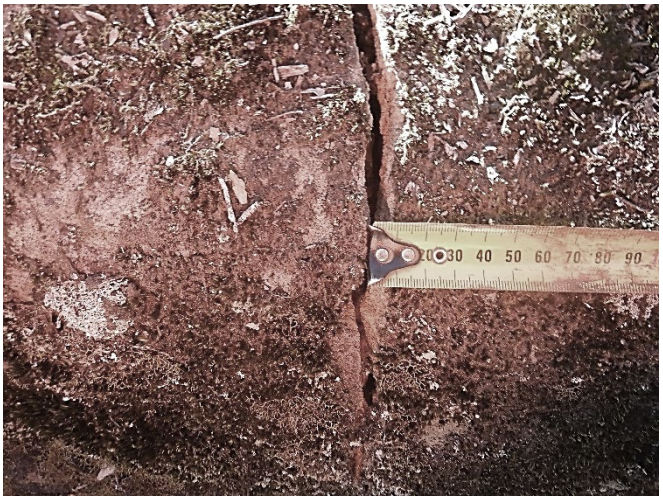


Photo 59: *DA3C_LW21_009*, maximum width of the rock fracture. Taken on 19/06/2023.

Photo 60: *DA3C_LW21_009*, overview of the rock fracture. Taken on 19/06/2023.

DA3C_LW21_010 (E 291772, N 6194167)

DA3C_LW21_010 is located approximately 125m west of Fire Road 6F (Figure 3). The impact consists of rock fracturing at a rock outcrop covered in shallow soil and leaf litter (Photo 60 and Photo 61). Rock movement/displacement is also evident between a large boulder and adjacent soil at the southern extent of the impact (Photo 59). The total impact area is approximately 60m^2. The rock fracture has a maximum continuous length of 7.6m, a maximum width of 0.20m and a maximum measurable depth of 1.4m. Flagging tape barricading is in place at the site as a safety precaution.

DA3C_LW21_010 is a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture between 100mm and 300mm width.

Photo 61: *DA3C_LW21_010*, Overview of the rock movement/displacement. Taken on 19/06/2023.

Photo 62: *DA3C_LW21_010*, maximum width of the rock fracture. Taken on 19/06/2023.

Photo 63: *DA3C_LW21_010*, overview of the rock fracture. Taken on 19/06/2023.

DA3C_LW21_011 (E 291767, N 6194198)

DA3C_LW21_011 is located approximately 95m west of Fire Road 6F (Figure 3). The impact consists of 25m of discontinuous rock fracturing and soil cracking to a rock outcrop and adjacent bushland (Photo 62 and Photo 63). The fracturing has a maximum continuous length of 8m, a maximum width of 0.06m and a maximum measurable depth of 0.44m. The rock fracturing has resulted in the displacement of rock from the edge of the rock outcrop (Photo 64 and Photo 65).

DA3C_LW21_011 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 64: *DA3C_LW21_011*, section of rock fracturing. Taken on 19/06/2023.

Photo 65: *DA3C_LW21_011*, maximum width of the fracture. Taken on 19/06/2023.

Photo 66: *DA3C_LW21_011*, section of rock fracturing and rock displacement. Taken on 19/06/2023.

Photo 67: *DA3C_LW21_011*, section of rock fracturing and rock displacement. Taken on 19/06/2023.

DA3C_LW21_012 (E 291605, N 6194206)

DA3C_LW21_012 is located approximately 240m west of Fire Road 6F (Figure 3). The impact consists of a rock fracture at a small rock step which disappears upslope into bushland (Photo 66 to Photo 68). The impact has a maximum continuous length of 2.65m, a maximum width of 0.01m and a maximum measurable depth of 0.30m.

DA3C_LW21_012 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 68: *DA3C_LW21_012*, section of the rock fracture. Taken on 27/06/2023.

Photo 69: *DA3C_LW21_012*, maximum width of the rock fracture. Taken on 27/06/2023.

Photo 70: *DA3C_LW21_012*, overview of the rock fracture. Taken on 27/06/2023.

DA3C_LW21_013 (E 291260, N 6194232)

DA3C_LW21_013 is located approximately 600m west of fire Road 6F (Figure 3). The impact consists of rock fracturing to a rock outcrop with some minor associated soil cracking/rock displacement. The impact has a maximum continuous length of 3.7m, a maximum width of 0.02m and a maximum measured depth of 0.7m (Photo 69 to Photo 71).

DA3C_LW21_013 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 71: *DA3C_LW21_013*, section of the rock fracture. Taken on 03/07/2023.

Photo 72: *DA3C_LW21_013*, maximum width of the rock fracture. Taken on 03/07/2023.

Photo 73: *DA3C_LW21_013*, overview of section of impact. Taken on 03/07/2023.

DA3C_LW21_016 (E 291248, N 6194087)

Impact *DA3C_LW21_016* consists of a small rockfall to a mapped step on tributary *WC20* (Figure 3). The fracturing was observed beneath the overhang of the step and has an approximate volume of 0.14m^3 (Photo 72 and Photo 73).

DA3C_LW21_016 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Rockfall from a cliff (step) which is mostly left intact, resulting in insignificant ground disturbance.

Photo 74: *DA3C_LW21_016*, fragments of rockfall from step. Taken on 11/07/2023.

Photo 75: *DA3C_LW21_016*, underside of step from which rock fragments fell. Taken on 11/07/2023.

DA3C_LW21_016 (Update) (E 291249, N 6194096)

Impact *DA3C_LW21_016* was first observed on 11 July 2023 and consisted of a small rock fall (≈0.14m^3) at a step 10m north of tributary *WC20* (Figure 3). On a follow up inspection on 26 July 2023, an increase in the rockfall area was identified. The following measurements were estimated at a distance due to safety concerns. The rockfall now has a length of ≈7m, a width of ≈1m, a height of ≈2.5m, a total volume of ≈17.5m^3 and a ground disturbance area of ≈20m^2 (Photo 74 and Photo 75). Flagging tape is in place at the site as a safety precaution. Note- coordinates have been updated from initial report to better reflect the impact location.

DA3C_LW21_016 is now a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Rockfall or overhang collapse at a cliff (step) site, where characteristics of the cliff have changed, and there has been significant ground disturbance.

Photo 76: *DA3C_LW21_016,* looking at the rockfall. Taken on 26/07/2023.

Photo 77: *DA3C_LW21_016*, looking at the rockfall. Taken on 26/07/2023.

DA3C_LW21_018 (E 291273, N 6194190)

DA3C_LW21_018 is located approximately 105m north of tributary *WC20* (Figure 3). The impact consists of two rock fractures to a rock outcrop/ledge. The fracturing has a maximum continuous length of 2.87m and a maximum width of 0.003m (Photo 76 to Photo 78). Flagging tape is in place at the site as a safety precaution.

DA3C_LW21_018 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 78: *DA3C_LW21_018*, section of rock fracturing. Taken on 26/07/2023.

Photo 79: *DA3C_LW21_018*, section of rock fracturing. 26/07/2023.

Photo 80: *DA3C_LW21_018*, overview of rock fracturing. Taken on 26/07/2023.

DA3C_LW21_019 (E 291634, N 6194239)

DA3C_LW21_019 is located approximately 210m west of Fire Road 6F (Figure 3). The impact consists of a single rock fracture to a rock step. The fracture has a continuous length of 2m, a maximum width of 0.03m and a maximum measurable horizontal depth of 0.3m (Photo 79 to Photo 81). Flagging tape is in place at the site as a safety precaution.

DA3C_LW21_019 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;

- Crack or fracture up to 10m length.

Photo 81: *DA3C_LW21_019,* looking at the rock fracture.
Taken on 1/08/2023.

Photo 82: *DA3C_LW21_019,* looking at the rock fracture.
Taken on 1/08/2023.

Photo 83: *DA3C_LW21_019,* looking at the width of the rock fracture.
Taken on 1/08/2023.

DA3C_LW21_022 (E 291477, N 6193846)

Impact *DA3C_LW21_022* consists of a rockfall from a rock outcrop/step approximately 420m west of Fire Road 6F (Figure 3). Weathered sections of rock face are observed along with fresh rock face. The impact is likely from a natural fracture which has opened further and fallen away due to mining. Approximate volume of the rock is less than 0.5m^3 (Photo 82 to Photo 84).

DA3C_LW21_022 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Rockfall from a cliff (step) which is mostly left intact, resulting in insignificant ground disturbance

Photo 84: *DA3C_LW21_022,* overview of boulder fallen away from step. Taken 7/08/2023.

Photo 85: *DA3C_LW21_022,* Rockfall showing unweathered rock, looking down from step above. Taken 7/08/2023.

Photo 86: *DA3C_LW21_022,* Close-up of boulder showing fresh edge of fracture. Taken 7/08/2023

DA3C_LW21_023 (E 291206, N 6194204)

DA3C_LW21_023 is located approximately 100m north of tributary WC20 (Figure 3). The impact consists of a fracture to a rock outcrop (Photo 85 to Photo 87). The impact has a maximum continuous length of 2.10m, a maximum width of 0.004m and a maximum measurable depth of 1.30m.

DA3C_LW21_023 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 87: *DA3C_LW21_023*, section of the rock fracture. Taken: 31/08/2023.

Photo 88: *DA3C_LW21_023*, section of the rock fracture. Taken: 31/08/2023.

Photo 89: *DA3C_LW21_023*, maximum width of the rock fracture. Taken: 31/08/2023.

DA3C_LW21_024 (E 291250, N 6194199)

DA3C_LW21_024 is located approximately 100m north of WC20 (Figure 3). The impact consists of a fracture to a rock outcrop (Photo 88 and Photo 89). The impact has a maximum continuous length of 3.80m and a maximum width of 0.005m.

DA3C_LW21_024 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length;

Photo 90: *DA3C_LW21_024*, section of the rock fracture. Taken: 31/08/2023.

Photo 91: *DA3C_LW21_024*, maximum width of the rock fracture. Taken: 31/08/2023.

DA3C_LW21_025 (E 291112, N 6194193)

DA3C_LW21_025 is located approximately 80m north of tributary WC20 (Figure 3). The impact consists of fracturing, rockfall and rock displacement to a rock overhang and outcrop (Photo 90 to Photo 92). Some of the measurements have been estimated due to safety concerns. The impact has a maximum continuous length of ≈5m, a maximum width of ≈0.03m. Total rockfall volume was estimated to be ≈0.7m^3. Caution tape barricading is in place at the site as a safety precaution.

DA3C_LW21_025 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length;
- Rockfall from a cliff (step) which is left mostly intact resulting in insignificant ground disturbance.

Photo 92: *DA3C_LW21_025*, section of the rock fracture in overhang. Taken: 06/09/2023.

Photo 93: *DA3C_LW21_025,* section of the rock fracture. Taken: 06/09/2023.

Photo 94: *DA3C_LW21_025*, section of the rock fracture. Taken: 06/09/2023.

DA3C_LW21_026 (E 291034, N 6194170)

DA3C_LW21_026 is located approximately 50m north of tributary WC20 (Figure 3). The impact consists of a rockfall and rock fracturing to a rock overhang (Photo 93 to Photo 96). Some measurements were estimated due to safety concerns. The rockfall volume was estimated to be ≈1m^3 in total, the rock fracturing has a maximum length of 1.7m and maximum width of 0.032m.

DA3C_LW21_026 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length;
- Rockfall from a cliff which is left mostly intact resulting in insignificant ground disturbance.

Photo 95: *DA3C_LW21_026*, section of rock fracture and rockfall. Taken 06/09/2023.

Photo 96: *DA3C_LW21_026*, close-up section of rockfall. Taken 06/09/2023.

Photo 97: *DA3C_LW21_026*, section of rock fracture and rockfall. Taken 06/09/2023.

Photo 98: *DA3C_LW21_026*, Width of rock fracture. Taken 06/09/2023.

DA3C_LW21_027 (E 291221, N 6194124)

DA3C_LW21_027 is located approximately 20m north of tributary WC20 (Figure 3). The impact consists of a rockfall to the rock step at Landscape Monitoring site *LW21_SS1* (Figure 1) (Photo 97 and Photo 98). The measurements were estimated due to safety concerns. The rockfall has a maximum length of ≈6.5m, a maximum width of ≈3m and a maximum height of ≈3m, with a total volume of ≈15m^3 and ground disturbance area of ≈10m^2. Caution tape barricading is in place at the site as a safety precaution.

DA3C_LW21_027 is a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Rockfall or overhang collapse at a cliff (step) site, where characteristics of the cliff (step) have changed, and there has been significant ground disturbance.

Photo 99: *DA3C_LW21_027*, overview of rockfall. Taken 06/09/2023.

Photo 100: *DA3C_LW21_027*, overview of rockfall. Taken 06/09/2023.

DA3C_LW21_028 (E 291287, N 6194140)

DA3C_LW21_028 is located approximately 55m north of tributary WC20 (Figure 3). The impact consists of a horizontal fracture to a rock outcrop (Photo 99 and Photo 100). The fracture has a maximum length of 1m, a maximum width of 0.003m and a maximum measurable depth of 0.06m.

DA3C_LW21_028 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 101: *DA3C_LW21_028*, rock fracture. Taken 06/09/2023.

Photo 102: *DA3C_LW21_028*, width of rock fracture. Taken 06/09/2023.

DA3C_LW21_029 (E 291222, N 6194184)

DA3C_LW21_029 is located approximately 80m north of tributary WC20 (Figure 3). The impact consists of fracturing to a rock outcrop and step at Landscape Monitoring site *LW21_SS3* (Figure 1) (Photo 101 and Photo 102). Some measurements were estimated due to safety. The fracturing has a maximum length of ≈6m and a maximum width of ≈0.01m.

DA3C_LW21_029 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 103: *DA3C_LW21_029*, section of rock fracture. Taken 6/09/2023.

Photo 104: *DA3C_LW21_029*, section of rock fracture. Taken 6/09/2023.

DA3C_LW21_030 (E 291566, N 6194131)

DA3C_LW21_030 is located approximately 155m northeast of tributary WC20 (Figure 3). The impact consists of a fracture to a rock outcrop (Photo 103 and Photo 104). The rock fracture has a maximum continuous length of 1.85m, a maximum width of 0.04m and a maximum measurable depth of 0.91m.

DA3C_LW21_030 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 105: *DA3C_LW21_030,* overview of rock fracture. Taken: 12/09/2023.

Photo 106: *DA3C_LW21_030*, width of rock fracture. Taken: 12/09/2023.

DA3C_LW21_031 (E 291337, N 6194140)

DA3C_LW21_031 is located approximately 75m north of tributary WC20 (Figure 3). The impact consists of a small rock fracture to the bottom of a step (Photo 105 and Photo 106). The fracture has a maximum continuous length of 0.32m, a maximum width of 0.015m and a maximum measurable depth of 0.012m.

DA3C_LW21_031 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically**:**

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length;

Photo 107: *DA3C_LW21_031,* width of rock fracture. Taken: 12/09/2023.

Photo 108: *DA3C_LW21_031,* overview of rock fracture. Taken: 12/09/2023. Note - measurement tape set to 0.5m for scale.

DA3C_LW21_032 (E 291055, N 6194151)

DA3C_LW21_032 Is located approximately 30m north of tributary WC20 (Figure 3). The impact consists of multiple fractures to a rock step/overhang, with varying lengths and orientations (Photo 107 and Photo 108). Measurements were estimated from distance for safety reasons. The rock fracturing has an approximate maximum continuous length of ≈1m and a maximum width of ≈0.035m. Caution tape barricading is in place at the site as a safety precaution due to the overhanging nature of the step.

DA3C_LW21_032 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically**:**

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 109: *DA3C_LW21_032,* overview of fracturing to rock step/overhang.
Taken 12/09/2023.

Photo 110: *DA3C_LW21_032,* overview of fracturing to rock step/overhang.
Taken 12/09/2023.

DA3C_LW21_033 (E 291033, N 6194174)

DA3C_LW21_033 is located approximately 55m north of tributary WC20 (Figure 3). The impact consists of a small rock fracture beneath a rock step/overhang (Photo 109 and Photo 110). The rock fracturing has a maximum continuous length of 0.2m, a maximum width of 0.01m and a maximum measurable depth of 0.1m.

DA3C_LW21_033 is a Level 1 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture up to 100mm width;
- Crack or fracture up to 10m length.

Photo 111: *DA3C_LW21_033,* overview of rock fracture. Taken 12/09/2023.

Photo 112: *DA3C_LW21_033,* width of rock fracture. Taken 12/09/2023.

DA3C_LW21_034 (E 291046, N 6194236)

DA3C_LW21_034 is located approximately 120m north of the tributary WC20 (Figure 3). The impact consists of rock movement and soil cracking (Photo 111 and Photo 112). The soil crack extends for 1.9m beneath the rock feature, with a maximum width of 0.17m. The soil cracking potentially extends away from the rock feature as unstable soil was observed during the inspection (Photo 113).

DA3C_LW21_034 is a Level 2 trigger as per the Dendrobium Landscape TARP (Table 8), specifically:

- Crack or fracture between 100 and 300mm width.

Photo 113: *DA3C_LW21_034* overview of rock movement and soil crack. Taken: 12/09/2023.

Photo 114: *DA3C_LW21_034* width of soil crack. Taken 12/09/2023.

Photo 115: *DA3C_LW21_034*. Dashed line shows approximate section of unstable soil/leaf litter extending from rock movement. Taken 12/09/2023.

7 TARP TRIGGERS

7.1 Water Quality

There were no water quality triggers recorded during the extraction of Longwall 21. A comprehensive water quality assessment will be undertaken as part of the specialist Longwall 21 EoP Surface and Shallow Groundwater Assessment.

7.2 Shallow Groundwater

Swamp 144 (144_01)

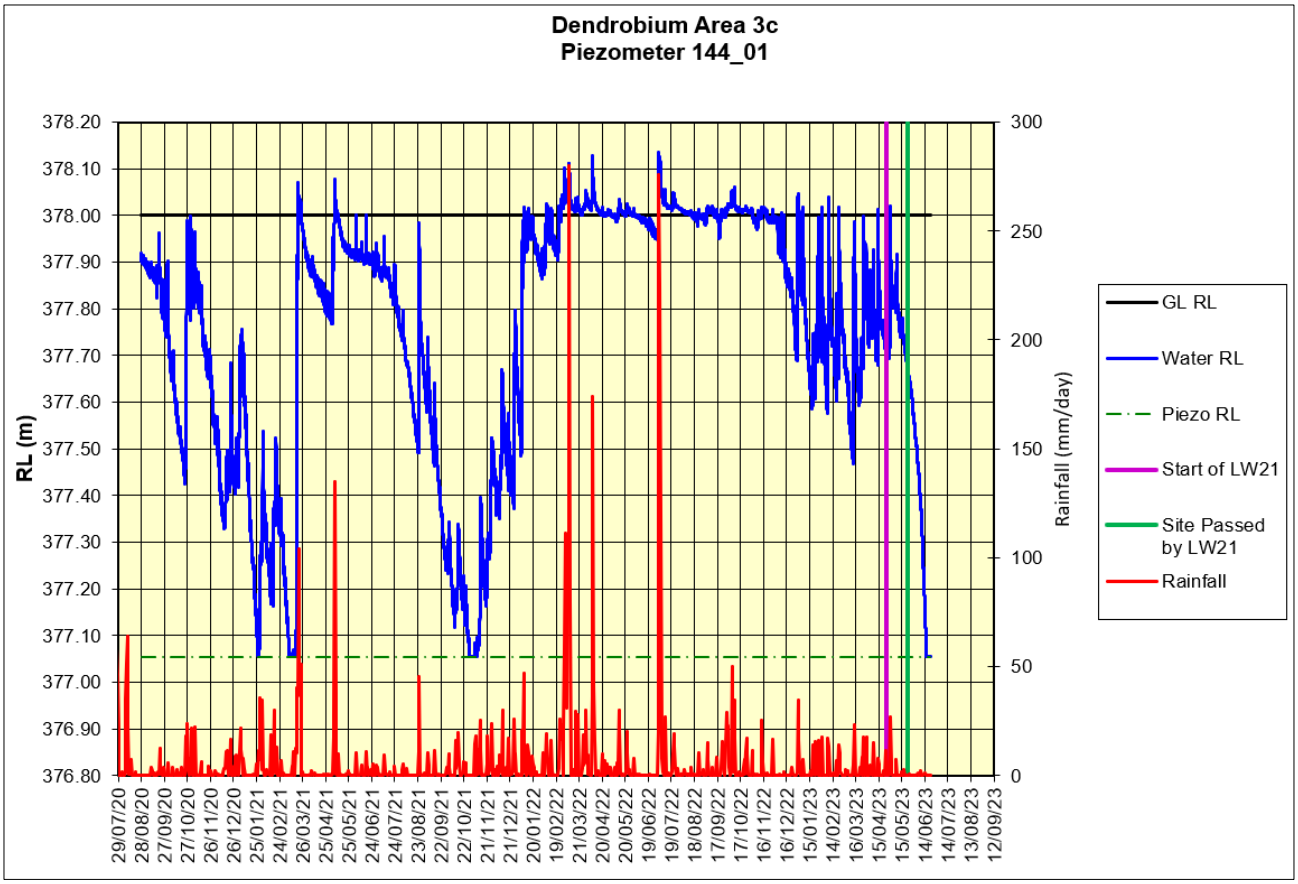
A shallow groundwater trigger was recorded in Swamp 144 (piezometer *144_01)* during analysis of groundwater data for the swamp. The site *144_01* is located 277m to the south-west of the start of Longwall 21 (Figure 3), i.e. within the Longwall 21 mining area (400 m buffer zone) since the start of mining. The site was passed by Longwall 21 on 22 May 2023 at a distance of 120m. The post mining rate of water level recession (34.96 mm/day calculated between 3/06/23 13:00 and 16/06/23 6:00) exceeded the rate recorded at the same depth interval before mining (29.79 mm/day calculated between 12/01/21 12:00 and 27/01/21 11:00) (Graph 1).

These results contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Groundwater level lower than baseline level at >80% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps[#]); and/or rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at >80% of monitoring sites (within 400 m of mining) within the swamp.

It should be noted that there is only one shallow borehole in Swamp 144, therefore only a Level 3 trigger can apply.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 1: Shallow groundwater levels at *144_01*, logged hourly, date range: 28/08/2020 to 27/06/2023.

Swamp 15a (15a_19) (Longwall 19)

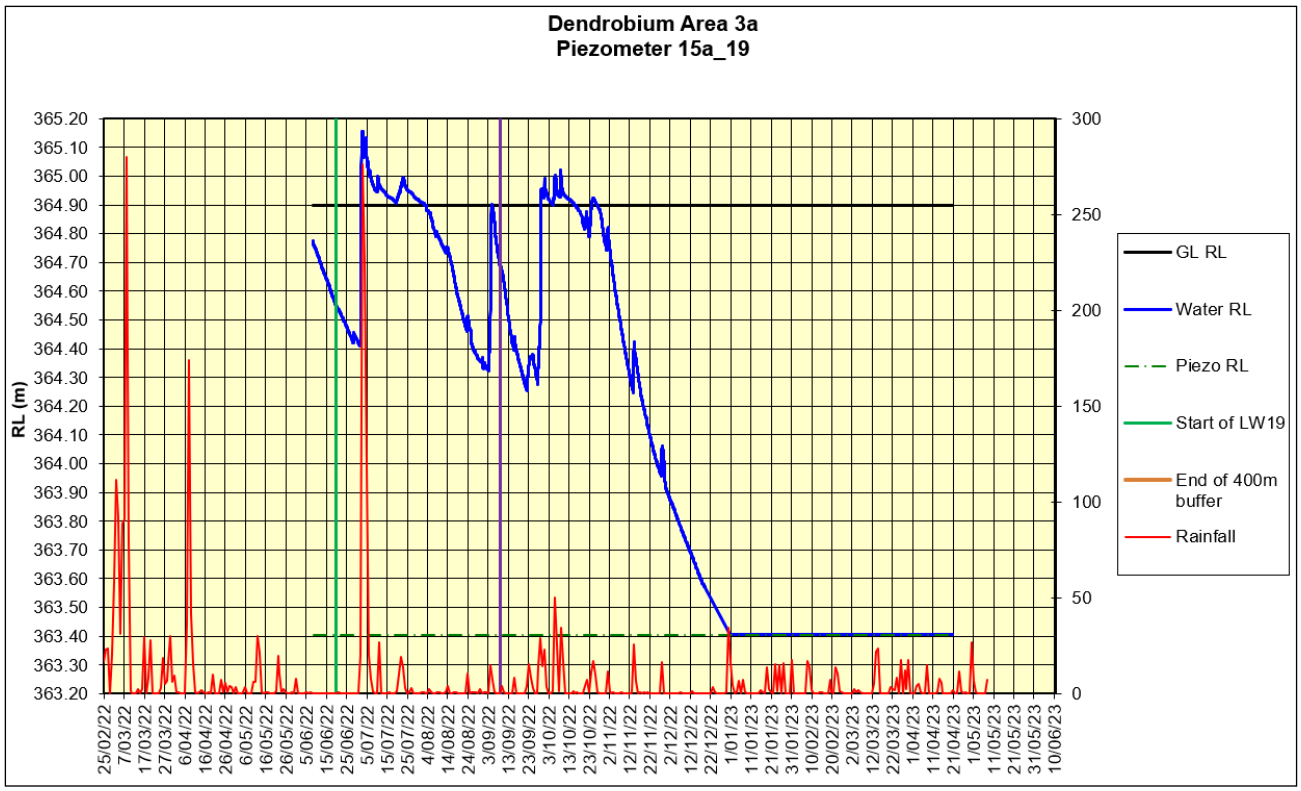
A shallow groundwater trigger was recorded in Swamp 15a (piezometer *15a_19)* during analysis of groundwater data for the swamp. Site *15a_19* is located approximately 140m south-west from the start of Longwall 19 i.e., within the longwall's 400 m buffer zone (mining area) since the start of mining (Figure 4). The site was passed by Longwall 19 on 11 July 2022 at a distance of approximately 70 m and exited the buffer zone on 9 September 2022. Water level in borehole receded below the level of the piezometer on 31 December 2022 and borehole remained dry (Graph 2).

These results contribute to a Level 1 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Groundwater level lower than baseline level at any monitoring site (within 400 m of mining) within a swamp (in comparison to reference swamps[#]).

It is important to take into consideration the very short baseline monitoring period at site *15a_19* and the fact that the monitoring started during period of high rainfall.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 2: Shallow groundwater levels at *15a_19*, logged hourly, date range: 08/06/2022 to 20/04/2023.

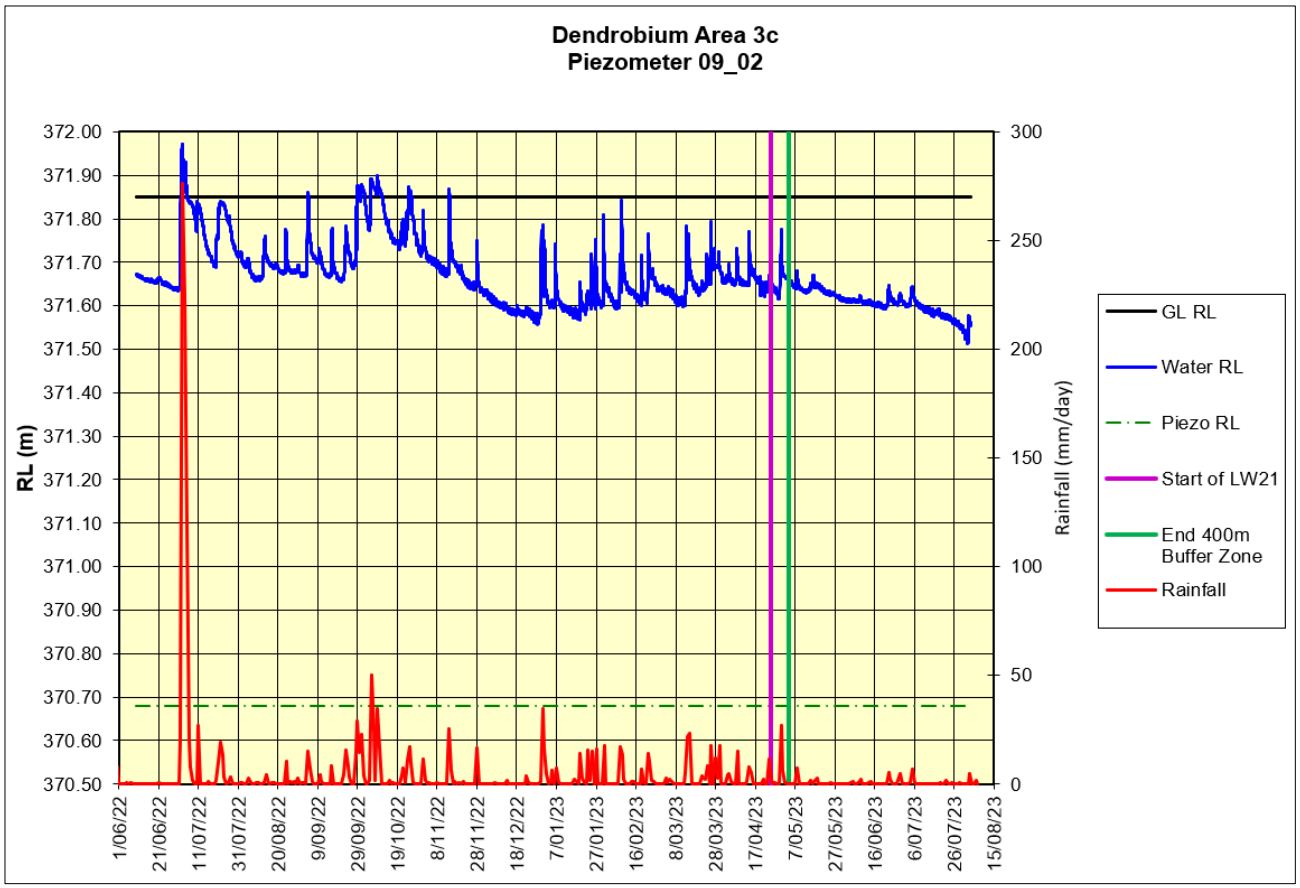
Swamp 9 (09_02)

A near-surface groundwater trigger was recorded in Swamp 9 (Piezometer *09_02)* during analysis of groundwater data for the swamp. Site *09_02* is located 350 m east of the starting (eastern) end of Longwall 21 (Figure 3), i.e. within the longwall's 400 m mining area since the start of mining. The site exited the buffer on 4 May 2023. On 27 July 2023 the water level in the borehole receded below the lowest level recorded before mining (Graph 3). There are two piezometers installed in Swamp 9 (one triggered and one not triggered, at time of impact report).

These results contribute to a Level 2 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Groundwater level lower than baseline level at 50% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps[#]).

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 3: Shallow groundwater levels at *09_02*, logged hourly, date range: 08/06/2022 to 03/08/2023.

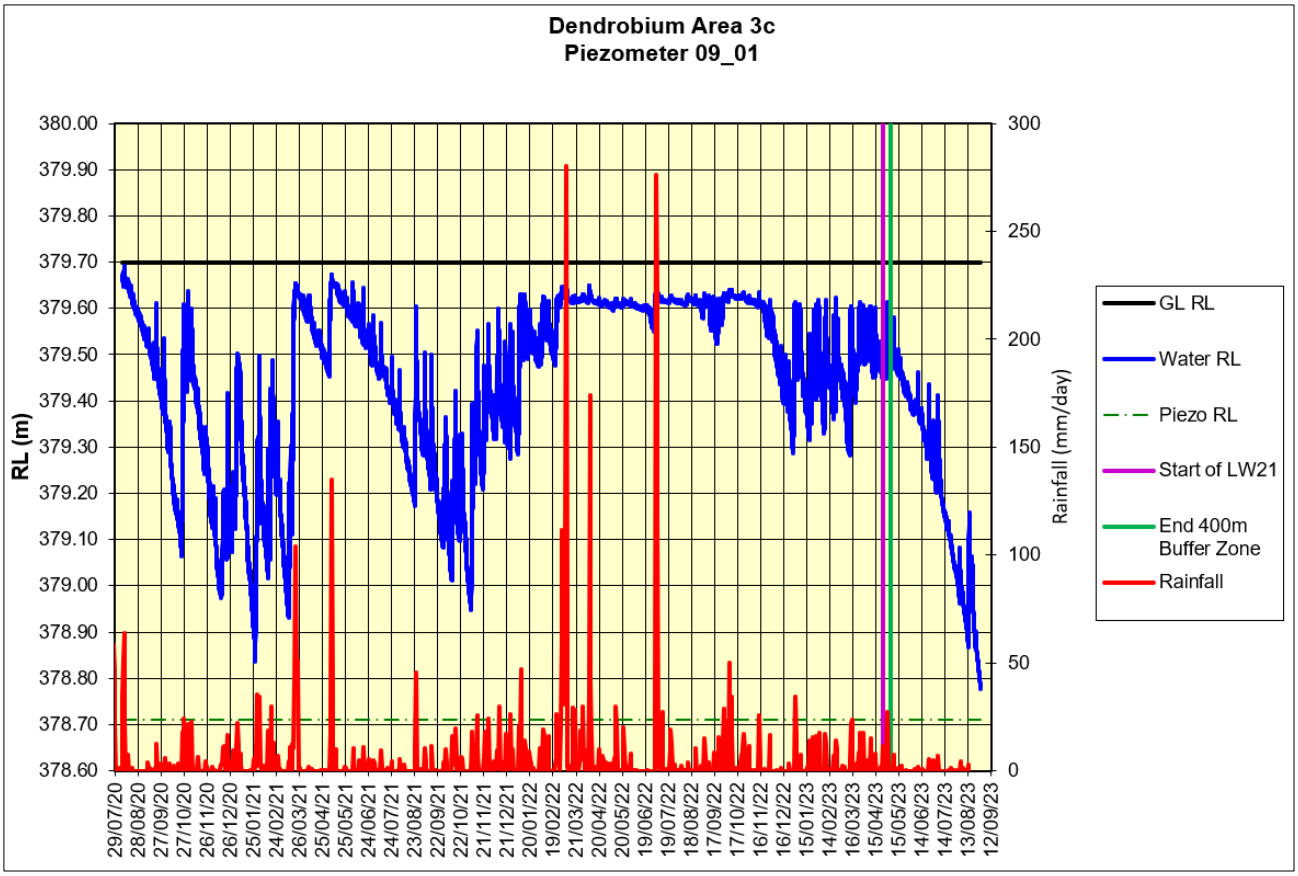
Swamp 9 (09_01)

A shallow groundwater trigger was recorded in Swamp 9 (Piezometer *09_01)* during analysis of groundwater data for the swamp. Site *09_01* is located 368 m east of the eastern end of Longwall 21 (Figure 3). The site was within the 400m active mining area between 25 April 2023 and 2 May 2023. On 25 August 2023 the water level in the borehole 09_01 receded below the lowest level recorded during the baseline monitoring period (Graph 4).

The addition of site *09_01* trigger contributes to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Groundwater level lower than baseline level at >80% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps[#]).

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 4: Shallow groundwater levels at *09_01*, logged hourly, date range: 07/08/2020 to 29/08/2023.

7.3 Soil Moisture

Swamp 144 (S144_01)

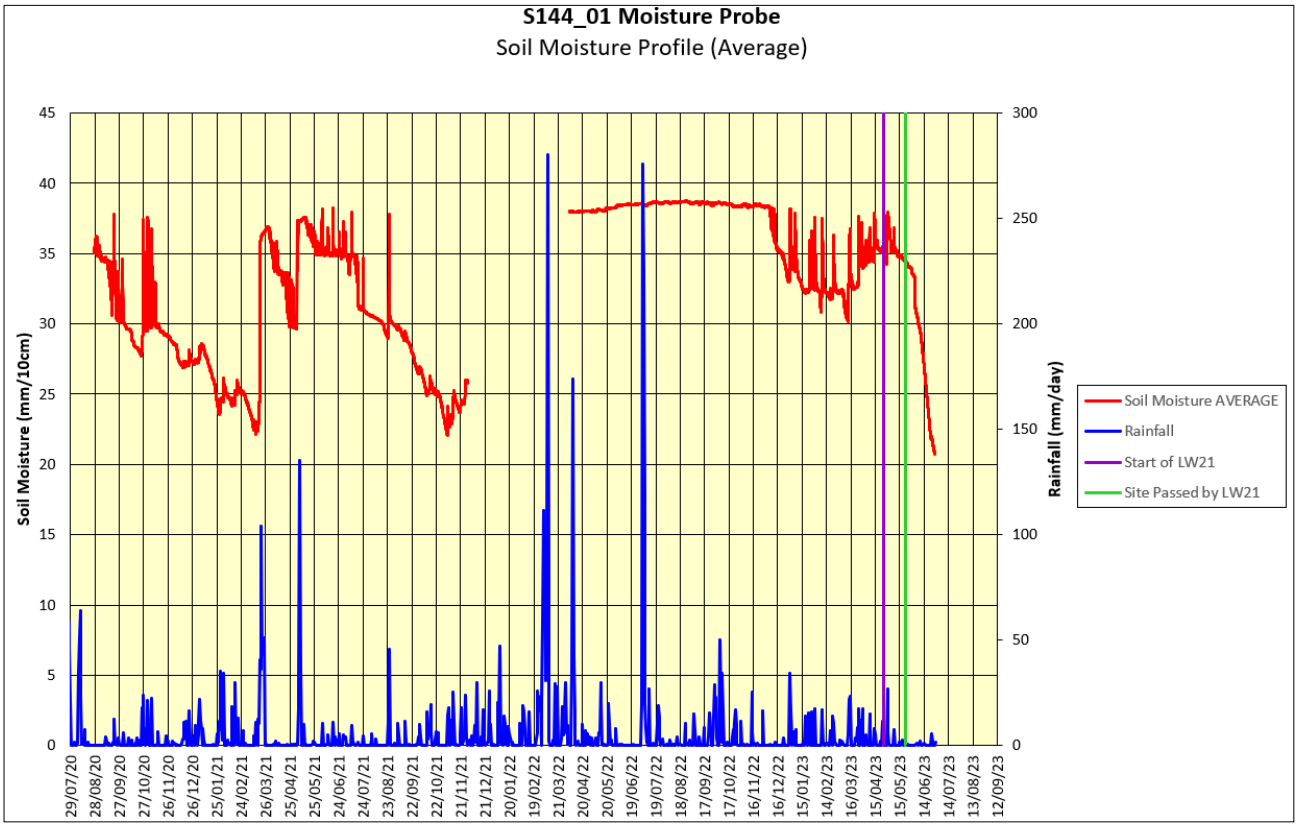
A soil moisture trigger was recorded in Swamp 144 (soil moisture probe *S144_01*) during analysis of groundwater data for the swamp. Site *S144_01* is located 277m to the south-west of the start of Longwall 21 (Figure 3), i.e. within the Longwall 21 mining area since the start of mining. The site was passed by Longwall 21 on 22 May 2023 at a distance of 120m. On 21 June 2023 the average soil moisture value recessed below the lowest level recorded before mining (Graph 5).

These results contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Soil moisture level lower than baseline level at >80% of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps[#]).

It should be noted that there is only one soil moisture probe in Swamp 144, therefore only a Level 3 trigger can apply.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 5: Average soil moisture levels at *S144_01*, logged hourly, date range: 28/08/2020 to 27/06/2023.

Swamp15a (S15a_07, S15a_15 and S15a_19) (Longwall 19)

Soil moisture triggers were recorded in Swamp 15a during analysis of groundwater data for the swamp. This included soil moisture triggers at sites *S15a_07, S15a_15* and *S15a_19* (Graph 6 to Graph 8).

Site *S15a_07* is located approximately 245m south-west from the start of Longwall 19 i.e., within the longwall's 400 m mining area since the start of mining (Figure 4). The site was passed by Longwall 19 on 17 July 2022 at a distance of approximately 173 m and exited the mining area on 14 September 2022. On 24 December 2022 the average soil moisture value receded below the lowest level recorded before mining (Graph 6). Below average rainfall was also recorded through this period, continuing to date.

Site *S15a_15* is located approximately 335m south-west from the start of Longwall 19 i.e., within the longwall's 400 m mining area since the start of mining (Figure 4). The site was passed by Longwall 19 on 13 July 2022 at a distance of approximately 303 m and exited the mining area on 21 August 2022. On 11 March 2023 the average soil moisture value receded below the lowest level recorded before mining (Graph 7). Below average rainfall has also been observed through this period.

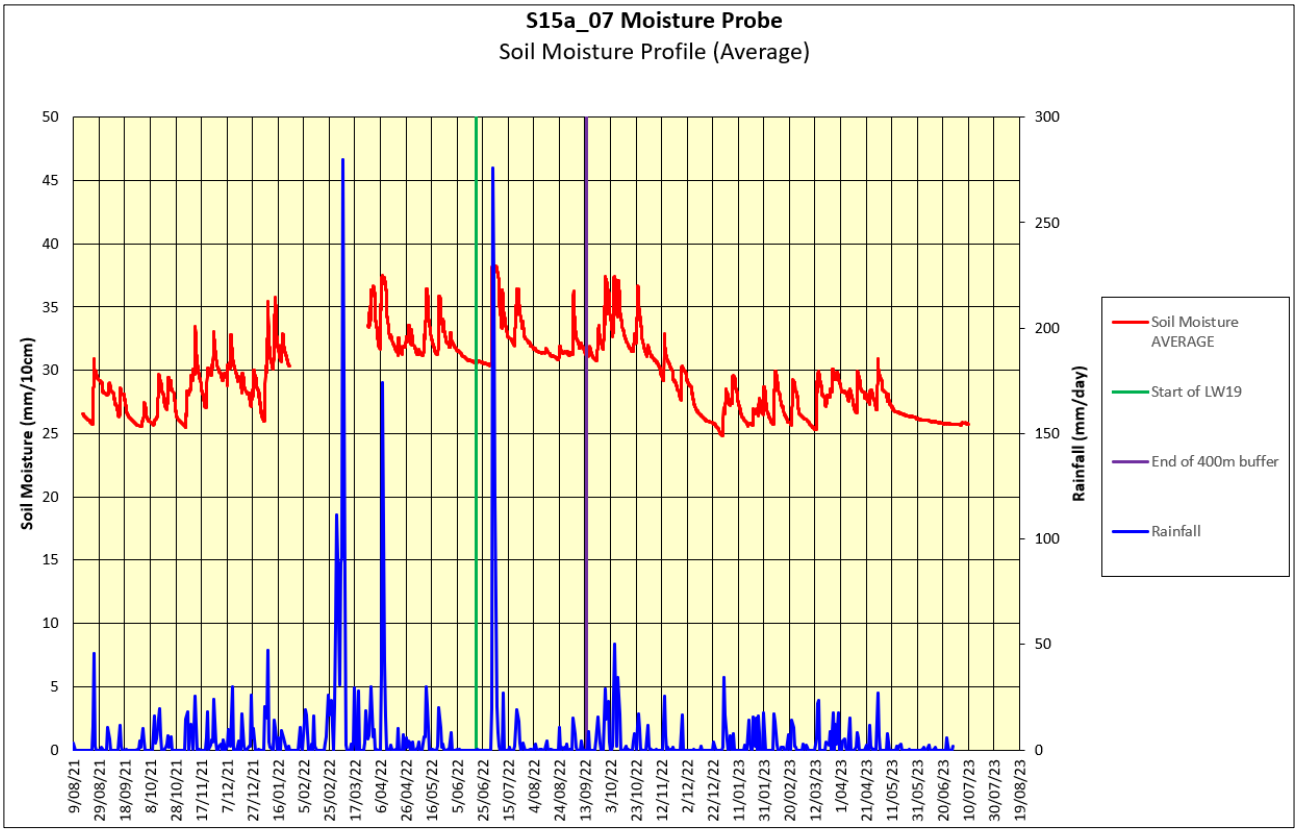
Site S*15a_19* is located approximately 140m south-west from the start of Longwall 19 i.e., within the longwall's 400 m mining area since the start of mining (Figure 4). The site was passed by Longwall 19 on 11 July 2022 at a distance of approximately 70 m and exited the buffer zone on 9 September 2022. On 12 September 2022 the average soil moisture value receded below the lowest level recorded before mining and has not recovered since (Graph 8). Site *15a_19* was not part of the Longwall 19 SIMMCP. This site was installed relatively recently to investigate distance of groundwater response from longwall goaf. The relatively recent installation date means it has a very short baseline period and while it is being included in this TARP assessment, the short baseline period should be considered.

These results contribute to a Level 2 trigger for soil moisture, according to the Dendrobium Swamps TARP (Table 6), specifically:

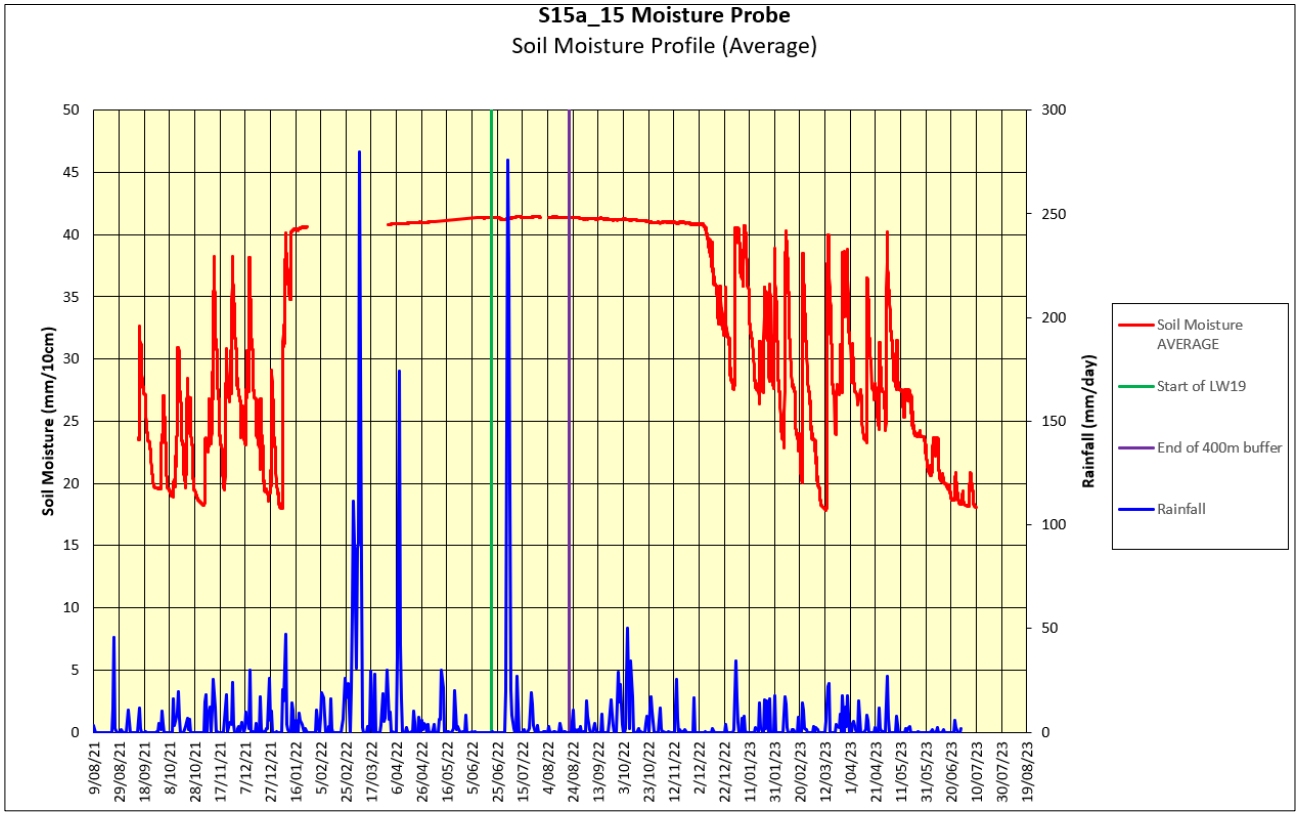
- Soil moisture level lower than baseline level at 50% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps[#]).

It is important to take into consideration the very short baseline monitoring period at site *S15a_19* and the fact that the monitoring started during period of high rainfall.

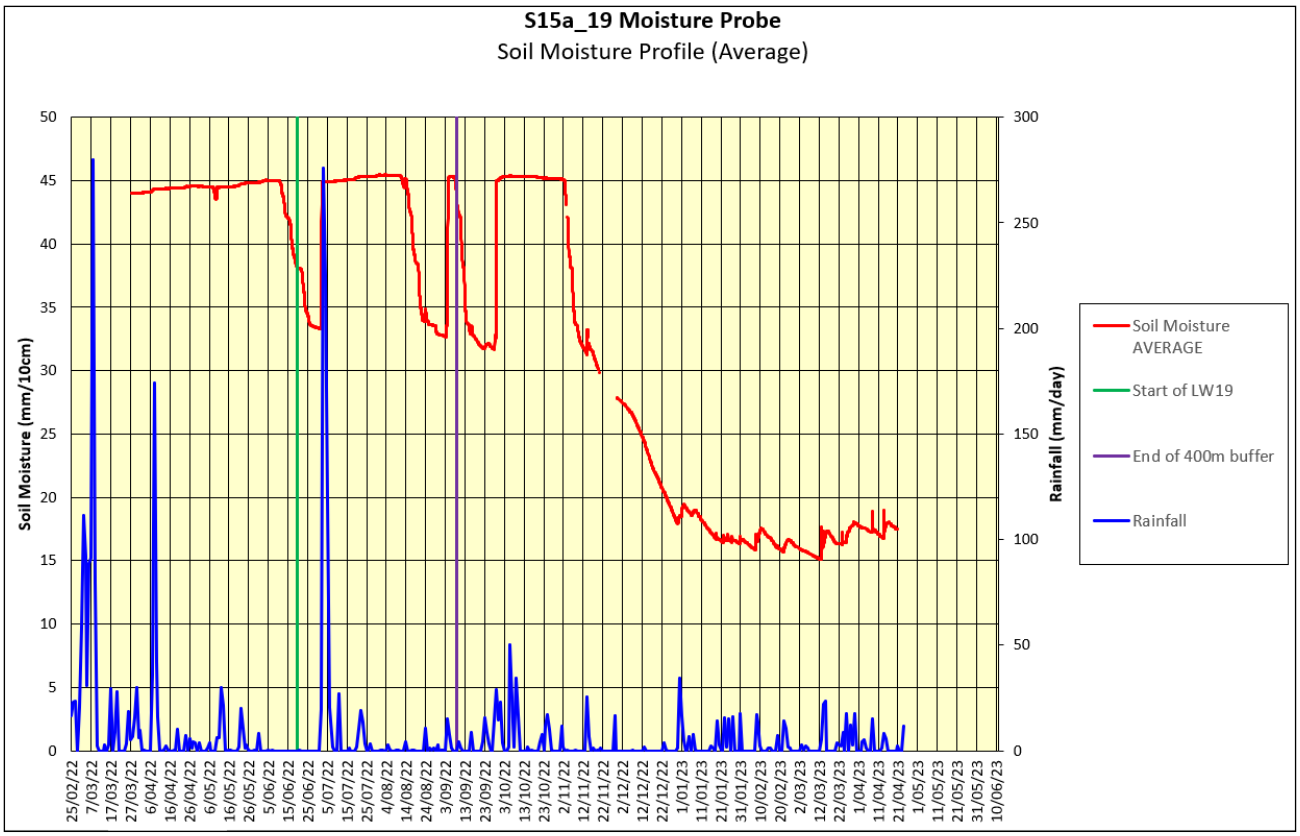
[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 6: Average soil moisture levels at *S15a_07*, logged hourly, date range: 16/08/2021 to 10/07/2023.



Graph 7: Average soil moisture levels at *S15a_15*, logged hourly, date range: 13/09/2021 to 10/07/2023.



Graph 8: Average soil moisture levels at *S15a_19*, logged hourly, date range: 27/03/2022 to 20/04/2023.

Swamp 145 (S145_01)

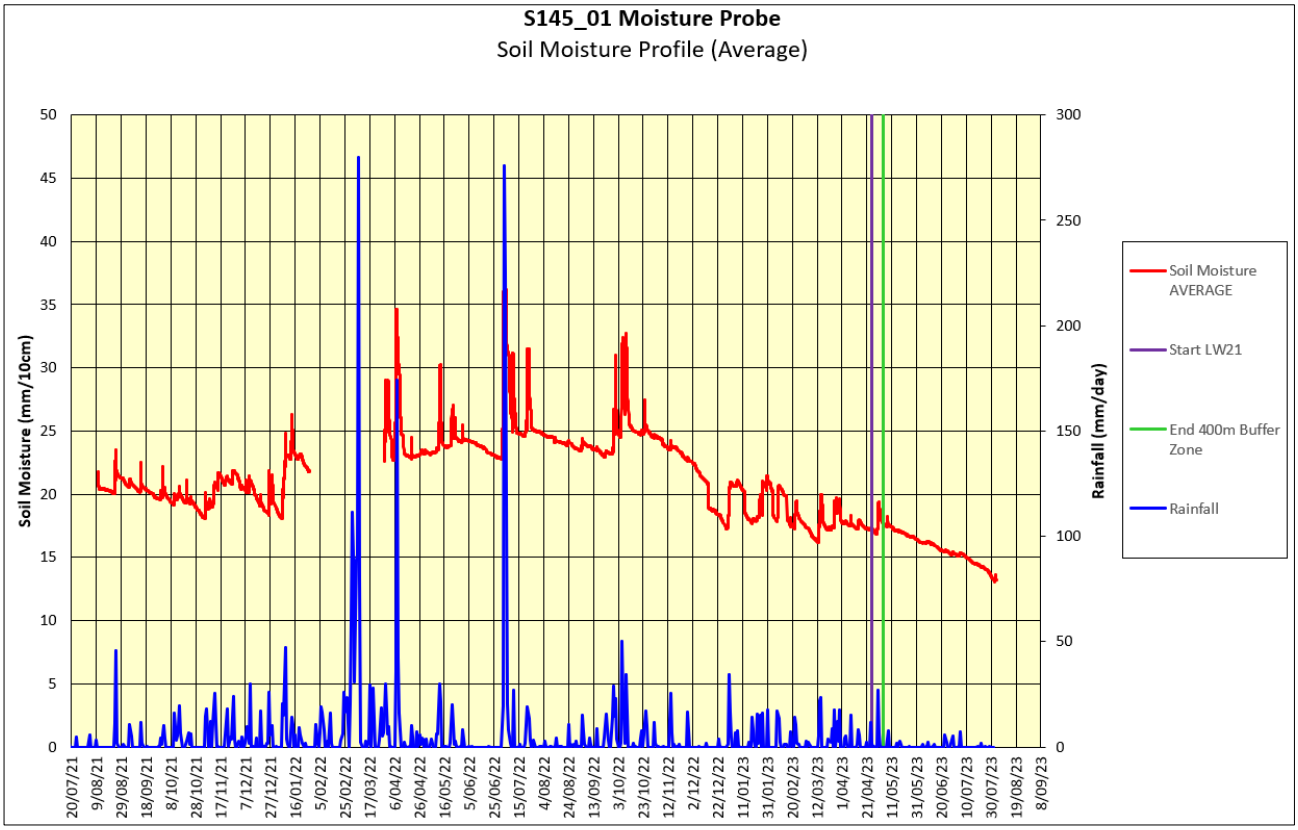
A soil moisture trigger was recorded in Swamp 145 (moisture probe S*145_01).* Site *S145_01* is located 359 m to the south-east of the starting (eastern) end of Longwall 21 (Figure 3), i.e. within the longwall's 400 m buffer zone since the start of mining. The site exited the buffer on 4 May 2023. On 3 June 2023 the average soil moisture value receded below the lowest level recorded before mining (Graph 9).

These results contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6):

- Soil moisture level lower than baseline level at >80% of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps[#]).

It should be noted that there is only one soil moisture probe in Swamp 145, therefore only a Level 3 trigger can apply.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 9: Average soil moisture levels at *S145_01*, logged hourly, date range: 10/08/2021 to 03/08/2023.

Swamp 15a (Update) (S15a_12 and S15a_18) (Longwall 19)

Soil moisture triggers were recorded in Swamp 15a during analysis of groundwater data for the swamp. These included soil moisture triggers at sites *S15a_12* and *S15a_18.*

Site *15a_12* is located 185 m south-east from the start of Longwall 19 (Figure 4), i.e., within the longwall's 400 m mining area since the start of mining. The site exited the mining area on 25 July 2022. On 25 July 2023 the average soil moisture value recessed below the lowest level recorded before mining (Graph 10).

The site *15a_18* is located 284 m east of the start of Longwall 19 (Figure 4) i.e., within the longwall's 400 m mining area since the start of mining. The site exited the buffer zone on 09 July 2022. On 18 July 2023 the average soil moisture value recessed below the lowest level recorded before mining (Graph 11).

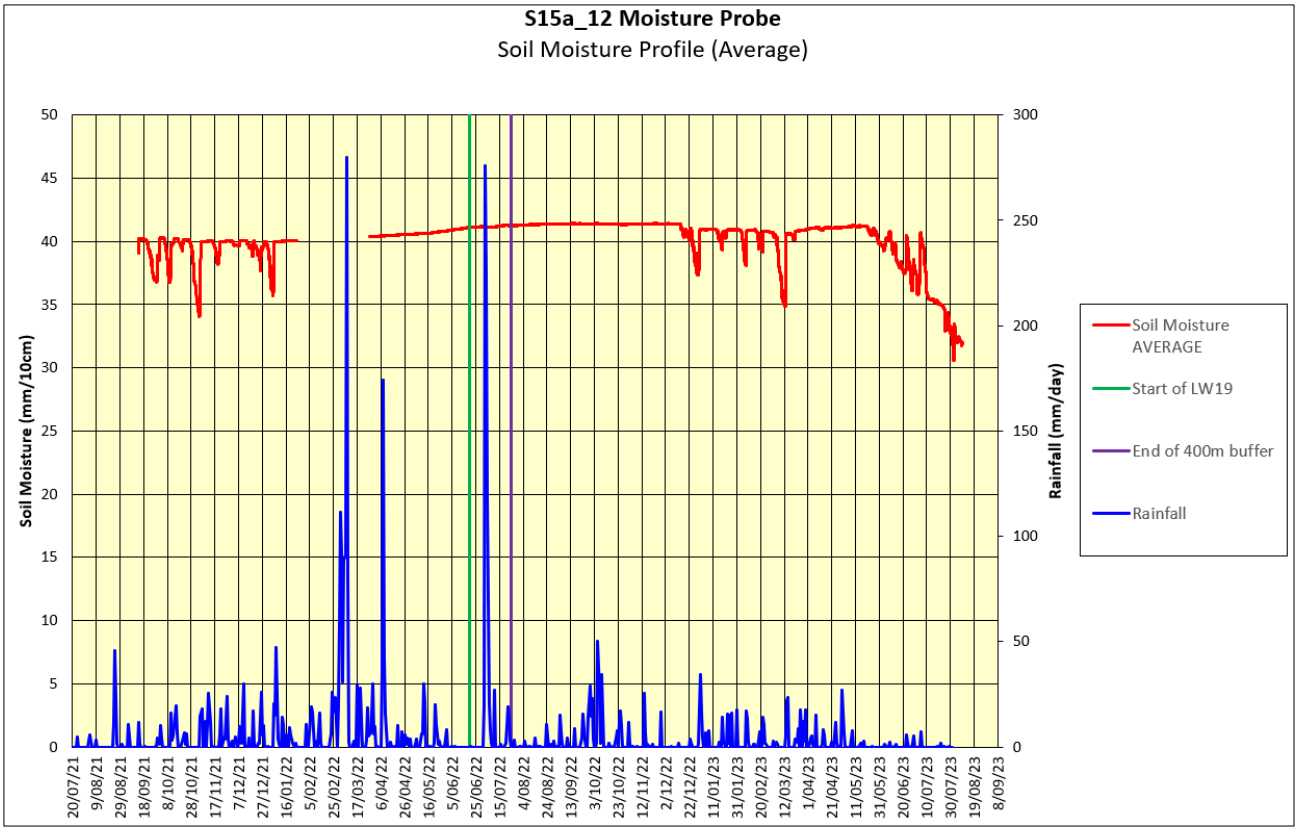
Soil moisture triggers in three sites within Swamp 15a were previously reported.

The results now contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

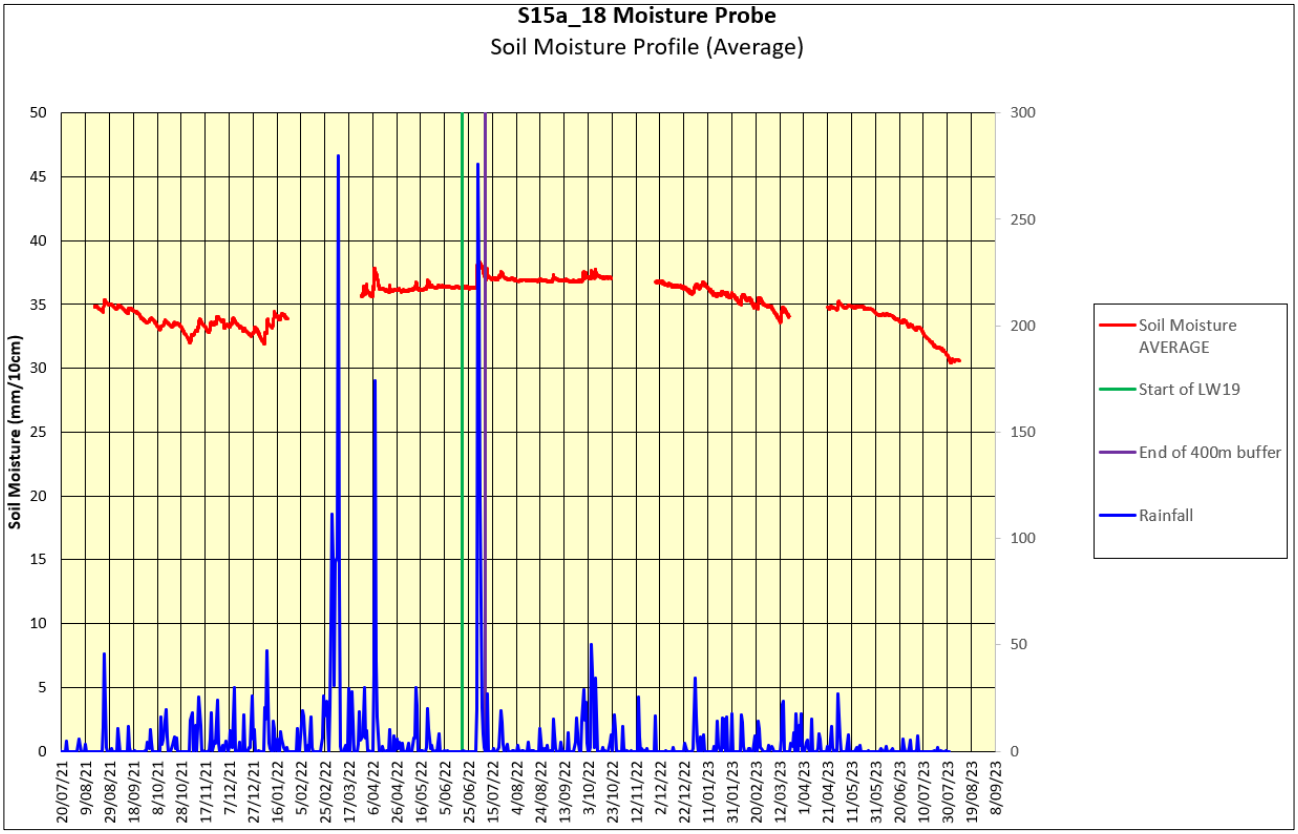
- Soil moisture level lower than baseline level at >80% of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps[#]).

It is important to note the relatively short baseline monitoring period, the fact that the monitoring begun during period of unusually high rainfall and that there were no impacts recorded when the soil moisture probes were within the respective LW19 400m area.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 10: Average soil moisture levels at *S15a_12*, logged hourly, date range: 13/09/2021 to 09/08/2023.



Graph 11: Average soil moisture levels at *S15a_18*, logged hourly, date range: 16/08/2021 to 09/08/2023.

Swamp 12 (S12_04) (Longwall 19)

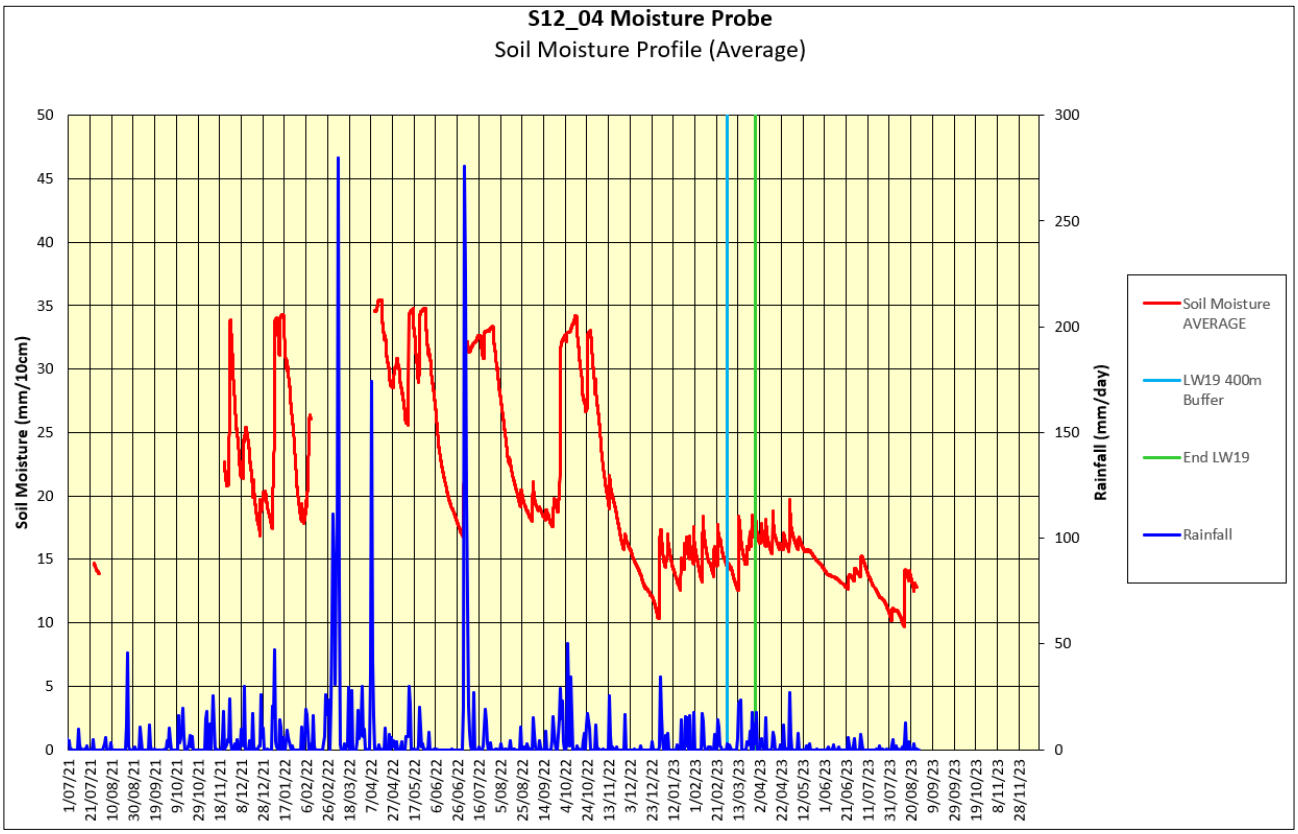
A soil moisture trigger was identified at monitoring site *S12_04* in Swamp 12 during analysis of moisture data. *S12_04* is located 395 m north from the western end of Longwall 19 (Figure 4). The site entered the Longwall 19 400m active mining area on 3 March 2023 and remained within the active mining area until the end of extraction. On 1 August 2023 the average soil moisture value receded below the lowest level recorded during the baseline monitoring period (Graph 12).

As *S12 _04* is the only soil moisture site in Swamp 12 within 400 m of Longwall 19 mining, these results contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Soil moisture level lower than baseline level at >80% of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps[#]).

It is important to note that *S12_04* has previously been within 400m of the active mining area during the extraction of Longwall 6, Longwall 7 and Longwall 8 (between 2010 and 2012). The baseline monitoring period for this site occurred during a period of unusually high rainfall in 2021 and 2022. In contrast, 2023 has been the driest year during the *S12_04* monitored period and the third driest year-to-date in the 22 years of rainfall records from Cordeaux Colliery. There were no impacts recorded when the site was within the Longwall 19 active mining area.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessement.*



Graph 12: Average soil moisture levels at site *S12_04*, logged hourly, date range: 27/07/2021 to 25/08/2023.

Swamp 150 (S150_01) (Longwall 18)

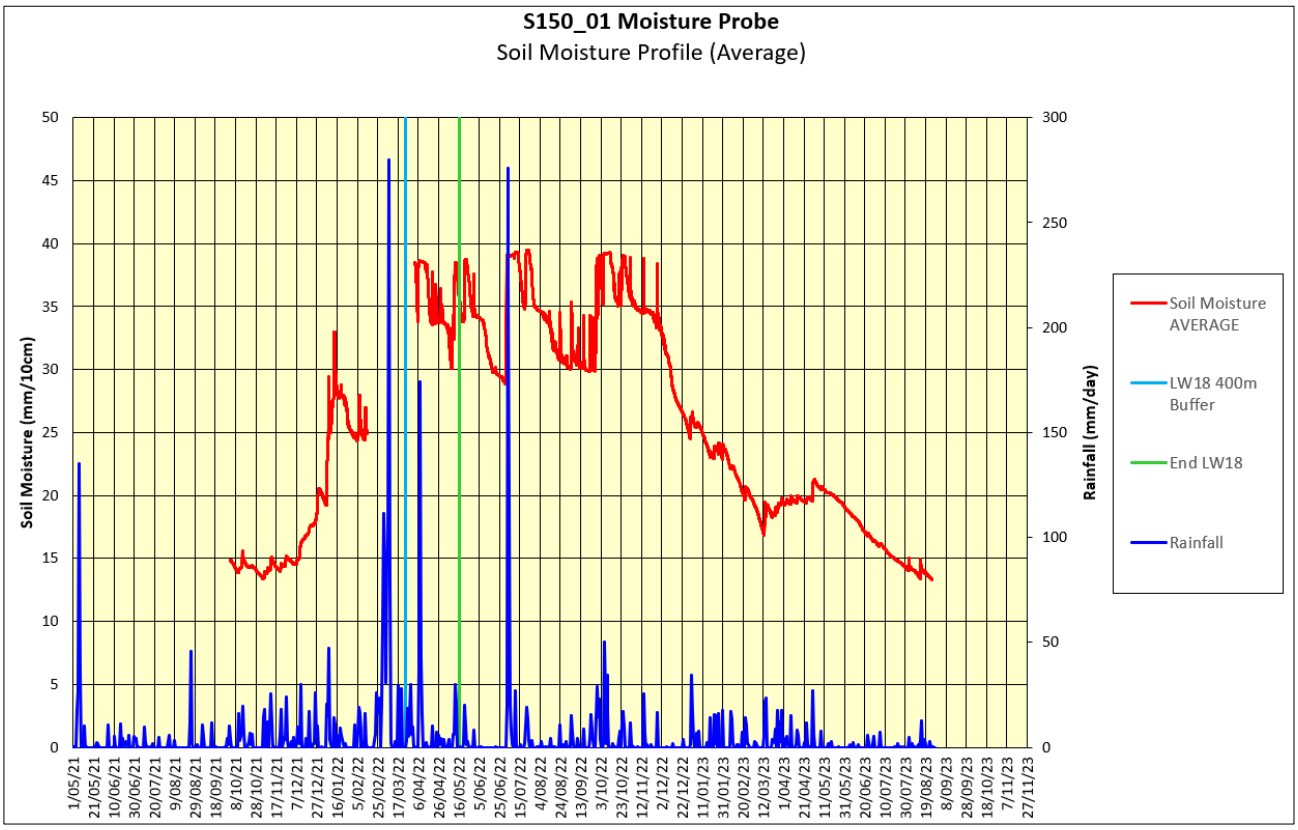
A soil moisture trigger was identified at monitoring site *S150_01* in Swamp 150 during recent analysis of soil moisture data. *S150_01* is located 280 m south of the eastern end of Longwall 18 (Figure 4). The site entered the Longwall 18 400m active mining area on 24 March 2022 and remained in the active mining area until the end of extraction. On 24 August 2023, one year and three months after completion of Longwall 18, the average soil moisture value receded below the lowest level recorded during the baseline monitoring period (Graph 13).

As the soil moisture probe *S150 _01* is the only one installed in Swamp 150, these results contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Soil moisture level lower than baseline level at >80% monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).

Monitoring for this site has predominately occurred during a period of unusually high rainfall in 2021 and 2022. In contrast, 2023 has been the driest year during the *S150_01* monitored period and the third driest year-to-date in the 22 years of rainfall records from Cordeaux Colliery. There were triggers recorded when the soil moisture probe was within the Longwall 18 active mining area.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 13: Average soil moisture levels at site *S150_01*, logged hourly, date range: 02/10/2021 to 25/08/2023.

Swamp 9 (S09_01 and S09_02)

Soil moisture triggers were identified at monitoring sites *S09_01* and *S09_02* in Swamp 9 during analysis of soil moisture data.

Site *S09_01* is located 368 m east of Longwall 21 (Figure 3). The site was within the 400m active mining area between 25 April 2023 and 2 May 2023. On 28 August 2023 the average soil moisture value at *S09_01* receded below the lowest level recorded before mining (Graph 14).

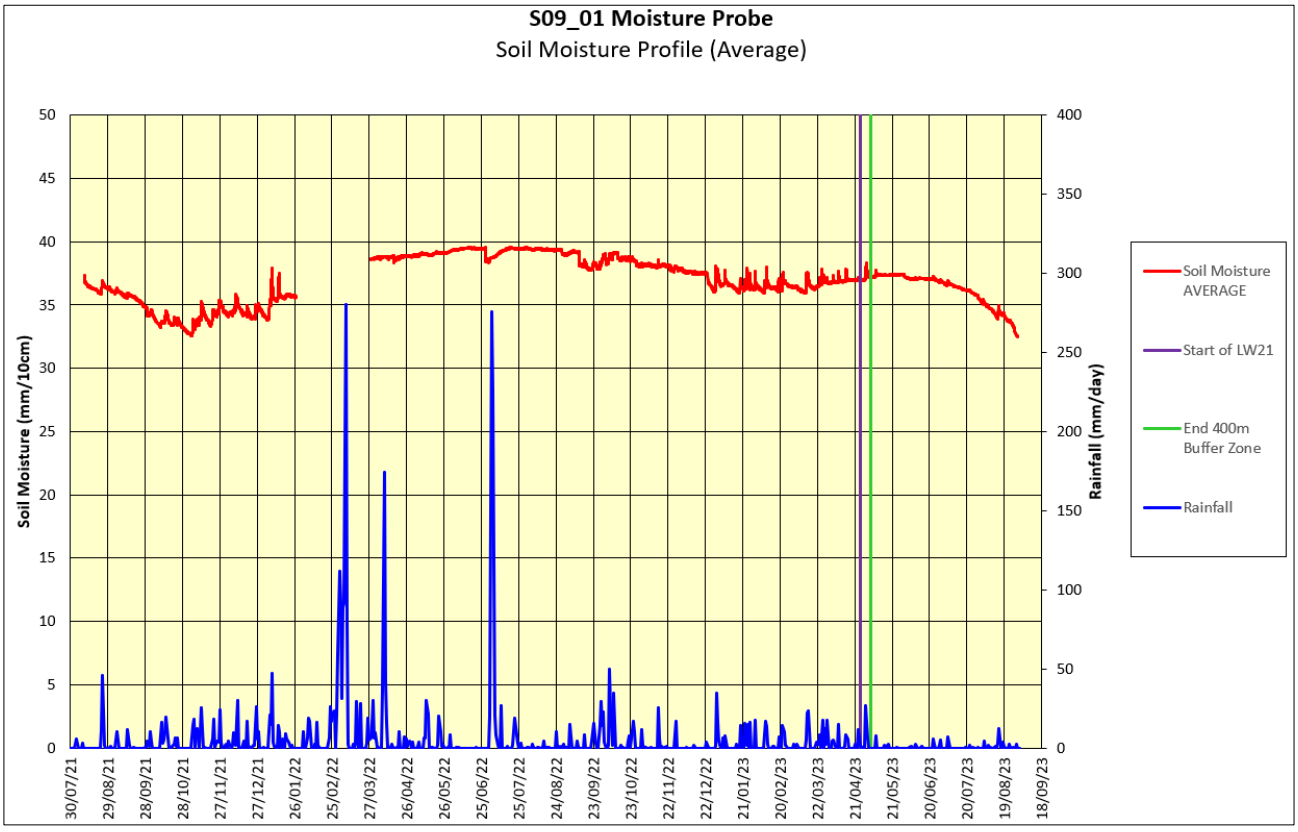
Site *S09_02* is located 350 m east of Longwall 21 (Figure 3). The site was within the 400m active mining area between 25 April 2023 and 4 May 2023. On 1 August 2023 the average soil moisture value in the probe *S09_02* receded below the lowest level recorded before mining (Graph 15). The groundwater trigger at site *09_02* was reported on 9 August 2023.

These results contribute to a Level 3 soil moisture triggers according to the Dendrobium Swamps TARP (Table 6), specifically:

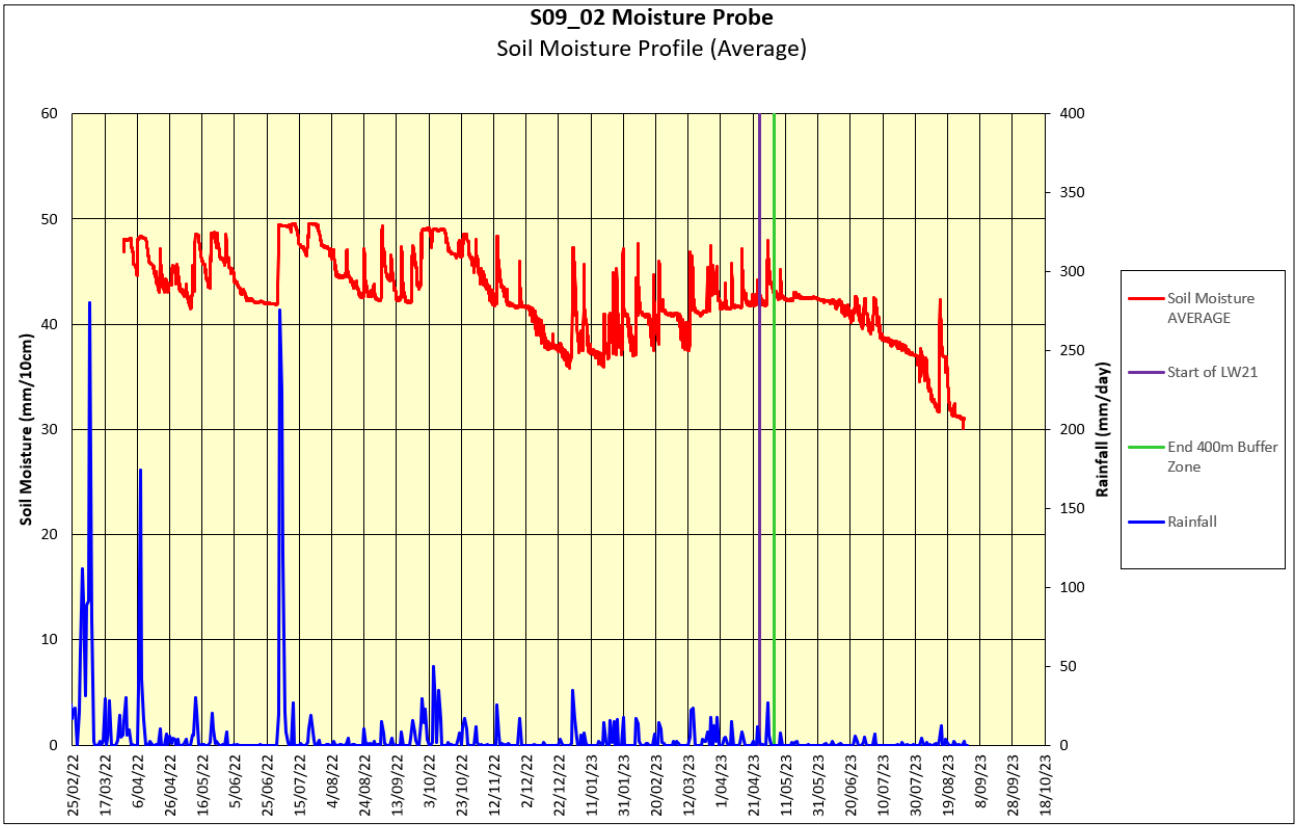
- Soil moisture level lower than baseline level at >80% monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).

It is important to note the baseline monitoring period occurred during a period of unusually high rainfall, with low rainfall since.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 14: Average soil moisture levels at site *S09_01*, logged hourly, date range: 10/08/2021 to 29/08/2023.



Graph 15: Average soil moisture levels at site *S09_02*, logged hourly, date range: 28/03/2022 to 29/08/2023.

Swamp 15b (S15b_H1)

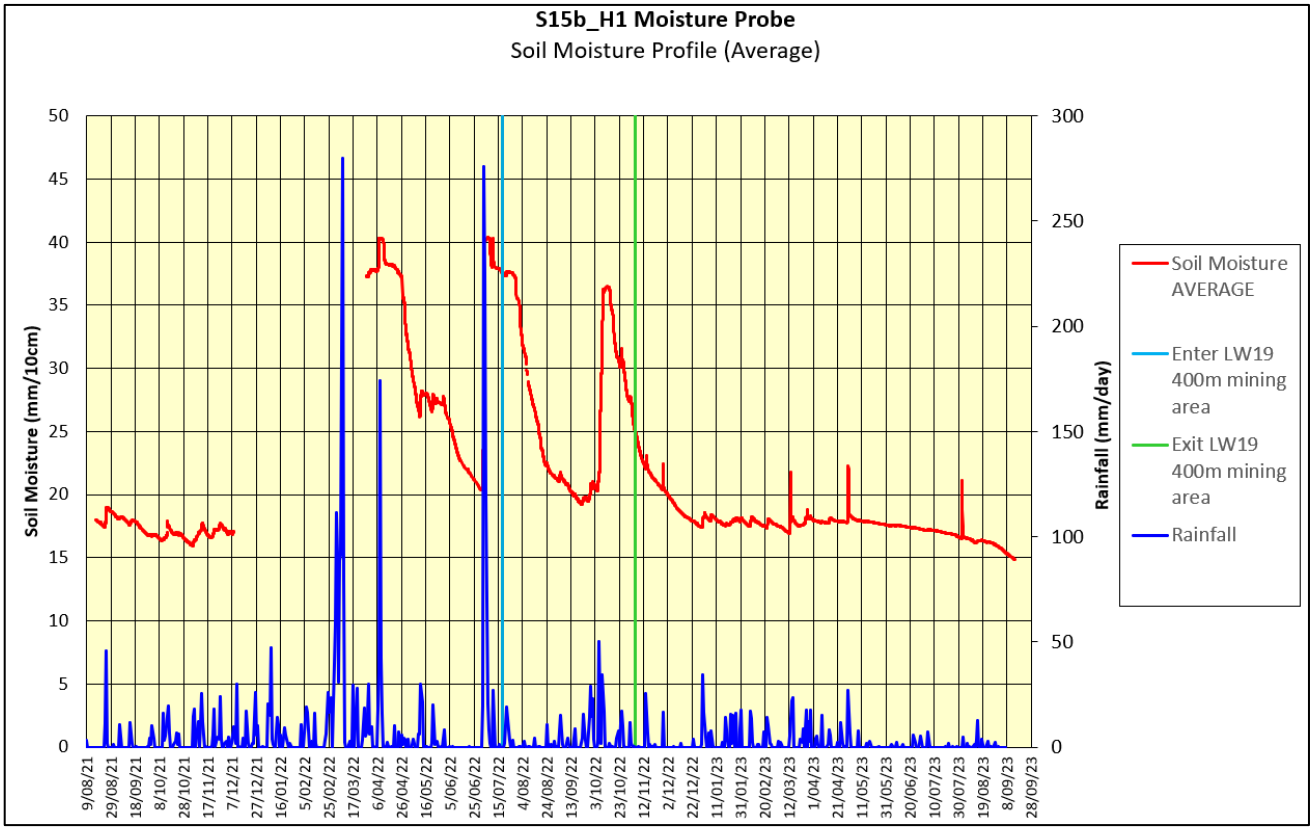
Four soil moisture probes and dataloggers were installed in *Swamp 15b* at sites *S15b_H1, S15b_H2, S15b_H3 and S15b_39* in August 2021. Recent analysis of records at *S15b_H1* shows the average soil moisture data after completion of extraction being lower than the lowest data recorded during the baseline period (Graph 16). Soil moisture triggers at *S15b_H2, S15b_H3* and *S15b_39* were identified and reported in May 2023.

These results contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Soil moisture level lower than baseline level at >80% monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).

It should be noted that Longwalls 7 and 8 were extracted between 4 May 2011 and 29 December 2012 and would likely have had an influence on soil moisture in the swamp however soil moisture probes were not part of swamp monitoring at this time. The proximity of Longwalls 7 and 8 to Swamp 15B is displayed in Figure 4. As such, the baseline period for recent soil moisture data should be treated as Longwall 19 pre-mining data only.

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



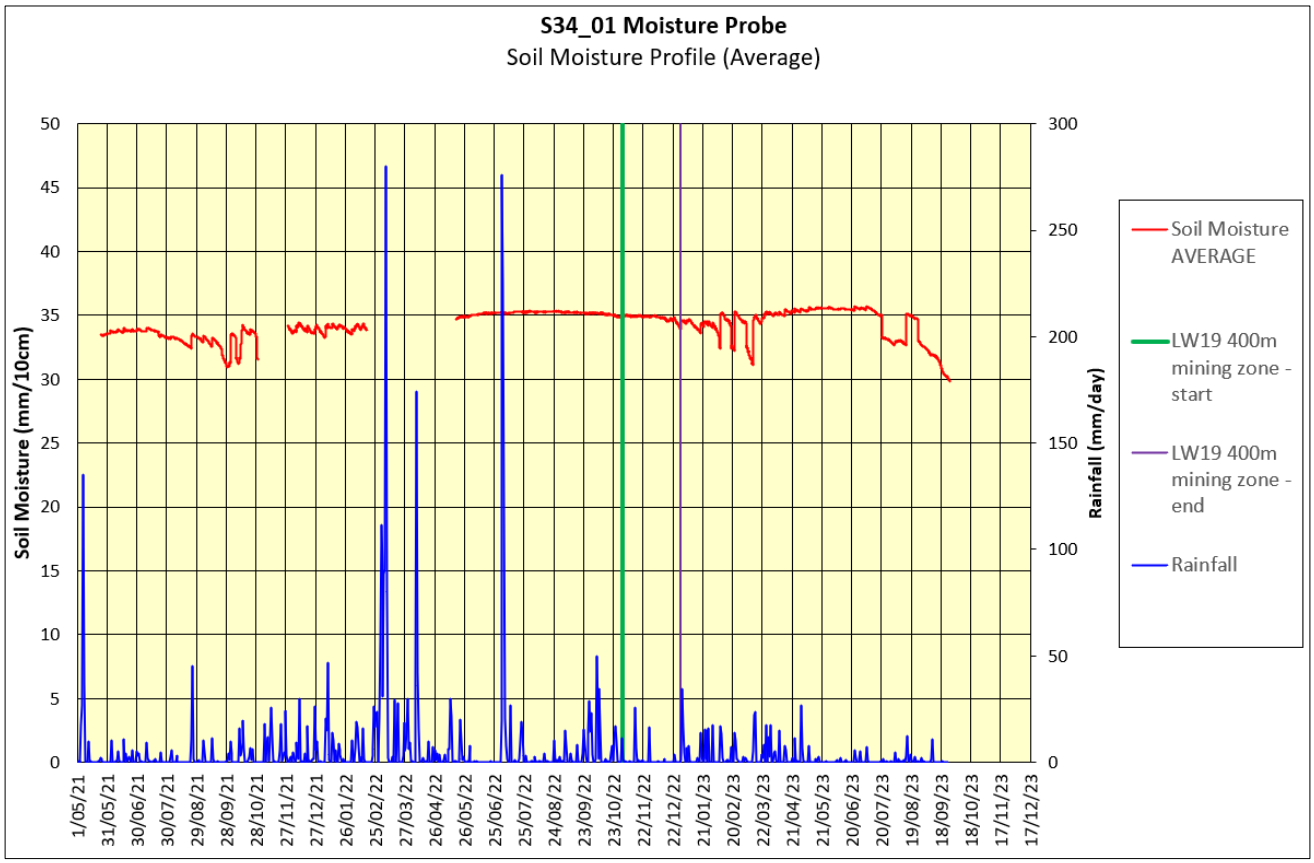
Graph 16: Average soil moisture records at *S15b_H1*, logged hourly. Date range: 16/08/2021 to 14/09/2023

Swamp 34

A soil moisture trigger was identified at monitoring site *S34_01* in Swamp 34 during recent analysis of moisture data by the IMCEFT. *S34_01* is located approximately 360 m south of Longwall 19. It entered the Longwall 19, 400m active mining area on 1 November 2022 and remained in the mining area until 29 December 2022. Recent analysis of records shows that the average soil moisture data after the completion of extraction is now lower than the lowest data recorded during the baseline period. As *S34_01* is the only soil moisture site in Swamp 34, these results contribute to a Level 3 trigger according to the Dendrobium Swamps TARP (Table 6), specifically:

- Soil moisture level lower than baseline level at >80% monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).

[#] *Comparison with reference swamps is undertaken as part of specialist End of Panel assessment.*



Graph 17: Average soil moisture records at *S34_01*, logged hourly. Date range: 25/05/2021 to 26/09/2023.

8 IMPACTS TO BUILT FEATURES

There were no impacts to built features recorded during the extraction of Longwall 21.

9 CURRENT AND FUTURE MONITORING

Monitoring undertaken during Longwall 21 and recommendations for future monitoring

Table 4: Monitoring Sites associated with Longwall 21 and monitoring proposed for Longwall 19A.

Aspect	Monitoring Sites Associated with Longwall 21	Monitoring Frequency	Future Monitoring
Watercourses	**Observational, photo point and water monitoring**		
	Longwall 21 Monitoring • Wongawilli Creek • WC20 • WC21 • WC24 • WC24A • LC5 **Reference Sites:** • CR36	Monthly 2 years pre and post mining, weekly when longwall is within 400m of monitoring site. Reference sites 6 monthly. Landscape Sites: pre and post mining, monthly when longwall is within 400m of monitoring site.	**Longwall 19A Monitoring** • WC13 • WC13A • WC14 • SC10
	Water Quality		
	Longwall 21 Monitoring • Wongawilli Creek (WC_Pool 49, WC_Pool 46, WC_Pool 45, WC_Pool 44, WC_Channel 10, WWU1, WWU4, Wongawilli Creek (FR6)) • WC20 (WC20_Pool 8, WC20_Rockbar 17) • WC24 (WC24_Pool 10, WC24_Pool 22) • WC24A (WC24A_Pool 1) • LC5 (LC5_Pool 26, LC5_S1) Lake Cordeaux (LC_1) **Reference Sites:** • CR36_S1	Monthly monitoring pre, during and post mining for two years.	**Longwall 19A Monitoring** • WC13, (WC13_Pool 3) • WC13A (WC13A_Pool 4) • WC14 (WC14_Pool 3, WC14_Pool 16) • SC10_Pool 26a, SC10_Pool 31, SC10_Pool 34
Swamps	**Observational, Photo Point and Water Monitoring**		
	Longwall 21 Monitoring • Swamps 9, 144 and 145	Pre and post mining for 2 years, monthly when longwall is within 400 m of monitoring site. Weekly inspection and pool water levels when longwall is within 400 m of monitoring site. Reference sites 6-monthly.	**Longwall 19A Monitoring** • Swamps 15a, 34 and 148

Aspect	Monitoring Sites Associated with Longwall 21	Monitoring Frequency	Future Monitoring
	Shallow Groundwater Level		
	Longwall 21 Monitoring • Swamp 9: 09_01, 09_02 • Swamp 144: 144_01 • Swamp 145: 145_01 **Reference Sites** • Swamp 22: 22_01, 22_02 • Swamp 24: 24_01 • Swamp 25: 25_01 • Swamp 33: 33_01, 33_03 • Swamp 84: 84_02 • Swamp 85: 85_01, 85_02 • Swamp 86: 86_01, 86_02 • Swamp 87: 87_01, 87_02 • Swamp 88: 88_01, 88_02	For open hole sites: • Monthly monitoring pre, during and post mining for two years to be reviewed annually • Reference sites 6 monthly For instrumented sites: • Automatic groundwater level monitoring pre, during and post mining (1-hour interval or similar) • Monitoring post mining for five years to be reviewed annually	**Longwall 19A Monitoring** • Swamp 15: 15a_03, 15a_04, 15a_06, 15a_07, 15a_08, 15a_09, 15a_11, 15a_12, 15a_15, 15a_19 • Swamp 34: 34_01 • Swamp 148: 148_01 **Reference Sites** • Swamp 22: 22_01, 22_02 • Swamp 24: 24_01 • Swamp 25: 25_01 • Swamp 33: 33_01, 33_03 • Swamp 84: 84_02 • Swamp 85: 85_01, 85_02 • Swamp 86: 86_01, 86_02 • Swamp 87: 87_01, 87_02 • Swamp 88: 88_01, 88_02
	Soil Moisture		
	Longwall 21 Monitoring • Swamp 9: 09_01, 09_02 • Swamp 144: 144_01 • Swamp 145: 145_01 **Reference Sites:** • Swamp 22: 22_01, 22_02 • Swamp 24: 24_01 • Swamp 25: 25_01 • Swamp 33: 33_01, 33_03 • Swamp 84: 84_02 • Swamp 85: 85_01, 85_02 • Swamp 86: 86_01, 86_02 • Swamp 87: 87_01, 87_02 • Swamp 88: 88_01, 88_02	For manually measured sites: • Monthly monitoring for 2 years baseline and post mining and 6-monthly reference sites • Weekly monitoring when longwall is within 400 m of monitoring site For instrumented sites: • Automatic soil moisture monitoring pre, during and post mining (1-hour interval or similar) • Monitoring post mining for five years to be reviewed annually	**Longwall 19A Monitoring** • Swamp 15a: 15a_03, 15a_04, 15a_07, 15a_12, 15a_15, 15a_19 • Swamp 34: 34_01 • Swamp 148: 148_01 **Reference Sites:** • Swamp 22: 22_01, 22_02 • Swamp 24: 24_01 • Swamp 25: 25_01 • Swamp 33: 33_01, 33_03 • Swamp 84: 84_02 • Swamp 85: 85_01, 85_02 • Swamp 86: 86_01, 86_S2 • Swamp 87: 87_01, 87_02 • Swamp 88: 88_01, 88_02
Landscape	**Targeted Sites**		
	Cliffs • DA3-CF13 **Fire Trails** • Fire Road 6F (across active mining area)	Monthly monitoring during any subsidence period. Post-mining inspection of all sites following completion of the longwall	**Cliffs** • DA3-CF7 • DA3-CF17 • DA3-CF18 • DA3-CF24 **Fire Trails** • Fire Road 6F (across active mining area)

Aspect	Monitoring Sites Associated with Longwall 21	Monitoring Frequency	Future Monitoring
	Inspection of Active Mining Area – Landscape Features, Vegetation, Watercourses		
	Continue monitoring of all mapped cliff, steep slope, watercourse, swamp and fire trail sites in subsidence area. Continue general observation of active mining areas.	Weekly monitoring when longwall extraction is within 400m of feature.	Continue monitoring of all mapped cliff, steep slope, watercourse, swamp and fire trail sites in subsidence area. Continue general observation of active mining areas.

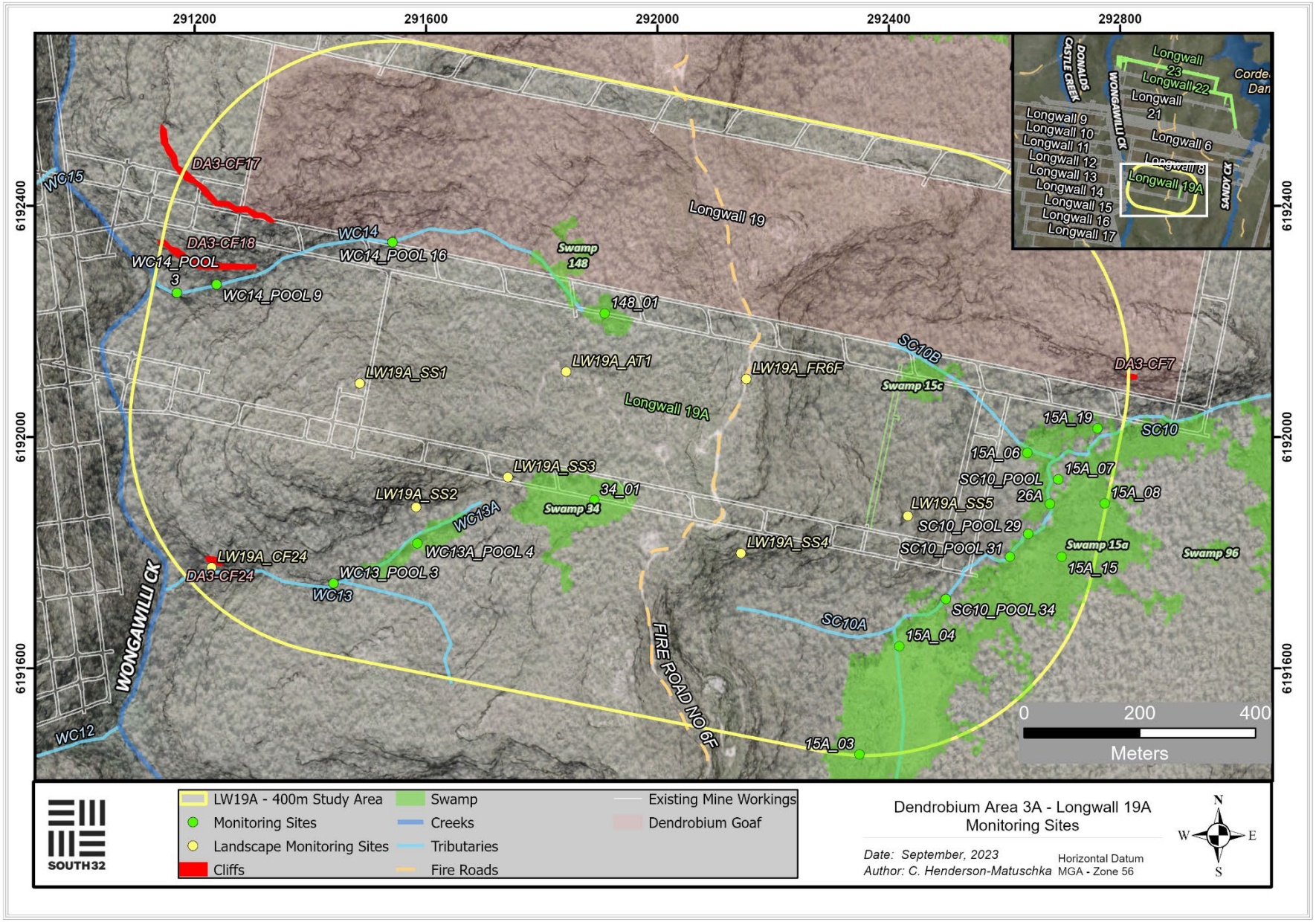


Figure 6: Map showing monitoring sites relevant to Longwall 19A

10 PREDICTED AND OBSERVED IMPACTS

The below table provides a summary of the predicted and observed impacts for Longwall 21 (Table 5).

Table 5: Dendrobium Area 3C impacts, TARPs and performance measures for Longwall 21.

Performance measures	Potential Impacts	Exceeding prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
WATERCOURSES					
Observational Monitoring					
Wongawilli Creek & Donalds Castle Creek *Dendrobium Area 3C SMP Approval:* **Minor environmental consequences** including: • *minor* fracturing, gas release and iron staining; and • *minor* impacts on water flows, water levels and water quality	Minor environmental consequences including: minor fracturing, gas release and iron staining; and minor impacts on water flows, water levels and water quality	Mining results in more than minor environmental consequences in Wongawilli Creek, including: • Structural integrity of the bedrock base of any significant permanent pool or controlling rockbar cannot be restored i.e. pool water level within the pool after CMAs continues to be lower than baseline period • Gas release results in vegetation dieback that does not revegetate • Gas release results in mortality of threatened species or ongoing loss of aquatic habitat • Iron staining and associated increases in dissolved iron resulting from mining is observed in water at Donalds Castle Creek	<u>*Level 1:*</u> • Crack or fracture up to 100mm width at its widest point with no observable loss of surface water or erosion • Crack or fracture up to 10m length with no observable loss of surface water or erosion • Erosion in a localised area (not associated with cracking or fracturing) which would be expected to naturally stabilise without CMA and within the period of monitoring • Observable release of strata gas at the surface • Observable increase in iron staining within the mining area • Observation that a pool on a subject Creek is dry • Observation that the subject Creek has ceased to flow	***DA3C_LW21_035:*** Iron staining present flowing on within proximity to Wongawilli Ck ***DA3C_LW21_036:*** Iron staining present flowing on within proximity to Wongawilli Ck	- See impact report dated 11/10/2023 - See impact report dated 11/10/2023

		downstream monitoring site Donalds castle Creek (FR6) • Iron staining and associated increases in dissolved iron resulting from the mining is observed in water at Wongawilli Creek downstream monitoring site Wongawilli Creek (FR6)	*Level 2:* • Observation that a single pool on a subject Creek is dry in consecutive monitoring events • Observation that two or more pools on a subject Creek are dry in a single monitoring event • Observation that the subject Creek has ceased to flow in consecutive monitoring event • Crack or fracture between 100 and 300mm width at its widest point or any fracture which results in observable loss of surface water or erosion • Crack or fracture between 10 and 50m length • Soil surface crack that causes erosion that is likely to stabilise within the monitoring period without intervention • Observable increase in iron staining within the mining area continues to outside the mining area i.e. 400m from the longwall	**No Level 2 Impacts observed**	
			Level 3: • Crack or fracture over 300mm width at its widest point	**No Level 3 impacts observed**	

			• Crack or fracture over 50m length • Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water • Soil surface crack that causes erosion that is unlikely to stabilise within the monitoring period without intervention • Gas release results in vegetation dieback, mortality or loss of aquatic habitat • Observable increase in iron staining within the mining area continues more than 600m from the longwall		
Drainage Line/Tributaries			<u>*Level 1:*</u> • Crack or fracture up to 100mm width at its widest point with no observable loss of surface water or erosion • Crack or fracture up to 10m length with no observable loss of surface water or erosion • Erosion in a localised area (not associated with cracking or fracturing) which would be expected to naturally stabilise without CMA	***DA3C_LW21_017:*** Rock fracturing on WC20 ***DA3C_LW21_020:*** Iron staining present on WC24 ***DA3C_LW21_021:*** Iron staining present on headwaters of WC20	- See impact report dated 31/07/2023 - See impact report dated 02/08/2023 - See impact report dated 02/08/2023

			and within the period of monitoring • Observable release of strata gas at the surface • Observable increase in iron staining within the mining area		
			<u>*Level 2:*</u> • Crack or fracture between 100 and 300mm width at it's widest point or any fracture which results in observable loss of surface water or erosion • Crack or fracture between 10 and 50m length • Soil surface crack that causes erosion that is likely to stabilize within the monitoring period without intervention • Observable increase in iron staining within the mining area continues outside the mining area i.e. 400m from the longwall	***DA3C_LW21_014*** Rock fracturing on WC20 ***DA3C_LW21_015*** Rock fracturing on WC20	- See impact report dated 17/07/2023 - See impact report dated 17/07/2023
			<u>*Level 3:*</u> • Crack or fracture over 300mm width at it's widest point • Crack or fracture over 50m length • Fracturing observed in the bedrock base of any significant permanent pool which resuls in	**No Level 3 impacts observed**	

			observable loss of surface water • Soil surface crack that causes erosion that is unlikely to stabilize within the monitoring period without intervention • Gas release results in vegetation dieback, mortality or loss of aquatic habitat • Observable increase in iron staining within the mining area continues more than 600m from the longwall		
Water Quality					
Wongawilli Creek	Minor environmental consequences	Mining results in two consecutive exceedances or three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45 – EC 154.1 uS/cm – DO 50.5%	<u>*Level 1:*</u> • One exceedance of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45 – EC 154.1 uS/cm – DO 50.5%	**No Level 1 Impacts observed**	
			<u>*Level 2:*</u> • Two non-consecutive exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45	**No Level 2 Impacts observed**	

			– EC 154.1 uS/cm – DO 50.5%		
			Level 3: • Three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45 – EC 154.1 uS/cm – DO 50.5%	**No Level 3 Impacts observed**	
Donalds Castle Creek	Minor environmental consequences	Mining results in two consecutive exceedances or three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	*Level 1:* • One exceedance of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	**No Level 1 Impacts observed**	
			Level 2: • Two non-consecutive exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	**No Level 2 Impacts observed**	

			Level 3: • Three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	**No Level 3 Impacts observed**	
Lake Cordeaux *Dendrobium Area 3C SMP Approval:* Operations do not result in reduction (other than negligible reduction) in the quality or quantity of surface water or groundwater inflows to Lake Cordeaux	Negligible reduction in the quality and quantity of surface water and groundwater inflows to Lake Cordeaux	Mining results in more than negligible reduction in the quality or quantity of surface water or groundwater inflows to Lake Cordeaux, including: • measured surface water flow reduction, based on Assessment Methods C, D, to be compared against predictions made in contemporary groundwater modelling conducted (to the satisfaction of the Secretary) to assess whether effects that cannot be explained by natural variability • mining results in two consecutive exceedances or three	*Level 1*: • One exceedance of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.96 – EC 137 uS/cm – DO 49.4%	**No Level 1 impacts observed**	
			Level 2: • Two non-consecutive exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.96 – EC 137 uS/cm – DO 49.4%	**No Level 2 impacts observed**	

		exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months that cannot be attributed to natural variation – pH 3.96 – EC 137 uS/cm – DO 49.4%	<u>*Level 3:*</u> • Three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.96 – EC 137 uS/cm – DO 49.4%	**No Level 3 impacts observed**	
Cordeaux River *Dendrobium Area 3C SMP Approval:* Operations do not result in reduction (other than negligible reduction) in the quality or quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek	Negligible reduction in the quality and quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek	Mining results in more than negligible reduction in the quality or quantity of surface water inflows to the Cordeaux River at its confluence with Wongawilli Creek, including: • Measured surface water flow reduction in Wongawilli Creek at its confluence with Cordeaux River is greater than predicted by modelling (to the satisfaction of the Secretary) that cannot be attributed to natural variation • mining results in two consecutive exceedances or three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months that cannot be attributed to natural variation		**No impacts observed**	

Pool Water Level					
Wongawilli Creek **Donalds Castle Creek**	Relevant Performance Measure(s): • Wongawilli Creek – minor environmental consequences • Donalds Castle Creek – minor environmental consequences	• Fracturing resulting in diversion of flow such that >10% of the pools have water levels lower than baseline period	*Level 1:* • Single pool on a subject Creek is observed as dry	**No Level 1 Impacts observed**	
			Level 2: • Single pool on a subject Creek is observed as dry in consecutive monitoring event • Two or more pools on a subject Creek are observed as dry in a single monitoring event	**No Level 2 Impacts observed**	
			Level 3: • Fracturing resulting in diversion of flow such that <10% of the pools have water levels lower than baseline period	**No Level 3 Impacts observed**	
Performance measures	**Potential Impacts**	**Exceeding prediction**	**TARP Trigger Level**	**Observed Impacts/Triggers**	**Additional Comments**
SWAMPS					
Minor changes in ecosystem functionality of the swamps	Falls in surface or near-surface **groundwater levels** in swamps *NB. Not linked specifically to a performance measure*		*Level 1:* Groundwater level lower than baseline level at any monitoring site within a swamp (in comparison to reference swamps); and/or	***Swamp 15a (15a_19)*** Rate of recession exceeded baseline	- See impact reported dated 17/07/2023

	and would not be considered a breach if predictions were exceeded		Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at any monitoring site (measured as average mm/day during the recession curve).		
			<u>*Level 2:*</u> Groundwater level lower than baseline level at **50%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps); and/or Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at a **50%** of monitoring sites (within 400m of mining) within the swamp.	***Swamp 9 (09_02)*** Groundwater level lower than baseline	- See impact report dated 09/08/2023
			<u>*Level 3:*</u> Groundwater level lower than baseline level at **>80%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **>80%** of monitoring sites (within 400 m of mining) within the swamp.	***Swamp 144 (144_01)*** Rate of recession exceeded baseline ***Swamp 9 (09_01)*** Groundwater level lower than baseline	- See impact report dated 28/06/2023 - See impact report dated 04/09/2023

Minor changes in ecosystem functionality of the swamps	Falls in **soil moisture** levels in swamps *NB. Not linked specifically to a performance measure and would not be considered a breach if predictions were exceeded*		<u>*Level 1:*</u> Soil moisture level lower than baseline level at **any** monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).		
			<u>*Level 2:*</u> Soil moisture level lower than baseline level at **50%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps).	***Swamp 15a (S15a_07, S15a_15, S15a_19)*** Average soil moisture lower than baseline	- See impact report dated 17/07/2023
			<u>*Level 3:*</u> Soil moisture level lower than baseline level at **>80%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps).	***Swamp 144 (S144_01)*** Average soil moisture lower than baseline	- See impact report dated 28/06/2023
				Swamp 145 (S145_01) Average soil moisture lower than baseline	- See impact report dated 09/08/2023
				Swamp 15a (S15a_12 and S15a_18) Average soil moisture lower than baseline	- See impact report dated 18/08/2023
				Swamp 12 (S12_04) Average soil moisture lower than baseline	- See impact report dated 04/09/2023
				Swamp 150 (S150_01) Average soil moisture lower than baseline	- See impact report dated 04/09/2023
				Swamp 09 (S09_01 and S09_02) Average soil moisture lower than baseline	- See impact report dates 04/09/2023
				Swamp 15b (S15b_H1) Average soil moisture lower than baseline	- See impact report dated 21/09/2023

Performance measures	Potential Impacts	Exceeding prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
LANDSCAPE					
Longwall 21 Study Area **Cliffs** All mapped cliff sites in subsidence area **Steep Slopes** All mapped steep slopes in subsidence area **Fire Trails** All mapped fire trails in subsidence area			<u>*Level 1:*</u> • Rock fall from a cliff which is left mostly intact (<10% length), resulting in insignificant ground disturbance • Surface movement or rock displacement with negligible soil surface exposed • Crack at the surface, which should not result in any significant erosion or further ground movement • Crack in a fire trail which should not result in erosion or impede access • Crack or fracture up to 100 mm width • Crack or fracture up to 10 m length • Erosion in a localised area which would be expected to naturally stabilise without CMA and within the period of monitoring	***DA3C_LW21_001*** Rock fracturing to an outcrop ***DA3C_LW21_005*** Rock fracturing to an outcrop ***DA3C_LW21_006*** Rock fracturing to an outcrop ***DA3C_LW21_008*** Rock fracturing and soil cracking to a rock step ***DA3C_LW21_009*** Rock fracturing to a step ***DA3C_LW21_011*** Soil cracking, rock fracturing and displacement to an outcrop ***DA3C_LW21_012*** Rock fracturing to a rock step ***DA3C_LW21_013*** Rock fracturing to a rock outcrop ***DA3C_LW21_016*** Rockfall on step ***DA3C_LW21_018*** Rock fracturing to outcrop/ledge	- See impact report dated 09/06/2023 - See impact report dated 19/06/2023 - See impact report dated 19/06/2023 - See impact report dated 20/06/2023 - See impact report dated 20/06/2023 - See impact report dated 20/06/2023 - See impact report dated 28/06/2023 - See impact report dated 04/07/2023 - See impact report dated 17/07/2023 - See impact report dated 31/07/2023

				DA3C_LW21_019 Rock fracturing to rock step	- See impact report dated 02/08/2023
				DA3C_LW21_022 Rock fall on outcrop/step	- See impact report dated 09/08/2023
				DA3C_LW21_023 Rock fracturing to an outcrop	- See impact report dated 04/09/2023
				DA3C_LW21_024 Rock fracturing to an outcrop	- See impact report dated 04/09/2023
				DA3C_LW21_025 Rock fracturing to an outcrop	- See impact report dated 08/09/2023
				DA3C_LW21_026 Rockfall and fracturing to rock step	- See impact report dated 08/09/2023
				DA3C_LW21_028 Rock fracturing to an outcrop	- See impact report dated 08/09/2023
				DA3C_LW21_029 Rock fracturing to an outcrop at *LW21_SS3*	- See impact report dated 08/09/2023
				DA3C_LW21_030 Rock fracturing to an outcrop	- See impact report dated 14/09/2023
				DA3C_LW21_031 Rock fracturing to a rock step	- See impact report dated 14/09/2023
				DA3C_LW21_032 Rock fracturing to a rock step	- See impact report dated 14/09/2023
				DA3C_LW21_033	- See impact report dated 14/09/2023

				Rock fracturing to a rock step	
			<u>*Level 2:*</u> • Rock fall or overhang collapse at a cliff site, where characteristics of the cliff have changed, and there has been significant ground disturbance • Surface movement or rock displacement that has exposed significant areas of soil • A crack at the surface, which could result in significant erosion or movement at the surface • A crack at the surface with potential risk to safety and/or fauna entrapment • A crack in the fire trail, which could result in significant erosion or impede vehicle access • Crack or fracture between 100 and 300mm width • Crack or fracture between 10 and 50m length • Significant erosion at any location, which is not likely to naturally stabilise within the period of monitoring, or is located in a sensitive area e.g. swamps, creek, lake shore, and may result in increased sediment transport to	***DA3C_LW21_002*** Rock fracturing and rock movement to an outcrop at *LW21_RO1.* ***DA3C_LW21_003*** Rock fracturing and rockfall to an outcrop ***DA3C_LW21_004*** Rock fracturing to an outcrop ***DA3C_LW21_007*** Rock fracturing and rockfall to an outcrop ***DA3C_LW21_010*** Rock fracturing and movement/displacement to an outcrop ***DA3C_LW21_016 (Update)*** Rockfall to step ***DA3C_LW21_027*** Rockfall to step at *LW21_SS1.* ***DA3C_LW21_034*** Rock movement and soil cracking	- See impact report dated 09/06/2023 - See impact report dated 09/06/2023 - See impact report dated 09/06/2023 - See impact report dated 19/06/2023 - See impact report dated 20/06/2023 - See impact report dated 31/07/2023 - See impact report dated 08/09/2023 - See impact report dated 14/09/2023

			Cordeaux Dam, or has been previously identified as Level 1, but is not likely to naturally stabilise within the monitoring period		
			Level 3: • Major cliff collapse where the characteristics of the cliff change significantly and there is significant ground disturbance that is unlikely to naturally stabilise within the monitoring period • Crack or fracture over 300 mm width • Crack or fracture over 50 m length • Mass movement of a slope causing large areas of exposed • Soil with potential for further movement	**No Level 3 Impacts observed**	

11 APPENDIX A – TRIGGER ACTION RESPONSE PLANS

Table 6: Dendrobium Area 3C Swamp Impacts, Triggers and Response Plan.

Performance Measures	*Potential Impacts*	*Performance Triggers*	*Management Strategies*	*Offsets*	*Other Actions*
Negligible erosion of the surface of the swamp	Gully erosion or similar	*Level 1:* The increase in length of erosion within a swamp (compared to its pre-mining length) is **2%** of the swamp length or area; and/or Erosion in a localised area (not associated with cracking or fracturing) which would be expected to naturally stabilise without CMA and within the period of monitoring. *Level 2:* The increase in length of erosion within a swamp (compared to its pre-mining length) is **3%** of the swamp length or area; and/or Soil surface crack that causes erosion that is likely to stabilise within the monitoring period without intervention; and/or Gully knickpoint forms or an existing gully knickpoint becomes active. *Level 3:* The increase in length of erosion within a swamp (compared to its pre-mining length) is **4%** of the swamp length or area; and/or Soil surface crack that causes erosion that is unlikely to stabilise within the monitoring period without intervention. *Exceeding Prediction:* Mining results in the total length of erosion within a swamp (compared to its pre-mining length) to increase **>5%** of the length or area of the swamp compared to any increase in total erosion length in a reference swamp (i.e. increase in length or area of erosion in an impact swamp less any increase in length or area in erosion in a reference swamp is **>5%**).	a.) upfront mine planning b.) erosion monitoring (i.e. ALS, observation) c.) coir logs d.) knickpoint control e.) water spreading f.) weeding g.) fire management h.) reporting i.) investigation and review j.) update future predictions	Offset required **immediately**, if no remediation considered practicable. Offset required **2 years** following remediation, if it is ineffective. This period can be extended to **5 years**, with the agreement of the Secretary.	
Minor changes in the size of the swamps **Minor changes** in the ecosystem	Swamp vegetation changes: – Swamp size – Species richness,	**Swamp Size** *Level 1:* A trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for two consecutive monitoring periods, greater than observed in the Control Group, and exceeding the standard error (SE) of the Control Group.	a.) upfront mine planning b.) vegetation monitoring c.) water spreading d.) seeding/planting e.) weeding	Offset required **immediately**, if no remediation considered practicable.	Monitoring period for swamp size is related to capture of Lidar data at the end of

functionality of the swamps **No significant change** to the composition or distribution of species within the swamps	– distribution, composition, and diversity Vegetation sub-communities	*Level 2:* A trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for three consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group. *Level 3:* A trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for four consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group. *Exceeding Prediction:* Mining results in a trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for five consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group. **Ecosystem Functionality** *Level 1:* A trending decline in the extent of any individual groundwater dependent community within a swamp for two consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group. *Level 2:* A trending decline in the extent of any groundwater dependent community within a swamp for three consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group. *Level 3*: A trending decline in the extent of any groundwater dependent community within a swamp for four consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group. *Exceeding Prediction:* Mining results in a trending decline in the extent of a groundwater dependent community within a swamp for five consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group. **Species Composition and Distribution** *Level 1:* A **2%** (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for **two** consecutive years; and/or	f.) fauna monitoring g.) fire management h.) grouting of controlling rockbars and bedrock base and/or use of other remediation techniques i.) reporting j.) investigation and review k.) update future predictions	Offset required **5 years** following remediation, if it is ineffective. This period can be extended to **10 years**, with the agreement of the Secretary.	each longwall ~ 1 year Triggers for groundwater decline result in increased intensity and frequency of vegetation monitoring

		Level 2: A **5%** (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for **three** consecutive years. *Level 3:* An **8%** (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for **four** consecutive years. *Exceeding Prediction:* Mining results in a **>10%** (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for **five** consecutive years.			
Maintenance or restoration of the structural integrity of the bedrock base of any significant permanent pool or controlling rockbar within the swamps	Subsidence impacts (ie cracking) on bedrock base or controlling rockbar	*Level 1:* Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water of **10%** compared to baseline for the pool (in addition to any decrease in reference pools). *Level 2:* Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water of **20%** compared to baseline for the pool (in addition to any decrease in reference pools). *Level 3:* Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water of **20%** compared to baseline for the pool for **>20%** of the time over a period of **1** year (in addition to any decrease in reference pools). *Exceeding Prediction:* Structural integrity of the bedrock base of any significant permanent pool or controlling rockbar cannot be restored, i.e. pool water level within the swamp after CMAs continues to be **>20%** lower than baseline for **>20%** of the time over a period of **1** year.	a.) upfront mine planning b.) subsidence monitoring c.) surface water monitoring d.) groundwater monitoring e.) grouting of controlling of controlling rockbars and bedrock base and/or use of other remediation techniques f.) CMAs g.) reporting h.) investigation and review i.) update future predictions	Offset required **immediately**, if no remediation considered practicable. Offset required **2 years** following remediation, if it is ineffective. This period can be extended to **5 years**, with the agreement of the Secretary.	
Minor changes in the ecosystem functionality of the swamps	Falls in surface or near-surface groundwater levels in swamps	*Level 1*: Groundwater level lower than baseline level at any monitoring site within a swamp (in comparison to reference swamps); and/or Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at any monitoring site (measured as average mm/day during the recession curve).	a.) upfront mine planning b.) groundwater monitoring c.) implementation of swamp		Triggers for groundwater decline result in increased intensity and frequency of vegetation

	NB. Not linked specifically to a PM and would not be considered a breach if predictions were exceeded.	<u>*Level 2:*</u> Groundwater level lower than baseline level at **50%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps); and/or Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at a **50%** of monitoring sites (within 400m of mining) within the swamp. <u>*Level 3:*</u> Groundwater level lower than baseline level at **>80%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **>80%** of monitoring sites (within 400 m of mining) within the swamp.	research program d.) weeding e.) fire management f.) reporting g.) update future predictions		monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars
Minor changes in the ecosystem functionality of the swamps	Falls in soil moisture levels in swamps *NB. Not linked specifically to a PM and would not be considered a breach if predictions were exceeded.*	<u>*Level 1:*</u> Soil moisture level lower than baseline level at **any** monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps). <u>*Level 2:*</u> Soil moisture level lower than baseline level at **50%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps). <u>*Level 3*</u>: Soil moisture level lower than baseline level at **>80%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps).	a.) upfront mine planning b.) soil moisture monitoring c.) water spreading d.) weeding e.) fire management f.) reporting g.) update future predictions		Triggers of soil moisture decline result in increased intensity and frequency of vegetation monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars

Table 7: Dendrobium Area 3C Watercourse Impacts, Triggers and Response Plan.

OBSERVATIONAL MONITORING		
Donalds Castle Creek and Wongawilli Creek **Relevant Performance Measure(s):** • Donalds Castle Creek - minor environmental consequences • Wongawilli Creek - minor environmental consequences General observation of streams in active mining areas when longwall is within 400m	***Level 1*** • Crack or fracture up to 100mm width at its widest point with no observable loss of surface water or erosion • Crack or fracture up to 10m length with no observable loss of surface water or erosion • Erosion in a localised area (not associated with cracking or fracturing) which would be expected to naturally stabilise without CMA and within the period of monitoring • Observable release of strata gas at the surface • Observable increase in iron staining within the mining area • Observation that a pool on a subject Creek is dry • Observation that the subject Creek has ceased to flow	• Continue monitoring program • Submit an Impact Report to BCD, DPIE, Resources Regulator, WaterNSW • Report in the End of Panel Report • Summarise actions and monitoring in AR
	Level 2 • Observation that a single pool on a subject Creek is dry in consecutive monitoring events • Observation that two or more pools on a subject Creek are dry in a single monitoring event • Observation that the subject Creek has ceased to flow in consecutive monitoring event • Crack or fracture between 100 and 300mm width at its widest point or any fracture which results in observable loss of surface water or erosion • Crack or fracture between 10 and 50m length • Soil surface crack that causes erosion that is likely to stabilise within the monitoring period without intervention • Observable increase in iron staining within the mining area continues to outside the mining area i.e. 400m from the longwall	• *Actions as stated for Level 1* • Carry out Water Flow Assessment Method D • Review monitoring frequency • Submit letter report to BCD, DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required • Implement agreed CMAs as approved (subject to agency feedback)
		• *Actions as stated for Level 1* • Review monitoring frequency • Submit letter report to DPIE, DRG and WaterNSW and seek advice on any CMA required • Implement agreed CMAs as approved (subject to agency feedback)
	Level 3 • Crack or fracture over 300mm width at its widest point • Crack or fracture over 50m length	• *Actions as stated for Level 2* • Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW

	• Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water • Soil surface crack that causes erosion that is unlikely to stabilise within the monitoring period without intervention • Gas release results in vegetation dieback, mortality or loss of aquatic habitat • Observable increase in iron staining within the mining area continues more than 600m from the longwall	• Implement additional monitoring or increase frequency if required • Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator, WaterNSW • Completion of works following approvals and at a time agreed between S32, DPIE, WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success • Review relevant TARP and Management Plan in consultation with key agencies
	Exceeding Prediction • Structural integrity of the bedrock base of any significant permanent pool or controlling rockbar cannot be restored i.e. pool water level within the pool after CMAs continues to be lower than baseline period • Gas release results in vegetation dieback that does not revegetate • Gas release results in mortality of threatened species or ongoing loss of aquatic habitat • Iron staining and associated increases in dissolved iron resulting from mining is observed in water at Donalds Castle Creek downstream monitoring site Donalds castle Creek (FR6) • Iron staining and associated increases in dissolved iron resulting from the mining is observed in water at Wongawilli Creek downstream monitoring site Wongawilli Creek (FR6)	• *Actions as stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent
DC13, LC5, WC20, WC21, WC22, WC23, WC24, WC25, WC26, WC27 and WC29 General observation of streams in active mining areas when longwall is within 400m	***Level 1*** • Crack or fracture up to 100mm width at its widest point with no observable loss of surface water or erosion • Crack or fracture up to 10m length with no observable loss of surface water or erosion • Erosion in a localised area (not associated with cracking or fracturing) which would be expected to	• Continue monitoring program • Submit an Impact Report to BCD, DPIE, Resources Regulator, WaterNSW • Report in the End of Panel Report • Summarise actions and monitoring in AEMR

	naturally stabilise without CMA and within the period of monitoring • Observable release of strata gas at the surface • Observable increase in iron staining within the mining area	
	Level 2 • Crack or fracture between 100 and 300mm width at it's widest point or any fracture which results in observable loss of surface water or erosion • Crack or fracture between 10 and 50m length • Soil surface crack that causes erosion that is likely to stabilize within the monitoring period without intervention • Observable increase in iron staining within the mining area continues outside the mining area i.e. 400m from the longwall	• *Actions as stated for Level 1* • Review monitoring frequency • Submit letter report to BCD, DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required • Implement agreed CMAs as approved (subject to agency feedback)
	Level 3 • Crack or fracture over 300mm width at it's widest point • Crack or fracture over 50m length • Fracturing observed in the bedrock base of any significant permanent pool which resuls in observable loss of surface water • Soil surface crack that causes erosion that is unlikely to stabilize within the monitoring period without intervention • Gas release results in vegetation dieback, mortality or loss of aquatic habitat • Observable increase in iron staining within the mining area continues more than 600m from the longwall	• *Actions as stated for Level 2* • Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW • Implement additional monitoring or increase frequency if required • Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator, WaterNSW • Completion of works following approvals and at a time agreed between S32, DPIE, Resources Regulator and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success • Review relevant TARP and Management Plan in consultation with key agencies

WATER QUALITY		
Wongawilli Creek **Relevant Performance Measure(s):** • Wongawilli Creek - minor environmental consequences Wongawilli Creek (FR6) Baseline means: • pH 5.98 • EC 98.8 uS/cm • DO 89.5%	***Level 1*** • One exceedance of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45 – EC 154.1 uS/cm – DO 50.5%	• Continue monitoring program • Submit an Impact Report to BCD, DPIE, Resources Regulator and WaterNSW • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	Level 2 • Two non-consecutive exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45 – EC 154.1 uS/cm – DO 50.5%	• *Actions as stated for Level 1* • Review monitoring frequency • Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required • Implement agreed CMAs as approved (subject to agency feedback)
	Level 3 • Three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45 – EC 154.1 uS/cm – DO 50.5%	• *Actions as stated for Level 2* • Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW • Implement additional monitoring or increase frequency if required • Review relevant TARP and Management Plan in consultation with key agencies • Develop site CMA (subject to agency feedback). This may include: – Limestone emplacement to raise pH where it is appropriate to do so • Completion of works following approvals and at a time agreed between S32, DPIE, Resources Regulator and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success
	Exceeding Prediction • Mining results in two consecutive exceedances or three exceedances of the ±3 standard deviation level	• *Actions as stated for Level 3* • Investigate reasons for the exceedance

	(positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.45 – EC 154.1 uS/cm – DO 50.5%	• Update future predictions based on the outcomes of the investigation • Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent
Donalds Castle Creek **Relevant Performance Measure(s):** Donalds Castle Creek – minor environmental consequences Donalds Castle Creek (FR6) Baseline means: • pH 5.41 • EC 116 uS/cm • DO 85.6%	***Level 1*** • One exceedance of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	• Continue monitoring program • Submit an Impact Report to BCD, DPIE, Resources Regulator WaterNSW • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	Level 2 • Two non-consecutive exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	• *Actions as stated for Level 1* • Review monitoring frequency • Submit letter report to DPIE, RESOURCES REGULATOR and WaterNSW and seek advice on any CMA required • Implement agreed CMAs as approved (subject to agency feedback)
	Level 3 • Three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	• *Actions as stated for Level 2* • Offer site visit with BCD, DPIE, RESOURCES REGULATOR, WaterNSW • Implement additional monitoring or increase frequency if required • Review relevant TARP and Management Plan in consultation with key agencies • Collect laboratory samples and analyse for: – pH, EC, major cations, major anions, Total Fe, Mn & Al – Filterable suite of metals • Develop site CMA (subject to agency feedback). This may include: – Limestone emplacement to raise pH where it is appropriate to do so • Completion of works following approvals and at a time agreed between S32, DPIE, Resources Regulator and WaterNSW

		(i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success
	Exceeding Prediction • Mining results in two consecutive exceedances or three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 3.60 – EC 185.8 uS/cm – DO 40.1%	• *Actions as stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent
Lake Cordeaux **Relevant Performance Measure(s):** Lake Cordeaux - negligible reduction in the quality of surface water inflows to Lake Cordeaux LC5_S1 Baseline means: • pH 5.54 • EC 102.4 uS/cm • DO 93.6%	***Level 1*** • One exceedance of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.16 – EC 254.9 uS/cm – DO 61.2%	• Continue monitoring program • Submit an Impact Report to BCD, DPIE, Resources Regulator, Water NSW • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	Level 2 • Two non-consecutive exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.16 – EC 254.9 uS/cm – DO 61.2%	• *Actions as stated for Level 1* • Review monitoring frequency • Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required • Implement agreed CMAs as approved (subject to agency feedback)
	Level 3 • Three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.16 – EC 254.9 uS/cm – DO 61.2%	• *Actions as stated for Level 2* • Offer site visit with BCD, DPIE, Resources Regulator, WaterNSW • Implement additional monitoring or increase frequency if required • Review relevant TARP and Management Plan in consultation with key agencies • Collect laboratory samples and analyse for: – pH, EC, major cations, major anions, Total Fe, Mn & Al – Filterable suite of metals

		• Develop site CMA (subject to agency feedback). This may include: – Limestone emplacement to raise pH where it is appropriate to do so – Grouting of fractures in rockbar and bedrock base of any significant pool where flow diversion results in pool water level lower than baseline period • Completion of works following approvals and at a time agreed between S32, DPIE, DRG and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success
	Exceeding Prediction • Mining results in two consecutive exceedances or three exceedances of the ±3 standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: – pH 4.16 – EC 254.9 uS/cm – DO 61.2%	• *Actions as stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent

Table 8: Dendrobium Landscape Impacts, Triggers and Response Plan.

Landscape Features		
Longwall 21 Study Area **Cliffs** All mapped cliff sites in subsidence area *(Refer to Figure 1 for location of sites)* **Steep Slopes** Mapped steep slopes in subsidence area *(Refer to Figure 1 for location of sites)* **Fire Trails** All mapped fire trails in subsidence area *(Refer to Figure 1 for location of sites)*	***Level 1*** • Rock fall from a cliff which is left mostly intact (<10% length), resulting in insignificant ground disturbance • Surface movement or rock displacement with negligible soil surface exposed • Crack at the surface, which should not result in any significant erosion or further ground movement • Crack in a fire trail which should not result in erosion or impede access • Crack or fracture up to 100 mm width • Crack or fracture up to 10 m length	• Continue monitoring program • Submit an Impact Report to key stakeholders • Summarise impacts and report in the EOP and AR

	• Erosion in a localised area which would be expected to naturally stabilise without CMA and within the period of monitoring	
	Level 2 • Rock fall or overhang collapse at a cliff site, where characteristics of the cliff have changed, and there has been significant ground disturbance • Surface movement or rock displacement that has exposed significant areas of soil • A crack at the surface, which could result in significant erosion or movement at the surface • A crack at the surface with potential risk to safety and/or fauna entrapment • A crack in the fire trail, which could result in significant erosion or impede vehicle access • Crack or fracture between 100 and 300 mm width • Crack or fracture between 10 and 50 m length • Significant erosion at any location, which is not likely to naturally stabilise within the period of monitoring, or is located in a sensitive area e.g. swamps, creek, lake shore, and may result in increased sediment transport to Cordeaux Dam, or has been previously identified as Level 1, but is not likely to naturally stabilise within the monitoring period	• *Actions as stated for Level 1* • Review monitoring frequency • Notify relevant technical specialists and seek advice on any CMA required • Provide safety signage and barricades as appropriate • Implement approved repairs to ensure safety and serviceability on fire trails • Implement agreed CMAs as approved *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Level 3 • Major cliff collapse where the characteristics of the cliff change significantly and there is significant ground disturbance that is unlikely to naturally stabilise within the monitoring period • Crack or fracture over 300 mm width • Crack or fracture over 50 m length • Mass movement of a slope causing large areas of exposed • Soil with potential for further movement	• *Actions as stated for Level 2* • Immediately notify stakeholders and technical specialists and seek advice on any CMA required • Offer site visit with stakeholders • Implement additional monitoring or increase frequency if required • Completion of works following approvals and at a time agreed between S32, DPIE and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success • Review relevant TARP and Management Plan in consultation with key agencies

		Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts