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Subject	SPR1301 Trigger Investigation	Project Name	Springvale Groundwater Monitoring
Attention	Natalie Gardiner	Project No.	IA132000
From	Quan Bui		
Date	22 June 2021		
Copies to			

1. Introduction

This memorandum, prepared by Jacobs (Australia) Pty Ltd (Jacobs), provides notification and review of the exceedance of the short term groundwater level trigger at ridge piezometer SPR1301. Shallow aquifer piezometer site SPR1301 is a monitoring location in both the Longwall 424-427 Swamp Monitoring Program and the Water Management Plan. Springvale is following the TARP process of the Swamp Monitoring Program which is also referenced in the Water Management Plan.

The current longwall 424 to 427 (LW424-427) Swamp Monitoring Plan (SMP) and Trigger Action Response Plan (TARP) (Centennial 2018) details investigative measures and reporting requirements required following a trigger exceedance. The measures include a series of checks to discern non-mining impacts from mining related impacts.

This memorandum documents investigation of the observed groundwater declines following an eight week monitoring period, subsequent to the time that the initial pressure declines were observed. The investigation is undertaken in general accordance with the trigger action response plan (TARP) (Chart 1, 2 and 3) of the SMP for LW424-27 (Centennial Coal, 2018).

The monitoring bore – SPR1301 – is screened in the Bankswall Sandstone (above the Mt York Claystone and the target coal seam) and is 87 m deep has been monitored since May 2014. The monitoring bore – SPR1301 – was within the 600 m Trigger Investigation Area (TIA) for Longwall 427 (LW427) about 5 February 2021 and entered into the post mining period. During the April 2021 monitoring campaign, the groundwater levels were found to be below the 5th percentile trigger for more than a month in the post mining period.

Notification of exceedance at SPR1301 was received by Centennial Coal Springvale from Jacobs on the 10 May 2021 following scheduled monitoring and subsequent data verification. As required by the TARP, notification of the trigger was provided to Department of Planning Industry and Environment (DPIE) on 13 May 2021.

2. Background

2.1 Groundwater Triggers

Variations in groundwater levels within swamps are assessed using trigger levels defined in the SMP. Triggers are used to determine whether changes in the physical setting are within or outside an expected range of conditions naturally occurring in a swamp. Trigger levels for monitoring boreholes have been developed using statistical analysis (percentile based triggers) of pre-mining monitoring data with post mining monitoring data used to determine whether the triggers have been exceeded. Pre-mining data is collected before the active longwall is within 600m of the impact piezometer and post-mining data is collected thereafter.

Using this statistical based percentile method, groundwater level triggers have been classified into two categories:

- Short-term changes – Trigger level exceeded if the 7 day moving average groundwater depth exceeds the 5th percentile pre-mining groundwater depth more than one (1) month.
- Long-term changes – Trigger level is exceeded if the post-mining 50th percentile groundwater depth exceeds the 20th percentile pre-mining level.

In this instance, the short term trigger for SPR1301 has been exceeded. Long term impacts are assessed when sufficient long term post mining data has been collected (typically one year). SPR1301 will be compared to reference site monitoring boreholes in accordance to the SMP. Reference sites are locations where mining induced impacts are unlikely due to their distance away from active mining.

Relevant groundwater monitoring locations are shown in Figure 2.1

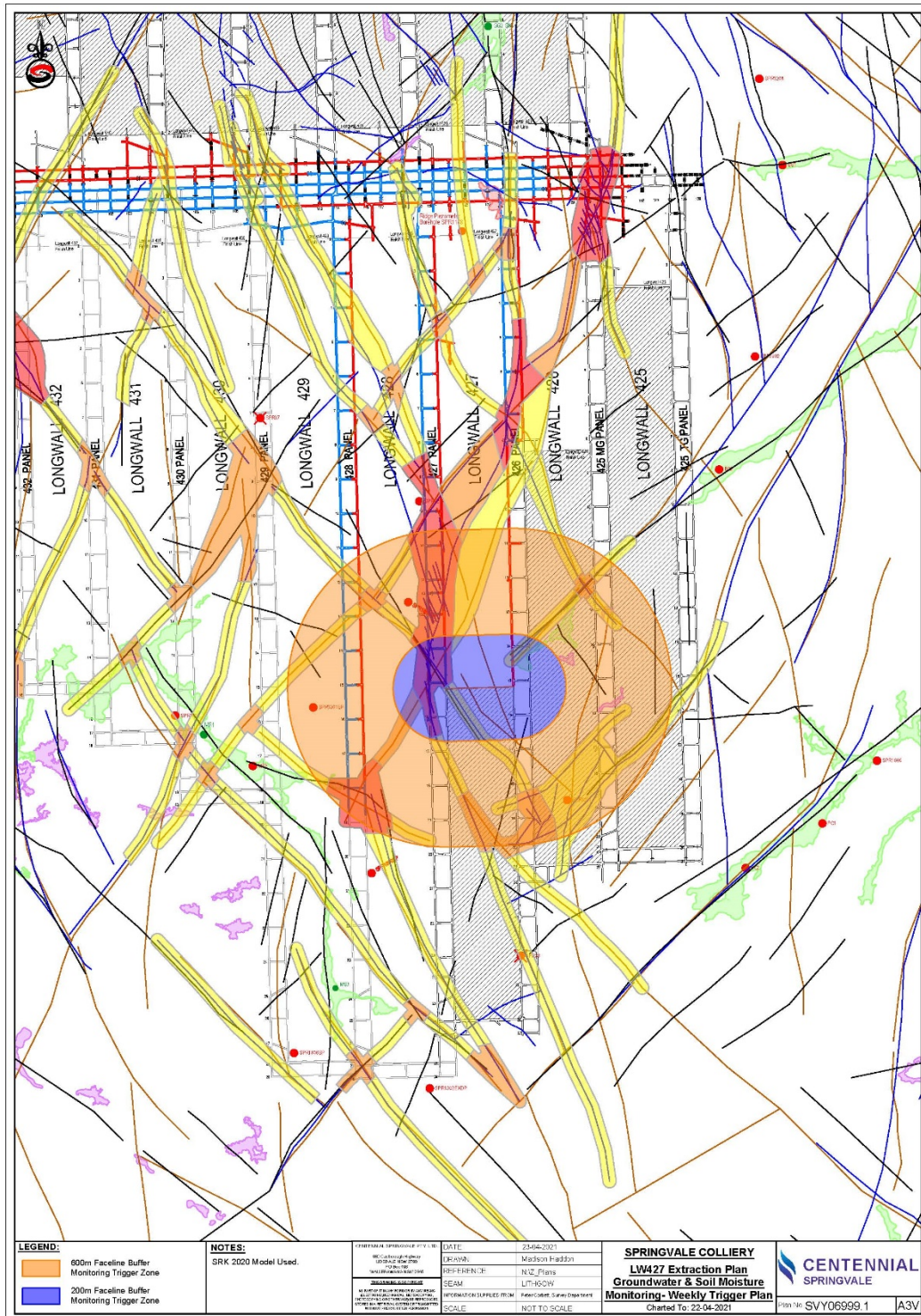


Figure 2.1: Groundwater monitoring locations

2.2 Monitoring Borehole Details

The Mount York Claystone layer separates the perched (Burralow Formation) and shallow (Bankswall Sandstone Formation) aquifer systems from the deep (Burra-Moko, Caley and Illawarra Coal formations) aquifer systems. It is believed to be an effective aquitard with an average thickness of 20 m. The Bankswall Sandstone formation and the Burralow formation, which are located above the Mount York Claystone aquitard are aquifers of note. The monitoring of the shallow aquifer systems gives insights into the propagation of subsidence impacts above the Mount York Claystone and the potential impacts on nearby swamp ecosystems.

SPR1301 is located above proposed LW429. The monitoring bore is screened at 87 m in the Banks Wall Sandstone Formation, which lies above the Mt York Claystone. Groundwater levels have been monitored since May 2014 with an automatic groundwater level logger taking daily readings. Data is downloaded monthly.

2.3 Mining Period

Mining in LW427 commenced on 28 September 2020 with the longwall face advancing northward. LW427 encroached within the 600m Trigger Investigation Area (TIA) around 5 February 2021.

2.4 Initial Notification to Centennial of Occurrence

Groundwater data was downloaded routinely (typical monthly interval) and subsequently processed by Jacobs in late April 2020. The review of the data showed groundwater levels at SPR1301 had been below the short term trigger level for a more than a month in the post mining period. Centennial was notified on 10 May 2021 and received by DPIE on 13 May 2021.

3. Centennial Actions Following Notification

The approved SMP TARP Charts 1 to 3 are attached to this letter for reference.

SMP TARP Chart 2 requires that *"If a trigger level or exceedance is identified the following Management Measures are to be carried out within 2 months"*:

- *Check anomalous data for accuracy.*
- *Determine whether similar triggers were activated at reference sites.*
- *Identify anthropogenic/ natural impacts responsible.*
- *Review monitoring result in the light of any abnormal weather conditions.*
- *Was active mining within 600 m?*
- *Was there evidence of mining related impacts?*

SMP TARP Chart 3 requires additional investigation to:

- Check exceedances of secondary performance indicators (any significant change in groundwater level not related to recent meteorological conditions or any significant change in groundwater level relative to groundwater level behaviour at reference sites during the same period). This section is covered in Chart 2.
- Check for anthropogenic or natural causes of the anomalous data. This section is covered in Chart 2.
- Carry out field inspections to determine extent and causes.
- Consider additional or more frequent monitoring.

Centennial have implemented relevant Management Measures required under Chart 2 and 3 within the required timeframe.

4. Hydrograph Response Summary

The hydrograph of SPR1301 is shown on Figure 4.1 and a detail of the same hydrograph is shown on Figure 4.2. The yellow vertical dotted line represents the start of the post mining period when active mining was within 600 m of the site. The red horizontal dotted line represents the short term 95th percentile trigger.

- A general declining trend in groundwater levels from mid 2015 to early 2020 corresponding to drought and mirroring a subdued CRD curve.
 - Stabilising groundwater levels following significant rainfall in February 2020 and subsequent average to above average rainfall conditions.
 - In the pre-mining period, in April 2019 the water level movement was likely due to logger placement after it was retrieved for download, as the timing aligns with monitoring dates.
 - In the pre-mining period, in June 2020 a sudden drop in water level (approximately 0.15 m) was observed on the 20 June 2020 and followed by a slower decline (0.15 m) over four days between 22 and 25 June 2020. A comparison between manual field measurements and logger data between 16 June 2020 and 1 July 2020 shows the water level declined 0.15 m and 0.21 m respectively. The cause of the decline is unknown.
- It is noted mining was outside of the 600 m TIA (approximately 800 m away) and moving further

away when this decline was observed. Furthermore, SPR1210 and SPR1807 were within the 600m TIA at the time and did not record unusual water level movements.

- A gradual water level increase was observed following the decline. The water level remained around the 95th percentile trigger.
- In the post mining period in April 2021, the trigger condition activated after the 7 day moving average water level remained below the 95th percentile short term trigger level for more than a month into the post mining period.
- A more pronounced water level movement was observed in March 2021 (approximately a 0.1 m decline). The water level fluctuation closely corresponds to the CRD curve.
- In late April 2021, the water level increased above the short term trigger level.

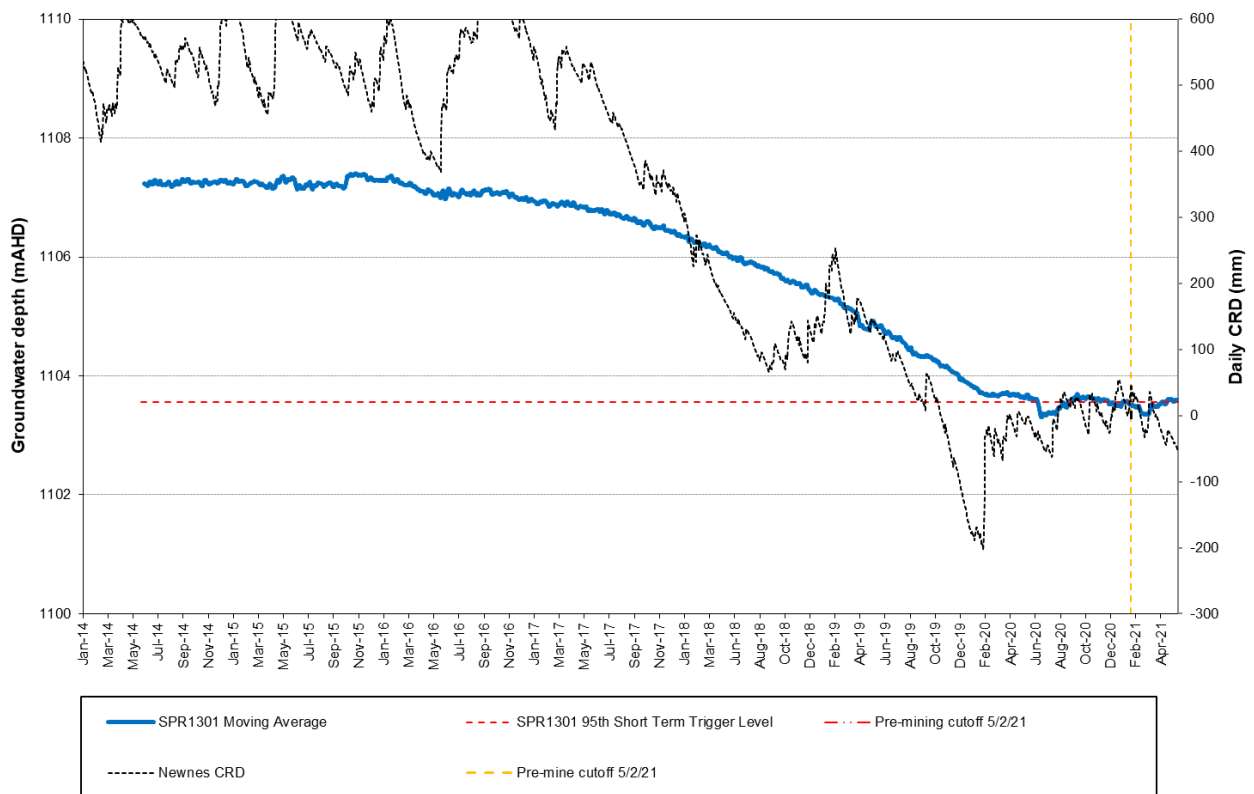


Figure 4.1: SPR1301 Hydrograph - 7 day moving average

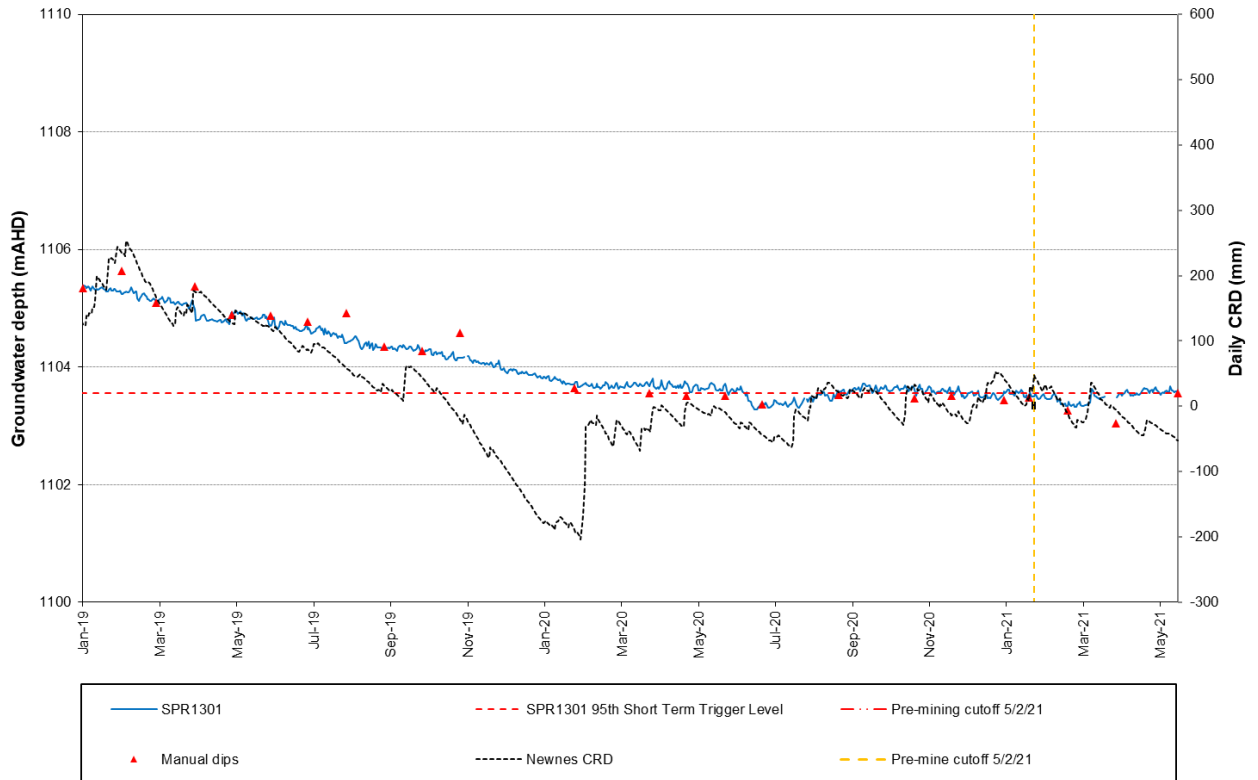


Figure 4.2: SPR1301 Hydrograph detailed

5. Summary of Actions Conducted (SMP TARP LW424-427)

5.1 Check anomalous Data for Accuracy

The data collected from the loggers was reviewed against manual readings from field records. The manual readings aligned closely with logger readings and the relative stability of logger readings do not indicate the data is erroneous.

5.2 Determine whether similar triggers were activated at reference sites

In the LW424-427 SMP (Centennial Coal 2018), reference sites are those sites that will not be encroached upon by the area of disturbance (AOD) or occur within the trigger investigation area (TIA). The two reference sites identified in Table 23 of the SMP (Centennial 2018):

- **AP5PR** – Located adjacent to reference swamp site Twin Gully and screened at approximately 94 m below ground level (mBGL) in the Banks Wall sandstone. Monitoring began at AP5PR in July 2010.
- **AP1105** – Located above an unmined area in the Angus Place lease. The monitoring bore is screen at approximately 76 mBGL in the Bankswall Sandstone formation. Monitoring began at AP1105 in November 2011.

These reference sites are suitable for comparison as they are far from past and current mining activities and can be used to discern potential mining impact and/or climatic influences and if so determine if changes are localised or regional. They target the Banks Wall Sandstone Formation where SPR1301 is also screened.

The hydrographs for the reference monitoring bores are present alongside SPR1301 with a shifted axis for comparison (refer Figure 5.1 and Figure 5.2). A comparative 95th percentile short term trigger was calculated for the reference sites using the same pre-mining cut off date as SPR1301 (5/2/2021).

AP5PR has been declining from mid 2016 to early 2020 during the drought, similar to SPR1301. At the peak of the drought in late 2019, AP5PR fell below the comparative 95th percentile trigger level. Except for the sharp decline at SPR1301 in June 2020, both sites displayed similar water level trends; between February and July 2020 a reversal of the declining trend was observed; from July 2020 a stronger increasing trend is apparent. Between September 2020 and March 2021, AP5PR water level hydrograph stabilises and recovers almost to pre-drought levels, while SPR1301 displays a slight decline. AP5PR appears to have a more subdued response to the climatic conditions. Between 2016 and 2020, AP5PR water levels declined approximately 1.2 m while SPR1301 declined approximately 3.7m.

AP1105 hydrograph also declined in the drought between 2016 and 2020 falling approximately 2.7 m in the period. The slight correction in December 2019 was due to the bushfire damaging the monument and not a water level response. AP1105 fell below its comparative 95th percentile trigger in October 2020 and the lowest water level was recorded in March 2021. A slight increase in water level was observed around March 2021 around the same time as SPR1301, but AP1105 remained below the comparative trigger.

In summary, both reference sites displayed declining trends during the drought and at some point fell below their comparative 95th percentile trigger.

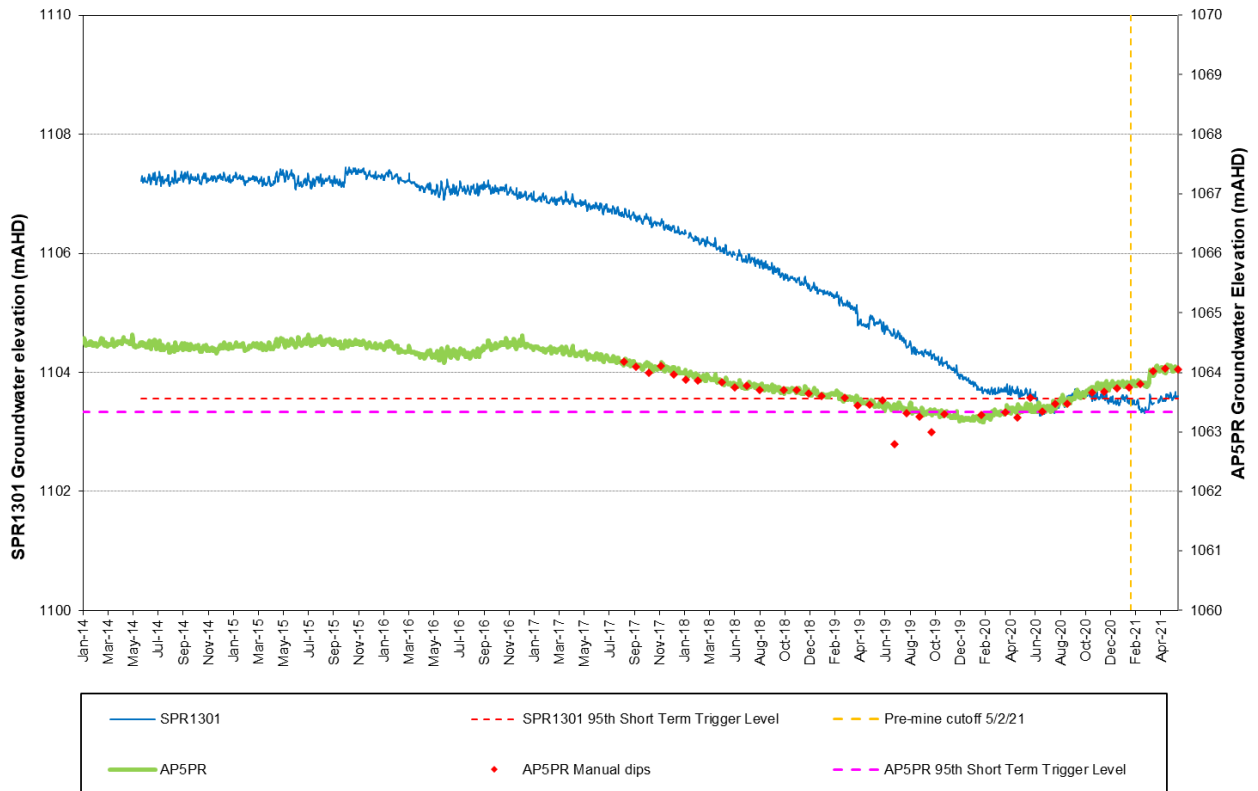


Figure 5.1: AP5PR Hydrograph comparison

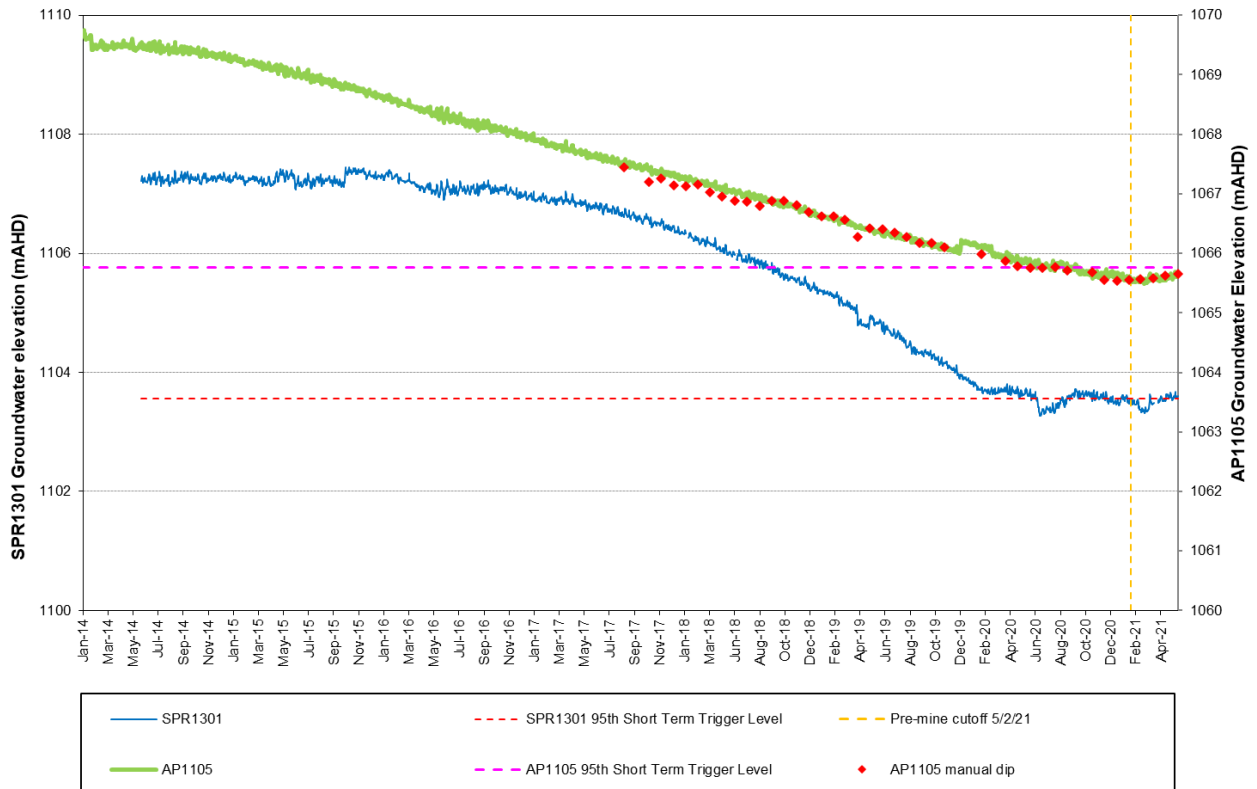


Figure 5.2: AP1105 Hydrograph comparison

5.3 Identify Anthropogenic/ Natural impacts responsible?

No other anthropogenic or natural impacts have been identified in the post mining period.

Natural groundwater level movements in the aquifers in the Newnes plateau are generally slow and subdued and this is reflected in the logger data.

The cause of the pre-mining water level decline in June 2020 is unknown.

5.4 Review monitoring result in the light of any abnormal weather conditions

There have been no abnormal weather conditions. The Gospers Mountain Bushfire in 2019/2020 have not had a significant impact on the deeper groundwater levels.

5.5 Was active mining within 600m

The first instance when SPR1301 dropped below the trigger level in June 2020, long wall mining at LW426 was approximately 800 m away. The longwall had not intersected with the NE-SW lineament running close to SPR1301.

In the pre-mining period in December 2020, the water level temporarily dropped below the 95th percentile again.

In April 2021, when the trigger notification was sent after the water level remained below the 95th percentile trigger level, active mining was within 600m of SPR1301.

5.6 Was there evidence of mining related impacts

It is apparent the overall water level decline is related to climatic conditions, but it is not clear if any mining related impacts are present.

The water level decline in June 2020 does not align with historical observations when monitoring boreholes were affected by mining. The active longwall was approximately 800 m away from the site and moving further away towards the north, and the lineament was not intersected.

The subsidence survey in June/ July 2020 (Centennial, 2020) did not detect anomalous surface movements, no TARP trigger levels were exceeded, and no surface evidence of subsidence was noted.

In SPR1211, which has been impacted by mining, water levels were observed to decline when active mining was around 200 m away. Similarly, at VWP SPR1804 the deeper aquifer below the Mount York Claystone was observed to depressurise when the active longwall was less than 600 m away, and the shallower Banks Wall Sandstone aquifer above the Mount York Claystone was observed to depressurise when it was less than 100 m from the longwall face. The water level decline in June 2020 at SPR1301 is unusual because active mine was over 800 m away at the time.

In the case of Pine and Nine Mile Swamp, where mining induced water level declines are evident, the declines occurred after the lineament had been intersected. The lineament close to SPR1301 has not been intersected and SPR1301 does not lie directly above the lineament which was the case for Pine and Nine Mile Swamp.

Subsidence data would need to be further analysed to rule out if mining had an impact on the water level decline in the post mining period.

5.7 Carry out field inspections to determine extent and causes

A field assessment and data download were carried out in June 2021. There were no recent faults at SPR1301 with the logger and manual readings aligned with the logger data.

5.7.1 Marrangaroo Swamp

The nearby Marrangaroo Swamp was reviewed for potential impacts and the extent of impacts. The post mining water levels at Marrangaroo Swamp are above the 95th percentile short term trigger and there are no observable negative mining impacts. Groundwater level movements are in line with the prevailing rainfall conditions. It is noted that around June 2020, when SPR1301 recorded a water level decline, Marrangaroo Swamp water levels had been declining since May 2020 and reached a local minimum in late July 2020 (approximately 0.3 m decline over the period). In the post-mining period, in March 2021, when SPR1301 recorded a decline in water levels below the short term trigger, Marrangaroo Swamp similarly recorded a decline in water levels that mirrored the CRD curve (refer Figure 5.3). It is likely the water level movements at Marrangaroo Swamp and SPR1301 are climatically influenced.

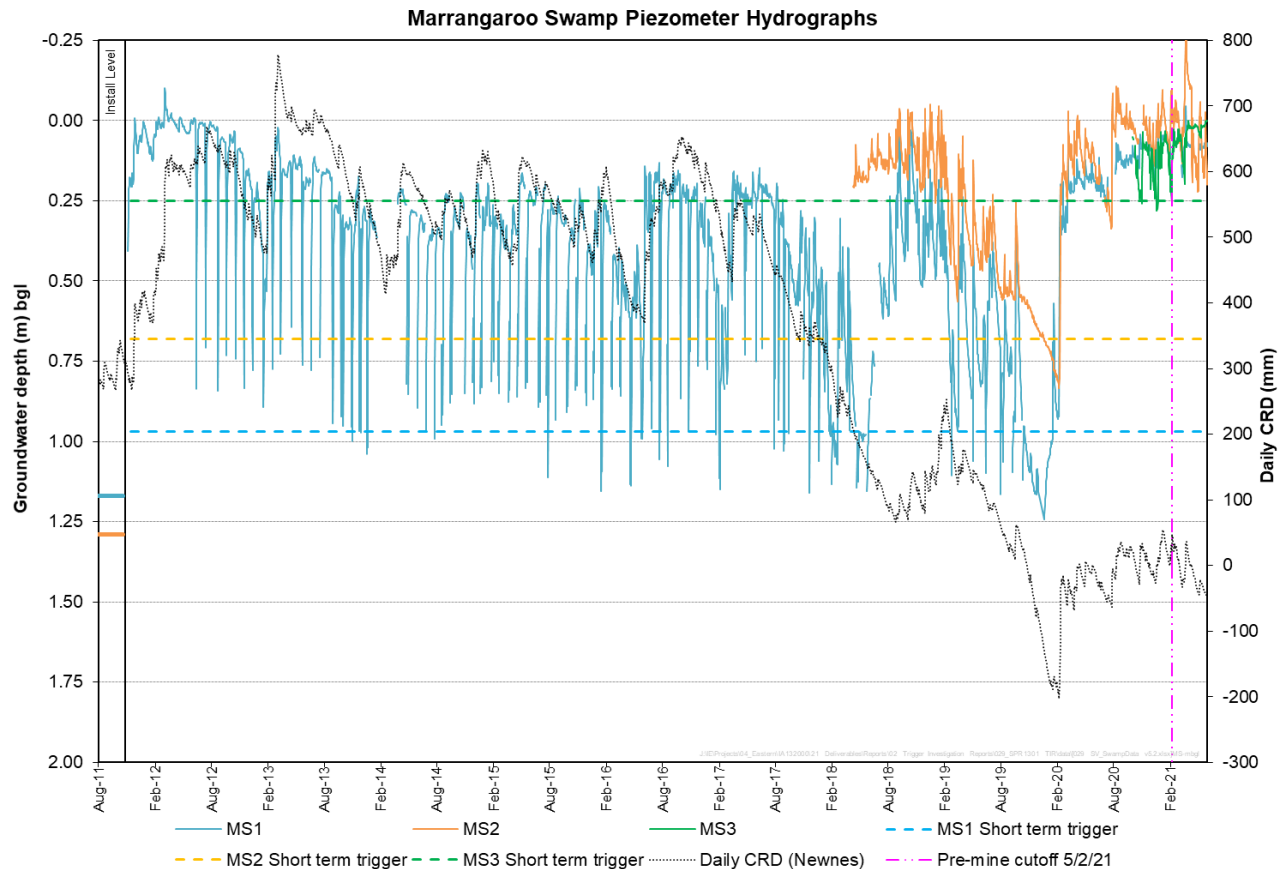


Figure 5.3: Marrangaroo Swamp Hydrograph

5.7.2 Adjacent groundwater monitoring sites

The nearby ridge groundwater monitoring bores recorded groundwater declines from mining impacts generally showed impacts when active mining was within 600 m of the sites and more pronounced impacts when they were within 200 m. The magnitude of water level declines was greater and more rapid compared to SPR1301; for example, SPR1211 and SPR1808 declined over 20 m and 10 m, respectively.

Nearby ridge groundwater monitoring bores SPR1210 and SPR1806 (refer Figure 5.4), which have not been within 200 m of the active mining face, have observed a stable water level or a gradual decline, respectively. The groundwater level movements differ between SPR1301 to these two nearby monitoring boreholes. SPR1301 hydrograph reflects a subdued CRD curve with short term trends following the CRD curve, whereas SPR1210 and SPR1808 show a more stable hydrograph with minimal responses to short term rainfall events.

Nearby VWP sites, SPR38 and SPR1302, had previously recorded depressurisation from the previous longwalls LW425 and LW426. The depressurisation in the upper sensors were observed when active mining was within 600 m of site and the depressurisation response was in the order of 10 m to 30 m.

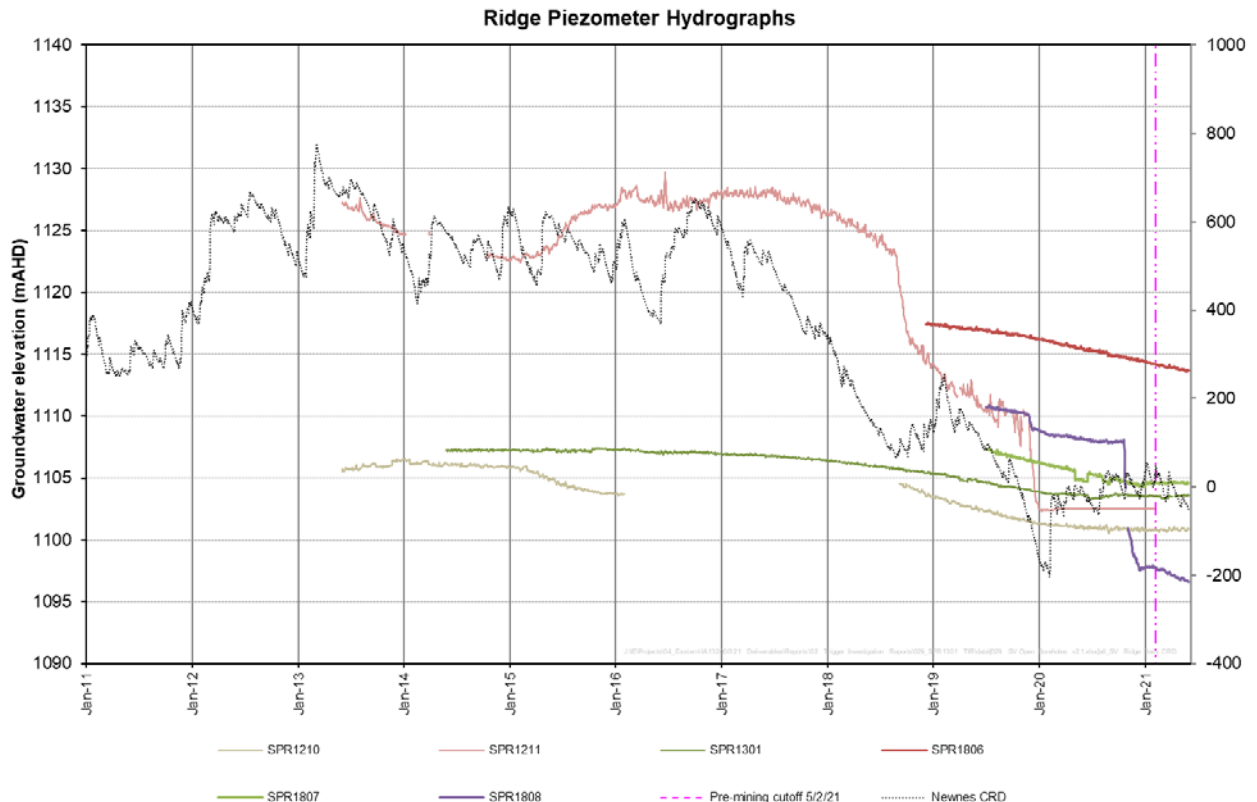


Figure 5.4: Adjacent groundwater ridge monitoring hydrograph

5.8 Consider additional or more frequent monitoring

The current monitoring program is considered adequate as data is logged continuously at daily intervals.

6. Conclusion

Actions have been carried out according to Chart 2 of the LW424-427 SMP.

In February 2021, SPR1301 entered into its post-mining period and after the April 2021 monitoring round the water level was observed to remain below the 95th percentile trigger level and activated the trigger protocol.

The review of the groundwater data observed groundwater level movements that correspond with the CRD curve and declines in the adjacent reference bores. In the post mining period, the declines could be linked to the prevailing rainfall conditions. It is likely the groundwater level declines are climate related but additional reviews will need to be completed before the impacts of mining can be ruled out.

7. Proposed Action Plan

The following actions are recommended:

- Continued monitoring as per Chart 3 of the SMP for LW424-427
- Observe monitoring data in nearby swamp piezometers MS1 , MS2 and MS3 for potential propagation of impacts to THPSS.

8. References

Centennial Coal . (2017). *Subsidence interactions with geological fault zones and groundwater systems at Springvale Mine.*

Centennial Coal. (2018). *Swamp Monitoring Program for LW424 to LW427.*

Centennial Coal. (2020, September). *Six Monthly Environmental Monitoring Report Springvale Colliery September 2020.*