Centennial Coal

Longwall 411 to 418

Subsidence Management Status Report

Springvale Colliery

November 2017

Approved 07/11/2017

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Mine Manager Springvale

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Appendices

1. INTRODUCTION

Springvale Colliery is an existing underground coal mine producing high quality thermal coal for both domestic and international markets. It is located 15 kilometres to the northwest of the regional city of Lithgow and 120 kilometres west-northwest of Sydney in New South Wales.The regional locality of Springvale Mine is shown on **Figure 1**.

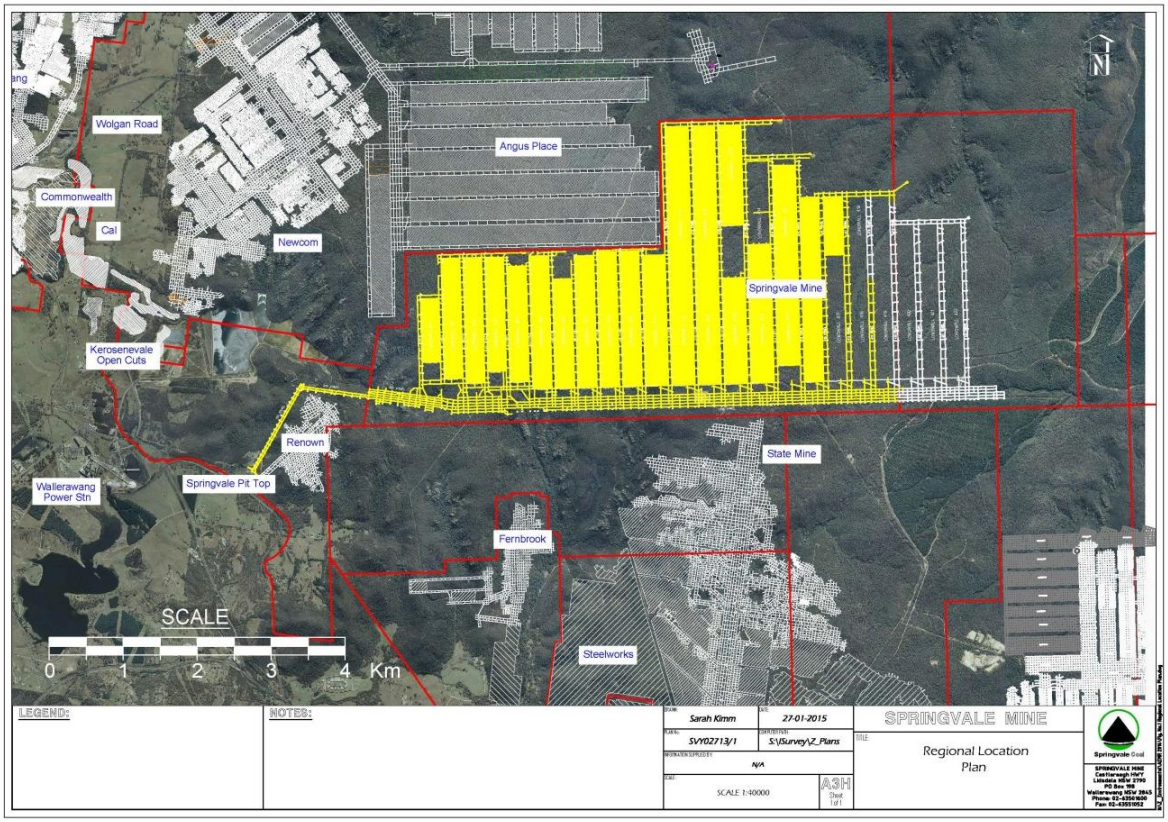


Figure 1 Regional Locality

This Subsidence Management Status Report (SMSR) fulfils the requirement of Condition 14 of the Springvale Mine SMP Approval Conditions for Longwalls 411 to 418. This SMSR covers the monitoring period between the 1st of June and the 30th of September 2017, with monitoring results available for this period presented in this report. Some results collected during the reporting period may not be included due to the time associated with analysis and presentation of results following field work. These results will however be included in future reports.

Regulatory requirements applicable to the SMP are outlined in Section 2.

2. PURPOSE AND SCOPE

The purpose of this document is to report in accordance with and comply with the requirements of Condition 14 of the Springvale Mine SMP Approval. Table 1 summarises the requirements of this Condition and where they have been addressed in this document.

Table 1. Subsidence Management Status Report Requirements

Condition	Condition Requirement	Section Addressed
17a	The current face position of the panel being extracted;	3
17b	A summary of any subsidence management actions undertaken by the leaseholder;	4
17c	A summary of any comments, advice and feedback from consultation with stakeholders in relation to the implementation of this approval (including the preparation, implementation and review of plans, programmes, reports or strategies required by this approval) undertaken or received and a summary of the leaseholders response to the comments, advice and feedback given by the stakeholders;	4
17d	A summary of any observed and/or reported subsidence impacts, incidents, service difficulties, community complaints, and any other relevant information reported to the leaseholder and a summary of the leaseholders response to these impacts, incidents, service difficulties and complaints	5
17e	A summary of subsidence development based on monitoring information compared with any defined triggers and/or predicted subsidence to facilitate early detection of potential subsidence impacts;	6
17f	A summary of the adequacy, quality and effectiveness of the implemented management processes based on the monitoring and consultation information summarised above; and	7
17g	A statement regarding any additional and or outstanding management actions to be undertaken or the need for early responses or emergency procedures to ensure adequate management of any potential subsidence impacts due to longwall mining	8

This report also provides the opportunity for relevant stakeholders to provide feedback regarding the Springvale Mine monitoring and management measures as required under Condition 9.

3. FACE POSITION OF THE LONGWALL

Extraction of Longwall 418 commenced on the 22nd of October 2015 and was completed on the 27th of May 2016 with a total retreat of 2487m. Extraction of LW419 commenced on the 2nd of August 2016 and was completed on 18th of March 2017 with a total chainage of 2340m. Extraction of LW420 commenced on the 29th of April 2017 and chainage at 30th of September 2017 was 242m.

Longwall locations and the face position with reference to subsidence monitoring lines are shown below in Figure 2.

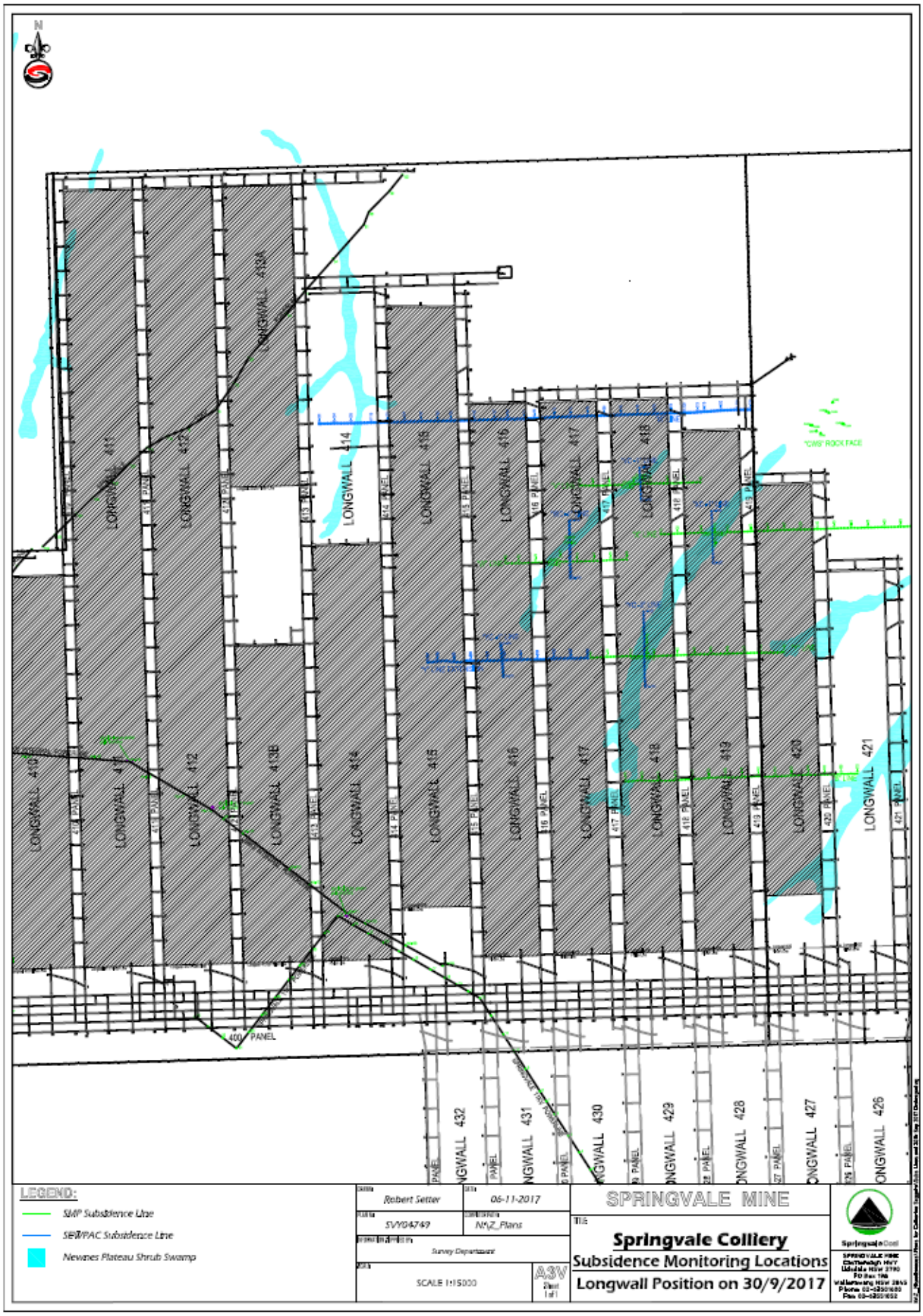


Figure 2 Face Position and Subsidence Monitoring Locations

4. MANAGEMENT ACTIONS AND CONSULTATION

4.1. Management Actions

There has been no management actions required during the reporting period.

4.2. Consultation

The contact details for Springvale personnel responsible for environment management and community relations, along with details for community complaints and enquiries have been provided in Table 2.

Table 2. Primary Contact Springvale Colliery

Contact	Position	Contact Details
Primary Contacts		
Brian Nicholls	Mine Manager	T: (02) 6350 1613
		F: (02) 6355 1502
Catherine Suggate	Environment and Community Co-ordinator	T: (02) 6350 1672
		F: (02) 6355 1502
Community Enquiries/Complaints		
Springvale Enquiries and Community Complaints		T: (02) 6350 1640

Recent consultation with stakeholders is outlined in Table 3 below:

Table 3. Correspondence Summary

Date	Topic	Further Details
30/08/2017	Flora Trigger Exceedance – Investigative Report	Subsequent to the flora trigger notification provided to the Department of Environment on the 5th of July 2017, in accordance with the LW 415 – 417 and LW418 THPSS MMPs as well as Springvale EPBC Act Approvals, an Investigative Report was submitted to the Department of Environment on the 30th of August 2017.

5. OBSERVED IMPACTS AND NOTIFICATIONS

There were no observed subsidence impacts, incidents or service difficulties during the retreat of Longwall 418. Inspections were conducted by Craven Elliston & Hayes before and after mining. Details regarding the photo-monitoring undertaken are documented in Section 6.8.

6. MONITORING PROGRAM

This section presents the subsidence and environmental monitoring that was undertaken during the reporting period. Subsidence monitoring locations (or subsidence lines) are presented in Figure 2. The environmental monitoring locations are presented in Figure 3. Plans are presented in Appendix 1.

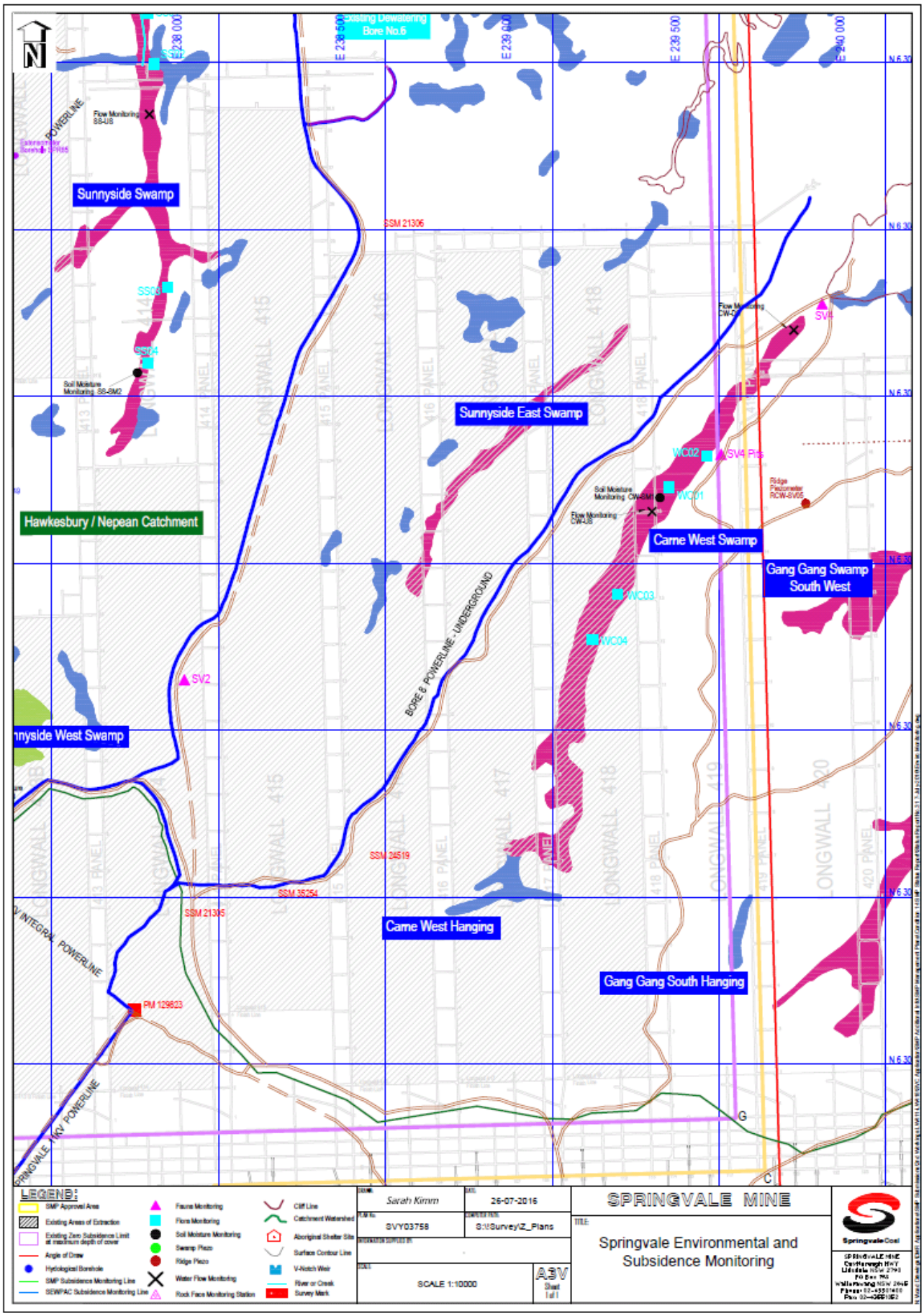


Figure 3 Environmental Monitoring Locations

6.1. Subsidence

All required subsidence monitoring lines have been installed and all pre-mining subsidence surveys completed in accordance with the approved Subsidence Monitoring and Reporting Program. All subsidence, tilt and strain results are within the predicted range.

The maximum recorded subsidence values for each of Springvale's Subsidence Lines since extraction of LW418 commenced are provided below:

B Line – Surveyed 15/05/2016 – Value = -1.275m

Y Line – Surveyed 15/02/2016 – Value = -0.552m

CWS Line – Surveyed 10/8/2015 – Value = -0.005m

X Line – Surveyed 15/02/2016 – Value = -0.224m

V Line – Surveyed 03/02/2016 – Value = -0.556m

W Line – Surveyed 15/02/2016 – Value = -0.815m

6.2. Rainfall

Daily rainfall is measured at the Bureau of Meteorology rain gauge at Maddox lane, Lithgow (BOM Station No. 063132), and the Centennial Newnes Plateau Prison Farm Rain Gauge. Rainfall data is summarised in Table 4 and Figure 4.

Table 4. Rainfall data

	Observed Rainfall		Average Rainfall	
Month	**Newnes Plateau (mm)**	**Lithgow (mm) (Maddox Lane)**	**Newnes Plateau (mm)**	**Lithgow (mm) (Maddox Lane)**
June 2017	44.6	19.6	110.0	50.6
July 2017	8.6	6.6	56.7	50.8
August 2017	33.4	41.8	58.8	63.6
September 2017	0.4	4.2	49.0	52.7
Total	**87.0**	**72.2**	**274.5**	**217.7**

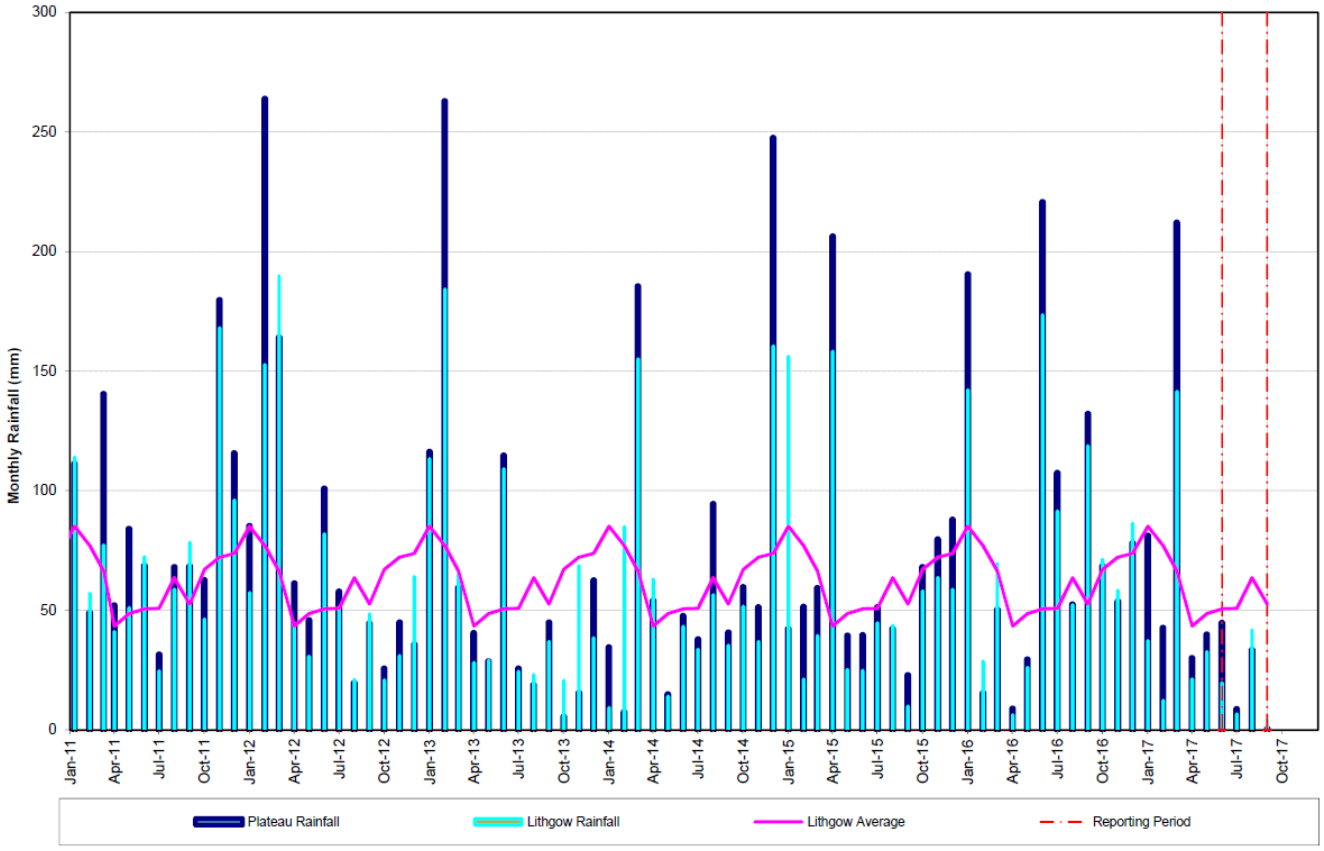


Figure 4 Monthly Rainfall

It is noted that the Newnes Plateau rain gauge spans a period of almost 19 years, from August 1998 to present, whereas the Maddox Lane gauge covers a period of 58 years. The longer term average rainfall from Maddox Lane is therefore included for comparison. It is noted that there are often large differences between the two sites.

From the rainfall data collected at Newnes Plateau during the monitoring period (1 June to 30 September 2017), the following general observations can be made:

- Observed rainfall at Newnes Plateau for the reporting period is well below average for June and August 2017 and significantly below average for July and September 2017.
- Total rainfall for the period at Newnes Plateau was 87.0mm, which equates to 32% of the long term average for the same period.
- At Maddox Lane, total rainfall in July was the second lowest observation since 1970 where 2.7mm was recorded.
- At Maddox Lane, total rainfall in September was the second lowest observation since 1994 and 2007 where 3.7mm was recorded.

Calculated cumulative rainfall deficit (CRD) is analysed in conjunction with groundwater monitoring results to correlate the long term impacts of rainfall patterns on groundwater levels. This assists in the interpretation of data undertaken as part of the subsidence environmental monitoring program.

6.3. Groundwater Monitoring Program

6.3.1. Methodology

Groundwater monitoring is carried out within the Newnes Plateau Shrub Swamps in order to monitor the Standing Water Level of shallow aquifers. Deeper piezometers are installed on the plateau/ridges (to monitor depth of aquifers) in between the Shrub Swamps. Groundwater monitoring locations are listed in Tables 5 and 6 below.

Table 5. EMP Monitoring Locations

Monitoring Site	Swamp Name	Site in 2009 EMP?	2009 EMP Reference	Site in 2015 EMP?	Quality Monitoring 2015
WE1	East Wolgan Swamp	Yes	EW-SV6	No	N/A
WE2	East Wolgan Swamp	Yes	EWS-SV7	No	N/A
SS1	Sunnyside Swamp	Yes	SS-SV8	No	N/A
SS2	Sunnyside Swamp	Yes	SS-SV9	No	N/A
SS3	Sunnyside Swamp	No	N/A	No	N/A
SS4	Sunnyside Swamp	No	N/A	No	N/A
SS5	Sunnyside Swamp	No	N/A	No	N/A
CW1	Carne West Swamp	Yes	CW-SV10	Yes	Yes
CW2	Carne West Swamp	Yes	CW-SV11	Yes	Yes
CW3	Carne West Swamp	No	N/A	Yes	No
CW4	Carne West Swamp	No	N/A	Yes	No
SSE1	Sunnyside East Swamp	Yes	SSE-SV12	Yes	No
SSE2	Sunnyside East Swamp	Yes	SSE-SV13	Yes	No
SSE3	Sunnyside East Swamp	Yes	SSE-SV14	Yes	Yes
SW1	Sunnyside West Heath	Yes	SSW1	No	N/A
CC1	Carne Central Swamp	No	N/A	Yes	Yes
MS1	Marrangaroo Swamp	No	N/A	Yes	Yes
TS1	Tri Star Swamp	No	N/A	Yes	No
TG1	Twin Gully Swamp	No	N/A	Yes	No

Table 6. Ridge/Aquifer Piezometer Locations

Monitoring Site	Location	Site in 2009 EMP?	2009 EMP Reference	Site in 2015 EMP?
RSS	Ridge Piezometer over 411 Gateroads	Yes	R-SV3	Yes
RSE	Ridge Piezometer over 415 Longwall Block	Yes	R-SV4	No
SPR1101/SPR1401*	Over Longwall 416	No	N/A	Yes
SPR1104/RCW	Ridge Piezometer over 419 gateroads	Yes	R-SV5	Yes
SPR1107	Over Longwall 420	No	N/A	Yes
SPR1108	South of Longwall 420 over Longwall 427	No	N/A	Yes
SPR1109	Overall Longwall 418	No	N/A	Yes
SPR1110	Over Longwall 416/417	No	N/A	Yes
SPR1111	North of Longwall 422	No	N/A	Yes
SPR1113	Over Longwall 423	No	N/A	Yes
AP5PR	NW of Angus Place Mine	No	N/A	Yes

*Note: SPR1101 water levels dropped below the base of the piezometer in December 2013 and SPR1401 was installed as a replacement in November 2014.

Monitoring and reporting has been undertaken in accordance with the Springvale Colliery Longwalls 411 to 418 Subsidence Management Plan Environmental Management Plan Approval dated 14th of August 2015.

6.3.2. Groundwater Level Results

Monitoring results between the period June 2017 to September 2017 are summarised in the following section.

East Wolgan Swamp

Water levels at East Wolgan Swamp are monitored at WE1 and WE2 and displayed below in Figure 5.

Water levels at WE1 and WE2 have remained below the base of the piezometer for the review period and show no apparent responses to rainfall. Both piezometers have been mostly dry from January 2007 and demonstrate peaky and short term water levels to protracted rainfall events.

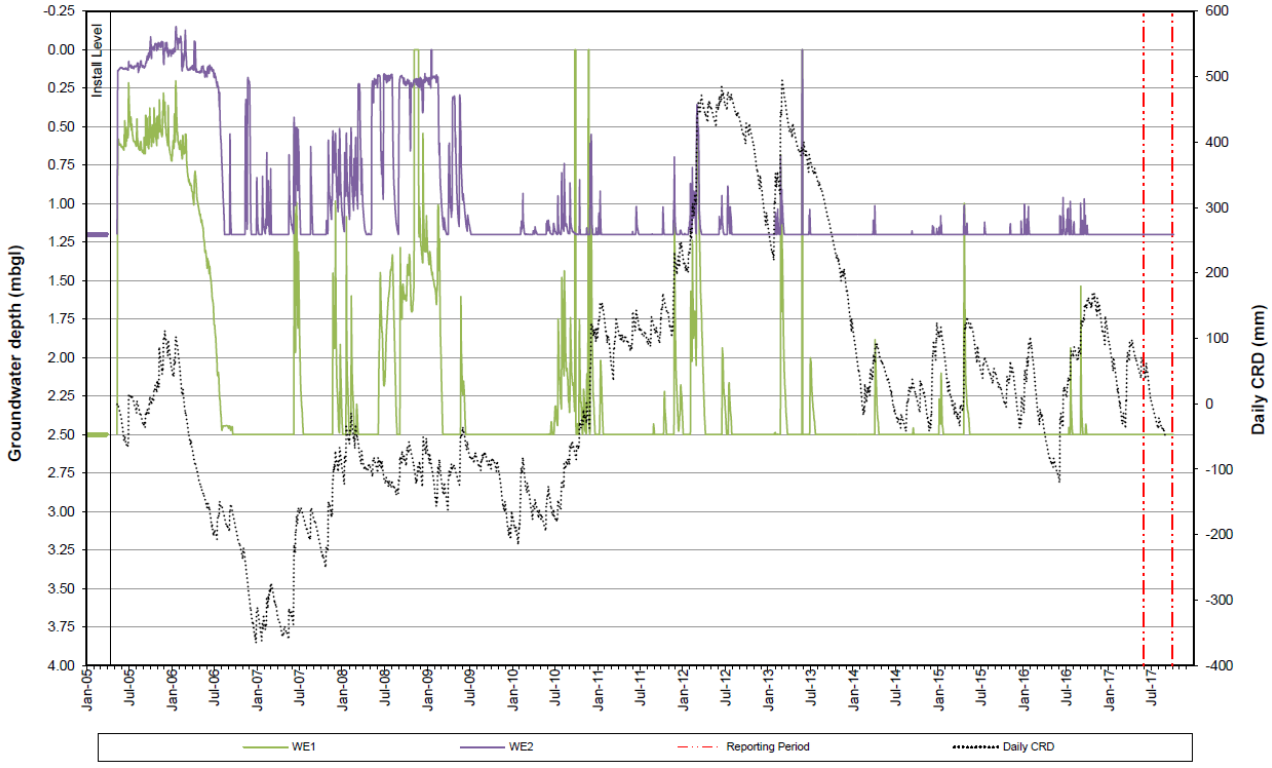


Figure 5 East Wolgan Swamp Hydrograph

Sunnyside Swamp

The water levels at Sunnyside Swamp are monitored by five piezometers, SS1, SS2, SS3, SS4 and SS5. Sites SS1 and SS2 formed part of the monitoring program for the 2009 SMP EMP, as mining of Longwalls 414 progressed below Sunnyside Swamp. No sites were part of the 2014 SMP EMP as mining had passed the swamp area, however monitoring of all five piezometers has continued.

Figure 6 below shows water levels at SS1, SS2, SSE3, SSE4 and SSE5.

All Sunnyside Swamp piezometers showed slight declining trends over the monitoring period except for SS3 which was dry. There was a slight increase in water levels in early June and early August

which corresponded to less than average rainfall events. Water level trends at Sunnyside Swamp are consistent with historical observations.

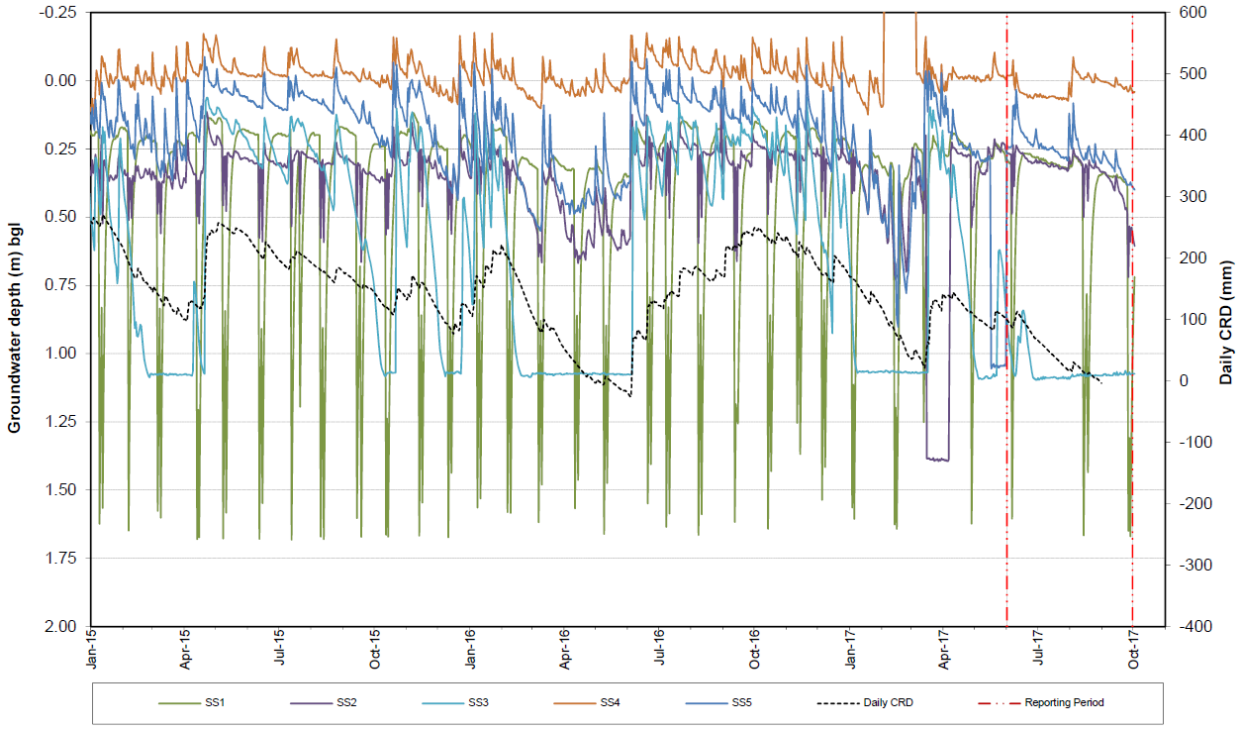


Figure 6 Sunnyside Swamp Hydrograph

Carne West Swamp

The water levels at West Carne Swamp are monitored at piezometers CW1, CW2, CW3 and CW4 (Figure 7).

Water levels at CW1, CW2, CW3 and CW4 have remained at or below the base of the piezometers for the review period. There are no apparent responses to rainfall.

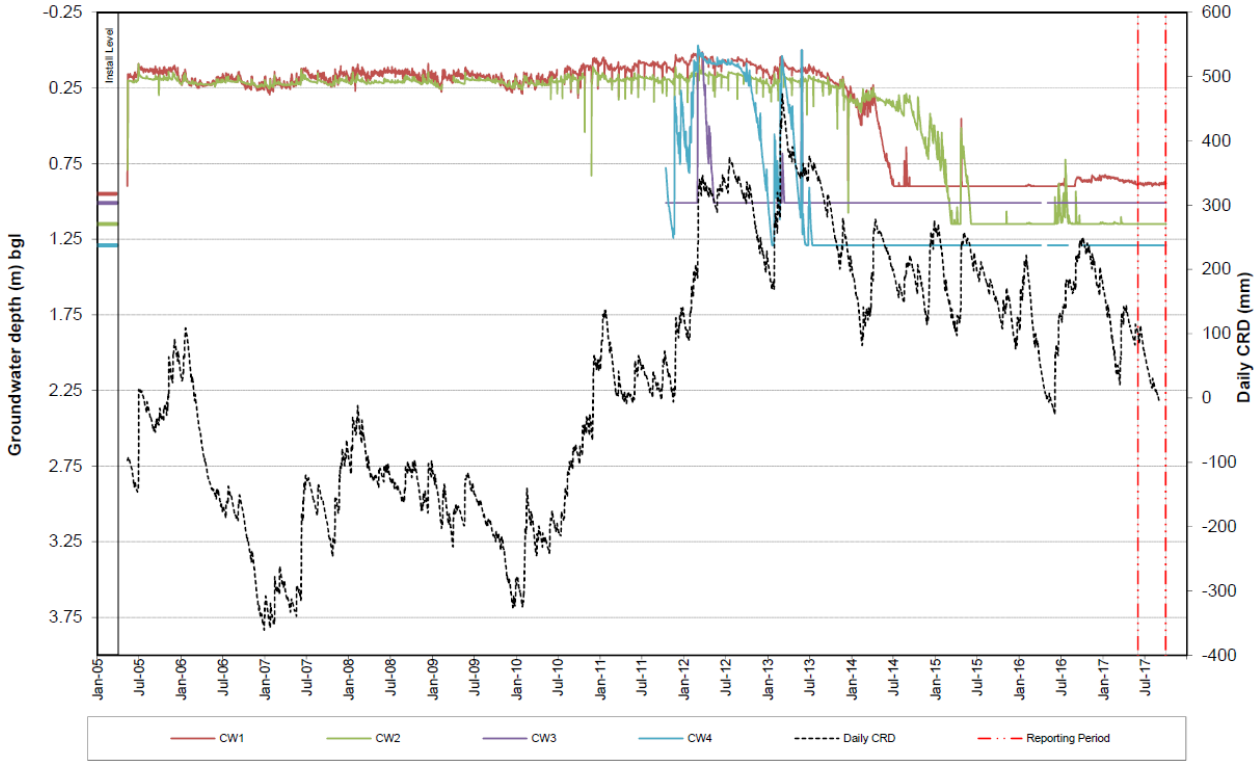


Figure 7 Carne West Hydrograph

CW1 and CW2 were within the angle of draw of Longwall 418. On the 18th of December 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at CW1 and CW2 under the Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan for LWs415–417 (THPSS MMP). A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 22nd of December 2015.

The preliminary investigation indicated that water levels at CW1 and CW2 piezometers now display trends that are more rainfall dependent as opposed to predominantly groundwater dependent, which had been the case for the entire baseline monitoring period from 2005 up to 2014. Further data analysis is required to determine if the changes to water levels in Carne West Swamp are related to mine subsidence or the decline in the regional groundwater table aquifer, which appears to be a delayed response to longer term climatic influences.

CW3 and CW4 were within the angle of draw of Longwall 417 in March and April 2015. On the 29th of July 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at CW3 and CW4 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 5th of August 2015.

The preliminary investigation indicated that given the trigger level was reached prior to mining within 200m of the monitoring location, a rainfall deficit is likely to have contributed to the reduction in water level at CW3 and CW4. The change in climatic conditions has resulted in a change in pre-mining groundwater levels which is not reflected by the triggers defined in the THPSS MMP. This behaviour is similarly exemplified in the Tri Star reference swamp.

Sunnyside East Swamp

Water levels at Sunnyside East Swamp are monitored at piezometers SSE1, SSE2 and SSE3 (Figure 8).

Water levels have remained at or below the base of the piezometer since June 2013. There are no apparent responses to rainfall over the monitoring period.

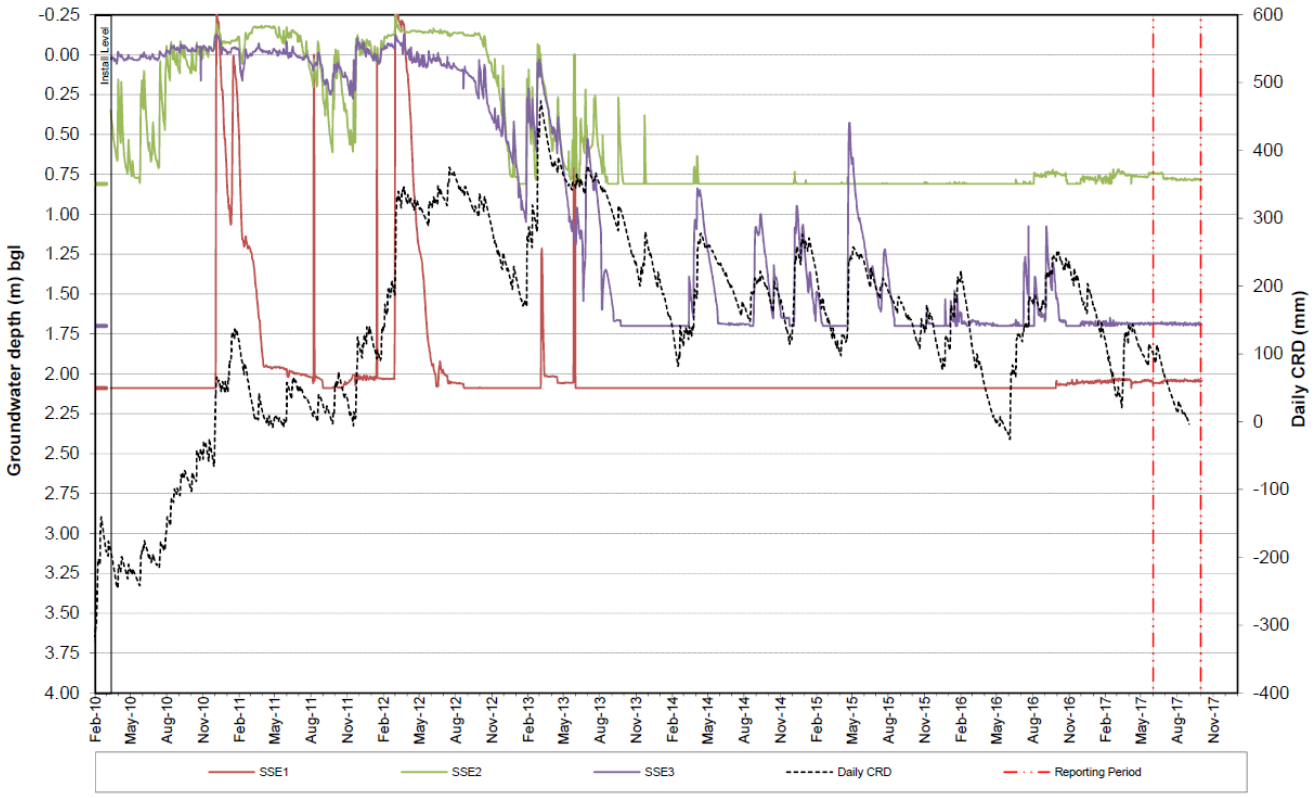


Figure 8 Sunnyside East Hydrograph

SSE1 was within the angle of draw of Longwall 416 in January 2013. On the 24th of March 2014, RPS notified Springvale of an exceedance of the water level trigger thresholds at SSE1 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 28th of March 2014.

The preliminary investigation indicated that the likely cause was an extended period of dry weather, which contributed to the reduction in water level within the reference swamp piezometers (which are located away from mining activities).

Following the implementation of the action plan, reporting was conducted by RPS and Gingra Ecological Surveys.

RPS concluded that “water levels at TS1 and TG1 were both above the 95th percentile when the trigger level was exceeded in SSE1. The statistics for MS1 and CC1 are heavily skewed by sampling events which are displayed as sharp drawdown spikes in the hydrograph. These events are not reflective of mining activities and recover to normal groundwater level relatively quickly. Both these

sites would have exceeded the 95th percentile if the sampling events were not taken into account. The reference sites support the low water levels observed in SSE1."

Gingra concluded that "The patterns of decline observed in vegetation along Sunnyside East Swamp appear, at this stage, to be driven by the combination of the post-fire response of vegetation and climatic conditions which have prevailed since early 2012."

SSE2 and SSE3 were within the angle of draw of Longwall 417 between November 2014 and March 2015. On the 27th of March 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at SSE2 and SSE3 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 30th of March 2015.

The preliminary investigation indicated a rainfall deficit may have contributed to the reduction in water level at the before mentioned monitoring locations. The change in climatic conditions has resulted in a change in pre-mining groundwater levels which is not reflected by the triggers defined in the THPSSMMP.

At the location of the three piezometer sites, there has been no evidence of mining related impact.

Sunnyside West Heath

Water level at Sunnyside West is monitored at piezometer SW1 (Figure 9). Water levels over the review period have been consistent with those of the past five years.

Rainfall in early June temporarily recharged the swamp around SW1 however water levels steadily declined for the remainder of the monitoring period due to below average rainfall. SW1 is rainfall dependent and trends during the monitoring period were within historical observations.

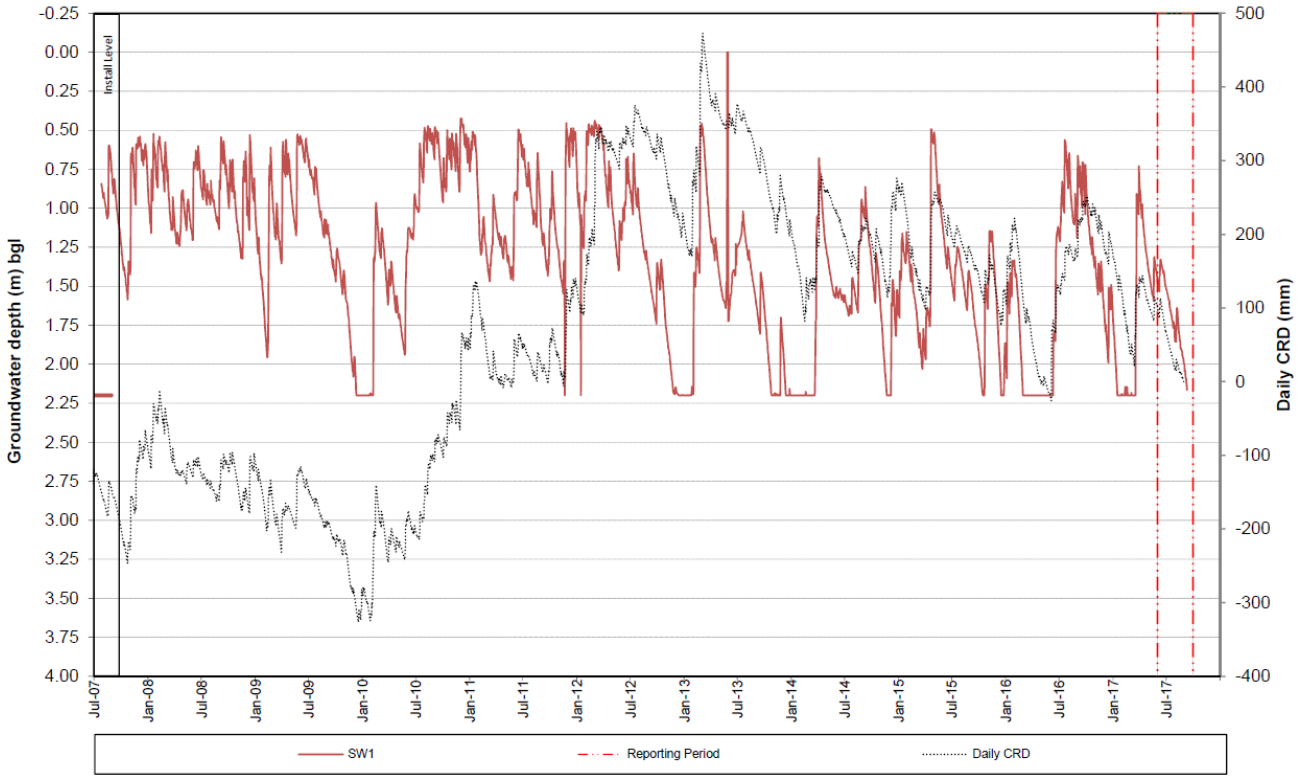


Figure 9 Sunnyside West Hydrograph

Reference Swamps

Carne Central Swamp

The water levels at Carne Central Swamp are monitored at piezometer CC1 (Figure 10).

Water levels have been declining across the monitoring period with some recharge observed during rainfall events in early March and early August. Water levels have been declining since the last rainfall event in August which corresponds with below average rainfall. A very dry September has seen CC1 water level drop steadily. The gradient of the water level drop is consistent with historical observations. However, historical observations show more fluctuation due to intermittent rainfall events that were not observed during September.

Marangaroo Swamps

The water levels at Marrangaroo Swamp are monitored at piezometer MS1 (Figure 11).

Water levels have been declining across the monitoring period with some recharge during rainfall events in early March and early August. Water levels have been falling since the last rainfall event in August which corresponds with below average rainfall. The gradient of water level decline is consistent with historical observations.

Tristar Swamp

The water levels at Tristar Swamp are monitored at piezometers TS1, TS2 and TS3 (Figure 12).

Only piezometer TS1 is required for compliance by the 2015 EMP. TS1 has remained at or below the base of the piezometer and TS2 shows a relatively constant declining trend. Both TS1 and TS2 are consistent with historical observations. TS3 shows a mostly stable water level that began declining at the start of September due to below average rainfall.

Twin Gully Swamp

The water levels at Twin Gully Swamp are monitored at piezometer TG1 (Figure 13). During the monitoring period TG1 shows a mostly stable water level that began declining at the start of September due to below average rainfall.

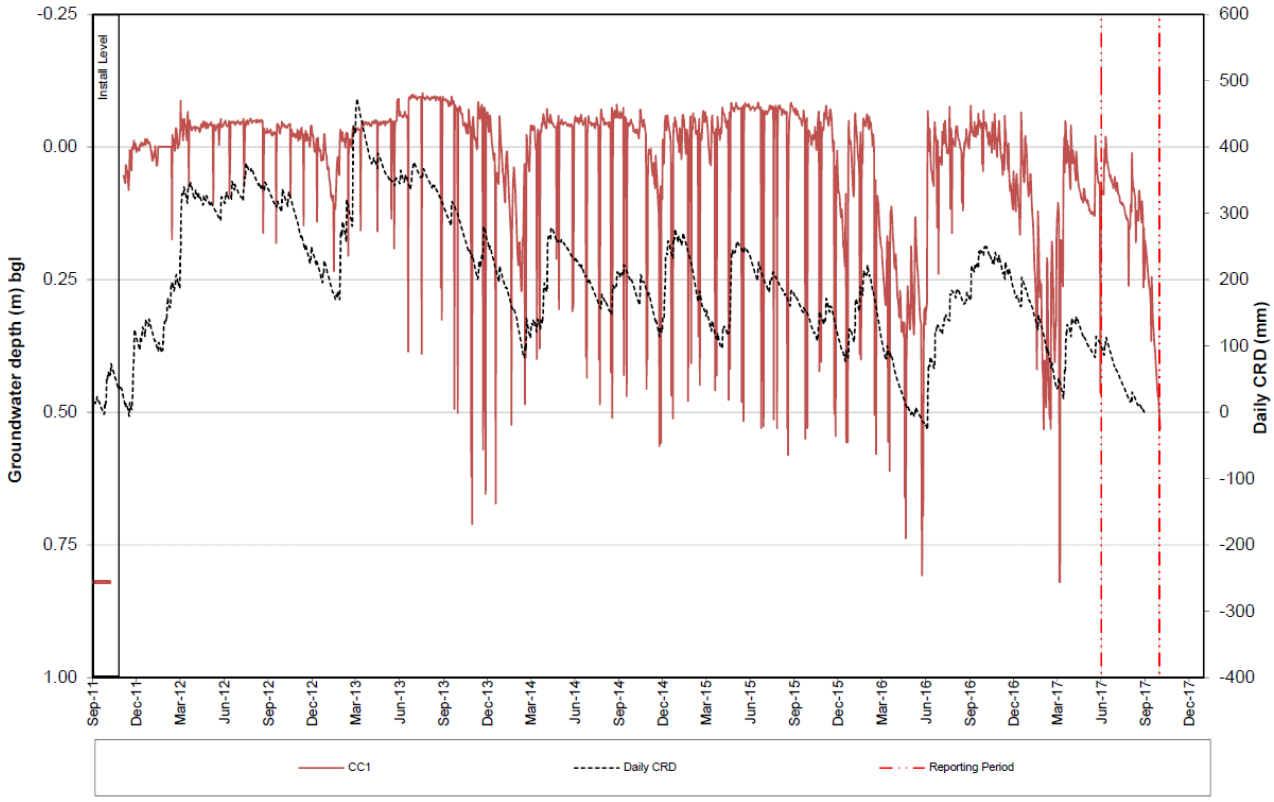


Figure 10 Carne Central Swamp Hydrograph

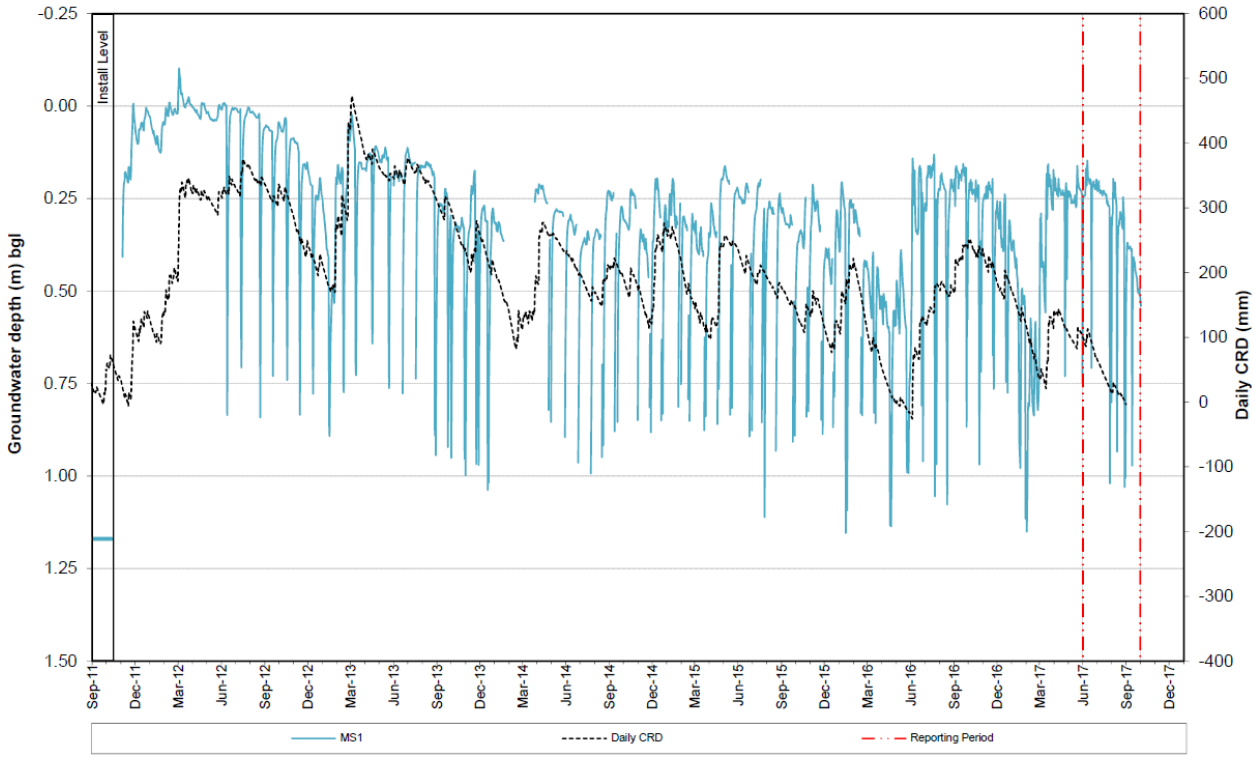


Figure 11 Marrangaroo Swamp Hydrograph

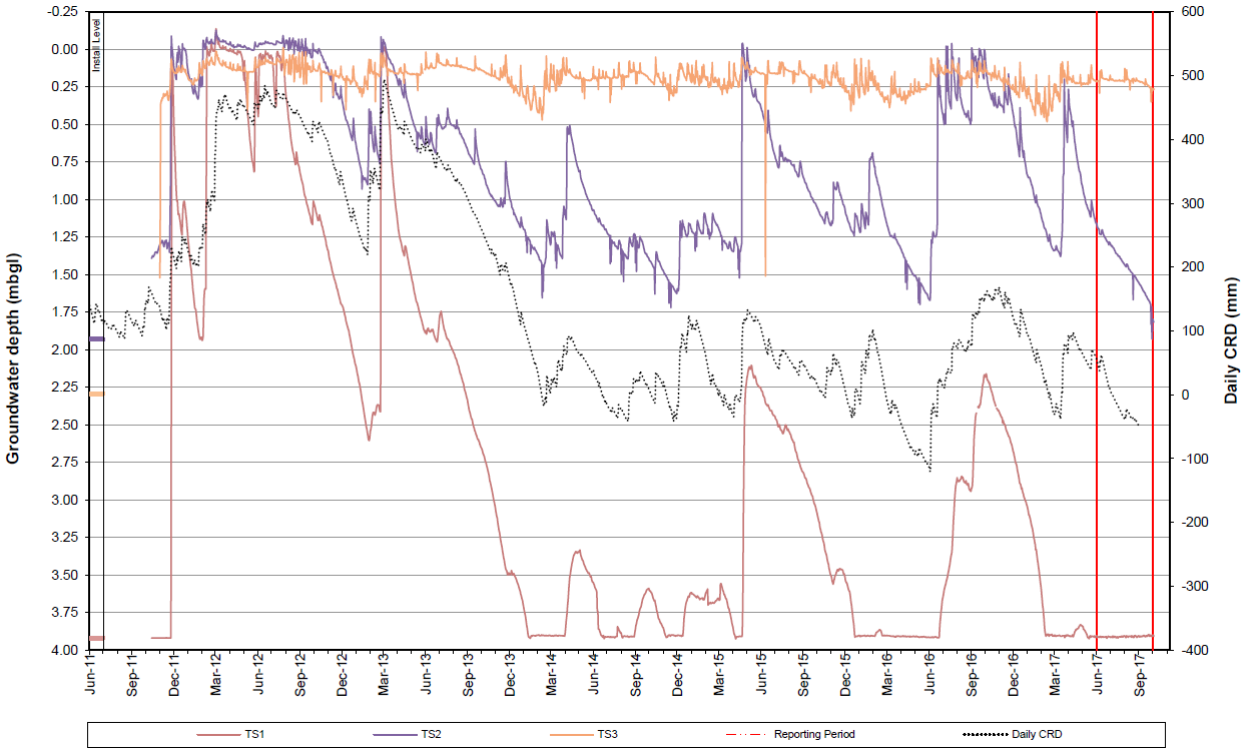


Figure 12 Tri Star Swamp Hydrograph

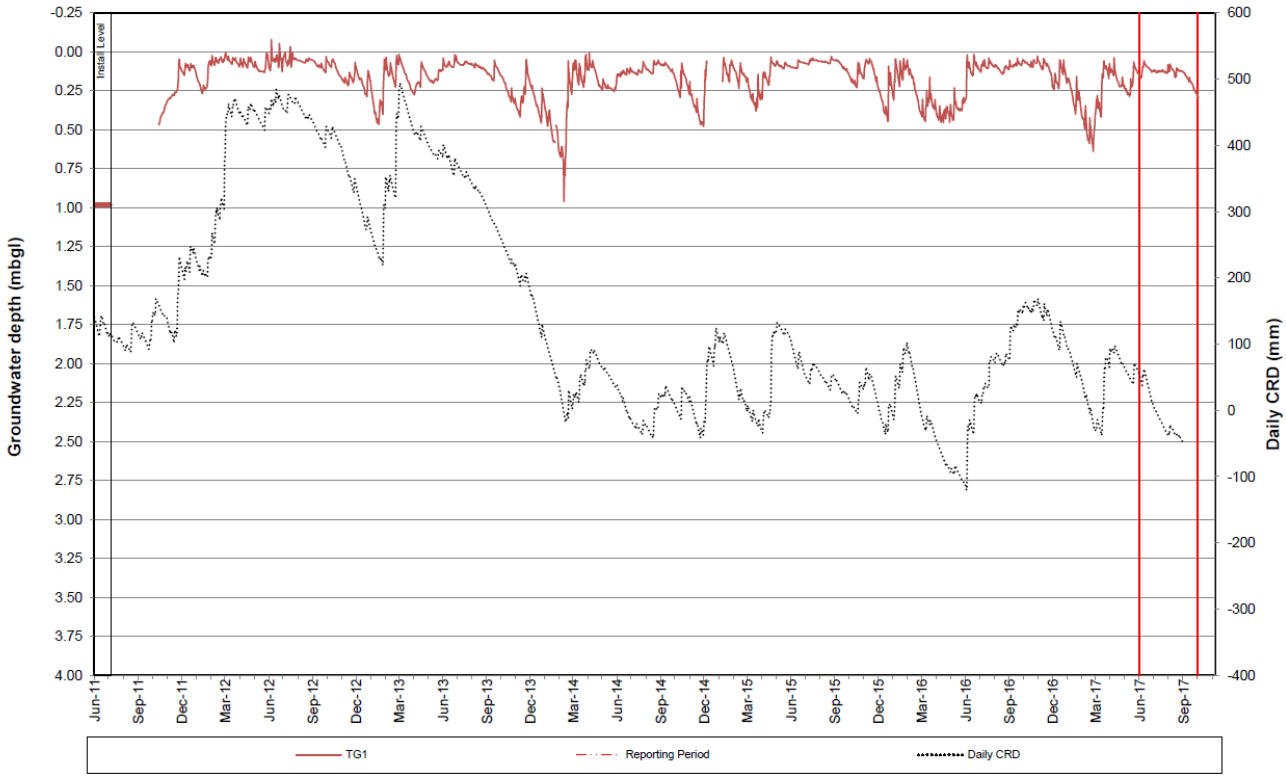


Figure 13 Twin Gully Swamp Hydrograph

Ridge and Aquifer Piezometer Monitoring

As per Section 8 of the 2015 EMP, groundwater monitoring is carried out within the ridge piezometers to monitor the water levels within the deep and shallow groundwater systems. A series of ridge piezometers and VWPs have been established to monitor the groundwater level in the near-surface unconfined aquifer in the Banks Wall Sandstone at Springvale. All ridge piezometers are monitored using water level data loggers besides RSE, which is manually measured during monitoring rounds.

The groundwater levels for ridge piezometers are shown in Figure 14 and 15.

The following is noted over the reporting period:

Impact Groundwater Sites

The groundwater levels at the designated impact sites are presented on Figure 14. The following observations can be made for the reporting period:

- Water levels at SPR1101 dropped below the base of the piezometer in December 2013 due to LW416 subsidence. A replacement piezometer, SPR1401, was installed in November 2014 which has equalised to a similar water level as SPR1101 before it was impacted. Over the current reporting period water levels at SPR1401 have remained stable. The water levels in SPR1401 rose approximately 1m on the 30/06/2017. This increase is not related to a rainfall event and is likely interference from water quality sampling.
- The groundwater level at SPR1104 shows a gradual decrease when LW419 passed in September 2016. The groundwater level has been gradually declining during 2017 until it was undermined by LW420 in late June where the water level dropped steeply and is now dry.
- The groundwater level at SPR1107 was below the base of the logger for the majority of the monitoring period. The logger was lowered on the 5/09/2017. For the remainder of the reporting period, the groundwater level continued declining at a similar gradient to previously observed readings.
- The groundwater level at SPR1109 shows a gradual decrease when LW417 passed in December 2014. The groundwater level continued to slowly decline until it was undermined by LW418 in December 2015 which was observed as stepped drops in groundwater levels. The groundwater level slowly declined until it dropped below the logger on the 31/12/16. The logger was lowered on 5/05/2017 and observed water levels show a fluctuating and slightly declining trend at a similar gradient to previously observed.
- Over the reporting period, the water levels in SPR1110 have remained below the base of the piezometer.
- The water levels in RSS have been gradually declining for the monitoring period.

Reference Groundwater Sites

Groundwater levels at groundwater monitoring reference sites are provided on Figure 15. The following observations can be made for the monitoring period:

- The water levels in SPR1108 have been gradually declining.

- Due to far field subsidence effect from LW419, a sudden drop in groundwater levels was observed at SPR1111. The sudden drop in groundwater levels was confirmed with manual measurements as a legitimate aquifer response. Observations after the drops shows an unsteadiness in groundwater levels but has remained stable.
- The water levels in SPR1113 have been gradually declining.
- The water levels in AP5PR have been gradually declining.

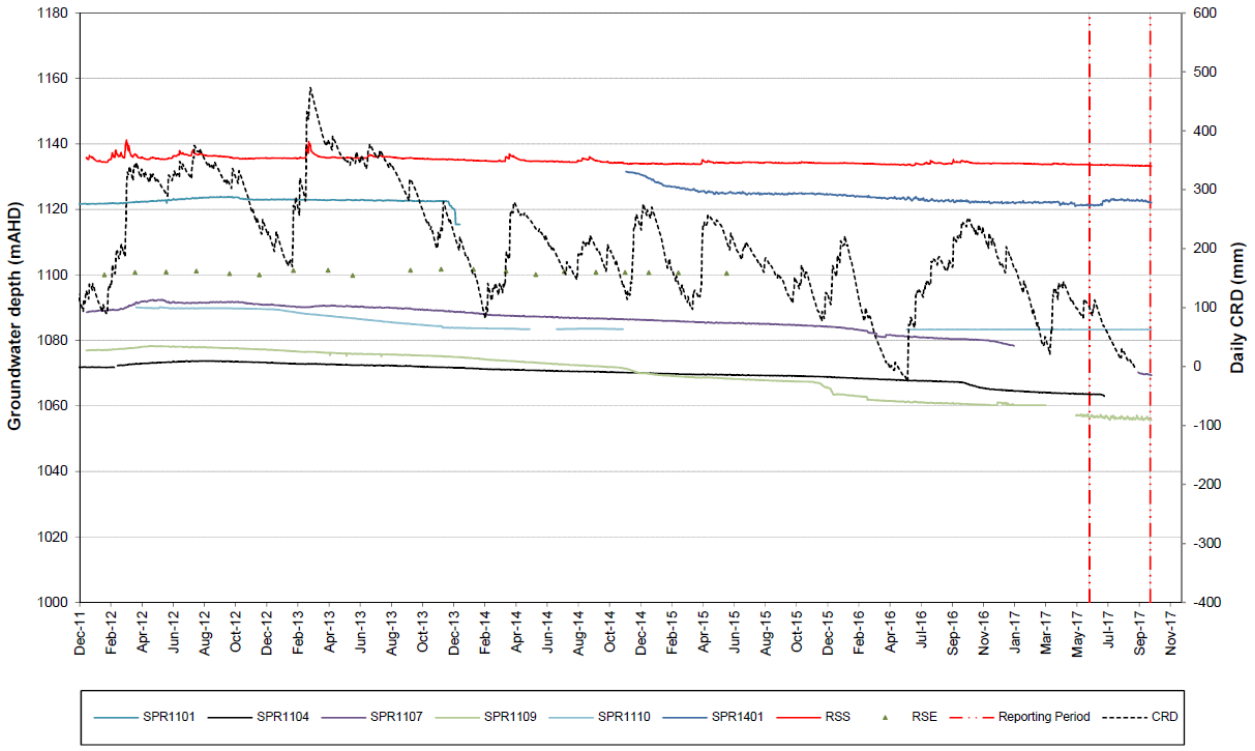


Figure 14 Impact Aquifer Piezometers

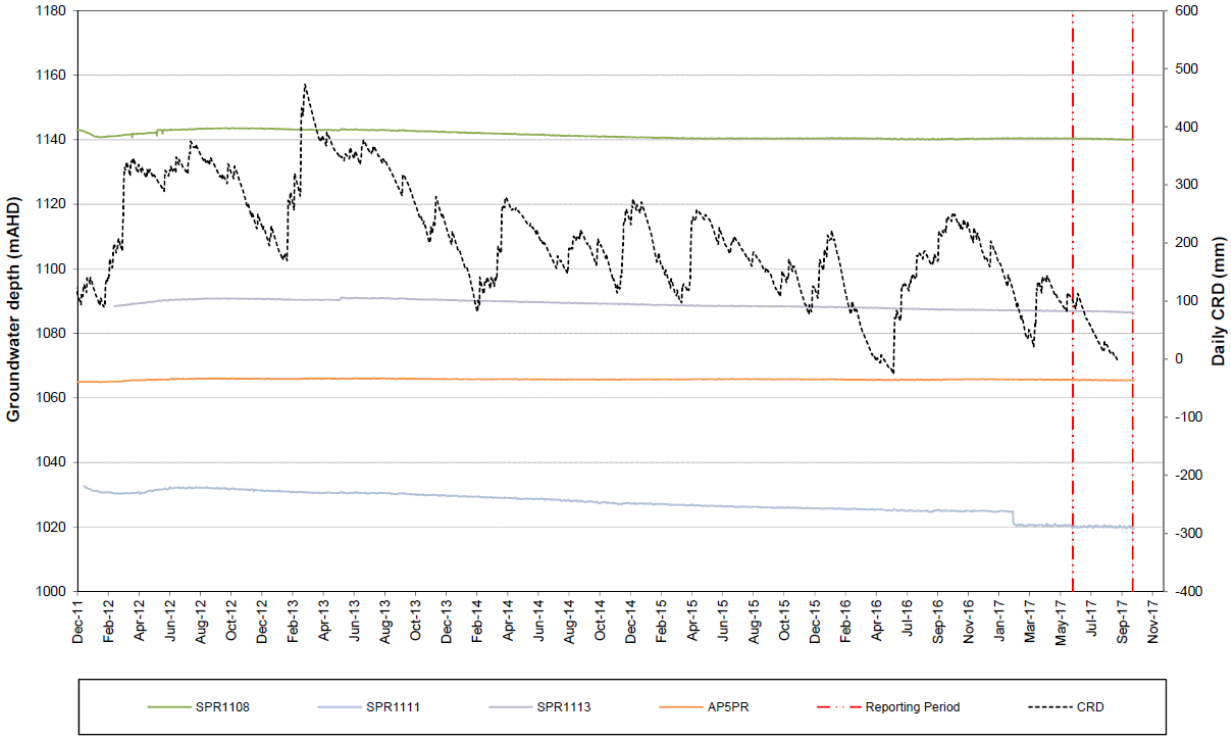


Figure 15 Reference Aquifer Piezometers

SPR1101

SPR1101 was first within the angle of draw of Longwall 416 in September 2013. On the 24th of March 2014, RPS notified Springvale of an exceedance of the water level trigger threshold at the aquifer piezometer SPR1101 under the THPSS MMP. The trigger was based on historical monitoring data which indicated a decline in water level at SPR1101. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 28th of March 2014.

The investigation indicated that the likely cause was the depth of drilling of the SPR1101 exploration borehole, which was subsequently inappropriately used as a water level monitoring bore. The drilling of the SPR1101 borehole, was likely to have intersected the zone of discontinuous fracturing (B-Zone) caused by subsidence related to the extraction of Longwall 416 at Springvale.

Historical monitoring indicates that the aquifers which supply groundwater to the swamp have not been impacted by adjacent mining activities. The SPR1101 borehole was drilled to a depth below the aquifers which supply groundwater to the swamp, and it is considered that the decline in water level based on data from this borehole does not represent an impact to the groundwater system which supplies water to the swamp.

SPR1109

SPR1109 was first within the angle of draw of LW418 in November 2015. On the 18th of December 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at SPR1109 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 22nd of December 2015.

The preliminary investigation indicated that it was likely that the changes to aquifer groundwater levels at SPR1109 were consistent with a delayed response to longer term climatic influences.

6.3.3. Groundwater Quality Results

The 2015 EMP requires swamp groundwater quality monitoring at impact sites SSE3, CW1, and CW2, and at reference sites CC1 and MS1. The swamps are monitored for parameters pH, electrical conductivity (EC) and dissolved iron.

Parameters are used to monitor possible impacts on swamp water quality resulting from subsidence induced cracks and fractures which can cause the oxidation of fresh rock surfaces. Indicators of oxidation are a decrease in pH (increase acidity), an increase in EC and an increase concentration of dissolved iron.
Performance indicators for groundwater quality will be considered to have been exceeded if statistically significant changes are indicated by the data including:

- For short-term change – if any measured parameter is greater than the baseline 80th percentile by two standard deviations for more than two months; and
- For long-term change – if the post-mining 50th percentile level for any analyte exceeds the 80th percentile pre-mining level after a minimum of 12 months.

CW1, CW2 and SSE3 have been dry since 29/04/14, 25/07/16 and 27/10/16 respectively. Water levels at CW1, CW2 and SSE3 now only occur during protracted rainfall events making it difficult to collect routine monthly groundwater samples for analysis.

pH

pH readings from impact sites CW1, CW2 and SSE3; and reference sites MS1 and CC1 are presented in Figure 16. Only measurements from MS1 and CC1 were available for the reporting period because CW1, CW2 and SSE3 were dry.
The pH levels for MS1 and CC1 have not fluctuated greatly and remain within historical limits. MS1 is relatively high, with a pH value of 6.2, which occurred in August (which is above the 80th percentile of baseline pH data). In September, the pH at MS1 returned to within the 80th percentile.

EC

EC readings from impact sites CW1, CW2 and SSE3; and reference sites MS1 and CC1 are presented in Figure 17. Only measurements from MS1 and CC1 were available for the reporting period because CW1, CW2 and SSE3 were dry.

Two (assumed anomalously) high EC readings of 244 and 1,310 µS/cm were recorded at MS1 in June and August respectively. These readings are not consistent with previously observed data. Furthermore, no large rainfall events (which can spike EC readings due to increased sediment loads and/or flushing of decaying organic matter) were recorded during this time. It is possible that these observations are representative but given historical trends are considered erroneous. Possible reasons for the high observations could be as simple as a laboratory transcription error.

The EC values observed for CC1 were lower than the previous reporting period however were within historical observations.

Fe

Dissolved Iron (Fe) readings from impact sites CW1, CW2 and SSE3 and reference sites MS1 and CC1 are presented in Figure 18. Only measurements from MS1 and CC1 were available for the reporting period because CW1, CW2 and SSE3 were dry.

For MS1, the Fe concentrations were below the detection limit (<0.05 mg/L). For CC1 the Fe concentrations were also low in comparison compared to historical data.

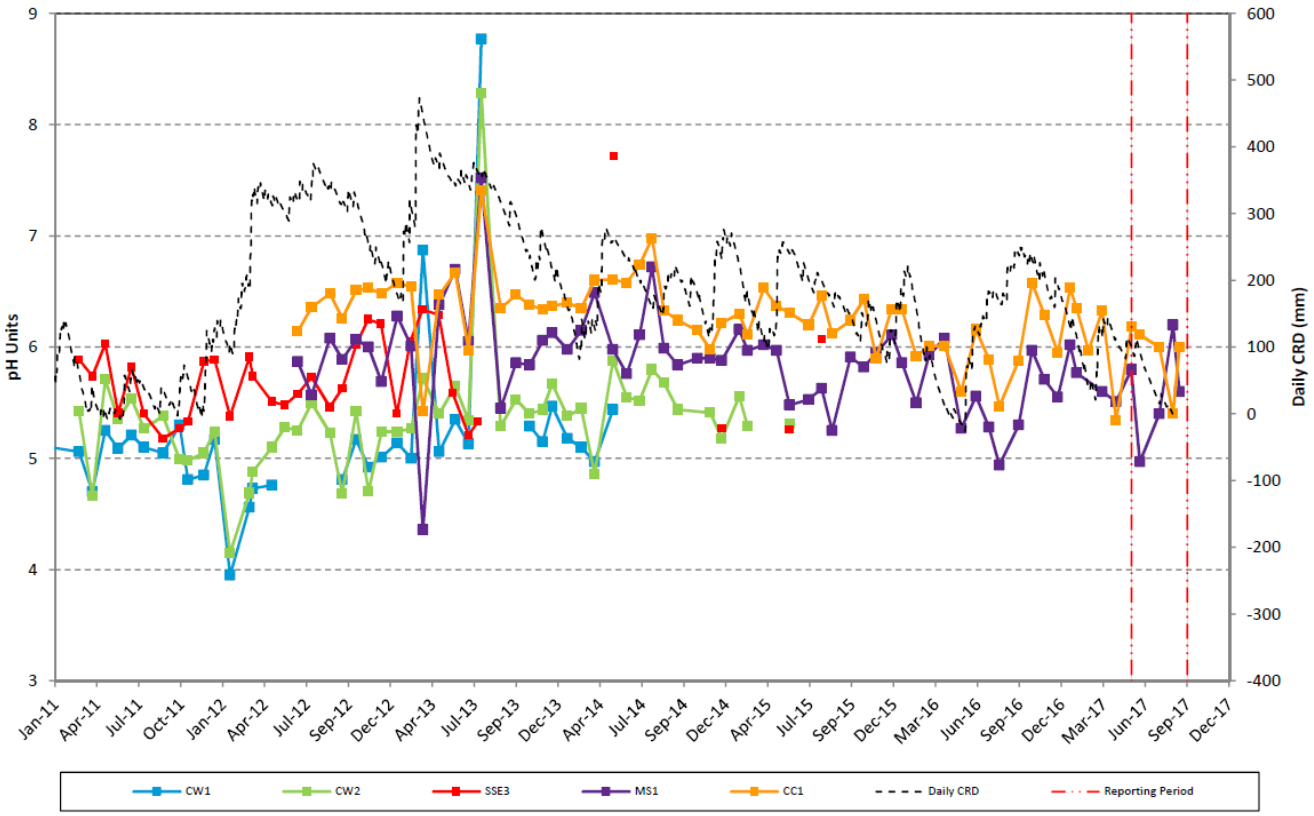


Figure 16 pH Swamp Piezometers

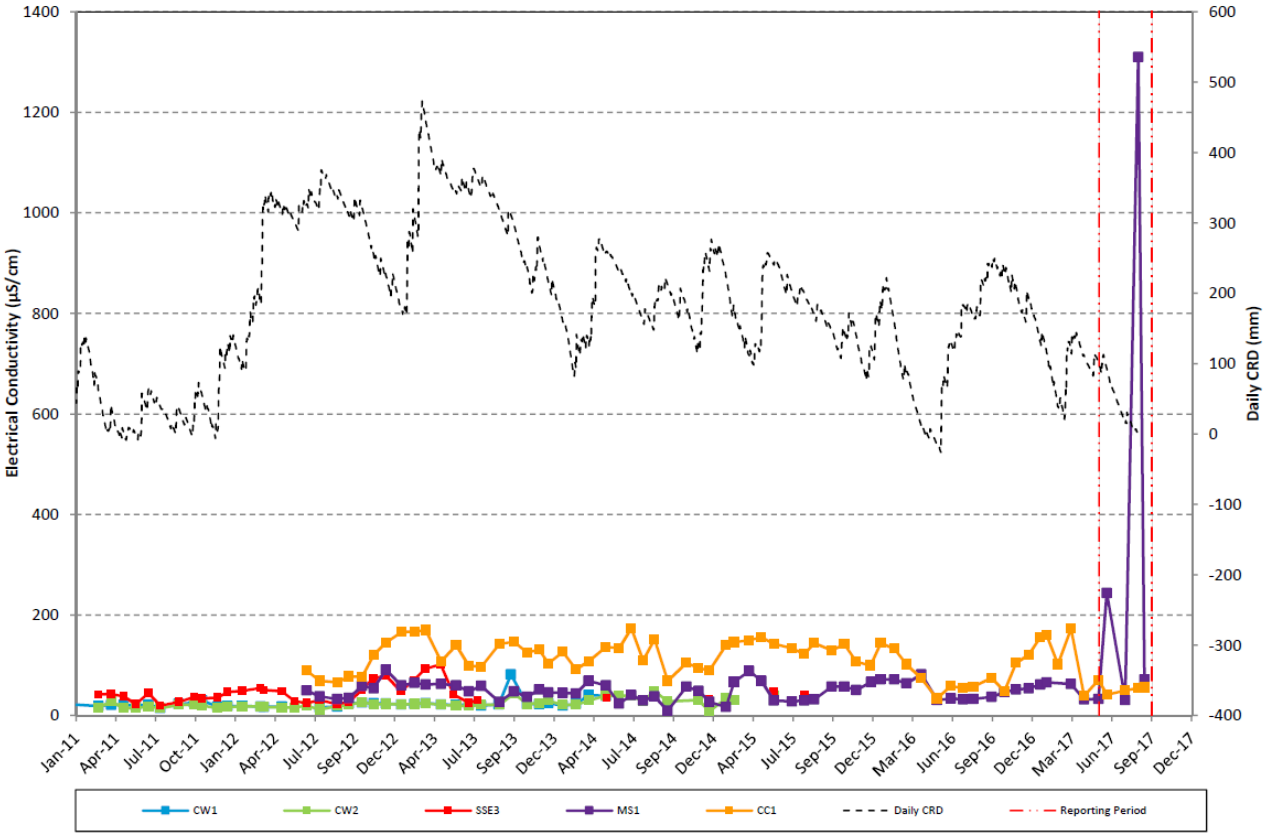


Figure 17 EC Swamp Piezometers

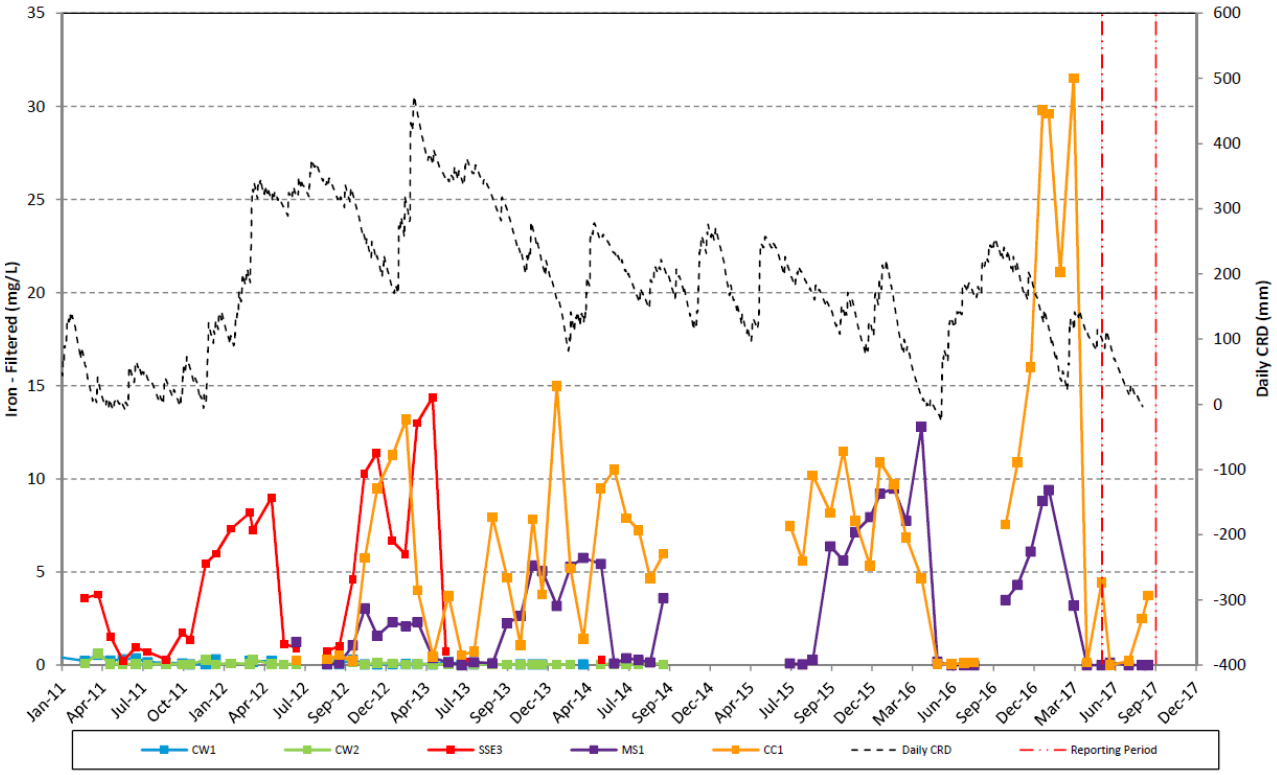


Figure 18 Fe Swamp Piezometers

6.4. Surface Water Monitoring Program

6.4.1. Methodology

Flow monitoring sites and standing water levels (where appropriate) within surface streams above Springvale are located in Table 7 below.

Table 7. Surface Water Monitoring Sites

Monitoring Site	Description	Site in 2009 EMP?	2009 EMP Reference	Site in 2015 EMP?
East Wolgan Upstream	Upstream	Yes	East Wolgan 1	No
East Wolgan Downstream	Downstream	Yes	East Wolgan 2	No
Sunnyside U/S Junction	Upstream	Yes	Wolgan Tributary 1	No
East Wolgan D/S Junction	Downstream	Yes	Wolgan Tributary 2	No
Sunnyside U/S	Upstream	Yes	Sunnyside 1	No
Sunnyside D/S	Downstream	Yes	Sunnyside 2	No
Carne West Upstream	Upstream	Yes	Carne West 1	No
Carne West Downstream/ Carne West	Downstream	Yes	Carne West 2	Yes
CWP	Nth end of Carne West Swamp	No	N/A	Yes
SS3 D/S	Nth end of Sunnyside East Swamp	No	N/A	Yes
Marrangaroo Creek Upstream	Marrangaroo Creek Upstream	No	N/A	Yes

Streams flows are monitored on a fortnightly basis using a pygmy flow meter under the 2009 EMP and monthly under 2015 EMP for flow, electrical conductivity, manganese, iron, temperature and visual inspection of colour. Total suspended solids are monitored monthly. If there is no flow no quality parameters are monitored. The exception is Carne West Pool where water pool monitoring is undertaken to assist in monitoring stream flow.

6.4.2. Surface Water Flows

Wolgan River

Surface flow contributions to the upper Wolgan River are monitored at tributaries at East Wolgan River downstream of the junction with Sunnyside Swamp and at Sunnyside Swamp upstream of the junction. Flows are shown on Figure 19. Flows at both East Wolgan D/S Junction and Sunnyside U/S Junction were low due to below average rainfall.

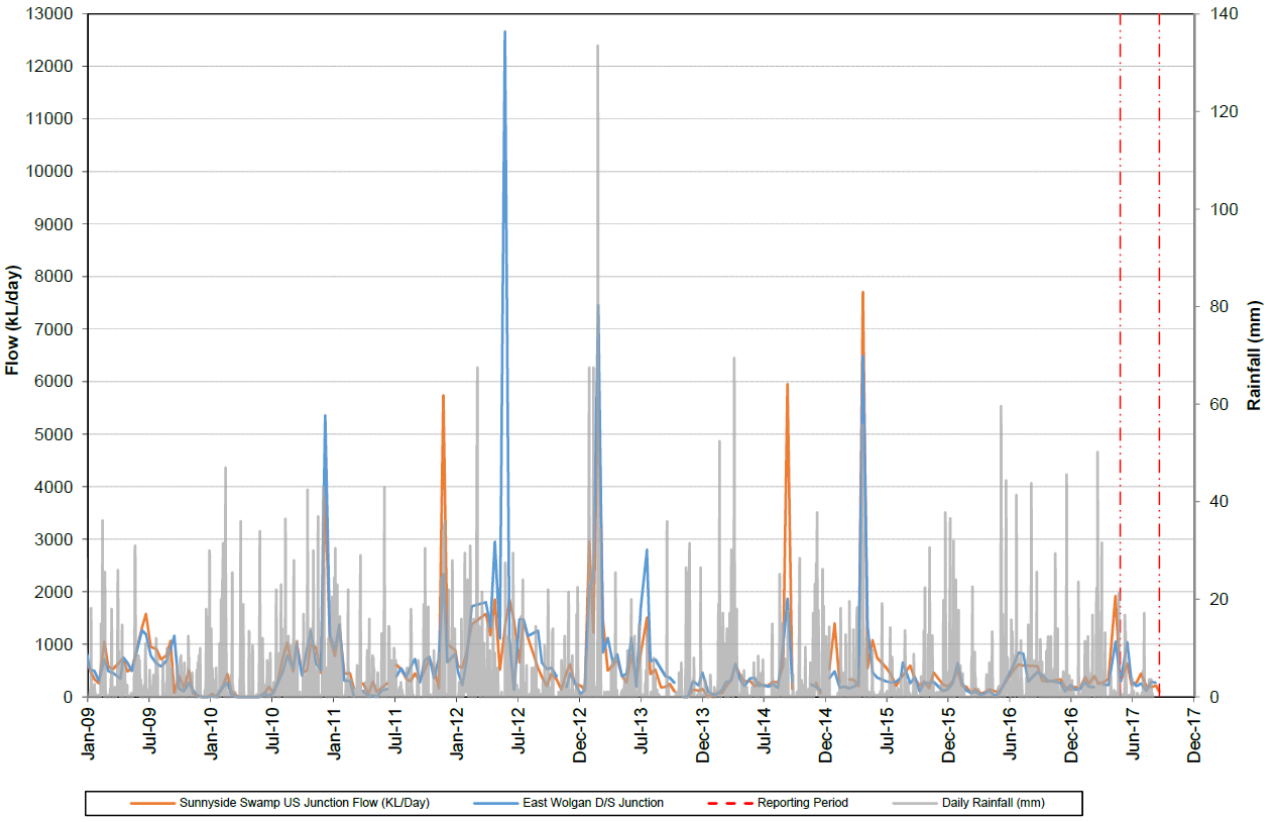


Figure 19 Wolgan River Flow

Table 8 presents the statistical comparison of the historic data and data for the monitoring period of the stream flows. For both East Wolgan D/S Junction and Sunnyside U/S Junction, streamflow was below the historic average due to low rainfall conditions.

Table 8. Wolgan River Flow Statistics

Monitoring Site	Average Stream Flow - All Data (KL/Day)	Average Reporting Period Stream Flow (KL/Day)	Stream Flow Range All data (KL/day)	Comments
East Wolgan D/S Junction	687	353	0 – 12,668	Much lower than average streamflow due to very dry months of July and September
Sunnyside U/S Junction	659	285	0 – 8,977	Much lower than average streamflow due to very dry months of July and September

East Wolgan

East Wolgan Swamp is located in proximity to Longwall 411. There has been no mining in the vicinity of this site. No emergency discharges have occurred during the reporting period.

Surface flows at East Wolgan swamp are monitored at East Wolgan Upstream and East Wolgan Downstream. Historically, no significant flows are recorded at these locations and the sites were recorded as being dry during the review period.

Historic flows are presented in Figure 20.

Sunnyside East Swamp

Surface flows at Sunnyside East Swamp are monitored at SS3 Downstream. SS3 Downstream has been dry since early 2015. Previous to this, flows were too low for gauging. No flows were recorded during the reporting period.

Historic flows are presented in Figure 20.

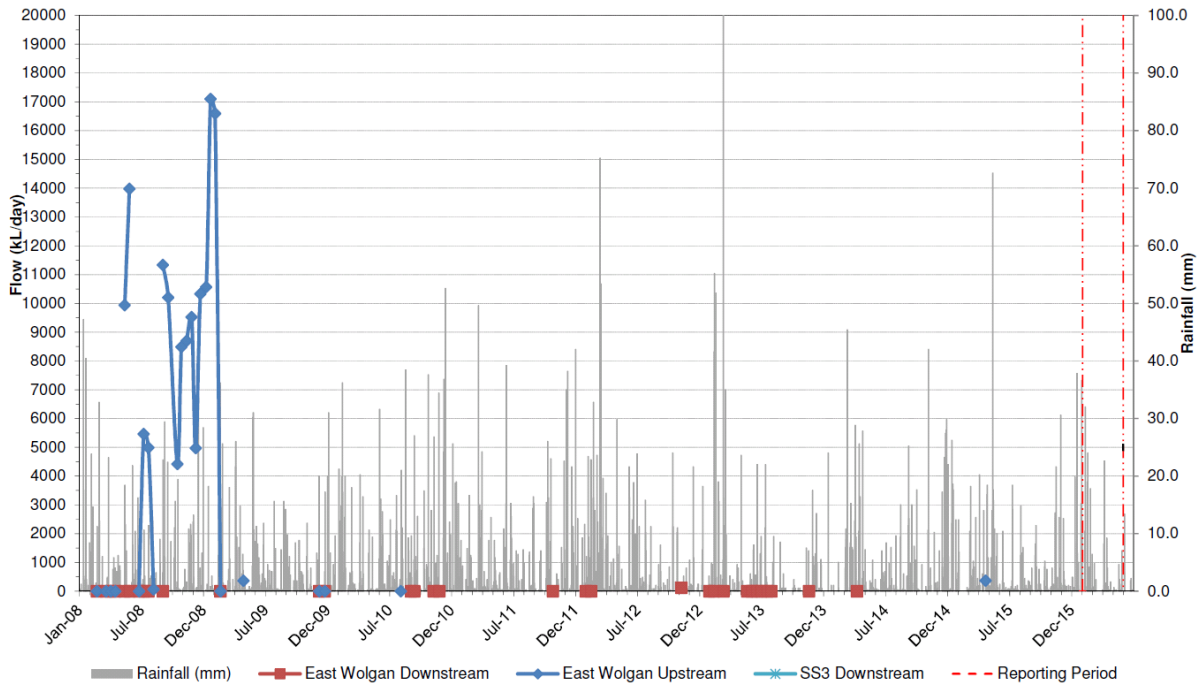


Figure 20 East Wolgan and Sunnyside East Flow

Sunnyside Swamp

Surface flows at Sunnyside Swamp are monitored at Sunnyside Upstream and Sunnyside Downstream. Flows are shown on Figure 21. Flows observed at Sunnyside Upstream show a large peak on 13/07/2017 due to a short rainfall event, but otherwise there was little or no flow recorded at both locations during the reporting period.

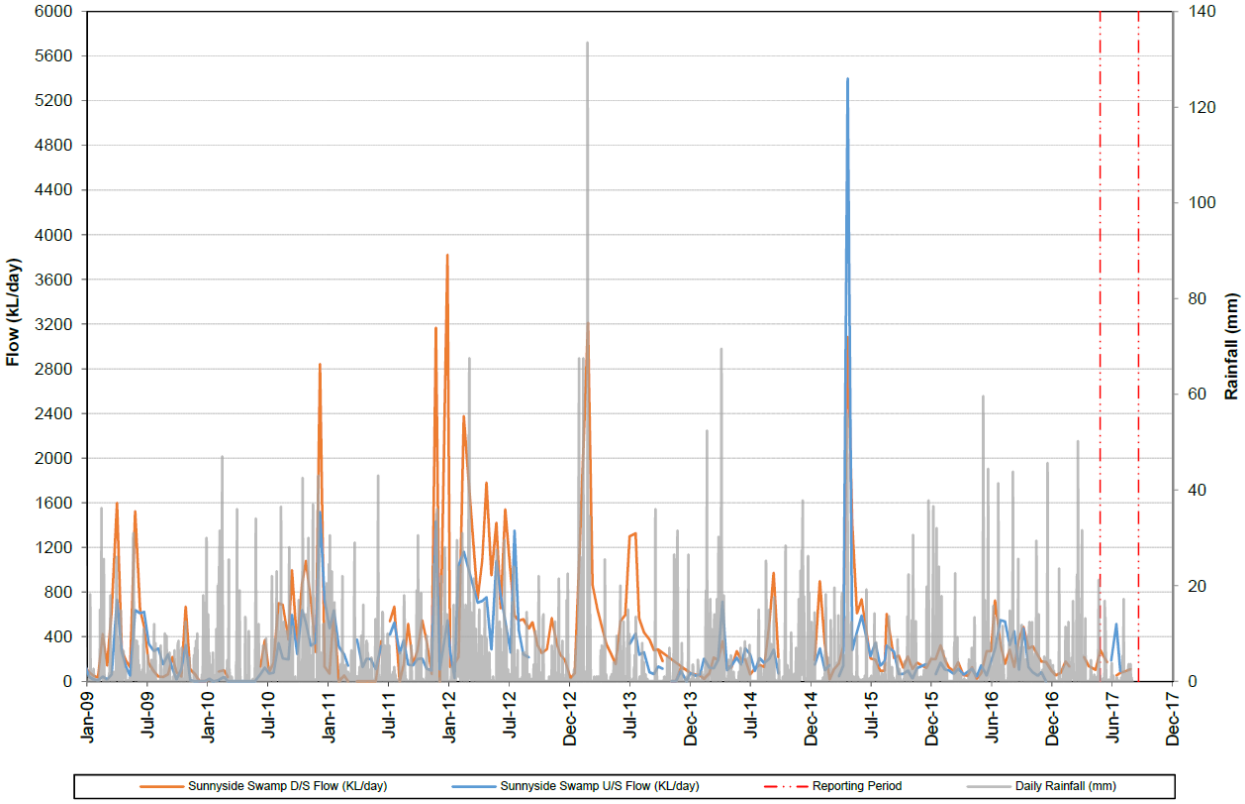


Figure 21 Sunnyside Swamp Flow

Table 9 presents the statistical comparison of historical data and the data for the monitoring period. Flows for both Sunnyside Upstream and Sunnyside Downstream were below historic observed average due to lower than average rainfall during the reporting period.

Table 9. Sunnyside Swamp Flow Statistics

Monitoring site	Average Stream Flow - All Data (KL/Day)	Average Reporting Period Stream Flow (KL/Day)	Stream Flow Range All data to 25/01/17 (KL/day)	Comments
Sunnyside Swamp U/S	301	242	0 – 5,399	Slightly lower than average streamflow due to very dry months of July and September
Sunnyside Swamp D/S	420	100	0 – 4,252	Much lower than average streamflow due to very dry months of July and September

Carne West Swamp

Surface water flows and depths at Carne West Swamp are monitored at Carne West Upstream, Carne West Downstream and a pool depth monitor; Carne West Pool (CWP). CWP is adjacent to Carne West Downstream.

No flow data was recorded for Carne West Upstream and Carne West Downstream during the reporting period due to the intermittent nature of flows in the swamp which has become rainfall dominated.

Pool depths at CWP are presented on Figure 22. CWP was mostly dry during the reporting period, responding to small rainfall events in June, July and August. No water levels were observed during September due to below average rainfall.

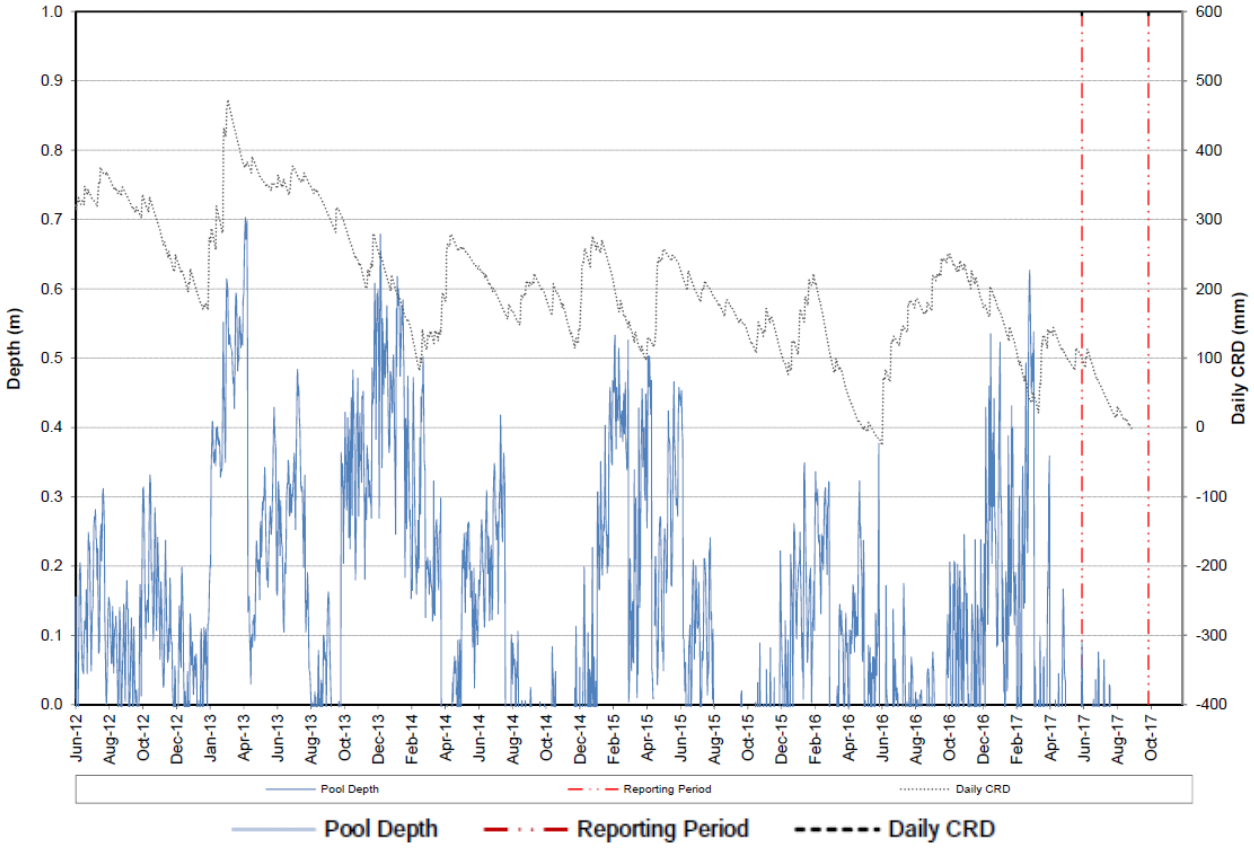


Figure 22 CWP Waterhole

Reference Site – Marrangaroo Creek

Although there was adequate water to take water quality samples from fresh pools near the monitoring point, water levels were too low to measure flow due to below average rainfall during the reporting period.

6.4.3. Surface Water Quality

All surface water monitoring sites are monitored for electrical conductivity (EC), pH, manganese, iron, total suspended solids (TSS) and temperature. The monitoring results are discussed below.

Results for temperature and TSS are driven by climatic influences and can vary greatly depending on the time of day the samples are taken. Temperature fluctuations are dominated by the season and time of day the samples are obtained. TSS measurements are driven by rainfall runoff intensity and fluctuations will vary greatly depending on the time the sample is taken. Spot samples are generally not representative of true maximum and minimum values.

As outlined above in section 6.4.2 Carne West and East Wolgan monitoring sites are not presented in this section as the monitoring sites were either dry or experienced low flow during the reporting period. The monitoring results at Carne West and East Wolgan are therefore unrepresentative of long term trends.

Marrangaroo Creek

A statistical summary of the samples collected during the reporting period are presented in Table 10.

Table 10. Marrangaroo Creek Quality Statistics

Parameter	Statistic	All Data	Reporting Period	95th Percentile (all data)
pH	Range	3.47 - 8.85	5.08 – 7.57	4.38, 7.43
	Median	5.70	6.40	
	Mean	5.68	6.42	
EC (µS/cm)	Range	7 – 71	17 - 37	61.7
	Median	30	24	
	Mean	46.4	25.6	
Mn (mg/L)	Range	0 - 0.4	0.001 - 0.015	0.02
	Median	0.009	0.006	
	Mean	0.014	0.007	
Fe (mg/L)	Range	0.05 - 4.38	0.05 – 4.38	0.844
	Median	0.05	0.06	
	Mean	0.22	0.61	

Over the reporting period pH values ranged from 5.08 to 7.57, EC values ranged from 17.0 to 37.0µS/cm, Mn concentration values ranged from 0.001 to 0.015mg/L and Fe concentrations from 0.05 to 4.38mg/L.

The Fe concentration was below the limit of reporting (<0.05mg/L) for half of the samples collected. The maximum value for all of the Fe observations occurs on13/06/2017. However, this is considered erroneous because it is proportionally larger than the previous and successive data points.

Except for the erroneous data point for iron concentrations, all parameters at Marrangaroo creek remained within the historical limits. The peak pH value during the reporting period exceeded the 95th percentile; however, the mean and median values were below the 95th percentile.

Wolgan River

Table 11 summarizes water quality data for the reporting period.

Table 11. Wolgan River Quality Statistics

Parameter	Statistic	Sunnyside U/S Junction			Wolgan East D/S Junction		
		2006 – Current	Reporting Period	95th Percentile (all data)	2006 – Current	Reporting Period	95th Percentile (all data)
pH	Range	3.87 – 8.49	6.1 – 8.34	6.02, 7.90	3.66 – 9.74	6.00 – 9.74	5.97, 7.72
	Median	6.91	7.19		6.90	7.00	
	Mean	6.95	7.11		6.91	7.30	
EC (µS/cm)	Range	5 - 390	22 – 47	55	4 – 350	19 – 35	74
	Median	34	27.5		33	27	
	Mean	38	28.8		39	27	
Mn (mg/L)	Range	0.000 – 0.300	0.002 – 0.014	0.012	0.000 – 0.472	0.001 – 0.005	0.012
	Median	0.005	0.003		0.005	0.002	
	Mean	0.007	0.005		0.009	0.002	
Fe (mg/L)	Range	0.11 – 0.176	0.18 – 0.47	1.33	0.05 – 3.13	0.12 – 0.48	1.28
	Median	0.56	0.26		0.52	0.27	
	Mean	0.64	0.27		0.62	0.27	

pH at both sites were very similar throughout the reporting period. There are significantly alkaline pH values recorded at both sites on the 25/08/2017. This pH value is the second most alkaline pH (8.34) recorded for Sunnyside Swamp U/S Junction and the most alkaline pH (9.74) recorded for East Wolgan D/S Junction. Whilst there is a large peak, the mean and median of the data for the monitoring event was still within the historical limit.

The EC data for both of the sites is relatively constant during the monitoring period. The values observed are within historical limits.

Mn concentrations at the Sunnyside U/S Junction were higher than East Wolgan D/S Junction. The maximum value at Sunnyside U/S Junction exceeds the 95th percentile for all data. This increase is not sustained and both the median and mean are within the historical limits. The Mn concentrations observed at Sunnyside U/S Junction and East Wolgan Junction are within historical limits.

The Fe data for both monitoring locations are very similar during the reporting period. Both sites are within the historical limits.

Sunnyside Swamp

Table 12 summarizes water quality data for the reporting period.

Table 12. Sunnyside Swamp Quality Statistics

Parameter	Statistic	Sunnyside Swamp U/S			Sunnyside Swamp D/S		
		2006 – Current	Reporting Period	95th Percentile (all data)	2006 – Current	Reporting Period	95th Percentile (all data)
pH	Range	5.31 – 8.94	5.6 – 8.32	6.12, 7.3	5.55 – 11.29	6.4 – 11.29	5.73, 7.8
	Median	6.66	6.35		6.85	7.4	
	Mean	6.57	6.7		6.91	7.7	
EC (µS/cm)	Range	1 – 820	26 – 46	75	1 – 840	23 – 55	198
	Median	45.5	31		42	31	
	Mean	52.3	32		65	32	
Mn (mg/L)	Range	0.002 – 0.071	0.002 – 0.015	0.017	0.000 – 2.500	0.002 – 0.007	0.013
	Median	0.007	0.007		0.005	0.003	
	Mean	0.008	0.007		0.015	0.004	
Fe (mg/L)	Range	0.11 – 2.15	0.17 – 0.47	1.46	0 – 5	0.06 – 0.44	1.96
	Median	0.51	0.28		0.68	0.37	
	Mean	0.62	0.28		0.88	0.33	

The pH data for both of the monitoring locations indicated that there was a relatively alkaline pH in Sunnyside Swamp which were observed on the 27/06/2017 and 25/08/2017. For Sunnyside Swamp Downstream, a pH of 11.29 was observed which was the highest reading recorded at Sunnyside Swamp Downstream. The mean and medians for each of the locations for the reporting period was slightly higher for all of the data however within the bounds of historical observations

The EC data for both of the monitoring locations are relatively similar. Both monitoring locations are within historical limits. Observations for Mn and Fe at Sunnyside Swamp Downstream and Sunnyside Swamp Upstream are within historical limits.

6.5. Fauna Monitoring Program

6.5.1. Methodology

As part of the on-going monitoring program at Springvale, fauna monitoring is undertaken three times per year, during spring, summer and autumn. Monitoring is undertaken at five locations throughout the year, as outlined in Table 14. Autumn monitoring was conducted between the 20th and 24th March, and 10th and 14th April 2017. Spring monitoring is scheduled to take place during November 2017.

Table 13. Fauna Monitoring Sites

Location	Site
Newnes Plateau Woodland	F-SV2
Sunnyside Swamp	F-SV3
Carne West Swamp	F-SV4
Carne West Swamp South	F-SV5
East Wolgan Swamp	F-AP3

The faunal surveys sample a range of faunal groups with a specific emphasis on threatened and endangered species. Targeted searches are carried out for threatened species during the season within which they are most active.

Data from the surveys is then analysed to show:

- Species count;
- Habitat characteristics;
- Species diversity; and
- Species richness.

Results presented in Section 6.5.2 are from the 2017 Autumn Fauna Monitoring Report for the Springvale SMP area. The results of the Spring monitoring will be presented in the March 2018 SMSR.

6.5.2. Results

Habitat Measurements

Habitat characteristics are presented below in Table 14.

It is now possible to compare the results from the surveys undertaken in 2017 with those from the surveys in autumn 2007 to 2016. There are significant differences in tree, tall shrub, low shrub, low sapling, fern, grass and forb cover over time. Cover parameters have varied over the years for all sites. With the exception of tree and tall shrub cover showing some reduction around 2013, most upper and mid strata characteristics show a neautral trend over the long term. The overall trend for

lower and ground strata characteristics is also neutral, except forb and grass cover which seemed to decline around 2015. Two-way Repeated Measures ANOVA's were conducted on habitat variables that exhibited significant variation. Variation was only significant over time (years), not with treatment (mining impact). This suggests that the variation in these characteristics reflects changes in environmental conditions on Newnes Plateau rather than impacts from mining.

Table 14. 2017 Autumn Habitat Characteristics

% Cover	SV2	SV3	SV4	SV5	AP3	Mean
Tree Cover	32	20	24	8	20	21
Tall Shrub Cover	8	48	36	44	32	34
Tall Sapling Cover	36	8	16	4	4	14
Low Shrub Cover	96	84	56	84	80	80
Low Sapling Cover	44	20	4	4	8	16
Cutting Grass	52	40	32	56	20	40
Grass Cover	52	64	12	4	24	31
Forb Cover	72	56	56	28	28	48
Fern Cover	12	48	72	92	88	62
Reed Cover	0	56	36	80	52	45
Vine Cover	4	0	4	0	0	2
Litter Cover	4	0	4	0	0	2
Log Cover	44	20	44	8	20	27
Rock Cover	24	16	0	0	0	8
Tree Hollows	4	4	8	4	0	4

Habitat complexity scores are used to provide an index of habitat complexity that can be used to determine changes in habitats over time. The system scores the following parameters: tree cover, tall and short shrub cover, ground cover, logs/rocks and litter cover. The scores range from 0 to 3, hence the maximum score is 18. Autumn habitat complexity scores for monitoring sites over time are provided in Table 15. Tracking habitat complexity scores over time provides insight into changes in habitat value.

The scores indicate moderate habitat complexity. Habitat Complexity Scores differed significantly over the years (Two-way Repeated Measures ANOVA, p=0.031 for year), but not with mining impact. Scores in 2015 were significantly lower than those in 2009 and 2010, but not to other years. This suggests variation in habitat complexity reflects changing environmental conditions across Newnes

Plateau rather than mining impacts. 2017 has seen a recovery from the low scores in 2015. These scores show that all sites still provide good habitat for ground-dwelling mammals and woodland birds.

Table 15. Autumn Habitat Complexity Scores for Monitoring Sites over Time

Site	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SV2	14	15	16	17	15	16	15	13	14	15	15
SV3	13	14	15	15	14	14	14	16	12	13	13
SV4	15	15	16	17	17	16	16	16	13	14	16
SV5	-	-	-	-	-	-	-	-	11	12	13
AP3	15	15	15	15	15	13	14	10	12	13	13
Overall mean	14.3	14.8	15.5	16.0	15.3	14.8	14.8	13.8	12.4	13.4	14.0

Biodiversity

Seventeen native mammal (plus three introduced), forty-nine bird, eleven reptile and three amphibian species were recorded from the SMP Area. Biodiversity indices are provided in Table 16.

Table 16. Autumn 2017 Biodiversity Indices for Fauna in Springvale SMP Area

Fauna Group	Evenness	Simpson's Index of Diversity	Abundance	Species Richness
Birds	0.870	0.954	689	49
Native Mammals (non-bat)	0.885	0.860	52	10
Reptiles	0.887	0.877	31	11

There appears to be a slight increase on last year in most diversity indices for all three fauna groups. The only exception is mammal numbers which were down. This could be due to heavy trap disturbance at three sites. Statistics suggest the changes are not due to undermining in the Springvale SMP Area and may be related to climatic variation.

Six threatened species were located (Scarlet Robin, Flame Robin, Powerful Owl, Greater Glider, Large-eared Pied Bat and Blue Mountains Water Skink), as well several bird species dependent upon woodland habitats. As recorded in previous years, numbers and diversity of honeyeaters were high (8 species).

6.6. Flora Monitoring Program

Flora Monitoring sites in the 2009 EMP and 2015 EMP are listed in Table 17.

Table 17. Flora Monitoring Sites

Monitoring Site	Description	Site in 2009 EMP?	Site in 2015 EMP?
NP07	Sunnyside West Heath	Yes	No
KC01	Kangaroo Creek Swamp	Yes	No
KC02	Kangaroo Creek Swamp	Yes	No
NO005	Junction Swamp	Yes	No
NP006	Junction Swamp	Yes	No
WE01	Sunnyside Swamp	Yes	No
WE02	Sunnyside Swamp	Yes	No
CLA03	Prickly Swamp	Yes	No
CLA04	Prickly Swamp	Yes	No
WC01	Carne West Swamp	Yes	Yes
WC02	Carne West Swamp	Yes	Yes
WC03	Carne West Swamp	Yes	Yes
WC04	Carne West Swamp	Yes	Yes
SSE01	Sunnyside East	No	Yes
TG01	Twin Gully	No	Yes
TG02	Twin Gully	No	Yes
TRI01	Tristar	No	Yes
TRI02	Tristar	No	Yes
LGG01	Lower Gang Gang Swamp	No	Yes
UGE01	Upper Gang Gang East Swamp	No	Yes
BS01	Barrier Swamp	No	Yes
CCS01	Carne Central Swamp	No	Yes

The following parameters are measured at each quadrate during the monitoring period:

- Species Composition Cover/abundance;
- Condition of Swamps and associated vegetation;
- Plant species diversity;
- Discussion on comparative monitoring results; and
- Indicator species including eucalypts, sphagnum cristatum.

Monitoring is carried out in summer, autumn, winter and spring.

The following sections summarises results from the Autumn 2017 monitoring results report.

6.6.1. Native Species Diversity

A modified Braun-Blanquet scale was used to visually estimate cover abundance for species occurring within each site.

Total native plant species richness for impact and reference sites is shown in Table 18. Results from the quadrat (400 m^2) and four 20 m transects are tabulated for comparison between sampling methods and reference/impact sites.

THPSS MMP Sites

Species richness at most sites was below the baseline means, which may reflect the preceding uncharacteristically warm and dry conditions. Mean species richness using the point intercept method was slightly lower at impact sites (15.4 ± 5.2) than reference sites (17.0 ± 3.4). A similar difference was found within 400m2 quadrats where species richness at impact sites (20.0 ± 8.6) was lower than reference sites (23.2 ± 3.7). Two previous triggers reported for West Carne impact sites (WC01 and WC02) (RPS 2017a) are no longer classed as triggers for species richness, as was TRI01, a reference site (Table 18). No repeat or new triggers have occurred in the autumn monitoring season.

Species diversity at the reference sites was slightly higher than the impacted swamp plots. As reported in RPS (2017a), there remains a significance difference between impact (i.e. West Carne and Sunnyside East sites) and reference swamps ($t(9) = -3.15$, $p = 0.01$). Notwithstanding, evenness scores appear similar or higher in the impact swamps, indicating relatively consistent abundances. This metric indicates that these differences are small and do not necessarily represent a tangible difference between control and impact sites. It does suggest that the relative species richness and abundances remain fairly consistent between seasons.

Table 18. Total native plant species richness

Site	Species Richness		Shannon-Wiener Index (point intercept method)	Evenness
	400m^2 Quadrat	Point Intercept Method		
Impact sites				
WC01	13	11	1.85	0.77
WC02	15	13	1.88	0.73
WC03	13	11	1.86	0.77
WC04	13	12	1.91	0.77
SSE01	25	17	2.14	0.75
LGG01	34	25	2.28	0.71
UGE01	27	19	2.10	0.71
Mean±SD	20.2 ± 8.6	15.4 ± 5.2	2.10	
Reference sites				
TG01	24	13	2.15	0.84
TG02	23	18	2.16	0.75
TRI01	28	21	2.35	0.77
TRI02	22	13	1.95	0.76
BS01	17	17	2.18	0.77
CCS01	25	20	2.21	0.71
Mean±SD	23.2 ± 3.7	17.0 ± 3.4		

SEMP Sites

Total native plant species richness for impact and reference sites are shown in Figure 23 for the previous three seasons and graphically compare monitoring results throughout a 12 month period. Interpretation of the results is inhibited by the compromise of the original control sites under the monitoring program. The monitoring of swamps is now covered by updated swamp monitoring programs for specific longwalls.

Monitoring sites appear to have remained fairly consistent with no changes in the number swamp species detected greater than 2. The results presented here for the SEMP monitoring are for visual reference only, as the control sites in West Carne were undermined in 2015 and can no longer be used for comparison.

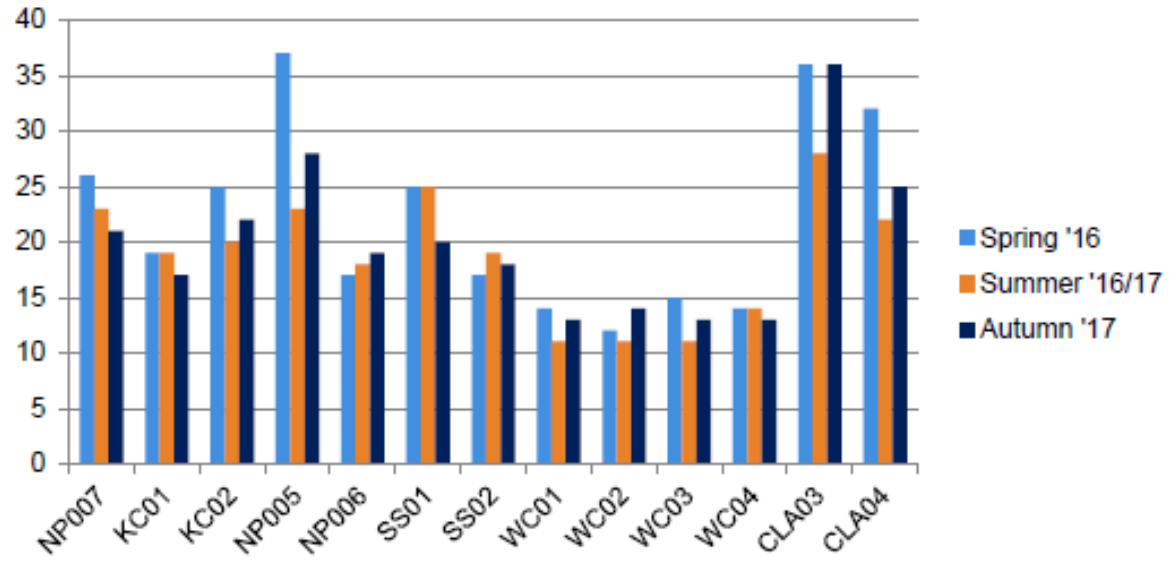


Figure 23 Species richness recorded in SEMP monitoring site for Spring 2016, Summer 2016/2017 and Autumn 2017

6.6.2. Eucalypt Recruitment

Non-swamp eucalypt presence was estimated by summing incidence recorded in each 0.5 m x 0.5 m quadrat centred on sequential 1 metre intervals along each of the four parallel transects. This provided a total of approximately 80 quantitative measurements of eucalypt presence per monitoring quadrat.

THPSS MMP Sites

Eucalypt recruitment over seasonal monitoring is shown in Table 19 below.

Table 19. Eucalypt Recruitment over Time

Site	Seasons				
	Autumn '16	Winter '16	Spring '16	Summer '16/'17	Autumn '17
Impact					
WC01	2	-	-	-	-
WC02	2	-	-	-	-
WC03	-	-	-	-	-
WC04	-	-	-	1	-
SSE01	3	4	1	**3**	**1**
LGG01	-	1	2	**1**	**2**
UGE01	-	-	-	-	-
Reference					
TG01	-	-	-	1	-
TG02	-	-	-	-	-
TRI01	-	-	-	1	-
TRI02	-	-	1	1	1
BS01	-	-	-	-	-
CCS01	6	-	-	-	-

Continued above trigger thresholds eucalypt recruitment was observed in LGG01 and SSE01. Eucalypt recruitment below trigger thresholds was noted for the first time in WC04 during summer '2016/2017, with no re-occurrence of this observation in the autumn 2017 monitoring event. The continuance of sub trigger eucalypt recruitment was detected at TRI012, with no subsequent recruitment observations made in TG01 and TRI01. It is possible that a trigger event may be recorded in TRI02 in subsequent monitoring events as the cumulative recruitment count currently stands at three.

SEMP Sites

No increase in eucalypt recruitment was observed in the SEMP monitoring sites during the autumn 2017 monitoring period. Additionally, as previously stated the control sites for this monitoring program have since been compromised.

6.6.3. Species Condition Scores

Four parallel transects were established to measure species condition scores. The starting points of these transects were positioned randomly along a predetermined edge of the 400 m^2 permanent monitoring quadrat. A condition score was estimated for each plant species intersected every 0.5 m along the transects.

THPSS MMP Sites

Overall mean species condition scores for impact and reference sites are shown in Table 20.

Table 20. Overall condition scores for each site and for key swamp species (Autumn 2016 v Autumn 2017)

Site	Mean Condition					
	All Species		Gleichenia dicarpa		Baumea rubigonsa	
	2016	2017	2016	2017	2016	2017
Impact						
WC01	3.4	3.5	2.8	2.3	2.1	3.0
WC02	3.8	3.7	3.6	2.9	3.0	2.8
WC03	2.9	3.2	2.2	2.1	2.9	3.5
WC04	3.5	3.6	2.5	2.1	3.9	2.5
SSE01	4.0	4.5	3.4	3.6	3.8	4.1
Reference						
TG01	3.2	45	3.7	4.0	4.2	4.4
TG02	4.1	4.3	3.8	4.0	4.3	4.3
TRI01	4.3	4.5	4.0	4.1	4.0	4.4
TRI02	4.4	4.5	4.2	4.6	4.8	4.6
BS01	3.8	4.2	3.8	3.9	3.8	3.9
CCS01	3.7	4.1	-	-	-	-
LGG01	4.6	4.4	4.9	4.2	5.0	N/A
UGE01	4.3	4.2	4.5	3.7	4.4	1.5

No impact sites were below the ‘all species’ condition threshold. However, three impact sites in West Carne (WC01, WC03 and WC04) were below the condition trigger threshold for the important swamp species *Gleichenia dicarpa* and three sites (WC02, WC04 and UGE01) triggered for *Baumea rubiginosa*. The negative trend observed is a continuation from previous monitoring events in summer, spring and winter of the previous three seasons. No further species conditions are presented here as the chosen species occur in most sites at reasonably high frequencies and are considered amphibious species (Brownstein et. al. 2014).

SEMP Sites

Stable condition scores for swamp species have been recorded in the previous 12 months of monitoring (Table 21).

Table 21. SEMP Mean Species Condition

Site	Spring 2016	Summer 2016/2017	Autumn 2017
NP007	4.58	3.7	3.7
KC01	4.72	4.6	4.4
KC02	4.44	4.7	3.8
NP005	4.64	4.7	3.8
NP006	4.6	4.4	3.5
SS01	4.8	4.2	3.5
SS02	401	4.5	3.4
WC01	3.6	2.6	3.8
WC02	2.9	2.7	3.9
WC03	3.5	2.8	3.7
WC04	3.4	3.0	3.1
CLA03	4.4	4.0	4.8
CLA04	4.3	4.1	4.8

Some condition related improvement has been observed in the West Carne monitoring sites, while there has been a marked decline in condition at Sunnyside and NP (Junction Swamp: NP005 and NP006; and Sunnyside West Heath: NP007) sites. Further seasonal monitoring will determine if this is a trend or simply seasonal variance due to climatic conditions. As previously mentioned, the West Carne sites are no longer valid reference sites for the presented monitoring period as they have since been undermined. The SEMP monitoring results are presented here for compliance. No triggers were detected for SEMP by RPS during the monitoring periods prior to West Carne being undermined.

6.6.4. Non Live Ground Cover

Bare earth scoring was estimated at each of the 0.5 m intervals inspected for species condition.

Percent of non-live ground cover was estimated using both the Braun-Blanquet cover abundance scale for the entire 400 m^2 quadrat and the point intercept method.

THPSS MMP Sites

Results are tabulated in Table 22. An increase of 25% or greater represents a greater than 100m2 increase in non-live cover.

Table 22. Non-live ground cover results comparing Autumn 2017 to Summer 2016/2017 (previous survey)

Site	Bare Ground (%) Summer 2016/2017	Bare Ground (%) Autumn	% Change
Impact			
WC01	3.75	15	16.875
WC02	2.5	10	11.875
WC03	8.125	21.875	13.75
WC04	8.125	37.5	29.375
SSE01	4.375	6.875	-3.125
Reference			
TG01	0.625	4.375	3.75
TG02	0.625	0.625	0
TRI01	0.625	0	-0.625
TRI02	0.625	0	-0.625
BS01	1.875	0	-1.875
CCS01	0	0	0
LGG01	7.5	16	8.5
UGE01	10	6.875	-3.125

The trigger criterion for non-live ground cover requires an increase of bare ground of more than 100m2 over a three-year period. Consequently, a continued trigger in the performance criterion for non-live ground cover was detected in the autumn 2017 monitoring period for WC04. There were also substantial increases in detected non-live ground cover within all of the West Carne monitoring quadrats as well as a notable increase at reference site LGG01.

SEMP Sites

No detectable change in non-live groundcover has been observed in the SEMP monitoring sites since 2013.

6.6.5. Establishment of Non-native Weeds

THPSS MMP Sites

The results this monitoring event indicates a weed free status for all sites. This is consistent with results from the 2016/2017 summer monitoring event. Given the consistent low incidence of exotic species using the point intercept method and anecdotally the apparent absence of exotic species from the monitored sites the spread of exotic species appears to be non-existent.

SEMP Sites

One monitoring site was observed to contain an exotic plant species within this monitoring period. Cats Ear (*Hypochaeris radiata**) was observed at KC01 again. Incidence was low and has remained relatively stable for the past 2 years.

6.6.6. Conclusions

Monitoring results were compared with the flora trigger levels specified in the THPSS MMP. The results of this comparison are provided in Table 23.

Table 23. Monitoring results and flora trigger levels

Performance indicator	Parameter measured	Trigger level	Autumn 2017
Change in species assemblage	Change in diversity of native species	A change in the number of species of greater than 30 % for a given site within a three year period.	No sites trigged in autumn 2017.
	Recruitment of eucalypt species	An increase in eucalypts in an impact site compared to reference sites of more than three individual plants within a one year period.	Two sites (impact sites SSE01 and reference sites LGG01) showed an increase in eucalypt recruitment beyond the trigger level.
Change in condition	Condition of key species	A decline in condition score at an impact site of more than 1.5 compared to the average condition score at reference sites within a one year period.	Four impact sites showed a decrease in condition beyond the trigger level for Gleichenia dicarpa (WC01, WC03 and WC04) and/or Baumea rubiginosa (WC02 and WC04). Reference site UGE01 showed a decrease in condition for Baumea rubiginosia.
	Non-live ground cover	An increase of bare ground of more than 100m^2 in a site within a three year period.	No sites trigged in autumn 2017.
	Non-native weeds	An increase in non-native weed species of more than 4 in a monitoring site (each having a cover of greater than 5%) compared to the average number in reference sites within a one year period.	No impact sites showed an increase in weed species beyond the trigger level.

Continued triggers occurred in SSE01 and LGG01 for an increase in Eucalypt seedling detection within a one year period. These triggers represent a steady state for these sites with no large increases detected. A previous investigation has been conducted in Sunnyside Swamp East as a result of a previous trigger and concluded the increase in eucalypt detection was likely due to the persistent dry and hot conditions that were prevailing at the time, combined with the geomorphology and the prevalence of overhanging eucalypt trees (RPS, 2016).

Continued trigger exceedances were detected at WC01, WC03 and WC04 for *Gleichenia dicarpa* and WC02 and WC04 for *Baumea rubiginosa*. The decrease in condition for species within the above sites may reflect a recent drop in groundwater levels that sustain the swamp system. These triggers reflect some recovery in the West Carne quadrats as all four previously triggered for both of the above

mentioned species. The changes observed correlate with the drop in ground water levels soon after longwall mining commenced in the area. Future monitoring events will reveal whether the recovery will continue or it is a response to other abiotic factors, e.g. stochastic large rain events.

No new notifications are required as a result of the Autumn 2017 flora monitoring.

6.7. Photo-monitoring

6.7.1. Surface Features

Photographic inspections are conducted pre and post mining. The surveys target surface features which may include rock formations, drainage lines, roads, Forests NSW tracks, waterholes, steep slopes and rock beds within the watercourses.

Table 24 summarises the photographic survey monitoring undertaken as relevant to Longwall 418 extraction.

Table 24. Longwall 418 Photographic Monitoring Summary

Area Photographed	Date Photographed	Resurvey Number
LW418 Areas 1,2, (Pre-mining)	2/2/2014 and 4/4/2014	Baseline Survey
LW418 Areas 1,2, (Pre-mining)	20/8/2014 and 29/8/2014	Resurvey 2*
LW 418 Areas 1, 2 (Pre-mining)	25/2/2015 and 26/2/2015	Resurvey 3
LW418 Areas 1, 2,	6/8/2015	Resurvey 4
LW418 Undermining	23/10/2015	Resurvey 5
LW418 Undermining 1	11/11/2015	Resurvey 6
LW418 Area 1 Undermining	21/12/2015	Resurvey 7
LW418 Undermining	27/01/2016	Resurvey 8
LW418 Undermined	10/02/2016	Resurvey 9
LW418 Undermined	8/3/2016	Resurvey 10
LW418 Undermined	6//04/2016	Resurvey 11
LW418 Areas 1, 2	6//04/2016	Resurvey 12
LW418 Undermined	10+11/05/2016	Resurvey 13

Area Photographed	Date Photographed	Resurvey Number
LW418 Undermined	3/06/2016	Resurvey 14
LW418 End of Panel	15/7/2016	End of Panel

* Second survey

Photos from the last survey of the features are presented in Table 25.

Table 25. Comparison of Key Surface Features above Longwall 418

Sunnyside East Swamp	
Baseline survey	End of Panel
	
LW418-2_Photo 033_2014_Feb04_IMG 033	LW418-2_Photo 033_2016_Jul15_IMGP0005
Carne West Swamp	
Baseline survey	End of Panel
	
LW418-1_Photo 046_2014_Feb02_IMG 0050	LW418-1_Photo 046_2016_Jul15_IMGP0052

Tracks	
Baseline survey	End of Panel
	
LW418-1_Photo 004_2014_Feb02_IMG 0004	LW418-1_Photo 004_2016_Jul15_IMGP0063
Rock Feature	
Baseline	End of Panel
	
LW418-1_Photo 037_2014_Feb02_IMG 0041	LW418-1_Photo 037_2016_Jul15_IMGP0099

Subsidence Lines	
Baseline	End of Panel
	
LW418-2_Photo 043_2014_Feb04_IMG 043	LW418-2_Photo 043_2016_Jul15_IMGP0014

Photos are considered consistent with previous photographic records.

6.7.2. Newnes Plateau Shrub Swamps

Photographic monitoring sites have been established for each swamp overlying the SMP area.

Relevant to the extraction of Longwall 417 and 418 is Sunnyside East Swamp.

Table 26 summarises the photographic survey monitoring undertaken in reference to Sunnyside East Swamp.

Table 26. Sunnyside East Swamp photographic Monitoring Summary

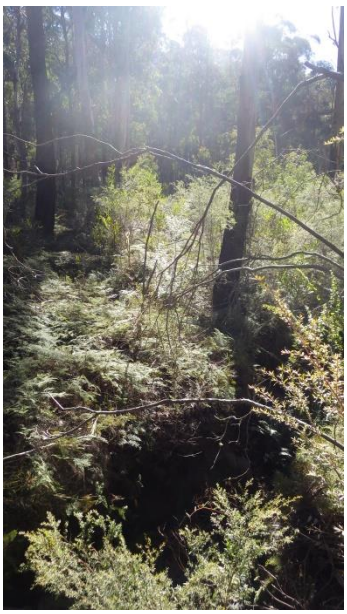
Date Photographed	Resurvey Number
14/4/2009	Baseline
28-30/10/2009	Resurvey 1
21/5/2010	Resurvey 2
17/11/2010	Resurvey 3
24/5/2011	Resurvey 4
24/1/2012	Resurvey 5
25/7/2012	Resurvey 6
25/1/2013	Resurvey 7
3/4/2013	Resurvey 8
20/6/2013	Resurvey 9
19/9/2013	Resurvey 10
3/12/2013	Resurvey 11
15/1/2014	Resurvey 12
14/3/2014	Resurvey 13
22/4/2014	Resurvey 14
22/7/2014	Resurvey 15
27/10/2014	Resurvey 16
19/1/2015	Resurvey 17
16/4/2015	Resurvey 18
6/7/2015	Resurvey 19
2/10/2015	Resurvey 20
28/01/2016	Resurvey 21
4/4/2016	Resurvey 22

Date Photographed	Resurvey Number
19/07/2016	Resurvey 23
26/10/2016	Resurvey 24
23/01/2017	Resurvey 25
26/04/2017	Resurvey 26
11/07/2017	Resurvey 27

The following images compare baseline to the last survey undertaken. The monitoring tool is used as a visual tool and data collected is used in combination with other monitoring methodology e.g. flora, groundwater, climatic data to assist in interpretation.

Photos from the last survey of the features are presented in Table 27.

Table 27. Comparison of Sunnyside East Swamp Photographic Monitoring

Baseline	Resurvey 27
 Photo_003_2009_0414Image0049	 SSES_Photo 003_2017_Jul 11_IMGP0067
 Photo_006_2009_0414Image0052	 SSES_Photo 006_2017_Jul 11_IMGP0072

Baseline	Resurvey 27
 Photo_022_2009_0414ImageSSE_Stitch2	 SSES_Photo 022_2017_Jul 11_IMGP0081-82
 Photo_067_2009_0414Image2407	 SSES_Photo 067_2017_Jul 11_IMGP0124
 Photo_073_2009_0414Image0104	 SSES_Photo 073_2017_Jul 11_IMGP0130

Photos are considered consistent with previous photographic records.

Table 28 summarises the photographic survey monitoring undertaken in reference to Carne West Swamp.

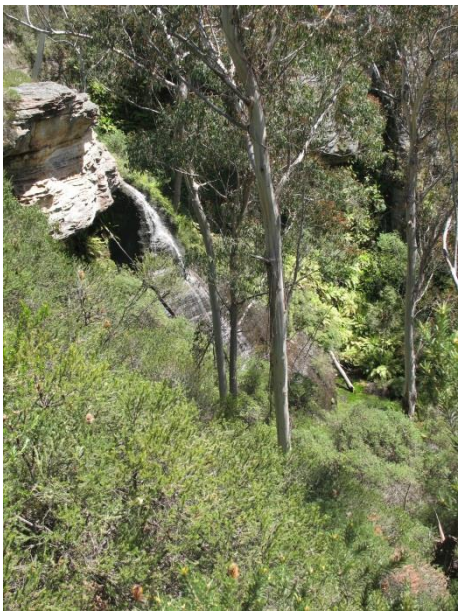
Table 28. Carne West Swamp photographic Monitoring Summary

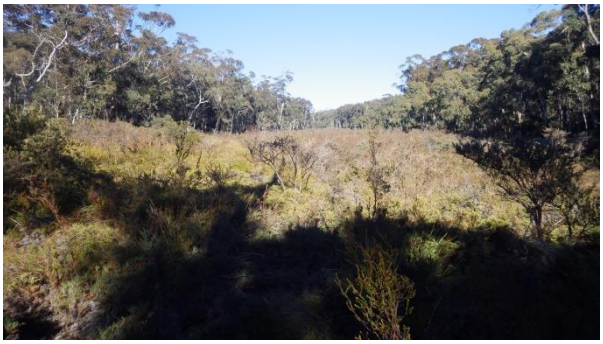
Date Photographed	Resurvey Number
24/11/2008	Baseline
22/12/2009	Resurvey 1
25/6/2010	Resurvey 2
25/3/2011	Resurvey 3
3/6/2011	Resurvey 4
25/10/2011	Resurvey 5
3/4/2012	Resurvey 6
30/10/2012	Resurvey 7
30/4/2013	Resurvey 8
11/12/2013	Resurvey 9
23/4/2014	Resurvey 10
23/7/2014	Resurvey 11
10/10/2014	Resurvey 12
16/1/2015	Resurvey 13
10/4/2015	Resurvey 14
8/7/2015	Resurvey 15
6/10/2015	Resurvey 16
17/01/2016	Resurvey 17
5//04/2016	Resurvey 18
28/7/2016	Resurvey 19
13/10/2016	Resurvey 20
6/1/2017	Resurvey 21
26/04/2017	Resurvey 22
11/07/2017	Resurvey 23

The following images compare baseline to the last survey undertaken. The monitoring tool is used as a visual tool and data collected is used in combination with other monitoring methodology e.g. flora, groundwater, climatic data to assist in interpretation.

Photos from the last survey of the features are presented in Table 29.

Table 29. Comparison of Carne Swamp Photographic Monitoring

Baseline	Resurvey 23
 CWS_Photo_002_2008_1124Image0004	 CWS_Photo 002_2017_July 11_IMGP0001
 CWS_Photo_006_2008_1124Image0006	 CWS_Photo 006_2017_July 11_IMGP0004

Baseline	Resurvey 23
 CWS_Photo_013_2008_1124Image0013	 CWS_Photo 013_2017_July 11_IMGP0013
 CWS_Photo_020_2008_1124Image0020	 CWS_Photo 020_2017_July 11_IMGP0020
 CWS_Photo_048_2008_1124Image0065	 CWS_Photo 048_2017_July 11_IMGP0048

Photos are considered consistent with previous photographic records.

7. ADEQUECY, QUALITY AND EFFECTIVENESS

The adequacy, quality, effectiveness of the implemented management processes based on monitoring and consultation is considered to be satisfactory to date.

There were no non-compliances with the conditions of the SMP approval during the reporting period.

8. PROPOSED MANAGEMENT ACTIONS

There are no outstanding management actions requiring an update.

9. THPSS MMP PERFORMANCE TRIGGERS

No THPSS MMP performance measures were triggered during the reporting period.

10. CONCLUSIONS

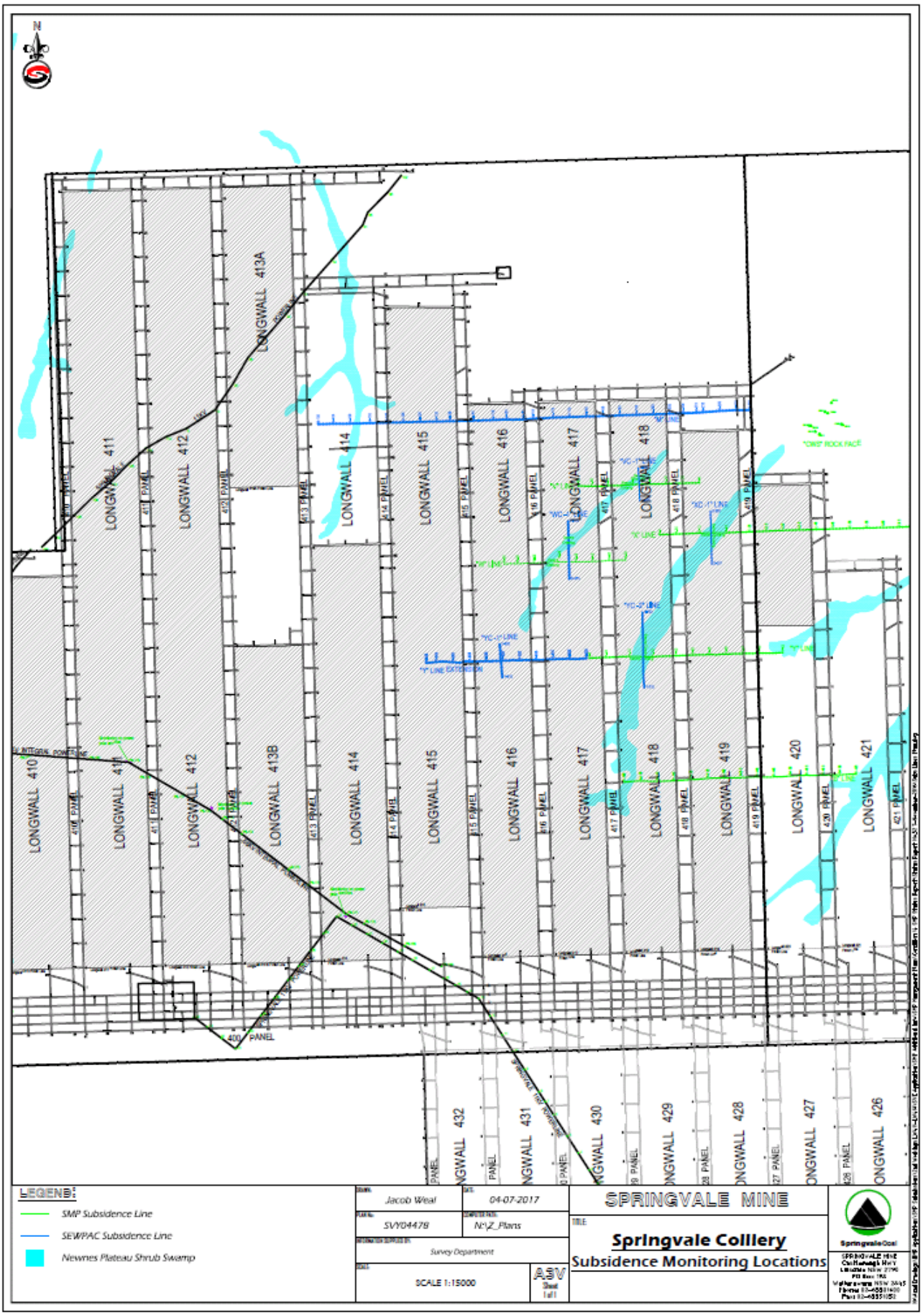
Extraction of Longwall 418 commenced on the 22nd of October 2015 and was completed on the 27th of May 2016 with a total retreat of 2487m. Extraction of LW419 commenced on the 2nd of August 2016 and was completed on 18th of March 2017 with a total chainage of 2340m. Extraction of LW420 commenced on the 29th of April 2017 and chainage at 30th of September 2017 was 242m.

There were no observed subsidence impacts, incidents or service difficulties during the retreat of Longwall 418. Subsidence results have been within predications.

Threatened species continue to be recorded within the SMP Area. Fauna monitoring results show that the assemblages found are typical of that found throughout Newnes Plateau and are similar to that obtained in the remainder of Springvale Colliery.

No THPSS MMP performance measures were triggered during the reporting period.

Appendix 1
Plans


N
LONGWALL 410
LONGWALL 411
LONGWALL 412
LONGWALL 413A
LONGWALL 413B
LONGWALL 414
LONGWALL 415
LONGWALL 416
LONGWALL 417
LONGWALL 418
LONGWALL 419
LONGWALL 420
LONGWALL 421
LONGWALL 426
LONGWALL 427
LONGWALL 428
LONGWALL 429
LONGWALL 430
LONGWALL 431
LONGWALL 432
400 PANEL
LEGEND:
SMP Subsidence Line
SEWPAC Subsidence Line
Newnes Plateau Shrub Swamp
Jacob Weal
04-07-2017
SVY04478
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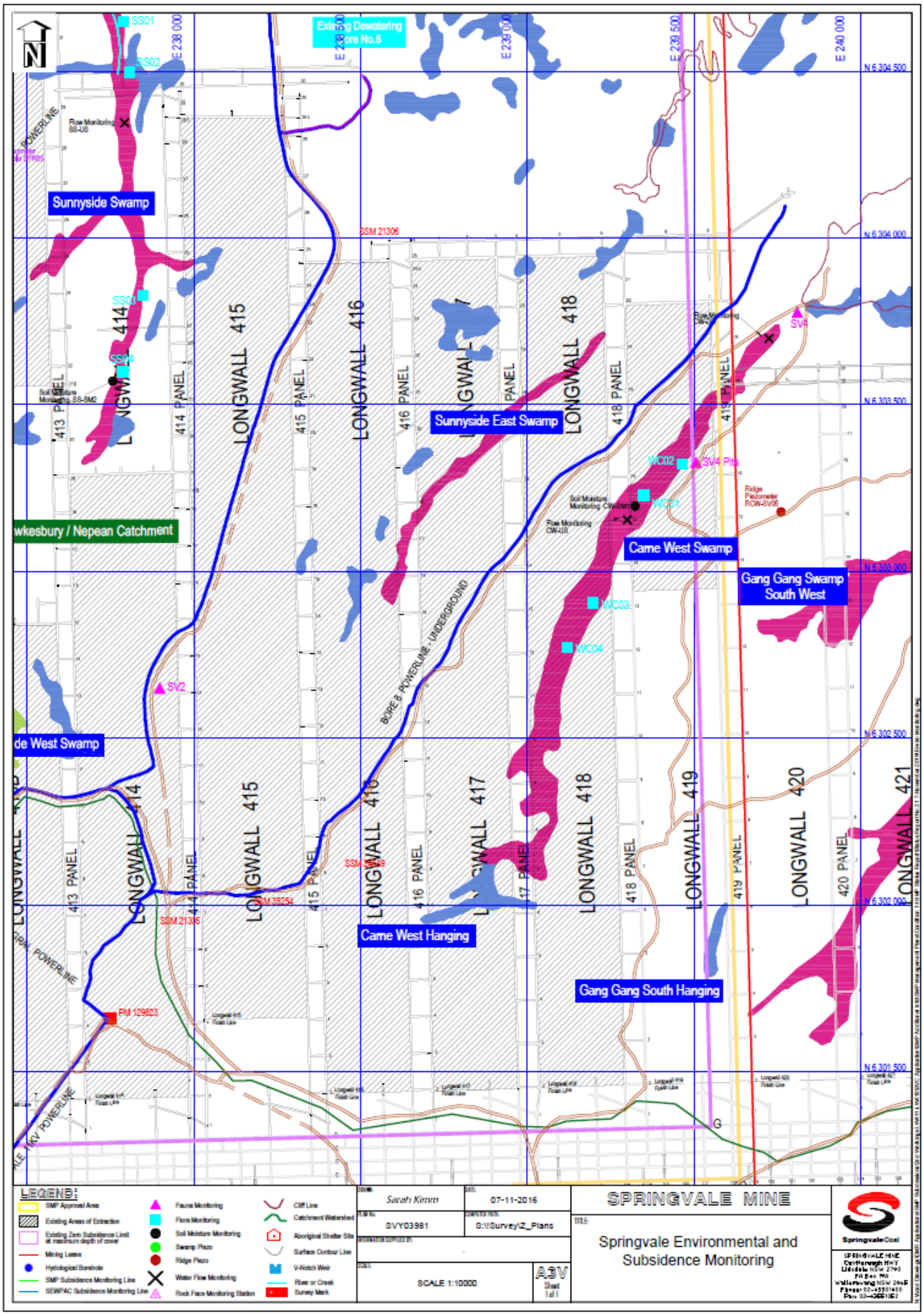
Survey Department
SCALE 1:15000
A3V
SPRINGVALE MINE
Springvale Colliery
Subsidence Monitoring Locations
SpringvaleCoal


Existing Dewatering Bore No.6
Sunnyside Swamp
Sunnyside East Swamp
Came West Swamp
Gang Gang Swamp South West
Came West Hanging
Gang Gang South Hanging
wkesbury / Nepean Catchment
de West Swamp
LONGWALL 414
LONGWALL 415
LONGWALL 416
LONGWALL 417
LONGWALL 418
LONGWALL 419
LONGWALL 420
LONGWALL 421
413 PANEL
414 PANEL
415 PANEL
416 PANEL
418 PANEL
419 PANEL
420 PANEL
SS01
SS02
SS03
SS04
SV2
SV4
SV4 Pipe
WC01
WC02
WC03
WC04
SSM 21306
SSM 35154
SSM 21305
PM 129823
BORE 6 POWERLINE - UNDERGROUND
POWERLINE
E 238 000
E 238 500
E 239 000
E 239 500
E 240 000
N 6 304 500
N 6 304 000
N 6 303 500
N 6 303 000
N 6 302 500
N 6 302 000
N 6 301 500
LEGEND:
SMP Approval Area
Existing Areas of Extraction
Existing Zero Subsidence Limit at maximum depth of cover
Mining Lease
Hydrological Borehole
SMP Subsidence Monitoring Line
SEWPAC Subsidence Monitoring Line
Fauna Monitoring
Flora Monitoring
Soil Moisture Monitoring
Swamp Piezo
Ridge Piezo
Water Flow Monitoring
Rock Face Monitoring Station
Cliff Line
Catchment Watershed
Aboriginal Shelter Site
Surface Contour Line
V-Notch Weir
River or Creek
Survey Mark
Sarah Kirwin
07-11-2016
SVY03981
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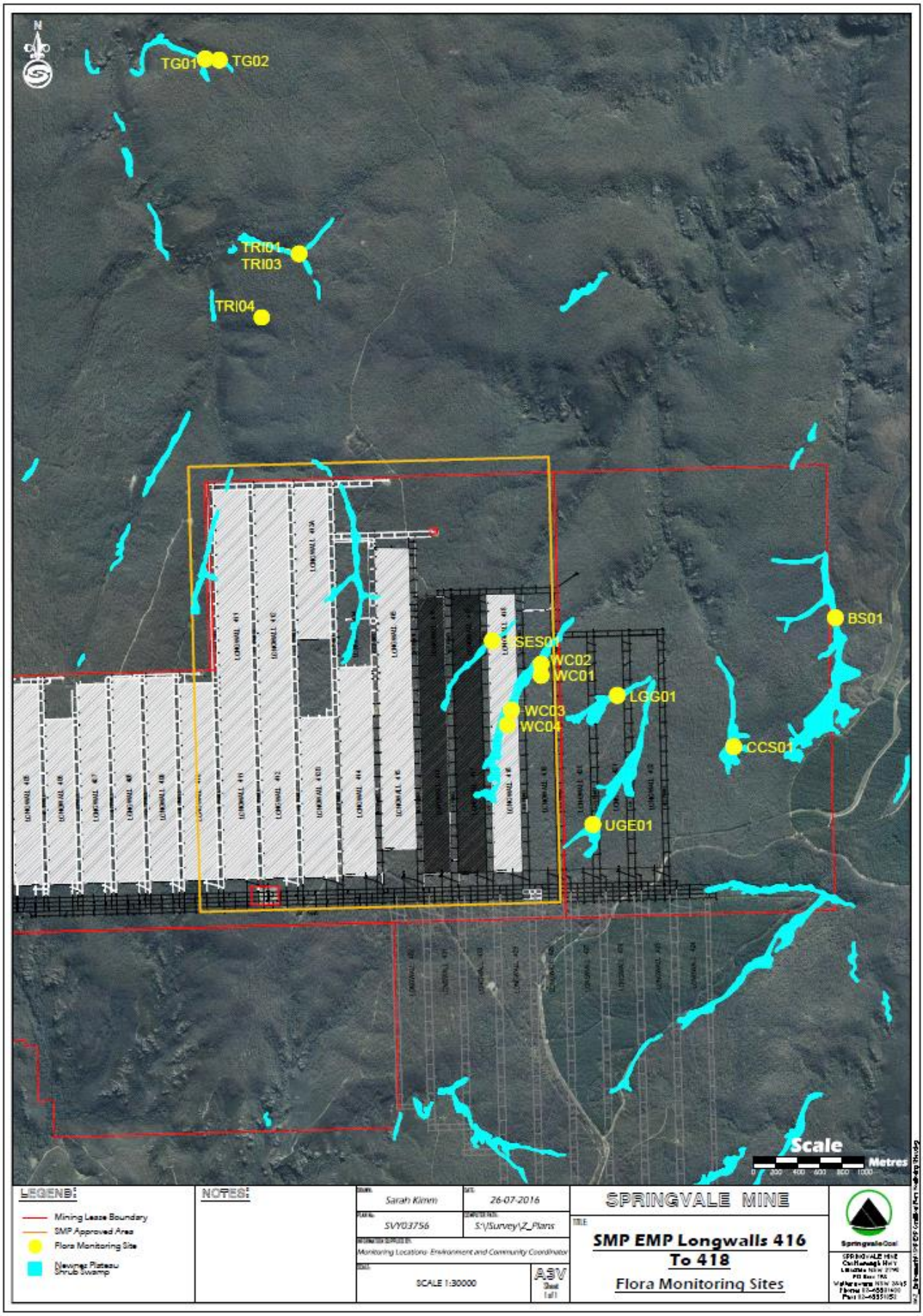
Sheet 1 of 1
SPRINGVALE MINE
Springvale Environmental and Subsidence Monitoring
Springvale Coal


TG01
TG02
TRI01
TRI03
TRI04
SES01
WC02
WC01
WC03
WC04
LGG01
UGE01
BS01
CCS01
Scale
Metres
LEGEND:
Mining Lease Boundary
SMP Approved Area
Flora Monitoring Site
Newnes Plateau Shrub Swamp
NOTES:
Sarah Kimm
26-07-2016
SVY03756
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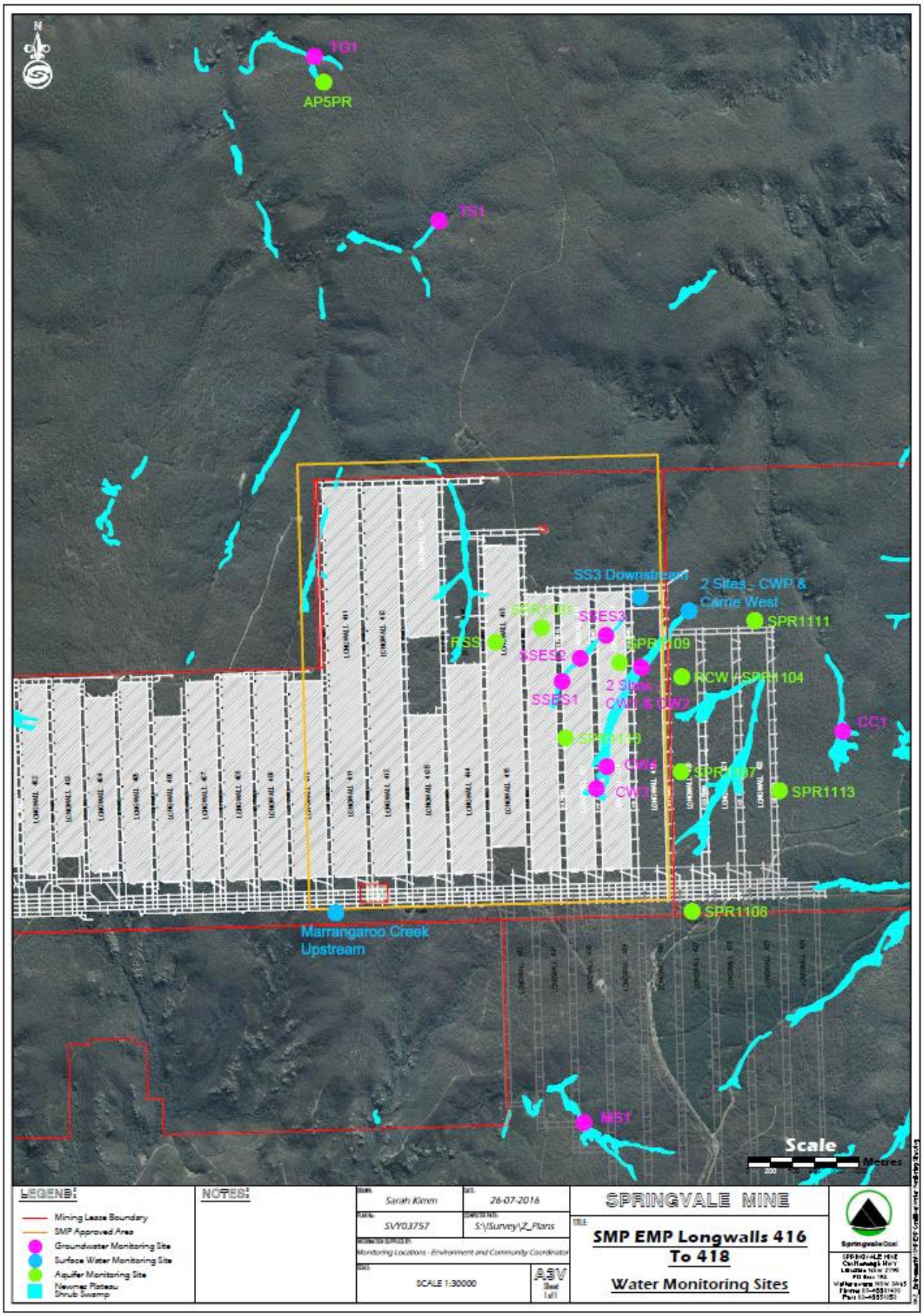
SPRINGVALE MINE
SMP EMP Longwalls 416 To 418
Flora Monitoring Sites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AP5PR
TS1
SS3 Downstream
2 Sites - CWP & Carrie West
SPR1111
SSES3
SPR1109
SSES2
RCW / SPR1104
SSES1
2 Sites - CW1 & SW2
CC1
CW4
SPR1107
SPR1113
CW3
SPR1108
Marrangaroo Creek Upstream
MS1
Scale
Metres
LEGEND:
Mining Lease Boundary
SMP Approved Area
Groundwater Monitoring Site
Surface Water Monitoring Site
Aquifer Monitoring Site
Newnes Plateau Shrub Swamp
NOTES:
Sarah Kimm
26-07-2016
SVY03757
S:\Survey\Z_Plans
Monitoring Locations - Environment and Community Coordinator
SCALE 1:30000
A3V
SPRINGVALE MINE
SMP EMP Longwalls 416 To 418
Water Monitoring Sites
Springvale Coal

Centennial Coal

Springvale Colliery

Castlereagh Highway

Lidsdale NSW 2790