Centennial Coal

Longwall 411 to 418

Subsidence Management Status Report

Springvale Colliery

July 2017

Approved 06/07/2017

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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**.

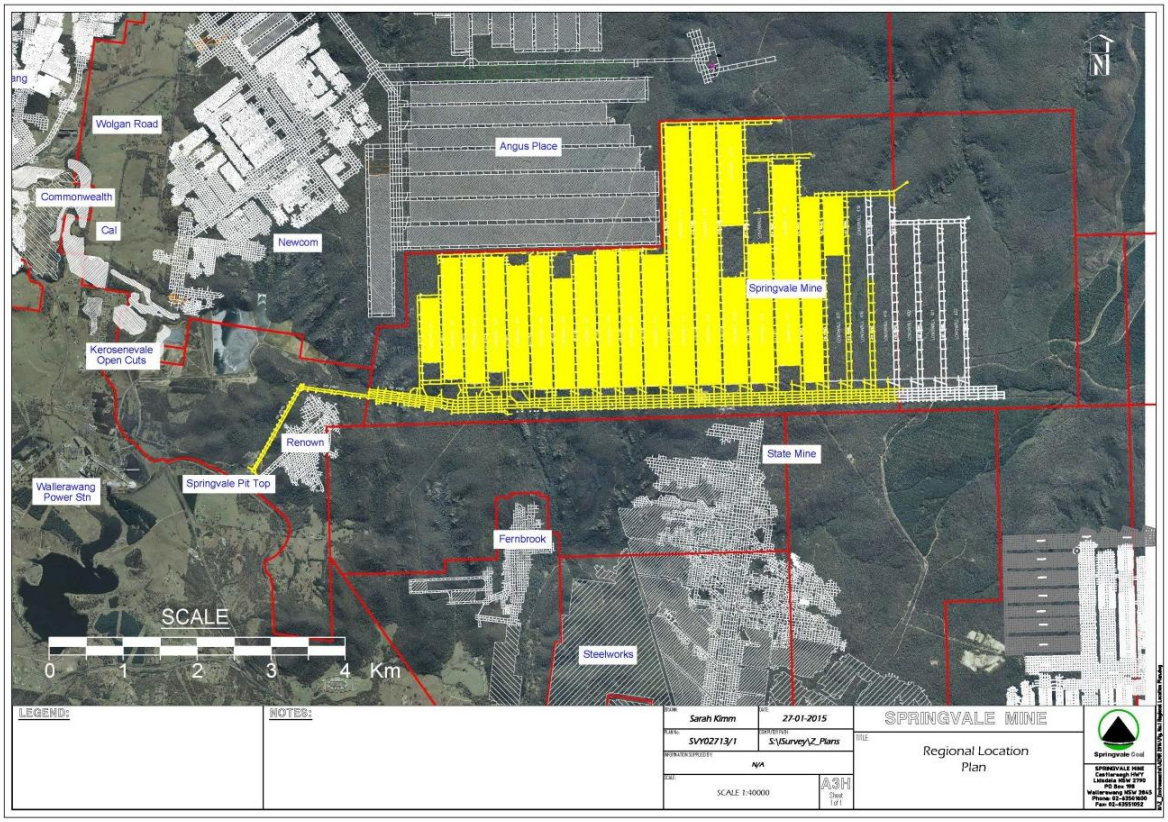


Figure 1 Regional Locality

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 February 2017 and the 31st of May 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 June 2017 was 636.5m.

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

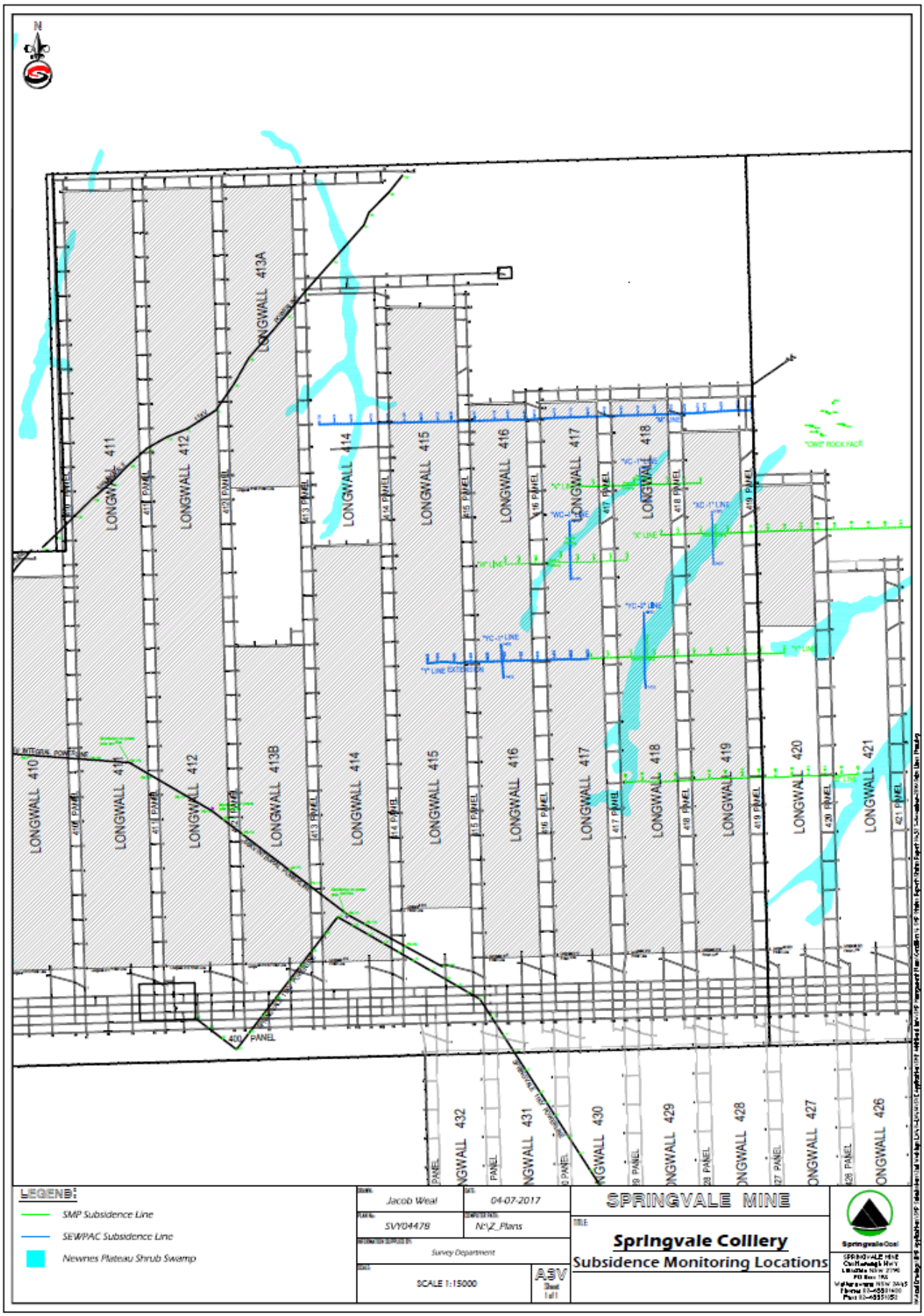


Figure 2 Face Position and Subsidence Monitoring Locations

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
03/07/2017	Flora Trigger Exceedance – Initial Notification	In accordance with the LW 415 – 417 and LW418 THPSS MMPs as well as Springvale EPBC Act Approvals, a trigger notification was provided to the Department of Environment on the 3rd of July 2017. Further details are provided in Section 9 of this report.
29/05/2017	MOP 2015 – 2022 Amendment B Submission	The purpose of the amendment was to provide updated information on activities to occur within the MOP term. The changes primarily related to Modification 1 to Springvale Consent SSD 5594 (approved 19th April 2017), approving an extension of the Springvale stockpile footprint. The MOP was approved by DRE on the 4th of July 2017.
31/03/2017	2016 Annual Review	Springvale submitted the 2016 Annual Review (a requirement of SSD5594) to the Department of Planning and Environment, as well as relevant stakeholders, on the 30th of March 2017.
31/03/2017	Environmental and Rehabilitation Monitoring Program (ERMP) Submission	The ERMP was required by Condition 1 of the Springvale Mining Operations Plan, dated the 11th of May 2016. The Condition is reproduced below: 1. *A document compiling all environmental and rehabilitation monitoring undertaken at Springvale Colliery must be developed within 6 months of the previous MOP approval dated 25 February 2016. The report may reference other management or monitoring plans with more detailed information or may copy information from these plans but needs to provide sufficient information to give a detailed overview of all monitoring undertaken. The report must include:* • *A Plan or Plans showing the location of all monitoring sites.* • *The type of monitoring undertaken including parameters.* • *The frequency of monitoring.* • *Where applicable, a reference to other document(s) in which the monitoring is detailed.* DRE provide feedback on the 21st of November 2017 requesting further information be included in the ERMP and re-submission of the amended document with the Annual Review, due the 31st of March 2017. Springvale submitted the amended ERMP on the 31st of March 2017. DRE approved the amended ERMP on the 25th of May 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.

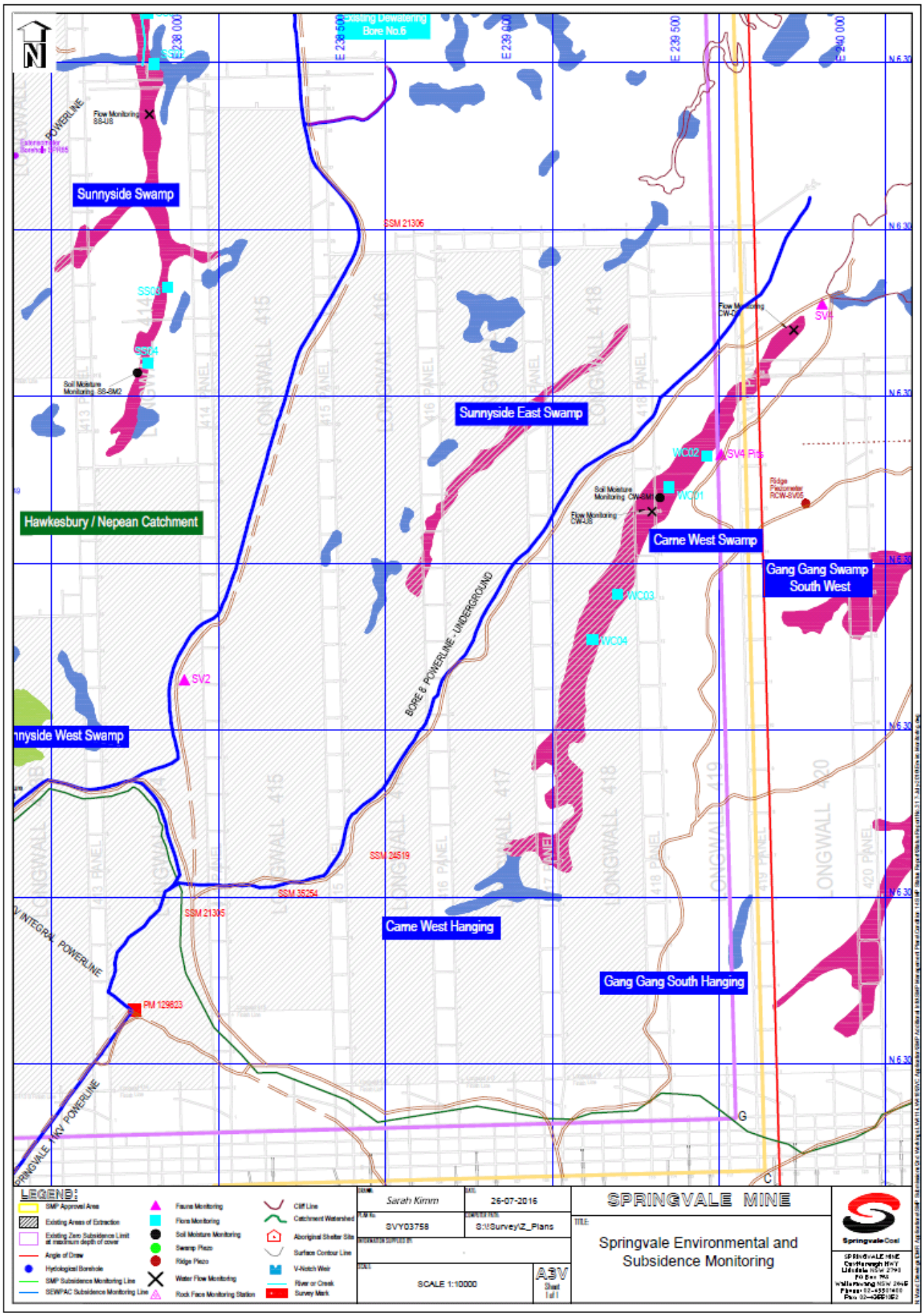


Figure 3 Environmental Monitoring Locations

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

Month	Observed Newnes Plateau (mm)	Long Term Average Newnes Plateau (mm)	Observed Lithgow (mm) (Maddox Lane)	Long Term Average Lithgow (mm) (Maddox lane)
February 2017	42.6	110.2	12.2	77
March 2017	212	74.8	141.4	65.1
April 2017	30	52.1	21.2	43.5
May 2017	39.8	45.1	32.6	49
Total	324.4	282.2	207.4	234.6

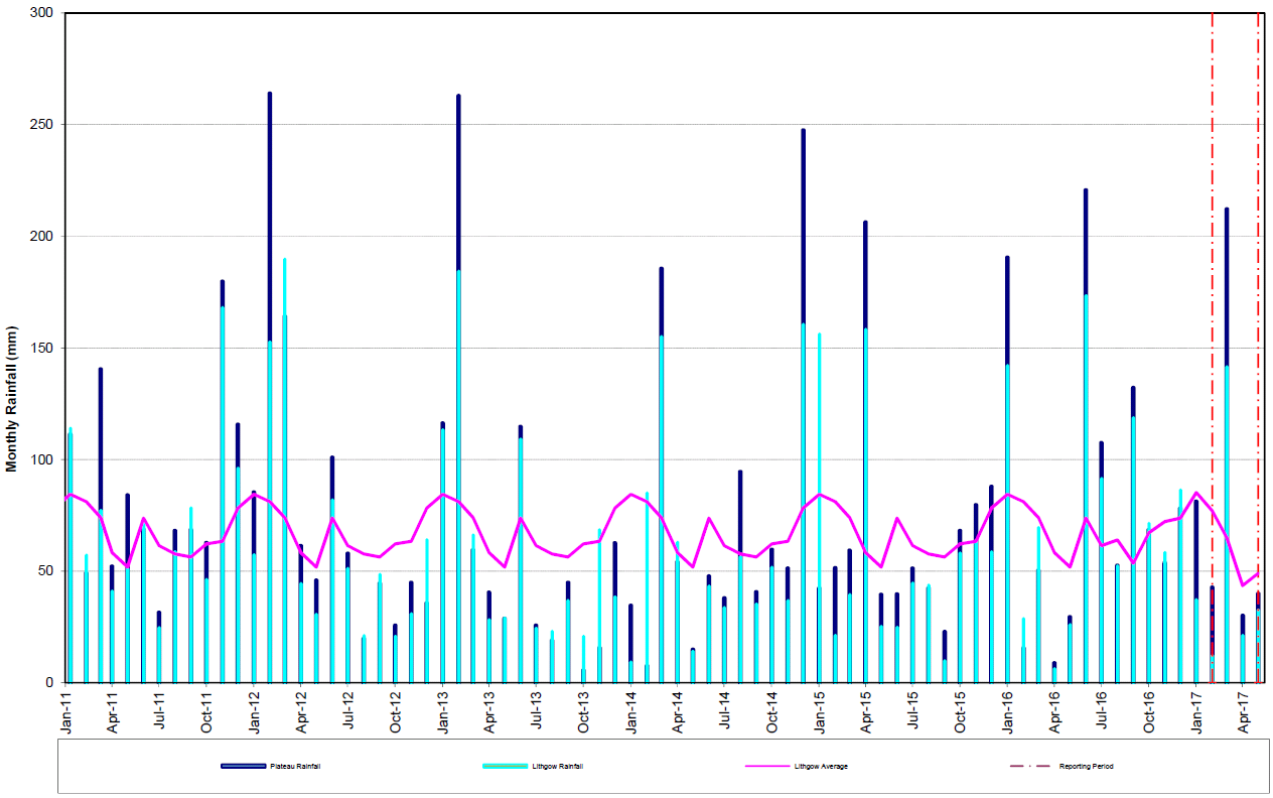


Figure 4 Monthly Rainfall

It is noted that the Newnes Plateau rain gauge spans a period of almost 20 years, from August 1998 to present, whereas the Maddox Lane gauge covers a period of 56 years. The longer term average rainfall from Maddox lane is therefore included for comparison, although it is noted that there are often large discrepancies between the two sites.

From the rainfall data collected at Newnes Plateau during the monitoring period (1st February 2017 to 31st May 2017), the following general observations can be made:

- Total rainfall for the period at Newnes Plateau was 324.4 mm, which equates to 15% increase in the long term average for the same period, while rainfall at Maddox Lane was 207.4 mm, which equates to 12% below the long term average.
- Over the reporting period on the plateau there was one rain day in excess of 50 mm, and ten days totalling 10 mm to 32 mm.

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 February 2017 to May 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 East Wolgan have previously responded temporarily to periods of above average rainfall. Since early 2009 the responses have declined to short duration spikes in water levels with water levels below the base of piezometer in times between these spikes. During the review period both WE1 and WE2 remained below the base of the bores.

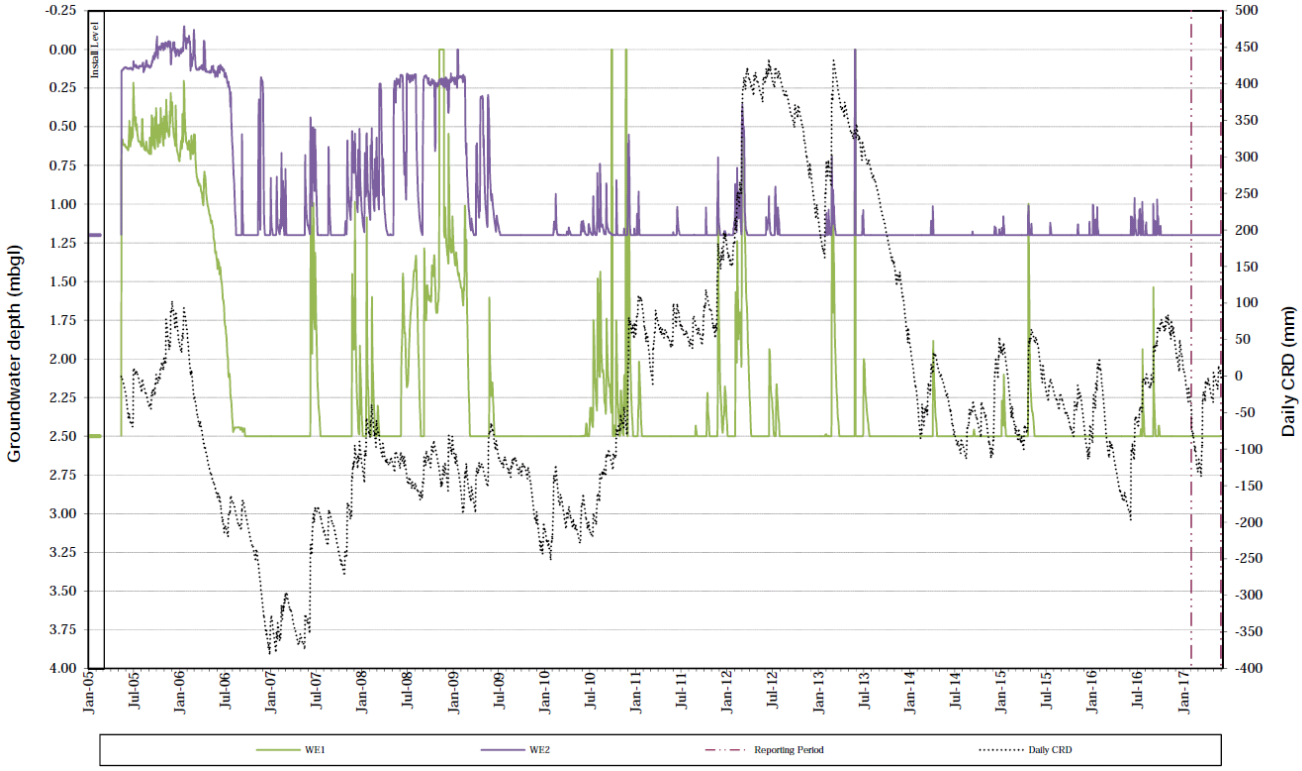


Figure 5 East Wolgan Swamp Hydrograph

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 are consistent with monitoring results over the past three years.

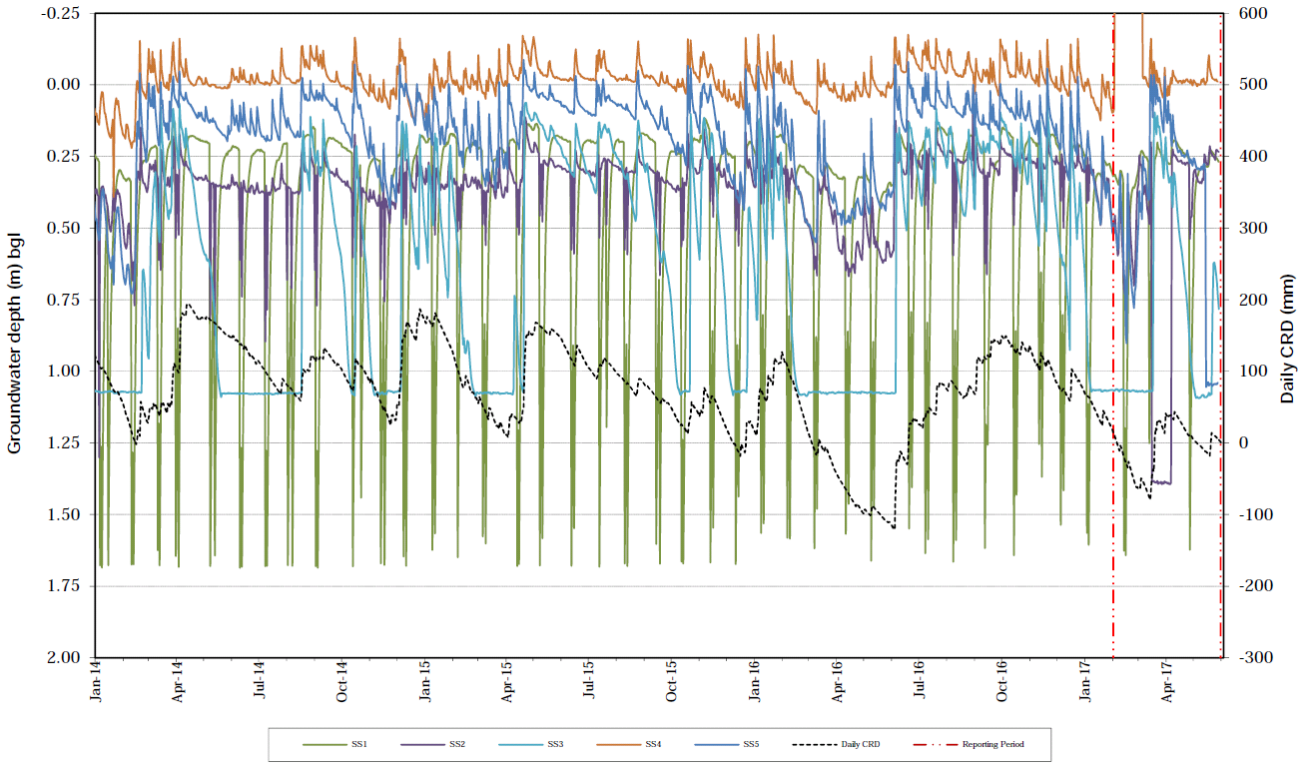


Figure 6 Sunnyside Swamp Hydrograph

Carne West Swamp

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

Water levels at CW3 and CW4 have all remained below the base of piezometer for the review period. Water levels at CW1and CW2 showed some minor responses to rainfall. These levels are consistent with those over the previous three years, except for CW2 levels, which are lower than those measured over the same period two years previous (October 2014 to January 2015).

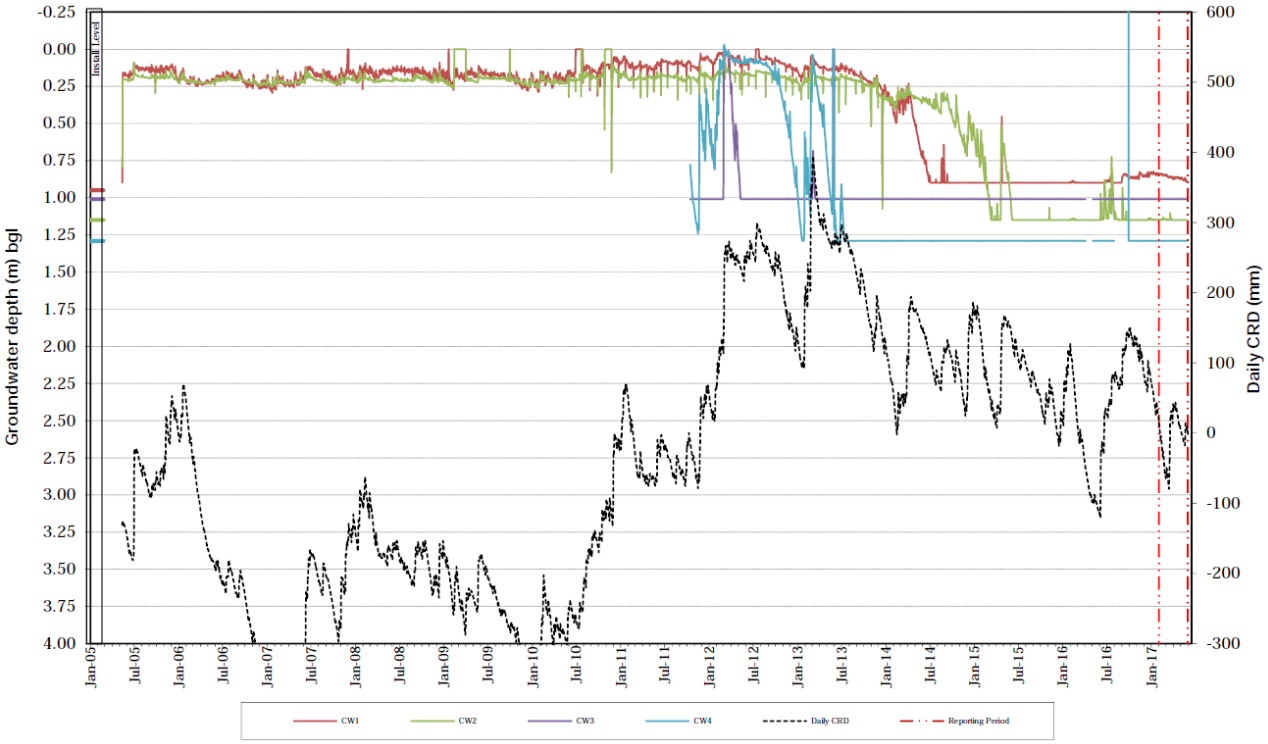


Figure 7 Carne West Hydrograph

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 at SSE1 to SSE2 have generally remained below the base of the piezometer for the past three years. Water in SSE3 was also below the base of piezometer for the review period, but has shown historical responses to rainfall events in the past three years.

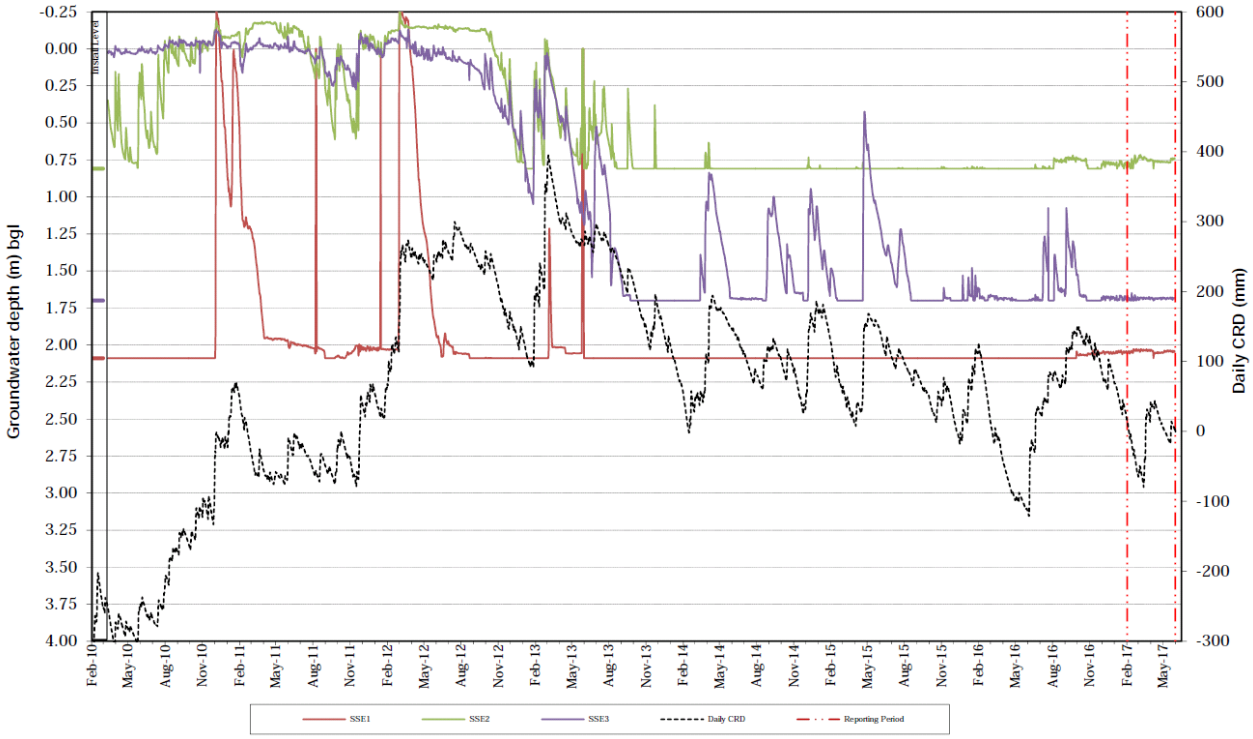


Figure 8 Sunnyside East Hydrograph

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.

A clear relationship between rainfall and groundwater levels can be seen with SW1 groundwater levels correlating with rainfall patterns and intensity. Following large rainfall events, if above average rainfall conditions are not maintained the water levels quickly decline to the base of the piezometer. This response is typical of SW1 and can be seen in previous observations.

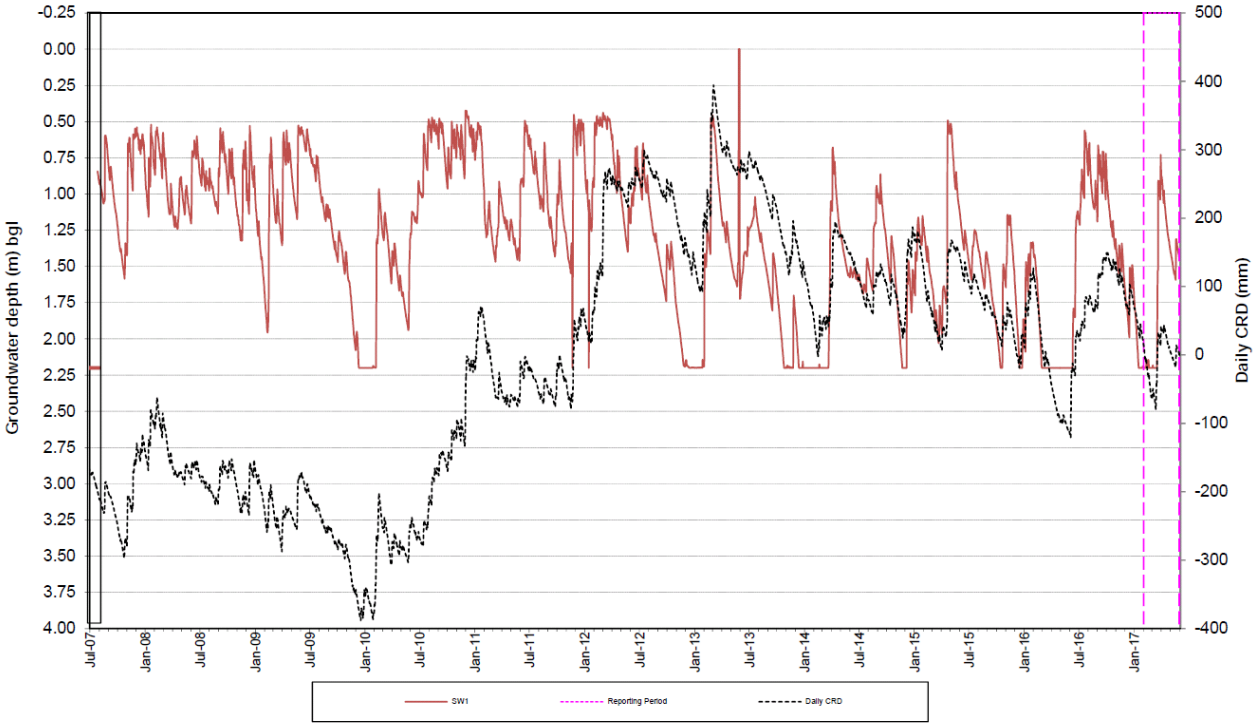


Figure 9 Sunnyside West Hydrograph

Reference Swamps

Carne Central Swamp

Water levels at CC1 (Figure 10) were above ground level for most of the monitoring period before decreasing during February 2017. Levels at CC1 are slightly lower than levels over the last three years.

Marangaroo Swamps

Water levels in MS1 (Figure 11) historically show fluctuations consistent with the CRD trend. Water levels over the reporting period are consistent with those of the last three years.

Tristar Swamp

Water levels at TS1 (Figure 12) have historically shown significant variation, with a maximum range of the order of 4 metres. Water levels in TS1 generally show a good correlation with CRD. Recent levels in the three piezometers are consistent with those of the past three years. Over the review period water levels dropped up to 1.5m and appeared to directly correlate to a decrease in CRD during the review period.

Twin Gully Swamp

Water levels at TG1 (Figure 13) have historically remained near the surface, mostly within 0.25m to 0.6m of ground level, with some minor periods of lower water levels corresponding with low CRD trends. Over the review period, water levels showed a slight increase in February with some minor fluctuations in response to rainfall.

Water levels at reference swamps are presented in Figures 10 to 13.

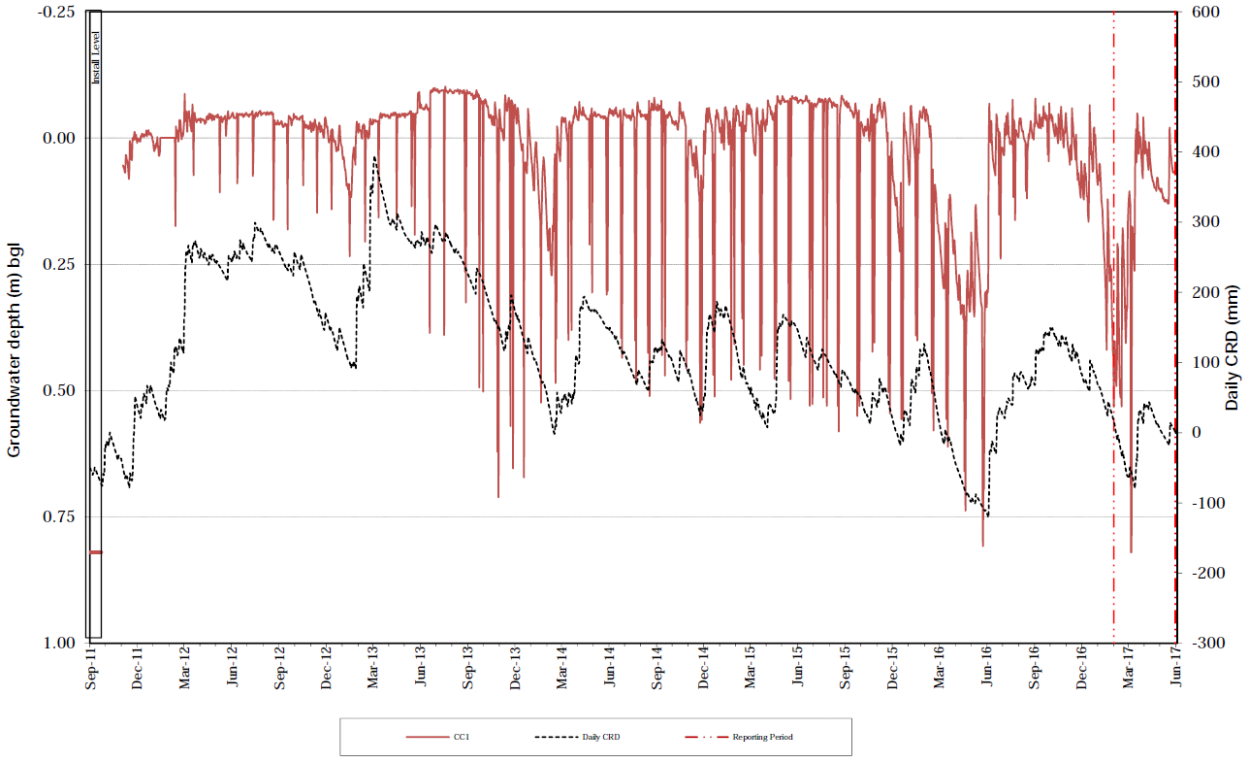


Figure 10 Carne Central Swamp Hydrograph

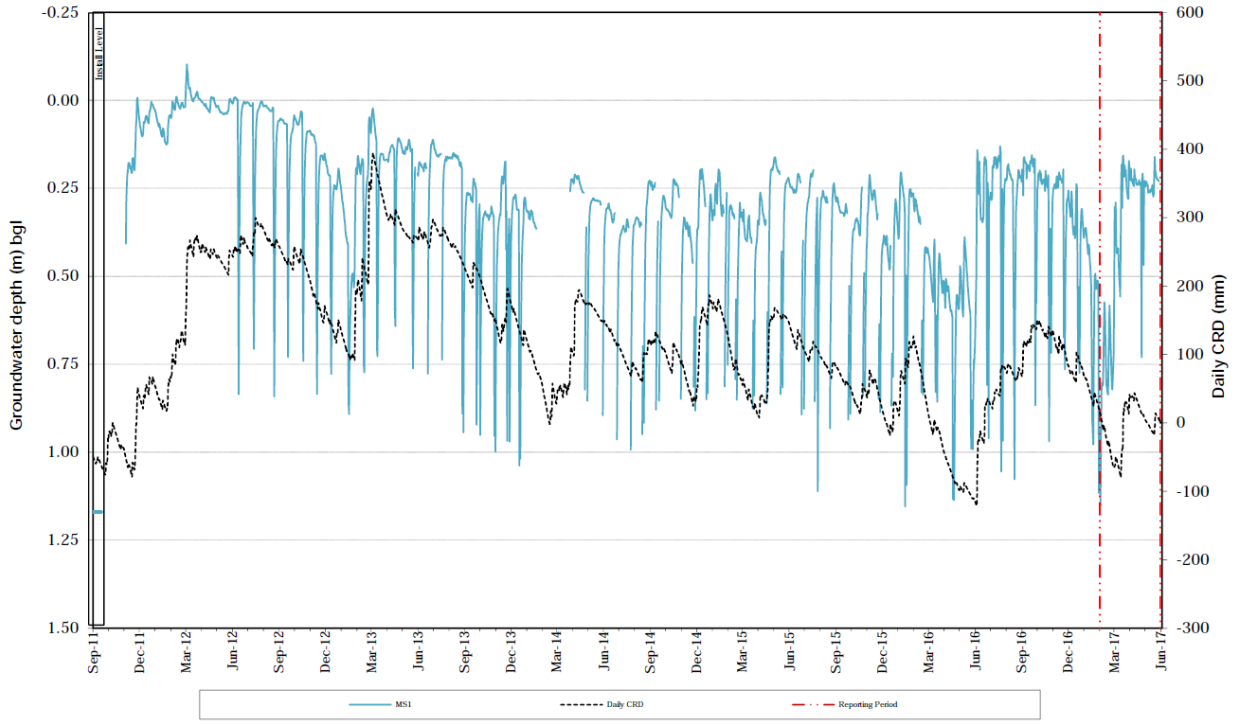


Figure 11 Marrangaroo Swamp Hydrograph

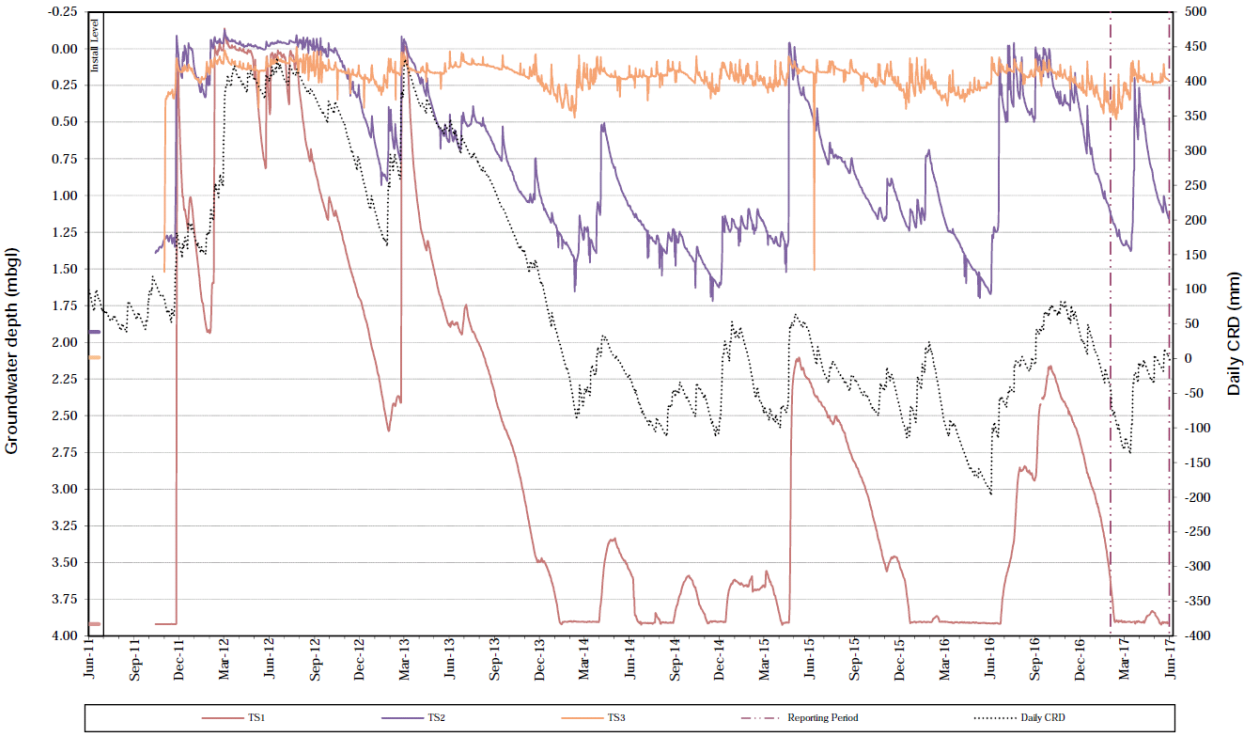


Figure 12 Tri Star Swamp Hydrograph

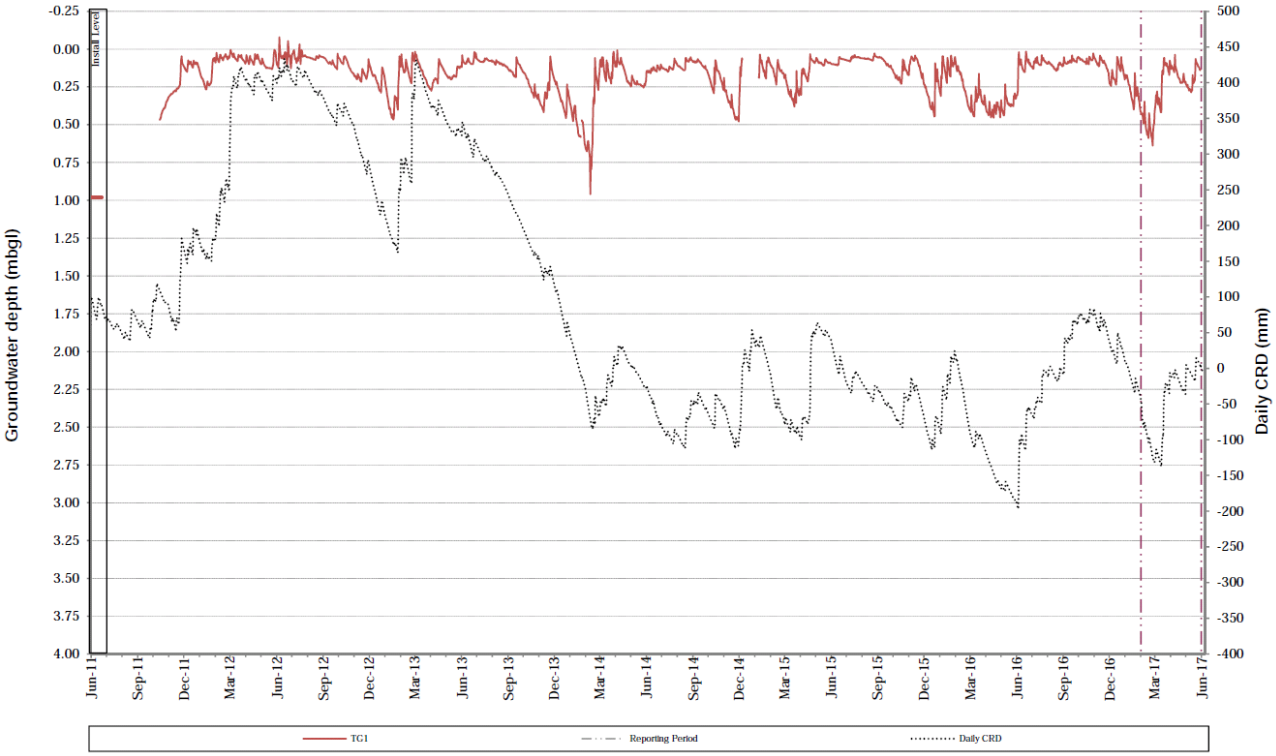


Figure 13 Twin Gully Swamp Hydrograph

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

Groundwater levels at groundwater monitoring impact sites are provided on Figure 14.

- Water levels at SPR1101 dropped below the base of the piezometer in December 2013. A replacement bore, SPR1401, was installed in November 2014. Water levels at SPR1401 initially showed a decline due to subsidence equilibration from LW417 but stabilized over the second half of 2015. A further, minor, stepped decline coinciding with LW418 is also apparent. Over the current reporting period water levels have remained stable.
- The water level at SPR1104 showed a stepped decline beginning in October 2016 and showed a continuation of a slight declining trend in the current reporting period.
- Water levels at SPR1107 show a stabilisation over the reporting period of a previous gradual decline. As with SPR1104, a slight stepped decline is apparent during the previous reporting periods, this is inferred to be associated with mining of LW418/419.
- Water levels at SPR1109 showed the continuation of a gradual decline following the depressurisation event in late 2015 when the piezometer was undermined by LW418. In early May 2017 the water level has dropped below the base of the bore and the transducer is now exposed to the atmosphere.
- Over the reporting period water levels at SPR1110 have remained below the base of the piezometer.
- The groundwater level at RSS increased slightly during the previous reporting period but has remained stable through the current reporting period.
- Over the reporting period water levels at RSE have remained below the base of the piezometer since June 2015.

Reference Groundwater Sites

Groundwater levels at groundwater monitoring reference sites are provided on Figure 15.

Water levels at sites SPR1108, SPR1113 and AP5PR generally show stable water levels over the reporting period.

Reference site SPR1111 experienced a large (3.5 m) drop between the 1st and 2nd of February, 2017. A trigger notification was issued to Springvale under the LW420-422 Swamp Monitoring Program and is currently being investigated.

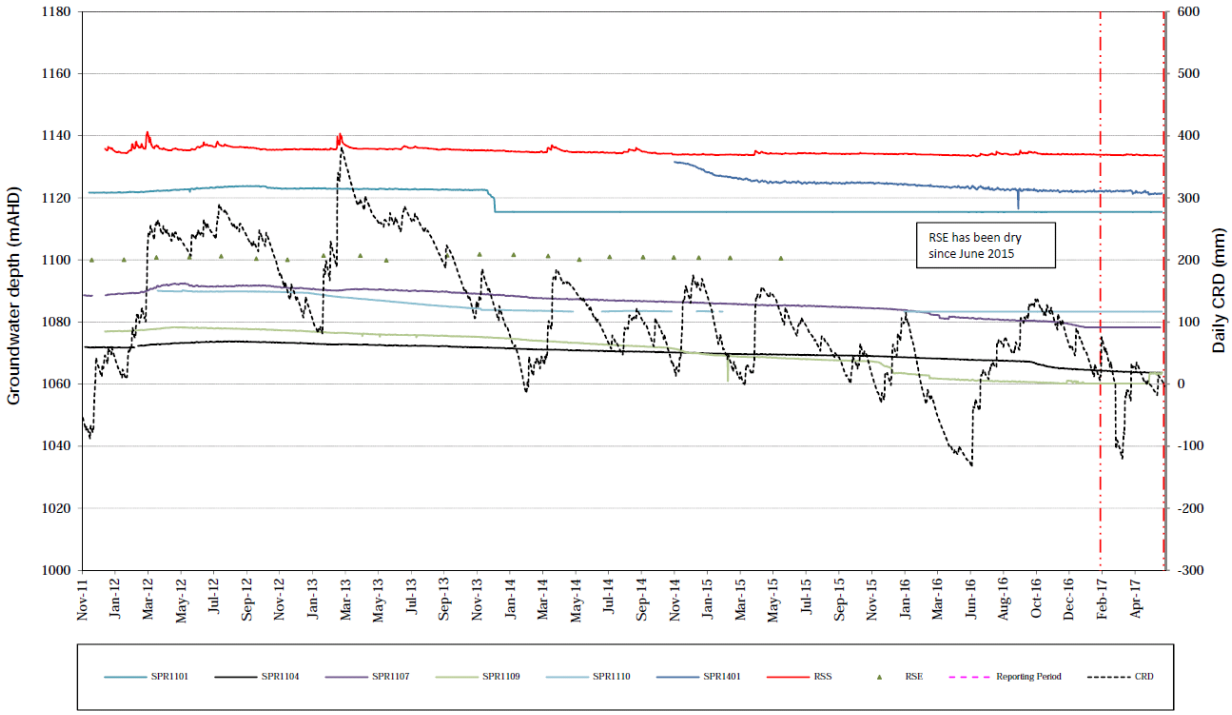


Figure 14 Impact Aquifer Piezometers

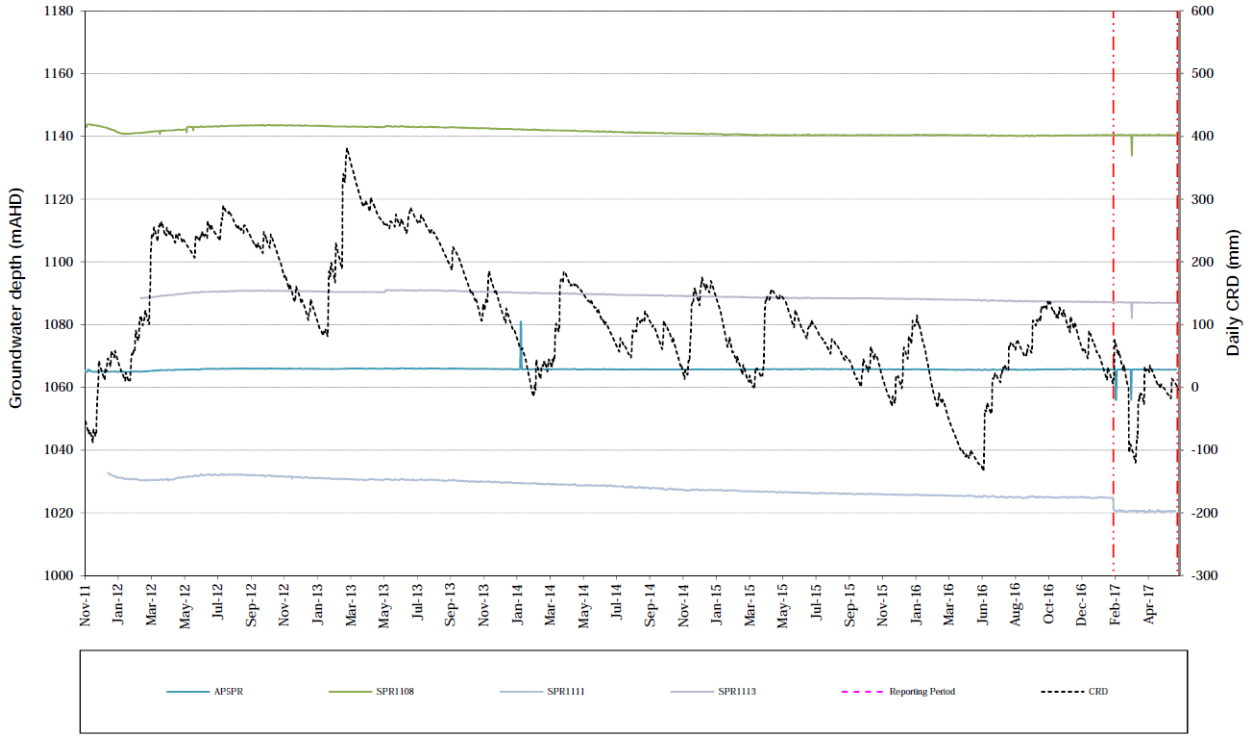


Figure 15 Reference Aquifer Piezometers

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. These sites are essentially weirs that monitor surface water flow, although some have standpipe piezometers installed to measure water levels. The swamps are monitored for parameters that act as potential indicators of mining related impacts, these being pH, electrical conductivity, and iron. The main possible impact on groundwater quality from mining is the potential for oxidation of fresh rock surfaces in subsidence induced cracks that may form in the rock under the base of a swamp.

Only measurements from reference sites CC1 and MS1 are available for the reporting period as water levels at impact sites CW1, CW2 and SSE3 were too low to collect samples. Hence, the analysis for this period is relevant to the reference sites only.

pH

pH readings from impact sites CW1, CW2, and SSE3; and reference sites MW1 and CC1 are presented in Figure 16. The pH levels for reference sites CC1 and MS1 remained within historical levels over the review period. No pH trend is identified in CC1 over the monitoring period; however pH levels in MS1 have fluctuated during the reporting period which is interpreted to be due to an increased proportion of groundwater and evaporation concentrating salts as water levels decrease during periods of lower than average rainfall over the review period.

EC

Electrical Conductivity (EC) readings from impact sites CW1, CW2, and SSE3; and reference sites MW1 and CC1 are presented in Figure 17. The EC levels for reference sites CC1 and MS1 remained within historical levels over the review period. EC levels at both sites are following a seasonal trend which is interpreted to be due to evaporation concentrating salts in the drier periods and lowering during increased rainfall.

Fe

Historical dissolved iron (Fe) readings from impact sites CW1, CW2 and SSE3 and reference sites MW1 and CC1 are presented in Figure 18. Fe levels for reference sites CC1 and MS1 remained within historical levels over the review period. Fe levels at both sites recently have had an increasing trend which is interpreted to be due to evaporation concentrating salts, but for the current review period the concentrations are slightly lower which is likely due to the increase in rainfall during the reporting period.

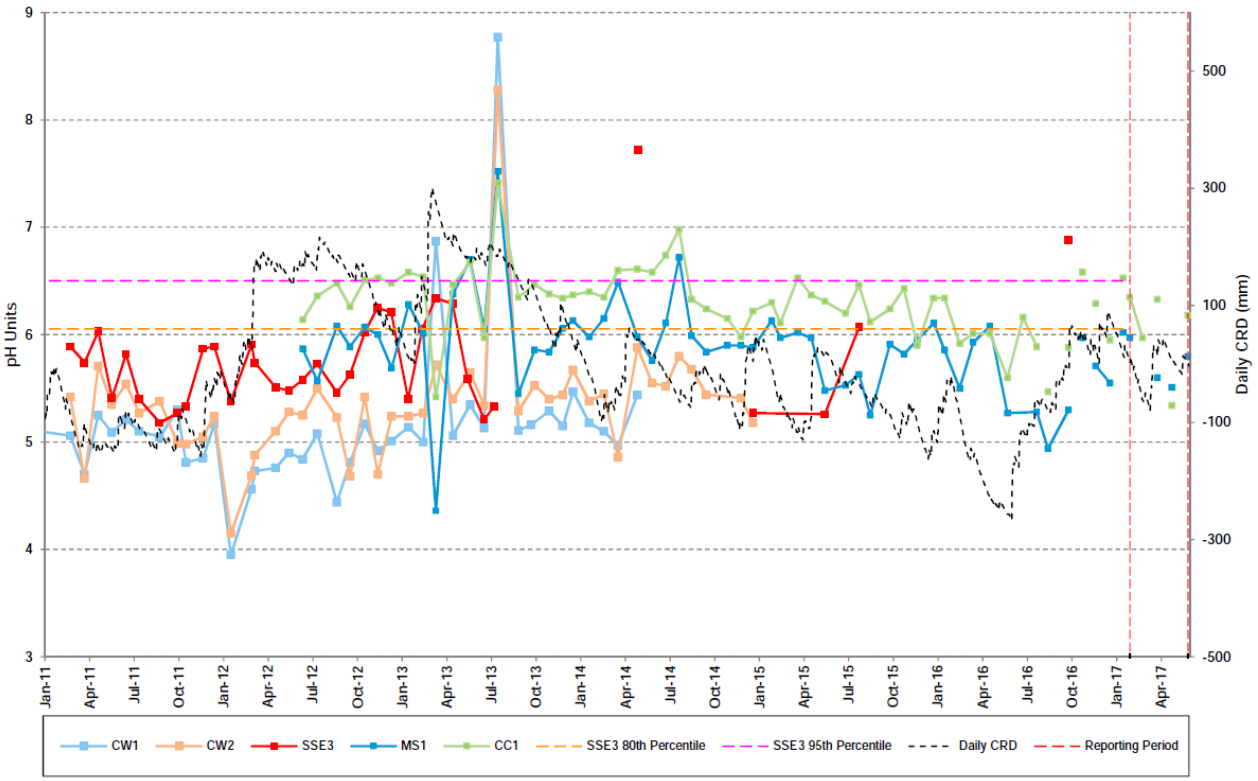


Figure 16 pH Swamp Piezometers

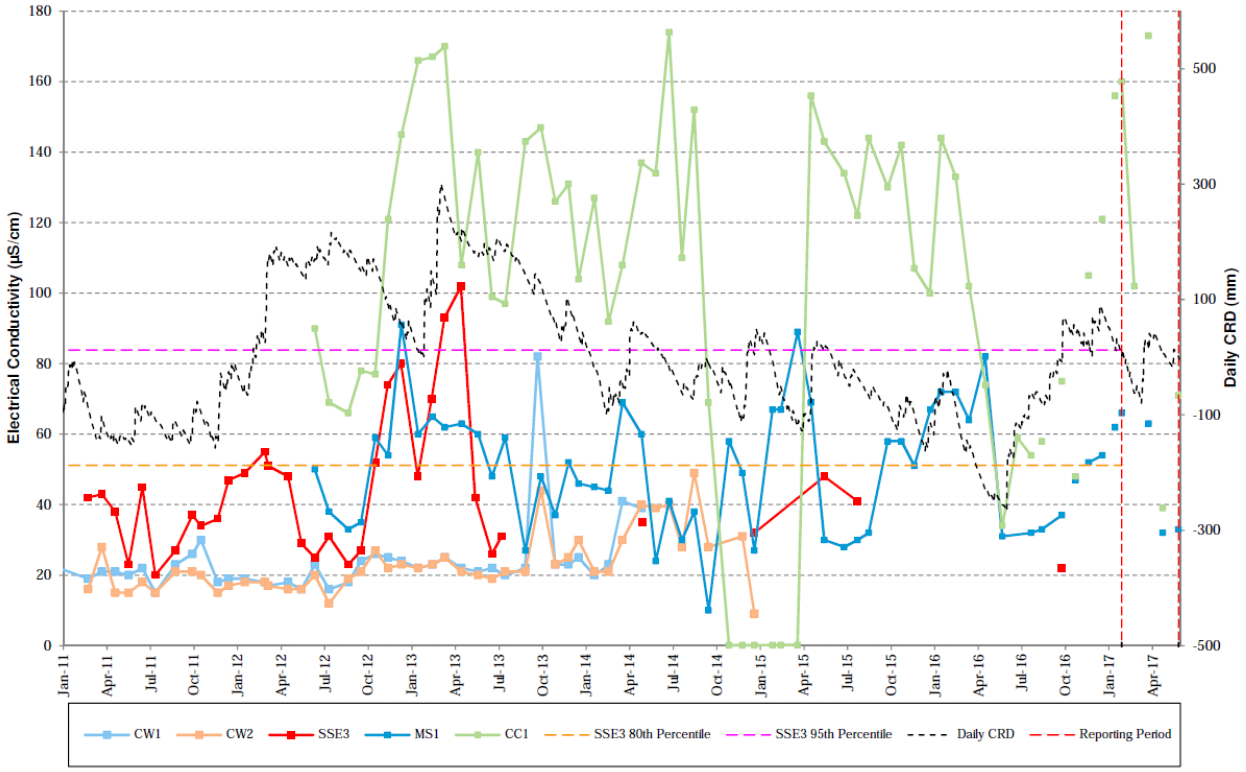


Figure 17 EC Swamp Piezometers

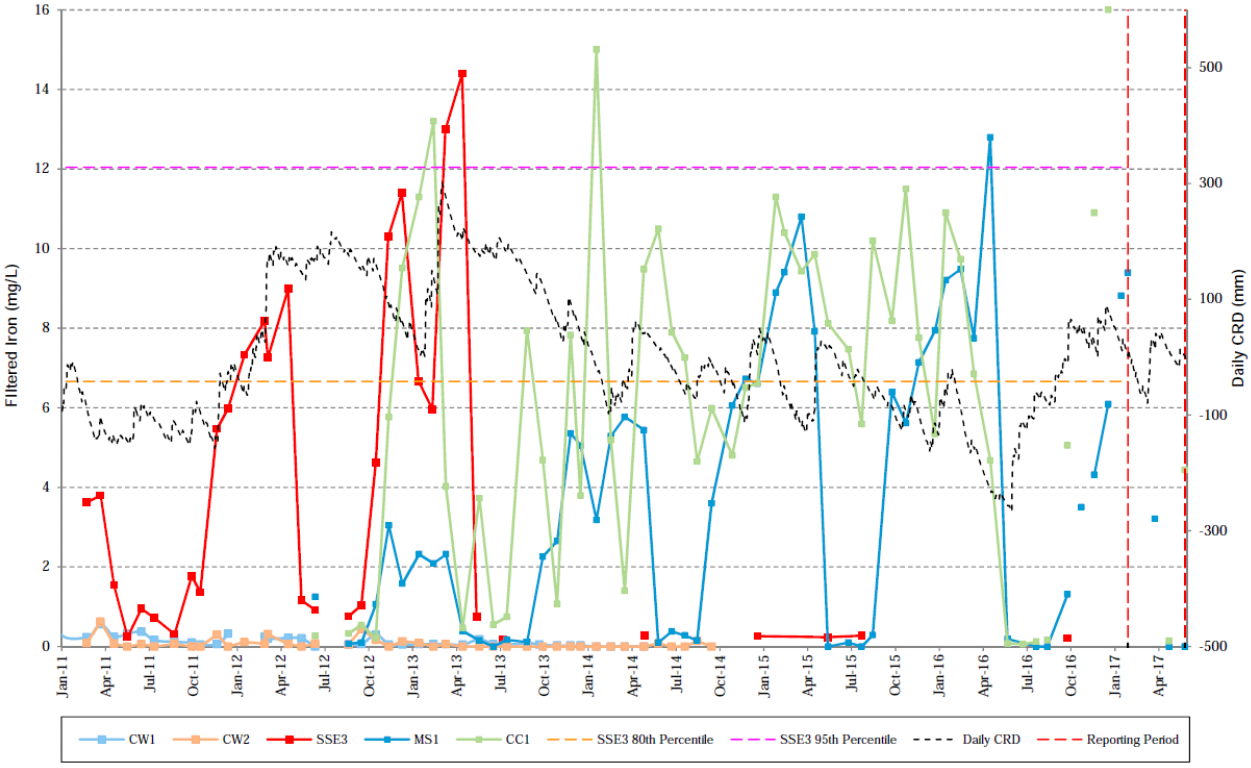


Figure 18 Fe Swamp Piezometers

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. Decreased rainfall resulted in slightly lower than average flow conditions over the review period.

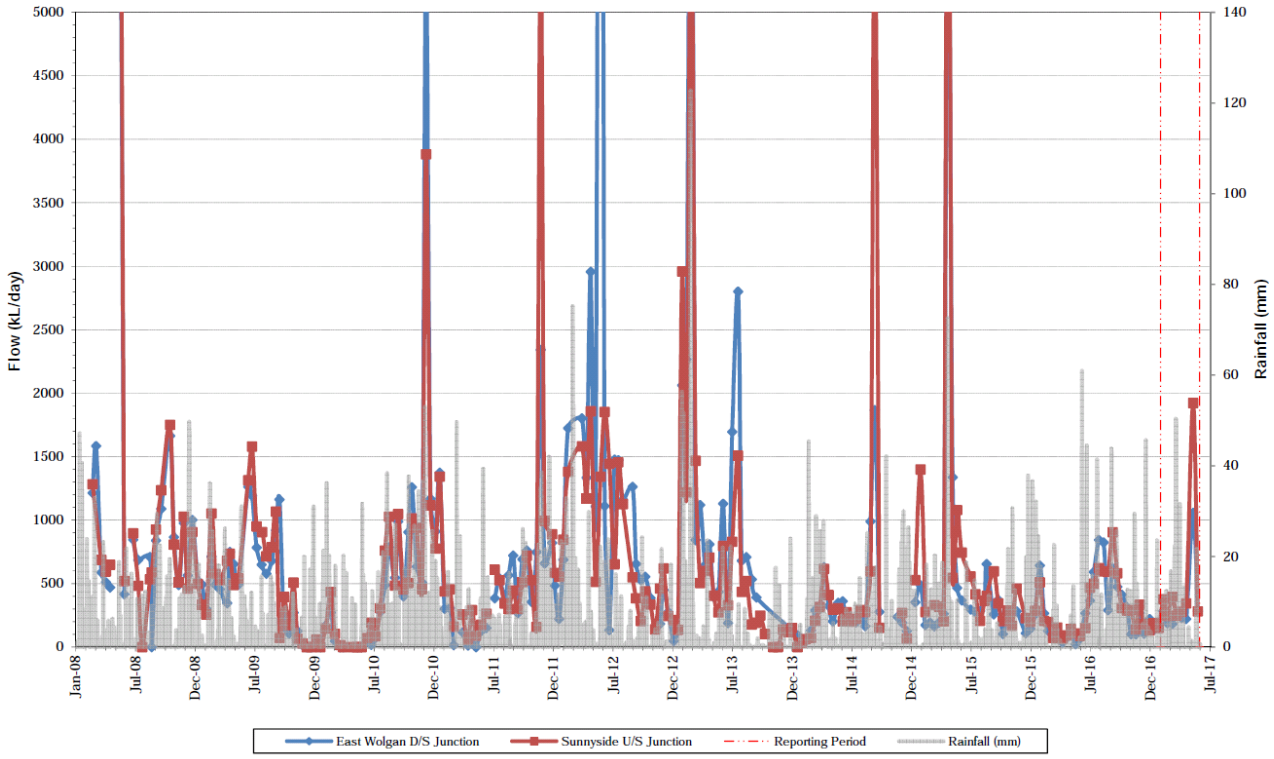


Figure 19 Wolgan River Flow

Table 8 shows a comparison of reporting period flow data with historical flow data for Wolgan River. For both East Wolgan Downstream Junction and Sunnyside Upstream Junction, average flow for the reporting period was significantly below the long term average for all historical data. This is due to lower than average rainfall conditions during the reporting period.

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 to 25/01/17 (KL/day)	Comments
East Wolgan D/S Junction	706	350	0 – 12,668	Lower reporting period average due to lower than average rainfall conditions during the reporting period.
Sunnyside U/S Junction	666	511	0 – 8,977	Lower reporting period average due to lower than average rainfall conditions during the reporting period.

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. SSE3 was below the base of piezometer for the review period and prior to this had only minor flows that were too low to gauge. SSE3 Downstream remained dry during the reporting period.

Historic flows are presented in Figure 20.

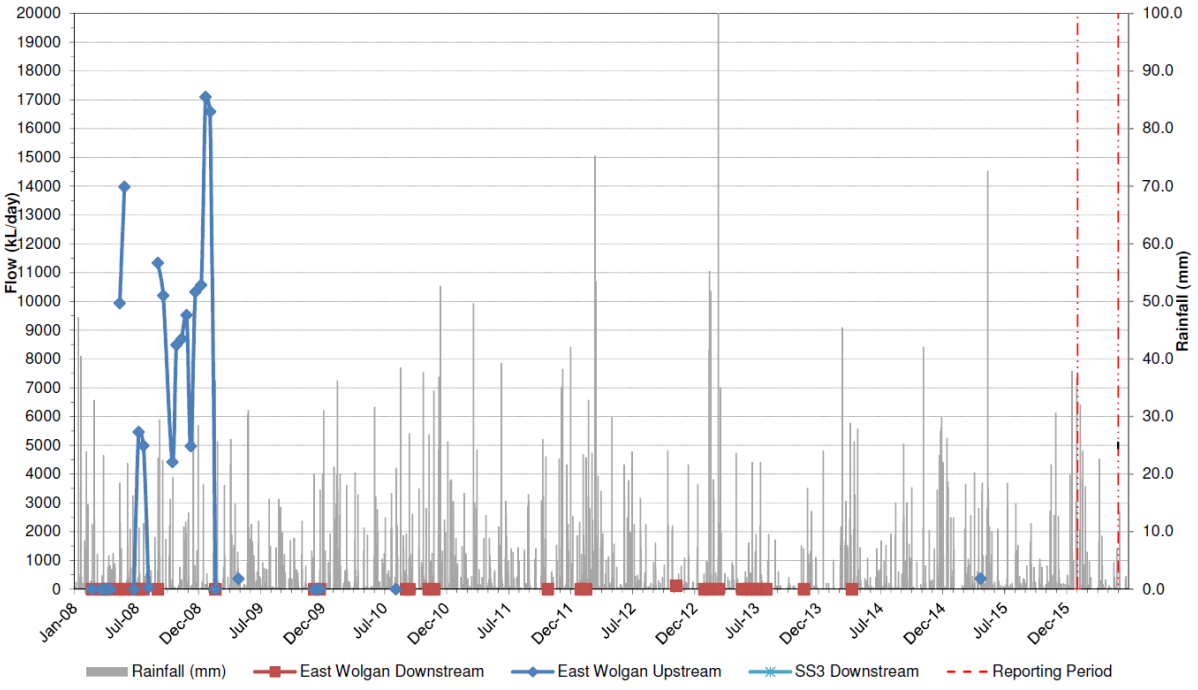


Figure 20 East Wolgan and Sunnyside East Flow

Sunnyside Swamp

Surface flows at Sunnyside Swamp are monitored at Sunnyside Upstream and Sunnyside Downstream. Flows are shown on Figure 21. Over the reporting period low flows were recorded at Sunnyside Upstream and Sunnyside Downstream.

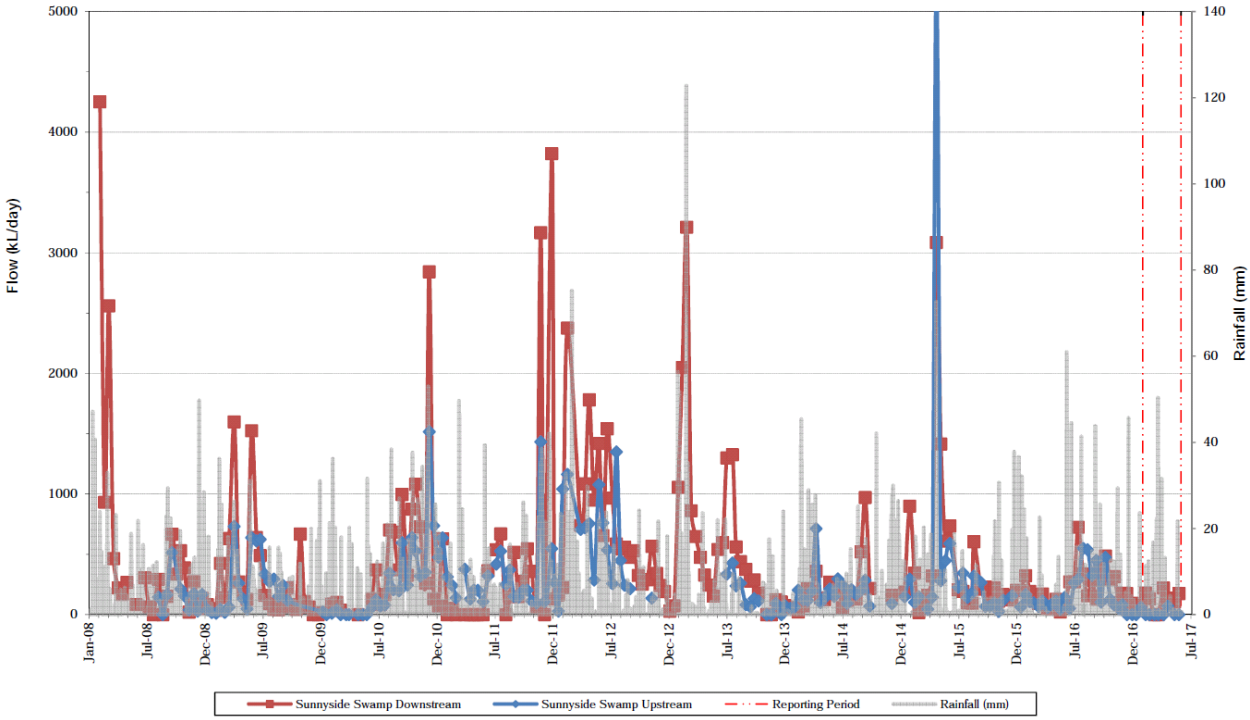


Figure 21 Sunnyside Swamp Flow

Table 9 shows a comparison of reporting period flow data with historical flow data for Sunnyside Swamp. Average flow during the reporting period for Sunnyside Upstream and Sunnyside Downstream was significantly below average for all data. Average long-term flows at Sunnyside Downstream are over 35% greater than those at Sunnyside Upstream.

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	270	9	0 – 5,399	Lower reporting period average due to lower than average rainfall conditions during the reporting period.
Sunnyside Swamp D/S	432	158	0 – 4,252	Lower reporting period average due to lower than average rainfall conditions during the reporting period.

Carne West Swamp

Surface water at Carne West Swamp is monitored at Carne West Upstream and Carne West Downstream as well as pool depth monitoring at Carne West Pool (CWP) adjacent to Carne West Downstream. Surface flows are typically too low for accurate gauging at Carne West Upstream and Downstream. Pool depths at CWP are shown on Figure 22. Historically, CWP displays highly variable water depth, up to approximately 0.7 m. Over the reporting period CWP depths were up to approximately 0.6 m and consistent with historical variability.

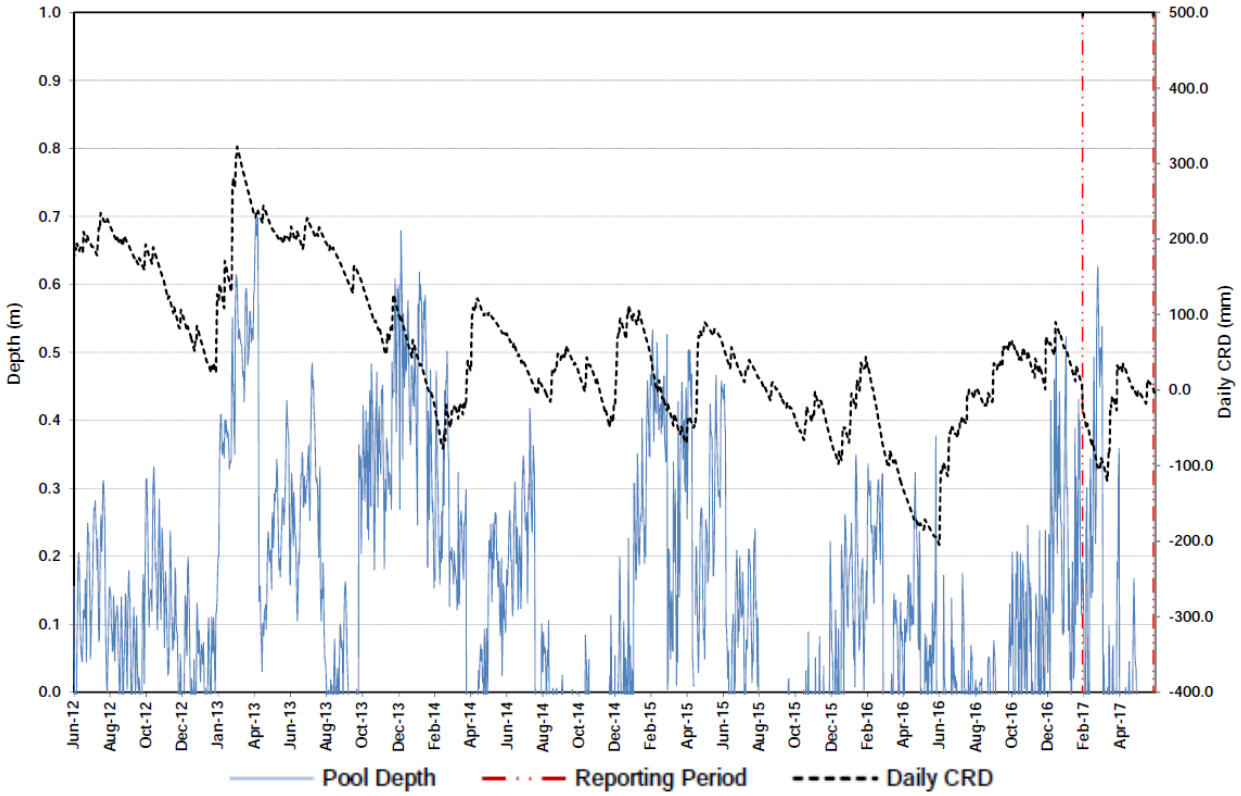


Figure 22 CWP Waterhole

Flow results at Carne West Upstream and Downstream were dry or too low for accurate gauging during the reporting period.

Reference Site – Marrangaroo Creek

Dry or low flow measurements are often recorded in Marrangaroo Creek. Flows over the reporting period are summarised on Table 10. No flows were reported from February 2017 to May 2017.

Table 10. Marrangaroo Creek Flow Gauging

Date	06-Feb-17	20-Feb-17	06-Mar-17	20-Mar-17	05-Apr-17	19-Apr-17	08-May-17	22-May-17	06-Feb-17
Flow (kl/day)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry

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 11.

Table 11. Marrangaroo Creek Quality Statistics

Parameter	Statistic	All Data	Reporting Period	95th Percentile*
pH	Range	3.47 - 8.85	4.22 - 7.51	7.69
	Median	5.20	6.11	
	Mean	5.53	6.10	
EC (µS/cm)	Range	7 - 2438	21 - 27	66
	Median	34	24	
	Mean	36	23.9	
Mn (mg/L)	Range	0 - 0.04	0.007 - 0.014	0.01
	Median	0.01	0.009	
	Mean	0.01	0.01	
Fe (mg/L)	Range	0.05 - 4.34	0.11 - 0.11	4.06
	Median	0.14	0.11	
	Mean	0.86	0.1	

Over the reporting period pH values ranged from 4.22 to 7.51 and EC values ranged from 21 to 27µS/cm.

Manganese concentrations ranged from 0.007 to 0.014mg/L and iron concentrations ranged from 0 to 0.11mg/L.

Iron concentrations were below the limit of reporting for six of the last eight monitoring events.

Over the reporting period, all parameters at Marrangaroo Creek remained within historical limits. The peak EC and iron concentrations at Marrangaroo Creek remained within the 95th percentile during the review period, while the mean manganese concentration exceeded the 95th percentile.

Wolgan River

Table 12 summarizes water quality data for the reporting period.

Table 12. Wolgan River Quality Statistics

Parameter	Statistic	Wolgan East D/S Junction			Sunnyside U/S Junction		
		2006 – Current	Reporting Period	95th Percentile*	2006 – Current	Reporting Period	95th Percentile*
pH	Range	3.66 - 8.30	5.86 - 6.97		3.87 - 8.49	5.84 - 7.07	
	Median	6.90	6.73	7.70	6.90	6.73	7.86
	Mean	6.89	6.44		6.90	6.50	
EC (µS/cm)	Range	4 - 350	22 - 39		5 - 390	17 - 120	
	Median	33	28.5	73	34	34.50	64.2
	Mean	39.34	29.38		38.8	45.38	
Mn (mg/L)	Range	0 - 0.47	0.003 - 0.01		0 - 0.3	0.003 - 0.009	
	Median	0.01	0.005	0.01	0.005	0.01	0.01
	Mean	0.01	0.005		0.006	0.01	
Fe (mg/L)	Range	0.05 - 3.13	0.32 - 0.81		0.11 - 1.76	0.33 - 0.07	
	Median	0.53	0.47	1.27	0.53	0.51	1.30
	Mean	0.63	0.49		0.63	0.49	

Both sites show highly variable pH throughout the reporting period with values remaining within historical range (~1 to 1.5 units). The pH at Wolgan East and Sunnyside U/S Junction were both slightly acidic to neutral and similar to historical values and below the 95th percentile.

EC values are within historical limits with exception of one reading at Sunnyside U/S Junction which recorded 120 µS/cm on 9th February, 2017 which exceeded the 95th percentile.

Long term Manganese concentrations show a seasonal variation and this seasonal increasing trend continued over the reporting period. Average concentrations for the reporting period were above the long term average for Sunnyside U/S Junction and at the 95th percentile limit.

Iron concentrations were well below the long term average for both Wolgan River D/S Junction and Sunnyside U/S Junction.

Sunnyside Swamp

Table 13 summarizes water quality data for the reporting period.

Table 13. Sunnyside Swamp Quality Statistics

Parameter	Statistic	Sunnyside Swamp U/S			Sunnyside Swamp D/S		
		2006 – Current	Reporting Period	95th Percentile*	2006 – Current	Reporting Period	95th Percentile*
pH	Range	5.31 - 8.94	5.35 - 7.29	7.27	5.55 - 8.40	5.69 - 7.17	7.71
	Median	6.66	6.25		6.85	6.68	
	Mean	6.56	6.27		6.82	6.53	
EC (µS/cm)	Range	1- 820	27 - 77	75	1 - 840	24 - 43	194.40
	Median	46	34		42	31.50	
	Mean	53	41.25		48.21	32	
Mn (mg/L)	Range	0 - 0.07	0.002 - 0.028	0.02	0 - 2.5	0.004 - 0.008	0.01
	Median	0.01	0.01		0.01	0.01	
	Mean	0.01	0.01		0.01	0.01	
Fe (mg/L)	Range	0.11 - 2.15	0.1 - 0.69	1.45	0 - 5	0.32 - 0.82	1.95
	Median	0.52	0.36		0.70	0.55	
	Mean	0.62	0.31		0.81	0.53	

Table 5.7 summarises water quality data for the reporting period. Figures for water quality data can be seen in Figures 24 to 27.

pH for this reporting period was highly variable but not inconsistent with the past five years. During the reporting period pH at Sunnyside Swamp U/S and Sunnyside D/S were both outside the 95th percentile and slightly lower than the long term average.

EC remained relatively stable and within historic limits. Median and mean concentrations for the reporting period are below historical levels at both Sunnyside U/S and Sunnyside D/S.

Manganese concentrations at both sites are within historical limits during this reporting period.

Filtered Iron remained within historic limits at both sites. Median and mean concentrations for the reporting period are below historical levels at both Sunnyside U/S and Sunnyside D/S.

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.

Table 14. 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.

6.5.2. Results

Habitat Measurements

Habitat characteristics are presented below in Table 15.

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 variaiton in these characteristics reflects changes in environmental conditions on Newnes Plateau rather than impacts from mining.

Table 15. 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 16. 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 16. 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 17.

Table 17. 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 18.

Table 18. 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 Summer 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 19. Results from the quadrat (400 m^2) and four 20 m transects are tabulated for comparison between sampling methods and reference/impact sites.

Table 19. Total native plant species richness

Site	Species Richness		Shannon-Wiener Index (point intercept method)	Evenness
	400m^2 Quadrat	Point Intercept Method		
Impact sites				
WC01	**11**	**11**	1.83	0.76
WC02	**12**	**12**	1.86	0.75
WC03	11	11	2.02	0.84
WC04	14	13	1.97	0.77
SSE01	21	20	2.28	0.76
LGG01	31	21	2.24	0.70
UGE01	21	20	2.21	0.73
Mean±SD	17.3 ± 2.8	15.4 ± 1.8	2.04	
Reference sites				
TG01	17	15	2.19	0.81
TG02	20	18	2.20	0.76
TRI01	**20**	**15**	2.06	0.76
TRI02	17	16	2.00	0.72
BS01	15	13	2.14	0.71
CCS01	25	25	2.02	0.79
Mean±SD	19.0 ± 1.4	17.0 ± 1.7	2.12	

Mean species richness using the point intercept method was slightly lower at impact sites (15.4 ± 1.8) than reference sites (17.0 ± 1.7). A similar difference was found within 400m2 quadrats where species richness at impact sites (17.3 ± 2.8) was lower than reference sites (19.0 ± 1.4). Two West Carne (WC01 and WC02) impact sites were below the lower species richness trigger level (i.e. trigger levels of 11.2 and 13.3 respectively) as was the reference site TRI01 (25.2 lower trigger level threshold). The triggers in the West Carne sites are new triggers as the species richness at these sites was previously within the trigger thresholds in the Spring 2016 monitoring period.

Species richness was almost unilaterally below the baseline means, and may reflect the previous year's uncharacteristically warm and dry conditions as reported in the Spring and annual monitoring period.

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.

Eucalypt recruitment over seasonal monitoring is shown in Table 20 below.

Table 20. Eucalypt Recruitment over Time

Site	Seasons			
	Autumn 2016	Winter 2016	Spring 2016	Summer 2016/2017
Impact				
WC01	2	-	-	-
WC02	2	-	-	-
WC03	-	-	-	-
WC04	-	-	-	1
SSE01	3	4	1	**3**
LGG01	-	1	2	**1**
UGE01	-	-	-	-
Reference				
TG01	-	-	-	1
TG02	-	-	-	-
TRI01	-	-	-	1
TRI02	-	-	1	1
BS01	-	-	-	-
CCS01	6	-	-	-

Eucalypt recruitment below trigger thresholds was noted for the first time in WC04. Eucalypt recruitment above trigger thresholds were observed for the first time in LGG01 with continued above trigger thresholds observed at SSE01. Sub trigger eucalypt recruitment was detected for the first time at two reference sites (TG01 and TRI01) with continued detection at TRI012.

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.

Overall mean species condition scores for impact and reference sites are shown in Table 21. Mean condition scores for *Gleichenia dicarpa* and *Baumea rubigonsa* have also been included as this is a key swamp species.

Table 21. Overall condition scores for each site and for key swamp species

Site	Overall mean condition	*Gleichenia dicarpa* mean condition	*Baumea rubigonsa* mean condition
Impact			
WC01	2.6	1.6	1.5
WC02	2.7	**2.4**	1.9
WC03	2.8	**1.5**	1.9
WC04	3.0	**1.8**	1.0
SSE01	3.3	3.3	3.1
LGG01	4.5	4.6	-
UGE01	3.9	3.8	5.0
Mean condition (impact)	3.3	2.8	2.6
Reference			
TG01	4.5	4.0	4.5
TG02	4.2	3.9	4.4
TRI01	4.5	4.0	3.9
TRI02	4.5	4.0	4.5
BS01	3.7	3.4	3.8
CCS01	3.5	-	3.1
Mean condition (reference)	4.1	3.9	4.1

The mean condition score at impact sites was 3.3 (range 2.6 – 4.5) compared with 4.1 (range 3.5 – 4.5) at reference sites. Two sites in the West Carne Swamp (WC01 and WC02) were below the condition threshold overall and all four sites in West Carne were below the condition threshold for the important swamp species *Gleichenia dicarpa* and *Baumea rubiginosa*. The decrease in condition is coincident with a drop in ground water levels.

The negative trend observed is a continuation of prior monitoring events (i.e. spring and winter 2016). However, this is the first monitoring period that all four sites have been below the condition threshold for *Gleichenia dicarpa* and *Baumea rubiginosa*. No further species condition scores are presented here as those chosen adequately demonstrate the declining trend.

The sustained poor condition scores within the West Carne sites and the continued decline in overall condition for all species suggests that recovery is not occurring and this is not an isolated event.

These observed poor condition scores are coincident with longwall mining in the area; thus suggesting the incidence of a mining related impact.

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. Results are tabulated in Table 22.

Table 22. Summer 2017 Non-live ground cover (cover abundance and point intercept methods)

Site	Bare Ground (%) Summer 2016/2017
Impact	
WC01	3.75
WC02	2.5
WC03	8.125
WC04	8.125
SSE01	4.375
LGG01	7.5
UGE01	10
Reference	
TG01	0.625
TG02	0.625
TRI01	0.625
TRI02	0.625
BS01	1.875
CCS01	0

With the exception of LGG01 (7.5% increase) and UGE01 (7.7% increase) there was no substantial increase in the number of sample points containing non-live ground cover. The reason for the observed increase at LGG01 and UGE01 is may be related to a recent drop in groundwater levels detected. These sites have recently become impacted and have been assessed with the impact sites to reflect the change. Although these sites have not triggered any criteria they should be closely monitored for further changes.

6.6.5. Establishment of Non-native Weeds

The results from the Summer monitoring event indicated no weeds at any monitored sites. This is consistent with results from the previous summer monitoring event.

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	Summer 2016/2017
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.	Flora trigger observed in two impact sites (WC01 and WC02). Flora trigger observed in one reference site (TRI01).
	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.	Flora trigger observed in two impact sites (SSE01 and LGG01). LGG01 is a new trigger.SSE01 is a continuance of a prior trigger.
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.	Flora trigger observed in all four West Carne sites for overall condition (WC01, WC02, WC03 and WC04). WC01 and WC02 exhibited trigger level decreases in condition for the key swamp species *Gleichenia dicarpa* and *Baumea rubiginosa.*
	Non-live ground cover	An increase of bare ground of more than 100m^2 in a site within a three year period.	No impact sites showed an increase in bare earth beyond the trigger level.
	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. Invasive species previously detected in CCS01 and LGG01 were not detected in this monitoring event.

One trigger exceedance (i.e. species richness) was observed for a reference site (TRI01) during the summer 2016/17 monitoring period. Trigger exceedances where observed in four impact swamp monitoring sites under the same performance measure (condition of key species at WC01, WC02, WC03 and WC04). These sites have been the subject of a previous trigger notification and investigation. A new trigger for ‘change in diversity of native species’ was recorded at sites WC01 and WC02.

A new trigger for ‘non-swamp species’ (i.e. recruitment of eucalypt species) was observed in LGG01, with continuance of this trigger noted in SSE01. While LGG01 is an impact monitoring site, it is not currently within the trigger investigation area as mining is yet to pass near this monitoring site. This swamp was subject to a major fire event in 2013 and as such it is possible that the observed eucalypt recruitment is a function of this fire event. Continued monitoring is warranted to determine if this is the case.

Required notification and investigation will be conducted in accordance with the THPSS MMP requirements.

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
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

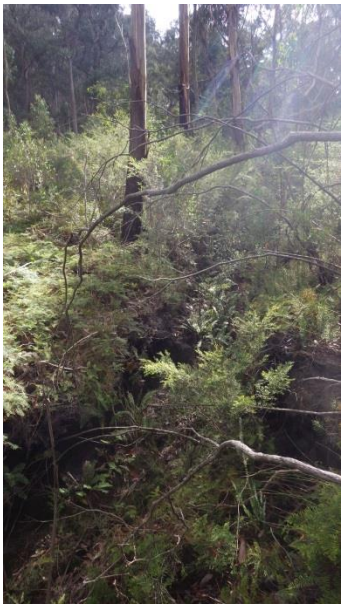
Date Photographed	Resurvey Number
14/4/2009	Baseline
28-30/10/2009	Resurvey 1
21/5/2010	Resurvey 2
17/11/2010	Resurvey 3
24/5/2011	Resurvey 4
24/1/2012	Resurvey 5
25/7/2012	Resurvey 6
25/1/2013	Resurvey 7
3/4/2013	Resurvey 8
20/6/2013	Resurvey 9
19/9/2013	Resurvey 10
3/12/2013	Resurvey 11
15/1/2014	Resurvey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

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 26
 Photo_003_2009_0414Image0049	 SSES_Photo 003_2017_Apr 26_IMGP0066
 Photo_006_2009_0414Image0052	 SSES_Photo 006_2017_Apr 26_IMGP0072

Baseline	Resurvey 26
 Photo_022_2009_0414ImageSSE_Stitch2	 SSES_Photo 022_2017_Apr 26_IMGP0080-81
 Photo_067_2009_0414Image2407	 SSES_Photo 067_2017_Apr 26_IMGP0123
 Photo_073_2009_0414Image0104	 SSES_Photo 073_2017_Apr 26_IMGP0129

Photos are considered consistent with previous photographic records.

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

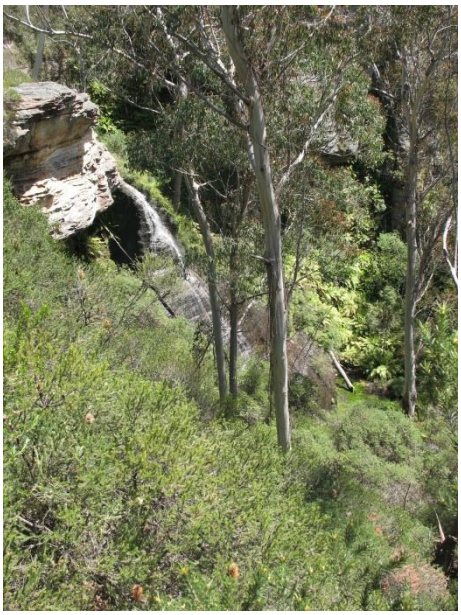
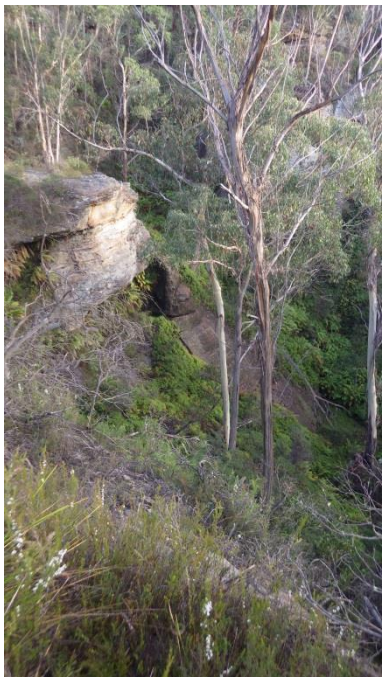
Table 28. Carne West Swamp photographic Monitoring Summary

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

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 22
 CWS_Photo_002_2008_1124Image0004	 CWS_Photo 002_2017_Apr 26_IMGP0001
 CWS_Photo_006_2008_1124Image0006	 CWS_Photo 006_2017_Apr 26_IMGP0004

Baseline	Resurvey 22
 CWS_Photo_013_2008_1124Image0013	 CWS_Photo 013_2017_Apr 26_IMGP0013
 CWS_Photo_020_2008_1124Image0020	 CWS_Photo 020_2017_Apr 26_IMGP0020
 CWS_Photo_048_2008_1124Image0065	 CWS_Photo 048_2017_Apr 26_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

Springvale received the RPS Shrub Swamp Monitoring Summer 2016/2017 Report on the 3rd of July 2017. The report was undertaken in accordance with the EMP for LWs411-418 and the Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan (THPSS MMP) for Longwall 418. The report indicated three new flora performance indicator investigation triggers, as defined under the THPSS MMP, were exceeded during the reporting period. The performance indicator investigation triggers exceeded for:

- Recruitment of eucalypts. Four identified at LGG01 (Lower Gang Gang Swamp), an increase of three or more individuals within a year period.
- Condition in diversity of native species. Sites WC01 and WC02 (Carne West) observed a change in the number of species of greater than 30% within a three period.

In accordance with the LW415 – 417 THPSS MMP, LW418 THPSS MMP and EPBC Act Approvals (2011/5949 and 2013/6881), initial notification was provided to the Department of Environment (DoE) on the 5th of July 2017. An Investigative Report will be prepared in relation to the triggers and subsequently provided to DoE.

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 June 2017 was 636.5m.

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.

Three flora performance indicator investigation triggers, as defined under the THPSS MMP, were exceeded during the reporting period (as reported on in Section 9). Required notification and investigation will be conducted in accordance with the THPSS MMP requirements. Springvale will continue to work through the TARP actions in response to the triggered flora performance indicators.

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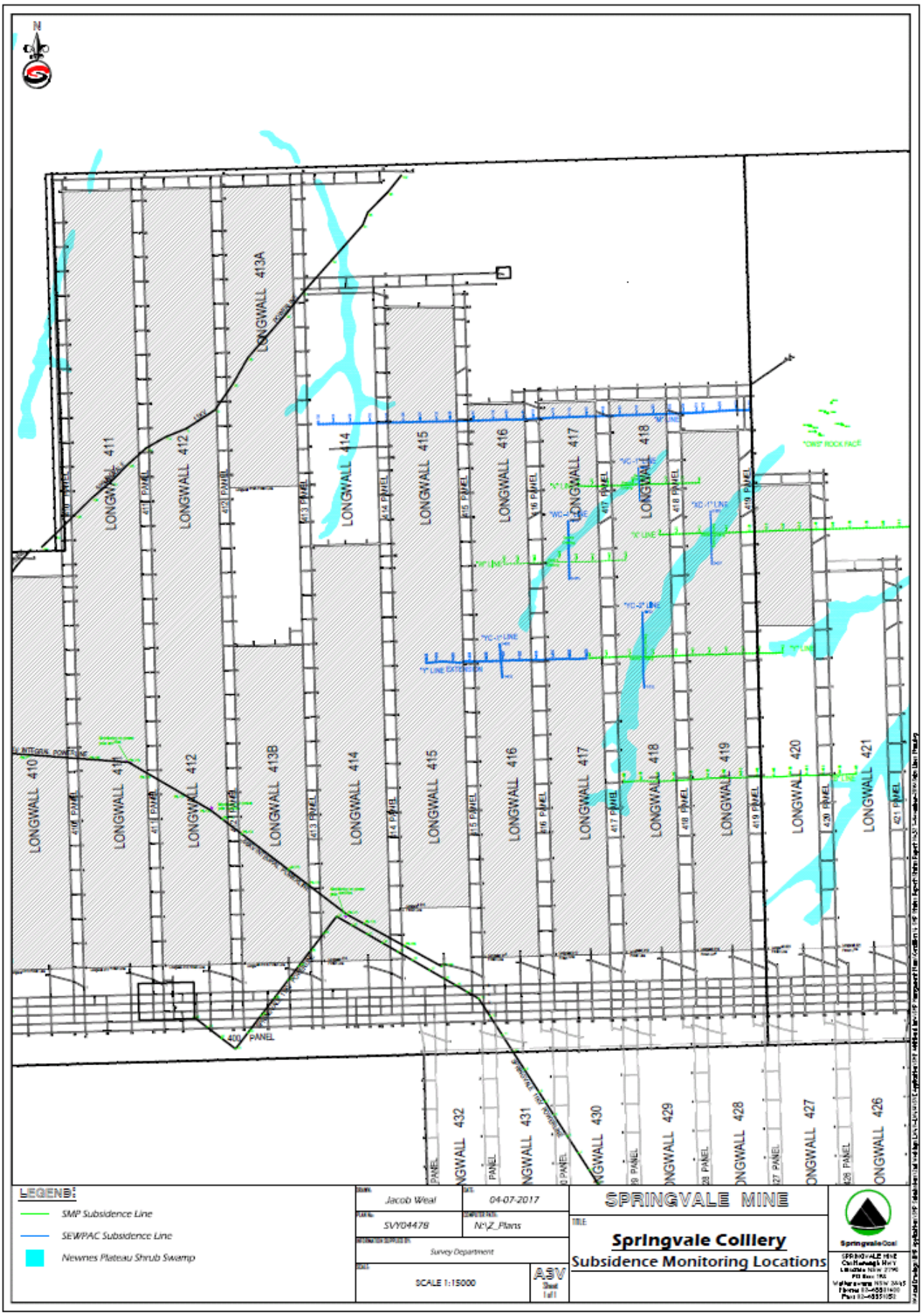
Appendix 1
Plans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LONGWALL 410
LONGWALL 411
LONGWALL 412
LONGWALL 413A
LONGWALL 413B
LONGWALL 414
LONGWALL 415
LONGWALL 416
LONGWALL 417
LONGWALL 418
LONGWALL 419
LONGWALL 420
LONGWALL 421
LONGWALL 426
LONGWALL 427
LONGWALL 428
LONGWALL 429
LONGWALL 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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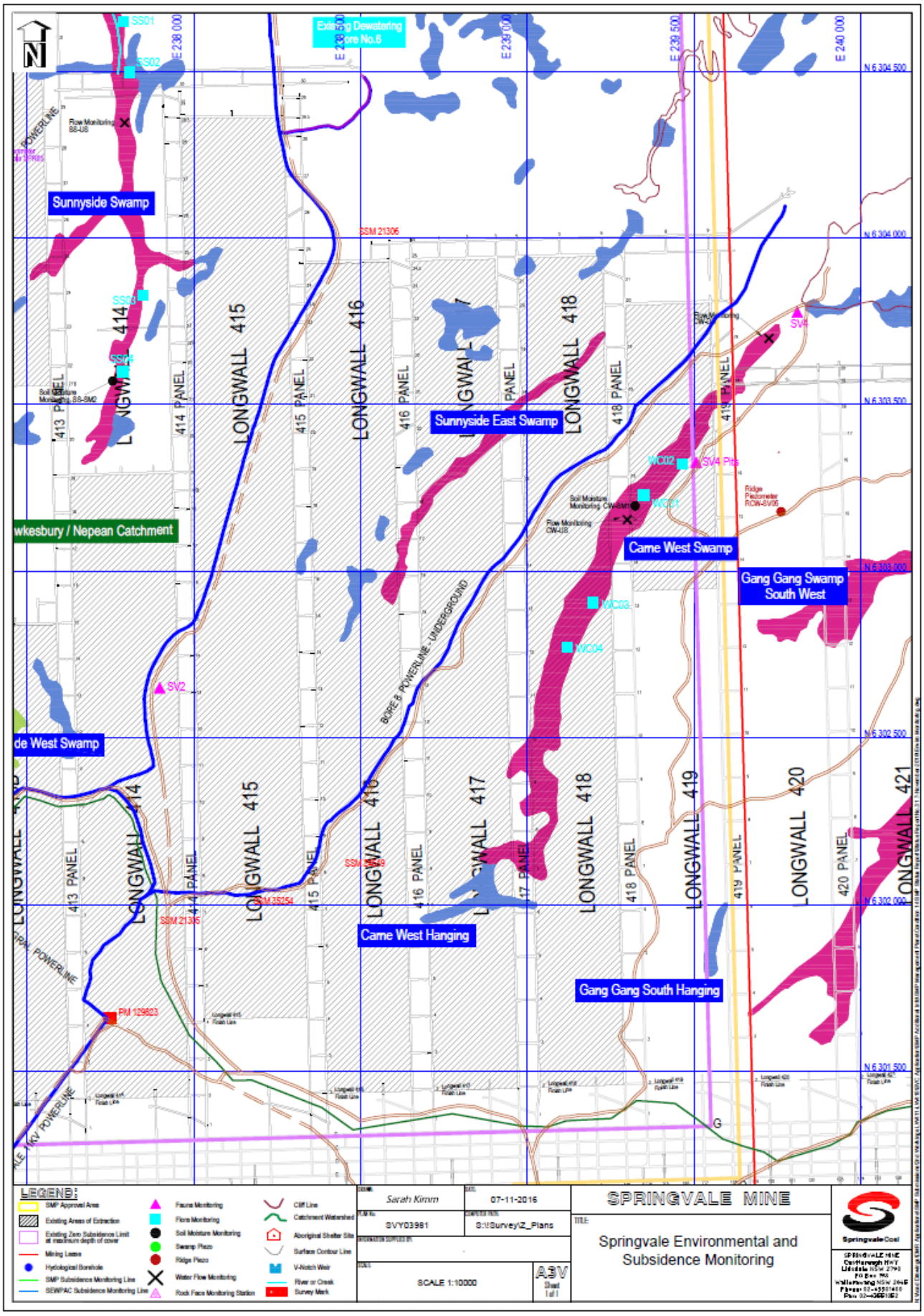
Survey Department
SCALE 1:15000
A3V
SPRINGVALE MINE
Springvale Colliery
Subsidence Monitoring Locations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Sunnyside Swamp
Sunnyside East Swamp
Came West Swamp
Gang Gang Swamp South West
Came West Hanging
Gang Gang South Hanging
wkesbury / Nepean Catchment
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 21385
PM 129823
BORE 6 POWERLINE - UNDERGROUND
POWERLINE
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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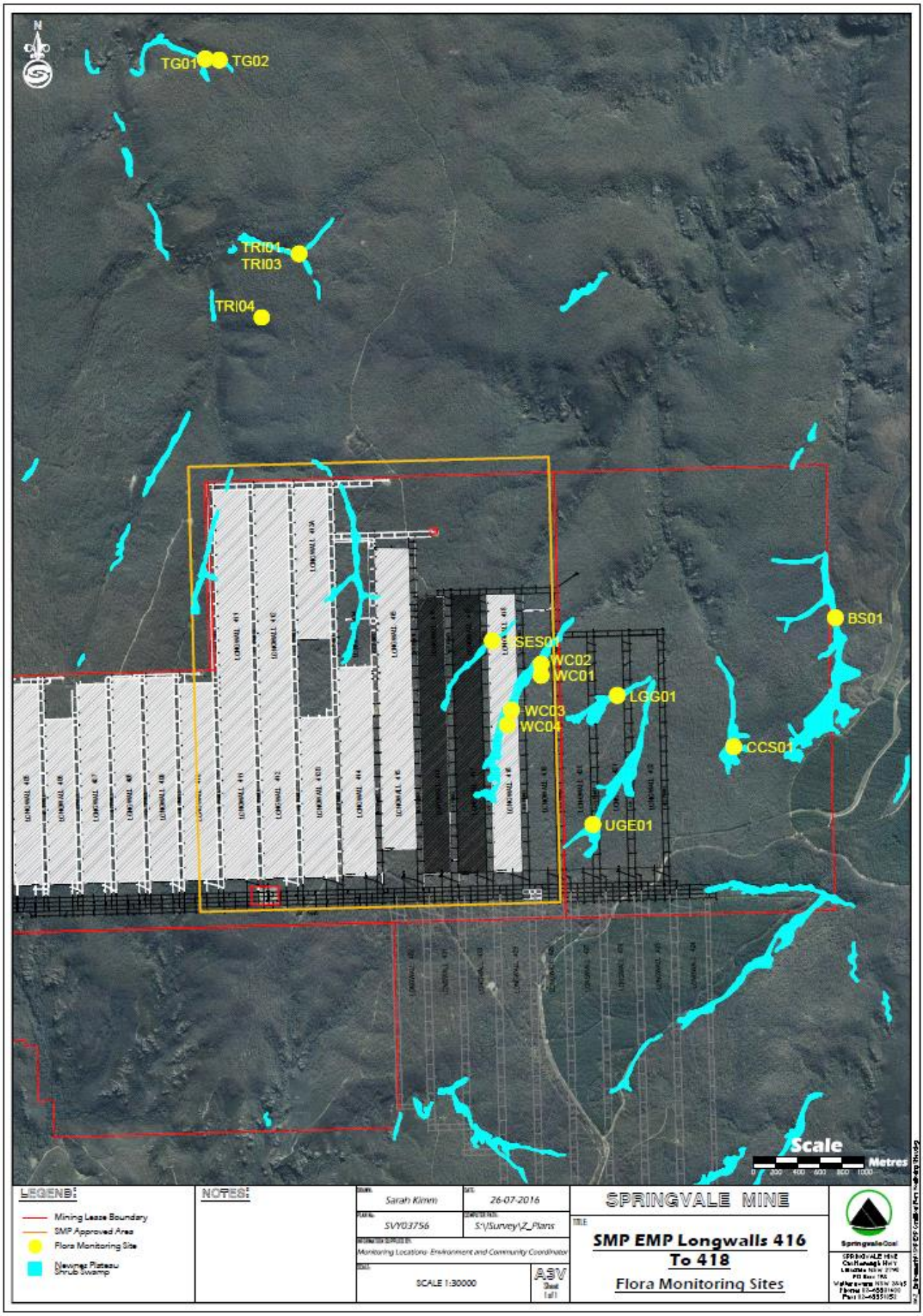
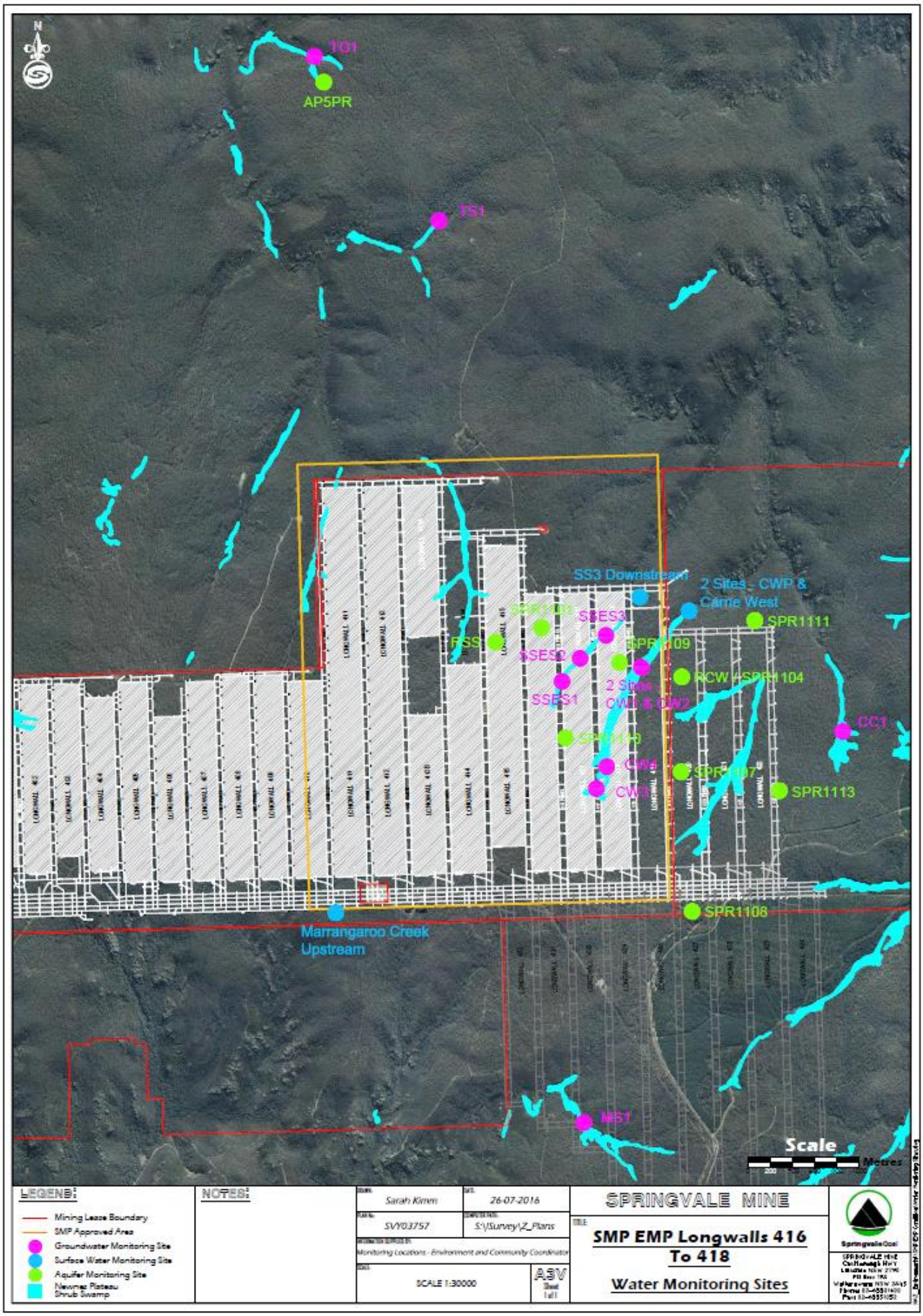
A3V
SPRINGVALE MINE
Springvale Environmental and Subsidence Monitoring
Springvale Coal


TG01
TG02
TRI01
TRI03
TRI04
SES01
WC02
WC01
WC03
WC04
LGG01
BS01
CCS01
UGE01
Scale
Metres
LEGEND:
Mining Lease Boundary
SMP Approved Area
Flora Monitoring Site
Newnes Plateau Shrub Swamp
NOTES:
Sarah Kimm
26-07-2016
SVY03756
S:\Survey\Z_Plans
Monitoring Locations- Environment and Community Coordinator
SCALE 1:30000
A3V
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 - CWP1 & CWP2
CC1
CWP4
SPR1107
SPR1113
CWP3
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

Appendix 2 Groundwater and Surface Water Report

Centennial Coal

Springvale Colliery

Castlereagh Highway

Lidsdale NSW 2790