Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan LW 415 to 417

Annual Report

Springvale Mine

March 2017

TABLE OF CONTENTS

1. INTRODUCTION

Springvale Coal Pty Ltd (Springvale) is an underground longwall mine located 12km north west of Lithgow in NSW and 3 km south of the Centennial Angus Place Mine. The mine is a joint venture owned in equal share by Centennial Springvale Pty Ltd (a wholly owned subsidiary of Banpu Minerals Ltd) and Springvale SK Kores Pty Limited.

EPBC Approval 2011/5949 was issued to Springvale by the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) on the 14th of March 2012. EPBC 2011/5949 is related to a controlled action area of the Springvale mine for mining of longwall panels (LW) 415 – 417 as shown in Figure 1.

On the 21st of October 2013 Springvale received approval from SEWPAC for the Temperate Highland Peat Swamps on Sandstone Monitoring Plan (THPSSMMP) for Longwalls 415 to 417, as required under Condition 7 of the EPBC approval.

This Annual Report has been prepared to satisfy Condition 10 of the EPBC approval which states:

"A report detailing the results of actions carried out under the monitoring and management plan must be prepared and provided to the department annually on the anniversary date of this approval. The minister may request that the report be reviewed by an independent reviewer approved by the department".

The annual reporting period has been defined as the 1st of January to 31st of December 2016 to allow the compilation of data and input of specialist reports.

Figure 1 Controlled Action Area Longwalls 415 to 417

2. MONITORING SITES

2.1. Subsidence

Existing survey monitoring lines have already been installed in accordance with the approved *Springvale Subsidence Management and Reporting Plan for LW415 to 417 (September 2011)*. These lines include B, M, T, V, W, X and Y across Sunnyside East and Carne West THPSS. The survey lines installed to date have not been established in the THPSS to minimise impacts during the establishment of the lines and during monitoring.

Additional longitudinal centre lines have been installed at several key locations to provide early-warning and three dimensional (3-D) swamp subsidence data for trigger level review and corrective action management purposes should corrective action be required.

The location of the subsidence monitoring locations are shown in Figure 2.

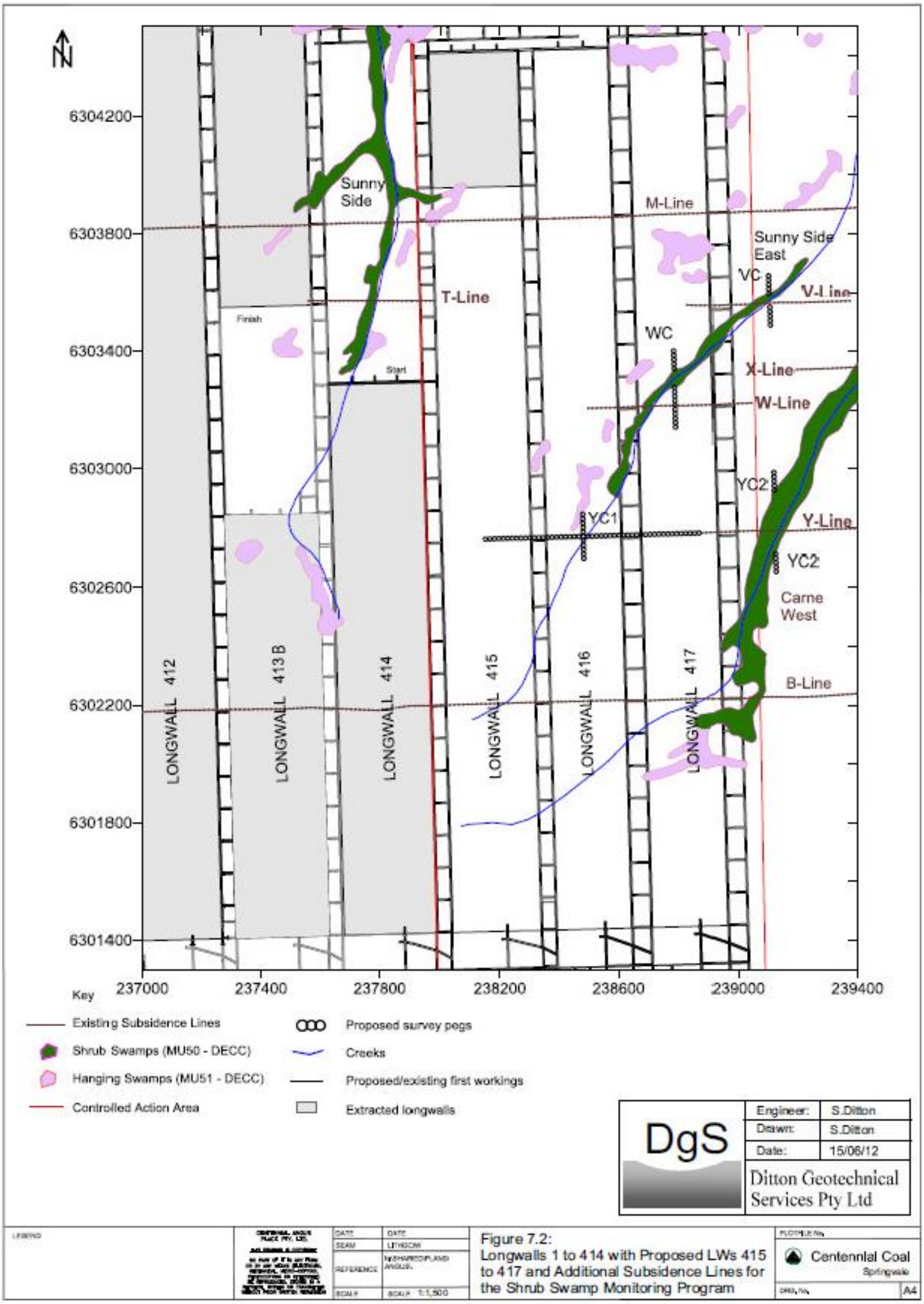

Figure 2 Subsidence Monitoring Locations

2.2. Flora

Centennial Coal has conducted flora monitoring of THPSS across the Newnes Plateau since 2003. Forty-six sites are now monitored which includes undermined swamps and swamps that have not been undermined. The data from these sites will be used as reference data where needed in combination with the specific sites that will be monitored as part of this THPSSMP.

Table 1 provides details of the flora monitoring and reference sites which are part of the THPSSMP while their locations are shown in Figure 3.

Table 1. Flora Monitoring Sites

Monitoring site name	Swamp	Easting (GDA94)	Northing (GDA94)	Description
Impact Sites				
WC01	Carne West Swamp	239461	6303219	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
WC02	Carne West Swamp	239461	6303321	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
WC03	Carne West Swamp	239195	6302908	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
WC04	Carne West Swamp	239157	6302773	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
SSE01	Sunnyside East	239022	6303531	Southern half is generally dry and channelized. Northern half likely permanently wet. Dominant species include *Gleichenia dicarpa, Leptospermum grandifolium*, *Baumea rubiginosa* and *Gahnia sieberiana*
Reference Sites				
TG01	Twin Gully	236565	6308755	Permanently wet, groundwater fed swamp. Dominant species include *Baeckea linifolia*, *Grevillea acanthifolia*, *Gleichenia dicarpa* and *Sphagnum cristatum.*
TG02	Twin Gully	236439	6308765	Permanently wet, groundwater fed swamp. Dominant species include *Baeckea linifolia*, *Grevillea acanthifolia*, *Gleichenia dicarpa* and *Sphagnum cristatum.*
TRI01	Tristar	236565	6308755	Permanently wet, groundwater fed swamp. Dominated by *Baeckea linifolia, Gleichenia*

Monitoring site name	Swamp	Easting (GDA94)	Northing (GDA94)	Description
				dicarpa, Grevillea acanthifolia, Lepidosperma limicola, Leptospermum grandifolium
TRI02	Tristar	236439	6308765	Permanently wet, groundwater fed swamp. Dominated by *Baeckea linifolia, Gleichenia dicarpa, Grevillea acanthifolia, Lepidosperma limicola, Leptospermum grandifolium*
LGG01	Lower Gang Gang Swamp	240148	6303040	Permanently wet, groundwater fed swamp, with channelised flows. Dominated by *Leptospermum grandifolium, Lepidosperma limicola, Boronia deanei and Gleichenia dicarpa.*
UGE01	Upper Gang Gang East Swamp	239928	6301878	Ephemeral, likely rainfall fed. Dominated by *Gleichenia dicarpa, Leptospermum grandifolium, Lepidosperma limicola, Gymnoschoenus sphaerocephalus and Xyris gracilis ssp. gracilis.*
BS01	Barrier Swamp	242111	6303738	Permanently wet, groundwater fed swamp. Dominated by *Gleichenia dicarpa, Leptospermum grandifolium, Lepidosperma limicola, Gymnoschoenus sphaerocephalus and Xyris gracilis ssp. gracilis.*
CCS01	Carne Central Swamp	241196	6302578	Ephemeral, likely rainfall fed. Dominated by *Lepidosperma limicola*, *Empodisma minus*, *Callistemon pityoides*, *Grevillea acanthifolia.*

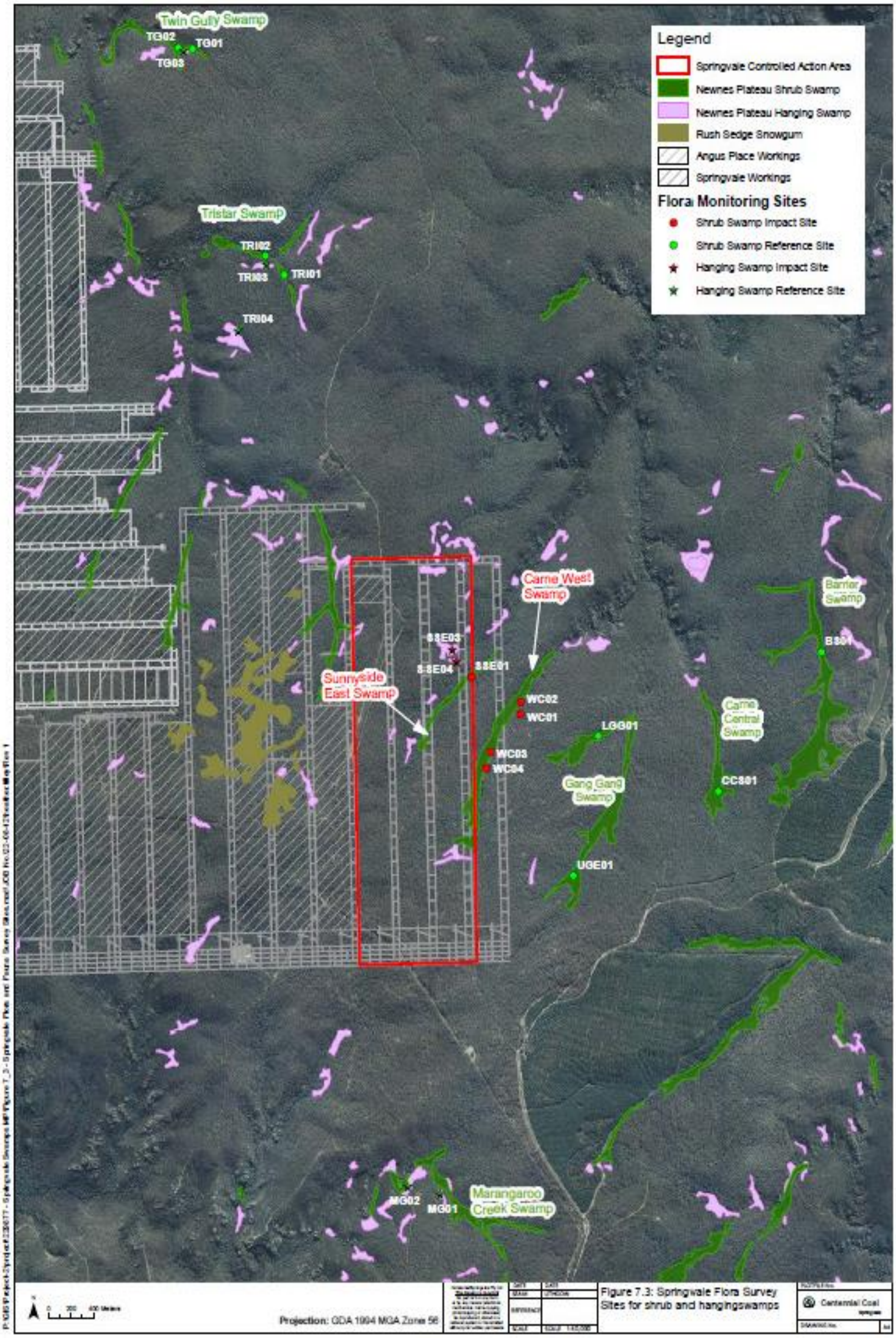

Figure 3 Flora Monitoring Locations

2.3. Groundwater

The THPSS baseline groundwater monitoring program commenced in May 2005 and has been gradually expanded to incorporate groundwater level and groundwater quality monitoring.

Piezometers have been installed in swamp systems and are referred to as swamp piezometers. These piezometers are hand augured to refusal and are shallow with a depth of up to 3 metres. These piezometers are used for direct measurement of swamp groundwater fluctuations.

Piezometers have also been installed outside of swamp systems and are referred to as aquifer piezometers. These piezometers often extend down through ridge lines and are deeper than the swamp piezometers extending to a depth of up to 30 metres. The aquifer piezometers are used to measure groundwater fluctuations outside of swamp systems.

Details of the groundwater monitoring program are presented below.

Groundwater monitoring locations are also shown on Figure 4.

2.3.1. Swamp Piezometers

The swamp piezometers are generally located on the edges of the swamps to minimise damage to swamp vegetation. The groundwater level measured at the swamp margin is representative of the groundwater level across the swamp.

Groundwater chemistry is monitored only in piezometers located in permanently waterlogged swamp conditions as sampling in periodically waterlogged conditions is often not possible due to the lack of groundwater in the piezometer.

Table 2 and 3 provides a summary of the groundwater monitoring undertaken at impact and reference swamps respectively.

Table 2. Groundwater Impact Monitoring Sites

Site name	Easting (GDA94)	Northing (GDA94)	Location	Mining Date (estimated)	Parameters monitored	
					Depth	Water Quality
Sunnyside East Swamp						
SSE1	238668	6303143	Over proposed LW416/417	Undermined December 2013 / March 2015	✓	
SSE2	238831	6303352	Over proposed LW 417	Undermined December 2014	✓	
SSE3	239064	6303558	Over proposed LW 418	Undermined November 2015	✓	✓
Carne West Swamp						
CW1	239352	6303196	Over proposed LW 419	Undermined November 2016	✓	✓
CW2	239382	6303247	Over proposed LW 419	Undermined November 2016	✓	✓
CW3	238977	6302179	Over proposed LW 417	Undermined April 2015	✓	
CW4	239070	6302377	Over proposed LW 417	Undermined April 2015	✓	

Table 3. Groundwater Reference Monitoring Sites

Site name	Easting (GDA94)	Northing (GDA94)	Mining Area	Mining date (estimated)	Parameters monitored	
					Depth	Water Quality
Carne Central Swamp						
CC1	241193	6302693	East of LW 418	No approved mining to date	✓	✓
Marangaroo Swamp						
MS1	238860	6299169	East of LW 418	No approved mining to date	✓	✓
Tristar Swamp						
TS1	237559	6307289	Over Angus Place – NE Area	No approved mining to date	✓	
Twin Gully Swamp						
TG1	236438	6308766	Over Angus Place – NE Area	No approved mining to date	✓	

2.3.2. Aquifer Piezometers

Aquifer piezometers are located outside of swamp systems in the laterally extensive shallow aquifer to monitor groundwater fluctuations around the periphery of THPSS. The data collected from these piezometers provides a comparison with any fluctuations measured in the swamp piezometers to detect any mining related impacts.

Groundwater chemistry is not monitored in aquifer piezometers because these piezometers are located at a greater depth from the surface (i.e. on ridge lines) than swamp piezometers and the oxidation of analytes such as iron and managanese is unlikely due to a lack of freely available oxygen at this depth from surface.

Table 4 and 5 provides a summary of the groundwater monitoring undertaken at impact and reference swamps respectively.

Table 4. Aquifer Impact Monitoring Sites

Site Name	Easting (GDA94)	Northing (GDA94)	Location	Mining date (estimated)	Parameters monitored	
					Depth	Quality
RSS	238072	6303500	Over LW 415	September 2012	✓	
SPR1101	238484	6303627	Over LW 416	October 2013	✓	
RCW/ SPR1104	239746	6303184	Over LW 420	To be undermined 2017 if approved	✓	
SPR1107	239739	6302330	Over LW 420	To be undermined 2017 if approved	✓	
SPR1109	239186	6303314	Over LW 418	December 2015	✓	
SPR1110	238699	6302635	Over LW 416 / 417	January 2014 / March 2015	✓	

Table 5. Aquifer Reference Monitoring Sites

Site name	Easting (GDA94)	Northing (GDA94)	Location	Mining date (estimated)	Parameters monitored	
					Depth	Quality
SPR1108	239840	6301075	South of LW 420 Over LW427	To be undermined after 2025 if approved	✓	
SPR1111	240404	6303692	Nth of LW 422	Will not be undermined	✓	
SPR1113	240625	6302160	Over LW 423	To be undermined 2021 if approved	✓	
AP5PR	236523	6308535	NE of Angus Place Mine	Will not be undermined in the foreseeable future	✓	

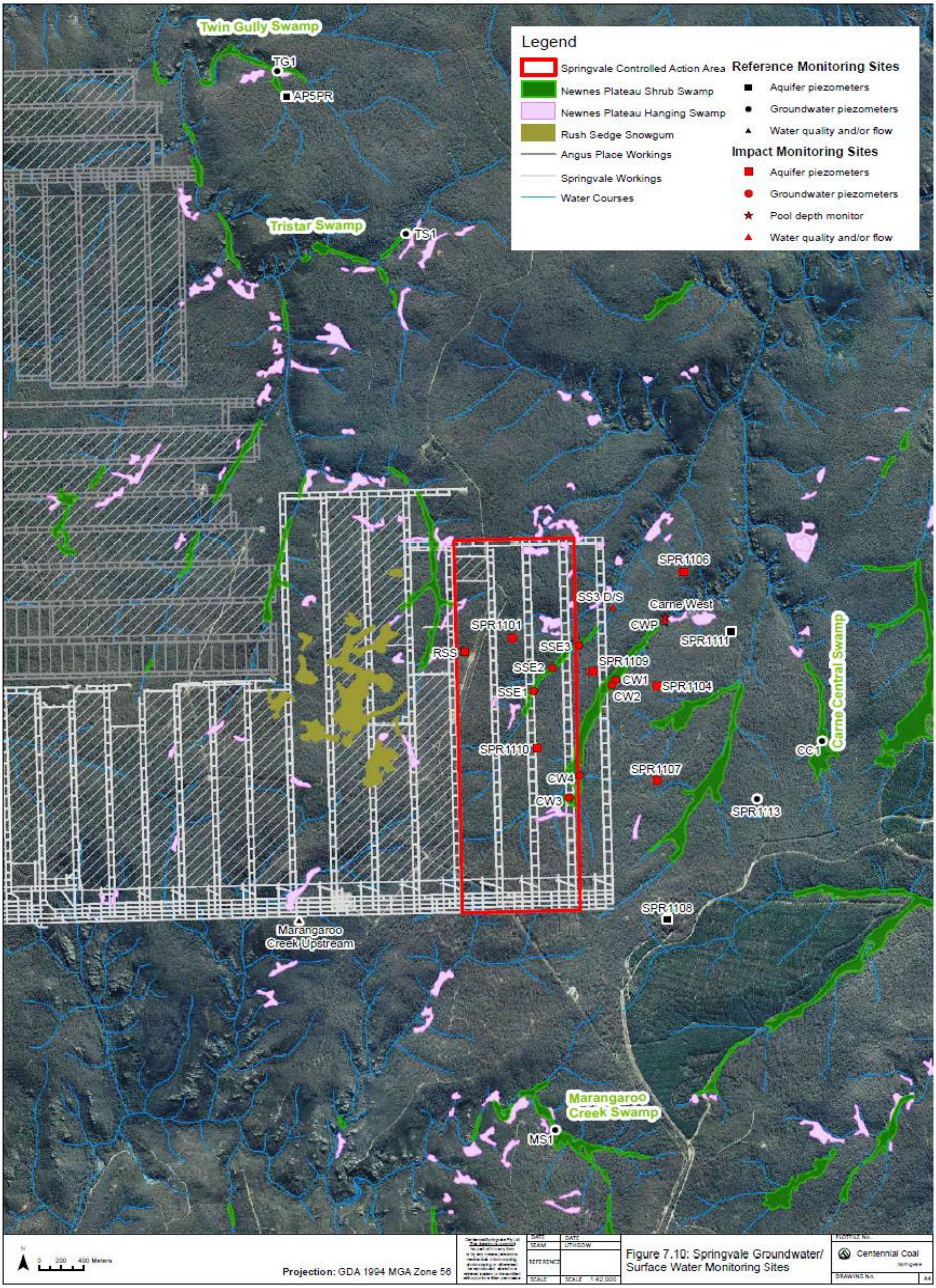

Figure 4 Groundwater and Surface Water Monitoring Locations

2.4. Surface Water

The most significant surface water flows in the Springvale controlled action area in the drainage lines that feed into the sub-permanently and permanently waterlogged swamps.

Details of the surface water monitoring sites are given in Table 6.

Groundwater monitoring locations are also shown on Figure 4 in Section 2.3.

Table 6. Surface Water Monitoring Sites

Site Name	Easting (GDA94)	Northing (GDA94)	Location	Mining date	Parameters monitored		
					water depth	flow rate	water quality
Surface Water Quality - Impact Sites							
Carne West	239808	6303782	Nth end of Carne West Swamp	Swamp will be undermined December 2015 – March 2016 (LW418) and September – October 2016 (LW419)		✓	✓
CWP	239816	6303814	Nth end of Carne West Swamp		✓		
SS3 D/S	239363	6303908	Nth end of Sunnyside East Swamp	Swamp undermined December 2013 (LW416), December 2014 (LW417) and November 2015 (LW418).			✓
Surface Water Quality - Reference Site							
Marangaroo Creek Upstream	236633	6301063	Marangaroo Creek upstream	Will not be undermined		✓	✓

3. MINING ACTIVITY

During the 2016 reporting period, coal was extracted from longwalls 418 and 419.

Relevant to this report are longwalls 415 to 417 which were mined between 2012 and 2015. A summary of longwall start and finish dates are presented below.

Longwall 415	Commenced on the 15th of March 2012 and was completed on the 17th of September 2013.
Longwall 416	Commenced on the 25th of September 2014 and was completed on the 19th of August 2014.
Longwall 417	Commenced on the 11th of October 2014 and was completed on the 4th of July 2015
Longwall 418	Commenced on the 22nd of October 2015 and was completed on the 27th of May 2016.
Longwall 419	Commenced on the 2nd of August 2016. Chainage at the 31st December 2016 was 734m.

Reporting requirements for longwalls 418 and 419 are covered under approval EPBC 2013/6881.

Mining activity undertaken in 2016 is shown in Figure 5.

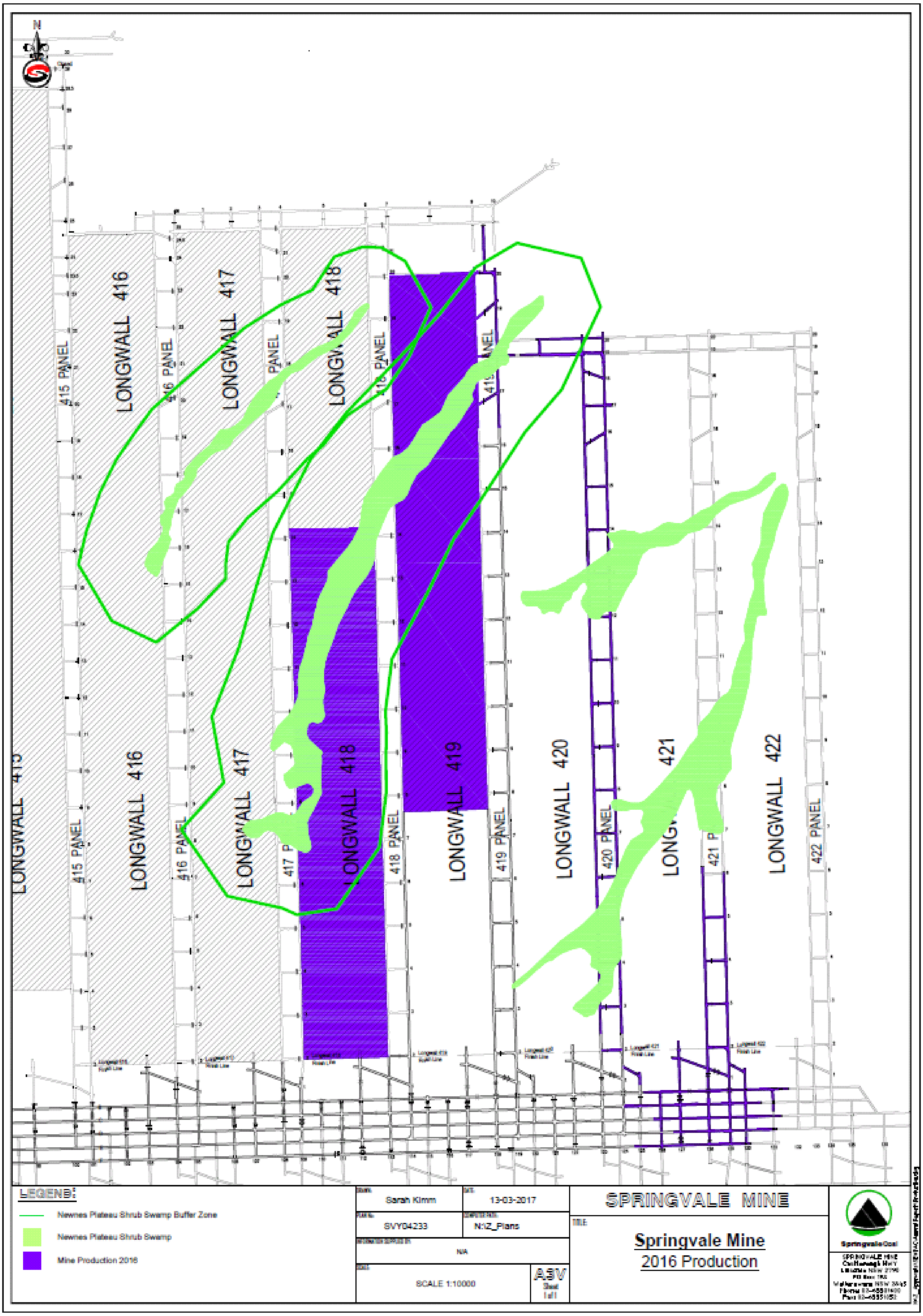

Figure 5 Mining Undertaken During 2016

4. METEROLOGICAL CONDITIONS

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.

Both Newnes Plateau and Lithgow rainfall levels for 2016 were above the Lithgow long term average and this year's data was notable due to large rainfall events in January, June, July and September.

Historically the June 2016 rainfall event was the second largest event and the July 2016 rainfall event was the largest event recorded for corresponding periods since monitoring began in 2003. In general, the annual rainfall for 2016 was average to above average with an above average rainfall period from June to September 2016.

Monthly rainfall data is summarised in Table 7 and presented in Figure 6.

Table 7. Total Monthly Rainfall for 2016 and Long Term Average

	2016 Observed Rainfall (mm)		Long term Average Rainfall (mm)	
	Newnes Plateau	**Lithgow Maddox Lane**	**Newnes Plateau**	**Lithgow Maddox Lane**
January 2016	190.4	142	86.9	89.4
February 2016	15.4	28.8	113.2	99.5
March 2016	50.2	69.6	73.7	68.8
April 2016	8.8	6.2	53.7	45.9
May 2016	29.4	26.0	46.7	34.8
June 2016	220.6	173.4	97.1	77.6
July 2016	107.4	91.4	50.9	42.5
August 2016	52.4	52.2	55.0	44.0
September 2016	132	118.6	53.4	51.9
October 2016	68.4	71.4	66.0	57.3
November 2016	53.6	58.4	100.8	82.0
December 2016	78.0	86.4	106.6	85.1
Annual Total	**1006.6**	**924.4**	**903.9**	**778.8**

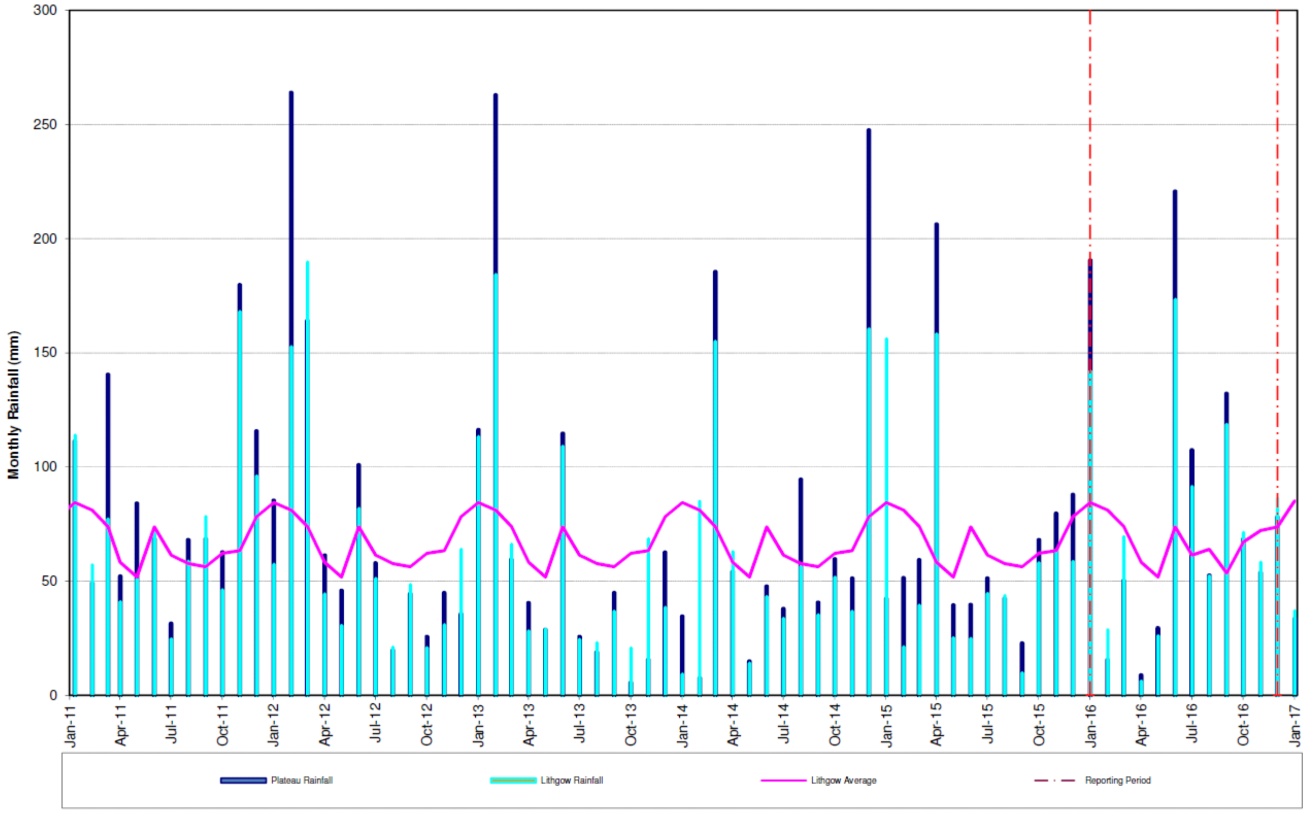

Figure 6 Monthly Rainfall – 2011 to 2017

5. MONITORING RESULTS

5.1. Subsidence

Subsidence monitoring has occurred in accordance with the Springvale Subsidence Management and Reporting Plan for Longwalls 415 to 417 (September 2011).

The following sections documents the maximum monitoring result for surveys undertaken for longwalls 415 - 417. Results presented were based on the End of Subsidence Review completed for Longwall 417.

All recorded subsidence results were below the trigger values established in the THPSSMP.

5.1.1. B Line Subsidence Monitoring

The following table summarises the results for the B Line. It is important to note that the B line uses the total station method which is known to be less accurate. Supplementary information may therefore be used to confirm results obtained in the event a trigger value is exceeded.

Table 8. B-Line Monitoring Results

	Subsidence (mm)		Tilt (mm/meter)		Tensile Strain (mm/meter)		Compressive Strain (mm/meter)	
	Max Result	**Trigger value**	**Max Result**	**Trigger value**	**Max Result**	**Trigger value**	**Max Result**	**Trigger value**
LW415	1231	1500	15.4	10	1.5	15	6.2	18
LW 416 to 418	920	1100	6.8	7	3.8	5	6.8	>6(plateaus) >14(valleys)

The exceedance of a subsidence trigger value has occurred in the tilt category. Tilt occurs when two points vertically displace at different rates resulting in an increase to the slope of the surface.
The subsidence event has occurred at a distance of approximately 630m from the nearest Temperate Highland Peat Swamp on Sandstone Ecological Community located in Carne West Swamp. This distance is approximately 450m greater than the distance specified for an anomalous subsidence trigger level.

The Temperate Highland Peat Swamp on Sandstone Monitoring and Management Plan for Longwalls 415 - 417 states that the anomalous subsidence trigger level for tilt is a value greater than 10mm/m when occurring within 200 metres of a Temperate Highland Peat Swamp on Sandstone Ecological Community. The value surveyed, located well outside the Buffer Zone, is between survey marks B345 and B346 at 15.2mm/m.

5.1.2. M Line Subsidence Monitoring

The following table summarises the results for the M Line.

Table 9. M-Line Monitoring Results

	Subsidence (mm)		Tilt (mm/meter)		Tensile Strain (mm/meter)		Compressive Strain (mm/meter)	
	Max Result	Trigger value	Max Result	Trigger value	Max Result	Trigger value	Max Result	Trigger value
LW415	842	1500	7.3	10	3.0	15	2.6	18
LW 416 to 418	342	1100	1.5	7	0.4	5	1.4	>6(plateaus) >14(valleys)

The table above demonstrates compliance with the trigger values defined in the THPSSMP.

5.1.3. V and VC Line Subsidence Monitoring – Sunnyside East Swamp

The following table summarises the results for the V and VC Lines.

Table 10. V and VC Monitoring Results

	Subsidence (mm)		Tilt (mm/meter)		Tensile Strain (mm/meter)		Compressive Strain (mm/meter)	
	Max Result	Trigger value	Max Result	Trigger value	Max Result	Trigger value	Max Result	Trigger value
LW417 to LW418	345	1100	3.5	7	0.5	5	4.7	14

The table above demonstrates compliance with the trigger values defined in the THPSSMP.

5.1.4. W and WC Line Subsidence Monitoring – Sunnyside East Swamp

The following table summarises the results for the W and WC Lines.

Table 11. W and WC Monitoring Results

	Subsidence (mm)		Tilt (mm/meter)		Tensile Strain (mm/meter)		Compressive Strain (mm/meter)	
	Max Result	Trigger value	Max Result	Trigger value	Max Result	Trigger value	Max Result	Trigger value
LW416 to 418	724	1100	5	7	1.6	5	5.8	14

The table above demonstrates compliance with the trigger values defined in the THPSSMP.

5.1.5. Y and YC2 Line Subsidence Monitoring – Carne West Swamp

The following table summarises the results for the Y and YC2 Lines.

Table 12. Y and YC2 Monitoring Results

	Subsidence (mm)		Tilt (mm/meter)		Tensile Strain (mm/meter)		Compressive Strain (mm/meter)	
	Max	Trigger	Max	Trigger	Max	Trigger	Max	Trigger

	Result	value	Result	value	Result	value	Result	value
LW416 to 418	406	1100	2.4	7	0.9	5	5.5	14

The table above demonstrates compliance with the trigger values defined in the THPSSMP.

5.1.6. LiDAR

A LiDAR campaign was undertaken in June 2016. There were no anomalous results detected from the flight.

5.2. Flora

Springvale engages a specialist consultant to undertake monitoring and analyse the results of vegetation monitoring. Data analysis focuses on trends that have been observed that may relate to mining impacts between seasons in 2013 and 2014, in addition to assessing the extent of variation in vegetation composition and condition between monitoring surveys in 2014 and those conducted in previous years.

The following sections present a summary of the 2016 Spring report.

The following table shows impact and reference sites to assist in the interpretation of data.

Table 13. Flora Impact and Reference Sites

Impact Sites	Reference sites
SSE01	TG01
WC01	TG02
WC02	TRI01
WC03	LGG01
WC04	UGE01
	BS01
	CCS01

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

Species richness across reference and impact swamps has remained relatively consistent in spring 2016.

Table 14. Total Native Plant Species Richness

Site	Species Richness		Shannon-Wiener Index (point intercept method)	Evenness
	400m² Quadrat	Point Intercept Method		
Impact sites				
WC01	18	14	1.94	0.74
WC02	17	12	2.10	0.84
WC03	15	13	1.90	0.74
WC04	13	11	1.90	0.79
SSE01	22	18	2.27	0.78
Mean±SD	17.0 ± 3.4	13.6 ± 2.7		
Reference sites				
TG01	24	15	2.12	0.78
TG02	20	15	2.11	0.78
TRI01	25	17	2.29	0.81
TRI02	20	19	2.16	0.73
LGG01	38	26	2.42	0.74
UGE01	25	21	2.09	0.69
BS01	21	18	2.28	0.79
CCS01	27	19	2.17	0.74
Mean±SD	25.1 ± 6.2	18.8 ± 3.6		

Lower mean native species richness was observed in impact sites (17.0 ± 3.4) when compared with reference sites (25.1 ± 6.2), however species richness across reference and impact swamps has remained relatively consistent in spring 2016 relative to winter 2016.

Mean species richness results against trigger levels are presented in Table 15. No exceedance in species richness was observed at impact sites. One exceedance was recorded at reference site TRI01 (result 25 against a lower trigger level of 25.2) and LGG01 (result 38 against an upper trigger level of 37.7).

Table 15. Mean Species Richness and Trigger Levels

Site	Mean Species Richness (baseline)	Upper Trigger	Lower Trigger	Result
Impact sites				
WC01	16	20.8	11.2	18
WC02	19	24.7	13.3	17
WC03	15	19.5	10.5	15
WC04	16	20.8	11.2	13
SSE01	29	37.7	20.3	22
Reference sites				
TG01	23	29.9	16.1	24
TG02	26	33.8	18.2	20
TRI01	36	46.8	25.2	**25**
TRI02	18	23.4	12.6	20
LGG01	29	37.7	20.3	**38**
UGE01	26	33.8	18.2	25
BS01	18	23.4	12.6	21
CCS01	29	37.7	20.3	27

The reason for a continued exceedance a reference sites TRI01 and LGG01 is unknown although Erskine and Fletcher (2011) indicate a number of potential casual environmental factors other than mining (e.g. climate, biotic or anthropogenic) requiring consideration.

The upper exceedance of trigger levels for LGG01 may be attributed to the intermediate disturbance hypothesis (IDH), which postulates that both high (e.g. fire) and low rates of disturbance will result in low species diversity., while at intermediate levels of disturbance, species diversity will increase as both early and late successional species can coexist. LGG01 underwent major disturbance from fire in 2012 and has, likely, since been in a state of regeneration. Exceedance of the upper trigger level for LGG01 may be attributed to it being in a transitional successional stage of regeneration, which may facilitate a temporary invasion of dry sclerophyll species.

As regeneration of the community proceeds, species diversity and the species present may return to baseline ranges, thus not exceeding any trigger levels. If groundwater loss from mining is not the reason for the change in species richness, then it is considered that further monitoring events are likely to show a return to baseline conditions as the effects of competitive exclusion on dry sclerophyll species are experienced.

5.2.2. 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 within monitoring sites for the spring period is shown in Table 16 below.

Table 16. Eucalypt Recruitment in Spring 2016

Site	Transect (metre intercept)			
	2	8	9	20
Impact				
WC01	-	-	-	-
WC02	-	-	-	-
WC03	-	-	-	-
WC04	-	-	-	-
SSE01	-	-	1	-
Reference				
TG01	-	-	-	-
TG02	-	-	-	-
TRI01	-	-	-	-
TRI02	-	-	-	1
LGG01	-	-	-	2
UGE01	-	-	-	-
BS01	-	-	-	-
CCS01	-	-	-	-

Eucalypt recruitment results for spring 2016 did not represent an exceedance in trigger levels.

5.2.3. Species Condition Scores

Four parallel transects were established to measure condition. 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 transect.

Mean species condition scores for impact and reference sites is shown in Table 17. Mean condition scores for *Gleichenia dicarpa* have also been included as this is a key swamp species.

Table 17. Species Condition: Overall Mean and a Key Swamp Species *Gleichenia dicarpa*

Site	Overall mean condition	*Gleichenia dicarpa* mean condition	*Gleichenia dicarpa - Spring 2016*
Impact			
WC01	3.60	2.91	2.52
WC02	2.93	**1.47**	3.41
WC03	3.46	**1.74**	2.22
WC04	3.37	**1.53**	2.70
SSE01	4.15	3.08	4.96
Mean condition (impact)	3.5	2.15	2.0
Reference			
TG01	4.32	3.39	-
TG02	4.2	3.31	-
TRI01	4.19	3.22	-
TRI02	2.93	4.0	-
LGG01	4.29	-	-
UGE01	4.27	4.02	-
BS01	4.02	3.62	-
CCS01	4.05	3.37	-
Mean condition (reference)	4.03	3.56	-

No sites triggered overall mean condition scores. However, the condition of *Gleichenia dicarpa* (a key swamp species) is below the trigger threshold for three Carne West monitoring sites (i.e. WC02, WC03 and WC04). This result is consistent with findings reported in the winter 2016 monitoring report for WC03 and WC04. However, differences to the winter 2016 reporting include a new trigger event at WC02 and a return to within range condition for WC01. In reference to WC01, it is important to note that the mean condition score for *Gleichenia dicarpa* remains below the mean score for reference sites. Further information on this is provided in Section 6.2.

5.2.4. 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 18.

Table 18. **Non-live Ground Cover (point intercept method)**

Site	Point intercept Method (%)
Impact	
WC01	0
WC02	0
WC03	12.5
WC04	**28.8**
SSE01	5.6
Reference	
TG01	8.1
TG02	3.1
TRI01	0
TRI02	0
LGG01	2.3
UGE01	1.3
BS01	0
CCS01	0

A trigger event has been recorded at WC04 (i.e. increase in bare ground of greater than 100 m^2 over a 3 year period). The change observed is 1.25% in summer 2016 to 28.75% in spring 2016. Further information on this is provided in Section 6.2.

5.2.5. Establishment of Non-Native Weeds

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

No weeds were detected using the point intercept method or within the 400 m^2 flora quadrats.

5.2.6. Conclusions

Monitoring results were compared with the flora trigger levels specified in the THPSS MMP. The results of this comparison are provided in Table 19.

Table 19. **Monitoring Results and Flora Trigger Levels**

Performance indicator	Parameter measured	Trigger level	Spring 2016
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.	Trigger in LGG01 (reference swamps). Reason unknown.
	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.	No exceedance in trigger values observed.
Change in condition	Condition of key species	A decline in condition score at	WC02, WC03 and WC04 has

Performance indicator	Parameter measured	Trigger level	Spring 2016
		an impact site of more than 1.5 compared to the average condition score at reference sites within a one year period.	recorded a trigger level exceedance for the condition of *Gleichenia dicarpa*. Continued investigation recommended.
	Non-live ground cover	An increase of bare ground of more than $100m^2$ in a site within a three year period.	Increase of magnitude exceeding the trigger level was observed in WC04. Trigger consistent with 'condition of key species' trigger.
	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.

The species richness exceedance within two reference site represents a continuation of an existing trend and requires no further action.

The condition of Gleichenia dicarpa, an identified key swamp species, has declined in Carne West with triggers observed at three sites (WC02, WC03 and WC04). These triggers are already under investigation, which may identify the need for management. Observed changes are in visible vegetation attributes and, within the context of reference swamp observations, may represent a response to mining activity beneath the Carne West swamp.

5.3. Groundwater

A specialist consultant is engaged by Centennial Springvale to analyse groundwater data results. The following sections summarise the results of the monitoring undertaken.

5.3.1. Swamp Piezometer Results

Table 20 presents a comparison of the baseline defined in the THPSSMP to the recalculated baseline based upon additional monitoring data presented prior to 200m from the piezometer location.

Table 20. Comparison of Swamp Piezometers 95th Percentile

Impact Site	95th Percentile 2005-2012	95th Percentile 2005 to 2014	95th Percentile: difference between 2005-2012 and 2005-2014
SSE1	2.12	2.16	0.04
SSE2	0.7	0.86	0.16
SSE3	0.17	1.71	1.54
CW1	0.25	0.91	0.66
CW2	0.24	0.36	0.12
CW3	1.01	1.07	0.06
CW4	1.20	1.34	0.14

Sunnyside East

The water level at Sunnyside East Swamp is monitored at piezometers SSE1, SSE2 and SSE3. All three piezometers were installed in March 2010.

SSE1

SSE1 is the deepest of the three piezometers installed at Sunnyside East and has shown water levels to be below the base of the piezometer throughout 2016. Historically this site has shown some strong responses to rainfall but only after prolonged rainfall and higher than average seasonal rainfall. No responses to rainfall were observed in SSE1 in 2016. This is not uncommon for this piezometer, as frequently in previous years the water level in the piezometer remains unresponsive for durations of 8 to 10 months.

As the water level tends to remain below the bottom of the piezometer it is difficult to determine any mining influences at this location.

SSE1 had exceeded the short term trigger level to initiate an investigation during the passing of LW416. An Investigative Report was submitted in May 2014 in accordance with Springvale approvals. The water level remained beneath the trigger level throughout the extraction of LW418 and LW419.

Groundwater levels for SSE1 are presented in Figure 7.

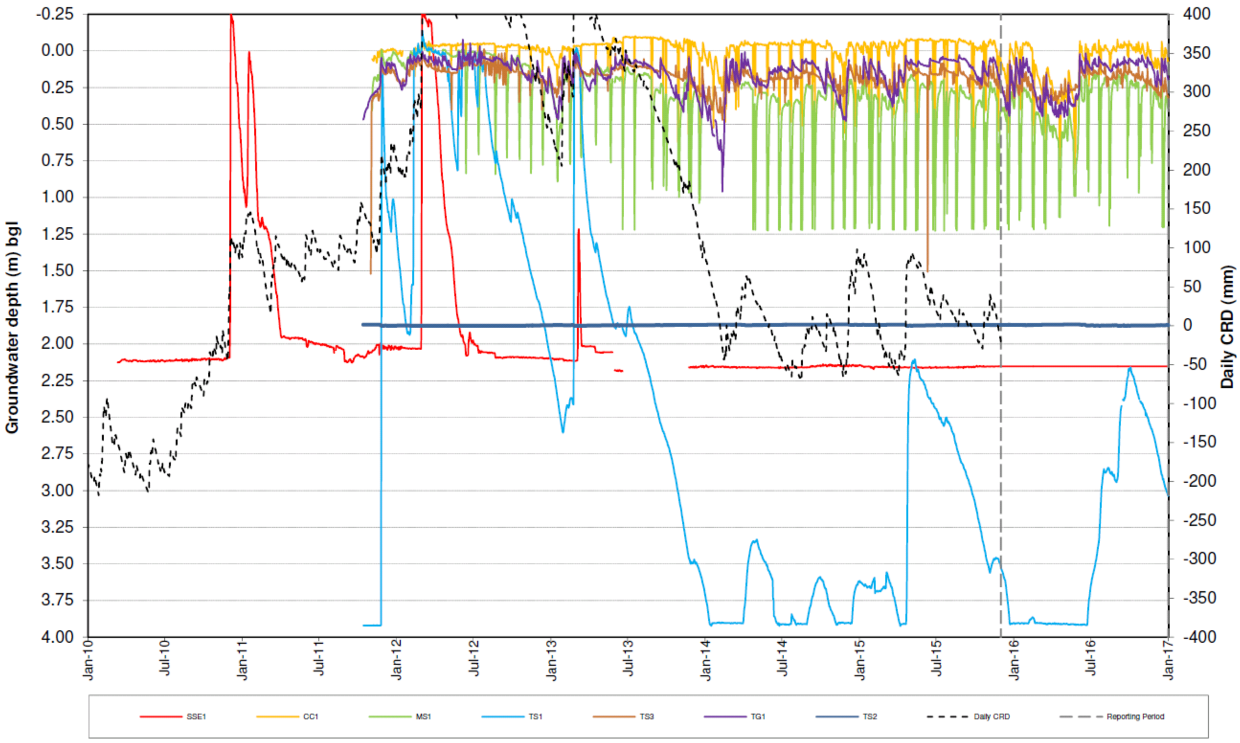

Figure 7 SSE1 and Reference Sites Swamp Piezometer Hydrograph - 2010 to 2017

SSE2

The water level in SSE2 has predominantly remained below the base of the piezometer since 2013 following a period of decline that started in March 2013. The onset of this decline coincides with a prolonged period of below average rainfall, which continued up to early 2014. Subsequent rainfall has been around average with short intense periods of rainfall followed by a longer period of lower than average rainfall of up to 12 months. Only minor water level responses to rainfall are observed in this piezometer over the review period, however they do suggest that natural water levels are being observed as opposed to water trapped within the base of the piezometer.

The initial 2013 decline observed at SSE2 shows a similar, and more subdued, trend to reference swamp TG1. While it is difficult to make comparison with the water levels from 2014 onwards, it is worth noting that TG1 has only shown one water level response above the equivalent level to when SSE2 declined below the base of the piezometer in 2013 (approximately 2.5mbgl). This suggests that the responses observed during the reporting period are possibly due to natural climatic variations.

SSE2 exceeded the short term trigger level to initiate an investigation during the passing of LW416. An Investigative Report was submitted in May 2015 in accordance with Springvale approvals. The water level remained beneath the trigger level throughout the extraction of LW418 and LW419.

Groundwater levels for SSE2 are presented in Figure 8.

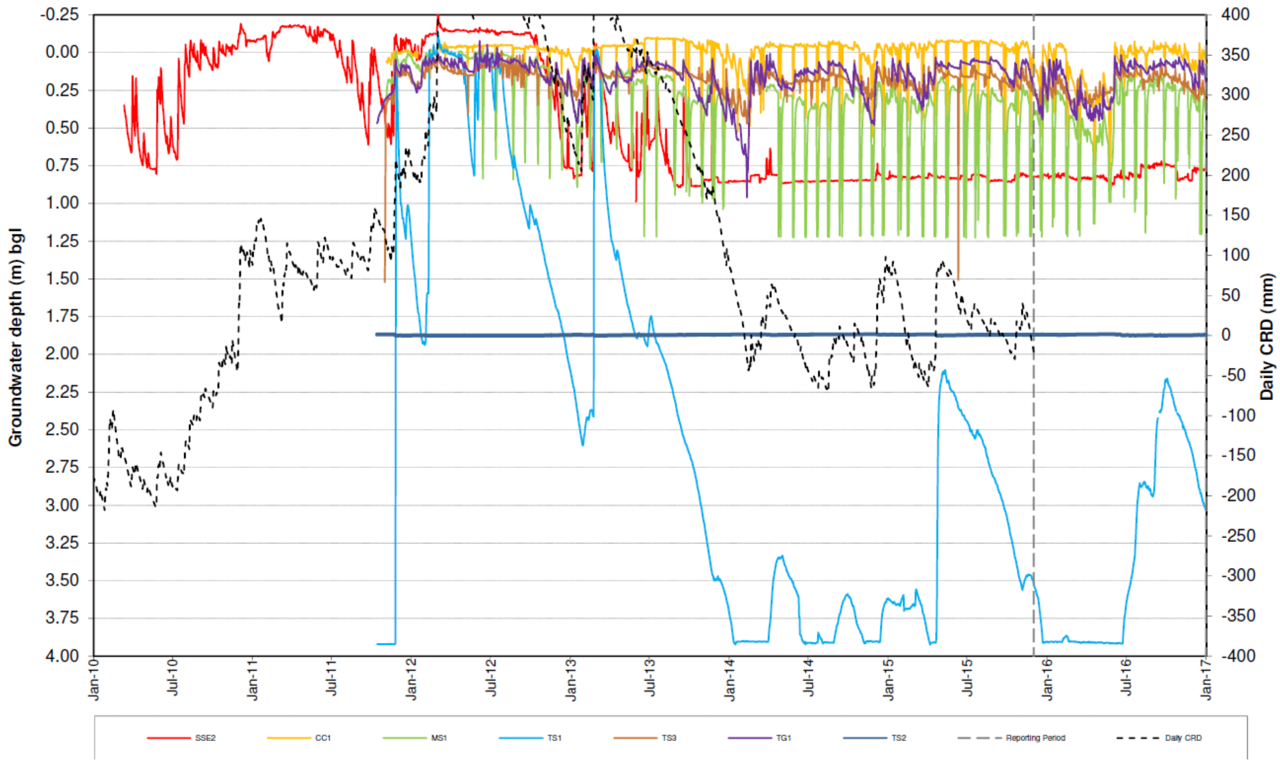

Figure 8 SSE2 and Reference Sites Swamp Piezometer Hydrograph - 2010 to 2017

SSE3

SSE3 water levels have shown a very similar pattern to those in SSE2 with a decline from approximately ground level during the latter half of 2012 and commencing the current review period with the water level below the base of the piezometer at around 1.7mbgl. The onset of this decline in 2012 coincides with a prolonged period of below average rainfall, which continued up to March 2014. During the current review period, SSE3 showed definitive responses to the two significant rainfall events of 2016 – in January and the period July to September. Overall, during 2016 despite being below the base of the piezometer for considerable periods, the water levels showed a characteristic rainfall influenced trend only rising after prolonged and significant rainfall events.

SSE3 is responsive to moderate rainfall intensity events as well as extended periods of below average rainfall. SSE3 shows similar trends to both SSE2 and TG1 although more accentuated than those at SSE2. This indicates that the responses observed during the reporting period are likely due to natural climatic variations although it is noted that the water level has not recovered to the levels observed prior to the drops observed in 2012.

SSE3 exceeded the short term trigger level to initiate an investigation during the passing of LW417. An Investigative Report was submitted in May 2015 in accordance with Springvale approvals.

Groundwater levels for SSE3 are presented in Figure 9.

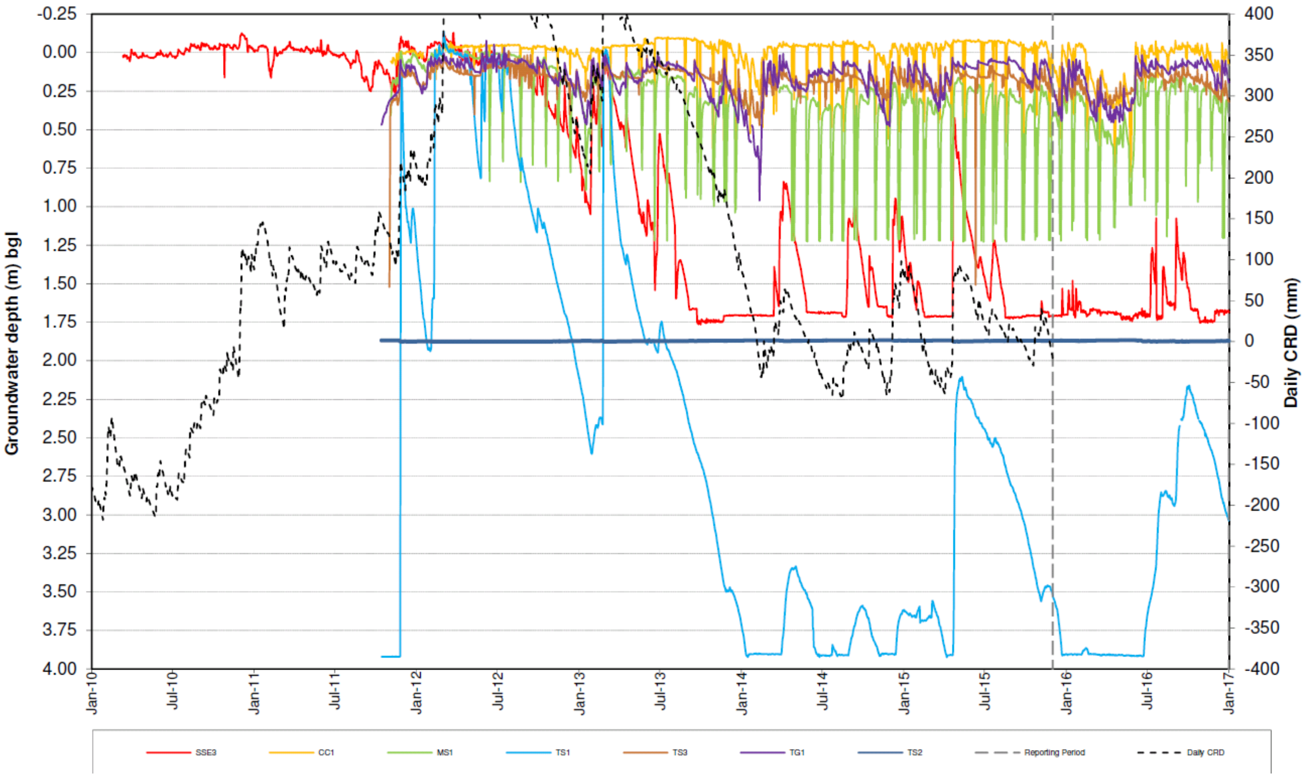

Figure 9 SSE3 and Reference Sites Swamp Piezometer Hydrograph - 2010 to 2017

Carne West

The water level at Carne West Swamp is monitored at piezometers CW1, CW2, CW3 and CW4. CW1 and CW2 were installed in May 2005, originally to provide background data on hydrogeological conditions in the swamp as well as comparative background data for other swamps. CW1 and CW2 provide an indication if standing water level changes occur in Carne West Swamp upstream of the monitoring sites. CW3 and CW4 were installed in October 2011 at the southern end of the swamp to provide monitoring coverage in the vicinity of LW417.

CW1

The water level observed in CW1 has shown a significant drop during 2014 and during the current review period remained below the base of the piezometer based upon regular manual dips although the transducer is possibly recorded trapped water in the base of the piezometer. This decline started in March 2013 and continued throughout 2014 until the water level reached the bottom of the piezometer (approximately 0.92mbgl) in mid-July. This level represents the lowest water level since monitoring began.

CW1 has typically shown similar fluctuation magnitudes to reference sites CC1, MS1 and TG1 prior to March 2013. The rapid water level decline is not typical for the swamp and indicates there may be a loss of baseflow to the swamp. Whether this is mine related or due to the steady decline observed in the regional groundwater table is unclear.

CW1 exceeded the short term trigger level to initiate an investigation during the passing of LW418. An Investigative Report was submitted in February 2016 in accordance with Springvale approvals.

Groundwater levels for CW1 are presented in Figure 10.

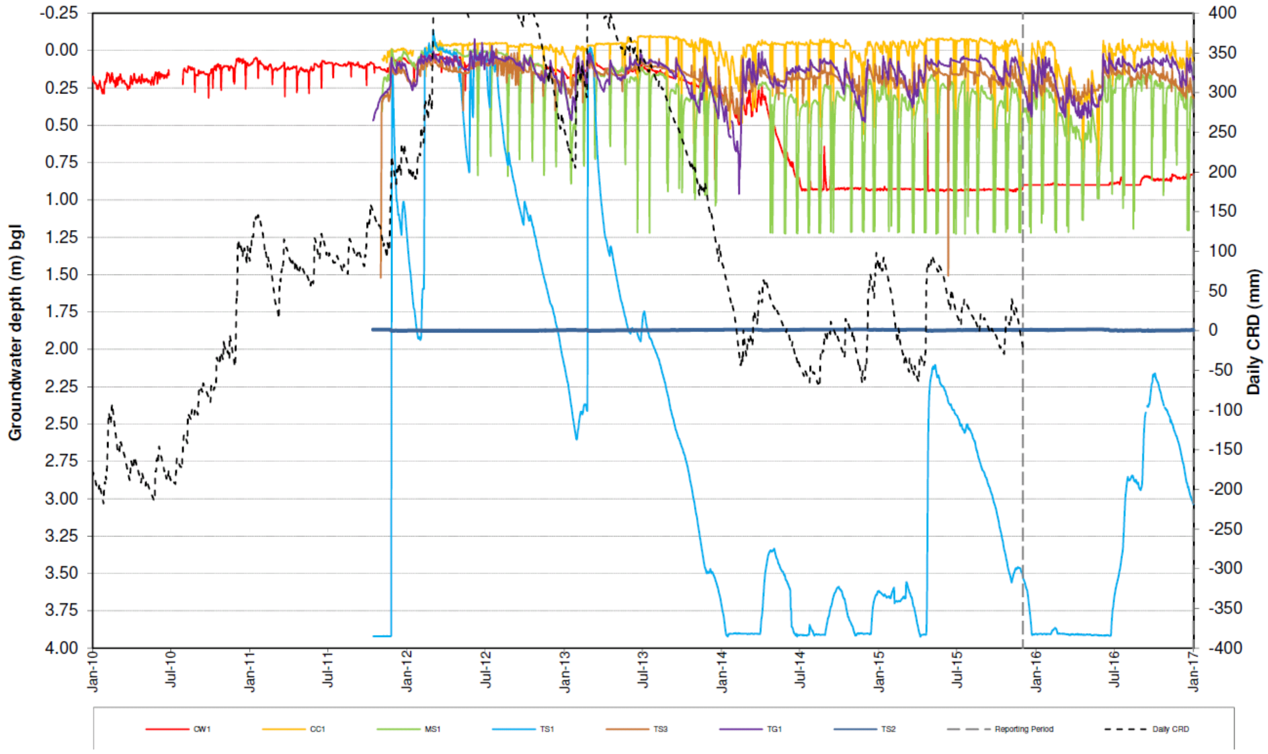

Figure 10 CW1 and Reference Sites Swamp Piezometer Hydrograph - 2010 to 2017

CW2

The water level observed in CW2 has shown a decline in standing water level throughout 2014 with the water level dropping below the base of the piezometer in March 2015 where it remained until the middle of 2016. A series of short lived spikes in water level rainfall events occurred until September where the water level dropped below the base of the piezometer and has remained there until the end of the reporting period. CW2 historically showed similar fluctuation magnitudes to reference sites CC1, MS1 and the decline from 2014 is uncharacteristic and not consistent with responses observed at any of the reference swamps.

CW2 exceeded the short term trigger level to initiate an investigation during the passing of LW418. An Investigative Report was submitted in February 2016 in accordance with Springvale approvals.

Groundwater levels for CW2 are presented in Figure 11.

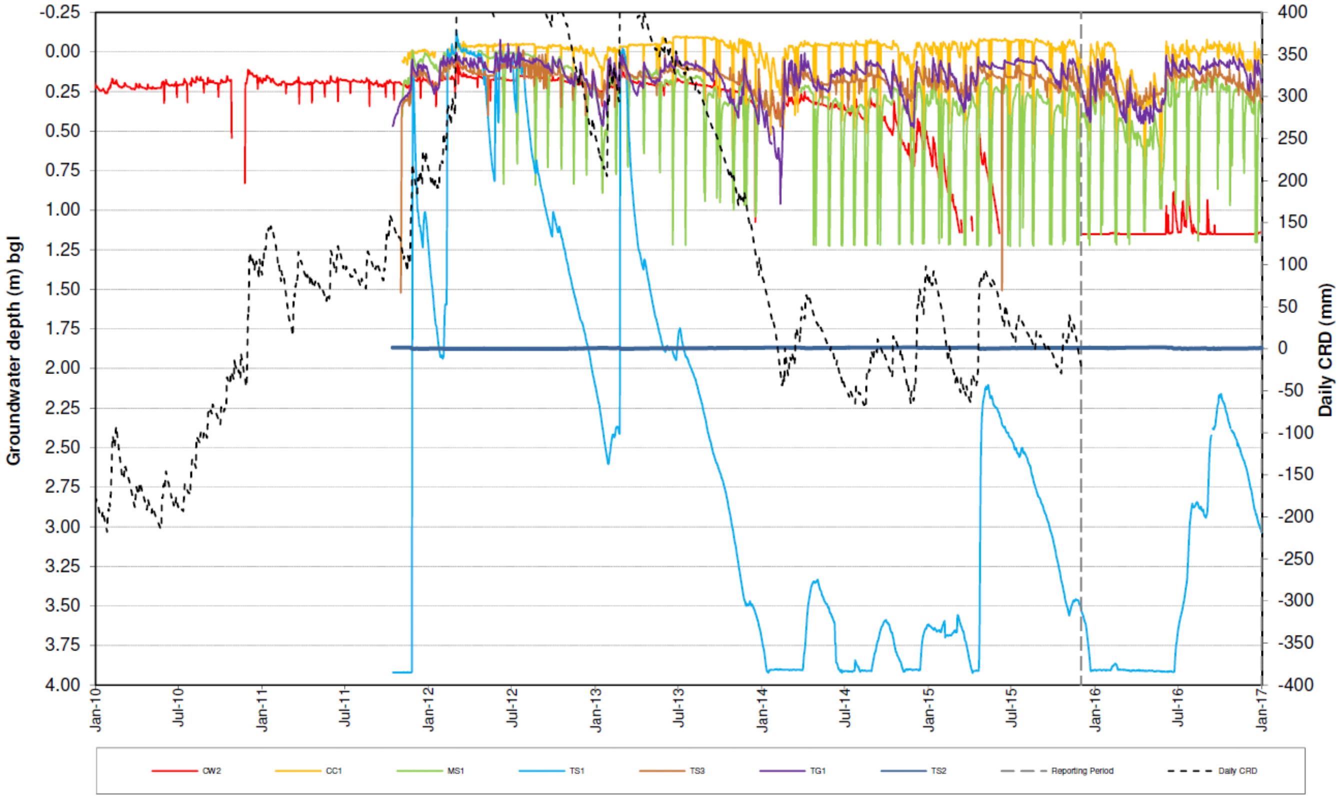

Figure 11 CW2 and Reference Sites Swamp Piezometer Hydrograph - 2010 to 2017

CW3

The water level in CW3 remained below the base of the piezometer throughout the current review period. Since monitoring was initiated CW3 responded only to significant and prolonged rainfall events on two occasions, once in March 2012 and again in February 2013. The characteristic response for this piezometer comprises rapid rises and subsequent declines in water level to a depth below the base of the piezometer. The hydrograph indicates that the two above average rainfall periods in 2016 did not result in observed water levels above the bottom of the piezometers in CW3.

CW3 exceeded the short term trigger level during the passing of LW417. An Investigative Report was submitted in September 2015 in accordance with Springvale approvals.

Groundwater levels for CW3 are presented in Figure 12.

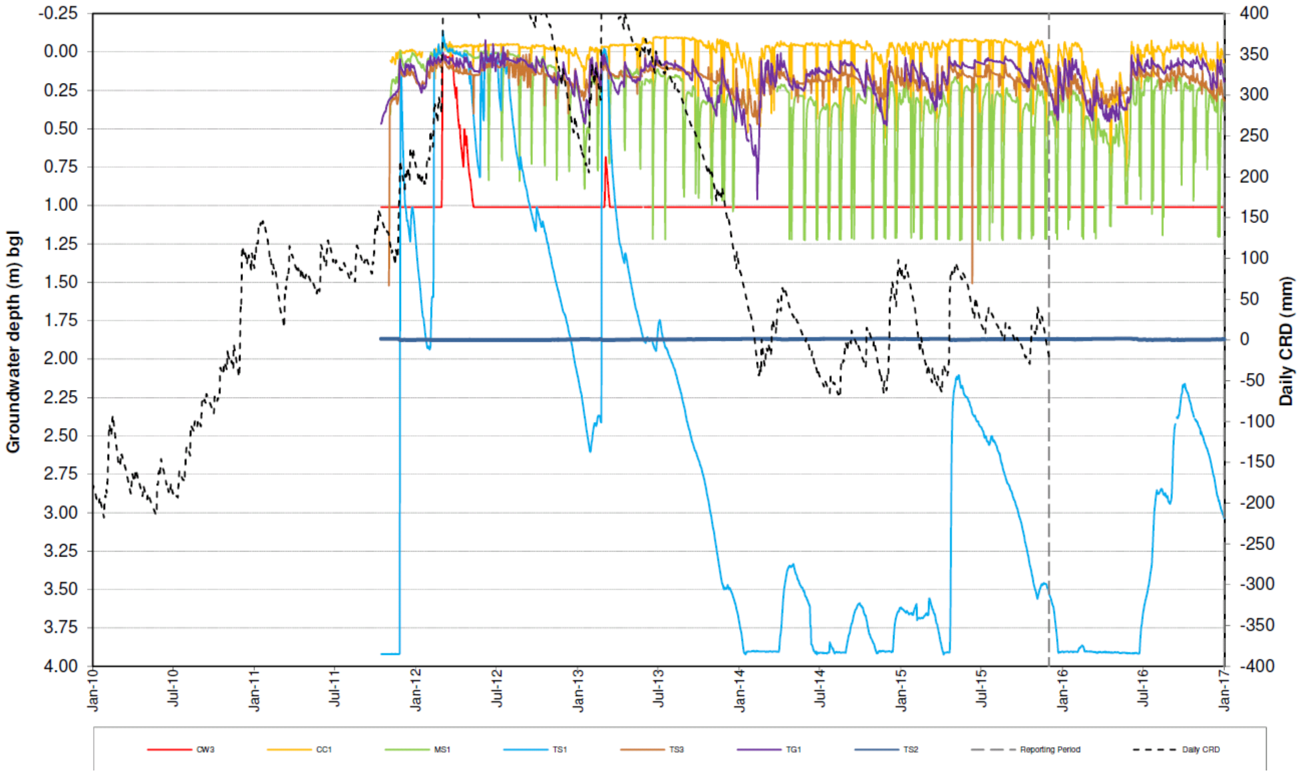

Figure 12 CW3 and Reference Sites Swamp Piezometer Hydrograph - 2010 to 2017

CW4

The water level in CW4 remained beneath the base of the piezometer throughout the review period. Since monitoring was initiated CW4 had been highly responsive to rainfall events and water levels corresponded closely with the Cumulative Rainfall Deficit (CRD) until the middle of 2013. Subsequent periods of above average rainfall in 2015 and 2016 has not led to water levels rising above the base of the piezometer.

CW4 has typically shown similar groundwater fluctuations as observed in reference sites TG1 and TS1 and is intermediate between the two.

CW4 exceeded the short term trigger level during the passing of LW417. An Investigative Report was submitted in September 2015 in accordance with Springvale approvals.

Groundwater levels for CW4 are presented in Figure 13.

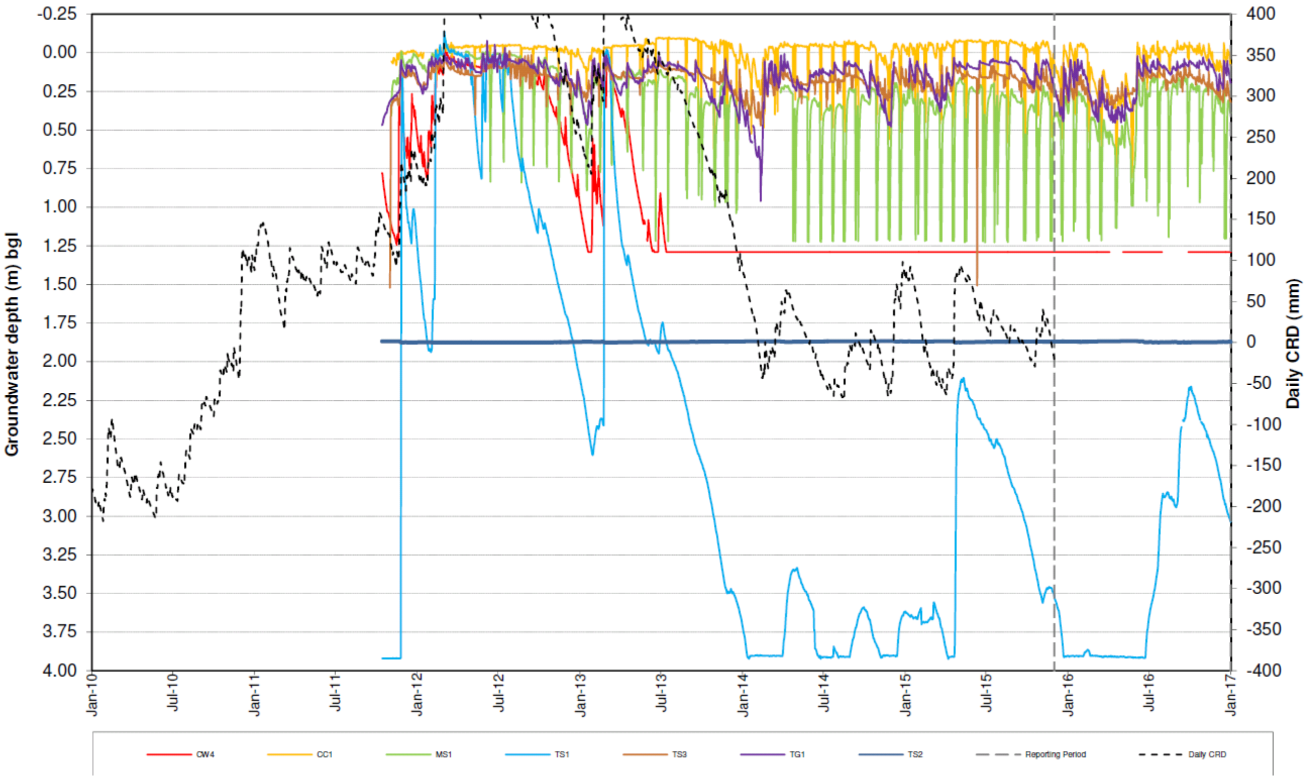

Figure 13 CW4 and Reference Sites Swamp Piezometer Hydrograph - 2010 to 2017

5.3.2. Aquifer Piezometer Results

A series of fifteen ridge piezometers have been established to monitor the groundwater level in the near-surface unconfined aquifers in the Burralow Formation and Banks Wall Sandstone at Springvale. Six of these have been chosen as impact swamps including RSS, SPR1110, SPR1104, SPR1107, SPR1109, and SPR1110 due to their close proximity to the active longwalls. Ridge piezometers are equipped with water level data loggers.

As with the swamp piezometer results, Table 21 presents a comparison of the baseline defined in the THPSSMP to the recalculated baseline based upon additional monitoring data presented prior being within 200m of the instruments.

Table 21. Comparison of Regional Aquifer Piezometers 95th Percentile

Impact Site	**95th Percentile 2005-2012**	**95thPercentile 2005 to 2016**	**95th Percentile: difference between 2005-2012 and 2005-2014**
RSS	29.52	29.80	0.28
SPR1101	36.08	N/A	N/A
SPR1104	25.28	29.07	1.57
SPR1107	22.50	31.84	2.00
SPR1109	36.19	41.50	5.31
SPR1110	58.78	65.26	6.48

RSS

RSS is located directly overlying LW415. Apart from a slight rise June to September 2016, the water levels in this piezometer maintained a steady trend throughout 2016 with the stabilisation of a decline during previous years.

Groundwater levels for RSS are presented in Figure 14.

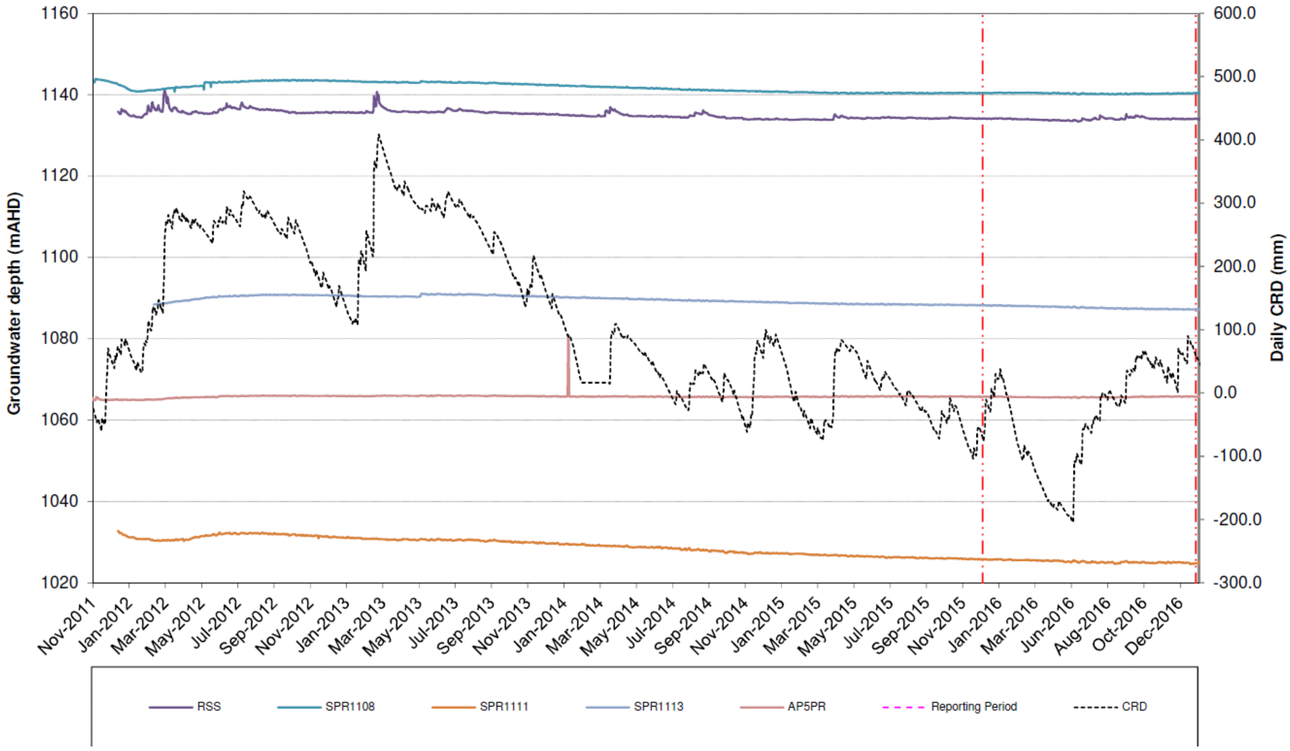

Figure 14 RSS and Reference Ridge Piezometer Hydrograph - 2011 to 2016

SPR1101

The water level in this borehole has typically remained relatively stable at 35mbgl throughout its monitoring history. However, the water level began to decline on 3 December 2013 to 42.29mbgl on 22 December 2013. This represents a drop of 6.99m to a level below the bottom of the piezometer as the piezometer is dry. This period also corresponds to the time when LW416 was passing underneath. An investigation into the reason for the rapid drop in the water level in this monitoring point has been conducted. The investigation found that the piezometer hole was previously used as an exploration borehole and was drilled to a depth which intersected strata where bed separation effects and increased storage occurred, and while the water level has declined, it does not represent any net loss of water from the aquifer.

The replacement of SPR1101 with a deeper piezometer to intercept the reduced water level has been completed (SPR1401). A groundwater level logger was installed in this piezometer on the 20th November 2014. The water level in SPR1401 declined to around 35mbgl in mid-2015 and then stabilised. The stabilisation confirms the decline to be due to bed separation effects.

Groundwater levels for SPR1101 are presented in Figure 15.

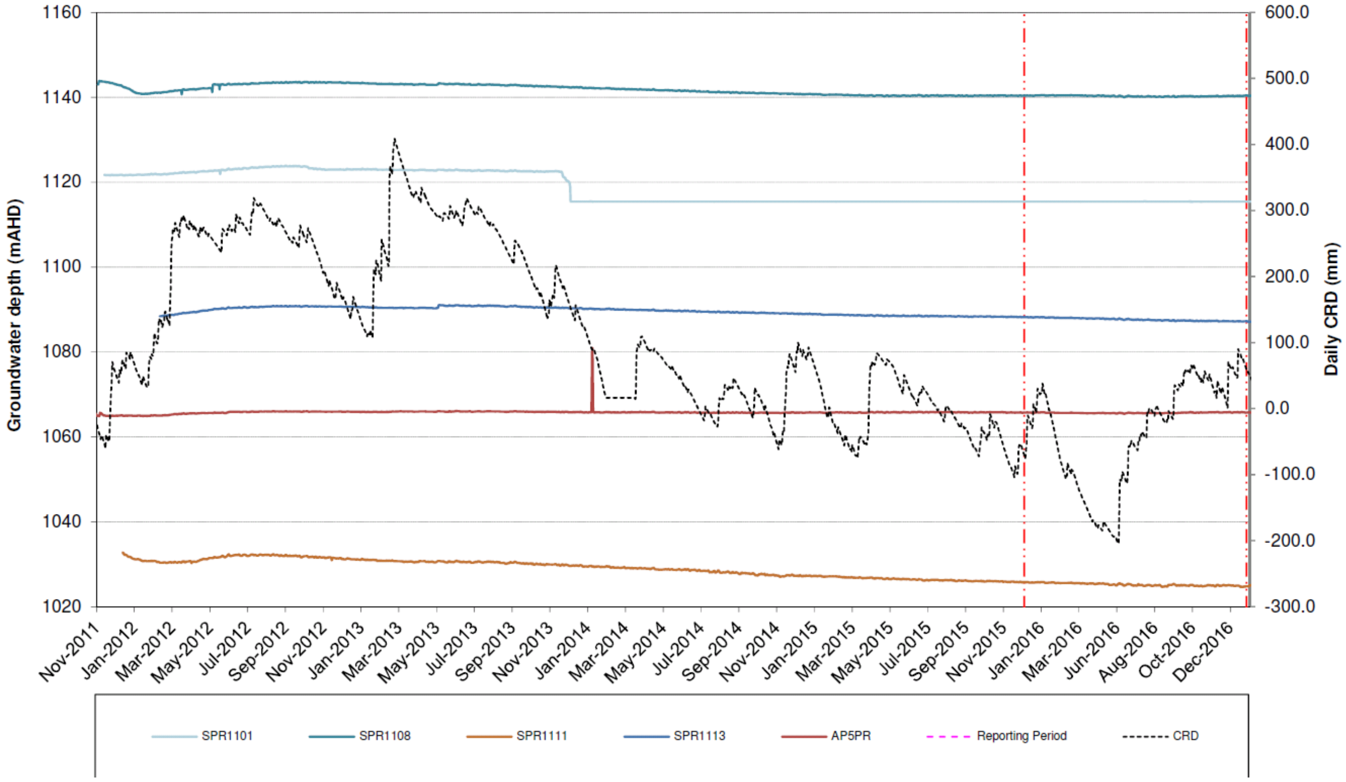

Figure 15 SP1101 and Reference Ridge Piezometer Hydrograph - 2011 to 2016

SPR1104

SPR1104 shows an almost identical groundwater level response to the reference piezometers SPR1113, SPR1108 and SPR1111, both historically and throughout the current review period until October 2016 when water level dropped then appears to have stabilised in December towards the end of the reporting period. This has been inferred to be in response to LW419 mining leading to bed separation effects as noted historically in SPR1101. SPR1104 dropped below the short term trigger (pre-mining 5th percentile) on the 2nd of August 2016 immediately upon entering the 600m trigger investigation area associated with LW419.

As a result of the long term trend of slowly decreasing water levels at ridge piezometers, the measured water level before mining approached SPR1104 was already at the lower end of the dataset (i.e. >5%). A statistical review of SPR1104 indicated that the 7 day rolling average had been greater than the short term trigger criteria (pre-mining 5th percentile) prior to mining occurring within the 600m trigger investigation area. The trigger has been initiated by mining occurring within the 600m trigger investigation area and not by an observed stepped decrease in water levels. This correlates with the hydrographs showing the long term trend of steadily dropping water levels.

An Investigative Report was submitted in February 2017 in accordance with Springvale approvals.

Groundwater levels for SPR1104 are presented in Figure 16.

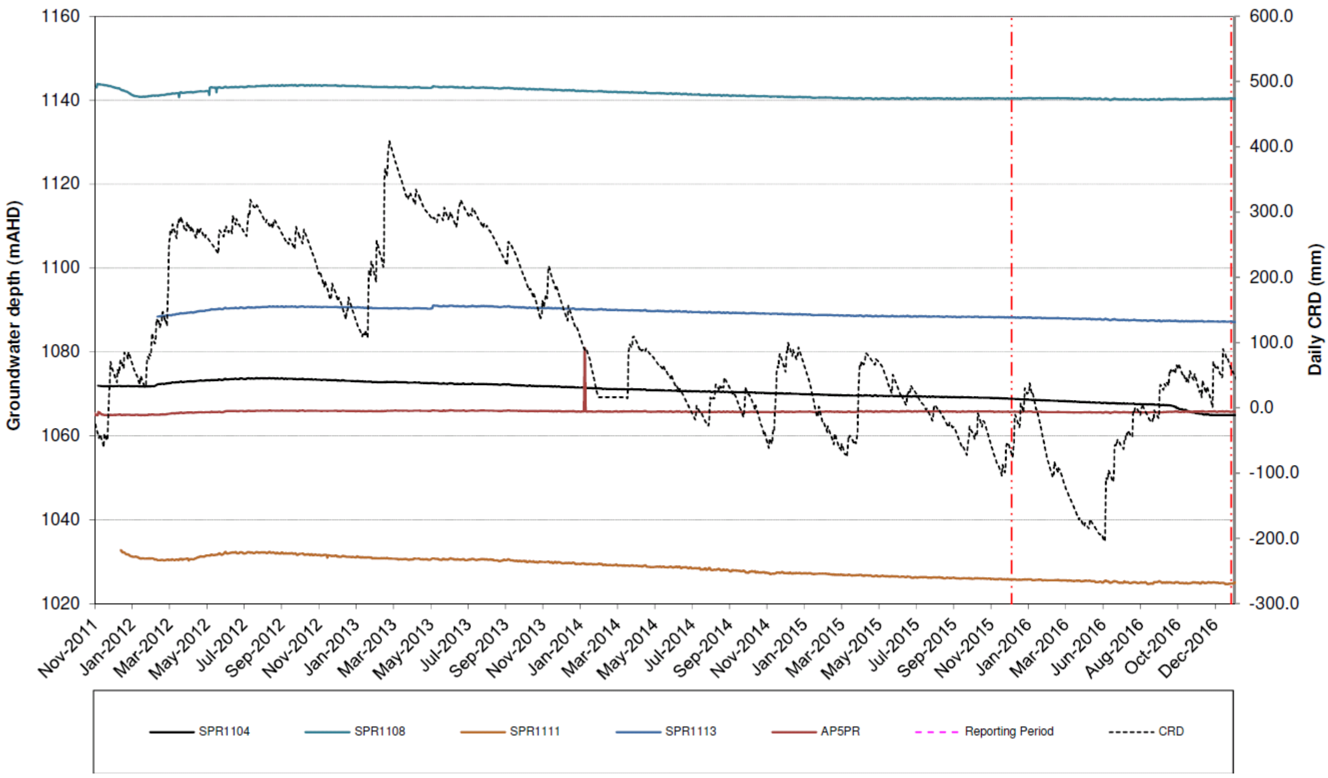

Figure 16 SPR1104 and Reference Ridge Piezometer Hydrograph - 2011 to 2016

SPR1107

SPR1107 showed similar groundwater level response to the reference piezometers SPR1113, SPR1108 and SPR1111 historically, throughout the current review period the water level has departed from the historical trend by steadily dropping. SPR1107 has not yet been undermined although it is within the 600m trigger investigation area for LW419. SPR1107 dropped below the short term trigger (pre-mining 5th percentile) on the 4th of November 2016 immediately upon entering the trigger investigation area associated with LW419.

As a result of the long term trend of slowly decreasing water levels at ridge piezometers, the measured water level before mining approached SPR1107 was already at the lower end of the dataset (i.e. >5%). A statistical review of SPR1104 indicated that the 7 day rolling average had been greater than the short term trigger criteria (pre-mining 5th percentile) prior to mining occurring within the 600m trigger investigation area. The trigger has been initiated by mining occurring within the 600m trigger investigation area and not by an observed stepped decrease in water levels. This correlates with the hydrographs showing the long term trend of steadily dropping water levels.

An Investigative Report was submitted in February 2017 in accordance with Springvale approvals.

Groundwater levels for SPR1107 are presented in Figure 17.

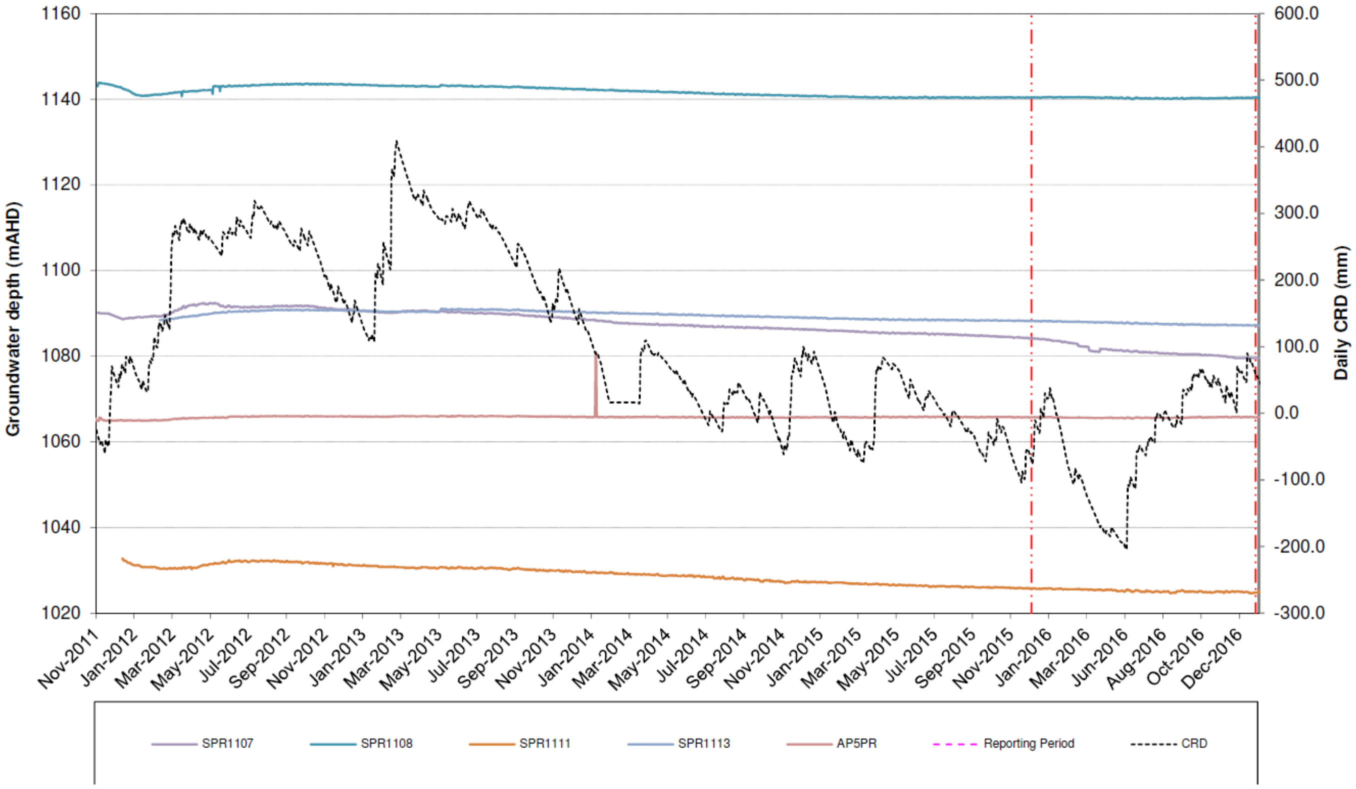

Figure 17 SPR1107 and Reference Ridge Piezometer Hydrograph - 2011 to 2016

SPR1109

SPR1109 shows similar groundwater level response to the reference swamps SPR1113, SPR1108 and SPR1111 up to the end of 2015. In series of stepped drops can be seen during the early part of 2016 which has been inferred to be due to mining induced bed separation effects and increased storage occurring, this is confirmed by the stabilization of water levels in the second half of 2016.

SPR1109 had exceeded the short term trigger level during the mining of LW418 in 2015. An Investigative Report was submitted in February 2016 in accordance with Springvale approvals.

Groundwater levels for SPR1109 are presented in Figure 18.

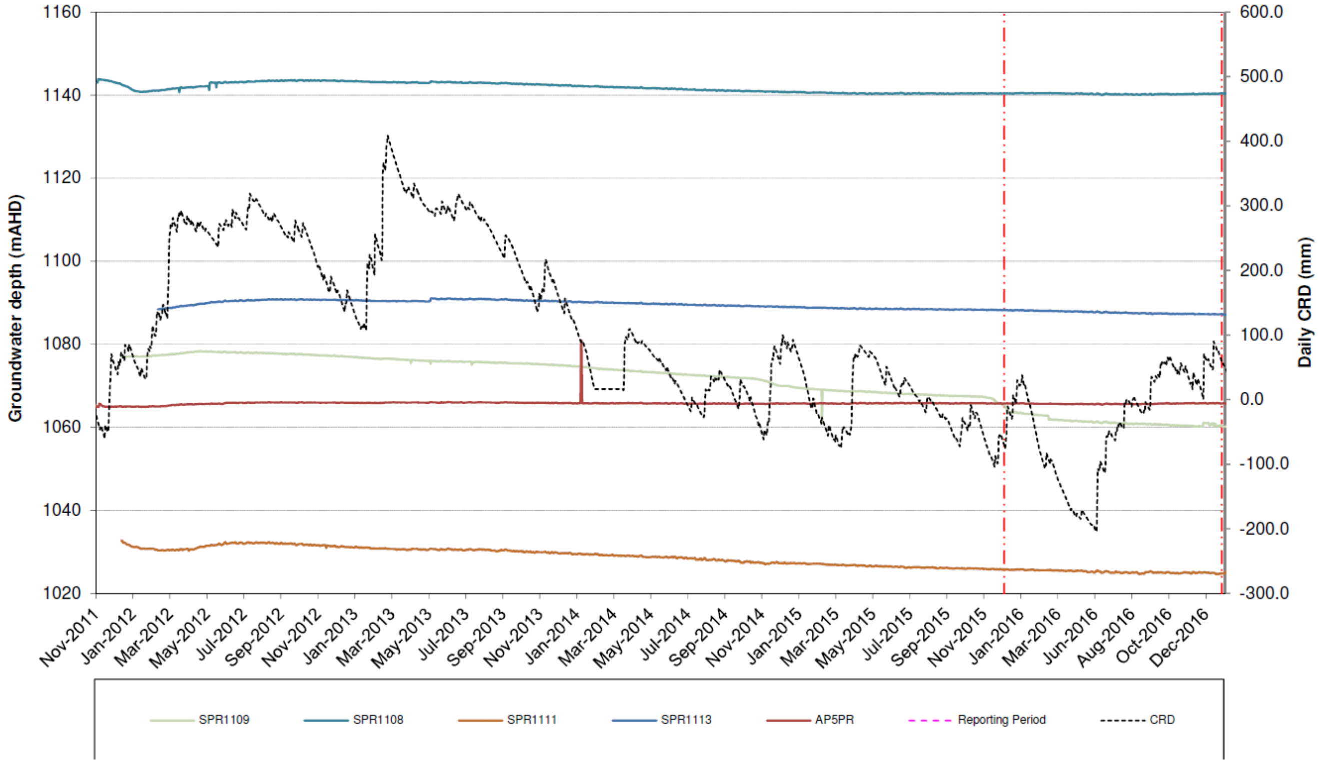

Figure 18 **SPR1109 and Reference Ridge Piezometer Hydrograph - 2011 to 2016**

SPR1110

SPR1110 is located above LW417 panel, a declining trend is observed in this piezometer during January 2013 with water levels declining to below the base of the piezometer where it has remained. It is possible that SPR1110 is responding to longer term climatic trends, however no response is observed to individual rainfall events and the decline may also be due to bed separation effects following LW416 extraction.

Groundwater levels for SPR1110 are presented in Figure 19.

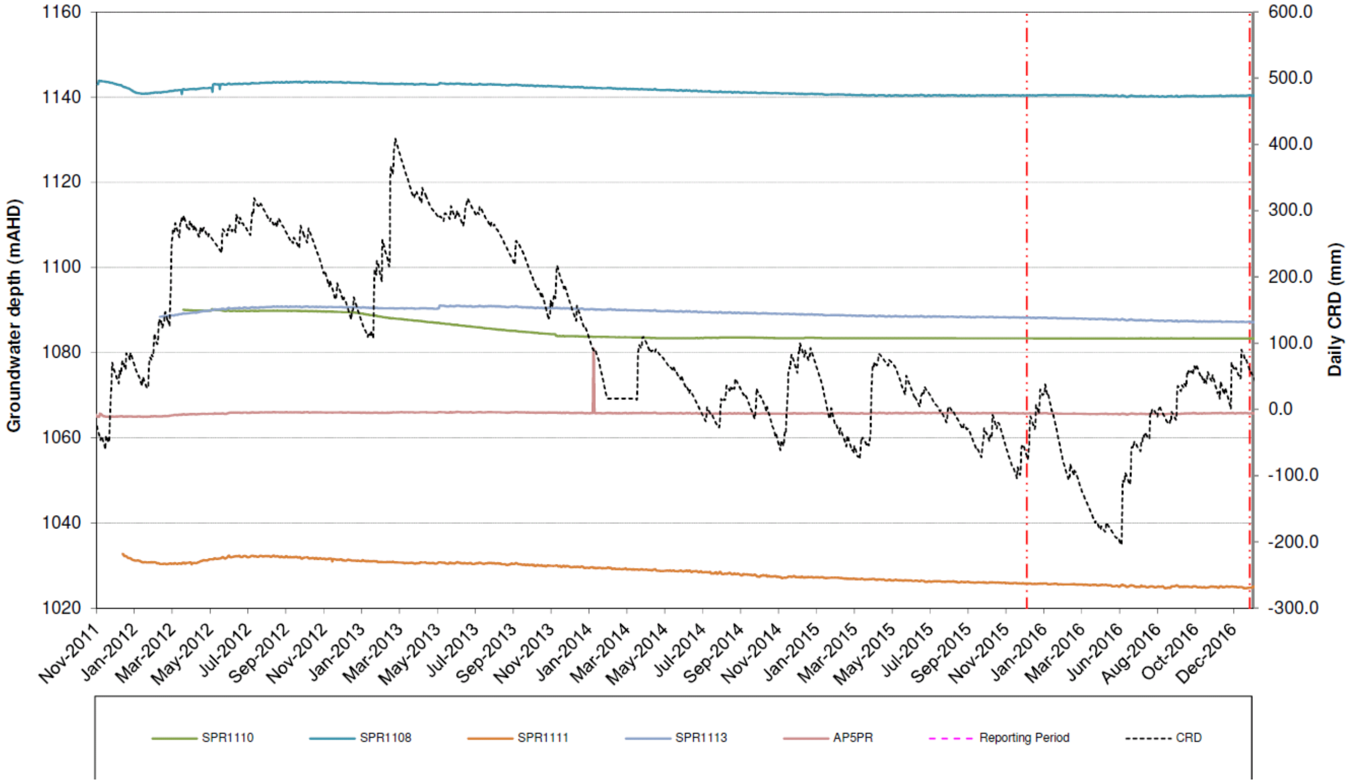

Figure 19 SPR1110 and Reference Ridge Piezometer Hydrograph - 2011 to 2016

5.3.3. Groundwater Quality

Groundwater monitoring samples are collected opportunistically based upon groundwater level which is presented in Section 5.3.1.

There have therefore been no triggers during the reporting period.

Carne West

CW1 and CW2

Water quality data for CW1 is available until May 2014, after this date the piezometer was largely dry and unable to be sampled. No samples were able to be obtained from CW1 throughout 2016. Historic results are presented for reference.

Water quality data for CW2 is available until May 2015, after this date the piezometer has been dry and unable to be sampled. Only three samples were obtained from CW2 throughout 2015 and no samples collected during 2016.

Figure 20 presents pH results for CW1 and CW2.

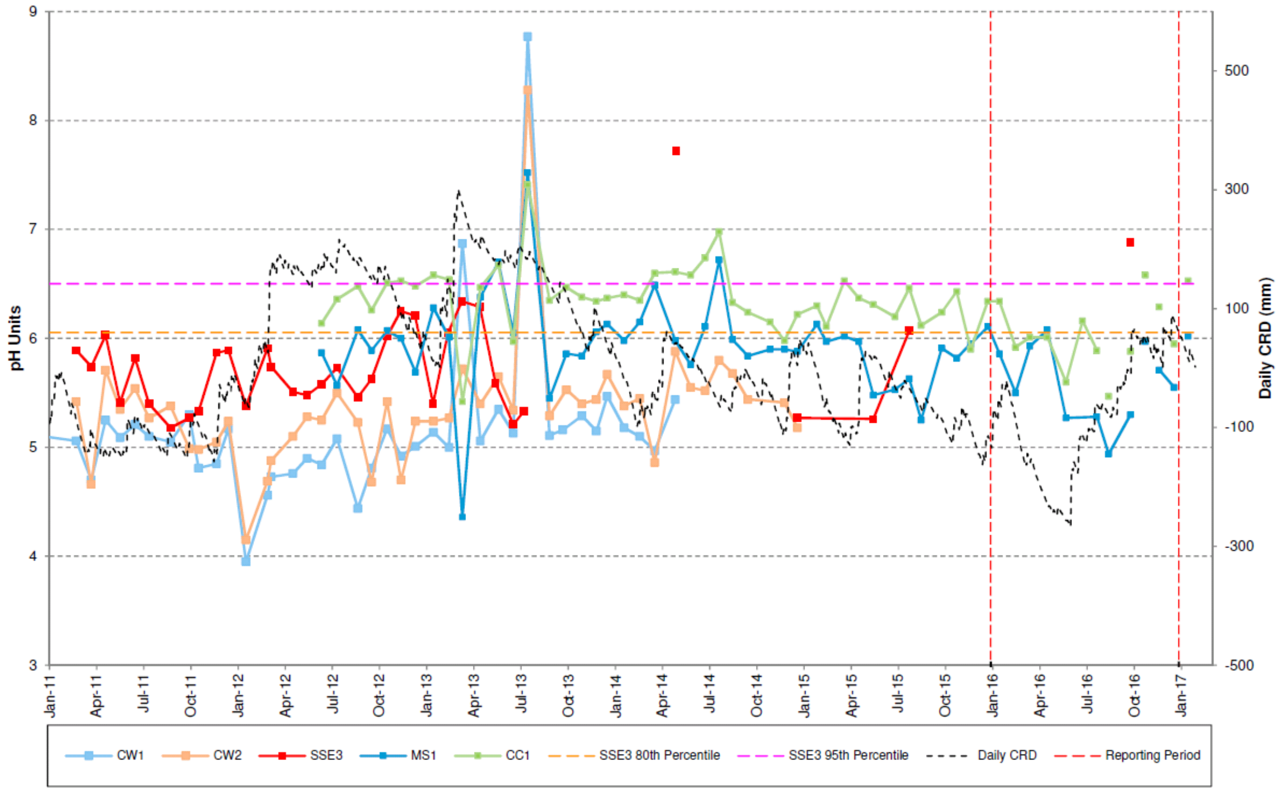

Figure 20 CW1 and CW2 Monitoring Data – pH - 2011 to 2017

Figure 21 presents Electrical Conductivity (EC) results for CW1 and CW2.

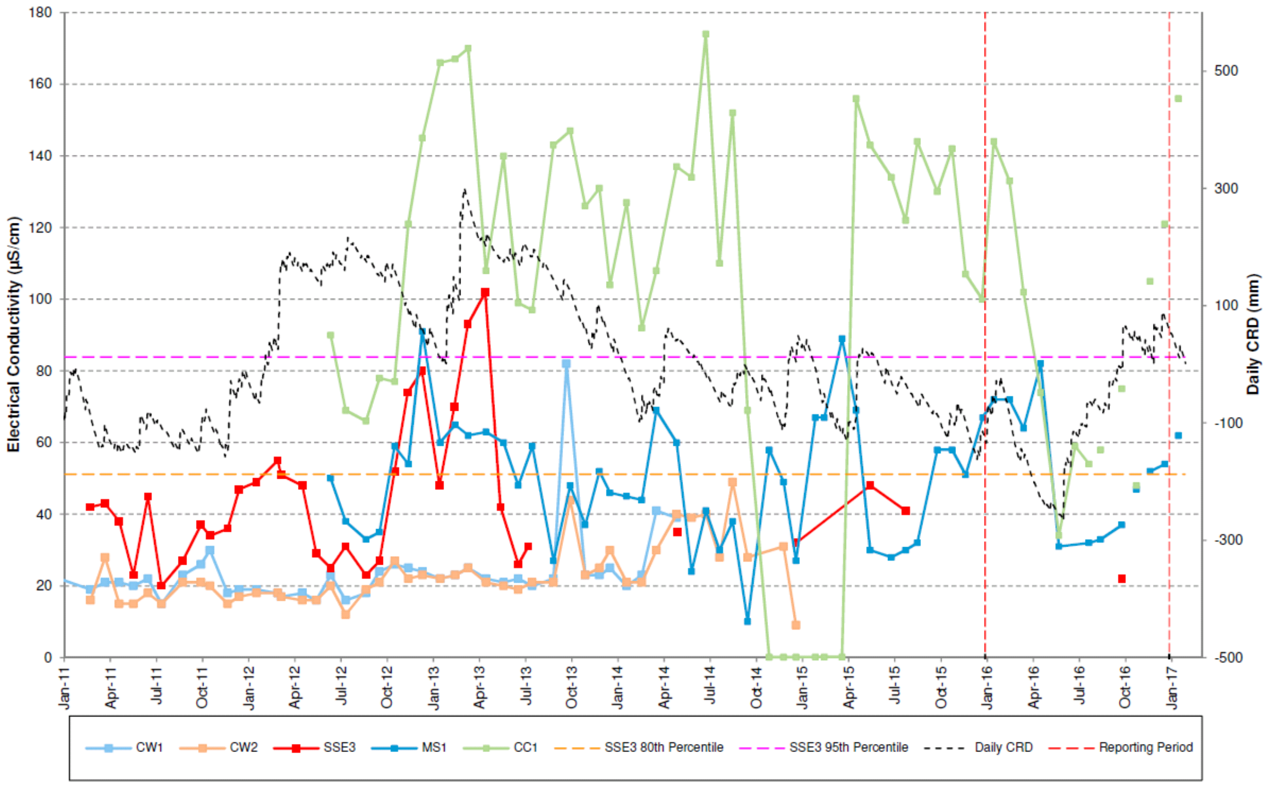

Figure 21 CW1 and CW2 Monitoring Data – EC - 2011 to 2017

Figure 22 presents filterable iron results for CW1 and CW2.

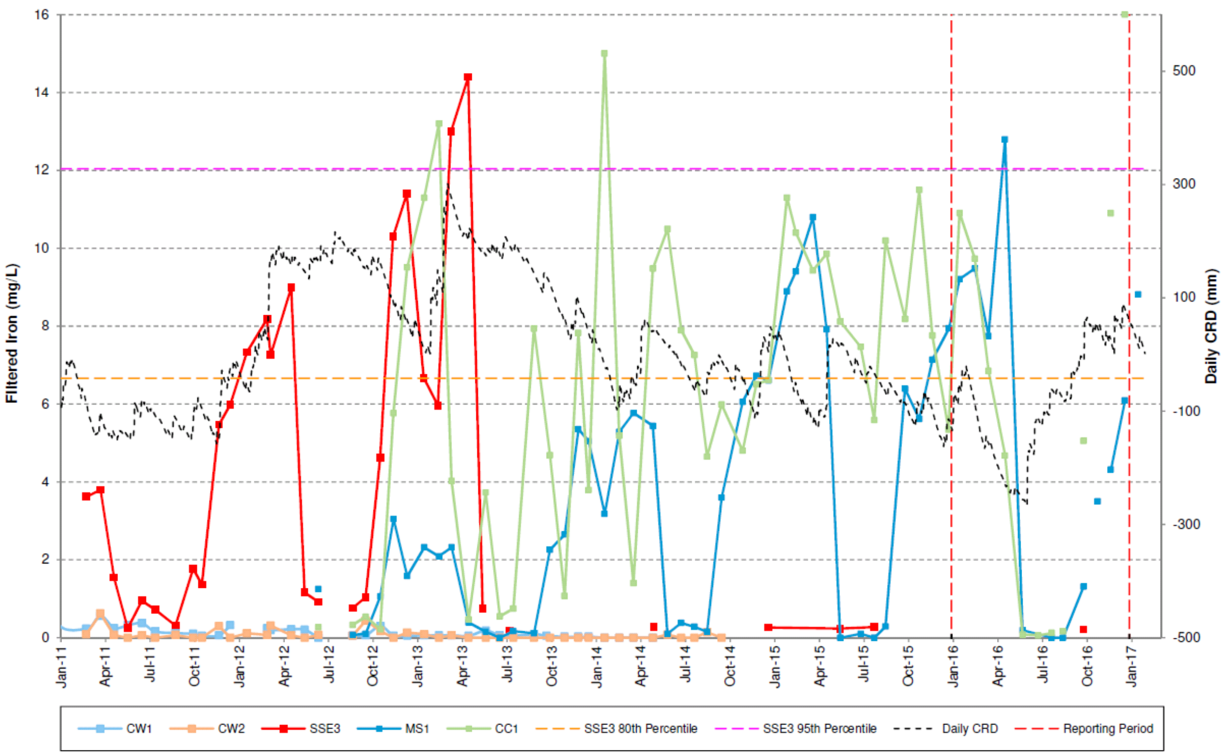

Figure 22 CW1 and CW2 Monitoring Data – Fe - 2011 to 2017

SSE3

A decline in water levels at SSE3 has meant that only limited sampling has been possible since 2014. Over the reporting period one samples for pH, EC and Fe could be collected.

pH

The pH at SSE3 has historically fluctuated between 5.2 and 6.3 pH units. These fluctuations are considered natural and are consistent with the reference swamps.

Figure 23 presents pH results for SSE3.

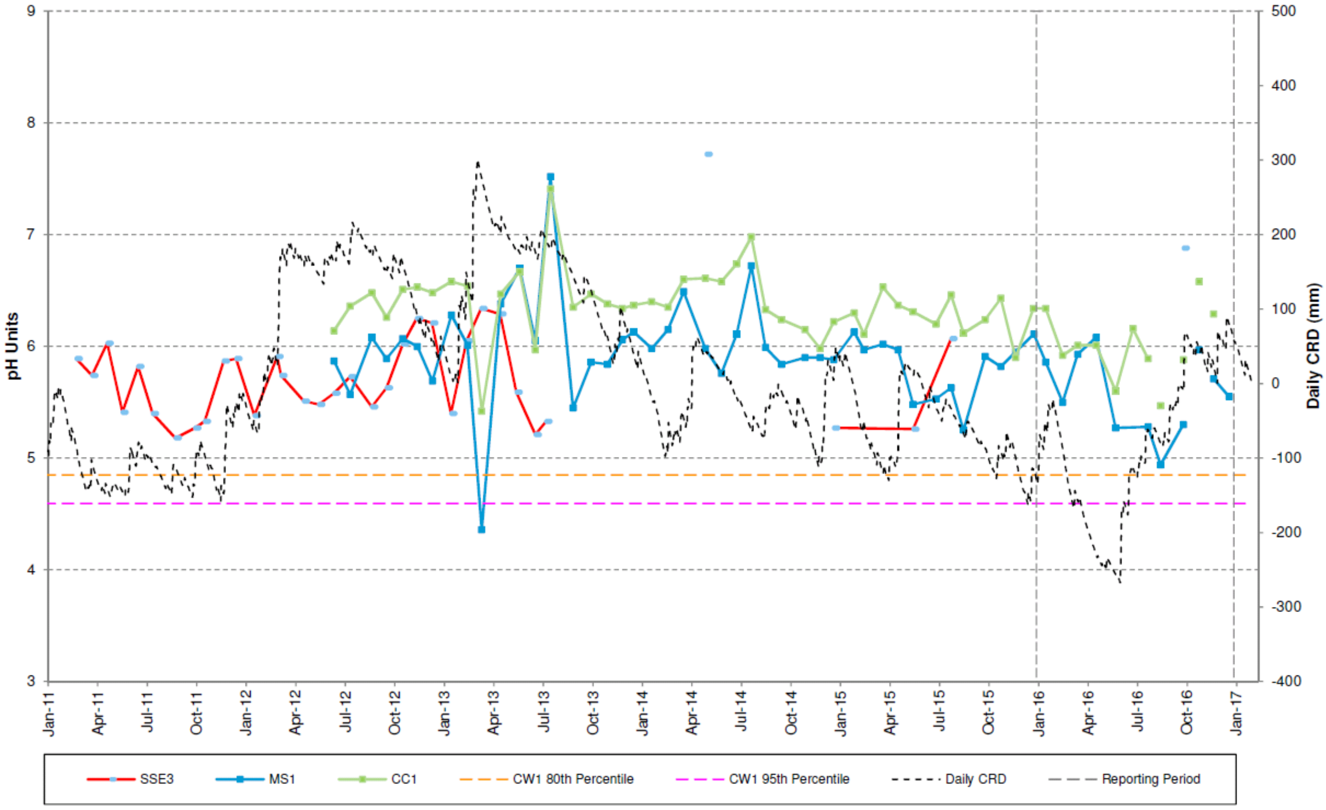

Figure 23 SSE3 Swamp Piezometers – pH - 2011 to 2017

Electrical Conductivity

EC at SSE3 is generally very fresh, historically ranging between 20 and 100µS/cm. This is similar to the MS1 reference site and less than the CC1 reference site.

During the review period the one measured EC value of 22 µS/cm was well below the 80th and 95th percentile values.

Figure 24 presents EC results for SSE3.

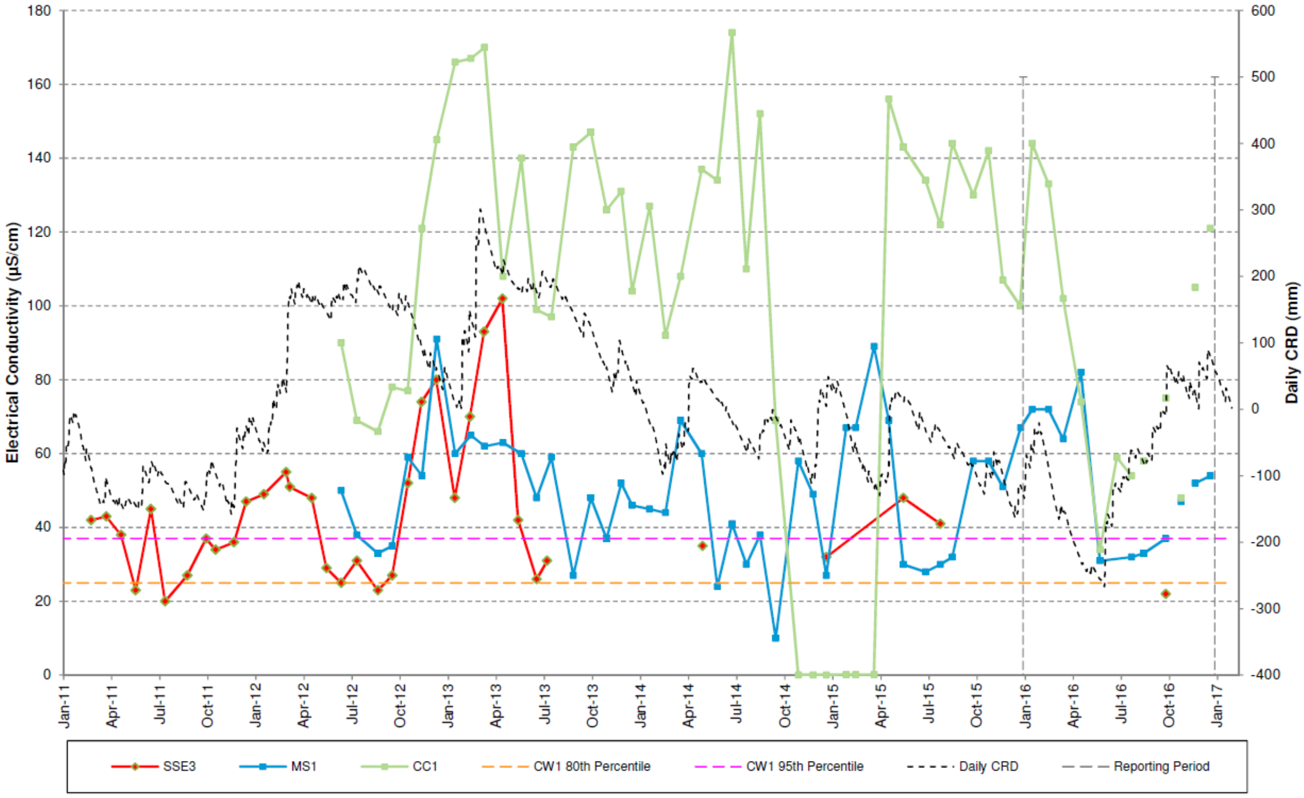

Figure 24 SSE3 Swamp Piezometers – EC - 2011 to 2017

Iron

The concentration of filtered iron at SSE3 has historically ranged between 0.18 and 14.4mg/L with elevated values correlating reasonably well with periods of above average rainfall.

The sample (0.21mg/L) obtained during 2016 was below the 80th and 95th percentiles.

Figure 25 presents filterable iron results for SSE3.

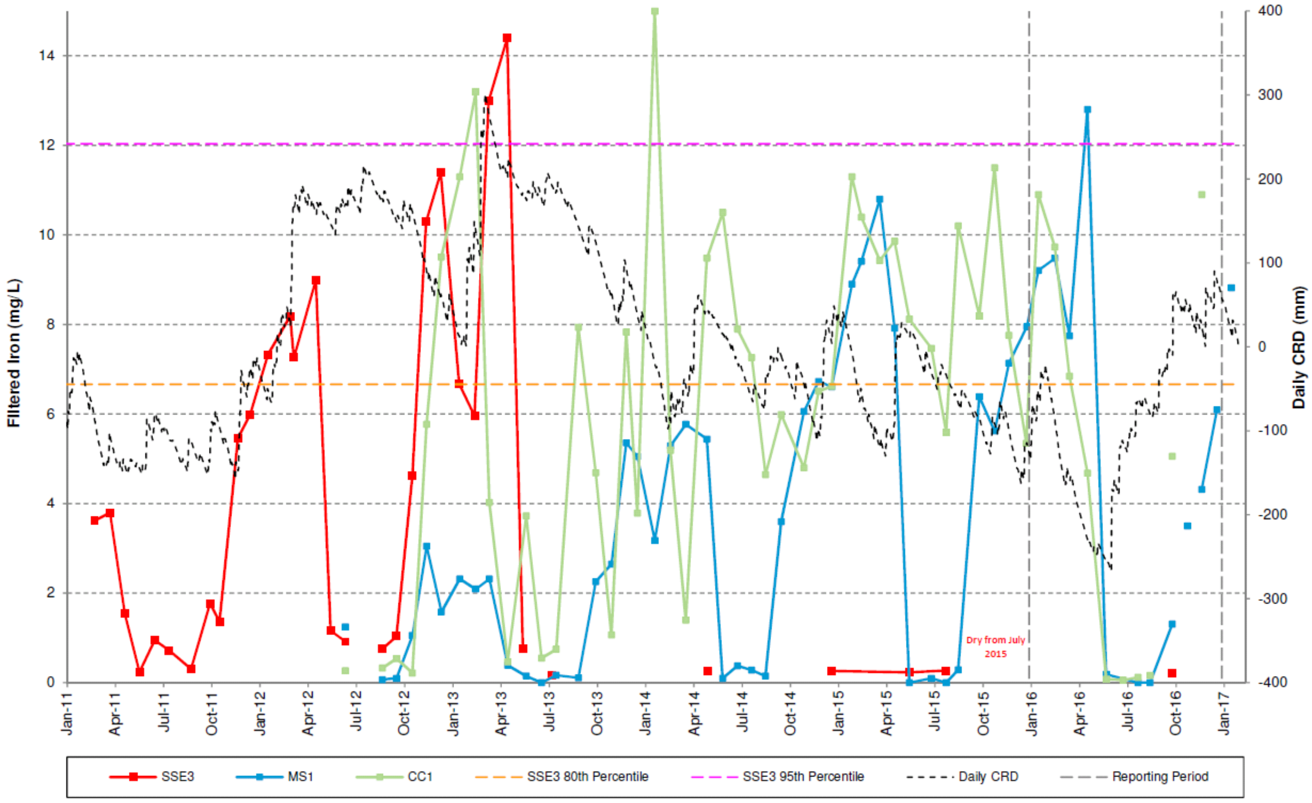

Figure 25 SSE3 Swamp Piezometers – Fe - 2011 to 2017

5.4. Surface Water

Surface water monitoring samples are collected opportunistically based upon groundwater level flow rates.

There have therefore been no triggers during the reporting period.

5.4.1. Carne West

Flow Rate

Flows in Carne West historically showed a close correlation with the CRD, increasing during periods of above average rainfall and spiking with large rainfall events until mid 2014 since when no flows have been recorded. The change in flow regime is likely in part due to an extended dry period from 2014 through to early 2016 when moderate rainfall has been observed reversing the negative CRD trend. It is possible that rainfall has not been sufficient to allow flow to reoccur during the reporting period in Carne West.

Figure 26 presents flow rate monitoring results for Carne West.

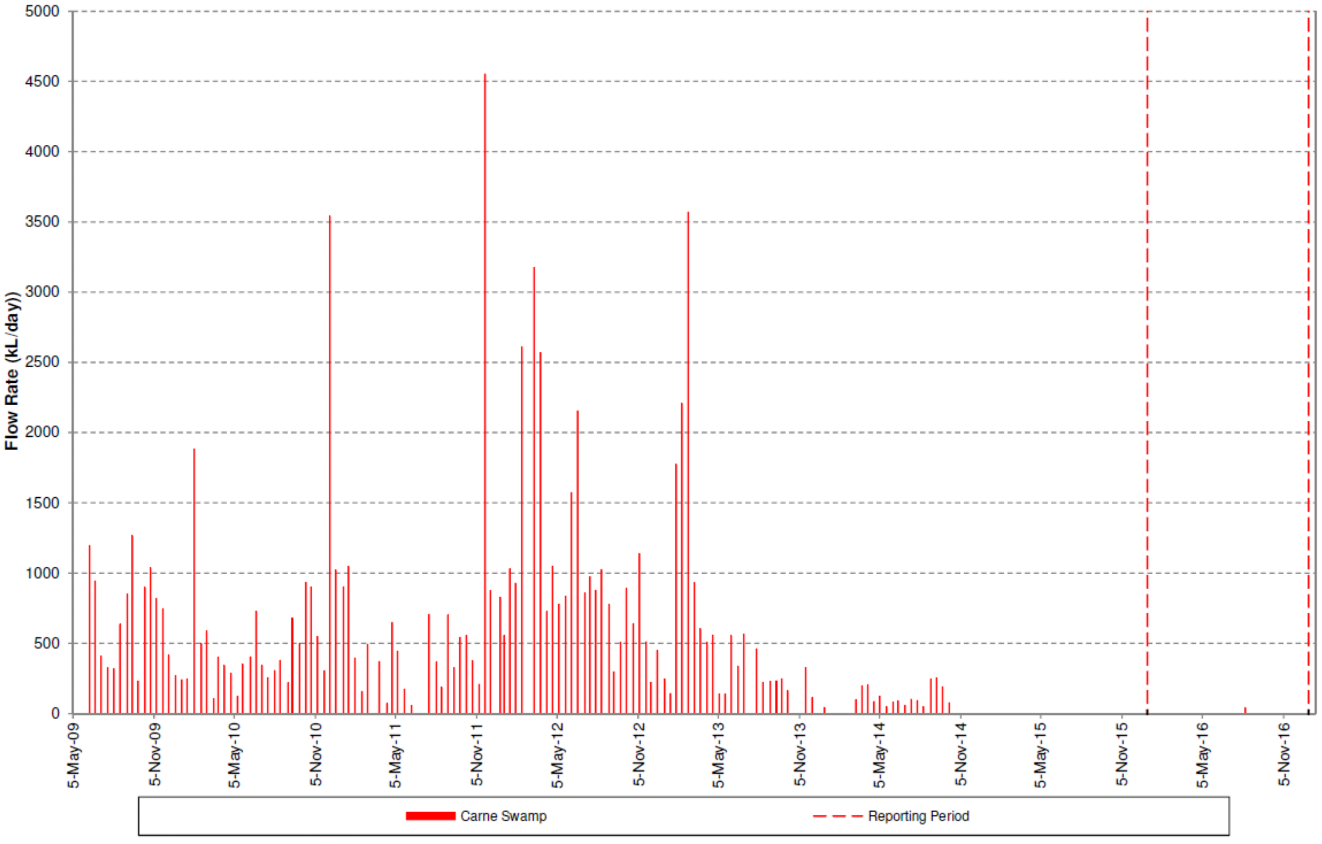

Figure 26 Carne West Flow Monitoring Results June 2009 to 2016

Water Quality

pH

The pH at Carne West has historically fluctuated between 4 and 8 pH units. These fluctuations are considered natural given that the pH at Marrangaroo Creek fluctuates between similar levels. The pH at Carne West largely remained below the 80th Percentile for the entire review period and only rarely exceeded the 95th percentile. None of these exceedances were repeated so are interpreted as natural variations.

Figure 27 presents pH results at Carne West.

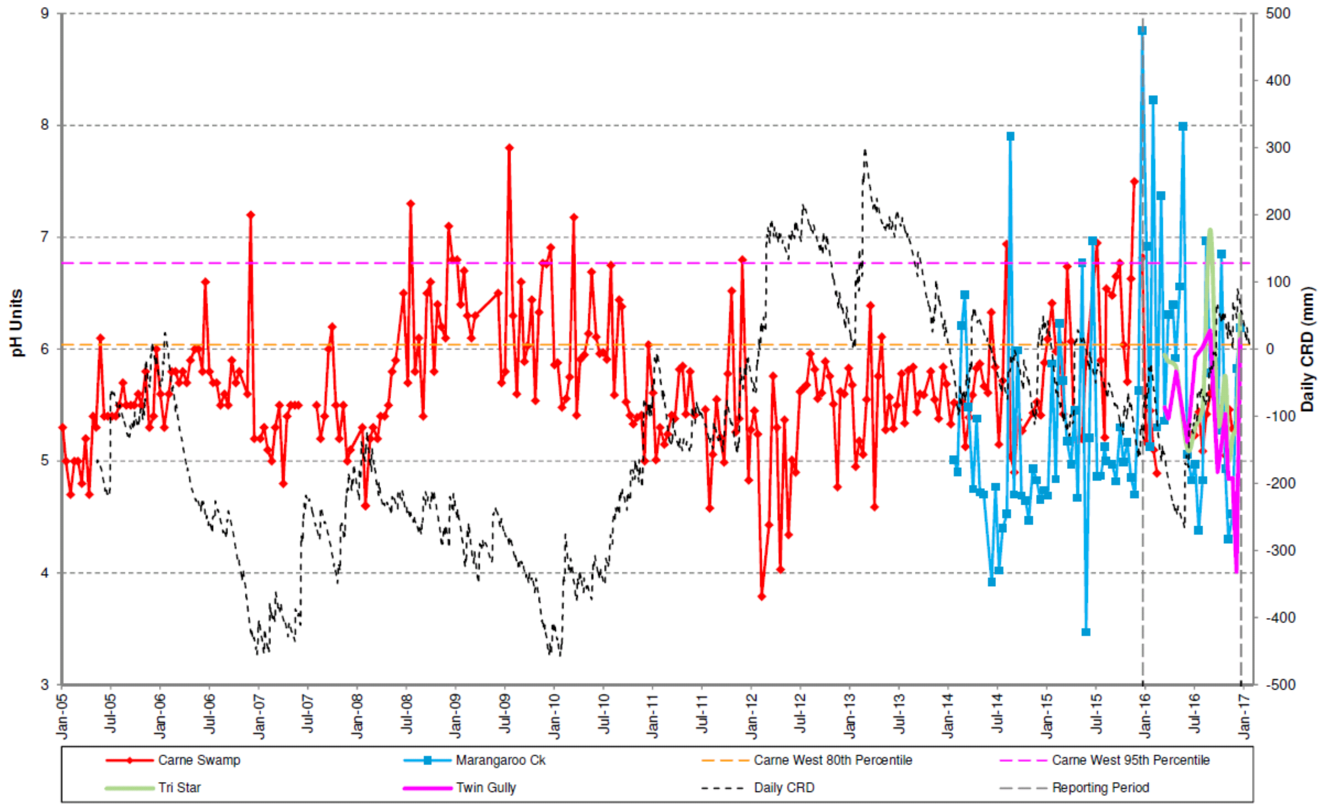

Figure 27 Carne West Monitoring Data – pH - 2005 to 2017

Electrical Conductivity

The EC at Carne West is extremely fresh ranging historically between 10 and 40µS/cm, which is close to the EC of rain water. Marrangaroo Creek has historically fluctuated between 10 and 70µS/cm, which is also considered fresh. The EC remained beneath the 95th percentile throughout the review period and rarely exceeded the 80th percentile.

Figure 28 presents EC results at Carne West.

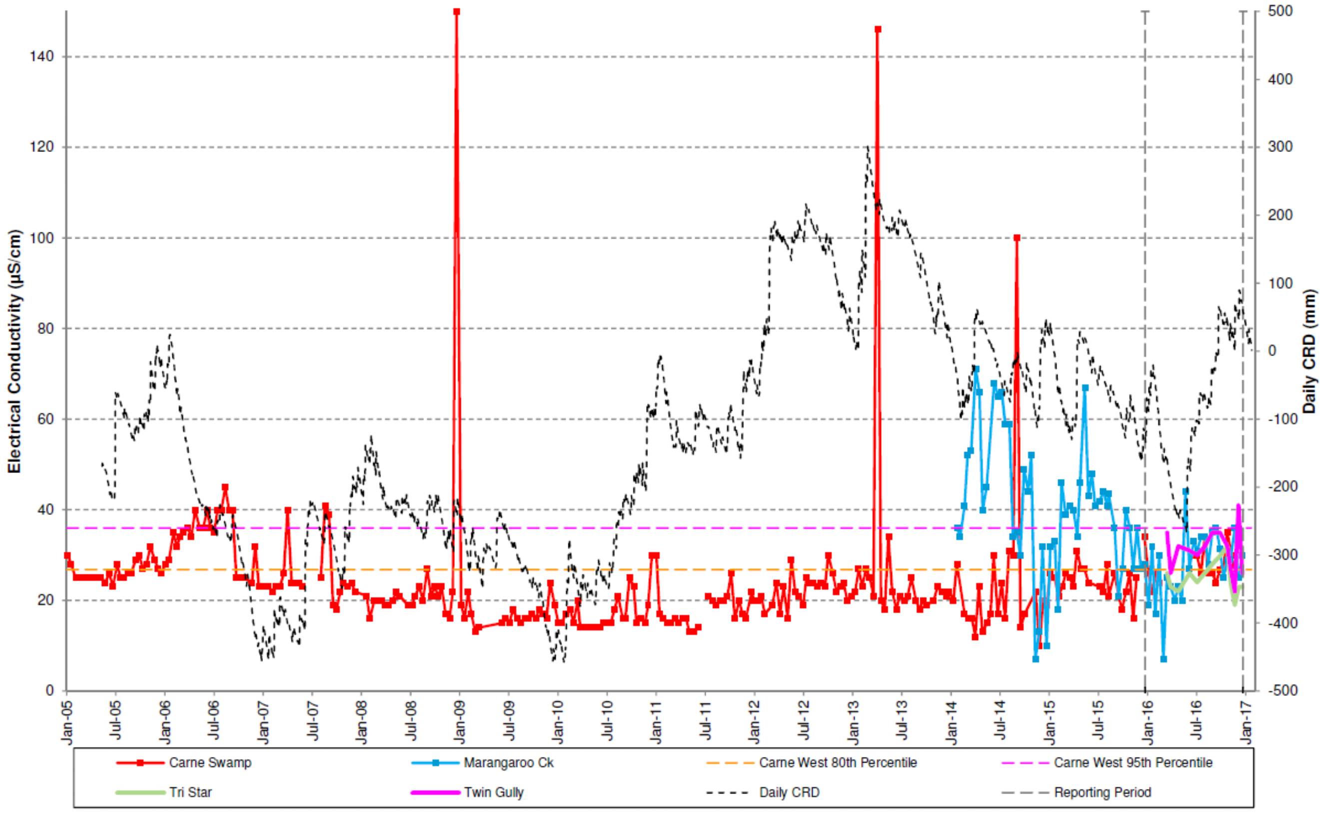

Figure 28 Carne West Monitoring Data – EC - 2005 to 2017

Manganese

The concentration of filtered manganese at Carne West historically fluctuates between 0 and 0.05mg/L with occasional spikes recorded during periods of increased rainfall. These results are similar to those recorded at Marrangaroo Creek. The concentrations exceeded the 80th and 95th percentile.

Figure 29 presents Manganese results at Carne West.

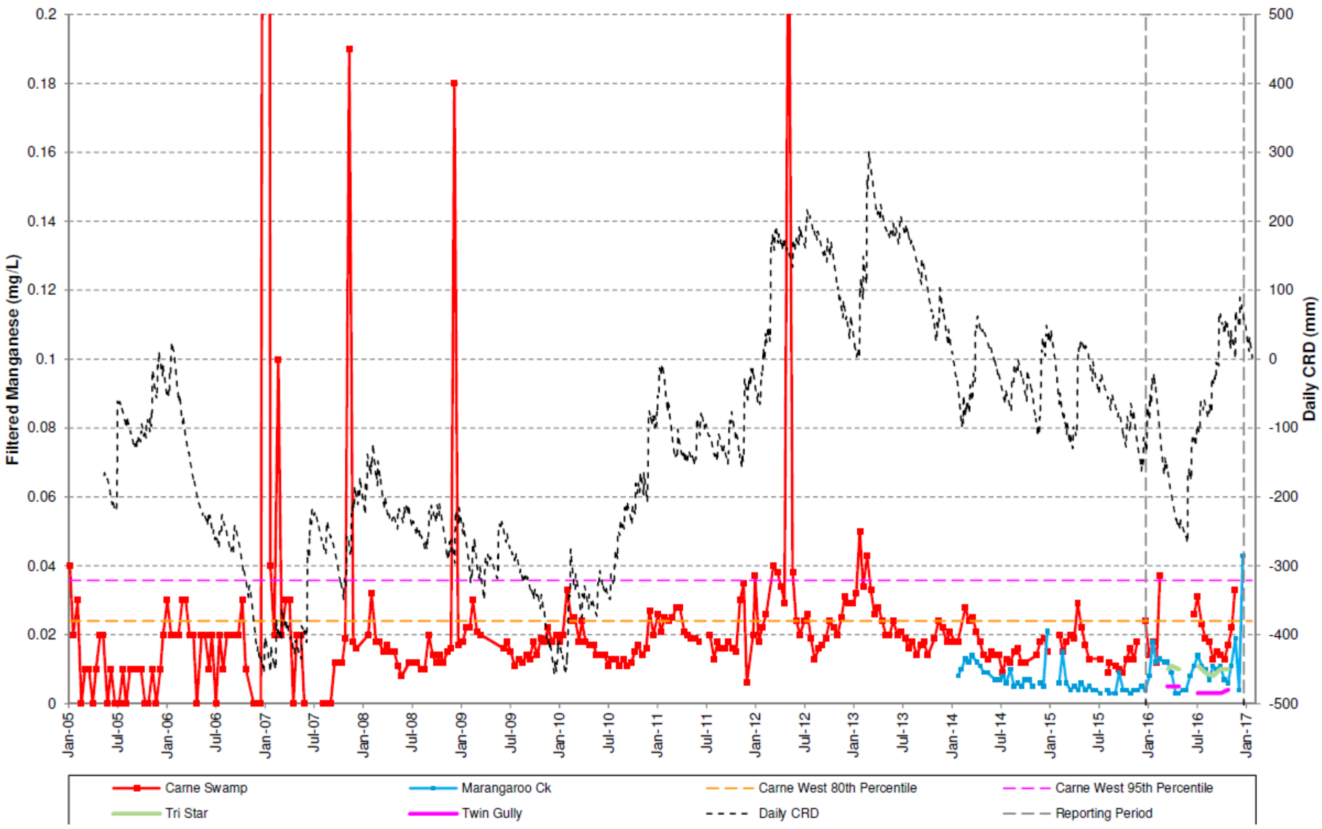

Figure 29 Carne West Monitoring Data – Mn - 2005 to 2017

Iron

The concentration of filtered iron at Carne West historically fluctuates between 0.1 and 1.0mg/L with occasional spikes recorded during periods of increased rainfall. These results are similar to those recorded at Marrangaroo Creek. Concentrations remained within historic levels throughout the reporting period. The concentrations remained beneath the 95th percentile throughout the review period and rarely exceeded the 80th percentile.

Figure 30 presents Iron results at Carne West.

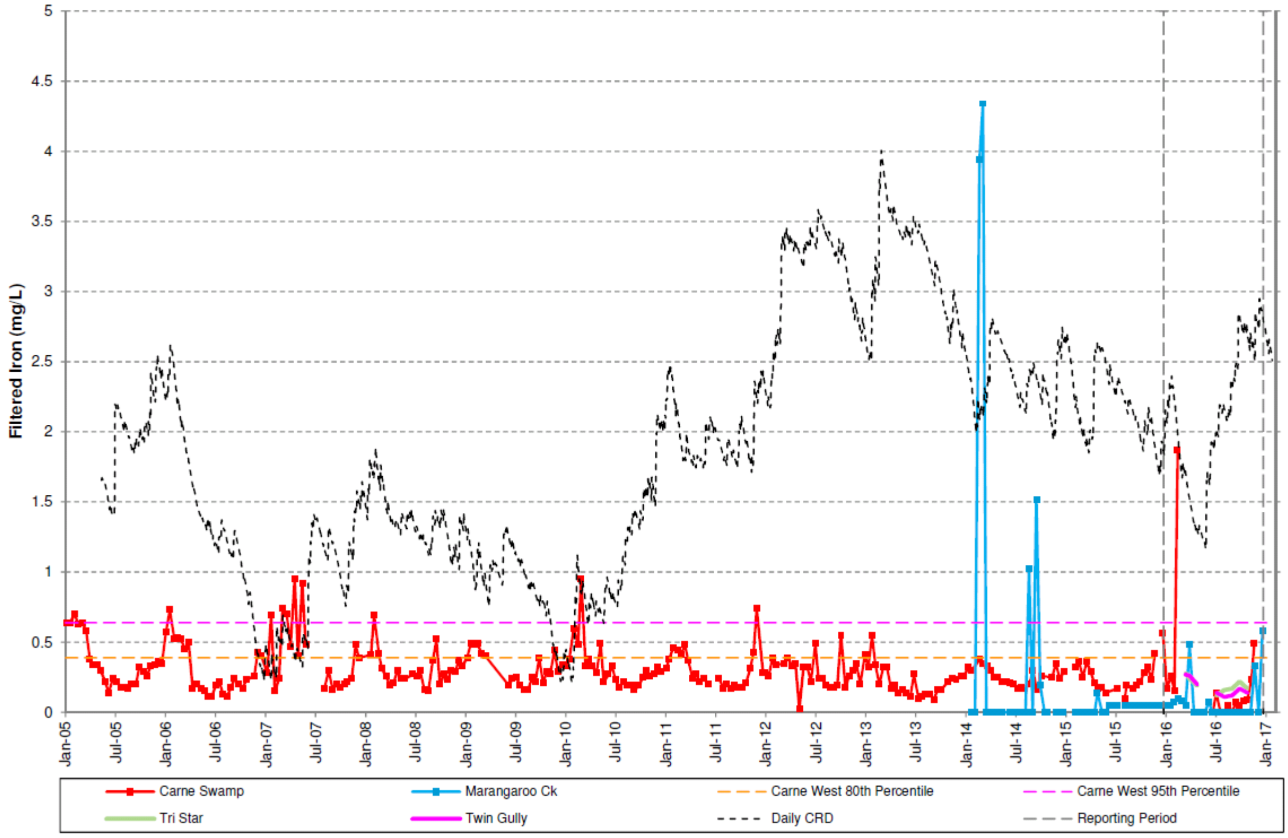

Figure 30 Carne West Monitoring Data – Fe - 2005 to 2017

5.4.2. Carne West Pool (CWP)

Water Depth

Pool data depths show characteristic spikes which correspond to rainfall. Pool depths were higher during the first half of the review period in response to the elevated rainfall in January and June. Pool depths then dropped off from September until the end of the reporting period in delayed response to the rain in September. Despite the pool water level falling below the sensors detection limit, flow continues to be observed downstream of the monitoring point. The observed responses are considered to be consistent with rainfall received and with past behaviour.

Spikes in pool depth do not always have a clear immediate relationship with rainfall events. Progressive increases in pool depth during periods of below average rainfall indicate that there is considerable storage retained in the swamp alluvium/peat, and a delayed release of this water to the stream is occurring.

Carne West Pool water depth data is presented in Figure 31.

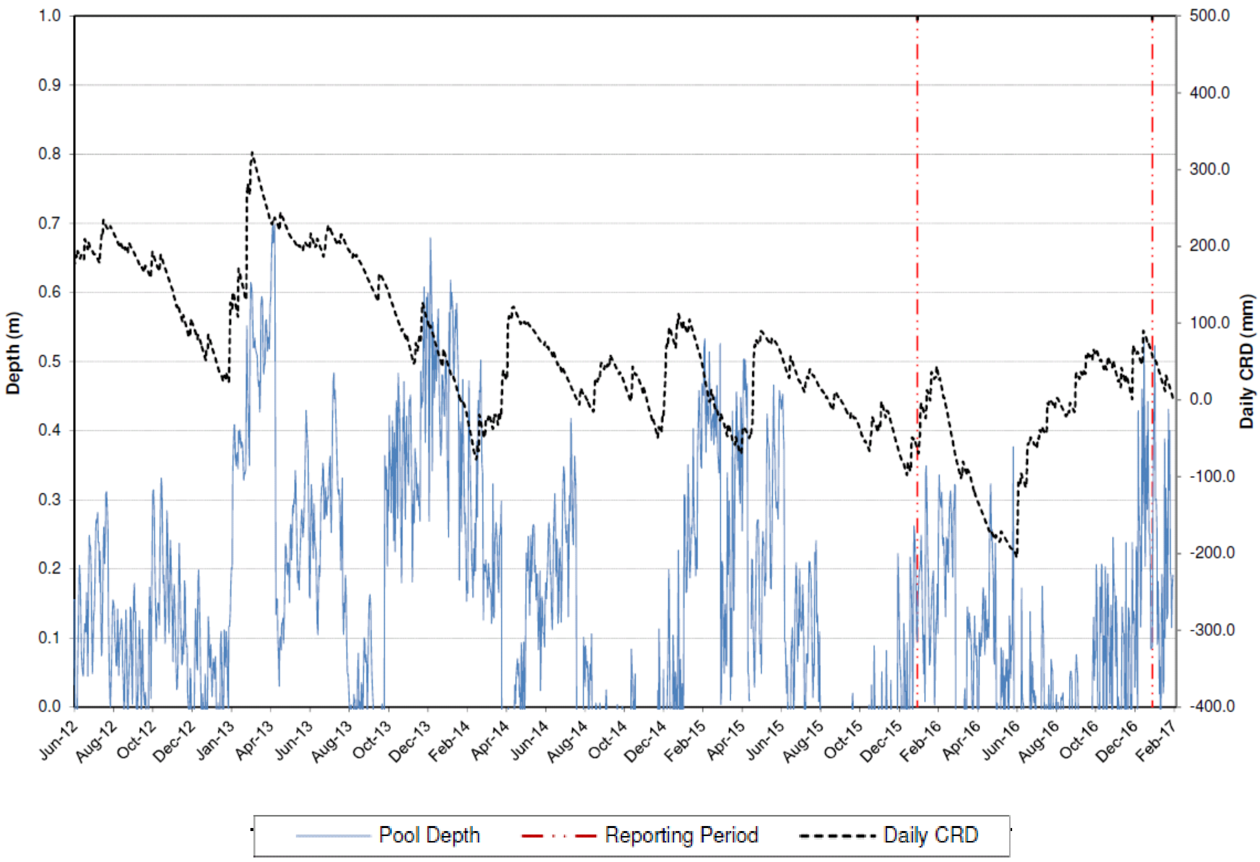

Figure 31 Carne West Pool Monitoring Data 2012 to 2017

5.4.3. SS3 Downstream

Water Quality

pH

The pH at SSE3 Downstream has historically fluctuated between 4.5 and 7.5 pH units. These fluctuations are considered natural given that the pH at Marrangaroo Creek fluctuates between similar levels.

The surface water level in SSE3 Downstream was too shallow to sample throughout 2016.

Figure 32 presents pH results for SS3 Downstream.

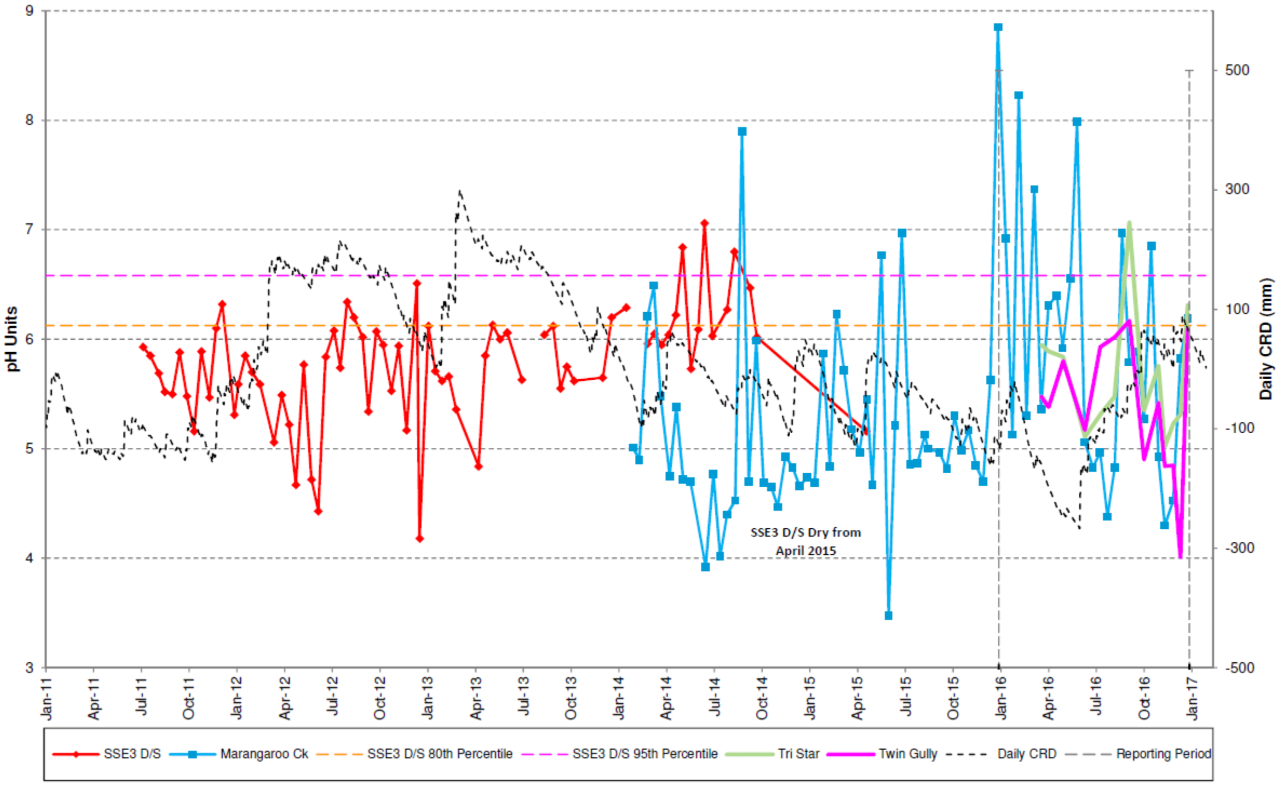

Figure 32 SS3 D/S Monitoring Results – pH - 2010 to 2017

Electrical Conductivity

The EC at SSE3 Downstream is extremely fresh ranging historically between 10 and 40μS/cm. which is close to the EC of rain water. Marrangaroo Creek has historically fluctuated between 10 and 70μS/cm, which is also considered fresh. No samples have been collected during the reporting period due to the sampling site being dry.

Figure 33 presents electrical conductivity results SS3 Downstream.

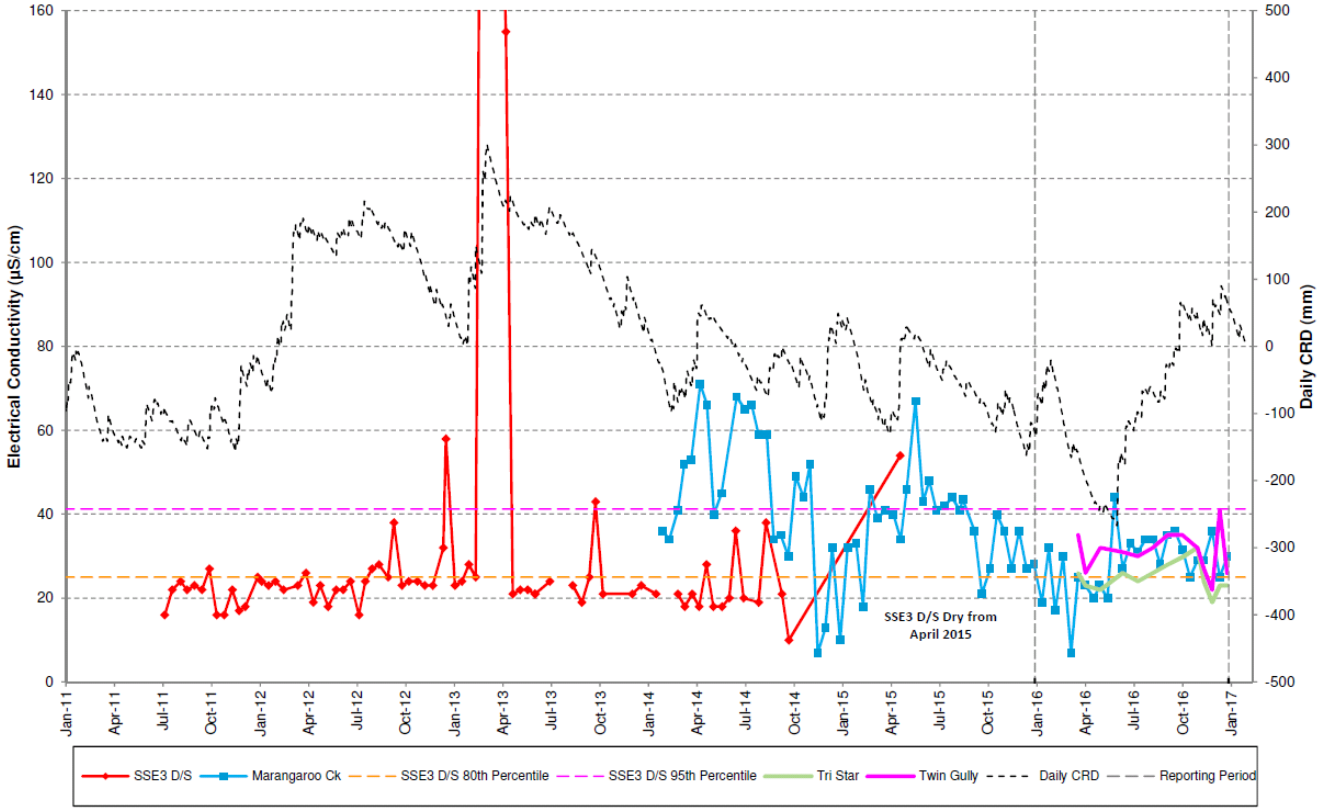

Figure 33 SS3 D/S Monitoring Results – EC - 2010 to 2017

Managanese

The concentration of Filtered Manganese at SSE3 Downstream historically fluctuates between 0.01 and 0.05mg/L with occasional spikes recorded during periods of increased rainfall. These results are similar to those recorded at Marrangaroo Creek. No sample could be collected during the reporting period due to the sampling site being dry.

Figure 34 presents filterable manganese results for SS3 Downstream.

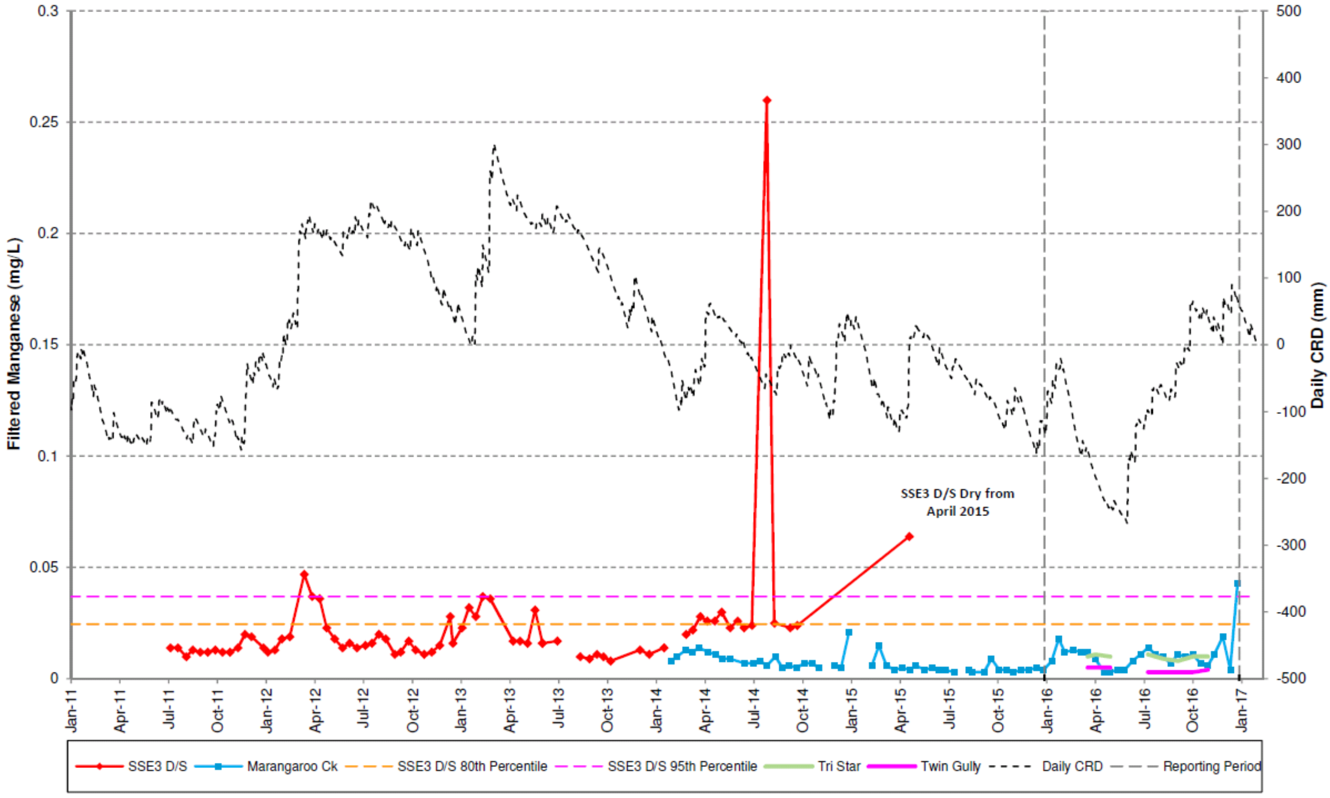

Figure 34 SS3 D/S Monitoring Results – Mn – 2011 to 2017

Iron

The concentration of Filtered Iron at SSE3 Downstream historically fluctuates between 0.1 and 0.5mg/L with occasional spikes recorded during periods of increased rainfall. These results are similar to those recorded at Marrangaroo Creek. No samples could be collected during the reporting period due to the site being dry.

Figure 35 presents filterable iron results for SS3 Downstream.

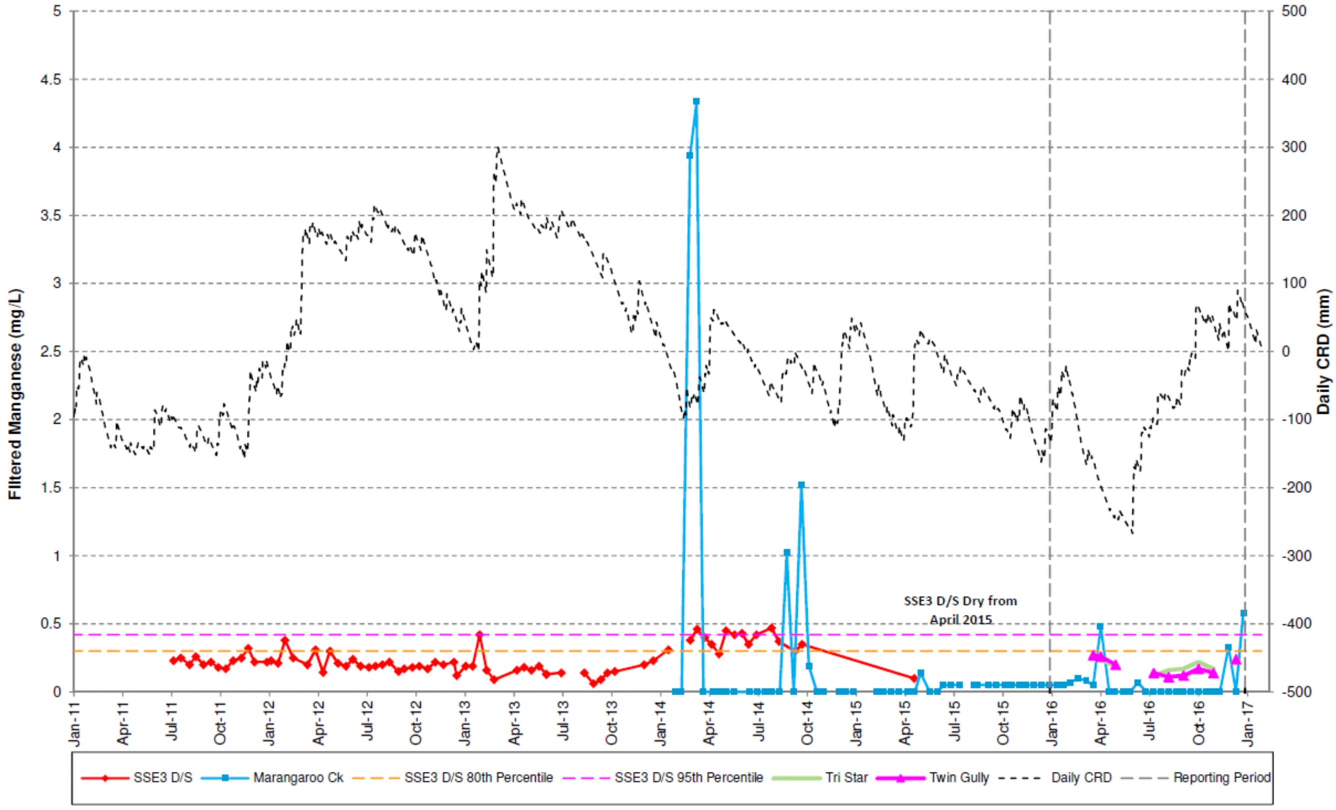

Figure 35 SS3 D/S Monitoring Results – Fe - 2010 to 2017

6. TRIGGER LEVELS AND EXCEEDANCES

6.1. Subsidence

Triggers for subsidence have been developed following modelled predictions for subsidence above longwall panels 415, 416 and 417. The modelling is based on previous monitoring data as well as subsidence theory.

Anomalous subsidence is defined in the Springvale Coal EPBC approval 2011/5949. The subsidence trigger levels from the THPSSMP are presented in Table 22.

Table 22. Subsidence Trigger Levels

Location	**Survey Sites**	**Performance Trigger Levels**	
		Anomalous Subsidence	
LW415 **(W=315 metres)**	B and M lines	Subsidence	>1.5 metres
		Tilt	> 10 mm/metres
		Tensile Strain	> 15 mm/metres
		Compressive Strain	>18 mm/metres
LW416 and 417 **(W=260 metres)**	B and M lines	Subsidence	> 1.1 metres
		Tilt	> 7 mm/metres
		Tensile Strain	> 5 mm/m
		Compressive Strain	> 6 mm/m (plateaus) > 14 mm/m (valleys)
Sunnyside East Swamp	*V-VC and W-WC Lines* *LiDAR*	Subsidence	>1.1 metres
		Tilt	> 7 mm/metre
		Tensile Strain	> 5 mm/metre
		Compressive Strain	>14 mm/metre
Carne West Swamp	Y-YC1, YC2 and B Lines LiDAR	Subsidence	>1.1 metres
		Tilt	> 7 mm/metre
		Tensile Strain	> 5 mm/metre
		Compressive Strain	>14 mm/metre

During the reporting period there was no anomalous subsidence within 200 metres of a Temperate Highland Peat Swamp on Sandstone Ecological Community associated with longwalls 415 – 417.

6.2. Flora

Triggers for flora have been developed using data collected from reference site monitoring carried out since 2003. The triggers have been developed based on an analysis of natural variance in vegetation communities which has been determined following an analysis of reference site data.

Details of trigger levels for flora are set out in Table 23. Each trigger has a defined level of change and a defined timescale in which this change is to be observed to determine whether an impact has occurred.

Winter 2016 Report Results

Two flora performance trigger indicators were found to have exceeded performance indicator triggers during Winter 2016 monitoring. These were:

- An increase of 1 additional eucalypt individual at impact site SSE01 in Sunnyside East Swamp (i.e. an increase of more than 3 individuals within a one year period).
- The condition of *Gleichenia dicarpa* (a key swamp species) declined at three Carne West Swamp sites (i.e. WC01, WC03 and WC04) by greater than a 1.5 condition score between impact and reference sites for this key species.

An Initial Notification Report and Trigger Investigation report were completed as per the THPSSMP for Longwalls 415 - 417 and are further detailed in Section 7.2 of this report.

Details of the triggers are also detailed in Table 23.

Spring 2016 Report Results

Two flora performance trigger indicators were found to have exceeded performance indicator triggers during Spring 2016 monitoring. These were:

- The condition of *Gleichenia dicarpa* (a key swamp species) was below the trigger threshold for three Carne West monitoring sites (i.e. WC02, WC03 and WC04). This result is consistent with findings reported in the winter 2016 monitoring report for WC03 and WC04. However, differences to the winter 2016 reporting include a new trigger event at WC02 and a return to within range condition for WC01.
- An increase in bare ground of greater than 100 m_2 over a 3 year period at WC04. The change observed is 1.25% in summer 2016 to 28.75% in spring 2016.

An Initial Notification Report was submitted to the Department of Environment in relation to the Spring 2016 performance indicator exceedances on the 9th of March 2016. A Trigger Investigation Report will follow in accordance with the THPSSMP. Findings and actions will be presented in Annual Reports.

Details of the triggers are also presented in Table 23.

Table 23. Flora Trigger Levels

Performance Indicator	Parameter Measured	Trigger Level*	Winter 2016	Spring 2016
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.	Trigger in TRI01 (reference swamp). Reason unknown.	Trigger in LGG01 (reference swamp). Reason unknown.
	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.	SSE01 has exceeded the trigger value for eucalypt recruitment and may require management action pending results of spring 2016 monitoring. Investigation recommended.	No exceedance in trigger values observed.
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 un-impacted sites within a one year period.	WC01, WC03 and WC04 have exceeded a condition trigger for the key swamp species *Gleichenia dicarpa*. Investigation recommended.	WC02, WC03 and WC04 have exceeded a condition trigger for the key swamp species *Gleichenia dicarpa*. Continued investigation recommended.
	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.	Increase of magnitude exceeding the trigger level was observed in WC04. Trigger consistent with 'condition of key species' trigger.
	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.	No impact sites showed an increase in weed species beyond the trigger level.

*Taken from THPSS MMP 415-417 and THPSS MMP 418. Data collection method used consistent with Erskine and Fletcher (2011).

6.3. Groundwater Depth

The methodology for developing groundwater level triggers to determine whether anomalous impacts have occurred is based on statistical analysis and the development of percentile based triggers.

Short-term significant changes in groundwater level are considered to occur at the 95th percentile level. However, exceedance of this level, by definition, will occur five percent of the time under natural conditions. This has led to the development of long term triggers that complement the short term triggers. Any mining-induced changes in groundwater levels will be inferred based on a set of trigger values for the groundwater depths in swamp piezometers and the groundwater elevations at ridge top aquifer piezometers installed beneath the ridges between swamps.

Table 24 details the short and long term change description for swamp and aquifer groundwater level.

Table 24. Short and Long Term Change Descriptions as Relevant to Swamp and Aquifer Groundwater Level

Type of Change	Description
Swamp groundwater depth (from ground surface)	
Short-term changes	Trigger level is exceeded if the groundwater depth in any piezometer > 95th percentile pre-mining groundwater depth for more than 7 consecutive days
Long-term changes	Trigger level is exceeded if the post-mining 50th percentile groundwater depth for any piezometer > 80th percentile pre-mining level
Aquifer groundwater level	
Short-term changes	Trigger level is exceeded if the groundwater level > baseline 95th percentile or < baseline 5th percentile pre-mining groundwater level for more than one month
Long-term changes	Trigger level is exceeded if the post-mining 50th percentile groundwater level for any bore is > baseline 80th percentile or < baseline 20th percentile pre-mining level

Due to the relatively short time period since undermining long term changes to groundwater depth cannot yet be determined.

The trigger levels are based on the monitoring records from 1 January 2005 up to 31 December 2011 at the swamp piezometers and up to 30 April 2012 for aquifer piezometers. Groundwater triggers for swamp piezometer water are presented in Table 25 while aquifer piezometer trigger levels are presented in Table 26. Baseline data collection is however considered up to the time until mining is within 200m of the piezometer. Trigger levels have therefore been recalculated when considering the results presented. Accordingly Centennial Coal will update the THPSSMP in consultation with Department of Environment (formally SEWPaC).

Table 25. Groundwater Trigger Levels for Swamp Piezometers

Location	LW 415-417 THPSS MMP Short-term Change 7-day moving average greater than the Pre-mining 95th Percentile for 7 days (metres below ground level)	Recalculated Pre-Mining Trigger Short-term Change 7-day moving average greater than the Pre-mining 95th Percentile for 7 days (metres below ground level	LW 415-417 THPSS MMP Long-term Change Post-mining median greater than the Pre-mining 80th Percentile (metres below ground level)	Recalculated Pre-Mining Trigger Long-term Change Post-mining median greater than the Pre-mining 80th Percentile (metres below ground level)	Pre-mining calculated cut-off date
Permanently Waterlogged					
CW1	0.25	0.93	0.21	0.26	LW418 - 05/12/2015
CW2	0.24	1.16	0.22	0.28	LW418 - 03/12/2015
SSE3	0.17	1.71	0.04	1.48	LW417 – 12/11/2014
Periodically Waterlogged					
CW3	1.01	1.07	1.01	1.06	LW417 – 19/03/2015
CW4	1.21	1.34	1.13	1.33	LW417 – 05/03/2015
SSE1	2.12	2.16	2.11	2.15	LW416 – 10/01/2014
SSE2	0.70	0.83	0.41	0.61	LW416 – 16/12/2013

Table 26. Groundwater Trigger Levels for Aquifer Piezometers

Location	LW415-417 THPSS MMP: Short-term Change (7-day moving average less than the Pre-mining 5th Percentile for 1 month)	LW415-417 THPSS MMP: Short-term Change (7-day moving average greater than the Pre-mining 95th Percentile for 1 month)	Recalculated Pre-Mining Trigger Short-term Change (7-day moving average greater than the Pre-mining 95th Percentile for 1 month)	LW415-417 THPSS MMP: Long-term Change (Post-mining median less than the Pre-mining 20th Percentile)	LW415-417 THPSS MMP: Long-term Change (Post-mining median greater than the Pre-mining 80th Percentile)	Recalculated Pre-Mining Trigger Short-term Change (7-day moving average greater than the Pre-mining 95th Percentile for 1 month)	Pre-mining calculated cut-off date
RSS	1125.6	1131.4	1128.16	1127.9	1129.8	1128.86	LW415 - 20/09/2012
SPR1101	1089.9	1090.8	1089.93	1090.0	1090.6	1090.03	LW415 – 18/09/2012
SPR1104	1070.1	1073.1	1069.2	1071.8	1072.8	1067.97[1]	LW419 – 01/08/2016
SPR1107	1090.0	1093.7	1086.2	1090.5	1093.2	1080.66[2]	LW419 – 03/11/2016
SPR1109	1077.0	1078.3	1067.7	1077.1	1078.0	1069.3	LW418 – 25/11/2015
SPR1110	1089.8	1090.1	1083.4	1089.8	1090.0	1083.6	LW416 – 18/09/2014

[1]Pre-mining trigger recalculated from 1069.8 at cut-off date 31/12/2015.

[2]Pre-mining trigger recalculated from 1087.3 at cut-off date 31/12/2015.

A short-term trigger was activated in aquifer piezometers SPR1104 and SPR1107 during the reporting period. The trigger was based on historical monitoring data which indicated a decline in the water level in the aquifer piezometers.

While the reporting of the exceedances was undertaken in accordance with the Longwall 419 Swamp Monitoring Program, the trigger has been reported on in this report as both SPR1104 and SPR1107 were impact piezometers under the Longwall 415 – 417 THPSSMP. Section 7.1 provides details on the investigation undertaken and proposed response strategy.

6.4. Groundwater Quality

Triggers for groundwater quality have been developed using data collected from reference sites. This data has been assessed using the ANZECC (2000) Water Quality Guidelines for the Protection of Aquatic Life (95% species protection levels) to calculate the triggers. Groundwater quality triggers were developed using the ANZECC (2000) guidelines procedure for setting local guidelines when the water quality does not meet the default ANZECC (2000) guideline values because of local conditions. The 80th percentile value of background water quality is used as the local water quality value in the case where the background concentrations are higher than the ANZECC (2000) guidelines. The default is used if the 80^{th} percentile is lower than the default trigger value. This approach has been used to develop the water quality triggers for groundwater.

Trigger levels for groundwater quality are presented in Table 27.

Table 27. Groundwater Quality Trigger Levels

Element	Short-term Minor Change (1)	Short-term Major Change (2)	80^{th} Percentile Baseline
CW1			
pH	4.6 – 5.3	4.1 – 5.8	4.8 – 5.0
EC (uS/cm)	30	30	22
Fe (Filterable Mg/L)	0.57	1.69	0.37
CW2			
pH	4.5 – 5.6	4.0 – 6.2	4.8 – 5.4
EC (uS/cm)	23.1	27.1	20.2
Fe (Filterable Mg/L)	0.48	0.67	0.30
SSE3			
pH	5.2 – 5.9	4.8 – 6.5	5.3 – 6.1
EC (uS/cm)	52	69	48

Element	Short-term Minor Change (1)	Short-term Major Change (2)	80^{th} Percentile Baseline
Fe (Filterable Mg/L)	8.43	13.51	7.27

6.5. Surface Water Quality

Surface water quality triggers have been developed using the ANZECC (2000) water quality guidelines for protection of aquatic life (95% species protection levels). Minor and major variation / impacts will be assessed by using the ANZECC protocols of comparing the pre-mining 80^{th} and 95^{th} percentile baseline with the 50^{th} percentile of the post-mining data and allowing for the effects of short-term spikes due to rainfall runoff events.

Table 28 provides a description short term and long term changes in reference to minor or major variations. The surface water triggers levels are presented in Table 29.

Table 28. Short and Long Term Change Descriptions as Relevant to Minor and Major Changes in Surface Water

Type of change	Description
Minor Changes	
Long-term minor changes	For each analyte, if the post-mining 50th percentile ≤ baseline 80^{th} percentile, the changes are considered minor and would not have an unacceptable impact on aquatic life (i.e. provided the long-term increase in concentrations is such that the 50^{th} percentile does not exceed the baseline 80^{th} percentile, the increase is considered to be minor)
Short-term minor changes –	For each analyte, if any measured parameter > baseline 80^{th} percentile, but ≤ baseline 95^{th} percentile (5^{th} percentile for pH) trigger value for ≤ two months, the changes are considered minor and would not have an unacceptable impact on aquatic life. It should be noted that about 20% of observations will exceed the 80^{th} percentile and these are usually short-term spikes in concentrations, which are often due to rainfall runoff events. These short-term spikes generally occur for less than two consecutive months.
Major Changes	
Long-term major changes	For each analyte, if the post-mining 50^{th} percentile > baseline 80^{th} percentile, the changes are considered major.
Short-term major changes	For each analyte, if any measured parameter > baseline 80^{th} percentile by two standard deviations for more than two months, the changes are considered major

Table 29. Surface Water Quality Triggers

Element	Short-term Minor Change [(1)]	Short-term Major Change [(2)]	80th Percentile Baseline
Carne Swamp			
pH	4.80 – 6.8	4.1 – 7.3	5.3 – 6.1
EC (uS/cm)	40	51	27
Mn (Filterable Mg/L)	0.036	0.174	0.022
Fe (Filterable Mg/L)	0.69	0.77	0.44
Sunnyside East Swamp			
pH	5.0 – 6.5	4.5 – 6.5	5.5 – 6.0
EC (uS/cm)	27	33	24
Mn (Filterable mg/L)	0.037	0.037	0.019
Fe (Filterable Mg/L)	0.313	0.363	0.260
Marrangaroo Creek Upstream (Reference Site)			
pH	5.2 – 6.7	4.5 – 7.1	5.5 – 6.1
EC (uS/cm)	40	47	33
Mn (Filterable Mg/L)	0.02	0.11	0.01
Fe (Filterable Mg/L)	0.10	0.26	0.08

7. RESPONSE STRATEGIES

As indicated in Section 6, exceedances have occurred in relation to groundwater triggers and flora performance indicators. In accordance with relevant approval requirements, Centennial has notified the Department of Environment and undertaken investigations into the exceedances. The following sections summarise the actions undertaken in relation to each trigger. Additional detail is included in the reports provided to the Department.

7.1. SPR1104 and SPR1107

7.1.1. Initial Notification

Notification of an exceedance of water level trigger thresholds (short-term) at SPR1104 and SPR1107 was received by Centennial from RPS on the 22nd of December 2016, following scheduled monitoring and subsequent data verification. Notification of the triggers was provided to the Department of Environment and the Department of Planning and Environment on the 22nd of December 2016, as required under Springvale approvals.

7.1.2. Investigation Report

A Trigger Investigation Report was submitted to both Departments on the 16th of February 2017. The Report outlined a series of checks to discern non-mining impacts from mining related impacts and a proposed action plan.

7.1.3. Response Strategy

The following actions are currently being undertaken by Centennial:

- Centennial will continue investigations into subsidence affects to groundwater systems to determine if there is a relationship between mine subsidence and the change in groundwater level behaviour observed at SPR1104 and SPR1107.
- Continue to monitor conditions for a 6 month period and:
    - Undertake any necessary investigations if conditions worsen.
    - Review data from all monitoring programs.

7.1.4. Investigation Outcomes

Both SPR1104 and SPR1107 exceeded the 5th percentile pre-mining thresholds during the pre-mining period. This caused the immediate trigger of SPR1104 and SPR1107 when the longwall approached within the 600m trigger investigation area. With the same trigger criteria applied, reference piezometers SPR1108, SPR1111, and SPR1113 were also found to trigger during the pre-mining period, indicating a regional climatic influence on groundwater levels. This is supported by a rainfall deficit from March 2013 which is observable through CRD.

SPR1104 shows a sharp declining trend towards the end of September 2016 that does not correlate with reference piezometers or climatic conditions. The hydrograph indicates that groundwater level in the vicinity of the piezometer has re-equilibrated with reduced groundwater levels above the longwall goaf which have been impacted by subsidence, likely fracture dilation and bed separation resulting in increased storage capacity and a corresponding reduction in groundwater levels. This is further supported by stabilisation towards the end of the data set. There is no evidence of continued decline that might be associated with vertical fracturing or deep drainage at this stage.

Post-mining, the groundwater level at SPR1107 has continued at a similar gradient to reference piezometers. Continued monitoring may be expected to show a similar response with the passing of Longwall 419, as observed at SPR1104.

7.2. SSE1 and WC01, WC03 & WC04

7.2.1. Initial Notification

Notification of an exceedance of flora performance indicator triggers at monitoring locations SSE1 (Sunnyside East Swamp) and WC03 & WC04 (Carne West Swamp) was received by Centennial from RPS on the 8th of November 2016. Notification of the triggers was provided to the Department of Environment on the 10th of November 2016, as required under the response protocol in the Longwall 415 – 417 THPSSMP and Longwall 418 THPSS MMP TARP.

7.2.2. Investigation Report

A Trigger Investigation Report was submitted to the Department on the 23rd of December 2016. The Report outlined a series of checks to discern non-mining impacts from mining related impacts and a proposed action plan.

7.2.3. Response Strategy

The following actions were recommended for consideration and are currently being undertaken/investigated by Centennial:

SSE1

- Continue to perform monitoring activities in accordance with the THPSSMP for Longwalls 415 – 417.
- Repeat investigations performed in this analysis to evaluate eucalypt recruitment at a swamp scale.
- Instigate a swamp rehabilitation program centering on the removal of eucalypt regrowth throughout the central and lower parts of the swamp.*

* Note: this recommendation may necessitate application for a licence under Section 91 of the *Threatened Species Conservation Act* 1995. Consultation is required with the Office of Environment and Heritage to discern this requirement.

WC01

- Continue to perform monitoring activities in accordance with the THPSS MMP for LW418.

- Review recent data collected from monitoring methods applied in accordance with the Swamp Monitoring Program for LW419 (i.e. Brownstein et al 2014).
- Consider options for reducing the amount of entry into Carne West for monitoring purposes and/ or consider alternate access options (e.g. installation of raised boardwalk to piezometer sites).
- Consider construction of a barrier along the swamp margin at the vehicle track elbow to disperse fauna movements thus potentially reduce trampling impacts.

WC03 & WC04

- Continue to perform monitoring activities in accordance with the THPSS MMP for LW418.
- Review recent data collected from monitoring methods applied in accordance with the Swamp Monitoring Program for LW419 (i.e. Brownstein et al 2014).

7.2.4. Investigation Outcomes

SSE1

The drying effect of the incision feature (an aged and previously documented erosion feature within Sunnyside East Swamp that pre-dates mining) and the recent prolonged period of dry weather provide an alternative hypothesis for the emergence of eucalypt recruitment. Contrary to other monitored swamps, it is also noteworthy to mention the extensive eucalypt canopy overhang within Sunnyside East Swamp, thus its increased exposure to eucalypt seed accumulation.

Unseasonably dry warm conditions were also prevalent in the preceding months adding further pressure on water availability in the upper peat layers. The combined influence of the incision feature and weather conditions could explain the emergence of eucalypt regeneration within the swamp.

Other measures monitored at SSE01 remain within the expected range and have not resulted in a trigger event. While inconclusive, it is reasonable to speculate that the eucalypt trigger is not necessarily related to mining, rather may be a function of weather and opportunity (i.e. a considerable proportion of Sunnyside East Swamp has overhanging eucalypt cover).

WC01, WC03 & WC04

Coral Fern is a characteristic species in THPSS of the Newnes Plateau area. At Carne West this species forms dense aggregations on the swamp margins decreasing to dense patches in the central parts. Being a fern, this species generally develops a shallow root system in the upper parts of the peat profile and is reliant on constant high soil moisture for growth and vigour. These two factors make this species particularly susceptible to water loss and/ or fluctuation.

According to Hose et al. (2014), Coral Fern is characteristic of the wetter parts of the 'Budderoo' THPSS where it associates with sedge (i.e. Gymnoschoenus sphaerocephalus) and tussock (Xyris operculata) species. Zonation of this nature in Carne West is not exactly the same as described by Hose et al. (2014), however is broadly similar with Xyris ustulata substituting X. operculata and the sedge Lepidosperma limicola substituting G. sphaerocephalus on the swamp margins.

Centennial (2016) provides insight into the recent hydrological regime of Carne West indicating a shift in 2014 from a groundwater to rainfall dependent swamp. Ongoing groundwater investigations are currently being performed to determine if this shift in water reliance is mining induced or is a delayed response to longer term climatic influences.

In consideration of Hose et al. (2014) and Centennial (2016), the exclusion of mining as a possible cause for the decline in Coral Fern condition is a feasible conclusion given that recent dry warm weather conditions may represent a plausible reason for the observed change. If Carne West is rainfall dependent then it is reasonable to assume that the swamp margins will experience the greatest water stress and do so earlier than the swamp axis. Other anthropogenic and natural influences may also have contributed to the sharp decline in Coral Fern condition. Therefore, without clarity on the reason for change in water dependency, it is premature to conclude if the change in Coral Fern condition is mining related or not.

8. SUMMARY

Springvale received conditional approval to mine Longwalls 415 to 417 which are beneath Temperate Highland Peat Swamps on Sandstone (THPSS). A THPSS Management Plan (THPSSMP) has been developed and implemented in accordance with the conditions of approval. This includes and extensive monitoring program which covers both the controlled action and the surrounding environment to assist in identifying any potential impact from mining.

During 2016 coal was mined from Longwalls 418 and 419. These longwalls are covered under EPBC 2013/6881, the Longwall 418 THPSS MMP and Longwall 419 Extraction Plan.

Subsidence monitoring has been undertaken in accordance with the Springvale Subsidence Management and Reporting Plan for Longwalls 415 to 417. Subsidence, tilt, tensile strain and compressive strain results demonstrates compliance with the trigger values defined in the THPSSMP.

Climatic conditions must be considered when analysing monitoring data. Rainfall levels remained below the long-term average for the majority of the year. Both Newnes Plateau and Lithgow rainfall levels for 2016 were above the Lithgow long term average and this year's data was notable due to large rainfall events in January, June, July and September.

Groundwater trigger levels were exceeded at aquifer piezometers SPR1104 and SPR1107. Springvale has reported, investigated and undertaken action to determine any potential impact from mining in accordance with site approvals.

Flora performance indicator triggers were exceeded at Sunnyside East Swamp (SSE1) and Carne West (WC01, WC03 and WC04) during the reporting period. Springvale has reported, investigated and undertaken action to determine any potential impact from mining in accordance with site approvals.

Surface water flows and water chemistry show trends that are consistent with that observed in previous years monitoring showing no discernable effects from mining.

Springvale Coal
PO Box 198
Wallerawang NSW 2845
www.centennialcoal.com.au