



Centennial Coal



***CENTENNIAL MANDALONG PTY
LTD
Mandalong Mine
ANNUAL REVIEW***

March 2019



Annual Review Title Block

Name of Operation	Mandalong Mine
Name of Operator	Centennial Mandalong Pty Ltd
Development Consent/ Project Approval #	SSD-5144, SSD-5145, DA97/800, DA 35-2-2004.
Mining Lease #	Mining Lease 1431 Mining Lease 1443 Mining Lease 1543 Mining Lease 1553 Mining Lease 1722 Mining Lease 1744
Name of Holder of Mining Lease	Centennial Mandalong Pty Ltd
Water License #	WAL39767
Name of Holder of Water License	Centennial Mandalong Pty Ltd
MOP/RMP Start Date	1 December 2016
MOP/RMP End Date	30 November 2023
Annual Review Start Date	1 January 2018
Annual Review End Date	31 December 2018
<p>I, certify that this audit report is a true and accurate record of the compliance status of Centennial Mandalong for the period 1 January to 31 December 2018 and that I am authorized to make this statement on behalf of Centennial Mandalong Pty Ltd.</p> <p><i>Note:</i></p> <p>a) The Annual Review is an 'environmental audit' for the purposes of s122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion) in an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, \$1 million and for an individual, \$250,000.</p> <p>b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (intention to defraud by false or misleading statement – maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents –maximum penalty 2 years imprisonment or \$22,000, or both).</p>	
Name of Authorised Reporting Officer	ANDREW MYORS
Title of Authorised Reporting Officer	DIRECTOR
Signature of Authorised Reporting Officer	A.J. Myors
Date	21/3/19

Contents

1	STATEMENT OF COMPLIANCE	1
2	INTRODUCTION.....	3
2.1	OVERVIEW	4
2.2	SCOPE.....	4
3	APPROVALS.....	6
3.1	DEVELOPMENT CONSENTS	9
3.1.1	<i>Development Consent SSD-5144 for the Mandalong Southern Extension Project.....</i>	<i>9</i>
3.1.2	<i>Development Consent DA 97/800 for the Mandalong Mine</i>	<i>10</i>
3.1.3	<i>Development Consent DA 35-2-2004 for the Delta Entry Site.....</i>	<i>12</i>
3.1.4	<i>Development Consent SSD-5145 for Northern Coal Logistics Project.....</i>	<i>12</i>
3.2	MINING AUTHORITIES	12
3.3	ENVIRONMENT PROTECTION LICENCE.....	12
3.4	AUTHORISATIONS & EXPLORATION LICENCES.....	12
3.5	CONSENT CONDITIONS – ANNUAL REVIEW REQUIREMENTS.....	13
4	OPERATIONS SUMMARY	18
4.1	OTHER OPERATIONS	18
4.2	EXPLORATION.....	19
5	ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW	20
5.1	MINE WATER REDUCTION TARGETS	21
5.2	WASTE MANAGEMENT	22
6	ENVIRONMENTAL PERFORMANCE	23
6.1	NOISE MONITORING.....	24
6.1.1	<i>Summary of Noise Monitoring Results.....</i>	<i>26</i>
6.2	BLAST MONITORING.....	28
6.3	AIR QUALITY MONITORING	29
6.3.1	<i>Mandalong.....</i>	<i>29</i>
6.3.2	<i>Delta Entry Site</i>	<i>30</i>
6.3.3	<i>Cooranbong Entry Site.....</i>	<i>31</i>
6.3.4	<i>Mandalong South Surface Site</i>	<i>32</i>
6.3.5	<i>Air Quality Monitoring Data Interpretation</i>	<i>32</i>
6.3.6	<i>Particulate Matter</i>	<i>34</i>
6.3.7	<i>HVAS (High Velocity Air Samplers)</i>	<i>36</i>
6.3.8	<i>Greenhouse Gas Monitoring.....</i>	<i>38</i>
6.3.9	<i>Greenhouse Gas Abatement Investigations Measures</i>	<i>38</i>
6.4	BIODIVERSITY MONITORING.....	40
6.4.1	<i>LW22-24A Extraction Plan Areas.....</i>	<i>40</i>
6.4.2	<i>Land Management Strategy for the MSSS and TL24 Offset Areas.....</i>	<i>44</i>
6.4.3	<i>MSSS & TL24 Nest Box Monitoring.....</i>	<i>48</i>
6.4.4	<i>VAM-RAB Rehabilitation Off-Set Monitoring.....</i>	<i>48</i>
6.4.5	<i>Green & Golden Bell Frog Research Program</i>	<i>51</i>
6.5	CULTURAL HERITAGE & ARCHAEOLOGY	53
6.5.1	<i>Aboriginal Archaeology –LW22-23 & LW24-24A Extraction Plan Areas</i>	<i>53</i>
6.5.2	<i>Aboriginal Archaeology – LW25-31 Extraction Plan Area</i>	<i>54</i>
6.5.3	<i>European Heritage</i>	<i>55</i>
6.6	RAINFALL MONITORING RESULTS	56
6.7	SUBSIDENCE MONITORING.....	57
6.7.1	<i>Subsidence Performance Measures</i>	<i>57</i>
6.7.2	<i>Subsidence Reporting.....</i>	<i>58</i>
6.7.3	<i>Subsidence Performance Summary</i>	<i>59</i>
6.8	AGRICULTURAL LAND SUITABILITY	69
6.8.1	<i>Agricultural Suitability Classification.....</i>	<i>69</i>
6.8.2	<i>Assessment of Agricultural Suitability</i>	<i>70</i>
6.8.3	<i>Agricultural Suitability Impact Assessment</i>	<i>71</i>

6.9	FLOODPATH MONITORING	81
7	WATER MANAGEMENT	82
7.1	SURFACE WATER MONITORING	82
7.1.1	Mandalong & Cooranbong Entry Site.....	82
7.1.2	Cooranbong Haul Road	82
7.1.3	Surface Water Monitoring Results	84
7.1.4	Data Interpretation.....	86
7.2	WATER BUDGET	88
7.2.1	Water Supply, Use & Discharge.....	88
7.2.2	Mine Water Management.....	90
7.3	GROUNDWATER MANAGEMENT.....	91
7.3.2	Groundwater Levels	95
7.3.3	Groundwater Quality	96
8	REHABILITATION	98
8.1	PROGRESSIVE REHABILITATION AND COMPLETION	99
8.2	MANDALONG MINE REHABILITATION.....	100
8.2.1	Longwall Mining Area.....	100
8.2.2	Exploration Sites	100
8.2.3	Delta Entry Site	100
8.2.4	Cooranbong Entry Site.....	101
8.2.5	Cooranbong Haul Road	101
8.2.6	Mandalong South Surface Site	101
8.3	BUILDINGS	102
8.3.1	Mandalong Mine.....	102
8.3.2	Delta Entry Site	102
8.3.3	Cooranbong Entry Site.....	102
8.4	REHABILITATION TRIALS AND RESEARCH.....	102
8.4.1	Use of Analogue Sites.....	102
8.4.2	Mandalong Mine VAM-RAB Offset Area.....	103
8.4.3	Land Management Strategy for the MSSS and TL24 Offset Areas.....	103
8.4.4	Moran's Creek Rehabilitation Trial.....	103
9	COMMUNITY CONSULTATION	105
9.1	EXTRACTION PLAN CONSULTATION.....	105
9.2	COMMUNITY SPONSORSHIP.....	106
9.3	COMMUNITY COMPLAINTS.....	107
10	INDEPENDENT ENVIRONMENTAL AUDIT	108
11	NON-COMPLIANCES DURING THE REPORTING PERIOD	109
12	ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD.....	111
13	REFERENCES.....	112

List of Tables

TABLE 1: STATEMENT OF COMPLIANCE	1
TABLE 2: 2018 NON-COMPLIANCES.....	2
TABLE 3: CENTENNIAL MANDALONG ENVIRONMENTAL CONTACT DETAILS	5
TABLE 4: ENVIRONMENTAL APPROVALS HELD BY CENTENNIAL MANDALONG.	6
TABLE 5: ANNUAL REVIEW REQUIREMENTS	13
TABLE 6: PRODUCTION SUMMARY & FORECAST	18
TABLE 7: OPERATIONS SUMMARY.....	18
TABLE 8: MANDALONG COAL DELIVERY SYSTEM (DELTA ENTRY SITE) MONTHLY TONNAGES.....	19
TABLE 9: ACTIONS FROM PREVIOUS ANNUAL REVIEW	20
TABLE 10: SUMMARY OF MONITORING REQUIREMENTS	23
TABLE 11: DESCRIPTION OF DEPOSITIONAL DUST GAUGES	29
TABLE 12: SUMMARY OF DEPOSITIONAL DUST RESULTS BETWEEN JANUARY 2018 AND DECEMBER 2018 SURROUNDING MANDALONG MINE.....	29
TABLE 13: LOCATION OF DELTA ENTRY SITE DEPOSITIONAL DUST GAUGES.....	30
TABLE 14: SUMMARY OF DEPOSITIONAL DUST RESULTS BETWEEN JANUARY 2018 AND DECEMBER 2018 SURROUNDING DELTA ENTRY SITE	31
TABLE 15: SUMMARY OF DEPOSITIONAL DUST RESULTS BETWEEN JANUARY 2018 AND DECEMBER 2018 SURROUNDING THE COORANBONG ENTRY SITE.....	32
TABLE 16: SUMMARY OF DEPOSITIONAL DUST RESULTS BETWEEN JANUARY 2018 AND DECEMBER 2018 SURROUNDING THE MANDALONG SOUTH SURFACE SITE.....	32
TABLE 17: DETAILED DUST MONITORING AND ANALYSIS SHOWING THE ANNUAL ROLLING AVERAGE AND CHANGE IN DEPOSITION FROM THE PRE-CONSTRUCTION AVERAGE (PCA) FOR DUST GAUGES DG6, DG8 AND DG9.....	33
TABLE 18: TOTAL GHG EMISSIONS FROM MANDALONG MINE IN 2018 FINANCIAL YEAR.....	38
TABLE 19: LAND MANAGEMENT STRATEGY SITE LOCATIONS	44
TABLE 20: SUBSIDENCE ON ABORIGINAL CULTURAL HERITAGE SITES (LW22-24A)	53
TABLE 21: ABORIGINAL CULTURAL HERITAGE SITES (LW25-31).....	54
TABLE 22: RAINFALL AT MANDALONG MINE FOR THE PERIOD JANUARY 2018 TO DECEMBER 2018.....	56
TABLE 23: SSD-5144 SUBSIDENCE PERFORMANCE MEASURES – NATURAL AND HERITAGE FEATURES	57
TABLE 24: SSD-5144 SUBSIDENCE PERFORMANCE MEASURES – BUILT FEATURES.....	58
TABLE 25: SUBSIDENCE REPORTS 2018.....	59
TABLE 26: MAXIMUM VERTICAL SUBSIDENCE DEVELOPED OVER LW22	61
TABLE 27: MAXIMUM VERTICAL SUBSIDENCE DEVELOPED OVER LW23	61
TABLE 28: MAXIMUM VERTICAL SUBSIDENCE DEVELOPED OVER LW24	61
TABLE 29: MAXIMUM VERTICAL SUBSIDENCE DEVELOPED OVER LW24A.....	61
TABLE 30: MEASURED SUBSIDENCE FREQUENCY HISTOGRAM SUMMARY LONGWALLS 6 TO 24A	63
TABLE 31: ASSESSMENT OF SUBSIDENCE PERFORMANCE AGAINST PERFORMANCE MEASURES AND PREDICTED IMPACTS	64
TABLE 32: AGRICULTURAL SUITABILITY CLASSIFICATION AND LAND USE	70
TABLE 33: DETAILS OF PONDING & REMEDIAL ACTION	71
TABLE 34: WATER TAKE	82
TABLE 35: SUMMARY OF MONITORING LOCATIONS WITH RESPECT TO POSITION WITHIN THE CATCHMENTS ..	83
TABLE 36: AVERAGE SURFACE WATER QUALITY FOR THE 12 MONTH PERIOD FROM JANUARY 2018 TO DECEMBER 2018 ('ANNUAL') AND THE LONG-TERM AVERAGE ('LTA').	84
TABLE 37: LDP001 DISCHARGE VOLUME	85
TABLE 38: WATER QUALITY LDP001.....	85
TABLE 39: WATER QUALITY LDP002.....	86
TABLE 40: WATER QUALITY LDP003	87
TABLE 41: WATER QUALITY LDP004	87
TABLE 42: 2018 SUMMARY OF WATER INPUTS AND OUTPUTS	89
TABLE 43: GROUNDWATER MONITORING BORE DETAILS	91
TABLE 44: REHABILITATION AND DISTURBANCE RATES DURING THE MOP TERM	99
TABLE 45: 2018 COMMUNITY COMPLAINT DETAILS.	107
TABLE 46: RECORD OF ANNUAL COMMUNITY COMPLAINTS FOR 2017 & 2018	107
TABLE 47: NON-COMPLIANCE 1	109
TABLE 48: FORECAST OPERATIONS FOR 2019	111

List of Figures

FIGURE 1: REGIONAL CONTEXT	3
FIGURE 2: MANDALONG MINE NOISE MONITORING LOCATIONS	24
FIGURE 3: COORANBONG ENTRY SITE NOISE MONITORING LOCATIONS	25
FIGURE 4: MSSS NOISE MONITORING LOCATIONS.....	28
FIGURE 5: DEPOSITIONAL DUST RESULTS SURROUNDING MANDALONG MINE FOR 2018.....	30
FIGURE 6: 2018 DEPOSITIONAL DUST RESULTS FOR DELTA ENTRY SITE	31
FIGURE 7: MONTHLY ROLLING ANNUAL AVERAGE DUST DEPOSITION FOR 2018.	34
FIGURE 8: TSP AND PM10 2018 ANNUAL ROLLING AVERAGE.....	36
FIGURE 9: MMAS PM10 MONITORING RESULTS	37
FIGURE 10: MMAS PM2.5 MONITORING RESULTS	37
FIGURE 11: BIOMETRIC PLOTS LW22-24A SITES	42
FIGURE 12: AQUATIC ECOLOGICAL MONITORING LOCATIONS.....	43
FIGURE 13: MANDALONG FARM OFFSET AREA.....	46
FIGURE 14 : CHAPMAN ROAD BUSH BLOCK OFFSET AREA	47
FIGURE 15: LOCATION OF FLORISTIC SAMPLE PLOTS	50
FIGURE 16: MANDALONG ANNUAL RAINFALL	56
FIGURE 17: LOCATION OF SUBSIDENCE MONITORING LINES	60
FIGURE 18: SUBSIDENCE PARAMETERS MEASURED ALONG CROSSLINE 19 (TOBINS Rd).....	62
FIGURE 19: SUBSIDENCE PARAMETERS MEASURED ALONG CROSSLINE 8 MANDALONG RD.....	62
FIGURE 20: LDP001 WATER QUALITY MONITORING	86
FIGURE 21: MANDALONG MINE GROUNDWATER MONITORING LOCATIONS.....	94
FIGURE 22: ANNUAL COMMUNITY COMPLAINTS.....	108

Plans

Plan Reference	Plan Name
Plan 2-1	Mandalong South Surface Site Domains at Commencement of MOP
Plan 2-2	Mandalong Mine Access Site Domains at Commencement of MOP
Plan 2-3	Delta Entry Site Domains at Commencement of MOP
Plan 2-4	Cooranbong Entry Site Domains at Commencement of MOP
MG10815	Mandalong Mine Monthly Production 2018
MG10722d	Mandalong Mine Location of Environmental Monitoring Points
MG10722c	Delta Entry Site Locations of Environmental Monitoring Points
MG10722b	Cooranbong Service Site Location of Environmental Monitoring Points
MG10722f	Mandalong South Surface Site Location of Environmental Monitoring Points
MG10502	Mandalong Surface Water and Groundwater Monitoring Locations

Appendices

Appendix No.	Appendix Name
1	Bank Guarantee – DA97/800 CC24
2	Floodpath Condition Report – 2018
3	2016 Independent Environmental Audit Action Plan
4	Centennial Mandalong Rehabilitation Security Estimate (DRG only)

1 STATEMENT OF COMPLIANCE

Table 1: Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
DA97/800 (MOD10)	Yes
DA97/800 MOD 4 Statement of Commitments	Yes
DA97/800 MOD 7 Statement of Commitments	Yes
SSD-5144 (MOD5)	No
SSD-5144 Mandalong Southern Extension Project Statement of Commitments	Yes
SSD-5144 MOD 1 Statement of Commitments	Yes
SSD-5145 (MOD 1)	Yes
DA35-2-2004 (MOD 1)	Yes
EPL 365	No
Mining Lease 1431	Yes
Mining Lease 1443	Yes
Mining Lease 1543	Yes
Mining Lease 1553	Yes
Mining Lease 1722	Yes
Mining Lease 1744	Yes
WAL39767	Yes
EPBC Approval 2013/6906	Yes

Table 2: 2018 Non-Compliances

Relevant Approval	Condition #	Condition summary	Compliance Status	Comment	Table # Addressed in Annual Review
EPL365	L1.1 Pollution of Waters	The licensee must comply with Section 120 of the POEO Act 1997.	Low	Water was recorded discharging from the Mandalong South Surface Site (MSSS) Sediment Basin. The overflow from the MSSS Sediment Basin was into an ephemeral tributary of Morans Creek	Table 47
SSD-5144	Schedule 3 Condition 13	The applicant must comply with Section 120 of the POEO Act.			

Note: Compliance Status Key for Table 2

Risk Level	Colour Code	Description
High		Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium		Non-compliance with: <ul style="list-style-type: none"> Potential for serious environmental consequences, but is unlikely to occur; or Potential for moderate environmental consequences, but is likely to occur
Low		Non-compliance with: <ul style="list-style-type: none"> Potential for moderate environmental consequences, but is unlikely to occur; or Potential for low environmental consequences, but is likely to occur
Administrative		Only to be applied where the non-compliance does not result in any risk of environmental harm (eg submitting a report to government later than required under approval conditions)

2 INTRODUCTION

Mandalong Mine is owned and operated by Centennial Mandalong Pty Ltd (Centennial Mandalong), a subsidiary of Centennial Coal Company Limited ('Centennial'). Centennial completed the purchase of the Mandalong Mine in August 2002. Centennial was subsequently purchased by Banpu Public Company Limited ("Banpu") in October 2010.

Mandalong Mine is a modern underground longwall operation located on the western side of Lake Macquarie near Morisset and west of the M1 Motorway. The Mine is situated approximately 130 km north of Sydney and 50 km from the Port of Newcastle, supplying up to 6.5 million tonnes of coal to the domestic power and export markets (**Figure 1**).



Figure 1: Regional Context

2.1 OVERVIEW

Mandalong Mine comprises the underground workings and surface infrastructure of:

- The Mandalong Mine underground workings including longwall panels, development units and surface infrastructure located near Morisset;
- The Cooranbong Entry Site, consisting of the Cooranbong Colliery underground workings and surface infrastructure located near Dora Creek;
- The Mandalong South Surface Site located off Mandalong Road; and
- The Delta Entry Site, which encompasses an entry and coal delivery system, located near Wyee at the Vales Point Rail Unloader Facility.

An Environmental Impact Statement (EIS) was submitted in 1997 and a Commission of Inquiry held in 1998. The Mine was granted development consent DA 97/800, in October 1998. After obtaining development consent, Centennial constructed the Mandalong Mine site and decline tunnel to access the Mandalong mining area. Longwall mining operations at Mandalong commenced in January 2005. The Mine has approval to extract up to 6.5 million tonnes per annum of coal from the West Wallarah Seam and Wallarah-Great Northern Seam using the longwall mining method.

Development consent DA 35/2/2004 granted in July 2004 by the then NSW Department of Planning & Infrastructure approved the construction and operation of the coal handling and clearance system at the Delta Entry Site. Construction of the Delta Coal Clearance System was completed in 2006. The Cooranbong Entry Site and the Delta Entry Site contain coal handling infrastructure, enabling the Mandalong Mine to process and convey as permitted by their respective development consents up to 10 million tonnes of coal per annum. These sites are maintained under current mine leases as detailed in **Table 4**.

Development consent SSD-5144 was granted by the Planning & Assessment Commission (PAC) on 12 October 2015. As per Condition 13 of Schedule 2 of SSD-5144 and agreed with the Secretary of the Department of Planning & Environment on 16 September 2016 in accordance with Section 104A of the Environmental Planning and Assessment Act 1979 (EP&A Act) Centennial Mandalong shall surrender DA97/800 by 30 April 2019.

2.2 SCOPE

This Annual Review details the progress of environmental management covering Mandalong Mine, Mandalong South Surface Site, Cooranbong Entry Site and the Delta Entry Site collectively, for the period 1 January 2018 to 31 December 2018.

The Annual Review has been prepared in accordance with the Mandalong Mine conditions of consent as detailed in SSD-5144 and DA 97/800. The Annual Review has also been prepared in accordance with the requirements of Schedule 3, Condition 4 of DA35-2-2004 (Mandalong Coal Delivery System – Delta Link Project).

Development Consent SSD-5145 (Northern Coal Logistic Project) was approved by the DPE on 29 September 2015. The approval consolidates the receipt, handling, processing and transport of run-of-mine coal from Centennial Coal's underground operations at Mandalong Mine, Newstan Colliery and Awaba Colliery.

This Annual Review document also addresses the requirements of Schedule 5, Condition 11 of SSD-5145 for the Cooranbong Entry Site (CES). The others operations covered by SSD-5145 are described in the Newstan Annual Review required by SSD-5145.

Table 3: Centennial Mandalong Environmental Contact Details

Name	Position	Email	Phone
Richard Gelson	Mine Manager	richard.gelson@centennialcoal.com.au	02 49730911
Jeffrey Dunwoodie	Environment & Community Coordinator	jeffrey.dunwoodie@centennialcoal.com.au	02 49730947
Phil Enright	Mining Approvals Coordinator	phil.enright@centennialcoal.com.au	02 49730948

3 APPROVALS

Table 4: Environmental Approvals held by Centennial Mandalong.

Name	Description	Issued By	Expiry Date	Renewal Procedure
Consolidated Coal Lease 762	Title to Cooranbong Workings includes some surface land, some environmental conditions	Dept. Primary Industry (Mineral Resources)	13/10/2022	Group Manager Property, Titles and Survey
Consolidated Coal Lease 746 (sublease)	Title for Cooranbong Workings includes some surface land – some environmental conditions	Dept. Primary Industry (Mineral Resources)	31/12/2028	Group Manager Property, Titles and Survey This lease is managed by Centennial Newstan
Mining Purposes Lease 191	Title to surface land for water tanks at Cooranbong – requires annual environmental management report on anniversary	Dept. Primary Industry (Mineral Resources)	24/2/2023	Group Manager Property, Titles and Survey
Mining Lease 1431	Title to surface land for proposed shaft at the back of Morisset	Dept. Primary Industry (Mineral Resources)	27/5/2019	Group Manager Property, Titles and Survey
Mining Lease 1443	Mandalong Project Mining Lease – includes some surface land	Dept. Primary Industry (Minerals Resources)	01/03/2020	Group Manager Property, Titles and Survey
Mining Lease 1543	Mining Lease – Mandalong Mine Project	Dept. Primary Industry (Mineral Resources)	25/11/2024	Group Manager Property, Titles and Survey
Mining Lease 1553	Mining Lease Delta Link Project – includes surface land	Dept. Primary Industry (Mineral Resources)	07/09/2025	Group Manager Property, Titles and Survey
Mining Lease 1722	Mining Lease – Southern Extension Area	Dept. Industry Resources & Energy	17/12/2036	Group Manager Property, Titles and Survey

Name	Description	Issued By	Expiry Date	Renewal Procedure
Mining Lease 1744	Mining lease associated with proposed mining operations in the Olney State Forest areas within the Southern Extension Area	Dept. Industry Resources & Energy	6/10/2037	Group Manager Property, Titles and Survey
Exploration Licence 4443	Exploration Licence	Dept. Primary Industry (Mineral Resources)	23/10/2017 [#]	Group Manager Property, Titles and Survey
Exploration Licence 4969	Exploration Licence	Dept. Primary Industry (Mineral Resources)	31/07/2017 [#]	Group Manager Property, Titles and Survey
Exploration Licence 5892	Exploration Licence	Dept. Primary Industry (Mineral Resources)	31/07/2017 [#]	Group Manager Property, Titles and Survey
Exploration Licence 6317	Exploration Licence	Dept. Primary Industry (Mineral Resources)	08/08/2019 [#]	Group Manager Property, Titles and Survey
Authorisation 404	Exploration Licence	Dept. Primary Industry (Mineral Resources)	31/07/2017 [#]	Group Manager Property, Titles and Survey
Mine Operations Plan (MOP) – Amendment B	Summary of Mining Activities – Mandalong	Department of Planning & Environment – Division of Resources & Geoscience.	30/11/2023	MOP approved for the period 1 December 2016 to 30 November 2023.
Environmental Protection Licence 365	Permits scheduled activity “coal mining” and discharge of water from licensed discharge points.	Environment Protection Authority	Perpetual	Requires payment and Annual Return February each year

Name	Description	Issued By	Expiry Date	Renewal Procedure
Mandalong Mine Development Consent No.97/800	Permits development and works to occur as described in the EIS.	NSW Department of Planning & Environment	October 2020	To be surrendered by 30 April 2019.
Mandalong Mine Development Consent No. DA 35-2-2004	Permits construction and operation of the Delta Coal Handling Facility	NSW Department of Planning & Environment	31/12/2040	Requires new development consent after expiry date.
Mandalong Mine Development Consent SSD-5144	Extension of underground operations into the Mandalong Southern Extension Area.	NSW Department of Planning & Environment	31/12/2040	Requires new development consent after expiry date.
Centennial Northern Coal Services Development Consent SSD-5145	Receipt, handling, processing and transport of run-of-mine coal from Centennial Coal's underground operations at Mandalong Mine, Newstan Colliery and Awaba Colliery.	NSW Department of Planning & Environment	31/12/2045	Requires new development consent after expiry date.
Northern Coal Logistics EPBC Approval 2013/6906	To upgrade coal preparation, handling infrastructure, transport and water management activities at the existing Northern Coal Services Site	Department of the Environment & Energy	31/12/2055	Requires new EPBC approval after expiry date.
Cooranbong Borehole WAL39767	Dewatering of Mine Workings	Department of Industry – Crown Lands & Water	This water access licence continues to be in force until it is cancelled.	Not applicable.
Radiation Licence 5064217	Radiation management	Environment Protection Authority	26/6/2019	Submit renewal application.

Note # Renewal applications have been lodged and acknowledged for these titles however, no renewal offers have been received at the time of writing of this Annual Review.

3.1 DEVELOPMENT CONSENTS

The Mandalong Mine, which is an extension of the old Cooranbong Colliery, was originally granted Development Consent DA 97/800 by the then Minister for Urban Affairs and Planning on 14 October 1998 under Part 4 of the EP&A Act following the submission of the *Cooranbong Colliery Life Extension Project Environmental Impact Statement* (Umwelt, 1997) and a Commission of Inquiry. In 2015 Development Consent SSD-5144 was granted by the Planning & Assessment Commission (PAC) for the Mandalong Southern Extension Project.

The currently approved Mandalong Mine comprises the underground workings and surface infrastructure of the:

- Mandalong Mine, including the Mandalong Mine Access Site, encompassing underground workings and associated surface infrastructure near Morisset;
- Cooranbong Entry Site encompassing a coal delivery system and surface infrastructure (coal handling and processing) near Dora Creek; and
- The new surface facilities site currently under construction, referred to as the Mandalong South Surface Site located off Mandalong Road.

The other operations directly related to the currently approved Mandalong Mine are the two components which comprise the Delta Link Project, namely:

- The construction and use of the Mandalong Coal Delivery System for the underground transportation of coal from the Mandalong Mine to the Delta Entry Site; and
- The receipt and handling of coal at the Wyee Coal Handling Plant at the Delta Entry Site.

The approved Mandalong Mine, and the other operations which directly relate to it, are currently regulated by four planning approvals.

3.1.1 Development Consent SSD-5144 for the Mandalong Southern Extension Project

Development Consent SSD-5144 was granted by the Planning & Assessment Commission (PAC) on 12 October 2015 for the Mandalong Southern Extension Project.

The primary components of the Project are:

- Continue the currently approved operations at the Mandalong Mine, with the exception of the surface infrastructure and operations at the Cooranbong Entry Site (i.e. the continued use of the coal delivery system, the ventilation shaft and the extent of workings at Cooranbong Entry Site for water management.) Note: The surface infrastructure and operations at the Cooranbong Entry Site are part of the Northern Coal Logistics Project SSD-5145, however continue to be managed by Centennial Mandalong;
- Extend the Mandalong Mine's underground mining operations into the Southern Extension Area using a combination of continuous miner and longwall mining methods;
- Extract up to 6.5 Mtpa of ROM coal from the West Wallarah and Wallarah-Great Northern Seams within the current mining lease areas;
- Deliver ROM coal from the underground workings to the Cooranbong Entry Site at a rate of up to 6 Mtpa and to the Delta Entry Site at a rate of up to 6 Mtpa;
- Continue to utilise, and upgrade where required, the existing surface infrastructure of the Mandalong Mine Access Site and Delta Entry Site;

- Install and operate surface infrastructure at the proposed Mandalong South Surface Site to service the extended underground mining operation;
- Increase manning to 420 full-time employees and up to 50 contractors during longwall relocations;
- Undertake on-going exploration drilling activities within the bounds of Centennial Mandalong's mining leases and exploration licences;
- Increase the life of mine to 25 years from the granting of a mining lease(s); and
- Continue to operate 24 hours per day, seven days per week.

Approval to modify SSD-5144 (**MOD 1**) to allow for the relocation of Transgrid's 330 kV Transmission Line TL24 was granted by the DPE on 14 June 2016.

In August 2016, Centennial Mandalong submitted a second application to modify Development Consent SSD-5144 (**MOD 2**) to the DPE. The modification sought to extend development of first workings associated with maingates for longwall panels 22 and 23. This modification was approved on 22 September 2016.

A further modification (**MOD 3**) to increase the annual production limit for the Mandalong Mine from 6 million tonnes per annum to 6.5 million tonnes per annum of ROM coal was approved by DPE on 16 November 2016. This increase is required due to the mine optimising the production process, both in terms of mechanical improvements and through the continuing development and training of underground operators.

An igneous sill exists to the north of approved Longwall panels 22 to 24. Due to historic uncertainty associated with the extent of the igneous sill, Longwall panels 22 to 24 were shortened as a conservative measure to mitigate the sill's impact on production. Through ongoing geological exploration and the successful extraction of adjacent Longwall panels 19, 20 and 21 below the igneous sill, its extent and condition had become better understood. This resulted in the proposed extension of Longwall panels 22 to 24 and the addition of Longwall panel 24A within the existing development consent boundary.

This extension of Longwall mining however existed beyond the development layout. To address this, a Statement of Environmental Effects was prepared titled the Mandalong Longwall Panel 22-23 Extension Modification (**MOD 4**) which was approved by the Department of Planning & Environment on 24 March 2017.

The Mandalong Longwall 24-24A modification (**MOD 5**) was approved by the Department of Planning and Environment on 1 August 2017 following public exhibition of the Statement of Environmental Effects. This modification approves the extension of Longwall 24 and the addition of Longwall 24A.

3.1.2 Development Consent DA 97/800 for the Mandalong Mine

Development application DA 97/800 was lodged with LMCC on 27 November 1997 and described in the *Cooranbong Colliery Life Extension Project Environmental Impact Assessment* (Umwelt, 1997), including the Applicants submissions to the Commission of Inquiry, and as modified on nine occasions as follows:

- **MOD 1 (August 2001)** - minor changes to the conditions of consent relating to the preparation of subsidence management plans and notification of landholder requirements, as described in the modification application dated 29 March 2001.
- **MOD 2 (February 2005)** - installation of methane drainage plant and the transport of 1,000 tonnes of mined coal by road, as described in *Mandalong Mine Methane*

Drainage Plant and Coal Haulage, Statement of Environmental Effects, dated 28 October 2004 and prepared by Sinclair Knight Merz.

- **MOD 3 (March 2006)** - installation and operation of enclosed methane gas flare units for high purity methane drainage gas. This was undertaken in response to condition 60a(iii) imposed as part of MOD 2, which required Centennial Mandalong to submit a report on the progress towards implementing greenhouse gas abatement measures. This modification is as described in the *Statement of Environmental Effects for the Installation and Operation of Enclosed Methane Gas Flare Units*, dated February 2006 and prepared by Umwelt.
- **MOD 4 (July 2009)** - installation and operation of gas engines (yet to be constructed) to produce up to 12 megawatts of electricity using high purity methane drainage gas, increase the coal production rate from 4 Mtpa to 6 Mtpa, relocate a ballast borehole and update subsidence conditions. This modification is as described in the Environmental Assessment entitled *Mandalong Mine Modification to Development Consent Environmental Assessment*, dated September 2008.
- **MOD 5 (November 2009)** - coal from Mandalong Mine (Cooranbong Entry Site) permitted to be washed at Newstan Colliery and a temporary increase in the volume of coal transported by conveyor from the Cooranbong Entry Site to the Earing Power Station stockpiles for subsequent road haulage to Newstan Colliery (until construction of the Cooranbong Private Haul Road was complete). This modification is as described in the Statement of Environmental Effects entitled *Washing of Mandalong Coal at Newstan Section 96(A) Application Statement of Environmental Effects*, dated October 2009.
- **MOD 6 (November 2009)** - changes to the locations and heights of approved (but not previously constructed) coal handling infrastructure at the Cooranbong Entry Site. This modification is as described in the Statement of Environmental Effects entitled *Relocation of Infrastructure within the Mandalong Services Site Section 96(1A) Application Statement of Environmental Effects*, dated November 2009.
- **MOD 7 (October 2011)** - installation and operation of a new technology known as a ventilation air methane regenerative after burner (VAM-RAB) as a trial unit to demonstrate the ability of the technology to capture and abate ventilation air methane from the underground mine. This modification is as described in the *Environmental Assessment: Ventilation Air Methane Abatement Demonstration Project, Mandalong Mine – Section 75W Modification*, dated June 2011 and additional information provided in the document entitled *Mandalong Mine Ventilation Air Methane Abatement Demonstration Project – Response to Submissions* dated September 2011.
- **MOD 8 (August 2012)** - increase in the volume of coal permitted to be transported from the Cooranbong Entry Site to both Newstan Colliery and the Earing Power Station from 2 Mtpa to up to 4 Mtpa and back haulage of middlings (middle quality coal product) from Newstan Colliery to the Cooranbong Entry Site for subsequent supply to the Earing Power Station. This modification is as described in the *Environmental Assessment: Mandalong Mine – Cooranbong Entry Site – Cooranbong Distribution Project – Section 75W Modification to Development Consent DA 97/800*, (GSS Environmental, 2012) and additional *Noise Mitigation Assessment*, dated 31 May 2012.
- **MOD 9 (February 2013)** - administrative amendment to conditions 1A(c) and (d) to allow the coal delivery limits approved as part of MOD 8 (i.e. up to 4 Mtpa from Cooranbong Entry Site to both Newstan Colliery and the Earing Power Station).
- **MOD 10 (November 2014)** - a minor modification to conditions 1A(b) and 1A (c) for a small increase in the amount of coal allowed to be delivered from the underground workings to the Cooranbong Entry Site from 4 Mtpa to 4.1 Mtpa in 2014 only.

3.1.3 Development Consent DA 35-2-2004 for the Delta Entry Site

Development Consent for the transportation of coal to the Delta Entry Site via the underground Mandalong Coal Delivery System, as approved by development consent DA 35-2-2004 and described in the *Delta Link Project – Statement of Environmental Effects* (Umwelt, 2004). This development consent is held by Centennial Mandalong.

Centennial Mandalong sought to modify Development Consent DA 35-2-2004 (**MOD 1**) in September 2017 in order to increase the life of the Mandalong Coal Delivery System from 2021 to 2040. There was no change proposed to the volume of coal permitted to be transported via the Mandalong Coal Delivery System (4 Mtpa), nor any other proposed changes.

The modification would make the life of the Mandalong Coal Delivery System consistent with the life of Mandalong Mine as currently approved under Development Consent SSD-5144 and, as a result, enable continuation of the transportation of coal from Mandalong Mine to the Vales Point Power Station.

This was essentially an administrative amendment. The modification application was submitted to the NSW Department of Planning and Environment in September 2017 and was supported by an Environmental Assessment. Approval was granted by the Department of Planning & Environment on 17 October 2017.

3.1.4 Development Consent SSD-5145 for Northern Coal Logistics Project

Development Consent SSD-5145 for the Northern Coal Logistic Project was approved by the DPE on 29 September 2015. The approval consolidates the receipt, handling, processing and transport of run-of-mine coal from Centennial Coal's underground operations at Mandalong Mine, Newstan Colliery and Awaba Colliery.

The surface infrastructure and operations at the Cooranbong Entry Site are part of the Northern Coal Logistics Project SSD-5145, however continue to be managed by Centennial Mandalong.

The Centennial Northern Coal Services modification (SSD-5145 **MOD 1**) was approved by the Department of Planning & Environment on 25 January 2018. The modification allows Northern Coal Services to:

- Increase the number of full-time equivalent (FTE) employees based at the Cooranbong Entry Site from 14 to 60; and
- Amend the operational noise criteria specified by Condition 2 of Schedule 3 for the privately-owned residences in the vicinity of the Cooranbong Entry Site.

3.2 MINING AUTHORITIES

The Mandalong Mine holding comprises a number of leases as shown in **Table 4**.

3.3 ENVIRONMENT PROTECTION LICENCE

Centennial Mandalong holds Environment Protection Licence (EPL) 365 under the Protection of the Environment Operations Act 1997 for the Mandalong Mine, Cooranbong Entry Site and the Delta Entry Site.

3.4 AUTHORISATIONS & EXPLORATION LICENCES

The Mandalong Mine holding comprises a number of leases as shown in **Table 4**. There were no renewals completed for the Mandalong Mine Exploration Licences during 2018.

The approved Mining Operations Plan for the period 1 December 2016 to 30 November 2023 was amended in 2017 (Amendment A) for the extension of Longwalls 22 and 23. The MOP Amendment A was approved by the DPE Division of Resources and Geoscience (DRG) on 12 April 2017 and by DPE on 23 June 2017.

The approved Mining Operations Plan for the period 1 December 2016 to 30 November 2023 was amended in 2018 (Amendment B) for the extension of Longwall 24 and the addition of Longwall 24A. The MOP Amendment B was approved by the DPE Division of Resources and Geoscience (DRG) on 6 March 2018 and by DPE on 10 April 2018.

3.5 CONSENT CONDITIONS – ANNUAL REVIEW REQUIREMENTS

The Annual Review has been developed to satisfy the reporting requirements of the approvals listed in **Table 5**. Condition 12 of Schedule 6 of SSD-5144 and Condition 11 of Schedule 5 of SSD-5145 include the requirements for the Annual Review. Conditions 105-107 of DA97/800 (MOD 10) also detail requirements for an Annual Environmental Management Report (AEMR) (now referred to as an Annual Review). Schedule 3 condition 4 of the Delta Entry Site Development Consent (DA 35-2-2004) requires an Annual Report to be submitted as part of the Mandalong Mine AEMR.

Table 5: Annual Review Requirements

Approval	Condition No	Requirement	Where addressed in Annual Review
SSD-5144	Schedule 6 Condition 12	By the end of March each year, or as otherwise agreed by the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development, to the satisfaction of the Secretary. This review must:	
		a) describe the development (including any rehabilitation) that was carried out in the last calendar year, and the development that is proposed to be carried out over the current calendar year;	Section 2, Section 3, Section 8 & Section 12.
		b) include a comprehensive review of the monitoring results and complaints records of the development over the past calendar year, which includes a comparison of these results against the: <ul style="list-style-type: none"> • relevant statutory requirements, limits or performance measures/criteria; • requirements of any plan or program required under this consent; • monitoring results of previous years; and • relevant predictions in the 	Section 6, Section 7 & Section 9.

Approval	Condition No	Requirement	Where addressed in Annual Review
		documents identified in condition 2(a) and (b) of Schedule 2;	
		c) Identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to ensure compliance;	Table 1, Table 2 & Table 47.
		d) identify any trends in the monitoring data over the life of the development;	Section 6, Section 7 & Section 9.
		e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies;	Section 6, Section 7 & Section 9.
		f) describe what measures will be implemented over the current calendar year to improve the environmental performance of the development.	Table 48
SSD-5145	Schedule 5 Condition 11	By the end of March each year, or as otherwise agreed by the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development to the satisfaction of the Secretary. This review must:	
		a) describe the development (including any rehabilitation) that was carried out in the past calendar year, and the development that is proposed to be carried out over the current calendar year;	Section 2, Section 3, Section 8 & Section 12.
		b) include a comprehensive review of the monitoring results and complaints records of the development over the past calendar year, which includes a comparison of these results against the: <ul style="list-style-type: none"> • relevant statutory requirements, limits or performance measures/criteria; • requirements of any plan or program required under this consent; • monitoring results of previous years; and • relevant predictions in the documents identified in condition 2(a) of Schedule 2; 	Section 6, Section 7 & Section 9.

Approval	Condition No	Requirement	Where addressed in Annual Review
		c) identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to ensure compliance;	Table 1, Table 2 & Table 47.
		d) identify any trends in the monitoring data over the life of the development;	Section 6, Section 7 & Section 9.
		e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and	Section 6, Section 7 & Section 9.
		f) describe what measures will be implemented over the current calendar year to improve the environmental performance of the development.	Table 48
DA97/800	Condition 105	The Applicant shall through out the life of the mine and for a period of at least five years after the completion of mining, prepare and submit an Annual Environmental Management Report (AEMR) to the satisfaction of the Director General. The AEMR shall review the performance of the mine against the Environmental Strategy and the relevant Mining Operations Plans, the conditions of consent, and other licences and approvals relating to the mine. To enable ready comparison with the EIS predictions, diagrams and tables the report shall include, but not be limited to, the following matters:	
		i. An annual compliance audit of the performance of the project against the conditions of this consent and statutory approvals;	Table 1
		ii. A review of the effectiveness of the environmental management of the mine in terms of EPA, OEH, NOW, DRE and council requirements;	Table 1
		iii. Results of all environmental monitoring required under this consent or other approvals, including interpretations and discussion by a suitably qualified person;	Section 6, Section 7 & Section 9.
		iv. An assessment of any changes to agricultural land suitability resulting from the mining operations, including cumulative changes;	Section 6.8

Approval	Condition No	Requirement	Where addressed in Annual Review
		v. A listing of any variations obtained to approvals applicable to the subject area during the previous year;	Section 3.1
		vi. The outcome of the water budget for the year, the quantity of water used from water storages and details of discharge of any water from the site;	Section 7.2
		vii. Rehabilitation report; and	Section 8
		viii. Environmental management targets and strategies for the next year.	Section 12
	Condition 106	In preparing the AEMR the applicant shall:	
		I. Consult with the Director General during the preparation of each report for any additional requirements;	Section 5
		II. Comply with any requirements of the Director General or other relevant Government Agency; and	Section 5
		III. Ensure that the first report is completed and submitted within twelve months of this consent, or at a date determined by the Director General in consultation with the DRE, EPA and OEH.	N/A
	Condition 107	The applicant shall ensure that copies of each AEMR are submitted at the same time to the Department, EPA, OEH, NOW, Council and the Community consultative Committee, and made available for public information at Council within fourteen days of submission to these authorities.	Section 3.5
DA 35-2-2004	Schedule 3 Condition 1	The Applicant may incorporate any plan, audit or Annual Review required by this consent with the plans, audits or Annual Review required for the Mandalong Mine or any other adjoining operation in common ownership or under common management.	Noted.
	Schedule 3 Condition 4	By the end of March each year, or other timing as may be agreed by the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development, to the satisfaction of the Secretary. This review must:	
		a) provide monthly records of the amount of coal transported on the MCDS;	Table 8
		b) include a comprehensive review of the groundwater monitoring results of the development over the previous calendar year, which	Section 7.2.2.2

Approval	Condition No	Requirement	Where addressed in Annual Review
		includes a comparison of these results against the: <ul style="list-style-type: none"> • relevant statutory requirements, limits or performance measures/criteria; • requirements of any plan or program required under this consent; • monitoring results of years prior; and • relevant predictions in the documents listed in condition 2(a) of Schedule 2; 	
		c) evaluate and report on the compliance with the performance measures, criteria and operating conditions in this consent;	Section 6, Section 7 & Section 9.
		d) detail any non-compliance over the past calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence;	Table 1, Table 2 & Table 47.
		e) identify any trends in the monitoring data over the life of the development;	Section 6, Section 7 & Section 9.
		f) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies;	Section 6, Section 7 & Section 9.
		g) describe the measures to be implemented over the current calendar year to improve the environmental performance of the development; and	Section 12
		h) be prepared in accordance with the Department's <i>Annual Review Guideline (2015)</i> .	Noted.

The 2017 Annual Review (Centennial Mandalong, 2018) was provided to DPE, DRE, LMCC, Central Coast Council, DPI-Water, EPA, OEH and the Mandalong Mine CCC consistent with DA97/800 condition 106(i).

As required by DA97/800 consent condition 105(v) a listing of any variations to approvals during the reporting period are provided in **Table 4**. DA97/800 Consent Condition 24 requires a Land Access, Management and Compensation Security in the form of a Bank Guarantee and that evidence of the Guarantee shall be provided in the Annual Review. A copy of the current Bank Guarantee is included in **Appendix 1**.

4 OPERATIONS SUMMARY

Table 6: Production Summary & Forecast

Material	Approved Limit (and source)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
Waste Rock/ Overburden	N/A			
ROM Coal	6.5 MTPA	5,509,194	5,245,292	4,745,076
Coarse reject	N/A			
Fine reject (Tailings)	N/A			
Saleable product	6.5 MTPA	5,452,443	5,217,175	4,699,396

4.1 OTHER OPERATIONS

Table 7: Operations Summary

	Approved Limit	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Comment
Hours of operation	24/7	24/7	24/7	
Transport (rail)	N/A			
Product to Vales Point PS	4 MTPA	1,180,340	1,311,749	
Mandalong to Cooranbong	6 MTPA	4,328,854	3,933,543	
Product to Eraring PS	6 MTPA	2,742,197	2,580,681	
Cooranbong to Newstan for Washing	6 MTPA	1,747,127	1,354,495	

Table 8: Mandalong Coal Delivery System (Delta Entry Site) Monthly Tonnages

Month	Product to Vales Point PS (4 Mtpa limit)
January 2018	131,484
February 2018	91,992
March 2018	65,452
April 2018	74,947
May 2018	284,094
June 2018	124,356
July 2018	111,142
August 2018	47,894
September 2018	37,633
October 2018	149,431
November 2018	95,689
December 2018	97,635
Total 2018 CY	1,311,749

4.2 EXPLORATION

Centennial Mandalong drilled five exploration boreholes in 2018. The boreholes were primarily targeting further delineation of the seam split along the Main Headings and the extent of the igneous sill to the west of the proposed longwall panels.

All boreholes sites have been rehabilitated. Applications for additional boreholes will be ongoing as potential sites are identified.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

Mandalong Mine Access Site, Mandalong South Surface Site, Cooranbong Entry Site and Delta Entry Sites

DPE in their letter dated 19 September 2018 found that the 2017 Annual Review was acceptable for the reporting period and completed a site inspection on 1 November 2018. DPE noted several issues which were required to be addressed as detailed in **Table 9**.

DRG in their letter dated 3 December 2018 acknowledged receipt of the 2017 Annual Review. Furthermore, DRG had previously completed a compliance inspection at the Mandalong South Surface Site on 29 May 2018 and requested that an update on their requested corrective actions be completed in the 2018 Annual Review. Centennial Mandalong has addressed these corrective actions as detailed in **Table 9**.

Table 9: Actions from Previous Annual Review

Action Required	Requested By	Action Taken	Where addressed in Annual Review
<p>Corrective Action 1: Implement erosion and growth media development maintenance and monitoring program. The program is to include:</p> <ul style="list-style-type: none"> a) Review erosion control and growth medium Performance Indicator and Completion Criteria as per MOP Section 6-Table 25 Growth medium development; b) Review erosion control structures on batters as steep slopes may need alternative treatment as per MOP Section 2.2.8. c) Maintenance of erosion observed on batters. 	DRG	The weekly environmental construction inspection procedure (WP-7154) has been updated to include the seven rehabilitation areas around the access road and MSSS. The monitoring procedure includes a requirement for an assessment of new or increased erosion (including batters), growth improvement, weeds and remedial work if required.	Refer to Section 8.2.6 of the Annual Review
<p>Corrective Action 2: Develop a maintenance and monitoring program for long-term stockpiles. The program is to include:</p> <ul style="list-style-type: none"> a) Review of the long term stockpiles, identifying location, estimated balance, waste material, soil testing (e.g. soil fertility, amelioration 	DRG	A review of stockpile locations was completed with the main stockpile established to the north-west of the MSSS in 2018. The batters of the main MSSS stockpile have been covered with mulch as no topsoil was available. VENM testing was completed and 7500m ³ of material from the stockpile was transported to Newstan as described in the MSEP	Refer to Section 8.2.6 of the Annual Review

Action Required	Requested By	Action Taken	Where addressed in Annual Review
requirements) and an assessment of risks to rehabilitation as per MOP Section 2.2.9 for long-term stockpiling.		EIS (SLR, 2013). The weekly environmental construction inspection procedure (WP-7154) includes a requirement to review erosion and sediment control issues associated with the main MSSS stockpile.	
Monitoring Trend Analysis – Please include graphs were possible to demonstrate trends with environmental and community monitoring data for the life of the Mine.	DPE	Graphs included for environmental and community monitoring data in Annual Review.	Refer to Sections 6, 7 and 9 of the Annual Review.
Surface water discharges – Please include the date and volume of all water discharges from the various sites, including sediment basins.	DPE	Addressed in Surface Water Monitoring section of the Annual Review.	Refer to Section 7.1 of the Annual Review.
Rehabilitation – Please include details of key issues that may affect successful rehabilitation in future AR's.	DPE	Issues for rehabilitation for each site including the MMAS, CES, DES and MSSS are included in the Annual Review.	Refer to Section 8.2 of the Annual Review.
Reporting of Non-Compliances – Where non-compliances are identified in future AR's please ensure information on reporting the non-compliances to the relevant agencies is provided.	DPE	Included in Table 47 of the Annual Review.	Table 47

5.1 MINE WATER REDUCTION TARGETS

DA97/800 Condition 66 requires the mine to investigate opportunities to reduce mine water discharge at Mandalong and report on such in the Annual Review. The water balance model (GHD, 2019a) estimated 748 ML of water from the underground mine and surface water was discharged via LDP001 in 2018 which is greater than the water volume discharged in 2017 (702.8 ML).

Investigations into reducing the mine water discharge by recycling underground mine water were undertaken in 2009 and 2010. These included a water treatment options study and engineering design and feasibility assessments. The preferred option, recycling the underground mine water by treatment in a Reverse Osmosis (RO) plant, was assessed as not feasible for the Mine. The feasibility of the RO plant was limited due to the inability to discharge waste brine generated by the RO plant to receiving waters. Disposal methods, other than the discharge of waste brine, were cost prohibitive and not feasible at this stage. In addition the RO treatment plant was not capable of supplying mining equipment with potable water for 100% of the time as required by operations, due to equipment malfunction

and routine maintenance requirements. Given the currently limited options for waste brine disposal and RO treatment plant availability the investigations conclude recycling of underground mine water by an RO treatment, does not at this time, provide a feasible business option to reduce mine water discharges from the Mine.

5.2 WASTE MANAGEMENT

All opportunities for waste avoidance and minimisation are considered by all staff and contractors across all areas including; contracts, purchasing, equipment procurement and waste generation processes.

Waste oil and greases are stored in tanks and drums within bunded areas for removal by a licenced waste management contractor for recycling or disposal. Oil water separation is achieved by the use of hydro-cyclone oil water separators at Mandalong and at the Cooranbong Entry Site on flows from vehicle work and storage areas and the wash down bays.

Hydrocarbon spill kits are inspected weekly by a licenced waste management contractor and re-stocked as required. Oily rag bins and oil filter bins are also serviced on a weekly basis.

Office paper and cardboard is collected and recycled by a licenced waste management contractor on a weekly basis. Metals are collected and stored in steel bins at Mandalong and the Cooranbong Entry Site. In 2018, a total of 354.66 tonnes of scrap steel was recycled. This is an increase compared to 2017 during which a total of 271.83 tonnes of scrap steel was recycled.

General refuse and non-recyclable materials are sorted and stored in 30m³ steel bins at Mandalong and the Cooranbong Entry Site. The material was collected by a licenced waste management contractor for disposal. In 2018, 640.92 tonnes of refuse material was taken off-site for disposal which is an increase compared with 584.84 tonnes of refuse material in 2017.

Of the total waste collected at Mandalong in 2018, 65.7% was recycled including steel, timber, liquid waste, oils, paper and cardboard, filters grease, oily rags and oil filters. This compares with a recycling result of 61.37% in 2017.

6 ENVIRONMENTAL PERFORMANCE

Condition 12 of Schedule 6 of SSD-5144, Condition 11 of Schedule 5 of SSD-5145, Condition 4 of Schedule 3 of DA35-2-2004 and Condition 105(iii) of DA97/800 require the presentation and discussion on all monitoring required under the Development Consents and other approvals. **Table 10** includes a summary of the monitoring required by the Development Consents, current status and report section in the Annual Review

Table 10: Summary of Monitoring Requirements

Monitoring Type	Status	Report Section
Noise Monitoring	Annual survey	Section 6.1
Blast Monitoring	As required	Section 6.2
Air Quality Monitoring	Ongoing	Section 6.3
Independent Noise and Dust Monitoring	Not Requested	N/A
Greenhouse Gas reporting and abatement measures	Ongoing	Section 6.3.8
Biodiversity Monitoring	Ongoing	Section 6.4
Cultural Heritage Monitoring	Ongoing	Section 6.5
Meteorological Monitoring	Ongoing	Section 6.6
Surface Water Monitoring	Ongoing	Section 7.1
Groundwater Monitoring	Ongoing	Section 7.3
Rehabilitation Monitoring	Ongoing	Section 8

6.1 NOISE MONITORING

Annual noise monitoring was conducted to assess operational noise levels compared to the noise limits specified by SSD-5144, SSD-5145 and EPL 365 in accordance with the requirements of the Northern Region Noise Management Plan. The Mandalong Mine Noise Monitoring Program requires Centennial Mandalong to survey noise from the operation annually at the Mandalong Mine and the Cooranbong Entry Site (shown in **Figure 2** and **Figure 3**), and quarterly at the Mandalong South Surface Site (**Figure 4**).



Figure 2: Mandalong Mine Noise Monitoring Locations

Noise monitoring during the construction of the Mandalong South Surface Site (MSSS) commenced in March 2017 on a quarterly basis in accordance with the Northern Region Noise Management Plan.

The Mandalong Southern Extension Project Environmental Impact Statement (SLR, 2013) described the results of operational noise modelling for the Mandalong Mine Access Site and indicated that the relevant intrusive and amenity noise criteria will be achieved at all the nearest sensitive receivers. The noise impact assessment completed as part of the Northern Coal Logistics Project Environmental Impact Statement (SLR, 2014) predicted that operational noise levels at the Cooranbong Entry Site will meet the project-specific noise criteria at all nominated residential locations.

6.1.1 Summary of Noise Monitoring Results

GHD was engaged by Centennial Mandalong to conduct an annual noise compliance assessment for the Mandalong Mine and Cooranbong Entry Site in accordance with the Northern Region Noise Management Plan.

Operator attended noise measurements were conducted on Monday 25 June 2018, Tuesday 26 June 2018, Thursday 28 June 2018 and Friday 29 June 2018 at the 10 focus locations surrounding the operations locations during the day, evening and night-time periods.

The operator attended operational noise monitoring results showed that the noise contributions from Mandalong Mine and Cooranbong Entry Site comply with the EPL 365, Development Consent SSD-5144 and SSD-5145 noise criteria at all monitoring locations and during all time periods. However, exceedances of SSD-5145 and EPL 365 were measured at location M1 during the evening and night-time. It is relevant to note that the meteorological conditions during these times were during stability category F or G. As specified in condition L5.3 of EPL 365 and Appendix 3 of SSD-5145, the noise limits do not apply under these conditions. GHD (2018c) concluded that it is considered unlikely that the noise levels would exceed the noise criterion under normal meteorological conditions.

The operator attended sleep disturbance noise monitoring results show that the noise contributions from Mandalong Mine and Cooranbong Entry Site comply with the EPL 365, Development Consent SSD-5144 and SSD-5145 relevant sleep disturbance noise criteria at all monitoring locations. However, an exceedance of EPL 365 and Development Consent SSD-5145 was measured at location M1 and an exceedance of EPL 365 sleep disturbance criterion of LA1 (1 minute) 45 dBA was measured at M8. The cause of the exceedances was due to onsite banging and horn blasts. It is relevant to note that the meteorological conditions during these times were at times during stability category F or G. As specified in condition EPL L5.3, the noise limits do not apply under these conditions.

Following the June 2018 monitoring, further additional noise monitoring was recommended by GHD to be undertaken under normal meteorological conditions at M1 during the evening, and night time period. Monitoring was undertaken for 30 minutes during the evening and 1 hour during the night-time on 19 November 2018.

The operator attended operational noise monitoring results showed that the noise contributions from Cooranbong Entry Site M1 monitoring location exceed the EPL 365 and Development Consent SSD-5145 noise criteria during the evening and night time periods. The meteorological conditions during these times were during stability category F. As specified in condition L5.3 of EPL 365 and Appendix 3 of SSD-5145, the noise limits do not apply under these conditions. It is considered unlikely that the noise levels would exceed the noise criterion under normal meteorological conditions. Given the steady state nature of the acoustically significant noise sources generated at the Cooranbong Entry Site, the daytime

noise measurements at location M1 under normal meteorological conditions, as presented in GHD's previous report Mandalong Mine 2018 Annual Compliance Noise Monitoring, dated August 2018, are likely to represent the evening and night-time noise levels under normal meteorological conditions (GHD, 2018c).

The operator attended sleep disturbance noise monitoring results from the monitoring undertaken in November 2018, show that the noise contributions from Cooranbong Entry Site comply with the EPL 365 and Development Consent SSD-5145 relevant sleep disturbance noise criteria at all monitoring locations.

6.1.1.1 Mandalong South Surface Site

GHD was engaged by Centennial Mandalong to conduct quarterly noise compliance assessment for the construction activities which commenced in February 2017 at the Mandalong South Surface Site in accordance with the Northern Region Noise Management Plan. The Noise Management Plan – Northern Region (May 2018) specifies the project-specific noise goals for construction activity (excluding shaft sinking). They have been established with reference to the Interim Construction Noise Guideline (ICNG) (DECC, 2009). The noise monitoring network locations at the Mandalong South Surface Site are shown in **Figure 4**.

Operator attended noise measurements were conducted during the day period on Thursday 15 March 2018, Wednesday 27 June 2018, Tuesday 18 September 2018 and Monday 17 December 2018. The noise assessment consisted of attended monitoring to quantify construction noise levels at three noise sensitive receivers (R12, R16 and R20) near the Mandalong South Surface Site.

The results of the 2018 quarterly noise surveys indicate that construction noise levels were below the relevant construction criteria at the closest residential receivers and therefore additional noise mitigation was not required.

The quarterly noise monitoring of the MSSS construction will continue in 2019. The development consent SSD-5144 specifies noise limit criteria for operational noise generated by the development including maintenance activities, shaft construction and exploration drilling. Shaft construction at the MSSS had begun in early 2019 and will continue throughout 2019.

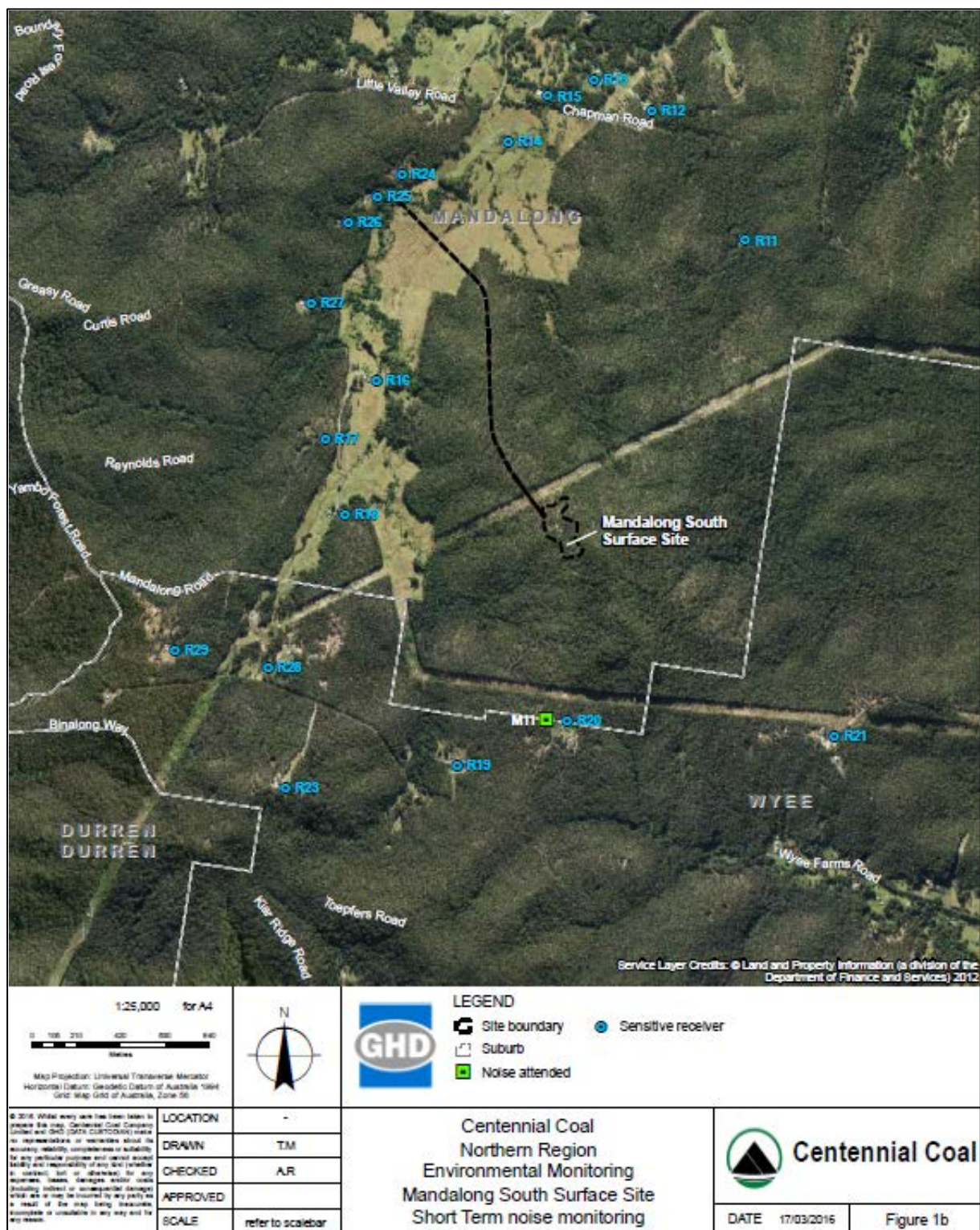


Figure 4: MSSS Noise Monitoring Locations

6.2 BLAST MONITORING

Mandalong

There was no blasting carried out at the Mandalong Mine in 2018.

Delta and Cooranbong Entry Sites

There was no blasting carried out at the Delta and Cooranbong Entry sites during 2018.

6.3 AIR QUALITY MONITORING

6.3.1 Mandalong

Depositional dust monitoring results are shown in **Table 12**. The results are presented as:

- Long-term average (all data since the commencement of monitoring at its present location - Sept 1999 to present);
- Average during the report period (January 2018 to December 2018); and
- Pre-construction average (September 1999 to August 2000).

Table 11: Description of Depositional Dust Gauges

Dust Gauge No.	Locality
D4	41 Gradwells Road Dora Creek (near Cooranbong Entry Site)
D6	Mandalong Mine Site Eastern Boundary (Near Sediment Basin)
D8	West of main front entrance (Mandalong Site)
D9	184 Mandalong Road
D10	202 Mandalong Road West of Mandalong Mine
D12	Mandalong South Surface Site
D14	North of Mandalong South entrance road (near wetland)

Table 12: Summary of depositional dust results between January 2018 and December 2018 surrounding Mandalong Mine.

	Insoluble Solids (Combustible Matter + Ash) g/m ² /month			
	DG6	DG8	DG9	DG10
Long Term Average	1.3	0.7	1.1	1.6
Average 2018 (Reporting Period)	1.7	0.7	1.0	2.2
Pre-Construction Average	0.8	0.8	0.9	*
EPA Dust Deposition Goal	4.0	4.0	4.0	4.0

* not available. Dust gauges installed after commencing construction.

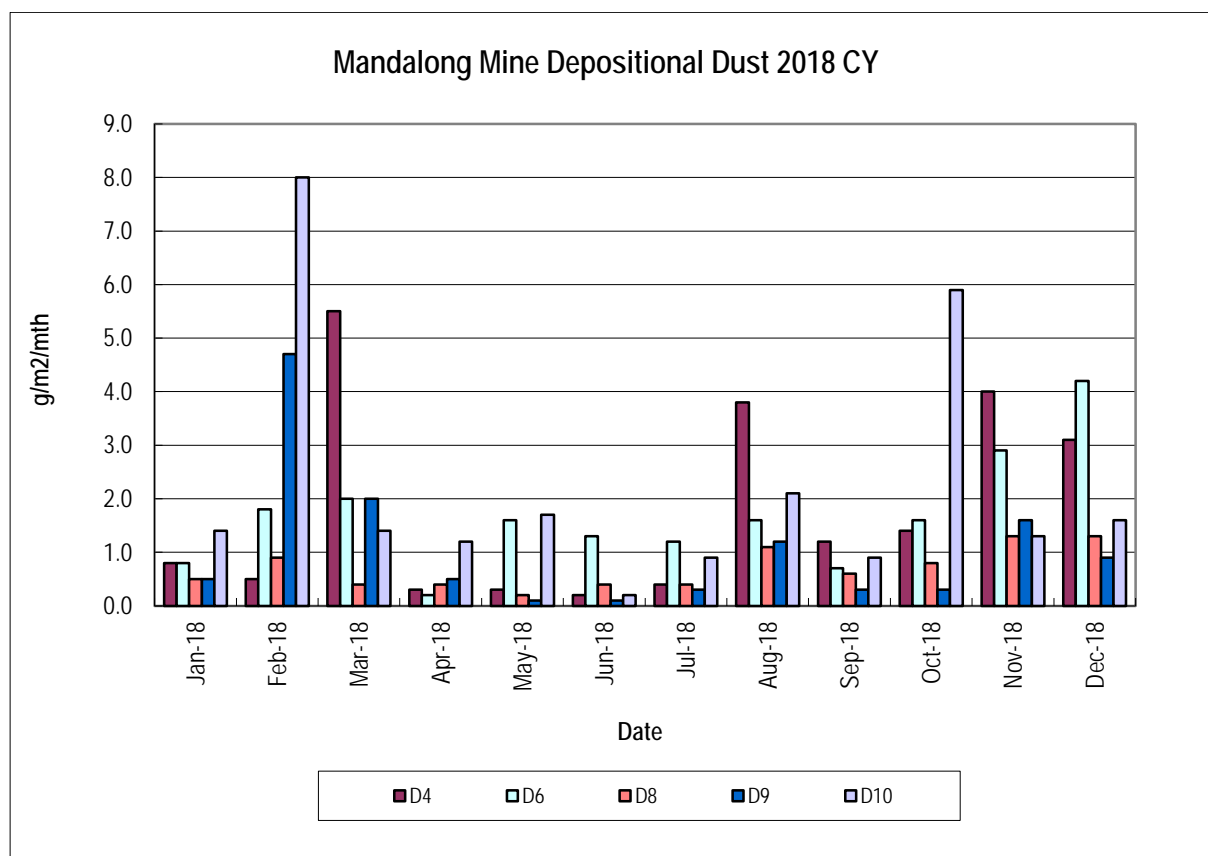


Figure 5: Depositional Dust Results Surrounding Mandalong Mine for 2018

6.3.2 Delta Entry Site

Three dust deposition gauges were installed at the Delta Entry Site in July 2004. **Table 13** details the location of the dust gauges and their localities are shown on plan **MG10722C**. These gauges were positioned to monitor depositional dust around the Delta Entry Site.

Table 13: Location of Delta Entry Site Depositional Dust Gauges

Dust Gauge No	Locality
DG1	North east side of settling ponds on decline site.
DG2	Main gates to decline off Rutley's Road.
DG3	Delta clearing left hand side Rutley's Road.

Depositional dust monitoring results are provided in **Table 14**. The monthly dust monitoring data for the Delta Entry Site for 2018 is included in **Figure 6**.

Table 14: Summary of Depositional Dust Results between January 2018 and December 2018 surrounding Delta Entry Site

	Insoluble Solids (Combustible Matter + Ash) g/m ² /month		
	DG1	DG2	DG3
Long Term Average	0.6	0.7	0.7
Average 2018 (Reporting Period)	0.5	0.9	0.8
EPA Dust Deposition Goal	4.0	4.0	4.0

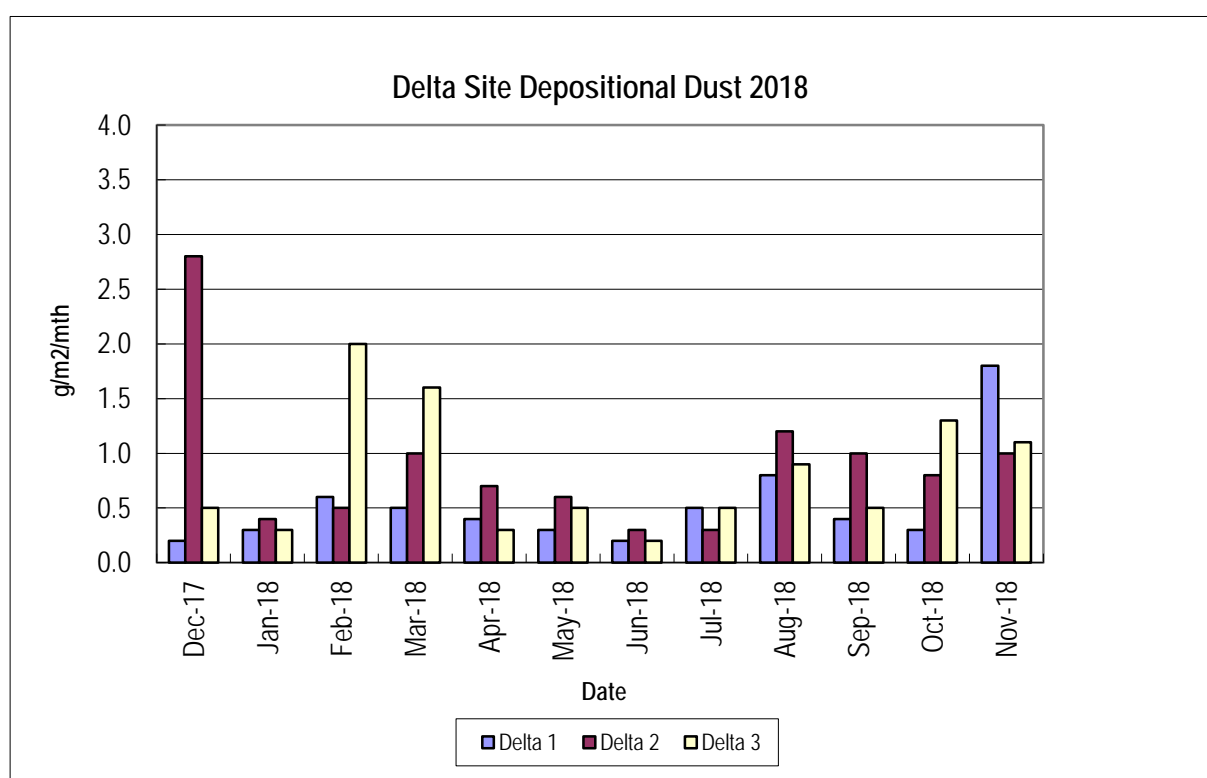


Figure 6: 2018 Depositional Dust Results for Delta Entry Site

6.3.3 Cooranbong Entry Site

The Cooranbong Colliery Life Extension Project EIS predicted that dust emissions from the operational phase of the Cooranbong Preparation Plant were unlikely to cause a dust nuisance due to the distance to sensitive receptors (Umwelt, 1997). The Cooranbong Distribution Project EA (GSS Environmental, 2012) and the Northern Coal Logistics Project EIS (March 2014) modelling predictions for dust deposition also show that incremental and cumulative annual average dust deposition rates are predicted to be well below the impact criteria of 2g/m²/month and 4g/m²/month (assuming a background rate of 1.2 g/m²/month) at the nearest surrounding residences.

Annual average depositional dust results for 2018 and the EPA goal are provided in **Table 15**. The complete monthly dust monitoring data is provided in **Figure 5**.

Table 15: Summary of Depositional Dust Results between January 2018 and December 2018 surrounding the Cooranbong Entry Site.

	Insoluble Solids (Combustible Matter + Ash) g/m ² /month
	DG4
Long Term Average	1.3
Average 2018 (Reporting Period)	1.8
EPA Dust Deposition Goal	4.0

6.3.4 Mandalong South Surface Site

Depositional dust gauges were installed at the Mandalong South Services Site in June 2014 for the purpose of pre-construction air quality monitoring. Construction of the Mandalong South Surface Site access road commenced in February 2017 and construction of the Surface Site commenced in July 2017. Annual average depositional dust results for 2018 and the EPA goal are provided in **Table 16** and **Figure 7**. The results for DG14 have been impacted by contamination as a bird has been continuously trying to build a nest on the sampling equipment as reported to DPE on 21 December 2018.

Table 16: Summary of Depositional Dust Results between January 2018 and December 2018 surrounding the Mandalong South Surface Site.

	Insoluble Solids (Combustible Matter + Ash) g/m ² /month	
	DG12	DG14
Long Term Average	0.7	2.2
Average 2018 (Reporting Period)	1.4	5.1
EPA Dust Deposition Goal	4.0	4.0

6.3.5 Air Quality Monitoring Data Interpretation

6.3.5.1 Mandalong Mine & Cooranbong Entry Site

SSD-5144 requires that the Mine does not increase the dust deposition rate by more than 2g/m²/month, averaged over any 12 month period, as shown in **Table 12**, **Table 14**, **Table 15** and **Table 16**. All dust gauges recorded depositional dust levels that averaged an increase of less than 2 g/m²/month in the 12 month period (apart from DG14 due to contamination from bird nest establishment).

All dust gauges recorded results as shown in **Table 12**, **Table 14**, **Table 15** and **Table 16** are well below the EPA air quality goal of annual dust deposition of 4 g/m²/month. Dust levels at DG 8 & 10 located at the nearest sensitive receivers at the Mandalong Mine Access

Site boundary were well below the EPA air goals, confirming that the activities had minimal impact on surrounding air quality in 2018 as predicted in the Mandalong Southern Extension Project EIS (SLR, 2013).

Dust levels at DG4 located at the nearest sensitive receivers and on the operational boundary at Cooranbong were well below the EPA air goals, confirming that the Cooranbong operation had minimal impact on surrounding air quality in 2017 as predicted in the Cooranbong Colliery Life Extension Project EIS (Umwelt, 1997), the Cooranbong Distribution Project EA (GSS Environmental, 2012) and the Northern Coal Logistics Project EIS (SLR, 2014).

Dust gauges 2, 3, 4, 6, 10, 12 and 14 recorded annual averages slightly above the long-term average however; these increases were well below the EPA Air Quality Goals of 4 g/m²/month, except for DG14 that has an annual average of 4.44 g/m²/month. Centennial Mandalong is of the opinion that the DG14 annual rolling average does not comprise an exceedance of the deposited dust criteria listed in SSD-5144, due to the continued influence of bird life attempting to nest in the dust gauge.

Table 17: Detailed Dust Monitoring and Analysis showing the Annual Rolling Average and Change in Deposition from the Pre-construction Average (PCA) for Dust Gauges DG6, DG8 and DG9.

	DG6			DG8			DG9		
Date	Monitored Dust	Rolling Average (since 2012)	Change from PCA	Monitored Dust	Rolling Average (since 2012)	Change from PCA	Monitored Dust	Rolling Average (since 2012)	Change from PCA
19/01/2018	2.1	1.6	0.5	0.8	1.1	-0.3	0.5	1.1	-0.6
19/02/2018	0.8	1.6	-0.8	0.5	1.1	-0.6	4.7	1.1	3.6
21/03/2018	1.8	1.6	0.2	0.9	1.1	-0.2	2.0	1.1	0.9
20/04/2018	2.0	1.6	0.4	0.4	1.1	-0.7	0.5	1.1	-0.6
21/05/2018	0.2	1.6	-1.4	0.4	1.1	-0.7	0.1	1.1	-1.0
20/06/2018	1.6	1.6	0	0.2	1.1	-0.9	0.1	1.1	-1.0
20/07/2018	1.3	1.6	-0.3	0.4	1.1	-0.7	0.3	1.1	-0.8
21/08/2018	1.2	1.6	-0.4	0.4	1.1	-0.7	1.2	1.1	0.1
19/09/2018	1.6	1.6	0	1.1	1.1	0	0.3	1.1	-0.8
19/10/2018	0.7	1.6	-0.9	0.6	1.1	-0.5	0.3	1.1	-0.8
19/11/2018	1.6	1.6	0	0.8	1.1	-0.3	1.6	1.1	0.5
19/12/2018	2.9	1.6	1.3	1.3	1.1	0.2	0.9	1.1	-0.2

6.3.5.2 Delta Entry

Average annual depositional dust results for dust gauges DG1, DG2 and DG3 are relatively low. The highest average depositional dust rate for the period was 0.9 g/m²/month for DG2. All results are well below the EPA air quality goal of 4 g/m²/month and are provided in **Table 14** and **Figure 6**.

The three dust gauges at the Delta Entry Site are not required to be monitored in 2019, as they were removed from EPL365 in October 2018.

6.3.5.3 Mandalong South Surface Site

All dust gauges except DG12 during November and December recorded results below the EPA air quality goal of annual dust deposition of 4 g/m²/month (**Figure 7**). The results for DG14 in April and May were excluded due to a bird building a nest within the dust gauge funnel. The results for DG14 during November and December have been impacted by the contamination as a result of a bird continually attempting to build a nest in the monitoring equipment.

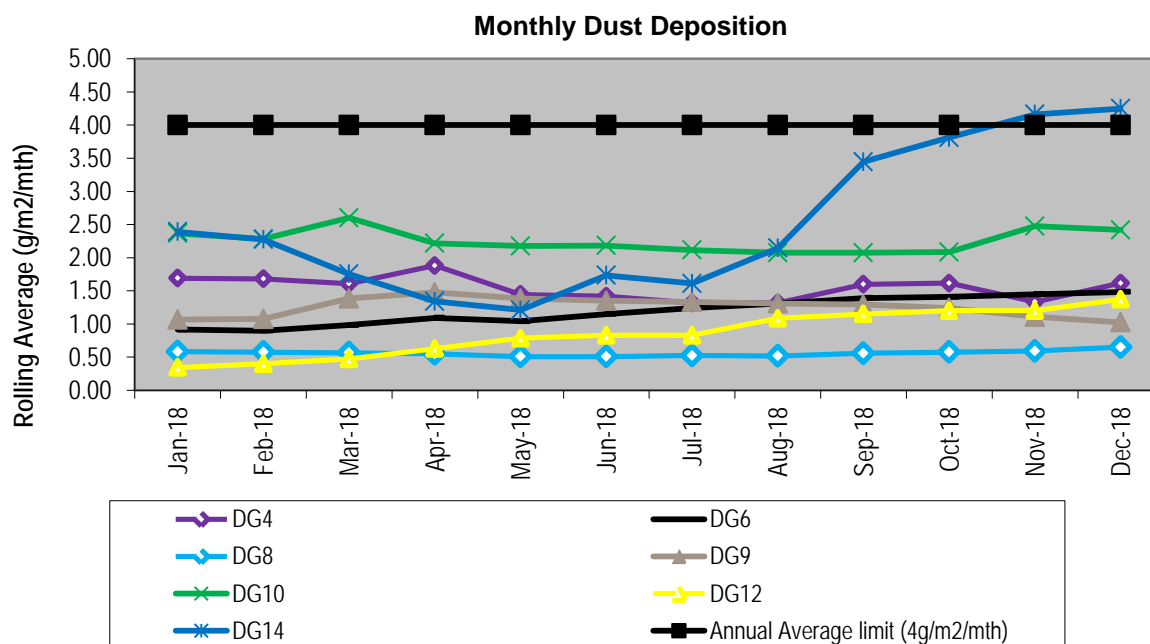


Figure 7: Monthly Rolling Annual Average Dust Deposition for 2018.

6.3.6 Particulate Matter

The Northern Coal Logistics Project EIS (SLR, 2014) concluded that incremental and cumulative annual average TSP concentrations were predicted to be well below the impact criterion of 90 ug/m³ at the nearest sensitive residences. The EA and the EIS also predicted that incremental and cumulative annual average PM10 concentrations will be below the impact criterion of 30 ug/m³ at the nearest surrounding residences.

Continuous dust monitoring was installed in June 2013 at the Cooranbong Entry Site to monitor total suspended particles (TSP) and particulate matter (PM10) as per the condition M2.2 of EPL365. SSD-5144 and SSD-5145 require that air quality impacts at the Cooranbong Entry Site do not exceed the limit criteria of:

- 90ug/m³ annual average for TSP;
- 30ug/m³ annual average for PM10; and
- 50ug/m³ 24 hour average for PM10.

TSP and PM10 monitoring results are shown in **Figure 8**. The results are presented as an annual average for the monitoring period (July 2013 to December 2018). TSP and PM10 monitoring results to date since installation in June 2013 are in accordance with the predictions from the air quality impact assessment for the Cooranbong Distribution Project EA (GSS Environmental, 2012). TSP and PM10 monitoring results to date since October 2015 are in accordance with the predictions from the air quality impact assessment for the Northern Coal Logistics Project EIS (SLR, 2014).

Two regional dust events occurred during the 2018 sampling period. The July 2018 PM10 sampling recorded a maximum of 58.84µg/m³ which occurred on 18 July 2018. This result occurred due to a regional dust event on this day, with the Wyong OEH air quality monitoring station also recording a 24-hr average PM10 concentration above 50µg/m³. The event reported in local media quoted an Office of Environment and Heritage spokesperson with the following statement;

“On Wednesday morning (18th July 2018), there was a moderate dust storm occurring over inland NSW, with additional dust transported to the east/northeast over Illawarra, Sydney Basin and further north, leading to increase in PM10 levels over these regions. The PM10 exceedance over the Upper Hunter Region was related to this event.”

The 24-hour average PM10 criterion (50µg/m³) in the Development Consent SSD-5145 is intended to be considered incrementally (that is, the individual contribution of the project) with extraordinary events such as the regional dust storm excluded. Therefore, the PM10 result recorded on 18 July 2018 does not comprise a limit criteria exceedance. Centennial Mandalong provided a notification of the PM10 result of 18 July 2018 to DPE on 3 August 2018.

The second regional dust event occurred during the November sampling period, with two PM10 (24 hour) results of 122.42µg/m³ and 103.25µg/m³, which were recorded at the Cooranbong Entry Site on 22 and 23 November 2018. These results occurred due to a regional dust event on these days, with the Wyong OEH air quality monitoring station also recording a 24-hr average PM10 concentration above 50µg/m³. The 24-hour average PM10 criterion (50µg/m³) in the Development Consent SSD-5145 is intended to be considered incrementally (that is, the individual contribution of the project) with extraordinary events such as the regional dust storm excluded. Therefore, the PM10 results recorded on 22 and 23 November do not comprise a limit criteria exceedance. Centennial Mandalong provided a notification of the PM10 results of 22 and 23 November 2018 to DPE on 4 December 2018.

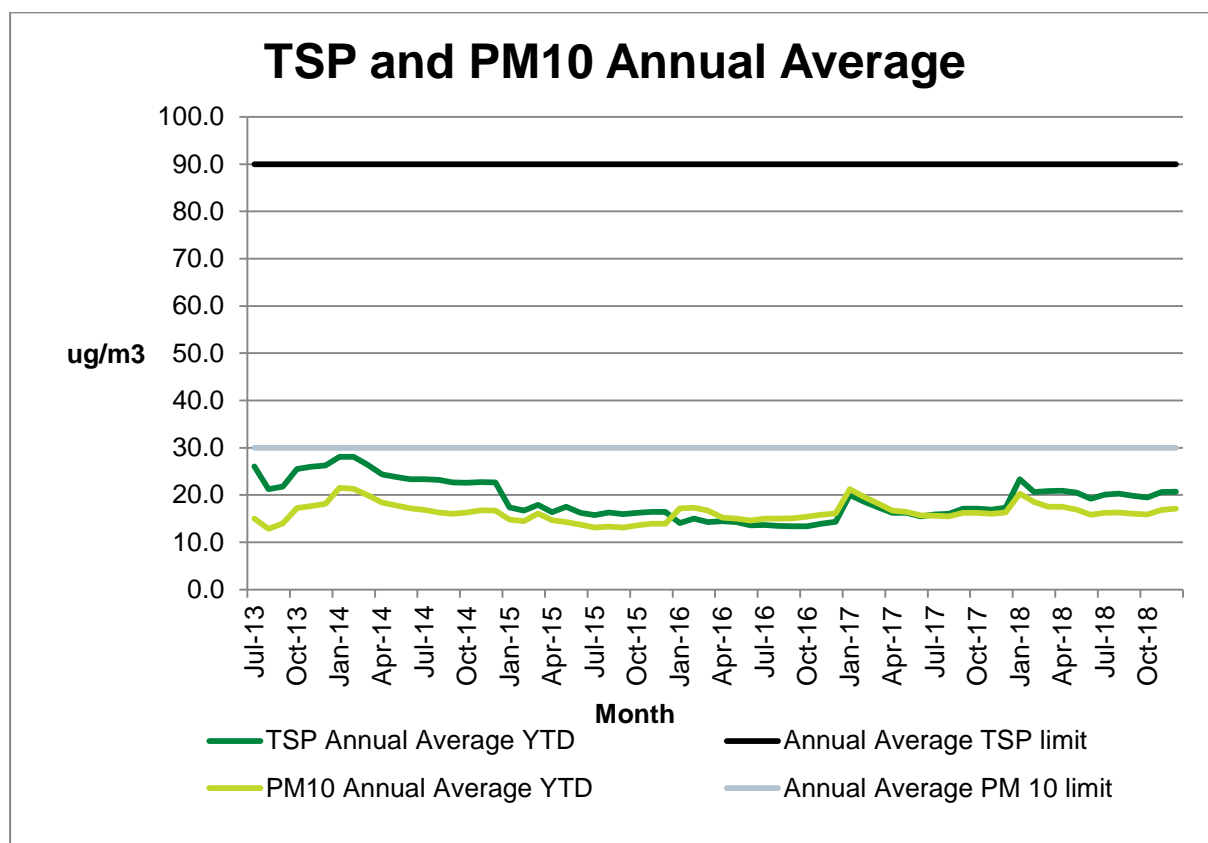


Figure 8: TSP and PM10 2018 Annual Rolling Average

6.3.7 HVAS (High Velocity Air Samplers)

PM₁₀ and PM_{2.5} High velocity air samplers were installed in January 2014 at Mandalong to monitor fine particles from the Mandalong Mine Access Site.

Results from the 2018 HVAS sampling during 2018 recorded a PM₁₀ rolling annual average of 14.1 ug/m³ and PM_{2.5} ug/m³ with a rolling annual average of 6.4 ug/m³. Refer to **Figure 11** for the 2018 monthly PM₁₀ results and **Figure 12** for the monthly 2018 PM_{2.5} results.

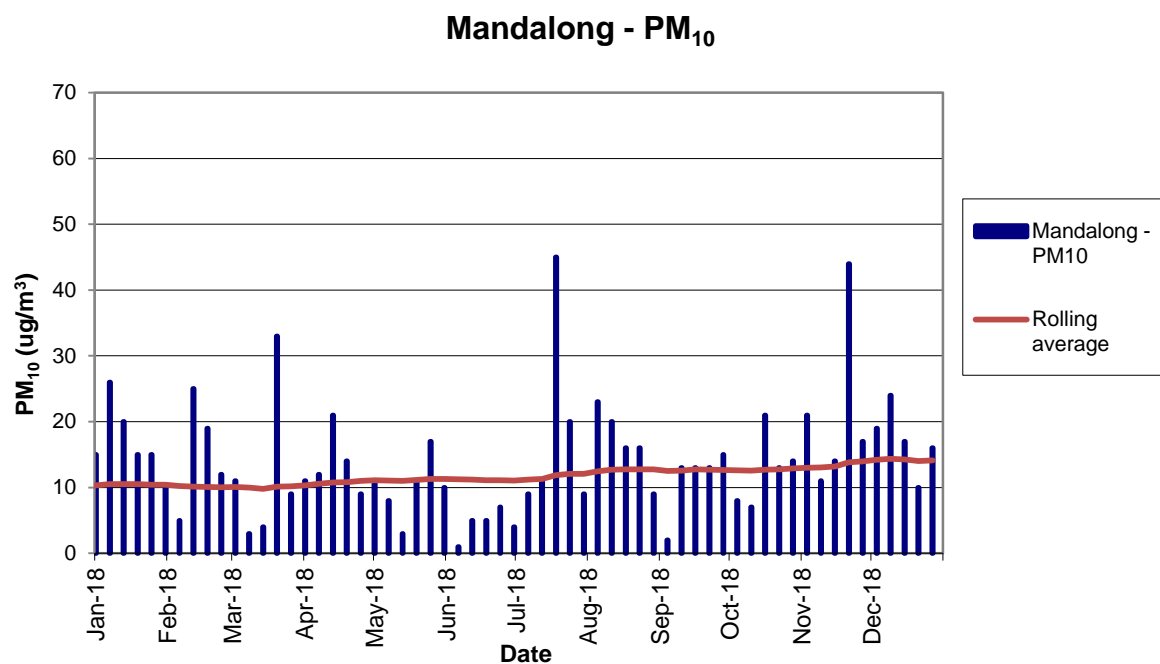


Figure 9: MMAS PM10 Monitoring Results

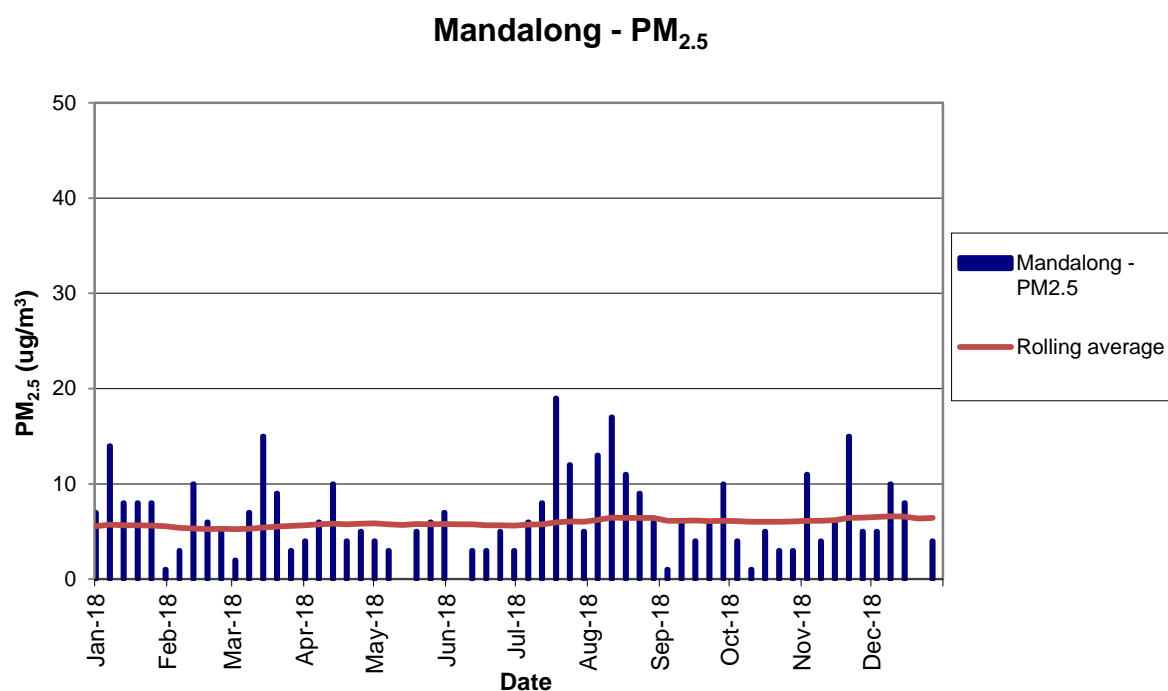


Figure 10: MMAS PM2.5 Monitoring Results

6.3.8 Greenhouse Gas Monitoring

DA97/800 conditions 60A (i) & (iv) require Mandalong Mine to monitor greenhouse gas (GHG) emissions and report these in the Annual Review. In accordance with Centennial Coal's standard for GHG reporting the 2018 financial year (FY 1 July 2017 to 30 June 2018), emissions in CO₂ equivalent tonnes (Co₂-eT) as defined in the *National Greenhouse and Energy Reporting Act 2007* are provided in **Table 18**. Total GHG emissions for the 2018 FY period were 1,934,635 Co₂-eT, which is higher than the 2017 FY emissions of 1,626,678 Co₂-eT.

The majority of GHG emissions in 2018 were caused by fugitive methane contributing to 91.73% of all GHG emissions. Mandalong Mine as discussed below is currently working towards GHG reduction measures to abate fugitive methane emissions.

Table 18: Total GHG Emissions from Mandalong Mine in 2018 Financial Year

Emissions Summary (Co ₂ -eT) July 2017 to June 2018	Total
Electricity	68,548
Diesel	3,841
Petroleum Based Oils and Greases (PBOG)	90
SF ₆	6
Fugitives - CH ₄	1,708,008
Fugitives - CO ₂	66,715
Fugitives – N ₂ O	31
Surface Fugitive - Post Mining	87,396
TOTAL	1,934,635

6.3.9 Greenhouse Gas Abatement Investigations Measures

As reported in previous Annual Reviews, Centennial Coal has invested in technologies to reduce fugitive methane GHG emissions from the Mandalong Mine. A three stage process is planned to address this Greenhouse Abatement. Construction of Stage 1 and Stage 2 were completed in November 2013.

Stage 1 Gas Flares - A consent modification approval was obtained in 2005 to construct multiple enclosed flares planned to be used to reduce fugitive methane GHG emissions from the Mine's surface gas drainage plant. Civil works for construction of the gas flares commenced in October 2012, with final commissioning completed and automated operations commencing in November 2013. The construction of the enclosed gas flare will assist with abating drainage gas emissions of up to 1,500 litre/sec flow rate.

Stage 2 Ventilation Air Methane Regenerative After Burner (VAM RAB®) - Approval for a modification to DA97/800 was sought in 2011, to allow for the installation and ongoing operation of a single VAM RAB® unit as a demonstration project to examine the performance capability. Approval was granted by the Planning Assessment Commission (PAC) on behalf of the Minister for the then Department of Planning and Infrastructure on 11 November 2011.

The VAM RAB® technology initially proposed for Mandalong includes installation and operation of a single VAM RAB® unit as part of a demonstration project to demonstrate capture and abatement of approximately 10 cubic metres per second (m³/s) of the mine's total Ventilation Air Methane (VAM). The VAM is a low concentration methane in the mine ventilation stream and the VAM RAB® system overcomes this technical difficulty by directing the mine ventilation air into a large oxidation vessel, oxidising the methane into carbon dioxide. This technology is based on well tested coke-oven principles, utilised in the steel industry.

Civil construction works on the surface pad for the VAM RAB® unit commenced in December 2011 and were completed in November 2013. The VAM RAB® demonstration plant has been heated up on a number of occasions during the last six months of 2014, with some minor configuration changes made in 2015 and 2016.

The VAM RAB® plant is currently impacted by technical issues. From a technical perspective, refinements are required for the VAM RAB® to reach a suitable temperature profile to allow trial abatement of methane. Over the project life, a number of test procedures have been conducted resulting in significant changes to the design and structure of the plant. These have included a rebuild of the VAM RAB® core.

The current status of the Project is that it is on hold in its commissioning phase. It has not progressed to, or completed, the formal experiment Stage 1 (6 week VAM simulation) or Stage 2 (12 months on VAM).

Stage 3 Gas Engines - In July 2009 Mandalong Mine received approval from the then DP&I to construct and operate multiple methane gas engines to generate electricity. If the generation facility is implemented, power will be supplied to the site and excess power sold to the grid. The flare units will remain available as back-up or for peak gas flows.

In 2018, Centennial Mandalong commenced planning and design works for the Gas Engines project. This project will continue to be progressed in 2019.

6.4 BIODIVERSITY MONITORING

6.4.1 LW22-24A Extraction Plan Areas

The monitoring of sensitive environments subject to potential subsidence impacts is a requirement as per Schedule 4 Condition 6 of SSD-5144 and Condition 72 of DA97/800. The aim of the 2018 monitoring conducted by RPS was to detect any changes in sensitive ecological communities (EECs and Groundwater Dependent Ecosystems (GDEs)), which may be attributable to mining of LW22-24A (RPS, 2019a). Additionally, the program aims to evaluate the conditions of known populations of threatened flora against reference and baseline population conditions. Repeated sampling will allow for the detection and quantification of change over time. The study area consists of the proposed subsidence extent of Longwalls LW22-24A covering approximately 279.90 hectares. The northern boundary of the study area extends into the Olney State Forest. The southern boundary area extends into heavily vegetated areas whilst the majority of the western and eastern boundaries are situated within rural agricultural lands with remnant patches of vegetation. The location of biometric plots with the LW22-24A area is shown in **Figure 11**.

The monitoring is to be performed on an annual basis in accordance with the relevant approved Extraction Plan and associated Biodiversity Management Plan. Study methods include biometric plots and condition assessment for threatened species. Monitoring was conducted by RPS between October and December 2018, with further monitoring scheduled for 2019.

The 2018 survey suggests that mining of LW22-24A is not having a substantial negative impact on vegetation communities that were predicted to experience impact, which were:

- PCT 684 Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion;
- PCT 1723 *Melaleuca biconvexa* – Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast (Swamp sclerophyll forest on coastal floodplains of the NSW North Coast| Sydney Basin and South East Corner bioregions TEC);
- PCT 1568 Blackbutt - Turpentine – Sydney Blue Gum mesic tall open forest on ranges of the Central Coast; and
- PCT 1587 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (RPS, 2019a).

Threatened flora baseline data has been collected from the impact area for threatened flora (i.e. *Melaleuca biconvexa* and *Maundia triglochinos*). Consistency between the 2017 (pre-mining) and 2018 (post-mining) monitoring results suggest that mining LW22-24A is not having a substantial impact on *M. biconvexa*. The lower heights of trees estimated in 2017 was likely attributed to observer bias, which was within an acceptable range (i.e. <10%). Impacts on *M. triglochinos* were not assessable due to an absence of this species within plots. Future monitoring efforts should seek new plots during summer (flowering period) to better assess impacts of mining (RPS, 2019a).

6.4.1.1 Aquatic Ecology Monitoring

The objectives of the monitoring conducted by RPS in the Spring of 2018 were to gain an understanding of the macroinvertebrate communities within the downstream receiving environment of the LW22-24A Extraction Plan areas; identify spatial and temporal changes in macroinvertebrate community structure; identify any potential key impacting processes resulting in changes to aquatic ecosystems health; identify the likely spatial and temporal scale of any potential impacts to aquatic communities; and provide recommendations for the improvement of future monitoring rounds (RPS, 2019b).

RPS was responsible for conducting the spring sampling event at multiple sites (**Figure 12**) in accordance with the Biodiversity Management Plan (BMP).

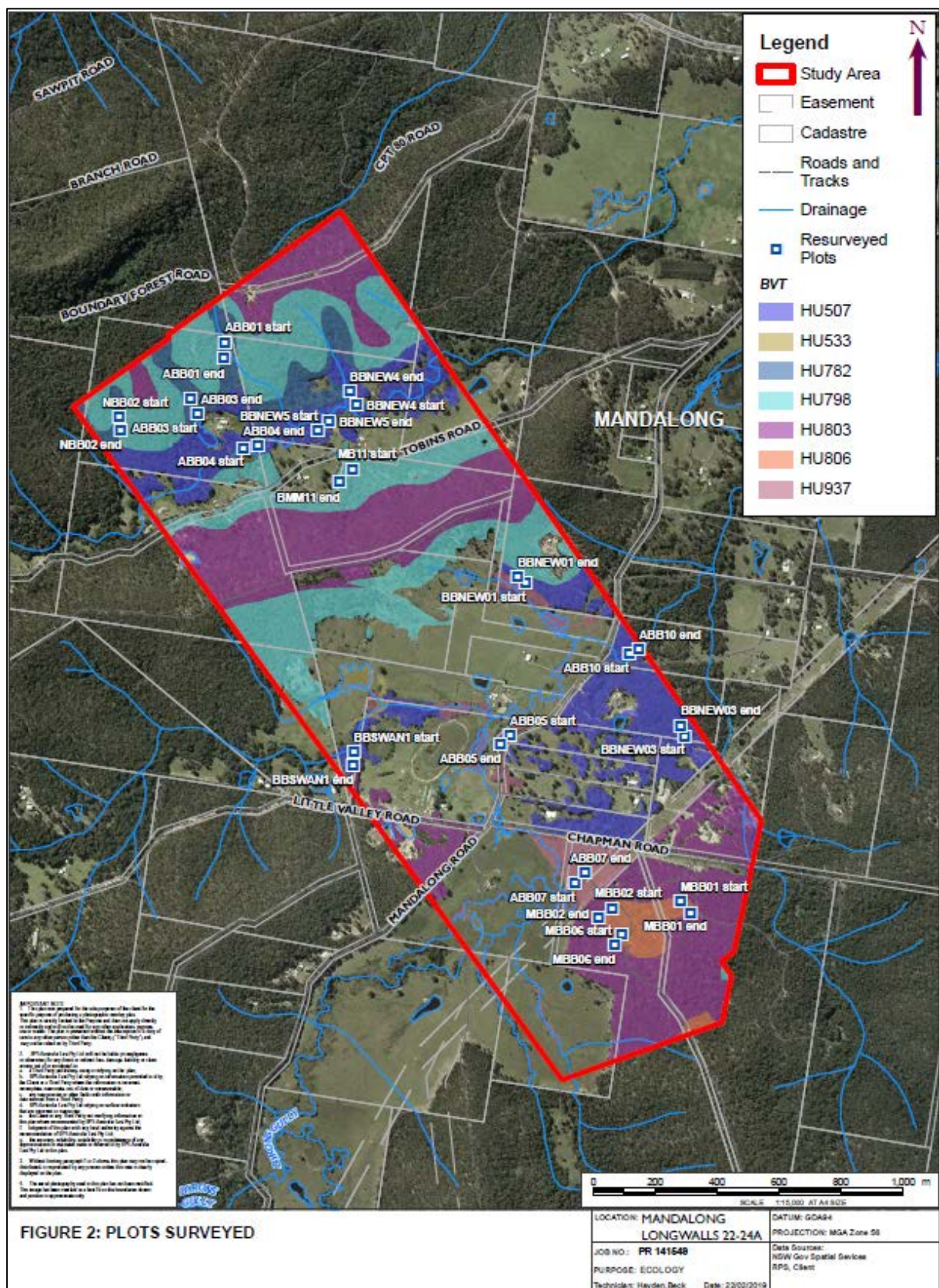
All survey sites recorded nutrient concentrations above the available guideline values for TP and TN. Furthermore, physico-chemical water quality results (i.e. DO) for all sites were lower than the ANZECC (2000) guideline range.

The elevated water quality parameters (i.e. nutrients) and low DO concentrations were expected, given that the sampling event occurred in the drying phase of the normal ephemeral hydrological cycle. Diffuse pollution from agriculture land use within the Lake Macquarie and Tuggerah catchment would also contribute to the elevated nutrient levels within the creeks sampled.

The macroinvertebrate taxa present included both pollution tolerant and pollution sensitive taxa. The macroinvertebrate indices for the test site MA-MO1T suggest this downstream test site was subject to water and/or environmental degradation. This supposition was somewhat supported by water quality results, where turbidity and TP were the highest at MA-MO1T in comparison to other sites.

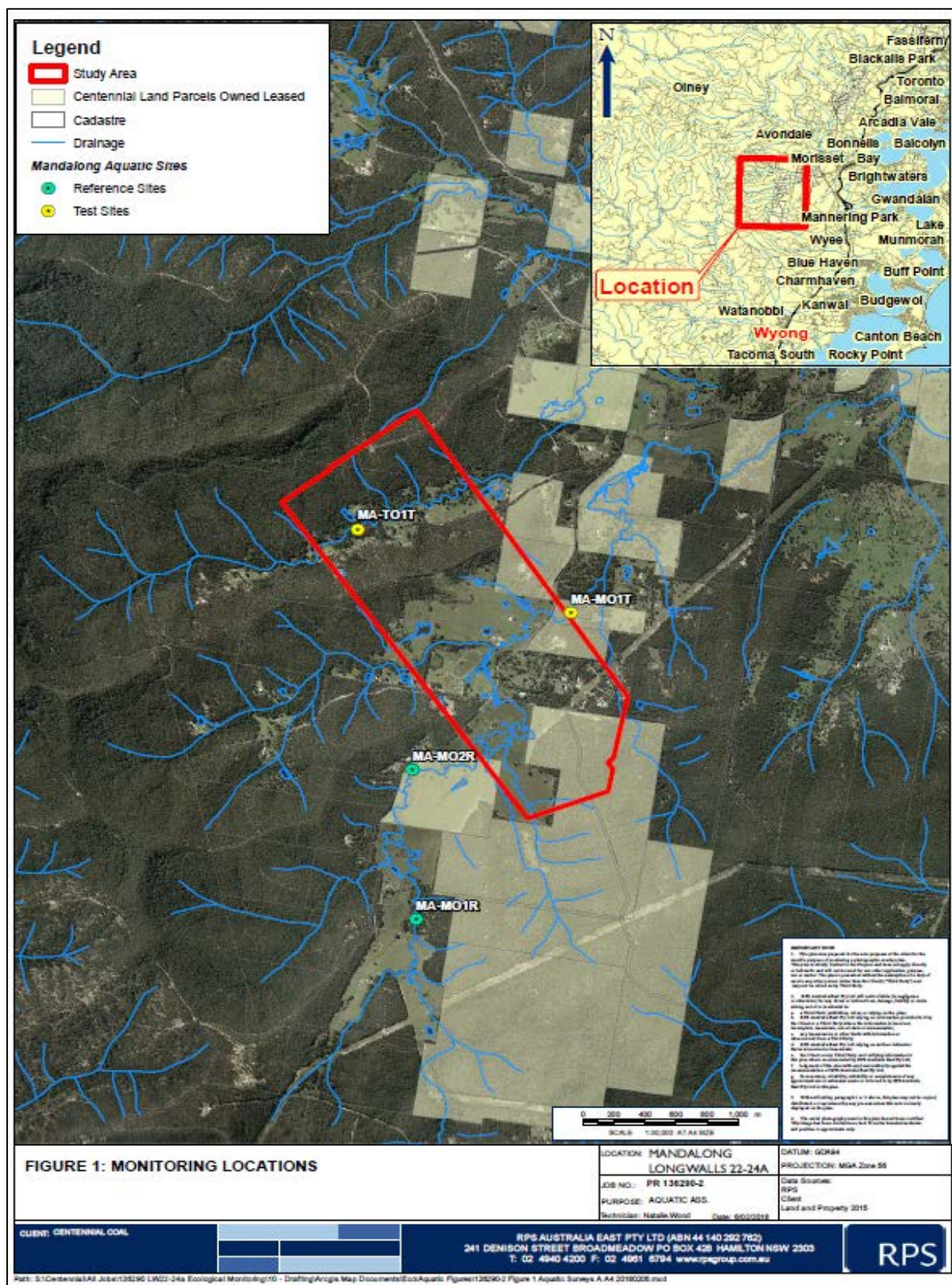
It was evident during the site inspection that the test site MA-TO1T contained the smallest body of water and was more advanced in its drying phase compared to all other sites. Limited edge habitat available during sampling was a likely contributor to the difference in the macroinvertebrate community structure between MA-TO1T and reference site condition.

Based on the sampling rounds undertaken to date, there does not appear to be any significant biological health or water quality impacts to the freshwater aquatic systems resulting from activities associated with the LW22-24A extraction area.



Source: (RPS, 2019a).

Figure 11: Biometric Plots LW22-24A Sites



Source: (RPS, 2018c).

Figure 12: Aquatic Ecological Monitoring Locations

6.4.2 Land Management Strategy for the MSSS and TL24 Offset Areas

The construction of the MSSS and access road which was completed in 2017 resulted in the clearing of approximately 11.3 ha of MU 15: Coastal Foothills Spotted Gum – Ironbark Forest, which is not commensurate with any threatened ecological community listed under the Threatened Species Conservation Act (TSC Act 1995) or Environmental Protection and Biodiversity Conservation Act (EPBC Act 1999) (SLR, 2013a).

MU 15 is very common and widespread in the locality, occupying approximately 2,502 hectares within the Study Area and approximately 21,094 hectares between Ourimbah and Beresfield (NPWS 2003, cited in (SLR, 2013a). The proposed approved clearing area (which was 15.6 ha), therefore, amounts to approximately 0.6 percent of the total available vegetation community within the immediate area and approximately 0.07 percent of the total available vegetation community within the region. None of the land proposed to be cleared contains threatened flora species or endangered ecological communities.

For these reasons, Centennial Mandalong did not propose to provide a direct offset strategy. Rather, as a substantial landholder in the Mandalong Valley, Centennial Mandalong has developed a Land Management Strategy for land owned by Centennial in the Valley.

In addition, the relocation of TL24 has also resulted in 8.03 ha of vegetation clearing for the establishment of the new easement. Centennial Mandalong has also included in the Land Management Strategy an additional area of 73.6 ha in order to compensate for the loss of vegetation communities.

The Land Management Strategy provides for four lots identified in **Table 19**. The four lots form two sites referred to as Mandalong Road and Chapman Road. The two sites have been placed under a Conservation Property Vegetation Plan (PVP) under Native Vegetation Regulation 2013 (Clause 9(1)) in 2017.

Table 19: Land Management Strategy Site Locations

Approval Reference	LMS Site Reference	Lot	DP	Ownership	LGA	Area (ha)
SSD-5144	Mandalong Road Northern Lot	580	733227	Centennial Fassifern Pty Ltd	LMCC	18.37
	Mandalong Road Southern Lots	Lot A	110119	Centennial Fassifern Pty Ltd	LMCC	106.52
		902	541065	Centennial Fassifern Pty Ltd	LMCC	
SSD-5144 (MOD 1)	Chapman Road	152	755238	Centennial Fassifern Pty Ltd	LMCC	72.3

The objective of land management at Mandalong Road and Chapman Road are as follows - **Mandalong Road Objective** - coexistence of conservation and agricultural practices that retain or improve habitat.

Chapman Road Objective - retain/maintain or improve ecological diversity of land to a self-sustaining system/environment.

RPS Australia East Pty Ltd (RPS) was engaged by Centennial Mandalong Pty Ltd to undertake the 2018 annual ecological monitoring of the land management sites as described in the Mandalong Land Management Strategy (LMS). These sites comprise land described as Lot 580 DP733227; Lot A DP110119; Lot 902, DP541065 and Lot 152, DP755238 as shown in **Figure 13** and **Figure 14** and their total areas indicated in **Table 19**.

A total of 22 BioMetric plots were undertaken between 22 January and 1 February 2018. Habitat assessment has been completed to determine condition of floristics within the Habitat Enhancement Map Units of the land management sites. Native and exotic plant species were recorded within a 20m x 20m (400 m²) plot nested within the 50m x 20m (1,000 m²) Cover abundance for each plant species was estimated and recorded. Species composition, condition and photographic data was also recorded.

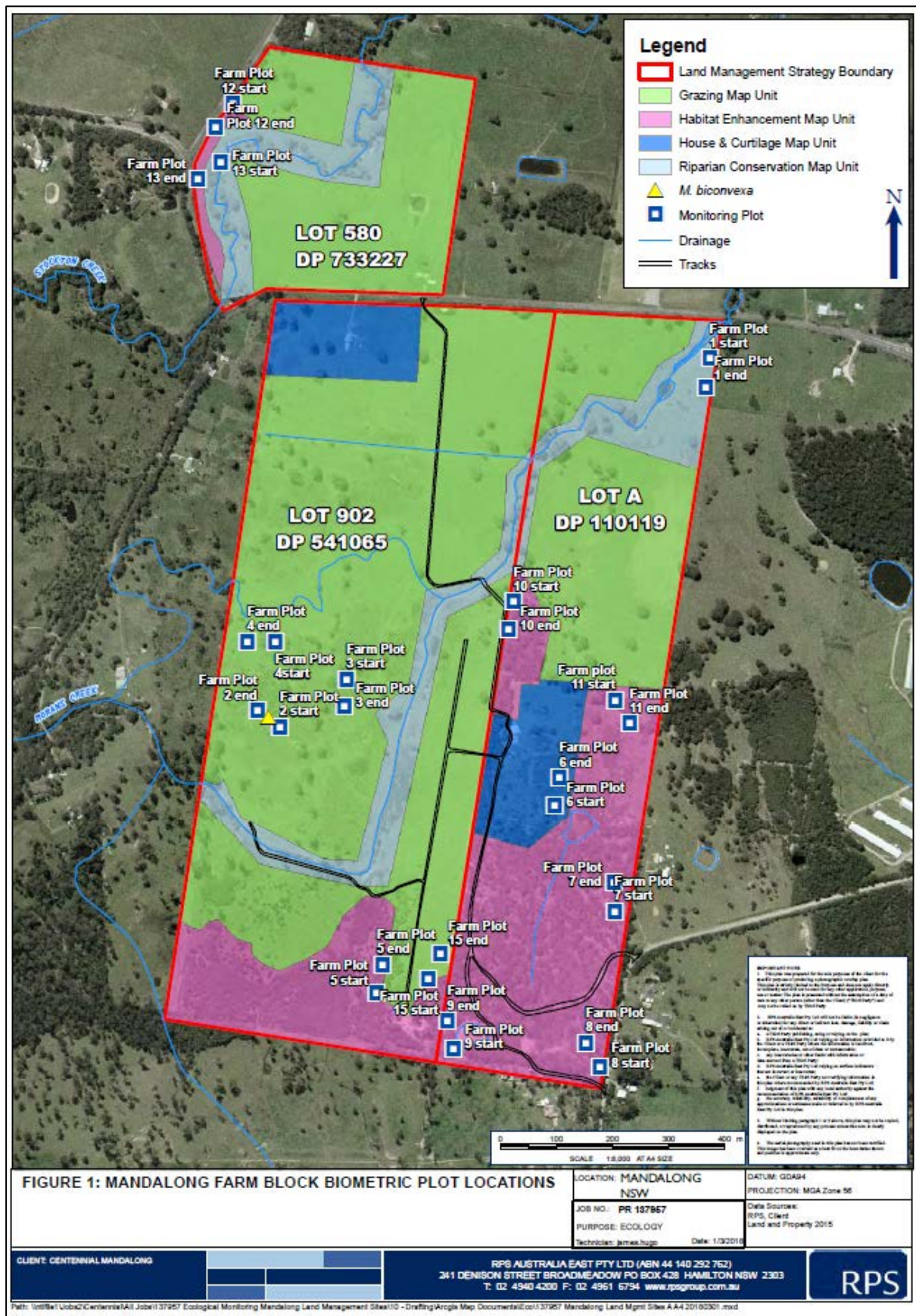
BioMetric (Gibbons et al. 2009), as amended by the NSW BioBanking Assessment Methodology 2014 (BBAM 2014) (Office of Environment and Heritage, OEH 2014), was used as the monitoring method. Calculations were performed using the online NSW BioBanking Credit Calculator (BBCC) to compare monitoring data. The NSW Vegetation Information System (VIS) was interrogated to extract current benchmark data for BioMetric Vegetation Types (BVTs) used to classify each vegetation community examined in the monitoring program.

Baseline flora and fauna surveys were undertaken by RPS ecologists from 9-12, 16-20 and 23-27 March 2015. Contemporary monitoring surveys of 22 BioMetric plots were undertaken between 22 January and 1 February 2018. Site based assessments evaluated a number of attributes including native vegetation cover and exotic species prevalence. Site Value Scores produced from data collected from BioMetric plots was compared with the corresponding BVT benchmark data to evaluate current condition (i.e. Site Value Score).

Comparisons between 2015 and 2018 monitoring and benchmark data indicates that the Site Value Scores across all sites can be classed as being in moderate/ good (medium-high) condition with the exception of Carex Grasslands - HU 812 (derived) which was deemed moderate/ good (poor).

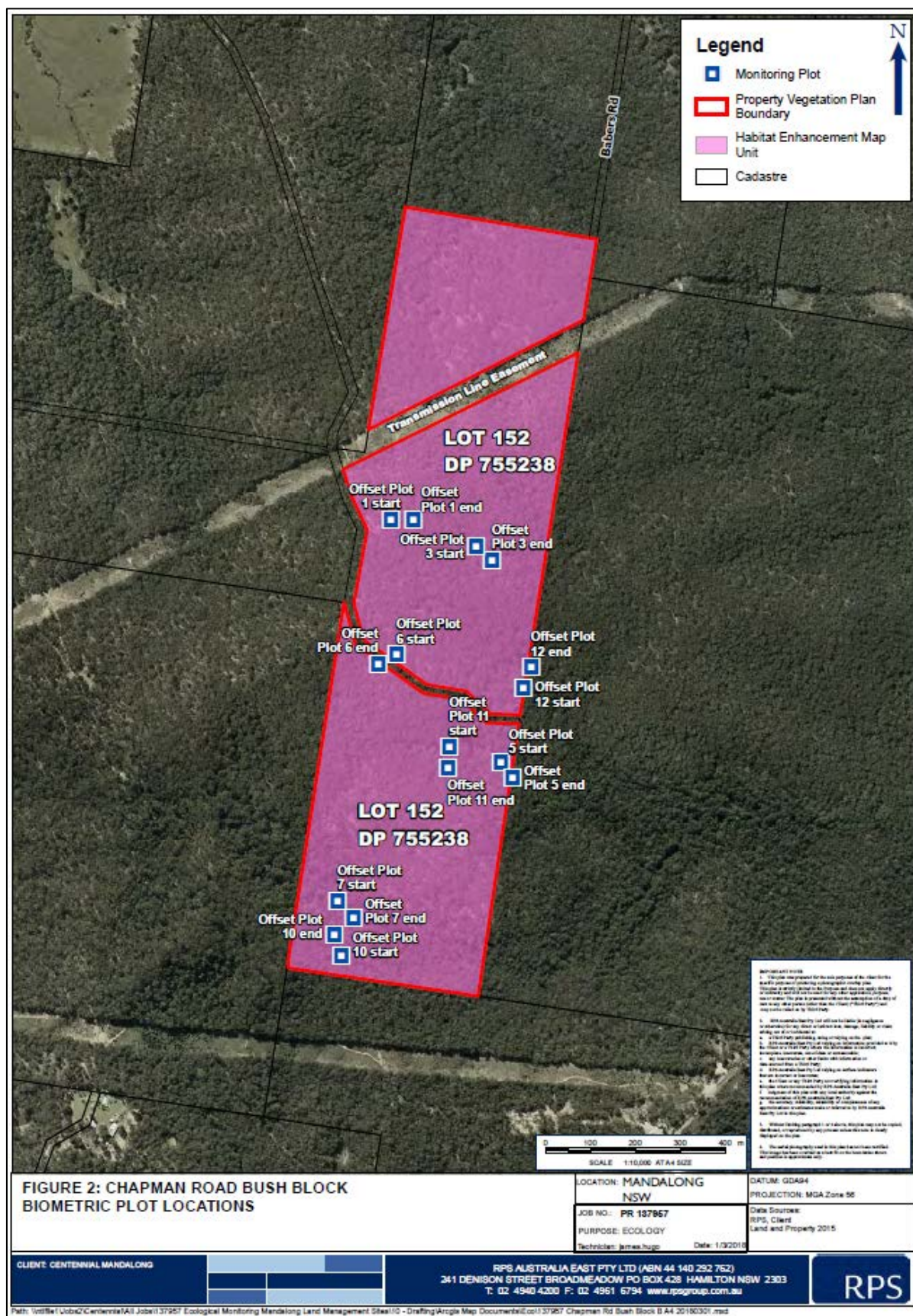
Mandalong Farm Site Value Scores illustrated an overall increase across all BioMetric plots with the exception of Farm plot 9 (Coastal Plains Smooth-barked Apple Woodland - HU 833), which illustrated a substantially decreased Site Value Score. This was attributed to an observed decrease in percentage cover of native grasses across all sites in addition to slightly lower other native groundcovers and increased weed cover. High levels of exotic species cover were identified in a number of plots; thus identifying the need for management intervention. Continued (follow-up) weed suppression is recommended across all Mandalong Farm plots.

The Chapman Road Bush Block Site Value Scores illustrated a large degree of variance in the intervening period. Coastal Narrabeen Moist Forest - HU 794 plots illustrated an overall improved condition. Adversely, a number of sites were subject to disturbance and a moderate intensity grass fire, particularly Coastal Foothills Spotted Gum – Ironbark Forest - HU 802 which illustrated a significant decrease of Site Value Scores across all three plots. Controlled fire management and controlled burns reduce bushfire intensity effectively reducing negative impacts on native species cover parameters.



Source: (RPS, 2018c)

Figure 13: Mandalong Farm Offset Area



Source: (RPS, 2018c).

Figure 14 : Chapman Road Bush Block Offset Area

6.4.3 MSSS & TL24 Nest Box Monitoring

In July and December 2018 RPS ecologists undertook the bi-annual monitoring of 158 nest boxes. The nest boxes were installed as a result of hollow-bearing tree loss associated with the Mandalong South Surface Site and associated Access Road, and the TL24 Relocation Project. This nest box monitoring program included:

- 128 nest boxes installed for the Transmission Line off-set (TL24-13 to TL24-140).
- 30 nest boxes previously installed for the Mandalong South Surface Site and Transmission Line offset (MSSS-01 to MSSS-18 and TL24-1 to TL24-12).

All nest boxes were inspected using a scope and camera to minimise disturbance to any fauna occupying the nest boxes and to minimise personal safety risks involved with climbing ladders.

During the monitoring round in July 2018, five nest boxes contained micro bats totalling a number of 12 individuals. One nest box was occupied by a Brush-tailed possum and three other nest boxes had evidence of nesting by aboral mammals with the accumulation of leaves within the nest boxes.

In December 2018, one nest box was occupied by a Brush-tailed possum and four other nest boxes had evidence of nesting by aboral mammals with the accumulation of leaves within the nest boxes.

6.4.4 VAM-RAB Rehabilitation Off-Set Monitoring

Centennial Mandalong received approval in 2011 (DA97/800 Modification 7) for the trial installation of a ventilation air methane regenerative afterburner unit (VAM-RAB) that would remove and breakdown the exhaust methane.

Installation of the VAM-RAB unit necessitated clearing of some native vegetation. Two endangered ecological communities (EEC) listed in Schedule 3 of the NSW Threatened Species Conservation Act 1995 were included in the areas to be cleared. These were: Swamp Sclerophyll Forest (SSF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and River-Flat Eucalypt Forest (RFEF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

DA97/800 Condition 76A included a requirement for a 1.25 hectare rehabilitation off-set area to be established on cleared land adjoining the VAM-RAB construction site. These EEC were represented by communities described in the regional vegetation mapping and classification (NPWS 2000) as: MU37 Swamp Mahogany Paperbark Forest (SSF); and MU38 Redgum – Rough-barked Apple Swamp Forest (RFEF).

An ecology survey (Hunter Eco, 2011) prepared for the VAM-RAB project application described the area to be rehabilitated as mostly dominated by weeds. This being the case, active regeneration was required and this was commenced in January 2012 and completed in March 2012.

Further to the requirement to rehabilitate, DA97/800 Condition 76A also requires that the progress of the rehabilitation be monitored annually for five years. Hunter Eco commenced baseline monitoring in October and November of 2012, with the first annual monitoring completed in October 2013, the second annual round of monitoring completed in December 2014, the third annual round of monitoring completed in December 2015, the fourth annual round of monitoring completed in October 2016, the fifth round of monitoring completed in December 2017 and the sixth round of monitoring completed in December 2018 (Hunter Eco, 2018).

The aim of the monitoring program conducted by Hunter Eco was to collect data that would enable a quantitative comparison between the relatively undisturbed communities and the areas being rehabilitated. This is achieved through the collection of floristic data from 400 m²

permanently established plots. The normal plot size is 20 m x 20 m but the dimension can vary depending on the configuration of the available space. Two plots were established in each of the two undisturbed communities and two in each of the two areas being rehabilitated to these communities; eight plots in all.

All plots were permanently established with star pickets at each corner in 2012, and floristic data was collected on 15 December 2018. Hunter Eco have found that rehabilitation areas remain substantially different to that in the reference areas. However, the cover contribution of the planted species is increasing and has contributed to improved similarity with many of the planted trees now growing vigorously.

Hunter Eco (2018) have recommended that further spraying of Blackberry be undertaken. Recent spraying has been successfully but there are developing runners in and around several plots (3, 4, 5, 6 and 9) and it is recommended that these be hand sprayed before they can establish. Plots 4 and 5 contain early developing clusters of Noogoora Burr plants and it is essential that these be eradicated before they flower and develop fruit either by spraying or simply being pulled out. Plots 3, 4 and 5 contain tussocks of the millet South African Pigeon Grass (*Setaria sphacelata*). These tussocks need to be eradicated by targeted spraying (Hunter Eco, 2018). Weed management of the VAM-RAB offset area will continue in 2019.

Hunter Eco (2018) has described the results of what is effectively five years of rehabilitation given the initial year lost to herbivory prior to fencing. Overall the results to date are encouraging suggesting that the measures taken should result in successful rehabilitation, although over a longer period than the required five year monitoring program.



Source: (Hunter Eco, 2017)

Figure 15: Location of Floristic Sample Plots

6.4.5 Green & Golden Bell Frog Research Program

In 2016 Centennial Mandalong commenced the preparation and implementation of a research and monitoring program for the Green and Golden Bell Frog (GGBF) in accordance with EPBC approval (2013/6906) conditions of the Northern Coal Logistics Project.

As part of current operations at the Cooranbong Entry Site, underground mine water is pumped from the existing Mandalong Mine underground workings at an average rate of 0.6 to 2.5 ML/day and is discharged into an unnamed creek from Licensed Discharge Point 001 (LDP001) at the Cooranbong Entry Site. The unnamed creek flows into Muddy Lake which is also connected to Lake Macquarie via Lake Eraring.

Ecological surveys were first undertaken at Muddy Lake in October 2015. During these surveys, approximately five Green and Golden Bell Frog *Litoria aurea* (GGBF) individuals were identified. The Green and Golden Bell Frog is listed as an endangered species under the NSW *Threatened Species Conservation Act* 1995 (TSC Act) and as a vulnerable species under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

The GGBFs identified at Muddy Lake are the only known records of the species within a 10 km radius of the Cooranbong Entry Site.

The research project will monitor GGBF populations and habitat quality within Muddy Lake in conjunction with reference populations to fulfil the relevant EPBC approval conditions. Monitoring commenced in late 2016, with approval received from the Department of Environment & Energy on 30 November 2016 for Professor Michael Mahoney to act as an independent peer reviewer for the purpose of reviewing the Green and Golden Bell Frog Research Program's methodology and final report.

Surveys were conducted by GHD within the study area over a two-week period in January - February 2017 and also in Spring 2017 and Summer 2017 / 18. Adult males, adult females and juvenile Green and Golden Bell Frogs were captured during the surveys. The size of the juveniles indicated that breeding has occurred either within the study area or within adjacent habitat in the past twelve months. At this stage, this suggests that the population is viable, although further surveys will be required to examine trends in population structure. The presence of a viable population on the Central Coast, a large distance from the two known key populations, is likely to be important for the conservation of the species in the region.

Further surveys were conducted by GHD in December 2018 and in total, around 150 Green and Golden Bell Frog individuals were recorded during surveys across the lake. In the December 2018 surveys, 37 individuals were captured and released during the targeted surveys, an additional 85 individuals recorded as a result of canoe based surveys, and 25 individuals observed or heard during spotlighting surveys. Canoe-based surveys have shown to be a successful technique at Muddy Lake for assessing occupancy and population numbers (GHD, 2019b).

There have been no substantial changes to water quality variables compared to water quality monitoring during Green and Golden Bell Frog monitoring conducted in previous years and the aquatic ecology monitoring. pH at Muddy Lake is within the range tolerated by the Green and Golden Bell Frog. Salinity is high for a freshwater system, but this is expected given the interaction with brackish water from Lake Eraring and the discharges into the lake. Salinity is within the range tolerated by the species, and may assist with preventing establishment of the Chytrid fungus at the lake (GHD, 2019b).

Based on genetic analysis of tow webbing samples collected in 2017 and 2018, GHD (2019b) have found that the Muddy Lake population is at the higher end of genetic diversity

estimates, indicating that this population is likely to be large and relatively stable through time and there is no evidence of it being subject to a genetic bottleneck in its recent past.

Despite there being some potential barriers to movement (road and rail line), GHD's analysis has shown that there is no local spatial structure between individuals and thus all Green and Golden Bell Frogs at Muddy Lake can be considered to be one population for management purposes (GHD, 2019b).

There is no evidence of a decline in the extent, quality or availability of Green and Golden Bell Frog habitat downstream of the discharge locations, and there is no evidence of a decline in the abundance or extent of the Muddy Lake Green and Golden Bell Frog population. There are no proposed changes to the program design for the summer 2019/2020 monitoring (GHD, 2019b).

6.5 CULTURAL HERITAGE & ARCHAEOLOGY

6.5.1 Aboriginal Archaeology –LW22-23 & LW24-24A Extraction Plan Areas

In 2016, RPS prepared a Heritage Management Plan (RPS, 2016) to support an Extraction Plan for the extraction of coal from Mandalong Mine Longwalls 22 and 23. The Study Area for the Heritage Management Plan encompassed the 26.5 degree angle of draw around the secondary extraction areas of Longwalls 22 and 23.

A survey of the Longwall 22-23 Study Area was undertaken by RPS archaeologists Cheng Yen Loo and Jo Nelson on 14 and 15 June 2016 accompanied by Phil Enright (Centennial Mandalong Mining Approvals Coordinator). Based on the areas surveyed and ground truthing of existing sites, a total of four Aboriginal sites were located inside the Study Area: three that were previously identified in 2011 and one newly recorded scarred tree site named #45-3-3678 (RPS Mand 2016_1).

Two of the sites inside the Study Area were artefact scatters (#45-3-3446/45-3-3537 and #45-3-3538), one was a grinding groove site (#45-3-3454) located in the angle of draw for Longwall 21 which would not be directly undermined as a result of the extraction of Longwalls 22 or 23, and the fourth was a scarred tree site (#45-3-3678 - RPS Mand 2016_1).

Table 20: Subsidence on Aboriginal Cultural Heritage Sites (LW22-24A)

AHIMS Number	Artefact No.	Aboriginal Cultural Heritage Site	Mining Location	Predicted Subsidence	Actual Subsidence	Comment
45-3-3454	RPS MAND Nth 5	Grinding Groove	Angle of Draw Longwall 21	<20mm		Not undermined
45-3-3453	RPS MAND Nth 6	Artefact Scatter	Outside influence of mining.	100mm		Not mined – LW20 shortened due to seam intruded by igneous sill.
45-3-3446 45-3-3537		Artefact Scatter	Longwall 22 abutment pillar	40mm	<20mm	Based on nearest monitoring point. Inspection 14/11/18 – no impact observed.
45-3-3538		Isolated Find	Longwall 23	60mm		Inspected 14/11/18 - no impact observed.
45-3-3678	RPS Mand 2016_1	Scarred Tree	Longwall 24	700mm	700mm	Based on nearest monitoring point (TL24 Tower 45). Initial post mining inspection completed on 14/11/18. No impact observed.

A pre-mining baseline recording of Aboriginal grinding groove site AHIMS #45-3-3454-RPS (Mand North 5) was undertaken on 1 November 2016 by Tessa Boer-Mah (RPS), Arthur Fletcher (Wonn1), Mark Harrower (Centennial), Jeffrey Dunwoodie (Centennial) and Tim Gayner (Centennial). The baseline recording located the grinding grooves to survey control standard, included a detailed archaeological recording and archival photography, as well as a 3D scan.

The baseline pre-mining recording was undertaken in accordance with Phase 1 of the ACHMP (RPS 2016). The post mining initial condition inspection (Phase 2) was undertaken on 1 March 2017 and the post mining secondary condition inspection (Phase 3) was undertaken on 23 October 2017. All recording and inspections were undertaken with Aboriginal community participation. No mining induced changes were noted for each of the grinding grooves as the site (RPS, 2017a).

The artefact scatter (#45-3-3446/45-3-3537) located above the Longwall 22 abutment pillar and the isolated find (#45-3-3538) above Longwall 23 were monitored in 2018. The baseline pre-mining recording was undertaken for both sites in accordance with Phase 1 of the ACHMP (RPS 2016) on 1 March 2017. The post mining initial condition inspection (Phase 2) was undertaken on 23 October 2017 at the artefact scatter ((#45-3-3446/45-3-3537) and on 8 March 2018 for the isolated find. The post mining secondary condition inspection (Phase 3) was undertaken on 23 October 2017 for both sites (RPS, 2018a). All recording and inspections were undertaken with Aboriginal community participation. No visible evidence of harm to the Aboriginal sites through subsidence was identified.

AHIMS # 45-3-3678 scarred tree was originally recorded by RPS archaeologists. A detailed baseline recording was undertaken on 23 October 2017 by Tessa Boer-Mah (RPS), Tracey Howie (Guringai Tribal Link), Jackson Walker (Awabakal Traditional Owners Aboriginal Corporation), Kane Leven (Awabakal Descendants Traditional Aboriginal Owners Corporation), Mark Harrower (Centennial) and Jeffrey Dunwoodie (Centennial). The post mining initial condition inspection (Phase 2) was undertaken on 14 November 2018 with members of the Aboriginal community present. A final post mining inspection (Phase 3) will be conducted in 2019.

6.5.2 Aboriginal Archaeology – LW25-31 Extraction Plan Area

In 2018, RPS prepared a Heritage Management Plan (RPS, 2018b) to support an Extraction Plan for the extraction of coal from Mandalong Mine Longwalls 25 to 31. The Study Area for the Heritage Management Plan encompassed the 26.5 degree angle of draw around the secondary extraction areas of Longwalls 25 to 31. Eleven (11) Aboriginal heritage sites/items are located inside the Longwall 25-31 Extraction Plan Area. As shown in **Table 21** these eleven Aboriginal heritage sites/items are located within the mine workings area and thus may be impacted by subsidence.

Table 21: Aboriginal Cultural Heritage Sites (LW25-31)

AHIMS Number	Artefact No.	Aboriginal Cultural Heritage Site	Mining Location	Predicted Subsidence	Actual Subsidence	Comment
45-3-1223	Moran's Creek	Artefact Scatter	Longwall 31	620mm		
45-3-3469	RPS MAND STH AH03	Grinding Groove	Longwall 27	<20mm		
45-3-3490	RPS MAND STH CYL07	Grinding Groove	Longwall 25	80mm		Phase 1 baseline inspection conducted on 8 March 2018.
45-3-3501	RPS DF03	Grinding Groove	Longwall 25	70mm		Phase 1 baseline inspection conducted on 8 March 2018.

AHIMS Number	Artefact No.	Aboriginal Cultural Heritage Site	Mining Location	Predicted Subsidence	Actual Subsidence	Comment
45-3-3502	RPS DF04	Grinding Groove	Longwall 25	<20mm		Phase 1 baseline inspection conducted on 8 March 2018.
45-3-3506	RPS MAND STH PS11	Grinding Groove	Longwall 25	90mm		Phase 1 baseline inspection conducted on 8 March 2018.
45-3-3536	RPS MAND STH TBM29	Artefact Scatter	Longwall 30	640mm		
45-3-3539	RPS MAND STH TBM31	Grinding Groove	Longwall 28	870mm		
45-3-3540	RPS MAND STH TBM32	Stone Arrangement	Longwall 28	880mm		
45-3-3541	RPS MAND STH TBM33	Modified Tree (carved or scarred)	Longwall 28	910mm		
45-3-3542	RPS MAND STH TBM34	Grinding Groove	Longwall 28	720mm		

A pre-mining baseline recording of Aboriginal grinding groove sites AHIMS 45-3-3501, AHIMS 45-3-3490, AHIMS 45-3-3502 and AHIMS 45-3-3506 (RPS names DF03, CYL07, DF04 and PS11) was undertaken on 8 March 2018 by Tessa Boer-Mah and Dragomir Garbov of RPS along with the following RAP representatives: Peter Leven of Awabakal Descendants Traditional Owners Aboriginal Corporation (ADTOAC), Tracey Howie of Guringai Tribal Link Aboriginal Corporation (GTLAC), Jackson Walker (ATOAC) and Darcy Dole (Wonn1). The baseline recording located the grinding grooves to survey control standard, included a detailed archaeological recording and archival photography, as well as a 3D scan.

Monitoring of the sites RPS DF04 and RPS PS11 will be undertaken in 2019 in accordance with the requirements of Condition 10 of Schedule 4 of SSD-5144 (Grinding Groove Trial Mitigation) with monitoring results to be presented in the 2019 Annual Review.

6.5.3 European Heritage

A Historic Heritage Management Plan was developed for Mandalong in 2016 to address European Heritage items located within the Mandalong lease boundary. The archival recording of the Landing Skid 2 which is located within the Mandalong South Surface Site disturbance boundary was completed by RPS in 2016 (RPS, 2017b). Landing Skid 2 was subsequently demolished in 2017 during the construction of the Mandalong South Surface Site. There were no further impacts to European Heritage items in 2018.

Subsidence on the section of Convict Road (Brisbane Waters to Wallis Plains Road) above Longwall panels 1 and 2 was last recorded at 320mm in 2012. No observed subsidence damage was identified to the road which is in accordance with the predictions in the EIS (Umwelt, 1997). Subsidence monitoring was completed in 2012 as approved by the DRG.

6.6 RAINFALL MONITORING RESULTS

The total monthly rainfall data is shown below in **Table 22** and in **Figure 16**.

Table 22: Rainfall at Mandalong Mine for the Period January 2018 to December 2018.

2018 Month	Mandalong Mine Total Rainfall (mm)
January	16.8
February	102
March	85.8
April	58.6
May	13.8
June	173.1
July	3.4
August	15.2
September	43.8
October	165
November	110.6
December	57.2
Total	845.3

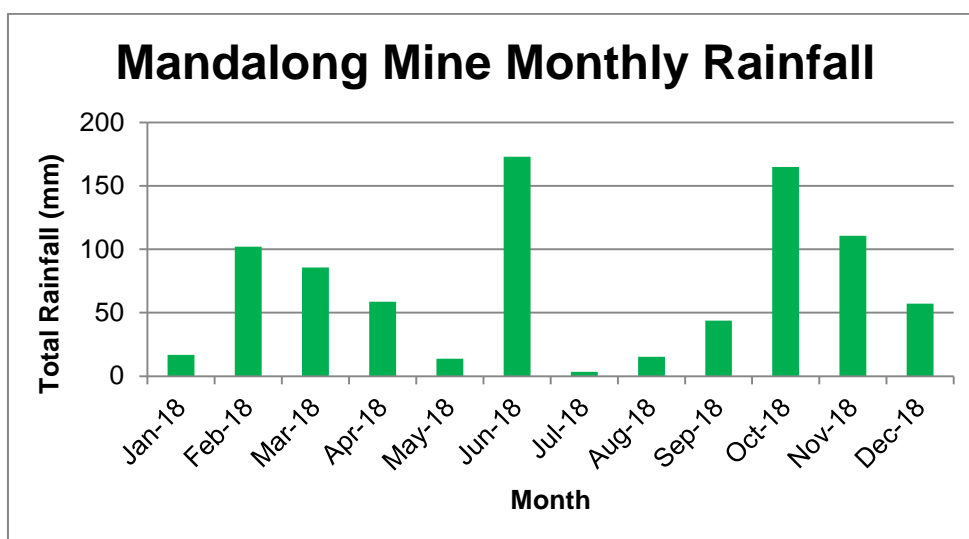


Figure 16: Mandalong Annual Rainfall

A total of 845.3 mm of rainfall was recorded at the Mandalong Mine site during the reporting period. The total annual rainfall for 2018 was lower than the annual average rainfall (1,124 mm) recorded at the Cooranbong Station (BOM station number 61012) from 1889 to 2016. The wettest monthly period in 2018 was June recording 173.1 mm.

6.7 SUBSIDENCE MONITORING

Subsidence monitoring programs are developed and approved for each Extraction Plan. During 2018 both Longwall 23 and Longwall 24 completed extraction, while Longwall 24A completed extraction in early January 2019. Subsidence effects from Longwall 23 were managed in accordance with Extraction Plan LW22-23 and Longwall 24 and Longwall 24A by Extraction Plan LW24-24A.

Subsidence monitoring aims to confirm that subsidence predictions and expected subsidence impacts are consistent with the Extraction Plan and. Where subsidence predictions and or impacts are greater than predicted, Trigger Action Response Plans (TARPs) provide the appropriate and agreed management. The subsidence monitoring program includes monitoring for subsidence performance on built features including private dwellings, public roads, Telstra Network, Ausgrid powerlines, TransGrid 330kV towers and natural features including wetlands, creeks, steep slopes and flood path inspections.

6.7.1 Subsidence Performance Measures

The Extraction Plans for Longwall 22 to 24A operate within mining leases ML1443 and ML1543 and are approved under Development Consent SSD-5144 MOD 5. Subsidence Performance Measures are detailed in Schedule 4, Condition 1 Table 6 and Condition 4 Table 7 as shown below in **Table 23** and **Table 24** respectively.

Table 23: SSD-5144 Subsidence Performance Measures – Natural and Heritage Features

Watercourses	
3 rd Order and above streams Groundwater-dependent Ecosystems	<ul style="list-style-type: none"> No connective cracking between the surface, or the base of the alluvium, and the underground workings. No subsidence impact or environmental consequence greater than minor.
1 st and 2 nd Order streams	<ul style="list-style-type: none"> No subsidence impact or environmental consequences greater than predicted in the documents listed in condition 2(b) of Schedule 2. No connective cracking between the surface and the underground workings.
Aquatic and riparian ecosystems, including affected sections of Morans Creek, Wyee Creek, Tobins Creek and Mannering Creek	<ul style="list-style-type: none"> Maintain or improve baseline channel stability. Develop site-specific in-stream water quality objectives in accordance with ANZECC 2000 and <i>Using the ANZECC Guidelines and Water Quality Objectives in NSW</i> procedures (DECC 2006), or their latest versions.
Land	
Steep slopes and rock outcrops	<ul style="list-style-type: none"> No subsidence impact or environmental consequence greater than predicted in the documents listed in condition 2(b) of Schedule 2.
Agriculture	<ul style="list-style-type: none"> No loss of agricultural productivity greater than minor.
Biodiversity	
Threatened species, threatened populations and endangered ecological communities	<ul style="list-style-type: none"> Negligible environmental consequences.
Heritage sites	
Stone Arrangement RPS TBM 32	<ul style="list-style-type: none"> Negligible subsidence impacts or environmental consequences
All other Aboriginal Cultural Heritage sites/items at the site	<ul style="list-style-type: none"> No subsidence impact or environmental consequence greater than predicted in the documents listed in condition 2(b) of

	Schedule 2.
Mine workings	
First workings under an approved Extraction Plan beneath any feature where performance measures in this table require negligible subsidence impacts or negligible environmental consequences	<ul style="list-style-type: none"> To remain long-term stable and non-subsiding.
Second workings	<ul style="list-style-type: none"> To be carried out only within the approved mine plan, in accordance only with an approved Extraction Plan.

Table 24: SSD-5144 Subsidence Performance Measures – Built Features

Key Public Infrastructure	
M1 Motorway	Always safe and serviceable.
Main Northern Railway	Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.
330 kV power supply infrastructure	
Other Built Infrastructure	
Power lines and power poles	Always safe.
Telecommunications infrastructure	Serviceability should be maintained wherever practicable.
Privately-owned residences	
Local Roads	
Other built features and improvements, (including access roads, farm dams, swimming pools, tracks and fences)	<p>Loss of serviceability must be fully compensated.</p> <p>Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.</p>
Public Safety	
Public Safety	Negligible additional risk.

6.7.2 Subsidence Reporting

The preparation of an Annual Report replaced the requirement for the preparation of four monthly status reports and End of Panel Reports in the previous Subsidence Management Plans (SMP) (DA97/800). The Department of Planning and Environment (DPE) approved the consolidation of End of Panel Reporting as required by DA 97/800 Condition 18 into the Annual Review as required by Condition 12 of Schedule 6 of SSD-5144.

The Extraction Plans for LW22-23 and LW24-24A provides six-monthly reporting in accordance with the Extraction Plan Guidelines. All reports were completed at the specified timeframes as detailed in **Table 25**.

Table 25: Subsidence Reports 2018

Report	Report Period	Date Issued
Six Monthly Report Extraction Plan LW22-23	1 October 2017 to 31 March 2018	April 2018
Six Monthly Report Extraction Plan LW24-24A	1 April 2018 to 30 September 2018	October 2018

6.7.3 Subsidence Performance Summary

Subsidence performance was reviewed by Seedsman Geotechnics following the completion of Longwall 23 (2018a), Longwall 24 (2018b) and Longwall 24A (2019). Subsidence over the longwall panels was measured along crosslines and monitoring installed on properties, dwellings and transmission towers as shown in **Figure 17**.

Table 26 to **Table 29** show the maximum predicted and measured subsidence values on crosslines located over Longwalls 22 to 24A, while **Figure 18** and **Figure 19** graph the subsidence parameters measured along Crossline 19 and Crossline 8.

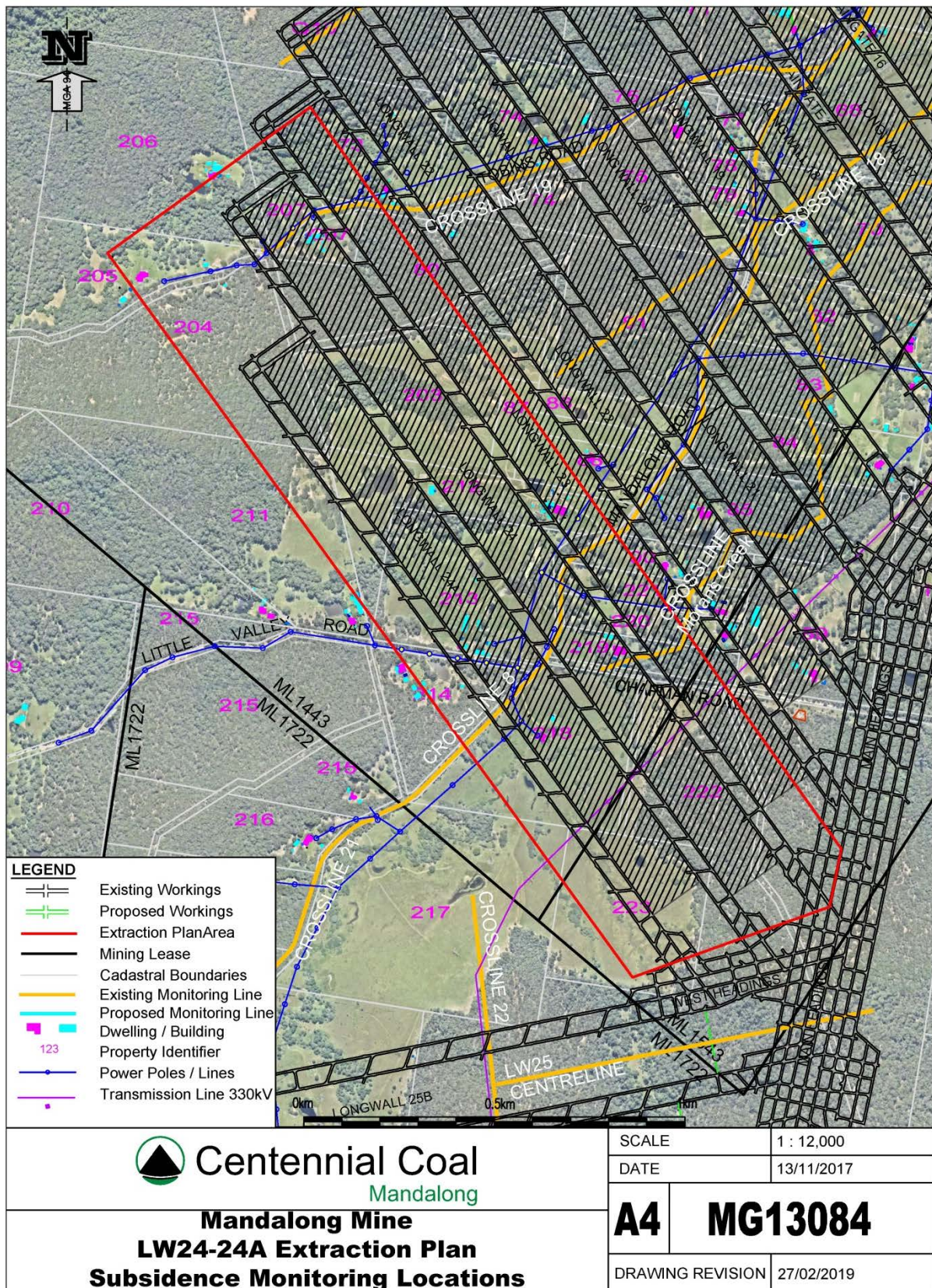


Figure 17: Location of Subsidence Monitoring Lines

Table 26: Maximum Vertical Subsidence developed over LW22

Subsidence Line	Depth of Cover (m)	Predicted Maximum Subsidence LW22 (m)	Measured Maximum Subsidence LW22 (m)	Difference Measured less Predicted (m)	Comment
Crossline 3Ex	330	0.40	0.25	-0.15	
Crossline 19	280	0.95	1.03	0.08	Tobins Rd
Crossline 18	260	0.85	0.81	-0.04	
Crossline 8	260	0.60	1.24	0.64	Mandalong Rd
Morans Creek	260	0.60	0.93	0.33	Morans Creek

Table 27: Maximum Vertical Subsidence developed over LW23

Subsidence Line	Depth of Cover (m)	Predicted Maximum Subsidence LW23 (m)	Measured Maximum Subsidence LW23 (m)	Difference Measured less Predicted (m)	Comment
Crossline 19	280	0.75	0.86	0.11	Tobins Rd
Crossline 8	260	0.70	1.26	0.56	Mandalong Rd
Morans Creek	260	0.70	1.21	0.51	Morans Creek

Table 28: Maximum Vertical Subsidence developed over LW24

Subsidence Line	Depth of Cover (m)	Predicted Maximum Subsidence LW24 (m)	Measured Maximum Subsidence LW24 (m)	Difference Measured less Predicted (m)	Comment
Crossline 19	280	0.40	0.46	0.06	Tobins Rd
Crossline 8	260	0.75	1.23	0.48	Mandalong Rd
Morans Creek	260	0.75	1.07	0.32	Morans Creek

Table 29: Maximum Vertical Subsidence developed over LW24A

Subsidence Line	Depth of Cover (m)	Predicted Maximum Subsidence LW24A (m)	Measured Maximum Subsidence LW24A (m)	Difference Measured less Predicted (m)	Comment
Crossline 8	260	0.45	0.87	0.42	Mandalong Rd

Crossline 19 is located along Tobins Road, that is positioned and near the commencement end of the longwall panels up to Longwall 24 and shown on **Figure 17**. The measured subsidence data is graphed in **Figure 18**. The subsidence associated over the longwall panels is dominated by the deformation of the coal pillar system, with lesser amounts of sag over the panels. Maximum vertical subsidence was consistent with the predicted values. Tilts and strains were within the anticipated ranges.

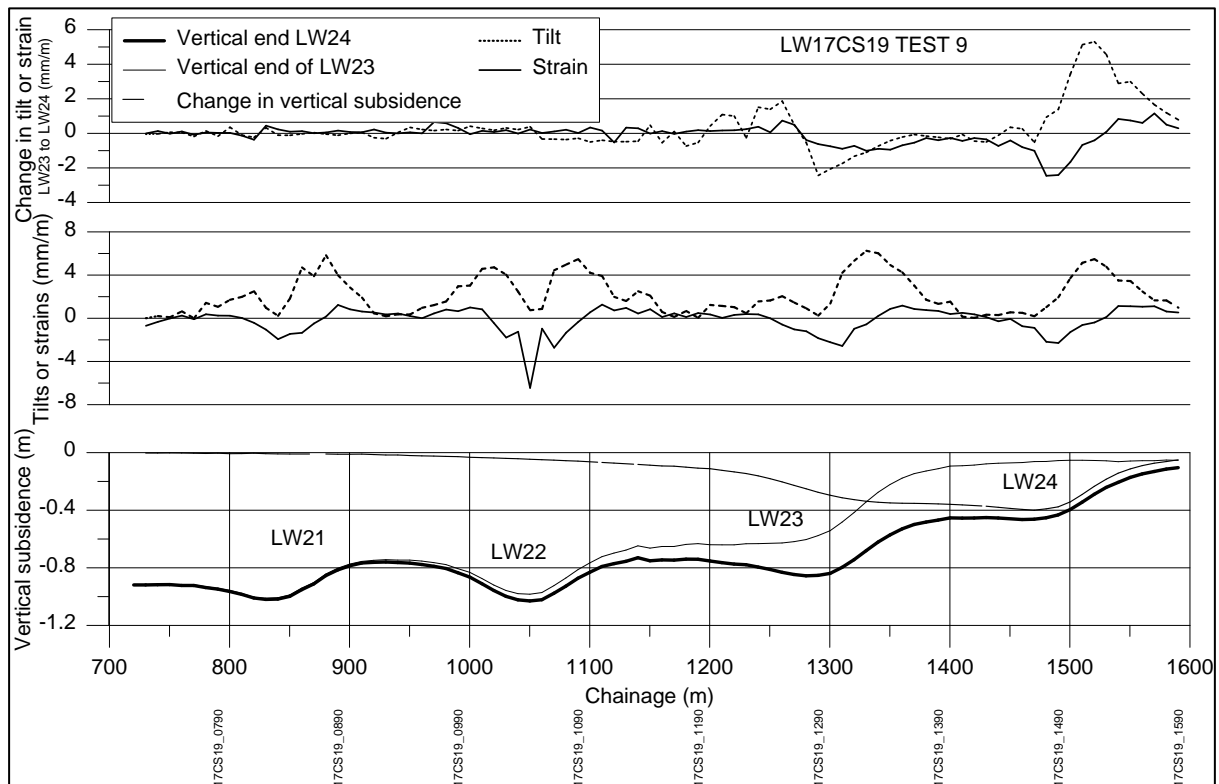


Figure 18: Subsidence Parameters measured along Crossline 19 (Tobins Rd)

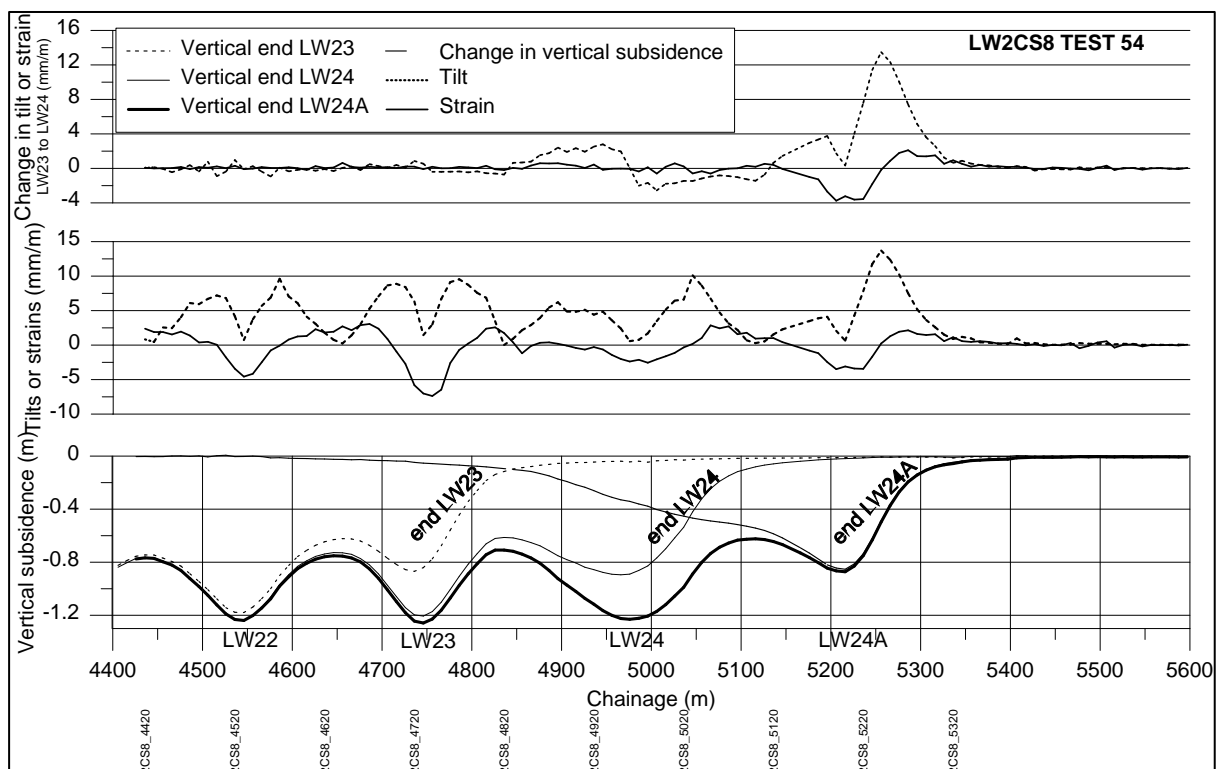


Figure 19: Subsidence parameters measured along Crossline 8 Mandalong Rd

Crossline 8 is located along Mandalong Road that traverses the floodplain. **Figure 19** shows the pattern of vertical subsidence has been similar over the last four longwall panels. Pillar compression is between 0.6m to 0.8m, while the sag is 0.5m. Measured vertical subsidence over Longwalls 22 to 24A has been greater than the predicted values and most likely due to geological variations in conglomerate beam thickness as a result of limited borehole data obtained to the south-east of Mandalong Road.

Values for Safe Serviceable and Repairable (SSR) criteria for dwellings have been assessed as being less than 5mm/m for tensile and compressive strains and less than 7mm/m of tilt. To review the range of tilt and strain measurements up to Longwall 24A, frequency histograms for tilt, tensile strain and compressive strain have been used after the extraction of each panel to assess subsidence performance. The histograms are based on the results of all subsidence monitoring lines located over the longwall panels as shown in **Figure 17**. The histograms compare the subsidence results against the SSR criteria values. **Table 30** provides a summary of the histogram results measured over Longwalls 6 to 24A compared to SSR criteria for dwellings. The results confirm the high level of confidence in the mine design achieving low levels of subsidence and impact on both built and natural features.

Table 30: Measured Subsidence Frequency Histogram Summary Longwalls 6 to 24A

Frequency Histogram Summary for Longwalls 6 to 24A Measured Subsidence Compared Against SSR Criteria for Dwellings			
Longwall Panel	Tilt Less than 7mm/m	Tensile Strain Less than 5mm/m	Compressive Strain Less than -5mm/m
LW6	97.7%	99.8%	97.4%
LW7	97.6%	100%	97.8%
LW8	100%	100%	99.4%
LW9	100%	100%	100%
LW10	98.8%	100%	98.5%
LW11	96.5%	100%	100%
LW12	96.4%	100%	93.3%
LW13	95.6%	100%	95.6%
LW14	100%	100%	100%
LW15	96.9%	100%	100%
LW16	90.9%	100%	96.7%
LW17	96.0%	100%	96.3%
LW18	97.9%	100%	95.7%
LW19	95.0%	100%	100%
LW20	100%	100%	100%
LW21	98.2%	100%	100%
LW22	92.2%	100%	98.6%
LW23	96.6%	100%	94.9%
LW24	95.5%	100%	100%
LW24A	81.3%	100%	100%
Average	96.2%	100%	98.1%

Table 31 provides a summary of the assessment of subsidence performance against the specified subsidence performance measures and predicted impacts Extraction Plan LW22-23 and Extraction Plan LW24-24A. As shown in the summary table, subsidence impacts

were within the predicted levels for private property, surface infrastructure, natural features and heritage items.

Table 31: Assessment of Subsidence Performance against Performance Measures and Predicted Impacts

Feature	Subsidence Performance Measures	Predicted Subsidence Impact EP LW22-23 EP LW24-24A	Assessment of Performance against Predicted Impact
Private Property			
<i>Dwellings</i>	<p><i>Always safe.</i></p> <p><i>Serviceability should be maintained wherever practicable.</i></p> <p><i>Loss of serviceability must be fully compensated.</i></p> <p><i>Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.</i></p>	Subsidence predictions below SSR criteria, with all dwellings remaining SSR.	<p>Impact as predicted</p> <p>12 private dwellings impacted by subsidence from LW22 to LW24A. All remained SSR.</p> <p>Repairs required to dwellings included adjustment of roof drainage and replacement of cracked floor tiles.</p>
<i>Flood – dwelling and access</i>	<i>Dwelling floor level to remain 0.5m above post mining 100 year ARI flood level - acquisition and compensation procedure if subsided floor level is below flood level.</i>	All dwellings freeboard remains above 100 year flood level at the maximum predicted subsidence and two times maximum predicted subsidence.	<p>Impact as predicted</p> <p>Maximum subsidence was consistent with prediction and flood modelling sensitivity analysis at the dwelling locations.</p>
<i>Agriculture</i>	<i>No loss of agricultural productivity greater than minor.</i>	No loss of landuse to State Forest or agricultural productivity to private property (hobby farms) and Centennial properties.	<p>Impact as predicted</p> <p>No reported or observed impact to landuse.</p> <p>Temporary remnant ponding remediation in consultation with landowner.</p>
Infrastructure			
Local Roads and Access	<p><i>Always safe.</i></p> <p><i>Serviceability should be maintained wherever practicable.</i></p> <p><i>Loss of serviceability must be fully compensated.</i></p> <p><i>Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.</i></p>	<p>Low level of damage predicted to Tobins Rd and Mandalong Rd.</p> <p>To remain safe, serviceable and repairable.</p> <p>No change to flood hazard.</p>	<p>Impact as predicted</p> <p>Subsidence impacts consistent with prediction.</p> <p>Two compression humps (40mm) and tensile cracking developed on Mandalong Rd. pavement over LW24A (low tensile and compressive strains measured)</p> <p>LMCC conducted temporary repairs to mill off compression humps in</p>
	Public Roads		

Feature	Subsidence Performance Measures	Predicted Subsidence Impact EP LW22-23 EP LW24-24A	Assessment of Performance against Predicted Impact
	Management Plan LW22-23 Public Roads Management Plan LW24-24A		pavement. Permanent repairs to be conducted following final subsidence over LW24A.
Electricity Transmission Lines (330kV)	<i>Always safe and serviceable. Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.</i> Transmission Line Management Plan LW22-23 for TL24 Towers 46-47 Transmission Line Management Plan LW24-24A for TL24 Towers 45-46	No impact to serviceability of transmission lines.	<i>Impact as predicted</i> No observed or reported damage to transmission line TL24 Towers 45, 46 and 47. Vertical Subsidence at Tower 47 (LW22) was within prediction. Vertical subsidence was slightly above the predicted values for Towers 45 (LW24A) and 46 (LW24). No subsidence impact to the structures retro-fitted with concrete cruciform footings.
Powerlines (11kV)	<i>Always safe and serviceable. Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired</i> Powerline Management Plan LW22-23 and Powerline Management Plan LW24-24A	No impact to serviceability of powerlines.	<i>Impact as predicted</i> Increased sag on 11kV powerline conductors occurred on private property with a 211m span (LW23). Ausgrid installed additional pole to correct sag. No observed impact to remaining powerlines over LW23, LW24 and LW24A.
Communications	Telstra Management Plan	Low impact. No disruption to copper cable network. No impact to inactive fibre optic cable located along Mandalong Rd.	<i>Impact as predicted</i> Subsidence monitoring confirmed subsidence consistent with predicted maximum values (strains). No interruption to service detected or reported.
Natural Features			
Biodiversity	<i>Negligible environmental</i>	Negligible environmental	<i>Impact as predicted</i>

Feature	Subsidence Performance Measures	Predicted Subsidence Impact EP LW22-23 EP LW24-24A	Assessment of Performance against Predicted Impact
	<i>consequences to threatened species, threatened populations and endangered ecological communities</i>	consequences.	There has been no measured or reported impact to threatened flora and fauna affected by LW22 to LW24A subsidence.
Floodplain	Floodplain inspection and monitoring	Minimal changes to creek channel flows or alignment. Predicted no surface cracking on floodplain.	<i>Impact as predicted</i> Minimal changes to creek channel grades resulting in a negligible change to stream flows. No mining induced erosion or deterioration in stream bank condition. No subsidence related soil cracking was observed in report period in areas with higher depth of cover or alluvial flood plain area above LW1 to LW24A.
Wetlands	Wetland Monitoring Management Plan	No long-term impact was predicted.	<i>Impact as predicted</i> Wetland Monitoring is ongoing as per management plan.
Remnant Ponding	Flood Modelling	Minor increase to existing ponding predicted over LW22 to LW24A.	<i>Impact as predicted</i> Increased ponding observed on private property (Ref.220) in a paddock located over LW23 and front of property over LW24. Remediation completed in paddock (LW23) in consultation with landowner. Currently assessing options for temporary remediation of ponding at the front of the property. Predicted ponding at property (90) access road entrance over LW23 and temporary repairs were conducted. Ponding near dam as expected has occurred following subsidence LW24. Currently assessing remediation options.

Feature	Subsidence Performance Measures	Predicted Subsidence Impact EP LW22-23 EP LW24-24A	Assessment of Performance against Predicted Impact
			<p>Ponding at front of property (221) over LW23. Currently investigation remediation options.</p> <p>Remediated ponding along property boundary (86) over LW22.</p> <p>Ponding at property (212) access road over LW23 was remediated in consultation with the landowner and LMCC.</p> <p>Ponding at property (213) trotting track as predicted over LW24. SA NSW completed temporary drainage.</p> <p>Redesign of trotting track drainage developed in consultation with landowner. Drainage works to be completed in early 2019.</p>
Groundwater	Groundwater Monitoring and Management Plan	Predicted no adverse subsidence related impacts on alluvium groundwater levels and water quality.	<p>Impact as predicted</p> <p>The monitoring data indicates that there is no adverse impact on groundwater levels in the alluvial aquifers.</p>
Steep Slopes and rock outcrops	<p><i>No subsidence impact or environmental consequence greater than predicted in the documents listed in SSD-5144 Condition 2(b) of Schedule 2.</i></p> <p>Public Safety Management Plan LW22-23</p> <p>Public Safety Management Plan LW24-24A</p>	<p>No additional risk to public safety.</p> <p>No cliffs or potential for rock fall hazards exist. Possible opening of rock joints.</p>	<p>Impact as predicted</p> <p>Subsidence within predicted levels. No observed impact to steep slopes or evidence of rock falls or rollout. No opening of rock joints observed.</p> <p>The majority of steep slope areas were not mined due to the shortening of LW22-24A as a result of encountering the igneous sill at the commencement end of the panels.</p>
Heritage			
Heritage and	<i>No subsidence impact or</i>	No impact to the three	Impact as predicted

Feature	Subsidence Performance Measures	Predicted Subsidence Impact EP LW22-23 EP LW24-24A	Assessment of Performance against Predicted Impact
Archaeology	<i>environmental consequence greater than predicted in the documents listed in SSD-5144 Condition 2(b) of Schedule 2.</i>	Aboriginal cultural heritage sites identified within EP LW22-23 and EP LW24-24A. (Two artefact scatters and one scarred tree.	Subsidence within prediction and no impact to heritage sites observed during post-mining inspections with RAPs.

6.8 AGRICULTURAL LAND SUITABILITY

This section details the assessment of changes to agricultural land suitability resulting from the mining operations, including cumulative changes, at the Mandalong Site as required by DA97/800 condition 105(iv).

6.8.1 Agricultural Suitability Classification

The agricultural suitability and land capability of the Mandalong area was classified in the Environmental Impact Statement titled *“Cooranbong Colliery Life Extension Project”* (Umwelt, 1997). As stated in the EIS the land areas range from fairly level country in which the majority of the areas have been cleared, to steep heavily timbered country which is not capable of sustaining economically viable agricultural operations. Agricultural land suitability classification is mapped using the definitions in the Department of Urban Affairs and Planning *“Rural Land Evaluation Manual”*, which classifies land into five different classes, based on the potential productivity of the land in the relevant social and economic context. The agricultural suitability system classifies land in terms of suitability for general agricultural use, including both cropping and pastoral purposes.

The Agricultural Suitability of the land in the Mandalong area was assessed in the EIS (Umwelt, 1997) to range from class 3 to 5. The majority of the level land at Mandalong has an Agricultural Suitability of 3, suited to grazing and limited cultivation in rotation pasture. The timbered area on level ground and timbered areas on sloping foothills were classified in the EIS with an Agricultural Suitability of 4 and 5 respectively. Agricultural Suitability with a classification of 4 is not suitable for cultivation but is suitable for grazing. These areas tend to be prone to water logging and production of these areas is constrained by the land size. Timbered land with an Agricultural Suitability of 5 in the Mandalong area is not suitable for agricultural production due to major constraints by native vegetation regulation and the costs associated with improving this land to a productive level.

To update information in the EIS (Umwelt, 1997) 19 agricultural assessments have been completed on properties during the development of Private Property Subsidence Management Plans (PSMP's). In 2009 an additional five agricultural surveys were undertaken on private properties located above longwall panels 11 to 14 for PSMP's. No further agricultural assessments were required in 2018.

The agricultural assessments completed in 2009 concurred with the agricultural suitability classes described in the EIS. Monitoring has confirmed that Longwalls 1 to 22 are stable. Tilts and strains have also remained unchanged over these 22 longwall panels. Agricultural assessments for the properties above these panels are unchanged from previous Annual Reviews and as such are removed from **Table 32**. The properties situated above the current zone of subsidence in 2018 above Longwall 23-24A are highlighted in **Table 32** and have an agricultural classification ranging from three to five as defined above.

Table 32: Agricultural Suitability Classification and Land Use

Property Reference (Number)	Agricultural Suitability Class 3	Agricultural Suitability Class 4	Agricultural Suitability Class 5	Current Agricultural Land use
73	x	x	x	Biodynamic farming is practiced on the property including a small orchard.
80		x	x	
86	x			Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
203		x	x	Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
87	x	x		Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
88	x			Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
90	x			Cattle
221	x			
220	x			Horses
207	x			Horses
212	x	x		Farm - cattle, horses, pigs, emus, goats, lamas, alpacas
219	x	x		
Centennial 222	x		x	
213	x			Agistment
205			x	Horses
218	x			Orchards
223	x			Orchards

6.8.2 Assessment of Agricultural Suitability

Since commencing longwall mining operations, Mandalong Mine has fully extracted Longwalls 1 to 24A. No additional subsidence was recorded above Longwalls 1 to 22. As such the agricultural suitability following mining is as reported in previous Annual Reviews. In 2018, 17 properties were influenced by subsidence movements on Longwalls 23 to 24A. Of these 17 as highlighted in **Table 32**, 13 currently use land for agricultural purposes and

typically have agricultural land suitability of class 3 or 4. The predominant land use on these properties is recreational/lifestyle, horse breeding and agistment and cattle/horse grazing.


6.8.3 Agricultural Suitability Impact Assessment

Vertical subsidence levels on Longwalls 23, 24 and 24A are generally within predicted maximums. The distribution of subsidence above Longwalls 23, 24 and 24A indicates subsidence on the floodplain, where the majority of pasture areas are found, typically ranges up to 1.2 m. There is little evidence that these relatively low levels of subsidence have impacted on pasture condition, as further discussed below.




A number of private and Centennial owned properties as described in **Table 32** were noted as undertaking cattle and horse enterprises. Inspections of these properties were undertaken during surveys to assess the level of subsidence related changes. No significant changes to stock levels were reported as a result of subsidence following the extraction of Longwalls 23, 24 and 24A in 2018.





Forty-eight ponding locations have been identified by Hunter Eco and Centennial Mandalong as per the predictions in the flood modelling assessments, most of which were in open grassland and have since been drained and restored by Centennial Mandalong. **Table 33** provides a description of each ponding instance and what if any remediation was undertaken.

Table 33: Details of Ponding & Remedial Action


Remnant Ponding Remediation							
Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 1 (P1)	Open grassland	No remediation required.	Negotiations with landowner finalised.	No	Yes	Completed	Ref. 6 2/557230
Longwall 2 (P2)	Open grassland	Drained	Constructed open drain and connected to nearby water course. 	Yes	Yes	Completed	Ref. 7, 8 1/557230 3/557230

Remnant Ponding Remediation


Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 3 (P3)	Open grassland	Drained	Constructed open drain and connected to nearby water course. 	Yes	Yes	Completed	Ref. 7 1/557230
Longwall 4 (P4)	Open grassland	Allowed to remain as a source of water for stock.		Yes	Yes	Completed	Ref. 7, 59 1//557230 580/73322 7
Longwall 5 (P5)	Open grassland	Drained	Constructed open drain and connected to nearby water course. Fenced to restrict stock access causing erosion. 	No	Yes	Completed	Ref. 59 580/73322 7

Remnant Ponding Remediation							
Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 6 (P6)	Open grassland	Drained	Installed sub-surface drainage and drainage to Stockton Creek. 	Yes	Yes	Completed	Ref. 56 12/582283
Longwall 6 (P6A)	Open grassland	Drained	Improved existing open drainage to ponded area. 	No	Yes	Completed	Ref. 61 903/54230 6
Longwall 7 (P7)	Open grassland fringed with Cabbage Gums and <i>Melaleuca biconvexa</i> .	Drained	Open drain constructed and connected to nearby water course. Drainage designed to allow access across by farm machinery and stock. 	Yes	Yes	Completed	Ref. 56 12//58228 3
Longwall 7 (P7A)	Open grassland	Allowed to remain as extension of existing dam.	Extension of existing dam	Yes	Yes	Completed	Ref. 55 11/582283
Longwall 7 (P7B)	Open grassland		Regrade natural drainage line and open drain. 	No	Yes	Completed	Ref. 52 93/9632




Remnant Ponding Remediation

Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 8 (P8)	Expansion of an already wet area having scattered Swamp Mahogany and <i>Melaleuca biconvexa</i> .	Remain as expansion of existing freshwater wetland and fenced. Included in Wetland Monitoring Program as Wetland 9.	Following a period of monitoring and limited options for drainage, a decision was made to fence the wetland to protect from stock and allow to develop as a freshwater wetland. 	Yes	Yes	Completed	Ref. 55 11/582283
Longwall 8 (P8A)	Open grassland and <i>Melaleuca biconvexa</i> Existing wetland	Expansion of existing Wetland 8.	To remain as a wetland.	No	Yes	Completed	Ref.42 25/755238
Longwall 9 (P9)	Mixed Cabbage Gum and paperbark forest.	Remain as extension of existing freshwater wetland.	Several threatened <i>Melaleuca biconvexa</i> paperbarks are present and remediation would involve losses of these through gaining access by machinery. Consequently remediation was not undertaken.	Yes	Yes	Completed	Ref. 57 180/85943 4
Longwall 10 (P10)	Mixed Cabbage Gum and paperbark forest.	Remain as freshwater wetland.	Several threatened paperbarks <i>Melaleuca biconvexa</i> are present and remediation would involve losses of these through gaining access by machinery. Consequently remediation was not undertaken.	No	Yes	Completed	Ref. 57 180/85943 4




Remnant Ponding Remediation

Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 11 (P11)	Mixed paperbark woodland in an already periodically inundated area. Contains threatened <i>Melaleuca biconvexa</i> paperbarks. Ponding has extended an existing wetland.	Remain as freshwater wetland	To remain as a freshwater wetland.	Yes	Yes	Completed	Ref. 44 9/800491
Longwall 13 (P13)	Open grassland and Redgum Rough-barked Apple Forest	Minor increase in low lying area. No permanent ponding.	Existing ponding has been moved towards centre of longwall panel. 	No	Yes	Completed	Ref. 44 , 50 9/800491 10/800491
Longwall 13 (P13A)	Open grassland	Minor increase in low lying area. No permanent ponding.	No impact on grazing area.	Yes	Yes	Completed	Ref. 26 10/650914
Longwall 15 (P15)	Alluvial Tall Moist Forest and Redgum Rough-barked Apple Forest.	No remediation required.	No increase to existing ponding evident.	Yes	Yes	Completed	Ref. 67, 69 16//81338 5 61/755238




Remnant Ponding Remediation




Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 16 (P16)	Redgum Rough-barked Apple Forest and Coastal Foothill Spotted Gum-Ironbark Forest.	Increase in existing ponded area remediated to pre-mining condition. Minimal impact on flora	Constructed open drain and connected to nearby water course to return existing ponding to pre-mining levels. Quarterly ecology monitoring program completed. 	Yes	Yes	Completed	Ref. 69 61/755238
Longwall 16 (P16A)	Open grassland	Filled and drain installed to restore drainage due to increase in depth and extent of ponding.		Yes	Yes	Completed	Ref.33 861/83516 0
Longwall 17 (P17)	Freshwater Wetland Complex EEC and Redgum Rough-barked Apple Forest EEC	No remediation required.	Marginal increase in extent and depth of wetland as predicted. No predicted long-term impact on wetland. Wetland 4 & 5 in Wetland Management Plan – property sole and monitoring finished 	Yes	Yes	Completed	Ref. 68 22/812406

Remnant Ponding Remediation




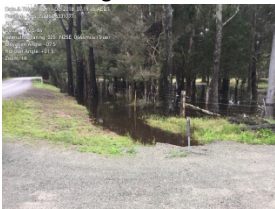
Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 17 (P17A)	Open grassland and Redgum Rough-barked Apple Forest EEC	Installed open drain and pipes to reduce slight increase in area and depth of existing ponding.	 <small>Open & Tree-Road Map 11/12/2014 11:00 AM Position: 34.5 30.000 11.000 Datum: AUSTRALIAN GEOIDIC 1984 (GDA94) Elevation: 100.000 Elevation Angle: +12.0 Datum: 11.000</small>	Yes	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18)	Freshwater Wetland Complex EEC and Redgum Rough-barked Apple Forest EEC	No remediation required.	Marginal increase in extent and depth of wetland predicted. No predicted long-term impact on wetland. Wetland 4 & 5 in Wetland Management Plan. Property sold and monitoring finished	Yes	Yes	Completed	Ref. 68 22/812406
Longwall 18 (P18A)	Open grassland	Filled ponded area to restore pasture.		No	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18B)	Prickly Ridge Forest Road Hunter Valley Moist Forest Open grassland	Upgraded road and installed additional drainage lines.	Increase in length and depth of ponding along Prickly Ridge Forest Road was remediated and road upgraded as agreed by Forest Corporation NSW.  <small>Open & Tree-Road Map 11/12/2014 11:00 AM Position: 34.5 30.000 11.000 Datum: AUSTRALIAN GEOIDIC 1984 (GDA94) Elevation: 100.000 Elevation Angle: +12.0 Datum: 11.000</small>	Yes	Yes	Completed	Ref. 71, 37 45/115922 9 46/755238
Longwall 18 (P18C)	Access road and open grassland	Raise access road, install pipes and regrade existing drain.	 <small>Open & Tree-Road Map 11/12/2014 11:00 AM Position: 34.5 30.000 11.000 Datum: AUSTRALIAN GEOIDIC 1984 (GDA94) Elevation: 100.000 Elevation Angle: +12.0 Datum: 11.000</small>	Yes	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18D)	Open grassland	Construct drain from dam overflow to the existing drain and regrade.	 <small>Open & Tree-Road Map 11/12/2014 11:00 AM Position: 34.5 30.000 11.000 Datum: AUSTRALIAN GEOIDIC 1984 (GDA94) Elevation: 100.000 Elevation Angle: +12.0 Datum: 11.000</small>	Yes	Yes	Completed	Ref. 70 54/755238

Remnant Ponding Remediation

Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 18 (P18E)	Open grassland	Constructed dam at location of existing ponding site. Overflow constructed with open drain and pipes to creek.		Yes	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18F)	Open grassland	Filled minor ponding with top soil.		No	Yes	Completed	Ref. 77 1/1063659
Longwall 19 (P19)	Farm dam and open grassland	No ponding occurred.	No ponding occurred due to LW18 and LW19 being shortened to protect property improvements.	Yes	No	Completed	Ref. 82 1/957458
Longwall 19 (P19A)	Open grassland and access road	Installed drainage to creek and upgraded access road.	Ponding against and along access road was remediated with sub-surface drainage. Upgraded access road. 	No	Yes	Completed	Ref. 82 1/957458
Longwall 19 (P19B)	Open grassland and dam	No remediation required to minor increase in existing ponding near dam.		No	Yes	Completed	Ref. 82 1/957458
Longwall 19 (P19C)	Open grassland	Regraded existing drain to remove remnant ponding in paddock.		No	Yes	Completed	Ref. 70 54/755238

Remnant Ponding Remediation							
Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 20 (P20)	Open grassland	Installed four pipes at existing ponding site and minor regrading of existing drainage line. Replace open drain with 350mm diameter pipes.		Yes	Yes	Completed	Ref. 82 1/957458
Longwall 21 (P21)	Open grassland and dam	Ponding did not occur. Constructed swale drain to restore dam catchment. Modify dam inlet and cleaned out sediment from dam.	Topography of dam catchment near centre of longwall affected. Constructed open drain to restore catchment 	Yes	Yes	Completed	Ref. 74 76/755238
Longwall 22 (P22)	Observation Point F Open grassland near creek	No evidence of ponding.	Photographic monitoring points established on chain pillars and centre of Longwall 22 and 23.	Yes	Yes	Completed	Ref. 73 93/755238
Longwall 22 (P22A)	Observation Point 'G' and 'N' Open grassland		Predicted increase in existing ponding.	Yes	Yes	Monitoring	Ref. 85 4/957458
Longwall 22 (P22B)	Observation Point 'O' Channel and floodplain		Predicted increase in existing ponding.	Yes	Yes	Monitoring	Ref. 89 41/755238
Longwall 22 (P22C)	Open grassland and dam	Fill and construct drainage line to restore paddocks.	Construct table drain and fill low lying areas to provide access. Fill and construct access along boundary fence. 				

Remnant Ponding Remediation

Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 23 (P23)	Observation Point E Dam	Currently assessing remediation options.	Increase in ponding between dam and raised access road.	Yes	No	In progress	Ref. 90 11/869483
Longwall 23 (P23A)	Paddock	Filled ponded area with topsoil		No	No	Completed	Ref. 220 3/168774
Longwall 23 (P23B)	Road reserve and driveway	Constructed new drainage lines, upgrade property access and filled ponded areas with topsoil.	Ponding along road reserve and property access road. 	No	Yes	Completed	Ref. 212 3/3039
Longwall 24 (P24)	Observation Point 'K' Trotting track	Installation of additional drainage lines and resurface affected section of track. Final design completed following LW24A subsidence.	Increased ponding on recently upgraded trotting track. 	Yes	No	In progress	Ref. 213 2/755238
Longwall 24 (P24A)	Observation Point L Open grassland and dam		Potential increase in ponding on floodplain and dam.	Yes	No	Monitoring	Ref. 219 4/168774
Longwall 24 (P24B)	Observation Point 'M' Morans Creek		Potential increase in ponding along drainage line near Chapman Rd.	Yes	No	Monitoring	Ref. 218 17/755238
Longwall 24 (P24C)	Paddock and drainage line.	Proposed regrade and install additional drainage lines. Partially fill ponded area.	Increased ponding in paddock adjacent Mandalong Rd. 	No	No	In progress	Ref. 220 3/168774

Remnant Ponding Remediation							
Location	Description	Remediation	Remediation Comments	Ponding Predicted	Subsidence Completed	Status	Property Ref. Lot & DP
Longwall 24A P24AA	Dam	Raised dam wall to restore dam capacity and regrade drainage lines.	Tilted dam and reduced capacity.	Yes	Yes	Completed	Ref. 212 3/3039
Longwall 24A P24AB	Trotting Track		Alteration of drainage system around track. Loss of catchment to horse swimming dam. Survey and design in progress.	Yes	Yes	In progress	Ref. 213 7/755238

6.9 FLOODPATH MONITORING

The condition of floodpaths and stream channels are discussed in the Mandalong Mine “*Floodpath Condition Report 2018*” (Centennial Mandalong, 2019) in **Appendix 2**. DA97/800 and the LW22-23 and LW24-24A Extraction Plan – Water Management Plans require the condition of major floodpaths be inspected every six months or following a flood event. This Floodpath Condition Report for 2018 has been developed to compile survey and photographic records of subsidence induced changes to Morans Creek and Tobins Creek as per the assessment methodology in **Appendix 2**.

Appendix 2 assesses the changes to the condition of floodpaths along stream reaches undermined by Longwall 23, 24 and 24A in 2018 and previously subsided longwall panels 15 to 22, identifying the effects of subsidence on the floodpaths. The pre-mining condition of the floodpaths above longwall panels 25 to 31 is also documented in this report.

On the basis of the information obtained from field surveys, the pre mining characteristics of Morans Creek and Tobins Creek can be described as having a generally poorly defined channel system, in which creek lines give way to undefined overland flow paths in several areas. The levels of predicted subsidence and associated grade changes along Morans Creek and Tobins Creek over Longwalls 23, 24 and 24A are of a similar order of magnitude to the existing creek bed slopes. The levels of predicted subsidence along Morans Creek and Tobins Creek are relatively small over Longwalls 23, 24 and 24A and it is therefore considered that these will not significantly alter the flow conveyance capacity of the existing channels. The associated impacts on the maximum flood depths and flood hazards that have been modelled are not considered to be significant.

7 WATER MANAGEMENT

Mandalong Mine holds a water access licence (WAL39767) permitting the extraction of groundwater from the coal measures encountered during the process of mining. This water access licence permits the Mine to dewater the underground coal measures via a submersible dewatering pump located at Cooranbong. The WAL entitles the Mine to extract 1825 ML of groundwater annually for the period 1 July to 30 June from North Coast Fractured and Porous Rock Groundwater Sources. This mine water is subsequently discharged at LDP001.

Mandalong Mine extracted a total volume of 667ML of ground water during the annual period 1 July 2017 to 30 June 2018. There are no other conditions on the Water Access Licence.

The passive take inflow (groundwater make) for the 2018 report period was calculated to be 334ML (GHD, 2019a) which is a slight increase on the 327.6ML for 2017 report period (GHD, 2018a).

An average of the passive take inflow volume for 2017 and 2018 Water Balance report periods will be used as an estimate for the water access licence period. The estimated passive take volume for the water access licence annual period is 330ML.

Table 34: Water Take

License #	Water Sharing Plan, source and management zone (as applicable)	Entitlement	Passive take / inflows	Active pumping	TOTAL (1 July to 30 June).
WAL39767	North Coast Fractured and Porous Rock Groundwater Sources	1825 ML	330 ML	667 ML	337 ML

7.1 SURFACE WATER MONITORING

7.1.1 Mandalong & Cooranbong Entry Site

There is an established surface water quality monitoring program for the Mandalong catchment conducted since periodic sampling commenced in 1996, with the program established on a regular frequency since August 1999. Three surface water monitoring points (SW13-15) above licenced discharge points LDP001 and LDP002 at the Cooranbong Entry Site and two monitoring points (SW16-17) in the receiving waters below the LDP's were added in late 2011. The monitoring locations are shown on **Plan MG10722b**, **Plan MG10502**, **Plan MG10722d**, **Plan MG10722f** and are summarised below in **Table 35**.

7.1.2 Cooranbong Haul Road

The Cooranbong Haul Road crosses three ephemeral creeks in the Lords Creek sub-catchment. Six sediment basins have been constructed along the haul road to contain dirty water runoff. Monitoring of the water quality in the haul road sediment control dams was undertaken in 2018 to assess the effectiveness of water treatment prior to controlled releases.

Table 35: Summary of Monitoring Locations with Respect to Position within the Catchments

Location Reference	Creek Sub-catchment
SW008	Upper Stockton Creek
SW004	Mid Stockton Creek
SW012	Lower Stockton Creek
SW011	Upper Morans Creek
SW003	Mid Morans Creek
SW006	Lower Morans Creek
SW002	At confluence of Morans Creek and Stockton Creek
SW001	Downstream confluence on Stockton Creek
SW009	South Pourmalong Creek
SW010	North Pourmalong Creek
SW018	Mandalong Mine Site
SWMP01	Mannering Creek within Olney State Forest
SWMP02	Mannering Creek at Hue Hue Road
SWMP03	Wyee Creek at Wyee Farms Road
SWMP04	Wyee Creek at Wyee Farms Road Bridge
SWMP05	Wyee Creek at junction of Schofield Road and Manhire Road
SWMP06	Morans Creek at Mandalong Road
SWMP07	Upper catchment of Morans Creek
SW13	Muddy Lake (Unnamed tributary upstream LDP001).
SW14	Muddy Lake (Unnamed tributary upstream LDP002).
SW15	Muddy Lake (Unnamed tributary upstream LDP002).
SW16	Muddy Lake (Unnamed water body 1km downstream Simpson Rd Causeway Crossing)
SW17	Muddy Lake (North Dora Creek Village)

7.1.3 Surface Water Monitoring Results

7.1.3.1 Mandalong & Mandalong South

LDP003 and LDP004 were added to EPL365 in October 2018. LDP003 is located at the overflow of the Mandalong Mine Sediment Dam. LDP004 is located at the overflow of the Mandalong South Surface Site Sediment Dam. LDP003 and LDP004 are to be monitored daily during discharge. The parameters required to be tested are oil and grease, pH and TSS.

Surface water quality is monitored at 23 locations on a quarterly basis. These locations encompass four different catchment areas. The water is tested for pH, Total Suspended Solids (TSS) and Electrical Conductivity (EC). The annual and long-term average (LTA) results are summarised in **Table 36**.

Table 36: Average Surface Water Quality for the 12 month Period from January 2018 to December 2018 ('Annual') and the Long-term Average ('LTA').

Site Location	Catchment	pH		TSS		Specific Conductance uS/cm	
		Average	LTA	Average	LTA	Average	LTA
SW008	Stockton	6.9	6.1	21.5	29.5	476.0	859.0
SW004		6.6	6.7	25.0	18.5	234.0	737.7
SW012		6.5	6.1	31.0	31.5	239.0	1121.8
SW018		7.2	7.3	10.0	41.6	604.0	566.7
SW011	Moran's		6.6		50.4		559.6
SW006		6.5	6.5	14.8	18.1	520.3	517.7
SW003		6.2	6.4	38.3	15.6	639.0	479.1
SWMP06		6.5	6.5	67.3	51.8	765.0	662.9
SWMP07		6.5	6.7	18.0	10.7	338.0	537.0
SW002	Stockton and Moran's Creek (Confluence)	6.9	6.9	15.3	14.4	17339.5	14740.0
SW001		7.3	7.1	25.3	12.4	31575.0	29875.6
SW009	Pourmalong	6.4	6.4	16.3	17.4	224.8	301.5
SW010		6.0	6.0	12.5	30.4	211.5	469.1
SWMP01	Mannering Creek	6.0	6.7	0.0	5.2	484.0	484.0
SWMP02		6.4	6.6	32.5	12.7	297.5	463.4
SWMP03	Wyee Creek	6.6	6.6	13.0	12.6	444.0	407.8
SWMP04		6.7	6.7	17.8	13.1	525.5	652.3

Site Location	Catchment	pH		TSS		Specific Conductance uS/cm	
		Average	LTA	Average	LTA	Average	LTA
SWMP05		6.7	6.6	21.0	27.8	227.8	510.1
SW013	Muddy Lake	7.8	6.6	6.5	9.8	3955.0	3318.8
SW014		6.5	6.9	12.5	15.3	1027.5	699.7
SW015		5.6	5.7	132.0	88.3	74.4	83.5
SW016		8.4	8.2	117.3	707.6	3814.2	3262.7
SW017		8.6	8.3	26.7	12.9	4070.8	3232.3

7.1.3.2 Cooranbong Entry Site

Water quality is monitored daily as per the requirements of EPL 365 at Licenced Discharge Points LDP001 and LDP002 located at the Cooranbong Entry Site. The water is tested for pH, Total Suspended Solids (TSS), EC and Oil and Grease (mg/L). The average annual results at LDP001 & LDP002 are summarised in **Table 38** and **Table 39**: Water Quality LDP002. Graphs of the LDP001 water quality results for these parameters are provided in **Figure 20**.

Table 37: LDP001 Discharge Volume

Frequency	No. of measurements made	Lowest result (kL)	Mean result (kL)	High result (kL)
Daily during any discharge	351	0	2055	2574

Table 38: Water Quality LDP001

Pollutant	Unit of Measure	No of samples required by licence	No. of samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value
Oil & Grease	milligrams per litre	351	363	0	0.24	8
pH	pH	351	363	7.53	7.83	8.25
Total suspended solids	milligrams per litre	351	363	0	3.91	16

Table 39: Water Quality LDP002

Pollutant	Unit of Measure	No of samples required by licence	No. of samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value
Oil & Grease	milligrams per litre	0	0	0	0	0
pH	pH	0	0	0	0	0
Total suspended solids	milligrams per litre	0	0	0	0	0

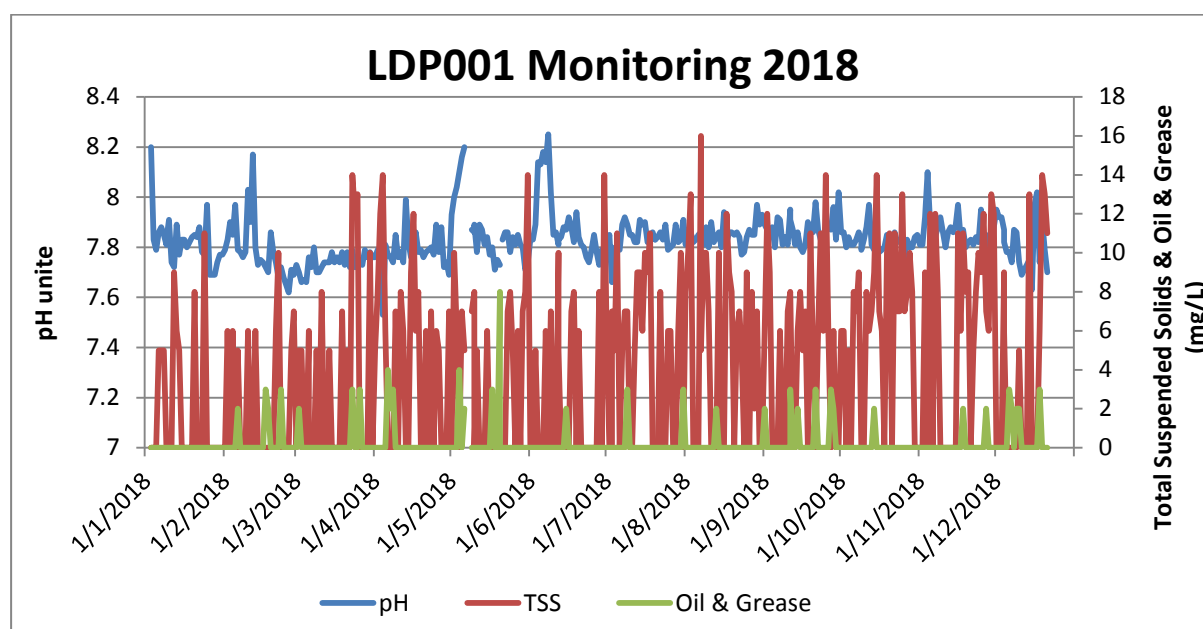


Figure 20: LDP001 Water Quality Monitoring

7.1.4 Data Interpretation

The results presented in **Table 36** are characteristic of the natural conditions of the area, particularly for Stockton, Moran's, Mannering & Wyee Creeks. Both Stockton and Morans Creek are the main drainage systems for the Mandalong area. Stockton Creek is located within the longwall mining area (LW1-16) and Morans Creek is also located within the current longwall mining area (LW15-24A). Both Mannering and Wyee Creek are located within the Mandalong Southern Extension Area (future longwall mining).

7.1.4.1 Mandalong and Mandalong South Surface Site

There were no discharges from LDP003 or LDP004 during the report period.

Table 40: Water Quality LDP003

Pollutant	Unit of Measure	No of samples required by licence	No. of samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value
Oil & Grease	milligrams per litre	0	0	0	0	0
pH	pH	0	0	0	0	0
Total suspended solids	milligrams per litre	0	0	0	0	0

Table 41: Water Quality LDP004

Pollutant	Unit of Measure	No of samples required by licence	No. of samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value
Oil & Grease	milligrams per litre	0	0	0	0	0
pH	pH	0	0	0	0	0
Total suspended solids	milligrams per litre	0	0	0	0	0

Surface waters are tested for pH, TSS and EC and the annual and LTA results are summarised in **Table 36**. The Cooranbong Entry Site monitoring sites SW13, SW14, SW15, SW16 and SW17 were sampled on a monthly basis. The monitoring sites SW001, SW002, SW003, SW004, SW006, SW008, SW009, SW010, SW011, SW012, and SW018 were sampled on a quarterly basis during the reporting period. The Mandalong Southern Extension monitoring sites SWMP01, SWMP02, SWMP03, SWMP04, SWMP05, SWMP06 and SWMP07 were also sampled on a quarterly basis during the reporting period. There were no results recorded for SW011 during the monitoring period due to insufficient water at the monitoring point.

The EC (salt content) for the 2018 period shows a relatively consistent level compared with the long-term average. The average EC recorded for sites SW004, SW008, SW009, SW010, SW012, SW015, SWMP02, SWMP04, SWMP05, and SWMP07 for this period is lower than the long-term average.

The average TSS for 2018 are relatively low and are characteristic of natural surface water conditions in creeks. SW015 recorded the highest annual average TSS of 132 mg/L in 2018. All sites had a 2018 annual average that was similar to the LTA. The SW015 annual average was higher than the LTA (88mg/L) due to a high result in September and November 2018.

All of the monitoring points recorded a pH annual average similar to the LTA. SW15 had the lowest pH annual average of 5.6 in 2018. The highest pH annual average during 2018 was 8.6 recorded at SW017.

7.1.4.2 Cooranbong Entry Site

Plan **MG10722b** shows the location of the discharge monitoring points LDP001 and LDP002. The water quality results for LDP001 (**Table 38**) show the 2018 annual average for pH, TSS and Oil & Greases is similar to the long term average. The pH annual average of 7.83 is similar to the long term average of 7.87. The TSS annual average of 3.91 mg/L is greater than the long term average of 2.13 mg/L. The oils and grease annual average of 0.24 mg/L is greater than the long term average of 0.15 mg/L.

There was no discharge from LDP002 during the 2018 report period.

EPL 365 permits the Mandalong Mine to discharge a maximum of 5 ML/day from LDP001 and allows for exceedance of this limit if the discharge occurs solely as a result of rainfall exceeding 10 mm during the 24 hours immediately prior to the commencement of discharge. The average daily discharge volume of 2.055 ML and highest daily discharge volume of 2.574 ML was recorded at LDP001 in 2018.

7.1.4.3 Cooranbong Haul Road

Monitoring for the surface water in the six sediment control dams on the haul road was conducted to determine compliance with the EPL limits prior to discharge. Prior to discharge the sediment control dams were treated by adding a flocculent to the water to remove suspended solids. Prior to discharge water quality in the haul road sediment control dams is required to meet the water quality discharge criteria detailed in the EPL and the Cooranbong Haul Road Surface Water Management Plan.

7.2 WATER BUDGET

The 2018 water balance analysis was prepared by GHD (2019a) in the report titled "*Mandalong Mine 2018 Annual Water Balance*". The water balance for 2018 is shown in **Table 42**. In accordance with DA97/800 condition 105 (vi) the quantity of water used from water storages and details of water discharges from the Mine are discussed below.

7.2.1 Water Supply, Use & Discharge

The Mandalong Mine is connected to town water and sewer. Potable water for underground use is currently supplied by Hunter Water Corporation (HWC) via a pipeline to the Cooranbong Entry Site and to the Mandalong Mine. Potable quality water is used underground in mining equipment as uncontaminated water is required for cooling systems on drive motors, in dust suppression sprays on miners and transfer points. The total potable water used in 2018 was 500.1 ML. A total of 457.5 ML was supplied via the Cooranbong Entry Site and Mandalong Mine Site to underground equipment. A total of 20.2 ML was used on the surface within the Cooranbong CHP and bathhouse, 11.7 ML in the Mandalong Mine bathhouse and 10.7 ML for Mandalong Mine Surface operations.

The total potable water usage (500.1ML) for 2018 is slightly above the water usage in 2017 (486.6 ML). Potable water was primarily supplied to the longwall and underground equipment (longwall, continuous miners and conveyors) for coolant on motor transmissions and dust suppression.

GHD's (2019a) water balance model reports 787 ML was discharged in 2018 from the Mandalong Mine, Mandalong South Surface Site, Cooranbong Entry Site and the Delta Entry Site. A total of 747.4 ML was discharged from the Cooranbong Entry Site via LDP001 and 7.6 ML from the Construction Dam (clean water dam). 21.1 ML of surface water run off water was discharged from Delta Entry Site dams. 11.6ML was discharged from the Sediment Basin at the Mandalong South Surface Site (LDP004 as of October 2018). There were no discharges from LDP002 and LDP003 during the 2018 report period.

Table 42: 2018 Summary of Water Inputs and Outputs

Element	Transfer in 2018 (ML/year)
INPUTS	
Direct rainfall and runoff	125.4
Potable water supply	500.1
Groundwater inflows	334
TOTAL INPUTS (rounded)	959.5
OUTPUTS	
Evaporation	24.5
Spray irrigation	16.8
Sewage to HWC	12.2
Discharge from LDP003 (Mandalong Mine Access Site)	0.0
Discharge through LDP001 (Cooranbong Entry Site)	747.4
Discharge through LDP002 (Cooranbong Entry Site)	0.0
Discharge from Construction Dam (Cooranbong Entry Site)	7.6
Discharge from Delta Entry Site	21.1
Discharge from LDP004 (Mandalong South Surface Site)	11.6
Extracted ROM coal moisture	156
TOTAL OUTPUTS (rounded)	997.2
CHANGE IN STORAGE	
Cooranbong Underground Storage	0.8
Surface water storages	-39.0
TOTAL CHANGE IN STORAGE (rounded)	-38.2
BALANCE	
Inputs – outputs – change in storage	0.0

7.2.1.1 Mandalong Mine

Managing runoff from rainfall events is the only surface water management required at the Mandalong Mine Pit-Top. Clean water is diverted around the western area of the site. A dam has been constructed to capture this water. Clean water runoff from Mandalong Road, the M1 Motorway on-ramps and the car park has been diverted around the eastern perimeter of the site.

Water from all other areas of the surface is considered 'dirty' and is directed to sediment control systems. Surface and subsurface drainage directs dirty water to the sediment control system. This system comprises of a gross pollutant trap (GPT) and a sediment control dam.

Water from the sediment control dam is used for irrigation of surrounding grassed areas as required. An oil water separator at the GPT removes hydrocarbons from potentially contaminated runoff from the refuelling bay, oil store, workshop, washdown bay and equipment yard.

7.2.1.2 Cooranbong Entry Site

Water from the hardstand area is directed to the 5 ML dam for treatment before discharge by an overflow culvert at LDP002. A dewatering pump installed in the 5 ML Dam allows low water levels in the dam to be maintained. Contaminated water from the workshop, equipment storage and washdown bay areas drain to an oil water separator used to remove hydrocarbons from waste water.

Dirty water contaminated with coal fines from the CHP, conveyor gantries and ROM stockpile is directed to dedicated sediment control sumps to remove coarse fines material. Dirty water is then directed to the large GPT for further settlement of fines. Treated water from the GPT is then pumped to Sediment Dam 1 or directly underground. Sediment Dams 1 and 2 have a capacity of 7.6 ML.

A sediment control dam (ROM Stockpile Dam) and GPT were constructed in 2010 to capture and treat contaminated surface water runoff from the 100 000 T ROM coal stockpile. Sediment is captured in the ROM Stockpile Dam prior to flowing via pipeline into Sediment Dam 1 (via the Export Bin Sump).

7.2.1.3 Delta Entry Site

Clean and dirty water systems have been constructed at the Delta Entry Site. Site runoff also utilises the existing stormwater infrastructure at the Wyee Coal Unloader, which includes clean water diversion drainage and two large dirty water settling ponds (9ML capacity) sufficient to treat contaminated water prior to discharge.

Another settling pond was constructed down slope of the decline portal for the pre-treatment of dirty water from the Delta Site. Sediment in runoff is settled out via the Final Sediment Sump and the decline settling pond prior to discharge into the large 9 ML settlings ponds.

7.2.1.4 Cooranbong Haul Road

Clean and dirty water are separated along the haul road. Clean water is diverted by drains away from the haul road. Dirty water from the haul road and batters, is captured and treated within six sediment basins constructed along the haul road. Dirty water contained within the sediment basins is required to meet specific water quality criteria prior to discharge.

7.2.2 Mine Water Management

7.2.2.1 Mandalong Mine

Water from the active underground mining area is pumped to a temporary settling area to reduce suspended solids. All water is then pumped to a goaf area (Cooranbong underground longwall void) in the north-west of the Cooranbong Entry Site. This void area has a significant storage capacity, and also acts as a primary settlement area for the removal of suspended solids. Dirty water from the Cooranbong Sediment Dams is also pumped or decanted via the existing infrastructure to the Cooranbong void to maintain low water levels in the surface dams.

Water in the Cooranbong void is then pumped to the surface through a borehole pump and overland to the Borehole Dam at the Cooranbong Entry Site. Water discharges via a surface pipeline directly to LDP001.

7.2.2.2 Delta Site

No mine water is discharged from the Delta Entry Site, as in-seam water from the Delta underground headings and decline tunnel is pumped to the existing Mandalong Mine water system.

7.3 GROUNDWATER MANAGEMENT

7.3.1.1 Mandalong Mine

An annual review of the groundwater monitoring results was undertaken by GHD titled “Centennial Mandalong Annual Groundwater Monitoring Review 2018” (GHD, 2019c). An extensive groundwater monitoring network has been developed at Mandalong Mine with monitoring undertaken on many of the bores since August 1997. This program has been established to provide timely warnings of deviations from natural or background levels, so that if necessary, remedial measures and/or management strategies can be put in place.

The network consists of standpipe monitoring bores installed in alluvial and fractured rock groundwater sources. Locations were monitored monthly for groundwater level and limited water quality parameters (electrical conductivity and pH).

Monitoring data for Mandalong South presented herein is limited to MSGW04 series, given their proximity to current mining of Longwalls 23, 24 and 24A during 2018. Two private bores, GW105311 and GW078043, were identified within 1 km of Longwalls 24 and 24A. On inspection, GW105311 was found to be blocked at 12.6 m below top of casing. GW078043 has been incorporated within the monitoring program since July 2017 (GHD, 2019c).

Details of the groundwater monitoring bores in the current groundwater monitoring program are summarised in **Table 43**. The location of the groundwater monitoring bores is shown in **Figure 21**.

Table 43: Groundwater Monitoring Bore Details

Bore	Monitoring Period	Lithology	Longwall Area
BH01	Aug 1997 – present	Alluvium	–
BH02A	Oct 2005 – present	Sandstone	LW3
BH03	Aug 1997 – present	Alluvium	–
BH03A	Nov 2005 – present	Alluvium	–
BH03B	Dec 2005 – present	Sandstone	–
BH04	Aug 1997 – present	Alluvium	–
BH05	Aug 1997 – present	Alluvium	–
BH06A	Nov 2005 – present	Sandstone	LW7

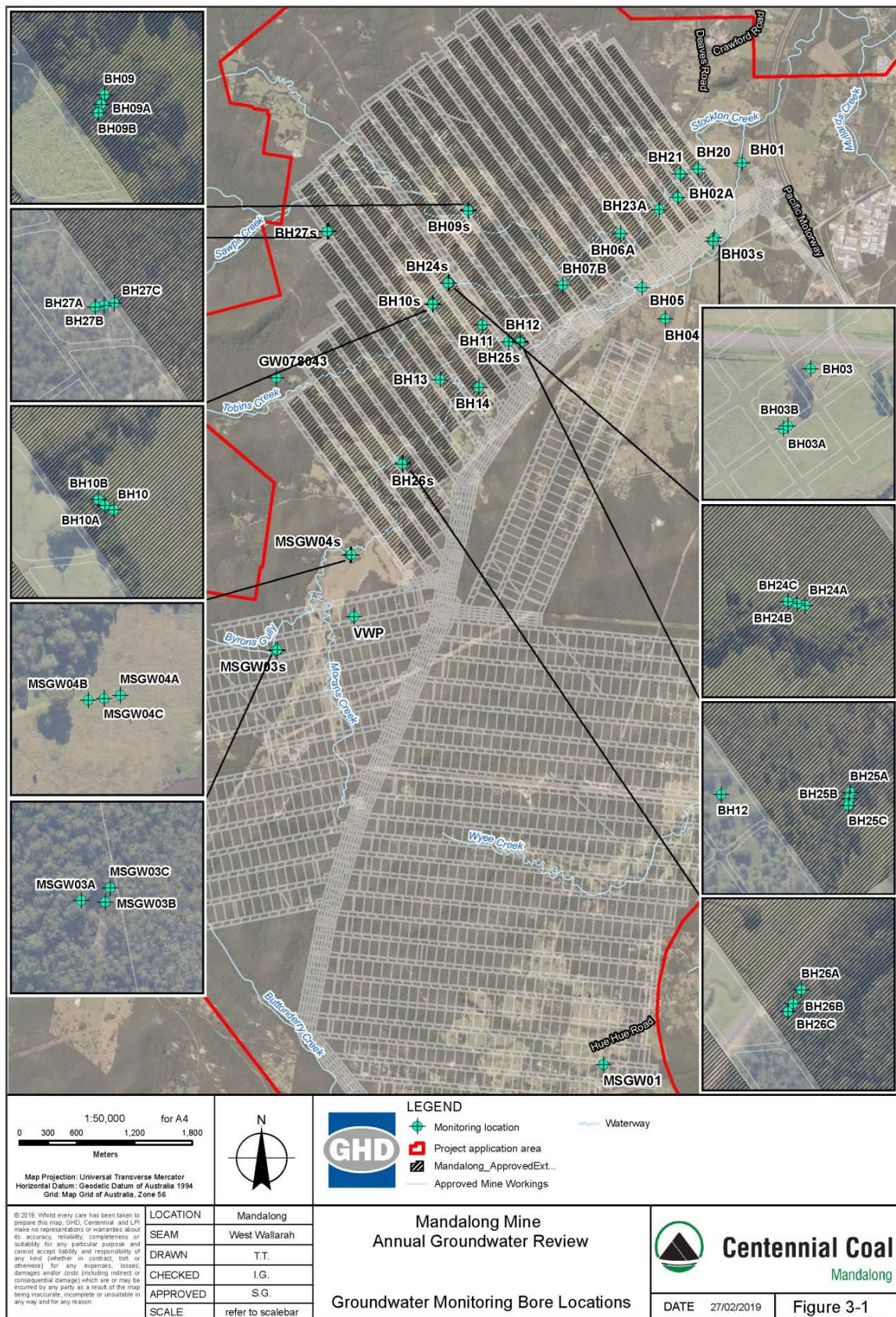
Bore	Monitoring Period	Lithology	Longwall Area
BH07B	Jan 2006 – present	Siltstone	LW10/11
BH09	Aug 1997 – present	Alluvium	LW12
BH09A	Jun 2010 – present	Mudstone/sandstone	LW12
BH09B	July 2010 – present	Mudstone/sandstone	LW12
BH10	Aug 1997 – present	Alluvium	LW16
BH10A	Jun 2010 – present	Mudstone/sandstone	LW16
BH10B	Jun 2010 – present	Sandstone	LW16
BH11	Aug 1997 – present	Alluvium	LW15
BH12	Aug 1997 – present	Alluvium	LW14/15
BH13	Aug 1997 – present	Alluvium	LW18
BH14	Aug 1997 – present	Alluvium	LW17
BH20	Dec 2003 – present	Conglomerate	LW1
BH21	Dec 2003 –present	Conglomerate	LW2
BH23A	Jan 2006 – present	Mudstone	LW4/5
BH24A	Jun 2010 – present	Alluvium	LW15
BH24B	Jun 2010 – present	Sandstone	LW15
BH24C	Jun 2010 – present	Mudstone/sandstone	LW15
BH25A	Jun 2010 – present	Alluvium	LW14
BH25B	Jun 2010 – present	Sandstone	LW14
BH25C	Jun 2010 – present	Mudstone/sandstone	LW14
BH26A	Oct 2011 – present	Alluvium	LW22

Bore	Monitoring Period	Lithology	Longwall Area
BH26B	Oct 2011 – present	Sandstone	LW22
BH26C	Oct 2011 – present (blocked at 35 m at Jan 2018)	Conglomerate	LW22
BH27A	Oct 2011 – present	Alluvium	LW18/19
BH27B	Oct 2011 – present	Sandstone	LW18/19
BH27C	Oct 2011 – present	Conglomerate	LW18/19
MSGW04A	Sept 2011 – present	Morans Creek alluvium	-
MSGW04B	Sept 2011 - present	Sandstone (Tuggerah)	-
MSGW04C	Sept 2011 – present	Conglomerate (Munmorah)	-
GW078043	August 2017 – present	Sandstone/Conglomerate	-

Source: (GHD, 2019c).

7.3.1.2 Delta Entry Site

Groundwater monitoring at the Delta site was finalised at the completion of construction in December 2005. No groundwater is discharged at the Delta site. The Delta underground workings are limited to two Maingate roadways therefore, inseam groundwater make is minimal and is pumped via the existing inseam dewatering system to the Cooranbong longwall void area and discharged via LDP001 at the Cooranbong Entry Site.



Source: (GHD, 2019c)

Figure 21: Mandalong Mine Groundwater Monitoring Locations.

7.3.2 Groundwater Levels

7.3.2.1 Alluvial Groundwater Sources

Groundwater levels fell after undermining at BH24A from approximately 16.8 m AHD in January 2014 to 14.8 m AHD in August 2014. Following this fall, groundwater levels have partially recovered to 15.5 m AHD in October 2018. HARTT analysis of post-August 2014 groundwater levels at BH24A indicates that the increasing trend in groundwater levels is independent of rainfall (GHD, 2019c).

The decreasing trend in groundwater level at BH25A is not completely attributable to mining. Post-mining groundwater levels have generally been within the observed range of pre-mining levels and continued to respond to Cumulative Rainfall Departure (CRD). Temporary, short-term variation in groundwater levels is evident following mining. The variation in groundwater levels at BH25A may be a result of the development of shallow tensile and compressive cracks resulting in localised increases in hydraulic conductivity and porosity. It is expected that such voids will fill over time and the hydraulic conductivity and porosity should return to pre-mining values. Supporting evidence has been observed at BH22A, and now also in the rising levels at BH24A (GHD, 2019c).

HARTT analysis was not undertaken for the data set at BH27A due to limited observed water level records (limited to four within 2012 only). BH27A has been dry post 2012 (GHD, 2019c).

Trigger values for alluvial groundwater levels have been defined in the WMP (GHD, 2018b). GHD (2019c) have completed a review of the trigger values and identified that trigger level exceedances occurred at four locations being BH11, BH12, BH13 and BH25A. At BH11 and BH13 exceedances are considered minor (<0.5 m) and temporary (occurring without an ongoing decreasing trend). Groundwater fluctuations in the alluvial monitoring bores BH11 and BH13 have occurred both prior to and after undermining and therefore are attributed to natural causes. It is recommended that the triggers values be updated to reflect the extended monitoring record and variation in climate (GHD, 2019c).

At BH12 and BH25A the magnitude of the exceedances is slightly greater (0.66 m and 0.56 m respectively). Additionally these trends appear to be occurring over a period of more than 12 months. The variation in groundwater levels at BH25A may be a result of the development of shallow tensile and compressive cracks resulting in localised increases in hydraulic conductivity and porosity. BH12 is located in close proximity to BH25A, and therefore the observed trend at BH12 is likely to be as a result of the same cause as at BH25A. The decreasing trends at BH25A and BH12 are also attributable to generally below average rainfall during 2017 and 2018 as evidenced by the decreasing CRD curve in the hydrographs. As the site has experienced below average rainfall over the period of decreasing trend, the exceedance of the trigger values are not considered attributable to mining related activities at this stage (GHD, 2019c).

7.3.2.2 Fractured and porous rock aquifers

At the time of the assessment completed by GHD (2019c), all deeper monitoring bores, with the exception of MSGW04B and MSGW04C, had been directly undermined by longwall panels. These bores are screened within Triassic sandstone and conglomerate.

Monitoring bores BH02A, BH03B, BH06A, BH07B, BH09A, BH09B, BH10A, BH10B, BH23A, BH24B, BH24C, BH25B, BH25C and BH27B are screened within the sandstone and siltstone of the Tuggerah Formation approximately 120 m to 230 m above the coal seam. A consistent drop in groundwater pressure at most of these locations (with the exception of BH07B and BH27B), has been observed post undermining. The gradual drop in groundwater

pressure suggests that discontinuous fractures have developed in the rock overlying the mine workings at these locations, consistent with EIS predictions (GHD, 2019c).

A number of these locations (including BH02A, BH03B, BH09A, BH09B and BH23A), have had levels re-stabilise to between 2 m AHD and -12 m AHD or have shown slight increases towards pre-mining levels three to five years post-undermining.

Monitoring bores BH20, BH21 and BH27C are screened within the Munmorah Conglomerate, underlying the sandstone of the Tuggerah Formation. All have recorded decreasing groundwater elevations over the monitoring period. Groundwater elevations at BH20 and BH21 initially dropped suddenly and have fluctuated between approximately -40 m AHD and -50 m AHD since. Groundwater levels at BH27C showed a decreasing pre-mining trend including a sudden drop in levels in November 2014 related to purging and sampling. BH27C was undermined in July 2015, resulting in the bore becoming dry. Continued monitoring at this location has been prevented due to shortening of the bore (originally 165 m BGL, now registering a depth of 125 m BGL). Most likely post-mining movement of the strata has caused damage to the bore. Movement of strata may explain the temporary increase in groundwater level at adjacent bore BH27B following undermining. The sources monitored by these bores are approximately 100 m to 170 m above the coal seam (GHD, 2019c).

7.3.3 Groundwater Quality

7.3.3.1 Alluvial Groundwater Sources

The GHD (2019c) review of alluvial groundwater quality indicates that at most alluvial bores the groundwater pH is consistently within the range of 5 to 8 and groundwater EC varies considerably within the alluvium across the mining area, ranging from less than 1,000 $\mu\text{S}/\text{cm}$ to over 10,000 $\mu\text{S}/\text{cm}$.

As discussed by AGE (2014), there is variability in groundwater EC at a number of alluvial monitoring bores at Mandalong Mine. As part of the Mandalong Mine Southern Extension Project response to submissions process it was identified that this variability in EC was attributable to sampling of bores by bailing without initial purging and surface water ingress (BH05 and BH13). Since January 2015, alluvial monitoring bores at Mandalong Mine have been sampled by low flow techniques where possible (i.e. peristaltic pump) with purging continuing until pH and EC parameters show stabilisation. Following the update of the groundwater monitoring methodology, variability in observed EC within individual location datasets has generally reduced. However, salinity between locations continues to range fresh to saline (GHD, 2019c).

Notable water quality trends for 2018 include:

- Elevated EC at BH03, BH12 and BH25A (with a gradual decreasing trend).
- Elevated EC at BH05 compared to 2013 to 2017 data, but similar to pre 2013 data.
- Rising EC at BH10.
- Continued decreasing pH at BH03 and BH12.
- Slight increasing trend in pH at BH13.

Site specific trigger values for groundwater quality are quantified in the LW24-24A Extraction Plan WMP (GHD, 2018b). The stage 1 EC trigger was exceeded for MSGW04A as follows:

- EC exceedance (three consecutive 80th percentile upper bound) at MSGW04A in July

EC exceedances in MSGW04A are within historical ranges and no developing trend of concern is observed (GHD, 2019c).

7.3.3.2 Fractured and porous rock groundwater sources

Rock aquifer groundwater is generally characterised by a pH range of 7 to 8 and an EC range of 6,000 to 10,000 $\mu\text{S}/\text{cm}$. The EC range was notably broader at locations BH03B,

BH07B, BH20 and BH21 during 2018. In addition to the high degree of temporal variability considerable spatial variability is also evident (GHD, 2019c). Post-review of 2018 results and historical trends, the following are of note:

- An overall decreasing pH trend at BH07B, EC has slightly increased at this location since 2013;
- An increasing EC trend at BH10A;
- High variability in both pH and EC at BH20 with seemingly increasing trends;
- Increasing trends and increasing variability in pH and EC at BH20 and BH21; and
- Increasing trend in pH at MSGW04B.
- Increasing pH at BH21 and increasing variability in EC.

Monitoring locations BH20 and BH21 are bailed on account of insufficient well volumes to allow other sampling methods. Water volumes are less than one bail, no purging is undertaken given the low recharge rates and therefore the samples are not considered representative of the aquifer (GHD, 2019c).

On 10 April 2018, Centennial Mandalong wrote to the Department of Planning and Environment (DPE) and Lands and Water to inform of exceedances of the Stage 2 electrical conductivity (EC) trigger as per the LW22-23 and LW24-24A Extraction Plan WMP for the groundwater monitoring location BH26B. A subsequent investigation completed by GHD concluded that the exceedances were largely the result of incorrect trigger values in the WMP. DPE recommended that the trigger values be revised. Centennial submitted a revised LW24-24A WMP on 26 November 2018.

There were no complaints from adjacent landholders regarding groundwater quality in 2018. Stage 1 pH and EC triggers were exceeded for BH26B and MSGW04B as follows:

- pH exceedance (three consecutive 80th percentile upper bound) at MSGW04B in July and October 2018;
- EC exceedance (three consecutive 80th percentile upper bound) at BH26B in January, April, July and October 2018.
- EC exceedance (100th percentile upper bound) at BH26B in January 2018.

pH levels in MSGW04B have shown evidence of a rising trend beginning in 2013 (before potential mining impacts) but should continue to be observed in future. EC in BH26B has shown increased variability in 2017 but was gradually decreasing during 2018 (GHD, 2019c).

During 2018 EC at BH26B was elevated but remained within the historical range of values. An investigation report provided in response to Lands and Water's request for an update on EC in BH26B concluded that the EC observed at BH26B during 2018 is within the range of historical variability. Therefore natural variability is a more likely reason for the above average EC, since the groundwater model predicts no drawdown at BH26B due to mining. For this reason, the trigger exceedances are not considered to warrant action beyond continued monitoring (GHD, 2019c).

8 REHABILITATION

The Rehabilitation Management Plan / Mining Operations Plan (MOP) was prepared in 2016 for the period 1 December 2016 to 30 November 2023 in accordance with SSD-5144 Schedule 3 Condition 33. The MOP was approved by DRG on 29 November 2016 and by DPE on 2 February 2017.

A MOP amendment (Amendment A) was prepared following the approval of a modification (MOD 4) to SSD-5144 in 2017. The MOP Amendment A was approved by DRG on 12 April 2017 and by DPE on 23 June 2017.

A MOP amendment (Amendment B) was prepared following the approval of a modification (MOD 5) to SSD-5144 in August 2017. The MOP Amendment B was approved by DRG on 6 March 2018 and by DPE on 10 April 2018.

As described in the MOP, the conceptual long term mine rehabilitation objective is to provide a low maintenance, geotechnically stable and safe landform. Specific conceptual long-term objectives include:

- Prevent public access to former underground workings;
- Re-establishing land disturbed by the operations of Centennial Mandalong to an appropriate final land use;
- Provide habitat for fauna and corridors for fauna movement within the final landform;
- Monitor rehabilitation success in terms of physical and biological parameters;
- Relinquishment of the surface leases as rehabilitation objectives are achieved; and
- Compliance with appropriate Centennial and regulatory policies and guidelines.

Post mining land use options for the Mandalong Mine (MMAS and MSSS) were assessed in the *Mandalong Southern Extension Project Decommissioning and Rehabilitation Strategy* (SLR, 2013) which was prepared for the Mandalong Southern Extension Project EIS. Post mining land use options for the CES were assessed in the *Northern Coal Logistics Project Decommissioning and Rehabilitation* (SLR, 2014) which was prepared for the Northern Coal Logistics Project EIS.

It is intended to re-develop the MMAS and the CES for an industrial based land use(s). The option of leaving this infrastructure in the final landform will be discussed in consultation with DRE and after discussions with potential buyers have been held.

The intended post-mining land use for the MSSS is native bushland commensurate with the pre-mining conditions.

Post-mining land use for the Delta Entry Site will be addressed in consultation with Delta Electricity with the intended post-mining land use being native bushland commensurate with the pre-mining conditions.

As Mandalong is an underground mine, the majority of the MOP Area will not be disturbed. The exception to this might be areas impacted by subsidence which will be addressed and managed on an ongoing basis through the approved SMP or Extraction Plan. As there will be limited disturbance, the pre-mining land use(s) will not be significantly impacted and therefore the post-mining land use(s) will be consistent with pre-mining conditions.

Table 44: Rehabilitation and Disturbance Rates during the MOP Term

Year	Total Disturbance Area (ha)	Total Rehabilitation Area (ha)	Cumulative Rehabilitation Area (ha)
Start of MOP*	33.4	2.7	200.9
2017	13.2 (11.3 actual for MSSS in 2017).	0	200.9
2018	6.8 (0 actual for 2018).	0	200.9
2019	0	0	200.9
2020	0	0	200.9
2021	0	0	200.9
2022	0	0	200.9
2023	0	0	200.9
End of MOP*	53.4	2.7	200.9

Note: Start of MOP is 1 December 2016 and end of MOP is 30 November 2023. Cumulative rehabilitation area includes the Biodiversity Offset Area to the north and east of the Mandalong Mine Access Site ventilation and gas management facilities and the MSSS and TL24 offset areas.

8.1 PROGRESSIVE REHABILITATION AND COMPLETION

Since the Mandalong Mine is an underground mine, the relatively small disturbance footprint associated with surface infrastructure means that there are limited opportunities for progressive rehabilitation. To what extent is appropriate, rehabilitation will be undertaken progressively on areas that cease to be used for mining or mining related activities as soon as is reasonably practicable.

Rehabilitation activities forecast for the current MOP term (2016-2023) include:

- Rehabilitation of areas disturbed during the construction of the MSSS and access road;
- Progressive rehabilitation of exploration and/or groundwater monitoring sites;
- Rehabilitation of areas affected by subsidence, as required, in accordance with an approved SMP or Extraction Plan;
- Maintenance and monitoring of the VAM-RAB offset area which was established in 2012 at the Mandalong Mine;
- Maintenance and monitoring of the MSSS and TL24 offset areas; and
- Maintenance and monitoring of areas of existing rehabilitation.

Following the construction of the relocated TL24 transmission line and demolition of the redundant section, disturbance around the new and redundant tower sites and any temporary access tracks established to the redundant tower sites will be rehabilitated in accordance with TransGrid's rehabilitation objectives and in consultation with landholders. The new towers, easement and access tracks will remain in place to allow TransGrid to operate and maintain the transmission line.

TransGrid will be responsible for extinguishing the redundant easement in consultation with relevant stakeholders.

8.2 MANDALONG MINE REHABILITATION

The majority of Mandalong Mine Access Site has been rehabilitated following the completion of construction activities in 2005. Rehabilitated sections of the Mine's surface area are well established and have provided vegetation cover to effectively minimise the potential for erosion.

Centennial Mandalong received approval in 2011 (DA97/800 Modification 7) for the trial installation of a ventilation air methane regenerative afterburner unit (VAM-RAB) that would remove and breakdown the exhaust methane. Installation of the VAM-RAB unit in 2012 necessitated clearing of some native vegetation. Two endangered ecological communities (EEC) listed in Schedule 3 of the NSW Threatened Species Conservation Act 1995 were included in the areas to be cleared. These were: Swamp Sclerophyll Forest (SSF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and River-Flat Eucalypt Forest (RFEF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

DA97/800 Condition 76A included a requirement for a 1.25 hectare rehabilitation off-set area to be established on cleared land adjoining the VAM-RAB construction site. These EEC were represented by communities described in the regional vegetation mapping and classification (NPWS 2000) as: MU37 Swamp Mahogany Paperbark Forest (SSF); and MU38 Redgum – Rough-barked Apple Swamp Forest (RFEF).

An ecology survey (Hunter Eco, 2011) prepared for the VAM-RAB project application described the area to be rehabilitated as mostly dominated by weeds. This being the case, active regeneration was required and this was commenced in January 2012. Further to the requirement to rehabilitate, DA97/800 Condition 76A also requires that the progress of the rehabilitation be monitored annually for five years. This monitoring was conducted by Hunter Eco in December 2018 and is described in **Section 6.4.4** of the Annual Review.

8.2.1 Longwall Mining Area

The surface areas above the completed longwall mining panels are inspected as per the schedules prescribed in the LW22-23 and LW24-24A Extraction Plan Water Management Plans (WMP). The LW22-23 and the LW24-24A Extraction Plan WMPs require that the floodpaths are to be inspected every six months or after a flood event (refer to **Appendix 2**). During the course of these inspections observations are made on the progress of remedial measures implemented to minimise subsidence related effects (refer **Table 33**).

An update on ponding remediation completed in 2018 is provided in **Table 33**.

8.2.2 Exploration Sites

Five surface exploration drill sites were prepared in 2018. The sites were located on private property and were rehabilitated following the sealing of the borehole. Existing tracks were utilised to gain access to the exploration drill site where possible and required no vegetation clearing. The sites were seeded with sterile grass species to stabilise the drill site following the re-instatement of the land surface. Landholder sign-off was received for rehabilitated sites on private property.

Ongoing rehabilitation of exploration sites will be conducted in 2019 and reported in the Annual Review.

8.2.3 Delta Entry Site

Construction of the Delta coal clearance system was largely completed in 2005 and rehabilitation of the site was completed in 2006. Rehabilitation at the Delta Entry Site was inspected in 2018 to assess the effectiveness of the works to stabilise disturbed areas onsite. The direct seeding rehabilitation methods used have been successful in establishing a substantial area of the site with pasture and tree groundcover. Ground cover on the direct tree seeded areas is approximately ninety percent similar to those recorded in 2017. Ninety-

five percent ground cover has been achieved in rehabilitated pasture seeded areas. The area is slashed to maintain access to infrastructure and as part of the asset protection zone.

8.2.4 Cooranbong Entry Site

A total of 3.9 hectares have been disturbed from the construction of the upgrades to the CHP and haul road at the Cooranbong Entry Site in 2009. Construction activities were completed in May 2010 with all disturbed areas rehabilitated by the Contractor shortly after. No further rehabilitation works were undertaken in 2018.

8.2.5 Cooranbong Haul Road

The haul road construction resulted in approximately 18 hectares of disturbance. Of this 3.9 hectares of disturbed land associated with the CHP upgrades (stockpile and conveyor) and haul road are located on Mandalong Mine's Mining Lease. 1.25 hectares of disturbed area not occupied with haul road and CHP infrastructure was rehabilitated in 2010. The remaining areas are located on the Newstan Colliery Mining Lease CCL764. Of this, nine hectares along the haul road was rehabilitated in 2009. Six hectares of land will not be rehabilitated as it is occupied by the haul road infrastructure.

As per the requirement of the Mandalong Haul Road Landscape and Rehabilitation Plan, the Mandalong Environment & Community Coordinator audited the rehabilitation on the haul road in October 2018. The audit assessment required the following issues be addressed: -

- *An assessment of surface and slope stability.*
- *Properties of the soil or root zone media (such as chemistry, fertility and water relations).*
- *Plant community structural attributes (such as cover, woody species, density and height).*
- *Plant community composition (such as presence of desirable species, weeds).*
- *Selected indicators of ecosystem functioning analysis (such as soil microbial biomass).*

The 2018 audit focused on identifying sites where remedial action or maintenance is required to bring sites to an acceptable standard. The inspection strategy involved one person inspecting the full length of the Haul Road to access 100% of the disturbed area.

In total six sites were inspected and recorded an action priority from highest to lowest. The highest priorities included maintenance of sediment and erosion controls along the Haul Road drains and at the dam inlets.

The audit provides a useful assessment of baseline rehabilitation completed to date on the haul road following the completion of all construction activities in 2011. In general rehabilitated sections of the haul road are well established and continued growth occurred in 2018. Maintenance and effectiveness of the haul road rehabilitation will be assessed in 2019 and reported in the next Annual Review.

8.2.6 Mandalong South Surface Site

The construction of the access road for the MSSS was completed in 2018. The clearing of the MSSS was completed in 2018, with shaft sinking commencing in late 2018. The construction of the access road and clearing of the MSSS resulted in approximately 11.3 hectares of disturbance.

The areas disturbed by the construction of the access road were stabilised in 2018 with the application of hydro-mulch and bark-blower mulch / seed which was applied to the road batters. Hydro-mulch and bark-blower mulch was also applied to the batters of the MSSS in 2018.

The weekly environmental construction inspection procedure (WP-7154) has been updated to include the rehabilitation areas around the access road and MSSS. The monitoring procedure includes a requirement for an assessment of new or increased erosion (including batters), growth improvement, weeds and remedial work if required.

A review of stockpile locations was completed with the main stockpile established to the north-west of the MSSS in 2018. The batters of the main MSSS stockpile have been covered with mulch as no topsoil was available. VENM testing was completed and 7500m³ of material from the stockpile was transported to Newstan as described in the MSEP EIS (SLR, 2013). The weekly environmental construction inspection procedure (WP-7154) also includes a requirement to review erosion and sediment control issues associated with the MSSS, the access road and the main stockpile area.

In general, rehabilitated sections adjacent to the access road and MSSS have established well. Maintenance and effectiveness of the rehabilitation will be assessed in 2019 and reported in the next Annual Review.

8.3 BUILDINGS

8.3.1 Mandalong Mine

No buildings or infrastructure were removed or decommissioned in 2018.

8.3.2 Delta Entry Site

All buildings at the Delta Entry Site are associated with the coal conveying system and as such are a permanent fixture. The buildings associated with the construction of the site were decommissioned and removed prior to the site being rehabilitated in 2006. No decommissioning of buildings occurred at the Delta Entry Site in 2018 and as such no rehabilitation of buildings was undertaken.

New portable buildings were installed in 2018 at the Delta Entry Site which included office and lunchroom facilities.

8.3.3 Cooranbong Entry Site

To ensure continuation of coal handling operations and mine support infrastructure, surface buildings and mine related infrastructure have been retained at the Cooranbong Entry Site. The Cooranbong Entry Site, CHP and supporting infrastructure were used in 2018 to supply coal to the Eraring Power Station and to Newstan.

No buildings or infrastructure at the Cooranbong Entry Site were removed or decommissioned in 2018.

8.4 REHABILITATION TRIALS AND RESEARCH

8.4.1 Use of Analogue Sites

Data from analogue rehabilitation sites is an integral part of the monitoring procedure throughout the monitoring process. The purpose of analogue sites is to provide a reference against which to document the progress of rehabilitation towards reaching ecosystem health, structure and composition consistent with undisturbed areas.

During the MOP term (2016 - 2023) in 2020, Centennial Mandalong will engage a suitably qualified person to select and monitor analogue sites to assess whether they are suitable in the context of the proposed final land use and to suggest the species that will be appropriate for revegetation.

Analogue sites are proposed with undisturbed areas in the vicinity of the proposed Mandalong South Surface Site (MSSS) and the Delta Entry Site corresponding with the intended post mining land use of native bushland, commensurate with pre-mining conditions.

The majority of the Mandalong Mine Access Site and the Cooranbong Entry Site are proposed to be retained as infrastructure and therefore no reference monitoring in the vicinity is deemed necessary.

Specific analogue sites will be selected based on the following general criteria:

- Contain vegetation types similar to the rehabilitation sites;
- Secure from future mining related disturbance; and
- Contain vegetation and conditions suitable as a basis for rehabilitation performance criteria.

The monitoring results from analogue sites will provide the basis for comparison to measure the success of the rehabilitation against the relevant closure criteria. Results of analogue site monitoring will be reported in future Annual Reviews.

8.4.2 Mandalong Mine VAM-RAB Offset Area

Refer to **Section 6.4.4** of the Annual Review for details on the Mandalong Mine VAM-RAB Offset Area.

8.4.3 Land Management Strategy for the MSSS and TL24 Offset Areas

Refer to **Section 6.4.2** of the Annual Review for details on the Mandalong Mine Land Management Strategy for the MSSS and TL24 Offset Areas.

8.4.4 Moran's Creek Rehabilitation Trial

During consultation with local landowners, concerns were raised regarding historical land management practices which have resulted in extensive clearing of native vegetation and severe erosion of creek banks and drainage lines across the Mandalong Valley. The Moran's Creek rehabilitation trial was initiated in 2007 to respond to local landowner concerns in particular the historical erosion on Morans Creek caused by flood flows and stock accessing creek areas. Local landowner's cited evidence that excavation of the creek in the 1950's caused the creek to widen as a result of the creek banks eroding.

In November 2007 a trial commenced to rehabilitate a section of Morans Creek on a Centennial owned property. The objective of the trial is to assess the effectiveness of direct seeding and tube stock planting to re-establish a native vegetation community on a degraded section of Moran's Creek.

Direct seeding of the trial area commenced in January 2008 with annual inspections since 2011 concluding that the direct seeding method has been successful in establishing tree cover over the majority of the area. Juvenile species including *Eucalyptus tereticornis*, *E. robusta* and *Casuarina glauca* have successfully established on the trial area. The trial direct seeding area has been largely successful in re-establishing the native vegetation found along Morans Creek. Further weed spraying was conducted in 2016 to control Tobacco weed (*Elephantopus mollis*), Scotch Thistle (*Onopordum acanthium*) and Blackberry (*Rubus fruticosus*).

The 2,000 tube stock planted in November 2008 along the fenced Morans Creek rehabilitation corridor are now established along Moran's Creek with trees heights of up to 4 to 5 m. The rehabilitation site is a reference site for the Catchment Management Authority (CMA) vegetation monitoring report. The monitoring has recorded the baseline vegetation conditions and will evaluate the rehabilitation measures implemented at Moran's Creek.

A Macquarie University Research Project was completed in November 2013 titled "*How has the Water Quality of Morans Creek Changed Since Rehabilitation?*" A variety of methods were employed in order to answer the questions regarding the health of Morans Creek, including water quality sampling and counting of macroinvertebrates. The study concluded that:

- Riparian vegetation and bank stability had increased at the rehabilitation site; and
- Banks remain unstable and riparian zones small if they exist at all within the fences area beyond the rehabilitation site.

9 COMMUNITY CONSULTATION

Mandalong Mine consults with the community through forums such as, the Mandalong Mine Community Consultative Committee and community organised events.

Meetings of the Mandalong Mine Community Consultative Committee (CCC) were held in February, June and October 2018. Representatives of the Mandalong community, a Dora Creek community representative, appointed community representatives; relevant government organisations and company representatives attended the meetings. A detailed presentation was provided to attendees at each CCC meeting on the Mine's production, geological update, subsidence results, environmental monitoring, Extraction Plan update, upcoming projects and sponsorship.

Additional agenda items discussed in 2018 included the Mandalong South Extension Project, MSSS construction and traffic management, MSSS shaft drilling, TL24 Relocation Project, Ausgrid 33Kv Extension Project, the Mine's exploration drilling program and Centennial's land management programs.

9.1 EXTRACTION PLAN CONSULTATION

Extensive community consultation with landowners in the Mandalong mining area is undertaken for the purpose of monitoring and assessing subsidence effects on private properties. In general, the Mandalong Mine community consultation has included:

- Community consultation in line with the Stakeholder Engagement Strategy;
- Individual landowner notification and consultation associated with the implementation of Extraction Plan LW22-23, Extraction Plan LW24-24A and development of Extraction Plan LW25-31 and their associated PSMP's;
- Consultation and general communication with all relevant government agencies and infrastructure owners during the implementation of the Extraction Plan LW22-23 and Extraction Plan LW24-24A, as well as the development of Extraction Plan LW25-31;
- Individual landowner consultation and implementation of PSMPs during mining of Longwalls 22 to 24A;
- Individual landowner consultation for rehabilitation of remnant ponding and subsidence related repairs to property;
- Three meetings of the Mandalong Mine Community Consultative Committee (MMCCC) chaired by Margaret MacDonald-Hill delivered updates on the status of Development Consent modifications, Extraction Plan approvals, Mining Operations Plan, subsidence monitoring and subsidence management on Centennial property, private property and public infrastructure.
- The MMCCC attended two site inspections of the Mandalong South Surface Site during construction;
- Ongoing consultation with relevant stakeholders on the development and implementation of Infrastructure Management Plans including Public Roads (LMCC), powerlines (Ausgrid), communication lines (Telstra) and high voltage transmission lines (TransGrid);
- One month mining notifications were provided to landowners prior to mining beneath their property, with follow-up meetings and inspections undertaken; and
- Six-monthly Reports were prepared and provided to DRE, DPE, CCC and stakeholders in April 2018 and October 2018 as required by the Extraction Plans for LW22-23 and LW24-24A.

9.2 COMMUNITY SPONSORSHIP

The Mandalong Mine continues to support the local community through various sponsorship avenues to the following community activities, groups and associations in 2018 –

- Sponsorship of Morisset Agricultural Society Show held in February 2018;
- St. John Vianney Morisset School end of year awards presentations;
- Support provided for local community service - Cooranbong Pre-school;
- Lake Macquarie Heritage College Spring Fair & Fun Day;
- LMCC 2018 School Environment Awards;
- Mandalong Community Association;
- 2018 Morisset Country Club Pro-Am Event;
- Wangi Wangi Fire Station; and
- Emerald Park Equine Drought Support;
- Wyee Public School Fete;
- Mindaribba Warriors Rugby League Team;
- Morisset Public School Raffle;
- Mandalong Chicken Rescue;
- Wallsend Hockey Club;
- Wyee Rural Fire Service;
- Newcastle Variety Bash;
- Morisset United Soccer Club;
- Morisset Rotary Golf Day;
- Cooranbong Markets;
- PCYC Morisset Film Making Workshop;
- Mandalong Stock Feeds – Chris O'Brien Lifehouse; and
- Watagan Mountains Campdraft Event.

9.3 COMMUNITY COMPLAINTS

One complaint was received by Centennial Mandalong from the community during the period January 2018 to December 2018, as described in **Table 45**.

Table 45: 2018 Community Complaint Details.

Mandalong Complaint Log Number	Date Complaint Logged	Type of Complaint	Comments
4/2018/ccapp 1000428	13/2/2018	A complaint was received from a Mandalong resident stating that a heavy vehicle involved with Centennial operations had interacted with the school bus on Mandalong Road on 8/2/18 at 7.50am.	Install variable message board on Mandalong Road notifying operators of school bus hours. Contractor re-inducted all drivers. Induction form updated. Update Contractor CEMP to include CTMP requirements.

One community complaint was received in 2018, showing a decrease in complaints compared with the previous reporting period, as detailed in **Table 46**.

Table 46: Record of annual community complaints for 2017 & 2018

Community Complaints						
Year	Air	Water	Noise	Waste	Other	Total
2017	0	0	0	0	3	3
2018	0	0	0	0	1	1

Figure 22 shows a general decrease in the number of community complaints received since 2011 with only one complaint received in 2013, 2014 and 2015. There has been a slight increase in complaints received since 2015 with two complaints in 2016 and three in 2017. 2018 has seen a decrease in complaints with one complaint down from three in the previous year. Since 2011 no community complaints have been received regarding air quality or waste.

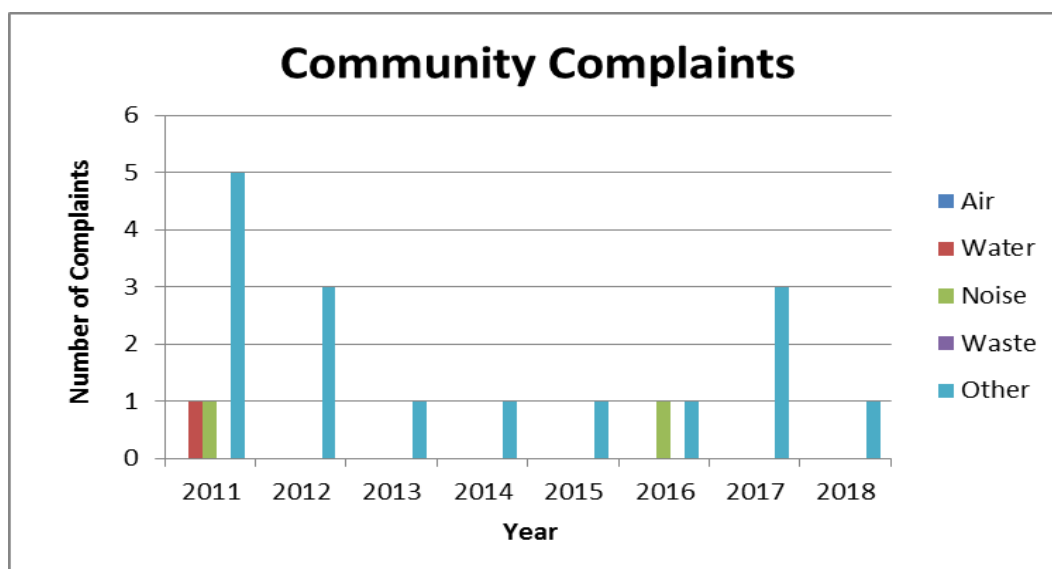


Figure 22: Annual Community Complaints

10 INDEPENDENT ENVIRONMENTAL AUDIT

An Independent Environmental Audit (MCW Environmental, 2016) of the Mandalong's operations was completed by MCW Environmental in July 2016. The audit report is publically available on the Centennial Mandalong website, and a copy was provided to CCC members and the DPE in July 2016.

The Mandalong Mine action plan prepared in response to the non-compliances and recommendations listed in the 2016 Independent Environmental Audit was provided to DPE in July 2016 and an updated version is included in **Appendix 3**.

The next Independent Environmental Audit of the Mandalong Mine operations in accordance with SSD-5144 Schedule 6 Condition 13 and DA97/800 (MOD10) Condition 108 is required to be commissioned prior to March 31, 2019. The audit was organised to commence on 4 March 2019.

11 NON-COMPLIANCES DURING THE REPORTING PERIOD

Table 47: Non-Compliance 1

Nature of the incident/non-compliance	Water was recorded discharging from the Mandalong South Surface Site (MSSS) Sediment Basin. The discharge continued until approximately 1.00 am on Tuesday 27 February 2018. The overflow from the MSSS Sediment Basin was into an ephemeral tributary of Morans Creek.
Date of incident / non-compliance (if known; if not known state not known)	6:50am Monday 26 February 2018.
The location of the incident/non-compliance (include a figure if appropriate), if known	The Mandalong South Surface Site is located at 803 Mandalong Road, Mandalong NSW. The land is owned by Centennial Fassifern Pty Ltd.
Detail the cause of the incident/non-compliance	<p>The construction of the MSSS Sediment Dam was completed by Daracon on 25 January 2018. On Tuesday 20 February 2018 a 42.1mm rainfall event (recorded at the MSSS rain gauge) between 3.00 am – 12.45 pm filled the MSSS Sediment Basin to approximately 60% of its 1.3 ML capacity. The Sediment Basin was empty prior to this event.</p> <p>A diesel pump was delivered to the MSSS on the evening of Tuesday 20 February 2018. On Wednesday 21 February 2018, irrigation pipe was installed at the MSSS and pumping from the Sediment Basin commenced on the afternoon of Thursday 22 February and continued intermittently until Sunday 25 February 2018. Prior to the 25-26 February rainfall event the water level within the MSSS Sediment Basin was at approximately 50% of its 1.3ML capacity.</p> <p>The 78mm rainfall event between 3.00 pm on Sunday 25 February 2018 and 5pm on Monday 26 February 2018 resulted in the discharge event from the MSSS Sediment Basin.</p> <p>Notifications of the incident were made in accordance with the PIRMP via phone on 26 February 2018 to the EPA at 7.29am, the DPE at 8.05am and to DRG at 8.08am. A written notification was provided to the EPA, DPE and DRG on 5 March 2018.</p>
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/non-compliance	<p>Flocculent dosing was undertaken to reduce the suspended solids loads in flows to the MSSS Sediment Basin at 8.30am.</p> <p>Suction tanker truck commenced removal of water from MSSS Sediment Basin (via Gross Pollutant Trap). Suction tanker truck removed 110,000 litres from site between 7.15 pm on 26/2 and 3.15 am on 27/2.</p>

<p>Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance</p>	<p>The following preventative actions were undertaken-</p> <ul style="list-style-type: none"> • Install irrigation system at MSSS. • Install evaporators at the MSSS. • Increase the capacity of the sediment basin. • Installed level monitoring in sediment basin. • Apply to have a discharge point added to EPL365 for the MSSS Sediment Basin. • Review long-term water management for the site.
--	---

12 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Table 48: Forecast Operations for 2019

Centennial Mandalong
Implement Environmental Management Plans required by SSD-5144. Implement LW25-31 Extraction Plan Management Plans Commence LW32-37 Extraction Plan and baseline monitoring.
Mandalong Mine Access Site
Commence construction of Gas Engines.
Cooranbong Entry Site
Nil major targets for 2019.
Delta Entry Site
Nil major targets for 2019.
Mandalong South Surface Site
Continue construction of the Mandalong South Surface Site and continue shaft sinking. Commence construction of 33kV power supply to MSSS (pending approvals).

13 REFERENCES

- Centennial Mandalong. (2018). *Annual Review 2017*.
- Centennial Mandalong. (2019). *Floodpath Condition Report 2018*.
- GHD. (2018a). *Mandalong Mine 2017 Water Balance*.
- GHD. (2018b). *Longwalls 24-24A Extraction Plan - Water Management Plan*.
- GHD. (2018c). *2018 Annual Compliance Noise Monitoring*.
- GHD. (2019a). *Mandalong Mine 2018 Water Balance*.
- GHD. (2019b). *Muddy Lake Green & Golden Bell Frog Monitoring - Summer 2018/19 Monitoring Report*.
- GHD. (2019c). *Centennial Mandalong Annual Groundwater Monitoring Review*.
- GSS Environmental. (2012). *Cooranbong Distribution Project Environmental Assessment*.
- Hunter Eco. (2011). *Mandalong Mine Ventilation Air Methane Abatement Demonstration Project - Ecology Report*.
- Hunter Eco. (2017). *VAM-RAB Site Vegetation Rehabilitation Monitoring Year 5 Mandalong Mine December 2017*.
- Hunter Eco. (2018). *VAM-RAB Site Vegetation Rehabilitation Monitoring Year 6 Mandalong Mine December 2018*.
- MCW Environmental. (2016). *Independent Environmental Audit - Mandalong Mine & Mandalong South Extension Project*.
- RPS. (2016). *Heritage Management Plan - Extraction Plan Longwalls 22 to 23*.
- RPS. (2017a). *Aboriginal Grinding Groove 45-3-3454 - Baseline Recording & Post Mining Inspections*.
- RPS. (2017b). *Archival Recording - Landing Skid 2 Mandalong South*.
- RPS. (2018a). *Phase 3 Secondary Post Mining Check - AHIMS 45-3-3446 & AHIMS 45-3-3538*.
- RPS. (2018b). *Heritage Management Plan for LW25-31 Extraction Plan*.
- RPS. (2018c). *2017 Annual Ecological Monitoring Report: LW22-24A*.
- RPS. (2019a). *2018 Annual Ecological Monitoring Report for LW22-24A*.
- RPS. (2019b). *2018 Aquatic Ecology Monitoring Report for LW22-24A*.
- Seedsman Geotechnics. (2018a). *Centennial Mandalong Review of Subsidence - LW23, MAND18-03*.
- Seedsman Geotechnics. (2018b). *Centennial Mandalong Review of Subsidence - LW24, MAND18-09*.
- Seedsman Geotechnics. (2019). *Centennial Mandalong Review of Subsidence - LW24A, MAND19-01*.
- SLR. (2013). *Mandalong Southern Extension Project EIS*.
- SLR. (2014). *Northern Coal Logistics Project EIS*.
- Umwelt. (1997). *Cooranbong Colliery Life Extension Project Environmental Impact Statement*. Umwelt (Australia) Pty Ltd.
- Umwelt. (2004). *Delta Link Project - Statement of Environmental Effects*.

