Centennial Coal

NSW DEPARTMENT OF PLANNING & INFRASTRUCTURE

ANNUAL ENVIRONMENTAL MANAGEMENT REPORT 2013

Centennial Mandalong Mine

For the period 1 January 2013 to 31 December 2013

Centennial Coal Environment Matters

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	J. Trotter	DRE	1	
	R. Bath	OEH	1	

Abbreviations		
	AEMR	Annual Environmental Management Report
	ANZECC	Australia and New Zealand Environment and Conservation Council
	Co2-eT	Emissions in CO2 equivalent tonnes
	Coal Handling Plant	CHP
	CO2	Carbon Dioxide
	CH4	Methane
	NOW	NSW Office of Water (NOW) (formerly the Department of Environment, Climate Change and Water)

	DP&I	Department of Planning & Infrastructure (formerly, DIPNR, DLWC and PNSW)
	DRE	NSW Department of Trade and Investment – Division of Resources and Energy (DRE) (formerly Industry and Investment)
	EIS	Environmental Impact Statement
	EPA	Environmental Protection Authority (formerly Climate Change and Water)
	EPL	Environmental Protection Licence
	EC	Electrical Conductivity
	GHG	Greenhouse Gas
	LMCC	Lake Macquarie City Council
	MMCCC	Mandalong Mine Community Consultative Committee
	MSB	Mine Subsidence Board
	MOP	Mining Operations Plan
	NPWS	National Parks and Wildlife Service
	NOW	NSW Office of Water (formerly Department of Water and Energy, DNR and DLWC)
	OEH	Office of Environment & Heritage
	PPV	Peak Particle Velocity
	SMP	Subsidence Management Plan
	SSR	Safe Serviceable and Repairable
	SEE	Statement of Environmental Effects
	UMEMP	Underground Mining Environmental Management Plan

1 INTRODUCTION

1.1 OVERVIEW

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 Powercoal including Mandalong in August 2002. Centennial was subsequently purchased by Banpu Public Company Limited ("Banpu") in October 2010.

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

- The Mandalong Mine underground workings including a longwall panel and development units and surface infrastructure near Morisset;
- The Cooranbong Services Site underground workings and surface infrastructure of the Cooranbong Entry Site, near Dora Creek; and
- The Delta Entry Site, which encompasses an entry and coal delivery system, near Wyee at the Vales Point Rail Unloader Facility.

Mandalong Mine is a modern underground longwall operation located in the Lake Macquarie area near Morisset west of the M1 Motorway. The Mine is situated approximately 130 km north of Sydney suppling coal to the domestic power and export market. The Mandalong Mine was proposed by Powercoal Pty Ltd after an extensive exploration program. An Environmental Impact Statement (EIS) was submitted in 1997 and a Commission of Inquiry (CoI) held in 1998. The Mine was granted development consent ("consent") DA 97/800, in October 1998. After obtaining consent, Centennial constructed 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 six million tonnes per annum of coal from the West Wallarah Seam using the longwall mining method.

Development consent DA 35/2/2004 granted in July 2004 by the NSW DP&I 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 (refer to Section 2.3 Construction). The Cooranbong Service Site and Delta Service Site contain coal handling infrastructure, enabling the Mine to process and convey as permitted by their respective development consents up to eight million tonnes of coal per annum. These sites are maintained under current mine leases as referred to Section 1.4.

1.2 SCOPE

This Annual Environmental Management Report (AEMR) details the progress of environmental management covering Mandalong, Cooranbong Services Site and Delta Entry Site collectively, for the period 1 January 2013 to 31 December 2013. The AEMR has been prepared in accordance with the Mandalong Mine conditions of consent as detailed in Section 1.5 below.

1.3 SUMMARY OF WORKS

Mandalong Mine

The majority of construction activities at the Mandalong Mine were completed by the end of 2004 in preparation for the workforce relocating from Cooranbong Colliery. In November 2004 Mandalong Mine became an operating mine site with personnel accessing the Mandalong underground workings via the decline tunnel. Completed facilities at the Mandalong Mine Site (refer to plan MG10069) include:

- Surface to underground decline (1 in 8 gradient – 1400 metres in length);
- Bathhouse and Administration buildings;
- Store Warehouse;
- Diesel Refuelling Station and Storage Shed;

- Machinery Washdown Bay;
- Mechanical Workshop;
- Equipment and materials storage areas;
- Fire Fighting and Emergency Equipment Store;
- Compressor Shed;
- Electrical Sub-Station;
- Mine Fan;
- Methane Gas Drainage Plant;
- Gas Flares;
- VAM-RAB Facility;
- Solcenic Mixing Plant; and
- Waste sorting area.

Construction of the VAM-RAB facility adjacent to the Mine's ventilation fan was completed in 2013. Civil works for construction of the gas flares was also completed in 2013, with automated operations also commencing in 2013. Further details on both the VAM-RAB facility and the gas flares are provided in Section 5.7 of the AEMR.

Delta Entry Site

The Delta entry site consists of the Delta Coal Clearance System and decline tunnel. The Delta coal clearance system conveys coal from the underground mining areas by a 4.5 km long underground conveyor within the coal seam. Coal is then conveyed up the decline tunnel, to the surface at the Delta entry site. At the surface coal is transported by conveyor to the transfer tower and then into the crusher building to be sized. After coal is sized it is then transported by conveyor onto the Wyee overland conveyor and supplied to the Vales Point Power Station.

Construction on the above coal conveyor systems was completed by the end of 2005. No further construction occurred at the Delta Entry Site in 2013.

Cooranbong Services Site

The Cooranbong Services Site consists of a Coal Handling Plant (CHP) and mine support infrastructure which includes decline tunnels, coal stockpiles, conveyors, mine fan, and workshop buildings. The CHP and supporting infrastructure remain in use at Cooranbong to supply coal to Eraring Power Station.

Construction of the approved CHP upgrades commenced in June 2009 with the removal of the decommissioned north drift conveyor gantry and drive head buildings. Construction of the CHP upgrades and haul road were completed in May 2010. The CHP and road haulage infrastructure is shown in Plan MG11217 and consists of: -

- Reclamation of some existing (unused) components for integration into the upgrade.
- Installation of new prefabricated aerial conveyor system.
- The installation of a 1200T truck loading bin.
- The construction of infrastructure for a nominal 100 000 T ROM stockpile.
- Upgrade works to the existing CHP (ROM bin) to maximise throughput.
- The installation of new electrical systems, incorporating energy saving components.
- The installation of a Plant Control System, incorporating remote monitoring via camera systems, and improved diagnostics to reduce plant downtime.

- Construction of internal road network capable of supporting B-Double haul trucks
- 100T, 27 m long truck weighbridge.
- Security fencing.
- Drainage and water treatment system to contain and manage dirty water from the new ROM, conveyor and road network.

Coal loading and haulage operations from the truck loading bin and 100 000 T ROM stockpile in 2013 were undertaken by Giacci Bros Pty Ltd. Coal handling operations were undertaken by Transfield at the Cooranbong CHP. Coal deliveries to customers in 2013 are described in Section 4.2.

Mandalong Haulage Road

A 3.5 kilometre section of new private haul road and rail overpass bridge has been constructed immediately north of Cooranbong Service Site and connects with the existing Newstan – Eraring private haul road. The construction of the haul road was largely completed in 2009 with remaining road sections completed by May 2010. The haul road is designed to facilitate the transport of coal from the Mandalong Mine to the Newstan Colliery surface facilities for processing and transport into the export market. The asphalt road surface was removed in 2011 due to potholing and replaced with a new asphalt surface in April 2011.

The Mandalong haul road removes significant amounts of coal trucks from using public roads and reduces the noise and dust impacts on the local community. The road is constructed along a horizontal alignment which has been selected to avoid threatened flora species and minimise environmental impact.

The construction consisted of stripping topsoil/vegetation to an average depth of 100 mm across the whole site, approximately 260,000 m^3 of cut to fill in clay, highly weathered rock, and moderately weathered rock has been carried out to achieve pavement sub-grades and the overall formation levels. Construction plant and equipment for this operation included scrapers, dozers, water cart, 60t excavator and 40t dump trucks, compacting roller, graders and minor equipment. The pavement material has been imported to satisfy the structural requirements of the design life and criteria. The road is sealed with asphalt, line marked and signposted to Australian standards.

A new overpass Bridge approximately 33m long, 11m wide has been constructed over the Main Northern Railway to the approved design and methodology of Railcorp. The bridge is a single span concrete structure with precast concrete Super-T girders. A concrete crash barrier has been installed with throw screens to prevent material from entering the rail corridor. The construction includes all footing, pile, column, abutment, girder and all deck works associated with the bridge installation. The bridge works also included the relocation of Railcorp 66kV, 11kV electrical and optic fibre assets within the Railcorp easement.

The disturbed areas across the site have been stabilised with topsoil and revegetated where appropriate as described in Section 9.2. Drainage culverts have been installed in four locations to maintain existing creek flows. Several fauna overpass and underpass structures as described in section 5.8.3 have also been included in the construction. Several sediment basins have been installed to manage dirty water from the roadway and clean water diversion drains constructed to intercept water from entering the dirty water system and avoid contamination. The entire western length of the haul road is fenced with fauna friendly security chainmesh fence.

1.4 REGULATORY FRAMEWORK

1.4.1 Development Consents

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. 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; and
- Cooranbong Entry Site encompassing a coal delivery system and surface infrastructure (coal handling and processing) near Dora Creek; and

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 the three planning approvals listed below.

Development Consent DA 97/800 for the Mandalong Mine - being development application DA 97/800 lodged with LMCC on 27 November 1997 and described in the *Cooranbong Colliery Life Extension Project Environmental Impact Assessment* (Umwelt, 1997), including the Applicant's 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 prepared by Powercoal, 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 Eraring 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 Eraring Power Station from 2 Mtpa to up to 4 Mtpa and back haulage of middlings (middle quality coal product) from Newstan Colliery to Cooranbong Entry Site for subsequent supply to the Eraring 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*, dated May 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 Eraring Power Station).

Development Consent DA 35-2-2004 for the Delta Entry Site – being 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.

Development Consent DA 2501/2004 for the Wyee Coal Handling Plant at the Delta Entry Site – as approved by development consent DA-2501/2004 and described in the *Delta Link Project – Statement of Environmental Effects* (Umwelt, 2004) and revised information letter dated 27 April 2004. This development consent is held by Delta Electricity.

1.4.2 Mining Authorities

The Mandalong Mine holding comprises a number of leases as shown in Table 1 listing the leases within the Mine's Colliery holding. No changes to the Mining Authorities occurred in 2013.

1.4.3 Other Approvals

The surface holdings at Mandalong Mine and Cooranbong Services & Delta Entry Sites are licensed for the scheduled activity of coal mines under the Protection of the Environment Operations Act (2005) in mine's Environmental Protection Licence EPL 365. The following variations were made to EPL 365 by the Environmental Protection Agency in February 2013:

1.4.4 Authorisations and Exploration Licences

The Mandalong Mine holding comprises a number of leases. **Table 1** sets out the leases within the Mine's Colliery Holding Boundary

Four of Mandalong Mine Exploration Licences were renewed during 2013. These licences included EL4968, EL4969, EL5892 and Authorisation 404 and will now expire on 31/7/17. Renewal of EL4443 is pending. Part transfer of Consolidated Coal Lease 762 to Centennial's Myuna Colliery (ML1632) was also approved during the report period.

Mandalong Mine applied to NSW Department of Trade and Investment – Division of Resources and Energy (DRE) for a new Mining Operations Plan (MOP) for an agreed period of two (2) years. The two year time frame was selected to coincide with the anticipated approval of the Mandalong Southern Extension Project. The MOP was prepared to satisfy conditions of the various mining leases covered by the MOP and prepared with reference to the *NSW Trade & Investment, Regional Infrastructure and Services – Division of Resources & Energy: Mining Operations Plan (MOP) Guidelines September 2013* (DRE, 2013) as well as Development Consent Conditions 10, 11 and 12. The MOP was approved by DRE on 24 December 2013 for the period 1 January 2014 to 30 November 2015.

A summary of the development consents, mining and exploration lease and licenses held by Mandalong Mine are listed in **Table 1**.

Table 1: Mandalong Mine Development Consent, Mining and Exploration Leases and Licences

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	Manager Title and Property- North
Consolidated Coal Lease 746 (sublease)	Title for Cooranbong Workings includes some surface land – some environmental conditions	Dept. Primary Industry (Mineral Resources)	31/12/2028	Manager Title and Property- North
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	Manager Title and Property- North
Mining Purposes Lease 329	Title to surface land for old water supply line from Eraring Power Station – requires annual environmental management report on anniversary	Dept. Primary Industry (Mineral Resources)	4/8/2015	Manager Title and Property- North
Mining Lease 1443	Mandalong Project Mining Lease – includes some surface land	Dept. Primary Industry (Minerals Resources)	01/03/2020	Manager Title and Property- North
Mining Lease 1431	Title to surface land for proposed shaft at the back of Morisset	Dept. Primary Industry (Mineral Resources)	27/5/2019	Manager Title and Property- North
Mining Lease 1543	Mining Lease – Mandalong Mine Project	Dept. Primary Industry (Mineral Resources)	25/11/2024	Manager Title and Property- North
Mining Lease 1553	Mining Lease Delta Link Project – includes surface land	Dept. Primary Industry (Mineral Resources)	07/09/2025	Manager Title and Property- North
Exploration Licence 6317	Exploration Licence (renewed 2nd Nov 2009)	Dept. Primary Industry (Mineral Resources)	08/08/2014	Manager Title and Property- North
Exploration Licence 4443	Exploration Licence	Dept. Primary Industry (Mineral Resources)	23/10/2012*	Manager Title and Property- North

Name	Description	Issued By	Expiry Date	Renewal Procedure
Exploration Licence 4968	Exploration Licence	NSW Trade & Investment – Division of Resources & Energy	31/07/2017	Manager Title and Property- North
Exploration Licence 4969	Exploration Licence	Dept. Primary Industry (Mineral Resources)	31/07/2017	Manager Title and Property- North
Exploration Licence 5892	Exploration Licence	NSW Trade & Investment – Division of Resources & Energy	31/07/2017	Manager Title and Property- North
Authorisation 404	Exploration Licence	NSW Trade & Investment – Division of Resources & Energy	31/07/2017	Manager Title and Property- North
Mine Operations Plan (MOP)	Summary of Mining Activities – Mandalong	NSW Trade & Investment – Division of Resources & Energy	30/11/2015	Application two months prior to expiry date.
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
Mandalong Mine Development Consent No.97/800	Permits development and works to occur as described in the EIS.	NSW Department of Planning	October 2020	Requires new development consent after expiry date for mine leases.
Mandalong Mine Development Consent No. DA 35-2-2004	Permits construction and operation of the Delta Coal Handling Facility	NSW Department of Planning	July 2021	Requires new development consent after expiry date for mine leases.

Note: * Renewal pending

1.5 CONSENT CONDITIONS – AEMR REQUIREMENTS

Conditions 105-107 of the Mandalong Development Consent detail the requirements for an AEMR. Condition 15 of the Delta development consent requires an Annual Report to be submitted as part of the Mandalong Mine AEMR. These conditions are provided in **Appendix 1**.

The 2012 AEMR (Centennial Mandalong, 2013) was presented to the Director-General of the DP&I, DRE, LMCC, NOW, EPA and the Mandalong Mine CCC consistent with Consent Condition 106(i).

DRE in their letter dated 11 October 2013 found that the AEMR was acceptable for the reporting period and completed a site inspection on 10 October 2013. Further detail on the site inspection and DRE's requirements for the 2013 AEMR are provided in Section 3.3 of this AEMR.

DP&I in their letter dated 4 November 2013 requested that the Independent Environmental Audit recommendations be reported on in the 2013 AEMR. The Mandalong Mine Independent Environmental Audit Action Plan is included in **Appendix 13**.

As required by consent condition 105(v) a listing of any variations to approvals during the report period are provided in Section 1.4. There were no other requirements or actions to be addressed relating to the 2012 AEMR from NOW or the EPA.

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 Environmental Management Report (AEMR). A copy of the current Bank Guarantee is included in **Appendix 2**.

The remainder of this AEMR specifies the specific consent conditions being addressed at the beginning of each section.

2 COMPLIANCE WITH CONSENT CONDITIONS

A summary of the compliance with the Mandalong Mine development consent DA97/800 has been determined through a compliance review in accordance with consent condition 105(i). This review applies to the DA 97/800.

2.1 CONSENT CONDITION 105 (I) – COMPLIANCE AUDIT MANDALONG MINE

A compliance review on the performance of the Mandalong Mine against the conditions of consent has been completed. The results of the review are tabulated and displayed in **Appendix 3**. There are no other statutory approvals relevant to Condition 105(i) requiring a compliance review in 2013.

2.2 CONSENT CONDITION 108 – INDEPENDENT ENVIRONMENTAL AUDIT

An Independent Environmental Audit of Mandalong's operations were completed by URS in May 2013. The audit report is publically available on the Centennial Mandalong website, and a copy was provided to CCC members and Department of Planning & Infrastructure in June 2013.

The Mandalong Mine action plan prepared in response to the recommendations listed in the 2013 Independent Environmental Audit is included in **Appendix 13**.

The next Independent Environmental Audit of the Mandalong Mine in accordance with consent condition 108 is required to be completed prior to March 31, 2016.

3 ENVIRONMENTAL MANAGEMENT

The following is a summary of the specific requirements of relevant government departments with respect to the Mandalong Mine, in accordance with condition 105(ii) of the Mandalong Consent. Information is also provided on the Delta Entry Site. The government department requirements are in addition to the legislative requirements and the consent conditions for the Mandalong Mine.

3.1 ENVIRONMENTAL PROTECTION AUTHORITY (EPA) REQUIREMENTS

Mandalong Mine, Cooranbong and Delta Entry Sites – Centennial Mandalong holds EPL 365 under the Protection of the Environment Operations Act 1997 for the Mandalong Mine. The EPA in 2009 conducted an industry wide review of the coal mining EPL's as required under s78 of the *Protection of the Environment Operations Act 1997*. The Mine consulted with the EPA on the proposed modifications and as a result the Mine's EPL (no. 365) was varied in February 2011.

Condition A1.2 was varied to be consistent with the modification (MOD 4) of development consent (DA97/800) by way of increasing the fee based activity scale to allow for coal mining and works up to 6 Million tonnes per annum, consistent with development consent production limit. Changes to the premises details in condition A2 and naming of monitoring locations, condition P1 to be consistent with the premises operations were made to the EPL.

The EPA modified condition M2.1 requiring the monitoring of additional water quality analysts from the licensed discharge points (LDP001 & 002) and to conduct an assessment of water quality against ANZECC (2000) after two years of monitoring. The requirement to operate a weather station and monitor weather at Mandalong Mine was incorporated by the addition of condition M7. Monitoring the volume of water discharged from LDP001 was amended to be by an electronic level sensor and continuous logger. Condition L5 was added restricting off site waste, requiring an EPL, from being received at the Mine. Control measures to manage dust from the premises and coal haulage activities were added in condition 3.

The changes are consistent with the EPA's approach to regulating coal mines in NSW. Mandalong Mine has either existing environmental control systems in place or has rectified these to comply with these conditions of the EPL.

In December 2011 the EPA issued a separate variation notice for the preparation of a report on the practicability of implementing best practice measures to reduce particle emissions from Mandalong Mine. This condition was applied following consultation with the NSW Minerals Council, to each coal mine with an EPL in NSW as, a result of the EPA commissioned report *on "Best Practice Measures to Prevent and or Minimise Emission of Particulate Matter from Coal Mines in the Greater Metropolitan Regions of NSW"* (Keystone Environmental Pty Ltd, 2010).

The following variations were made to EPL 365 by the Environmental Protection Agency in February 2013:

- Condition P1.1 - The inclusion of ambient air monitoring at Point 6.
- Condition L4 - Amendment to the standard Waste condition to allow for wastes that may meet resource recovery exemptions.
- Condition L5 - Noise Limits have been included to the licence.
- Condition L6 - The addition of standard conditions for potentially offensive odours.
- Condition M2.3 - To allow until 30 June 2013 for the licensee to fully comply with the condition.
- Condition M2.4 - Water and/or Land Monitoring Requirements. Metals that have been analysed but are below detection limits at Point 1 and 2 have been deleted. The requirement to conduct further monitoring of metals has been relocated to PRP U1 -Assessment of Potential Impacts of Metals.
- Condition M2.5 - deleted as results have been submitted to the EPA.

- Condition M4.1 - A requirement to monitor noise is included in the licence.
- Condition M5.1 - A requirement to monitor for air temperature, sigma-theta and relative humidity is included to the weather monitoring.
- Condition M5.3 - The licensee must comply by with the weather monitoring requirements by 30 June 2013.
- Condition R4.1 - The requirement for the licence to provide a noise monitoring report is included to the licence.
- Condition U2 - The Coal Mine Particulate Matter Control Best Practice PRP is removed from the licence.

3.2 NSW OFFICE OF WATER (NOW) REQUIREMENTS

Mandalong, Cooranbong Services and Delta Entry Sites – NOW has not indicated in 2013 there are any additional requirements for environmental management other than the legislative requirement and condition of consent requirements for the reporting period.

3.3 NSW DEPARTMENT OF TRADE AND INVESTMENT – DIVISION RESOURCES AND ENERGY REQUIREMENTS

Mandalong, ***Cooranbong Services and Delta Entry Sites*** – DRE in their letter dated 11 October 2013 found that the AEMR was acceptable for the reporting period and completed a site inspection on 10 October 2013. In the course of the DRE inspection, some issues were identified that either required comment or continued management as detailed in the DRE Action Plan included as **Table 2.** DRE requested that the next AEMR be provided by 31 March 2014.

Table 2 DRE Inspection Action Plan

Number	DRE Observation	DRE Action	Mandalong Response
1	Surface drain behind Mandalong Oil Store / Workshop at risk of overtopping.	1. Remove accumulated silt. 2 If drain freeboard is inadequate, re-establish drain capacity.	No off site impacts were identified. However, drain upgrade works were completed by a contractor in November 2013.
2	Evidence of hydrocarbon contamination at rear of refuelling station	1. Ensure hydrocarbons are stored or transferred on pavement areas which drain to the oil/water separator.	There was no evidence of hydrocarbon contamination at the rear of the diesel refuelling station at Mandalong. The black material within the drain to the Gross Pollutant Trap (GPT) was coal fines. The drum adjacent to the drain does not contain hydrocarbons. The drum has been filled with concrete and has been installed as a gate post.
3	Silt fencing between gas flares and VAM unit requires attention	1. Repair silt fencing still required. Remove any redundant fencing.	All sediment fencing was determined as redundant as rehabilitation had been completed and was removed in October 2013.

Number	DRE Observation	DRE Action	Mandalong Response
4	Water management – oil/water separator and associated settling pond.	1. Provide a typical analysis of settling pond water quality. 2. Demonstrate the irrigated water is suitable for irrigation.	A typical water quality analysis for the Mandalong Mine Dam was provided to DRE in October 2013.

3.4 LAKE MACQUARIE CITY COUNCIL (LMCC) REQUIREMENTS

Mandalong, ***Cooranbong Services and Delta Entry Sites*** – LMCC in 2013 did not indicate any specific environmental management requirements in addition to the legislative requirements and those previously agreed to in the Mandalong Haul Road Environmental Management Plans. Actions from the haul road management plans as discussed in Sections 5.8.3 and 9.4.

4 OPERATIONS DURING REPORTING PERIOD

4.1 EXPLORATION

Surface Exploration

Exploration in 2013 included the drilling of eight surface exploration boreholes (CM 107, 113 and CM115 to CM120).

Private landowners were notified of exploration drilling in advance of drilling commencing, with the Mine providing a letter including information on the program and background information on exploration. Further consultation with landowners included extending the 'Access Agreement' with Forests NSW for another 12 months (Forests NSW Occupation Permit HW50477) and residents within 450m of the proposed drill site were also informed in writing of any drilling activities within the area prior to work commencing. Exploration drill sites were surveyed and developed as described in the Mine's Exploration Drilling Review of Environmental Factors (GSS, 2008).

All eight boreholes, except CM117, were 'open hole' drilled until the top of the conglomerate beam, and then cored to a nominal depth of 18m below the floor of the West Wallarah Seam. CM 107 was drilled on Centennial owned land to provide gas permeability data to assist with the design and layout of the mines inseam longhole gas drainage system. CM113 is located in Olney State Forest on the eastern side of Prickly Ridge Road. CM115, CM116 and CM118 were drilled on Centennial owned grazing land. These four holes (CM113, 115, 116 & CM118) were drilled to infill our existing borehole database and provide information on coal thickness, structure, coal quality, and geotechnical characteristics of the seam overburden and floor. CM117 is located in bushland owned by Centennial and was drilled to prove the proposed main development headings were located to the west of a seam split. Information from CM119, located on Centennial property, and CM120 located on private land, were drilled to better define the extent of the igneous sill that is known to have intruded the West Wallarah Seam, allowing more accurate mine planning, and to maximise resource recovery.

The surface exploration boreholes were sealed with concrete and rehabilitated in 2013. Drill sites were reseeded to re-establish the native vegetation or as per the landowner requirements as described in **Section 9.0**.

Further investigation including surface exploration drilling of these geological features will be undertaken in 2014 to accurately map their location, and will be used to plan future mine layout(s). Work has commenced and private landowners notified on the proposal to drill a further seven exploration sites within the Olney State Forest. An amended Review of Environmental Factors was submitted and subsequently approved by the DRE (SLR, 2013a). Also, an Exempted Area Application and Surface Disturbance Notice was lodged and approved by the DRE to allow this drilling to proceed in 2014.

Underground Exploration

A total of 26 inseam roof and floor coring holes were drilled from 13 locations in the Maingate 13 and Maingate 14 gateroad developments. This coring was undertaken to complement the geological information obtained from the 500m spaced surface exploration boreholes. The holes were drilled to depths of 8m up into the roof and down through the remainder of the West Wallarah Seam and the Awaba Tuff to the Fassifern Seam contact. The information was used to refine the geological and geotechnical model of Mandalong mine.

In addition, gas drainage holes from Maingate 13 and Maingate 14 were extended to delineate and explore for silica rich dykes in the Longwall 14 panel and the planned Longwall panels 15 and 16. The silica rich dykes cannot be identified from surface magnetic surveys. Therefore, inseam drilling is the only option to identify these silica rich dykes. The drilling extended gas drainage holes from Maingate 13 at 25CT to intersect the silica rich dyke in Longwall 15. Further delineation drilling is planned from Maingate 15 gateroad development. A further 2 inseam gas drainage boreholes from Maingate 14 at 8CT and 14CT respectively were extended to further delineate and evaluate the extent of an intrusion throughout Longwall 18. This dyke was previously identified from surface magnetic surveys as it is

doleritic in composition. This dyke runs parallel to the longwall axis and is a moderately hard doleritic dyke. Similar dykes have previously been identified from inseam drilling.

Routine gas drainage drilling was also used to derive roof horizon profiles to refine the geological model.

Mandalong Southern Extension Project
Centennial Mandalong holds an exploration licence EL6317 which adjoins the southern boundary of the existing Mandalong Mining Leases. The exploration program has approval for 53 partly cored boreholes. To date 51 boreholes have been drilled, which completes the exploration for the time being. A comprehensive range of testing and analysis has been undertaken on these boreholes to facilitate mine planning studies. A mine plan has now been determined.

The seven nested ground water monitoring bores and a series of vibrating wire piezometers that were installed in 2011 have been monitored throughout the year for water level and water quality. This data along with the information from the continuous groundwater level data loggers within the alluvial monitoring bores has been used for the groundwater impact assessment for the Project.

2013 was consumed with finalising the specialist environmental reports and preparing the Environmental Impact Statement (GSS, 2013) for the Project. The EIS was sent to the NSW Department of Planning and Infrastructure (DP&I) in May 2013 and the adequacy review was completed by September 2013. The EIS was then placed on public exhibition at the end of October 2013 and remained on exhibition until mid-December 2013. The Project team are currently in the process of drafting a 'Response to Submissions' document, which will be sent to the DP&I by the end of March 2014.

There was no exploration in the areas of the Cooranbong and Delta workings exploration licences in 2013.

4.2 MINE PRODUCTION

The longwall mining method was used at Mandalong Mine to extract coal during the reporting period from the West Wallarah Seam. **Plan MG10815** shows the coal extracted from longwall panels and development units for the reporting period. Four continuous miner units operated during the reporting period developing the Maingate and Main Heading roadways for the longwall panels. The majority of coal produced was extracted from the longwall panels with a minor amount of coal produced from the continuous miner units developing the supporting roadways.

Run of Mine (ROM) coal production in 2013 was from both Longwall 14 and Longwall 15 and the development of Maingate's 14, 15, 16 and 17 and the continuation of the Main Headings between 78 cut-through and 88 cut-through.

Longwall 14 commenced production on 16 February 2013 and completed extraction on 5 August 2013. During the development of Longwall 15 installation roadway a roof fall required a new installation roadway to be driven, delaying the commencement of Longwall 15 to 24 September 2013. By the end of 2013, Longwall 15 had extracted 1300m which represents 40% of the longwall panel.

Maingate 14 completed the final roadways for Longwall 14 by the end of January 2013 then was relocated to Maingate 16 in February 2013 and continued development throughout the year. Maingate 15 was completed in September 2013 in preparation for Longwall 15. Maingate 15 equipment was relocated to Maingate 17 and commenced development during September. At the end of the report period Maingate 17 had developed about one third of its required length.

The development of Main Headings was ongoing, advancing approximately 650m using two continuous miner units. The Main Headings completed the roadways required for the installation of Maingate 17 and 18. During 2013, almost 23 km of roadways were developed. The development unit production is summarised in **Table 3.**

Table 3 Development Unit Production Metres January 2013 – December 2013

Development Panels	January 2013	Finish Date	Developed Metres
Maingate 14	1/1/13	28/1/13	216
Maingate 15	1/1/13	8/9/13	5936
Maingate 16	1/2/13	ongoing	7701
Maingate 17	18/9/13	ongoing	2435
Main Headings	1/1/13	ongoing	6450
			22738

A summary of the monthly and total annual production in 2013 is detailed in **Table 4**. ROM production for Mandalong Mine from 1 January 2013 to 31 December 2013 totalled 4,888,532 tonnes. Mandalong Mine produced 4,845,076 tonnes of saleable product coal in 2013. The removal of the ash in the washing process during the production of export coal at Newstan Colliery accounted for the losses of saleable product.

During the reporting period 2,660,200 and 1,109,050 tonnes of saleable coal were delivered to Eraring and Vales Point Power Stations respectively. **Table 4** shows the majority of ROM coal produced was delivered to Cooranbong Services site for processing through the coal handling plant before delivery via Eraring's overland conveyor to Eraring Power Station.

ROM coal was transported by trucks on the Mandalong private haul road with 939,565 tonnes sent to the Newstan Colliery washery. The washed coal was then transported by rail to the port of Newcastle for export.

Table 4: Production Tonnes and Saleable Tonnes in 2013

Month	ROM Tonnes	Total Saleable Product Tonnes	Saleable Product to Eraring PS	Saleable to Product Vales Point PS	Saleable Product to Export
Jan 2013	53,121	53,121	-	54,506	-
Feb 2013	156,509	156,258	96,290	29,559	11,969
March 2013	562,381	552,681	278,209	94,001	19,719
April 2013	519,981	518,628	292,896	120,079	167,758
May 2013	709,583	700,890	334,111	167,019	129,465
June 2013	701,489	691,315	331,429	165,614	171,314
July 2013	575,683	569,617	360,789	107,788	178,314
Aug 2013	42,099	41,603	13,496	25,773	77,526
Sept 2013	82,779	82,528	58,326	14,454	18,829
Oct 2013	513,222	508,631	261,184	117,041	23,591
Nov 2013	558,310	556,942	310,945	177,037	61,840
Dec 2013	413,375	412,862	322,525	36,179	79,240
Total 2013 CY	**4,888,532**	**4,845,076**	**2,660,200**	**1,109,050**	**939,565**

4.3 WASTE MANAGEMENT

Waste oil and greases are stored in tanks and drums within bunded areas for removal by JR Richards for recycling or disposal. Oil water separation is achieved by the use of two hydro-cyclone oil water separators at Mandalong and one at Cooranbong on flows from vehicle work and storage areas and the Wash Down Bays.

Hydrocarbon spill kits are inspected weekly by JR Richards and re-stocked as required. Oily rag bins and oil filter bins are also serviced by J. R. Richards on a weekly basis.

Office paper and cardboard is collected and recycled by JR Richards on a weekly basis. Metals are collected and stored in steel bins at Mandalong and Cooranbong. Simm's Metal is contracted to collect the scrap metal. In 2013, a total of 639.2 tonnes of scrap steel was collected by Simm's Metal.

General refuse and non-recyclable materials are sorted and stored in 30m steel bins at Mandalong and Cooranbong. The material was collected by JR Richards for disposal in 2013. In 2013, 657.5 tonnes of refuse material was taken off-site by JR Richards.

Of the total waste collected at Mandalong, 70% was recycled including steel, liquid waste, oils, paper and cardboard, filters grease, oily rags and oil filters.

5 MONITORING

Mandalong

Consent condition 105(iii) of the Mandalong Consent requires presentation and discussion on all monitoring required under the consent and other approvals. **Table 5** summarises the monitoring required by the Mandalong Consent, current status and report section in the AEMR.

Table 5: Summary of Monitoring Requirements

Consent Condition No.	Monitoring Type	Status	Report Section
44 & 45	Noise Monitoring	Annual survey	5.5 & Appendix 8
49	Blast Monitoring	As required (underground dyke removal LW14 and LW15)	5.6
51(c)	Air Quality Monitoring	Ongoing Ongoing	5.1
57	Independent Noise and Dust Monitoring	Not Requested	n/a
60A	Greenhouse Gas reporting and abatement measures	Ongoing	5.7
63	Groundwater Monitoring Surface Water Monitoring	Ongoing Ongoing	5.2, 5.3 & Appendix 5 & 6.
72 and 74	Wetland Monitoring	Ongoing	5.8.2 & 5.10
76A (c)	Rehabilitation Monitoring	Annual survey for first five years (commenced 2012).	5.8.3
82	Convict Road Monitoring	Ongoing	5.10
95	Meteorological Monitoring	Ongoing	5.4

Delta Entry

Development consent (No. DA 35-2-2004) for the operation of the Delta Services Site condition 15(a) requires information on the amount of coal transported on the Mandalong coal delivery system. This is reported in the above section 4.2. Condition 15(b) of the Delta consent requires groundwater monitoring data to be reported in the AEMR which is addressed in Section 5.2.

5.1 DEPOSITIONAL DUST MONITORING

Mandalong
Depositional dust monitoring has been undertaken at two locations around the Mandalong Site (DG5 & DG7) since September 1999. These gauges are positioned to monitor dust levels on the mine site, where as, the three gauges (DG6, DG8 & DG9) in the environmental impact assessment were utilised to determine the general background dust levels. One of the original dust gauges, in the vicinity of the Cooranbong Services Site (DG4) is still being monitored.

In September 2006 two additional dust gauges (D10 & D11) were installed (refer to Plan **MG10722D**) to extend the dust monitoring network to the west of Mandalong Mine. In November 2009 one additional dust gauge (DG1) was installed on the western boundary of the Cooranbong Services Site to monitor dust levels from the CHP and stockpiles.

Table 6 describes the location of the dust gauges and these localities are shown on plans **MG10722D** and **MG10722C**.

Table 6: Description of Depositional Dust Gauges Location

Dust Gauge No	Locality
D1	Cooranbong Services Site (western boundary)
D4	41 Gradwells Road Dora Creek (near Cooranbong Site)
D5	Northern end Mandalong Mine Site (Adjoining Property)
D6	Mandalong Mine Site Eastern Boundary (Near Pollution Control Ponds)
D7	Rear of the former Project Office (Mandalong Site)
D8	West of main front entrance (Mandalong Site)
D9	184 Mandalong Road
D10	202 Mandalong Road West of Mandalong Mine
D11	North Western Boundary fence on Mandalong Mine

Delta Entry

Three dust deposition gauges were installed at the Delta Entry Site in July 2004. **Table 7** 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 7: Location of Delta depositional dust gauges

Dust Gauge No	Locality
D1	North east side of settling ponds on decline site.
D2	Main gates to decline off Rutley's Road.
D3	Delta clearing left hand side Rutley's Road.

5.1.1 Depositional Dust Results

Mandalong

Depositional dust monitoring results are shown in **Table 8**. 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 2013 to December 2013); and
- Pre-construction average (September 1999 to August 2000).

The complete monthly depositional dust results are included in **Appendix 4**.

Table 8: Summary of depositional dust results between January 2013 and December 2013 surrounding Mandalong Mine.

	Insoluble Solids (Combustible Matter + Ash) g/m^2/month						
	DG5	**DG6**	**DG7**	**DG8**	**DG9**	**DG10**	**DG11**
Long Term Average	0.8	1.2	1.4	0.9	1.2	1.4	1.1
Average 2013 (AEMR Period)	0.5	1.05	1.3	0.8	0.7	1.9	0.6
Pre-Construction Average	0.7	0.8	3.4	0.8	0.9	*	*
EPA Dust Deposition Goal	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**

* not available. Dust gauges installed after commencing construction.

Delta Entry

Depositional dust monitoring results are provided in **Table 9**. The complete monthly dust monitoring data for Delta are included in **Appendix 4**.

Table 9: Summary of Depositional Dust Results between January 2013 and December 2013 surrounding Delta Entry Site

	Insoluble Solids (Combustible Matter + Ash) g/m^2/month		
	DG1	**DG2**	**DG3**
Long Term Average	0.7	0.8	0.6
Average 2013 (AEMR Period)	0.6	0.8	0.5
EPA Dust Deposition Goal	**4.0**	**4.0**	**4.0**

Cooranbong Services Site

Annual average depositional dust results for 2013 and the EPA goal are provided in **Table 10**. The complete monthly dust monitoring data is provided in **Appendix 4**.

Table 10: Summary of Depositional Dust Results between January 2013 and December 2013 surrounding the Cooranbong Services Site

	Insoluble Solids (Combustible Matter + Ash) g/m^2/month	
	DG1	**DG4**
Long Term Average	1.6	1.3
Average 2013 (AEMR Period)	1.4	1.9
EPA Dust Deposition Goal	**4.0**	**4.0**

5.1.2 Data Interpretation

Mandalong Mine & Cooranbong Service Site

The development consent requires that the Mine does not increase the dust deposition rate by more than 2 g/m^2/month, averaged over any 12 month period, as shown in **Table 10**. All dust gauges recorded depositional dust levels below 2 g/m^2/month in all given 12 month periods.

All dust gauges recorded results as shown in tables 7, 8 & 9 are well below the EPA air quality goal of annual dust deposition of 4 g/m^2/month. Dust levels at DG 8, 10 & 11 located at the nearest sensitive receivers and on the Mine's boundary were well below the EPA air goals, confirming that the Mine's activities had minimal impact on surrounding air quality in 2013.

Dust gauges 1, 5, 6, 7, 8, 9, & 11, recorded 2013 annual averages lower than their respective long term averages. Dust gauges 4 & 10 recorded annual averages above the long-term average however; these increases were well below the EPA Air Quality Goals of 4 g/m^2/month.

Dust gauge DG6 was relocated in September 2013 to avoid contamination from the Mandalong Mine Sediment Control Dam sprinkler system. Due to the relocation of the dust gauge a sample was not collected for September.

All dust results for 2013 were well below the EPA annual dust deposition air quality goal of 4 g/m^2/month.

Table 11: 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**	**12 Month Average**	**Change from PCA**	**Monitored Dust**	**12 Month Average**	**Change from PCA**	**Monitored Dust**	**12 Month Average**	**Change from PCA**
18/01/2013	1.0	1.2	0.4	0.7	0.8	-0.1	0.9	0.7	-0.2
18/02/2013	1.1	1.3	0.5	0.7	0.8	-0.2	0.8	0.7	-0.3
18/03/2013	0.6	1.3	0.5	0.3	0.8	-0.1	0.1	0.7	-0.3
18/04/2013	0.9	1.3	0.5	0.7	0.7	-0.2	1.7	0.7	-0.2
16/05/2013	0.5	1.3	0.4	0.4	0.7	-0.2	0.5	0.8	-0.2
17/06/2013	1.0	1.3	0.4	0.4	0.7	-0.2	0.3	0.8	-0.1
19/07/2013	1.5	1.1	0.3	0.4	0.7	-0.2	0.2	0.8	-0.1
19/08/2013	0.8	0.9	0.1	0.4	0.7	-0.2	0.3	0.8	-0.1
16/09/2013	*	0.9	0.1	0.7	0.6	-0.3	0.3	0.8	-0.2
17/10/2013	1.6	1.0	0.2	3.0	0.8	-0.1	0.4	0.8	-0.2
18/11/2013	0.9	1.0	0.2	1.2	0.8	-0.1	0.5	0.7	-0.2
18/12/2013	1.6	1.0	0.2	0.8	0.8	-0.1	1.4	0.6	-0.3

* Sample not collected due to DG6 relocation.

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 0.8 g/m^2/month for DG 2. All 2013 annual depositional dust level averages were below the long term annual average results. All results are well below the EPA air quality goal of 4 g/m^2/month and are provided in **Appendix 4**.

Particulate Matter

Continuous dust monitoring was installed in June 2013 at the Cooranbong Services site to monitor total suspended particles (TSP) and particulate matter (PM10) as per the condition M2.2 of EPL365. The development consent requires that the Mine does not exceed the limit criteria of:

- 90ug/m^3 annual average for TSP
- 30ug/m^3 annual average for PM10 and,
- 50ug/m^3 24 hour average for PM10

The monitoring of particulate matter was conducted from the 1st July 2013. Particulate matter monitoring results are shown in **Figure 1.** The results are presented as annual average for year to date during the report period (July 2013 to December 2013).

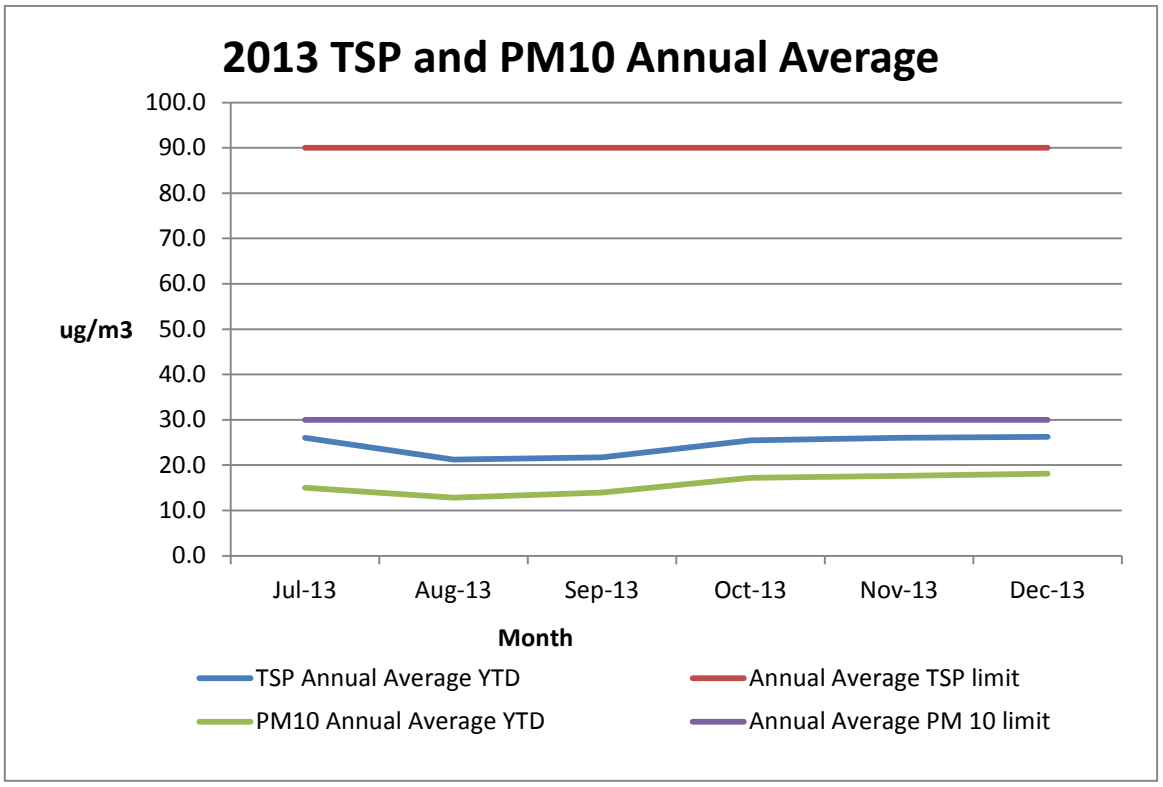


Figure 1: TSP and PM10 Annual Average Year to Date

5.2 GROUNDWATER MONITORING

Mandalong
Groundwater is monitored on a monthly frequency at the groundwater wells shown on the plan **MG10502**.

Delta
Construction of the Delta decline tunnel was completed in 2005. No groundwater monitoring was required in 2013 due to water reporting via inseam pumps to the Cooranbong Services Site and is monitored at LDP001.

5.2.1 Groundwater Monitoring Results

Mandalong
The groundwater monitoring results are summarised in **Table 12** and

Figure 2**, Figure 3 & Figure 4.** Hydrographs of the groundwater levels and Electrical Conductivity (EC) are included in the Australasian Groundwater and Environmental Consulting (AGE) report (2014) provided in **Appendix 5**.

Table 12: Average Groundwater Quality for the Mandalong Valley for the 12 month period from January 2013 to December 2013 ('Avg') and the Long-Term Average ('LTA').

Bore	pH		Ec (uS/cm)		Depth (m)	
	Avg	LTA	Avg	LTA	Avg	LTA
BH001	6.35	6.45	469	509	3.46	3.51
BH002	5.83	5.65	2316	4399	2.15	2.63
BH002A	7.25	7.16	2022	5890	21.10	19.37
BH002B	6.30	6.27	4496	6440	2.90	3.25
BH002C	5.63	5.37	4464	1606	2.43	2.78
BH003	5.97	6.45	2049	3002	3.36	3.54
BH003A	6.26	6.18	4940	6530	2.64	2.87
BH003B	6.71	6.76	5825	9356	17.75	16.27
BH004	5.92	6.22	7522	12938	0.67	0.76
BH005	6.67	4.95	1403	11998	1.17	1.32
BH006	6.34	6.40	3430	4598	2.84	2.81
BH006A	7.35	7.31	5528	7583	8.95	8.52
BH006B						
BH007	6.13	6.40	7603	9722	1.32	1.11
BH007A*						
BH007B	6.86	8.82	5591	7723	9.50	7.49
BH008	6.34	6.63	5333	6855	1.87	2.08
BH009	6.04	6.33	275	468	2.06	2.20
BH009A	11.65	11.88	6006	7080	15.73	11.02
BH009B	11.80	12.06	5953	7056	16.86	13.60
BH010	6.07	6.14	1957	2613	1.64	1.85
BH10A	7.68	7.69	5325	6049	4.37	4.11
BH10B	11.01	11.55	4576	4959	13.31	12.16
BH011	5.79	5.95	3831	5135	0.85	0.93
BH012	6.70	6.73	5498	7144	1.38	1.44
BH013	6.75	6.59	938	3988	1.10	0.91
BH014	6.34	6.42	8808	12403	0.83	1.09
BH015	6.79	6.79	3167	3908	2.69	4.94
BH016						
BH17A1	6.41	5.92	1172	1929	2.53	3.03

Bore	pH		Ec (uS/cm)		Depth (m)	
	Avg	LTA	Avg	LTA	Avg	LTA
BH017*						
BH018*						
BH019*						
BH20					52.34	43.91
BH20A	6.02	6.18	4859	7226	1.44	1.70
BH20B	6.37	6.52	4207	5609	1.61	2.90
BH21	8.06	7.48	5875	6629	53.36	45.62
BH21A	5.76	5.91	5044	6731	3.02	3.44
BH22A	6.31	6.45	4045	5482	2.10	2.09
BH22B	7.47	7.41	7565	10676	10.33	10.85
BH22C*						
BH23	7.21	7.24	4939	5930	56.66	56.30
BH23A	7.51	7.36	4592	5647	16.22	11.87
BH23B	6.34	6.36	3334	4495	3.02	3.34
BH24A	6.38	6.74	6905	9204	1.66	1.51
BH24B	7.73	9.28	7902	9330	9.37	8.71
BH24C	7.51	8.17	7588	8974	14.89	10.24
BH25A	6.47	6.61	4617	5695	0.96	0.89
BH25B	7.20	7.22	5126	6223	4.70	3.98
BH25C	8.19	8.65	5673	6806	8.44	7.04
BH26A	6.20	6.49	6262	7538	1.77	1.77
BH26B	7.20	7.21	5047	5766	0.96	0.94
BH26C	8.19	8.13	4749	5488	9.22	7.75
BH27A						
BH27B	7.70	7.64	4918	5226	77.84	77.47
BH27C	7.88	7.93	4166	4474	88.40	80.42

* No data collected during reporting period due to depth of groundwater or obstruction in bore.

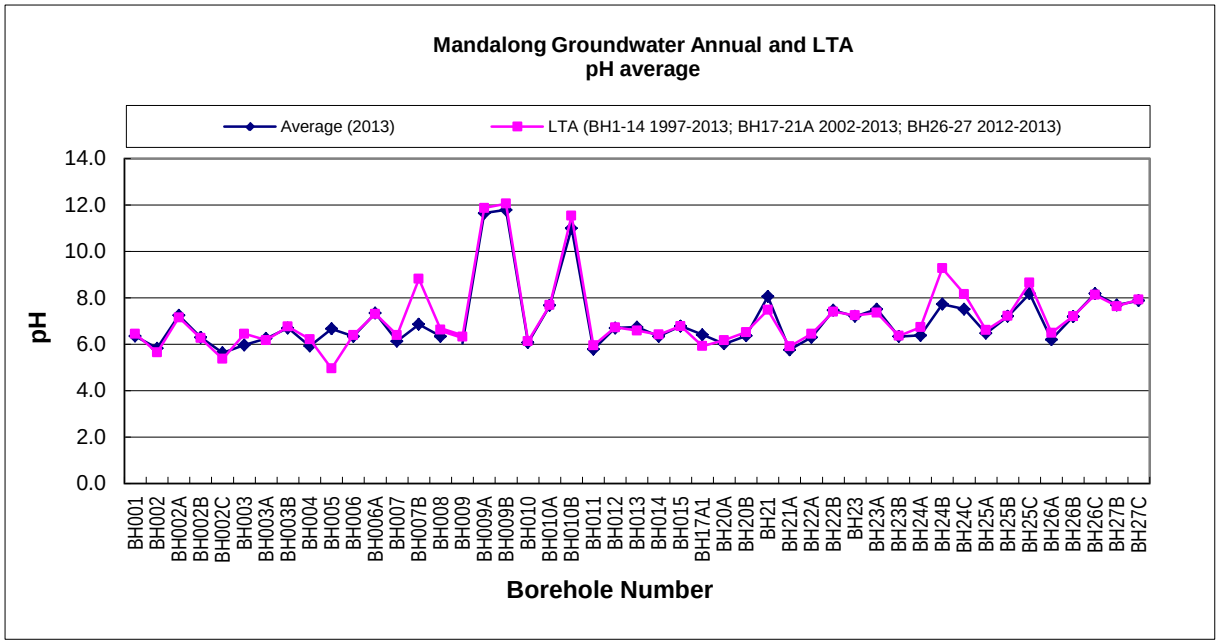


Figure 2: Long-Term Average (LTA) and Annual Average Groundwater pH

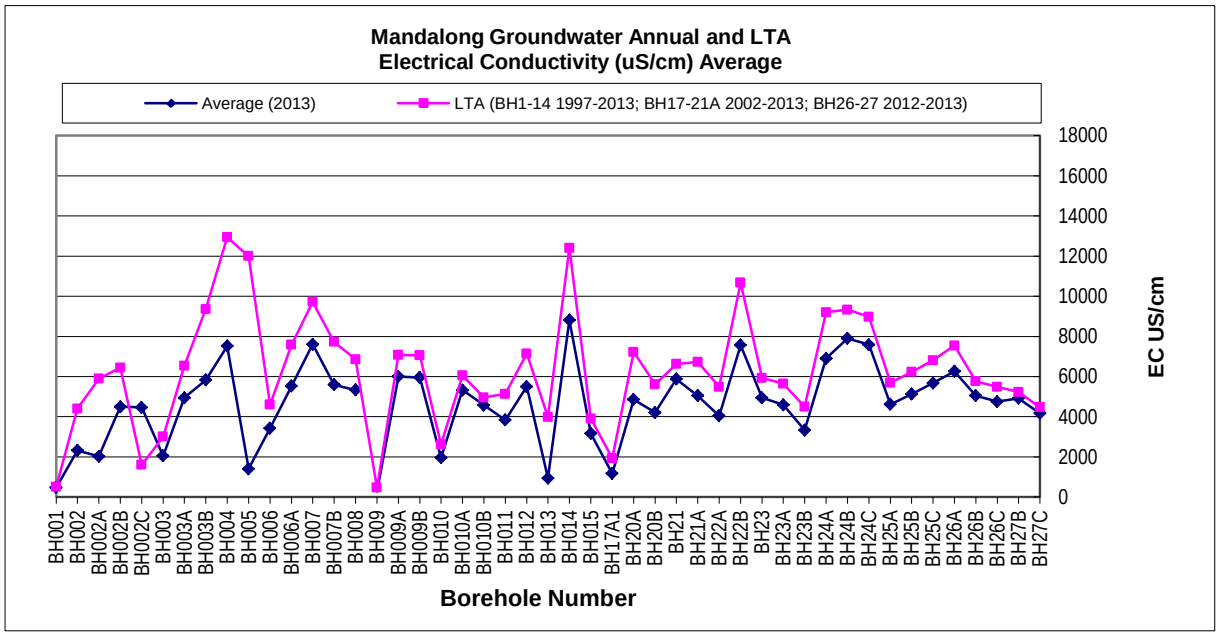


Figure 3: Long-term Average (LTA) and Annual Average Groundwater EC

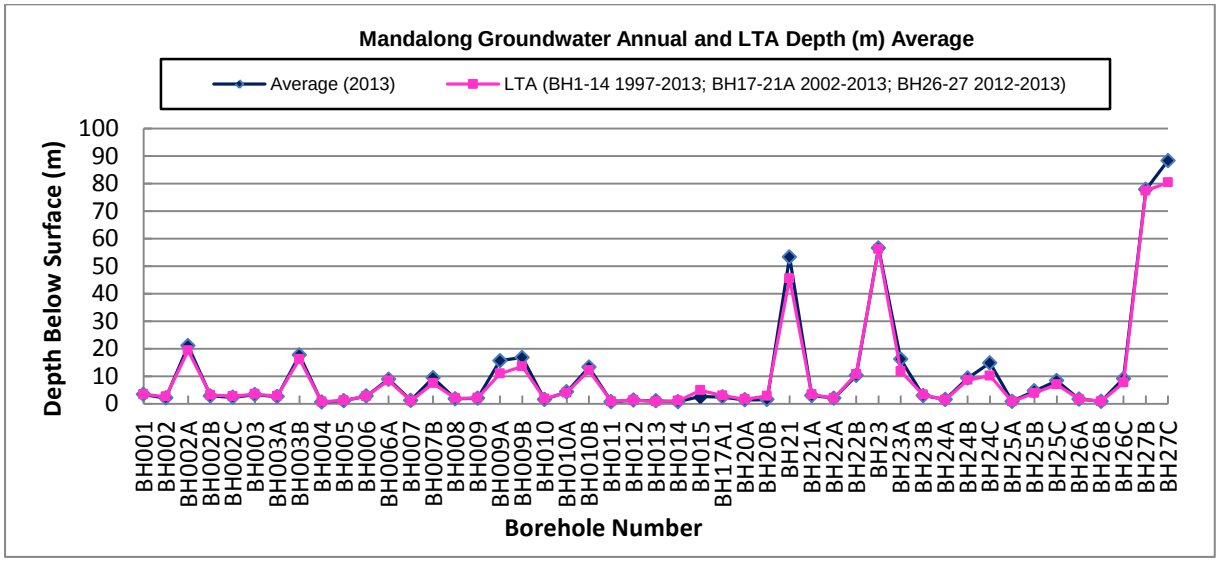


Figure 4: Long-term Average (LTA) and Annual Average Groundwater Borehole Depth (m)

Delta Entry

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.

5.2.2 Data Interpretation

Mandalong

This section discusses the recorded groundwater data. The natural groundwater system shows some variability in quality and depth. The pH ranges from a low of 3.92 in November 2013 at BH008 to a high of 12.37 at BH009A in May 2013. The majority of boreholes display an annual pH average very similar to their respective long-term averages. BH05 and BH24B however showed a difference in the annual average pH compared to the long term average with the results further discussed in section 8.1.3.2.

The electrical conductivity (analogous to salt content) is characterised by variability. The freshest water (lowest EC) is found at BH002C, with an EC of 159 µS/cm in March 2013. The most saline water was found at BH014, with an EC of 15210 µS/cm recorded in September 2013. Most of the results are relatively consistent with the long-term trend. The greatest variation from the long term average was seen at BH005. The 2013 Annual Average was below the long term average for all boreholes except BH002C.

The recorded depth is relative to the ground surface. The deepest water is found at BH27C averaging 88.4 m during the report period. The shallowest groundwater is found at BH004, which averaged 0.67m for the reporting period. **Figure 4** shows the annual average and long-term average depths are very similar with only minor variations for most boreholes.

A discussion on the groundwater results in relation to mining is contained within section 8.1.3.2 of the AEMR and full review of the data in the AGE (2014) report is provided in **Appendix 5**.

5.3 SURFACE WATER MONITORING

Mandalong

There is an established surface water quality monitoring program for the Mandalong catchment conducted by the Mine since periodic sampling commenced in 1996, with the program established on a regular monthly frequency since August 1999. Graphs and monitoring data of the monthly results for each monitoring location are shown in **Appendix 6**. Three surface water monitoring points (SW13-15) above the Licenced Discharge Points one & two (LDP001 & LDP002) 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 the plans **MG10502** and **MG10722E** and are summarised below in **Table 13**.

Cooranbong Haul Road

The Cooranbong Haul Road crosses three ephemeral creeks in the Lords Creek sub-catchment. During construction, monitoring of creeks was undertaken however this was finalised in 2009. Six sediment basins have been constructed along the haul road to contain dirty water runoff from the haul road. Monitoring of the water quality in the haul road sediment control dams was undertaken in 2013 to assess the effectiveness of water treatment prior to controlled releases. Water quality is required to meet the water quality criteria of the Mandalong Mine EPL prior to discharge as presented in Section 5.3.1.

Table 13: Summary of Monitoring Locations with Respect to Position within the Catchments

Location Reference	Creek Sub-catchment	Position along Creek Sub-catchment
SW008	Stockton Creek	Upper
SW004	Stockton Creek	Mid
SW012	Stockton Creek	Lower
SW011	Moran's Creek	Upper
SW003	Moran's Creek	Mid
SW006	Moran's Creek	Lower
SW002	Stockton and Moran's	At Confluence
SW001	Stockton Creek	Downstream Confluence
SW009	Pourmalong Creek	South
SW010	Pourmalong Creek	North
SW13	Muddy Lake (Unnamed tributary upstream LDP001).	Upper
SW14	Muddy Lake (Unnamed tributary upstream LDP002).	Upper
SW15	Muddy Lake (Unnamed tributary upstream LDP002).	Upper
SW16	Muddy Lake (Unnamed water body 1km downstream Simpson Rd Causeway Crossing)	Mid
SW17	Muddy Lake (North Dora Creek Village)	Lower

5.3.1 Surface Water Monitoring Results

Mandalong

Surface water quality is monitored at 15 locations on a monthly or quarterly basis. These locations encompass four different catchment areas. The water is tested for pH, Total Suspended Solids (TSS) and Specific Conductance/Electrical Conductivity (EC). The annual and long-term average (LTA) results are summarised in **Table 14**.

Table 14: Average Surface Water Quality for the 12 month Period from January 2013 to December 2013 ('Annual') and the Long-term Average ('LTA').

Site Location	Catchment	pH		TSS		Specific Conductance uS/cm	
		Average	LTA	Average	LTA	Average	LTA
SW008	Stockton	7.0	6.0	4.6	32.0	905.3	863.5
SW004		6.9	6.7	23.7	18.9	605.2	634.4
SW012		6.5	6.1	13.0	29.7	1280.4	1133.6
SW018		7.1	7.2	49.4	30.0	606.0	538.2
SW011	Moran's	6.8	6.6	16.2	53.2	547.1	561.9
SW006		6.5	6.6	34.9	18.8	384.9	537.0
SW003		6.4	6.4	9.1	15.0	383.1	486.9
SW002	Stockton and Moran's Creek (Confluence)	6.9	7.0	10.9	15.2	8019.4	14862.5
SW001		6.9	7.1	7.8	12.3	18488.1	30336.8
SW009	Pourmalong	6.7	6.6	14.5	18.8	403.5	295.5
SW010		5.8	6.1	11.8	18.3	945.0	432.2
SW013	Muddy Lake	5.2	6.2	7.0	20.9	3224.6	1599.8
SW014		6.9	7.1	7.8	20.1	380.4	463.0
SW015		5.7	5.9	80.6	81.3	80.2	98.1
SW016		8.3	8.2	12.6	16.7	2663.3	2249.8
SW017		8.1	8.1	849.5	943.9	2898.2	3040.0

Cooranbong

Water quality was monitored daily as per the requirements of EPL 365 at Licence Discharge Points (LDP) LDP001 and LDP002 located at the Cooranbong Services site as shown on the plan **MG10722E**. The water is tested for pH, Total Suspended Solids (TSS) and Oil and Grease (mg/L). The average annual results at LDP001 & 2 are summarised in **Table 15** and **Table 16**. Graphs of the LDP001 & 2 water quality results for these parameters are provided in **Appendix 6**. All metal results obtained in 2013 at these locations are provided in **Appendix 6**.

Table 15: Cooranbong Entry– Average Quality of Discharge Water Discharged through EPA Licensed Discharge Point 1 (LDP001)

Average Water Quality Monitoring Required by EPA Licence 365			
AEMR Period	**pH**	**TSS (mg/L)**	**Oil & Grease (mg/L)**
LDP001	7.94	2.03	0.11

Table 16: Cooranbong Entry –Average Quality of Discharge Water Discharged through EPA Licensed Discharge Point 2 (LDP002)

Average Water Quality Monitoring Required by EPA Licence 365			
AEMR Period	**pH**	**TSS (mg/L)**	**Oil & Grease (mg/L)**
LDP002	7.01	36	0.66

5.3.2 Data Interpretation

The results presented in **Table 14** are characteristic of the natural conditions of the area, particularly Stockton and Moran's Creek. Both Stockton and Moran's creek are the main drainage systems for the Mandalong area. Stockton Creek is located within longwall mining area while Moran's Creek is situated to the south-east of the current longwall mining area (LW1-14). Mining will occur beneath Morans Creek from Longwall 15 onwards.

Mandalong

Surface waters are tested for pH, Total Suspended Solids (TSS) and Specific Conductance/Electrical Conductivity (EC) and the annual and long-term average (LTA) results are summarised in **Table 14**. **Appendix 6** contains graphs of EC, pH and TSS for each of the surface water monitoring points sampled in 2013. The Cooranbong Services Site monitoring sites SW013, SW014, SW015, SW016 and SW017 were sampled each month. The monitoring sites SW001, SW002, SW003, SW004, SW006, SW008 SW011, and SW012 were sampled monthly up to July and then quarterly and SW009 & SW010 quarterly during this period.

The EC (salt content) for the 2013 period shows a relatively consistent level compared to the long-term average. The average EC recorded for sites SW01, SW02, SW03, SW04, SW06, SW011, SW014, SW015 and SW017 this period is lower than the long-term average.

The average total suspended solids (TSS) for 2013 are relatively low and are characteristic of natural surface water conditions in creeks. SW017 (Muddy Lake) recorded the highest annual average TSS of 849.5 mg/L in 2013. At sites SW01, SW02, SW03, SW08, SW09, SW010, SW011, SW012, SW013, SW014, SW015, SW016 and SW017, the 2013 average was lower than the LTA.

At the majority of monitoring points, the results showed an annual average pH similar to the long-term average. SW013 and SW015 had the lowest pH average of 5.2 and 5.7 respectively. The highest pH average recorded during 2013 was 8.3 recorded at SW016.

Cooranbong

Plan **MG10722B** shows the discharge monitoring points for LDP001 and LDP002. The results shown in **Table 15** indicate an average pH 7.94 at LDP001 was slightly lower than the 2012 average pH of 8.00. Average Total Suspended Solids (TSS) at LDP001 of 2.03 mg/L was recorded in 2013. LDP002's average TSS of 36 mg/L, pH 7.01 and low levels of Oil and Grease 0.66 mg/L were similar to the 2012 average (TSS 17.02 mg/L, pH 7.18, O&G 0.11 mg/L).

EPL 365 permits the Mandalong Mine to discharge a maximum of 5 ML/day from LDP001 and exceed this limit when 10 mm rainfall has fallen in the prior 24 hours. The average daily discharge volume of 1.411 ML was recorded at LDP001 in 2013 and the highest daily discharge was 3.595 ML in August 2013.

Surface water runoff from the hardstand area at the Cooranbong Services Site drains to the 5 ML dam as shown in plan **MG10722B** to provide settling capacity to treat suspended solids. Water runoff from the workshop, hydrocarbon storage areas drain to an oil water separator to remove oily water before entering the dam.

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 EPA licence limits prior to discharge. Water was discharged from the sediment basins on 15 occasions in 2013. Prior to discharge the sediment control dams where treated by adding a flocculent to the water to remove suspended solids. Treated water discharged from the sediment control dams ranged in quality from 4mg/L to 42 mg/L TSS and pH 6.8-8.2 in 2013. No oil and grease was evident in any of the discharge events. Water quality in the haul road sediment control dams met the water quality discharge criteria detailed in the EPL and the Cooranbong Haul Road Surface Water Management Plan.

5.4 METEOROLOGICAL MONITORING

An automatic weather station has provided on site meteorological monitoring results since June 1999. The weather station records wind speed and direction, temperature, evaporation and rainfall.

5.4.1 Wind Monitoring Results

Wind speed data is shown in **Table 17**. Wind speed and direction are shown graphically in**, Figure 5, Figure 6 , Figure 7** and **Figure 8**.

Table 17: Average and Maximum Instantaneous Wind Speed Recorded at Mandalong Mine for the Period January 2013 to December 2013.

Month	Wind Speed (m/sec)	
	Average	Maximum
January	1.87	3.47
February	1.81	4.578
March	1.55	2.519
April	0.91	2.491
May	0.99	2.96
June	1.05	2.81
July	0.87	4.26
August	1.39	4.056
September	1.39	4.512
October	1.69	4.8
November	1.83	4.811
December	1.83	4.567

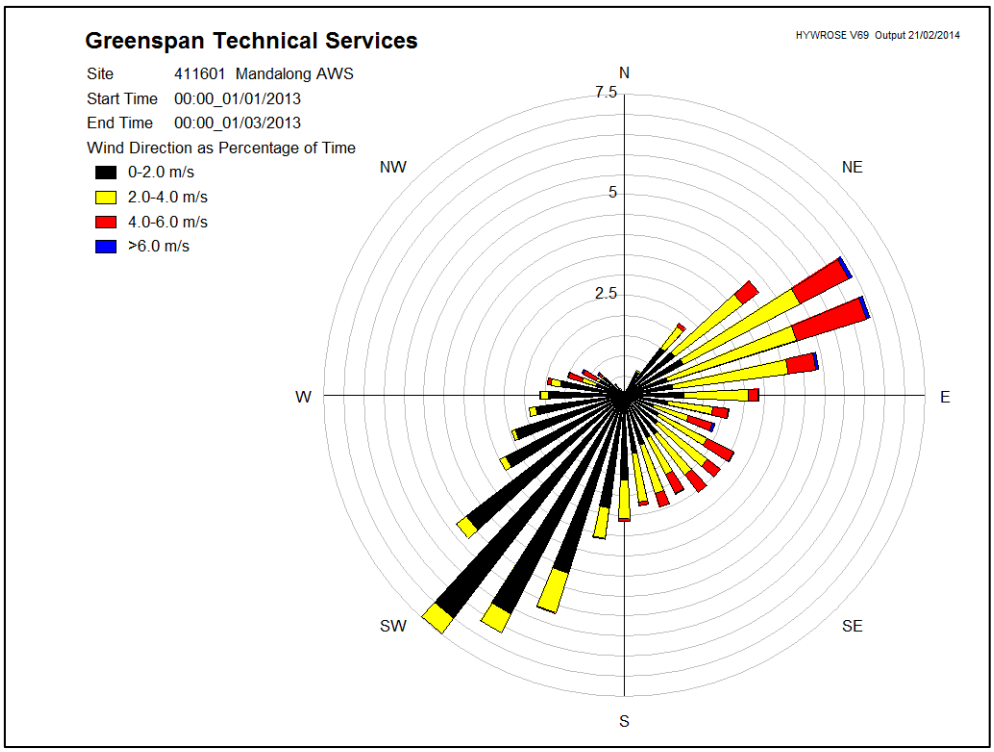


Figure 5: Average Daily Wind Direction Recorded for Summer 2013

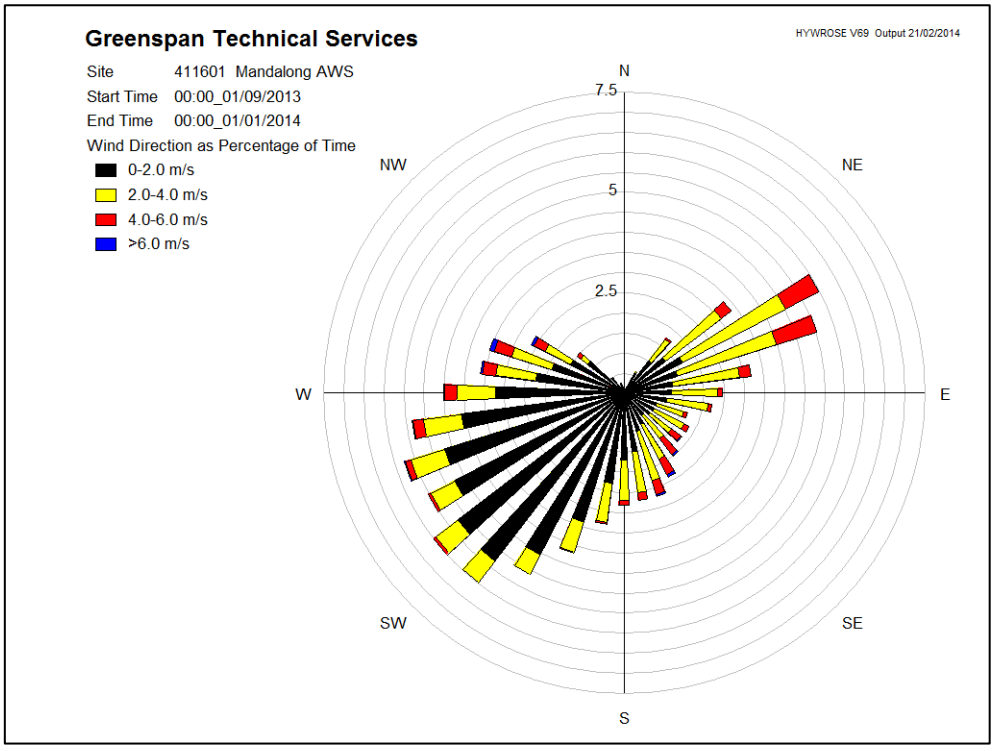


Figure 6: Average Daily Wind Direction Recorded for Spring 2013

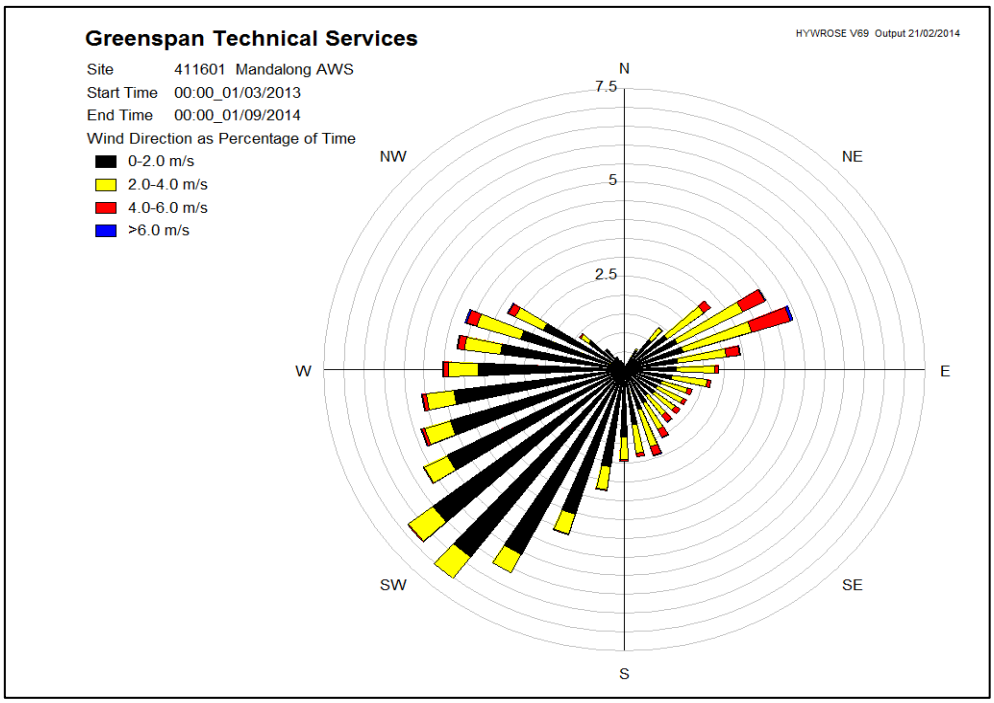


Figure 7: Average Daily Wind Direction Recorded for Autumn and Winter 2013.

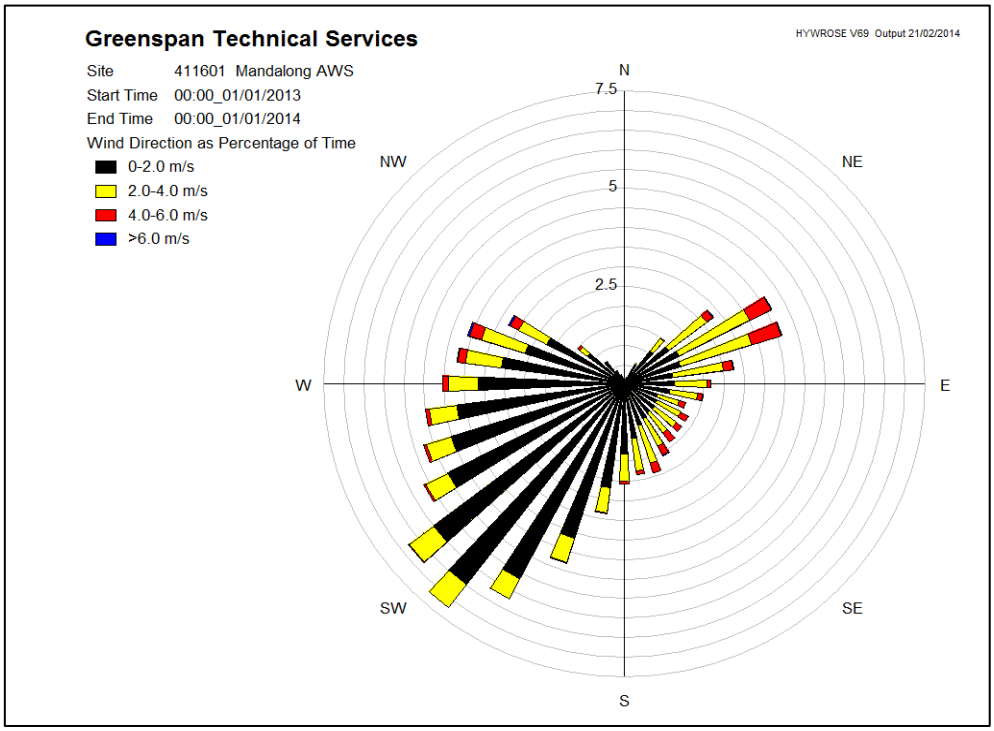


Figure 8: Annual Percentage of Wind Direction for the Period of 2013

5.4.2 Data Interpretation

Table 17 indicates the highest daily maximum wind speed (4.811 m/s) occurred in November 2013. The highest average daily wind speed (1.87 m/s) was also recorded during January 2013.

Figure 5 indicates that the wind is predominantly from the north east and south west direction for the summer period in 2013.

Figure 6 shows that the wind is predominantly from the north east and south west during spring in 2013.

Figure 7 indicates that wind from the south west is the most common during Autumn to Winter in 2013.

Figure 8 indicates that dominate wind direction for the 2013 period was from the south west.

5.4.3 Rainfall Monitoring Results

The total monthly rainfall data is shown below in **Table 18**. Monthly rain data recorded at Mandalong Mine's weather station is tabulated and shown graphically in **Appendix 7**.

Table 18: Rainfall at Mandalong Mine for the Period January 2013 to December 2013.

2013 Month	Mandalong Mine Total Rainfall (mm)
January	222
February	195
March	132
April	112
May	76
June	170
July	11
August	14
September	21
October	43
November	292
December	32
Total	**1320**

5.4.4 Data Interpretation

A total of 1320 mm of rainfall was recorded at the Mandalong Mine site during the reporting period. The total annual rainfall for 2013 was greater than the total rainfall (965mm) recorded in 2012. The wettest period was in November 2013 recording 292mm.

5.4.5 Evaporation and Temperature Monitoring Results

The average daily evaporation rates (mm/day) and maximum and average temperatures are recorded at the Mandalong Mine Meteorological station. Results for the reporting period are shown in **Table 19**.

Table 19: Average Daily Evaporation (mm) and Temperature Data for the Period January 2013 to December 2013

Period 2013	Average Daily Evaporation (mm)	Minimum Temperature (°C)	Maximum Temperature (°C)
January	3.70	11.00	45.00
February	3.30	11.60	32.04
March	3.34	9.34	32.85
April	2.26	4.31	30.06
May	1.65	1.20	28.78
June	1.10	1.66	23.20
July	1.46	-1.10	23.92
August	2.44	-0.59	28.95
September	3.42	3.68	34.80
October	4.34	1.89	42.32
November	4.18	4.82	37.07
December	4.10	8.00	38.49
Annual Average	**2.94**	**4.70**	**33.20**

5.4.6 Data Interpretation

The average daily evaporation rates are highest in summer and spring and tend to decrease during autumn and winter. This is consistent with maximum air temperatures. The highest temperature was recorded in January 2013 at 45.0°C. The highest average monthly evaporation of 0.121 m occurred in October 2013.

5.5 NOISE MONITORING

Annual noise monitoring was conducted to assess operational noise levels compared to the noise limits in the Mine's consent (condition 44) and EPL in accordance with the Noise Monitoring & Management Plan (NMMP) approved by NSW DP&I (condition 45) in December 2013. The NMMP requires the Mine to survey noise from the operation annually. A copy of the report including all monitoring results is provided in the report titled "Annual Compliance Noise Monitoring" by SLR Consulting (SLR, 2013b) in **Appendix 8**.

Operator attended noise surveys were conducted at each of the ten (10) locations for a minimum of 1.5 hour during the day; 30 minutes during the evening; and 1 hours during the night, to determine the character and relative contribution of ambient noise sources and mine contributions.

Measurements were conducted during worst case operational scenarios for both Mandalong and Cooranbong sites in order to capture associated worst case noise levels.

Summary of Noise Monitoring Results

SLR were engaged by Centennial Mandalong to conduct a noise compliance assessment for the Mandalong Mine and Cooranbong Services Site in accordance with the Mandalong Mine Noise Monitoring Program (August 2013).

Operator-attended noise measurements were conducted at the ten (10) focus locations surrounding the mine site during the day on Monday 19 August 2013, evening on Tuesday 20 August 2013 and during the night-time period on Wednesday 21 August 2013. Measurements were conducted during worst case operational scenarios for both Mandalong and Cooranbong sites in order to capture associated worst case noise levels.

Mine operations noise contributions were found to be within the relevant consent condition and EPL limits at all monitoring locations with the exception of a 3dBA exceedance during the evening and night-time at location M1. SLR noted that the consent criteria for location M1 are based on the assumption that the CHP and rotary crushing facilities are upgraded with additional cladding. Centennial Mandalong is in the process of upgrading these facilities with works due for completion at the end of June 2014, and once this has been completed, SLR predict that the mine noise source contributions will comply with the consent criteria.

5.6 BLAST MONITORING

Mandalong
Blast Monitoring was conducted by SLR (2014) between February and December 2013 and the results are provided in **Appendix 8**. Monitoring of ground vibration and over pressure levels was conducted during underground shot firing used to remove a stone and dyke material in longwall panel 14 and 15. A ground vibration monitor was installed on the Centennial property located off Saul Road, situated above the underground dyke. Similarly overpressure and ground vibration monitoring was also installed at the Mandalong Mine, in front of the Mine portal to monitor overpressure and vibration during shot firing.

The EPA recommends that blasting overpressure and ground vibration be assessed in accordance with the Australian and New Zealand Environment Council's (ANZECC) "*Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*" (ANZECC, 1990).

The ANZECC guideline provides the following recommended criteria in relation to blasting overpressure and ground vibration:

"Airblast

- *The recommended maximum level for airblast is 115 dB (Lin Peak)*

- *The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 120 dB (Lin Peak) at and time.*
- *Ground Vibration*
- *The recommended maximum level for ground vibration is 5 mm/sec (peak particle velocity (ppv).*
- *The ppv level of 5 mm/sec may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/sec at any time."*
- *Experience has shown that for almost all sites a ppv of less than 1 mm/sec is generally achieved. It is recognised that it is not practicable to achieve a ppv of this level at all sites and hence a recommended maximum level of 5 mm/sec has been selected. However, it is recommended that a level of 2 mm/sec (ppv) be considered as the long term regulatory goal for the control of ground vibration.*

Monitored blasting overpressure and ground vibration levels from blasting conducted at Mandalong mine for the period from February 2013 to December 2013 were found to be:

- Below the 5 mm/s ground vibration guideline at the nearest potentially affect receiver location.
- Below the 115 dB (Lin peak) airblast guideline at the nearest potentially affect receiver location.

Delta and Cooranbong Entry Sites
There was no blasting carried out at the Delta and Cooranbong Entry sites during 2013.

5.7 GREENHOUSE GAS MONITORING

Consent conditions 60A (i) & (iv) requires Mandalong Mine to monitor greenhouse gas (GHG) emissions and report these in the AEMR. In accordance with Centennial Coal's standard for GHG reporting the 2013 financial year (FY 1st July 2012 to 30th June 2013), emissions in CO2 equivalent tonnes (Co2-eT) as defined in the *National Greenhouse and Energy Reporting Act 2007* are provided in **Table 20**. Total GHG emission of the 2013 FY period of 1,049,795 Co2-eT is lower than the 2012 FY emissions of 1,157,732 Co2-eT.

The majority of GHG emissions in 2013 were caused by fugitive methane contributing to 86 % of all GHG emissions. Methane is liberated from the Mine's main ventilation fan and gas drainage plant when the coal seam is drained of methane via an underground drainage system to maintain a safe ventilated atmosphere and workings conditions. Mandalong Mine as discussed below is currently working towards GHG reduction measures to abate fugitive methane emissions.

Table 20: Total GHG Emissions from Mandalong Mine in 2013 Financial Year

Emissions Summary (Co2-eT) July 2012 to June 2013	Total
Electricity	59,062
Diesel	2,419
Petroleum Based Oils and Greases (PBOG)	266
SF6	6
Fugitives - CH4	898,233
Fugitives - CO2	8,768
Surface Fugitive - Post Mining	81,041
TOTAL	**1,049,795**

Greenhouse Gas Abatement Investigations Measures

As reported previously in AEMR's, 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 Planning and Infrastructure on 11 November 2011. Civil construction works on the surface pad for the VAM RAB unit commenced in December 2011 and was completed in November 2013. The commissioning of the VAM RAB facility commenced in December 2013.

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 (m^3/s), or one-thirtieth, of the mine's total VAM. The VAM RAB system overcomes the problem of low concentration methane by directing the ventilation air into a large oxidation vessel, and oxidising the methane to carbon dioxide. This technology is based on well tested coke-oven principles, utilised in the steel industry.

This project, undertaken on behalf of the NSW government and the underground coal industry, is co-funded by the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) via the NSW Clean Coal Fund (NSW CCF)

Stage 3 Gas Engines In July 2009 Mandalong Mine received approval from 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.

5.8 ADDITIONAL MONITORING

5.8.1 Mandalong Haulage Road

Flora

As required by the Mandalong Mine development consent, the haul road alignment proposed in the Mandalong Mine 1997 EIS and the surrounding vegetation was reassessed to identify any potential impacts to threatened flora species. The survey identified the *Acacia bynoeana, Grevillea parviflora subsp parviflora* and *Tetratheca juncea* all within the original haul road alignment.

As a result of the threatened flora surveys, the haul road alignment was relocated in order to avoid the four small populations of *Acacia bynoeana* identified, however it was not practical to connect a haul road from the Cooranbong Colliery to the Newstan-Eraring haul road without it resulting in the loss of some *Grevillea parviflora* subsp *parviflora* and *Tetratheca juncea* plants. The potential impacts to the *Tetratheca juncea* and *Grevillea parviflora subsp parviflora* as a result of the haul road construction represented only 1.0% and 1.8% of the estimated local population of these two species respectively and was determined not to be a significant impact to the ongoing viability of these two populations.

In the circumstance that species of threatened flora could not be avoided, the conditions of consent allowed for the translocation of the plants from the disturbance area. Consequently, all *Tetratheca juncea* and *Grevillea parviflora subsp parviflora* identified within the haul road disturbance area were translocated to four separate recipient sites adjacent to the haul road.

The monitoring of the translocation research programme was conducted in accordance with the Haul Road Flora and Fauna Management Plan in November 2013. The results of the programme are discussed in Section 9.4.

Fauna

The haul road design has incorporated six fauna underpasses/creek crossings (three fauna dedicated underpasses) and three fauna overpasses to minimise the impacts of the haul road on fauna movement within the area. Monitoring of these structures commenced in October 2010 by Ecobiological who conducted an 'Underpass and Overpass monitoring survey'. The second and final survey event was completed by Ecobiological (2011) between March and April 2011 completing the Underpass and Overpass monitoring project.

5.8.2 Wetland Monitoring

Condition 74 of development consent for the Mine requires monitoring and management of wetlands in the mining area. The wetlands management and monitoring plan (WMP) approved by LMCC was prepared by Hunter Eco (Hunter Eco, 2009), identifying 8 wetlands for monitoring (**Figure 9).** Wetlands 1, 2, and 3 are located outside of the subsidence zone and are control sites while the remaining 5 wetlands are within the proposed mining area. In April 2009 a baseline report was prepared by Hunter Eco which described the status of the wetlands prior to any subsidence having occurred.

In 2013 two monitoring rounds occurred in April (Hunter Eco, 2013b) and November (Hunter Eco, 2013c). The following is a summary monitoring results from the current report *"Mandalong Wetlands Monitoring Report"* by Hunter Eco (2013c), provided in **Appendix 12**.

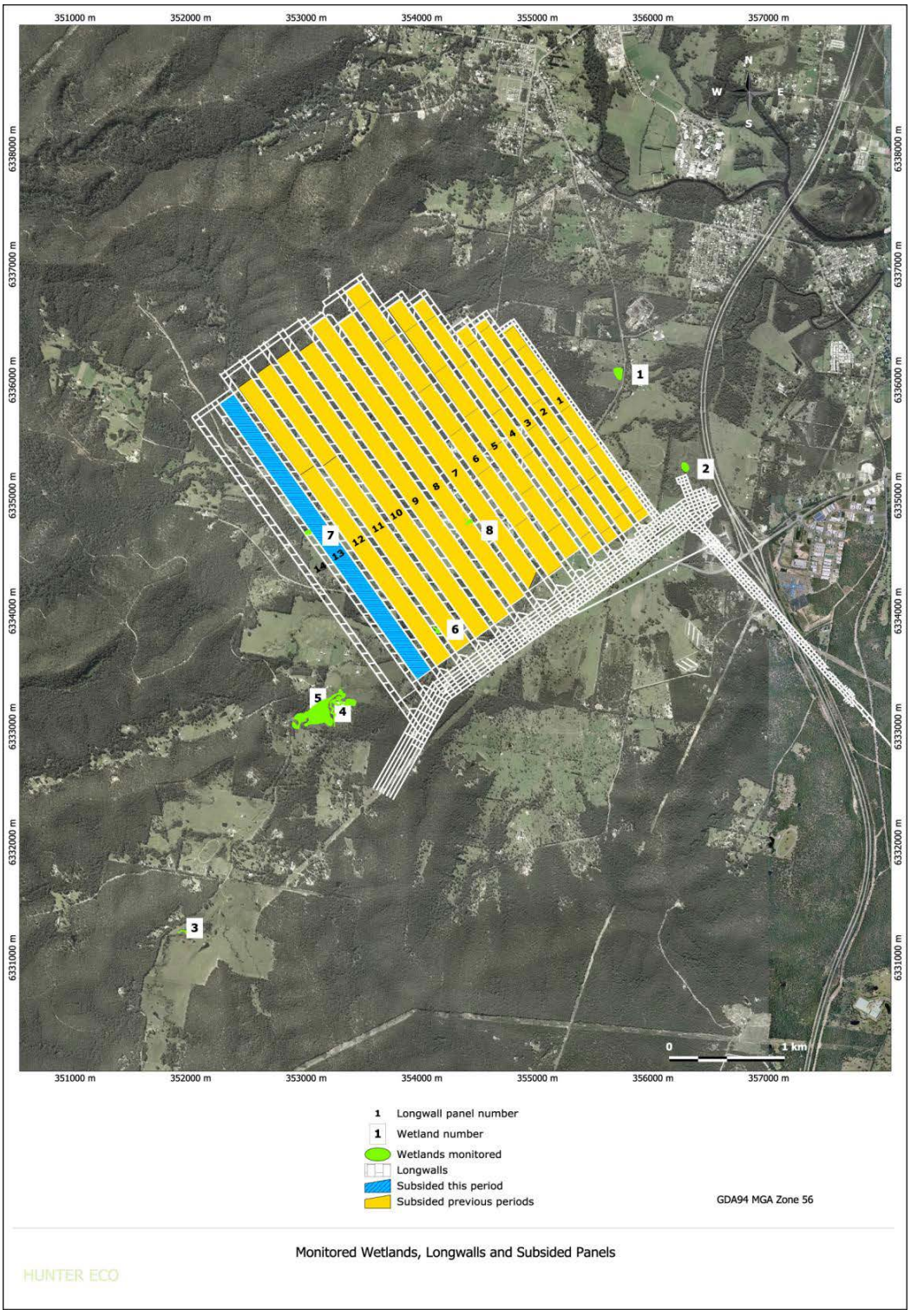


Figure 9: Wetland Monitoring Locations and underground workings.

The purpose of this monitoring program, as prescribed in the conditions of consent, is to determine what, if any, changes in the monitored wetlands in the Mandalong floodplain can be attributed to subsidence.

Monitoring of these eight wetlands commenced in April 2009 so as at November 2013 the total monitoring period has been over four years, ten monitoring occasions. All wetlands started out with water then began to dry until May 2010 when only Wetlands 1 and 3 had water. Hunter Eco (2013c)

report section 5.2 shows increasing rainfall trend up to May 2012, falling to November 2012 after which it has risen to the highest level since the start of monitoring.

Clearly these wetlands are dynamic ecosystems with species composition and diversity varying with the amount of available water and seasons. Variable land-use activities also have an influence on the state of the wetlands. Water analysis results continue to be highly variable, showing no trends over time or within or among wetlands.

Wetland 6 is located over a pillar between panels 11 and 12, both panels having been subsided. The most noticeable change at this wetland is the change from dry to margin habitat at the beginning of the transect. This change appears to now be a feature of this transect. Wetland 8 has been subject to subsidence for over three years and there is no change in the wetland vegetation and water levels that can clearly be assigned to being an impact of subsidence.

Around the middle of 2012, panel 13 was subsided beside Wetland 7 which is located over a pillar between panels 13 and 14. There is no subsidence monitoring through this wetland and it is too soon to detect any impact on the structure of this wetland.

When reading the Hunter Eco ((2013c) report regarding the plant species it is important to be aware of the distinction between occurrence and abundance. The species lists, as in Section 5.1 (**Appendix 12**) only provide occurrence information and say nothing about how many of any one species is present. Abundance information is contained in Section 6.3 (**Appendix 12**). The data show that species composition across all wetlands is relatively consistent over time. Few new species were added on this monitoring occasion suggesting that the majority of likely species have been recorded.

Weeds are primarily confined to the surrounding dry grassland with no invasion into the aquatic ecosystem (except Isolepis prolifera in Wetland 5 which declined in the period from November 2012 to November 2013). Section 5.1 (**Appendix 12**) shows that the proportion of weeds to native species over time has reduced significantly for Wetlands 6, 7 and 8 but has remained unchanged for the others.

Changes in the amount of the threatened Maundia triglochinoides are interesting with whole local populations disappearing by April 2011 (Wetlands 2 & 6) or substantially reducing in numbers (Wetlands 1 & 4). Since November 2011 a large area of the species at the south eastern end of Wetland 6 had recovered by November 2012 but had declined in April 2013 and November 2013.

Wetlands 4 and 5 had been fenced from stock since November 2012 however the property tenant reported seeing deer inside the fence and deer droppings were present on a track near Wetland 5 on the day of monitoring. Game cameras were positioned at the beginning of the Wetland 5 and 6 transects and left for one month from late May to late June 2013 and no deer were recorded.

Herbivory and environmental degradation caused by feral deer is listed as a Key Threatening Process in the NSW Threatened Species Conservation Act 1955. The impact of deer on wetlands could arise from direct grazing of wetland plants and indirectly by destroying underwater regrowth with continual trampling. Depending on severity, this type of disturbance will add a confounding factor to comparison between wetlands.

Table 21: Wetland Trigger Action Response Plan and Assessment

Trigger	Result at November 2013	Response
A steady trend in the decline of water level observed in more than one round for monitoring at monitored wetlands that cannot be explained by rainfall data or upstream agricultural activity.	Water was present in all wetlands.	No further action needed.
A significant increase in the trend of EC levels observed over greater than one monitoring round. AGEC (2008) describe the alluvial aquifer as having substantially elevated EC levels. Any increase in EC in a wetland could be the result of the alluvial aquifer coming into contact with surface water.	EC levels were all within an acceptable range.	No further action needed.
Substantial physical erosion or damage to the wetland soil that cannot be explained by natural or man-made erosion process and is caused subsidence cracking (>200 mm in width).	No erosion or cracking was found	No further action needed
A significant increase in water nutrient levels, particularly N and P that cannot be explained by natural variations in nutrient levels or manmade influences.	Nutrient levels were acceptable.	No further action needed
A steady trend in declining biodiversity observed over a period greater than one monitoring round.	Six wetlands have shown statistically significant declining diversity indices.	Not related to subsidence (see discussion in Section 6.2 of **Appendix 12**)
A landholder submits a complaint that a wetland has changed as a result of subsidence.	No landholder reports had been received.	No further action needed

Source (Hunter Eco, 2013c)

5.8.3 VAM-RAB Rehabilitation Off-Set Monitoring

Centennial received approval in 2011 (DA97/800 Modification 8) 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.

Consent 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, the consent 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 second annual monitoring completed in October 2013 (Hunter Eco, 2013d).

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 m^2 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 were collected on 21 and 25 October 2013 (**Source** (Hunter Eco, 2013d)
Figure 10).

Hunter Eco have found that rehabilitation areas remain substantially different to that in the reference areas. Examination of rainfall patterns indicates that for most of years 2012 and 2013 there has been average to above average rainfall, and even though July to September have been drier than average, rain earlier in the year should have promoted growth. It is concluded that herbivores have had the greatest impact and intrusions should be closely monitored and access points closed.

Fencing of the area and additional planting was completed at the site in early 2013. Further additional plantings will be undertaken in March / April of 2014.

Overall Hunter Eco (2013d) have concluded that 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, 2013d)

Figure 10: Location of Floristic Sample Plots

5.9 COMMUNITY COMPLAINTS

One complaint was received by the Mandalong Mine from the community during the period January 2013 to December 2013, as described in **Table 22**.

Table 22: Community Enquiries / Complaints Summary

Mandalong Complaint Log Number	Date Complaint Logged	Type of Complaint	Comments
4/2013/ccapp1000107	9/12/2013	Mandalong South resident claimed a noise logger placed on their property in 2012 was not sited in accordance with the EPA's Industrial Noise Policy.	An investigation was undertaken by the Mandalong Southern Extension Project Team with advice received from SLR Consulting that the location of the noise monitoring equipment was in accordance with the INP. This information was provided to the complainant on 13/12/2013.

5.10 SUBSIDENCE MONITORING

In accordance with the conditions of the development consent Mandalong Mine is to undertake a subsidence monitoring program. These are reported in the AEMR as detailed in **Table 23**.

Table 23: Summary of Consent Conditions

Consent Condition	AEMR Section
19. Summary, analysis and discussion on subsidence monitoring, effects, impacts and environmental consequences.	Section 5.10.2
63 & 65. Six monthly inspection of floodpaths:	Summary Section 5.10.1 & Appendix 9
63. Monitoring of groundwater level and quality	Section 5.2, Section 8.1.3 & Appendix 5
65. Consideration and monitoring of remedial works	Section 7, Section 9.

5.10.1 Stream Channel

The condition of floodpaths and stream channels are discussed in the Mandalong Mine "*Floodpath Condition Report 2013*" (Centennial Mandalong, 2014) in **Appendix 9** and should be referred to for further details. The Mine's development consent requires the condition of major floodpaths be inspected every six months or following a flood event in an area subject to a Subsidence Management Plan (SMP) application. This Floodpath Condition Report for 2013 has been developed to compile survey and photographic records of subsidence induced changes to Stockton Creek as per assessment methodology in Section 1.2 (refer to **Appendix 9**).

Appendix 9 assesses the changes to the condition of floodpaths along stream reaches mined beneath by longwall panels 14-15 in 2013 and previously subsided longwall panels 1 to 11, identifying the effects of subsidence on the floodpaths. The pre-mining condition of the floodpaths above longwall panels 14 and 15 is also documented in this report.

On the basis of the information obtained from field surveys the pre mining characteristics of Stockton Creek and the associated tributary in the mining area, are described as having a deep bed, broad stream section with some pre mining erosion on bank areas above longwall panels 4 and 5. Pre-mining stream condition above longwall panels 7 to 10 has stream widths broadening to some 7 to 20 m wide and low bank heights of 0.5 – 2 m. Surveys in June and December 2013 recorded some further minor erosion of stream banks along these stream sections likely to be caused by a combination of stock access exposing soils and concentrated flows scouring the banks. Areas of subsidence induced remnant ponding were also identified.

The subsidence levels above longwall panel's 3 to 6 remained unchanged in 2013. The stream condition in 2013 above longwall panels 1 to 3 and 6, where stock have been excluded, were in a similar condition to that recorded pre mining. No changes to the well established riparian vegetation was found on stream banks and with no further bank erosion.

The bank widening and erosion process above longwall panels four and five in Stockton Creek has been occurring prior to mining and for a considerable length of time prior to mining given the large difference in stream widths compared to other stream sections. This erosion process is unlikely to have been caused by subsidence as, the areas of erosion identified prior to mining, were observed in June 2008 to be a result of the concentrated flows on the opposing bank causing further erosion.

As described in Section 7.3 of this AEMR, remnant ponding was observed in limited areas above longwall panel 7 and 8 situated on an existing low lying area of Centennial's properties. The area consists of exotic pasture species primarily used for horse grazing. Centennial Mandalong will investigate the possibility of fencing this area for the establishment of wetlands or establishing drainage if feasible.

Ponding above longwalls 9 – 11 occurs in woodland/forest vegetation and these areas have not been remediated because it has been judged that damage by machinery to habitat, particularly the threatened *Melaleuca biconvexa*, would be unacceptable. These areas will be monitored at least annually to determine what impacts have been sustained as a consequence of ponding.

The maximum subsidence levels recorded in 2013 on longwall panels 14 to 15 are within the predicted range, with the changes in stream grade above these panels similar to pre-existing grades occurring on Stockton creek. All subsidence and stream grade changes are below the anomalous results triggers in the UMEMP therefore, further stream impact assessment or remedial works are not required. Given the unchanged stream condition recorded following mining and the low subsidence levels on Stockton Creek, it is likely that recent subsidence above longwall panel's 14 and 15 has had minimal adverse impacts to the stream flow conveyance, however further assessments will be conducted until subsidence is complete.

5.10.2 Subsidence Results

Subsidence performance and management has been reported in accordance with Subsidence Management Approval requirements of Conditions 17 and 18 of both SMP LW 11-14 and SMP LW15-17. Condition 17 requires Subsidence Management Status Reports to be prepared on a fortnightly basis as well as submitting four monthly reports to the Director, Environmental Sustainability (DRE) and relevant stakeholders, including the Department of Planning and Infrastructure. Condition 18 requires an end of panel report to be provided to DRE within four months of extraction being completed for each longwall panel. Mandalong Mine Development Consent, Condition 18 also requires an end of panel report to be provided to DP&I, Mandalong Mine CCC, DRE, EPA, NOW and any other relevant agency.

During 2013 the end of panel reports for Longwall 13 and Longwall 14 were completed and the required three Subsidence Management Status Reports were provided as outlined in **Table 24.**

Table 24: Subsidence Reports 2013

Report	Report Period	Date Issued
End of Panel Report Longwall 13	Completion of Longwall 13	March 2013
Subsidence Management Status Report No. 28	1 January 2013 to 30 April 2013	May 2013
Subsidence Management Status Report No. 29	1 May 2013 to 31 August 2013	September 2013
End of Panel Report Longwall 14	Completion Longwall 14	December 2013
Subsidence Management Status Report No. 30	1 September 2013 to 31 December 2013	January 2014

During 2013, Longwall 14 completed extraction and Longwall 15 had extracted approximately 40% of its length. Both longwalls continued the same orientation and face width of previous nine longwall panels. **Table 25** summaries the mining parameters for both Longwalls 14 and 15.

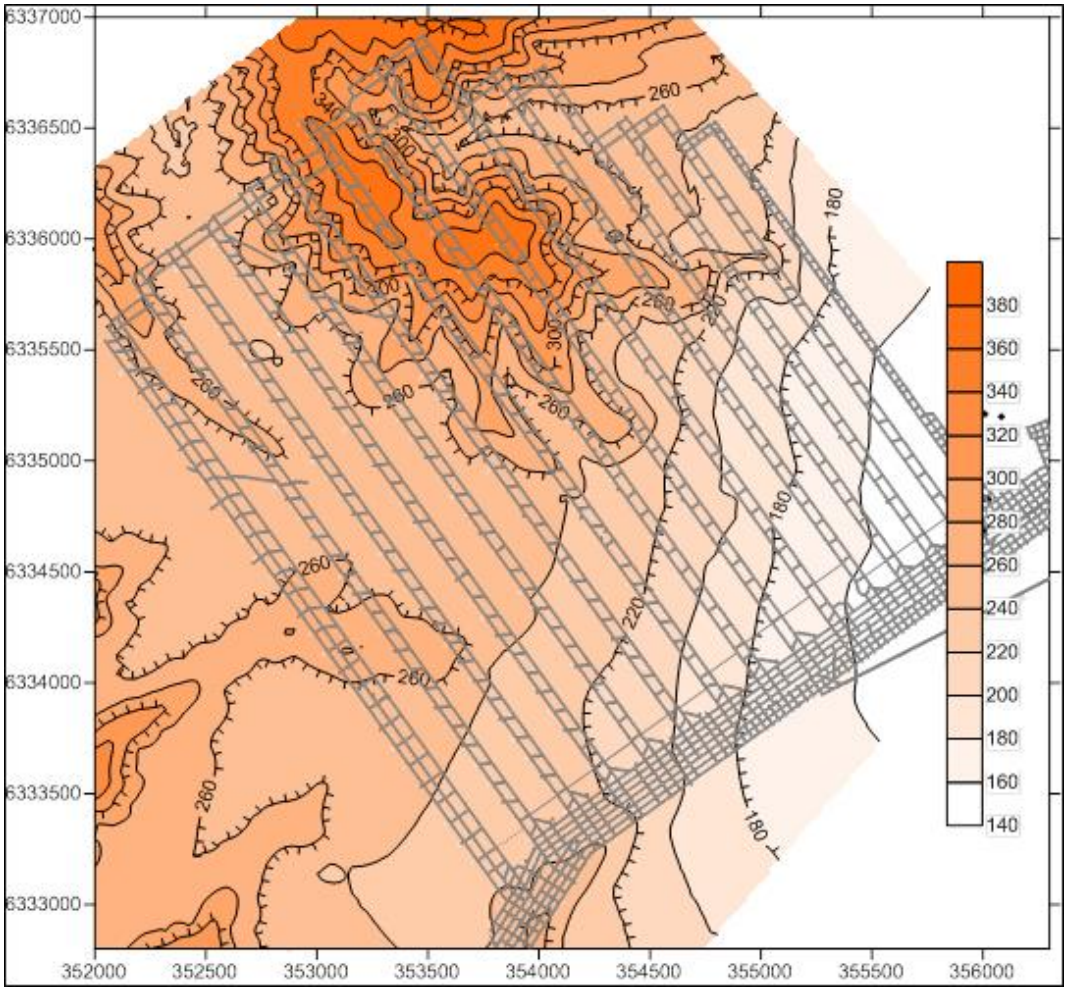
Table 25: Longwall 14 & 15 Mining Parameters

Mining Parameters	Longwall 14	Longwall 15
Length	2900m	2925m
Face Width	150m	150m
Void	160m	160m
Extraction Height	3.4m to 4.8m	3.4m to 4.8m
Chain Pillar Width (coal)	52m and 40m (3 heading Maingate 14)	46m
Cover Range	230m to 280m	240m to 270m
Commenced	16 February 2013	24 September 2013
Completed	5 August 2013	
Coal Extracted	2.9 Million Tonnes	

5.10.2.1 Description of impact

The area affected by Longwalls 14 and 15 extends from the foothills of the Watagan Mountains to the Mandalong Valley floodplain. The extraction of Longwall 14 occurred over a period of six months, commencing during February and finishing early August 2013. Longwall 14 had an extraction width of 160m and chain pillars 46m wide at the tailgate and 52m and 40m in the three heading Maingate 14.

The depth of cover was approximately 280m at the commencement of the panel, decreasing to around 230m at the end of the panel. There was less variation in depth of cover over both longwall panels compared to previous longwalls, primarily driven by the surface topography as shown in **Figure 11.**



Source (Seedsman Geotechnics, 2013b)

Figure 11: Depth of Cover Longwalls 1-14.

Similar to the previous longwall panels, the area affected by Longwall 14 covered properties both above and within the Mandalong floodplain. This area includes a total of 12 properties and three dwellings. Surface features include Stockton Creek, Sauls Rd, Mandalong Rd, Browns Rd, Telstra communications network and the Ausgrid network. The Subsidence Management Plan predicted low impact across the area influenced by the extraction of Longwall 14.

Two private and one Centennial owned dwelling were affected directly from the extraction of Longwall 14. All dwellings were predicted to and remained safe, serviceable and repairable. Two inquiries were made to the MSB for minor subsidence impacts to both of the private dwellings following the extraction of Longwall 14. There have been no observed or reported of damage to infrastructure during the extraction of Longwall 14.

Located above the current Longwall 15 panel are 10 properties including three private dwellings. Similar to the previous panel, surface infrastructure includes Mandalong Rd and Browns Rd, Telstra communications and Ausgrid powerlines. Also located above the commencement end of Longwall 15 is upper reaches of Stockton Creek, while a section of Morans Creek is located near the end of the longwall panel. By the end of 2013, there had been no reports of damage to property or infrastructure affected by Longwall 15.

The MSB inspected one private property regarding a claim for a leaking dam and minor cracking to a sealed access road. The dam is located over Longwall 7 and cracking to the road over Longwall 8. Subsidence monitoring has not detected any additional movement. MSB has completed works to repair the dam and access road.

Subsidence on the section of Convict Road (Brisbane Waters to Wallis Plains Road) above longwall panels one and two remain unchanged in 2012 at 320 mm. No observed subsidence damage has been identified to the road. Subsidence monitoring was completed in 2012 as approved by the DRE.

5.10.2.2 Monitoring Results

Subsidence monitoring was completed in accordance with the approved subsidence monitoring programme, which included 44 subsidence line surveys as well as monitoring a number of private dwellings and dams. **Figure 12** shows the installed subsidence monitoring lines.

The largest vertical subsidence recorded during the retreat of Longwall 14 was 0.53m measured on Crossline 9 at the intersection of Sauls Rd and Walls Lane, near the commencement end of the panel and the greatest depth of cover. Maximum subsidence over the majority of the panel was between 0.25m and 0.35m. Following the extraction of Longwall 15 and the maximum subsidence on Longwall 14 had settled to 0.64m. Monitoring along Crossline 2 has also shown an additional 0.1m subsidence from the settlement of Maingate 14 pillars, providing maximum subsidence of 0.34m over Longwall 14. Maximum subsidence recorded to date on Longwall 15 is 0.4m on Crossline 2.

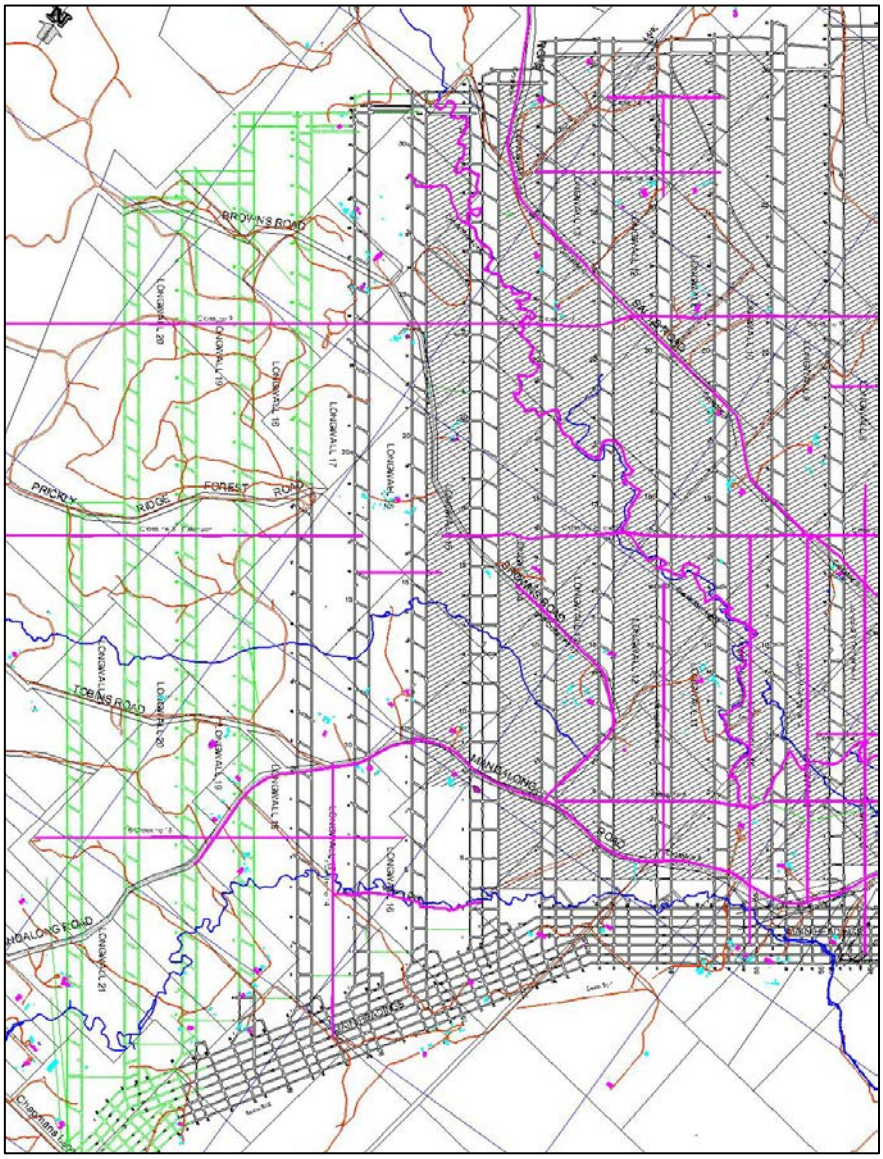
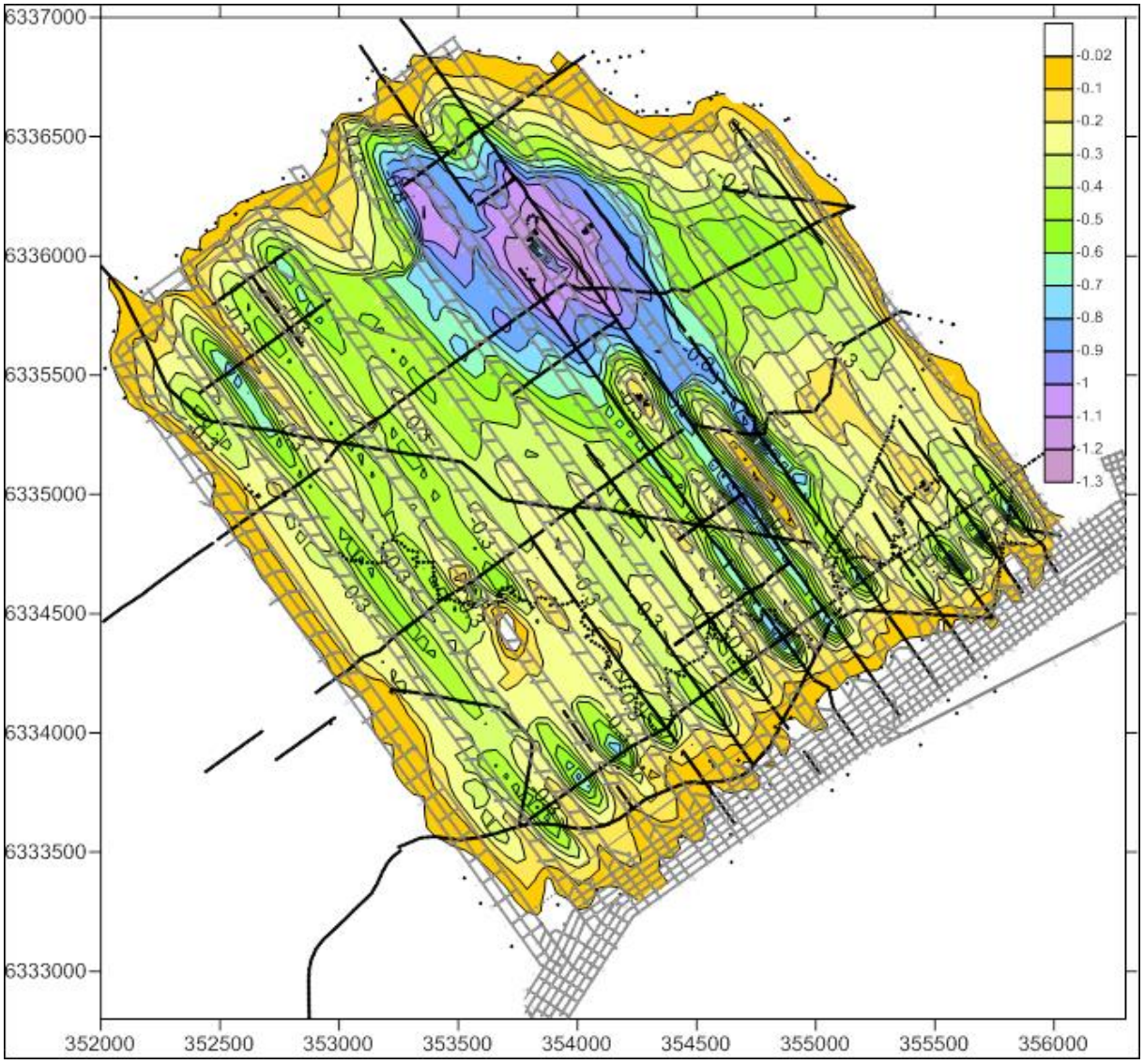


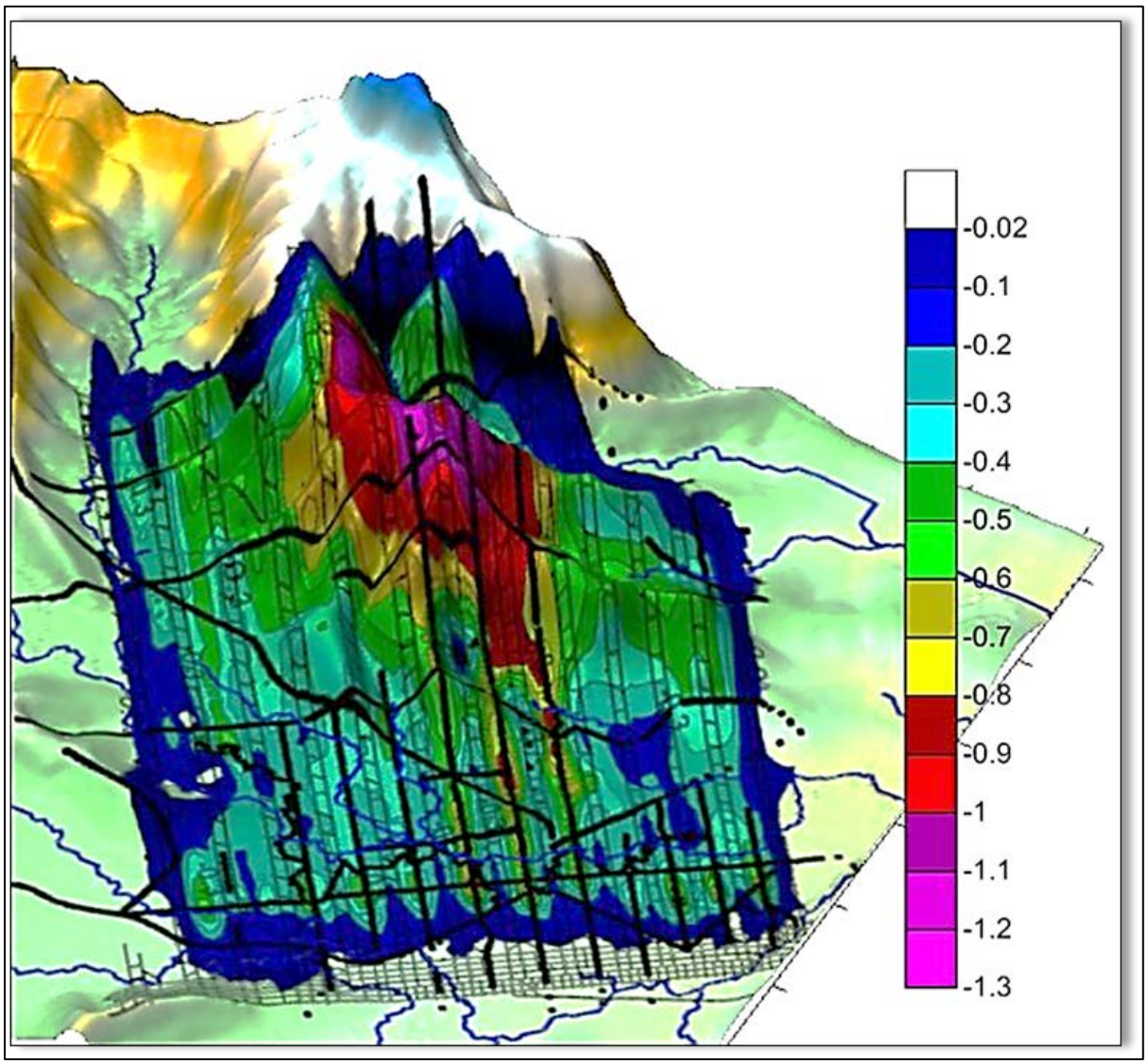
Figure 12: Subsidence Monitoring Location Plan

Figure 13 presents a visualisation of the vertical subsidence over the whole area based on interpolation of survey data from about 55km of subsidence lines over the mining area. **Figure 14** shows the subsidence visualisation overlayed on the topography and includes the subsidence lines.
The figure also illustrates the association of the greatest subsidence with the most elevated topography which provides greater the depth of cover. In addition, the sag above the extraction panels and general trend for increasing subsidence with depth can be seen.



Source (Seedsman Geotechnics, 2013b)

Figure 13: Visualisation of Subsidence to LW14

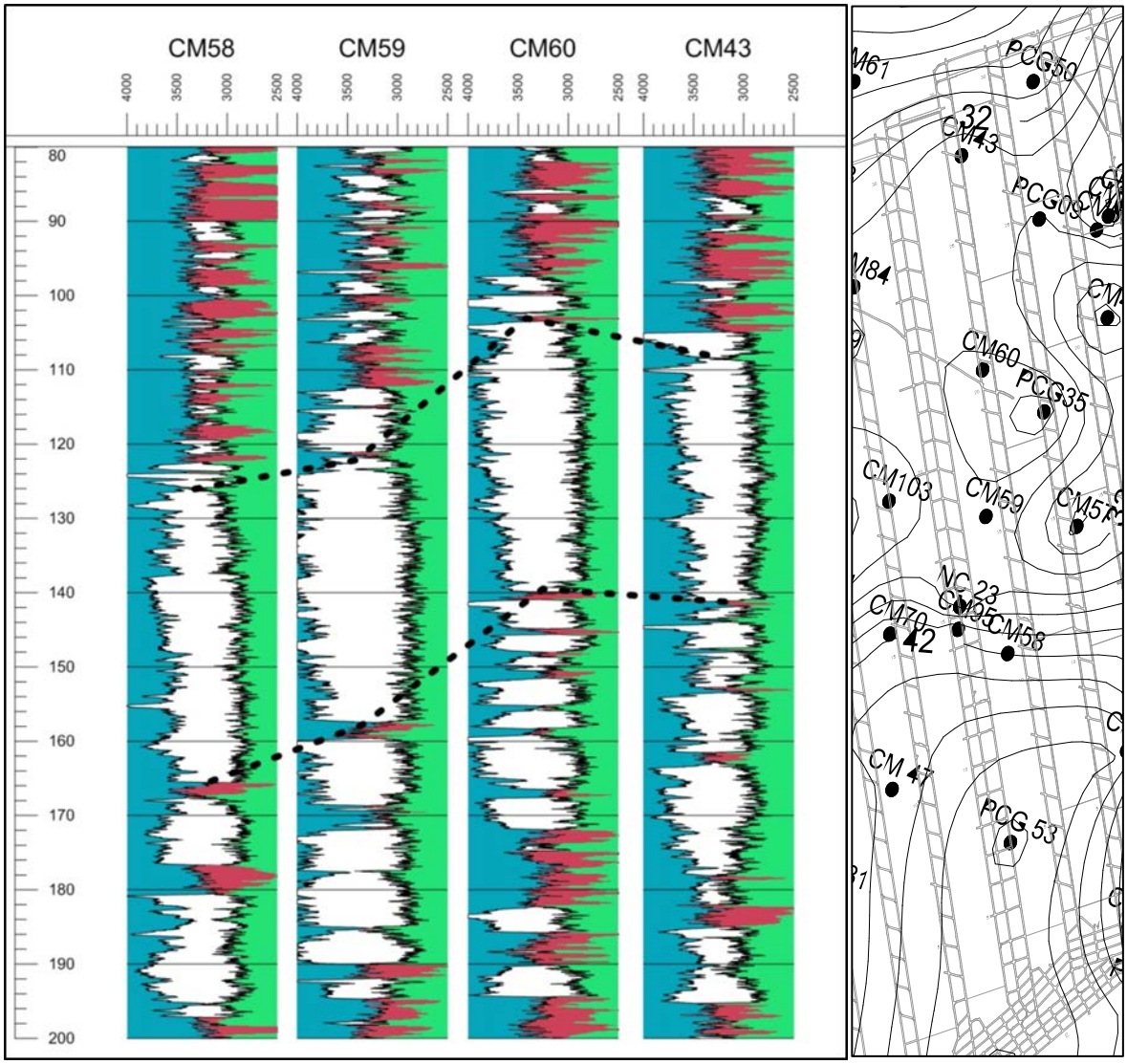


Source (Seedsman Geotechnics, 2013b)

Figure 14: Visualisation of Subsidence to LW14 Projected onto the Topography

5.10.2.3 Performance against Prediction

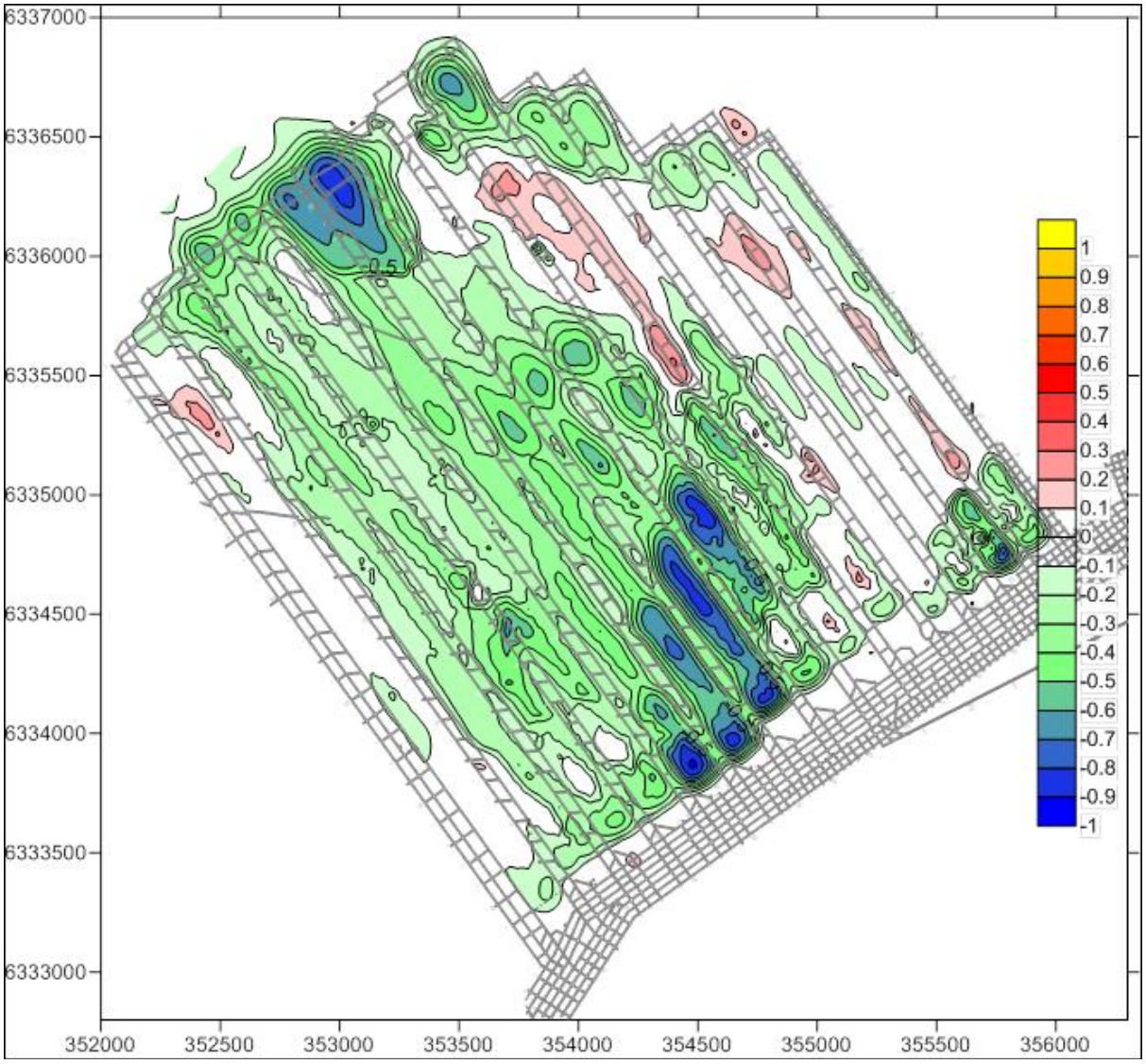
The subsidence results above Longwall 14 were generally within anticipated levels, with maximum vertical subsidence over the majority of the panel typically ranging between 0.25m and 0.35m, consistent with less variation in the depth of cover and conglomerate beam 35m to 40m thick as shown in **Figure 15**.



Source (Seedsman Geotechnics, 2013b)

Figure 15: Geophysical Logs showing Conglomerate Beam Thickness along LW14

Figure 15 below, shows the difference between actual and predicted subsidence, where green shading is where actual subsidence is less than predicted and red shading is where actual subsidence greater than predicted. Apart from the slight increase in subsidence at the commencement of the panel (0.53m), maximum subsidence was within the predicted range.



Source (Seedsman Geotechnics, 2013b)

Figure 16: Difference between Predicted and Actual Subsidence

Subsidence monitoring along the major Crosslines 2, 3, 5, 8 and 9 and longwall centrelines indicate that Longwalls 1 to 11 remain stable, while less than 40mm of additional subsidence was recorded over Longwall 12. Consistent with previous longwalls, the settlement of Longwall 13 has occurred as expected with the extraction of Longwall 14, providing an additional 0.1m to 0.2m subsidence over the chain pillars and to the maximum subsidence at the centre of the panel.

Following the extraction of each longwall panel and in preparation for End of Panel Reports, frequency histograms are produced to compare subsidence results against Safe, Serviceable and Repairable (SSR) criteria for dwellings. SSR values for dwellings are defined as being less than 5mm/m for tensile and compressive strains and less than 7mm/m for tilt. **Table 26** summaries the results from all monitoring points affected by subsidence from Longwalls 6 to 14. The results a confirm the high level of confidence in the mine design achieving low levels of subsidence with almost 98% of all results below SSR values.

A program to remove subsidence monitoring lines over Longwalls 6 to 7 was approved by the Principal Subsidence Engineer (DRE) and ongoing during the report period. Subsidence line 7 Centreline 9 was removed and both 6 Centreline 8 and 4 Crossline 10 were partially removed.

Two new subsidence lines were installed near the end of the longwall panels, one centreline over the end of Longwall 17 (17 Centreline 14) and a crossline covering Longwall 16 to 21 (16 Crossline 18). Major Crosslines 2 and 3 Ex were also extended to cover mining up to and including Longwall 21.

Table 26: Frequency Histogram Summary Longwalls 6 to 14

Frequency Histogram Summary for Longwalls 6 to 14 Compared Against SSR Criteria for Dwellings			
Longwall Panel	**Tilt Less that 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%
Average	**98.0%**	**99.9%**	**97.7%**

5.11 NATURAL FEATURES SUBSIDENCE IMPACTS AND PERFORMANCE AGAINST PREDICTED IMPACTS

Natural features are monitored in accordance with the LW15-17 **Environmental Monitoring Program (EMP)**. This monitoring included subsidence levels on Stockton Creek, groundwater, floodpath inspections, and native habitat (wetland) areas. **Table 27** below summarises the predicted impacts with the observed impacts on natural features in 2013.

Table 27: Summary of Predicted and Observed Subsidence Impacts Natural Features

Predicted Subsidence Impact LW 14 & 15	Observed Subsidence Impact LW 14 & 15
Predicted minor increase in ponding as a result of subsidence in areas of existing ponding on the floodplain.	**Impact as predicted.** There has been no observed or reported impacts to natural features affected by LW14 and the partly extracted LW15..
Predicted no adverse subsidence related impacts on alluvium groundwater levels.	**Impact as predicted (refer to Appendix 5)**. Groundwater levels above longwall panels 13 to 15 have remained relatively stable with groundwater levels responding to rainfall events since installation. Since Installation of piezometers GW10, GW10A, and

Predicted Subsidence Impact LW 14 & 15	Observed Subsidence Impact LW 14 & 15
	GW10B in 2012, the groundwater in all three bores had remained fairly stable, with only slight variation due to rainfall. A temporary increase in pressure was observed during June 2013 at GW10B and to a lesser extent GW10A. The change in pressure relates to compressional behaviour associated with mining of longwall 14. GW10 remained stable throughout. Longwall mining of panel 15 passed underneath the piezometers at GW24. Groundwater levels GW24A, GW24B, and GW24C had remained fairly stable since installation. Increases in pressure were observed at GW24B and GW24C during June 2013. These piezos are reading at approximately the same RL as GW10A and GW10B and therefore are probably reading the compression in the same 'rock beam' related to the mining of nearby longwalls. Groundwater increased slightly at GW24A in November due to higher than average rainfall in November and remained stable over the remainder of the period during undermining. Longwall mining of panel 14 passed underneath the piezometers at GW25. Previously groundwater at GW25A and GW25B has remained fairly level since installation with variation only in line with rainfall and water sampling. GW25C had been slowly declining until a sudden increase in pressure occurred on 28th October 2012. After the pressure peak on the 23 November 2012, it once again returned to a gradual declining trend. The groundwater level which has since been steadily increasing to a level of about two metres below its initial level. In the current review period groundwater pressures remained relatively stable at GW25B and GW25C.
Minimal changes to creek channel flows or alignment.	**Impact as predicted (refer to Appendix 9)**. Minimal changes to creek channel grades resulting in a negligible change to stream flows. No mining induced erosion or deterioration in stream bank condition.
Predicted no surface cracking on floodplain and some minor cracking in rock head areas in high depth of cover.	**Impact as predicted**. No subsidence related soil cracking was observed in 2013 in areas with higher depth of cover or alluvial flood plain area above longwall panels 14 and 15.
Predicted no net loss of native flora and fauna habitat.	**Impact as predicted**. There has been no observed or reported impacts to flora and fauna affected by LW14 and the partly extracted LW15.

6 COMMUNITY LIAISON

6.1 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 2013. Representatives of the MCA, 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, SMP update and sponsorship. Additional agenda items discussed in 2013 included the Mandalong South Extension Project, the Mine's exploration drilling, approvals status, VAM RAB project, and Centennial's land management.

Mandalong Mine and Centennial personnel attended the local Morisset Street Beat Festival in 2013 to provide information on Centennial's operations.

6.2 SMP 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. The existing community consultation process that is established under the Mandalong Mine Development Consent provides a good foundation to address the requirements under the SMP process. In general, the Mandalong Mine community consultation has included:-

- Community consultation in line with the Landowner Communication and Consultation Plan (LCCP).
- Individual landowner consultation associated with the development of SMP application for Longwalls 18 to 21 and their PSMP's.
- Consultation and general communication with all relevant government agencies and infrastructure owners during the development of SMP for Longwalls 18 to 21.
- Individual landowner consultation and implementation of PSMPs during mining of Longwall 14 and Longwall 15.
- Three meetings of the Mandalong Mine Community Consultative Committee (MMCCC) chaired by Margaret MacDonald-Hill delivered updates on the status of SMP approvals, subsidence monitoring and management. Mrs MacDonald Hill replaced Mr Milton Morris who served as chairman of the committee since its establishment in 1999.
- Ongoing consultation with relevant stakeholders on the development and implementation of infrastructure Management Plans including Public Roads and Telstra.
- One month mining notifications are provided to landowners prior to mining and follow-up meetings are undertaken if required.
- Subsidence Management Status reports are completed on a four monthly basis and an End of Panel Report were provided for Longwall 13 and Longwall 14 in 2013.
- Consultation with relevant government departments, MMCCC and stakeholders during the development of the new Mining Operations Plan for 2014 to 2015.

6.3 COMMUNITY SPONSORSHIP

Mandalong Mine continues to support the local community through various sponsorship avenues such as:

- Sponsorship of the LMCC School Environment Awards;
- Morisset Agricultural Show (February 2013);
- Sponsorship of the Morisset Community Festival (May 2013);

- Sponsorship of the Morisset Country Club “Morisset Pro Am Event 2013”;
- Sponsorship of Morisset United Soccer Club;
- Bahtabah LALC NAIDOC family fun day (July 2013);
- Morisset High School;
- Morisset Public School;
- Cooranbong Public School end of year presentation;
- Southlake Marketplace Community Service;
- Sponsorship of the Morisset St. John Vianney Primary School “swale” (drain) landscaping project and end of year presentation;
- Cooranbong Rural Fire Brigade;
- Funding provided for the Morisset Masonic Lodge hall upgrade;
- Newcastle Marching Koalas Band; and
- Sponsorship of the Southlakes Carers Community Christmas Lunch.

7 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 condition 105(iv) of the Mandalong Consent.

7.1 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 eleven to fourteen for PSMP's. No further agricultural assessments were required in 2013.

The agricultural assessments completed in 2009 concurred with the agricultural suitability classes described in the EIS. Monitoring has confirmed that Longwalls 1 to 11 are stable. Tilts and strains have also remained unchanged over these eleven longwall panels. Agricultural assessments for the properties above these panels are unchanged from previous AEMR's and as such are removed from **Table 28.** The properties situated above the current zone of subsidence in 2013 above Longwall 14-15 are highlighted in **Table 28** and have an agricultural classification ranging from three to five as defined above.

Table 28: Agricultural Suitability Classification and Land Use

Property Reference (Number)	Agricultural Suitability Class Three	Agricultural Suitability Class Four	Agricultural Suitability Class Five	Current Agricultural Land use
13			**x**	Nil
116			**x**	Nil
Centennial 23		**x**	**x**	Horses & Beef Cattle
22	**x**	**x**		Nil
39		**x**		Nil
34	**x**	**x**	**x**	Nil
38		**x**	**x**	Nil
Centennial 45	**x**	**x**		Horses
Centennial 44	**x**	**x**		Horses
Centennial 49	**x**			Horses & Beef Cattle
Centennial 27	**x**			Cattle
Centennial 23			**x**	Cattle & Horses
Centennial 26	**x**	**x**		Cattle & Horses
46	**x**	**x**		Horse Agistment
67	**x**	**x**		Nil
Centennial 40	**x**	**x**		Beef Cattle
Centennial 48			**x**	Beef Cattle
Centennial 50		**x**		Beef Cattle and Horses
47	**x**			Nil
Centennial 21	**x**	**x**		Horses
69		**x**	**x**	Nil

7.2 ASSESSMENT OF AGRICULTURAL SUITABILITY

Since commencing longwall mining operations, Mandalong Mine has fully extracted Longwalls 1 to 14. No additional subsidence was recorded above Longwalls 1 to 12 (refer to Section 5.10.2) in 2013. As such the agricultural suitability following mining is as reported in previous AEMRs. In 2013, 21 properties were influenced by subsidence movements on Longwalls 13 to 15. Of these 21, as

highlighted in **Table 28**, 12 currently use land for agricultural purposes and typically have agricultural land suitability of class three or four. The predominant land use on these properties is recreational/lifestyle, horse breeding and agistment and cattle/horse grazing.

7.3 AGRICULTURAL SUITABILITY IMPACT ASSESSMENT

Vertical subsidence levels on Longwalls 13 to 15 are generally within predicted maximums. The distribution of subsidence above Longwalls 13 to 15, shown in **Figure 16** indicates subsidence on the floodplain, where the majority of pasture areas are found, ranges up to 0.60 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 28** 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 14 and 15 in 2013.

The area disturbed during the construction of subsurface drainage, installed to alleviate remnant ponding above Longwall 6 on a Centennial owned property (56) was rehabilitated in October 2009. The area was inspected in 2013 following rainfall events. This confirmed the drains take up to seven days to remove ponded water from the paddock and varies depending on the amount of rainfall and the water level in Stockton Creek. Horses are able to use paddocks and are rotated out in wet conditions similar to other ponded areas of floodplain. This drying period is consistent with other areas of the flood plain which drain or dry out over a similar period.

The remanent ponding on Centennial's properties 59 & 61 above Longwalls 5 and 6 are now free draining following works to re-instate and extend existing surface drainage. Use by the tenants for cattle and other activates are now occurring as they did prior to mining.

In 2013, Hunter Eco completed a report titled "*Monitoring the Impact of Subsidence on Wetlands of the Mandalong Floodplain - Detection and Management of Surface Ponding*" (Hunter Eco, 2013e). LiDAR surface data and high resolution aerial photography (time series) were used to detect surface ponding.

The analysis completed by Hunter Eco has shown that remote LiDAR data and aerial imagery can be useful in detecting areas of ponding resulting from mine subsidence. Eleven ponding locations were identified at the southern end of the longwalls (**Figure 17**), most of which were in open grassland and had been drained. **Table 29** provides a description of each ponding instance and what if any remediation was undertaken.

Table 29: Details of Ponding & Remedial Action

Location	Description	Remediation
Longwall 1 (P1)	Open grassland	Drained
Longwall 2 (P2)	Open grassland	Drained
Longwall 3 (P3)	Open grassland	Drained
Longwall 4 (P4)	Open grassland	Allowed to remain as a source of water for stock.
Longwall 5 (P5)	Open grassland	Drained
Longwall 6 (P6)	Open grassland	Drained

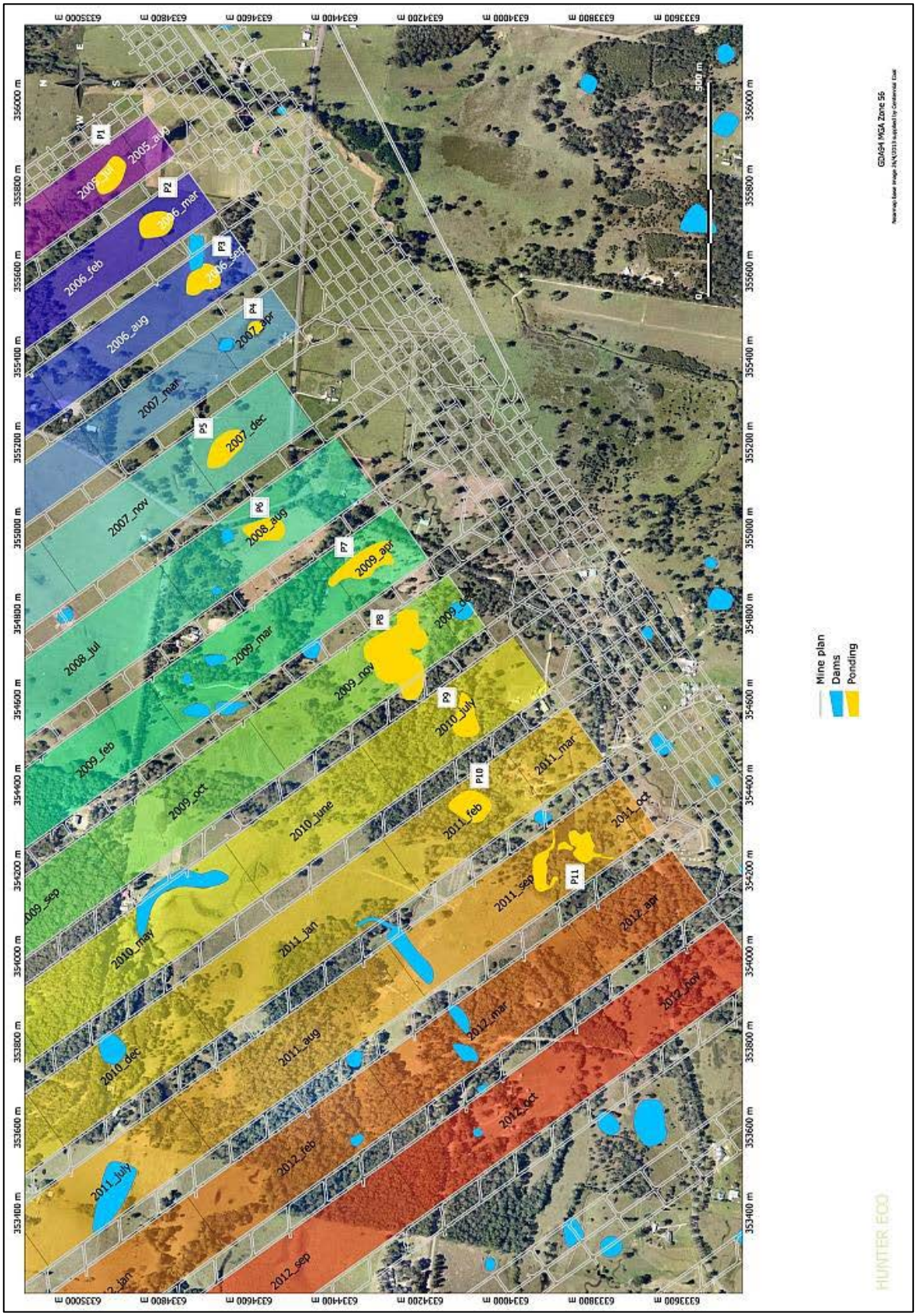
Location	Description	Remediation
Longwall 7 (P7)	Open grassland fringed with Cabbage Gums and *Melaleuca biconvexa*.	Drainage of this area is impractical with little fall available from the ponded area into the nearby creek. Investigation to be completed to determine whether fencing or drainage is possible.
Longwall 8 (P8)	Expansion of an already wet area having scattered Swamp Mahogany and *Melaleuca biconvexa*.	Drainage of this area is impractical with little fall available from the ponded area into the nearest creek, over 300 m to the east. Investigation to determine whether fencing or drainage is possible.
Longwall 9 (P9)	Mixed Cabbage Gum and paperbark forest.	Several threatened *Melaleuca biconvexa* paperbarks are present and remediation would involve losses of these through gaining access by machinery. Consequently remediation was not undertaken.
Longwall 10 (P10)	Mixed Cabbage Gum and paperbark forest.	Several threatened paperbarks *Melaleuca biconvexa* are present and remediation would involve losses of these through gaining access by machinery. Consequently remediation was not undertaken.
Longwall 11 (P11)	Mixed paperbark woodland in an already periodically inundated area. Contains threatened *Melaleuca biconvexa* paperbarks. Ponding has extended an existing wetland.	Will be monitored periodically to determine whether increased inundation is having a net detrimental impact on the habitat.

Remnant ponding was observed in limited areas above Longwall 7 and 8 situated on an existing low lying area of Centennial's properties. The area consists of exotic pasture species primarily used for horse grazing. Centennial Mandalong will investigate the possibility of fencing this area for the establishment of wetlands or establishing drainage if feasible.

Ponding in Longwalls 9 – 11 occurs in woodland/forest vegetation and these areas have not been remediated because it has been judged that damage by machinery to habitat, particularly the threatened *Melaleuca biconvexa*, would be unacceptable. These areas will be monitored at least annually to determine what impacts have been sustained as a consequence of ponding.

With the exception of some localised inundation on the above mentioned Centennial properties, the low subsidence levels and residual tilts and strains have contributed to maintaining pasture for grazing and stock condition following mining. The observed continuation of existing land use at similar stock rates following mining for small scale agricultural enterprises is attributed to limited surface

disturbance. The changes in agricultural suitability are therefore, considered to be negligible to minimal over the mined areas.



Source (Hunter Eco, 2013e)

Figure 17: Estimated Ponding Locations.

8 WATER BUDGET

This section summaries the water balance analysis prepared by GHD (2014) in the report titled *"2013 Water Balance"*. In accordance with condition 105 (vi) of the consent the quantity of water used from water storages and details of water discharges from the Mine are discussed below. The Mandalong, Cooranbong and Delta site water management plans can be viewed on plan references **MG10131**, **MG10069** and **MG10722B**.

8.1 WATER MANAGEMENT

8.1.1 Water Supply and Use

Mandalong is connected to town water and sewer. Potable water for underground use is currently supplied by Hunter Water Corporation (HWC) via a pipeline to Cooranbong and underground to Mandalong Mine. The total potable water used in 2013 was 415.8 ML. A total of 370 ML was supplied via the Cooranbong Services Site & Mandalong Mine Site to underground equipment. A total of 5 ML was used on the surface within the Cooranbong CHP and bathhouse and a further 35.8ML in the Mandalong Mine bathhouse.

The total potable water usage (415.8 ML) for 2013 is above the water usage in 2012 (337 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.

Mandalong Mine

Managing runoff from rainfall events is the only surface water management required at Mandalong. 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 Freeway 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 (GTP), a Sediment Control Dam and a polishing lagoon. Water from the Sediment Control Dam is used for irrigation of surrounding grassed areas as required. An oil water separator on the GPT removes hydrocarbons from potentially contaminated runoff from the fuel/oil, workshop, washdown buildings and equipment yard.

Cooranbong Services Site

Clean and dirty water systems at the Cooranbong site direct surface runoff as, shown in plan **MG10722B** to sediment control structures. 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 5ML in 2012 allowed 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 course fines material. Dirty water is then directed to the large GPT shown on plan **MG10722B** for further settlement of fines. Treated water from the GPT is then pumped to Settlement Dam 1 or directly underground. Settlement 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 Settlement Dam 1 (via the Export Bin Sump).

Delta Entry Site

Clean and dirty water systems have been constructed at the Delta 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 in the dam prior to discharge into the large 9 ML settlings ponds.

Mandalong 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 6 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 as discussed in section 5.3.2.

8.1.2 Minewater Management

Mandalong Mine

Mine water from the underground workings is pumped to the Cooranbong site for treatment and discharge. Mine water is collected and pumped from working areas through a series of underground tanks. Water from the active mining area is pumped to a temporary settling area to reduce suspended solids. All water is then directed to a goaf (Cooranbong longwall void) area 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 Settlement Dams is pumped via existing infrastructure to the Cooranbong void to maintain low water levels.

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

Delta Site

No mine water is discharged from the Delta entry site as, inseam water from the Delta underground headings and decline tunnel is pumped to the existing Mandalong mine water system.

8.1.3 Groundwater Management

8.1.3.1 Groundwater System

Mandalong Mine

This section summaries the groundwater monitoring results presented in **Appendix 5** as provided in the review undertaken by AGE Consulting Pty Ltd tilted *"Mandalong Longwall Mine Groundwater Monitoring Review for AEMR 2013"* (AGE, 2014). This report should be referred to for further detailed information on groundwater monitoring results.

An extensive groundwater monitoring network has been developed at Mandalong Mine with monitoring undertaken on many of the bores since August 1997.

Table 30 provides a summary of the establishment timeframe and purpose of the network. The bore locations are shown on Drawing No.1 in **Appendix 5.** Drawing No.1 in the AGE (2014) report illustrates the groundwater monitoring boreholes location in relation to the underground mining areas.

Table 30: Summary of Monitoring Bore Network Establishment

Bores	Established	Location	Purpose
BH1 – 14	June 1997	Mandalong Valley alluvial	To monitor groundwater levels and quality in the alluvium.
BH15 – 16	February 1998	Private property 1 km south-east of mine	To monitor water levels and the impact of mining on the coal seam.
BH17 – 19	Sept-Oct 2002	Over longwall panels LW4 and LW5	To monitor water levels and the impact of mining on the overburden aquifers.
BH20, 20A, 20B BH21, 21A	October 2003	Nested bores over longwall panels LW1 and LW2	To monitor the impact of mining LW1 and LW2 on the alluvial and overburden aquifers.
BH2A, 2B, 2C BH3A, BH3B BH6A, BH6B BH7A, BH7B, BH17A1 BH22, BH22A, BH22B BH23, 23A, 23B	Sept – Oct 2005	Nested monitoring bores over longwall panels	To provide a broader coverage of monitoring of the impact of longwall mining on the alluvial and overburden aquifers.
BH9A, BH9B, BH10A, BH10B, BH24A, BH24B, BH24C & BH25A, BH25B, BH25C.	May 2010	Nested monitoring bores over longwall panels	To provide a broader coverage of monitoring of the impact of longwall mining on the alluvial and overburden aquifers.
BH26 & BH27	June 2011	Nested monitoring bores.	To provide a broader coverage of monitoring of the impact of longwall mining on the alluvial and overburden aquifers.

Source (AGE, 2014)

There are essentially three groundwater systems in the Mandalong Valley (mine lease area) – alluvial groundwater, bedrock groundwater and overburden/interburden.

The alluvial groundwater is the most important as a usable resource, however there are not many licensed extraction bores within the Valley. The alluvial groundwater is typically recharged from surface infiltration through the sands and upstream recharge.

The bedrock groundwater is less important as a usable resource. The permeability of the Narrabeen Group rocks is generally very low, with little groundwater yield. Any water that is localised in joints or fractures is typically of poor quality.

In the coal seam itself, the bulk permeability is low with some occasional high permeability zones associated with joints, fracture zones or faults, which results in the seam being a confined aquifer relative to the surrounding strata.

Delta Site

Groundwater encountered at Delta underground headings is essentially the same as that found in the coal seam at Mandalong Mine and is managed by pumping this water through the existing inseam water management system at Mandalong Mine. Groundwater make at Delta is low to nil given the relatively low permeability of overlying strata and limited opening created by the decline tunnel and main headings in the coal seam.

8.1.3.2 Groundwater Effects

Cooranbong and Delta Sites

Water make in the Delta underground workings and decline tunnel was monitored during construction of the Delta Decline tunnel and was finalised at the completion of construction works. Groundwater produced from the Delta Decline tunnel is considered to be low to nil and is pumped via the underground water management system where it is discharged to the Cooranbong Services Site at LDP001.

Mandalong Mine

The review of groundwater results by AGE *(2014)* presented in **Appendix *5*** indicates *that there has been no impact from mining of LW1 to LW15 on the alluvial groundwater levels. The exception being a temporary decline of 1.8 m at site BH22A in December 2009 (Section 5.4), and a second temporary decline in September 2011. Similar minor temporary effects were identified in BH7, the closest bore to BH22, when longwall mining passed the bore. During 2013, all alluvial bores correlated closely with the CRD, indicating there has been no impact by mining.*

The shallow overburden has been impacted on various levels by mining at most monitoring sites due to bedding parting. Water levels, however, generally stabilised or recovered, especially in bores away from active mining, and there was no change in 2013 compared to previous years.

Mining of the longwall panels, however, has resulted in depressurisation of the deeper overburden. At these deeper levels, the bedrock has probably been depressurised/dewatered when mining intersected a fault and/or goafing provided hydraulic connection with the mine. While some bores remained dry and water levels in some bores continued to decline, the water levels of others stabilised during 2013.

The data also indicates that the Great Northern Seam to the south of the Mandalong Mine may have been depressurised as a result of mining in the area, but that the deeper Fassifern Seam has not been impacted.

In summary, the monitoring data indicates that although mining has impacted groundwater levels in overburden rocks, there has been no long-term impact, even in faulted areas, on groundwater levels in the alluvial aquifers.

8.1.3.3 Groundwater Management

An extensive groundwater monitoring network has been established, and a monitoring program implemented at the Mandalong Mine. 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 current monitoring network consists of 45 bores; 20 alluvial monitoring bores, 23 overburden monitoring bores and 2 coal seam monitoring bores. The bores consist of 12 nests of 2 or 3 bores monitoring strata at increasing depth at the same site, and 13 single bore sites. The bores are monitored every month with the water level, EC and pH being measured.

The Ground Water Monitoring Review *(AGE, 2014)* in **Appendix 5** presents the following findings;

- *The CRD compares very favourably with the hydrographs of all alluvial monitoring bores, lower middle and upper catchments, and demonstrates a close correlation between groundwater levels and rainfall. There does not appear to be a measurable drop in groundwater levels in any bore. It is concluded that groundwater level fluctuations in the alluvial aquifers are related to rainfall conditions, and not to longwall mining*.

- *the review of the EC data trends indicate that the fluctuation range since the commencement of mining is within the baseline, pre-mining range. As such, it is concluded that to date, mining does not appear to have impacted on water quality in the alluvial aquifer.*

- *Given the low yield and general poor quality of the groundwater in the coal seams and overburden, the environmental value has been classified as "primary industry" with the main potential use being for stock watering.*

- *the EC in the bores indicate that the fluctuation range since the commencement of mining is within the baseline, pre-mining range. The fluctuations are considered to be related to natural environmental conditions such as flooding, with EC levels eventually stabilising and returning to historic levels. It can be concluded that the salinity in the alluvium was not adversely impacted.*

- *Monitoring of the nested piezometers above and to the immediate west of LW1 to LW15 indicates that mining of these panels has not affected water quality in the overlying aquifers in 2013.*

- *The monitoring data has confirmed the Kendorski model and previous assessments of the potential impact of goafing associated with longwall mining on the overlying aquifers, viz:*

- *water levels in the alluvium and shallow overburden are not impacted by mining, the exception being a temporary decline of 1.8 m (Section 5.4), at site BH22 followed by a period of fluctuating water levels. The data indicates that a hydraulic connection has not been established from the alluvium at BH22A to the workings, and that the decline and temporary declines occur as a result of short-term depressurisation of the dilated zone. Similarly, one temporary water level change of about 1 m occurred at site BH7.*

- *water bearing overburden strata to depths in excess of 50 m are impacted by compression and dilation of the strata due to the passage of mining along the longwall panel, resulting in an increase or decrease in water level, but without hydraulic connection to the mine. Water levels are expected to recover within this zone over time;*

- *water bearing overburden strata at depths of greater than 90 m below ground level are depressurised/dewatered as a result of hydraulic connection with the longwall panel; and*

- *the coal seam aquifer that is being mined is locally depressurised/dewatered.*

- *We conclude, based on the analysis of the groundwater monitoring data, that there has been no adverse long-term impact on the alluvial aquifers or shallow overburden from longwall mining of panels LW1 to LW14. However, it is acknowledged that dewatering of the goafed zones in addition to the depressurisation of the deeper overburden has occurred due to mining.*

The approved Water Management Plan (WMP) specifies that if the alluvial groundwater data indicate anomalous groundwater behaviour, an assessment of the changes against climatic conditions and further investigation into the occurrence will be undertaken. As stated above the alluvium groundwater boreholes indicate groundwater water levels trend with CRD and there has been no permanent adverse impact recorded in alluvial groundwater monitoring boreholes as a result of mining, other than a temporary decline and recovery observed in BH22 and BH7 in 2010 and 2011. Therefore, no anomalous alluvial groundwater results have occurred requiring a groundwater investigation program and routine monitoring will continue as per the management plan.

8.1.3.4 Groundwater Licensing

A review of the groundwater licences held by Mandalong Mine under *Part 5A Water Act 1912* assessed the compliance licence conditions and the results area contained within **Appendix 10.** Groundwater monitoring licences are held for the purpose of monitoring groundwater levels in the Mandalong Mine lease area. The Mine's 2013 underground operations water cycle as shown in **Source** (GHD, 2014)
Figure 18.

Mandalong Mine also holds a production licence permitting the extraction of groundwater water from the coal measures encountered during the process of mining. The production licence permits the Mine to dewater the underground coal measures via a submersible dewatering pump located at Cooranbong. The extraction bore entitles the Mine to extract an annual entitlement of 1825 ML of groundwater for the period. This mine water is subsequently discharged at LDP001 and is monitored as discussed in Section 5.3.1.

In 2013, 597 ML was pumped by the dewatering borehole to the surface at the Cooranbong Services Site. Potable water usage in 2013 was 415.8 ML (imported process water). GHD (2014) estimate the ground water make in 2012 was 776.2ML.

8.2 WATER BALANCE – MANDALONG SITE

The 2013 water balance diagram (GHD, 2014) for Mandalong Mine is shown in **Figure 15.** The water balance for 2013 is presented in **Table 31**. The primary inputs for the water budget are potable water, groundwater, and surface run off as described below. The primary outputs from the water budget are discharged water, water loss in product coal and water to sewer.

Potable water is supplied by the HWC to the Cooranbong Services Site and the Mandalong Mine via overland pipes and is consumed underground by the mine equipment. 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. In 2013, 370ML or 1.01 ML per day was supplied underground for use on mining equipment. It is estimated a minor amount of potable water (5 ML) was used on the surface at the Cooranbong Services Site, for surface facilities.

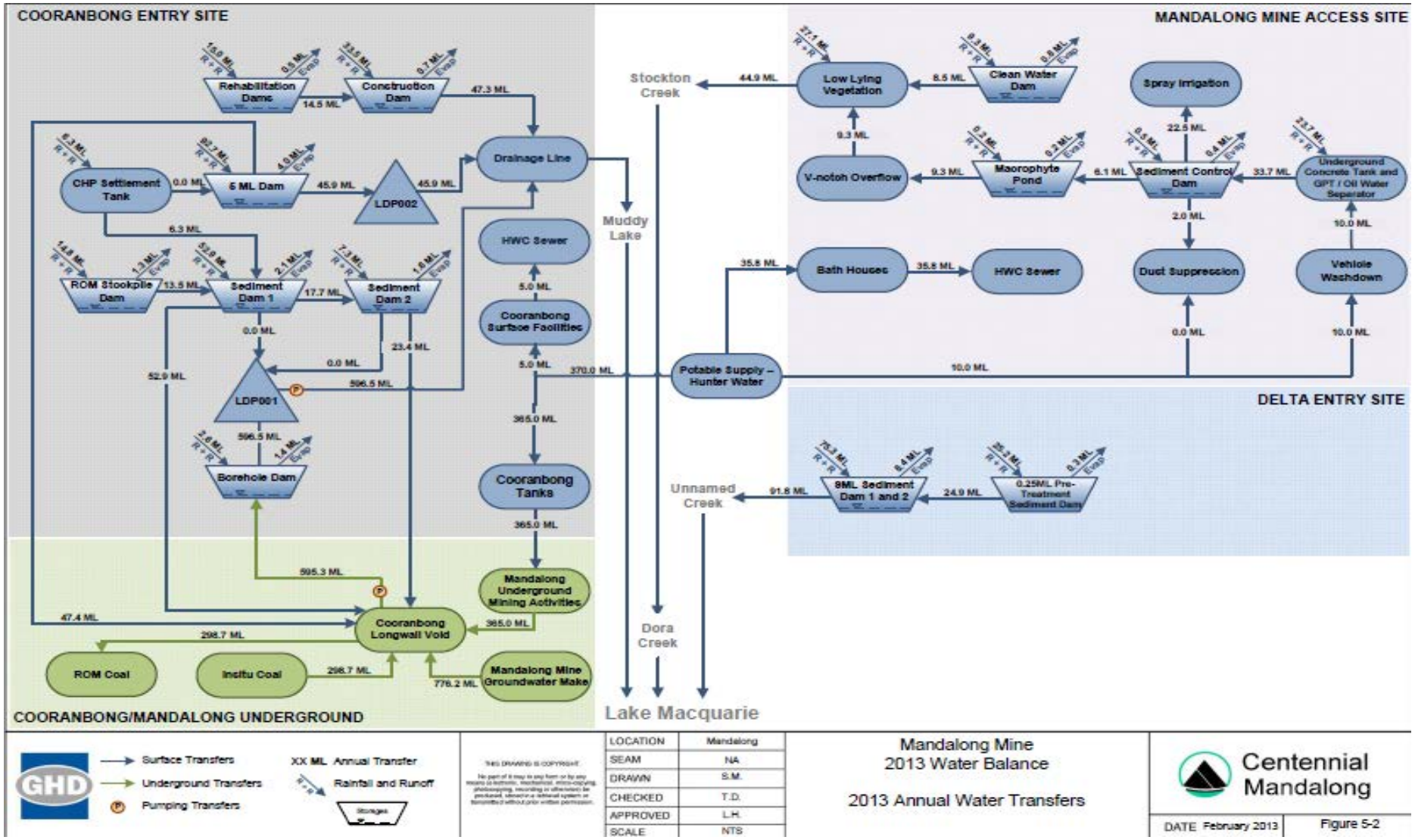
GHD's (2014) water balance model indicates 826.4 ML was discharged in 2013 from the Mandalong Mine, Cooranbong and Delta Services Sites. As shown in **Table 31** and **Source** (GHD, 2014)
Figure 18 this consisted of 44.9 ML from the Mandalong Mine Sediment Control Dam. A total of 689.7 ML was discharged from the Cooranbong Services Site, with 596.5 ML from LDP001, 45.9 ML from LDP002 (5 ML dam) and 47.3 ML from the construction dam (clean water dam). 91.8 ML of surface water run off water was discharged from Delta Entry Site dams.

The majority of discharged water from the sites is generated from surface water run-off as, shown in **Figure 18**. The exception being LDP001 at the Cooranbong Services Site. It is estimated 123.7 ML was pumped from the Cooranbong Settlement Dams to the underground to provide sufficient surface water storage during rainfall events.

Table 31: 2013 Water Balance Model

	Transfer in 2013 (ML/yr)	Source
INPUTS		
Direct Rainfall and Runoff	386.4	Water Balance Model
Potable Water Supply	415.8	Provided by Centennial
In Situ Coal Moisture	298.7	Water Balance Model
Inflows into Underground Workings	776.2	Hydrogeological Modelling (GHD, 2013)
TOTAL INPUTS	**1877**	
OUTPUTS		
Evaporation	21.7	Water Balance Model
Dust Suppression	2.0	Provided by Centennial
Spray Irrigation	22.5	Water Balance Model
Sewage to HWC	40.8	Water Balance Model
Discharge through LDP001 (Cooranbong)	596.5	Water Balance Model
Discharge through LDP002 (Cooranbong)	45.9	Water Balance Model
Discharge from Construction Dam (Cooranbong)	47.3	Water Balance Model
Discharge from Mandalong Mine Access Site	44.9	Water Balance Model
Discharge from Delta Entry Site	91.8	Water Balance Model
ROM coal moisture	298.7	Water Balance Model
TOTAL OUTPUTS	**1212**	
CHANGE IN STORAGE		
Cooranbong Longwall Void	669.6	Water Balance Model
Surface Water Storages	-4.6	Water Balance Model
TOTAL CHANGE IN STORAGE	**665**	
BALANCE		
Inputs – Outputs – Change in Storage	**0**	

Source (GHD, 2014)



Source (GHD, 2014)

Figure 18: GHD Water Balance Model 2013

9 REHABILITATION

9.1 BUILDINGS

Mandalong Mine

Construction of infrastructure discussed in section 1.1 including construction of the VAM-RAB facility and the Gas Flares was completed in 2013 as shown in plan **MG 10069**. No buildings or infrastructure were removed or decommissioned in 2013.

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 construction or decommissioning of buildings occurred at the Delta Entry Site in 2013 and as such no rehabilitation of buildings was undertaken.

Cooranbong Services Site

To ensure continuation of coal handling operations and mine support infrastructure, surface buildings and mine related infrastructure have been retained at the Cooranbong Services Site. The Cooranbong Services Site, CHP and supporting infrastructure were used in 2013 to supply coal to Eraring Power Station and to the Newstan Colliery for export. Other than the removal of infrastructure reported in previous AEMR's, no other buildings or infrastructure at the Cooranbong Services Site were removed or decommissioned from this site in 2013.

9.2 REHABILITATION OF DISTURBED LAND

Mandalong Mine

The majority of Mandalong Mine 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. Disturbance activities from the construction described in section 1.3 were largely within the Mine's existing operating footprint.

The new car park and demountable buildings water drainage have been connected into the existing surface water drains. The surface water structures at the Mine have previously been rehabilitated to prevent erosion and are stable.

Centennial received approval in 2011 (DA97/800 Modification 8) 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.

Consent 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, the consent condition 76A also requires that the progress of the rehabilitation be monitored annually for five years. This monitoring was conducted by Hunter Eco in November of 2013 and is described in Section 5.8.3 of this document.

Longwall Mining Area

The surface areas above the completed longwall mining panels are inspected as per the schedules prescribed in the approved LW15-17 Environmental Monitoring Plan and Subsidence Monitoring Plan (SMP). The EMP requires the floodpaths to be inspected every six months or after a flood event (refer to **Appendix 9**) and the SMP requires surface inspections during surveying of monitoring lines. During the course of these inspections observations are made on the progress of remedial measures implemented to minimise subsidence related effects.

The area disturbed during the construction of subsurface drainage, installed to alleviate remnant ponding above Longwall 6 on a Centennial owned property (56) was rehabilitated in October 2009. The area was inspected in 2013 following rainfall events. This confirmed the drains take up to seven days to remove ponded water from the paddock and varies depending on the amount of rainfall and the water level in Stockton Creek. Horses are able to use paddocks and are rotated out in wet conditions similar to other ponded areas of floodplain. This drying period is consistent with other areas of the flood plain which drain or dry out over a similar period.

The remanent ponding on Centennial's properties 59 & 61 above Longwalls 5 and 6 are now free draining following works to re-instate and extend existing surface drainage. Use by the tenants for cattle and other activates are now occurring as they did prior to mining.

Remnant ponding was observed on limited area above Longwall 7 situated on an existing low lying area of Centennial's properties in 2011. The area consists of exotic pasture species primarily used for horse grazing. Centennial Mandalong will investigate the possibility of fencing this area for the establishment of a wetland.

Exploration Sites

Eight surface exploration drill sites were prepared in 2013. Of these, only five sites required minor clearing (CM113 and CM117 to CM120). The drill sites were located within the Olney State Forest (CM113), a private Landholder (CM120) and Centennial owned land (CM107, CM115 to CM119). These sites were rehabilitated following the sealing of the boreholes. Existing tracks were utilised to again access to these exploration drill sites where possible and required limited vegetation clearing.

Above ground 20,000 litre drill sumps were used during the drilling process with only a small 500 litre tank dug into ground level. These sumps minimise the drilling fluids interaction with ground and greatly reduce the risk of drill sumps overflowing. The drill sumps where pumped out to remove and dispose of waste water and drill tailings then backfilled to re-instate the natural surface levels.

Sites CM 107, 113, 117 to 119 were seeded with native grass species consistent with surrounding areas. Sites CM 115 & 116 were seeded with non perennial grass species as these sites were located on horse grazing paddocks. The sites were lightly scarified to de-compact the soils using hand tools.

Forests NSW were consulted prior to commencing these works, so that the rehabilitation meet with their land use requirements. All rehabilitation works where completed by March 2013 and inspected by a Forests NSW representative on 26/03/13. Ongoing monitoring and maintenance of rehabilitated sites will be conducted in 2014 and reported in the AEMR.

Delta

Construction of the Delta coal clearance system was largely completed in 2005 and rehabilitation of the site was completed in 2006. Construction works were separated into two areas (refer to Plan **MG10131**). Stage one, located west of the existing Delta diversion drain consists of the portal, conveyor and fire fighting tanks. Stage two to the east of this drain consists of a transfer tower, crusher building and conveyors and the temporary topsoil stockpile located near the Delta 9 ML dams.

Rehabilitation at the Delta entry site was inspected in 2013 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 2012. 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.

The rehabilitation methods used on drainage lines have been successful as these are stable and are effective in directing surface runoff to sediment control structures.

Cooranbong Services Site

A total of 3.9 hectares have been disturbed from the construction of the upgrades to the CHP and haul road as described in section 1.3 at the Cooranbong Services Site in 2009. Construction activities where completed in May 2010 with all disturbed areas rehabilitated by the contractor (Leighton) shortly after. No further rehabilitation works were undertaken in 2013.

Mandalong Haul Road

The haul road construction has resulted in approximately 18 ha 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 as shown in plan **MG11217**. 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 Awaba Colliery Mining Lease. Of this, nine hectares along the haul road was rehabilitated in 2009 as described in the 2009 AEMR. Six hectares of land will not be rehabilitated as it is occupied by haul road infrastructure.

As per the requirement of the Mandalong Haul Road Landscape and Rehabilitation Plan, Jeff Dunwoodie (Environment & Community Coordinator) & Morgan Gleeson (Environmental Officer) audited the rehabilitation on the haul road in September 2013. 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 2013 audit focused on identifying sites where remedial action or maintenance is required to bring sites to an acceptable standard. The inspection strategy involved two people inspecting the full length of the Haul Road to address 100% of the disturbed area.

In total 9 sites were inspected and recorded an action priority from highest to lowest. The highest priorities included maintenance of sediment and erosion controls in the Hussey Quarry and along the Haul Road drains.

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 2013. Maintenance and effectiveness of the haul road rehabilitation will be assessed in 2014 and reported in the next AEMR.

9.3 OTHER INFRASTRUCTURE

No other infrastructure was rehabilitated during the reporting period.

9.4 REHABILITATION TRIALS AND RESEARCH

Moran's Creek Rehabilitation Trials

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 valley. The Moran's Creek Rehabilitation trial was initiated in 2007 to respond to local landowner concerns in particular the historical erosion on Moran's Creek caused by flood flows and stock accessing creek areas. Local landowner's sited 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 Moran's 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 inspections in 2011, 2012 and 2013 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 Moran's Creek. Weed spraying was conducted in 2013 to control Tobacco, Scotch Thistle and Blackberry.

The 2000 tube stock planted in November 2008 along the fenced Moran's Creek rehabilitation corridor are now established along Moran's Creek with trees heights of up to 1-2 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.

Translocation Research Program

Field investigation for the haul road project had established that the local populations of *Grevillea parviflora subsp. parviflora* and *Tetratheca juncea* were so extensive that it would not be possible to avoid the loss of some plants of these species no matter where the haul road was located. Consequently a translocation research programme had been developed in consultation with EPA for the translocation and ongoing monitoring and reporting for the threatened flora species *Tetratheca juncea* and *Grevillea parviflora* that would have otherwise been lost as a result of the haul road construction. The main aim of this translocation project was to implement an experimental model that would add to the knowledge base regarding the translocation of these species, building on available information from any previous attempts. The overall experiment ran for 5 years with interim reports prepared at the end of each year and a final report after the 5th year. Hunter Eco produced the final Centennial Coal Cooranbong-Awaba Haul Road Threatened Flora Translocation Monitoring Report for Centennial Coal in November 2013 (Hunter Eco, 2013a).

In January 2010 the first detailed monitoring report was completed by inspection of all sites containing the translocated threatened plant species within and around the haul road. The current report by Hunter Eco *"Cooranbong-Awaba Haul Road Threatened Flora Translocation Report"* (2013a), has established the extensive presence of *Grevillea parviflora* subsp. *pariflora* and *Tetratheca juncea* that has undergone a threatened flora translocation research programme between 27 April 2009 and 6 May 2009.

One recipient site for *Grevillea parviflora* subsp *parviflora* and three sites for *Tetrathea juncea* were established which were translocated by methods of an excavator and individual clumping.

Grevillea parviflora* subsp. *parviflora

Translocation of this taxon appears to have been a success with the population established, consisting of robust mature plants along with a range of early successional plants. There was no evidence of fruit production despite consistent flowering so it is likely that the smaller plants are clones sprouting from underground rhizomes.

Tetratheca juncea

There were three aims of this translocation experiment:
1. To compare translocating individual clumps (Site 2) with using an excavator to move large groups of clumps (Sites 3 and 4);
2. At Site 2, to determine whether loosening of soil around the recipient hole facilitated vegetative spread compared with unloosened soil;
3. At Site 3, to determine whether translocating *Tetratheca juncea* using an excavator could assist in rehabilitating a highly disturbed area.

Unfortunately these aims were thwarted by heavy grazing of the translocated *Tetratheca juncea* by herbivores at all three sites. Grazing pressure was such that the translocated clumps were not able to establish themselves. In this regard, comparison can be made with the *Tetratheca juncea* translocation experiment conducted at Gwandalan (Driscoll and Bell 2008 in (Hunter Eco, 2013a)) where herbivory was not a problem. That experiment was subdivided into ten groups of ten clumps each, all located in a variety of habitat types. In favourable habitat survival was as high as 90% after five years.

Nest Box Research Program

Habitat hollows are an important resource utilised by a variety of forest fauna. The abundance of hollow bearing trees in the Australian context is important for the survival of many endemic species. Many threatened species are obligate users that require the presence of hollows to survive and reproduce.

Nest boxes have been installed within the surrounding haul road vegetation communities as part of the offset strategy for the clearing of vegetation and hollow bearing trees required for the construction of the haul road. A research based approach to the installation and monitoring of nest boxes has been developed to more effectively offset the loss of hollow bearing limbs caused by the construction of the private haul road. The Mandalong haul road nest box research program will investigate factors that influence the use of nest boxes and the value that such nest box programs provide as an offset/management tool. Several research questions will be examined experimentally as part of the nest box research programme. These are:

- The impact of micro-climate on nest box use and the effect of nest box design (experiment 1). In particular, this will look at the temperature extremes and fluctuations experienced in standard nest box design versus naturally occurring hollows, and examine the effects of varying wall thickness (insulation) on reducing unfavourable microclimatic conditions within the nest boxes.
- The effect of nest box placement: does aspect matter (experiment 2). This involves examining the effect of differing aspects on nest box inhabitation. This will also be linked to microclimate within the nest boxes.
- Examining utilisation rates of nest boxes in areas of varying natural hollow density (experiment 3). This will involve an examination of the density of naturally occurring habitat hollows each experimental quadrat and correlating this to the rate of nest box use.

In January 2010 Ecobiological installed 150 nest boxes distributed across 15 quadrats (10 in each) located alongside the western perimeter of the haul road. The experimental design adopted, allowed each quadrat having four of each single walled nest box type (bat and glider) and one of each double-walled nest box type (bat and gilder). The two double-walled boxes were placed at a northern aspect in all quadrats, and the remaining eight, one of each design, at each aspect.

The inspection of all 150 nest boxes was undertaken by Kleinfelder (formerly Ecobiological) on the 12th and 13th of June 2013. A summary of the report is provided as follows.

Nest box usage is recorded in two ways:

a) actual use, animal sighted in the nest box; and
b) evidence of use which includes relatively recent nests or scats.

A total of 37 (25.7%) nest boxes were found to contain evidence of recent use during the winter 2013 surveys. This is an increase in recent usage from the 2013 summer survey (+2.25%) which is in accordance with the evident trend of nest box usage being significantly higher during the winter months. It is however a 7.6% decrease since last winter (2012). Animals present within nest boxes at the time of surveys rose to 9.33% from 6% in the 2013 summer period, however actual usage didn't meet the 2012 winter survey period of 22 nest boxes containing animals (14.7%) which is the highest to date.

The overall number of nest boxes that have contained any signs of use or an animal present over the last 3.5 years is 81 boxes out of the 150 boxes on site (54%). This rose from the last survey with four new boxes being utilised. The total usage of boxes has, as expected, continued to increase.

The use of nest boxes of each aspect has continued to increase since 2010 with a number of trends emerging during this time. Past analysis identified north and west facing boxes being favoured over east and south facing boxes however, with the addition of the winter 2013 data, the trend has altered and north facing boxes have declined in their level of preference.

Since the 2010 surveys, the thickness of nest box wall has shown to have a marked effect on their use, season to season. In winter 2013, the single walled boxes displayed a significant spike in use and for the first time had a higher usage rate that double walled boxes (26.5% and 22.2% respectively).

In addition to the highest usage rate to date (combined actual and evidence data), several other important results were found during surveys. Squirrel Gliders Petaurus norfolcensis, listed as Vulnerable under the Threatened Species Act 1995 (NSW) have been found occasionally since 2011 with generally only one nest box occupied. In the winter 2013 survey however, two separate groups (Q15 and Q2) were recorded. This is an important and encouraging sign for this species and the overall ecosystem health in the offset area.

The seventh nest box inspection was completed successfully and the subsequent data analysis has reinforced trends seen throughout the previous six surveys.

10 ENVIRONMENTAL MANAGEMENT TARGETS AND STRATEGIES

This section details the environmental management targets and strategies for the reporting period in accordance with condition 105(viii) of the consent. Targets and strategies for the Delta Entry Site are also provided in this section as part of the overall management of the Mandalong Mine, although this is not specifically required by any condition of consent.

10.1 SUMMARY OF PREVIOUS TARGETS

Several actions were committed for completion during this reporting period. A summary of actions completed during the 2013 period is shown in **Table 32**.

Table 32: Summary of Targets completed during 2013

Mandalong Mine Site – Planned Action	Status
▪ Commissioning and operation of Gas Flares	▪ Final commissioning completed and automated operations commenced in November 2013.
▪ Commissioning and operation of VAM-RAB	▪ The commissioning of the VAM-RAB facility without gas was completed in November, with hot commissioning commencing in December and the first simulated trial will commence in February 2014.
▪ Investigate installation of PM10 monitoring equipment.	▪ A PM10 High-Volume Air Sampler was installed at the Mandalong South Project Office in September 2013.
Delta Entry – Planned Action	
▪ None	▪ Not applicable.
Cooranbong Site – Planned Action	
▪ Install a dedicated truck wash at the truck turning circle	▪ The truck wheel wash was installed and operational at Cooranbong in October 2013.
▪ Install water cannons for localised dust control during loading off the stockpile.	▪ The water cannons were installed adjacent to the ROM stockpile in mid 2013.
▪ Finalise Settlement Dam De-watering bore project	▪ The Project was completed in 2013.
▪ Complete upgrade to 5ML Dam.	▪ Upgrade works to the 5ML Dam were completed in 2013.
▪ Install a real-time noise monitoring system	▪ A real-time noise monitoring system was installed and operational at Cooranbong in March 2013.
▪ Install a TEOM air quality monitoring system	▪ Continuous PM10 and TSP monitors (TEOMs) were installed at Cooranbong in June 2013.
▪ Complete noise mitigation works for 1200t export bin / truck loading system	▪ A sound wall was installed adjacent to the 1200 t export bin / truck loading system in March 2013.
▪ Complete cladding upgrades to CHP and rotary breaker building for noise mitigation.	▪ The cladding upgrade to the CHP and rotary breaker buildings is scheduled to be completed by June 2014.

10.2 TARGETS FOR 2014

The environmental targets associated with the Mandalong Mine during the next twelve-month reporting period are summarised in **Table 33**. Some actions were derived from the risk assessment document completed for the DRE Annual Environmental Risk Assessment.

Table 33: Summary of Targets for the period January 2014 to December 2014

Mandalong Mine
▪ Continue VAM-RAB demonstration trial.
Cooranbong Services Site
▪ Complete cladding upgrades to CHP and rotary breaker building for noise mitigation.
Delta Entry Site
▪ Complete installation of final sediment sump ▪ Complete de-silting of 9ML Dam

10.3 MINE WATER REDUCTION TARGETS

Consent Condition 66 requires the mine to investigate opportunities to reduce mine water discharge at Mandalong and report on such in the AEMR. The GHD (2014) water balance model estimated 596.5 ML of water from the underground mine and surface water discharge from LDP001 in 2013 (see Section 8.5 for further details) which is slightly higher than the water volume discharged in 2012 (570.5 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 & 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.

Centennial Coal in 2013 continued investigations into conventional water treatment and reuse options on a regional basis by undertaking initial collating of water quality and discharge requirements for the Centennial mines in the region.

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PLANS

APPENDICES