

Mount Thorley Warkworth

2014 Annual Environmental Review

March 2015



Rehabilitation Progress adjacent the Warkworth CHPP and the Golden Highway

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Name of Mine	Mount Thorley Warkworth
Titles/Mining Leases	Contained within Section 1.3 of this report
Annual Review Commencement Date	01/01/2014
Annual Review End Date	31/12/2014
Name of Leaseholder	Mount Thorley Warkworth Operations Pty Ltd Warkworth Mining Limited
Name of Mine Operator	Coal & Allied Operations Pty Limited
Reporting Officer	Mr Mark Rodgers
Title	General Manager Operations
Signature:	
Date:	27 March 2015

Executive Summary

Mount Thorley Warkworth (MTW) is an integrated operation of two open cut coal mines, Warkworth Mining Limited (WML) and Mount Thorley Operations (MTO). This Annual Environmental Review (Annual Review) reports on the environmental performance of Mount Thorley Warkworth (MTW) for the period 1 January 2014 to 31 December 2014.

This document has been prepared to meet the requirements of an Annual Environmental Management Report (AEMR) described in *Guidelines to the Mining, Rehabilitation and Environmental Management Process* (NSW Department of Trade and Investment, 2012) and following the *Guideline for Preparation of Annual Environmental Management Review (Annual Review) December 2012 (Draft)* from the Department of Planning and Environment (DP&E).

MTW produced 17.7 million tonnes of run-of-mine (ROM) coal during 2014, and 11.9 million tonnes of saleable coal, against an approved ROM coal production rate of 28 million tonnes per annum (mtpa).

Noise

MTW manages noise to ensure compliance with permissible noise limits at nearby private residences. Work continued during 2014 to reduce the noise from MTW's Heavy Mobile Equipment (HME) fleet. As at February 2015, 28% of Haul Trucks, 63% of Dozers and 38% of other Heavy Fleet are operating as sound suppressed units, attenuated to the "Stage Two" target of 115dB(A). There were no noise non compliances recorded against MTW's development consent limits. A total of 20,470 hours of mine stoppage were recorded due to proactive and reactive measures to minimise noise.

Blasting

During the reporting period 390 blast events were initiated at MTW. There were no non compliances against blasting conditions in MTW's development consents and licence conditions. MTW employs a blast fume management protocol to mitigate generation of post blast fume emissions. Three category 3 blast fumes were recorded in 2014. No category 4 or 5 fumes were recorded.

Air Quality

During 2014, MTW complied with all short term and annual average air quality criteria. A total of 7,110 hours of mine stoppage was recorded due to proactive and reactive measures to minimise dust. MTW achieved a haul road dust control efficiency of 97% against a target of 80% required by the EPA's dust pollution reduction programme. A total of 382 ha of land was aerial seeded during autumn to minimise wind eroded dust from overburden areas not yet available for rehabilitation.

Surface Water

MTW significantly reduced Hunter River intake in 2014 due to improved access to alternative external mine water supplies and revised inventory management practices. Improvements were made to increase water segregation and containment capacity for stormwater runoff emanating from the site. Works included upgrade of the Warkworth clean coal conveyor catchment (CC5) and rehabilitation of an old coal pad at the Mount Thorley Coal Loader.

Three incidents involving water leaving the mine premise required notification to government agencies. One incident was due to rupture of a pipeline during transfer of mine water. Two incidents involved sediment dams overtopping following high intensity rainfall events. Each incident was thoroughly investigated with corrective and preventative actions implemented.

Groundwater

Groundwater monitoring activities were undertaken in 2014 in accordance with the MTW Water Management Plan and groundwater monitoring programme. The monitoring results are used to establish and monitor trends in physical and geochemical parameters of surrounding groundwater potentially influenced by mining.

Groundwater monitoring data is reviewed on a quarterly basis. There were no non-compliances related to groundwater in 2014.

Visual amenity

Improvements were made to the visual appearance of the mine with substantial rehabilitation of east facing waste dumps in Warkworth's South Pit. The mine received 15 lighting complaints from 10 households. Lighting complaints are investigated and light emissions from the mine are routinely checked at night by the Community Response Officers.

Rehabilitation and Land Management

A total of 104.1 ha rehabilitation was undertaken during 2014 against a MOP target of 102.1 ha. Total disturbance undertaken during 2014 was 122.6ha which was 36.7ha lower than the MOP projection.. Rehabilitation quality improvements were progressed including the use of mixed waste compost to improve soil fertility, direct drilling of seed, use of cover crops and utilising seed harvesting areas to facilitate use of locally sourced seed. An accelerated rehabilitation plan for Warkworth's South Pit was submitted and approved by the Department of Planning and Environment.

Tailings Dam1 rehabilitation progressed with completion of the first stage of capping.

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Appendix 1 – Reference Guide to DRE and DPE guidelines

Appendix 2 – Summary of Complaints 2014

Appendix 3 – Incident Summary 2014

Appendix 4 – Rehabilitation Table

Appendix 5 – Rehabilitation and Disturbance Summary and Maps

Appendix 6 – Rehabilitation Monitoring Report

List of Abbreviations

ACARP	Australian Coal Association Research Program	EEO Act	<i>Energy Efficiency Opportunities Act 2006</i>
AHCS	Aboriginal Heritage Conservation Strategy	EIS	Environmental Impact Statement
ADCC	Aboriginal Development Consultative Committee	EPA	Environmental Protection Agency
AEMR	Annual Environmental Management Report	EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>
AHIMS	Aboriginal Heritage Information Management System	EPL	Environment Protection Licence
AS	Australian Standard	FFMP	Flora and Fauna Management Plan
CCL	Consolidated Coal Lease	GDP	Ground Disturbance Permit
CHAG	Community Heritage Advisory Group	GIS	Geographic Information System
CHPP	Coal Handling Preparation Plant	HMA	Habitat Management Area
CHWG	Cultural Heritage Working Group	HMP	Heritage Management Plan
CL	Coal Lease	HRSTS	Hunter River Salinity Trading Scheme
CO2CRC	The Cooperative Research Centre for Greenhouse Gas Technologies	HSEQ MS	Health, Safety, Environment & Quality Management System
DA	Development Application	HVAS	High Volume Air Samplers
DC	Development Consent	HVO	Hunter Valley Operations
DECC	NSW Department of Environment and Climate Change	INP	NSW EPA Industrial Noise Policy
DPI	NSW Department of Primary Industries	ML	Mining Lease
DP&E	NSW Department of Planning & Environment	MLA	Mining Lease Application
DRE	NSW Division of Resources and Energy	MOP	Mining Operations Plan
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities	MTIE	Mount Thorley Industrial Estate

EA	Environmental Assessment	MTO	Mount Thorley Operations
EC	Electrical Conductivity	MTJV	Mount Thorley Joint Venture
EEC	Endangered Ecological Community	MTW	Mount Thorley Warkworth
NCCSC	Australian National Carbon Capture and Storage Council	RL	Reduced Level
NSWCCC	New South Wales Clean Coal Council	ROM	Run of Mine
NDA	Non-Disturbance Area	RMS	NSW Department of Roads and Maritime Services
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>	SCADA	Supervisory Control and Data Acquisition
NHMRC	National Health and Medical Research Council	TEOM	Tapered Element Oscillating Microbalance
NOW	NSW Office of Water	TSP	Total Suspended Particulates
NPWS	National Parks and Wildlife Service	TSS	Total Suspended Solids
OCE	Open Cut Examiner	UHAQMN	Upper Hunter Air Quality Monitoring Network
OEH	Office of Environment & Heritage	UNE	University of New England
PA	Project Approval	WAL	Water Access Licence
pH	Measure of the hydrogen ion concentration, [H ⁺]	WML	Warkworth Mining Limited
PM ₁₀	Particulate Matter < 10 micron units	WSW	Warkworth Sands Woodland

List of Symbols

<	less than
>	greater than
dB(A)	decibels ("a" weighted)
dB (L)	decibels (linear)
g/m ²	grams per square metre
bcm	bank cubic meters
kg	kilogram
t	tonne
kt	kilotonnes
kL	kilolitre
L/s	litres per second
L/t	litres per tonne
m	metre
μ	micron
μg	micrograms
mg	milligrams
mg/L	milligrams per litre
μS/cm	microsiemens per centimetre
m	metre
m ²	square metre
m ³	cubic metre
mm	millimetres
mg/L	milligrams/litre
mm/s	millimetres/second
ML	mega litre
t	tonnes
Mtpa	million tonnes per annum
Ha	hectares
MWh	mega watt hours
GJ	giga joules
tCO ₂ -e	tonnes carbon dioxide equivalent

1. INTRODUCTION

Mount Thorley Warkworth Coal Mine (MTW) is an integrated operation consisting of Warkworth Mining Limited (WML) and Mount Thorley Operations (MTO), situated 14 km southwest of Singleton, in the Upper Hunter Valley region of NSW.

MTW is managed and operated by Coal & Allied, a Rio Tinto Group Company, on behalf of the joint venture partners:

- Mount Thorley: Coal & Allied Industries Limited (80%) and POSCO Australia Pty Ltd (20%)
- Warkworth: Coal & Allied Warkworth Australasia Pty Ltd (26.82%), Coal & Allied resources Limited (28.75%), Mitsubishi Development Pty Ltd (28.9%), Nippon Steel Australia Pty Ltd (9.53%), Mitsubishi Materials [Australia] Pty Limited (6%)

MTW is located in an area adjacent to other coal mines (Figure 1). Other industry in the locality includes: the Mount Thorley Industrial Estate; the Dyno Nobel Facility; Steggles Quarantine Facility; and the Redbank Power Station. Other surrounding land uses predominantly consist of a military base and agriculture. The villages of Bulga and Warkworth are located to the southwest and northwest of MTW operations respectively.

1.1 Document purpose

This report summarises the environmental performance of MTW for the period 1 January 2014 to 31 December 2014 and has been prepared in accordance with conditions of the development consents and Mining Leases (ML) held by MTW which require a report of the operation's environmental performance to be provided on an annual basis. This document has been prepared to meet the requirements of an Annual Environmental Management Report (AEMR) described in Guidelines to the Mining, Rehabilitation and Environmental Management Process (NSW Department of Trade and Investment, 2012) and following the Guideline for Preparation of Annual Environmental Management Review (Annual Review) (Draft) from the Department of Planning and Environment (DP&E).

Mount Thorley Warkworth Site Layout and Locality Plan

Date: 150304

Plan By: HF

Version: 2.0

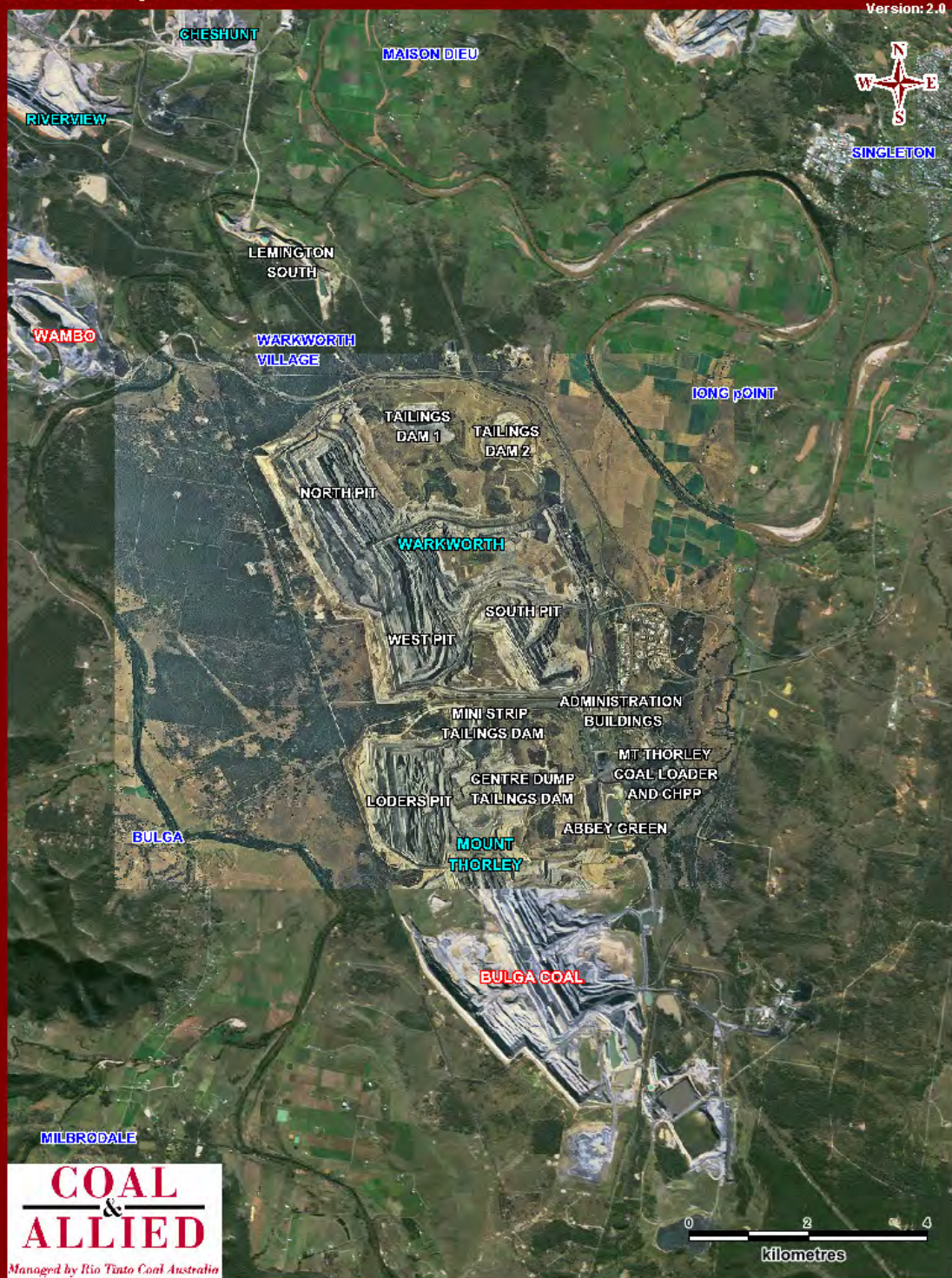


Figure 1: MTW Site Layout and Locality Plan

1.2 Reference Table

Table 1 is a brief summary of the conditions of the consent relevant to this Annual Review, and a reference to where each aspect is addressed within this Annual Review.

Table 1: Reference Table

Environmental Performance Condition	Compliance with Consent Conditions and MOP	Compliance with EA/EIS Prediction
Meteorological monitoring	3.1	NA
Noise	3.2	3.2.6
Blasting	3.3	3.3.2.1
Air Quality	3.4.2	3.4.3
Greenhouse & energy efficiency	3.5.2	NA
Surface water	3.7.2.3	3.7.2.1
Ground water	3.8.2	3.8.2.2
Biodiversity	5.12.1	NA
Aboriginal heritage	2.1.5.1	NA
European heritage	2.1.5.6	NA
Visual amenity	3.11	NA
Waste management	3.13.2	NA
Community engagement	4.2	NA
Rehabilitation and Landscape	5.1.1	5.4

Legend

Compliant	
Condition/impact criteria non-compliance	
Administrative Non-Compliance	

1.3 Approvals, leases and licenses

1.3.1 Current Approvals

The status of MTO and WML development consents, licenses and relevant approvals at 31st December 2014 are summarised in Table 2 to Table 8.

Table 2: Operations Approvals- Warkworth

Approval Number	Description	Authority	Dates
PA 09_0202	Warkworth Extension Project	DP&E	Approved 03/02/2012 Disapproved 15/04/2013
DA 300-9-2002-i	Extension of Warkworth Coal Mine – Extend Mining to Wallaby Scrub Road	DP&E	20/5/2003
DA 300-9-2002-i Mod 1	Modification of DA 300-9-2002-i – Rejects and ROM Bins Modifications	DP&E	19/10/2004
DA 300-9-2002-i Mod 2	S96(1) modification of the original Lot and DP schedule in DA 300-9-2002-i	DP&E	2/2/2007
DA 300-9-2002-i Mod 3	S96(2) modification of DA 300-9-2002-i for upgrades to the MTW electrical switchyard	DP&E	31/10/2007
DA 300-9-2002-i Mod 4	S75W modification of DA 300-9-2002-i for the coal bed methane pilot programme	DP&E	15/9/2008
DA 300-9-2002-i Mod 5	S96 (1A) modification of DA 300-9-2002-i for the relocation of the Reload Facility and Light Vehicle Wash Bay	DP&E	28/10/2009
DA 300-9-2002-I Mod 6	S75W modification of DA 300-9-2002-i for a 350m extension of mining activities	DP&E	29/01/2014
DA 292/2009	Demolition of buildings at 573 Wallaby Scrub Road, WARKWORTH (Lot 16 DP 755267) in Rural 1(a)	DP&E	8/10/2009 – 8/10/2014
EPBC 2009/5081	Approval under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) to extend the existing Warkworth Coal Mine over an additional 705 hectares of land at Warkworth NSW including associated modifications to existing mine infrastructure	DSEWPac	9/8/2012 – 31/3/2033
EPBC 2002/629	Approval under the EPBC Act to construct and operate an open cut coal mine extension at the Warkworth Coal Mine	DSEWPac	18/2/2004 (varied on 6/4/2004, 24/5/2004, 19/11/2004 and 13/7/2012) – 25/2/2039

Table 3: Operations Approvals - Mount Thorley

Approval Number	Description	Authority	Dates
DA 34/95	Development Consent Conditions - Construction and Operation of Surface Coal Mine Extensions.	DP&E	22/6/1996
DA 34/95 Mod 3	Modification of DA 34/95 – Rejects and ROM Bins Modifications	DP&E	19/10/2004
DA 34/95 Mod 4	Section 96 (1A) Modification of DA 34/95 – Extension to Mine Water Dam 9S	DP&E	7/5/2009
DA 34/95 Mod 5	Section 96 (1A) Modification of DA 34/95 – Extension of the existing Abbey Green North Pit	DP&E	2/5/2012 – 2/5/2033

Table 4: Licences and Permits

Licence Number	Description	Authority	Expiry Date
Warkworth			
EPL1376	Environmental Protection Licence	EPA	N/A
NDG018727*	Dangerous Goods Licence	WorkCover	N/A
28725	Radiation Licence	EPA	15 August 2014, after which replaced by RML28725 below
RML28725	Radiation Licence	EPA	2 May 2015
XSTR100160	Licence to Store – Explosives Act	WorkCover NSW	13 November 2018
Mount Thorley			
EPL24	Environmental Protection Licence	EPA	N/A
EPL1976	Environmental Protection Licence	EPA	N/A
NDG018727*	Dangerous Goods Licence	WorkCover	N/A
28618	Radiation Licence	EPA	15 July 2014, after which replaced by RML28618 below
RML28618	Radiation Licence	EPA	31 July 2015

* Mount Thorley and Warkworth are now operating under the same Dangerous Goods License

Note: Environmental Protection Licences remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Table 5: Mining Tenements

Mining Tenement	Type	Purpose	Status	Dates
Warkworth				
CCL 753	Consolidated Coal Lease	Prospecting and Mining Coal	Granted	23/5/1990 - 17/2/2023
ML 1412	Mining Lease	Prospecting and Mining Coal	Granted	11/1/1997 - 10/1/2018
ML 1590	Mining Lease	Prospecting and Mining Coal	Granted	27/2/2007 - 26/2/2028
MLA 352	Mining Lease Application	Prospecting, Mining Coal and Purposes	Application Pending	Mining Lease Application Lodged 2 nd June 2010
Mount Thorley				
CL 219	Coal Lease	Prospecting and Mining Coal	Granted	23/09/1981 - 22/09/2023
(Part) ML 1547	Sub-Lease	Mining Purposes	Registered	The part sublease area known as the "Bulga Mining Sublease" expires on 30 June 2015. The part sublease area known as the "Western Area Sublease" terminates on the later of 31 December 2015; or the completion of open-cut mining within the Bulga Mine.
EL 7712	Exploration Licence	Prospecting Coal	Granted	23/2/2011 - 22/02/2016
MLA 353	Mining Lease Application	Prospecting, Mining Coal and Purposes	Application Pending	Mining Lease Application Lodged 2 June 2010

Note: The authority for all mining tenements is Department of Trade and Investment, Regional Infrastructure and Services (Resources & Energy Division).

Table 6: Other Approvals

Approval	Authority	Dates
Emplacement Areas		
Warkworth		
Swan Lake Void	DPI	21/10/2002
Tailings Dam 2	DPI	22/10/2002
Tailings Dam 2 –130RL	DPI	9/12/2003
Mount Thorley		
Section 126 Variation to Reject Emplacement Area	DPI	20/3/2001
Section 126 Construction of Reject Emplacement Area Centre Ramp Tailings Dam	DPI	9/4/2001
Mini Strip 24 Tailings Storage Facility	DPI	8/9/2004
Dam Safety Committee Centre Ramp Tailings Storage Facility Stage 2	DPI	12/2/2004
Section 126 Centre Ramp Tailings Dam – Raising height of embankment	DPI	10/5/2006
Section 126 Abbey Green South Tailings Dam	DPI	10/5/2006
Other Approvals		
Installation of a single 500mm water pipeline under Putty Road	RMS	31/10/2007
Installation of two 600mm tailings pipelines under Putty Road	RMS	1/2/2007
Resource Recovery Exemption for coal washery rejects at Mount Thorley Warkworth	DECC	1/2/2010

Table 7: Water Licences

Licence Number	Type	Purpose	Legislation	Description	Renewal Date
20BL168821	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: MTAGP1, MTAGP2, ABGOH07, ABGOH43, ABGOH44, ABGOH45	Perpetuity
20BL170011	Bore	Excavation - Mining	Part 5 Water Act 1912	Mount Thorley Excavation	26 November 2016
20BL170012	Bore	Excavation - Mining	Part 5 Water Act 1912	Warkworth Pit Excavation	26 November 2016
20BL171729	Bore	Monitoring Bore	Part 5 Water Act 1912	G3 Charlton Levee	Perpetuity

Licence Number	Type	Purpose	Legislation	Description	Renewal Date
20BL171841	Bore	Monitoring Bore	Part 5 Water Act 1912	OH1126	Perpetuity
20BL171842	Bore	Monitoring Bore	Part 5 Water Act 1912	OH944	Perpetuity
20BL171843	Bore	Monitoring Bore	Part 5 Water Act 1912	OH1137	Perpetuity
20BL171844	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: OH1123 (E), OH1123 (W)	Perpetuity
20BL171845	Bore	Monitoring Bore	Part 5 Water Act 1912	OH1124	Perpetuity
20BL171847	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: OH1127, OH787	Perpetuity
20BL171848	Bore	Monitoring Bore	Part 5 Water Act 1912	OH1125	Perpetuity
20BL171849	Bore	Monitoring Bore	Part 5 Water Act 1912	OH1122	Perpetuity
20BL171850	Bore	Monitoring Bore	Part 5 Water Act 1912	OH1138	Perpetuity
20BL171864	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: OH786, OH942	Perpetuity
20BL171891	Bore	Monitoring Bore	Part 5 Water Act 1912	Bores: OH1121, OH788, OH943	Perpetuity
20BL171892	Bore	Monitoring Bore	Part 5 Water Act 1914	Bores: WOH2153 (PZ2), WOH2154 (PZ1), WOH2155 (PZ4), WOH2156 (PZ3)	Perpetuity
20BL171893	Bore	Monitoring Bore	Part 5 Water Act 1918	Bores: WOH2141 (PZ6), Ground Water Alluvial Modelling	Perpetuity
20BL171894	Bore	Monitoring Bore	Part 5 Water Act 1913	WOH2139 (PZ5)	Perpetuity
20BL172272	Bore	Monitoring Bore	Part 5 Water Act 1912	Warkworth Expansion Ground Water Alluvial Modelling	Perpetuity
20BL172273	Bore	Monitoring Bore	Part 5 Water Act 1912	Warkworth Expansion Ground Water Alluvial Modelling	Perpetuity
20CW802601	Controlled Work	Block Dam	Part 8 Water Act 1912	Charlton Rd Levee	24 August 2015

Licence Number	Type	Purpose	Legislation	Description	Renewal Date
20WA209905 WAL - TBA (Formerly 20SL051292)	Stream Diversion	Bywash Dams	Water Management Act 2000	Doctors Creek Bywash	31 July 2022
20CA209904 WAL - 19022	Stream Diversion	Bywash Dams	Water Management Act 2000	Sandy Hollow Creek	25 February 2023

Table 8: Surface Water Extraction Licenses

Licence Number	Type	Purpose	Description	Renewal Date	Approved Extraction (ML)*	Actual Extraction 2014 (ML)
20AL201242 (see WAL963)	Water Access Licence	Water Access Licence	Warkworth Mining Limited Hunter River Pump (General Security)	Perpetuity	243	0
20AL209903 (Formerly - 20SL050187) (see WAL19022)	Diversion Works	Irrigation	Sandy Hollow Creek (Unregulated River – Singleton Water Source)	25 February 2023	60	0
20AL201254 (see WAL969)	Water Access Licence	Water Access Licence	Glennies Creek Pump (General Security)	Perpetuity	39	0
WAL10543	Water Access Licence	Certificate of Title	Refer 20AL201239 and 20WA201241	Perpetuity	2226	854
WAL10544	Water Access Licence	Certificate of Title	Refer 20AL201240 and 20WA201241 (Hunter Regulated River – Domestic and Stock)	Perpetuity	5	0

Licence Number	Type	Purpose	Description	Renewal Date	Approved Extraction (ML)*	Actual Extraction 2014 (ML)
WAL963	Water Access Licence	Certificate of Title	Refer 20AL201242 and 20AL201242	Perpetuity	243	0
WAL19022	Water Access Licence	Certificate of Title	Refer 20AL209903 and 20CA209904	25 February 2023	60	0
WAL969	Water Access Licence	Certificate of Title	Refer 20AL201254 and 20CA201255	Perpetuity	39	0

* Approved extraction limits are for a financial year.

Permanent entitlements held is 1,012ML, however 1,214ML of temporary entitlements traded into WAL10543 in 13/14 financial year.

1.3.2 Amendments to Approvals and Licenses

1.3.2.1 Modification 6

On 29 January 2014, the Planning and Assessment Commission approved a small extension to the existing mine footprint. The modification comprises a 350 metre (m) extension of Warkworth Mine's disturbance limit for West Pit, which includes up to 300 m of mining activities and approximately 50 m disturbance west of this mining area for the provision of mining infrastructure, such as roads and water management infrastructure. The extension of West Pit allows for the mining of economic resources outside of the existing development consent boundary. Approximately 13 million tonnes of coal would be extracted from the area over a two year period.

1.3.2.2 Environmental Protection Licences

Environment Protection Licences 1376 (Warkworth) and 1976 (Mount Thorley) were each varied on 16 October 2014 by way of Section 58(5) notice. No variation to Environmental Protection Licence 24 (Mount Thorley Coal Loader) occurred during the reporting period.

The licence variations of 16 October introduced Pollution Reduction Programmes (PRP's) to licences 1376 and 1976 entitled *Coal Mine Wind Erosion and Exposed Land Assessment*. This PRP was introduced on an industry wide basis.

1.3.2.3 Environmental Protection and Biodiversity Conservation Act 1999 Approval

The Commonwealth Department of the Environment approved two Offset Management Plans prepared by WML in 2014. The Regional Offset Management Plan details the long term management and protection of offset areas within the Bowditch and Goulburn River Biodiversity Areas to satisfy the offset conditions for the environmental approval EPBC 2002/629. The Putty Road Offset Management Plan details the long term management and protection of the Putty Road Offset Area located within the Southern Biodiversity Area to satisfy the offset conditions for the environmental approval EPBC 2009/5081. These plan have been published on the Rio Tinto Coal Australia website

1.3.2.4 Mining Operations Plan

A Mining Operations Plan (MOP) was developed to replace the previous MOP and cover the existing MTW operations, as well as the approved Warkworth and Abbey Green extensions. The MOP outlines the proposed operational and environmental management activities planned for MTW. The MOP was also developed to satisfy a requirement of the WML Project Approval which relates to the development of the Rehabilitation Management Plan. Details regarding the submissions and approval dates for the current MOP are shown in Table 11.

1.3.2.5 Management Plan Status

MTW submitted Environmental Management Plans to the DP&E during 2014 as required by the January 2014 approval of Modification 6 to the Warkworth Development Consent (DA 300-9-2002-i).

Table 9 details the Management Plans and strategies which have been submitted for approval under the modified Mount Thorley consent (DA 34/95), while Table 10 details the Management Plans and strategies which were submitted for approval in accordance with the conditions of the Warkworth Mining Limited 2003 Approval (Mod 6). Table 11 details the current Mining Operations Plan (MOP) applicable to both Mount Thorley and Warkworth.

Table 9: Status of Management Plans required under Mount Thorley Approval

Management Plan	Date Required to be Submitted	Date Submitted	Approved
Noise	30/9/2012	29/06/2012	31/10/2012 ¹
Blast	30/9/2012	29/06/2012	31/10/2012 ¹
Air Quality and Greenhouse Gas	30/9/2012	29/06/2012	31/1/2013 ¹
Water	30/9/2012	26/09/2012	31/1/2013
Heritage Management Plan	30/9/2012 (unless agreed otherwise)	Requested approval for "staged" Plan on 5/3/2012. Stage 1 submitted 2/5/2012 Revised plan submitted 18/07/2014	2/7/2012 (Stage 1) 13/08/2014 (revision)
Rehabilitation Management Plan	30/9/2012	MOP satisfies this requirement, see details below	2/11/2014
Environmental Management Strategy	30/9/2012	28/9/2012	31/1/2013

¹ Plans submitted and approved in 2012 now superseded by consolidated "whole of MTW" plans outlined in Table 10

Table 10: Status of Management Plans Required under Warkworth Approval (Modification 6)

Plan / Program / Strategy	Current Version	Status
Flora and Fauna Management Plan	01/03/2013	Approved 28/3/08. Minor revision to include actions undertaken during 2012
Flora and Fauna Monitoring Program	01/03/2013	Approved
Air Quality Management Plan (incorporating MTW Air Quality Monitoring Programme)	07/08/2014	Approved
Noise Monitoring Program (incorporating MTW Noise Monitoring Programme)	07/08/2014	Approved
Blasting Monitoring Program (incorporating MTW Blast Monitoring Programme)	10/09/2014	Approved
Water Management Plan (incorporating MTW Surface and Groundwater monitoring programmes and Erosion and Sediment Control Plan)	10/09/2014	Approved
Archaeology and Cultural Heritage Management Plan	01/09/2003	Approved
Bushfire Management Plan	27/05/2003	Approved
Environmental Management Strategy	28/9/2012	Approved
Mount Thorley Warkworth MOP Amendment A	2012-2016	Approved 30/01/2014

Table 11: MOP Approval status for Mount Thorley Warkworth

Mining Operations Plan	Date Submitted	Date Approved
Mount Thorley Warkworth MOP 2012 to 2016	June 2012	Nov 2012
Mount Thorley Warkworth MOP 2014 to 2016	24/09/2014	30/09/2014
Mount Thorley Warkworth MOP 2014 to 2016 Amendment A (change to final landform)	4/11/2014	24/11/2014

1.3.3 Audits and Reviews

No Independent Environmental Audits were undertaken during the reporting period.

1.4 Environmental Management System

Mount Thorley Warkworth operates under the Rio Tinto Coal Australia Health, Safety, Environment and Quality Management System (HSEQMS). The Rio Tinto Coal Australia HSEQMS incorporates an Environmental Management System certified to ISO 14001:2004. The Coal & Allied Environmental Management Strategy details the components of the management system, available on the Rio Tinto Coal Australia website.

1.5 Mine Contacts

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127 John Street, Singleton

Or call:

Coal & Allied Information Line 1800 727 745 (free call)

1.6 Actions from previous Annual Review

An annual environmental inspection was undertaken at MTW by officers of DRE and DP&E on 26 May 2014. Both Departments were generally satisfied with the contents of the report, however a number of actions were identified as part of the inspection and review of the document. The actions and response are shown in Table 12 and Table 13.

Table 12: Response to Actions required from 2013 AEMR review by DRE

Issue	Recommended Action	Annual Review section
The AEMR does not address Section 5 of the AEMR guidelines	<p>Provide DRE with a revised AEMR for approval that addresses Section 5 (Rehabilitation) of the AEMR 2006 Guidelines.</p> <p>Provide a comparison between the Development Consent and MOP rehabilitation commitment against rehabilitation works completed in 2013.</p>	An addendum addressing the action was submitted to the DRE on the 29 August 2014.
Exploration Activities (excluding activities in the approved extraction area)	<p>Provide details of exploration activities undertaken within MTW (excluding high density exploration ahead of the approved open cut footprint):</p> <ul style="list-style-type: none"> • The location of the exploration activities (in the form of a map) • Brief description of the surface disturbance activity and the rehabilitation that has occurred post exploration) <p>Support this section with before and after photos where appropriate.</p>	An addendum addressing the action was submitted to the DRE on the 29 August 2014.
Tailings Dam 2 – Redbank Ash Disposal	<p>The management and rehabilitation program for Tailings Dam 2 must be detailed in the revised AEMR.</p> <p>The Rehabilitation Cost Estimate (RCE) for MTW is to be reviewed to include contingencies for the rehabilitation of Tailings Dam 2 post closure.</p>	An addendum addressing the action was submitted to the DRE on the 29 August 2014.
Hydrocarbon Management	Provide DRE with the hydrocarbon management plan, currently being revised by MTW	This document was provided to the DRE on the 26 February 2015
Drop structure management	The rock lined drop structure located at the northern section of South Pit, which was constructed in 2013, has eroded at the confluence of the contour drain and the drop structure. Provide evident to DRE that this failure has been remediated.	Refer to section 5.1.3
Target Performance Criteria	Preliminary monitoring to assist with the establishment of Target Performance Criteria to be reported in the 2014 AEMR.	Refer to section 5.1.1

Table 13: Response to Actions Required from 2013 AEMR Review by the DP&E

Issue	Recommended Action	Annual Review section
AEMR Report: Noise Section	The report indicated non-compliances for noise in March 2013 and comprehensively explained follow up actions. A Penalty Infringement Notice was issued at this time for noise and the report did not include this. It is a requirement of an AEMR report to identify all breaches of the mines consent and penalty actions. This will need to be amended in the AEMR and placed on the web site.	An updated version of the AEMR with this correction was uploaded to the Rio Tinto website.
AEMR Report: Hunter River water	The report indicated that the mine imported 1,854ML of Hunter River water. Whilst C&A has water licence to do this, it is not typical of other Hunter River mines and recycled mine water is available from neighbouring mines. We understand processes have commenced to use some of this nearby recycled water. This process needs to be accelerated in line with other mines efforts to reduce reliance on river water.	Refer to section 3.6.2.2
AEMR Report: Sound power screening	In Section 2.1.2.1 it describes 8 haul trucks as undergoing sound power level screening in the 2013 year. The Noise Management Plan requires all haul trucks to be tested over a 3 year period. The MTW mine has around 80 trucks, indicating the screening fell well short of the Management Plan requirements. This shortfall will need to be addressed in the 2014 year in addition to the testing required by the management plan.	Refer to section 3.2.2
AEMR Report: Blast Fume Management	The blasting section within the report did not report on fume management. As the mine now has a Blast Fume Management Strategy, some type of reporting against these requirements would be of community interest.	Refer to section 3.3.2.1
AEMR Report: Water quality triggers	Where there are a number of trigger resulting from water quality monitoring because results are outside usual levels, some explanation as to why the levels are varying is needed. As an example, the EC result for OH1138(1) on the 11/12/2013 should have been better explained.	This has been addressed where appropriate in this report
AEMR Field Inspection: ROM Pad Dust	Significant dust was seen being generated on the south ROM pad at Mt Thorley. The accompanying staff member observed this and was able to arrange for it to be addressed. Better management should have been applied so it did not occur in the first place. A follow up inspection will be undertaken to re-assess this area.	No further issues have been raised by the DPE in relation to dust management in this area. No follow up inspection has been facilitated through MTW.
AEMR Field Inspection: Disturbance	The area recently cleared for mining in the north of the Warkworth North pit was formerly an area of Warkworth Sands Woodland. Mulching of the vegetation was occurring during the inspection and the work appeared to be progressing to a good standard and consistent with the plans for this area. Once stripping of the prime topsoil from this area commences, the Department needs to be advised so an inspection and assessment of the soil management can be undertaken.	An inspection with DPE was undertaken as requested.

2. OPERATIONS SUMMARY

2.1 2014 Reporting Period

2.1.1 Exploration

During 2014 exploration drilling was undertaken on CCL 753 to support current mining operations and to assist in determining mining potential at MTW. Drilling to support current mining operations provided information on structure and coal quality. Drilling for sub surface definition provides more detailed information to determine the potential for at MTW and provided information on coal quality, structural and geotechnical.

A total of 10,244.38m drilling was undertaken within CCL 753 consisting of:

- 1,422.53m of cored drilling and 5,091.00m of non-cored drilling to support current mining operations; and
- 3,730.85 of cored drilling for sub-surface definition.

Total exploration drilling undertaken at MTW during 2014 was 10,244.38m with rehabilitation commencing post-drilling.

2.1.1.1 Exploration Drilling Rehabilitation

Rehabilitation of drill holes can be divided into two areas, internal and external to the MOP area.

External MOP Area Rehabilitation (EMAR): After a borehole has been drilled and all sampling and testing has been completed, the borehole is grouted to surface. All equipment and gravel is then removed from site (excluding installed piezometers) and the pad area is re-contoured to its original shape. Stockpiled top soil is placed back on the pad and the area is reseeded with suitable seed. Saplings felled to provide space or access for the pad are placed back on the pad and access tracks.

Internal MOP Area Rehabilitation (IMAR): After a borehole has been drilled and all sampling and testing has been completed, the borehole is grouted to the surface unless the hole has been drilled in spoil where the borehole is grouted to the base of casing. Casing is removed where possible or cut or backed off below surface where not possible to maximise casing recovery. All equipment and gravel is then removed from site (excluding installed piezometers) and where applicable the pad is re-contoured to its original shape. Stockpiled top soil is placed back on the pad and reseeded with suitable seed. Saplings felled to provide space or access for the pad are placed back on the pad and access tracks.

Rehabilitation progress of all exploration drill holes is tracked prior to internal sign off.

Drilling activity undertaken in 2014 is shown in Figure 2. An example of a drill site before and after drilling is shown in Figure 3 and Figure 4.

Mount Thorley Warkworth 2014 Exploration Drilling Rehabilitation

Date: 20/02/2015
Plan By: HF
Version: 1.0



Figure 2: 2014 Drill sites both internal and external to the MOP area



Figure 3: Pre-drill site



Figure 4: Rehabilitated drill site

2.1.2 Summary of Mining Activities

Areas to be mined are geologically modelled, a mine plan is formed and the relevant mining locations are surveyed prior to mining. Figure 5 illustrates the mining process. The percentage of coal produced by each pit at MTW is shown in Figure 6. MTW have no active underground workings.

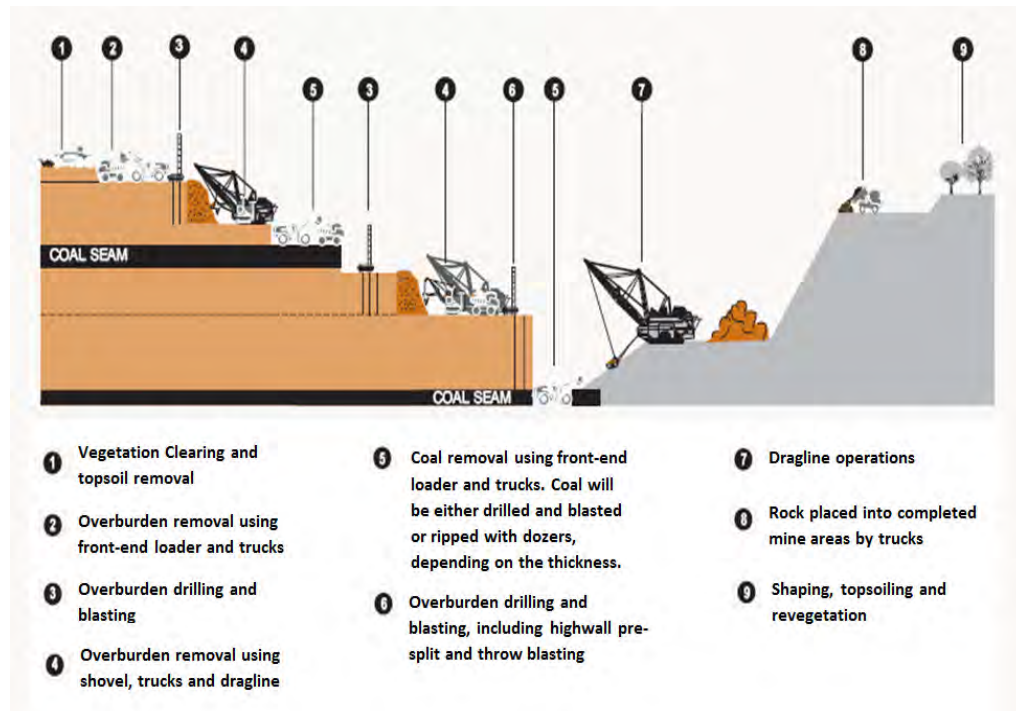


Figure 5: Mining Process

West Pit: Normal mining operations continued throughout 2014 with Truck and Shovel pre-strip on the upper and mid benches and Dragline operations on the lower two benches. MTW commenced a transition to an offset Dragline digging method during 2013 and completed in 2014 by taking a 120m wide strip on the BFA Dragline bench. The major constraint for West Pit mining going forward is the non- access to NDA1 in the middle/south of West Pit. The highwall is becoming noticeably stacked and 2015 coal production will be lower as a result. West Pit was the major coal mining area at MTW during 2014 with 40% of annual ROM coal production being mined from this area.

North Pit: Normal mining operations continued throughout 2014 with Truck and Shovel pre-strip operations on the upper and mid benches and single bench Dragline operations at the basal seam. North Pit remains a steady state mining area with adequate highwall offsets in place resulting in good working room for mining equipment. Dumping areas are well structured with rehabilitation of the North dumps sitting directly behind the active waste dumps. North Pit contributed 24% of ROM coal production in 2014.

MTO / Loders Pit: Normal mining operations continued throughout 2014 with Truck and Shovel pre-strip operations on the upper and mid benches and single bench Dragline operations at the basal seam. Loders Pit also remains in steady state with regard to pit set up, however the strike length of the pit has become noticeably shorter during 2014 with the southern endwall alignment changing as the reserves of this pit are depleted over time. Loders Pit was the second largest contributor of ROM coal (behind West Pit) during 2014 with 31% of MTW's coal being mined from this area.

South Pit: Normal mining operations continued throughout 2014 with Truck and Shovel pre-strip operations on the upper and mid benches and double bench Dragline operations on the lower 2 seams. As no coal exists within the pre-strip benches in South Pit, the advancing Highwall remains in a very stacked configuration. Each advancing strip to the west is dug entirely from top to bottom resulting in the absolute minimum amount of pre-strip material being moved in any given strip or year. During 2014 an extension to the southern end-wall of South Pit was commenced. South Pit remains a small "swing pit" at MTW, with only 5% of the 2014 ROM coal being mined from this area.

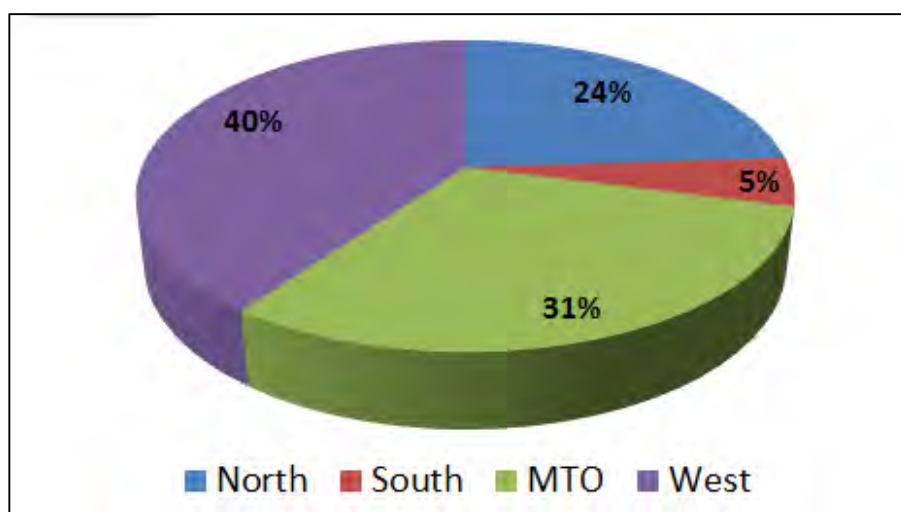


Figure 6: Production of Run of Mine coal as a percentage contribution by pit in 2014.

2.1.3 Summary of Processing Activities

All processing and rejects/tailings disposal activities undertaken in 2014 were consistent with the approved MOP and no changes were made to the processing and rejects/tailings disposal methods.

The currently active tailing emplacements are the Centre Ramp Tailings Storage Facility, Abbey Green South Tailings Storage Facility and Tailings Dam 2 (for Redbank Power Station ash only). Ash emplacement to Tailings Dam 2 ceased in July following the cessation of operations at Redbank Power Station. During 2014, capping works upon Tailings Dam 1 continued, with capping completion with rehabilitation planned for 2015.

2.1.4 Production Statistics

Project approvals allow for extraction for up to 28 million tonnes of ROM coal from MTW in a calendar year, comprising up to 18 million tonnes from ROM coal from the Warkworth Mine and 10 million tonnes from the Mount Thorley Mine. MTW Production Statistics for the period 2010-2014 are summarised in Table 14.

Coal from each plant is transported via conveyor to the Mount Thorley Coal Loader to be railed to the port. In 2014, 394 kt of coal was transported to Redbank Power Station and 11,527kt product coal was railed to the port.

Table 14: Production Statistics 2010-2014

	Units	2014	2013	2012	2011
ROM coal production	kt	17,693	18,709	16,787	13,751
Prime Overburden excavated	kbcm	98,019	108,361	108,518	108,805
Rejects and tailings	kt	5,228	6,228	5,935	4,441
Saleable production	kt	11,930	12,481	10,852	9,311
Sales tonnes	kt	12,076	12,540	10,507	9,481

2.1.5 Summary of Changes (developments and equipment upgrades)

Extension of mining in West Pit in accord with Modification 6 of the Warkworth DA was the key change to operations in 2014.

2.2 Heritage Summary

2.2.1 Aboriginal Heritage

2.2.1.1 Archaeological and Cultural Heritage Management

The Coal & Allied Upper Hunter Valley Aboriginal Cultural Heritage Working Group (CHWG) is the primary forum for Aboriginal community consultation on matters pertaining to cultural heritage. The CHWG is comprised of representatives from Rio Tinto Coal Australia and Registered Aboriginal Parties/stakeholders from Upper Hunter Valley Aboriginal community groups, corporations and individuals. The CHWG met on five occasions in 2014. Meetings were held on 19th February, 3rd April, 7th May, 10th July and 30th October.

In 2002, Coal & Allied developed and implemented two Archaeological and Cultural Heritage Management Plans (ACHMPs) in fulfilment of conditions of development consents held by WML and MTO. As these Plans were developed pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EPA Act), cultural heritage management activities for MTW are regulated through these Plans and under Part 6 of the National Parks and Wildlife Act 1974 (NPW Act). An updated MTO ACHMP, developed in compliance with the latest modification to the MTO development consent, was endorsed by the Department of Planning & Environment (DP&E) during 2014.

Aboriginal cultural heritage at MTW is managed in consultation with the Aboriginal community through the CHWG in accordance with the Rio Tinto Cultural Heritage Management Standard, RTCA Cultural Heritage Management System (CHMS) Work Procedures, ACHMPs, Development Consent conditions, the NPW Act (including the OEI Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010) and the EPA Act. The RTCA CHMS combines several elements to protect, manage and mitigate cultural heritage at MTW, including:

- Ongoing consultation and involvement of the local Aboriginal community in all matters pertaining to Aboriginal cultural heritage management;
- Compliance with existing ACHMP's and Development Consent conditions;
- A cultural heritage Geographic Information System (GIS) and Cultural Heritage Zone Plan (CHZP) incorporating cultural heritage spatial and aspatial data (site location, description, assessments, date recorded, associated reports, management provisions and various other details to assist with the management of sites);
- A Ground Disturbance Permit (GDP) system for the assessment and approval of ground disturbing activities to ensure these activities do not disturb cultural heritage places;
- Limit of Disturbance Boundary (LODB) procedures to demarcate approved disturbance areas and delineate areas not to be disturbed;
- Ongoing cultural heritage site inspections, monitoring and auditing along with regular compliance inspections of development works;
- Protective management measures such as fencing/barricading sites to avoid disturbance, protective buffer zones, cultural heritage off-set areas; and

- Communicating cultural heritage issues and site awareness to personnel via internal electronic and face to face processes.

2.2.1.2 Aboriginal Archaeological and Cultural Heritage Investigations

One Aboriginal cultural heritage assessment was conducted at MTW in 2014 in accordance with the OEH's Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010. This assessment was conducted in the south-eastern corner of the MTO mining lease, adjacent to Loders Creek, on land undisturbed by mining activity. This work occurred in September 2014. The purpose of this assessment was to record the nature and extent of Aboriginal cultural heritage in the area, and inform the Aboriginal community & Coal & Allied on the appropriateness of this land being set aside as an Aboriginal Cultural Heritage Conservation Area. Approximately 90ha was subject to a full coverage assessment survey involving 12.4 km of 100 m wide pedestrian transects. The fieldwork was conducted over two days with a field team of up to six Aboriginal cultural heritage field officers and two Coal & Allied heritage personnel, engaged in the roles of technical advisor, data management officer and site supervisor. The study recorded (or relocated) 66 Aboriginal artefact sites.

In addition to this assessment, two Aboriginal cultural heritage salvage collection programs were undertaken in 2014. The first was located in the Minor Extension to West Pit area and authorised under Aboriginal Heritage Impact Permit (AHIP) #C0000201, issued by OEH on 3 February 2014. The community collection of eight Aboriginal cultural heritage sites authorised under this AHIP was conducted with seven representatives of the Registered Aboriginal Parties, as well as RTCA professional heritage staff, on 10 February 2014.

The second mitigation program, incorporating surface collection as well as a salvage excavation component, was conducted at the Ramp 22 Sediment Dam, located on the MTO/Bulga Surface operations boundary. This program was authorised under AHIP #C0000181, issued by OEH on 2 May 2014. The salvage excavation/collection of one Aboriginal cultural Heritage site and the surface collection of 12 others was conducted with 6 representatives of the Registered Aboriginal Parties, as well as RTCA and consultant professional heritage staff, in July/August 2014.

2.2.1.3 Audits and Incidents

Coal & Allied has continued a comprehensive desk top review and ground-truthing audit of all Aboriginal cultural heritage sites located on Coal & Allied land, including MTW leases. The purpose of the process was to confirm, or revise and update the Aboriginal sites data held in the OEH Aboriginal Heritage Information Management System (AHIMS) sites database. Coal & Allied and OEH agree that there are inconsistencies between the AHIMS data and ground truthed data verified by Coal & Allied. These inconsistencies generally relate to errors in site location recording conducted over the last 20 years resulting in incorrect information being recorded in the AHIMS database. OEH have agreed that upon the completion of the sites auditing process, and subject to OEH auditing Coal & Allied's results, Coal & Allied's audited sites data will be provided to OEH to update the AHIMS sites database for Coal & Allied lands. This audit process will continue in 2015.

During 2014 there were 42 GDP applications submitted for disturbance activities at MTW. All ground disturbance works, outside of the two AHIP areas mentioned above, were conducted on an Aboriginal cultural heritage avoidance basis so that no extant cultural sites were impacted by these activities. Routine GDP compliance inspections and heritage site condition monitoring inspections were conducted adjacent to active mining areas throughout MTW and others more generally around the MTW mining leases. No incidents involving the un-authorised disturbance of Aboriginal cultural heritage sites at MTW were recorded during 2014.

2.2.2 Historic Heritage

2.2.2.1 Management

In 2012, RTCA established the Community Heritage Advisory Group (CHAG) as a community consultation forum for all matters pertaining to management of historic (non-Indigenous) heritage located on Rio Tinto Coal Australia lands. The CHAG is comprised of community representatives with particular knowledge and interests in the historic heritage of the region such as historical groups, individuals and local government. The CHAG met in April 2014 to discuss the results and recommendations arising from historic heritage surveys conducted over the entirety of MTW mining leases, with a follow up site tour conducted the following month.

2.2.2.2 Historical Archaeological Survey Studies

Comprehensive historic archaeological survey studies were conducted in 2014 to provide a baseline assessment for the EIS' required for the Warkworth Continuation 2014 and Mount Thorley Proposals. These studies built on previous assessments in 2012 of the former Bulga RAAF Base and that portion of the Great North Road that passes through the MTW leases.

3. ENVIRONMENTAL MANAGEMENT AND PERFORMANCE

3.1 Meteorological Data

Meteorological data is collected to assist in day to day operational decisions, planning, and environmental management and to meet Project Approval requirements. MTW operates a real time meteorological (weather) station which is located on Charlton Ridge. The meteorological station measures wind speed, wind direction, temperature, humidity, solar radiation, rainfall, and sigma theta. The meteorological station instruments are installed, calibrated, and maintained according to the relevant Australian Standard AS 3580.14 (2011). Meteorological data is available to employees and contractors via the Coal & Allied intranet. This service provides the mining operations with the trend assessment details required for informed operational decisions aimed at minimising impacts from the operation. Daily Meteorological data summaries are presented in the Monthly Environmental Monitoring reports, available via the Rio Tinto website (www.riotinto.com).

Meteorological data capture rate for 2014 was 99.4 percent. Several minor faults with the Charlton Ridge Station occurred during 2014 causing minor data loss. Data has been sourced from other nearby Meteorological Stations where possible during these times.

3.1.1 Rainfall

Total rainfall recorded in 2014 was 670.6mm. Table 15 details the monthly breakdown of rainfall. A comparison on rainfall data for the last three years can be seen in Figure 7.

Table 15: Rainfall Summary 2014

2014	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	12.0	104	115.8	56.8	12.2	16	22.8	71.6	24.2	30	17.8	187.4
Cumulative Rainfall (mm)	12.0	116.0	231.8	288.6	300.8	316.8	339.6	411.2	435.4	465.4	483.2	670.6
Wet Days*	3	9	19	13	7	8	5	13	6	4	6	15

* Wet days are classified as days receiving rainfall greater than 0.2 mm

3.1.2 Temperature

Maximum and Minimum temperatures recorded at the Charlton Ridge Meteorological station for 2014 are presented in Figure 8.

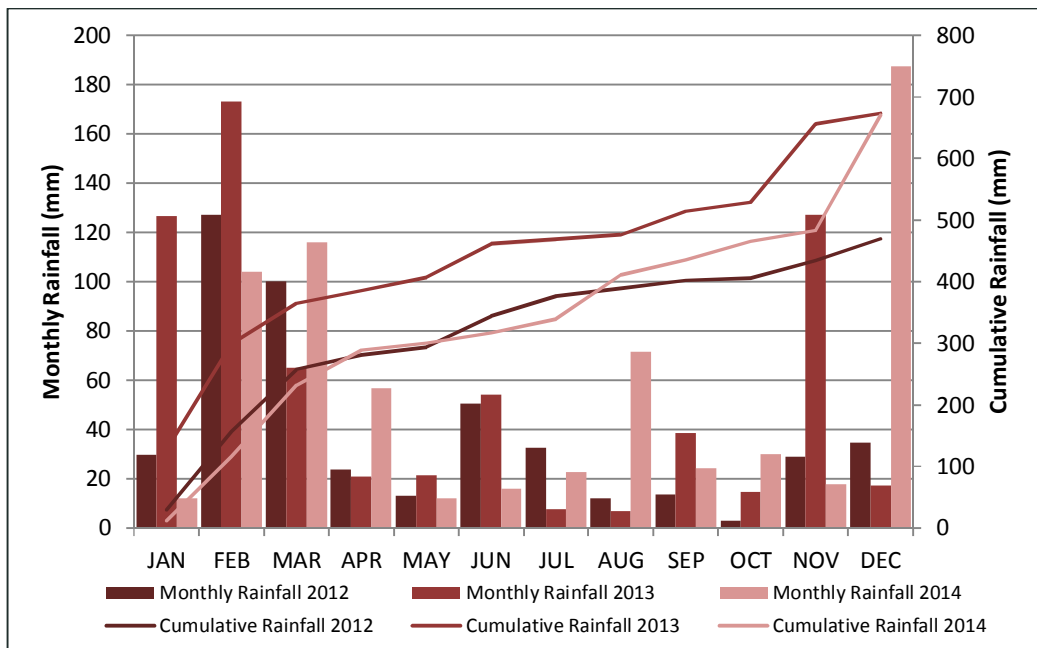


Figure 7: Monthly and Cumulative Rainfall 2012-2014

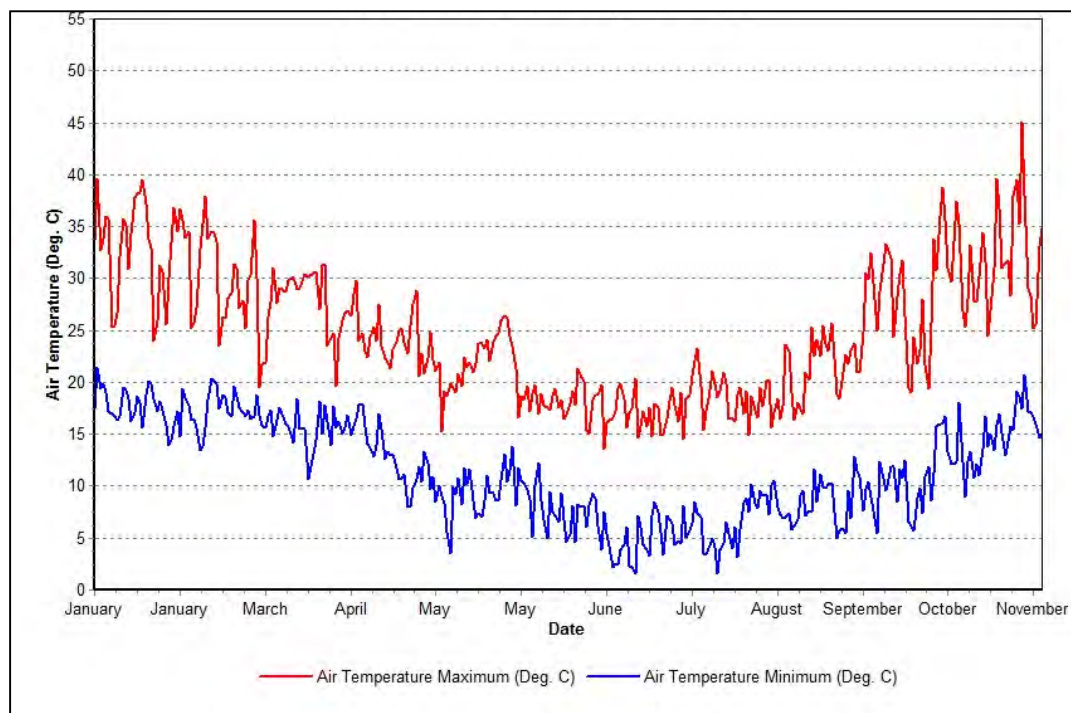


Figure 8: Maximum and Minimum Air Temperatures 2014

3.1.3 Meteorological Summary

A summary of monthly temperature, relative humidity, wind speed and solar radiation data recorded at the Charlton Ridge meteorological station is presented in Table 16. The 2014 annual wind rose is presented in Figure 9.

Table 16: Meteorological Data Summary for 2014

	Max. temp (°C)	Min. temp (°C)	Max. relative humidity (%)	Min. relative humidity (%)	Avg. wind speed (m/s)	Max. solar radiation (W/m ²)
Jan	39.6	13.9	97.2	62.3	3.3	1499
Feb	37.9	13.4	99.1	7.3	3.2	1443
Mar	31.3	10.7	99.7	23.8	2.6	1335
Apr	29.8	8.0	99.8	21.9	2.5	1200
May	26.5	3.5	100.0	31.8	2.6	1023
Jun	21.4	3.8	100.0	31.7	3.3	814
Jul	22.1	1.5	100.0	17.0	3.5	850
Aug	21.2	1.6	100.0	25.6	3.1	1186
Sep	31.5	5.0	99.6	0.0	2.2	980
Oct	38.8	5.4	95.4	4.4	2.7	1383
Nov	45.1	9.0	95.5	5.1	3.3	1515
Dec	37.2	12.1	96.9	6.1	3.0	1364

3.1.4 Wind Speed and Direction

During 2014 the predominant wind direction at the Charlton Ridge Meteorological Station was from the North and North West (approximately 30% of the time) and from South and South East (approximately 30% of the time). Wind Speeds were strongest from the North (Figure 9).

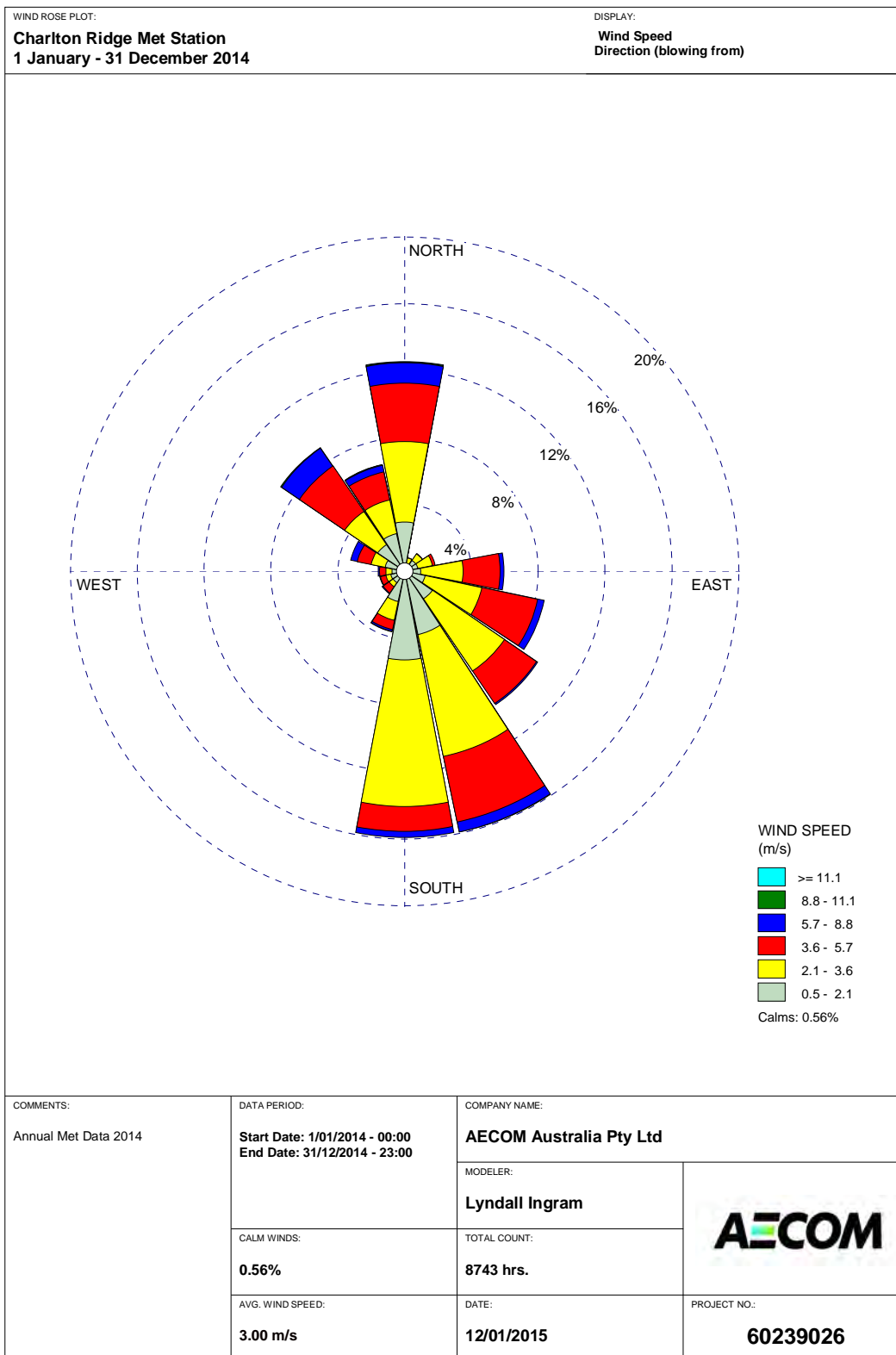


Figure 9: Annual Wind Rose

3.2 Operational Noise

3.2.1 Management

MTW manages noise to ensure compliance with permissible noise limits at nearby private residences and the MTW Noise Management Plan. A combination of both proactive and reactive control mechanisms are employed on a continuous basis to ensure effective management of noise emissions is maintained.

Noise management strategies and processes employed at MTW are detailed in the MTW Noise Management Plan (available for viewing via the Rio Tinto website www.riotinto.com).

3.2.1.1 Sound Attenuation Program

Extensive work was undertaken during 2014 to progress the introduction of Sound Attenuation to MTW's Heavy Mobile Equipment (HME) fleet. Significant time and investment was made into development and engineering of adequate custom attenuation packages for fitment to MTW's fleet of Caterpillar 795F and 789C, and Komatsu 830E-AC Truck fleets. This work has seen the collaboration of MTW Maintenance personnel and local suppliers to design, engineer, install and validate specific pieces of sound attenuation.

As at February 2015, 28% of Haul Trucks, 63% of Dozers and 38% of other Heavy Fleet are operating as sound suppressed units, attenuated to the "Stage Two" target of 115dB(A). A further 23 Trucks, 4 Excavators and 3 Drills are fitted with "Stage One" attenuation (118dB (A)).

During 2014, the following trucks received sound attenuation treatment to Stage Two:

Caterpillar 795F

Eight trucks in the Cat 795F fleet were fitted with attenuation components (units 424, 425, 427, 428, 432, 433, 434, and 436). Increase from Stage One to Stage Two attenuation of these trucks involved fitment of the following at a cost of \$1.8M and realised an average reduction of 6dB(A) per truck:

- Super muffler;
- Engine Enclosure; and
- Optimisation Software

Komatsu 830E (AC)

Five Komatsu 830E-AC trucks received attenuation treatment to Stage Two (units 757, 758, 759, 761, and 762). The suppression scheme for these trucks is comprehensive, realising an average noise benefit of 3dB(A) from baseline data gained from the analysis conducted using an acoustic camera as shown in Figure 10, comprising the following components:

- Gridbox;
- Engine Enclosure;
- Axil-box;
- Blower-hose wraps;

- Air Intake Silencer;
- Radiator Fan Splitter; and
- Dual skin exhaust

By using an acoustic camera to visually represent the noise generation of the haul fleet, dispersal of the sound was able to be interpreted and managed accordingly by retrofitting appropriate sound attenuation technologies (see Figure 10).

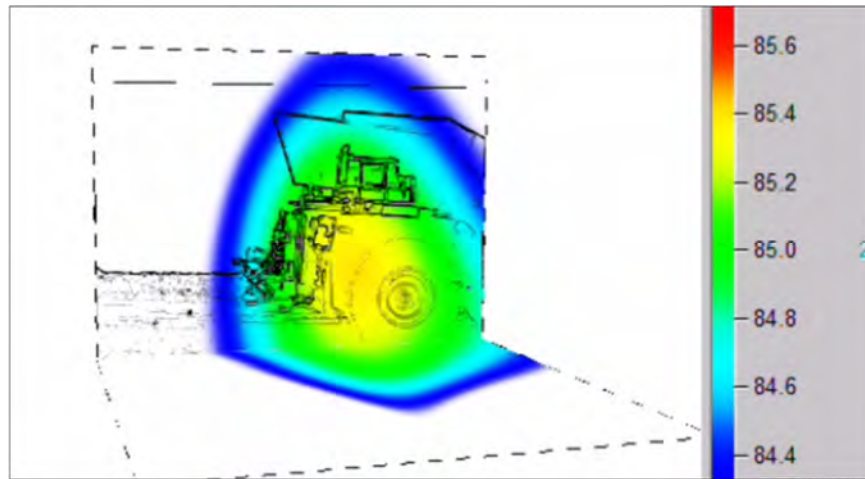


Figure 10: Komatsu 830E-AC truck analysis using acoustic camera

Caterpillar 789C

Two trucks were attenuated to Stage Two (units 713, 716). These fleets previously did not have any sound attenuation equipment installed prior to 2014. Fitment of Stage Two attenuation components has achieved a nominal reduction of 5dB(A) per truck on these units. Attenuation comprises:

- Radiator Fan Splitter;
- Body Panels; and
- Dual Skin Exhaust

Figure 11 shows a Radiation Splitter which prevents the air escaping above the radiator and instead directing air flow into the radiator increasing efficiency and decreasing noise.

Significant sound attenuation works are planned in the 2015 rebuild schedule, rolling out the suppression packages following completion of the design and development works in 2013 / 2014. At the end of 2015 68% of Haul Trucks, 77% of Dozers and 56% of other Heavy Fleet will be fully sound suppressed. By end of 2016 the remainder of the fleet will be complete. This will significantly reduce MTW's noise footprint, and increase operational flexibility.



Figure 11 - Top-down view of Radiation Splitter installed on MTW Cat 789C Haul truck

3.2.2 Sound Power Control

Regular maintenance of the heavy equipment fleet onsite ensures adequacy of sound suppression equipment. Prior to commencement of work activities on shift, each piece of equipment is visually inspected by the equipment operator, including visual assessment of any sound attenuation equipment installed. Where identified, defects are reported and repaired via the maintenance schedule.

In addition to visual inspections, MTW implements a Sound Power Level (SWL) screening program to assess the sound power outputs of individual pieces of equipment (Figure 12). Sound screening is undertaken on 33% of the attenuated haul fleet each year.

Thirty three attenuated haul trucks underwent SWL screening in 2014. Additional testing was undertaken to address a shortcoming in the 2013 program (eight trucks tested in 2013).



Figure 12 - Sound Power Screening being performed on Truck 762 following installation of sound attenuation components

3.2.2.1 Real Time Directional Monitoring Network Expansion

MTW's Real-Time (reactive) noise management framework provides an effective tool for managing instances of elevated noise, ensuring compliance is maintained, and responding to community concerns.

Acting as a conduit between the monitoring system, the mine Shift Co-ordinator, and members of the local community, The Community Response Officer role is pivotal in the effective implementation of the management framework, validating real-time alerts through supplementary handheld noise measurements and audible observations, driving operational change as required, and responding to community complaints. A summary of supplementary handheld noise measurements conducted by the Community Response Officer's in 2014 is presented in Table 17.

Table 17: Summary of hand held noise monitoring conducted by Community Response Officer 2014

Monitoring Location	Number of Assessments	Number of measurements >WML trigger [^]	Number of measurements > MTO trigger [^]	Average WML noise level (dB(A))*	Average MTO noise level (dB(A))*
Wollemi Peak Road	2330	124	135	33.5	35.4
Long Point	1232	8	0	33.1	Inaudible
Wambo Road	2568	194	0	35.6	31.4
Bulga Village	1073	22	1	33.9	33.1
South Bulga	196	2	5	33.1	32.3
Inlet Road West	545	42	42	31.7	31.7
Gowrie	76	1	0	32.2	29.8
Total	8020	393	141	-	-

[^]Triggers are internally set thresholds for operational response and are specified in the MTW Noise Management Plan. The number of measurements greater than the trigger cannot be used as an assessment or interpretation of compliance. Compliance assessment is provided in 3.2.3 and 3.2.4.

*Average noise levels do not take account of measurements taken where the noise source of interest was recorded as inaudible.

In response to the events listed in Table 17 which exceeded the trigger, 20,470 hours of equipment ceased operation to manage noise during 2014. Figure 13 lists the delays by month and equipment type. This is a significant increase in the number of delays over the 8,866 hours recorded in 2013 and is reflective of a matured reactive management process, whereby prompt and effective actions are taken in response to elevated noise, ensuring compliance is maintained.

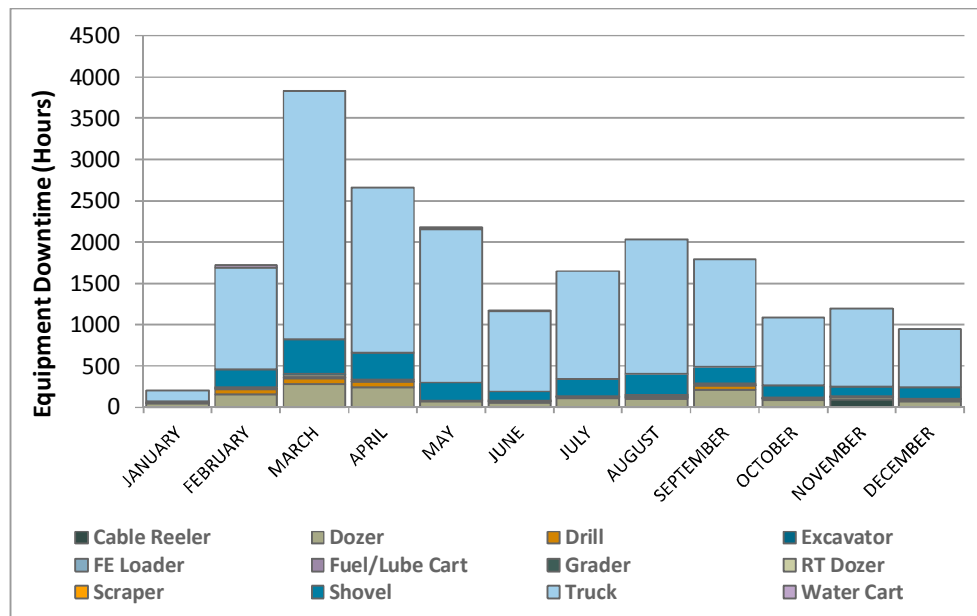


Figure 13: Equipment Delays due to Noise in 2014

3.2.3 Performance

In accordance with the MTW Noise Monitoring Programme, 100 compliance measurements were taken during 2014 by a qualified noise consultant. Each measurement involves an assessment of MTW mine noise against the various L_{Aeq} and $L_{A1, 1min}$ noise criteria in place under the Warkworth and Mount Thorley Approvals (a total of 700 assessments). Noise monitoring results are presented in the monthly Environmental Monitoring Reports, available via the Rio Tinto website (www.riotinto.com).

3.2.4 Non-Compliances

There were no measurements of non-compliance recorded in 2014.

3.2.5 Modifying Factors – Low Frequency Noise

In accordance with Section 4 of the NSW Industrial Noise Policy, MTW has assessed measured noise levels collected during the attended compliance programme for low frequency content, and applied the modifying factor adjustment where applicable. The application of the modifying factor results in four exceedances of the WML L_{Aeq} Impact Assessment Criteria and one exceedance of the MTO L_{Aeq} Impact Assessment Criteria (refer to Table 18). The Department of Planning and Environment was notified in writing of each measurement.

MTW reports these measurements so as to ensure full disclosure, however it remains MTW's position that the prescribed methodology is unsuitable when applied to receptors at large

distances from mine noise sources due to the nature of noise attenuation. Excess attenuation of noise with distance is greater for high frequency noise than it is for low frequency noise. At significant distance from a noise source (such as private residences from the MTW complex) this often results in large differentials between L_{Aeq} and L_{Ceq} . The NSW Industrial Noise Policy requires the penalty to be applied in these instances, irrespective of actual low frequency affectation. As such, MTW does not consider these instances to constitute non-compliance with the conditions of approval.

Coal & Allied looks forward to the NSW EPA review of the NSW Industrial Noise Policy, and the implementation of an appropriate methodology for assessing low frequency affectation for open cut mines in the Hunter Valley.

Table 18: Attended Noise Measurements Exceeding Consent Conditions following applications of Low Frequency Penalty

Location	Date/Time	Relevant Criteria	Criterion (dB)*	L_{Aeq} (dB)	Revised L_{Aeq} (dB)	Exceeds by (dB)
Inlet Road West	23/04/2014 23:56	WML L_{Aeq} Impact Assessment Criteria	35	31	36	1
Inlet Road West	09/05/2014 00:15	WML L_{Aeq} Impact Assessment Criteria	35	31	36	1
Inlet Road West	22/08/2014 00:09	WML L_{Aeq} Impact Assessment Criteria	35	33	38	3
Inlet Road West	15/12/2014 23:23	WML L_{Aeq} Impact Assessment Criteria	35	32	37	2
Bulga Village	16/12/2014 00:46	MTO L_{Aeq} Impact Assessment Criteria	40	36	41	1

3.2.6 Comparison against Last Years' Results

Changes in mine operations and variations in meteorological conditions from year to year makes it difficult to directly compare noise results from one year to another to assess the effectiveness of the noise management system. A comparison of non-compliances and exceedances between years is used as a measure of the effectiveness of noise management measures employed on site, and the level to which risks are being adequately addressed. Non-compliance is determined with reference to the applicable conditions of consent and the *NSW Industrial Noise Policy*.

Details of this comparison are provided in Table 19, which demonstrates a marked improvement in the management of offsite noise emissions. This improvement can be largely attributed to two key factors:

- Continued introduction of sound attenuated equipment into the operation (see section 1.2.1.1); and
- Mature and effective management process utilising real-time data, Community Response Officers, and prompt action in the event of elevated noise (see section 1.2.1.4)

Table 19: Comparison of 2014 noise monitoring results against previous years'

Year	Number of assessments	Number of measurements greater than allowable noise limits (under applicable met conditions)	Number of non-compliances
2014	700	0	0
2013	456	11	7
2012	562	13	3
2011	572	11	4
2010	561	3	3
2009	569	10	4

3.2.7 Comparison against EA Predictions

Table 20 provides a comparison of 2014 attended monitoring data and the predicted noise levels modelled in the 2002 Warkworth EIS. Comparison has been made against the modelled worst case noise levels for Year 10 and Year 15 of the development (nominally 2013 and 2018). The comparison data has been sourced from the modelled noise levels at the nearest residential receivers to the current monitoring locations. Reported 2014 data is the calculated quarterly average of WML contribution to measured $L_{Aeq (15 \text{ minute})}$ results obtained through compliance assessment (irrespective of applicability of noise criteria due to met conditions).

Where a monitoring event has been assessed as being “inaudible” or “not measurable”, a conservative value of 25dB has been used to calculate the L_{Aeq} average for the quarter.

Table 20: Predicted Night Time WML (EIS 2002) LAeq (15 minute) noise levels and averaged 2014 monitoring results

Monitoring Location	Year 10 Modelled Noise LAeq (15 minute) (dB)	Year 15 Modelled Noise LAeq (15 minute) (dB)	Quarter 1 2014 average LAeq (15 minute) (dB)	Quarter 2 2014 average LAeq (15 minute) (dB)	Quarter 3 2014 average LAeq (15 minute) (dB)	Quarter 4 2014 average LAeq (15 minute) (dB)
Mount Thorley Industrial Estate	44.5	43.6	25.0	35.3	31.7	35.3
Bulga Village	27.9	27.8	29.7	27.3	28.3	27.7
Gouldsville Road	36.6	35.5	33.7	37.7	33.3	29.7
Inlet Road West*	<35	<35	27.3	29	28	27.3
Long Point*	35-40	35-40	23.3	31.3	27	26.7
Wollemi Peak Road*	<35	<35	28.3	25.0	26.7	26.7
South Bulga	24.5	23.8	26.0	25.0	26.7	26.7
Wambo Road	29.7	30.1	31.7	31.3	30.0	27.5
Warkworth	33.6	36.5	25.0	25.0	25.0	N/A

*Denotes – No nearby receiver location modelled

NA = No measurements taken

3.2.8 Complaints

During 2014 MTW received 809 noise complaints compared to 631 in 2013 and 800 in 2012. The majority of complaints came from Bulga, with a smaller percentage from Long Point and Gowrie. Frequent noise complaints continue to be received from the Bulga community, despite compliance with noise criteria.

A common view shared amongst residents in Bulga is the perceived lack of response to elevated noise until a complaint is lodged. Whilst the vast majority of operational change occurs in response to noise monitoring MTW recognises the need to be more transparent with operational data in order to demonstrate this. In order to improve transparency of this information MTW are planning to commence an online daily public report, available to near neighbours, detailing the key aspects of noise management undertaken on a shift by shift basis. Reporting will commence from 2015.

3.2.9 Compliance Audits

No audits were undertaken in 2014.

3.3 Blasting

3.3.1 Blasting Management

The objective of blasting operations at MTW is to ensure that optimal fragmentation is obtained whilst minimising dust and fume generation, adhering to safety standards and conforming to approvals criteria for vibration and overpressure. Procedures to ensure compliance with conditions of the Project Approvals relating to blasting impacts are described in the MTW Blast Management Plan which is available on the Rio Tinto Coal Australia website. The MTW Blast Management Plan also provides a mechanism for assessing blast monitoring results against the relevant blast impact assessment criteria. The MTW Road Closure Management Plan and MTW Post Blast Fume Generation Mitigation and Management Plan are included in the Blast Management Plan.

3.3.2 Monitoring Locations

During 2014, MTW operated a network of Ecotech Dynamate DV6 R4 blast monitors. Monitors function as regulatory compliance monitors in accordance with the MTW Blast Monitoring Programme (appended to Blast Management Plan) and are located to monitor nearby privately owned residences. During 2014 the monitoring occurred at the following locations (refer Figure 14):

- Abbey Green (Abbey Green Station, Putty Road, Glenridding);
- Bulga Village (Wambo Road, Bulga);
- Police Station (Putty Road, Bulga) – decommissioned 25/11/2014
- Putty Road, Bulga (Putty Road, Bulga) – decommissioned 1/11/2014
- Mount Thorley Industrial Estate known as MTIE (Putty Road, Mount Thorley)
- South Bulga (Putty Road, Bulga);
- Wambo Road (Wambo Road, Bulga);
- Warkworth Village (former Warkworth Public School, Warkworth); and
- Wollemi Peak Road (intersection Putty Road & Wollemi Peak, Bulga) – commissioned 25/11/2014.

The Putty Road Bulga monitor was decommissioned in November 2014 when the property became mine owned. Private residences in the area beyond this location are represented by the Bulga Village monitoring location and hence relocation was not necessary.

The Wollemi Peak monitoring location was commissioned during November 2014 to address private residences in the Wollemi Peak Road area and replaced the Police Station location which was decommissioned in December 2014. The Wollemi Peak Road location is shared with Glencore Bulga Open Cut's 'Bulga' monitoring site.

All modifications to the blast monitoring network during 2014 were undertaken in consultation with the DP&E Singleton compliance office.

**Mount Thorley Warkworth
Blast Monitoring Locations 2014**

Date: 150227
Plan By: DS
Version: 1.0



RTCA - NSW Environmental Services

Figure 14: Blast Monitoring Locations

3.3.3 Performance

Statutory limits for ground vibration and airblast over pressure generated by blasts initiated at MTW must not be exceeded at any privately owned residence. These statutory limits are prescribed as follows:

- Airblast overpressure shall not exceed 120dB((L) Linear Peak) at any time;
- Airblast over pressure shall not exceed 115dB((L) Linear Peak) for more than 5 per cent of the total number of blasts over a 12 month period;
- Ground vibration shall not exceed 10mm/s at any time; and
- Ground vibration shall not exceed 5mm/s for more than 5 per cent of the total number of blasts over a 12 month period.

During the reporting period MTW initiated 442 discrete blasts across 390 blast events. Results of ground vibration and air overpressure recorded during 2014 are presented in the following figures.

No blast exceeded the 120 dB(L) airblast overpressure criteria or measured ground vibration greater than 10mm/s.

Two blasts in Mount Thorley Operations recorded ground vibration exceeding 5mm/s at the Police Station location (Figure 18). This represents 1.65% of the blasts fired during 2014 in the MTO consent area and is within the compliance limit of 5% of the total number of blasts. All blasts in Warkworth Mine measured vibration of less than 5mm/s.

Road closures occurred for all blasts within 500 metres of a public road. Public roads were also closed on occasions to mitigate potential impact upon road users from dust or when blast fume management zones encompassed public roads. There were no instances of impact upon a public road from flyrock or associated delay in reopening of a road due to flyrock impact.

Figure 15 to Figure 23 show the blast monitoring results from all compliance blast monitors, including overpressure, vibration and compliance limits.

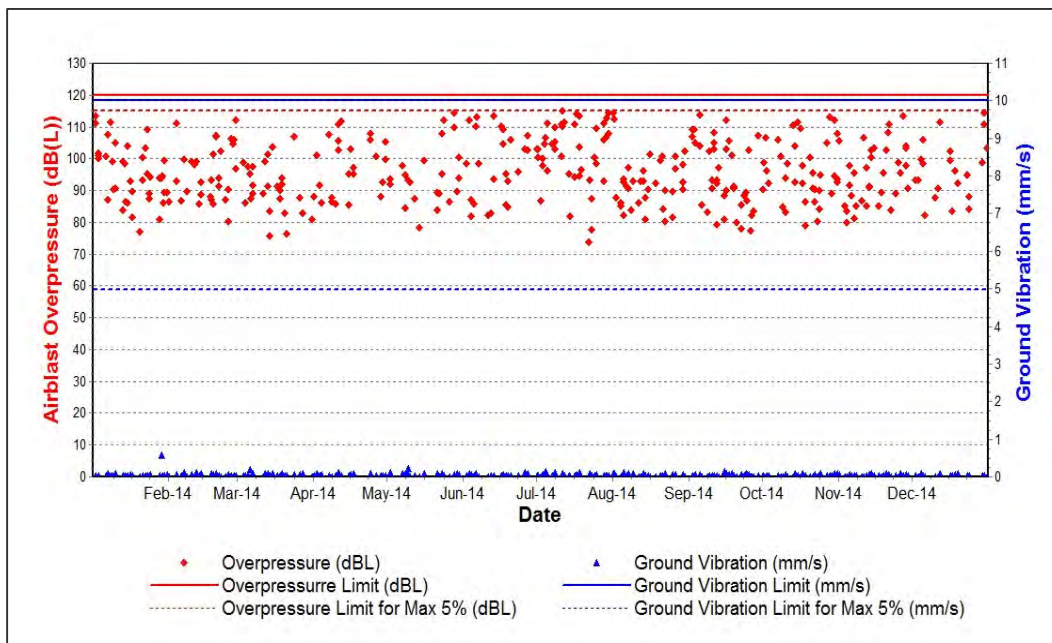


Figure 15: Abbey Green blasting results

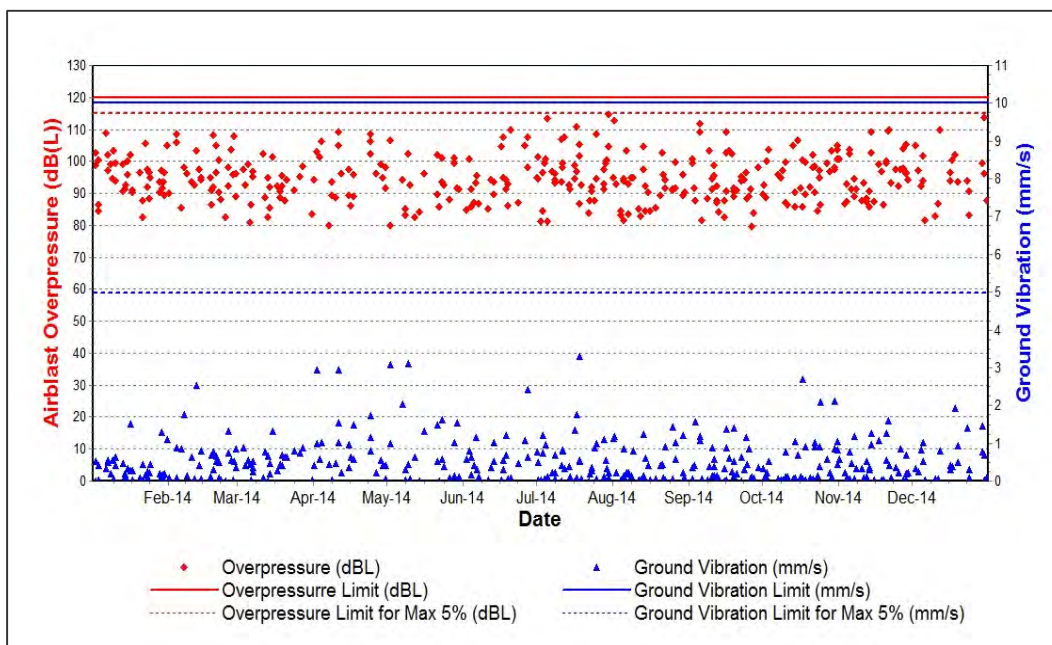


Figure 16: Bulga Village blast results

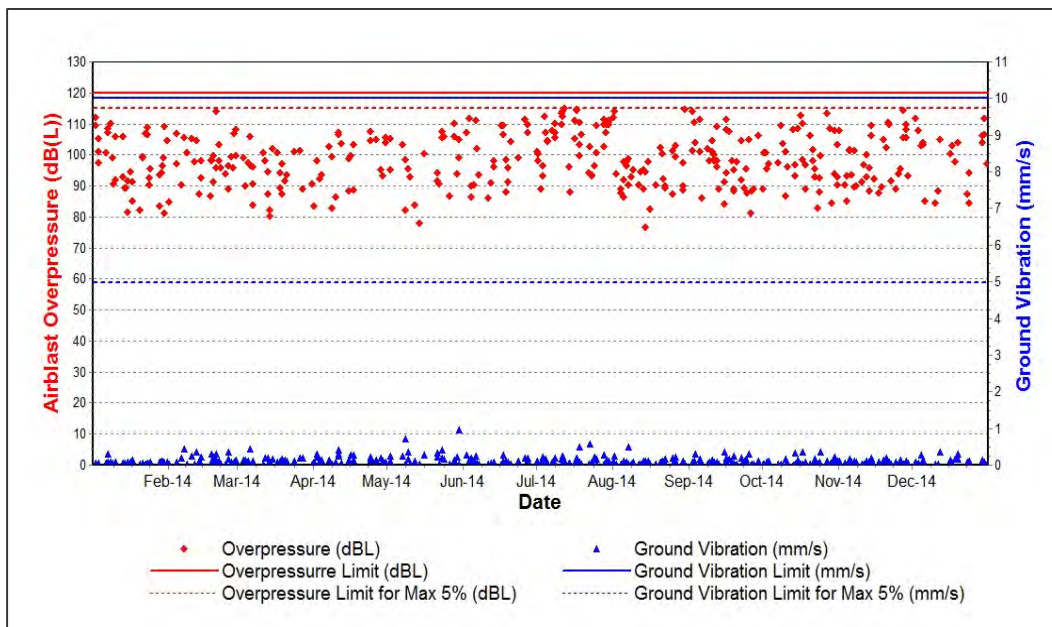


Figure 17: MTIE blast results

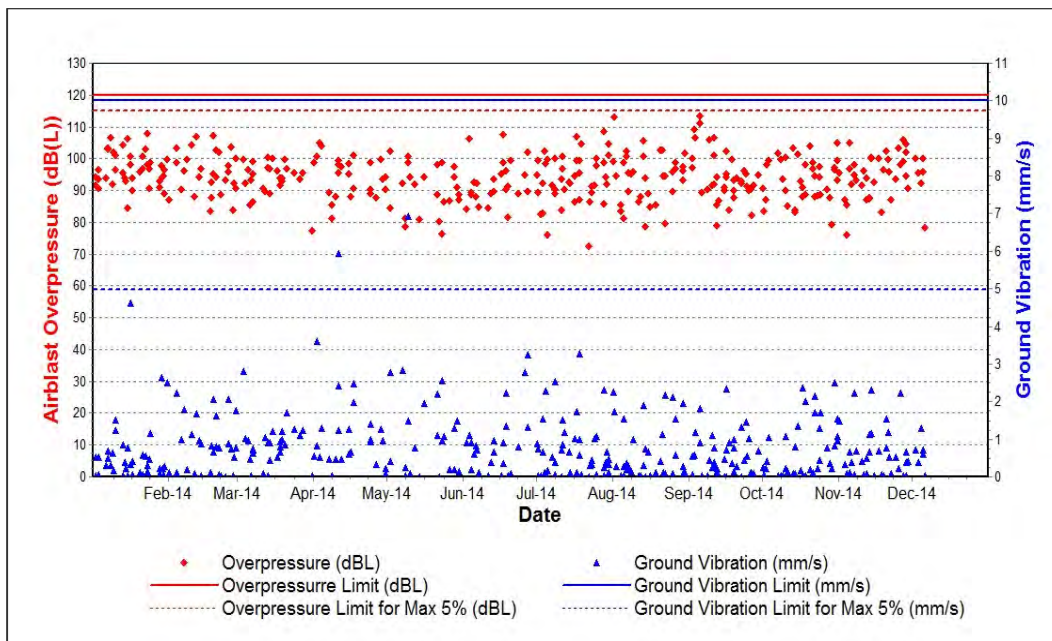


Figure 18: Police Station blast results (Note: unit decommissioned in December 2014, and replaced with the Wollomi Peak Rd Monitor)

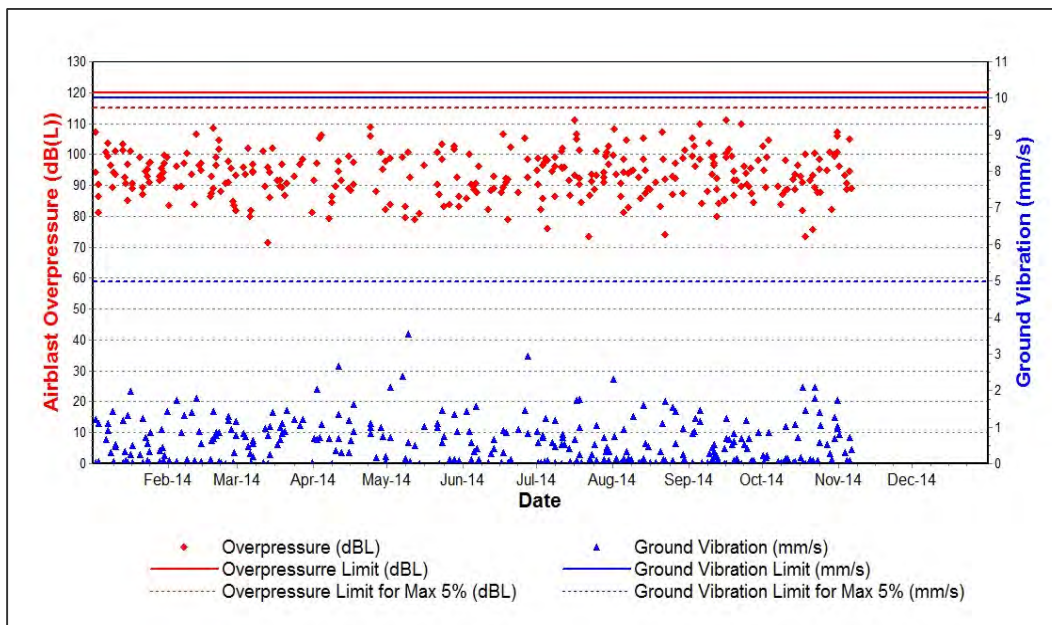


Figure 19: Putty Road Bulga blast results (Note: monitor was decommissioned in November 2014)

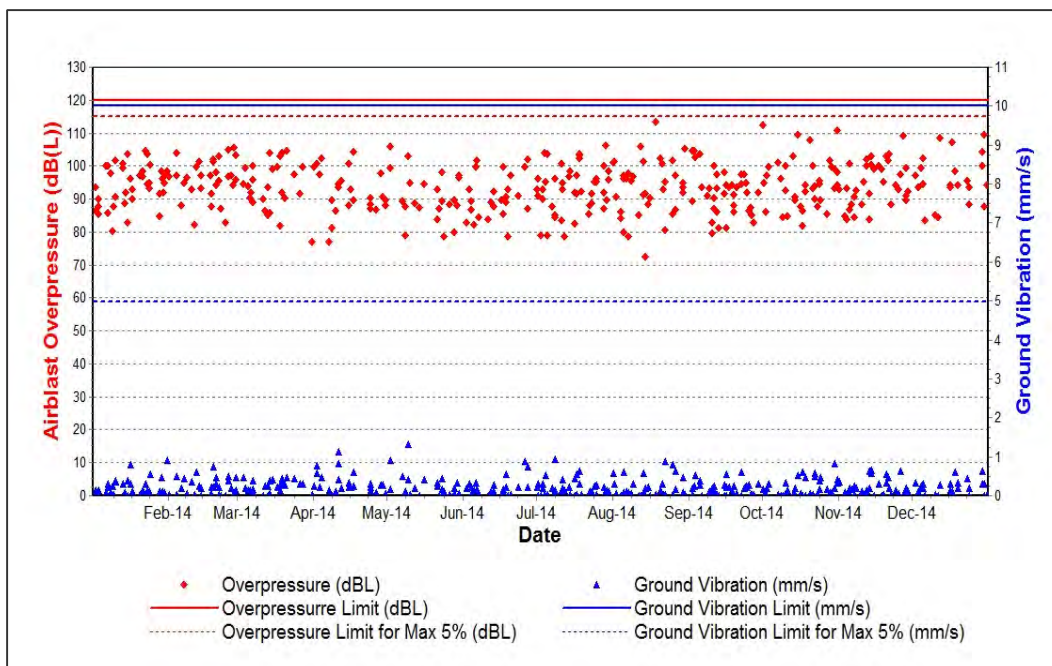


Figure 20: South Bulga blast results

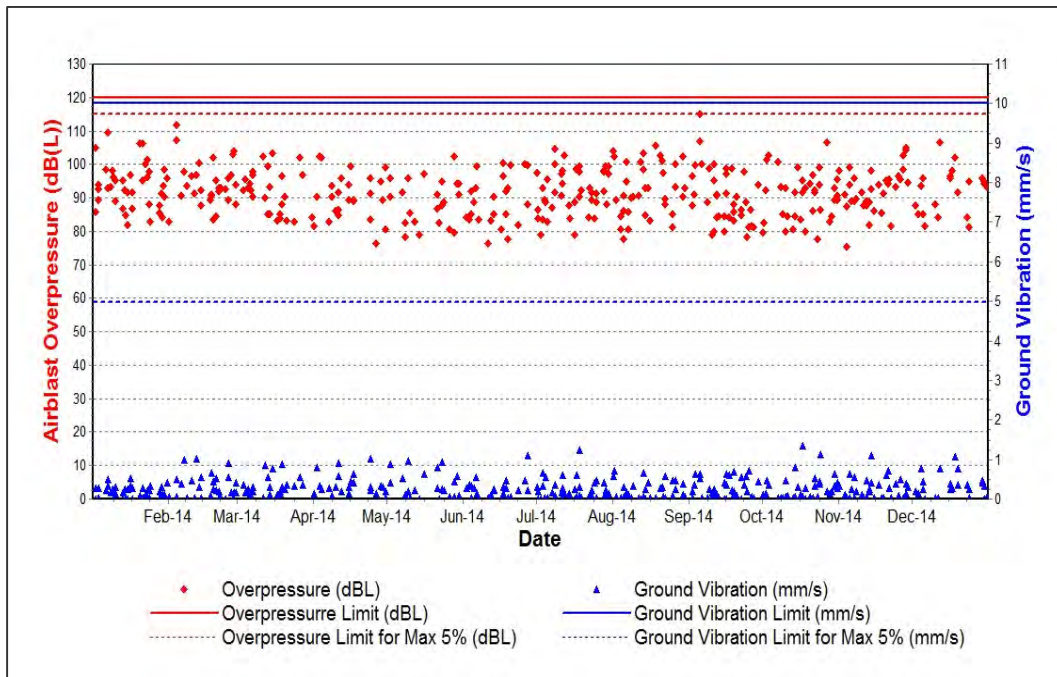


Figure 21: Wambo Road blast results

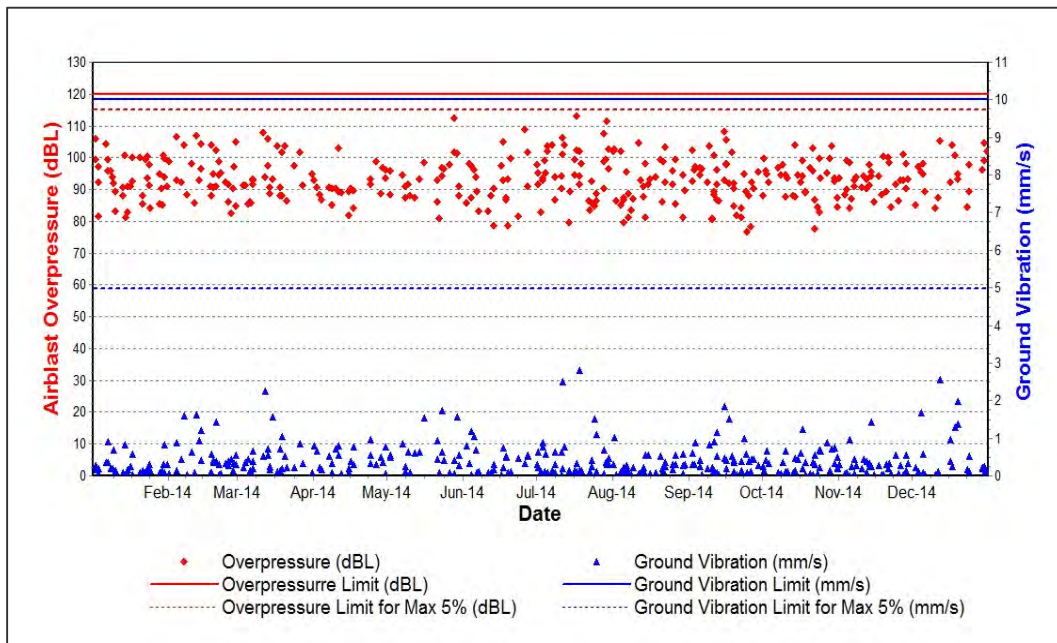


Figure 22: Warkworth blast results

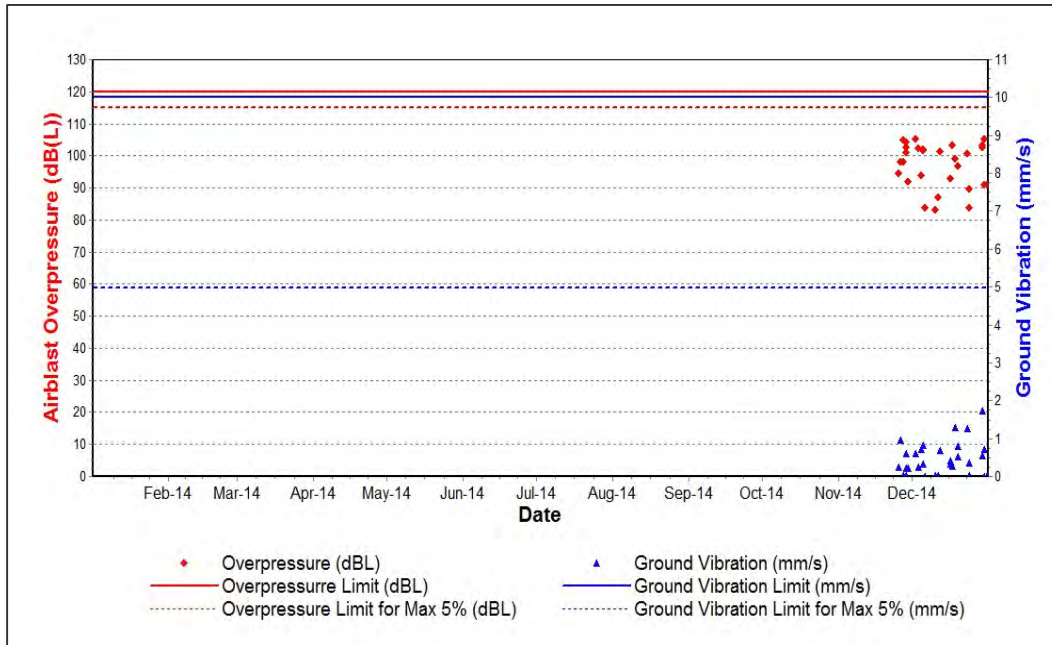


Figure 23: Wollemi Peak Road blast results (Note: monitor commissioned in December 2014 to replace the previous Police Station Monitor)

3.3.4 Blast fume management

MTW operates under a Post Blast Fume Generation Mitigation and Management Plan. This document outlines the practices to be utilised to reduce generation of post blast fume, and reduce potential offsite impact from any fume which may be produced. This includes risk assessment of the likelihood of fume production, specialised blasting design, appropriate product selection, on-bench water management, implementation of fume management zones and use existing blasting permissions to identify likely path of any fume which may be produced.

All blasts are observed for fume and any fume produced is ranked according to the Australian Explosive Industry & Safety Group (AEISG) Scale.

During 2014, no blast produced visible post-blast fume ranking as Level 4 or Level 5 according to the AEISG Scale.

Category three blast fume events were notified to the DP&E on 4 April, 27 June, and 3 October 2014 in accordance with notification requirements specified in the MTW Blast Management Plan. Mines are required to notify the DP&E of Category 3 blasts if they are visible when leaving the mine boundary. An incident report was subsequently provided to DP&E for the event on 27 June 2014. The blast fume originated from a blast fired in the upper strata of Mount Thorley Pit and dissipated over the mine. The fume migrated across to Bulga Coal Operations at height as a Category 1a fume.

The DP&E indicated that they were satisfied with the investigation and current and proposed controls.

Rankings for visible blast fume according to the AEISG scale for shots fired during 2014 and comparison to rankings distribution during previous years is provided in Table 21.

Table 21: Visible blast fume rankings according to the AEISG colour scale

AEISG Ranking	2014	2013	2012
0	355	398	380
1	61	56	68
2	18	15	29
3	8	5	11
4	0	0	1
5	0	0	0
Total*	442	474	489

* Where a number of individual blasts were fired as a blast event fume was assessed for each individual blast pattern rather than for the event as a whole.

3.3.5 Comparison of Monitoring Results Against Previous Years' Performance and EA Predictions

Blasting results recorded in 2014 are similar to results recorded in previous years and are consistent with EA predictions.

3.3.6 Non-Compliances

No exceedance of airblast overpressure or ground vibration criteria occurred during 2014.

On 31 January 2014 dust from a blast fired in Mount Thorley Operations migrated in a west-north-westerly direction dissipating at height north of Putty Road and to the east of Wollombi Brook. The blast was fired in accordance with Blast Management Plan. Following the event a number of complaints were received by regulators and to the operation. Incident reports were provided to Department of Planning & Infrastructure and the Environmental Protection Authority in relation to the event. Blast permissions across the site were reviewed following the event and made more conservative.

3.3.7 Complaints

There were 52 complaints relating to blasts during 2014 compared to 38 complaints in 2013 and 69 during 2012.

3.3.8 Audits and Reviews

There were no audits or reviews undertaken during 2014.

3.4 Air Quality

3.4.1 Management

MTW manages air quality to ensure compliance with permissible limits at nearby private residences and the MTW Air Quality Greenhouse Gas Management Plan (publically available via the Rio Tinto website www.riotinto.com).

3.4.2 Air Quality Performance

3.4.2.1 Proactive Air Quality Management

MTW utilises meteorological forecasts to assist in air quality management. A daily dust risk forecast report is received (Figure 24) and reviewed on a daily basis, which highlights periods of the day which are forecast to present heightened dust risk. The daily deliverable includes forecast data out to three days, allowing opportunity to forward plan additional controls as necessary.

RioTinto Daily Dust Email Alert

weatherzone®

Issued at 6am, 19th February 2015

Muswellbrook LGA Forecast																	Next 24hrs (6am-6am)											Active Alert			
Thursday, 19th February 2015							6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm							
Wind Speed							0.9m/s	1.6m/s	1.1m/s	1.8m/s	3.1m/s	4.1m/s	4.9m/s	4.8m/s	5.5m/s	5.9m/s	6.6m/s	7.2m/s	7.0m/s	6.5m/s	5.0m/s	4.6m/s	4.0m/s	3.5m/s							
Temp							16.3 °C	16.5 °C	18.6 °C	20.8 °C	23.6 °C	26.2 °C	27.4 °C	28.7 °C	29.1 °C	29.6 °C	29.0 °C	28.6 °C	27.4 °C	26.1 °C	24.4 °C	23.1 °C	22.2 °C	21.6 °C							
Lapse Rate /100m							2.98 °C	2.47 °C	-0.16 °C	-2.33 °C	-3.05 °C	-3.27 °C	-3.47 °C	-3.57 °C	-3.52 °C	-3.32 °C	-3.03 °C	-2.65 °C	-2.13 °C	-1.35 °C	-0.19 °C	0.22 °C	0.52 °C	0.83 °C							
Rainfall							NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO							
Friday							12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	
Wind Speed							3.0m/s	2.7m/s	2.2m/s	1.7m/s	1.7m/s	1.2m/s	1.3m/s	1.0m/s	1.4m/s	2.0m/s	2.8m/s	3.6m/s	4.3m/s	4.3m/s	5.0m/s	5.1m/s	5.8m/s	6.3m/s	6.3m/s	5.6m/s	4.3m/s	4.4m/s	4.0m/s	3.9m/s	
Temp							21.0 °C	20.6 °C	20.3 °C	19.9 °C	19.6 °C	18.9 °C	18.6 °C	19.8 °C	20.9 °C	21.9 °C	23.5 °C	24.2 °C	24.5 °C	24.4 °C	24.6 °C	24.3 °C	24.1 °C	23.6 °C	22.9 °C	21.5 °C	20.5 °C	20.2 °C	19.9 °C		
Lapse Rate /100m							1.28 °C	1.63 °C	1.93 °C	1.79 °C	1.81 °C	1.72 °C	1.71 °C	1.17 °C	-0.75 °C	-2.17 °C	-2.68 °C	-2.65 °C	-2.14 °C	-2.0 °C	-1.76 °C	-1.47 °C	-1.54 °C	-1.83 °C	-1.85 °C	-1.45 °C	-0.13 °C	0.19 °C	1.1 °C	0.19 °C	
Rainfall							NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES	YES
Saturday							12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	
Wind Speed							3.6m/s	3.5m/s	3.0m/s	2.7m/s	2.6m/s	2.0m/s	2.1m/s	2.2m/s	2.8m/s	3.4m/s	4.3m/s	5.2m/s	5.8m/s	5.8m/s	6.5m/s	6.6m/s	7.1m/s	7.6m/s	7.7m/s	6.7m/s	5.3m/s	5.1m/s	4.6m/s	4.0m/s	
Temp							19.4 °C	19.2 °C	18.9 °C	18.7 °C	18.5 °C	18.3 °C	17.9 °C	17.6 °C	19.1 °C	20.6 °C	21.9 °C	23.3 °C	24.2 °C	24.9 °C	25.3 °C	25.6 °C	25.6 °C	25.5 °C	25.0 °C	23.6 °C	21.7 °C	20.7 °C	20.0 °C	19.4 °C	
Lapse Rate /100m							-0.01 °C	-0.08 °C	-0.21 °C	-0.24 °C	-0.15 °C	0.04 °C	0.31 °C	0.18 °C	-1.66 °C	-2.57 °C	-2.21 °C	-2.26 °C	-1.78 °C	-1.75 °C	-2.02 °C	-2.77 °C	-3.01 °C	-2.55 °C	-1.97 °C	-1.17 °C	-0.12 °C	-0.03 °C	0.15 °C	0.32 °C	
Rainfall							YES	YES	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO

Singleton LGA Forecast																	Next 24hrs (6am-6am)											No Alert Current			
Thursday, 19th February 2015							6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm							
Wind Speed							1.9m/s	1.4m/s	2.0m/s	2.6m/s	3.6m/s	4.2m/s	4.4m/s	5.0m/s	5.3m/s	5.9m/s	6.3m/s	6.4m/s	5.9m/s	5.1m/s	3.7m/s	3.1m/s	2.7m/s	2.3m/s							
Temp							19.0 °C	19.6 °C	21.9 °C	23.8 °C	24.8 °C	26.1 °C	26.6 °C	26.8 °C	27.6 °C	27.5 °C	27.2 °C	27.1 °C	26.3 °C	25.5 °C	24.4 °C	23.5 °C	23.0 °C	22.7 °C							
Lapse Rate /100m							1.58 °C	0.5 °C	-0.98 °C	-1.69 °C	-2.26 °C	-3.0 °C	-3.31 °C	-3.48 °C	-3.34 °C	-3.21 °C	-2.96 °C	-2.53 °C	-1.31 °C	-0.79 °C	0.38 °C	0.71 °C	1.12 °C	1.64 °C							
Rainfall							NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	NO	NO	NO							
Friday							12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	
Wind Speed							2.3m/s	2.4m/s	2.2m/s	1.8m/s	1.4m/s	1.6m/s	1.0m/s	0.8m/s	1.2m/s	1.5m/s	2.4m/s	2.8m/s	3.2m/s	3.5m/s	3.6m/s	4.0m/s	4.2m/s	4.3m/s	4.0m/s	3.6m/s	2.5m/s	2.2m/s	2.2m/s	2.1m/s	
Temp							22.3 °C	22.1 °C	21.9 °C	21.7 °C	21.6 °C	21.0 °C	20.8 °C	20.8 °C	22.2 °C	23.2 °C	23.5 °C	23.9 °C	24.0 °C	23.6 °C	23.5 °C	23.5 °C	23.7 °C	23.3 °C	22.7 °C	21.4 °C	20.3 °C	20.2 °C	20.1 °C		
Lapse Rate /100m							1.92 °C	1.88 °C	1.84 °C	1.77 °C	1.77 °C	1.53 °C	1.22 °C	0.69 °C	-0.27 °C	-0.88 °C	-1.27 °C	-2.86 °C	-2.88 °C	-2.47 °C	-2.61 °C	-1.68 °C	-1.71 °C	-1.48 °C	-1.52 °C	-1.02 °C	0.57 °C	1.13 °C	1.13 °C	0.99 °C	
Rainfall							NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Saturday							12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	
Wind Speed							2.3m/s	2.7m/s	2.7m/s	2.3m/s	1.8m/s	2.3m/s	2.1m/s	1.9m/s	2.5m/s	3.2m/s	4.0m/s	4.5m/s	4.9m/s	5.2m/s	5.4m/s	5.8m/s	6.0m/s	6.3m/s	5.7m/s	5.1m/s	3.6m/s	3.1m/s	2.9m/s	2.5m/s	
Temp							20.1 °C	20.1 °C	20.1 °C	20.2 °C	20.3 °C	20.0 °C	19.7 °C	19.8 °C	21.3 °C	22.4 °C	22.8 °C	23.3 °C	24.0 °C	24.3 °C	24.6 °C	24.7 °C	24.5 °C	24.6 °C	23.9 °C	22.7 °C	21.6 °C	20.8 °C	20.7 °C	20.5 °C	
Lapse Rate /100m							1.06 °C	0.82 °C	0.58 °C	0.69 °C	0.35 °C	-0.02 °C	-0.21 °C	-0.48 °C	-1.79 °C	-2.5 °C	-2.9 °C	-2.73 °C	-3.15 °C	-2.11 °C	-2.19 °C	-2.91 °C	-2.88 °C	-2.56 °C	-2.07 °C	-1.36 °C	0.04 °C	0.76 °C	1.09 °C	1.26 °C	
Rainfall							YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES	YES	NO	YES

ACTIONS

- Communicate forecast to relevant staff
- Consider any preparatory actions required for triggers (e.g. ensure water cart availability; reschedule activities)
- Record any preparatory actions taken.

weatherzone®

For technical advice regarding this email please contact
support@weatherzone.com.au or (02) 9965 9200

Figure 24: Example of the daily dust risk forecast report

3.4.2.2 Real-Time Air Quality Management

Operational Downtime

MTW's real-time air quality monitoring stations continuously log information and transmit data to a central database, generating alarms when particulate matter levels exceed internal trigger limits.

510 real-time alarms for air quality and wind conditions were received and acknowledged during 2014. In response 7,110 hours of equipment downtime was recorded due to air quality management. A detailed breakdown of air quality related equipment stoppages (per month, per equipment type) is presented in Figure 25.

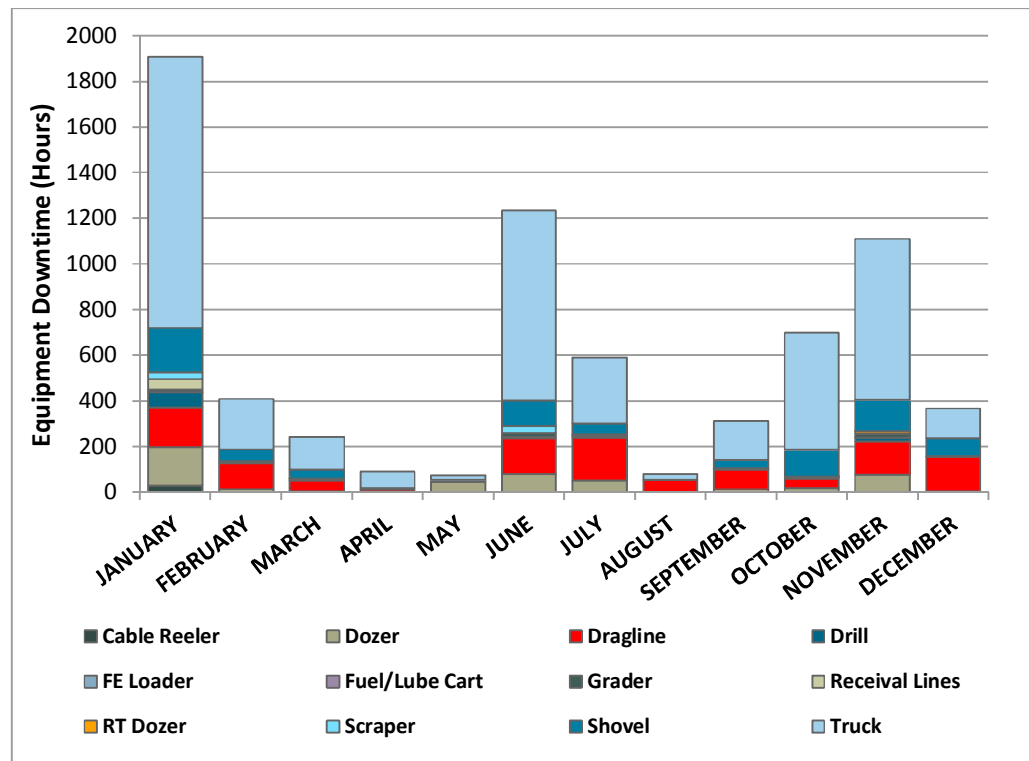


Figure 25: Equipment downtime for dust management by month

3.4.2.3 Adverse Conditions / Wheel Generated Dust

In accordance with the requirements of Pollution Reduction Programs U1 (Wheel Generated Dust) and U3 (Disturbing and Handling Overburden under Adverse Weather Conditions), Warkworth Mining Limited and Mount Thorley Operations submitted detailed reports to the Environment Protection Agency to satisfy the relevant conditions of the licences. Following submission, these reports were published to the Rio Tinto website and are now publically available.

MTW achieved a haul road dust control efficiency of 97% against a target of 80% required by the EPA's Wheel Generated Dust pollution reduction programme.

In letters to MTW dated 17 September 2014, the EPA confirmed that the reports submitted demonstrated substantial compliance with the conditions, and that accordingly the conditions would be removed from MTW's Environment Protection Licences.

3.4.2.4 Temporary Stabilisation

Aerial Seeding was undertaken in early May 2014 by a fixed wing aircraft to provide a temporary cover to areas exposed to wind generated dust and erosion at MTW. Waste dumps and exposed areas were selected for seeding if they were not planned to be disturbed within six months. The 382 hectares of area seeded included waste dumps and ahead of mining disturbance (see Figure 26). All areas were seeded using an exotic pasture grass and legume mix suitable for an autumn sowing. The seed mix was revised slightly from previous years to reduce the number of species to those which were most successful from previous years. A starter fertiliser was mixed with the seed prior to loading to provide sufficient nutrients for plant growth.

Plan of: 2014 Aerial Seeding Areas

Date: 150224
Plan By: KP
Version: 1.0

**COAL
&
ALLIED**

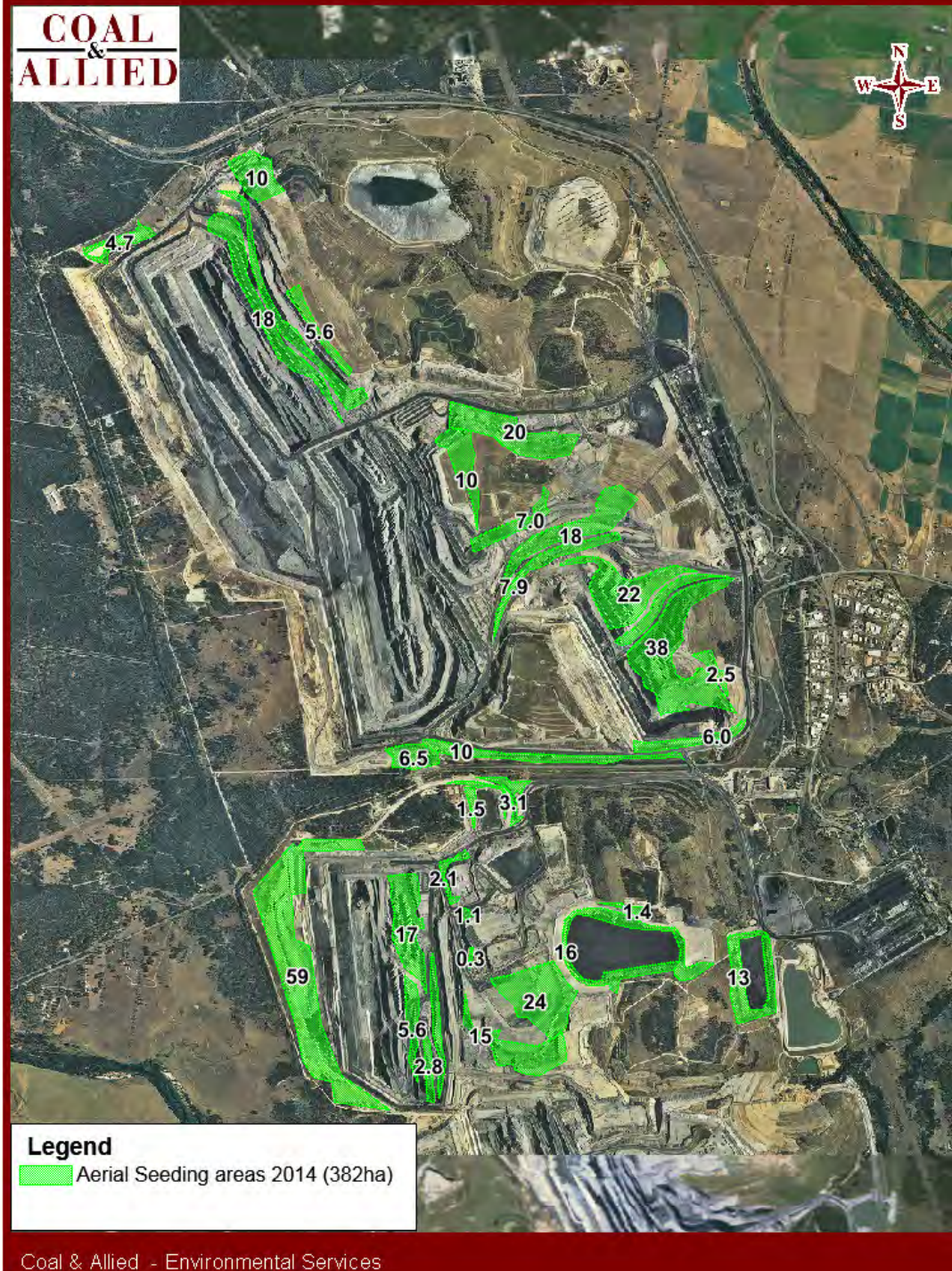


Figure 26: 2014 Aerial Seeding Areas

3.4.3 Air Quality Monitoring and Performance

Air quality monitoring at MTW is undertaken in accordance with the MTW Air Quality Monitoring Programme and protocol for evaluating non-compliances (available via the Rio Tinto website). The monitoring network comprises an extensive array of monitoring equipment which is utilised to assess performance against the relevant conditions of MTW's approvals. Air quality monitoring locations are shown in Figure 27. During 2014, MTW complied with all short term and annual average air quality criteria.

Air quality compliance criteria are shown in Table 22 and Table 23, along with a summary of MTW's performance against the criteria. Whilst MTW operates under two separate Planning Approvals the following compliance assessment has been undertaken on a 'whole of MTW site' basis, rather than individually assessing the contribution of each approval area to the measured results.

Regularly updated air quality monitoring data is made publically available through the MTW Monthly Environmental Monitoring Report, which can be viewed on the Rio Tinto website.

**Mount Thorley Warkworth
Air Quality Monitoring Locations**

Date: 140625

Plan By: DS

Version: 1.0



Figure 27: Air and Meteorological Monitoring Locations MTW 2014

Table 22: Air quality impact assessment criteria and 2014 compliance assessment (WML DA 300_9_2002_i and MTO DA 34/95)

Pollutant	Criterion	Averaging Period	Compliance
Deposited Dust	4 g/m ² /month	Maximum total deposited dust level	100%
	2 g/m ² /month	Maximum increase in deposited dust level	100%
Total Suspended Particulate matter (TSP)	90 µg/m ³	Long Term (Annual)	100%
Particulate matter <10µm (PM ₁₀)	30 µg/m ³	Long Term (Annual)	100%
	50 µg/m ³	Short Term (24 hour)	100%

Table 23: Air quality land acquisition criteria and 2014 compliance assessment (WML DA 300_9_2002_i and MTO DA 34/95)

Pollutant	Criterion	Averaging Period	Compliance
Deposited Dust	4 g/m ² /month	Maximum total deposited dust level	100%
	2 g/m ² /month	Maximum increase in deposited dust level	100%
Total Suspended Particulate matter (TSP)	90 µg/m ³	Long Term (Annual)	100%
Particulate matter <10µm (PM ₁₀)	30 µg/m ³	Long Term (Annual)	100%
	^a 150 µg/m ³	Short Term (24 hour)	100%
	^b 50 µg/m ³	Short Term (24 hour)	100%

a- Background PM₁₀ concentrations due to all other sources plus the incremental increase in PM₁₀ concentrations due to the mine alone

b – Incremental increase in PM₁₀ concentrations due to the mine alone

3.4.3.1 Deposited Dust

Deposited dust is monitored at nine locations situated on, or representative of privately-owned land, in accordance with AS3580.10.1 (2003). The 2014 annual average insoluble matter deposition rates compared with the depositional dust impact assessment criterion and previous years' data, shown in Figure 28. During 2014, all annual average insoluble matter deposition rates recorded on privately owned land were compliant with the long term impact assessment and land acquisition criteria. All monitoring locations also demonstrated compliance with the maximum allowable insoluble solids increase criteria of 2g/m²/month (Figure 29).

During 2014, monthly dust deposition rates equal to or greater than the long term impact assessment criteria of 4g/m²/month were recorded at number of sites. Often this is due to contamination of the open sample vessel. Where field observations denote a sample as contaminated (typically with insects, bird droppings or vegetation), the results are excluded from Annual Average compliance assessment. Meteorological conditions and the results of nearby monitors for the sampling period are also considered when determining MTW's level of contribution to any elevated result. Details of excluded results are presented in the relevant MTW Monthly Environmental Monitoring Report.

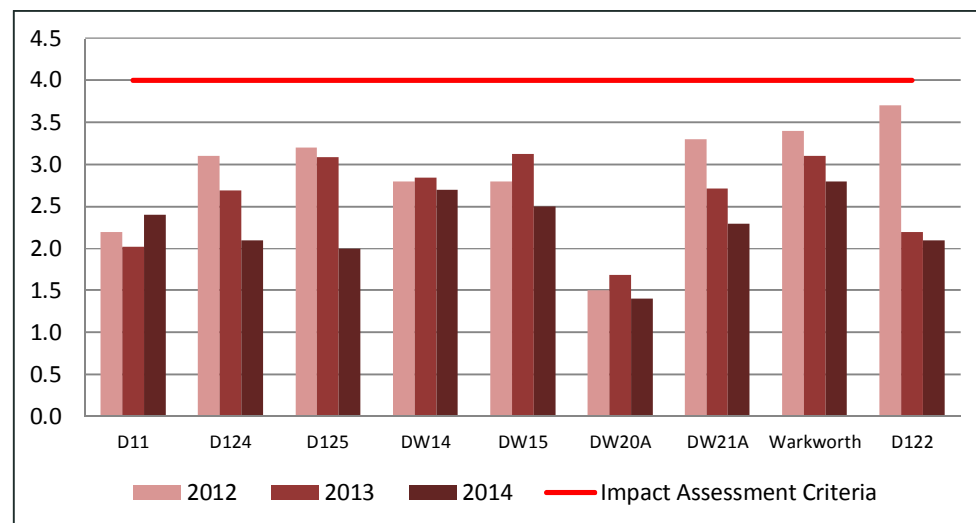


Figure 28: 2014 Depositional Dust results compared against the impact assessment criteria and previous years' results

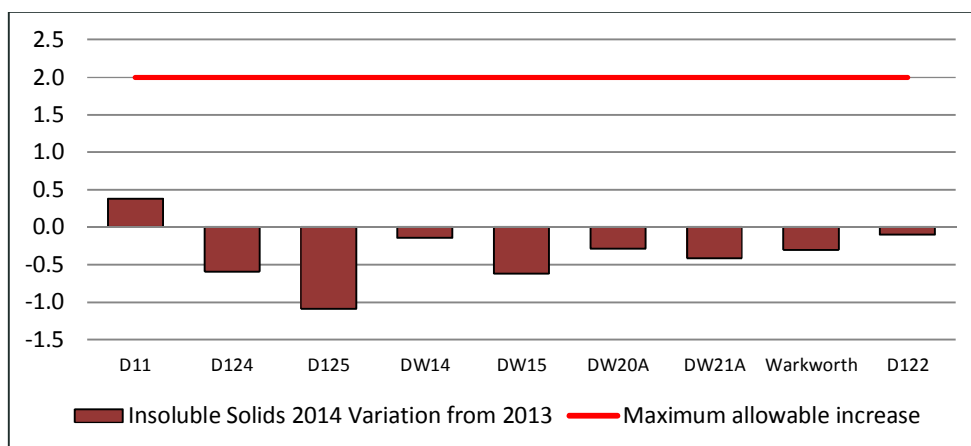


Figure 29: Variation in insoluble solids deposition rate from 2013 to 2014 compared against the impact assessment criteria

Total Suspended Particulates (TSP) is measured at five locations situated on or representative of privately owned land in accordance with AS3580.9.3(2003). Annual average TSP concentrations recorded in 2014 compared with the long term impact assessment criterion and previous years' data, are shown Figure 41. During 2014 all annual average results were compliant with the impact assessment and land acquisition criteria.

During the reporting period, 1 out of 305 TSP measurements was not able to be collected on the scheduled sampling date (based on a sampling frequency of every six days).

The annual average TSP concentrations recorded in 2014 are generally consistent with those recorded during previous years (Figure 30), with the exception of the MTO-TSP1 monitoring location which recorded an annual average of 70.61µg/m³. It should be noted that this monitoring location is no longer representative of any privately owned land following land ownership changes in 2014, and is proposed to be relocated to the west in 2015 to ensure the monitoring network records measurements which remain representative of impacts received by neighbouring privately owned lands.

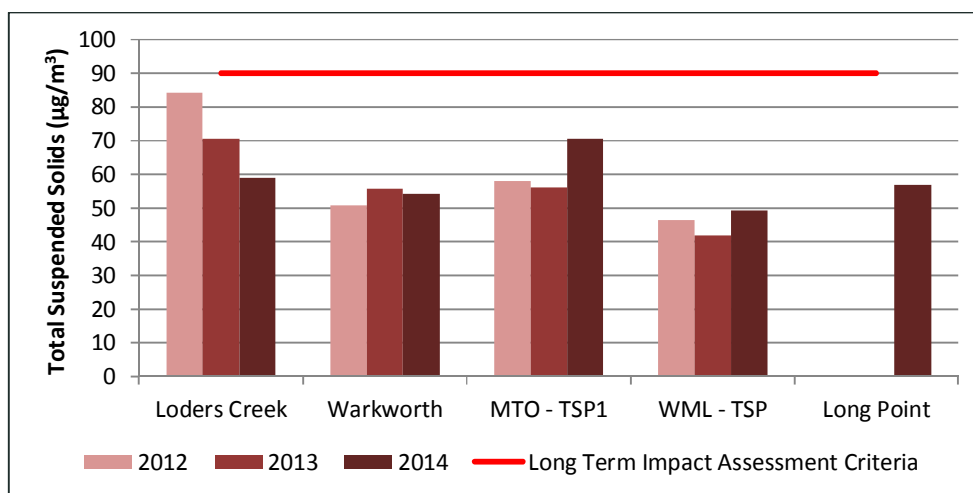


Figure 30: 2014 TSP Annual Average compared against the impact assessment criteria and previous years' results

3.4.3.2 Particulate Matter <10µm (PM₁₀)

In years' previous, compliance assessment with PM₁₀ criteria has been undertaken through direct comparison of results recorded through the PM₁₀ High Volume Air Sampler monitoring regime against the relevant criteria. The DP&E clarified reporting expectations to the industry in a directive dated 7 July 2014, requiring mines with real-time monitoring devices to report on the results for compliances purposes. Accordingly, PM₁₀ results recorded by both the High Volume Air Samplers and TEOM's are reported here.

Compliance assessment for Particulate Matter <10µm (PM₁₀) is measured at five locations on privately owned land in accordance with AS3580.9.6 (2003). During 2014, all short term and annual average results were compliant with the impact assessment and land acquisition criteria.

3.4.3.3 Short term PM₁₀ impact assessment criteria

Monitoring results for 2014 PM₁₀ (24 hour) collected through the High Volume Air Sampler monitoring regime compared against the short term impact assessment criteria is shown in Figure 31. All 24hr average results recorded by MTW's surrounding network of TEOM monitors is presented on a quarterly basis in Figure 31 to Figure 35.

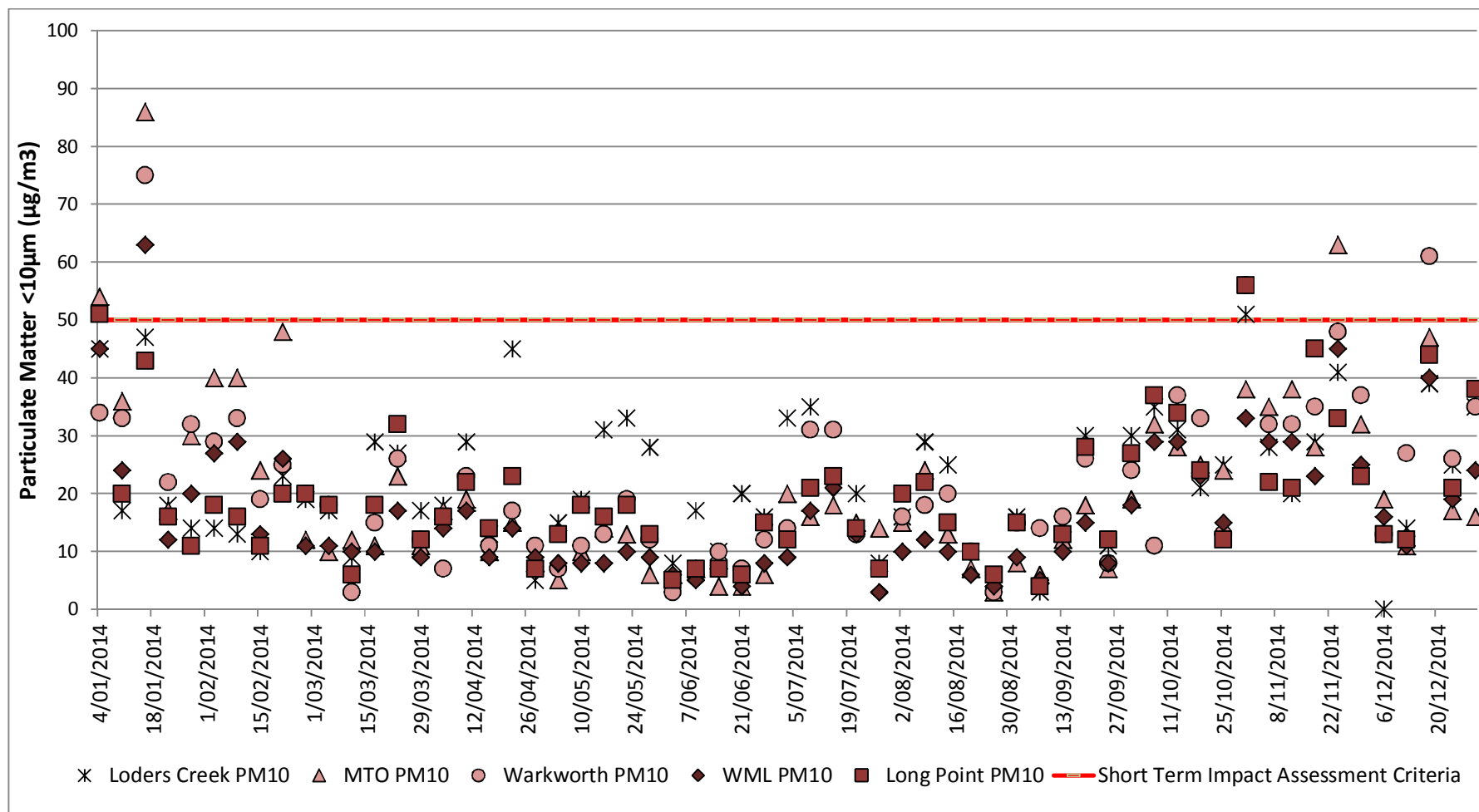


Figure 31: PM10 24hr monitoring results

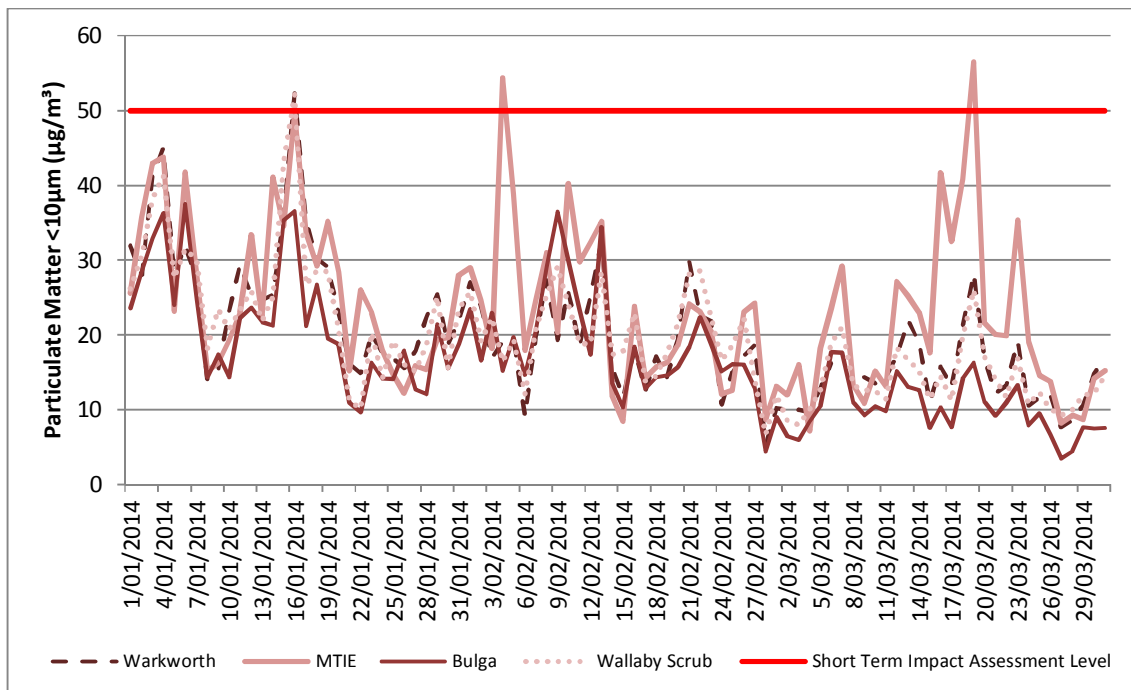


Figure 32: 24hr average PM10 measured at TEOM monitors surrounding MTW - Quarter One 2014

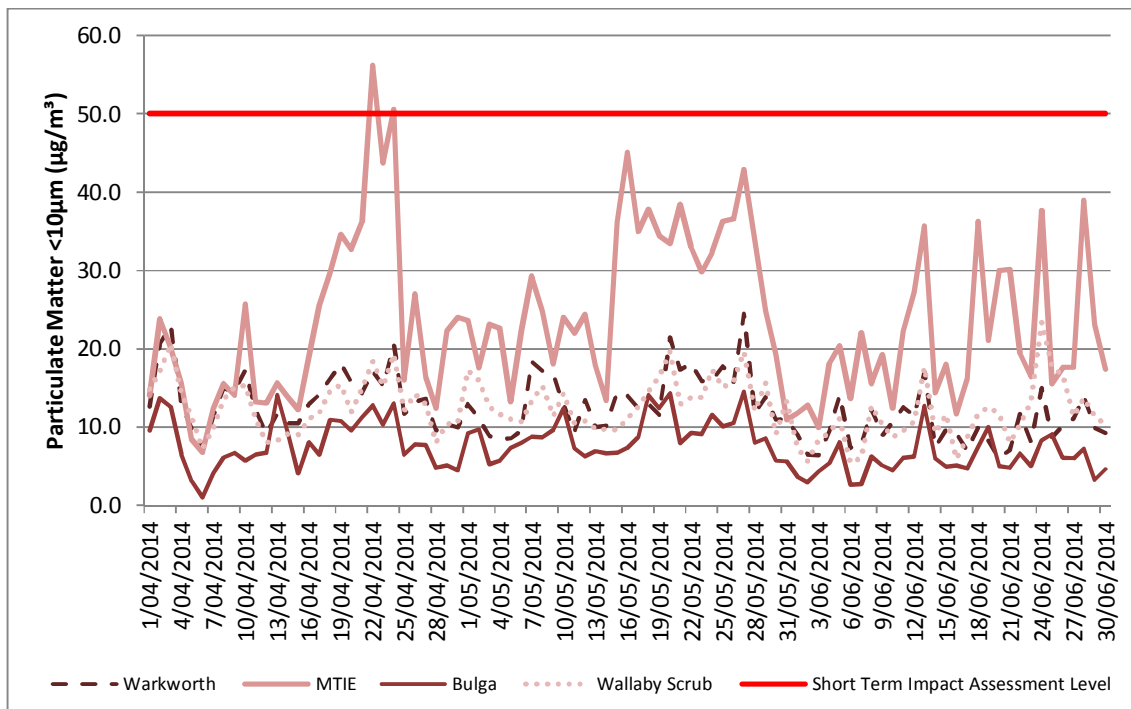


Figure 33: 24hr average PM10 measured at TEOM monitors surrounding MTW - Quarter Two 2014

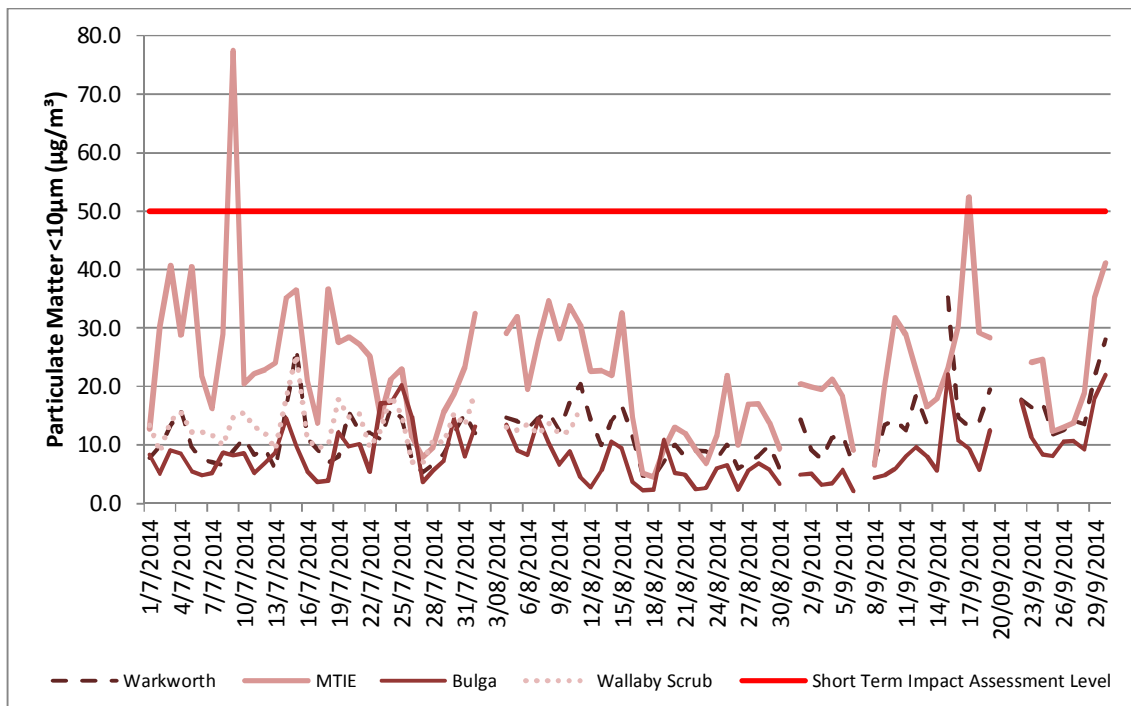


Figure 34: 24hr average PM10 measured at TEOM monitors surrounding MTW - Quarter Three 2014

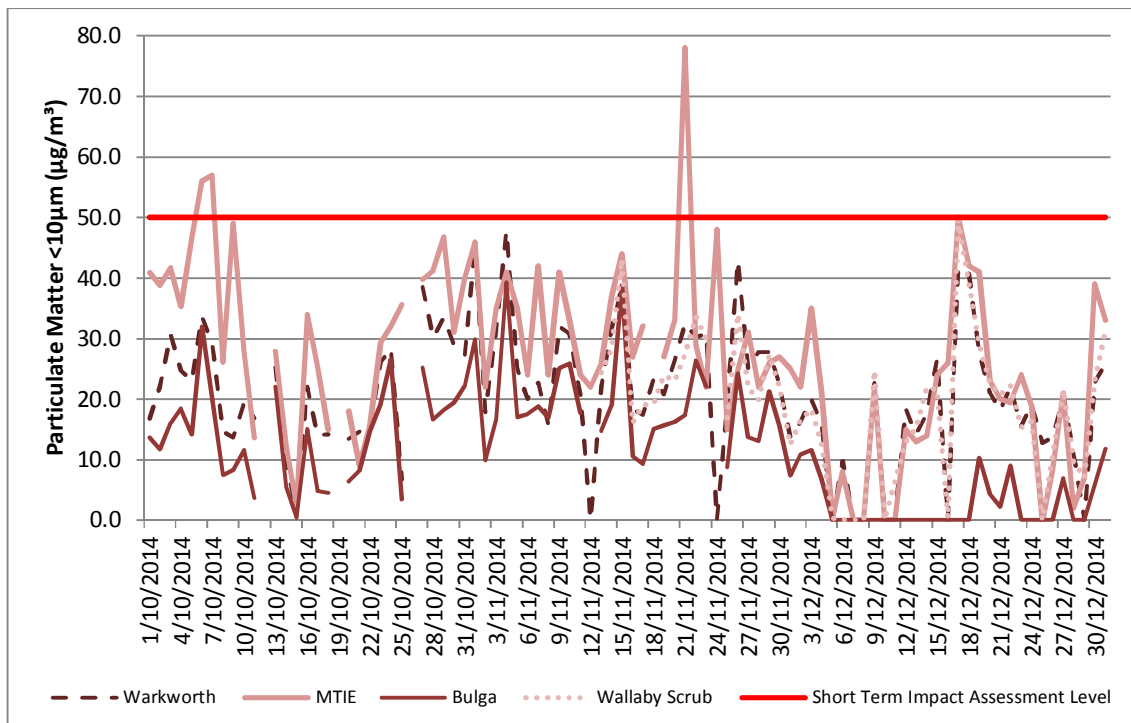


Figure 35: 24hr average PM10 measured at TEOM monitors surrounding MTW - Quarter Four 2014

Eight high volume air samples and 11 TEOM measurements exceeded the 24 hour short term impact assessment criteria during the reporting period. Each was investigated to determine the level of contribution from MTW activities to the elevated result (Figure 32). For each measurement, it was determined that MTW was not the predominant contributor hence compliant with the impact assessment criteria. The DP&E were notified at the time of each exceedance, with follow-up notifications to confirm the outcome of the investigation undertaken. Requests for further information were received from the Department on two occasions. These additional reports were provided as required.

A summary of the investigations undertaken for each short term PM₁₀ exceedance are provided in Table 24. Investigations for real time PM₁₀ exceedances are only shown from July 2014 when the requirement to use this data for compliance assessment came in to effect.

Table 24 : 24 hour PM10 investigations - 2014

Date	Site	24hr Result (µg/m ³)	Estimated Contribution (MTW) (µg/m ³)	Discussion
4/01/2014	Long Point	51	5	MTW contribution conservatively estimated to be 10% of the total measured level. The monitor was upwind of MTW operations for the majority of the day.
4/01/2014	MTO	54	15.4	MTW contribution conservatively estimated to be 29% of the total measured level, based on PM10 measurements measured at other real time monitors downwind/upwind of MTW on the day.
16/01/2014	WML	63	22.3	Measured levels significantly impacted by bushfire smoke. Satellite imagery shows the location of the HVAS units and the proximity to bushfires on the day.
	Warkworth	75	17.2	
	MTO	86	30.1	
9/07/2014	MTIE TEOM	77.5	-	This result is not considered valid as it has been derived from only 10 hours of data on the day. The full 24hrs data was unable to be captured due to an outage on the monitoring data server.

Date	Site	24hr Result ($\mu\text{g}/\text{m}^3$)	Estimated Contribution (MTW) ($\mu\text{g}/\text{m}^3$)	Discussion
17/09/2014	MTIE TEOM	52.4	29.3	An investigation including comparison of data at MTIE and the nearby UHAQMN Mount Thorley monitor (24hr average – 22.2 $\mu\text{g}/\text{m}^3$) was undertaken to determine MTW's likely level of contribution to the total on this day. Analysis of the PM10 trends at the two monitoring locations identifies close correlation in PM10 trends with the exception of a sharp increase in PM10 at the MTIE monitor at approx. 8:00pm which is not evident at the Mount Thorley monitor. Given the consistent wind conditions throughout the day (light – moderate West and Nor-westerly), it is reasonable to assume that significant emissions from a mine based source would also impact upon the Mount Thorley monitor. On this basis, it is considered that a local emission source located close to the MTIE monitor was responsible for the elevated PM10 measurements at approx. 8:00pm. MTW's contribution on the day is conservatively estimated at 29.3 $\mu\text{g}/\text{m}^3$. In follow-up to the elevated measurement, a local compliance officer met with MTW personnel and carried out an inspection of the MTIE monitoring location.
6/10/2014	MTIE TEOM	56	16	During periods of elevated dust on the day, winds were predominantly from the South or South-East. MTW's contribution estimated to be 16 $\mu\text{g}/\text{m}^3$.
7/10/2014	MTIE TEOM	57	28	An investigation found that the exceedance was predominantly the result of elevated dust measurements during a discrete period of the day, during which the winds were blowing from East.
31/10/2014	Loders Creek	51	27.0	MTW contribution conservatively estimated to be 52% of the total measured level, based on PM10 measurements at other real time monitors downwind/upwind of MTW on the day.
31/10/2014	Long Point	56	7.5	MTW contribution conservatively estimated to be 13% of the total measured level, based on PM10 measurements measured at other real time monitors downwind/upwind of MTW on the day.

Date	Site	24hr Result ($\mu\text{g}/\text{m}^3$)	Estimated Contribution (MTW) ($\mu\text{g}/\text{m}^3$)	Discussion
31/10/2014	Warkworth	56	15.7	MTW contribution conservatively estimated to be 27% of the total measured level, based on PM10 measurements measured at other real time monitors downwind/upwind of MTW on the day.
21/11/2014	MTIE TEOM	78	27	MTW contribution to the measured result at MTIE is a maximum of 34% of the measured level, or $27\mu\text{g}/\text{m}^3$. Given that dust levels were elevated at all locations around MTW at the time of a short period of high winds and associated elevated PM10, it is unlikely that MTW would have contributed significantly to the levels at MTW at the time. A report was prepared for the Department of Planning and Environment.
24/11/2014	MTO	63	31.7	MTW contribution conservatively estimated to be 50% of the total measured level, based on PM10 fluctuations measured at other real time monitors downwind/upwind of MTW on the day.

3.4.3.4 Long term PM₁₀ impact assessment criteria

Annual average PM₁₀ concentrations recorded at the five monitoring locations in 2014, compared with the long term PM₁₀ impact assessment criterion and previous years' data, are shown on Figure 36. During 2014, all annual average PM₁₀ concentrations recorded on privately owned land were compliant with the assessment criterion. Compared to 2013 annual average results, slight increases in PM₁₀ concentrations were recorded at MTO-PM₁₀ (3.4µg/m³), Warkworth (0.3µg/m³) and WML-PM₁₀(3.3µg/m³) locations. No assessment is made of MTW contribution to these results therefore the results are representative of the region and cannot be inferred to be directly attributed to MTW.

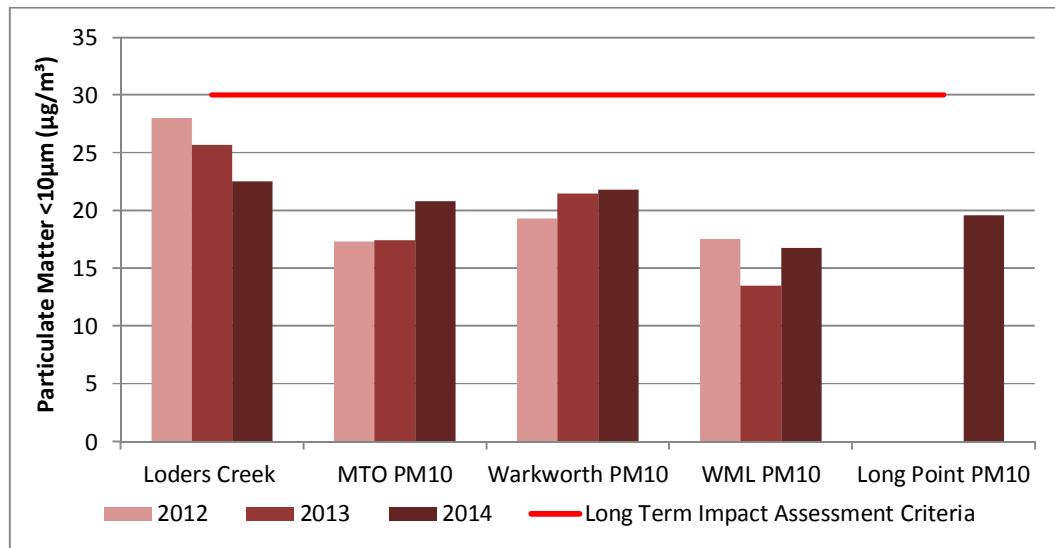


Figure 36: Annual average HVAS PM₁₀ results 2012 to 2014

3.4.3.5 Comparison of 2014 Air Quality data against EA predictions

Table 25 and Table 26 show a comparison between 2014 air quality data and the predictions made in the 2002 Warkworth Environmental Impact Statement (EIS). Comparisons have been made against the predictions listed in the EIS for the Year 10 (2013) and Year 15 (2018) for the nearest private residence to each monitoring location.

Annual average PM₁₀ measurements at all locations in 2014 were consistent with the modelled range for Year 10 of the development (nominally 2013). 2014 results at the Loders Creek and Long Point locations but slightly higher than levels predicted for Year 15 (nominally 2017). PM₁₀ measured levels at Loders Creek have been reducing since 2012 as mining in Warkworth progresses to the West, indicating that the annual average at this location in 2017 will be consistent with predicted levels. Given prevailing meteorological conditions in the Hunter Valley follow an annualised pattern of South-East to North-West airflow (and vice versa), it is unlikely that MTW is contributing significantly to measured PM₁₀ concentrations in the Long Point area. Change has occurred in the Hunter Valley landscape (particularly to the North of Long Point) in the years since the model predictions were generated in 2002. It is therefore considered reasonable to expect the annual average PM₁₀ recorded (Table 25) in this area to be greater than that predicted (albeit not significantly).

Table 25: 2014 PM10 Annual Average results compared against Cumulative Predictions for Years 10 and 15 - Warkworth EIS (2002).

Monitoring Location	Long Term (annual average) PM ₁₀ criteria		
	Year 10 (µg/m ³)	Year 15 (µg/m ³)	2014 Annual Average (µg/m ³)
MTO PM ₁₀	20-30	20-30	20.8
Loders Creek PM ₁₀	20-30	15-20	22.5
WML PM ₁₀	10-20	15-20	16.8
Warkworth PM ₁₀	10-20	15-20	21.8
Long Point PM ₁₀	10-20	<15	19.6

TSP annual averages at all monitoring locations were higher than modelled predictions for both Year 10 and Year 15 scenarios, but generally consistent with years' previous. The difference between modelled predictions and the measured result can be explained as a function of model inputs which do not account for TSP contribution from regional particulate events such as bushfires, stock movement, dust from local roads and driveways and agricultural activity.

Table 26: 2014 TSP Annual Average results compared against Cumulative Predictions for 2012 and 2017 Warkworth EIS (2002).

Monitoring Location	Long Term (annual average) TSP criteria		
	Year 10 ($\mu\text{g}/\text{m}^3$)	Year 15 ($\mu\text{g}/\text{m}^3$)	2014 Annual Average ($\mu\text{g}/\text{m}^3$)
MTO TSP1	30-50	30-50	70.6
Loders Creek TSP	20-30	20-30	58.9
WML- HV2a	20-30	20-30	49.3
Warkworth	20-30	20-30	54.4
Long Point	20-30	20-30	57.9

3.4.4 Air Quality Non-Compliances during reporting period

MTW complied with all air quality criteria in 2014.

3.4.5 Complaints

During 2014 MTW received 27 dust complaints, compared to 48 in 2013. The majority of dust complaints originated from the Bulga area, with a smaller number received from Long Point and Mount Thorley Industrial Estate.

3.4.6 Compliance Audits

Following dialogue between MTW and the NSW DP&E, MTW undertook a targeted review of the effectiveness of the Air Quality Management measures in place at the mine, particularly under extreme wind conditions. Jacobs (Independent air quality consultants) were engaged to complete the review, involving three main components:

- Data analysis – to determine what might constitute an extreme wind event, in terms of the air quality and meteorological monitoring records
- Site evaluation – to validate preparedness and response to an extreme wind event; and
- Documentation review – to check whether the documented procedures are consistent with onsite activities and to identify improvements to procedures or additional measures which could reasonably and feasibly be introduced

Data Analysis

The data analysis component found that those meteorological conditions which could be considered “extreme” are aligned with those conditions already the subject of MTW’s real-time air quality alert system (winds >8m/sec).

The data analysis also found no clear association between elevated PM₁₀ concentrations and strong winds (possibly explained by better dispersion of particulates under strong winds), highlighting the known disconnect between management of visible dust (subjective) and the practice of assessing the effectiveness of those management actions through quantitative means (PM₁₀ measurement).

Site Evaluation

The site evaluation component consisted of two days of “on-ground” inspection of activities at MTW. Inspections were undertaken on the 5th and 14th November, which had been identified through predictive forecast information to be days where “extreme winds” were likely. Observations were made of the following activities:

- Daily 10am production meeting between supervisors;
- Load and haul operations;
- Dragline operations;
- Blasting operations

Documentation Review

The documentation review, coupled with the data analysis and site evaluation culminated in the identification of seven recommendations for MTW to improve the Air Quality and Greenhouse Gas Management Plan, as follows:

- MTW could request that Weatherzone provide information on the performance and suitability of the predictive meteorology information provided to MTW;
- Background data section of the AQGGMP could be improved by including real-time (TEOM) PM₁₀ data;
- More information on wind speed statistics could be included to reinforce the adequacy of selected trigger points in the air quality management regime;
- The Plan could provide guidance on “hot, high wind conditions” to assist operators in decision making;
- The Plan could include more emphasis on visual surveillance. Based on the reviewer’s observations of radio communications on site, there is strong evidence of frequent communication based on operator’s visual observations;
- The Plan could include a schematic or flow chart that depicts the mechanics of the dust management approach; and
- Include information in the Plan on how and when the content in the Plan is communicated to operations staff

These recommendations will be considered for inclusion in the AQGGMP at the next review of the Plan. The review report was submitted to the Department of Planning and Environment, and can be viewed in full via the Rio Tinto website.

3.4.6.1 NSW EPA Loss of Coal during Rail Transport Compliance Audit Program

During 2014, MTW's Mount Thorley Coal Loader was the subject of a train load out audit, undertaken by the NSW EPA. The audit inspection was carried out by EPA Officers on 29 May 2014. In a final report issued to MTW in December 2014, three non-compliances were identified, as listed in Figure 37.

Assessment		Number of assessments
Yes (Compliant)		6
No (Not Compliant)	code red	0
	code orange	1
	code yellow	2
	code blue	0
Not Determined		0
Not Applicable		5
Total		14

Figure 37: Summary of Compliance (excerpt from EPA audit report)

Code Red = a non-compliance of considerable environmental significance which must be dealt with as a matter of priority

Code Orange = a non-compliance of environmental significance however of a lower priority than a code red

Code Yellow = of lower importance than a Code Red or Orange, but is still important and must be addressed

Code Blue = a non-compliance relating to an administrative, monitoring or reporting requirement with no direct environmental significance

The non-compliances related to the loading profile of coal within a number of wagons; a lack of controls to ensure that wagon doors are securely closed to prevent leaks; and the presence of one (only) measure to ensure the prevention of leaks and spills of coal from wagon doors during rail transport.

In a response to the EPA in regards to the non-compliances identified, MTW has questioned the materiality of the non-compliances with respect to the risk posed to people and the environment. Nonetheless, MTW considers the findings improvement opportunities and has developed an action plan to address the non-compliances identified in the audit (see Figure 38).

Item	Condition No.	Action Details	Non-Compliance Code	Target/Action Date
1	O1.1a	The licensee must implement reasonable and practicable measures which effectively minimise or prevent coal spills and dust emissions from the tops of wagons during rail transport.	code orange	30 June 2015
2		The licensee must implement reasonable and practicable measures which effectively minimise or prevent leaks and spills of coal from wagon doors.	code yellow	31 March 2015
3		The licensee must implement reasonable and practicable measures which minimise or prevent coal deposition on the exterior of wagons.	code yellow	31 March 2015

Figure 38: Action Plan to address non-compliances (excerpt from EPA audit report) (Note the dates are subject of discussion with the EPA)

The full audit report, along with MTW's response to the report can be viewed on the POEO Public Register (<http://www.epa.nsw.gov.au/prpoeoapp/>).

No further Independent Environmental Audits were undertaken in the reporting period.

3.5 Greenhouse Gas and Energy Management

3.5.1 Climate Change

During 2014, MTW continued to comply with Australian Government legislation for Greenhouse reporting. Under NGER, Rio Tinto is required to report its annual greenhouse gas emissions, energy use and energy production..

RTCA continues to invest in research and development initiatives (see Table 27), to find ways to reduce greenhouse gas emissions throughout the coal chain, with focus on;

- Research to identify new technologies;
- Technology upgrades to improve the way coal is burned; and
- Supporting a policy environment to enable the deployment of low emissions coal technologies.

Table 27: Product Stewardship Programs

Programme	Outcomes
COAL21	<p>Australian black coal producers contribute a voluntary levy to the Coal21 Fund to support the development of low emission coal technology in Australia.</p> <p>Rio Tinto Coal Australia committed \$2.3 million in 2013 and has committed \$52 million to this fund since 2007.</p>
Australian Coal Association Research Programme (ACARP)	<p>Australian black coal producers contribute five cents per tonne of product coal to fund research and the development of technologies that lead to the safe, sustainable production and utilisation of coal. During 2013 this contribution was around \$2 million.</p> <p>ACARP is currently coordinating work to develop improved methods for estimating fugitive emissions from underground coal mining. There is also considerable research activity on the reduction of dust emissions from coal during transport to and storage at the major export terminals in Australia and to understand opportunities to reduce fugitive greenhouse gas emissions from mines.</p>
The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC)	<p>The CO2CRC conducts research and development into carbon capture and storage technologies. It operates the Otway Project in Victoria, Australia's first demonstration of the deep geological storage, or geosequestration, of carbon dioxide. The project has successfully demonstrated the injection and storage of 65,000 tonnes of carbon dioxide.</p> <p>In addition to its \$250,000 annual membership contribution, Rio Tinto Coal Australia is providing the CO2CRC with \$6 million in funding over 3 years. The funding supports operations at the Otway Project and the Peter Cook Centre for CCS Research at the University of Melbourne.</p>
Global Carbon Capture and Storage Institute (GCCSI)	<p>The mission of the GCCSI is to accelerate the global adoption of CCS. Rio Tinto is a foundation member of the GCCSI.</p>
Leadership Roundtable for the Development of Low Emissions Technologies for Fossil Fuels (the Roundtable).	<p>Rio Tinto is a member of the Roundtable which was established in 2014 in recognition of the importance of actions by industry and governments to curb greenhouse gas emissions. The objective of the Roundtable is to share information on low emissions technologies for fossil fuels and may undertake fact based robust analyses of these technologies to support strategy development.</p>
Coal Industry Advisory Board (CIAB) to the International Energy Agency (IEA)	<p>The CIAB advises the IEA on issues related to coal including opportunities to reduce emissions from the use of coal. The CEO of Rio Tinto Energy is a member of the CIAB and Rio Tinto Energy actively contributes to the work of the CIAB.</p>

Energy Exchange Series

Rio Tinto Energy, the University of Queensland and the Energy Policy Institute of Australia ran a series of three breakfasts (the Energy Exchange Series) during 2014. Each Breakfast featured an internationally recognised speaker on an issue relevant to energy and was attended by up to 300 people. The purpose of the series is to make the highest quality information on the global energy issues available to the Australian debate.

3.5.2 Greenhouse Gas and Energy Use Performance

During 2014, MTW obtained energy from two main sources: (1) electricity supplied through the state electricity grid, and (2) diesel and other fuels. The total energy use for MTW is displayed in Table 28 and the total GHG emissions for MTW including fugitive coal seam gas emissions, and land management emissions are displayed in Table 29. Data includes Mount Thorley Operations, Warkworth Mining Limited and Mount Thorley Coal Loader.

Table 28: Energy Consumption

Mount Thorley Warkworth Energy Consumption	2011	2012	2013	2014
Electricity (GJ)	574,082	655,856	681,203	694,765
Diesel and other fuels (GJ)	3,444,792	4,625,440	4,722,010	4,533,775
Total Site (GJ)	4,018,874	5,281,296	5,403,213	5,228,540

Table 29: Greenhouse Emissions

Mount Thorley Warkworth Greenhouse Gas Emissions	2011	2012	2013	2014
Electricity (tCO ₂ -e)	142,707	161,244	165,570	166,949
Diesel and other fuels (tCO ₂ -e)	234,366	317,751	326,934	313,986
Coal Seam Gas (tCO ₂ -e)	615,510	452,560	213,524	323,023
Land Management (tCO ₂ -e)	12,090	8,230	1,210	7,220
Total Site (tCO ₂ -e)	1,004,673	939,785	707,239	811,177

3.5.3. Non-Compliances during the Reporting Period

There were no non-compliances or complaints relating to greenhouse gas or energy usage in 2014.

3.6. Water Balance

3.6.1. Water Management

An adaptive management approach is implemented at MTW to achieve the following objectives for water management:

- Preferential re-use of poor quality mine water over clean water;
- Minimise the use of fresh water; and
- Protect clean water systems.

This is achieved by:

- Preferentially using mine water for coal preparation and dust suppression;
- An emphasis on control of water quality and quantity at the source;
- Segregating waters of different quality where practical;
- Recycling on site water;
- Ongoing maintenance and review of the water management system; and
- Disposing of water to the environment in accordance with statutory requirements.

Plans showing the layout of all water management structures and key pipelines are shown in Figure 39. The MTW Water Management Plan contains further detail on management practices and is available on the Rio Tinto website.

Improvements to water management in 2014 have continued to focus on future water supply security, seeking to supplement abstraction from the Hunter River by sourcing water from neighbouring mines during peak demand periods. This includes:

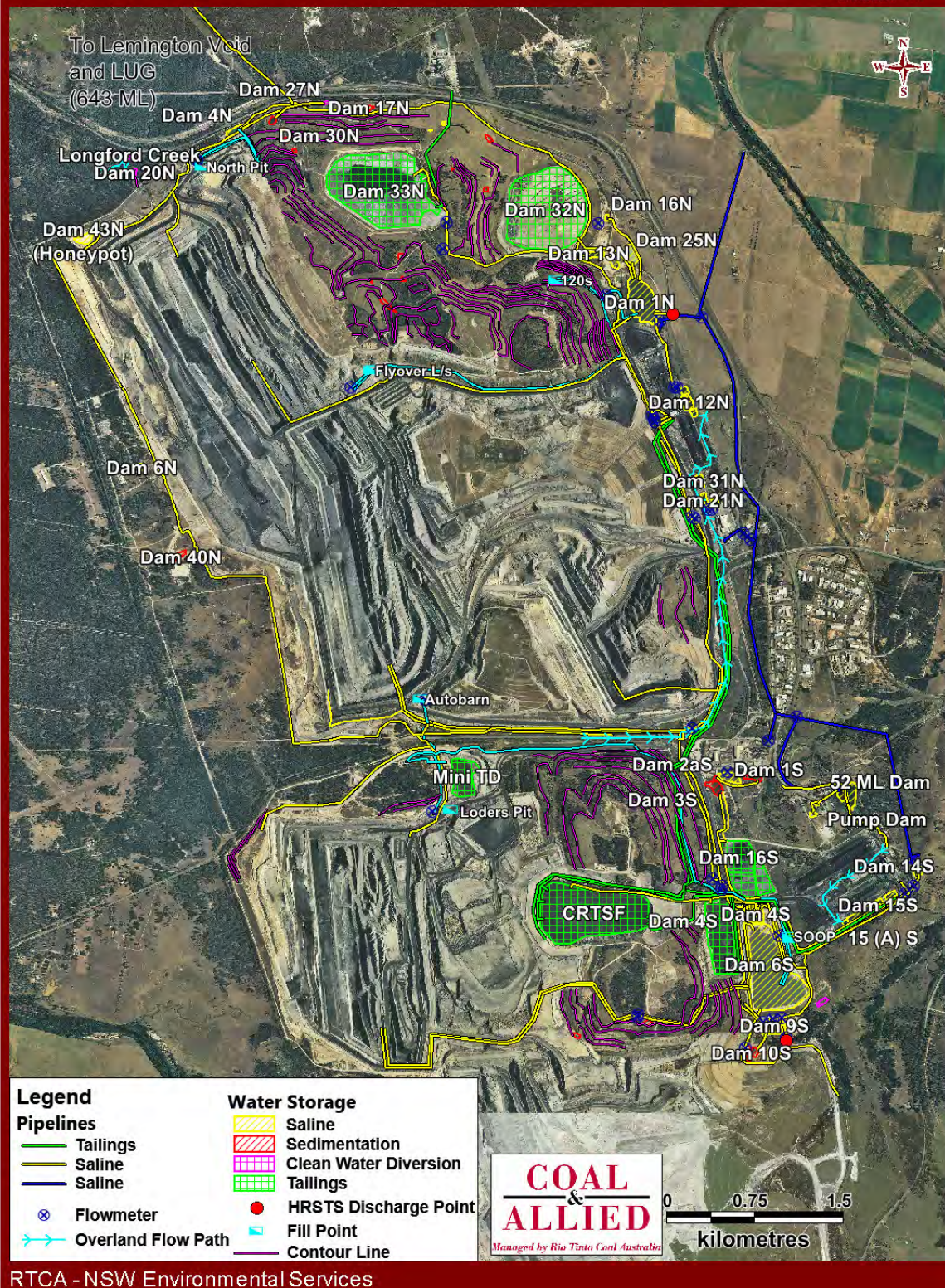
- Progressing a mine water transfer agreement with Peabody Wambo Coal mine, to supply surplus mine water to MTW where available; and
- Establishment of site water inventory tracking, to inform decision making on when to import water or to discharge water. This ensures sufficient water is available to meet operational demands, whilst mitigating the risk of excess water impacting production (due to insufficient buffer capacity in out of pit storage facilities).

Mount Thorley Warkworth Water Management Infrastructure Plan

Date: 150317

Plan By: KP

Version: 1.0



RTCA - NSW Environmental Services

Figure 39: Water Management Infrastructure Plan

3.6.2. Water Performance

3.6.2.1. Water Balance

MTW uses a water balance to record and assess water flux, but also to forecast and plan water management needs. These annual site water balances are then compared to previous results. A 2014 static water balance for MTW is presented in Table 30 and a simplified schematic of this balance is included as Figure 40. A salt flux schematic is shown in Figure 41.

Ongoing water balance modelling will be undertaken to enable the identification of water sharing efficiencies at MTW and HVO.

Table 30: Static Model Results, annual water balance

Water Stream	Volume (ML) (% Total)
Inputs	
Rainfall Runoff	3,017 (49%)
Hunter River (MTJV supply scheme)	854 (14%)
Potable (from Singleton Shire Council potable water supply)	54 (<1%)
Groundwater	284 (5%)
Recycled to CHPP from tailings (not included in total)	4,421
Imported (Bulga)	228 (4%)
Imported (HVO, including LUG bore, Wambo)	620 (10%)
Water from ROM Coal	1,050 (17%)
Total Inputs	6,107
Outputs	
Dust Suppression	2,365 (39%)
Evaporation – mine water dams	525 (8%)
Entrained in process waste	1,472 (24%)
Discharged (HRSTS)	0
Water in coarse reject	715 (12%)
Water in product coal	1,035 (17%)
Total Outputs	6,112
Change in storage (decreased)	5

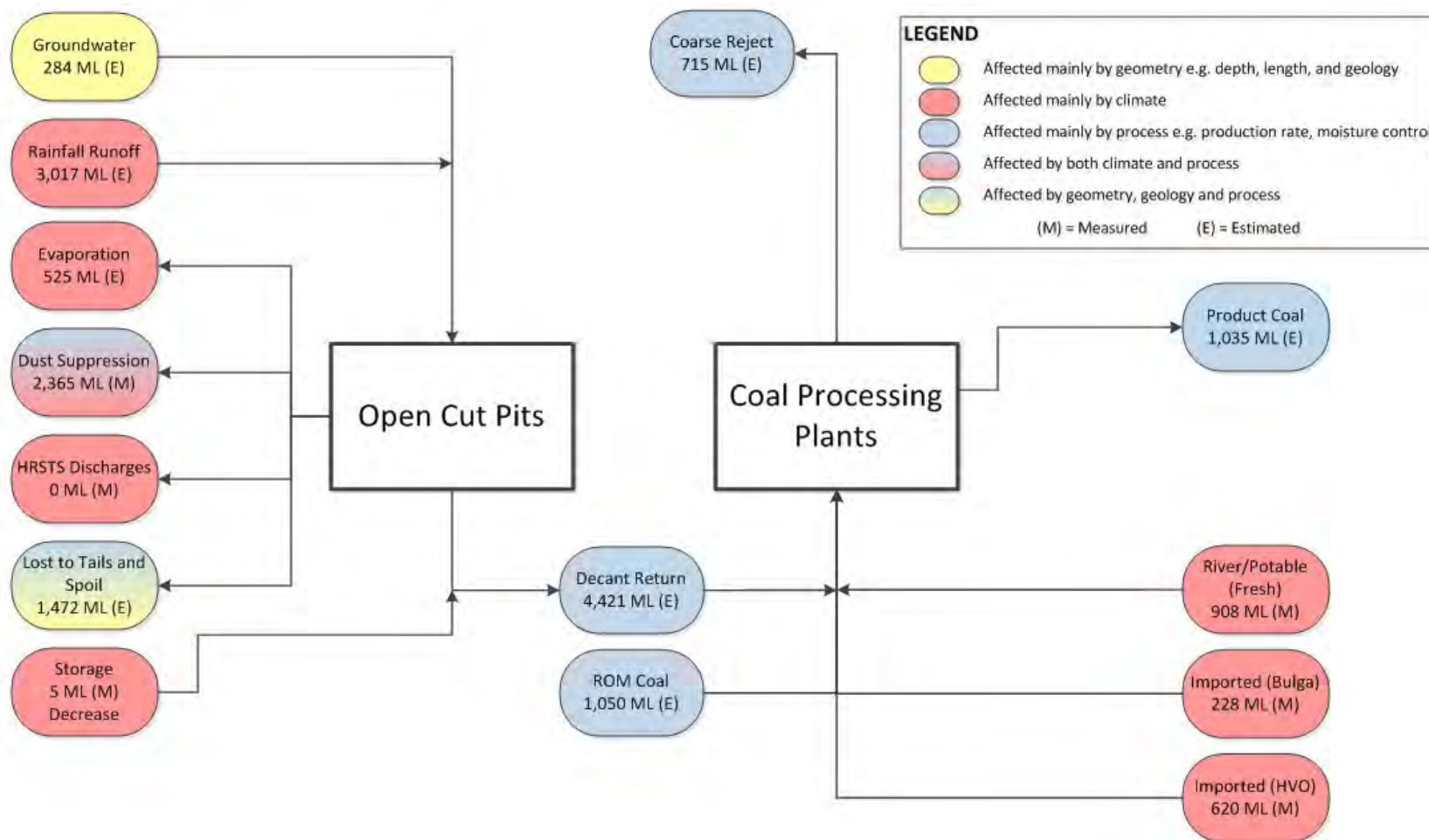


Figure 40: Schematic Diagram MTW Water Flux

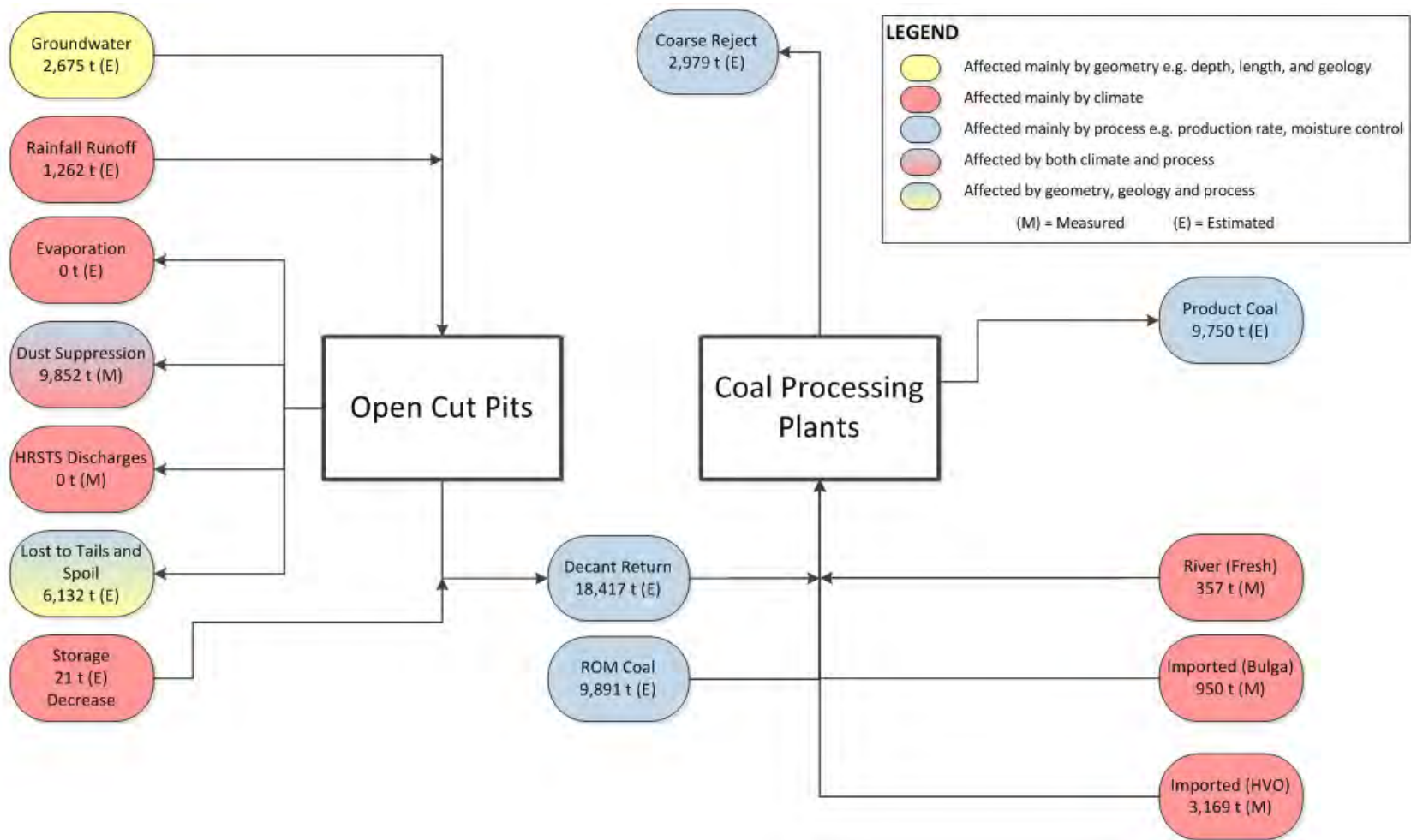


Figure 41: Schematic Diagram MTW Salt Flux

3.6.2.2. External Water Supply History

As the site water inventory is drawn down, importation of poor quality water from neighbouring mines occurs to meet site demand. In 2014, 848 ML of mine water was transferred to MTW, via intra-site pipelines. A total of 620 ML of water was supplied by Hunter Valley Operations, largely sourced from the Peabody Wambo mine, following the completion of a mine water transfer agreement for an initial tranche of water. An additional 228 ML was transferred from the Glencore Bulga mine in early 2014, under a water transfer agreement.

When external sources of mine water have been exhausted, water is sourced from the Hunter River via the Mount Thorley Joint Venture (MTJV) water supply scheme. Singleton Shire Council holds the high security water licence on behalf of the scheme members. Singleton Shire Council maintains and operates the scheme to supply raw water to MTW, Glencore's Bulga-Beltana complex, and to meet Council's own needs. MTW's share of the scheme allocation is 1,012 ML per financial year.

Abstraction of water from the Hunter River in 2014 reduced by 1,000 ML compared to 2013. The reduction is primarily a result of improved access to alternative external mine water supplies and revised inventory management practices.

Abstraction of water from the Hunter River via the MTJV water supply scheme in 2014 and previous years is summarised in Table 31. MTW will continue to work with neighbouring mines in 2015 to preferentially source additional mine water supplies.

Table 31: MTW Supply History from the Mount Thorley Joint Venture Supply Scheme

Year (financial)	Warkworth Usage (ML)	Mount Thorley Usage (ML)	Total (ML)
2011	42	68	161
2012	524	501	1,025
2013	1,172	682	1,854
2014	754	100	854

3.6.2.3. Water Discharges

No water was discharged off site during 2014 via the Hunter River Salinity Trading Scheme (HRSTS).

3.6.2.4. Review of Site Water Balance against EA Predictions

The site water balance predicted in the 2010 EA (EMGA Mitchell McLennan, 2010) has been compared to the actual site water balance in 2014.

Table 32 provides a summary of comments regarding the comparison. The imported water requirement for 2014, which was consistent with 2013 results, was significantly more than predicted. This is attributed to improved metering and increased water use for dust suppression, as a result of increased site and regulatory focus.

Table 32: Comparison of 2010 Predicted and 2014 Actual Water Balance

Prediction	Review comment
"Surface water runoff represents the predominant inflow to the system, accounting for more than 50% of all water inflows".	The rainfall runoff contribution estimated in the water balance indicates that actual was in line with the prediction. Surface runoff represented 49% of all water inflows in 2014.
"An average imported water requirement of 450ML per year is predicted over the mine life".	The 2014 draw from external supplies was 1,756 ML. Usage is largely consistent with contemporary predictions detailed in the Warkworth Continuation 2014 EIS.
"Storage risk profiles for in-pit storage all demonstrate storage levels less than 500ML for more than 95% of the time. All pits are generally maintained in a dewatered state at least 85% of the time".	Minutes from monthly Water Management Meetings indicate that this was the case in 2014.
"Acceptable management of mine water should be achievable without the need for additional salinity credits under the HRSTS".	MTW did not discharge water during 2014.

3.7. Surface Water

3.7.1. Water Management

MTW surface water management is detailed in the MTW Water Management Plan, and includes:

- Detailed plans of mine water infrastructure;
- Erosion and sediment controls;
- Performance criteria for the water management system and surface water quality; and
- Water quality and water flow triggers requiring action.

Surface water monitoring activities continued in 2014 in accordance with the MTW Water Management Plan and MTW Surface Water Monitoring Programme. MTW maintains a network of surface water monitoring sites located at site dams and surrounding natural watercourses, see Figure 42. Water quality monitoring is undertaken to verify the effectiveness of the water management system onsite, and to identify the emergence of potentially adverse effects on surrounding watercourses. Mine site dams are monitored routinely to verify the quality of mine water, used in coal processing, dust suppression, and other day to day activities around the mine.

Surface water monitoring data review involves a comparison of measured pH, EC and TSS results against internal trigger values which have been derived from the historical data set. The response to measured excursions outside the trigger limits is detailed in the MTW Water Management Plan.

**Mount Thorley Warkworth
Surface Water Monitoring Locations**

Date: 150219

Plan By: DS

Version: 1.0



Figure 42: Surface Water Monitoring Points

3.7.2. Surface Water Monitoring

Routine surface water monitoring was undertaken from 17 sites. Sampling of surface waters was carried out in accordance with AS/NZS 5667.6 (1998). Analysis of surface water was carried out in accordance with approved methods by a NATA accredited laboratory.

Water quality is evaluated through the assessment of pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS). Pertinent surface water sites were also sampled for comprehensive analysis annually. All required sampling and analysis was undertaken, except as detailed in Table 33. Trigger tracking results are described in Table 34.

Table 33: HVO Water Monitoring Data Recovery for 2014 (by exception)

Location	Data Recovery (%)	Comment
MTW Watercourses		
SP1	83%	Site recorded as dry during January and February monitoring events.
W3	75%	Site recorded as dry during September monitoring events.

A summary of all surface water monitoring results is provided in the MTW Monthly Environmental Monitoring Reports, and can be viewed via the Rio Tinto website.

Figure 43 to Figure 48 show long term water quality trends for the Hunter River, Wollombi Brook, other surrounding tributaries and site dams. Measurements of EC and pH were variable during the reporting period, however consistent with historical trends. A short term decrease in EC and pH were measured across most monitoring locations in March and December, associated with rainfall recharge events. The ephemeral nature of streamflow in watercourses is the primary reason for considerable variation in field water quality values.

Table 34: Surface Water Monitoring - Trigger Tracking Results

Location	Date	Trigger Limit	Action taken in response
W5	19/08/2014	EC - 95 th Percentile	Watching Brief*
	17/09/2014		
	13/10/2014		Trend consistent with historical water quality. Due to the ephemeral nature of stream flow, changes in electrical conductivity correlate strongly with rainfall runoff events.
	12/11/2014		4 th consecutive reading above trigger limit. See comment above.
W29	15/01/2014	EC - 95 th Percentile	Watching Brief. Due to the ephemeral nature of stream flow, changes in electrical conductivity correlate strongly with rainfall runoff events. Trigger limits to be revised in 2015 (Base data for trigger limits based on limited data from 2013 and 2014).
	19/02/2014		
	15/04/2014	EC – 5 th Percentile	
	14/05/2014		
	19/08/2014		
	17/09/2014	EC - 95 th Percentile	
	13/10/2014		
	12/11/2014		
	09/12/2014	EC - 5 th Percentile	

* = 1st / 2nd trigger. No specific action required. Watching brief established, pending outcomes of subsequent monitoring event.

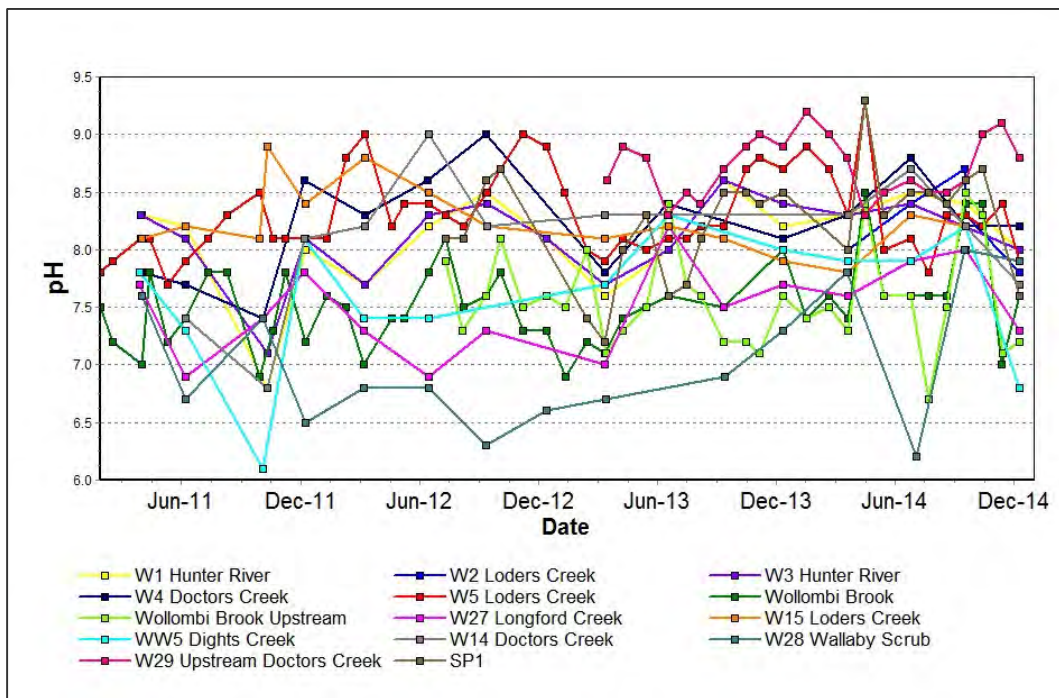


Figure 43: Watercourse pH Trends 2011 to 2014

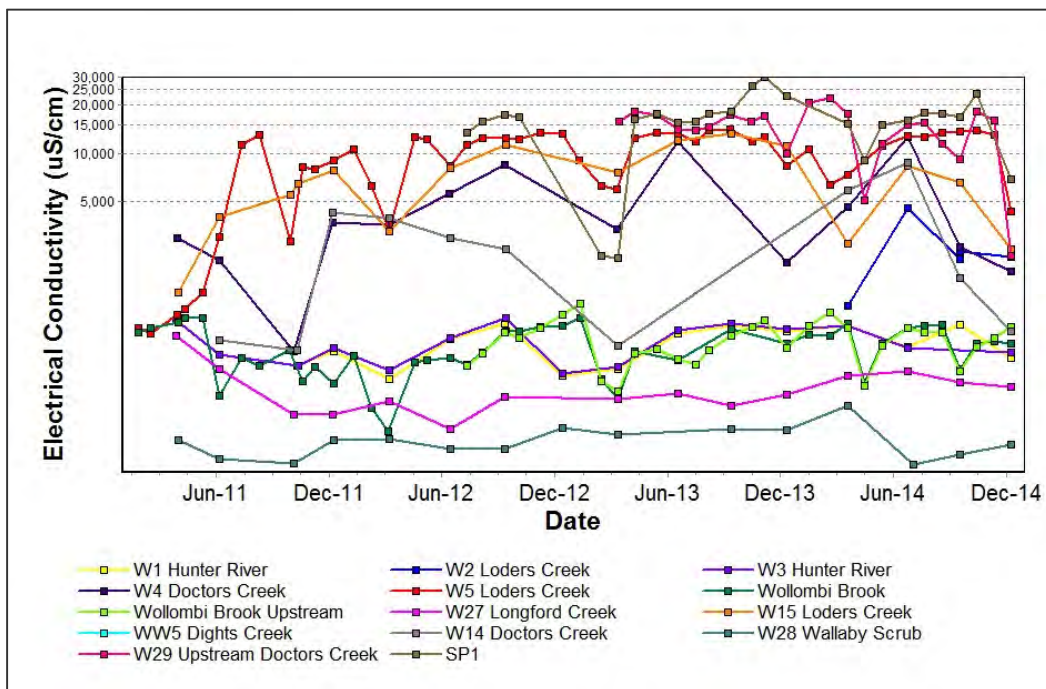


Figure 44: Watercourse EC Trends 2011 to 2014

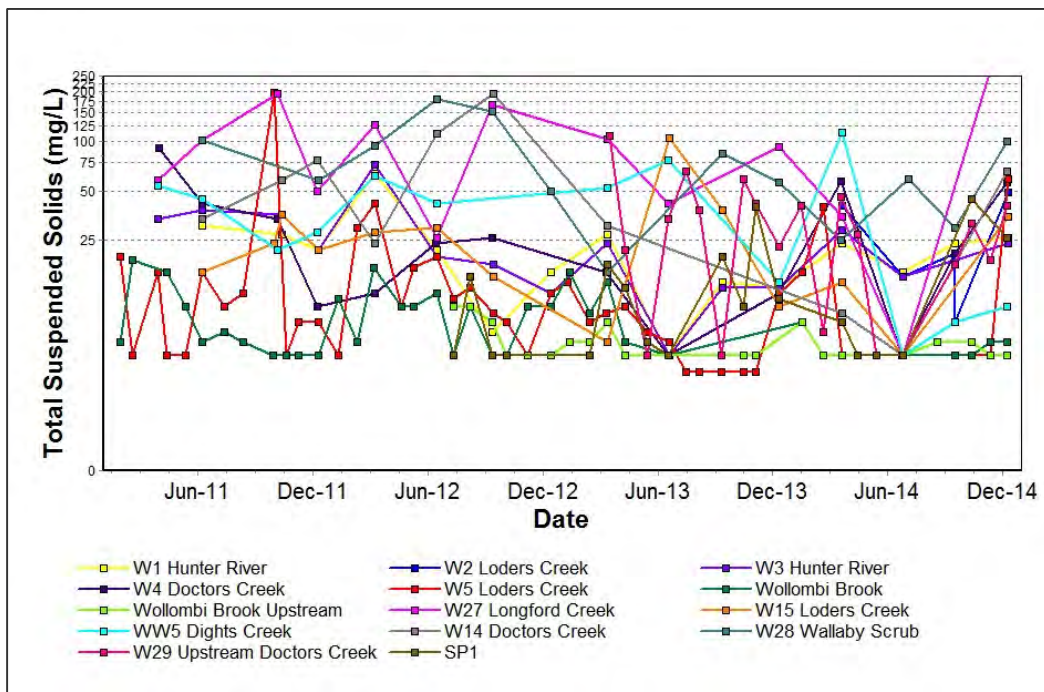


Figure 45: Watercourse TSS trends 2011 to 2014

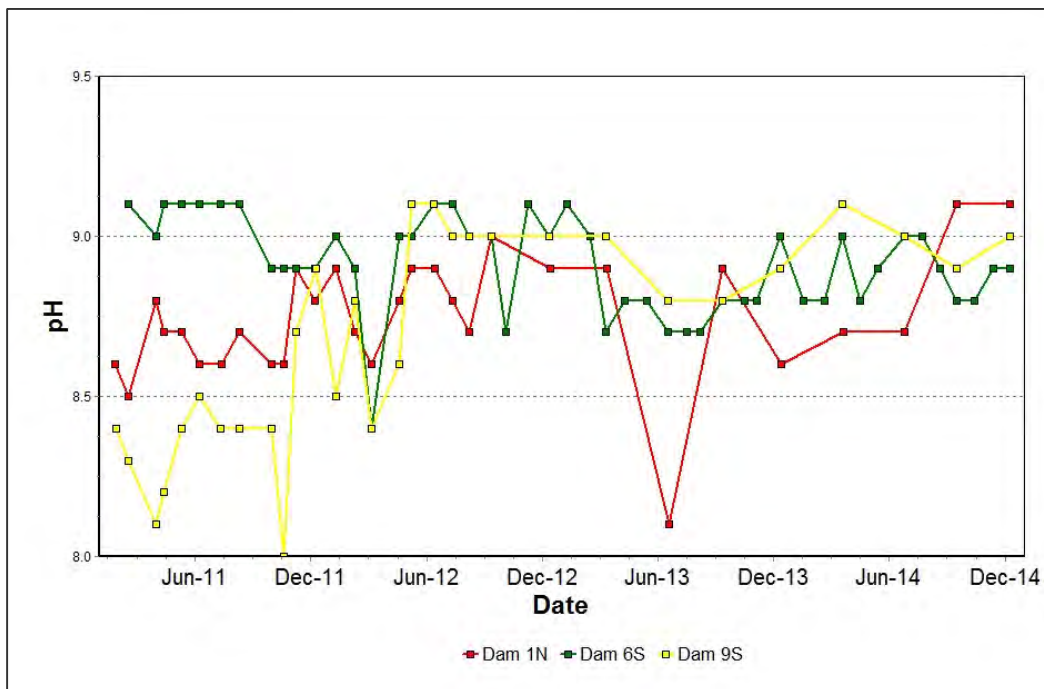


Figure 46: Site Dams pH trends 2011 to 2014

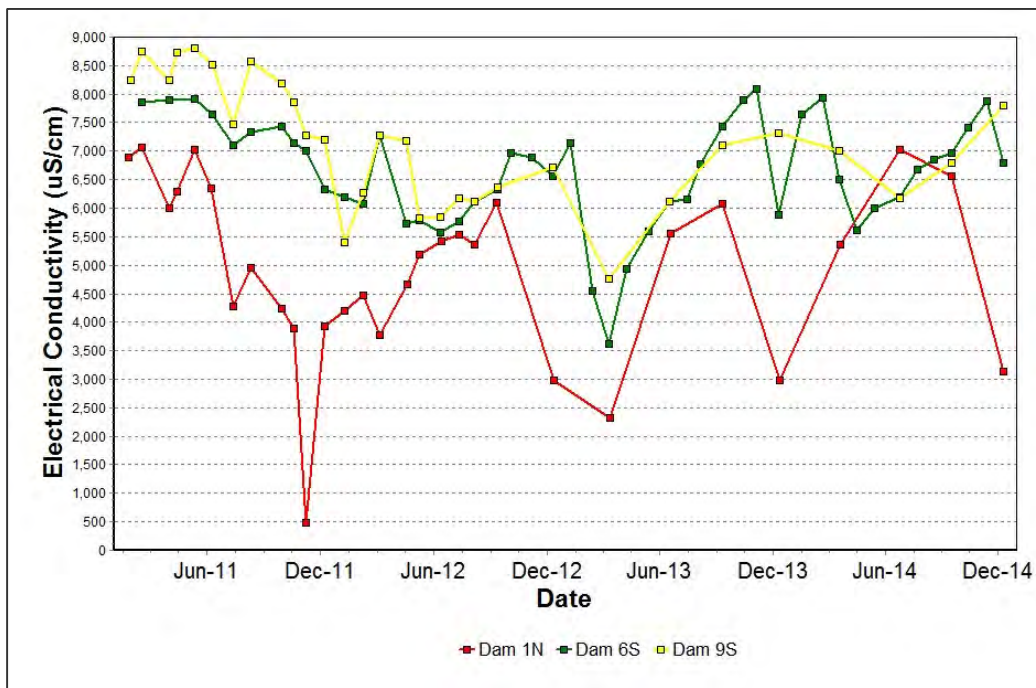


Figure 47: Site Dams EC trends 2011 to 2014

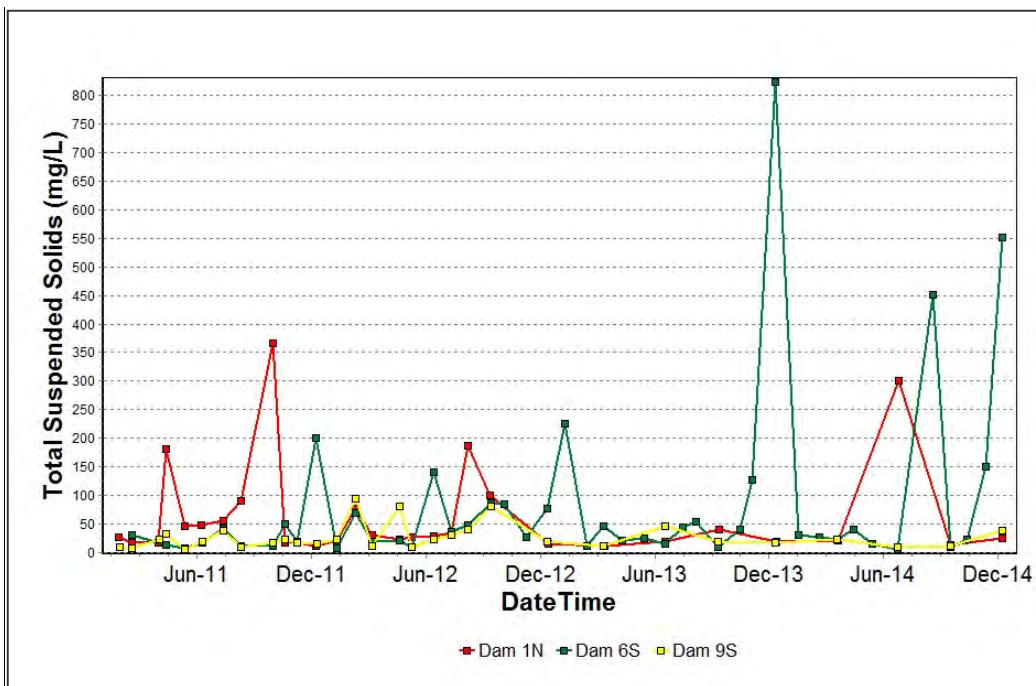


Figure 48: Site Dams TSS trends 2011 to 2014

3.7.3. Non-Compliances and Complaints during the Reporting Period

19 February 2014

Water was observed by site personnel to be intermittently overtopping a collection sump (CC5 Tail-end Sump) at the Warkworth CHPP and entering the Doctors Creek diversion channel. Although a precise figure is unknown, the volume of water which may have intermittently overtopped the sump during the period is estimated to be <0.1ML. A rain event of approximately 33.2 mm was received in the catchment over a 24 hour period on 19 February 2014 (midnight to midnight), including approximately 20mm in 20 minutes.

Any water that overtopped the sump and entered the Doctors Creek diversion channel was caused by the rainfall intensity exceeding the sump capacity and pump-out rate. It appears likely that cause of the spill was due to water being transferred to the local catchment via the CC5 conveyor line, which was flooded at a tunnel located upstream. As a result, the sump capacity and pump out rate was exceeded.

Immediate remedial actions were taken to prevent further water leaving site, including:

- i. Installation of a pump in the flooded upstream tunnel, to prevent the CC5 conveyor belt transferring water to the downstream catchment.
- ii. Blocked the culverts downstream of the spill location in Doctor's Creek and installed a pump to decant water back on to site.
- iii. Water sampling and active ongoing monitoring of any affected areas was undertaken to characterise potential impact upon receiving waters.
- iv. Follow up actions included the installation of additional scrapers to remove excess water from the belt prior to it entering the CC5 catchment

Both Planning & Environment and the Environment Protection Authority were notified of the event on 20 February 2014, with a follow up incident report prepared and sent to DP&E on 28 February 2014.

A number of follow-up actions have been implemented in 2014 to prevent a reoccurrence of this incident. This includes the installation of additional scrapers to remove excess water from the belt prior to it entering the CC5 catchment, an increase in sump and pump out capacity and installation of an overflow pipe in the sump.

9 October 2014

During a routine water infrastructure inspection at approximately 10:25am on 9 October 2014 it was identified that the water pipeline adjacent to the Lemington Underground (LUG) Bore had ruptured. The LUG Bore is an operating production bore that abstracts water from the disused Lemington Underground mine workings, to supply water to the neighbouring MTW and Hunter Valley Operations (HVO) mines. The pipe rupture appears to have resulted in a discharge of water from the pipe. Water has continued via overland flow to the north through a grassed paddock for approximately 400 m, resulting in some discharge into the Wollombi Brook.

The duration of discharge from the ruptured pipe is unknown, however, on a worst case scenario, was no greater than 19 hours. This is known because a routine inspection was completed at approximately 15:30 on 8 October 2014, with no pipeline rupture noted. So far as we have been able to determine, the most likely cause of the rupture was that the water pressure in the pipeline exceeded the maximum rated pressure of the pipe at this location.

The actions taken, or that will be taken, in respect of the incident included:

- i. The LUG Bore was immediately shut down following identification of the ruptured pipeline. Once the bore was shut down the flow of water ceased. The bore is currently isolated and unable to be restarted.
- ii. A review of immediate containment options for the leaked water were undertaken, however was not considered feasible due to the topography.
- iii. Follow up actions included the suspension of all intra-site water transfers, pending a review of the infrastructure, to confirm all infrastructure is adequately rated. Correspondingly, a review of all procedures, maintenance and inspection protocols are underway.
- iv. Implementing engineering controls to match pump water pressure with pipeline capacity
- v. Implementing a leak detection system

The Department of Planning & Environment, the Environment Protection Authority, Workcover, NSW Health, Singleton Council and Fire and Rescue were notified of the event on 9 October 2014. An incident report was prepared and sent to both regulators on 17 October 2014. The Environment Protection Authority is continuing their investigation in relation to the event.

11 December 2014

Following a high intensity, heavy rain and hail event on 10 December 2014, Mount Thorley Operation's sediment Dam 3s was found to be spilling into a clean water dam (known as the Powerline Dam) which in turn was spilling.

Two pumps were installed to drawdown the water level in the Powerline Dam and when sufficient capacity was available commenced decanting Dam 3s into adjacent mine-water Dam 2s. Sampling was undertaken to assess potential for impact. Given the high volume of water in the greater catchment compared to overflow water from the dam, potential for environmental harm was low.

The incident was notified to DP&E, EPA, , Workcover, NSW Health, Singleton Council and Fire and Rescue. As a precautionary measure two landholders whose properties adjoin Loders Creek were also notified. No concerns have been raised by these landholders.

A catchment review is being undertaken in this area to assess need for additional containment capacity and water drainage pathways.

3.7.4. Performance Relating to the HRSTS Discharges

MTW participates in the Hunter River Salinity Trading Scheme (HRSTS) allowing it to discharge from licensed discharge points during declared discharge events associated with increased flow in the Hunter River. HRSTS discharges are undertaken in accordance with HRSTS regulations, EPL 1376 and EPL 1976. MTW maintains two licensed HRSTS discharge monitoring locations:

- Dam 1N, located at WML North, which discharges to Doctor's Creek
- Dam 9S, located at MTO South, which discharges to Loders Creek.

As required by the EPLs, MTO and WML submitted an HRSTS discharge report for the 2013/14 financial year. No HRSTS discharges were completed during the 2013/14 reporting year or in the second half of 2014.

3.7.5. Complaints

No complaints were received in regards to water during 2014.

3.7.6. Audits and Reviews

No independent audits were undertaken at MTW during 2014.

3.8. Groundwater

3.8.1. Groundwater Management

Groundwater monitoring activities were undertaken in 2014 in accordance with the MTW Water Management Plan and groundwater monitoring programme. The monitoring results are used to establish and monitor trends in physical and geochemical parameters of surrounding groundwater potentially influenced by mining.

The groundwater monitoring programme at MTW measures the quality of groundwater against background data, EIS predictions and historical trends. Ground water quality is evaluated through the parameters of pH, EC, and standing water level. On a periodic basis (nominally once per annum), a comprehensive suite of analytes are measured, including major anions, cations and metals. Prior to sampling for comprehensive analysis, bore purging is undertaken to ensure a representative sample is collected.

Groundwater monitoring data is reviewed on a quarterly basis. The review involves a comparison of measured pH and EC results against internal trigger values (5th and 95th percentile) which have been derived from the historical data set. The response to measured excursions outside the trigger limits is detailed in the MTW Water Management Plan.

The monitoring locations are shown in Figure 49.

Mount Thorley Warkworth Groundwater Monitoring Locations

Date: 140220

Plan By: DS

Version: 1.0



Figure 49: Groundwater Monitoring Network at MTW in 2013

3.8.2. Groundwater Performance

Sampling of ground waters was carried out on 139 occasions from 39 bores across Mount Thorley Warkworth in accordance with AS/NZS 5667.6 (1998). Where laboratory analysis was undertaken, this was performed by a NATA accredited laboratory. Groundwater sampling and analysis was undertaken as required with the following exceptions detailed in Table 35.

Table 35: HVO Water Monitoring Data Recovery for 2014 (by exception)

Location	Data Recovery (%)	Comment
Hunter River Alluvium		
OH 944	75%	Site recorded as dry during March monitoring events.
Bowfield Seam		
OH1122(3)	75%	Site recorded as dry during December monitoring events.
OH1123(3)	75%	Site recorded as dry during December monitoring events.
Blakefield		
WOH2141B	25%	Site recorded as dry during March, September and December monitoring events.
OH1123(2)	75%	Site recorded as dry during December monitoring events.
Wambo		
WOH2156B	75%	Site recorded as blocked during September monitoring events.
OH1123(1)	50%	Site recorded as blocked during September and December monitoring events.

A summary of the monitoring results for MTW Groundwater Sites is provided in the Monthly Environmental Monitoring Reports, available via the Rio Tinto website (www.riotinto.com).

3.8.3. Groundwater Monitoring Summary

The following section presents groundwater monitoring data in relation to the geographic locations and target stratigraphy for groundwater monitoring bores. Each location is discussed below, and a summary of monitoring data presented. Where monitoring results were recorded outside the internal trigger limit, these results are summarised in tables for each location.

3.8.3.1. Bayswater Seam Bores

Groundwater monitoring in the Bayswater area was undertaken from seven sites during 2014. A total of 28 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Bayswater groundwater bores are shown in Figure 50, Figure 51 and Figure 52 respectively.

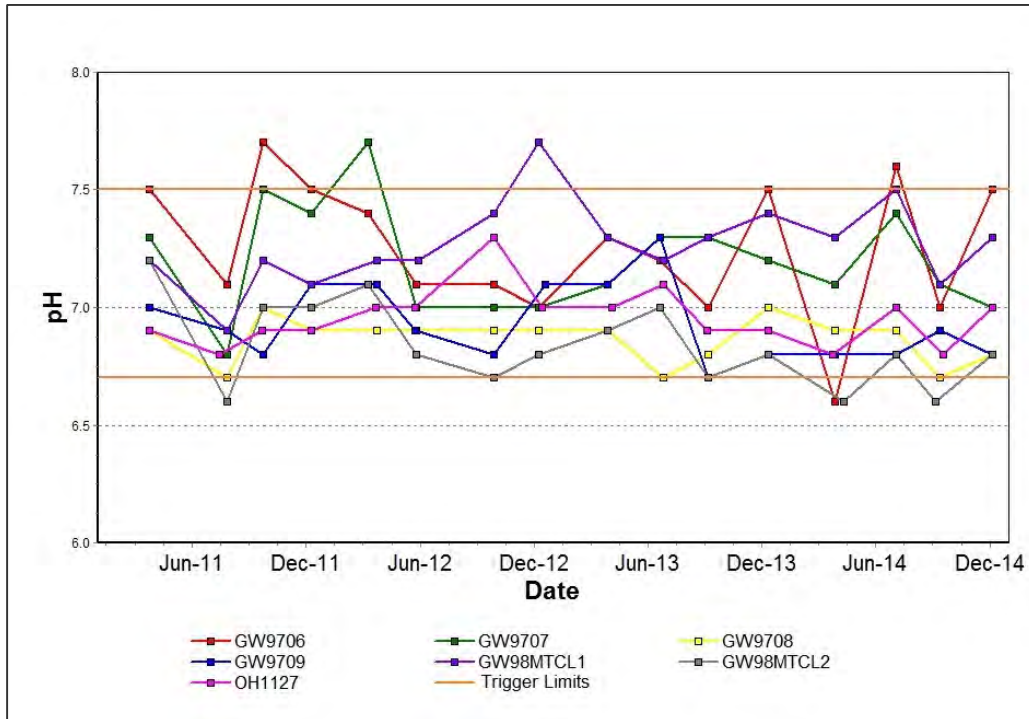


Figure 50: Bayswater Seam pH trends 2011 to 2014

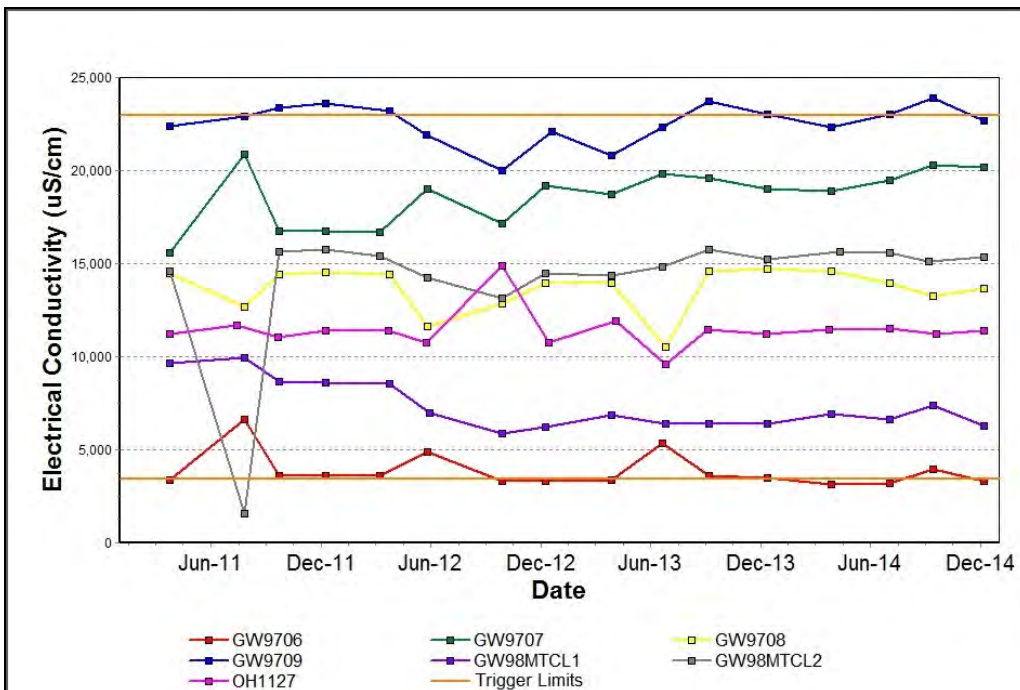


Figure 51: Bayswater Seam EC trends 2011 to 2014

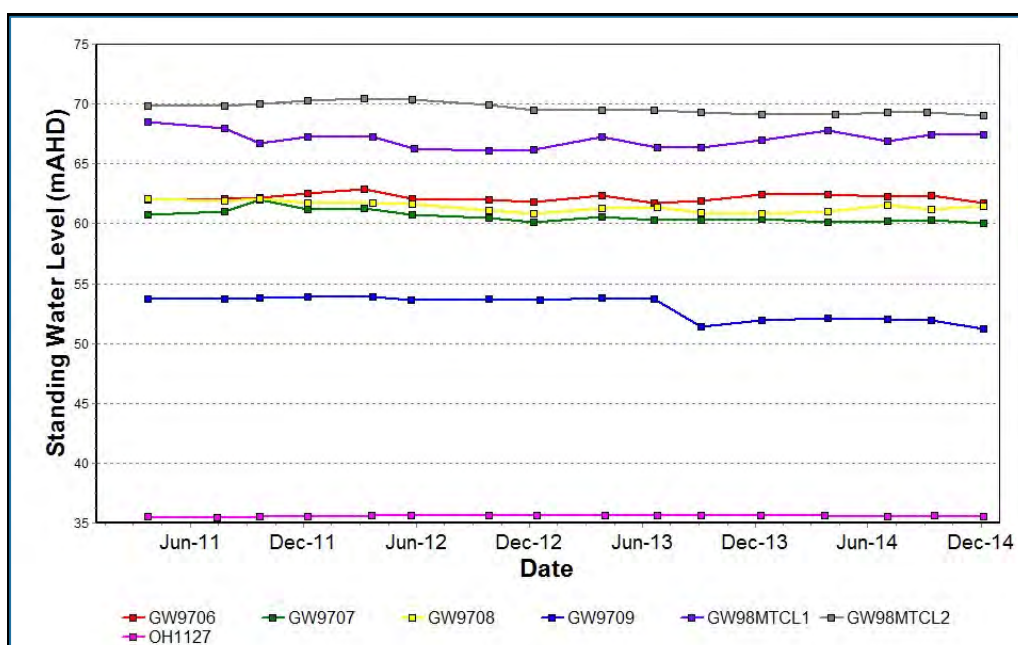


Figure 52: Bayswater SWL trends 2011 to 2014

3.8.3.2. Bowfield Seam Bores

Groundwater monitoring in the Bowfield seam area was undertaken from three sites during 2014. A total of 10 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Bayswater groundwater bores are shown in Figure 53, Figure 54 and Figure 55 respectively. Trigger tracking results are detailed in Table 36. OH1122(3) and OH1123(3) were both recorded as dry during the December monitoring event. The drop in OH1123(3) EC readings is due to depressurisation from mine advance.

Table 36: MTW Bowfield Seam Groundwater 2014 internal trigger tracking

Location	Date	Trigger limit	Action taken in response
OH1122(3)	21/03/2014	pH – 95 th percentile	Watching Brief*
	04/07/2014		
	11/09/2014		Trend generally consistent with historical data. No adverse impact due to mining identified.
OH1122(3)	21/03/2014	EC – 5 th percentile	Watching Brief*
	04/07/2014		
	11/09/2014		Trend generally consistent with historical data. No adverse impact due to mining identified

* = 1st/2nd trigger. Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required

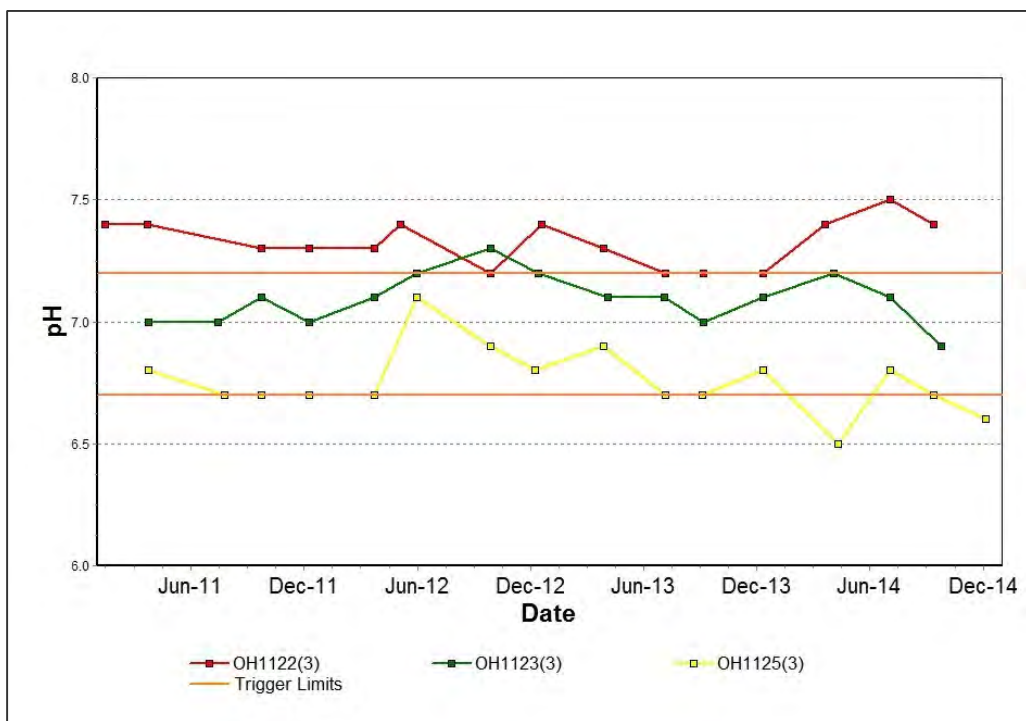


Figure 53 : Bowfield Groundwater pH Trends 2011 to 2014

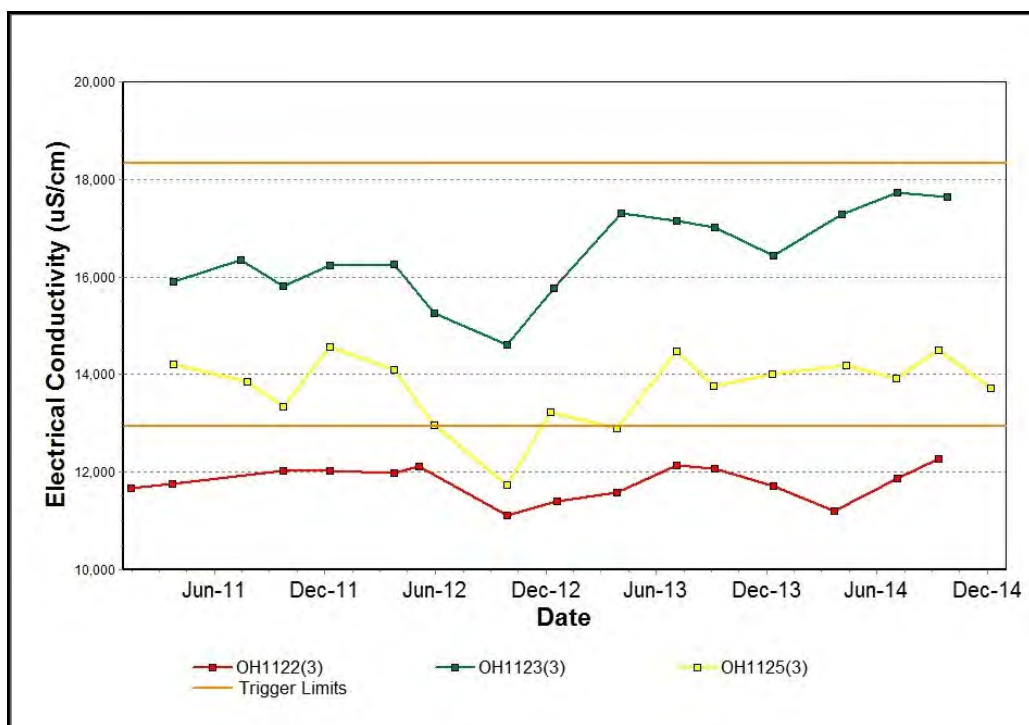


Figure 54: Bowfield Groundwater EC Trends 2011 to 2014

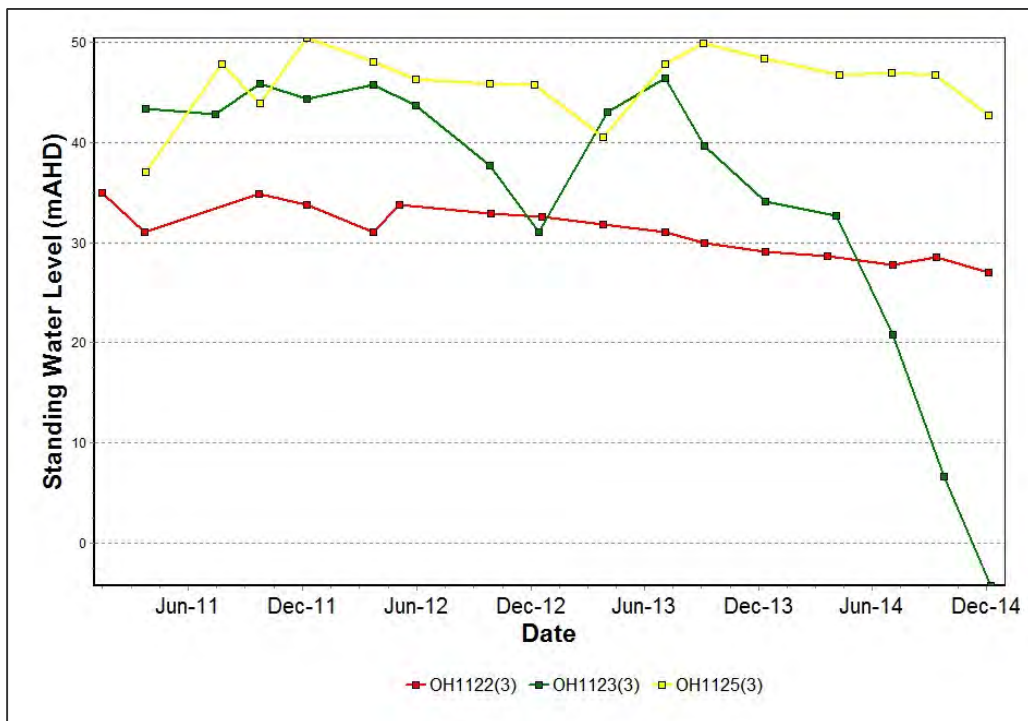


Figure 55: Bowfield Groundwater SWL Trends 2011 to 2014

3.8.3.3. Blakefield Seam Bores

Groundwater monitoring in the Blakefield seam area was undertaken from five sites during 2014. A total of 16 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Blakefield groundwater bores are shown in Figure 56, Figure 57 and Figure 58 respectively. Trigger tracking results are detailed in Table 37. WOH2141B was recorded as dry during the March, September and December monitoring events. Limited access to OH1123(2) during the December monitoring event due to mining advancement did not allow for the collection of water quality data. The bore is expected to be mined through in early 2015.

Table 37: MTW Blakefield Seam Groundwater 2014 internal trigger tracking

Location	Date	Trigger limit	Action taken in response
OH1125(1)	10/04/2014	pH – 5 th percentile	Watching Brief*
	03/07/2014		
	11/09/2014		Results consistent with historical trend. An outlying historical pH result within the Blakefield seam may be skewing the trigger limits and will be revised in 2015.
	05/12/2014		4 th consecutive reading below trigger limit. See above.

* = 1st/2nd trigger. Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required

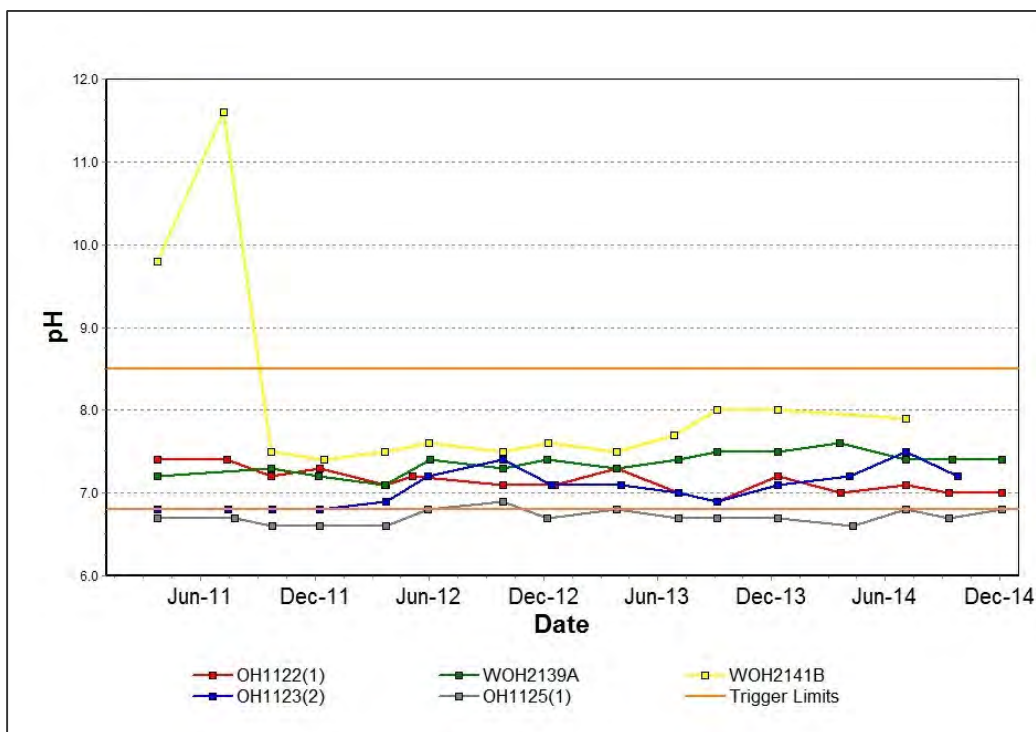


Figure 56: Blakefield Seam Groundwater pH Trends 2011 to 2014

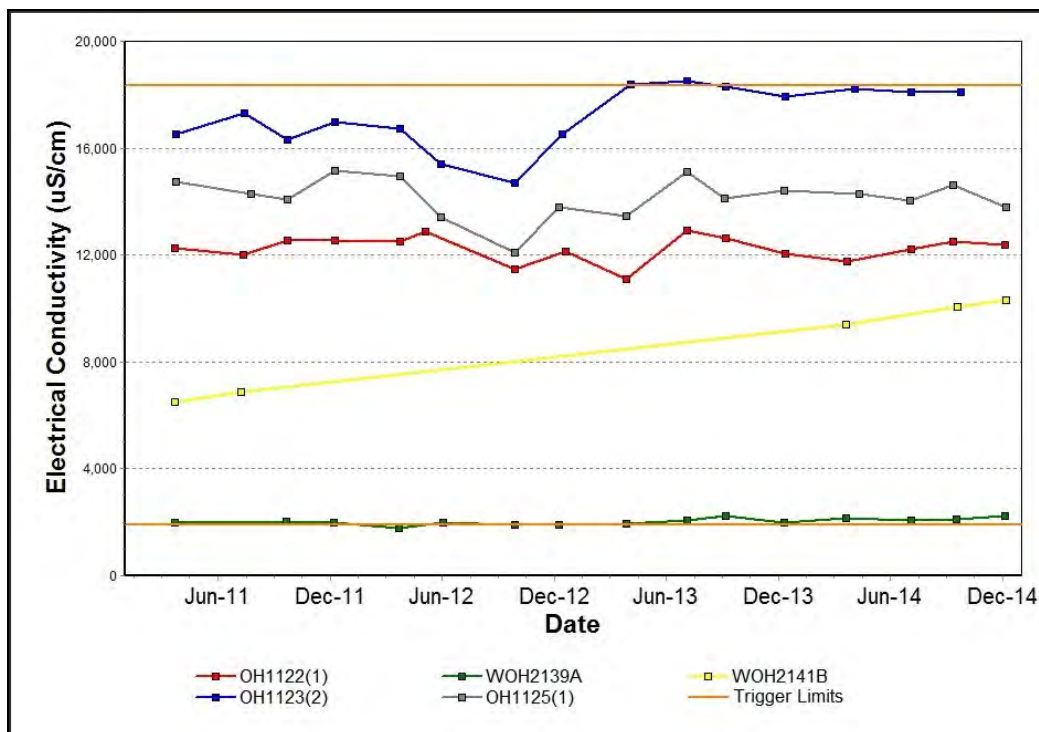


Figure 57: Blakefield Seam Groundwater EC Trends 2011 to 2014

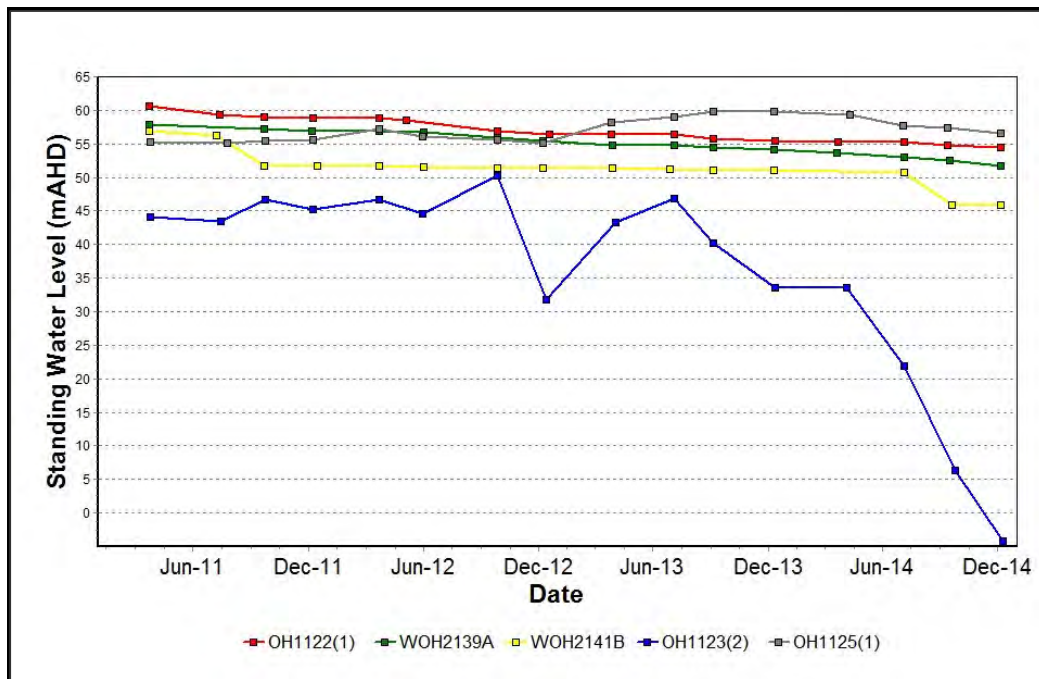


Figure 58: Blakefield Seam Groundwater SWL Trends 2011 to 2014

3.8.3.4. Hunter River Alluvium Bores

Groundwater monitoring in the Hunter River Alluvium seam area was undertaken from six sites during 2014. A total of 24 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Hunter River Alluvium groundwater bores are shown in Figure 59, Figure 60 and Figure 61 respectively. Trigger tracking results are detailed in Table 38. OH944 was recorded as dry during the March monitoring event.

Table 38: MTW Hunter River Alluvium Groundwater 2014 internal trigger tracking

Location	Date	Trigger limit	Action taken in response
OH944	03/07/2014	pH – 95 th percentile	Watching Brief*
	17/09/2014		
	05/12/2014		Review of data undertaken – limited historical data available, however 2014 results consistent with historical trend. No adverse impact due to mining identified.

* = 1st/2nd trigger. Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required

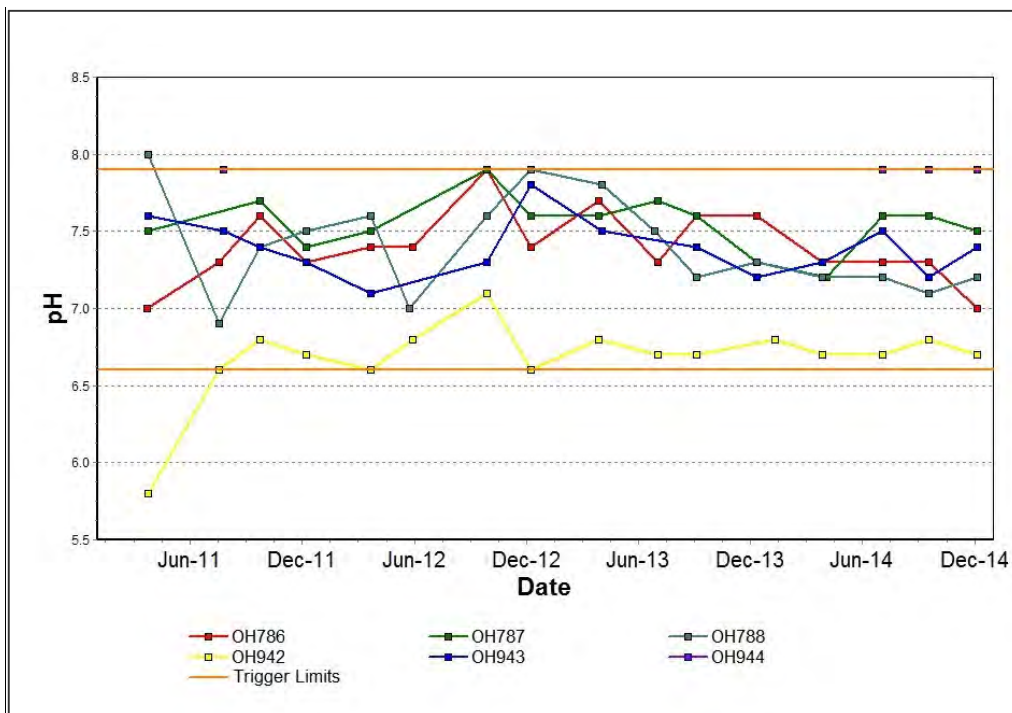


Figure 59: Hunter River Alluvium Seam Groundwater pH Trends 2011 to 2014

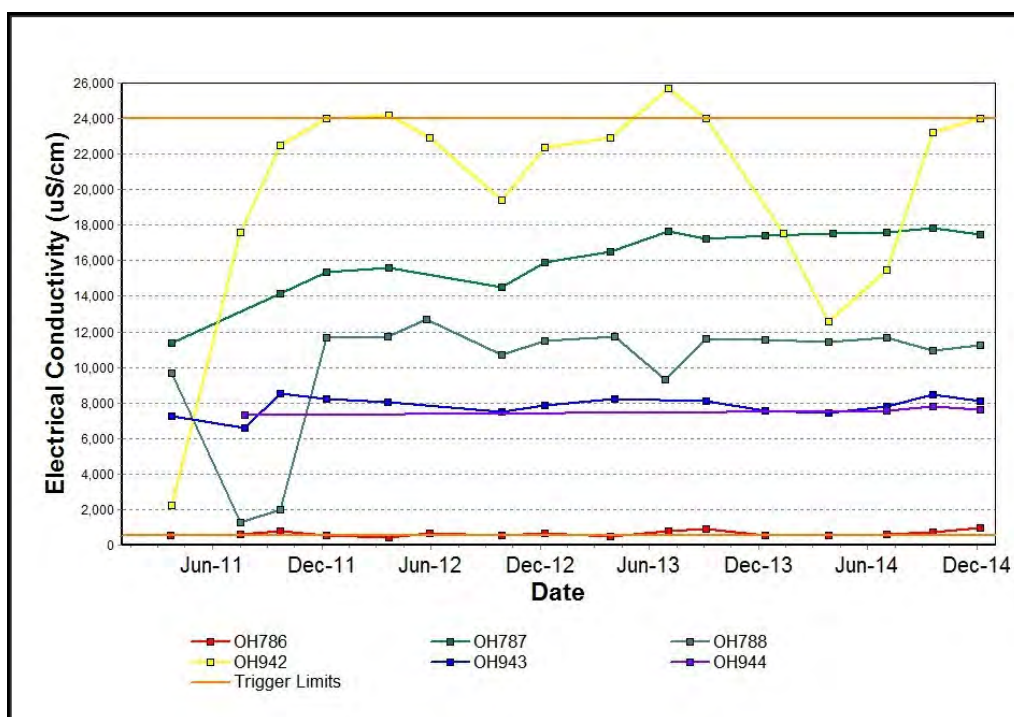


Figure 60: Hunter River Alluvium Seam Groundwater EC Trends 2011 to 2014

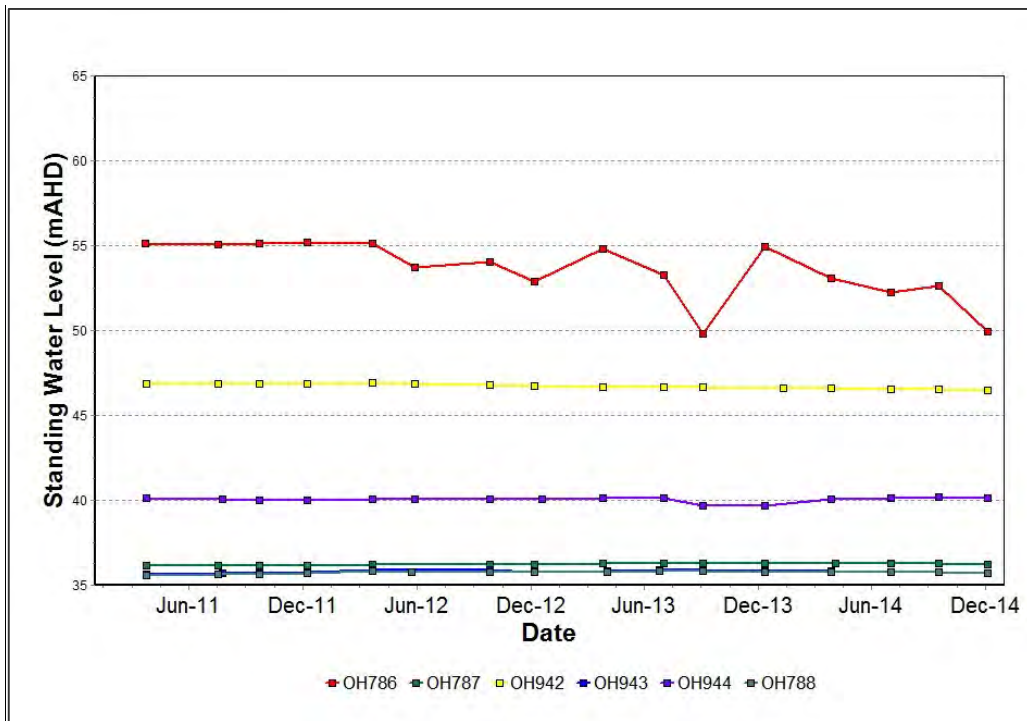


Figure 61: Hunter River Alluvium Seam Groundwater SWL Trends 2011 to 2014

3.8.3.5. Redbank Bores

Groundwater monitoring in the Redbank seam area was undertaken from four sites during 2014. A total of 16 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Redbank groundwater bores are shown in Figure 62, Figure 63 and Figure 64 respectively. Trigger tracking results are detailed in Table 39. A steady declining trend in water levels at all monitoring sites continued during the reporting period, likely a result of seam depressurisation due to mining.

Table 39 : MTW Redbank Seam Groundwater 2014 internal trigger tracking

Location	Date	Trigger limit	Action taken in response
WOH2154A	20/03/2014	pH - 5th percentile	Watching Brief*
WOH2154A	04/07/2014		
WOH2154A	15/09/2014		Trend associated with depressurisation of the seam, considered to be of no material impact. Commensurate with overall drop in RL at these bores. Trigger to be reviewed in 2015.
WOH2154A	05/12/2014		4th consecutive reading below trigger limit. see above.
WOH2155A	20/03/2014	pH - 5th percentile	Watching Brief *
WOH2155A	04/07/2014		
WOH2155A	15/09/2014		Trend associated with depressurisation of the seam, considered to be of no material impact. Commensurate with overall drop in RL at these bores. Trigger to be reviewed in 2015.
WOH2155A	05/12/2014		4th consecutive reading below trigger limit. see above.
WOH2156A	20/03/2014	pH - 5th percentile	Watching Brief *
WOH2156A	04/07/2014		
WOH2156A	15/09/2014		Trend associated with depressurisation of the seam, considered to be of no material impact. Commensurate with overall drop in RL at these bores. Trigger to be reviewed in 2015.
WOH2156A	05/12/2014		4th consecutive reading below trigger limit. See above.

	20/03/2014		
	04/07/2014		No Action*
WOH2153A	15/09/2014	EC – 5 th percentile	Results consistent with other Redbank seam bores, generally congruent with reduction in RL. Considered to be a result of depressurisation, no material impact associated with this trend.
	05/12/2014		4 th consecutive reading below trigger limit. See above.
	20/03/2014		
	04/07/2014		Watching Brief *
WOH2156A	15/09/2014	EC – 95 th percentile	Results consistent with other Redbank seam bores, generally congruent with reduction in RL. Considered to be a result of depressurisation, no material impact associated with this trend.
	05/12/2014		4 th consecutive reading below trigger limit. See above.

* = 1st/2nd trigger. Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required

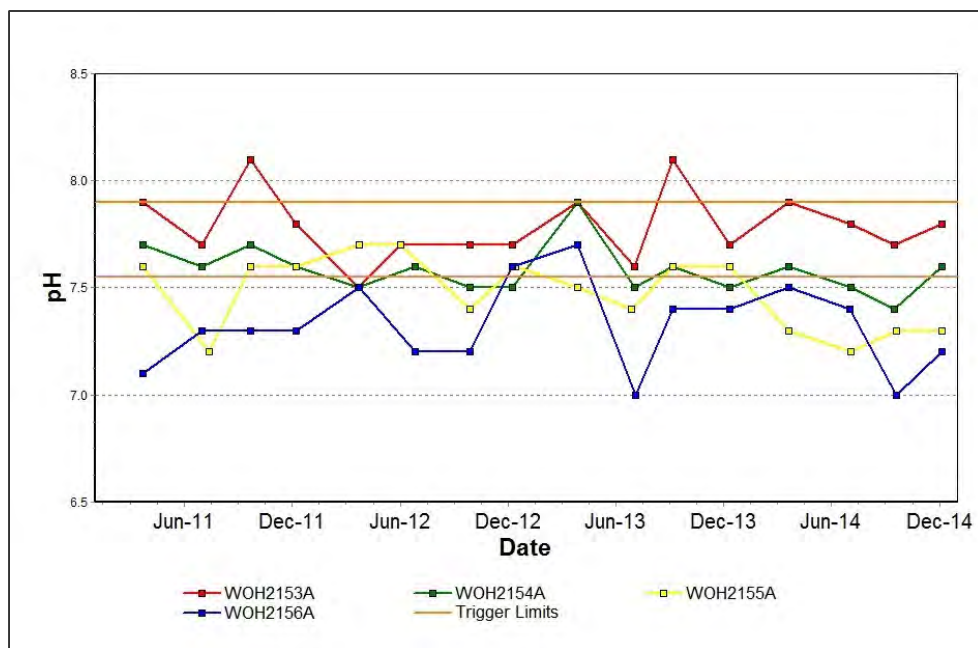


Figure 62: Redbank Seam Groundwater pH Trends 2011 to 2014

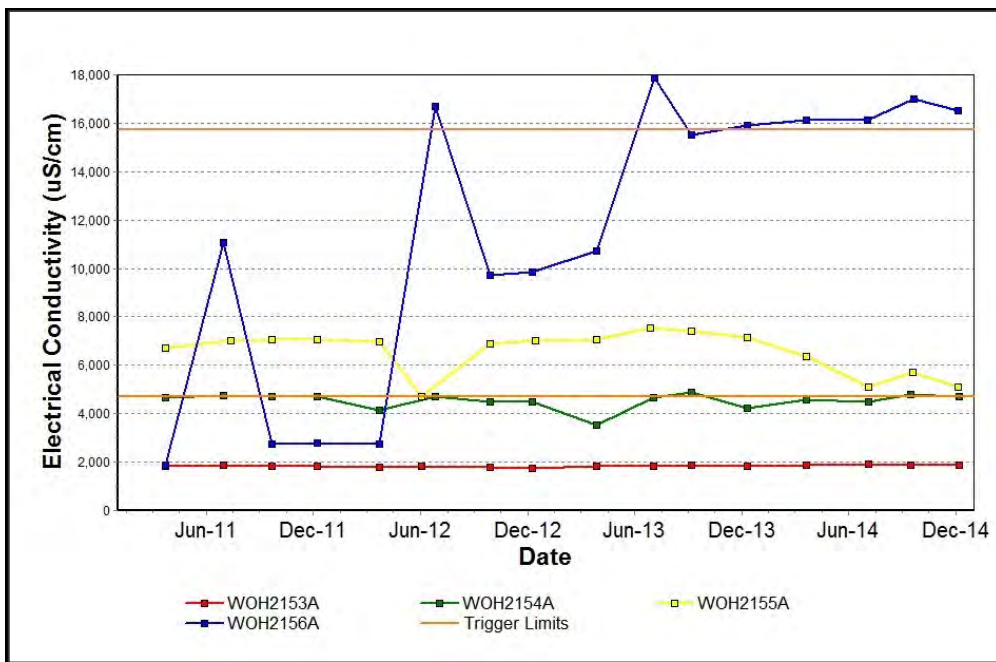


Figure 63: Redbank Seam Groundwater EC Trends 2011 to 2014

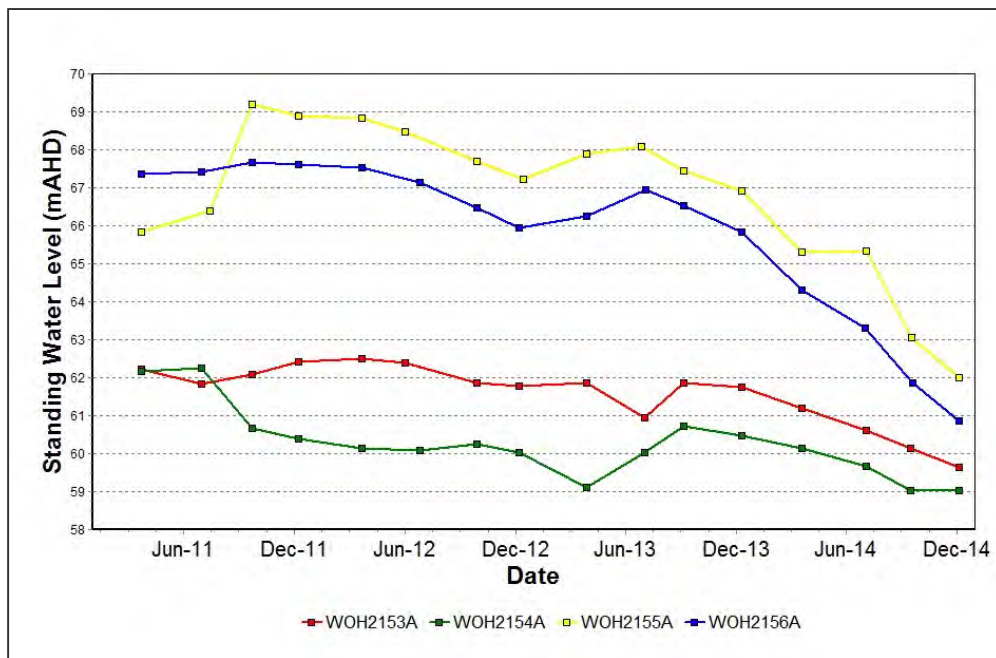


Figure 64: Redbank Seam Groundwater SWL Trends 2011 to 2014

3.8.3.6. Shallow Overburden Bores

Groundwater monitoring in the Shallow Overburden seam area was undertaken from three sites during 2014. A total of 12 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Shallow Overburden groundwater bores are shown Figure 65, Figure 66 and Figure 67 respectively. A steady declining trend in the water level of PZ9D is likely due to depressurisation due to mining; the bore is immediately adjacent to the Mt Thorley mine.

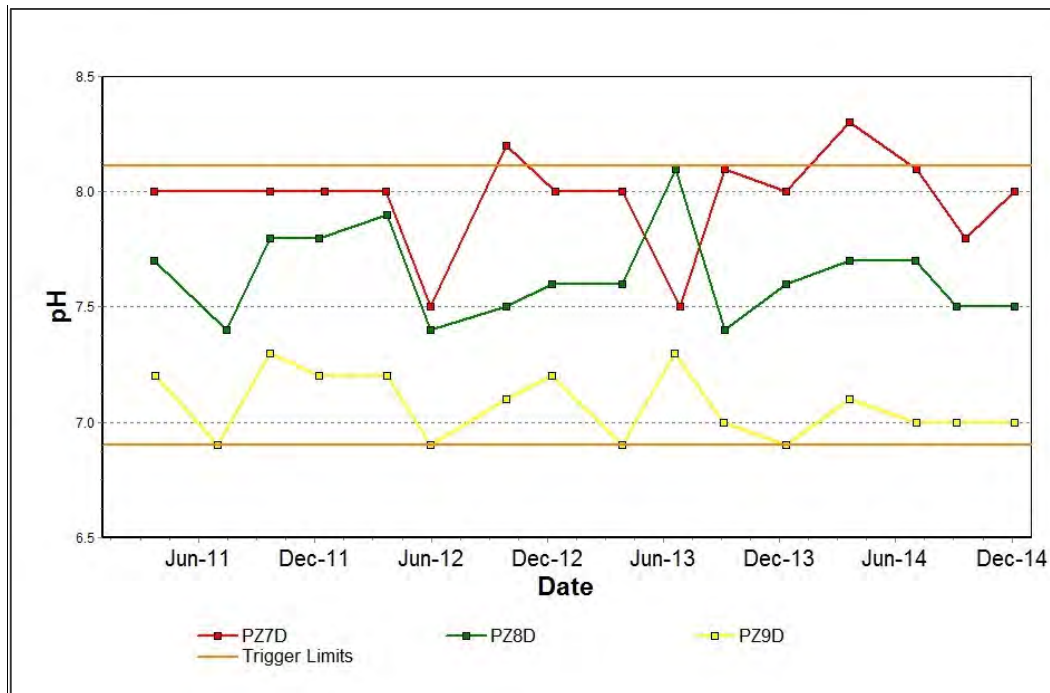


Figure 65 : Shallow Overburden Seam Groundwater pH Trends 2011 to 2014

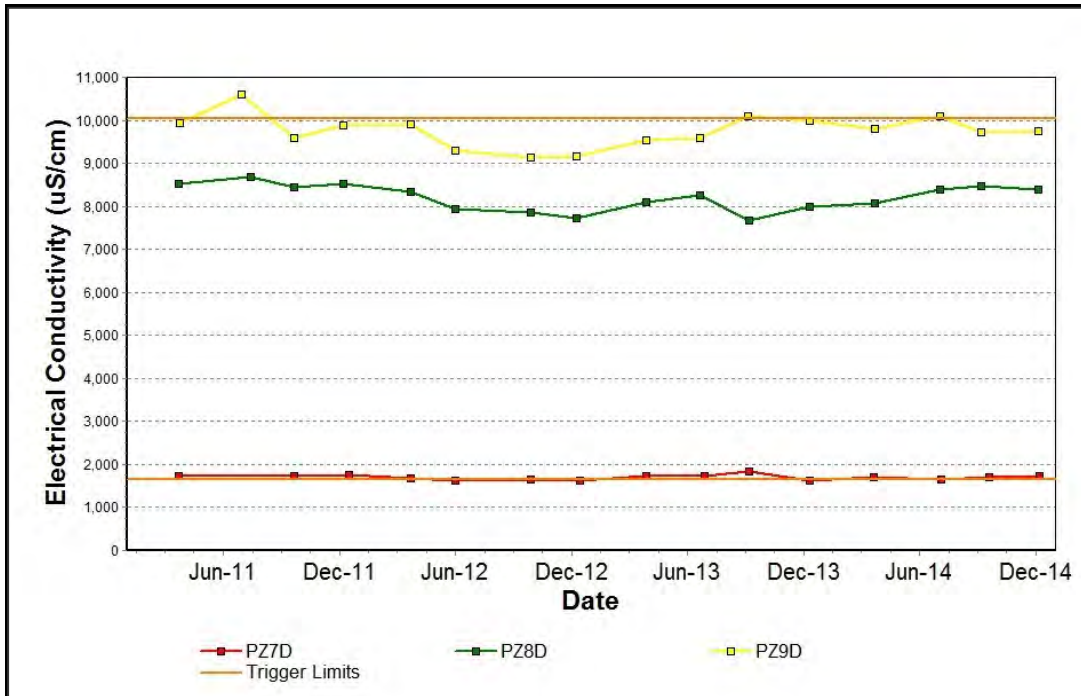


Figure 66: Shallow Overburden Seam Groundwater EC Trends 2011 to 2014

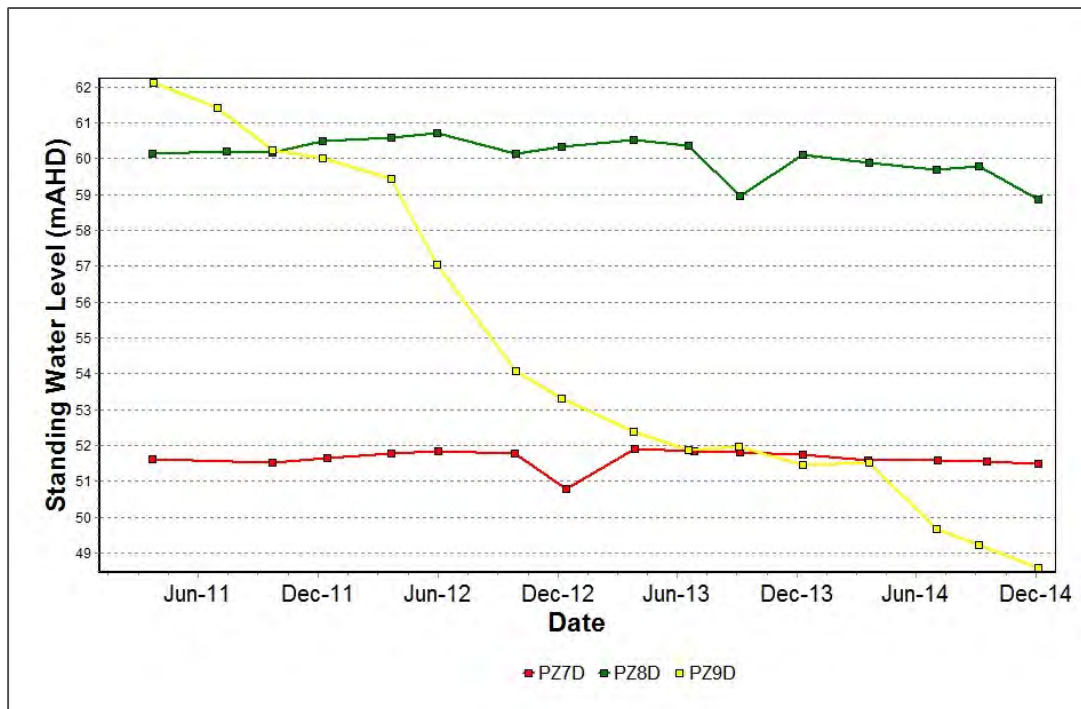


Figure 67: Shallow Overburden Seam Groundwater SWL Trends 2011 to 2014

3.8.3.7. Vaux Seam Bores

Groundwater monitoring in the Vaux seam area was undertaken from four sites during 2014. A total of 12 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Vaux groundwater bores are shown in Figure 68, Figure 69 and Figure 70 respectively; results are consistent with historical trends.

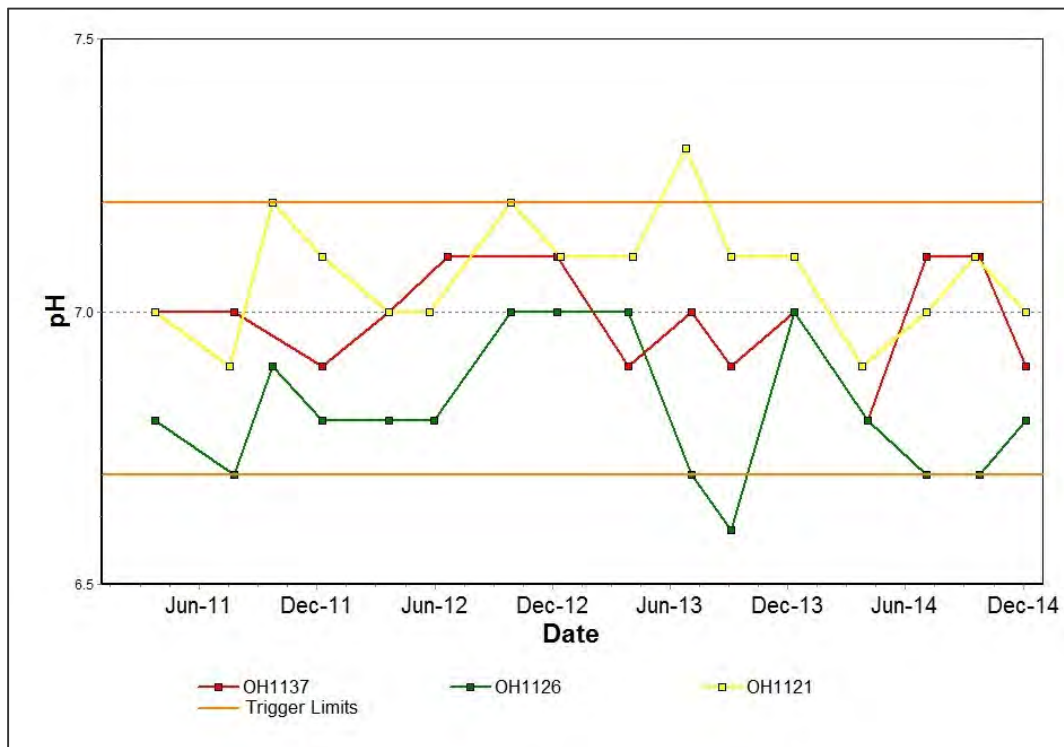


Figure 68: Vaux Seam Groundwater pH Trends 2011 to 2014

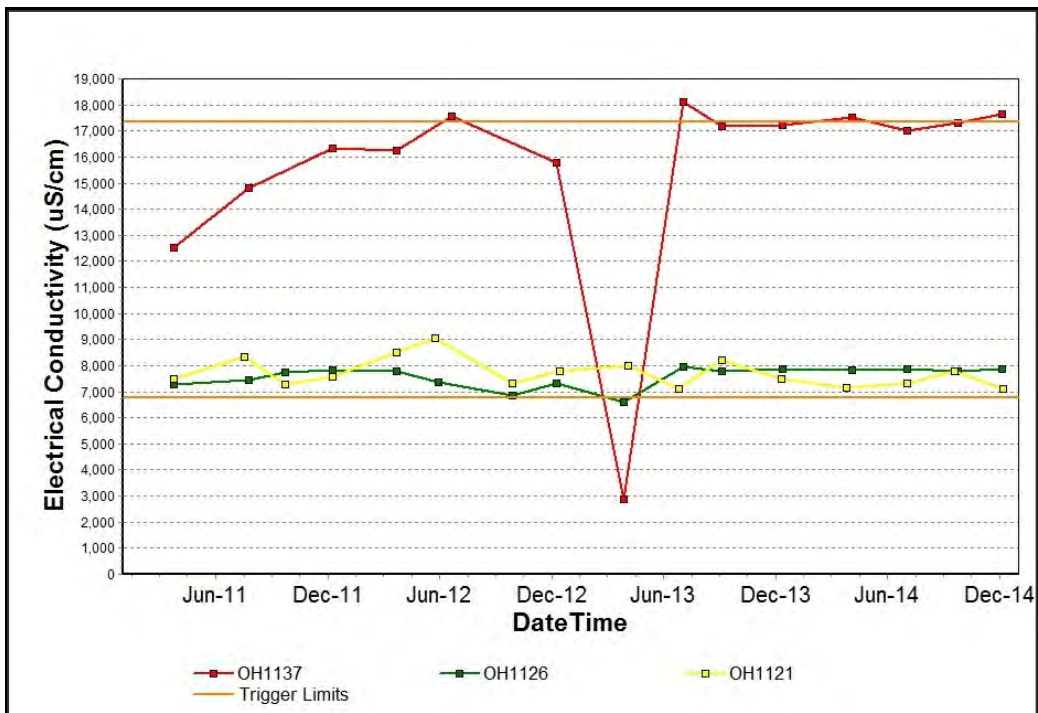


Figure 69: Vaux Seam Groundwater EC Trends 2011 to 2014

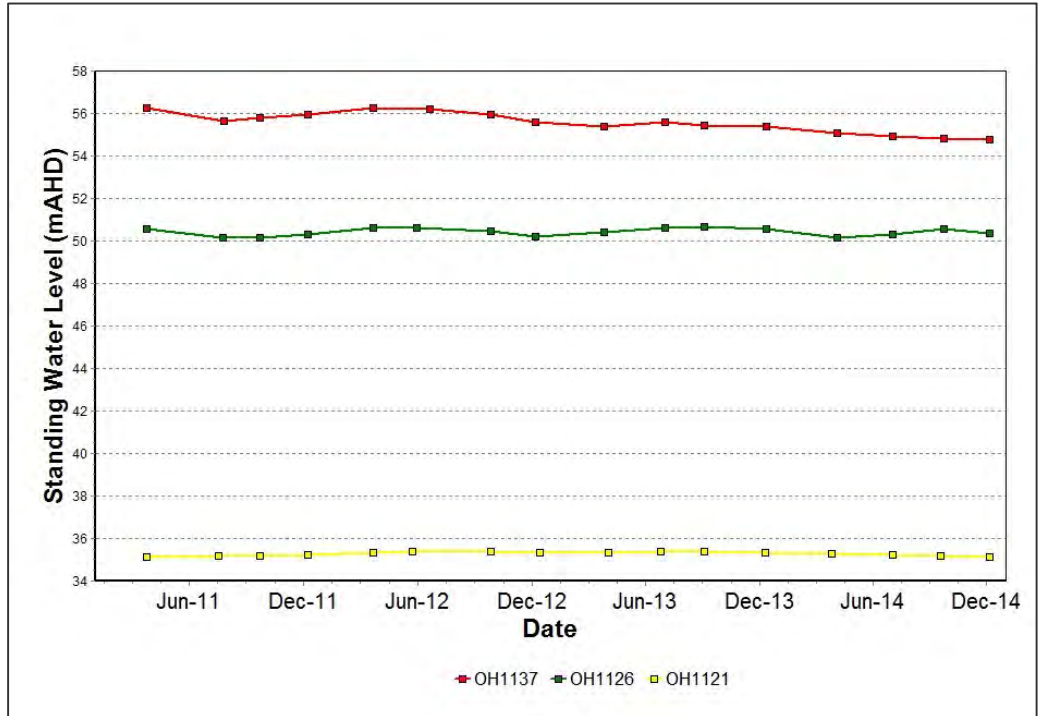


Figure 70: Vaux Seam Groundwater SWL Trends 2011 to 2014

3.8.3.8. Wambo Seam Bores

Groundwater monitoring in the Shallow Overburden seam area was undertaken from five sites during 2014. A total of 19 samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Wambo groundwater bores are shown in Figure 71, Figure 72 and Figure 73 respectively. Trigger tracking results are detailed in Table 40. WOH2156B was recorded as blocked during the September monitoring event. Depressurisation of the Wambo seam due to mining activities to the east appear evident in bores G3 and WOH2156B.

Table 40: MTW Wambo Seam Groundwater 2014 internal trigger tracking

Location	Date	Trigger limit	Action taken in response
G3	26/03/2014	pH – 95th percentile	Watching Brief *
	02/07/2014		
	05/09/2014		Trend associated with depressurisation and closely aligned with other Wambo seam bores in close proximity. No material concern
	04/12/2014		4 th consecutive reading above trigger limits. See comment above
WOH2156B	20/03/2014	EC – 95th percentile	Watching Brief *
	02/07/2014		
	04/12/2014		Rising trend is likely associated with depressurisation of Wambo seam due to mining. No adverse impact to environment as a result of mining identified.

* = 1st/2nd trigger. Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required

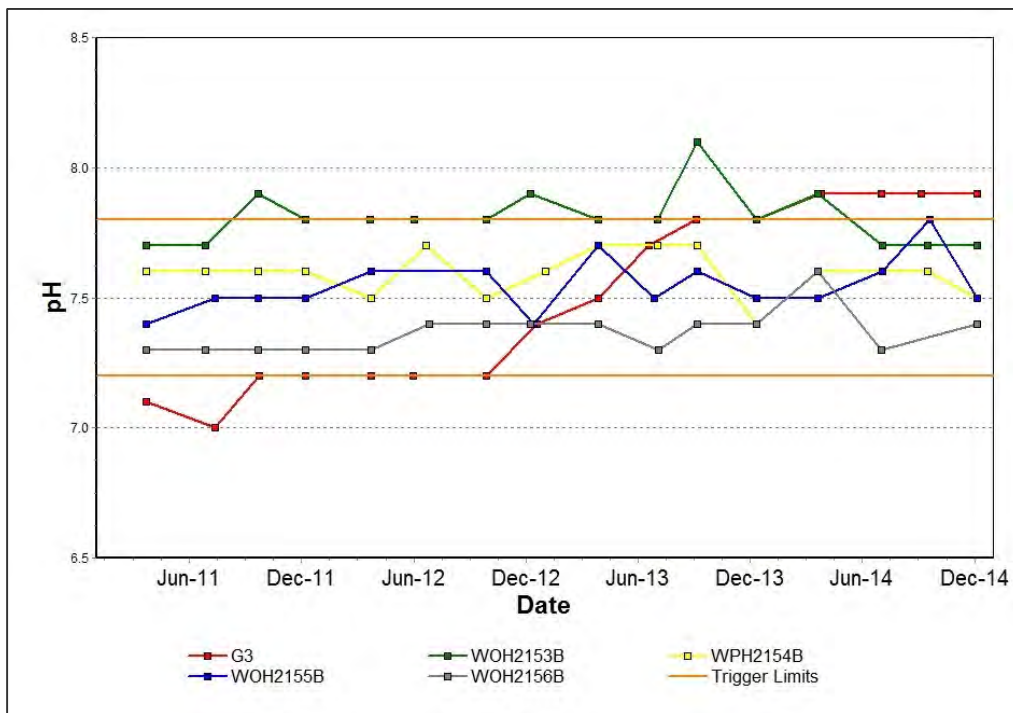


Figure 71: Wambo Seam Groundwater pH Trends 2011 to 2014

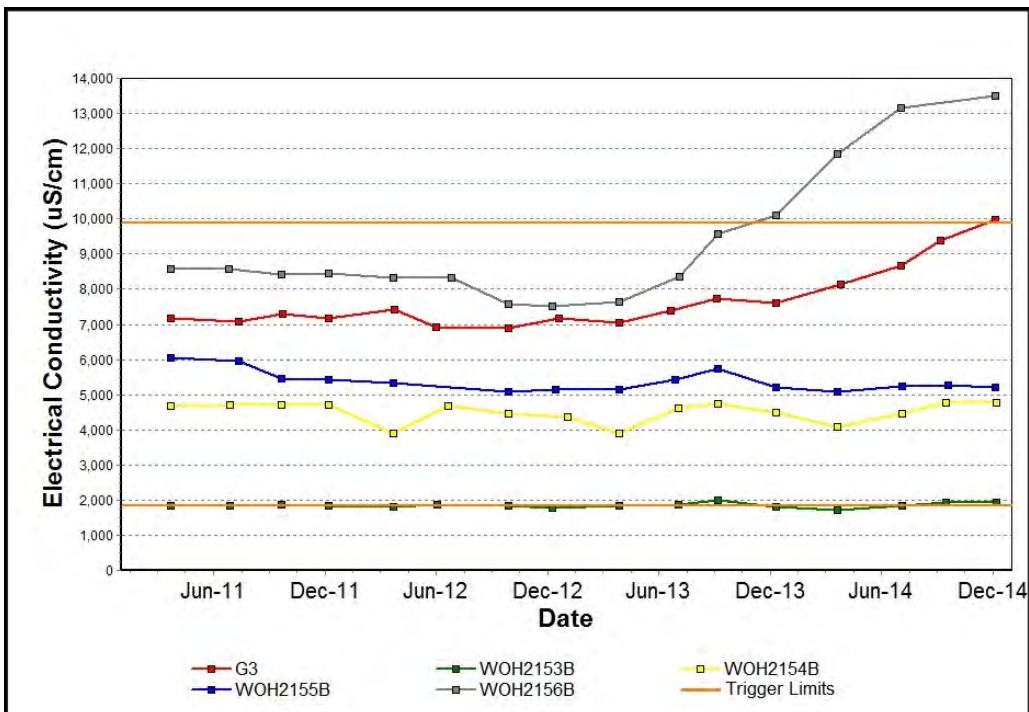


Figure 72: Wambo Seam Groundwater EC Trends 2011 to 2014

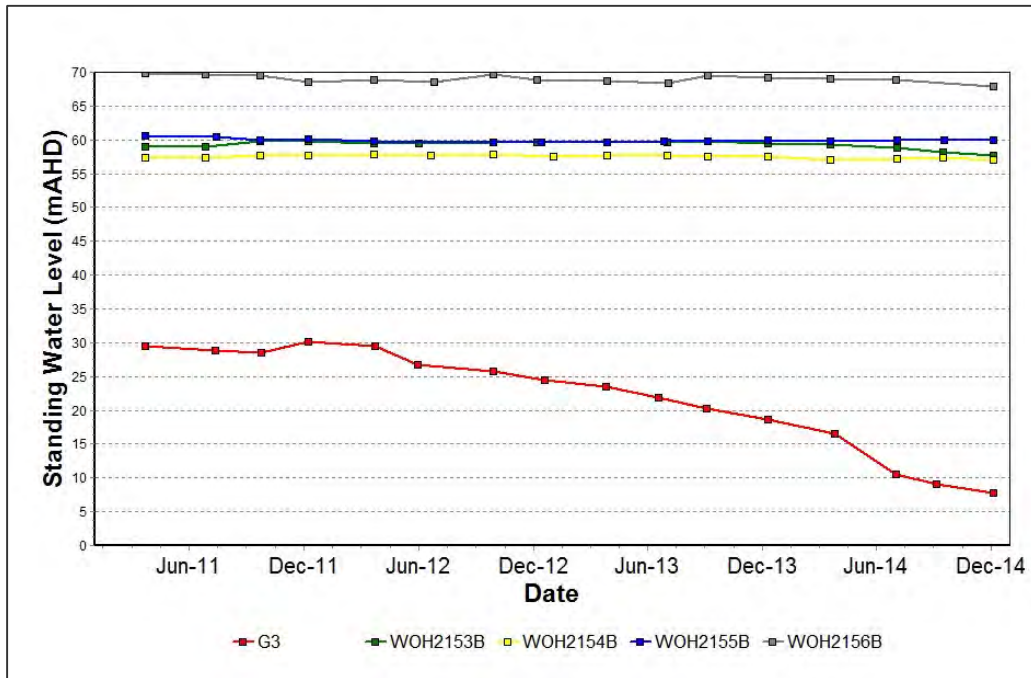


Figure 73: Wambo Seam Groundwater SWL Trends 2011 to 2014

3.8.3.9. Warkworth Seam Bores

Groundwater monitoring in the Warkworth seam area was undertaken from two sites during 2014. A total of eight samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Warkworth groundwater bores are shown in Figure 74, Figure 75 and Figure 76 respectively. Trigger tracking results are detailed in Table 41.

Table 41: MTW Warkworth Seam Groundwater 2014 internal trigger tracking

Location	Date	Trigger limit	Action taken in response
OH1138(1)	03/07/2014	EC – 95 th percentile	Watching Brief *
	23/09/2014		
	05/12/2014		

* = 1st/2nd trigger. Watching Brief established pending outcomes of subsequent monitoring events. No specific actions required

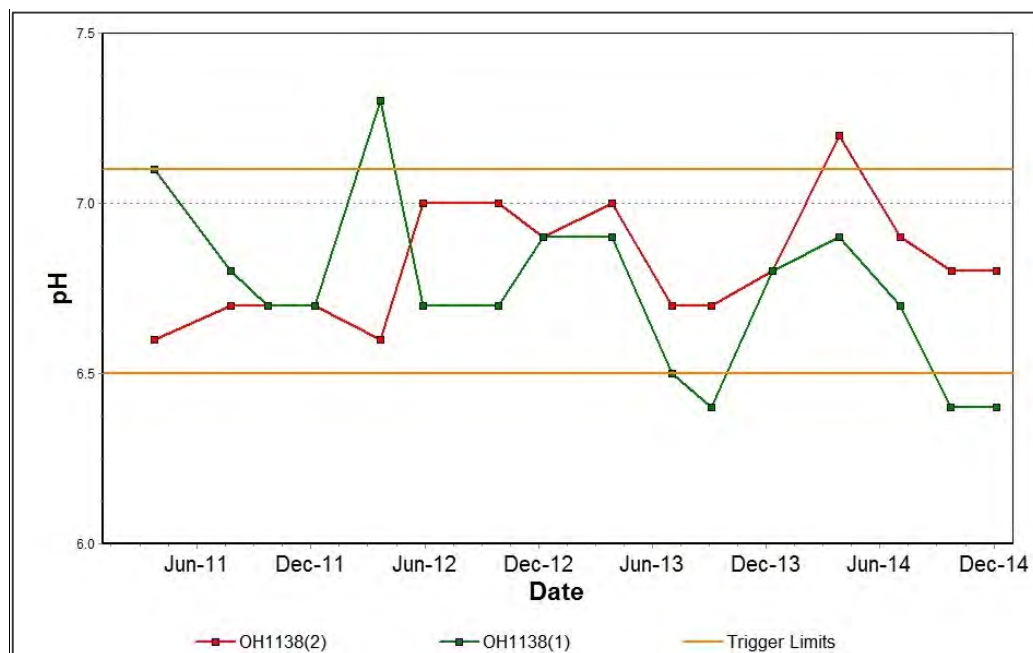


Figure 74: Warkworth Seam Groundwater pH Trends 2011 to 2014

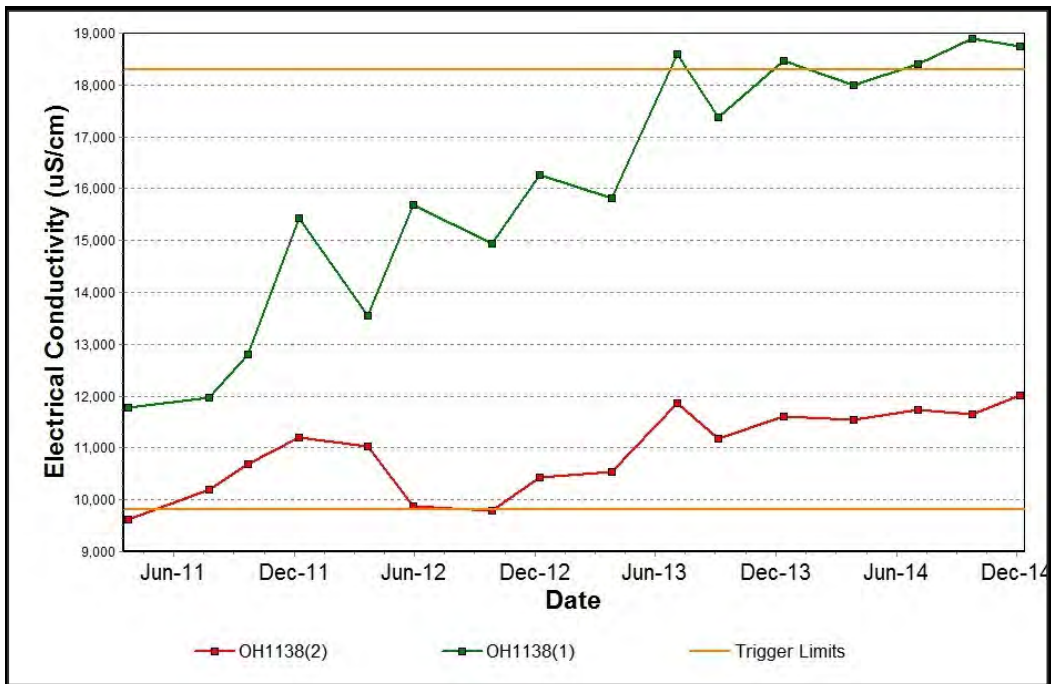


Figure 75: Warkworth Seam Groundwater EC Trends 2011 to 2014

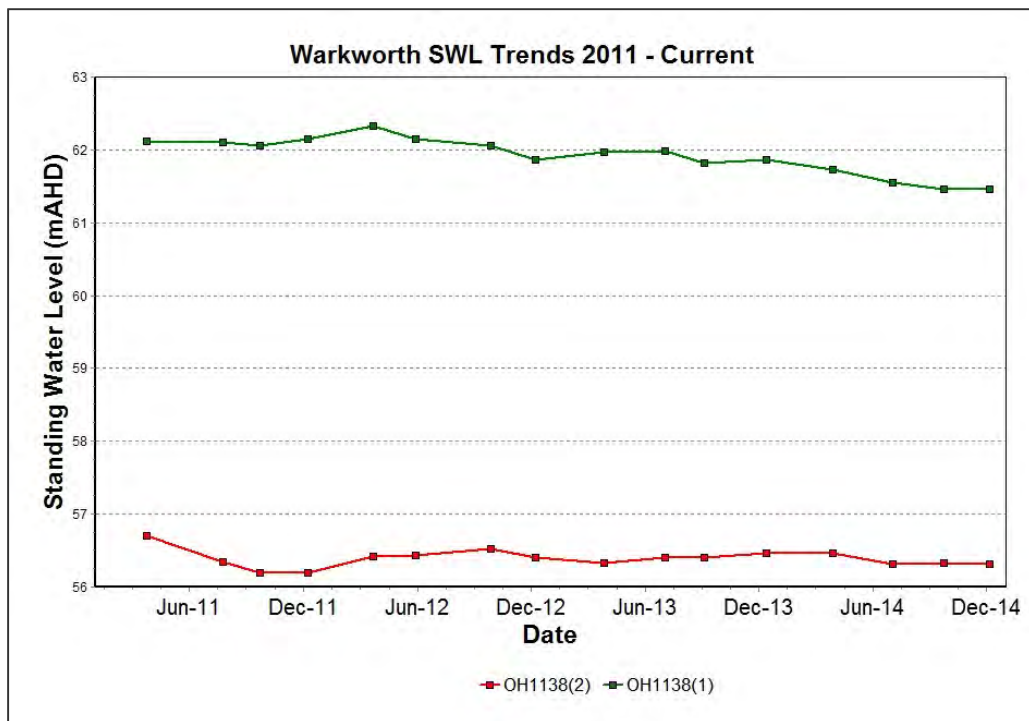


Figure 76: Warkworth Seam Groundwater SWL Trends 2011 to 2014

3.8.3.10. Wollombi Brook Alluvium Seam Bores

Groundwater monitoring in the Wollombi Brook Alluvium seam area was undertaken from three sites during 2014. A total of twelve samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Wollombi Brook Alluvium groundwater bores are shown in Figure 77, Figure 78 and Figure 79 respectively.

A review of the lithological log for PZ7S suggests the bore may not be screened in the alluvium, rather may be screened in the Aeolian Warkworth Sands. Further investigations will be undertaken in early 2015 to confirm the likely aquifer and reclassify the bore if required.

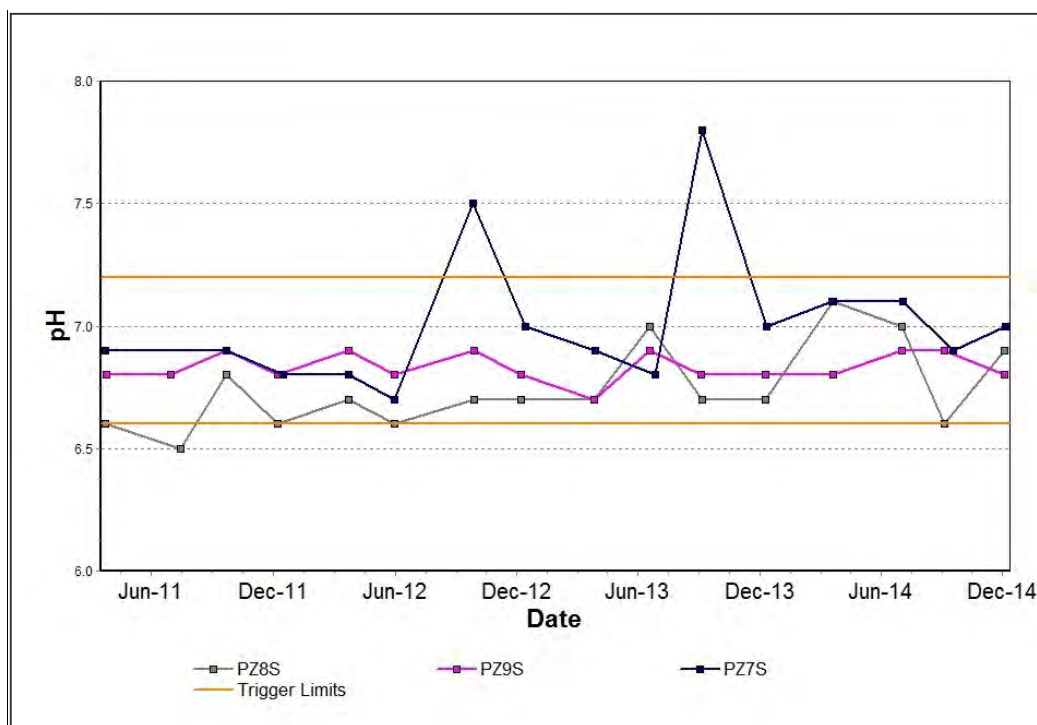


Figure 77: Wollombi Brook Alluvium Seam Groundwater pH Trends 2011 to 2014

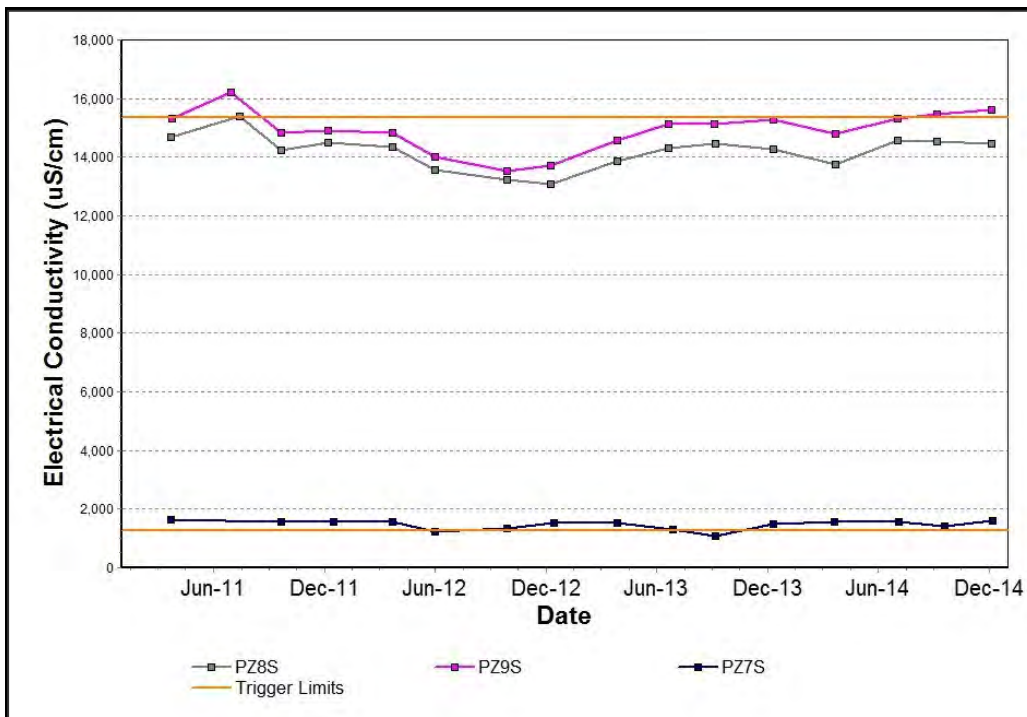


Figure 78: Wollombi Brook Alluvium Seam Groundwater EC Trends 2011 to 2014

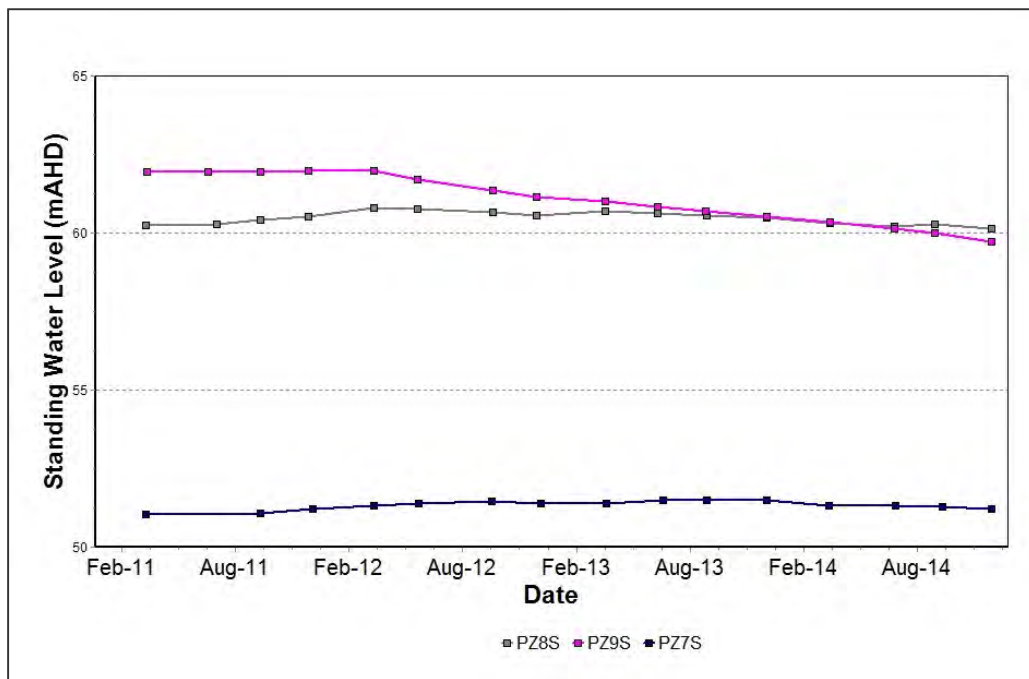


Figure 79: Wollombi Brook Alluvium Seam Groundwater SWL Trends 2011 to 2014

3.8.3.11. Woodlands Hill Seam Bores

Groundwater monitoring in the Woodlands Hill seam area was undertaken from one site during 2014. A total of two samples were collected during the reporting period. The pH, EC and SWL trends for 2011 to 2014 for Woodlands Hill Seam groundwater bore are shown in Figure 80, Figure 81 and Figure 82 respectively. OH1123(1) was recorded as dry during the September and December monitoring events.

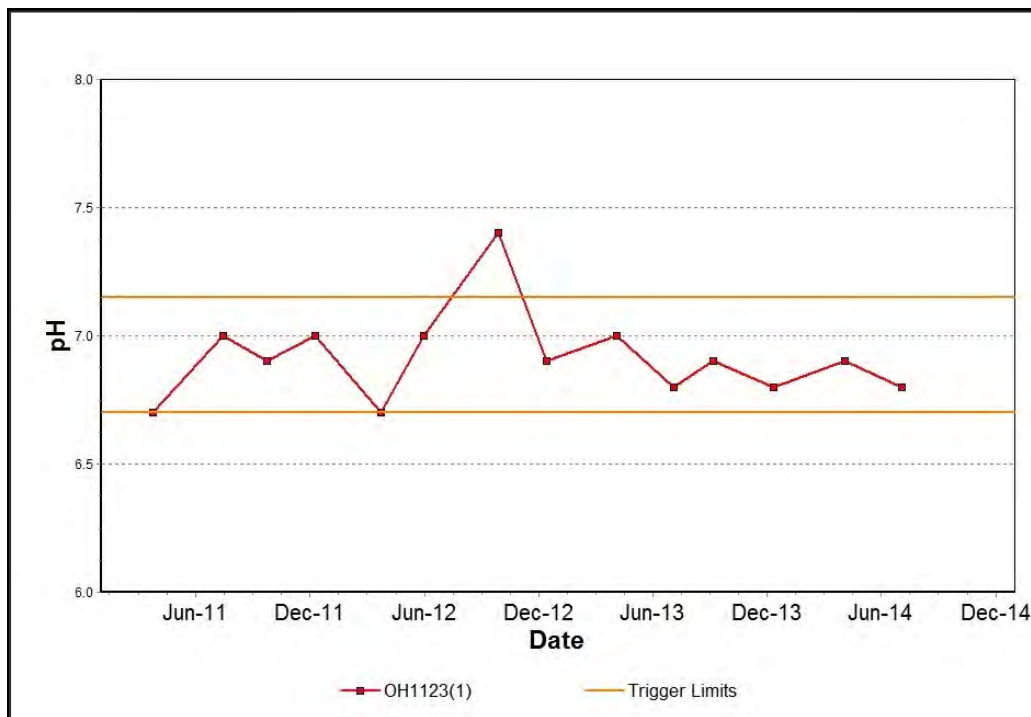


Figure 80 : Woodlands Hill Seam Groundwater pH Trends 2011 to 2014

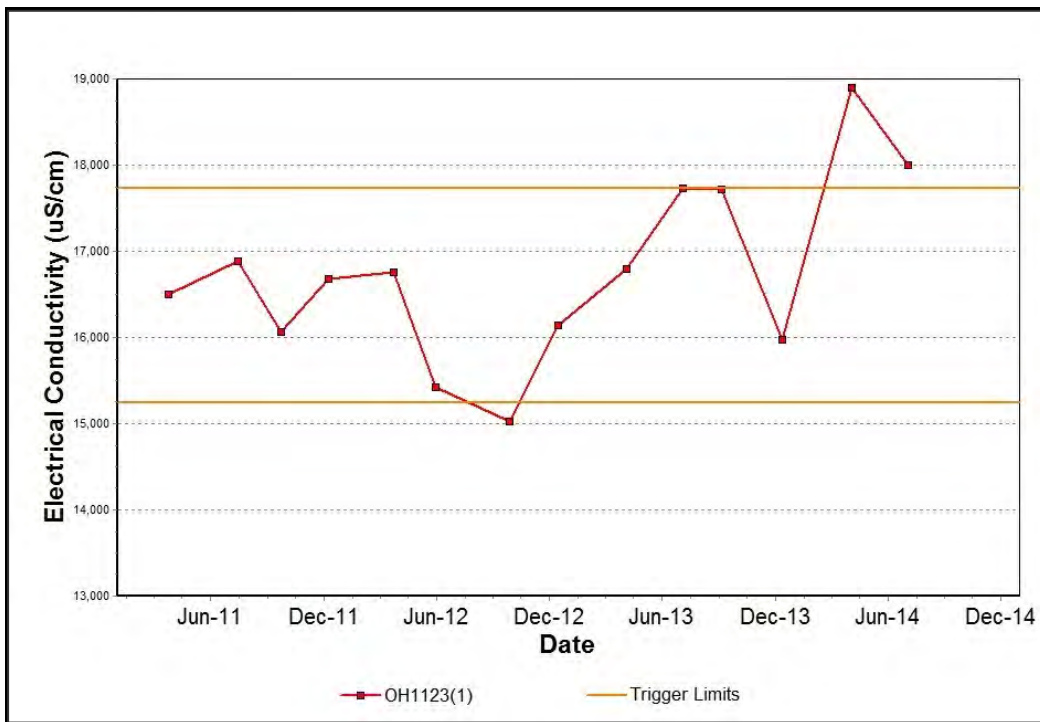


Figure 81: Woodlands Hill Seam Groundwater EC Trends 2011 to 2014

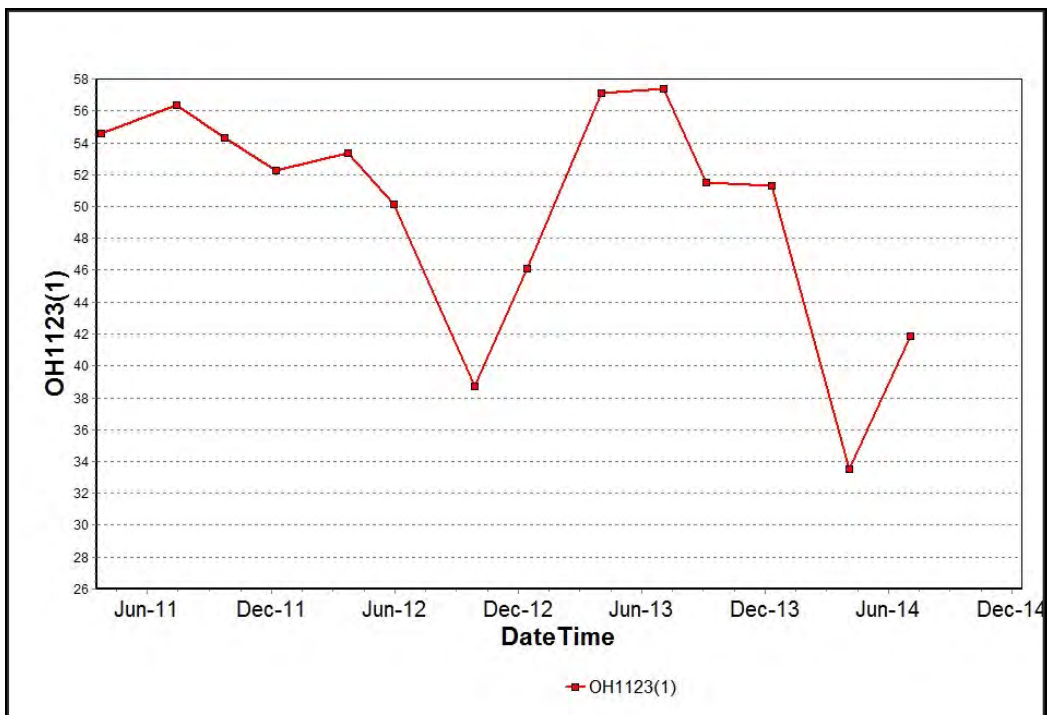


Figure 82: Woodlands Hill Seam Groundwater SWL Trends 2011 to 2014

3.8.4. Comparison of Water Quality Data with EA Predictions

The 2002 Warkworth Coal Mine EIS (ERM, 2002) indicated that the quality of groundwater entering the pits at MTW would continue to reflect an average of water quality for the coal measures spoils and contributions from the surrounding coal measures. An EC for water ranging from 4,000 to 6,500 $\mu\text{S}/\text{cm}$, based on measured data from Dam 1N (as the central repository for mine dewatering), was given. As Dam 1N received water abstracted from the Hunter River Dam 9S has been used for analogous comparison. The average EC measured in Dam 9S during the reporting period was 6,943 $\mu\text{S}/\text{cm}$, consistent with the predicted range. Some caution should be exercised in this comparison, given a significant component of water inputs during the reporting period were from external sources, including: Hunter River, Lemington Underground Bore, South Lemington Void and Bulga Mine.

3.8.5. Non-Compliances and Complaints during the Reporting Period

There were no non-compliances related to groundwater in 2014.

3.8.6. Complaints

No complaints were received in regards to groundwater during 2014.

3.8.7. Audits and Reviews

No independent audits were undertaken at MTW in 2014.

3.9. Contaminated Sites

Control strategies are in place at MTW to mitigate risk to the environment from contaminated land. Controls include infrastructure such as bunding and segregation systems, procedures for waste management, prevention control and remediation of site contamination. There are two bioremediation areas used by the mine to treat hydrocarbon contaminated material, both of which are maintained by regular maintenance and monitoring. A Contaminated Sites Register is used to record and ensure follow up of any contamination that occurs on site.

3.10. Dangerous Goods

Dangerous goods are regulated under the Work Health and Safety Act 2011 (NSW) and Explosives Act 2003 (NSW). MTW ensures that all regulatory requirements in relation to dangerous goods management are met. The storage of explosives or explosive precursors are managed in accordance with MTW's Major Hazard Management Plan - Explosives and SSDS security plan. These are internal documents which are regularly updated.

3.11. Visual Amenity and Lighting

3.11.1. Management

Coal & Allied aims to provide sufficient lighting for work to be undertaken safely, whilst minimising disturbance to neighbouring residents and public roads, particularly nearby residents in Bulga Village, Warkworth Village, Long Point, Gouldsville, Scott's Flats, and Milbrodale; and vehicular traffic on the Putty Road and Golden Highway. MTW has developed and implemented a work instruction which describes management of lighting to minimise light spillage and glow during both mining operations and periods of construction at MTW.

Actions undertaken in 2014 to manage visual amenity and lighting impacts include:

- Regular inspections conducted by Community Response Officers to observe operating practices and to ensure lights are not shining towards or affecting public roads. Lights are checked each shift when operating near roads and, if they are believed to adversely impact public roads methods of control are identified and implemented.
- Yellow and white lights are distributed based on risk and external exposure
- Alternate sheltered dumps are operated or work areas are shut down if lighting or visual amenity issues arise and cannot be sufficiently managed.

Work commenced on dumping, shaping and final rehabilitation of the South Pit North area during 2013 continuing into 2014. This area of the operation is highly visible to our neighbours to the east of MTW. This work will assist in managing noise and dust from mining operations as well as improve the visual aesthetics of the site.

3.11.2. Non-Compliances and Complaints

There were no non-compliances related to lighting management in 2014. Community complaints with respect to lighting are recorded and responded to in accordance with the Coal & Allied Community Complaints Procedure. There were 15 lighting complaints received from 10 households during the 2014 reporting period.

3.12. Bushfire Management

During 2014 firebreaks and asset protection zones were established and/or maintained around site infrastructure including the CC8 Conveyor from Warkworth to Mount Thorley Coal Loader, the boundary area with Mt Thorley Industrial Estate, and around the MTO CHPP. A Grazing Agreement was established at the WML CHPP authorising strategic grazing to assist with pasture based fuel load reduction in the Warkworth Rehabilitation Area adjacent the Golden Highway.

Dialogue with the NSW Rural Fire Service has occurred during the year in preparation of an updated MTW Bushfire Management Plan and during spring site inspections were undertaken with the RFS to identify key exposure areas. The MTW Emergency Response Team training schedule included preparations for bushfire response however no bushfire occurred on site during the year.

3.13. Waste

3.13.1. Management

The management of waste generated on the site is undertaken in accordance with Coal & Allied's Total Waste Management System which is designed to track and record all wastes leaving the site to meet regulatory requirements.

Non-hazardous waste not suitable for recycling is removed by a licensed contractor and disposed of at the Singleton Council Landfill, or other appropriate licensed facility. Co-mingled recyclable non-hazardous wastes are removed by a licensed contractor to a materials recycling facility at Thornton where wastes are sorted for further recycling.

Hydrocarbon wastes are managed and recycled in accordance with Coal & Allied's environmental work instruction for non-mineral waste management. Hydrocarbon waste is recycled via a licensed waste hydrocarbon disposal company.

The sewage treatment and disposal facilities at MTW consist of packaged sewage treatment plants which treat, disinfect and dispose, or re-use the treated effluent on site. The remaining effluent from some septic systems that cannot be treated on site is removed via licensed contractor to approved facilities for disposal.

All waste management contractors working at MTW are licensed by the EPA.

3.13.2. Performance

During the reporting period MTW continued to undertake regular inspections of areas where wastes are generated and stored, to reinforce the principles of a good waste management including waste segregation and maximising recycling.

In 2014 around 18 per cent of non-mineral waste material generated at MTW was disposed to licensed offsite landfill facilities, with the remaining wastes diverted to recycling or secondary use pathways.

There were no non-compliances or complaints related to waste management in 2014.

4. STAKEHOLDER RELATIONS

4.1. Complaints

A summary of complaints recorded in 2014 is presented in Appendix 6. A total of 911 complaints were recorded during the reporting period with the primary source of complaint related to noise (809 complaints), followed by blasting (52), dust (27) and lighting (15) as shown in Table 42. An additional 170 complaints were received during 2014 compared with 2013, predominantly in association with an additional 176 noise complaints. Levels of complaint for aspects other than noise are stable or trending down over recent years.

MTW values community feedback as a means to assist in continual improvement of its impacts and relationship with the community.

Table 42: Summary of Complaints by type for 2012 to 2014

Complaint type	2014	2013	2012
Noise	809	633	800
Blasting	52	38	69
Dust	27	48	57
Lighting	15	20	22
Water	0	0	1
Other	8	2	7
Total	911	741	956

4.1.1. Community Response Officers

Since 2012 three community response officers have been working with the mining team at MTW to provide community members with a more direct line of communication to the mine, particularly during the night. In addition to providing a timely response to community concerns during non-work hours their role includes on and off site inspections, capturing and communicating operational changes in response to alarms, weather conditions and community feedback and calls to MTW's Community Complaints Hotline. They also suggest continuous improvement ideas to further improve environmental performance.

4.2. Review of Community Engagement

4.2.1. Community Relations

Coal & Allied's approach to external relations is focused on building enduring relationships based on mutual respect, active partnerships and long term commitment.

4.2.2. Community Knowledge Base

To ensure that individuals remain informed about their local communities, Coal & Allied continued their participation in the Upper Hunter Region Domestic Omnibus Survey. Individuals are also informed by other local research activities, including the Hunter Research Foundation's Environmental Attitudes Survey and Wellbeing Watch. The information gathered through these studies is used to inform Coal & Allied's community relations programmes, Coal & Allied's Community Development Fund (CDF) and its Aboriginal Community Development Fund (ACDF). Results have also supported presentations to senior managers and other staff, all operational sites, Community Consultation Committees (CCC) and community partners. Information about Coal & Allied's approach to sustainable development in 2014, including targets and results, is available on the Rio Tinto website.

4.2.3. Communication

The Coal & Allied shopfronts in Muswellbrook (77 Bridge Street) and Singleton (127 John Street) continue to ensure that Coal & Allied remains an active and accessible member of the community.

Coal & Allied operates a free call Community Information Line (1800 727 745), which provides an avenue for community members to seek information regarding Mount Thorley Warkworth (MTW), as well as other Coal & Allied operations and activities. This number is advertised regularly in local newspapers, phonebooks, Coal & Allied community newsletters and on their website.

Similarly, Coal & Allied operates a free call 24-hour Community Complaints Hotline (1800 656 892), which enables community members to make enquiries or lodge an official complaint 24 hours a day, seven days a week. This number is publically advertised in the same mediums as the Community Information Line.

Coal & Allied provides regular updates on MTW and other activities in the community through its Hunter Valley Community Newsletter. Four editions of the newsletter were distributed to businesses and residences in the Singleton and Muswellbrook Local Government Areas (LGAs) in 2014. Coal & Allied also send quarterly letters to its near neighbours to provide an overview of MTW mining operations and other relevant activities, and to inform residents about what is being done to manage impacts.

In addition, Coal & Allied issued correspondence to specific near neighbours informing them about changes that they might be affected by, such as the reinstatement of 2012 acquisition rights under the 2014 MTW continuation project.

The community is invited to learn more about Coal & Allied's operations and projects by visiting the Rio Tinto website where copies of newsletters, public reports and information about MTW's CCC can be downloaded.

4.2.4. Community Consultation

Coal & Allied's approach to community engagement and consultation involves providing information regarding its activities in a timely, clear and transparent manner, while seeking feedback from communities to understand the potential impacts of its activities.

Coal & Allied engages in regular consultation and ongoing communication with their stakeholders regarding relevant operations and projects. Further, feedback from near neighbours and local communities is used to inform future decision-making.

In 2014, Coal & Allied undertook a range of consultation and engagement activities, including:

- MTW continuation project community information sessions at the Singleton Diggers Club and Bulga Hall
- Engagement and consultation with near neighbours to provide project updates at key project milestones and activities, and to response to concerns/queries raised by individual near neighbours
- Sirolli Institute Enterprise Facilitation community scoping sessions held at Singleton, Muswellbrook and Broke to understand community development needs and identify opportunities for local economic development and diversification
- MTW CCC meetings
- Local Council briefings
- Updates for business community, including the Singleton Business Chamber lunch hosted at MTW
- Singleton Business Chamber site visit to MTW
- School engagement- working with teachers and students to assist and enhance learning outcomes and build relationships
- Participation in the Upper Hunter Mining Dialogue- a programme coordinated by the NSW Minerals Council to engage the community across the Hunter Valley
- Participation in the NSW Minerals Council Industry Business Agreement Steering Group

Coal & Allied's relationships with local communities were strengthened through involvement in events, such as the Singleton Show and Coal & Allied's Singleton Professions Forum. The Professions Forum was a career expo style event planned and organised by student leaders from Singleton High School, St Catherine's Catholic College and the Australian Christian College. The event aimed to support career options and diversity within the Singleton area.



Figure 83: Hunter Coal Environment Group visit to MTW's Environmental Noise Compass located near Bulga village



Figure 84: Singleton Professions Forum Committee 2014

Capacity building

Across the Hunter Valley, Coal & Allied is continually focused on building the capacity of local Aboriginal businesses and community organisations to bid for and win small to medium contracts in the mining industry. This involved Procurement and Projects team site visits, and support for the development of teaming agreements with mainstream contractors.

Community Consultation Committee

The MTW Community Consultative Committee (CCC) met quarterly to provide a forum for discussion between the community, the Council and Coal & Allied representatives. The CCC is an important communication and engagement tool, as the group acts as the point of contact to provide feedback between the mine and the community.

In 2014 meetings were held in February, April, July and November. At each meeting business papers and presentations provided members with environmental monitoring data, operational updates, land management details and an overview of external relations activities, in addition to responses to issues of concern raised by community representatives. Members of the committee and regulators undertook a tour of site rehabilitation areas during May 2014.

In accordance with the Project Approvals copies of the MTW CCC minutes are available on the Rio Tinto Coal Australia website as well as copies of the committee meetings.

Following CCC meetings, a letter is mailed to near neighbours to update them about what was discussed and provide any additional information about MTW's operations.

4.3. Community Development

In 2014, Coal & Allied continued its focus on the long term sustainability of the communities where they operate through facilitating community development programmes such as:

- Coal & Allied Community Development Fund (CDF)
- Coal & Allied Aboriginal Community Development Fund (ACDF)
- Mount Thorley Warkworth Site Donations Committee
- Community partnerships

Coal & Allied's relationships with local communities were strengthened through involvement in events, such as the Singleton Show and Coal & Allied's Singleton Professions Forum.

4.4. Community Development Funding Programs

Priority areas for funding in 2014 included education, economic development, environment and social/cultural, with 29 new and 25 ongoing programmes supported by the CDF and ACDF. Together these programmes contributed more than \$1.8 million during 2014 to support capacity building and contribute to the long term sustainability of surrounding communities. For more information about Coal & Allied community funding programmes visit <http://www.riotinto.com/energy/community-funds-10413.aspx>.

Community Development Fund (CDF)

The year 2014 marked 16 years of operation of the CDF, which has invested \$13.5 million to support over 120 community projects in the Hunter Valley since its inception in 1999, across the areas of health, education, environment and economic development. In 2014, Coal & Allied announced that a further \$3 million would be made available to the CDF over a three year period (2015 – 2017) for projects in the Singleton, Muswellbrook and Upper Hunter LGAs.

In 2014, the CDF invested more than \$1.2 million in 11 new programmes aimed at delivering long term benefits for communities in the CDF catchment, which included the Singleton, Muswellbrook, Maitland, Cessnock and Upper Hunter LGAs (Table 43).

Table 43: Coal & Allied Community Development Fund projects approved in 2014

Programme	Partner
Place making in Singleton	Singleton Council
Supporting Children's Developing Social Competence	Early Links Inclusion Support Service
Voices of the Hunter	University of Newcastle
Outward Bound Youth Leadership Project (2014 - 2017)	Outward Bound
Total Schools Steer Challenge (2014 - 2017)	Department of Primary Industries- Total College
Business Development Officer (2014 - 2016)	Singleton Business Chamber
Club House Feasibility Study Project	Muswellbrook Golf Club
Enterprise Facilitation Project	Sirrolli Institute
Community First Response Vehicle	NSW Rural Fire Service- Hunter Valley
Science and Engineering Challenge, and SMART Program (2014 - 2017)	University of Newcastle
Upper Hunter Education Fund Scholarships (2014 - 2017)	Upper Hunter Education Fund

Table 44: Active Coal & Allied Community Development Fund programmes running throughout 2014

Programme	Partner
Time Capture... The Making of	Maitland City Council
Upper Hunter Shire Council Community Engagement (ended 31 Dec 2014)	Upper Hunter Shire Council
River Paramedics (ended 31 Dec 2014)	Conservation Volunteers Australia
Cessnock Grants Officer (ended 31 Dec 2014)	Cessnock City Council
Microenterprise Development in the Hunter (ended 31 Dec 2014)	Many Rivers Microfinance Limited

Community Liaison and Grants Officer

Muswellbrook Shire Council

(ended 31 Dec 2014)

Hunter Valley Creative Communities

The Song Room

(ended 31 Dec 2014)

Business Growth Seminars

Hunter Region Business Enterprise
Centre Inc.

(ended 31 Dec 2014)

Upper Hunter Science and Engineering Challenge,
and SMART program (ended 31 Dec 2014)

University of Newcastle

Building Skills and Leadership Capacity in Rural NSW

Royal Agricultural Society
(NSW) Foundation

Hunter Youth Leadership Program

The Australian Outward Bound
Development Fund

(ended 31 Dec 2014)

Upper Hunter Beef Bonanza Inc.

Upper Hunter Beef Bonanza

(ended 31 Dec 2014)

People in Your Neighbourhood- Sustainability Street

Muswellbrook Shire Council

Total Schools Steer Challenge

Department of Primary Industries Total
College

(ended 31 Dec 2014)

Local SME Supply Chain Participant project

HunterNet

Scholarship Program

University of Newcastle

Healthy Dads, Healthy Kids: Transitioning to
Sustainability (ended 31 Dec 2014)

Hunter Medical Research Institute

Economic Development and Funding Coordinator

Singleton Council

Interpreting the Great North Road

Convict Trail Project Inc.

Wollombi to Singleton

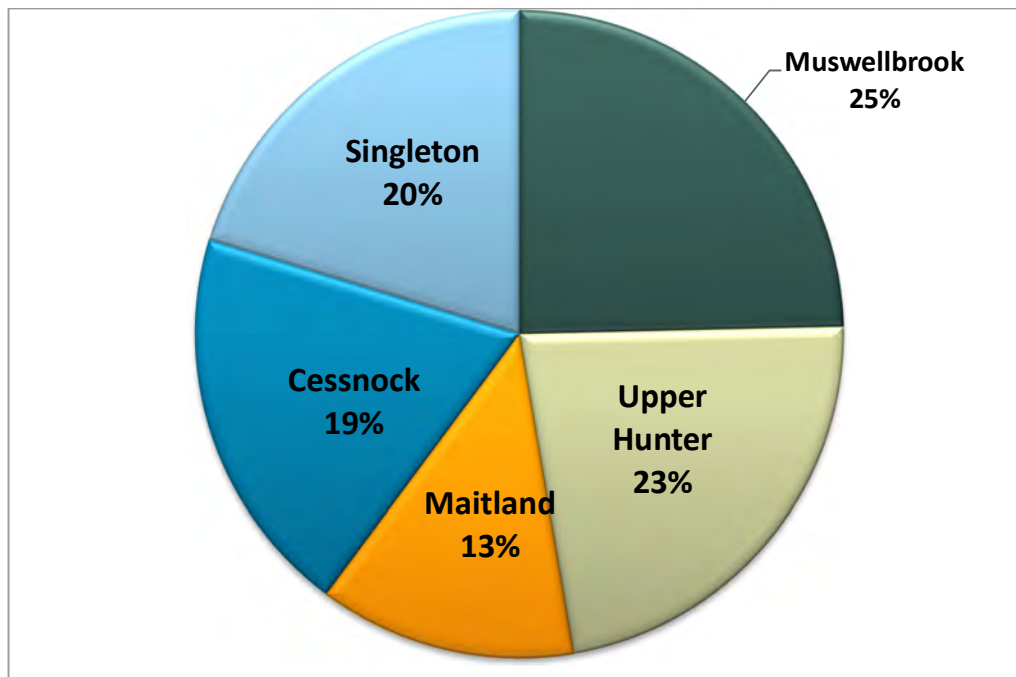


Figure 85: Distribution of Community Development Fund by LGA 2014

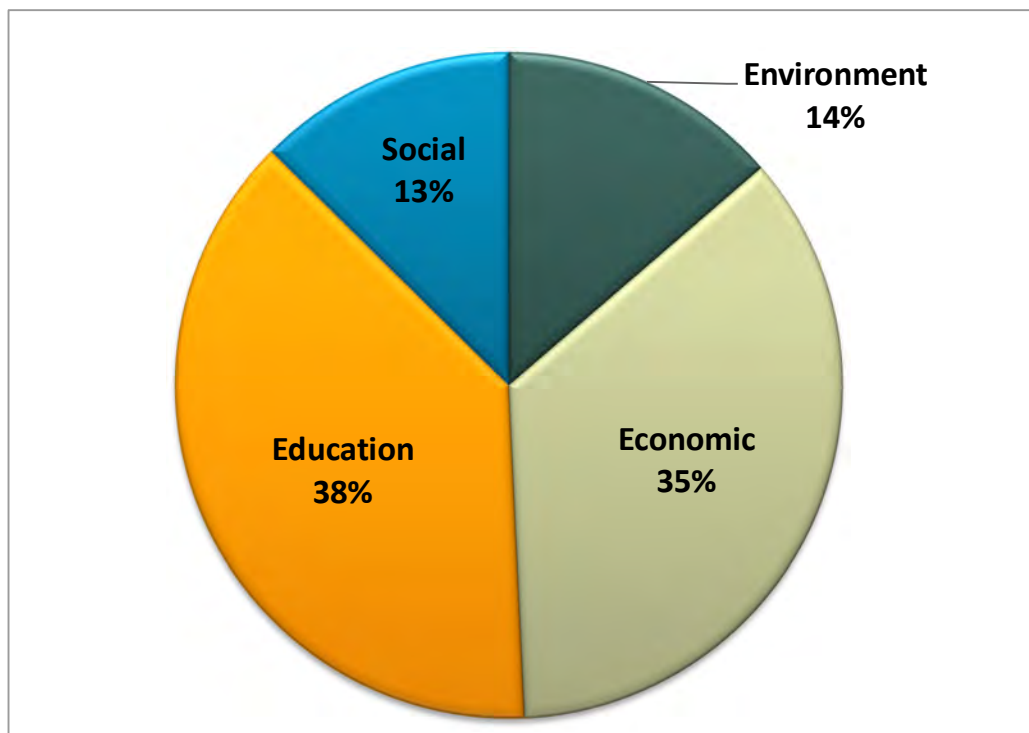


Figure 86: Distribution of Community Development Fund by category 2014

Aboriginal Community Development Fund (ACDF)

In 2006, Coal & Allied, in partnership with the Upper Hunter Valley Aboriginal Community, launched the ACDF (formerly the Aboriginal Development Consultative Committee). Since its inception, the fund has invested approximately \$600,000 each year to projects benefiting Upper Hunter Valley Aboriginal communities.

The ACDF is accessible to any Aboriginal person or organisation in the Upper Hunter Valley region who is undertaking a project to benefit specific target groups, or that has the potential to benefit the wider Aboriginal community.

Through the ACDF, Coal & Allied has been supporting education, cultural events, and community and business development projects most likely to deliver long term sustainable outcomes for Aboriginal communities in the Singleton, Muswellbrook and Upper Hunter LGAs.

In 2014, the ACDF invested \$641,030 (100% of available funds) in 18 programmes aligned with its priority funding areas: economic development, health, community and cultural development and education (Figure 87). Distribution of ACDF investments across LGAs is shown in (Figure 88).

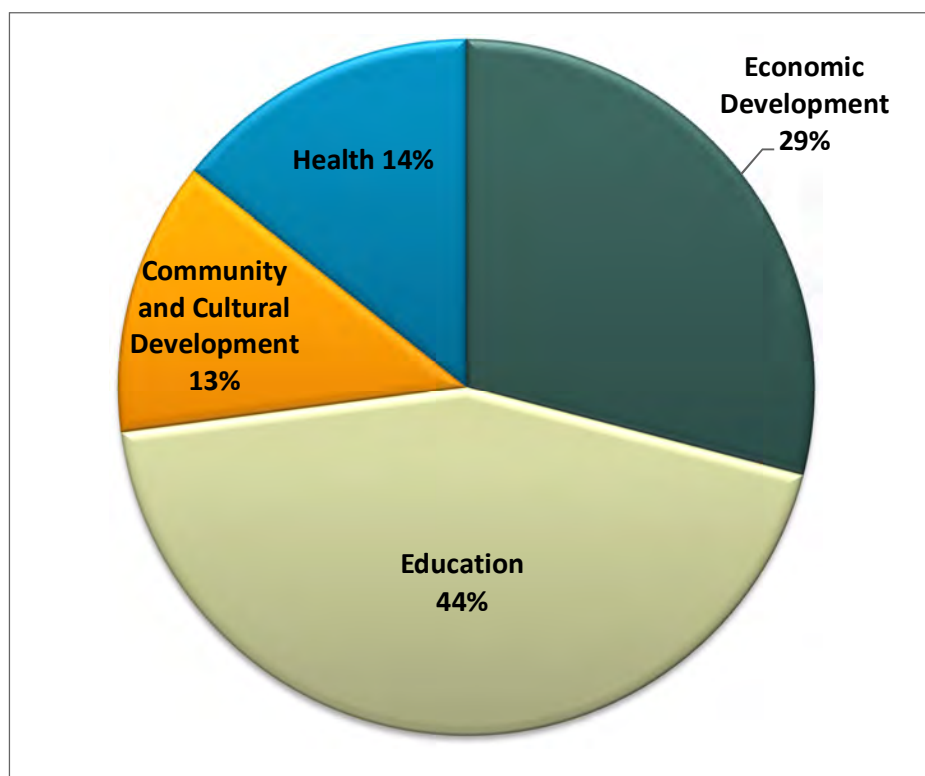


Figure 87: Distribution of Aboriginal Community Development Fund by Category

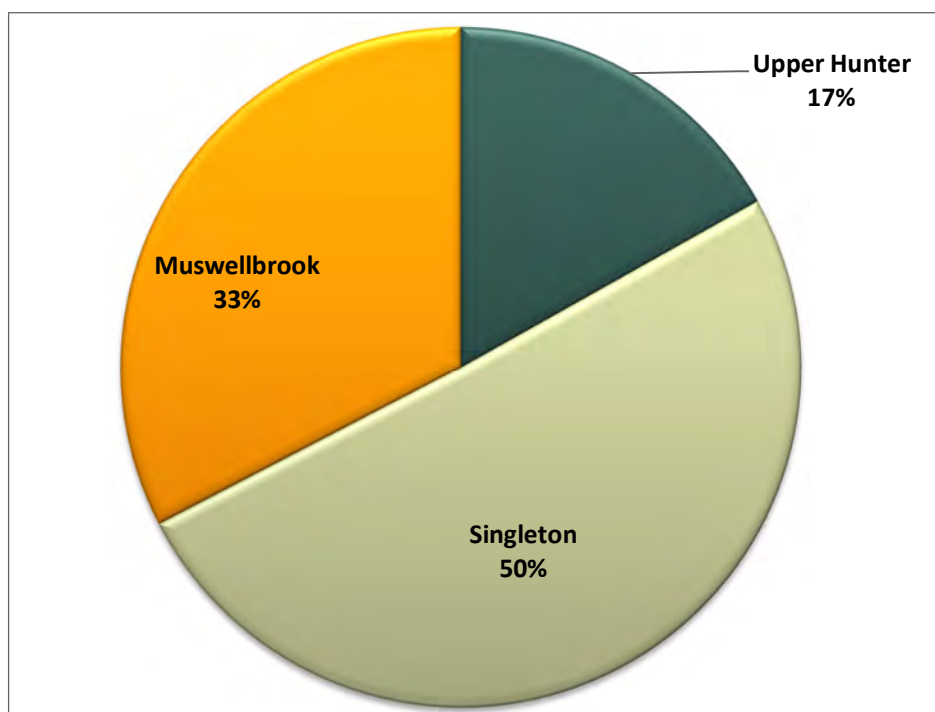


Figure 88: Distribution of Aboriginal Community Development Fund by LGA

Table 45: Coal & Allied Aboriginal Community Development Fund projects approved in 2014

Programme	Partner
Max Potential	Future Achievement Australia Foundation
The Gundi Programme (2014 – 2016)	St Heliers Corrective Centre
National Indigenous Tertiary Education Student Games	University of Newcastle
Hydrogen on Demand (2014 – 2016)	Darryl Brock (Many Rivers Microfinance)
Dookal Group Pty Ltd (2014 – 2016)	Ungooroo Aboriginal Corporation
The Australian Outward Bound Scholarships	The Australian Outward Bound
New South Wales Koori Knockout	Wanaruah Hunters
New South Wales Koori Knockout	Wonnarua United Rugby League Football Club
NAIDOC week activities (2014 - 2016)	Wanaruah Local Aboriginal Land Council
NAIDOC week activities	Singleton Management Group
Singleton Schools Aboriginal Dance Group (funding renewed)	Broke Public School
Singleton Art Prize (2014 – 2016)	Rotary Club of Singleton on Hunter Inc.
Study Assistance	Michael Hutt

Parents and Learning (PAL) (renewed 2015-2017)	Napranum Pre-School
Partnerships for Success (renewed 2015-2017)	Polly Farmer Foundation
Warrae Wannu School Readiness (renewed 2014-2015)	Muswellbrook South School
Dental Health Pilot Programme	Happy Tooth
Wupa@Wanaruah	Ungooroo Aboriginal Corporation

Table 46: Active Coal & Allied Aboriginal Community Development Fund projects approved in prior funding cycles

Programme	Partner
Sustainable Employment and Training	Compass Housing
Ka-wul New Beginnings (2013 – 2015)	Singleton High School
Social and Emotional Wellbeing Worker	Upper Hunter Drug and Alcohol Services
Indigenous Scholarships (2013 – 2015)	University of Newcastle
CEO & Strategic Plan Update	Wonnarua Nation Aboriginal Corporation
YINPI - Post School Pathways Programme (2013 – 2017)	Singleton High School

MTW Site Donations

In addition to these programmes, Coal & Allied considers applications for local donations and sponsorships that have a clear community benefit. In 2014, MTW provided more than \$75,000 towards 32 local projects and initiatives, including:

- Singleton Art Prize
- Centenary of Coal
- Singleton Theatrical Society
- WildLife Aid
- Anti-bullying program at St Catherine's College
- Computer Pals for Singleton Seniors
- Singleton Beef and Land Management Prime Stock Competition
- Transport to Treatment Cancer Assistance Program with the NSW Cancer Council
- Holstein's State Show
- Singleton Bull's Junior Rugby Club
- Singleton Council Mayoral Scholarships

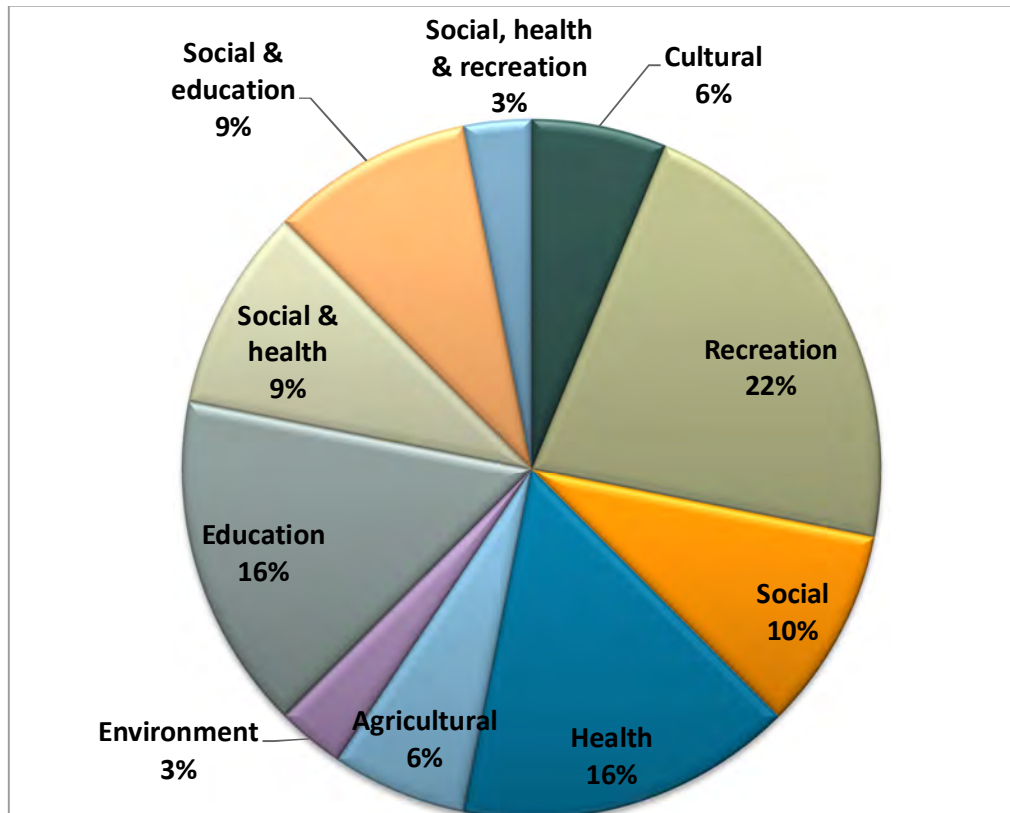


Figure 89: Allocation of MTW site donations in 2014

4.5. Community Partnerships

Coal & Allied has retained an active partnership programme in 2014 with key organisations that provide a service valued by the community and have an approach to their business that is aligned with Coal & Allied principles. Partners include:

- Hunter Medical Research Institute
- Hunter Valley Research Foundation
- Westpac Rescue Helicopter Service
- University of Newcastle

4.6. Employment

At 15 January 2015, MTW employed 1,444 permanent employees. Gender statistics represented in Table 47 and residential demographic illustrated in Table 48.

MTW contracts local companies to undertake cleaning, electrical maintenance, mechanical maintenance, rehabilitation and land management works, and earthmoving. Local companies are the preferred contractors and are used when possible.

Coal & Allied has achieved steady growth in Aboriginal employment levels over the past seven years through their Aboriginal Employment Strategy. They continue to progress towards the Rio Tinto Coal Australia target of 5 percent Aboriginal employment.

In 2012, Coal & Allied established the Conserving Country Training Programme (CCTP) to provide employment opportunities for Aboriginal people, respond to local Aboriginal people's aspiration to be involved in the rehabilitation of mined land, support wider work to embed Aboriginal relations within the business and build cross cultural understanding. The CCTP supports the Rio Tinto Australia Aboriginal Employment Strategy, Reconciliation Action Plan and more recently the Coal & Allied Diversity and Inclusion Strategy.

In 2014, Coal & Allied continued its partnership with Novaskill, a local not-for-profit Registered Training Organisation and Group Training Company, to manage recruitment, schedule work and deliver training packages for participants. The CCTP is utilised by Environmental Services, Land and Property, Projects and Offsets teams.

Table 47 : Gender breakdown for MTW as at 15 January 2015

Gender	Employees
Male	1,126
Female	185
Total	1311

Table 48: Residential locality of Permanent Coal and Allied Employees of Mount Thorley Warkworth as of January 2015

Council Area	Postcodes	Employees
Singleton Shire	2330, 2335	41.0%
Maitland Shire	2320, 2321, 2323, 2324, 2334, 2421	36.0%
Cessnock Shire	2325, 2326, 2327	12.5%
Newcastle Council	2287, 2289, 2291-2300, 2302-2305, 2322	6.5%
Muswellbrook Shire	2328, 2333, 2336	3.5%
Upper Hunter Shire	2337, 2340	0.3%

5. REHABILITATION

Rehabilitation progress has been compared to the MOP that was current during the reporting period (MTW MOP 2014-2016 approved 24th November 2014). The primary rehabilitation objectives for areas of post mined lands include:

- Re-creating approximately 32 ha of Endangered Ecological Community (EEC) woodland communities to a standard comparable to similar reference EEC communities;
- Establishing approximately 2,067 ha of trees over grassland areas, but not necessarily conforming to any particular vegetation community;
- Recreating 1,129 ha grassland communities with a native component on the residual disturbed mining areas;
- Establishing a network of tree corridors to ensure connectivity of woodland community areas; and
- Provide additional habitat for threatened species.

The woodland and trees over grassland component of the rehabilitation will form a north/south connecting corridor of vegetation between the existing vegetation to the north of the proposed Warkworth extension through the rehabilitation areas of Mount Thorley Mine and Bulga Mine and in the future will connect to the large tract of intact vegetation at Singleton Military Training Area. The proposed rehabilitation corridor will reduce the impacts of edge effects by forming one large linear block of vegetation rather than numerous scattered patches allowing for easier management due to reduced weed invasion and similar edge effects.

5.1. Summary of Rehabilitation

A total of 104.1 ha rehabilitation was undertaken during 2014 against a MOP target of 102.1 ha. Total disturbance undertaken during 2014 was 122.6ha which was 36.7ha lower than the MOP projection. The disturbance during 2014 was made up of 80.9ha of new disturbance; and 41.7ha of disturbance of previously rehabilitated area. Rehabilitation disturbance conducted during 2014 was mainly to the existing waste dumps in Mt Thorley.

Design work for the Common boundary landform between MTO and Bulga Mine was finalised in the first half of 2013. The Common Boundary Rehabilitation Plan has been prepared to summarise the proposed activities within the Common Boundary area and incorporated as an appendix in the MOP for both MTW and Bulga Surface Operations. Environmental management responsibilities and actions associated with operational activities and rehabilitation works within the Common Boundary area have been documented in the Plan, including erosion and sediment control requirements.

5.1.1 Results of Monitoring Against KPIs

Performance criteria for each rehabilitation phase have been detailed in the MOP for MTW (2014-2016). These criteria have been developed so that the rehabilitation success can be quantitatively tracked as it progresses through the phases outlined below:

- Stage 1 – Decommissioning
- Stage 2 – Landform Establishment
- Stage 3 – Growing Media Development
- Stage 4 – Ecosystem and Landuse Establishment
- Stage 5 – Ecosystem and Landuse Sustainability
- Stage 6 – Rehabilitation Complete

The performance criteria are objective target levels or values that can be measured to quantitatively demonstrate the progress and ultimate success of a biophysical process. A monitoring methodology has been developed to measure the performance criteria outlined in the MOPs utilising a combination of tools that provide quantitative data to assess changes occurring over time. The overall monitoring methodology comprises the following tools:

- Accredited soil analyses;
- Ecosystem Function Analysis;
- Assessment of Land Capability;
- Various measures of ecosystem diversity and habitat values;
- BioBanking Assessment Methodology – Site Value Score; and
- Assessment of pasture productivity, carrying capacity and stocking rates.

Although the criteria have been set, the target levels or values will be based on monitoring results from reference sites and therefore not determined until the end of 2015. After this the results of the rehabilitation monitoring program will be able to be compared against the targets levels to determine if rehabilitation has been successful or if additional intervention is needed.

Monitoring of grazing sites has been commenced for both reference sites and rehabilitation sites across HVO and MTW. Eight reference sites have been selected across Coal & Allied owned land adjacent to HVO and MTW. These sites were selected to cover the various soil types found in the area and to cover different Land Capability Classes (five sites on Land Capability Class IV to VI; and three sites on Land Capability Class I-III). Monitoring has also been conducted on four sites each at HVO and MTW on rehabilitated land returned to grazing. AECOM have prepared a report detailing the monitoring results and this has been included in Appendix 6.

The monitoring program for rehabilitated land returned to native vegetation has not yet commenced due to delays in finalising the Common Biodiversity Reference Site project being sponsored by the Upper Hunter Mining Dialogue (UHMD). This project is aimed at allowing mining companies that are re-establishing native vegetation communities to share monitoring information from a common pool of reference sites. It would also provide for commonality in performance criteria and monitoring methods used to measure the success of native vegetation rehabilitation in the Hunter Valley. Coal & Allied have delayed monitoring of native vegetation rehabilitation until the UHMD project gets underway to avoid undertaking monitoring that is not compatible with the monitoring methods that will be developed as part of the UHMD project.

In order to determine whether rehabilitated land is suitable for relinquishment, monitoring data from reference sites will be needed to set target levels for the performance criteria detailed in the MTW MOP. Monitoring results from rehabilitation areas will then be able to be compared against the performance criteria to identify areas that are suitable for relinquishment.

5.1.2 Discrepancies in Rehabilitation and Action Taken

Sowing in 2011 of rehabilitation areas to native vegetation included the use of seed mixes with a diverse native understorey (approximately 25 to 30 species of native grasses and other herbaceous plants). In some areas the results have been very good with good initial establishment of native grasses followed by establishment of trees and shrubs. However, in other areas the establishment of native species has been poor due to competition from galenia and non-native perennial grasses i.e. *Chloris gayana* (rhodes grass) and *Pennisetum clandestinum* (kikuyu grass). These observations confirmed early theories that weed competition would be the biggest threat to the establishment of a diverse native understorey. In response to these observations trials have been conducted since 2012 using an initial cover/clean-up crop phase in topsoil areas to allow control of weeds prior to sowing the native seed mixes.

The growth of cover crops in areas planted during 2012 was poor at MTW compared to the results achieved at HVO through the use of mixed source compost as a soil ameliorant. This result at MTW was despite chemical fertilisers being added at sowing time to provide nutrients. It appears that the compost provides other structural and microbial benefits to the soil which contribute to better growth. Compost was applied to all of the rehabilitation areas completed in 2014.

Weeds were found to be germinating during the cover crop phase of the rehabilitation process, which is not unexpected and part of the design for the clean-up phase of early rehabilitation. Germination of weed seeds during growth of the annual cover crop is, in fact, desirable because it exhausts weed seeds in the topsoil and the weeds can be targeted with herbicide when the crop has run its course. An additional benefit that has been observed is that shading of the weeds by the cover crop has meant that low-residual herbicide can be used to control weeds. Residual herbicides such as Grazon are required to provide an effective kill of mature *Galenia pubescens* plants but because weeds are being

kept small by the shading effect of cover crops therefore non-residual herbicides are proving effective in killing the emerging *G. pubescens*. The use of non-residual herbicides is beneficial because it avoids lengthy delays in sowing areas to final seed mixes containing sensitive species.

The weed dominance in topsoiled rehabilitation has also highlighted the need for improved control of weeds, particularly galenia, on topsoil stockpiles. Weed control of topsoil stockpiles across MTW was increased during 2014 and will continue in 2015. Re-sowing of topsoil stockpiles will also be undertaken to establish a vegetative cover of desirable species.

Sowing natives into a growth medium of spoil mixed with compost was trialled at MTW during 2014. This was on the back of good results at HVO in 2012. It was found that the natives established very well in this growth medium without weed competition that would normally result in topsoiled areas from the weed seed load in the topsoil. The spoil/compost areas sown at MTW were seeded using a hydroseeding truck as the rougher spoil surface was not suited to using the direct-drill seeder.

5.1.3 Maintenance of Existing Rehabilitation

Weed control was undertaken in 2012 and 2013 rehabilitation areas including North Pit North, Swan Lake and CD to target galenia. Ongoing maintenance of rehabilitation areas will continue in 2015, including weed management and sowing of successive cover crops, or native species.

Spot spraying of broadleaf weeds and perennial exotic grasses was conducted in areas sown to diverse native seed mixes in 2011. Both North Pit North and CD Dump rehabilitation areas are demonstrating good levels of diversity in the native understorey but there is evidence of weed incursions. Spot spraying in these areas allows emerging weeds to be controlled while maintaining the desired native understorey.

The drop-structure constructed in South Pit North 2013 rehabilitation is being replaced using a more competent design. Work involves importation of specific rock to line the drop structure, plus resizing of the structure to adequately manage the water catchment. This work will continue into 2015.

5.2 Decommissioning

MTW commenced work on the closure of Tailings Dam 1 during 2013 and Stage 1 capping of Tailings Dam 1 (TD1) was completed during 2014. This project is expected to be complete by 2015 and will be the first closure and rehabilitation of a tailings storage facility undertaken at MTW. This tailings storage facility had remained open because it was expected that reclamation and reprocessing of tailings from TD1 would supply up to 20% of the total contracted Redbank Power Station energy requirement. However, various methods trialled over 10 years failed to establish a feasible method for recovery and treatment of tailings from TD1. A decision was therefore made to cap the storage facility and Australian Tailings Consultants were engaged to prepare a rehabilitation plan for the facility. A Section 101 Approval (ministerial approval to discontinue use of an emplacement

area) was granted under the Coal Mine Health and Safety Act and capping works and monitoring are progressing in accordance with the rehabilitation plan. The final capping and rehabilitation of TD1 will be completed in 2015.

5.3 Rehabilitation Progression – in accordance with MOP Commitments

Table 49 summarises rehabilitation completed during the reporting period compared with the rehabilitation commitments in the MTW MOP. Table 50 details the disturbance completed in 2014. Appendix 4 provides the Annual Rehabilitation Report Form, including rehabilitation progress for each domain through the rehabilitation phases.

The area of rehabilitation that was sown during the reporting period slightly exceeded the MOP target for Warkworth. The MTW MOP had no rehabilitation planned on the Mt Thorley site during 2014.

The 2014 rehabilitation areas for MTW are shown in Appendix 5.

Table 49: Rehabilitation Completed in 2014

MOP	Pit Area	2014 Rehabilitation (ha)		Cumulative Rehabilitation During MOP Period* (ha)	
		Actual	MOP Commitment	Actual	MOP Commitment
MTW	Mt Thorley	0	0	0	0
	Warkworth	104.1	102.1	104.1	102.1
	MTW Total	104.1	102.1	104.1	102.1

Note: Rehabilitation areas relate to areas at or past the phase of Ecosystem and Landuse Establishment.

* MOP Period is 2014 - 2016

Table 50: Disturbance Completed in 2014

MOP	Pit Area	2013 Disturbance (ha)		Cumulative Disturbance During MOP Period* (ha)	
		Actual	MOP Commitment	Actual	MOP Commitment
MTW	Mt Thorley	33.5	87.2	33.5	87.2
	Warkworth	89.1	72.1	89.1	72.1
	MTW Total	122.6	159.3	122.6	159.3

* MOP Period is 2014 - 2016

5.4 Rehabilitation Progression – in Accordance with EA Commitments

Progressive rehabilitation commitments are outlined in Environmental Assessments. The 2002 Extension of Warkworth Coal Mine Environmental Impact Statement (ERM, 2002) modelled a total of 678 hectares of rehabilitation would be complete by 2013 (the closest modelled year in the document). There has been 641.1 hectares of rehabilitation completed at Warkworth, 95 per cent of the area modelled in the 2002 Warkworth EIS. Actual rehabilitation progress in comparison to EIS predictions is ahead in the North Pit area of Warkworth but is lagging in the South Pit area. In response to this, the South Pit South Accelerated Rehabilitation Plan was prepared, to detail how rehabilitation in this area will progress between 2014 and 2018. This includes alterations to the mine plan to expedite dumping of overburden in the area and avoid disturbance of existing vegetation, in order to deliver rehabilitation earlier. A map showing the comparison of areas rehabilitated versus EIS predictions is included in Appendix 5.

The Abbey Green Projects Alterations Statement of Environmental Effects (SEE, January 2010) is the most recent modification to the development approval. The SEE states that rehabilitation will be undertaken in accordance with the MOP. In 2014 no rehabilitation was undertaken in Mount Thorley which is consistent with the last approved MOP.

5.5 Rehabilitation Relinquishment

Monitoring data from reference sites will be needed to set target levels for the performance criteria detailed in the MTW MOP. Target levels will be determined and detailed in the MOP by the end of 2015. Monitoring results from rehabilitation areas will then be able to be compared against the performance criteria to identify areas that are suitable for relinquishment.

5.6 Spontaneous Combustion

MTW manage and control spontaneous combustion on site in accordance with an internal procedure, which outlines techniques employed to control, monitor and prevent spontaneous combustion. The spontaneous combustion procedure also details the physical characteristics pertaining to spontaneous combustion, methods used in the prevention and outlines research being undertaken to study spontaneous combustion.

The objectives of the spontaneous combustion procedure are to:

- ensure that spontaneous combustion outbreaks are minimised;
- identify potential areas that may be prone to spontaneous combustion before an outbreak occurs;
- ensure that all carbonaceous material is placed in such a manner that reduces the possible occurrence of spontaneous combustion;
- instigate a management plan for areas with longer term spontaneous combustion outbreaks; and
- ensure final rehabilitation is free from spontaneous combustion.

During the reporting period no spontaneous combustion was observed at MTW.

5.7 Weed Management

The objectives of the MTW weed control program which were carried out by Rural & Environmental Management during 2014 are to:

- Maintain compliance with legal obligations;
- Protect and enhance the environmental values of MTW by eradicating or substantially reducing the distribution and density of weed populations, particularly in post-mining rehabilitated areas; and
- Meet community expectations for responsible land stewardship.

5.7.1 Performance

The weeds identified at MTW occur primarily in areas that have been disturbed such as post mining rehabilitation areas, previous civil works areas, soil stockpiles, water management structure surrounds, and general areas of minor ground disturbance. Environmental weeds were also present on spoil dumps. Weeds on soil dumps are not generally targeted for control because they cannot be accessed safely, however, they are monitored to ensure they are not colonised by noxious species and do not become source areas for infestation of adjacent rehabilitation and undisturbed areas. Weed species identified during the weed survey in 2013 area listed in Table 51. These weeds were targeted during the 2014 weed management program.

A total of 72 days of weed management work was undertaken on site at MTW during 2014, with a total of 174.9 ha of land treated including maintenance of access tracks and Environmental Monitoring Points.

Figure 90 illustrates the weed treatment areas across the MTW site in 2014. Weed treatment areas are assessed following the completion of periods of work to determine the effectiveness of control works.

Table 51: Weed Species identified at MTW during the 2013 Annual Survey

Noxious Weeds		Environmental Weeds
Common Name	Class (Upper Hunter)	Common Name
African Boxthorn	Weed of National Significance (WoNS)	African Lovegrass
	4	
Bitou Bush	WoNS	African Olive
	2	
Lantana	WoNS	Castor Oil Plant
	4	
Mother of Millions	3	Galenia
<i>Opuntia</i> Species:	WoNS	Thistle <i>species</i> :
Creeping Pear	4	Scotch Thistle
Prickly Pear		Saffron Thistle
Tiger Pear		Variegated Thistle
Pampas Grass	4	
St Johns Wort	4	

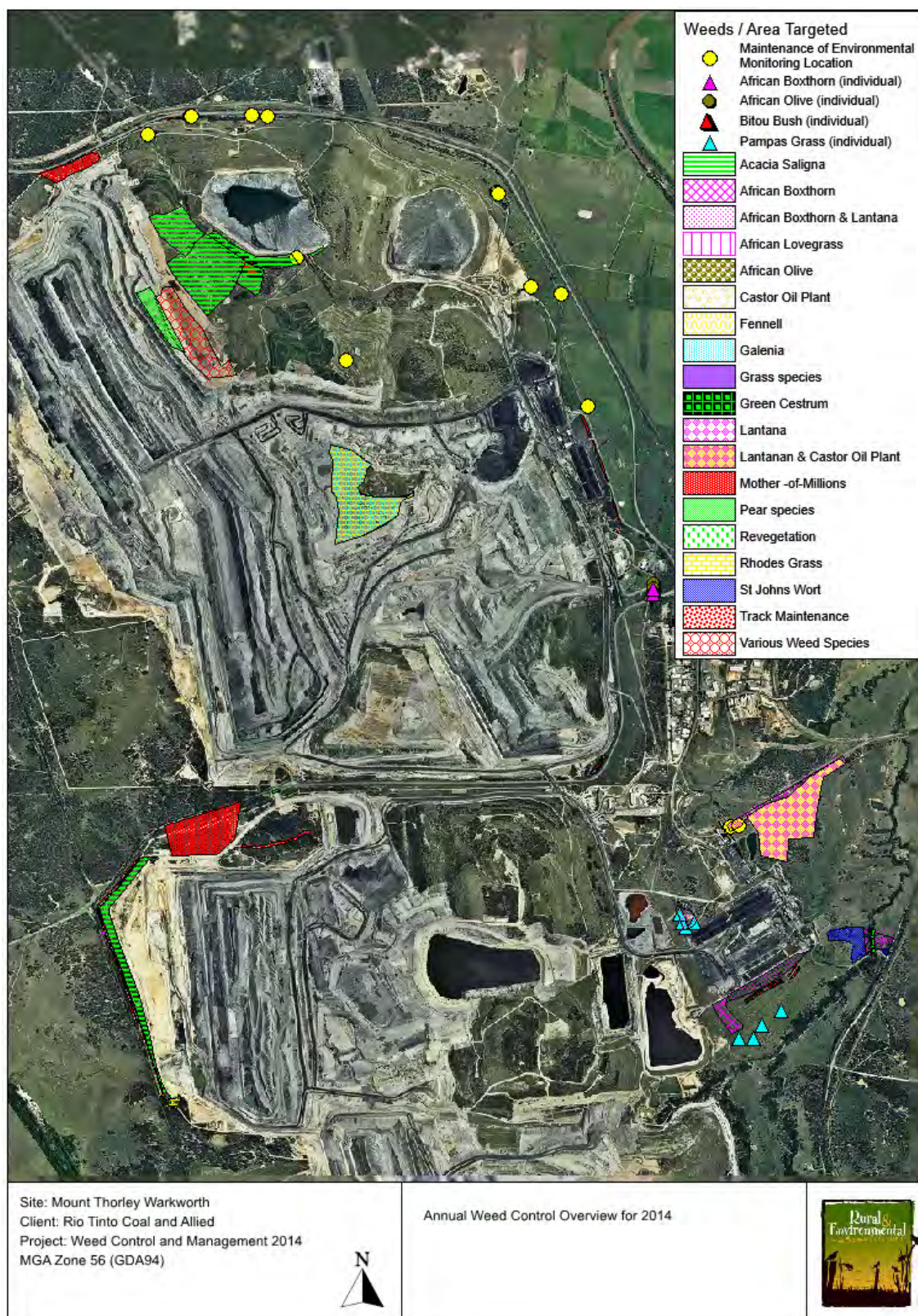


Figure 90: Annual Weed Control Overview for 2014

5.7.2 Annual Weed Survey

An annual site weed survey was undertaken during October 2014. Three weed species classified as Weeds of National Significance (WoNS) were identified during the survey:

- African Boxthorn (*Lycium ferocissimum*)
- Lantana (*Lantana camara*)
- Pear Species
 - Creeping Pear (*Opuntia humifusa*)
 - Prickly Pear *Opuntia stricta*),
 - Tiger Pear (*Optunia aurantiaca*)

Four other noxious weeds were identified at MTW during the survey, including:

- Mother of Millions (*Bryophyllum delagonesse*)
- Noogoora Burr (*Xanthium occidentale*)
- Pampas Grass (*Cortaderia celloana*)
- St Johns Wort (*Hypericum perforatum*),

Five environmental weed species were identified at MTW during the survey, they included:

- African Olive (*Olea europea subspecies cuspidae*)
- Castor Oil Plant (*Ricinus communis*)
- Galenia (*Galenia pubescens*),
- Moth Vine (*Araujia sericifera*)
- Various Thistles
 - Scotch Thistle (*Onopordum acanthium*),
 - Saffron Thistle(*Carthamus lanatus*),
 - Variegated Thistle (*Silybum marianum*) (to a lesser degree)

Nine weeds that are not officially declared or listed were also recorded at MTW including:

- Blackberry Nightshade (*Solanum nigrum*)
- Fennel (*Foeniculum vulgare*)
- Golden wreath wattle or Saligna (*Acacia saligna*) – sparsely scattered over entire site
- Mallow (Small -flowered Mallow) (*Malva parviflora*)
- Mustard Weed (*Sisymbrium sp*)
- Narrow Leaved cotton bush (*Gomphocarpus fruticosus*)- sparsely scattered over entire site
- Rhodes Grass (*Chloris gayana Kunth*)
- Spiny Rush (*Juncas acutus*)
- Stinking Roger (*Tagetes minuta*)

Species identified during the 2014 survey will form the basis of ongoing weed management works during 2015.

5.8 Vertebrate Pest Management

5.8.1 Performance

As part of MTW's Vertebrate Pest Action Plan, a control programme is carried out quarterly and on a seasonal basis. The results from each programme are considered when planning the next baiting programme. The 2014 vertebrate pest control targeted wild dogs and foxes using meat baits injected with sodium monofluoroacetate (commonly known as 1080). Table 52 summarises the vertebrate pest control undertaken at MTW during 2014.

The locations of feral animal control sites are depicted in Figure 91.

Table 52: Vertebrate Pest Control Summary

	Total Lethal Baits Laid	Wild Dog Takes	Fox Takes
Summer	240	12	12
Autumn	240	5	10
Winter	240	11	16
Spring	240	20	35
Total	960	48	73

Winter and Spring baiting in 2014 were extended to a 4 week period in place of the previously conducted 2 week programs in Summer and Autumn to increase exposure times of the programs to the target species. Consistently high fox bait takes during this time supports this 2014 program focus as MTW continues to limit feral pest impacts on its landholdings and surrounding neighbours.



Figure 91: Baiting Station Locations at MTW during the 2014 Control Programs

5.9 Rehabilitation Trials and Research

5.9.1 Compost Application and Incorporation

The benefits of adding compost material to soils have been well researched and are widely accepted including: improved soil structure, increased water holding capacity, addition of slow release nutrients, increased cation exchange capacities and re-introduction of beneficial soil microorganisms, with improved soil productivity and structure leading to better vegetation establishment. MTW commenced trials in 2012 using Mixed Source Compost from SITA composting plants at Kemps Creek and Raymond Terrace. Compost has been spread on all areas sown during 2014 at an average rate of 100 dry tonnes per hectare.

Two agricultural implements have been used to incorporate the compost through the top layer of growth medium. The first of these is a rock windrower (see Figure 92) which is typically used to sweep rocks into a windrow for removal from cropping paddocks. A rock picker is then used to pick up the windrowed rocks. The benefit of using the rock windrower and rock picker is that the soil surface is then free of rocks that would cause difficulties for the direct-drill that is used for sowing. Rock picking and aerating was completed on an as-needs basis during 2014, depending on ground conditions.



Figure 92: Rock windrower incorporating compost in rehabilitation, Cheshunt Pit HVO

The second implement is an aerator (see Figure 93) which is typically used in minimal tillage cropping operations to aerate soil that has been compacted due to equipment or grazing. Because the compost is typically being added to freshly spread topsoil the aerating function is not required but this implement was found to incorporate the compost while minimising the breakdown of soil structure that can be caused by traditional cultivation equipment. Where compost is being added to soil that has already formed a surface crust,

the aerator is also useful for breaking up the surface crust and providing a suitable seed bed for sowing. The aerator is also valuable as it does not pull rocks to the surface, as is typical with tyne-style equipment.



Figure 93: Aerator showing tyne arrangement

The outcome of trialling these two implements is that they were both beneficial for incorporating the compost and are used depending on the situation. The rock windrower and rock picker are used in areas containing surface rock that will cause problems for the direct-drill but it was found that the smooth surface left by the rock windrower was not suited to slopes. On slopes, the aerator is used after the rock windrower to leave a surface pattern that slows surface runoff and improves water harvesting. In areas without surface rock the aerator alone provides suitable incorporation of the compost

5.9.2 Methods for Providing Soil Coverage of Seed during Broadcast Sowing

A direct-drill is used for the majority of sowing on rehabilitation areas due to its ability to correctly position the seed; and provide soil cover and soil/seed contact. The direct-drill is prioritised on sowing the more expensive native seed mixes, which benefit from this seed/soil contact.

Broadcast spreading of cover crop seed onto a freshly-prepared aerated surface has been found to be most effective in establishing initial cover on slopes. Seedlings that establish in the holes left by the aerator can survive dry conditions because of the improved water harvesting ability of the aerator pattern. Harrows are not used to provide soil coverage after sowing because the seed that falls in the aerator holes is sufficiently buried by the movement of the fresh topsoil by rain and wind. Avoiding the use of harrows is important because they have been found to smooth out the aerator pattern and produce a slick surface less able to harvest water and more prone to erosion (see Figure 94 and Figure 95).

A new piece of machinery employed during 2014 was an aerator with a broadcast seeding attachment. This allows seed to be broadcast directly into the aerator pattern with the following benefits:

- One machinery pass; providing improved efficiency due to a larger machine performing two actions, and reducing tyre movement on aerated areas;
- The seed falls into the aerator pattern immediately after it is created. As the seed lands, slight gravitational movement of the soil after the aerator pass means some of the soil will cover over the seed, provided good soil to seed contact;
- Reduced possibility of the aerator pattern being damaged by wind or rain, or crusting up prior to seed being broadcast.



Figure 94: An area which has been harrowed, demonstrating poorer crop establishment and rill erosion



Figure 95: An area which has been aerated (not harrowed), showing healthy cover crop establishment in the aerator pattern

5.9.3 Cover Crop Sowing

For the last few years, Coal & Allied has used more of an agricultural approach to establishing rehabilitation. Along with the various ground preparation and seeding techniques described in this section, Coal & Allied has also been sowing a cover crop in some new areas of rehabilitation, rather than immediately sowing the final seed mix. Common cover crop species include millet, oats and barley. The benefits of sowing a cover crop include:

- Fast-growing cover crops provide soil stability from their root system;
- Weed seed in the topsoil spread on a rehabilitation area can germinate and be treated with herbicide without impacting on sensitive native species;
- Quick-colonising weed species do not out-compete native species which can be slower to establish;
- When the cover crop dies or is slashed, this incorporates extra organic material into the topsoil.

Multiple cover crops may be used in an area until the weed load of the topsoil is manageable, when a native pasture or woodland mix can then be planted.

5.9.4 Cover Crop Rolling

One of the aims of using sacrificial cover crops is to provide additional opportunities for weed control prior to sowing long term seed mixes. An issue that presented in 2013 was the difficulty of targeting small weed plants growing under a knee-high cover crop due to the high levels of herbicide spray interception on the standing cover crop. The solution that was adopted was the use of a flexiroller to flatten the cover crop on the surface and allow the weeds to poke up through the flattened stubble (see Figure 96 and Figure 97). The weeds are then exposed for effective herbicide spraying with a boom spray.

The configuration of the flexiroller lends itself to use in rehabilitation areas for this purpose because it is able to conform to the contours of the surface, whereas a conventional rigid roller will bridge across any low points. The bridging action of a rigid roller will result in over compaction of the high points and ineffective rolling in low areas.

Rolling the crop onto the surface rather than slashing/mulching the stubble was preferred because it leaves a more stable “attached” mulch (i.e. mulch still attached to roots) rather than small pieces of stubble which would be more prone to being washed or blown off the soil surface. Rehabilitation areas with the rolled cover crop on the surface have been found to be very stable and resistant to the effects of both wind and water erosion.



Figure 96: Crop rolling the millet cover crop on to the surface



Figure 97: The flexiroller is made up of individual rings which allow it to conform to the surface contours

5.9.5 Direct-drill Sowing of Native Seed

A direct-drill seeding machine has been sourced from an agricultural contractor for the purpose of seeding rehabilitation areas. The advantages of the direct-drill style machine over conventional broadcast seeding equipment are:

- Better placement of seed to enhance germination with lower seeding rates. The ability to get high germination levels with reduced seeding rates is particularly important for expensive orhard to source native seed;
- Minimal soil disturbance during sowing. Broadcast seeding requires a moderate amount of soil disturbance to prepare a fresh seed bed which can bring a new load of weed seed to the surface for germination. Use of cover crops and direct-drill seeder allows weed seeds to be depleted from the top soil layer and seed to be placed with minimal soil disturbance.
- Maintenance of mulch layer during seeding. Triple-disc configuration on direct-drill seeder allows seed to be planted through surface stubble.
- Soil stability and water holding capacity of the soil is maintained by leaving the mulch layer in place.

The direct-drill seeder in use across HVO and MTW has three seed boxes which allows for different depth of seed burial depending on seed size. Smaller seeds prefer shallower seed burial than large seeds and this can be accommodated by splitting the seed mix by seed size and allocating the various sizes to different seed boxes.

The seed mixes sown in 2014 using the direct-drill were split into three components: non-flowable, large-flowable and small-flowable. The non-flowable component is mainly made up of the native grass component which tends to be quite a bulky amount of seed compared to the other two components. The direct-drill was not able to be calibrated to meter out both the small amount of small-flowable and large-flowable seed with the bulky quantity of non-flowable seed. To make this possible, additional “bulking” material needed to be added to the flowable components. Vermiculite was trialled first as the bulking material but it caused blockages in the metering system. Additional bulking seed, in the form of Barley, Lucerne and Millet, was subsequently trialled which was successful from a seed metering viewpoint but additional seed introduces more potential germinants which compete with the species being sown.

Seed used as bulking material was chosen with the following attributes to counter the problem of introducing additional competition:

- Use of out-of-season species – for example millet sown in autumn/winter should either not germinate or be killed off by frost;
- Use of low viability seed – seed that has been stored incorrectly or actively treated to reduce viability of seed will result in less germinants.

In the trials that have been undertaken there appeared to still be excessive levels of germination of seed used as bulking material. It is unclear at this stage if the additional competition will negatively affect the germination of native species over the medium term

but germination of natives appears to be delayed. Further investigation of bulking materials will be undertaken to further reduce the risk of competition effects.

The native grass seed box on the direct-drill is equipped with agitators to keep the seed mix from bridging and pick-wheels to help pull seed down into metering points. Despite this the initial trials showed the native grass seed was still causing some blockages during seeding. Further processing of the native grass seed mix, by putting it through a garden style mulcher, was needed to reduce blockages. A commercial thresher was used for processing seed in 2014. This machine uses stiff brushes and sieves to process the seed in order to improve the flowability of the seed mix through the direct-drill. The use of the thresher rather than the garden mulcher reduces potential damage to seed caused by spinning mulcher blades.

Trials have been undertaken in 2014 by native grass seed contractors using custom-designed machinery to improve the flowability of the native seed through the direct-drill seeder. These trials have used a combination of threshers, sieves and shaker tables to separate the seed from the awn and floret appendages, and remove stalk (Figure 98). Further refinement of these processes will be undertaken during 2015 to produce native seed mixes that are more suitable for direct-drilling and potentially suitable for broadcast seeding through air seeding equipment.



Figure 98: Native grass seed thresher used to process harvested seed into a form suitable for the direct-drill seeder.

5.9.6 Native Seed Collection

The species composition of the native vegetation seed mixes has been based on the species present in the Endangered Ecological Communities existing in the HVO/MTW area, namely the Central Hunter Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest communities. Diversity targets have been set for the various functional groups to ensure sufficient levels of species diversity are included in the native vegetation seed mixes to cover the progression of rehabilitation through the various phases. The species composition will change as the rehabilitation areas progress from bare areas to mature woodland communities so the seed mixes have been designed to include representatives of species from primary colonisers through to long term shade tolerant species.

In order to consistently achieve the high level of diversity required to construct a native ecosystem, Coal & Allied has engaged the services of native seed specialists. Coal & Allied owned properties have been surveyed to identify suitable areas for the wild collection of native species and to identify gaps in seed supply.

During 2014, seed from native species was collected in the local area from both Coal & Allied owned properties and other properties. Native pastures on Coal & Allied owned properties were managed to improve the yield and quality of native grass seed harvests. The amount of native under-storey seed collected by Coal & Allied during 2014 was approximately 4,500kg with an estimated species diversity of 20 native understorey species. A further quantity of 317kg of tree and shrub seed was collected in the Hunter Valley area for approximately 22 native species. Polytunnels have been built on Coal & Allied owned properties to provide a weather proof area to dry grass and other native seed. The elevated temperature inside the polytunnel causes the vegetation to dry out quicker and release the seed for collection on weed mats.

Figure 99 shows the native grass seed harvesting implement used on Coal & Allied Properties and Figure 100 shows the harvested seed being dried prior to going into storage.



Figure 99: Native grass seed harvesting at a Coal & Allied owned property near Muswellbrook.



Figure 100: Harvested native grass seed material being dried before storage.

5.6.7 Seed Production Area Trial

Following surveys of the local area it has been identified that there are gaps in seed supply for some native species that would be useful to include in rehabilitation seed mixes. Seed for these species would either not be available in sufficient quantities or be very costly to collect from wild collections. In order to provide long term quantities of seed for selected species at reasonable cost a trial seed orchard was set up in 2013 at the Coal & Allied owned Wandewoi property near HVO. The 2ha trial plot was established in 2013 to investigate the viability of seed production areas for native species. Tubestock for planting in the seed orchard have been grown from seed collected locally. Seed collection methods used to provide the germplasm for the seed orchard were aimed at ensuring high levels of genetic diversity. Having genetically diverse parent plants in the seed orchard will provide seed with high levels of genetic diversity for use in rehabilitation activities.

5.10 Green Offsets

5.10.1 Management

The Warkworth Mine's impacts on biodiversity values are offset through the protection and management of Biodiversity Areas (BAs) which are managed in accordance with the Local, Putty Road, and Regional Offset Management Plans (OMPs). The Commonwealth has granted Warkworth Mining limited (WML) two environmental approvals with offset conditions under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC), they are the EPBC2002/629 and EPBC2009/5081 approvals. The NSW government has granted WML with a Development Approval (DA 300-9-2002i) with offset conditions under the NSW *Environmental Planning and Assessment Act* (EP&A Act). In 2014, WML lodged the Warkworth Continuation Project application with NSW to obtain approval to align the disturbance footprint with the EPBC2009/5081 approval.

The Local OMP describes the long term management of the Green Offset, Southern and Northern BAs and satisfies the requirements for the Flora and Fauna Management Plan, as specified in the conditions of the NSW DA 300-9-2002i. The Putty Road Offset Area is located within the Southern BA; this offset is required for the EPBC2009/5081 and Modification 6 to the NSW DA, and a separate Putty Road OMP was approved for this area by the Commonwealth government in July 2014. The management of the Putty Road Offset for NSW DA is contained within the Local OMP. The Southern BA also includes the Warkworth Sands Woodland Offset Area and the Warkworth Sand Woodland re-establishment areas; their management is also described in the Local OMP. The Local OMP was approved by the NSW government in January 2015. In addition the re-establishment of the Warkworth Sands Woodland (WSW) is guided by the Warkworth Sands Woodland Restoration Manual, accepted by the NSW government in January 2014.

The Regional OMP describes the long term management of the Goulburn River and Bowditch BAs to satisfy the requirements of the EPBC2002/629 approval. Within the Goulburn River BA is a 140 hectare offset area for the NSW Hunter Valley Operations

South Project Approval 06-0261. The Regional OMP was approved by the NSW and Commonwealth governments in July 2014.

The OMPs provide s the management framework for the entire BAs and their Offset Areas, as in some cases the entire BA is not an Offset Area, to enhance the biodiversity values through the implementation of conservation management strategies. All OMP includes the following:

- a description of the biodiversity values within the BA;
- conservation objectives and key performance indicators and completion criteria;
- all conservation management strategies;
- monitoring programme; and
- risk assessment and contingency measures.

All of the OMPs are available on the Rio Tinto website.

5.10.2 Research

The University of New England (UNE) whom undertook the *Restoration Research for Warkworth Sands Woodlands* project continued to publish the research papers arising from this research in 2014.

5.10.3 Green Offsets Management Activities

The OMPs describe the Conservation Management Strategies the following are the key actions completed throughout 2014 across all the BAs:

Weed control

- Declared and environment weeds were sprayed by contractors within the Northern and Southern BAs, control targeted significant outbreaks of lantana, mother of millions and prickly pear.

Pest Animal Control

- Contractors completed on ground control including trapping throughout 2014, targeting wild dogs.
- Aerial control of feral pigs and wild dogs was undertaken on the Goulburn River by the Hunter Local Land Service, resulting in 22 feral pigs destroyed on WML property.

Strategic Grazing

- No strategic grazing was undertaken in the BAs in 2014.

Revegetation

- Re-establishment of Warkworth Sand grassland, including the rehabilitation of a disused sand quarry commenced in 2014.

- It involved the collection seed, translocation of live plants ahead of mining, control of weed pre planting, spreading of composted mulch, topsoil and mulch (salvaged from the mined areas), planting of 8,235 tube stock, post plant weed control and watering. Survival assessment indicated a 70% survival rate for tube stock planted in spring 2014.
- Rehabilitation of the quarry involved salvage and translocation 15,000 m3 of sand and 5,000 m3 of topsoil and mulch ahead of mining, a rehabilitation trial was established to provided information of the effectiveness of different site preparation and planting techniques.

Seed collection

- Approximately 1kg of seed from 21 native plant species was collected from the Northern and Southern BAs during 2014, focussing on the WSW and Ironbark vegetation community.

Infrastructure Management and Improvement

- Two sheds were demolished within the Southern BA to enable re-establishment works. Initially three sheds were to be demolished; however one shed was found to contain cultural heritage artefacts and could not be disturbed.
- Fence lines within the Southern BA were removed to facilitate the re-establishment works
- Boundary fences on the Goulburn River BA were repaired and a fence audit completed for both the Goulburn River and Bowditch BAs.

Fire management

- A Regional Offset Bushfire Management Plan outlines the fire management activities regional BAs, this was prepared in consultation with the Rural Fire Service.
- The Warkworth Mine Bushfire Management Plan describes the fire management activities for the Local BAs, actions in 2014 include the slashing of fire breaks.

Monitoring

- 30 permanent ecological monitoring plots across the Southern and Northern BAs were established in late spring/ early summer 2014 to establish a baseline biodiversity condition and enable monitoring of the impact of conservation management strategies over time.
- 17 permanent ecological monitoring plots across the Goulburn River and Bowditch BAs were established in October to establish a baseline biodiversity condition and enable monitoring of the impact of conservation management strategies over time. A detailed floristic assessment was also undertaken to improve vegetation community mapping and classification across the BAs and to enable comparisons between the data collected and the Biometric benchmark values.

- Baseline bird monitoring was undertaken within the Local and Regional BAs by external consultants. 34 monitoring sites were located in woodland and grassland habitat across the BAs, with monitoring commenced in July 2014 for bird assemblages and the nationally threatened Regent Honeyeater and Swift Parrot. One hundred species of birds were recorded during monitoring with the total number of species per BA summarised in Table 53 below:

Table 53: Results of baseline bird monitoring within BAs

BA	Goulbourn River	Bowditch	Northern	Southern
No. of Bird Species	87	59	36	66

- Nine state significant species were detected at various locations in the four BAs – Black-chinned Honeyeater, Little Lorikeet, Varied Sittella, Brown Treecreeper, Grey-crowned Babbler, Little Eagle, Speckled Warbler, Diamond Firetail and Rainbow Bee-eater. Regent Honeyeater and Swift Parrot were not detected during monitoring; however the non-detection of the two species during monitoring does not confirm that the species do not use the sites. All four BAs support potential habitat for the two species which could visit any of the areas to forage when trees are in flower.
- Rapid Condition Assessments of mature and regrowth vegetation are undertaken on an annual basis, according to the methodology described in the OMPs, to provide regular feedback on the effectiveness of management strategies and inform ongoing management decisions such as:
 - weed control - new or significant changes to noxious weed infestations and control activities;
 - pest animal control - damage or presence of feral pest animal and control activities;
 - fire management - fire fuel hazard assessments and control activities; and
 - habitats - presence or absence of key habitat components.

5.10.4 Audits and Reviews

In September 2014, the annual EPBC 2002/629 Compliance Report was prepared and submitted to Department of the Environment, as per the requirements of Condition 4 of EPBC 2002/629.

5.10.5 Ground Disturbance Permits

Ground Disturbance Permits (GDPs) are required when clearing or digging is to occur on the MTW mine site. This permit system is also utilised across the Green Offset areas to prevent unauthorised disturbance. Where vegetation clearance is to occur within an NDA prior written agreement of the Minister is required under Condition 1 of the Warkworth EPBC Approval (2002/629) and is obtained prior to GDP issue. Details of existing and new GDPs relating to the Green Offsets during 2014 are presented in Table 54.

Table 54: GDPs in effect in the Green Offsets during 2014

GDP	Start Date	End Date	Detail	Status of Works
MTW 44	19 Dec 2013	9 Dec 2014	Removal of fences	Completed
MTW 45	3 Feb 2014	20 Jan 2015	Clearing, exploration and mining	Ongoing
MTW 61	13 Mar 2014	28 Jan 2015	Quarry restoration	Completed
MTW 75	2 Apr 2014	25 Mar 2015	Access track upgrades	Completed
MTW 77	19 Mar 2014	27 Feb 2015	Removal of West Pit radio power poles	Completed
MTW 102	11 Aug 2014	28 May 2015	Exploration drilling	Completed
MTW 129	23 May 2014	22 May 2015	Soil classification works	Completed
492A	9 Jan 2013	31 Dec 2014	Manual removal of weed species	Ongoing
542	21 Sep 2010	31 Dec 2015	Maintain existing tracks Fill potholes and grade	Ongoing

6. Planned Activities for 2015

6.1 Mining Operations

Mining activities will continue to advance to the west at Mount Thorley and Warkworth, in line with the current MOP. No additional or replacement heavy equipment is planned for purchase in 2015. Sound attenuation of the existing truck fleet will continue in 2015.

Production Statistics

The planned production and waste schedule for MTW is summarised below:

- 17.3Mt ROM coal
- 11.7 Mt Product coal;
- 130.6 Mbcm overburden; and
- 5.6Mt Tailings and reject

The Planned ROM coal production represents approximately 60% of the approved maximum ROM coal production for MTW.

Coal will continue to be transported via conveyer to the Mount Thorley Coal Loader and railed to the port.

6.2 Exploration

Plans for exploration drilling include open cut pre-production drilling within CCL 753 only. These plans include 595m of core drilling and 2,082.5m of non-core drilling for a total of 2677.50m of drilling. Drilling to support current mining operations in 2015 provides information for structure, coal quality and geotechnical requirements. All holes will be geophysically logged, sealed and rehabilitated at the completion of works.

6.3 Cultural Heritage

Aboriginal Cultural Heritage

Ongoing Aboriginal archaeological and cultural heritage management activities will occur in 2015 at MTW in accordance with the ACHMP, to inform ongoing land management and development planning. Condition monitoring of those sites peripheral to authorised disturbance areas will be conducted at regular intervals to ensure operational compliance with the ACHMPs. The AHIMS sites database audit will continue in 2015.

Historic Heritage

Conservation Management Plans (CMPs) have been, or will be, prepared for a number of historic sites at MTW. Protective maintenance and stabilisation of these sites, in line with the recommendations within the CMPs, will continue to be conducted throughout 2015.

6.4 Noise

Coal and Allied are committed to ongoing improvements within their operating fleet of mining equipment. The modification schedule for the 2015 reporting period is as follows:

- Significant sound attenuation works are planned in the 2015 rebuild schedule. At the end of 2015, 68% of Haul Trucks, 77% of Dozers and 56% of other Heavy Fleet will be fully sound suppressed.
- Implementation of the Environmental Noise Compass into the reactive management system; and
- Commencement of online reporting of noise management activities on a daily basis to increase transparency and re-build community trust

6.5 Blasting

Implementation of a new blast monitoring system will occur during 2015 in association with a change to a local contractor. Opportunities to optimise the blast monitoring network will also be investigated during 2015.

6.6 Air Quality

Improvements in 2015 will continue focus on proactive measures such as activities associated with the EPA's dust pollution reduction programme, and minor improvements to the coal train loading facility in accordance with the EPA audit findings in 2014. Further development and implementation of the Early Warning dust monitoring system will also continue into 2015.

6.7 Water

Improvements to water management in 2015 will continue to focus in water security for MTW. This will include investigation of a potential HVO/MTW water integration project, which will include potential upgrades to pipe and pump infrastructure, as well as installation of further secondary containment and leak detection on existing infrastructure.

6.8 Green Offsets

Biodiversity Area management and monitoring activities proposed for 2015 include:

- Minor updates to the Local and Regional OMPs to reflect the results of baseline monitoring;
- Continue the implementation of the Conservation Management Strategies detailed in Local and Regional OMPs;
- Continue the implementation of the Regional Offsets Bushfire Management Plan and the Coal & Allied Bushfire Management Plan; and
- Implementation of the Local and Regional 2015 Weed and Vertebrate Pest Plans.

6.9 Rehabilitation

Performance Criteria and Rehabilitation Monitoring

The Rehabilitation Monitoring programme will continue in 2015. Previously collected results will be used to determine suitable target levels for the rehabilitation performance criteria.

Tailings Dam 1 Capping

The capping of Tailings Dam 1 will be completed in 2015, and the area rehabilitated as part of the 2015 rehabilitation program.

Rehabilitation Maintenance

In 2015, a new method of herbicide application will be trialled in the form of a weed wiper. The weed wiper has a rotating carpeted roller which is soaked with herbicide. As the weed wiper travels across an area, the stems and leaves of the target plants are wiped with herbicide by the roller. The weed wiper is height adjustable, so can be raised or lowered apply herbicide to only the target species. This method will be used in areas where mature cover crops, exotic grasses or other tall weeds need to be targeted, but native species or desirable cover crop need to be retained.

Rehabilitation drainage

Work will continue in 2015 on establishing a rehabilitation drainage specification, to guide bulk shaping activities and ensure that final landforms are stable and resistant to erosion. This will focus on rock lined drop structures, contours and sediment dams. The drop structure in the South Pit North rehabilitation will be completed in 2015.

Native Seed Processing

Further methods of processing collected native grass seed will be investigated in 2015. This will include refinement of the thresher, sieve and shaker table arrangements to produce a seed mix that is more suitable for the direct-drill seeding equipment. Additional processing of individual species to a more flowable form will also allow seed to be transferred from the seed mixes going through the non-flowable seed box on the direct-drill to the seed mixes being distributed through the flowable seed boxes. Increasing the amount of native seed in the flowable seed mixes will reduce or eliminate the need for bulking seed to be included in the flowable seed mixes. This will lead to a reduced risk of competition effects from the germination of species included as bulking seed.

Processed native seed will also be trialled for sowing through the broadcast seeding equipment. This will be beneficial for seeding native seed on areas where spoil will be used as a replacement growth medium to topsoil. The rougher nature of the prepared spoil surface is more suited to broadcast seeding than drill seeding.

Spoil/Compost Growth Medium

The focus for trials of spoil/compost as a growth medium replacement for topsoil will be on seeding methods that are suitable to be used on a rough spoil surface. The germination results from a spoil/compost trial at Wilton, where the surface was cleared of rock using rock windrowing and rock picking in preparation for using the direct-drill seeder, were not as impressive as previous trials where a rough spoil surface had been maintained. Options that

will be investigated for seeding native seed on spoil/compost areas include broadcast seeding using a further refined seed mix and hydroseeding.

Topsoil Stockpile Weed Management

The observations of galenia infestations from previous rehabilitation indicate that improved control of galenia (and other problematic weeds) on topsoil stockpiles is required. A detailed topsoil stockpile management Programme will be initiated at MTW in 2015 to initially address newly created stockpiles. Work will include herbicide treatment of weed species and sowing the stockpile surface with native grass seed. Establishing a cover of desirable native grass species will reduce the potential for weed seed to germinate thus reducing the overall weed load of the topsoil.

Appendix 1:

Reference to DRE and DPE guidelines

DRE - EDG TABLE OF CONTENTS	Section of Annual Review	DP&I - Unreleased Draft AEMR GUIDELINE - SUGGESTED TOC	Section of Annual Review
Introduction Title block and contents page	1	1 Introduction Title block and contents page	1
		4.2 Quick reference table	1.2
1.1 Consents, lease and licences	1.3	4.3 Consents, lease and licences	1.3
1.2 Mine contacts	1.5	4.4 Mine contacts	1.5
1.3 Actions required at previous AEMR review Table 1. Actions required	1.6	4.5 Actions required at previous AEMR review Table 1. Actions required	1.6
		6.7 Actions required from government agency's review of the last aemr	1.6
2 Operations during the reporting period	2	5.1 Operations summary 2012 reporting period	2
		Production statistics (related to approval limits)	2.1.4
2.1 exploration	2.1.1		
2.2 land preparation	2.1.2	Summary of changes (developments, equipment upgrades)	2.1.5
2.3 construction	n/a		
2.4 mining	2.1.2	Mitigation, salvages, heritage works	2.2
2.5 mineral processing	2.1.3		
2.6 waste management	2.1.3		
2.7 ore and product stockpiles	2.1.3		
2.8 water management	3.6		
2.9 hazardous material management	3.10		
2.10 other infrastructure management	n/a		
Table 2 production and waste summary	2.1.4		
Table 3: stored water (Water Balance)	3.6.2.1		
3.0 Environmental management and performance	3	6.0 Environmental Performance	3
3.1 air quality	3.4	Air quality	3.4
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	3.4.1	6.1 Review of monitoring results	3.4.2
		6.2 Monitoring & performance reports required by other department	3.4.2
		6.5 Outcome of any independent environmental audit	n/a

DRE - EDG TABLE OF CONTENTS	Section of Annual Review	DP&I - Unreleased Draft AEMR GUIDELINE - SUGGESTED TOC	Section of Annual Review
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes	3.4.2		
		6.6 Outcomes of any independent review	N/a
		6.8 Identify any trends in the monitoring data	3.4.2
		6.9 Identify any discrepancies between the predicted and actual impacts	3.4.3.5
3.3 reportable incidents	3.4.4	6.3 Non-compliances	3.4.4
		6.4 Actions to ensure compliance	3.4.1
3.4 further improvements	6.6		
3.2 erosion and sediment		Erosion and sediment	
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	5.1	6.1 Review of monitoring results	n/a
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes	5.1		
		6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	n/a
		6.9 Identify any discrepancies between the predicted and actual impacts	n/a
3.3 reportable incidents	n/a	6.3 Non-compliances	n/a
		6.4 Actions to ensure compliance	n/a
3.4 further improvements	n/a		
3.3 surface water	3.7	Surface water	3.7
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	3.7.1	6.1 Review of monitoring results	3.7.2
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a

DRE - EDG TABLE OF CONTENTS	Section of Annual Review	DP&I - Unreleased Draft AEMR GUIDELINE - SUGGESTED TOC	Section of Annual Review
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes	3.7.2		
		6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	3.7.2
		6.9 Identify any discrepancies between the predicted and actual impacts	3.6.2.4
3.3 reportable incidents	3.7.3	6.3 Non-compliances	3.7.3
		6.4 Actions to ensure compliance	3.6.1
3.4 further improvements	6.7		
3.4 ground water	3.8	Groundwater	3.8
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	3.8.1	6.1 Review of monitoring results	3.8.2
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes	3.8.2		
		6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	3.8.2
		6.9 Identify any discrepancies between the predicted and actual impacts	3.8.4
3.3 reportable incidents	3.8.5	6.3 Non-compliances	3.8.5
		6.4 Actions to ensure compliance	3.8.1
3.4 further improvements	6.7		
3.5 contaminated land	3.9	Contaminated Land	3.9
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	3.9	6.1 Review of monitoring results	n/a
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance	3.9		

DRE - EDG TABLE OF CONTENTS	Section of Annual Review	DP&I - Unreleased Draft AEMR GUIDELINE - SUGGESTED TOC	Section of Annual Review
<ul style="list-style-type: none"> - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes 		6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	n/a
		6.9 Identify any discrepancies between the predicted and actual impacts	n/a
3.3 reportable incidents	3.9	6.3 Non-compliances	3.9
		6.4 Actions to ensure compliance	3.9
3.4 further improvements	n/a		
3.6 threatened flora	5.1	threatened flora	5.1
3.7 threatened fauna	5.1	threatened fauna	5.1
3.8 weeds	5.7	weeds	5.7
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	5.7	6.1 Review of monitoring results	5.7
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes	5.7.1	6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	5.7.1
		6.9 Identify any discrepancies between the predicted and actual impacts	n/a
3.3 reportable incidents	n/a	6.3 Non-compliances	n/a
		6.4 Actions to ensure compliance	n/a
3.4 further improvements	n/a		
3.9 blasting	3.3	Blasting	3.3
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	3.3.1	6.1 Review of monitoring results	3.3.2
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance	3.3.2		

DRE - EDG TABLE OF CONTENTS	Section of Annual Review	DP&I - Unreleased Draft AEMR GUIDELINE - SUGGESTED TOC	Section of Annual Review
<ul style="list-style-type: none"> - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes 		6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	3.3.2
		6.9 Identify any discrepancies between the predicted and actual impacts	n/a
3.3 reportable incidents	3.3.6	6.3 Non-compliances	3.3.6
		6.4 Actions to ensure compliance	3.3.1
3.4 further improvements	6.5		
3.10 operational noise	3.2	Noise	3.2
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	3.2.1	6.1 Review of monitoring results	3.2.2
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes	3.2.2		
		6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	3.2.2
		6.9 Identify any discrepancies between the predicted and actual impacts	3.2.7
3.3 reportable incidents	3.2.4	6.3 Non-compliances	3.2.4
		6.4 Actions to ensure compliance	3.2.1
3.4 further improvements	6.4		
3.11 visual, stray light	3.11		3.11
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	3.11.1	6.1 Review of monitoring results	n/a
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other	3.11.2		
		6.6 Outcomes of any independent review	n/a

DRE - EDG TABLE OF CONTENTS	Section of Annual Review	DP&I - Unreleased Draft AEMR GUIDELINE - SUGGESTED TOC	Section of Annual Review
department. -review performance outcomes		6.8 Identify any trends in the monitoring data	n/a
		6.9 Identify any discrepancies between the predicted and actual impacts	n/a
3.3 reportable incidents	3.11	6.3 Non-compliances	3.11
		6.4 Actions to ensure compliance	3.11
3.4 further improvements	n/a		
3.12 aboriginal heritage	2.2.1		2.2.1
3.1 environmental management - whether proposed control strategies were adequate - variation from proposed control strategies	2.2.1	6.1 Review of monitoring results	n/a
		6.2 Monitoring & performance reports required by other department	n/a
		6.5 Outcome of any independent environmental audit	n/a
3.2 environmental performance - summarised monitoring data - list monitoring, performance reports required by other department. -review performance outcomes	2.2.1.1		
		6.6 Outcomes of any independent review	n/a
		6.8 Identify any trends in the monitoring data	n/a
		6.9 Identify any discrepancies between the predicted and actual impacts	n/a
3.3 reportable incidents	2.2.1.2	6.3 Non-compliances	2.2.1.2
		6.4 Actions to ensure compliance	2.2.1
3.4 further improvements	6.3		
3.13 natural heritage	2.2.2		
3.14 spontaneous combustion	5.6		n/a
3.15 bushfire	3.12		n/a
3.16 mine subsidence	n/a		
3.17 hydrocarbon contamination	3.9		3.9
3.18 methane drainage/ventilation	n/a		n/a
3.19 public safety	n/a		n/a
4.1 environmental complaints	4.1	6.10 environmental complaints	4.1
4.2 community liaison	4.2	6.11 review of community engagement	4.2
5 REHABILITATION (this aemr	5	7.0 REHABILITATION	5

DRE - EDG TABLE OF CONTENTS	Section of Annual Review	DP&I - Unreleased Draft AEMR GUIDELINE - SUGGESTED TOC	Section of Annual Review
period)			
5.1 buildings	n/a		
5.2 rehabilitation of disturbed land	5.1	7.1 summary of rehabilitation undertaken on site	5.1
		7.3 rehabilitation progression - in accordance with mop commitments	5.3
5.3 other infrastructure	n/a	7.2 decommissioning	5.2
5.4 rehabilitation trials and research	5.9	7.5 rehabilitation trials and research	5.9
		7.4 rehabilitation relinquishment	5.5
		7.6 temporary stabilisation of disturbed mining area (aerial seeding)	3.4.2.4
		7.8 offset area management	5.10
5.5 Further development of the final rehabilitation plan	n/a		
		5.2 Operations summary - 2014 reporting period	2.1
6 Activities proposed in the next AEMR period	6	7(8) Proposed activities (next aemr)	6
Table 4 rehabilitation summary	5.3	Appendix 5 rehabilitation tables	Appendix 4

Appendix 2:

Summary of Complaints 2014

Mount Thorley Warkworth Complaints 2014

Type	Month	Date	Time	Method	Location
Noise	January	1/01/2014	21:37:00	Complaints Hotline	Bulga
Noise	January	2/01/2014	22:34:00	Complaints Hotline	Long Point
Noise	January	4/01/2014	5:59:00	Complaints Hotline	Bulga
Noise	January	5/01/2014	21:20:00	Complaints Hotline	Bulga
Noise	January	6/01/2014	9:08:00	Complaints Hotline	Long Point
Noise	January	6/01/2014	23:21:00	Complaints Hotline	Bulga
Noise	January	7/01/2014	2:01:00	Complaints Hotline	Bulga
Noise	January	8/01/2014	23:26:00	Complaints Hotline	Bulga
Noise	January	9/01/2014	0:17:00	Complaints Hotline	Bulga
Noise	January	10/01/2014	21:43:00	Complaints Hotline	Bulga
Noise	January	12/01/2014	5:56:00	Complaints Hotline	Bulga
Noise	January	13/01/2014	23:14:00	Complaints Hotline	Bulga
Noise	January	14/01/2014	5:50:00	Complaints Hotline	Bulga
Noise	January	14/01/2014	22:04:00	Complaints Hotline	Bulga
Noise	January	14/01/2014	22:43:00	Complaints Hotline	Bulga
Noise	January	15/01/2014	20:38:00	Complaints Hotline	Bulga
Noise	January	17/01/2014	21:26:00	Complaints Hotline	Bulga
Noise	January	17/01/2014	22:51:00	Complaints Hotline	Bulga
Noise	January	17/01/2014	23:19:00	Complaints Hotline	Bulga
Noise	January	18/01/2014	9:27:00	Complaints Hotline	Long Point
Dust	January	19/01/2014	16:35:00	Complaints Hotline	Bulga
Noise	January	21/01/2014	23:00:00	Complaints Hotline	Bulga
Noise	January	22/01/2014	22:24:00	Complaints Hotline	Bulga
Noise	January	22/01/2014	23:27:00	Complaints Hotline	Bulga
Noise	January	23/01/2014	21:32:00	Complaints Hotline	Bulga
Noise	January	23/01/2014	23:13:00	Complaints Hotline	Bulga
Noise	January	24/01/2014	7:10:00	Complaints Hotline	Long Point
Noise	January	27/01/2014	0:10:00	Complaints Hotline	Bulga
Noise	January	27/01/2014	7:33:00	Complaints Hotline	Bulga
Noise	January	27/01/2014	21:48:00	Complaints Hotline	Bulga
Noise	January	27/01/2014	23:07:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	January	28/01/2014	21:39:00	Complaints Hotline	Bulga
Noise	January	28/01/2014	22:30:00	Complaints Hotline	Bulga
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Blast	January	29/01/2014	11:31:00	Complaints Hotline	Bulga
Blast	January	29/01/2014	13:07:00	Complaints Hotline	Bulga
Noise	January	29/01/2014	23:06:00	Complaints Hotline	Bulga
Blast	January	30/01/2014	9:06:00	Complaints Hotline	Unknown
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Noise	January	31/01/2014	5:19:00	Complaints Hotline	Long Point
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Noise	January	31/01/2014	23:20:00	Complaints Hotline	Bulga
Noise	February	2/02/2014	22:58:00	Complaints Hotline	Bulga
Noise	February	2/02/2014	23:17:00	Complaints Hotline	Bulga
Noise	February	3/02/2014	2:26:00	Complaints Hotline	Bulga
Noise	February	3/02/2014	21:01:00	Telephone	Bulga
Noise	February	3/02/2014	21:22:00	Complaints Hotline	Bulga
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Noise	February	5/02/2014	23:44:00	Complaints Hotline	Bulga
Noise	February	6/02/2014	21:32:00	Complaints Hotline	Bulga
Noise	February	6/02/2014	22:26:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
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Noise	February	7/02/2014	21:58:00	Complaints Hotline	Bulga
Noise	February	7/02/2014	22:09:00	Complaints Hotline	Bulga
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Noise	February	9/02/2014	20:27:00	Complaints Hotline	Bulga
Noise	February	9/02/2014	21:40:00	Complaints Hotline	Bulga
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Type	Month	Date	Time	Method	Location
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Noise	March	3/03/2014	21:49:00	Complaints Hotline	Bulga
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Noise	March	3/03/2014	22:08:00	Complaints Hotline	Bulga
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Type	Month	Date	Time	Method	Location
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Noise	March	4/03/2014	21:27:00	Complaints Hotline	Bulga
Noise	March	4/03/2014	21:31:00	Complaints Hotline	Bulga
Noise	March	4/03/2014	21:43:00	Complaints Hotline	Bulga
Noise	March	4/03/2014	22:04:00	Complaints Hotline	Bulga
Noise	March	4/03/2014	22:55:00	Complaints Hotline	Bulga
Noise	March	6/03/2014	22:15:00	Complaints Hotline	Bulga
Noise	March	6/03/2014	23:11:00	Complaints Hotline	Bulga
Other	March	7/03/2014	14:05:00	Telephone	Bulga
Noise	March	7/03/2014	21:52:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	0:29:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	2:26:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	8:43:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	20:10:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	20:31:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	20:36:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	20:44:00	Complaints Hotline	Bulga
Noise	March	8/03/2014	23:31:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	8:49:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	9:02:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	20:50:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	20:56:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	21:32:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	21:56:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	22:45:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	22:47:00	Complaints Hotline	Bulga
Noise	March	9/03/2014	23:54:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	5:39:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	20:47:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	20:56:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	20:57:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	20:58:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	March	10/03/2014	21:01:00	Complaints Hotline	Bulga
Light	March	10/03/2014	21:25:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	21:43:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	21:47:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	21:51:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	22:22:00	Complaints Hotline	Bulga
Noise	March	10/03/2014	23:02:00	Complaints Hotline	Bulga
Light	March	11/03/2014	3:24:00	Complaints Hotline	Bulga
Noise	March	11/03/2014	4:58:00	Complaints Hotline	Bulga
Noise	March	11/03/2014	21:07:00	Complaints Hotline	Bulga
Noise	March	11/03/2014	22:12:00	Complaints Hotline	Bulga
Noise	March	11/03/2014	22:43:00	Complaints Hotline	Bulga
Noise	March	11/03/2014	23:06:00	Complaints Hotline	Bulga
Light	March	12/03/2014	22:07:00	Complaints Hotline	Bulga
Noise	March	13/03/2014	7:53:00	Complaints Hotline	Bulga
Noise	March	13/03/2014	21:06:00	Complaints Hotline	Bulga
Noise	March	14/03/2014	1:09:00	Complaints Hotline	Bulga
Noise	March	14/03/2014	3:27:00	Complaints Hotline	Bulga
Noise	March	15/03/2014	22:06:00	Complaints Hotline	Bulga
Noise	March	15/03/2014	22:32:00	Complaints Hotline	Bulga
Noise	March	17/03/2014	22:56:00	Complaints Hotline	Bulga
Noise	March	20/03/2014	19:37:00	Complaints Hotline	Bulga
Noise	March	20/03/2014	19:38:00	Complaints Hotline	Bulga
Noise	March	20/03/2014	19:53:00	Complaints Hotline	Bulga
Noise	March	20/03/2014	21:36:00	Complaints Hotline	Bulga
Noise	March	20/03/2014	23:48:00	Complaints Hotline	Bulga
Noise	March	21/03/2014	1:02:00	Complaints Hotline	Bulga
Noise	March	21/03/2014	5:23:00	Complaints Hotline	Bulga
Noise	March	21/03/2014	21:16:00	Complaints Hotline	Bulga
Noise	March	22/03/2014	20:58:00	Complaints Hotline	Bulga
Noise	March	23/03/2014	21:39:00	Complaints Hotline	Bulga
Noise	March	23/03/2014	22:06:00	Complaints Hotline	Bulga
Noise	March	23/03/2014	22:16:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	March	23/03/2014	23:00:00	Complaints Hotline	Bulga
Noise	March	24/03/2014	0:58:00	Complaints Hotline	Bulga
Noise	March	24/03/2014	20:03:00	Complaints Hotline	Long Point
Noise	March	26/03/2014	3:56:00	Complaints Hotline	Bulga
Other	March	27/03/2014	16:51:00	Complaints Hotline	Putty Road
Noise	March	27/03/2014	18:34:00	Complaints Hotline	Bulga
Noise	March	27/03/2014	21:36:00	Complaints Hotline	Bulga
Noise	March	27/03/2014	21:59:00	Complaints Hotline	Bulga
Noise	March	27/03/2014	22:04:00	Complaints Hotline	Bulga
Noise	March	27/03/2014	22:05:00	Complaints Hotline	Bulga
Noise	March	27/03/2014	22:54:00	Complaints Hotline	Bulga
Noise	March	27/03/2014	23:44:00	Complaints Hotline	Bulga
Noise	March	28/03/2014	1:19:00	Complaints Hotline	Bulga
Noise	March	29/03/2014	1:22:00	Complaints Hotline	Long Point
Noise	March	29/03/2014	21:13:00	Complaints Hotline	Bulga
Noise	March	29/03/2014	21:56:00	Complaints Hotline	Bulga
Noise	March	29/03/2014	22:12:00	Complaints Hotline	Bulga
Noise	March	29/03/2014	23:49:00	Complaints Hotline	Bulga
Noise	March	30/03/2014	20:34:00	Complaints Hotline	Bulga
Noise	March	30/03/2014	21:08:00	Complaints Hotline	Bulga
Noise	March	30/03/2014	21:26:00	Complaints Hotline	Bulga
Noise	March	30/03/2014	21:40:00	Complaints Hotline	Bulga
Noise	March	30/03/2014	22:11:00	Complaints Hotline	Bulga
Noise	March	31/03/2014	8:23:00	Complaints Hotline	Bulga
Noise	March	31/03/2014	20:31:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	2:32:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	20:01:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	20:44:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	20:54:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	21:08:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	21:34:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	21:37:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	21:42:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	April	1/04/2014	22:46:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	22:47:00	Complaints Hotline	Bulga
Noise	April	1/04/2014	22:53:00	Complaints Hotline	Bulga
Noise	April	2/04/2014	13:14:00	Complaints Hotline	Long Point
Blast	April	2/04/2014	14:22:00	Complaints Hotline	Bulga
Noise	April	2/04/2014	20:33:00	Complaints Hotline	Bulga
Noise	April	2/04/2014	21:07:00	Complaints Hotline	Bulga
Noise	April	2/04/2014	22:00:00	Complaints Hotline	Bulga
Noise	April	2/04/2014	23:23:00	Complaints Hotline	Bulga
Blast	April	3/04/2014	15:14:00	Complaints Hotline	Bulga
Noise	April	3/04/2014	20:28:00	Complaints Hotline	Bulga
Noise	April	3/04/2014	20:36:00	Complaints Hotline	Bulga
Noise	April	3/04/2014	21:12:00	Complaints Hotline	Bulga
Noise	April	3/04/2014	21:13:00	Complaints Hotline	Bulga
Noise	April	3/04/2014	21:37:00	Complaints Hotline	Bulga
Noise	April	3/04/2014	22:19:00	Complaints Hotline	Bulga
Noise	April	3/04/2014	22:29:00	Complaints Hotline	Bulga
Blast	April	4/04/2014	14:32:00	Complaints Hotline	Bulga
Noise	April	5/04/2014	22:07:00	Complaints Hotline	Long Point
Noise	April	6/04/2014	16:02:00	Complaints Hotline	Bulga
Noise	April	7/04/2014	14:03:00	Complaints Hotline	Bulga
Noise	April	7/04/2014	20:57:00	Complaints Hotline	Bulga
Noise	April	7/04/2014	21:40:00	Complaints Hotline	Bulga
Noise	April	7/04/2014	21:42:00	Complaints Hotline	Bulga
Noise	April	7/04/2014	22:50:00	Complaints Hotline	Bulga
Noise	April	7/04/2014	23:33:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	4:52:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	6:01:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	6:09:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	18:09:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	20:07:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	20:25:00	In Person	Bulga
Noise	April	8/04/2014	20:31:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	April	8/04/2014	20:39:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	20:44:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	22:44:00	Complaints Hotline	Bulga
Noise	April	8/04/2014	23:03:00	Complaints Hotline	Bulga
Noise	April	9/04/2014	19:39:00	Complaints Hotline	Bulga
Noise	April	9/04/2014	19:42:00	Complaints Hotline	Bulga
Noise	April	9/04/2014	20:08:00	Complaints Hotline	Bulga
Noise	April	9/04/2014	23:19:00	Complaints Hotline	Bulga
Noise	April	10/04/2014	19:54:00	Complaints Hotline	Bulga
Noise	April	10/04/2014	21:07:00	Complaints Hotline	Bulga
Noise	April	10/04/2014	21:29:00	Complaints Hotline	Bulga
Noise	April	10/04/2014	21:39:00	Complaints Hotline	Bulga
Light	April	11/04/2014	22:40:00	Complaints Hotline	Bulga
Noise	April	12/04/2014	21:55:00	Complaints Hotline	Long Point
Noise	April	14/04/2014	19:32:00	Complaints Hotline	Long Point
Noise	April	15/04/2014	23:01:00	Complaints Hotline	Bulga
Other	April	17/04/2014	10:52:00	Complaints Hotline	Unknown
Noise	April	17/04/2014	21:10:00	Complaints Hotline	Long Point
Noise	April	18/04/2014	8:32:00	Complaints Hotline	Unknown
Noise	April	19/04/2014	21:49:00	Complaints Hotline	Bulga
Noise	April	19/04/2014	22:06:00	Complaints Hotline	Bulga
Noise	April	21/04/2014	3:46:00	Complaints Hotline	Bulga
Noise	April	21/04/2014	21:59:00	Complaints Hotline	Bulga
Noise	April	21/04/2014	22:45:00	Complaints Hotline	Bulga
Noise	April	22/04/2014	22:20:00	Complaints Hotline	Bulga
Light	April	23/04/2014	18:44:00	Complaints Hotline	Bulga
Noise	April	23/04/2014	19:37:00	Complaints Hotline	Bulga
Light	April	23/04/2014	22:40:00	Complaints Hotline	Bulga
Other	April	24/04/2014	14:37:00	Complaints Hotline	Bulga
Noise	April	25/04/2014	16:22:00	Complaints Hotline	Bulga
Noise	April	25/04/2014	18:07:00	Complaints Hotline	Bulga
Noise	April	25/04/2014	19:47:00	Complaints Hotline	Bulga
Noise	April	25/04/2014	19:57:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	April	25/04/2014	22:10:00	Complaints Hotline	Bulga
Noise	April	25/04/2014	22:52:00	Complaints Hotline	Bulga
Noise	April	26/04/2014	3:25:00	Complaints Hotline	Bulga
Noise	April	26/04/2014	3:38:00	Complaints Hotline	Bulga
Noise	April	26/04/2014	3:40:00	Complaints Hotline	Bulga
Noise	April	26/04/2014	21:25:00	Complaints Hotline	Bulga
Noise	April	28/04/2014	18:34:00	Complaints Hotline	Bulga
Noise	April	28/04/2014	21:33:00	Complaints Hotline	Bulga
Noise	April	28/04/2014	22:26:00	Complaints Hotline	Bulga
Noise	April	29/04/2014	0:46:00	Complaints Hotline	Bulga
Noise	April	29/04/2014	8:41:00	Complaints Hotline	Bulga
Noise	April	29/04/2014	20:28:00	Complaints Hotline	Bulga
Other	April	30/04/2014	15:21:00	Complaints Hotline	Bulga
Noise	May	2/05/2014	23:02:00	Complaints Hotline	Bulga
Blast	May	5/05/2014	13:42:00	Telephone	Bulga
Noise	May	6/05/2014	20:59:00	Complaints Hotline	Bulga
Noise	May	6/05/2014	21:03:00	Complaints Hotline	Bulga
Blast	May	9/05/2014	13:51:00	Complaints Hotline	Bulga
Blast	May	9/05/2014	13:54:00	Complaints Hotline	Bulga
Blast	May	9/05/2014	13:55:00	Telephone	Bulga
Blast	May	9/05/2014	14:42:00	Complaints Hotline	Bulga
Noise	May	9/05/2014	20:45:00	Complaints Hotline	Bulga
Noise	May	9/05/2014	21:46:00	Complaints Hotline	Bulga
Noise	May	9/05/2014	22:59:00	Complaints Hotline	Bulga
Noise	May	10/05/2014	21:11:00	Complaints Hotline	Bulga
Noise	May	12/05/2014	21:18:00	Complaints Hotline	Bulga
Noise	May	13/05/2014	18:30:00	Complaints Hotline	Bulga
Noise	May	13/05/2014	20:17:00	Complaints Hotline	Bulga
Noise	May	13/05/2014	21:01:00	Complaints Hotline	Bulga
Noise	May	13/05/2014	21:28:00	Complaints Hotline	Bulga
Noise	May	13/05/2014	21:35:00	Complaints Hotline	Bulga
Noise	May	13/05/2014	22:08:00	Complaints Hotline	Bulga
Noise	May	13/05/2014	23:59:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Light	May	15/05/2014	18:08:00	Complaints Hotline	Bulga
Noise	May	15/05/2014	20:43:00	Complaints Hotline	Bulga
Noise	May	15/05/2014	21:51:00	Complaints Hotline	Bulga
Noise	May	15/05/2014	21:56:00	Complaints Hotline	Bulga
Noise	May	15/05/2014	22:09:00	Complaints Hotline	Bulga
Noise	May	15/05/2014	22:36:00	Complaints Hotline	Bulga
Noise	May	16/05/2014	22:43:00	Complaints Hotline	Bulga
Noise	May	17/05/2014	22:51:00	Complaints Hotline	Bulga
Noise	May	18/05/2014	20:43:00	Complaints Hotline	Bulga
Noise	May	20/05/2014	21:01:00	Complaints Hotline	Long Point
Noise	May	20/05/2014	23:41:00	Complaints Hotline	Long Point
Blast	May	21/05/2014	12:35:00	Complaints Hotline	Bulga
Noise	May	21/05/2014	20:45:00	Complaints Hotline	Long Point
Noise	May	21/05/2014	20:53:00	Complaints Hotline	Bulga
Noise	May	21/05/2014	22:45:00	Complaints Hotline	Bulga
Noise	May	21/05/2014	22:55:00	Complaints Hotline	Bulga
Noise	May	22/05/2014	22:15:00	Complaints Hotline	Bulga
Noise	May	23/05/2014	1:26:00	Complaints Hotline	Bulga
Noise	May	23/05/2014	4:16:00	Complaints Hotline	Long Point
Noise	May	23/05/2014	7:35:00	Complaints Hotline	Bulga
Noise	May	23/05/2014	21:03:00	Complaints Hotline	Long Point
Noise	May	24/05/2014	2:20:00	Complaints Hotline	Long Point
Noise	May	24/05/2014	4:11:00	Complaints Hotline	Bulga
Noise	May	24/05/2014	8:30:00	Complaints Hotline	Long Point
Light	May	25/05/2014	21:13:00	Complaints Hotline	Bulga
Noise	May	25/05/2014	22:19:00	Complaints Hotline	Long Point
Noise	May	26/05/2014	2:36:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	17:58:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	19:00:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	19:37:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	19:53:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	19:57:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	20:18:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	May	26/05/2014	20:27:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	20:33:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	21:38:00	Complaints Hotline	Bulga
Noise	May	26/05/2014	22:13:00	Complaints Hotline	Bulga
Blast	May	30/05/2014	12:59:00	Complaints Hotline	Mount Thorley
Blast	May	30/05/2014	13:04:00	Complaints Hotline	Mount Thorley
Noise	May	30/05/2014	16:40:00	Complaints Hotline	Bulga
Noise	May	30/05/2014	18:10:00	Complaints Hotline	Bulga
Noise	May	30/05/2014	20:15:00	Complaints Hotline	Bulga
Noise	May	30/05/2014	20:20:00	Complaints Hotline	Bulga
Noise	May	30/05/2014	20:55:00	Complaints Hotline	Bulga
Noise	May	30/05/2014	21:44:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	4:48:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	7:32:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	7:40:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	9:24:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	10:06:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	18:15:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	20:49:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	20:58:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	23:03:00	Complaints Hotline	Bulga
Noise	May	31/05/2014	23:11:00	Complaints Hotline	Bulga
Noise	June	1/06/2014	5:46:00	Complaints Hotline	Bulga
Noise	June	1/06/2014	8:13:00	Complaints Hotline	Bulga
Noise	June	2/06/2014	21:50:00	Complaints Hotline	Bulga
Noise	June	2/06/2014	22:07:00	Complaints Hotline	Bulga
Noise	June	2/06/2014	23:02:00	Complaints Hotline	Long Point
Noise	June	3/06/2014	21:58:00	Complaints Hotline	Unknown
Noise	June	4/06/2014	20:32:00	Complaints Hotline	Bulga
Noise	June	4/06/2014	20:59:00	Complaints Hotline	Bulga
Dust	June	8/06/2014	15:37:00	Complaints Hotline	Bulga
Noise	June	8/06/2014	21:08:00	Complaints Hotline	Bulga
Noise	June	9/06/2014	0:08:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	June	10/06/2014	19:39:00	Complaints Hotline	Bulga
Noise	June	10/06/2014	22:13:00	Complaints Hotline	Bulga
Noise	June	10/06/2014	22:25:00	Complaints Hotline	Bulga
Noise	June	10/06/2014	22:30:00	Complaints Hotline	Bulga
Noise	June	11/06/2014	0:38:00	Complaints Hotline	Bulga
Noise	June	11/06/2014	21:20:00	Complaints Hotline	Bulga
Noise	June	11/06/2014	21:57:00	Complaints Hotline	Bulga
Noise	June	11/06/2014	22:28:00	Complaints Hotline	Bulga
Noise	June	11/06/2014	23:57:00	Complaints Hotline	Bulga
Noise	June	12/06/2014	20:20:00	Complaints Hotline	Bulga
Noise	June	12/06/2014	20:44:00	Complaints Hotline	Bulga
Noise	June	12/06/2014	20:58:00	Complaints Hotline	Bulga
Noise	June	12/06/2014	21:46:00	Complaints Hotline	Bulga
Noise	June	12/06/2014	21:47:00	Complaints Hotline	Bulga
Noise	June	12/06/2014	23:03:00	Complaints Hotline	Bulga
Noise	June	13/06/2014	7:51:00	Complaints Hotline	Bulga
Dust	June	13/06/2014	10:21:00	Complaints Hotline	Bulga
Blast	June	13/06/2014	14:23:00	Email	Unknown
Dust	June	13/06/2014	16:25:00	Complaints Hotline	Bulga
Noise	June	13/06/2014	23:02:00	Complaints Hotline	Bulga
Noise	June	14/06/2014	22:57:00	Complaints Hotline	Long Point
Noise	June	15/06/2014	0:41:00	Complaints Hotline	Long Point
Noise	June	15/06/2014	2:34:00	Complaints Hotline	Long Point
Dust	June	15/06/2014	9:06:00	Complaints Hotline	Bulga
Noise	June	15/06/2014	23:23:00	Complaints Hotline	Unknown
Noise	June	17/06/2014	0:07:00	Complaints Hotline	Long Point
Blast	June	17/06/2014	13:59:00	Complaints Hotline	Bulga
Noise	June	18/06/2014	3:24:00	Complaints Hotline	Long Point
Blast	June	18/06/2014	12:45:00	Complaints Hotline	Bulga
Noise	June	19/06/2014	0:45:00	Complaints Hotline	Bulga
Noise	June	19/06/2014	10:34:00	Complaints Hotline	Bulga
Noise	June	19/06/2014	21:28:00	Complaints Hotline	Bulga
Noise	June	19/06/2014	23:13:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Blast	June	20/06/2014	14:00:00	Complaints Hotline	Bulga
Noise	June	21/06/2014	20:15:00	Complaints Hotline	Bulga
Noise	June	21/06/2014	20:38:00	Complaints Hotline	Bulga
Noise	June	21/06/2014	22:21:00	Complaints Hotline	Bulga
Noise	June	22/06/2014	18:36:00	Complaints Hotline	Bulga
Noise	June	22/06/2014	18:56:00	Complaints Hotline	Bulga
Noise	June	22/06/2014	21:24:00	Complaints Hotline	Bulga
Noise	June	22/06/2014	22:44:00	Complaints Hotline	Bulga
Blast	June	27/06/2014	12:47:00	Complaints Hotline	Bulga
Blast	June	27/06/2014	12:50:00	Telephone	Bulga
Noise	June	27/06/2014	21:43:00	Complaints Hotline	Bulga
Noise	June	29/06/2014	23:46:00	Complaints Hotline	Unknown
Noise	June	30/06/2014	21:19:00	Complaints Hotline	Long Point
Noise	June	30/06/2014	21:49:00	Complaints Hotline	Long Point
Noise	July	1/07/2014	23:05:00	Complaints Hotline	Unknown
Noise	July	2/07/2014	0:39:00	Complaints Hotline	Unknown
Noise	July	3/07/2014	0:03:00	Complaints Hotline	Bulga
Noise	July	3/07/2014	5:29:00	Complaints Hotline	Bulga
Light	July	6/07/2014	20:34:00	Complaints Hotline	Bulga
Dust	July	7/07/2014	21:27:00	Complaints Hotline	Bulga
Noise	July	8/07/2014	21:31:00	Complaints Hotline	Bulga
Noise	July	8/07/2014	23:05:00	Complaints Hotline	Bulga
Dust	July	9/07/2014	12:18:00	Complaints Hotline	Bulga
Dust	July	9/07/2014	12:47:00	Complaints Hotline	Long Point
Dust	July	9/07/2014	19:39:00	Complaints Hotline	Long Point
Blast	July	11/07/2014	12:37:00	Complaints Hotline	Bulga
Noise	July	14/07/2014	4:59:00	Complaints Hotline	Bulga
Dust	July	14/07/2014	9:26:00	Complaints Hotline	Bulga
Noise	July	14/07/2014	19:55:00	Complaints Hotline	Bulga
Noise	July	14/07/2014	22:11:00	Complaints Hotline	Bulga
Noise	July	14/07/2014	23:07:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	8:19:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	10:27:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	July	15/07/2014	19:44:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	20:05:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	20:41:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	20:54:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	21:53:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	22:15:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	22:38:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	23:04:00	Complaints Hotline	Bulga
Noise	July	15/07/2014	23:26:00	Complaints Hotline	Bulga
Noise	July	16/07/2014	3:59:00	Complaints Hotline	Bulga
Noise	July	16/07/2014	22:38:00	Complaints Hotline	Unknown
Other	July	17/07/2014	11:22:00	Complaints Hotline	Putty Road
Noise	July	18/07/2014	5:40:00	Complaints Hotline	Bulga
Blast	July	18/07/2014	11:40:00	Telephone	Bulga
Light	July	18/07/2014	20:20:00	Complaints Hotline	Bulga
Noise	July	18/07/2014	21:46:00	Complaints Hotline	Bulga
Noise	July	21/07/2014	2:36:00	Complaints Hotline	Bulga
Noise	July	21/07/2014	21:21:00	Complaints Hotline	Bulga
Noise	July	21/07/2014	21:53:00	Complaints Hotline	Bulga
Noise	July	21/07/2014	22:40:00	Complaints Hotline	Bulga
Noise	July	21/07/2014	23:07:00	Complaints Hotline	Bulga
Noise	July	22/07/2014	17:35:00	Complaints Hotline	Bulga
Noise	July	22/07/2014	18:12:00	Complaints Hotline	Bulga
Noise	July	22/07/2014	19:21:00	Complaints Hotline	Bulga
Noise	July	22/07/2014	21:13:00	Complaints Hotline	Bulga
Noise	July	22/07/2014	21:23:00	Complaints Hotline	Bulga
Noise	July	22/07/2014	22:36:00	Complaints Hotline	Bulga
Noise	July	22/07/2014	22:42:00	Complaints Hotline	Bulga
Noise	July	23/07/2014	8:34:00	Complaints Hotline	Bulga
Noise	July	23/07/2014	20:32:00	Complaints Hotline	Bulga
Noise	July	23/07/2014	20:33:00	Complaints Hotline	Bulga
Noise	July	23/07/2014	21:11:00	Complaints Hotline	Bulga
Noise	July	23/07/2014	22:08:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	July	24/07/2014	11:39:00	Complaints Hotline	Bulga
Noise	July	24/07/2014	18:20:00	Complaints Hotline	Bulga
Noise	July	24/07/2014	18:58:00	Complaints Hotline	Bulga
Noise	July	24/07/2014	20:01:00	Complaints Hotline	Bulga
Noise	July	24/07/2014	20:40:00	Complaints Hotline	Bulga
Noise	July	24/07/2014	20:45:00	Complaints Hotline	Bulga
Noise	July	24/07/2014	20:48:00	Complaints Hotline	Unknown
Noise	July	24/07/2014	21:46:00	Complaints Hotline	Bulga
Noise	July	25/07/2014	22:00:00	Complaints Hotline	Bulga
Noise	July	25/07/2014	22:52:00	Complaints Hotline	Bulga
Noise	July	26/07/2014	22:34:00	Complaints Hotline	Unknown
Noise	July	27/07/2014	21:53:00	Complaints Hotline	Long Point
Noise	July	28/07/2014	23:56:00	Complaints Hotline	Long Point
Noise	July	30/07/2014	21:26:00	Complaints Hotline	Bulga
Noise	July	30/07/2014	22:08:00	Complaints Hotline	Unknown
Noise	July	30/07/2014	23:01:00	Complaints Hotline	Long Point
Dust	August	1/08/2014	8:31:00	Complaints Hotline	Bulga
Dust	August	1/08/2014	16:10:00	Telephone	Unknown
Noise	August	1/08/2014	23:01:00	Complaints Hotline	Bulga
Noise	August	1/08/2014	23:24:00	Complaints Hotline	Unknown
Noise	August	1/08/2014	23:30:00	Complaints Hotline	Unknown
Noise	August	3/08/2014	8:56:00	Complaints Hotline	Long Point
Noise	August	3/08/2014	21:47:00	Complaints Hotline	Bulga
Noise	August	3/08/2014	23:06:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	4:31:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	19:33:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	20:30:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	20:48:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	21:20:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	21:22:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	21:22:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	21:27:00	Complaints Hotline	Bulga
Noise	August	4/08/2014	21:52:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	August	5/08/2014	21:50:00	Complaints Hotline	Bulga
Noise	August	5/08/2014	22:17:00	Complaints Hotline	Bulga
Noise	August	6/08/2014	1:36:00	Complaints Hotline	Bulga
Noise	August	6/08/2014	8:26:00	Complaints Hotline	Bulga
Noise	August	6/08/2014	8:47:00	Complaints Hotline	Bulga
Blast	August	7/08/2014	15:08:00	Complaints Hotline	Bulga
Blast	August	7/08/2014	15:38:00	Complaints Hotline	Bulga
Noise	August	7/08/2014	20:08:00	Complaints Hotline	Bulga
Noise	August	7/08/2014	20:40:00	Complaints Hotline	Bulga
Noise	August	7/08/2014	21:51:00	Complaints Hotline	Bulga
Noise	August	7/08/2014	22:07:00	Complaints Hotline	Bulga
Noise	August	7/08/2014	22:57:00	Complaints Hotline	Bulga
Noise	August	8/08/2014	19:29:00	Complaints Hotline	Bulga
Noise	August	8/08/2014	20:48:00	Complaints Hotline	Bulga
Noise	August	8/08/2014	22:06:00	Complaints Hotline	Bulga
Dust	August	11/08/2014	8:42:00	Complaints Hotline	Bulga
Noise	August	12/08/2014	21:44:00	Complaints Hotline	Bulga
Dust	August	13/08/2014	10:01:00	Complaints Hotline	Bulga
Blast	August	13/08/2014	13:09:00	Complaints Hotline	Bulga
Noise	August	13/08/2014	21:35:00	Complaints Hotline	Bulga
Noise	August	13/08/2014	21:42:00	Complaints Hotline	Bulga
Noise	August	14/08/2014	2:43:00	Complaints Hotline	Bulga
Noise	August	14/08/2014	2:43:00	Complaints Hotline	Bulga
Noise	August	14/08/2014	22:23:00	Complaints Hotline	Bulga
Noise	August	15/08/2014	20:05:00	Complaints Hotline	Bulga
Noise	August	15/08/2014	21:01:00	Complaints Hotline	Bulga
Noise	August	15/08/2014	21:52:00	Complaints Hotline	Bulga
Noise	August	16/08/2014	8:42:00	Complaints Hotline	Bulga
Noise	August	16/08/2014	8:50:00	Complaints Hotline	Bulga
Noise	August	16/08/2014	8:59:00	Complaints Hotline	Bulga
Noise	August	17/08/2014	22:44:00	Complaints Hotline	Long Point
Noise	August	17/08/2014	23:00:00	Complaints Hotline	Long Point
Noise	August	17/08/2014	23:30:00	Complaints Hotline	Unknown

Type	Month	Date	Time	Method	Location
Noise	August	18/08/2014	3:43:00	Complaints Hotline	Long Point
Noise	August	18/08/2014	8:31:00	Complaints Hotline	Unknown
Noise	August	20/08/2014	0:54:00	Complaints Hotline	Unknown
Noise	August	20/08/2014	1:03:00	Complaints Hotline	Unknown
Noise	August	21/08/2014	5:12:00	Complaints Hotline	Bulga
Blast	August	21/08/2014	11:25:00	Complaints Hotline	Bulga
Noise	August	22/08/2014	21:05:00	Complaints Hotline	Bulga
Noise	August	23/08/2014	8:23:00	Complaints Hotline	Bulga
Noise	August	23/08/2014	21:39:00	Complaints Hotline	Bulga
Noise	August	23/08/2014	21:53:00	Complaints Hotline	Bulga
Noise	August	24/08/2014	7:09:00	Complaints Hotline	Bulga
Noise	August	24/08/2014	18:40:00	Complaints Hotline	Bulga
Noise	August	24/08/2014	22:10:00	Complaints Hotline	Bulga
Noise	August	24/08/2014	22:15:00	Complaints Hotline	Bulga
Light	August	24/08/2014	22:33:00	Complaints Hotline	Unknown
Noise	August	25/08/2014	21:41:00	Complaints Hotline	Bulga
Noise	August	25/08/2014	21:45:00	Complaints Hotline	Bulga
Noise	August	25/08/2014	21:59:00	Complaints Hotline	Bulga
Noise	August	25/08/2014	22:35:00	Complaints Hotline	Bulga
Noise	August	25/08/2014	22:48:00	Complaints Hotline	Bulga
Noise	August	25/08/2014	23:31:00	Complaints Hotline	Unknown
Noise	August	29/08/2014	21:53:00	Complaints Hotline	Bulga
Noise	August	30/08/2014	18:12:00	Complaints Hotline	Unknown
Noise	August	30/08/2014	21:21:00	Complaints Hotline	Unknown
Noise	August	30/08/2014	22:05:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	20:10:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	20:20:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	20:36:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	20:47:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	20:47:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	20:48:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	21:01:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	21:02:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	August	31/08/2014	21:09:00	Complaints Hotline	Bulga
Noise	August	31/08/2014	21:45:00	Complaints Hotline	Bulga
Blast	September	2/09/2014	13:05:00	Complaints Hotline	Bulga
Noise	September	3/09/2014	23:29:00	Complaints Hotline	Bulga
Noise	September	3/09/2014	23:31:00	Complaints Hotline	Unknown
Noise	September	3/09/2014	23:33:00	Complaints Hotline	Unknown
Light	September	3/09/2014	23:35:00	Complaints Hotline	Unknown
Noise	September	3/09/2014	23:58:00	Complaints Hotline	Bulga
Noise	September	4/09/2014	0:03:00	Complaints Hotline	Unknown
Dust	September	4/09/2014	6:33:00	Complaints Hotline	Bulga
Noise	September	6/09/2014	1:04:00	Complaints Hotline	Bulga
Noise	September	6/09/2014	20:15:00	Complaints Hotline	Bulga
Noise	September	6/09/2014	21:02:00	Complaints Hotline	Bulga
Noise	September	6/09/2014	22:10:00	Complaints Hotline	Bulga
Noise	September	6/09/2014	22:31:00	Complaints Hotline	Bulga
Noise	September	6/09/2014	23:08:00	Complaints Hotline	Bulga
Noise	September	7/09/2014	2:34:00	Complaints Hotline	Bulga
Noise	September	7/09/2014	20:17:00	Complaints Hotline	Bulga
Noise	September	7/09/2014	20:27:00	Complaints Hotline	Bulga
Noise	September	7/09/2014	20:38:00	Complaints Hotline	Bulga
Noise	September	7/09/2014	22:03:00	Complaints Hotline	Bulga
Noise	September	7/09/2014	22:10:00	Complaints Hotline	Bulga
Noise	September	7/09/2014	23:44:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	8:35:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	18:40:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	20:17:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	20:56:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	22:26:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	23:07:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	23:30:00	Complaints Hotline	Bulga
Noise	September	8/09/2014	23:56:00	Complaints Hotline	Bulga
Noise	September	9/09/2014	21:13:00	Complaints Hotline	Bulga
Noise	September	9/09/2014	22:07:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	September	12/09/2014	19:46:00	Complaints Hotline	Bulga
Noise	September	12/09/2014	21:59:00	Complaints Hotline	Bulga
Noise	September	13/09/2014	4:05:00	Complaints Hotline	Bulga
Noise	September	13/09/2014	19:06:00	Complaints Hotline	Bulga
Noise	September	13/09/2014	19:28:00	Complaints Hotline	Bulga
Noise	September	13/09/2014	19:47:00	Complaints Hotline	Bulga
Noise	September	13/09/2014	20:02:00	Complaints Hotline	Bulga
Noise	September	13/09/2014	20:57:00	Complaints Hotline	Bulga
Noise	September	13/09/2014	21:54:00	Complaints Hotline	Bulga
Noise	September	15/09/2014	19:04:00	Complaints Hotline	Bulga
Noise	September	15/09/2014	19:42:00	Complaints Hotline	Bulga
Noise	September	15/09/2014	20:07:00	Complaints Hotline	Bulga
Noise	September	15/09/2014	22:21:00	Complaints Hotline	Bulga
Blast	September	16/09/2014	13:21:00	Complaints Hotline	Bulga
Blast	September	16/09/2014	13:22:00	Complaints Hotline	Bulga
Dust	September	17/09/2014	15:15:00	Complaints Hotline	Bulga
Dust	September	17/09/2014	17:51:00	Complaints Hotline	Singleton
Noise	September	18/09/2014	18:28:00	Complaints Hotline	Long Point
Noise	September	21/09/2014	20:20:00	Complaints Hotline	Bulga
Noise	September	21/09/2014	21:27:00	Complaints Hotline	Bulga
Noise	September	22/09/2014	19:19:00	Complaints Hotline	Bulga
Noise	September	22/09/2014	20:58:00	Complaints Hotline	Bulga
Noise	September	22/09/2014	21:02:00	Complaints Hotline	Bulga
Noise	September	22/09/2014	22:06:00	Complaints Hotline	Bulga
Noise	September	23/09/2014	19:44:00	Complaints Hotline	Bulga
Noise	September	23/09/2014	20:17:00	Complaints Hotline	Bulga
Noise	September	23/09/2014	22:18:00	Complaints Hotline	Bulga
Noise	September	24/09/2014	8:26:00	Complaints Hotline	Bulga
Noise	September	24/09/2014	20:20:00	Complaints Hotline	Bulga
Noise	September	24/09/2014	21:08:00	Complaints Hotline	Bulga
Noise	September	24/09/2014	21:11:00	Complaints Hotline	Bulga
Noise	September	24/09/2014	22:37:00	Complaints Hotline	Bulga
Noise	September	26/09/2014	2:48:00	Complaints Hotline	Long Point

Type	Month	Date	Time	Method	Location
Noise	September	26/09/2014	2:50:00	Complaints Hotline	Unknown
Noise	September	26/09/2014	2:53:00	Complaints Hotline	Unknown
Noise	September	26/09/2014	20:40:00	Complaints Hotline	Bulga
Noise	September	26/09/2014	21:01:00	Complaints Hotline	Bulga
Noise	September	27/09/2014	19:48:00	Complaints Hotline	Bulga
Noise	September	27/09/2014	21:56:00	Complaints Hotline	Bulga
Noise	September	28/09/2014	22:40:00	Complaints Hotline	Bulga
Noise	September	28/09/2014	22:54:00	Complaints Hotline	Bulga
Noise	September	28/09/2014	23:41:00	Complaints Hotline	Unknown
Noise	September	28/09/2014	23:42:00	Complaints Hotline	Unknown
Noise	September	28/09/2014	23:44:00	Complaints Hotline	Long Point
Noise	October	1/10/2014	22:17:00	Complaints Hotline	Bulga
Blast	October	3/10/2014	13:22:00	Complaints Hotline	Bulga
Noise	October	3/10/2014	21:45:00	Complaints Hotline	Bulga
Noise	October	3/10/2014	22:48:00	Complaints Hotline	Bulga
Noise	October	4/10/2014	9:34:00	Complaints Hotline	Unknown
Noise	October	4/10/2014	9:36:00	Complaints Hotline	Bulga
Noise	October	4/10/2014	21:41:00	Complaints Hotline	Bulga
Noise	October	4/10/2014	22:37:00	Complaints Hotline	Bulga
Noise	October	6/10/2014	2:57:00	Complaints Hotline	Bulga
Noise	October	6/10/2014	20:12:00	Complaints Hotline	Bulga
Noise	October	6/10/2014	20:18:00	Complaints Hotline	Bulga
Noise	October	6/10/2014	20:29:00	Complaints Hotline	Bulga
Noise	October	6/10/2014	20:57:00	Complaints Hotline	Bulga
Noise	October	8/10/2014	22:27:00	Complaints Hotline	Bulga
Noise	October	8/10/2014	22:27:00	Complaints Hotline	Bulga
Noise	October	9/10/2014	21:46:00	Complaints Hotline	Bulga
Noise	October	9/10/2014	22:06:00	Complaints Hotline	Bulga
Blast	October	10/10/2014	11:54:00	Complaints Hotline	Bulga
Blast	October	10/10/2014	13:17:00	Complaints Hotline	Bulga
Noise	October	10/10/2014	21:29:00	Complaints Hotline	Bulga
Noise	October	11/10/2014	8:50:00	Complaints Hotline	Unknown
Noise	October	11/10/2014	8:54:00	Complaints Hotline	Unknown

Type	Month	Date	Time	Method	Location
Noise	October	11/10/2014	9:13:00	Complaints Hotline	Long Point
Dust	October	11/10/2014	13:39:00	Complaints Hotline	Glenridding
Noise	October	11/10/2014	21:03:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	0:24:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	8:02:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	8:11:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	20:07:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	21:48:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	21:50:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	22:01:00	Complaints Hotline	Bulga
Noise	October	12/10/2014	22:57:00	Complaints Hotline	Bulga
Dust	October	13/10/2014	8:46:00	Complaints Hotline	Bulga
Noise	October	15/10/2014	21:48:00	Complaints Hotline	Bulga
Noise	October	15/10/2014	23:10:00	Complaints Hotline	Unknown
Noise	October	16/10/2014	21:53:00	Complaints Hotline	Bulga
Noise	October	16/10/2014	22:12:00	Complaints Hotline	Unknown
Noise	October	16/10/2014	22:38:00	Complaints Hotline	Unknown
Noise	October	16/10/2014	23:19:00	Complaints Hotline	Unknown
Noise	October	18/10/2014	21:34:00	Complaints Hotline	Bulga
Noise	October	18/10/2014	21:53:00	Complaints Hotline	Bulga
Noise	October	18/10/2014	22:16:00	Complaints Hotline	Bulga
Noise	October	19/10/2014	20:55:00	Complaints Hotline	Bulga
Noise	October	19/10/2014	21:32:00	Complaints Hotline	Bulga
Noise	October	19/10/2014	22:35:00	Complaints Hotline	Bulga
Noise	October	19/10/2014	22:58:00	Complaints Hotline	Bulga
Noise	October	19/10/2014	23:57:00	Complaints Hotline	Bulga
Noise	October	19/10/2014	23:58:00	Complaints Hotline	Bulga
Noise	October	21/10/2014	8:33:00	Telephone	Bulga
Noise	October	21/10/2014	16:44:00	Complaints Hotline	Bulga
Noise	October	21/10/2014	22:00:00	Complaints Hotline	Bulga
Noise	October	21/10/2014	23:07:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	1:51:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	3:39:00	Complaints Hotline	Bulga

Type	Month	Date	Time	Method	Location
Noise	October	22/10/2014	4:03:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	7:21:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	7:52:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	8:18:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	20:29:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	21:17:00	Complaints Hotline	Bulga
Noise	October	22/10/2014	21:27:00	Complaints Hotline	Bulga
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Blast	November	26/11/2014	12:34:00	Complaints Hotline	Bulga
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Noise	November	29/11/2014	20:57:00	Complaints Hotline	Bulga
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Noise	December	14/12/2014	2:00:00	Complaints Hotline	Bulga
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Dust	December	14/12/2014	18:06:00	Complaints Hotline	Bulga
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Noise	December	31/12/2014	23:33:00	Complaints Hotline	Bulga
Noise	December	31/12/2014	23:59:00	Email	Unknown

Appendix 3:

Summary of Incidents 2014

Mount Thorley Warkworth Environmental Incidents 2014

Incident Number	Date	Details
1000258741	16.01.2014	A dozer was undertaking work in a rehabilitation area under a Ground disturbance Permit (GDP) when they sighted upon a wrong marker when clearing north GDP boundary line. The dozer tracked outside the GDP boundary for approximately 40 metres prior to realising and reversing back inside the approved area. The dozer blade was not in contact with the ground and caused minor disturbance of ground surface from track passage and pushing over sparse juvenile vegetation. A refresher GDP toolbox talk was presented to crews and GDP deliniation improved.
1000259893	29.01.2014	Approximately 150 litres of coolant spilled to a warehouse storm water drain which subsequently reports to a mine water storage dam. The tank valve was shut down to stop the coolant leak. It was identified the leak was coming from split filters next to the pump. The valve was replaced with a stainless steel version and the replacement interval revised.
1000260125	31.01.2014	A blast identified as l44-wba-pr5 fired at 13:28 in the Loders Pit of Mount Thorley Operations produced a dusty blast cloud which migrated from the blast area and allegedly impacted privately owned land in the vicinity of Bulga Village. Observations by site personnel in the village area indicated that remnant elements of the blast cloud remained visible for a period after blasting and a degraded remnant dust cloud passed at height over the Putty Road to the east of the Wollomi Brook (east of the village). A number of complaints were received from residents of Bulga Village immediately following the blast which described blast vibration shaking homes. Further complaints were received approximately 10 minutes after firing which described a dust cloud visible from the village area. A report was provided to regulators and the blasting permissions for Loders Pit were revised.
1000273416	19.02.2014	Runoff waters from the catchment reporting to CC5 tailend sump overtopped a section of the sump and flowed to Doctors Creek located adjacent the sump. Overtopping was associated with a short duration high intensity storm event. Observations during the event suggest overtopping occurred across a brief period when the capacity of the sump pump was exceeded. Following the overtopping, downstream creek flow was temporarily impounded and a pump installed to the creek channel to return waters to site. A report was provided to regulators, a catchment review was undertaken and the drainage and pumping capacity of the area was upgraded.
1000276676	26.03.2014	Approximately 15 litres of hydraulic oil was spilled when a replacement hose on T731 fan drive system squirted hydraulic fluid on machine restart. Upon inspection, the hose fittings were found to be of incorrect diameter. The spill was banded and cleaned up.
1000276827	11.03.2014	Approximately 10 litres of oil was spilled on concrete around a scrap metal recycling bin after used GET placed in the drum pierced the base of drum and allowed residual oil to escape. The spill was cleaned up and a communication distributed with the requirements to clean drums prior to reuse.

Incident Number	Date	Details
1000276844	19.03.2014	Approximately 5 litres of hydraulic oil spilled from a loader oil tank following resealing of the tank sight glass. Upon machine restart following tank repair and glass reseal, oil blew out of the sight glass surrounds. Upon inspection, the glass surround was found to have a crack in the housing. A new sight glass was fitted and the spill was cleaned up.
1000278998	23.04.2014	Approximately 20 litres of hydraulic oil was spilled to ground when a hydraulic line failed on Loader 647. Smoke was observed coming from the engine bay by a passing truck operator. An emergency was initiated and the fire suppression system on 647 manually activated. A limited volume of oil impacted the ground surface and was removed to the bioremediation area.
1000279717	11.04.2014	Blast identified as l41-gma-md2 fired at 12:21 on 11 April 2014 recorded peak resultant vibration of 5.93mm/s at the Police Station Monitoring location, exceeding the site target for blast vibration of 5mm/s. The blast did not trigger exceedence of the 5% limit for blasts in the range 5-10mm/s over a 12 month period. The blast was investigated and the cause of the exceedence attributed to a design flaw in the blast.
1000280620	08.05.2014	A mulcher undertaking work in West Pit North under GDP 83 sighted upon wrong boundary marker when clearing for ring main pipeline relocation. The mulcher tracked outside boundary for approximately 40 metres prior to realising and reversing back inside approved area. Minor disturbance of the ground surface occurred from the track passage and some juvenile regrowth vegetation was pushed over. A refresher toolbox talk was presented to crews and improvements to the demarcation of GDPs.
1000280736	13.05.2014	Routine inspection of a truck parking area identified three pods of service fluids stored in a manner not complying with site procedure. Two of the pods had leaked and impacted the ground surface in the immediate vicinity. The area was cleaned up and compliant storage formed. The spills were cleaned up and contaminated soil taken to the bioremediation area. Routine inspection requirements reviewed and improved.
1000280937	09.05.2014	Blast identified as L41-GMA-MD4 fired at 13:49 on 9 May 2014 recorded peak resultant vibration of 6.9mm/s at the Police Station Monitoring location exceeding the site target for blast vibration of 5mm/s. The blast did not trigger exceedence of the 5% limit for blasts in the range 5-10mm/s over a 12 month period. An internal and external review of the blast was undertaken and a report was provided to the regulator.
1000282545	26.05.2014	Over the weekend of the 24th/25th May a camlock drainage fitting on an above ground sump leaked, allowing a small amount of biodegradable drilling fluid to migrate to the area adjacent the exploration pad. The fluid seeped into the basal trench of the sediment fence prior to migrating approximately 5 metres past the fence to an adjoining grassed area. The area inspection requirements were improved and the exploration team received a refresher training on environmental hazards and reporting.
1000283783	19.06.2014	An estimated 30 litres of oil was spilled to ground when the bolts holding the top plate on the suspension strut of a truck failed. The top of the strut was ejected, impacting the under-side of the deck then landing on the haul road 4 metres away from the truck. The impacted soil was taken to the bioremediation pad and the same bolt changed out across the truck fleet.

Incident Number	Date	Details
1000284893	27.06.2014	Blast identified as L48-WYC-PR1 located in Loders Pit produced visible blast fume rated as 3C according to the AEISG scale. After firing, the blast cloud migrated in a south-easterly direction within the blast exclusion zone and passed onto the adjacent mine site approximately 8-9 minutes after firing. When passing offsite the cloud was assessed as AEISG Level 1 equivalent (slight NOx gas). At the time of firing the exclusion zone extended into the neighbouring mine under the control of that site's personnel in communication with the MTW blasting crew. The blast was reviewed internally and externally for shot design and firing and a report provided to the regulators.
1000284895	27.06.2014	Excavator 310 experienced a hydraulic line failure on the boom when loading first truck after returning from service. Oil sprayed over boom and the house with some oil dripping onto the turbo and causing a small fire. Operator extinguished fire with hand held extinguisher. The hydraulic line was repaired and the impacted ground material (coal) was mined out and processed at the CHPP.
1000284897	29.06.2014	An estimated 200 litres of engine oil was spilled on the CD160 Ramp Dump when Truck 424 experienced a cross over line failure. Impacted material was recovered and removed to the bioremediation area.
1000285775	14.07.2014	During commission of the new 996 service cart it was parked at the back of the workshop. An operator was asked to move service cart to MTO north gate. On walk around inspection it was noticed a significant pool of predominantly diesel that had leaked from the rear cabinet. The diesel pump flange gasket had been incorrectly installed on rebuild. Contaminated dirt was removed and taken to bioremediation area.
1000286305	18.07.2014	An unattended 2" hose had been left in the above ground sump, pump had been turned off but due to the differential heights of the hose ends, gravity caused siphoning of drill sump. An indeterminate amount of fluid flowed on to the drill pad, pooled in the back corner, seeped through the windrow and through the sediment fence. Total fluid loss offsite Approx. 50 Litres of bio degradable drill waste. A physical process was introduced to ensure the hose cannot be fed by gravity even without an operational pump. A check list was formulated for site clean-up at the end of each shift.
1000287223	23.07.2014	Seepage of water was identified below the South CHPP Raw Water Dam (Dam 14S). The drainage pathway of the seepage was traced and all waters were confirmed as contained within existing site water management structures. Water sampling was undertaken to confirm water quality and the potential for the water to have leaked from Dam 14S. A diversion drain was installed to direct seepage into a mine water dam.

Incident Number	Date	Details
1000302602	18.08.2014	Oil disposal contractor was evacuating the main warehouse waste oil tank. The operator thought he understood how long the truck tank would take to fill and entered the cab to fill out paperwork. Moments later, the driver noticed oil spilling down over the tank. The operator then shut down the evacuation pump. An estimated 200L of waste oil was spilt on to the concrete path outside the bunded area. The oil was contained and cleaned up. The truck was taken to the wash bay and degreased by the operator before leaving site. Change in process implemented to ensure operator must observe the evacuation process and not leave the tank area unattended.
1000305610	30.08.2014	A small amount of water was observed to be leaking from butterfly valve on a pipeline adjacent the Lemington Underground Bore. The bolts on the valve were tightened, stopping the leak. Inspection of the pipeline was included in daily checklist carried out by water inspectors.
1000309236	09.10.2014	During a routine water infrastructure inspection it was identified that the water pipeline adjacent to the Lemington Underground Bore had ruptured. The LUG Bore is an operating production bore that abstracts water from the disused Lemington Underground mine workings, to supply water to the neighbouring MTW and Hunter Valley Operations (HVO) mines. The pipe rupture appeared to have resulted in a discharge of water from the pipe. An investigation was undertaken which found the most likely cause to be water pressure in the pipeline exceeding the maximum rated pressure of the pipe.
1000314928	10.12.2014	Some leaked oil which had pooled beneath an engine on the MTO Maintenance laydown area was flushed into the adjacent mine water dam during a storm. The spilled oil was contained with hydrocarbon booms prior to being pumped out.
1000315385	11.12.2014	<p>Following a high intensity rain and hail event on night of 10 December 2014 sediment Dam 3s overtopped to a clean water dam (Powerline Dam) which in turn overtopped to a tributary of Loders Creek. Rainfall in the order of 130mm was received at site from 5-11 December, predominantly in events on 5-6 December of ~50mm and night of 10 December of ~65mm. Dewatering of Dam 3S following the initial event was ongoing at the time of the second event. Available buffer storage in the dam was filled by the reporting runoff and Dam 3S overtopped. Two pumps were installed to dewater the Powerline Dam in addition to dewatering of Dam 3s. The Powerline Dam was confirmed to have ceased spilling on the morning of 14 December 2014.</p> <p>Investigation also found that the pump dewatering the system stopped during the night of 10 December after the suction became blocked, and hence contributed to the duration of the overtopping event. The overtopping was reported to regulators and water sampling undertaken.</p> <p>The system was dewatered and overtopping ceased.</p> <p>A review of management procedures of catchment and associated storages was completed.</p>

Appendix 4:
Rehabilitation Table

Annual Rehabilitation Report Form, Rehabilitation Maps and Rehabilitation Summary

Annual Rehabilitation Report Form – Mines
Year Ending: 2014
Mine: Mt Thorley Warkworth
Company: Rio Tinto Coal Australia – Coal & Allied
Plans Attached:
Mt Thorley Warkworth – AEMR MTW 2014
Approved Mining Operations Plan:
MTW MOP (2014 – 2016) - Approval Date 24/11/2014
Total Area Covered by Mining Operations Plan:
MTW MOP – 6,185ha
Total Area Covered by Mining Lease for This Mine: 6,185ha

Table 1: Rehabilitation Progress, 2014

Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area last reported (ha)	Total Area to date (ha)
1.1 Active mining and infrastructure area, facilities, including roads and tracks	1A	Final Void	Final Void	6.6	320.7
	1C	Final Void	Rehabilitation Area - Grassland	0.0	0.0*
	2A	Water Management Areas	Final Void	3.2	0.0*
	2B	Water Management Areas	Water Management Areas	46.9	0.0*
	2C	Water Management Areas	Rehabilitation Area - Grassland	5.1	24.33
	2D	Water Management Areas	Rehabilitation Area - Woodland	0.0*	28.92
	2E	Water Management Areas	Rehabilitation Area – Woodland EEC	9.3	0.0*
	3B	Infrastructure Area	Water Management Areas	5.1	0.0*
	3C	Infrastructure Area	Rehabilitation Area - Grassland	81.0	84.0
	3D	Infrastructure Area	Rehabilitation Area - Woodland	0.0*	69.0
	3E	Infrastructure Area	Rehabilitation Area – Woodland EEC	67.0	0.0*

Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area last reported (ha)	Total Area to date (ha)
	4C	Tailings Storage Facility	Rehabilitation Area - Grassland	45.8	45.48
	4D	Tailings Storage Facility	Rehabilitation Area - Woodland	1.1	92.04
	4E	Tailings Storage Facility	Rehabilitation Area - Woodland EEC	91.0	0.0*
	5A	Overburden Emplacement Area	Final Void	43.5	0.0*
	5B	Overburden Emplacement Area	Water Management Areas	0.3	0.0*
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	471.1	397.49
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	272.5	1419.47
	5E	Overburden Emplacement Area	Rehabilitation Area – Woodland EEC	1411.3	32.15
	Bulga Sublease Area	N/A – Outside Domain Boundary	N/A – Outside Domain Boundary	0.0*	12.82
1.2 Decommissioning	Total - Active			2561.0	2526.4
	Total - Decommissioning			0.0	0.0
1.3 Landform Establishment	Total - Landform Establishment			3.5 (Included in 1.1)	10.6 (Included in 1.1)
1.4 Growth Medium Development	Total - Growth Medium Development			3.1 (Included in 1.1)	0.0
1.5 Ecosystem and Land Use Establishment	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	0.0	5.6
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	0.1	98.6
	5E	Overburden Emplacement Area	Rehabilitation Area – Woodland EEC	61.6	0.0
1.6 Ecosystem and Land Use Development	Total - Ecosystem and Land Use Establishment			61.7	104.2
	1A	Final Void	Final Void	0.0	0.0*
	2B	Water Management Areas	Water Management Areas	0.8	0.0*
	2C	Water Management Areas	Rehabilitation Area - Grassland	0.8	0.0*
	5B	Overburden Emplacement Area	Water Management Areas	0.7	0.0*
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	571.8	541.72
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	32.4	263.12
	5E	Overburden Emplacement Area	Rehabilitation Area – Woodland EEC	199.1	0.0*
	Total - Ecosystem and Land Use Development			805.6	804.84

Rehabilitation Activity Type	Domain Identifier	Primary Domain	Secondary Domain	Total Area last reported (ha)	Total Area to date (ha)
1.7 Rehabilitation Complete	Total - Rehabilitation Complete			0.0	0.0
1.8 Total Area Disturbed (items 1.1 to 1.7)	1A	Final Void	Final Void	6.6	321.44
	2A	Water Management Areas	Final Void	3.2	0.0*
	2B	Water Management Areas	Water Management Areas	47.7	0.0*
	2C	Water Management Areas	Rehabilitation Area - Grassland	5.9	28.11
	2D	Water Management Areas	Rehabilitation Area - Woodland	0.0*	28.92
	2E	Water Management Areas	Rehabilitation Area – Woodland EEC	9.3	0.0*
	3B	Infrastructure Area	Water Management Areas	5.1	0.0*
	3C	Infrastructure Area	Rehabilitation Area - Grassland	81.0	84.0
	3D	Infrastructure Area	Rehabilitation Area - Woodland	0.0*	69.0
	3E	Infrastructure Area	Rehabilitation Area – Woodland EEC	67.0	0.0*
	4C	Tailings Storage Facility	Rehabilitation Area - Grassland	45.8	45.77
	4D	Tailings Storage Facility	Rehabilitation Area - Woodland	1.1	92.04
	4E	Tailings Storage Facility	Rehabilitation Area – Woodland EEC	91.0	0.0*
	5A	Overburden Emplacement Area	Final Void	43.8	0.0*
	5B	Overburden Emplacement Area	Water Management Areas	1.0	0.0*
	5C	Overburden Emplacement Area	Rehabilitation Area - Grassland	1042.9	941.44
	5D	Overburden Emplacement Area	Rehabilitation Area - Woodland	305.0	1779.75
	5E	Overburden Emplacement Area	Rehabilitation Area – Woodland EEC	1672.0	32.15
Bulga Sublease Area		N/A – Outside Domain Boundary	N/A – Outside Domain Boundary	0.0*	12.82
Total - Footprint				3428.4	3435.44

Table 2: Soil Management and Erosion, 2013

Soil Stockpiling/ Use	Soil Used This Period (m ³)	Soil Pre-stripped This Period (m ³)	Soil Stockpiled to Date (m ³)	Soil Stockpiled Last Report (m ³)
	98,660	122,560	1,174,066	1,256,541
2.2 Erosion Treatment	Total Area to Date (ha)	Total Area Last Report (ha)	Total Area This Report (ha)	Area Retreated This Period (ha)
	Not Available			
Approx. area of sheet or gully erosion requiring reshaping topdressing and/or resowing	Not Available			

Table 3: Weed Control and Feral Animal Control

	Area in ha
3.1 Approx. area adversely affected by weeds as of the date of this report.	Not Available
3.2 Area treated for weed control during the period covered by the report.	174.9ha
3.3 Give summary of control strategies used and verification by approval agency(s)	
Species targeted in rehabilitation areas during 2013 included: galenia, <i>Acacia saligna</i> , african boxthorn, mother of millions, patternsons curse, opuntia species (pear), thistle and pampas grass.	

Table 4: Management of Rehabilitated Areas

4.1 Area treated with maintenance fertiliser.	0ha
4.2 Area treated by rotational grazing, cropping or slashing.	90ha
Give summary	90ha Warkworth rehabilitation area licence agreement in place for grazing.

Table 5: Variations to Rehabilitation Program

Has rehabilitation work proceeded generally in accordance with the conditions of an accepted Mining Operations Plan	Yes
If not please cite any approval granted for variations, or briefly describe the seasonal conditions or other reasons for any changes and the nature of any changes which have been made.	
NA	

Table 6: Planned Operations During the Next Report Period

6.1 Area estimated to be disturbed (currently undisturbed) ha.	43.5ha
6.2 Area estimated to be rehabilitated (ha)	73.8ha

Appendix 5:

Rehabilitation and Disturbance Summary and Maps

Table A: Rehabilitation Summary

Rehabilitation Site Name	Rehabilitation Type	Rehabilitation Coordinates	Rehabilitation Area (ha)	Rehabilitation Summary	
Woodlands	Woodland	319,740 E 6,388,390 N	14.99	<ul style="list-style-type: none"> • Topsoil was spread at a nominal thickness of 100mm. • Compost was applied at a rate of 100 tonnes per hectare. • Gypsum was applied at a rate of 10 tonnes per hectare. • Soil Preparation included Windrowing, Rock Picking then Aerating as required. • Millet and legume mix was broadcasted into Aerated pattern at 30Kg/ha. 	
South Pit North	Woodland	320,440 E 6,390,270 N	54.4	<ul style="list-style-type: none"> • Topsoil was spread at a nominal thickness of 100mm to 48.85 ha of the total area. • Compost was applied at a rate of 100 tonnes per hectare. • Gypsum was applied at a rate of 5.5 tonnes per hectare. • Windrowing, Rock Picking then Aerating as required. • Millet was broadcast into an aerated pattern to a total of 30 ha at a rate of approximately 35 kg/ha. • Millet/legume mix was broadcast into Aerated pattern at 30 kg/ha to a total area of 23 ha. 	
CD Dump	Woodland	319,100 E 6,390,050 N	12.1	<ul style="list-style-type: none"> • Topsoil was spread at a nominal thickness of 100mm. • Compost was applied at a rate of 100 tonnes per hectare • Gypsum was applied at a rate of 10 tonnes per hectare. • Soil Preparation included Windrowing, Rock Picking then Aerating as required. • Millet/legume mix was broadcasted into Aerated pattern at 30Kg/ha 	
South Pit South	Grassland	321,190 E 6,388,610 N	5.58	<ul style="list-style-type: none"> • Topsoil was spread at a nominal thickness of 100mm. • Compost was applied at a rate of 100 tonnes per hectare. • Gypsum was applied at a rate of 10 tonnes per hectare. • Soil Preparation included Windrowing, Rock Picking then Aerating as required. • Millet and legume mix was broadcasted into Aerated pattern at 35Kg/ha. 	
North Pit	Woodland	317,630 E 6,391,950 N	17.18	<ul style="list-style-type: none"> • Topsoil was spread at a nominal thickness of 100mm. • Compost was applied at a rate of 100 tonnes per hectare • Gypsum was applied at a rate of 10 tonnes per hectare. • Soil Preparation included Windrowing, Rock Picking then Aerating as required. • Native mix was direct drilled into Aerated pattern at 26.5Kg/ha. 	

Millet/Legume mix:

Product	Quantity (kg/ha)
Burgundy Bean	2.4
Lucerne	6.3
Chicory	1.5
Red Clover	2.4
Millet	17.4

Native Mix:

Species		Sowing Rate (kg/ha)
Small Flowable mix		
<i>Calotis cuneata</i>	purple burr daisy	0.004
<i>Calotis lappulacea</i>	yellow burr dairy	0.063
<i>Capillipedium spicigerum</i>	scented top	0.027
<i>Einadia nutans</i>	climbing saltbush	0.185
<i>Einadia trigonos</i>	fishweed	0.075
<i>Eucalyptus crebra</i>	narrow leaved ironbark	0.150
<i>Eucalyptus dawsonii</i>	dawsons gum	0.020
<i>Eucalyptus fibrosa</i>	broad leaved ironbark	0.050
<i>Eucalyptus moluccana</i>	greybox	0.100
<i>Eucalyptus punctata</i>	grey gum	0.020
<i>Eucalyptus tereticornis</i>	forest redgum	0.060
<i>Fimbristylis dichotoma</i>	common fringe rush	0.010
<i>Kunzea ambigua</i>	white kunzea	0.010
<i>Panicum effusum</i>	hairy panic	0.429
<i>Poa labillardieri</i>	tussock grass	0.000
<i>Sporobolus creber</i>	western rats tail grass	0.000
<i>Wahlenbergia mix</i>	bluebells	0.023
	Low germinability Millet	4.000
Total		5.226
Large Flowable mix		
<i>Acacia cultriformis</i>	knife-leaf wattle	0.05
<i>Acacia decora</i>	golden wattle	0.46
<i>Acacia falcata</i>	sickle wattle	0.3
<i>Acacia implexa</i>	hickory	0.1
<i>Acacia leiocalyx</i>	black wattle	0.15
<i>Acacia paradoxa</i>	kangaroo thorn	0.04
<i>Acacia parvipinnula</i>	silver wattle	0.01
<i>Acacia salicina</i>	coobah	0.12
<i>Ajuga australis</i>	austral bugle	0.044
<i>Allocasuarina littoralis</i>	black sheoak	0.02
<i>Atriplex semibaccata</i>	creeping saltbush	0.175
<i>Bursaria spinosa</i>	blackthorn	0.2
<i>Corymbia maculata</i>	spotted gum	0.1
<i>Daviesia ulicifolia</i>	gorse bitter-pea	0.35
<i>Dianella caerulea</i>	blue flax lilly	0.062
<i>Dianella longifolia</i>	fairy flax lilly	0.044
<i>Dianella revoluta</i>	spreading flax lilly	0.039
<i>Enchylaena tomentosa</i>	ruby saltbush	0.01
<i>Eremophila debilis</i>	amulla	0.02
<i>Eremophila deserti</i>	desert emubush	0.01
<i>Gahnia aspera</i>	saw sedge	0.133
<i>Glycine clandestina</i>	love creeper	0.018
<i>Hakea sericea</i>	silky hakea	0.01

Species		Sowing Rate (kg/ha)
Large Flowable mix		
<i>Hardenbergia violacea</i>	native sarsparilla	0.1
<i>Indigofera australis</i>	austral indigo	0.21
<i>Jacksonia scoparia</i>	dogwood	0.01
<i>Lomandra longifolia</i>	mat rush	0.152
<i>Myoporum montanum</i>	western boobialla	0.01
<i>Notelaea microcarpa</i>	native olive	0.05
<i>Paspalidium distans</i>	spreading panic	0.267
<i>Podolobium ilicifolium</i>	prickly shaggy pea	0.03
<i>Pomax umbellata</i>	pomax	0.016
<i>Pulteaea microphylla</i>	small leaved bush-pea	0.05
<i>Senna artemesioides</i> subsp. <i>zygophylla</i>	punty bush	0.01
<i>Solanum cinereum</i>	narrawa burr	0.035
<i>Swainsona galegifolia</i>	darling pea	0.05
	Low germinability millet	10
Total		13.455
Non-flowable		
<i>Austrodanthonia setacea</i>	small flowered wallaby grass	0.303
<i>Austrostipa densiflora</i>	foxtail speargrass	0.040
<i>Austrostipa scabra</i>	rough speargrass	1.663
<i>Austrostipa verticillata</i>	slender bamboo grass	0.093
<i>Bothriochloa macra</i>	redgrass	2.231
<i>Cassinia arcuata</i>	drooping cassinia	0.200
<i>Cassinia quinquefaria</i>	long-leaved cassinia	0.200
<i>Chloris truncata</i>	windmill grass	0.620
<i>Chrysocephalum apiculatum</i>	yellow buttons	0.333
<i>Cymbopogon refractus</i>	barbed wire grass	0.026
<i>Desmodium brachypodium</i>	large tick-trefoil	0.030
<i>Dicanthium sericeum</i>	bluegrass	0.446
<i>Dichelachne crinita</i>	plumegrass	0.071
<i>Digitaria brownii</i>	cotton panic	0.094
<i>Echinopogon intermedius</i>	hedgehog grass	0.008
<i>Elymus scaber</i>	wheat grass	0.044
<i>Heteropogon contortus</i>	black speargrass	0.178
<i>Imperata cylindrica</i>	blady grass	0.044
<i>Joycea pallida</i>	hill wallaby grass	0.080
<i>Microleana stipoides</i>	weeping rice grass	1.275
<i>Olearia elliptica</i>	sticky daisy bush	0.200
<i>Ozothamnus diosmifolius</i>	rice flower	0.100
<i>Themeda triandra</i>	kangaroo grass	4.190
<i>Vittadinia sulcata</i>	furrowed new holland daisy	0.037
Total		12.506

Plan of: Rehabilitation Areas MTW 2014

Date: 150224

Plan By: KP

Version: 1.0



Figure A: Rehabilitation Areas 2014

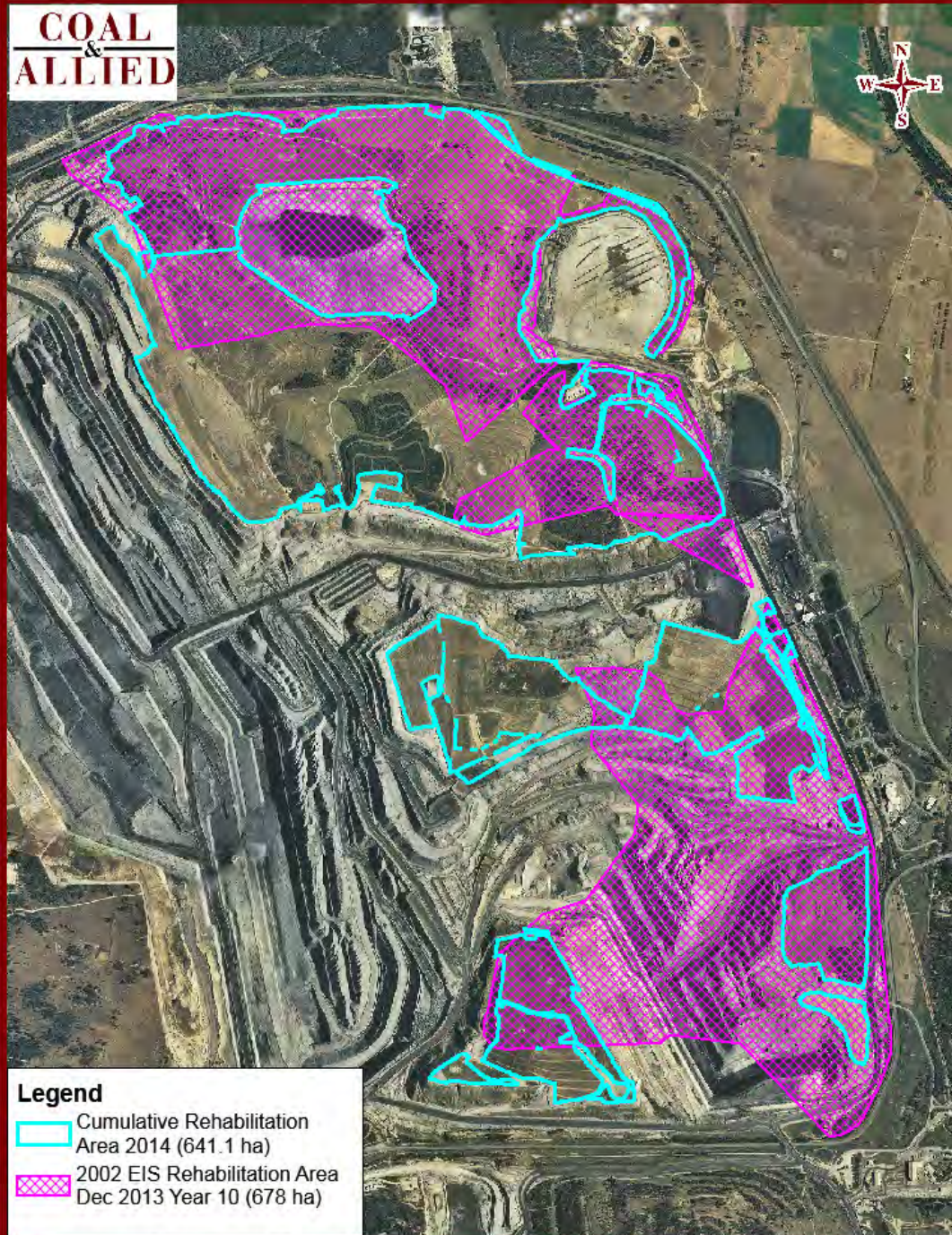
**Plan of: Actual Rehabilitation Progress
compared to EIS Projection**

Date: 150224

Plan By: KP

Version: 1.0

**COAL
&
ALLIED**



Coal & Allied - Environmental Services

Figure B: Cumulative Rehabilitation compared to EIS Prediction

Appendix 6:

Rehabilitation Monitoring Report

Rehabilitation Monitoring - Grasslands / Pasture Lands

MTW and HVO Mine Sites, 2015



Rehabilitation Monitoring - Grasslands / Pasture Lands

MTW and HVO Mine Sites, 2015

Client: Coal and Allied Operations Ltd

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Quality Information

Document Rehabilitation Monitoring - Grasslands / Pasture Lands

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Reviewed by Dee Murdoch (AECOM) and Neil Griffiths (NSW DPI)

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Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
B	27-Mar-2015	Final Report - Post Inclusion on Client feedback	James McIntyre Associate Director Environment	

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1.0 Introduction

The Mount Thorley Warkworth (MTW) and Hunter Valley Operations North (HVO North) mine sites are located in the Hunter Valley of NSW, approximately 15 km southwest and 24 km northwest of Singleton, respectively. Both open cut operations are managed by Coal and Allied Operations Ltd (C&A) (which in turn is managed by Rio Tinto Coal Australia).

This report presents the results of the monitoring of post-mined rehabilitated pasture lands at MTW and HVO North (with one monitoring site located at HVO South) and associated reference / analogue sites, undertaken by AECOM Australia Pty Ltd (AECOM) in association with the NSW Department of Primary Industries (DPI) | Agriculture. Monitoring was undertaken between 23 February and 27 February 2015.

1.1 Report Structure

This report is structured as follows:

- Section 1.0 provides some background to rehabilitation monitoring at MTW and HVO and details the scope of works for this monitoring event;
- Section 2.0 outlines the methodology adopted for the selection of monitoring sites and for the field data collection programme;
- Section 3.0 presents the monitoring sites studied during this monitoring event;
- Section 4.0 presents the monitoring results;
- Section 5.0 provides an interpretation and discussion of the monitoring results; and
- Section 6.0 provides a summary of the monitoring key findings and lists some recommendations pertaining to rehabilitation performance and the monitoring programme.

1.2 Background to Rehabilitation Monitoring

Rehabilitation monitoring at MTW and HVO North is undertaken to satisfy the following regulatory obligations:

- Schedule 4 – Condition 70(h) of Development Consent DA-300-9-2002i (Warkworth mine);
- Schedule 3 – Condition 42(g) of Development Consent DA 34/95 (Mount Thorley mine);
- Schedule 4 – Condition 62C(j) of Development Consent DA 450-10-2003 (HVO North); and
- Commitments made in respective Mining Operations Plans (MOPs) for MTW and HVO North.

Rehabilitation activities at MTW and HVO North are generally divided into areas of post-mined lands being returned to either a native ecosystem or a grazing pasture (or grassland) final land use. A comprehensive rehabilitation monitoring methodology has been developed in a document titled “*Monitoring Methodology - Post-mined Lands, MTW and HVO North Mine Sites*” (AECOM, 2012), which details the suite of monitoring tools to be implemented to assess the performance of rehabilitated lands being returned to either land use type. Central to this monitoring methodology is the requirement to include relevant reference (or analogue) sites which will be used to inform target setting for rehabilitation performance criteria.

Independent rehabilitation monitoring in accordance with the current MOPs commitments had previously not been undertaken at either MTW or HVO North, and the programme of works implemented during this project initiated the long-term rehabilitation monitoring programme for these sites.

This initial monitoring event was solely focused on the monitoring and assessment of areas of grazing pasture, including post-mined rehabilitated sites and associated analogue sites. Comprehensive monitoring of all rehabilitated lands (i.e. inclusive of native ecosystem areas) is intended by C&A to be rolled out and undertaken later this year.

1.3 Scope of Works

The scope of works for this initial monitoring event included the following tasks:

1. Review of the current rehabilitation monitoring methodology (AECOM, 2012), specifically with regards to pasture monitoring to identify potential areas of improvement. This task was undertaken in collaboration with staff of the NSW DPI | Agriculture.
2. Background desktop research and GIS study to determine appropriate locations for relevant analogue sites on C&A owned land.
3. Field data collection programme at 16 monitoring sites and in accordance with the methodology as revised during Task 1. Monitoring sites included eight sites located on post-mined rehabilitated pasture lands ('Rehabilitation Sites') and eight analogue sites amongst those identified in Task 2 ('Analogue Sites').
4. Development and provision of a monitoring report covering all aspects of the field work and site assessment and including: data presentation and interpretation and a list recommendation measures developed with a view to improve rehabilitation performance where required (this report).

2.0 Methods

2.1 Monitoring Sites Selection

2.1.1 Rehabilitation Sites

Rehabilitation sites monitored during this project were chosen by C&A's Environmental Specialist – Rehabilitation, and selected to include sites with different slope, aspect and age since completion of rehabilitation activities.

Rehabilitation monitoring sites are presented in Section 3.0; they included two sites in areas of younger rehabilitation where pasture establishment was in progress, and six sites in areas of older rehabilitation where pasture ecosystems were well-established.

2.1.2 Analogue Sites

The use of analogue sites to set performance benchmarks for rehabilitation is widely recognised as an appropriate way to track rehabilitation progress and outcomes. The data collected and derived from the analogue sites accurately reflect the local environmental and biophysical conditions for a specific vegetation type, and as such can be used as target values / long term goals for the corresponding restored / rehabilitated vegetation community (Nichols, 2005).

The selection of pasture analogue sites for the monitoring programme was undertaken with consideration of the following:

- The rehabilitation objectives and commitments for both sites in terms of final landform and landuse – to ensure that the analogue sites are representative of what is trying to be achieved on post-mined rehabilitated lands; and
- To ensure that the suite of analogue sites making up the monitoring programme appropriately capture the range of environmental and biophysical conditions occurring in the region.

In order to determine suitable locations for analogue sites on C&A owned land, an overlay study was undertaken using GIS software and the following variables: soil type, land capability and the predicted extent of future mining (to ensure perpetuity of analogue sites).

- The soil type variable included the four dominant soil formations in the area, comprising Alluvial Soils, Brown Clays, Yellow Podzolic Soils and Solodic Soils (other soil types occurring within the study area but with very limited geographical extent/distribution were excluded).
- The land capability variable was divided into two categories, grouping land capability classes I to III on one hand (i.e. land capable of supporting cultivation and/or grazing), and land capability classes IV to VI on the other (i.e. land capable of supporting grazing only). Land capability classes VII and VIII were excluded as those lands are incapable of agricultural land use, and because no post-mining landforms will be rehabilitated to these lower capability classes at MTW and HVO.

Potential analogue site locations were identified to capture various combinations of the above variables, and further short-listed by C&A Environmental Specialist – Rehabilitation with insight from C&A Landcare Specialist to account for access issues and overall suitability. Analogue monitoring sites are presented in Section 3.0.

Other variables of relevance to the selection of appropriate analogue sites included slope and aspect. These could not be mapped due to absence of workable GIS layers. However, these variables were accounted for in the field when choosing the location for monitoring site establishment, with various slope steepness and orientation trying to be captured.

2.2 Field Data Collection Programme

2.2.1 Site Establishment

Each monitoring site consisted of a 50m linear transect with nested plots/quadrats along which Landscape Function Analysis (LFA) and groundcover assessments were undertaken. Transects were established in accordance with the monitoring methodology document (AECOM, 2012), as follows:

- Transect lines were directed directly downslope and aligned with the maximum slope (where possible);
- Transects were permanently located to facilitate repeated measurements over time;

- The start and end points of each transect were marked by flexi-posts, and their geographic coordinates recorded by GPS.

The Botanal assessment (refer to Section 2.2.3) was implemented within an approximately four to five hectare polygon around the LFA transect, using as far as possible landform or landscape landmarks as polygon boundaries (e.g. fences, tracks, tree lines, etc.). Polygons boundaries were mapped using a handheld GPS to facilitate repeated measurements over time.

2.2.2 Landscape Function Analysis

Landscape Function Analysis (LFA) was implemented at all monitoring sites and in accordance with the methods described in Tongway and Hindley (2004). The LFA assessment consists of the following components: landscape organisation characterisation, soil surface assessment and rill survey.

Landscape Organisation Characterisation

The objective of this task was to characterise and map the monitored sites in terms of the spatial pattern of resource loss or accumulation. The procedure involved collecting a continuous record of patch and inter-patch classification along the transect line, which was used as the base to derive the Landscape Organisation Index (LOI). The LOI is the proportion of the length of patch to the total length of the transect and reflects the heterogeneity of the landscape in terms of the distribution of ground cover and other deposited materials.

Soil Surface Assessment

The soil surface condition was assessed for each patch type identified along the transect. The assessment examined the status of surface processes at about the one metre scale, with rapidly assessed indicators identified at the coarse scale. The eleven surface condition features assessed are: percentage of rain splash protection; percentage of perennial vegetation cover; percentage of litter cover; percentage of cryptogam cover; crust brokenness; soil erosion type and severity; deposited materials; soil surface roughness; surface nature; slake test; and soil surface texture.

These eleven features are assigned a score, then are compiled and calculated into three Soil Surface Condition Indices (SSCIs) (scaled from 0–100) including:

- Stability Index: indicates the ability of the soil to withstand erosive forces and to reform following disturbance;
- Infiltration Index: defines how the soil partitions rainfall into soil-water (i.e. water available for plant use) and runoff water which is lost from the local system, and may also transport resources (e.g. soil, nutrients, seeds) away; and
- Nutrient Cycling Index: indicates how efficiently organic matter is cycled back into the soil.

Rill survey

In accordance with the LFA methodology (Tongway and Hindley, 2004), rill surveys are to be carried out where rills are observed at less than 30 m spacing across the slope.

None of the 16 monitoring sites were impacted by rill erosion at the time of the survey, and therefore no rill surveys were undertaken.

2.2.3 Botanal

The Botanal monitoring tool is not part of the current monitoring methodology document (AECOM, 2012), and was added to the monitoring programme following consultation with Mr Lester McCormick of NSW DPI Agriculture. Mr McCormick currently co-leads the ACARP study of the sustainability and profitability of grazing on mine rehabilitated land in the Upper Hunter, which uses the Botanal monitoring tool to assess the quality of pastures.

Botanal (Tothill et al 1992; Hargreaves and Kerr 1992; McDonald et al 1996) is a technique for the visual estimation of botanical composition and herbage mass of pastures. It was added to the rehabilitation monitoring programme as it provides the following benefits:

- A 'whole-of-paddock' vs. a fixed transect-based assessment. The technique covers a much wider sampling area than the transect approach and as such provides a more comprehensive and representative assessment of pasture performance, factoring the variability of pasture quality across individual paddocks.
- Ensuring that the monitoring of rehabilitation at MTW and HVO North is aligned to the latest research on pasture assessments, and consistent with other current studies.

- Obtaining practical data that allows the land manager to make informed decisions in terms of carrying capacity and stocking rates.

The Botanal tool is most useful to assess the quality of well-established pastures, and as such was not applied at those younger rehabilitated sites where pasture establishment was in progress. Botanal was applied at 14 sites, including the eight reference sites and the six rehabilitation sites with well-established pastures. Methods are outlined below.

Outline of Procedure

A total of 50 quadrats were sampled per site within the 4-5 ha Botanal study polygon. Sampling locations were randomly located by walking in zig-zag across the paddock and dropping the quadrat every 20 steps. Quadrats were 40cm x 40cm in size.

Measurements

At each sampling location, the following measurements were taken within the quadrat:

- **Botanical composition by dry-weight-rank** – records were taken at the species level. Species were ranked first, second or third according to their estimated contribution to dry pasture herbage mass (i.e. with contributions of approximately 70%, 21% and 9%, respectively). Estimates were improved by not relying solely on using single ranks (i.e. only allocating 1, 2, or 3). If one species was dominant (e.g. > 85% of the quadrat dry-weight), a cumulative ranking was used, giving it both a first and second rank. If species have similar dry weights then ties are used. When species are tied, the ranks are divided equally between them. For example, if two species are tied for first, they each receive 0.5 for first and 0.5 for second (0.33 for three ties).
- **Herbage mass** – a visual estimate was made of total herbage mass, green herbage mass and dry herbage mass in kg DM/ha. This value was later corrected using the estimated and actual values from the calibration quadrats.
- **Groundcover** – a visual estimate was made of protective ground cover percentage within the quadrat.

Calibration Quadrats

Calibration quadrats are required to relate estimated and actual values of herbage mass and percent green. Before sampling commenced at each monitoring site, observers selected two calibration quadrats to represent high and low biomass for the paddock (i.e. rehabilitation polygon). The observers then together examined and estimated the range of herbage mass (total, green and dry) at the two selected calibration quadrats. During the calibration process observers agreed on species and compared estimates to ensure that they are following the correct procedures.

Calibration quadrats were then harvested to ground level using electric shears, stored in paper bags and taken to the Orange laboratory for processing as follows:

- All samples were dried for 48 hours at ~70-80°C using dehydrators.
- Following drying, samples were separated into green and dead material, and both fractions were weighed using a digital scale.

These data were then used to develop a regression for each observer relating estimated against actual data. Each regression equation was then applied to each quadrat observation to determine a value for herbage mass and percent green. These values were finally meaned to obtain an overall paddock (i.e. rehabilitation polygon) value.

Data processing

All Botanal data (i.e. field observations and calibration cuts data) were input and processed into the Botanal software to derive the following outputs:

- Total herbage, and green and dead herbage values;
- Herbage composition; and
- Ground cover.

2.2.4 Ground Cover

At the two younger rehabilitation sites where Botanal was not implemented, a rapid ground cover assessment was undertaken. At every 5 m intervals along the 50 m transect line (for a total of 10 sampling points per transect), the following information was visually assessed and recorded in 1 m² quadrats:

- The percentage cover of protective ground cover components (including dead and live plant material, litter, cryptogams, rocks >5cm and coarse woody debris);
- The percentage cover of bare ground; and
- The percentage cover of weeds.

At each sampling point, percentage cover was visually estimated to the nearest 10% using a 1 x 1 m frame. The overall percentage cover for the site was calculated by averaging results from all ten sampling points.

This assessment was not conducted at the older, well-established pasture sites as the relevant information was captured through Botanal.

2.2.5 Forage Quality – Feed Analysis

Forage quality was determined for all well-established pasture sites (i.e. all reference sites and at the six four older rehabilitated pasture sites). Pasture sampling was undertaken generally in accordance with the monitoring methodology document (AECOM, 2012), which recommends the guidelines provided by the by the NSW DPI for pasture sampling (*Collection technique guidelines – Form Collect1-Version No.2-01/11/07*, 2007).

Sampling was undertaken at random by taking between 15 and 20 'grab' samples at grazing height across the Botanal polygon study area. All 'grabs' were combined into a bucket and mixed well. The green fraction of the sample was then immediately separated from the dead fraction whilst in the field, and both sub-samples stored in plastic zip-lock bags in a cooled iced box (and subsequently in a fridge at the end of the working day). At completion of the field survey programme, all samples were wrapped in newspaper (to minimise thawing and sample degradation) and sent to the Wagga Wagga Agricultural Institute for feed quality testing using overnight courier. The Wagga Wagga Agricultural Institute is operated by the NSW DPI and is fully accredited by NATA. Samples were tested for the parameters defined in Table 1.

The feed quality results were then combined to the Botanal data (i.e. total green and dead herbage mass) to determine the amount of feed available, and derive potential carrying capacities and stocking rates for the sampled areas based on the NSW DPI's *'Beef stocking rates and farm size – Hunter Region'* (2006).

Table 1 Feed analysis parameters

Parameter	Unit	Definition
Dry matter content (DM)	%	'Dry Matter' is everything remaining after all the water in the sample has been removed. DM contains the energy, proteins, vitamins and minerals required by animals for maintenance and production.
Dry matter digestibility (DMD)	% of DM	DMD is the proportion of the DM in a feed that can be digested by an animal.
Organic matter content (OM)	% of DM	OM is everything present in a feed except ash.
Dry organic matter digestibility (DOMD)	% of DM	DOMC is the proportion of the organic matter in the dry matter that can be digested by an animal.
Crude protein content (CP)	% of DM	CP is the proportion of protein and non-protein nitrogen in the feed.
Fibre content	% of DM	Fibre is the structural part of plants and feeds, consisting mainly of compounds called hemicellulose, cellulose and lignin.
Metabolisable energy (ME)	MJ ME/kg DM	ME is the amount of energy in a feed that is available to an animal to utilise for maintenance, production and reproduction.

2.2.6 Soil Sampling and Analyses

Soil sampling was undertaken at all the monitoring sites, and carried out in accordance with the guidelines detailed in the monitoring methodology (AECOM, 2012). The samples were taken from the top 100 mm of the topsoil layer using a hand held spade. Each sample consisted of a bulk sample of 7 to 9 subsamples collected from an area within a 20 m radius around the starting point of the LFA monitoring transect, with subsamples collected 10 to 15 m apart.

All samples were placed in strong plastic zip-lock bags, labelled and sent via courier to the NATA-accredited SESL laboratory for testing of the following parameters: pH and electrical conductivity, nutrients as available to plants (including Nitrate, Phosphate, Potassium, Sulphur, Calcium and Magnesium), cation balance, organic matter and organic carbon contents and trace metals.

2.2.7 Photographic Monitoring

Photographic monitoring was undertaken at all monitoring sites and in accordance with the monitoring methodology (AECOM, 2012). At each monitoring site three photographs were taken from the permanent star pickets located at the start and end of the LFA monitoring transect, looking in the direction of the transect line. Once the 50m tape was laid between the two star pickets, the following photographs were taken¹:

- A photograph to the left of the tape (with the tape just in the frame in the far right);
- A photograph with the tape (and star picket) in the centre of the frame; and
- A photograph to the right of the tape (with the tape just in the frame in the far left).

2.3 Weather

Temperatures and rainfall in the four months preceding the field monitoring period are listed in Table 2.

Conditions during the field surveys were dry and hot, with high humidity levels. Low rainfall occurred overnight between 27th and 28th February (3.8 mm). Daily temperatures ranged from 19°C and 32°C.

Most plants were at the flowering growth phase at the time of monitoring, facilitating species identification and providing optimal conditions for Botanical data collection.

Table 2 Weather conditions preceding and during the monitoring period (BoM Station # 061397)

Month	Actual monthly mean			Historical average (2003-2014)		
	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
Oct-14	10.7	27.9	35.4	9.9	26.2	44.7
Nov-14	15.7	31.9	18.0	14.0	28.8	83.6
Dec-14	18.3	30.3	143.2	15.6	29.8	70.3
Jan-15	18.4	30.0	160.4	17.7	31.8	59.2
Feb-15 [#]	17.7	29.5	18.6	17.5	30.2	98.5

[#] includes data up to 26 February 2015.

¹ Camera zoom lens settings was zero

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3.0 Monitoring Sites

3.1 Rehabilitation Sites

The rehabilitation monitoring sites studied during this monitoring event are listed in Table 3, with their location shown in

Figure 1 a (for HVO sites) and Figure 1 b (for MTW sites). For each rehabilitation monitoring site, the location of the LFA monitoring transect and of the Botanal study polygon are presented in Figure 2 a.

Cattle grazing had only been undertaken at 'RHB_HVON_Carrington' and RHB_WML_TD1 monitoring sites, the other rehabilitation sites had not been used for cattle grazing.

Table 3 Rehabilitation monitoring sites

Site name	Location	Coordinates (GDA 94 zone 56)		Type	Slope	Aspect	Age
		Easting	Northing				
RHB_HVON_Carrington	HVO North	309,568	6,404,407	Established exotic pasture	Flat	n/a [#]	8 yrs
RHB_HVOS_Riverview	HVO South	313,333	6,398,562	In progress exotic pasture	~2%	SSE	2 yrs
RHB_HVOW_Plane_Dump	HVO West	309,942	6,412,113	Established exotic pasture	~20%	NW	32 yrs
RHB_HVOW_Wilton	HVO West	306,305	6,407,394	Established exotic pasture	~16%	NW	20 yrs
RHB_MTO_North_Dump	Mt Thorley	320,950	6,387,294	Established exotic pasture	~10%	E	21 yrs
RHB_MTO_South_CHPP	Mt Thorley	322,923	6,386,334	Established exotic pasture	~20%	E	25 yrs
RHB_WML_Swanlake	Warkworth	319,231	6,391,585	In progress native pasture	~12%	N	2 yrs
RHB_WML_TD1	Warkworth	319,200	6,393,220	Established exotic pasture	~20%	N	22 yrs

[#] Aspect is irrelevant on a flat landform

3.2 Analogue Sites

A total of 22 potential locations for analogue sites were identified by the GIS overlay study, with various characteristics of land capability class and soil type. From these 22 locations, eight sites were short-listed by C&A's Environmental Specialist – Rehabilitation for inclusion in this year's programme of works. These are presented in Table 4, and their location shown in (for sites located on HVO land) and Figure 1 b (for sites located on MTW land). For each analogue monitoring site, the location of the LFA monitoring transect and of the Botanal study polygon are presented in Figure 2 b.

Table 4 Analogue monitoring sites

Site name	Coordinates (GDA 94 zone 56)		Soil type	Land Capability Class	Slope	Aspect
	Easting	Northing				
ANA_Carrington_Billabong	309,661	6,402,406	Alluvials	I-III	Flat	n/a
ANA_Cheshunt	314,650	6,403,102	Alluvials	I-III	Flat	n/a
ANA_Lemington_Rd	306,986	6,403,518	Brown Clays	I-III	~6-7%	NE
ANA_Howick	308,227	6,411,597	Soloth / Solodic	IV-VI	~12%	ENE
ANA_Parnells	306,188	6,408,198	Soloth / Solodic	IV-VI	~4-5%	S

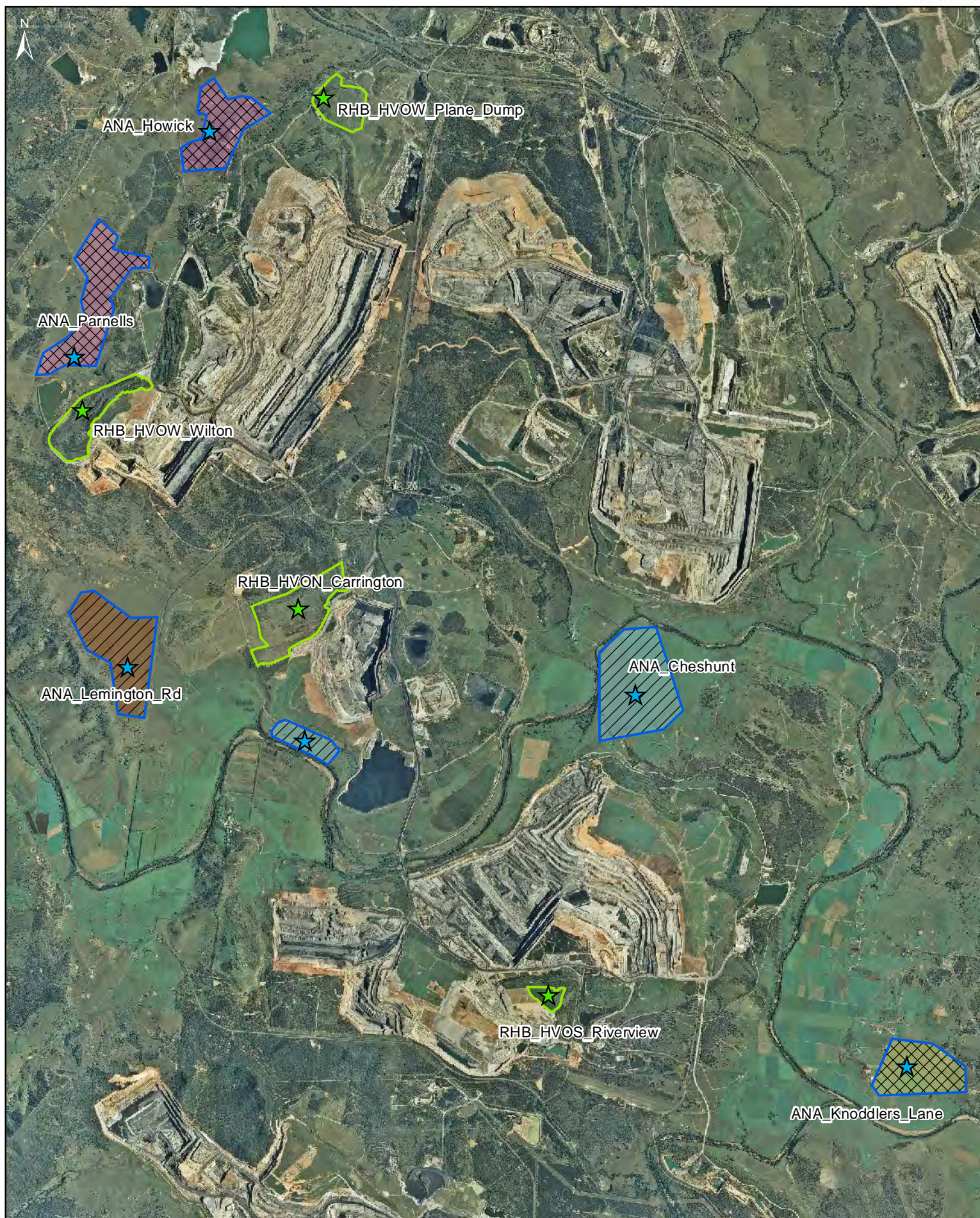
Site name	Coordinates (GDA 94 zone 56)		Soil type	Land Capability Class	Slope	Aspect
	Easting	Northing				
ANA_Knodlers_Lane	318,746	6,397,496	Yellow Podzolic	IV-VI	~1-2%	N
ANA_Newport	316,464	6,385,985	Yellow Podzolic	IV-VI	~5%	S
ANA_North_CHPP	321,232	6,390,970	Yellow Podzolic	IV-VI	Flat	n/a

Figure 1 a Rehabilitation monitoring programme – Monitoring sites locations, HVO

Figure 1 b Rehabilitation monitoring programme – Monitoring sites locations, MTW

Figure 2 a Rehabilitation monitoring sites – LFA transect and Botanal study polygon location

Figure 2 b Analogue monitoring sites – LFA transect and Botanal study polygon location



Monitoring sites



Analogue



Rehabilitation



Analogue Polygon (approx)



Rehabilitation Polygon

Soil Type



Brown Clays



Soloths/Solodic



Yellow Podzolic



Alluvials

Land Capability Class



I to III



IV to VI

Monitoring Sites Locations - HVO
 Rehabilitation Monitoring Programme 2015

Source: RTCA (2014), AECOM (2015)

0 250 500 1,000
 Metres

MAR 2015

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Fig. 1a



Monitoring sites



Analogue



Rehabilitation



Analogue Polygon (approx)



Rehabilitation Polygon

Soil Type



Brown Clays



Soloths/Solodic



Yellow Podzolic



Alluvials

Land Capability Class



I to III



IV to VI

Monitoring Sites Locations - MTW
 Rehabilitation Monitoring Programme 2015

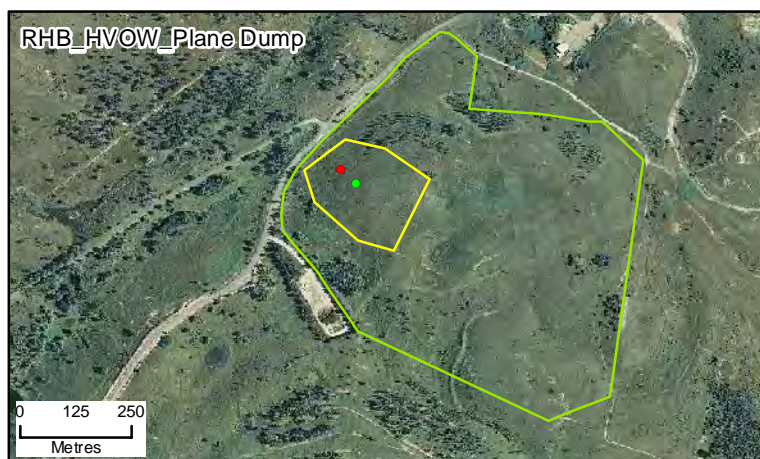
Source: RTCA (2014), AECOM (2015)

0 250 500 1,000
 Metres

MAR 2015

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Fig. **1b**



Rehabilitation Polygon
Botanal Study Area

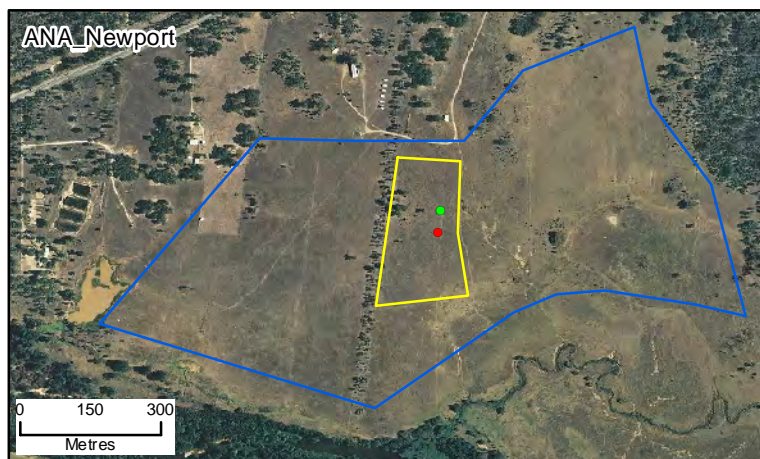
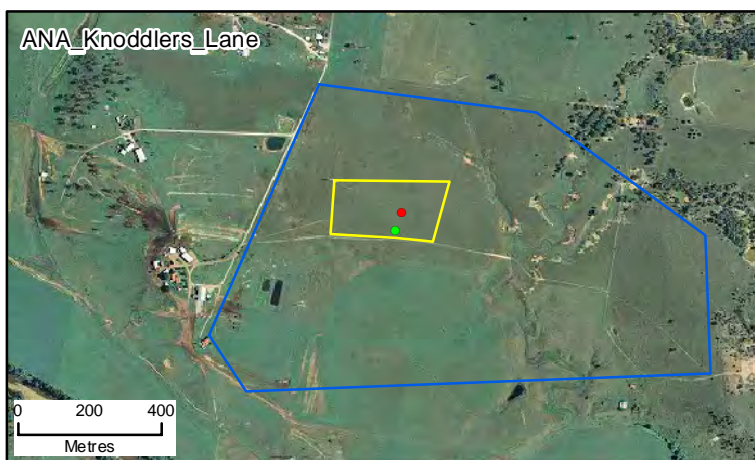
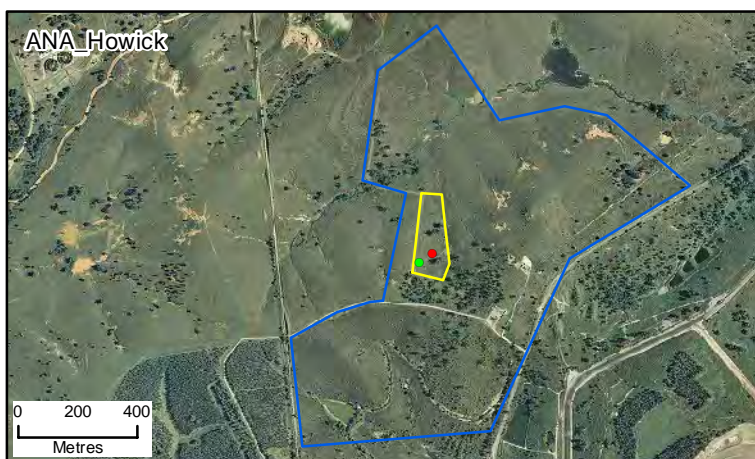
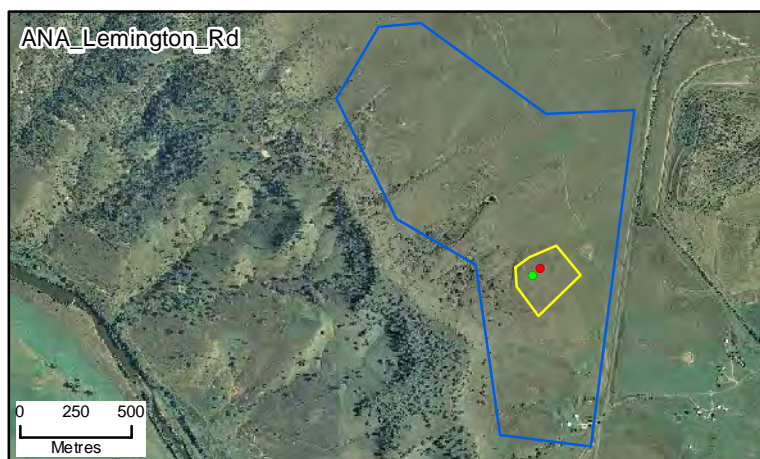
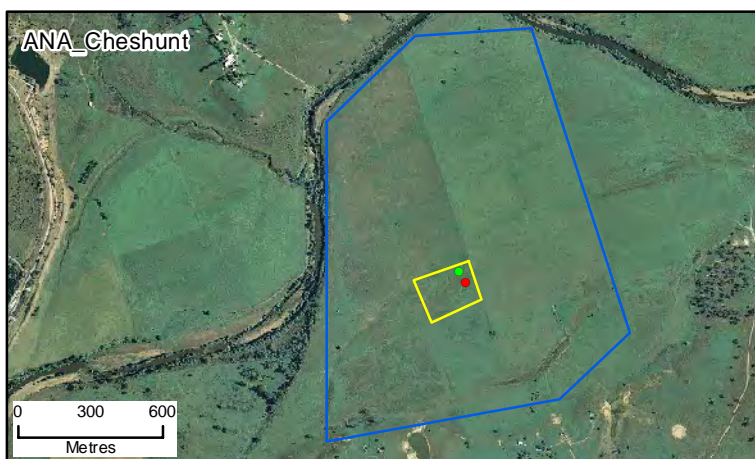
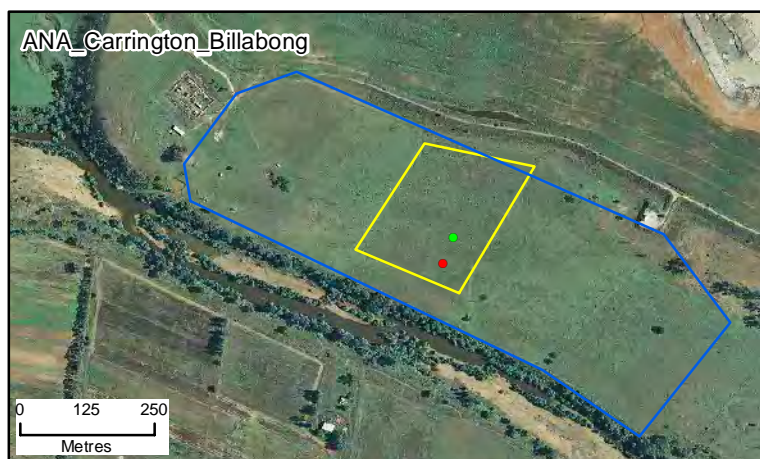
LFA Transect End
LFA Transect Start



**Rehabilitation monitoring sites:
LFA transects and Botanal study area location**
Rehabilitation Monitoring Programme 2015
Source: RTCA (2014), AECOM (2015)

MAR 2015
60340733

Fig. **2a**



Analogue Polygon (approx)
Botanal Study Area

LFA Transect End
LFA Transect Start



**Analogue monitoring sites:
LFA transects and Botanal study area location**
Rehabilitation Monitoring Programme 2015
Source: RTCA (2014), AECOM (2015)

MAR 2015
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Fig. **2b**

4.0 Monitoring Results

4.1 Landscape Function Analysis

The LFA results obtained at the 16 monitoring sites are summarised in Table 5, with the soil surface condition indices graphed in Figure 3.

Table 5 LFA monitoring results

Monitoring site		Landscape Organisation Index (LOI)	Soil surface condition indices		
			Stability	Infiltration	Nutrient cycling
Rehabilitation sites	RHB_HVON_Carrington	1.00	65.6	29.3	25.6
	RHB_HVOS_Riverview	1.00	67.2	28.0	26.6
	RHB_HVOW_Plane_Dump	1.00	66.3	32.3	28.7
	RHB_HVOW_Wilton	1.00	67.3	39.8	31.7
	RHB_MTO_North_Dump	0.98	64.7	33.3	25.8
	RHB_MTO_South_CHPP	1.0	66.3	31.1	25.1
	RHB_WML_Swanlake	0.93	60.4	30.8	22.6
	RHB_WML_TD1	0.97	66.8	34.7	30.0
Analogue sites	ANA_Carrington_Billabong	1.00	69.2	32.5	27.7
	ANA_Cheshunt	1.00	68.8	30.0	24.9
	ANA_Lemington_Rd	1.00	63.8	31.5	25.6
	ANA_Howick	1.00	66.9	36.8	30.7
	ANA_Parnells	1.00	67.2	37.3	30.7
	ANA_Knodlers_Lane	1.00	65.0	31.6	26.1
	ANA_Newport	1.00	63.8	29.4	24.1
	ANA_North_CHPP	1.00	65.6	32.2	25.6

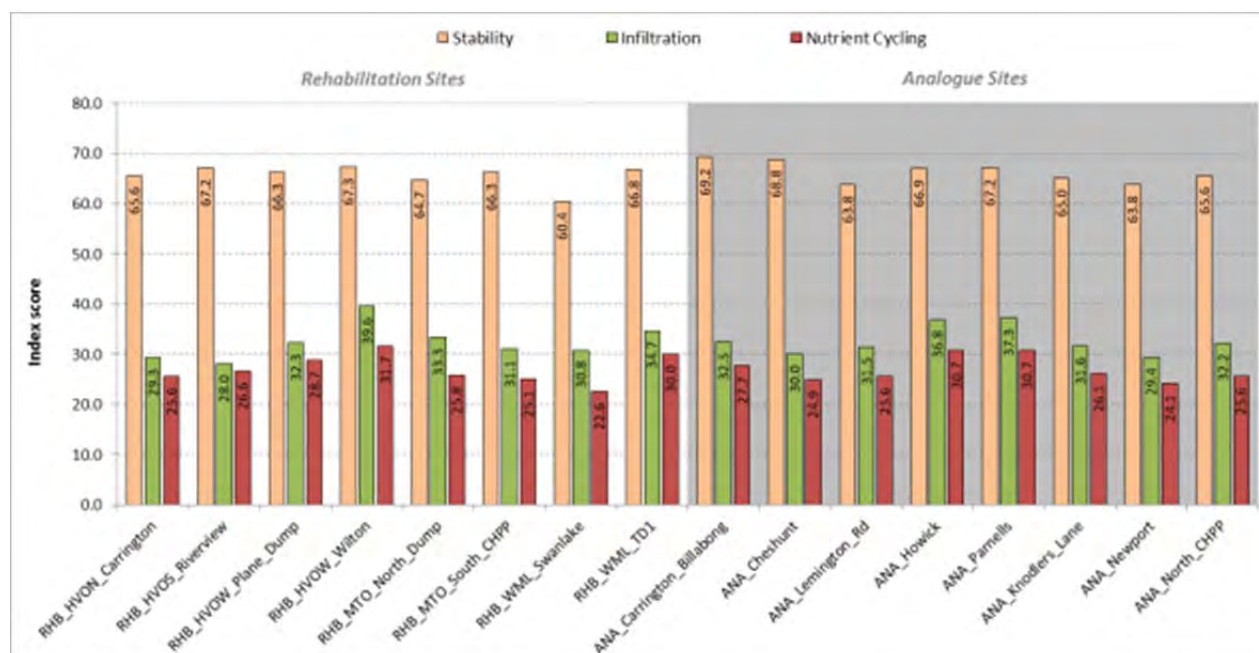


Figure 3 LFA monitoring results – Soil surface condition indices

4.2 Botanal

4.2.1 Herbage Mass

Botanal results for herbage mass (expressed in kg of Dry Matter (DM) per hectare) at each monitoring site are presented in Figure 4, which also shows the proportions of dead herbage and green herbage (by weight) making up the total herbage mass for each site.

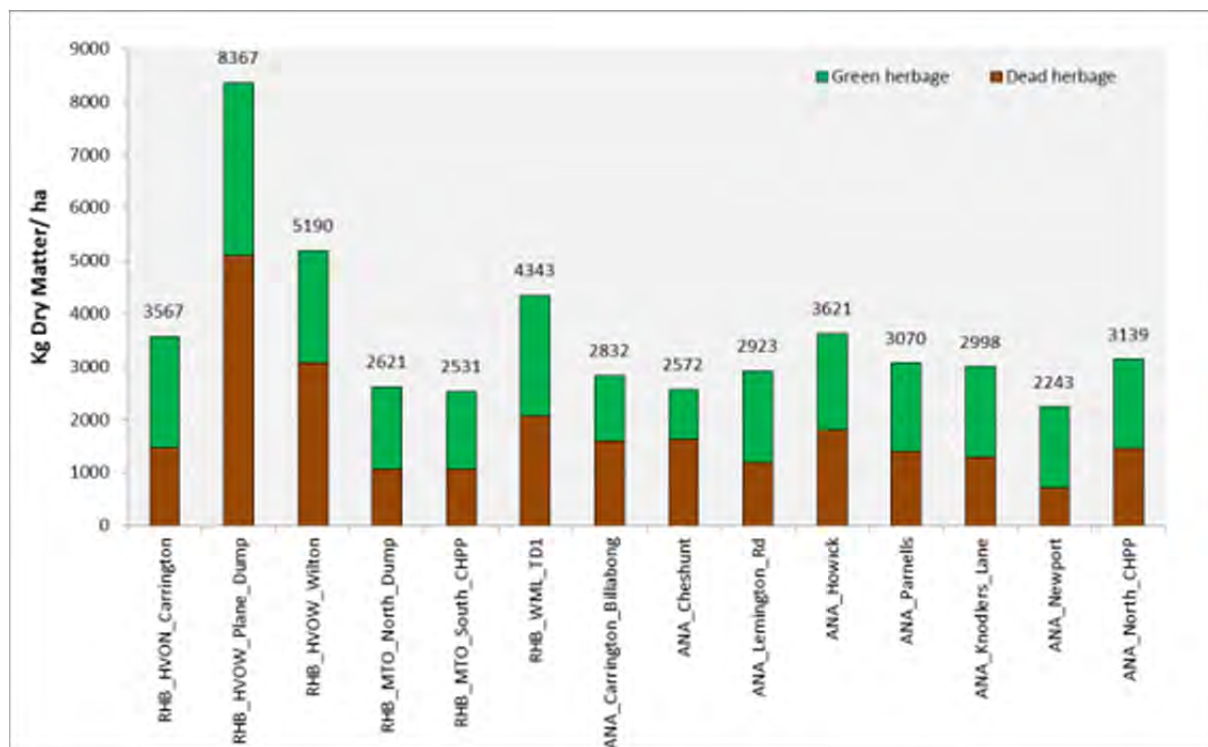


Figure 4 Botanal monitoring results – Herbage mass

4.2.2 Herbage Composition

Botanal results for herbage species composition (as a proportion of overall species diversity) are listed in Table 6 and presented graphically in Figure 5. The contribution of each species to the total herbage mass for each site is graphed in Figure 6.

Table 6 Botanal monitoring results – Herbage composition (percentage)

Monitoring site	Red Grass	Qld Bluegrass	Rat's Tail Grass	Rhodes Grass	Panic Grass	OPG [#] C3 ²	OPG C4 ¹	Legumes	Broadleaf weeds	Native forbs	Annual Grasses	Others	Total
RHB_HVON_Carrington	0	0	0	54	33	0	7	0	5	0	0	0	100
RHB_HVOW_Plane_Dump	0	0	0	94	5	0	0	0	0	0	0	0	100
RHB_HVOW_Wilton	0	0	0	98	0	0	0	0	2	0	0	0	100

² Native perennial grasses can be classified as either C3 or C4 plants, referring of the different pathways that plants use to capture carbon dioxide during photosynthesis. C3 plants are adapted to cool season establishment and growth in either wet or dry environments. On the other hand, C4 plants are more adapted to warm or hot seasonal conditions under moist or dry environments. A feature of C3 grasses is their greater tolerance of frost compared to C4 grasses. C3 species also tend to generate less bulk than C4 species; however, feed quality is often higher than C4 grasses (NSW DPI, non-dated).

Monitoring site	Red Grass	Qld Bluegrass	Rat's Tail Grass	Rhodes Grass	Panic Grass	OPG [#] C3 ²	OPG C4 ¹	Legumes	Broadleaf weeds	Native forbs	Annual Grasses	Others	Total
RHB_MTO_North_Dump	2	0	1	82	0	0	10	1	2	0	1	1	100
RHB_MTO_South_CHPP	35	1	6	6	2	0	34	2	12	2	1	1	100
RHB_WML_TD1	0	0	0	99	0	0	0	0	1	0	0	0	100
ANA_Carrington_Billabong	0	0	1	11	0	0	54	0	3	0	30	0	100
ANA_Cheshunt	0	0	0	0	0	0	25	0	11	0	64	0	100
ANA_Lemington_Rd	57	12	8	0	0	7	12	1	1	1	0	0	100
ANA_Howick	8	2	8	0	0	0	60	0	10	0	7	3	100
ANA_Parnells	14	4	53	0	0	1	20	1	4	0	1	1	100
ANA_Knodlers_Lane	3	1	43	0	0	0	44	0	2	1	5	1	100
ANA_Newport	31	2	30	0	0	0	20	0	2	14	1	1	100
ANA_North_CHPP	0	2	16	60	0	0	9	0	0	0	12	1	100

Key: [#] OPG = Other Perennial Grasses

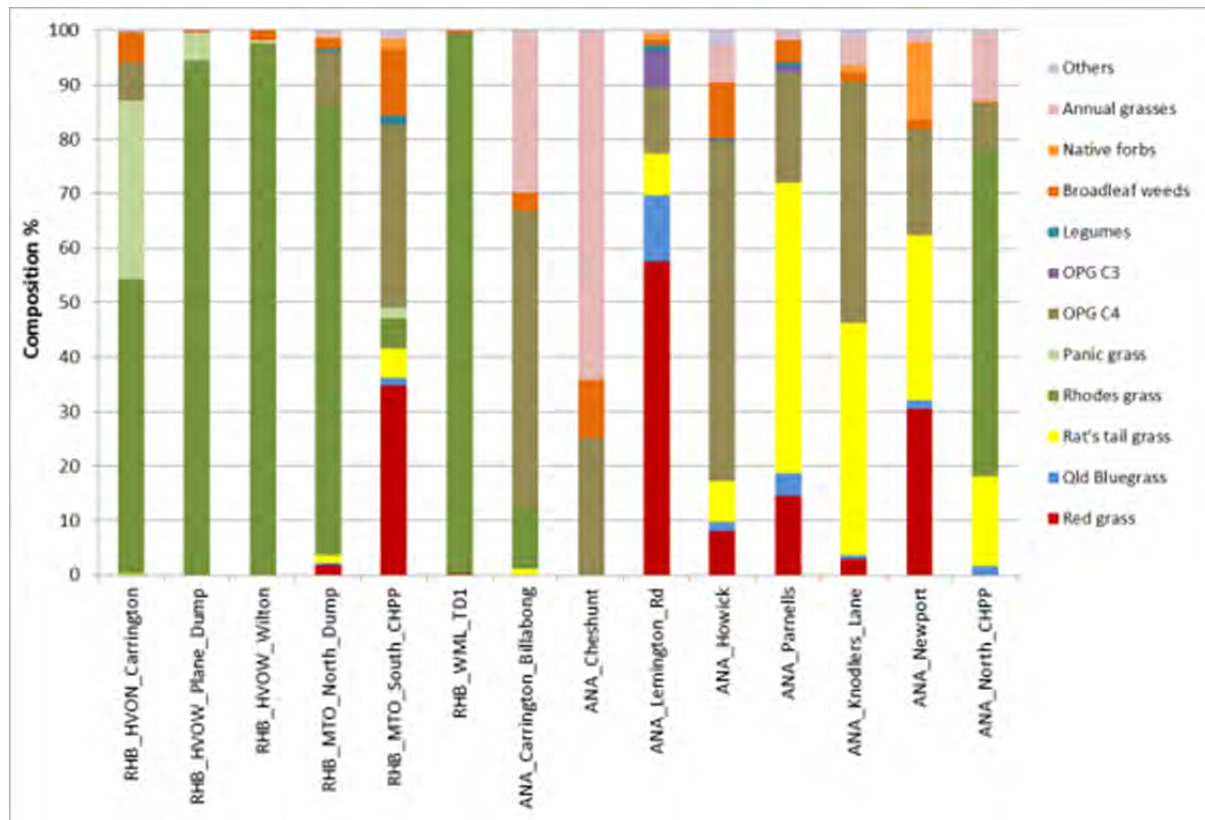


Figure 5 Botanical monitoring results – Herbage composition (percentage)

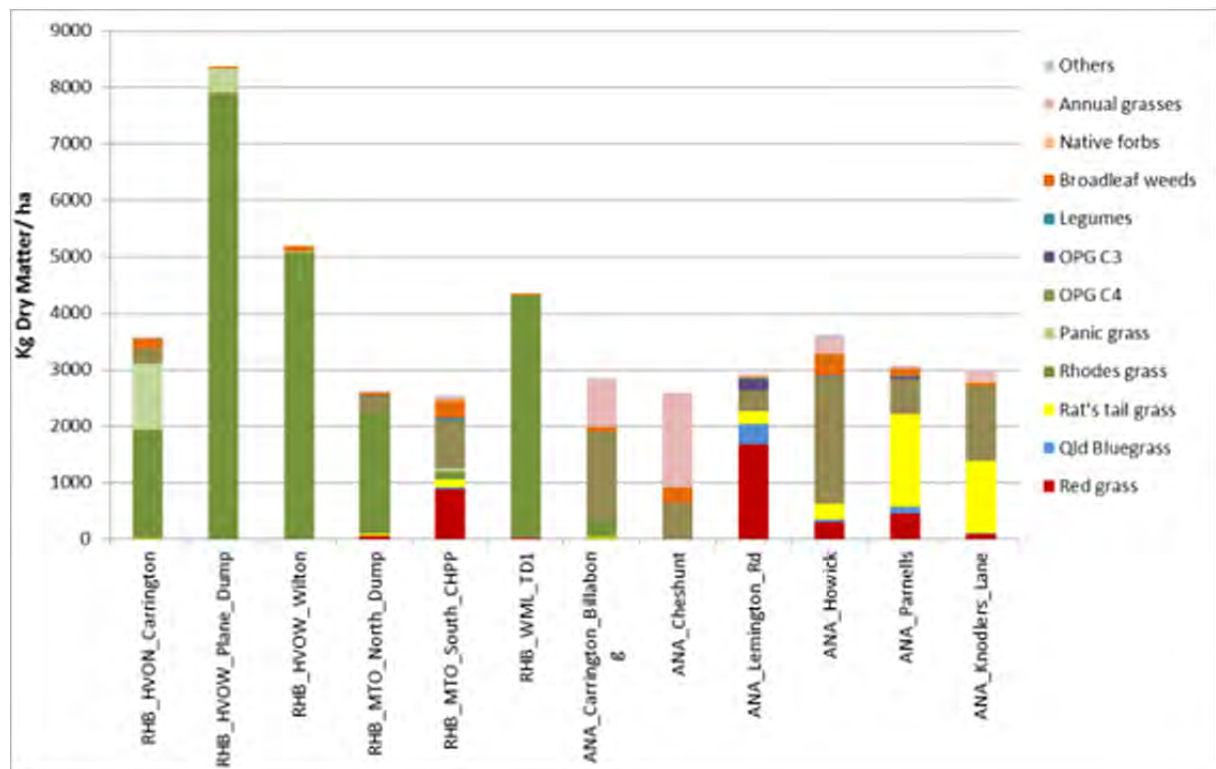


Figure 6 Botanical monitoring results – Herbage composition (contribution to total herbage mass)

4.3 Ground Cover

The ground cover performance of the younger rehabilitated pasture sites (assessed along the 50m linear transect) is shown in Figure 7. The ground cover results for the established rehabilitated pastures and the analogue sites (as assessed during Botanical) are graphed in Figure 8.

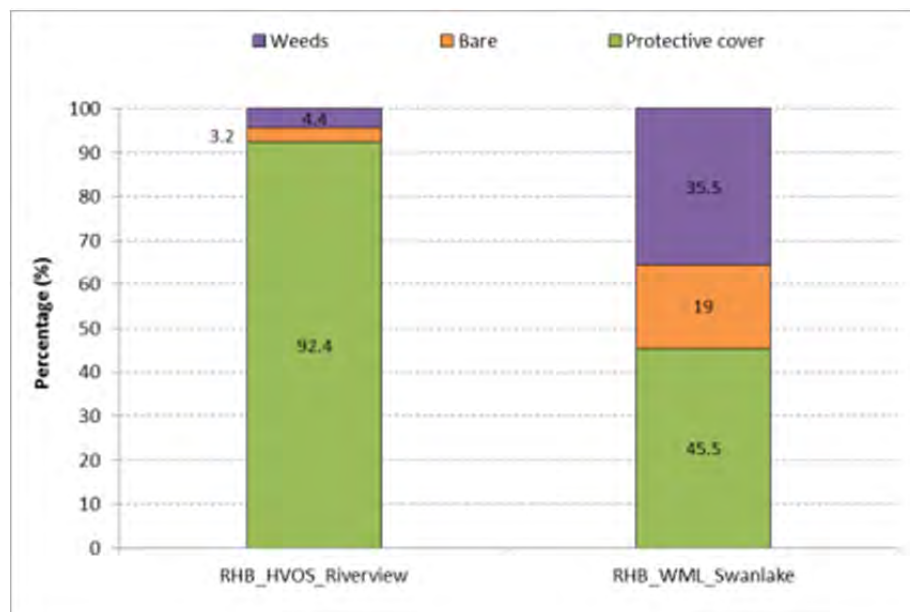


Figure 7 Groundcover monitoring results – young rehabilitation sites

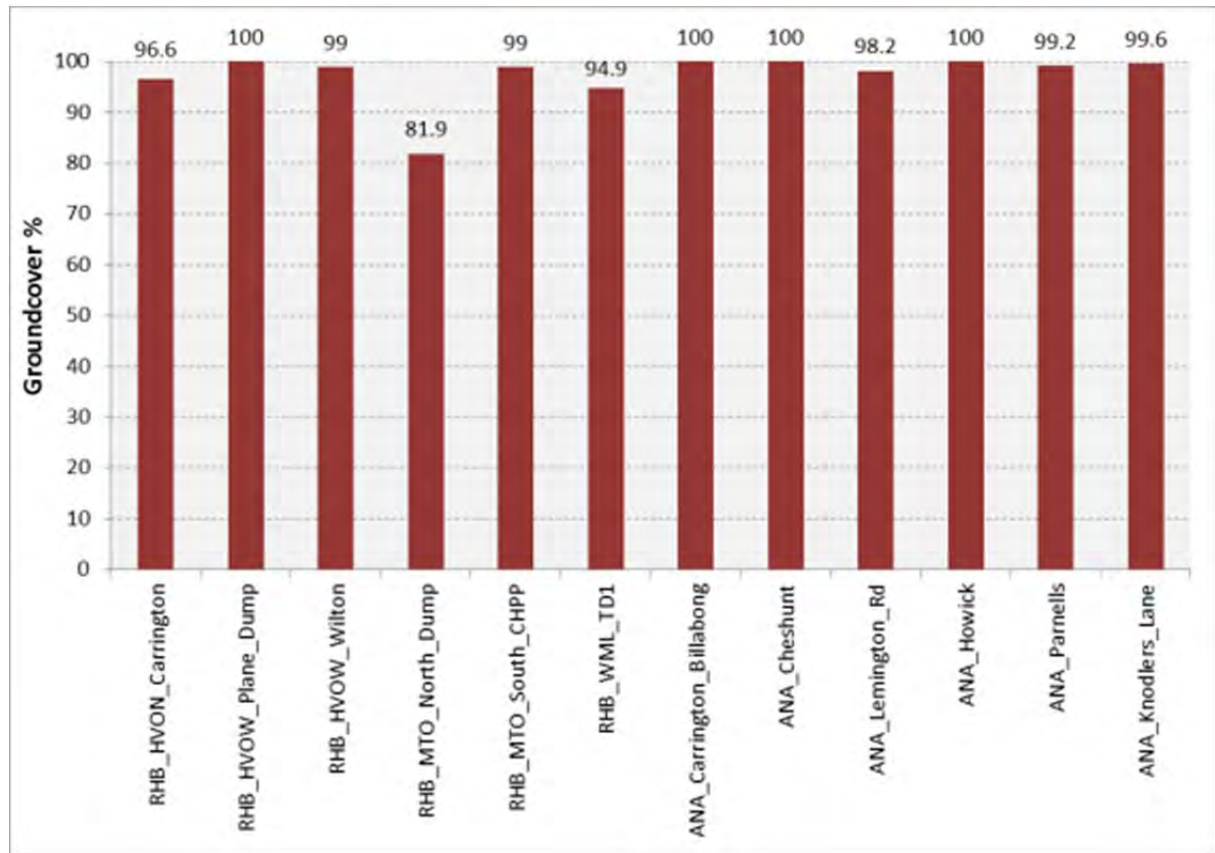


Figure 8 Groundcover monitoring results (Botanal) – Established pastures and analogue sites

4.4 Forage Quality – Feed Analysis

The feed analysis results have been summarised in Table 7, which includes the feed quality of both the green and dead components of the herbage at each monitoring site. Detailed results as provided by the laboratory are included in Appendix a.

Table 7 Feed analysis monitoring results

Monitoring site	Fraction	% of total herbage mass	DMD (%)	OM (%)	DOMD (%)	CP (%)	ME (MJ / kg DM)
RHB_HVON_Carrington	Green	58.6	60.0	90.0	58.0	7.5	8.7
	Dead	41.4	50.0	89.0	49.0	4.7	6.9
RHB_HVOW_Plane_Dump	Green	39.1	60.0	88.0	58.0	10.3	8.7
	Dead	60.9	43.0	85.9	43.0	6.9	5.7
RHB_HVOW_Wilton	Green	40.6	53.0	90.0	52.0	6.7	7.5
	Dead	59.4	46.0	91.0	46.0	3.9	6.2
RHB_MTO_North_Dump	Green	50.9	61.0	91.0	58.0	4.3	8.9
	Dead	41.0	46.0	88.0	46.0	0.1	6.2
RHB_MTO_South_CHPP	Green	57.6	58.0	91.0	56.0	7.9	8.4
	Dead	42.4	43.0	90.0	43.0	3.1	5.7
RHB_WML_TD1	Green	52.5	57.0	91.0	55.0	6.0	8.2
	Dead	47.5	45.0	88.0	45.0	2.1	6.1

Monitoring site	Fraction	% of total herbage mass	DMD (%)	OM (%)	DOMD (%)	CP (%)	ME (MJ / kg DM)
ANA_Carrington_Billabong	Green	43.3	64.0	91.0	61.0	6.4	9.4
	Dead	56.7	48.0	89.0	47.0	3.0	6.6
ANA_Cheshunt	Green	36.7	63.0	91.0	60.0	5.5	9.3
	Dead	63.3	52.0	87.0	54.0	3.9	7.6
ANA_Lemington_Rd	Green	59.1	65.0	90.0	62.0	6.2	9.6
	Dead	40.9	50.0	87.0	49.0	4.5	6.9
ANA_Howick	Green	50.2	61.0	91.0	59.0	10.8	9.0
	Dead	49.8	41.0	91.0	42.0	5.1	5.5
ANA_Parnells	Green	54.5	62.0	90.0	59.0	11.4	9.1
	Dead	45.5	46.0	90.0	46.0	6.1	6.3
ANA_Knodlers_Lane	Green	56.9	57.0	92.0	55.0	6.5	8.2
	Dead	43.1	44.0	91.0	44.0	9.0	6.0
ANA_Newport	Green	67.7	59.0	91.0	57.0	6.1	8.6
	Dead	32.3	47.0	89.0	47.0	0.1	6.5
ANA_North_CHPP	Green	53.8	55.0	90.0	54.0	4.0	7.9
	Dead	46.2	48.0	89.0	47.0	0.1	6.5

4.5 Soil Analyses

The results of the soil analyses for key soil chemistry parameters are summarised in Table 8³ (overleaf). Note that Table 8 only includes a summary of the most significant indicators of soil condition. The analyses results for the biosolids profile (i.e. trace metals/contaminants) have not been listed in Table 8 as results were generally very low for all elements and no restrictions to rehabilitation were noted.

For reference, the detailed results as provided by SESL are included in Appendix b.

4.6 Photographic Monitoring

The results of the photographic monitoring (i.e. photos taken from the start and end points of the monitoring transects) have been included in Appendix c.

³ It is noted that the testing methodologies used by SESL for major nutrient analyses were not the standard methods used for the assessment of growing media in NSW pastures. This is especially important for phosphorous (P) and sulphur (S) which are the two main limiting nutrients in NSW pastures. SESL used the Mehlich testing method for these nutrients whereas for soils in the Hunter Region P should be tested using the Colwell test method and S using the KCl40 test method. However and as far as possible, relevant conversions of P and S levels from Mehlich results to Colwell / KCl40 have been made throughout the discussion sections of this report.

Table 8 Soil analyses monitoring results

Monitoring Site	pH (CaCl ₂)	EC (dS/m)	Exchangeable cation percentage (%)				eCEC (me/100g)	Ca/Mg	OC (%)	Plants available nutrients (mg/kg)		
			Na	K	Ca	Mg				N (NO ₃)	P (PO ₄)	S (SO ₄)
RHB_HVON_Carrington	6.2	0.07	2.4	5.8	48.0	43.8	16.5	1.1	3.1	2.0	29.7	8.9
RHB_HVOS_Riverview	6.6	0.09	1.6	5.6	71.0	21.7	16.3	3.3	3.0	0.6	103.8	18.0
RHB_HVOW_Plane_Dump	7.0	0.1	0.6	5.5	51.3	42.9	20.0	1.2	3.8	2.0	21.9	11.0
RHB_HVOW_Wilton	6.2	0.93	2.5	2.9	43.1	51.6	26.1	0.8	3.3	5.2	31.9	894.0
RHB_MTO_North_Dump	7.0	0.38	11.6	4.3	39.1	45.0	23.2	0.9	5.3	2.1	51.0	157.0
RHB_MTO_South_CHPP	6.4	0.4	5.7	4.3	50.5	39.7	16.7	1.3	3.8	2.3	30.4	155.0
RHB_WML_Swanlake	7.0	0.26	3.7	3.6	64.8	27.7	17.2	2.3	3.4	1.1	16.8	121.0
RHB_WML_TD1	6.0	0.09	1.4	6.3	46.1	46.2	15.7	1.0	5.3	5.5	42.2	12.0
ANA_Carrington_Billabong	5.7	0.08	0.6	4.9	55.8	38.5	29.8	1.4	4.8	3.9	67.4	12.0
ANA_Cheshunt	6.1	0.09	0.6	4.0	59.7	35.7	28.6	1.7	4.0	4.9	77.0	9.5
ANA_Lemington_Rd	6.9	0.18	0.3	2.1	81.8	15.9	56.8	5.1	4.1	3.1	6.7	12.0
ANA_Howick	5.8	0.08	1.4	7.2	52.7	38.5	20.5	1.4	5.1	6.1	8.4	11.0
ANA_Parnells	5.4	0.06	2.8	7.8	57.4	31.8	15.4	1.8	3.9	5.1	5.9	10.0
ANA_Knodlers_Lane	4.9	0.05	1.0	9.0	26.4	18.6	7.0	1.4	2.4	2.1	12.4	12.0
ANA_Newport	5.4	0.07	4.1	6.5	32.6	56.8	14.3	0.6	2.5	1.8	8.6	10.0
ANA_North_CHPP	5.6	0.1	7.9	3.8	36.1	52.2	18.9	0.7	4.9	3.7	30.2	13.0

Keys: EC – Electrical Conductivity; Na – Sodium; K – Potassium; Ca – Calcium; Mg – Magnesium; eCEC – Effective Cation Exchange Capacity; OM – Organic Matter; OC – Organic Carbon; N (NO₃) – Nitrogen as Nitrates; P (PO₄) – Phosphorous as Phosphates; S (SO₄) – Sulphur as Sulphates.

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5.0 Discussion

It is noted that the discussion of the monitoring results undertaken in the following sections is primarily oriented towards the performance of the rehabilitation sites and how it compares against the benchmarks set at the corresponding analogue sites.

5.1 Landscape Function (Including Ground Cover)

Landscape function performance showed overall consistency across all monitoring sites, and the results obtained at all rehabilitation sites generally compared positively with those of the analogue sites. For reference, Table 9 lists the desired benchmarks for landscape function indices for rehabilitated mine sites. The benchmark values have been derived from Tongway and Hindley (2003) and CSIRO (2008), and adapted based on the index scores obtained for the analogue sites.

Table 9 Benchmarks for Landscape Function Indices

Rating	LOI	Stability Index	Infiltration Index	Nutrient Cycling Index
Excellent	>0.9	65+	35+	30+
Good	0.7-0.9	60-65	30-35	25-30
Satisfactory	0.5-0.7	50-60	25-30	20-25
Poor	0.3-0.5	40-50	20-25	15-20
Very poor	<0.3	<40	<20	<15

5.1.1 Landscape Organisation

The LOI values for all rehabilitation sites were very high and comprised between 0.93 and 1.0 (with five of the eight sites achieving a LOI score of 1.0) – where all analogue sites returned a LOI value of 1.0. The LOI is a measure of the number of obstructions per unit area of the transect, and the direct reflection of the amount of protective ground cover present. As such, the scores obtained were driven by the high levels of vegetation cover (and little bare ground) observed across the monitoring sites.

Protective ground cover was greater than 80% at all sites, and greater than 90% at six of the rehabilitation sites – which is consistent with groundcover levels observed at the analogue sites. The lowest ground cover scores were recorded at the 'RHB_WML_Swanlake' and 'RHB_MTO_North_Dump' monitoring sites with approximately 81-82% cover. It is noted that a high weed cover (principally of Hedge Mustard – *Sisymbrium officinale*) at 'RHB_WML_Swanlake' largely contributed to the protective ground cover score at this site (accounted for ~35.5% of the total protective ground cover), and therefore its groundcover performance may temporarily drop if weed suppression and control is implemented. However pasture establishment at this site was in progress and vegetation community composition irrelevant at this stage of monitoring.

Groundcover results were well correlated to LOI scores, with the lowest ground cover scores recorded at these three sites where a LOI value of 1.0 was not achieved.

Overall, vegetative cover was excellent and well above 70% at all sites, which can be considered a benchmark value in NSW for the minimum pasture cover required for soil protection, for efficient capture and use of rainfall and nutrients, and for sustainable long-term production (Lang, 1998).

5.1.2 Soil Surface Condition

Overall, the soil surface condition index scores were very consistent across all rehabilitation sites and generally comprised in the 'good' to 'excellent' range of values (refer to Table 9), indicating that all sites performed positively against the benchmarks set by the analogue sites.

Stability

Soil stability at all sites was largely promoted by the high ground cover provided by perennial grasses, and the relatively stable nature of the soil fragments as determined during the slake test field assessment. Stability indices

at most rehabilitation sites were within the 'excellent' range of values (i.e. $\geq 65\%$, refer to Table 9), with only 'RHB_MTO_North_Dump' and 'RHB_WML_Swanlake' returning indices falling within the 'good' range of values (i.e. 60-65%), which correlates well with these two sites also having the lowest ground cover percentage as discussed above. Overall, all rehabilitation sites were stable with no signs of active erosion observed during the field survey.

Infiltration

Infiltration indices were comprised between 28.0% and 39.8%. Soil infiltration potential was lowest at 'RHB_HVON_Carrington' and 'RHB_HVOS_Riverview' (yet still with index scores within the 'satisfactory' range of values, refer to Table 9), and highest at 'RHB_HVOW_Wilton' ('excellent' index score), with all other sites returning 'good' infiltration index scores (refer to Table 9). As with stability, the infiltration potential of the soils was greatly influenced by the dense grass vegetation cover across the sites. Indeed, the high vegetative ground cover present at all sites reduces water surface runoff velocities (thereby providing more time for water to infiltrate within the soil profile), and enhances infiltration processes by increasing the soil organic matter content, which in turns enhance soil aggregation and pore space within the soil profile (USDA 2008).

Nutrient Cycling

Nutrient cycling index scores are typically lower in pasture / grazing ecosystems when compared to what can be observed in areas of native vegetation, where mid and upper storey species provide for a lot more organic matter being returned to the ground. At all the pasture sites monitored, the nutrient cycling index was generally driven by the combined amount of perennial grass cover and grass litter (attached and loose). However in most cases the grass litter observed at the monitoring sites was not in an advanced stage of decomposition, generally with no fungal attack visible and no distinct layers in decomposition.

Nutrient cycling indices at the rehabilitation sites ranged from 22.6% to 31.7%, which was well aligned to the scores achieved at the analogue sites. The lowest nutrient cycling index was obtained at 'RHB_WML_Swanlake' – which was the least established pasture and showed lower ground cover and lower amount of grass litter, and had a high weed incidence. The site nonetheless returned a 'satisfactory' index (i.e. comprised between 20-25%, refer to Table 9). The highest nutrient cycling index was recorded at 'RHB_HVOW_Wilton' with a score within the 'excellent' range of values (refer to Table 9). All other sites returned indices comprised between 25-30%.

5.2 Pasture Performance

5.2.1 Herbage Mass and Composition

Herbage mass

Total herbage mass at the analogue sites was relatively uniform and comprised between ~2,200 kg DM/ha and ~3,600 kg DM/ha. In contrast, high variability was observed across the rehabilitation sites, where herbage mass ranged from ~2,500 kg DM/ha to ~8,400 kg DM/ha. In particular, the 'RHB_WML_TD1', 'RHB_HVOW_Wilton' and 'RHB_HVOW_Plane_Dump' monitoring sites supported herbage masses well above the analogue sites average (\pm standard deviation) with estimated productions of 4,343 kg DM/ha, 5,190 kg DM/ha and 8,367 kg DM/ha. This was explained by the overwhelming dominance of Rhodes grass at these three sites (accounting for $\geq 94\%$ pasture species composition) which formed a thick and tall vegetation cover, and by light grazing pressure at RHB_WML_TD1 and the absence of grazing at the other sites (apart from very light grazing pressure from kangaroos).

The proportions of dead and green matter composing the total herbage mass were overall consistent amongst the rehabilitation sites with an average of ~48.8% dead matter; and between the rehabilitation and analogue sites (~47.2% dead matter average for the analogue sites). The green herbage mass average at the rehabilitation sites was of 2,125 kg DM/ha (± 593 stdev), and of 1,538 kg DM/ha (± 282 stdev) at the analogue sites.

Herbage composition

Pasture composition was largely dominated by Rhodes Grass at most rehabilitation sites, with the exception of the 'RHB_MTO_South_CHPP' site which supported a higher pasture species diversity, and to some degree of the 'RHB_HVON_Carrington' where a high component of Panic Grass was present. Leguminous species were generally not occurring in rehabilitation sites. This differed greatly from the analogue sites where pasture composition was more diverse and where Rhodes and Panic grasses were generally absent (apart from at 'ANA_North_CHPP'). In this regard the 'RHB_MTO_South_CHPP' was the only rehabilitation site comparing reasonably well with the analogue benchmark in terms of pasture composition.

Pasture composition at the analogue sites was dominated by perennial C4 grasses (with dominant species usually including Slender Rat's Tail *Sporobolus creber* and Red grass *Bothriochloa macra*). Queensland Bluegrass *Dichanthium sericeum* was usually present but at low levels, as were native forbs and annual grasses. As for rehabilitation sites, legumes were generally absent at analogue sites.

It is noted that the condition of the pasture at 'ANA_Cheshunt' was poor with annual grasses largely dominating the pasture composition, and therefore this site may not constitute an appropriate reference for benchmark setting.

Weeds occurred at all monitoring sites inclusive of rehabilitation and analogue sites but their occurrence was overall limited (accounted for between 0% and 12% of herbage mass). Dominant weed species present were generally similar across all sites, with common species including Farmer's Friend (*Bidens pilosa*), Fennel (*Foeniculum vulgare*), Flaxleaf Fleabane (*Conyza bonariensis*), Galenia (*Galenia pubescens*), Narrow-leaf Cottonbush (*Gomphocarpus fruticosus*), Paddy's Lucerne (*Sida rhombifolia*), Plantain (*Plantago lanceolata*), Purpletop (*Verbena spp.*), Ragweed (*Ambrosia artemisiifolia*), and various Thistles.

5.2.2 Feed Quality and Potential Carrying Capacity

Despite obvious disparities in pasture composition, feed quality was very consistent across all monitoring sites, inclusive of rehabilitation and analogue sites. Of the parameters derived by the feed analyses, crude protein (CP), metabolisable energy (ME) and the digestibility of the dry matter (DMD) are the most useful indicators of feed value.

- The DMD at all sites was comprised between approximately 48-58%. The DMD of the feed at the rehabilitation sites averaged 52% (± 2.55 stdev), while the analogue sites average was 54.2% (± 2.52 stdev).
- The CP content was more variable amongst monitoring sites, but results for both rehabilitation and analogue sites were comprised within a comparable range of values (within 2.6-8.2% at rehabilitation sites and within 2.2-9.0% at analogue sites).
- The ME content of the feeds was very consistent across all sites. Average ME at rehabilitation sites was 7.3 MJ / kg DM (± 0.45 stdev), while average ME at analogue sites was 7.8 MJ / kg DM (± 0.44 stdev).

These results may be explained by the fact that Rhodes Grass (dominant in rehabilitation sites) and Slender rat's tail and Red grass (generally dominant in analogue sites) are all C4 perennial grasses and can have similar nutritional values especially in their late flowering / dough stage of growth – which was the case at all sites at the time of monitoring.

Feed quality was overall low at all sites, which is due to a number of factors including the late growth stage (flowering / dough) of plants at the time of monitoring (the feed value and digestibility of a pasture declines as it matures) and the overall absence of leguminous species. Legumes are very important to achieve a productive pasture, they provide high quality feed (generally with higher protein levels and digestibility than grasses, and more palatable to animals) and help improving soil fertility through nitrogen fixation, which in turns improves the growth of companion grass species.

Given the DMD of the feed at all monitoring sites (~52-54%), satisfactory production levels in beef cattle (dry cow) could only be maintained where a minimum green herbage mass of 3,400 kg DM/ha is available, including a legume content of 15% (NSW DPI, 2006b). As noted above, none of the monitoring sites achieved such levels of green herbage mass, nor contained sufficient proportions of legumes. Consequently, sustainable grazing enterprises could not be achieved at the monitoring sites without improved management measures being implemented. Immediate action could involve biomass reduction to keep the pastures in the growth phase where digestibility is higher (as opposed to flowering / dough phases).

Carrying capacity calculation – Using feed quality

For information and comparison purposes only, potential stocking rates and carrying capacities have been calculated in Table 10. Calculations have been made for a 450kg dry stock cattle enterprise and for a yearling production system.

- Stocking rates have been calculated using the amount of feed available, the ME content of the feed (as per laboratory results), and the average feed requirement of various livestock on a monthly basis. Importantly and for the purpose of stocking rates calculations, the following adjustments have been made to the amount of feed available (as derived by Botanal, refer to Section 4.2.1):

- Cattle do not graze herbage to ground level and grazing height is usually 5-10 cm above ground level. In a dense and abundant pasture (especially dominated by Rhodes Grass), the amount of herbage not grazed – called 'pasture residue', is usually in the order of 1,000 kg DM / ha (N. Griffiths, pers. Comm.). This amount of feed has been deducted from the total amount of feed available for each site.
 - A grazing efficiency of 100% cannot be achieved in a pasture system as some herbage wastage occurs via trampling by cattle, animal manure, etc. For the pasture studied here, a wastage of 30% of the total feed available can be reasonably expected (N. Griffiths, pers. Comm.). This amount has also been deducted from the total feed available.
- In the Hunter Valley, the average energy requirement for dry stock is 54.0 MJ/day and for 350kg yearlings gaining 1.5kg/ day is 116 MJ/day (from NSW DPI, 2006a). This equates to 1,620 MJ/month⁴ for dry stock and 3480 MJ/month for yearlings, respectively.
- Potential carrying capacities were calculated for the rehabilitation sites only, utilising the area of the rehabilitation polygon 'paddock' size (the polygon area was derived using GIS, discounting areas supporting dense tree cover occurring within a polygon). Carrying capacities could not be derived for the analogue sites as paddock size was unknown.

Table 10 Potential carrying capacities based on quality of feed available

Monitoring Site ⁵	Feed available [#] (kg DM / ha)	ME (MJ / kg DM)*	Potential stocking rate (animal / ha)		Paddock area (ha)	Carrying capacity (individuals)	
			Dry stock	Yearling		Dry stock	Yearling
RHB_HVON_Carrington	1,797	8.0	8.9	4.1	76.0	674	314
RHB_HVOW_Plane_Dump	5,157	6.9	22.0	10.2	42.0	922	429
RHB_HVOW_Wilton	2,933	6.7	12.1	5.6	15.0	182	85
RHB_MTO_North_Dump	1,135	7.8	5.5	2.5	43.0	235	109
RHB_MTO_South_CHPP	1,072	7.3	4.8	2.2	48.0	231	108
RHB_WML_TD1	2,340	7.2	10.4	4.8	84.0	873	407
ANA_Carrington_Billabong	1,282	7.8	6.2	2.9	N/A	N/A	N/A
ANA_Cheshunt	1,100	8.2	5.6	2.6	N/A	N/A	N/A
ANA_Lemington_Rd	1,346	8.5	7.1	3.3	N/A	N/A	N/A
ANA_Howick	1,835	7.3	8.3	3.8	N/A	N/A	N/A
ANA_Parnells	1,449	7.8	7.0	3.2	N/A	N/A	N/A
ANA_Knodlers_Lane	1,399	7.3	6.3	2.9	N/A	N/A	N/A
ANA_Newport	870	7.9	4.2	2.0	N/A	N/A	N/A
ANA_North_CHPP	1,497	7.3	6.7	3.1	N/A	N/A	N/A

[#] following relevant deductions of herbage residue and wastage.

* Averaged for green and dead fractions in proportion of their weight contribution to the total herbage mass.

The 'RHB_HVOW_Plane_Dump' and 'RHB_HVOW_Wilton' sites returned the highest potential stocking rates of all monitoring sites. Despite having the poorest feed quality, these sites could temporarily support such stocking rates thanks to the very high amount of feed available at the site. All other rehabilitation sites returned potential stocking rates in line with those achieved at the analogue sites.

It is important to note that these calculations have been undertaken for example purposes only. In reality, the amount of energy currently contained in the feed at the rehabilitation and analogue sites (i.e. ~7.0-8.0 ME / kg

⁴ Based on a 30 day month

⁵ Note that stocking rates calculations as shown in Table 10 and Table 11 and have not been undertaken for the 'RHB_HVOS_Riverview' and 'RHB_WML_Swanlake' where pasture establishment was in its early stages and thus where Botanal was not implemented.

DM) would be insufficient for yearlings to gain weight and would only provide for weight maintenance. This is based on the premise that a yearling production program based on a 350kg beast with a planned weight gain of 1.5kg/day requires 116 MJ/day of feed. As the feed quality in the paddocks averages ~7.0-8.0 ME / kg DM the beast would need to eat between 14.5 -16.5 kg of feed / day. .

Furthermore, it is noted that the stocking rates calculated in Table 10 were derived from the amount of feed available at that point in time when the monitoring was undertaken. At the time, herbage mass at most rehabilitation sites was very high due to the absence of active grazing, and to the excellent (and somewhat unseasonal) growing conditions experienced in mid-summer in the region (with unseasonably high rainfall, refer to Table 2 in Section 2.3). As such, the herbage mass recorded can be assumed to be unrepresentative of the herbage mass that would be available if the areas were actively managed with cattle grazing. Consequently, the calculated carrying capacities would be unsustainable.

Carrying capacity calculation – Using Soil phosphate levels

The NSW DPI's 'Beef Stocking Rates – Hunter Region' (2006) provides a generic method to approximate carrying capacities based potential land productivity as regulated by available soil phosphate (P) levels. This method does not account for pasture species composition and feed quality, but relies more on a knowledge of fertiliser history and Agricultural Suitability Class. Based on the soil sample analyses results and the NSW DPI (2006) guidelines, the potential stocking rates have been calculated with results presented in Table 11. For information and comparison purposes only, potential carrying capacities at the rehabilitation sites have also been calculated in Table 11 using the rehabilitation polygon areas as discussed above.

Calculations have been made for a 450kg dry stock cattle enterprise and for a yearling production system. The feed requirements for these production systems (and used in the calculations of carrying capacities) are 6.0 DSE⁶ / breeding unit and 18.6 DSE / breeding unit, respectively.

The results in Table 11 indicate that based on soil productivity, higher stocking rates can generally be achieved at rehabilitation sites than at analogue sites, where soil P levels were generally lower. The exception being for those analogue sites located on alluvial soils ('ANA_Carrington_Billabong' and 'ANA_Cheshunt') where soil P levels were highest. This indicates that when linked to pasture productivity, the growing media used in rehabilitated pasture lands (and associated historic fertiliser regime) has a potential for higher stocking rates than those analogue sites located on Brown Clays, Solodic and Yellow Podzolic soils, which are common soil types in the region and areas which have a typical fertiliser history or irregular or no super phosphate application.

It is also noted that the stocking rates achieved with this method are likely to be more realistic and sustainable than those calculated previously (using the feed quality results), as they are based on the productivity potential of the growing media over the medium term. However and as mentioned above, the legume content of the pastures would need to be increased.

Table 11 Potential carrying capacities based on soil phosphate levels

Monitoring site ⁷	Soil P level ⁸	Pasture productivity (DSE/ha)	Potential stocking rate (animal / ha)		Carrying capacity (individuals) ⁹	
			Dry Stock	Yearling	Dry Stock	Yearling
RHB_HVON_Carrington	Med-Low	4	0.66	0.21	50.6	16.3
RHB_HVOW_Plane_Dump	Med-Low	4	0.66	0.21	28	9.0
RHB_HVOW_Wilton	Med-Low	4	0.66	0.21	10	3.2
RHB_MTO_North_Dump	High	10	1.66	0.54	71.6	23.1
RHB_MTO_South_CHPP	Med-Low	4	0.66	0.21	32	10.3

⁶ DSE = Dry Sheep Equivalent. DSE is a measure used to compare the feed requirements of different animals. 1 DSE is the average amount of pasture feed consumed by a 50kg wether (an adult but non-lactating sheep) on a monthly basis.

⁷ Note that stocking rates calculations as shown in Table 10 and Table 11 and have not been undertaken for the 'RHB_HVOS_Riverview' and 'RHB_WML_Swanlake' where pasture establishment was in its early stages and thus where Botanal was not implemented.

⁸ P level range was defined as follow (when P measured using the Mehlich test as per current laboratory procedure): Low (<20 mg/kg), Medium-Low (20-40 mg/kg), Medium (40-70 mg/kg), or High (>70 mg/kg).

⁹ Carrying capacities could not be derived for the analogue sites as paddock size was unknown.

Monitoring site ⁷	Soil P level ⁸	Pasture productivity (DSE/ha)	Potential stocking rate (animal / ha)		Carrying capacity (individuals) ⁹	
			Dry Stock	Yearling	Dry Stock	Yearling
RHB_WML_TD1	Medium	8	1.33	0.43	112	36.2
ANA_Carrington_Billabong	High	10	1.66	0.54	N/A	N/A
ANA_Cheshunt	High	10	1.66	0.54	N/A	N/A
ANA_Lemington_Rd	Low	2	0.33	0.11	N/A	N/A
ANA_Howick	Low	2	0.33	0.11	N/A	N/A
ANA_Parnells	Low	2	0.33	0.11	N/A	N/A
ANA_Knodlers_Lane	Low	2	0.33	0.11	N/A	N/A
ANA_Newport	Low	2	0.33	0.11	N/A	N/A
ANA_North_CHPP	Med-Low	4	0.66	0.21	N/A	N/A

5.3 Growing Media

Note that the discussion below focuses on the most important parameters of soil condition as pertaining to a grazing pasture land use. For reference, Table 12 details the desirable values for these significant parameters (from Reid, 2004 and Hazelton and Murphy, 2007).

Table 12 Desirable values for soil characteristics (NSW temperate pastures)

Parameter	Satisfactory level
pH (CaCl ₂)	5.0-7.5
Electrical conductivity (salinity)	<0.2 µS/m (i.e. non-saline)
eCEC	> 10.0 meq/100g
Exchangeable calcium	65-80%
Exchangeable magnesium	10-20%
Exchangeable potassium	3-8%
Exchangeable sodium (sodicity)	< 6% (i.e. non-sodic)
Exchangeable aluminium	< 1%
Calcium/magnesium ratio	> 3
Phosphorous	Low (<20 mg/kg), Medium-Low (20-40 mg/kg), Medium (40-70 mg/kg), High (>70 mg/kg)
Nitrate	> 10 mg/kg
Sulphur	10-20 mg/kg
Organic carbon	> 2%

- pH levels at the rehabilitation sites were comprised between 6.0 and 7.0. This was generally higher than the pH observed at analogue sites (where levels were comprised between 4.9 and 6.9) yet within the satisfactory levels for pasture productivity listed in Table 12.

- Electrical conductivity levels were very low to low (i.e. non-saline) at four of the rehabilitation sites including 'RHB_HVOW_Plane_Dump', 'RHB_HVOS_Riverview', 'RHB_HVON_Carrington', and 'RHB_WML_TD1'. Moderate salinity (i.e. 0.2-0.4 $\mu\text{S/m}$) was recorded at 'RHB_MTO_South_CHPP', 'RHB_MTO_North_Dump' and 'RHB_WML_Swanlake', whilst 'RHB_HVOW_Wilton' was highly saline ($>0.8 \mu\text{S/m}$). In comparison, salinity was low to very low at all analogue sites.
 - The moderate and/or high salinity levels recorded at the rehabilitation sites did not appear to have a noticeable impact on pasture productivity (plant growth, feed value) at the time. However, close monitoring of salinity at 'RHB_HVOW_Wilton' in particular should be undertaken to ensure leaching occurs and salinity levels decline over time. Salinity – if sustained, has the potential to affect pasture production by interfering with nitrogen and water uptake, reducing growth and stopping plant reproduction. Sensitive leguminous species would particularly struggle to establish where salinity levels are elevated.
- In line with the analogue sites, the CEC was moderate to high at all rehabilitation sites, indicating a good potential for nutrient retention and holding capacity.
 - The cation balance was highly magnesian at all rehabilitation sites, and moderate sodicity (i.e. sodium content) was present at 'RHB_MTO_South_CHPP' and 'RHB_MTO_North_Dump'. At these two sites, the high magnicity combined with the moderate sodicity mean that fines in the soils are likely to be dispersive and prone to erosion. However both sites were stables with no active erosion observed.
 - With the exception of 'RHB_HVOS_Riverview', the Ca:Mg ratio was low for all rehabilitation site, indicating overall calcium deficiencies in the growing media.. However calcium levels were generally in line with those present at the analogue sites.
- With regards to available nutrients, the following points are raised:
 - Levels of phosphates were generally medium-low to medium, with the exception of 'RHB_MTO_North_Dump' where high levels were available (refer to Table 12). Phosphorous is one of the two main limiting nutrients for pasture productivity in the Hunter Valley (with sulphur), and P levels should be maintained around 20-40 mg/kg (Mehlich test) for improved pastures in the Hunter Valley. Most rehabilitation sites therefore showed adequate phosphate levels.
 - Nitrogen levels were very low at all sites and below the preferred levels of 10 mg/kg. However it is noted that nitrates levels fluctuate widely depending on the season and rainfall. Besides, N levels should not constitute a priority concern for pasture productivity in the region, and should be addressed only after satisfactory levels of P and S are achieved, and only once cattle management is introduced.
 - 'RHB_HVOW_Plane_Dump', 'RHB_HVOS_Riverview', 'RHB_HVON_Carrington', and 'RHB_WML_TD1' returned very elevated levels of sulphates, which is to be linked to the salinity levels observed at these sites. Sulphur levels at the other rehabilitation sites were satisfactory and aligned to that found in analogue areas.
- Organic carbon levels were high at all sites ($>3\%$) and comparable between rehabilitation and analogue sites. Organic carbon is a measure of the organic matter in the soil, and stores important nutrients, stabilises soil structure and feeds soil microbes. These results indicate overall good soil fertility.

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6.0 Conclusions and Recommendations

6.1 Overall Rehabilitation Performance

6.1.1 Landscape Function

Overall, the results of this monitoring event indicate that all rehabilitation monitoring sites are performing very well in terms of landscape function, with performances comparing positively with those achieved at the relevant analogue sites.

All rehabilitation sites appeared very stable with no rilling or other signs of active erosion. However, it is worth noting that two of the monitoring sites ('RHB_MTO_South_CHPP' and 'RHB_MTO_North_Dump') returned elevated levels of soil magnicity and sodicity, making them potentially prone to erosion should the protective ground cover decrease.

Soil stability was largely promoted by the excellent protective ground cover of perennial grasses achieved at all sites. Indeed, grass cover was above 80% at all sites, and $\geq 95\%$ at six of the eight sites monitored. In all cases grass cover was well above 70%, which can be considered a benchmark value in NSW for the minimum pasture cover required for soil protection, for efficient capture and use of rainfall and nutrients, and for sustainable long-term production (Lang, 1998).

The results of the LFA were very consistent across all sites monitored, inclusive of both rehabilitation and analogue sites. All LOI scores were very high as influenced by the excellent ground cover which leads to excellent resource retention across the slopes. Likewise, SSCI scores were generally within the high range of values at all sites, with stability, infiltration and nutrient cycling indices all driven up by the high grass cover and varying amount of grass litter present. Noticeably, LFA results at the younger rehabilitation sites were also well aligned to the performance of the older sites and of the analogue sites.

Plant growth (key to efficient landscape function) was usually promoted by the adequate soil physical and chemical properties, with most parameters analysed being within satisfactory range for pasture growth and production. The characteristics of the growing media on rehabilitated lands were comparing well against the values of the analogue sites, and soil fertility was generally satisfactory for pasture production, particularly in terms of organic carbon levels and phosphorous availability. However, salinity and sulphur levels were elevated at four of the rehabilitation sites although no negative discernible effects were obvious at the time of monitoring, these levels may constrain optimal pasture establishment and production in the longer-term on rehabilitated sites and should be closely monitored accordingly.

6.1.2 Pasture quality

The pasture composition measured in the rehabilitation sites was inconsistent with that of the analogue sites. Pastures at most rehabilitation sites were largely dominated by Rhodes Grass, which formed a dense and tall layer. The exception being the 'RHB_MTO_South_CHPP' site which supported a higher pasture species diversity, and to some degree of the 'RHB_HVON_Carrington' where a high component of Panic Grass was present. It is noted that these two sites were the oldest (age since establishment) of all monitored rehabilitated pastures, and their more diverse composition may be due to different rehabilitation techniques (e.g. species mix) or to progressive dieback of the Rhodes Grass (the species usually dies out after 4-5 years if not further disturbed or fertilised (Cook et al, 2005)). Legumes were altogether absent from the rehabilitated pastures.

Rhodes Grass often dominates when sown in a mixture due to its good seedling vigour and ability to spread through runners (Moore et al, 2006). Although the species offers palatability and quality feed grazing for livestock when young shoots are present, its quality significantly decreases with age. Management practices should therefore be implemented to maintain the productivity of the rehabilitated pastures where the species was overwhelmingly dominant.

In contrast, pasture composition was much more diverse in analogue sites, which were dominated by a range of C4 grasses and where Rhodes was generally absent (however the presence of legumes was also very limited in analogue sites). Overall, there didn't seem to be a significant difference in pasture composition at the analogue sites based on soil type and land class capability, with the exception of pasture composition on alluvial soils. However, the pasture compositions recorded at the monitored alluvial analogues were likely the result past and current land management practices, particularly with regards to the high proportion of annual grasses present.

The absence (or limited levels) of legumes at both rehabilitation¹⁰ and analogue sites will limit their overall productivity. Indeed, legumes are very important to achieve a productive pasture as they provide high quality feed (generally with higher protein levels and digestibility than grasses, and more palatable to animals) and help improve soil fertility through nitrogen fixation, which in turn improves the palatability of companion grass species.

Feed quality was overall low at all sites, which is due to a number of factors including the late growth stage (flowering / dough) of plants at the time of monitoring (the feed value and digestibility of a pasture declining as it matures) and the overall absence of leguminous species. The comparable feed quality returned for both rehabilitation and analogue sites – despite clear difference in composition, may be explained by the fact that Rhodes Grass (dominant in rehabilitation sites) and Slender rat's tail and Red grass (generally dominant in analogue sites) can have similar nutritional values especially in their late flowering / dough stage of growth. Results from the analogue sites also imply that species diversity may not influence animal production, and that a few well adapted, productive species may support animals as well or better than a highly diverse pasture.

Total herbage mass was generally higher in rehabilitation sites than at the analogue sites, which is explained by the high incidence of Rhodes Grass. Green herbage as a proportion of the total dry herbage mass was consistent across all monitoring sites and usually comprised between 45-50%.

Overall and most importantly, the pasture composition and feed quality at the rehabilitation monitoring sites largely reflected the lack of grazing (present and past) at the sites, and it is expected that grazing introduction and management would to a large extent influence what species dominate or decline in the pasture, and in turn influence the quality of feed available. Rhodes Grass biomass could very effectively be reduced via introduction of well-informed grazing management.

Finally, weeds were generally not an issue at the monitoring sites. Although some low levels were present, the introduction of grazing should assist in maintaining weeds at acceptable levels¹¹, provided that well informed and proper grazing management is implemented especially ensuring that over grazing does not occur. Only the young 'RHB_WML_Swanlake' monitoring site sustained a high infestation of weeds, especially Hedge Mustard – *Sisymbrium officinale*. However pasture establishment at this site was in progress and in its early stages, and it is understood that rehabilitation management practices at this stage are aimed at suppressing the weed seed bank present in the topsoil as far as possible, and that boom spraying of the area will occur prior to the desirable pasture species mix being sown. Consequently the infestation of Hedge Mustard at this site is not considered an issue at this stage.

6.2 Recommendations

6.2.1 Pertaining to Rehabilitation Performance

The following unprioritised recommendations are formulated as possible ways to improve the performance of rehabilitated pastures:

- To improve the quality of the rehabilitated pastures, it is recommended that their biomass is reduced, which will have the benefits of improving the palatability and feed value of existing dominant species (principally Rhodes Grass) and allow for the establishment and/or growth of other desirable species (esp. legumes). This may be achieved through:
 - Slashing and mulching of over mature species, or slashing and harvesting for hay when the plant is cut at or just before early flower;
 - Introduction of grazing trials (light grazing or rotational grazing) – this would need to be managed by an experienced grazier; or
 - crash grazing of the area i.e. introduce high stock numbers over a short period using suitable class of cattle (i.e. mature dry cows) – this would need to be managed by an experienced grazier.
- The reduction in the amount of roughage material should also increase stoloniferous growth of the Rhodes Grass which should assist in reducing the risk of soil erosion.

¹⁰ The absence - low level of legumes at the rehabilitation site has subjectively been assumed to be associated with the inability of the species sown to establish in the areas surveyed. This assumption is based on the premise that the weeks preceding the survey provided excellent growing conditions and if the legumes had been present then they would have been recorded.

¹¹ This assumes that the cattle entering the site are weed free and have been allowed to vent in a stockyard situation prior to being released to the paddocks.

- As feed quality of Rhodes Grass declines rapidly with the onset of flowering, the data collected during this monitoring event may present a slightly false picture of the productivity of the rehabilitated pastures. This being the case it is recommended that should cattle be introduced then a rapid assessment of carrying capacity is undertaken at monthly increments.
- The introduction of grazing would greatly (and beneficially) influence the overall performance of rehabilitated pasture lands, including species composition, feed quality and herbage mass. Therefore, grazing introduction is recommended so long as it is driven by well-informed management practices from experienced graziers.
- Undertake maintenance direct seeding once the amount of standing feed has been reduced by grazing with a view to increase species diversity, improve pasture productivity and enhance nutrient cycling. Ensure any species mix used in maintenance seeding:
 - Includes fast germinating species to promote and maintain extensive ground cover;
 - Includes leguminous species to improve soil fertility and nutrient cycling, for example subterranean clover or white clover or Lucerne species suited for dry land farming; and
 - Promotes species diversity in order to improve productivity and resilience of the pasture, provide erosion control and increase biodiversity. The mix should contain a large number of species with varying drought tolerance, feed values and persistence when grazed. For example, native grasses with high grazing value include Wallaby grass, Weeping grass or Kangaroo grass, which retain green leaf for most of the year (DPI, 2006).
- Maintain vigilance in terms of weed invasion and implement weed management / control programme as required.
- Review soil data in terms of soil fertility and capacity to provide an optimum growing media for pasture establishment (refer to SESL result in Appendix b for specific amelioration measure). In particular:
 - Gypsum applications should be considered to balance cations and increase calcium levels, minding the potential of such application to temporarily increase salinity. However, the use of lime to raise calcium levels is not recommended given the current neutral pH levels.
 - Assess the economic rationale of fertiliser applications in terms of weight / profit gain from the resultant feed.
- It is also recommended that the species mix used in rehabilitation works for pasture establishment is reviewed, as the current practices seem to result in Rhodes Grass becoming overwhelming dominant. If the immediate objective in the early phases of rehabilitation is to provide for rapid and extensive ground cover establishment (for soil stability) with a dense layer of Rhodes Grass, then there is potential cost saving to be achieved by removing other species from the mix.
- Review the data from the ACARP study currently being undertaken by Department of Primary Industry to assess the objective of the rehabilitation program at the sites covered by this monitoring program in context of the development of a sustainable land management program. The ACARP study should provide an overview of the rationale for beef cattle grazing, an assessment of the carrying capacity and stocking rates in context of the cost effectiveness of the land management practices and maintenance requirements. This assessment would then provide data on the style of beef cattle production that is best suited to these lands (e.g. dry cows vs. yearlings vs. bullocks) whilst also providing a platform for decision making in terms of budgetary allocation and ongoing land management.

6.2.2 Pertaining to the Monitoring Programme

The following recommendations are made with the view to optimise the monitoring programme:

- Given the high uniformity of the results, the value of implementing LFA at monitoring sites where a high ground cover is achieved is highly questionable. It is recommended that LFA is removed from the monitoring programme where a ground cover of 70% or more is achieved. Its application should be strictly limited to rehabilitation sites in the early stages of ecosystem establishment, and / or following a significant extreme weather event (e.g. drought) to allow for an assessment of ecosystem recovery. This would incur significant cost saving to the overall implementation of the rehabilitation monitoring programme.

- The timeframe for the implementation of Botanal should consider the seasonal conditions to ensure plants are in flower / reproductive stage at the time of the assessment. This greatly facilitates and speeds up the field data collection, and allows for greater confidence in species identification and pasture composition description. However this implies that resources (staff) can be deployed rapidly and on relatively short notice following a spell of good weather conditions.
- If cattle are introduced on rehabilitated lands, the monitoring frequency should be increased and Botanal implemented at least on a 6-monthly basis, and ideally on a trimestral basis. This would allow timely data collection and reporting on pasture condition (amount and quality of feed available) on a seasonal basis on which suitable stocking rates could be derived.
- In future monitoring events, the laboratory contracted to undertake the soil analyses is advised of the suitable methods to be used for testing of nutrients content as required for NSW pastures.
- Given the very large area of the rehabilitation polygons monitored, high variability in pasture condition can be expected across the polygon. In this regards, the amount of monitoring sites established and monitored should be reviewed to ensure that the data collected draw a true picture of rehabilitation performance across the site. The required density of monitoring transects should be as per the recommendations made in the current monitoring methodology document (AECOM, 2012).

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Appendix A

Feed Analysis Results

Appendix A Feed Analysis Results



Department of
Primary Industries

Wagga Wagga Agricultural Institute

Our Ref: R15-00295

Your Ref: Pasture

Prev. Ref: Samples

Laboratory Enquiries:

Invoice Enquiries: 1800 675 623

1300 720 773

LABORATORY REPORT

To: AECOM AUSTRALIA PTY LTD
17 Warabrook Bvde
WARABROOK
2304 NSW Australia
Attn: MATTHIEU CATTEAU

Owner:
Property:

Job Type: Feed

Job Manager: Richard Meyer

Date Sampled:

Date Sent: 2 Mar 2015

Date Received: 3 Mar 2015

Submitter Subject:

Samples Received: 6 x FORAGE

Analysis Method

Acid Detergent Fibre (Forage/Silage) - NIR - CSL

*AFIA Hay and Silage Grade

Inorganic Ash in Plant Material (Forage/Silage) - NIR; CSL

Inorganic Ash in Plant Material - Wet chemistry; AFIA Method 1.10R

Calculation of Metabolisable Energy; AFIA Method 2-2R

Crude Protein (Forage/Silage) - NIR; CSL

Dry Matter Digestibility - NIR; CSL

Dry and Grind inc Dry Matter - Reuter & Robinson 2.E.3; 2.E.4

Neutral Detergent Fibre (Forage/Silage) - NIR; CSL

*Water Soluble Carbohydrate (Forage/Silage) - NIR - CSL

Method ID

LMOP 2-1129

AFIA GRADING

LMOP 2-1129

LMOP 2-1123

LMOP 2-1124

LMOP 2-1129

LMOP 2-1129

LMOP 2-1100

LMOP 2-1129

LMOP 2-1129

Date of Test

6 Mar 2015

6 Mar 2015

6 Mar 2015

13 Mar 2015

6 Mar 2015

6 Mar 2015

6 Mar 2015

6 Mar 2015

6 Mar 2015

6 Mar 2015

* NATA Accreditation does not cover the performance of this service

Richard Meyer
Chemist



NATA Accreditation Numbers

14173 Environmental Laboratory Wollongbar

14488 Orange Agricultural Institute

14495 Elizabeth Macarthur Agricultural Institute

14949 Wagga Wagga Chemistry Services Laboratory

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Wagga Wagga Feed Quality Testing Laboratory**Specimen Type: Forage**

			0001	0002	0003	0004
			RHB_HVOW Wilton	RHB_MTO North Dump	ANA_Lemington Rd	ANA_Cheshunt
Results	Units	LOR	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction
Dry Matter	%	0.5	54.6	89.4	84.1	83.4
Neutral Detergent Fibre	%	10	74	72	66	63
Acid Detergent Fibre	%	4	47	43	42	41
*Water Soluble Carbohydrate	%	4.0	<4.0	<4.0	<4.0	<4.0
Crude Protein	%	2.0	3.9	<2.0	4.5	3.9
Inorganic Ash	%	3	9	12	13	13
Organic Matter	%	75	91	88	87	87
DMD	%	39	46	46	50	54
DOMD	%	38	46	46	49	52
*AFIA Grade			D4	d4	d4	c4
Metabolisable Energy	MJ/kg DM	4.3	6.2	6.2	6.9	7.6

Specimen Type: Forage

			0005	0006	0007	0008	0009
			ANA_Howick	ANA_Carrington Billabong	RHB_WML TD1	RHB_HVON Carrington	ANA_Parnells
Results	Units		Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction
Dry Matter	%		86.8	86.6	82.4	77.5	84.3
Neutral Detergent Fibre	%		71	68	72	68	71
Acid Detergent Fibre	%		47	44	46	42	44
*Water Soluble Carbohydrate	%		<4.0	<4.0	<4.0	<4.0	<4.0
Crude Protein	%		5.1	3.0	2.1	4.7	6.1
Inorganic Ash	%		9	11	12	11	10
Organic Matter	%		91	89	88	89	90
DMD	%		41	48	45	50	46
DOMD	%		42	47	45	49	46
*AFIA Grade			d4	d4	d4	d4	d4
Metabolisable Energy	MJ/kg DM		5.5	6.6	6.1	6.9	6.3

Specimen Type: Forage

		0010	0011	0012	0013	0014
		RHB_HVOW Plane Dump	ANA_Newport	ANA_Knodlers Lane	RHB_MTO South CHPP	ANA_North CHPP
Results	Units	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction	Fresh Pasture- DEAD fraction
Dry Matter	%	88.2	85.5	59.0	87.1	77.3
Neutral Detergent Fibre	%	75	69	71	72	70
Acid Detergent Fibre	%	50	44	44	45	44
*Water Soluble Carbohydrate	%	<4.0	<4.0	<4.0	<4.0	<4.0
Crude Protein	%	6.9	<2.0	3.0	3.1	<2.0
Inorganic Ash	%	14.1	11	9	10	11
Organic Matter	%	85.9	89	91	90	89
DMD	%	43	47	44	43	48
DOMD	%	43	47	44	43	47
*AFIA Grade		d4	d4	d4	d4	d4
Metabolisable Energy	MJ/kg DM	5.7	6.5	6.0	5.7	6.5

Specimen Type: Forage

		0015	0016	0017	0018	0019
		ANA_Newport	ANA_Parnells	ANA_Carrington Billabong	ANA_Knodlers Lane	ANA_Cheshunt
Results	Units	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction
Dry Matter	%	40.4	34.4	45.7	34.7	37.6
Neutral Detergent Fibre	%	65	67	62	66	62
Acid Detergent Fibre	%	38	39	37	37	36
*Water Soluble Carbohydrate	%	<4.0	<4.0	10.9	<4.0	6.3
Crude Protein	%	6.1	11.4	6.4	6.5	5.5
Inorganic Ash	%	9	10	9	8	9
Organic Matter	%	91	90	91	92	91
DMD	%	59	62	64	57	63
DOMD	%	57	59	61	55	60
*AFIA Grade		c4	b3	b4	c4	b4
Metabolisable Energy	MJ/kg DM	8.6	9.1	9.4	8.2	9.3

Specimen Type: Forage

		0020	0021	0022	0023	0024
		ANA_North CHPP	ANA_Howick	ANA_Lemington Rd	RHB_HVOW Wilton	RHB_MTO South CHPP
Results	Units	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction
Dry Matter	%	34.3	33.1	39.6	31.7	37.2
Neutral Detergent Fibre	%	68	65	62	69	65
Acid Detergent Fibre	%	39	40	37	40	38
*Water Soluble Carbohydrate	%	<4.0	<4.0	<4.0	<4.0	<4.0
Crude Protein	%	4.0	10.8	6.2	6.7	7.9
Inorganic Ash	%	10	9	10	10	9
Organic Matter	%	90	91	90	90	91
DMD	%	55	61	65	53	58
DOMD	%	54	59	62	52	56
*AFIA Grade		c4	b3	a4	c4	c4
Metabolisable Energy	MJ/kg DM	7.9	9.0	9.6	7.5	8.4

Specimen Type: Forage

		0025	0026	0027	0028
		RHB_HVOW Plane Dump	RHB_WML TD1	RHB_HVON Carrington	RHB_MTO North Dump
Results	Units	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction	Fresh Pasture- GREEN fraction
Dry Matter	%	34.2	34.6	35.4	34.7
Neutral Detergent Fibre	%	65	68	65	66
Acid Detergent Fibre	%	40	39	38	38
*Water Soluble Carbohydrate	%	4.7	<4.0	8.1	5.7
Crude Protein	%	10.3	6.0	7.5	4.3
Inorganic Ash	%	12	9	10	9
Organic Matter	%	88	91	90	91
DMD	%	60	57	60	61
DOMD	%	58	55	58	58
*AFIA Grade		b3	c4	b4	b3
Metabolisable Energy	MJ/kg DM	8.7	8.2	8.7	8.9

Comment(s): **DMD** = Dry Matter Digestibility
DOMD = Digestible Organic Matter in the Dry Matter

LOR = Limit of Reporting, the minimum quantity that can be reported with confidence.

All results are reported on a dry matter basis unless otherwise stated. All units of % are g/100g equivalent.

The results apply to the sample(s) as provided to the laboratory.

“For any further information or assistance on interpretation of results, please contact your local Livestock Officer.”

Copies

Appendix B

Soil Analysis Results

Appendix B Soil Analysis Results



Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 1 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** ANA-North CHPP
Address: PO Box 73 **Description:** Soil
 HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

RECOMMENDATIONS

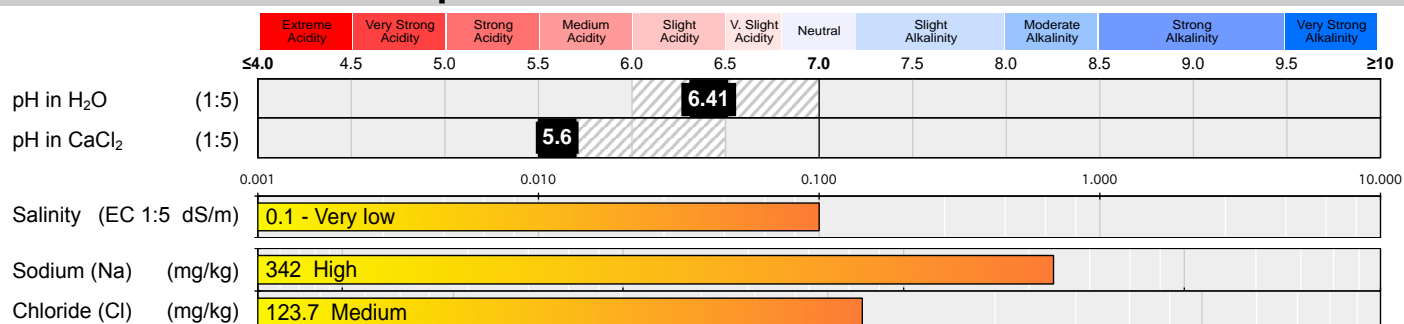
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and moderately sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity. The magnicity and sodicity will likely mean that any fines in this soil are dispersive and prone to erosion.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 2x100 kg/ha). P and K levels are also low. Apply superphosphate and muriate of potash both at 20 g/sqm (200 kg/ha). Applications of gypsum at 300 g/sqm (3 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

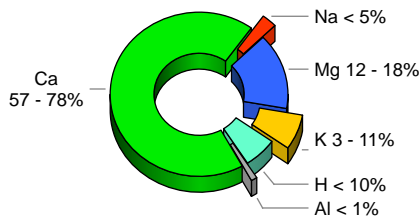
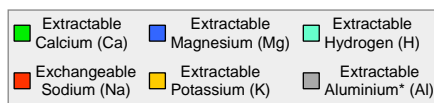
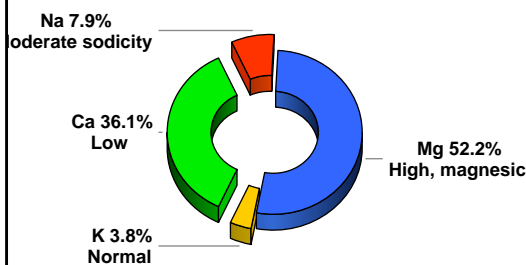
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.7	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	13.7	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.04	< 0.07
Comment: Acceptable		
K:Na	0.5	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.01 High potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837

Sample N°: 1

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	3.7						0.7	6	5.3
Phosphate-P (PO ₄)	30.2						6	12.6	6.6
Potassium (K) †	280						55.9	60.6	4.7
Sulphate-S (SO ₄)	13						2.6	13.6	11
Calcium (Ca) †	1366						272.5	431.7	159.2
Magnesium (Mg) †	1198						239	44.9	Drawdown
Iron (Fe)	222.7						44.4	110.1	65.7
Manganese (Mn) †	28						5.6	8.8	3.2
Zinc (Zn) †	8.4						1.7	1	Drawdown
Copper (Cu)	1.6						0.3	1.3	1
Boron (B) †	0.6						0.1	0.5	0.4

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

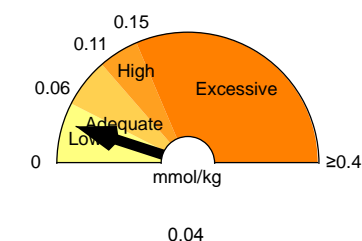
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **18.9**
Eff. Cation Exch. Capacity (eCEC): **18.9**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **1019**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **4.9 – Very high**
Organic Matter (OM%): **8.3**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 Sample N°: 2 Date Received: 3/3/15 Report Status: ☐ Draft ☒ Final

Client Name: **AECOM - Newcastle** Project Name: **60340733 - C & A Rehabilitation Monitoring 2015**
Client Contact: **Matthieu Catteau** MTW & HVO Mine Sites
Client Job N°:
Client Order N°:
Address: **PO Box 73** SESL Quote N°: **Q4235**
HRMC NSW 2310 Sample Name: **ANA-Parnells**
Description: **Soil**
Test Type: **FSC, TOC_DC, M5**

RECOMMENDATIONS

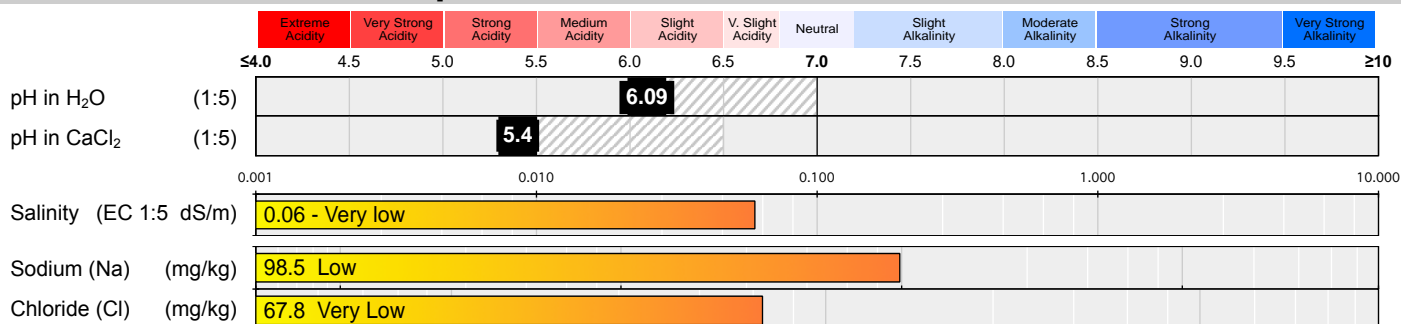
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P levels are also low. Apply super phosphate at 20 g/sqm (200 kg/ha). Applications of gypsum at 100 g/sqm (1 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

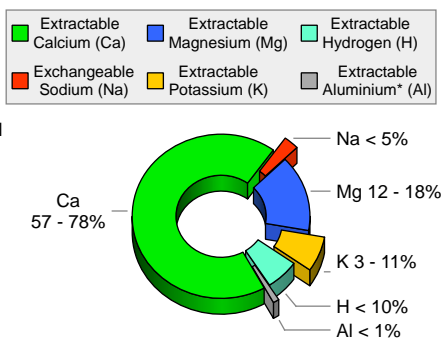
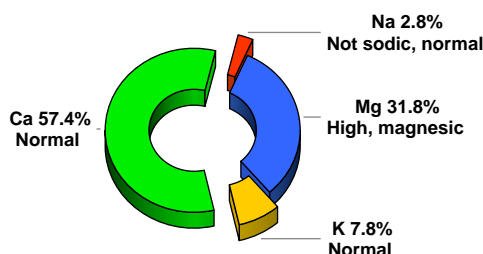
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.8	4.1 – 6.0
Comment: Calcium low		
Mg:K	4.1	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	0.09	< 0.07
Comment: High		
K:Na	2.8	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.02 High potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

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Batch N°: 33837

Sample N°: 2

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	5.1						1	6	5
Phosphate-P (PO ₄)	5.9						1.2	12.6	11.4
Potassium (K) †	469						93.6	60.6	Drawdown
Sulphate-S (SO ₄)	10						2	13.6	11.6
Calcium (Ca) †	1772						353.5	431.7	78.2
Magnesium (Mg) †	596						118.9	44.9	Drawdown
Iron (Fe)	169.7						33.9	110.1	76.2
Manganese (Mn) †	128						25.5	8.8	Drawdown
Zinc (Zn) †	4.8						1	1	0
Copper (Cu)	2.1						0.4	1.3	0.9
Boron (B) †	1.7						0.3	0.5	0.2

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

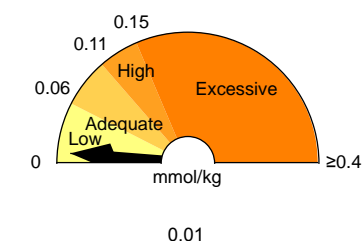
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.4**
Sum of Base Cations (meq/100g⁻¹): **15.4**
Eff. Cation Exch. Capacity (eCEC): **15.4**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **267**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **3.9 – Very high**
Organic Matter (OM%): **6.6**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 3 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** ANA-Knodlers Lane
Address: PO Box 73 **Description:** Soil
HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

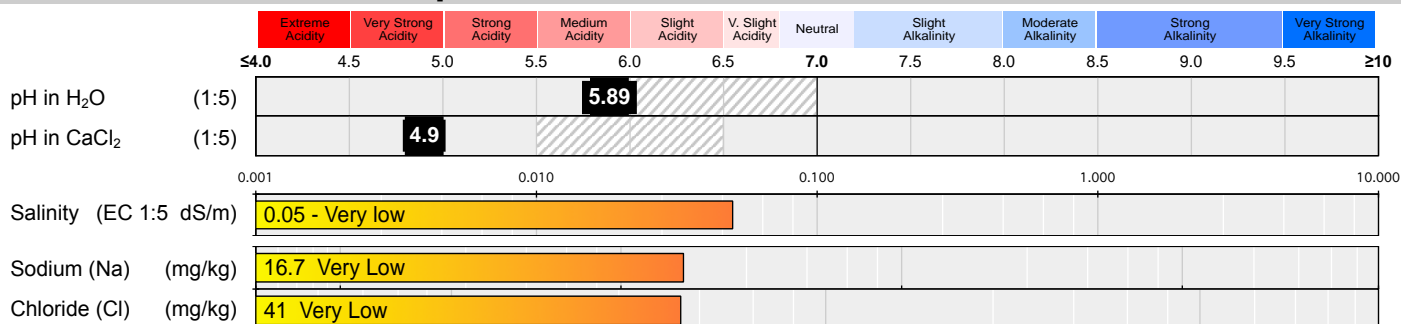
RECOMMENDATIONS

This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is strongly acidic, not saline and not sodic. The cation balance is dominated by hydrogen, leading to the acidity. The effective cation exchange capacity (eCEC) is low, indicating poor nutrient retention and holding capacity. We recommend raising the pH to above 5.5 in CaCl₂ to prevent toxicities. Achieve this through incorporating lime at 200 g/sqm (or 2 t/ha).

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, 200 kg/ha in total). P levels are also low. Apply super phosphate (DAP) at 20 g/sqm (200 kg/ha). Applications of gypsum at 100 g/sqm (1 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success. Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

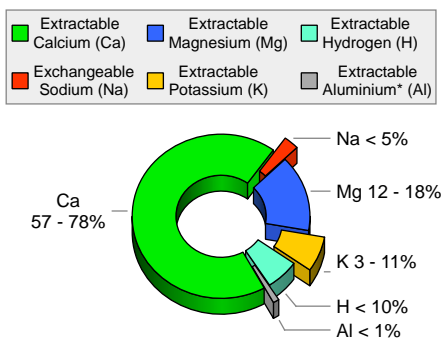
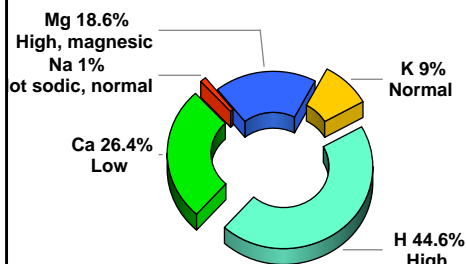
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.4	4.1 – 6.0
Comment: Calcium low		
Mg:K	2.1	2.6 – 5.0
Comment: Magnesium low		
K/(Ca+Mg)	0.2	< 0.07
Comment: High		
K:Na	9	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.05 Moderate potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

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Tel: 1300 30 40 80
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Web: www.sesl.com.au

Batch N°: 33837

Sample N°: 3

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	2.1						0.4	6	5.6
Phosphate-P (PO ₄)	12.4						2.5	12.6	10.1
Potassium (K) †	244						48.7	43.9	Drawdown
Sulphate-S (SO ₄)	12						2.4	13.6	11.2
Calcium (Ca) †	371						74	312.4	238.4
Magnesium (Mg) †	158						31.5	32.5	1
Iron (Fe)	232						46.3	110.1	63.8
Manganese (Mn) †	183						36.5	8.8	Drawdown
Zinc (Zn) †	3.4						0.7	1	0.3
Copper (Cu)	0.9						0.2	1.3	1.1
Boron (B) †	1.2						0.2	0.5	0.3

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

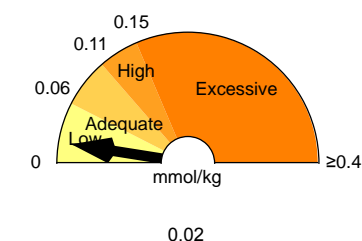
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.5**
Sum of Base Cations (meq/100g⁻¹): **3.9**
Eff. Cation Exch. Capacity (eCEC): **7**
Base Saturation (%): **55.71**
Exchangeable Acidity (meq/100g⁻¹): **3.12**
Exchangeable Acidity (%): **44.57**

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **208**
– to neutralise Al (g/sqm): **0**

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **137**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **2.4 – High**
Organic Matter (OM%): **4.1**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure-"Murphy" (1991), Colour-"Munsell" (2000))



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Soil Chemistry Profile

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Web: www.sesl.com.au

Batch N°: 33837 Sample N°: 4 Date Received: 3/3/15 Report Status: ☐ Draft ☒ Final

Client Name: **AECOM - Newcastle** Project Name: **60340733 - C & A Rehabilitation Monitoring 2015**
Client Contact: **Matthieu Catteau** MTW & HVO Mine Sites
Client Job N°:
Client Order N°:
Address: **PO Box 73** SESL Quote N°: **Q4235**
HRMC NSW 2310 Sample Name: **ANA Carrington Billabong**
Description: **Soil**
Test Type: **FSC, TOC_DC, M5**

RECOMMENDATIONS

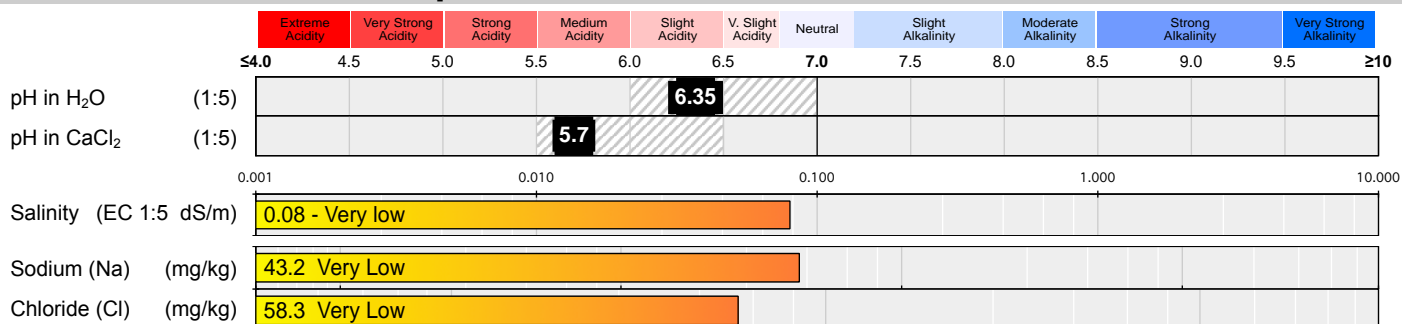
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is high, indicating excellent nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). Applications of gypsum at 200 g/sqm (2 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

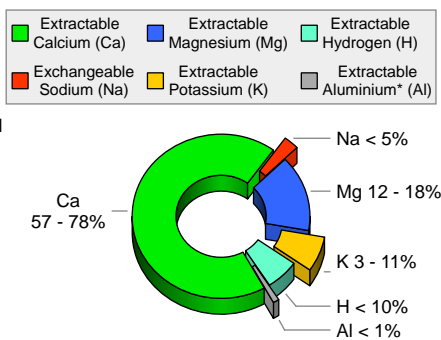
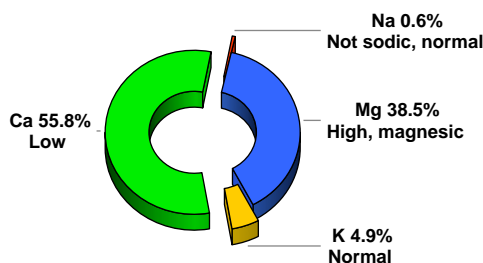
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.4	4.1 – 6.0
Comment: Calcium low		
Mg:K	7.8	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.05	< 0.07
Comment: Acceptable		
K:Na	7.7	N/A
Sodium Absorption Ratio: 0	Low	
Electrochemical Stability Index (ESI):	0.13	Low potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837

Sample N°: 4

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	3.9						0.8	6	5.2
Phosphate-P (PO ₄)	67.4						13.4	12.6	Drawdown
Potassium (K) †	574						114.5	77.4	Drawdown
Sulphate-S (SO ₄)	12						2.4	13.6	11.2
Calcium (Ca) †	3335						665.3	551.2	Drawdown
Magnesium (Mg) †	1394						278.1	57.7	Drawdown
Iron (Fe)	139.7						27.9	110.1	82.2
Manganese (Mn) †	73						14.6	8.8	Drawdown
Zinc (Zn) †	3.3						0.7	1	0.3
Copper (Cu)	2.2						0.4	1.3	0.9
Boron (B) †	1						0.2	0.5	0.3

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

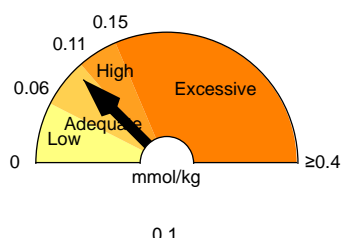
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Adequate. Economic response to P unlikely. P application recommended maintaining current P level.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **29.8**
Eff. Cation Exch. Capacity (eCEC): **29.8**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **597**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **4.8 – Very high**
Organic Matter (OM%): **8.1**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Brennan

D. McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure-"Murphy" (1991), Colour-"Munsell" (2000))



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 5 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** ANA-Newport
Address: PO Box 73 **Description:** Soil
HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

RECOMMENDATIONS

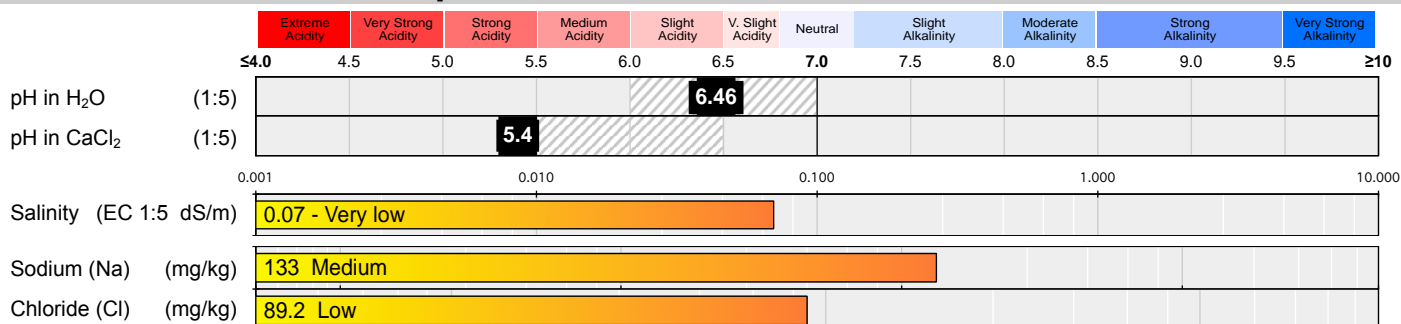
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P levels are also low. Apply super phosphate (DAP) at 20 g/sqm (200 kg/ha). Applications of gypsum at 300 g/sqm (3 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

pH and ELECTRICAL CONDUCTIVITY

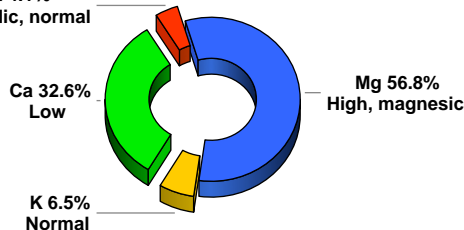


CATION BALANCE

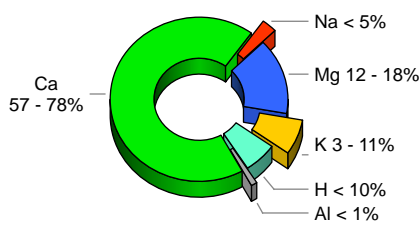
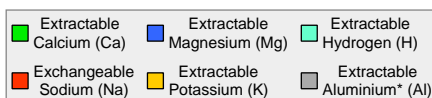
EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2

Na 4.1%
not sodic, normal



ACTUAL



IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.6	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	8.7	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.07	< 0.07
Comment: High		
K:Na	1.6	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.02 High potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Batch N°: 33837

Sample N°: 5

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	1.8						0.4	6	5.6
Phosphate-P (PO ₄)	8.6						1.7	12.6	10.9
Potassium (K) †	362						72.2	52.3	Drawdown
Sulphate-S (SO ₄)	10						2	13.6	11.6
Calcium (Ca) †	933						186.1	372.1	186
Magnesium (Mg) †	986						196.7	38.7	Drawdown
Iron (Fe)	160.2						32	110.1	78.1
Manganese (Mn) †	52						10.4	8.8	Drawdown
Zinc (Zn) †	4.4						0.9	1	0.1
Copper (Cu)	<0.64						0.1	1.3	1.2
Boron (B) †	0.4						0.1	0.5	0.4

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

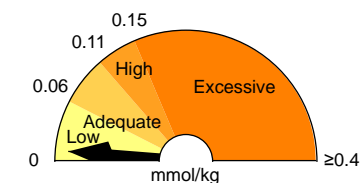
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.3**
Sum of Base Cations (meq/100g⁻¹): **14.3**
Eff. Cation Exch. Capacity (eCEC): **14.3**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **857**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **2.5 – High**
Organic Matter (OM%): **4.2**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

D. McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
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Texture/Structure/Colour - PM0003 (Texture-
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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 Sample N°: 6 Date Received: 3/3/15 Report Status: ☐ Draft ☒ Final

Client Name: **AECOM - Newcastle** Project Name: **60340733 - C & A Rehabilitation Monitoring 2015**
Client Contact: **Matthieu Catteau** MTW & HVO Mine Sites
Client Job N°:
Client Order N°:
Address: **PO Box 73** SESL Quote N°: **Q4235**
HRMC NSW 2310 Sample Name: **ANA-Cheshunt**
Description: **Soil**
Test Type: **FSC, TOC_DC, M5**

RECOMMENDATIONS

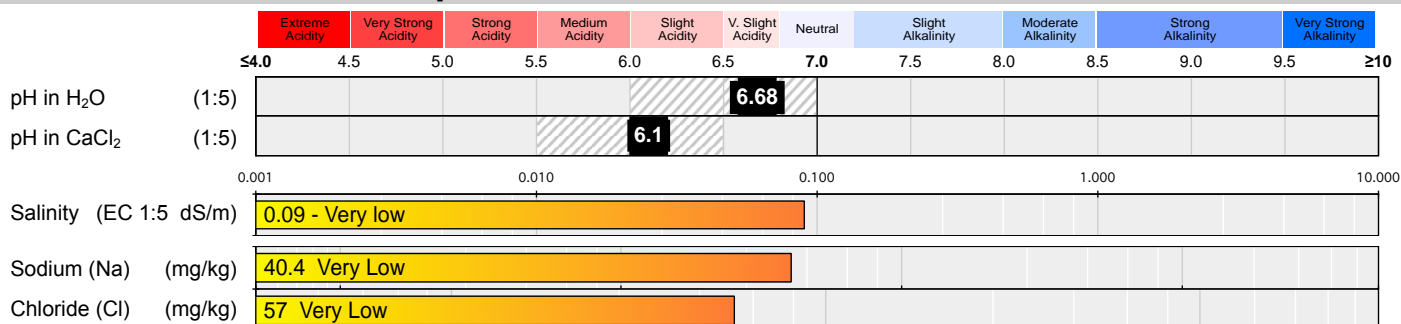
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is high, indicating excellent nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha). Applications of gypsum at 200 g/sqm (2 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

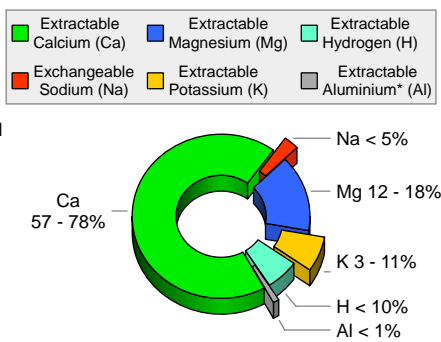
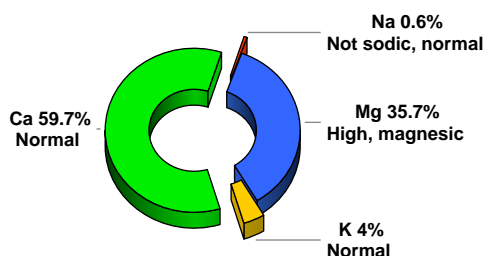
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.7	4.1 – 6.0
Comment: Calcium low		
Mg:K	8.9	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.04	< 0.07
Comment: Acceptable		
K:Na	6.4	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.15 Low potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

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Batch N°: 33837

Sample N°: 6

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	4.9						1	6	5
Phosphate-P (PO ₄)	77						15.4	12.6	Drawdown
Potassium (K) †	451						90	77.4	Drawdown
Sulphate-S (SO ₄)	9.5						1.9	13.6	11.7
Calcium (Ca) †	3420						682.3	551.2	Drawdown
Magnesium (Mg) †	1240						247.4	57.7	Drawdown
Iron (Fe)	135.5						27	110.1	83.1
Manganese (Mn) †	71						14.2	8.8	Drawdown
Zinc (Zn) †	4.1						0.8	1	0.2
Copper (Cu)	2						0.4	1.3	0.9
Boron (B) †	1						0.2	0.5	0.3

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

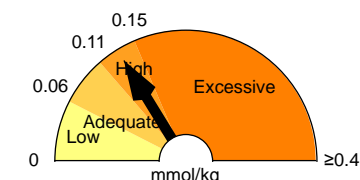
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



High. Soil P will not limit plant growth. No P recommended this season.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **28.6**
Eff. Cation Exch. Capacity (eCEC): **28.6**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **384**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **4 – Very high**
Organic Matter (OM%): **6.8**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure-"Murphy" (1991), Colour-"Munsell" (2000))



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Soil Chemistry Profile

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Batch N°: 33837 **Sample N°:** 7 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** ANA-Howick
Address: PO Box 73 **Description:** Soil
 HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

RECOMMENDATIONS

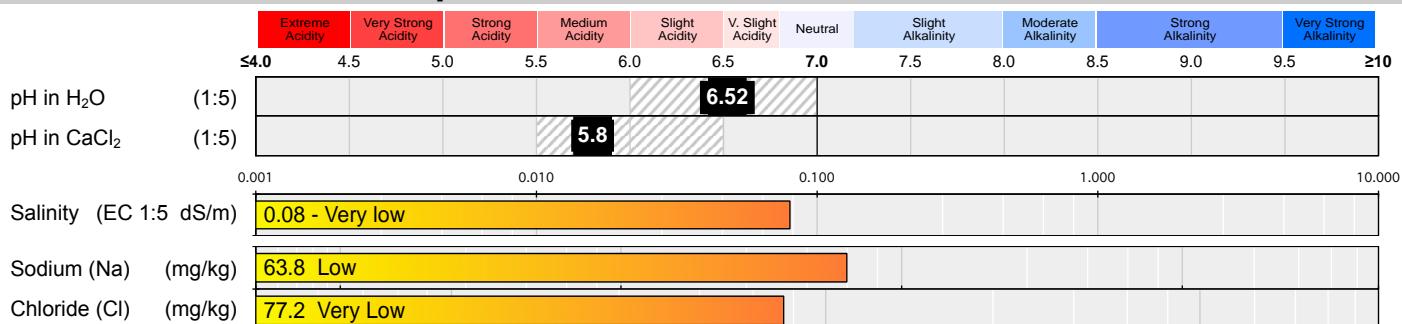
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P levels are also low. Apply super phosphate (DAP) at 30 g/sqm (300 kg/ha). Applications of gypsum at 200 g/sqm (2 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

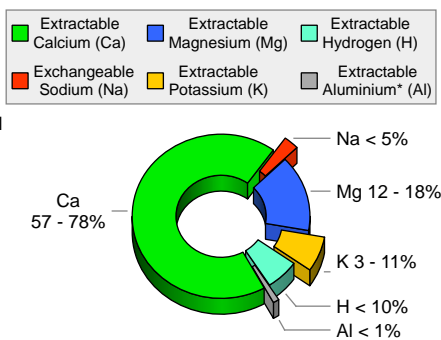
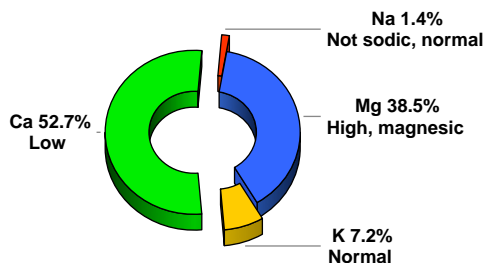
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.4	4.1 – 6.0
Comment: Calcium low		
Mg:K	5.3	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.08	< 0.07
Comment: High		
K:Na	5.3	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.06 Moderate potential for dispersion and soil structure collapse		
SOLUBLE CATIONS (meq/100g)		
Na:	K:	Ca: Mg:



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N^o: 33837Sample N^o: 7

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	6.1						1.2	6	4.8
Phosphate-P (PO ₄)	8.4						1.7	12.6	10.9
Potassium (K) †	580						115.7	69	Drawdown
Sulphate-S (SO ₄)	11						2.2	13.6	11.4
Calcium (Ca) †	2165						431.9	491.6	59.7
Magnesium (Mg) †	960						191.5	51.3	Drawdown
Iron (Fe)	146.6						29.2	110.1	80.9
Manganese (Mn) †	42						8.4	8.8	0.4
Zinc (Zn) †	6.8						1.4	1	Drawdown
Copper (Cu)	2.1						0.4	1.3	0.9
Boron (B) †	0.9						0.2	0.5	0.3

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

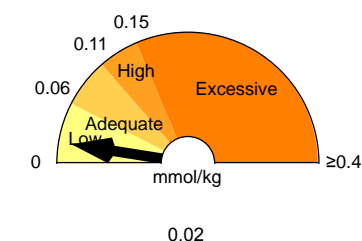
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **20.5**
Eff. Cation Exch. Capacity (eCEC): **20.5**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **522**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **5.1 – Very high**
Organic Matter (OM%): **8.7**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodman

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 Sample N°: 8 Date Received: 3/3/15 Report Status: ☐ Draft ☒ Final

Client Name: **AECOM - Newcastle** Project Name: **60340733 - C & A Rehabilitation Monitoring 2015**
Client Contact: **Matthieu Catteau** MTW & HVO Mine Sites
Client Job N°:
Client Order N°:
Address: **PO Box 73** SESL Quote N°: **Q4235**
HRMC NSW 2310 Sample Name: **ANA-Lemington Rd**
Description: **Soil**
Test Type: **FSC, TOC_DC, M5**

RECOMMENDATIONS

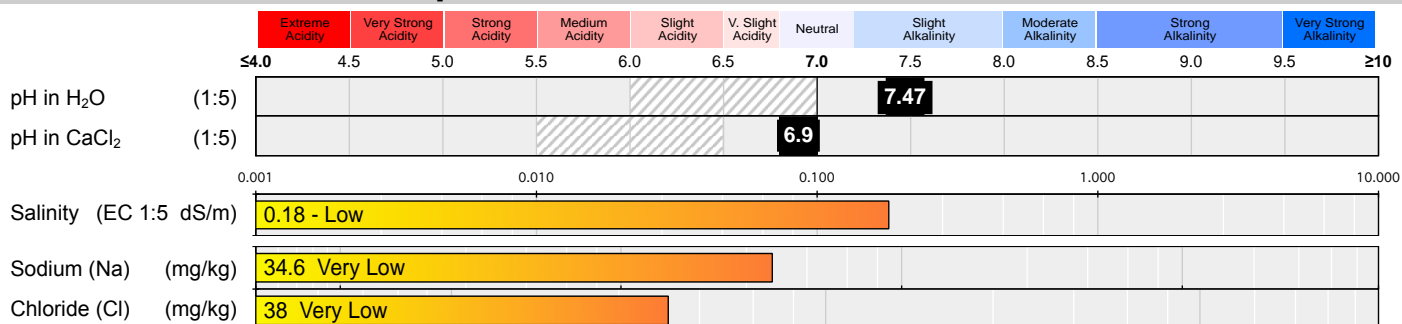
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and not sodic. The cation balance is calcic. The effective cation exchange capacity (eCEC) is high, indicating excellent nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P levels are also low. Apply super phosphate (DAP) at 30 g/sqm (300 kg/ha). These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

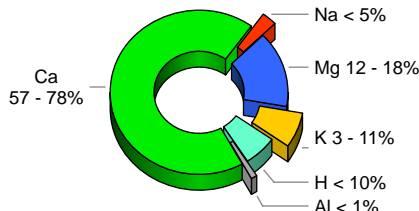
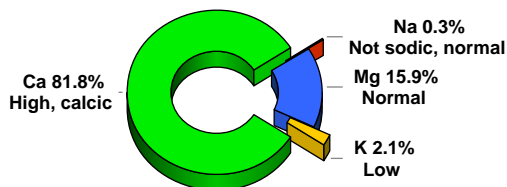
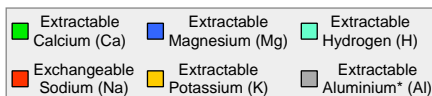
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	5.1	4.1 - 6.0
Comment: Balanced		
Mg:K	7.6	2.6 - 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.02	< 0.07
Comment: Acceptable		
K:Na	7.9	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.6 Low potential for dispersion and soil structure collapse		
SOLUBLE CATIONS (meq/100g)		
Na:	K:	Ca: Mg:



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Batch N^o: 33837Sample N^o: 8

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	3.1						0.6	6	5.4
Phosphate-P (PO ₄)	6.7						1.3	12.6	11.3
Potassium (K) †	467						93.2	77.4	Drawdown
Sulphate-S (SO ₄)	12						2.4	13.6	11.2
Calcium (Ca) †	9306						1856.5	551.2	Drawdown
Magnesium (Mg) †	1096						218.7	57.7	Drawdown
Iron (Fe)	42.1						8.4	110.1	101.7
Manganese (Mn) †	63						12.6	8.8	Drawdown
Zinc (Zn) †	2						0.4	1	0.6
Copper (Cu)	1.9						0.4	1.3	0.9
Boron (B) †	3						0.6	0.5	Drawdown

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

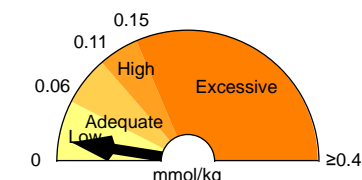
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **56.8**
Eff. Cation Exch. Capacity (eCEC): **56.8**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **0**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **4.1 – Very high**
Organic Matter (OM%): **6.9**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
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Texture/Structure/Colour - PM0003 (Texture-
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Soil Chemistry Profile

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Thornleigh NSW 2120

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Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 9 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** RHB-MTO South CHPP
Address: PO Box 73 **Description:** Soil
HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

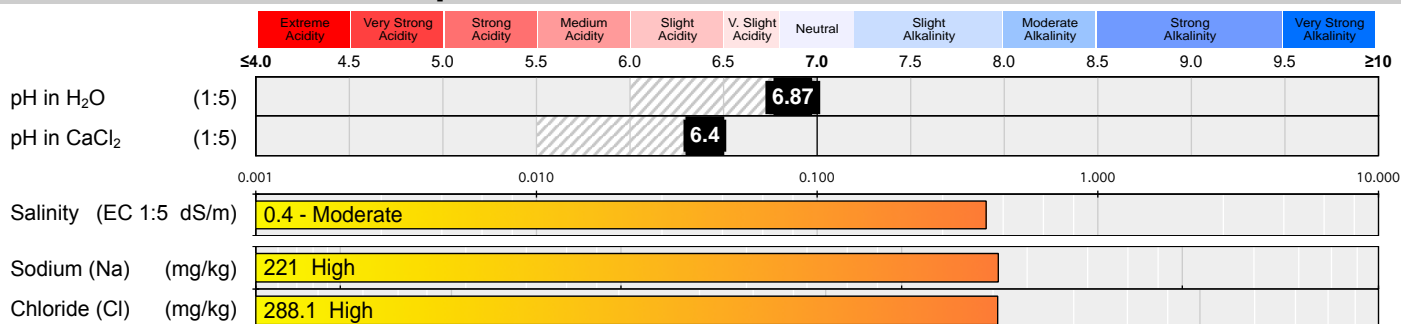
RECOMMENDATIONS

This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, moderately saline and moderately sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity. The magnicity and sodicity will likely mean that any fines in this soil are dispersive and prone to erosion.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P and K levels are also low. Apply super phosphate and muriate of potash both at 20 g/sqm (200 kg/ha). Applications of gypsum at 200 g/sqm (2 t/ha) will assist in balancing the cations and preventing any dispersion. This will temporarily elevate the salinity, so leaching should be encouraged through this period. These applications are considered the minimum to ensure pasture success. Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

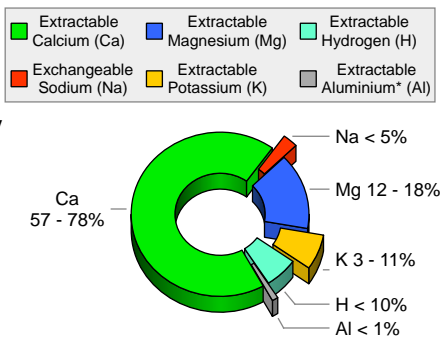
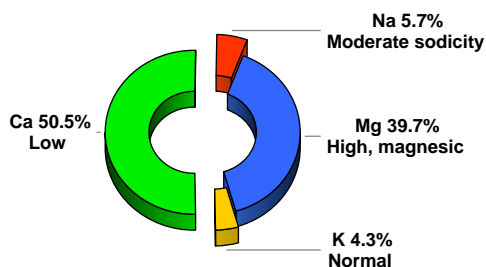
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.3	4.1 – 6.0
Comment: Calcium low		
Mg:K	9.3	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.05	< 0.07
Comment: Acceptable		
K:Na	0.7	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.07 Moderate potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

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Web: www.sesl.com.au

Batch N°: 33837

Sample N°: 9

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	2.3						0.5	6	5.5
Phosphate-P (PO ₄)	30.4						6.1	12.6	6.5
Potassium (K) †	279						55.7	60.6	4.9
Sulphate-S (SO ₄)	155						30.9	13.6	Drawdown
Calcium (Ca) †	1690						337.2	431.7	94.5
Magnesium (Mg) †	806						160.8	44.9	Drawdown
Iron (Fe)	127.5						25.4	110.1	84.7
Manganese (Mn) †	48						9.6	8.8	Drawdown
Zinc (Zn) †	4.9						1	1	0
Copper (Cu)	1.3						0.3	1.3	1
Boron (B) †	0.7						0.1	0.5	0.4

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

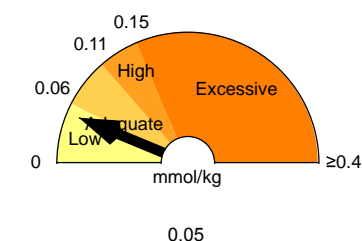
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **16.7**
Eff. Cation Exch. Capacity (eCEC): **16.7**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **488**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **3.8 – Very high**
Organic Matter (OM%): **6.4**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Brennan

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 10 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** RHB-HVOW Plane Dump
Address: PO Box 73 **Description:** Soil
HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

RECOMMENDATIONS

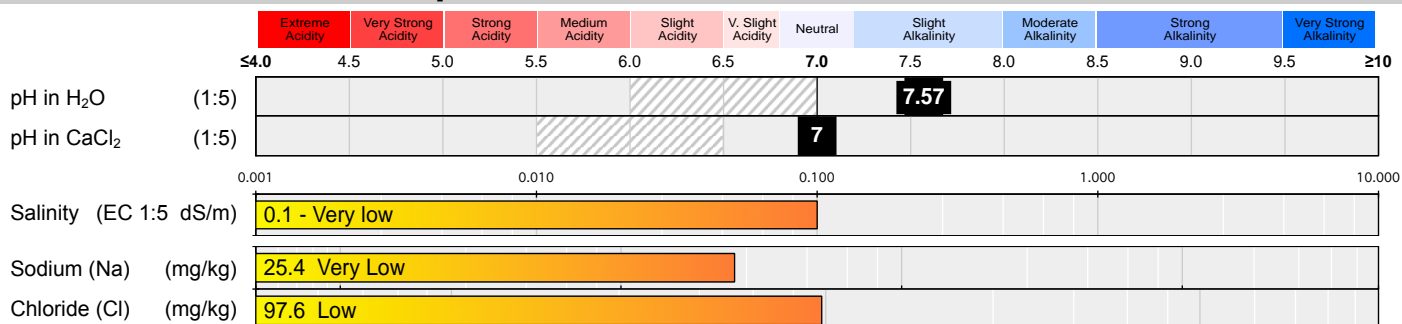
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is slightly alkaline, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P levels are also low. Apply super phosphate at 20 g/sqm (200 kg/ha). Applications of gypsum at 200 g/sqm (2 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

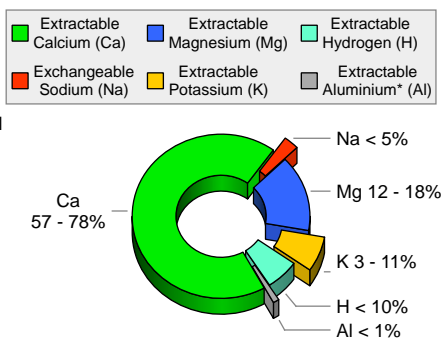
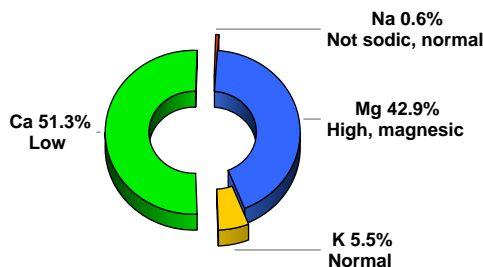
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.2	4.1 – 6.0
Comment: Calcium low		
Mg:K	7.9	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.06	< 0.07
Comment: Acceptable		
K:Na	9.9	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.17 Low potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	2						0.4	6	5.6
Phosphate-P (PO ₄)	21.9						4.4	12.6	8.2
Potassium (K) †	427						85.2	60.6	Drawdown
Sulphate-S (SO ₄)	11						2.2	13.6	11.4
Calcium (Ca) †	2053						409.6	431.7	22.1
Magnesium (Mg) †	1042						207.9	44.9	Drawdown
Iron (Fe)	99.1						19.8	110.1	90.3
Manganese (Mn) †	60						12	8.8	Drawdown
Zinc (Zn) †	5						1	1	0
Copper (Cu)	12						2.4	1.3	Drawdown
Boron (B) †	1.3						0.3	0.5	0.2

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

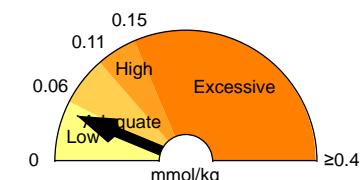
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **20**
Eff. Cation Exch. Capacity (eCEC): **20**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **558**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **3.8 – Very high**
Organic Matter (OM%): **6.5**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))



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Soil Chemistry Profile

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Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 11 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** RHB-MTO North Dump
Address: PO Box 73 **Description:** Soil
HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

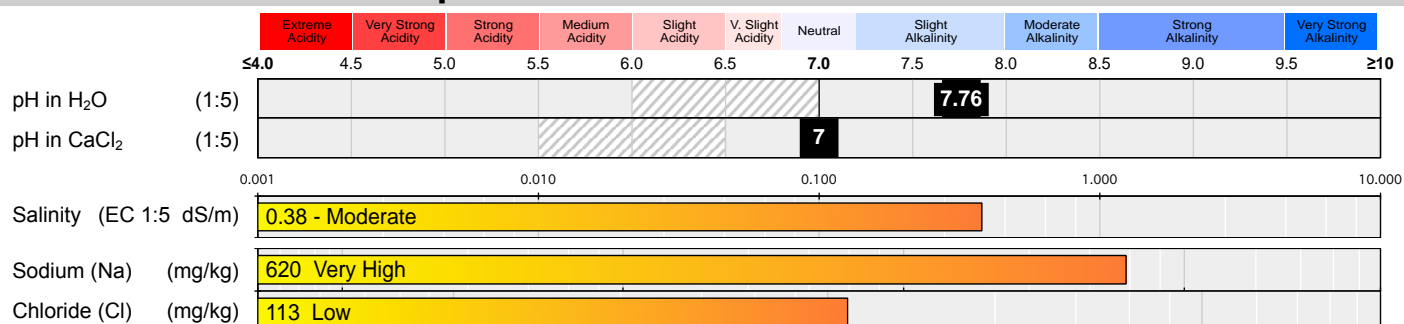
RECOMMENDATIONS

This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is slightly alkaline, moderately saline and moderately sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity. The magnicity and sodicity will likely mean that any fines in this soil are dispersive and prone to erosion.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). Applications of super phosphate at 20g/sqm and gypsum at 300 g/sqm (3 t/ha); the latter will assist in balancing the cations and preventing any dispersion. This will temporarily elevate the salinity, so leaching should be encouraged through this period. These applications are considered the minimum to ensure pasture success. Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

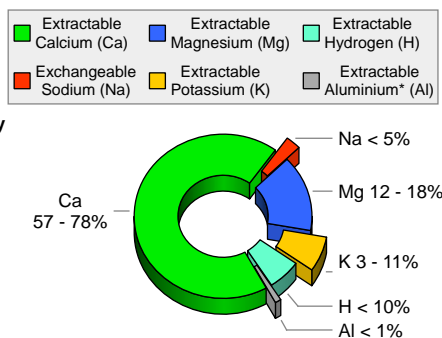
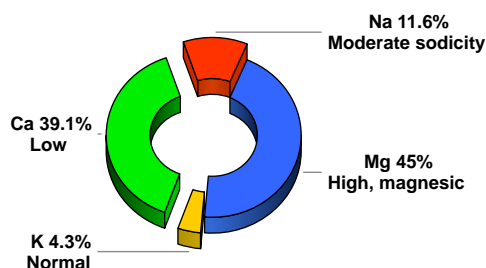
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ ≤ 5.2



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.9	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	10.6	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.05	< 0.07
Comment: Acceptable		
K:Na	0.4	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.03 High potential for dispersion and soil structure collapse		

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Batch N°: 33837

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Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	2.1						0.4	6	5.6
Phosphate-P (PO ₄)	51						10.2	12.6	2.4
Potassium (K) †	386						77	69	Drawdown
Sulphate-S (SO ₄)	157						31.3	13.6	Drawdown
Calcium (Ca) †	1819						362.9	491.6	128.7
Magnesium (Mg) †	1270						253.4	51.3	Drawdown
Iron (Fe)	261.5						52.2	110.1	57.9
Manganese (Mn) †	25						5	8.8	3.8
Zinc (Zn) †	16						3.2	1	Drawdown
Copper (Cu)	2.7						0.5	1.3	0.8
Boron (B) †	1.6						0.3	0.5	0.2

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

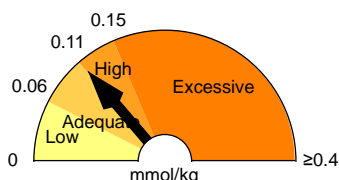
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Adequate. Economic response to P unlikely. P application recommended maintaining current P level.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **23.2**
Eff. Cation Exch. Capacity (eCEC): **23.2**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **1132**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **5.3 – Very high**
Organic Matter (OM%): **9**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

D. McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
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Batch N°: 33837 Sample N°: 12 Date Received: 3/3/15 Report Status: ☐ Draft ☒ Final

Client Name: **AECOM - Newcastle** Project Name: **60340733 - C & A Rehabilitation Monitoring 2015**
Client Contact: **Matthieu Catteau** MTW & HVO Mine Sites
Client Job N°:
Client Order N°:
Address: **PO Box 73** SESL Quote N°: **Q4235**
HRMC NSW 2310 Sample Name: **RHB-HVOS Riverview**
Description: **Soil**
Test Type: **FSC, TOC_DC, M5**

RECOMMENDATIONS

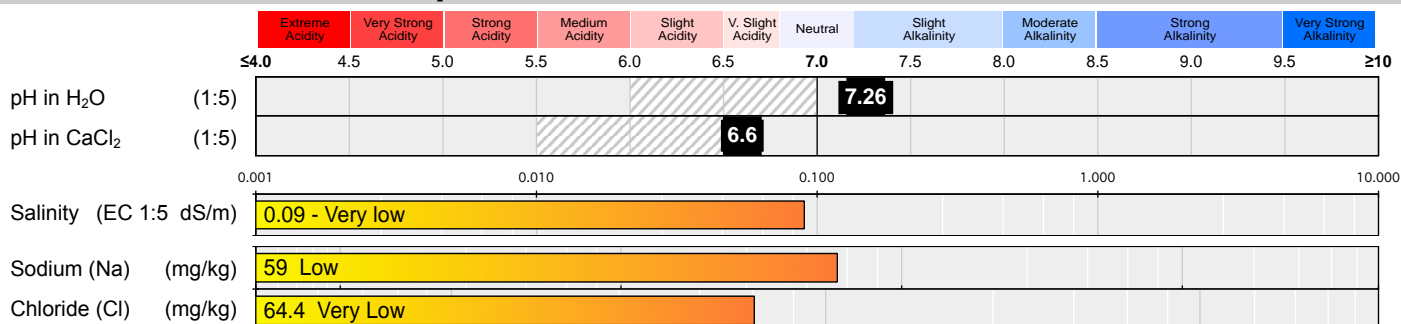
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is pH neutral, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). Applications of gypsum at 100 g/sqm (1 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

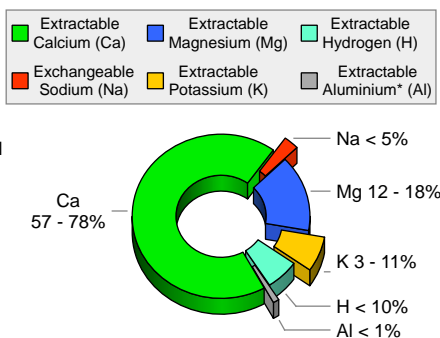
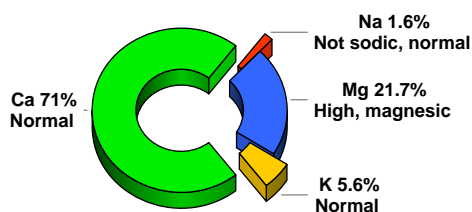
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	3.3	4.1 – 6.0
Comment: Calcium low		
Mg:K	3.8	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	0.06	< 0.07
Comment: Acceptable		
K:Na	3.5	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.06 Moderate potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Batch N°: 33837

Sample N°: 12

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	0.6						0.1	6	5.9
Phosphate-P (PO ₄)	103.8						20.7	12.6	Drawdown
Potassium (K) †	362						72.2	60.6	Drawdown
Sulphate-S (SO ₄)	18						3.6	13.6	10
Calcium (Ca) †	2318						462.4	431.7	Drawdown
Magnesium (Mg) †	430						85.8	44.9	Drawdown
Iron (Fe)	186.4						37.2	110.1	72.9
Manganese (Mn) †	49						9.8	8.8	Drawdown
Zinc (Zn) †	29						5.8	1	Drawdown
Copper (Cu)	3.5						0.7	1.3	0.6
Boron (B) †	0.7						0.1	0.5	0.4

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

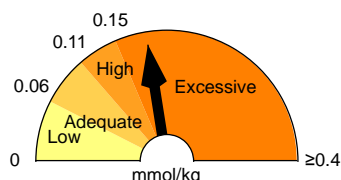
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Excessive. Exceeds environmental threshold. Implement improved P management to reduce potential for nonpoint P pollution.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **16.3**
Eff. Cation Exch. Capacity (eCEC): **16.3**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **0**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **3 – Very high**
Organic Matter (OM%): **5.1**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure-"Murphy" (1991), Colour-"Munsell" (2000))



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 13 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** RHB-HVON Carrington
Address: PO Box 73 **Description:** Soil
HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

RECOMMENDATIONS

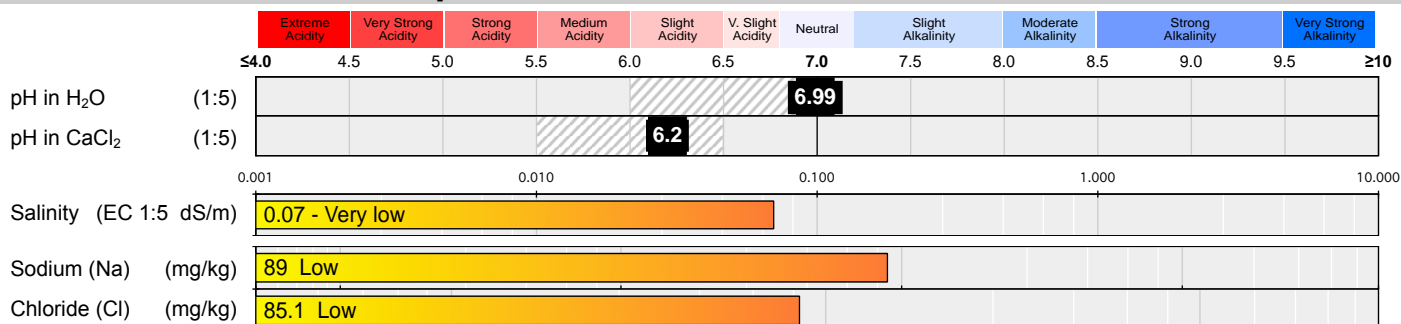
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is slightly acidic, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P levels are also low. Apply super phosphate at 20 g/sqm (200 kg/ha). Applications of gypsum at 200 g/sqm (2 t/ha) will assist in balancing the cations and preventing any dispersion. These applications are considered the minimum to ensure pasture success.

Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

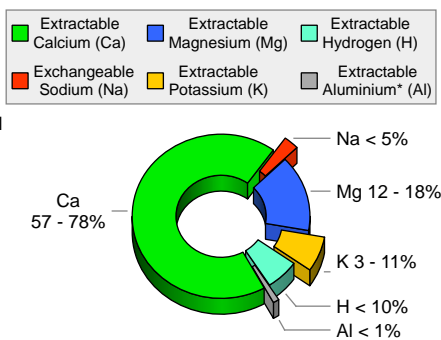
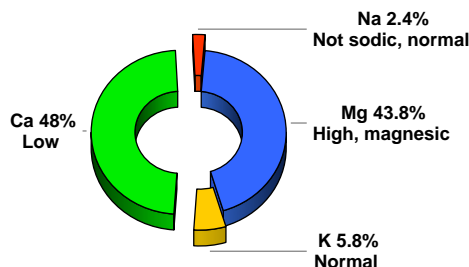
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.1	4.1 - 6.0
Comment: Calcium low		
Mg:K	7.5	2.6 - 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.06	< 0.07
Comment: Acceptable		
K:Na	2.5	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.03 High potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Batch N°: 33837

Sample N°: 13

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	2						0.4	6	5.6
Phosphate-P (PO ₄)	29.7						5.9	12.6	6.7
Potassium (K) †	376						75	60.6	Drawdown
Sulphate-S (SO ₄)	8.9						1.8	13.6	11.8
Calcium (Ca) †	1586						316.4	431.7	115.3
Magnesium (Mg) †	879						175.4	44.9	Drawdown
Iron (Fe)	142.8						28.5	110.1	81.6
Manganese (Mn) †	70						14	8.8	Drawdown
Zinc (Zn) †	4.1						0.8	1	0.2
Copper (Cu)	1.3						0.3	1.3	1
Boron (B) †	0.9						0.2	0.5	0.3

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

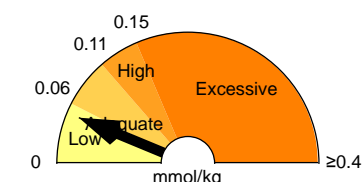
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **16.5**
Eff. Cation Exch. Capacity (eCEC): **16.5**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **552**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **3.1 – Very high**
Organic Matter (OM%): **5.2**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Thornleigh NSW 2120

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Pennant Hills NSW 1715

Tel: 1300 30 40 80
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Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 **Sample N°:** 14 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** RHB-HVOW Wilton
Address: PO Box 73 **Description:** Soil
HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

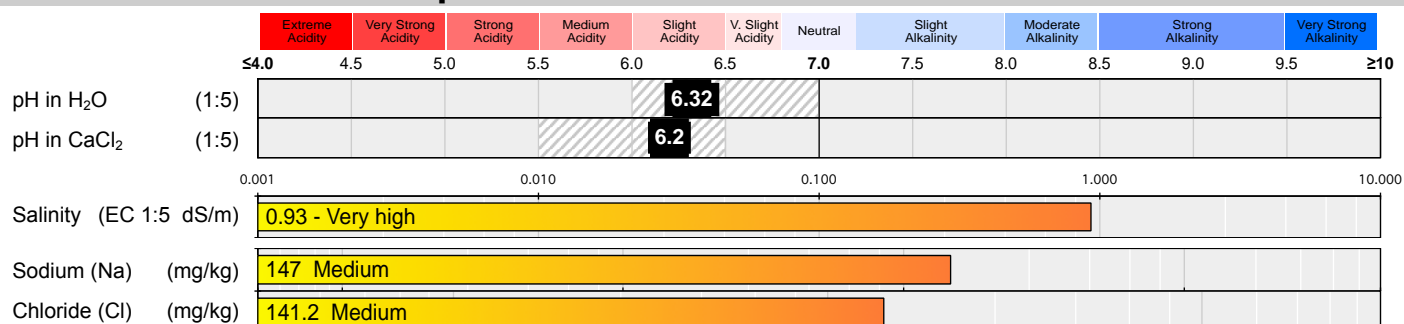
RECOMMENDATIONS

This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is slightly acidic, highly saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is high, indicating excellent nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P and K levels are also low. Apply super phosphate and muriate of potash, both at 20 g/sqm (200 kg/ha). Applications of gypsum at 300 g/sqm (3 t/ha) will assist in balancing the cations and preventing any dispersion. This will temporarily inflate the salinity, so leaching should be encouraged to reduce this. These applications are considered the minimum to ensure pasture success. Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

pH and ELECTRICAL CONDUCTIVITY

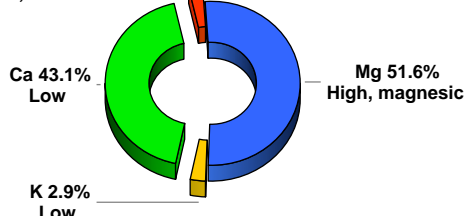


CATION BALANCE

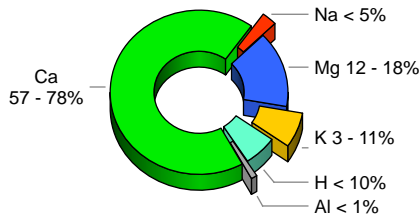
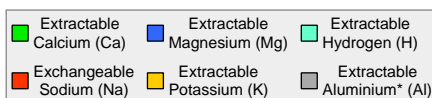
EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ ≤ 5.2

Na 2.5%
not sodic, normal



ACTUAL



IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.8	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	17.7	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.03	< 0.07
Comment: Acceptable		
K:Na	1.2	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.37 Low potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

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Web: www.sesl.com.au

Batch N°: 33837

Sample N°: 14

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	5.2						1	6	5
Phosphate-P (PO ₄)	31.9						6.4	12.6	6.2
Potassium (K) †	299						59.7	77.4	17.7
Sulphate-S (SO ₄)	894						178.4	13.6	Drawdown
Calcium (Ca) †	2257						450.3	551.2	100.9
Magnesium (Mg) †	1636						326.4	57.7	Drawdown
Iron (Fe)	145.7						29.1	110.1	81
Manganese (Mn) †	88						17.6	8.8	Drawdown
Zinc (Zn) †	7.2						1.4	1	Drawdown
Copper (Cu)	1.2						0.2	1.3	1.1
Boron (B) †	1.4						0.3	0.5	0.2

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

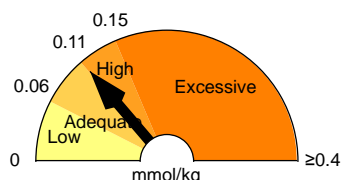
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Adequate. Economic response to P unlikely. P application recommended maintaining current P level.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **26.1**
Eff. Cation Exch. Capacity (eCEC): **26.1**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **1092**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **3.3 – Very high**
Organic Matter (OM%): **5.6**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
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Soil Chemistry Profile

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Batch N°: 33837 **Sample N°:** 15 **Date Received:** 3/3/15 **Report Status:** ☐ Draft ☒ Final

Client Name: AECOM - Newcastle **Project Name:** 60340733 - C & A Rehabilitation Monitoring 2015
Client Contact: Matthieu Catteau **MTW & HVO Mine Sites**
Client Job N°: **SESL Quote N°:** Q4235
Client Order N°: **Sample Name:** RHB-WML TD1
Address: PO Box 73 **Description:** Soil
 HRMC NSW 2310 **Test Type:** FSC, TOC_DC, M5

RECOMMENDATIONS

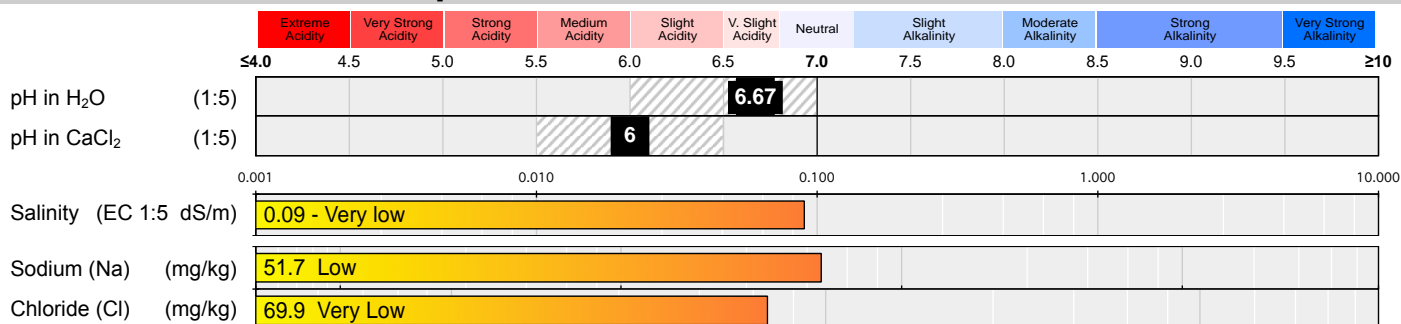
This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is acidic, not saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P levels are also low. Apply super phosphate at 20 g/sqm (200 kg/ha). Applications of gypsum at 200 g/sqm (2 t/ha) will assist in balancing the cations and preventing any dispersion.

These applications are considered the minimum to ensure pasture success. Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 **FERTILITY RATING:** ☐ Low ☒ Moderate ☐ High

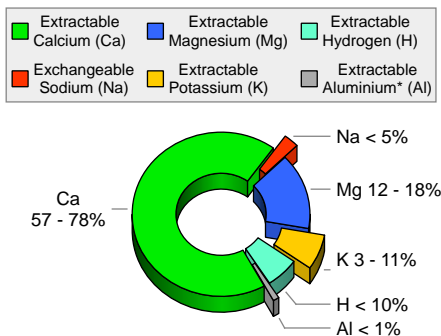
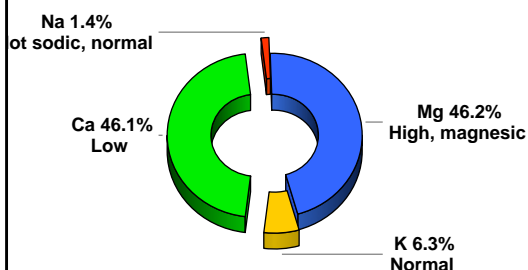
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1	4.1 – 6.0
Comment: Calcium low		
Mg:K	7.3	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.07	< 0.07
Comment: High		
K:Na	4.5	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.06 Moderate potential for dispersion and soil structure collapse		
SOLUBLE CATIONS (meq/100g)		
Na:	K:	Ca: Mg:



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Batch N°: 33837

Sample N°: 15

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	5.5						1.1	6	4.9
Phosphate-P (PO ₄)	42.2						8.4	12.6	4.2
Potassium (K) †	388						77.4	60.6	Drawdown
Sulphate-S (SO ₄)	12						2.4	13.6	11.2
Calcium (Ca) †	1450						289.3	431.7	142.4
Magnesium (Mg) †	882						176	44.9	Drawdown
Iron (Fe)	246.1						49.1	110.1	61
Manganese (Mn) †	34						6.8	8.8	2
Zinc (Zn) †	12						2.4	1	Drawdown
Copper (Cu)	0.8						0.2	1.3	1.1
Boron (B) †	0.5						0.1	0.5	0.4

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

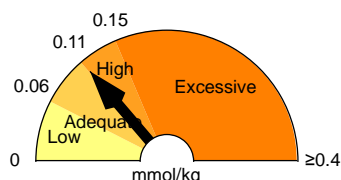
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Adequate. Economic response to P unlikely. P application recommended maintaining current P level.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **15.7**
Eff. Cation Exch. Capacity (eCEC): **15.7**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **578**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **5.3 – Very high**
Organic Matter (OM%): **8.9**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure-"Murphy" (1991), Colour-"Munsell" (2000))



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837 Sample N°: 16 Date Received: 3/3/15 Report Status: ☐ Draft ☒ Final

Client Name: **AECOM - Newcastle** Project Name: **60340733 - C & A Rehabilitation Monitoring 2015**
Client Contact: **Matthieu Catteau** MTW & HVO Mine Sites
Client Job N°:
Client Order N°:
Address: **PO Box 73** SESL Quote N°: **Q4235**
HRMC NSW 2310 Sample Name: **RHB-WML Swanlake**
Description: **Soil**
Test Type: **FSC, TOC_DC, M5**

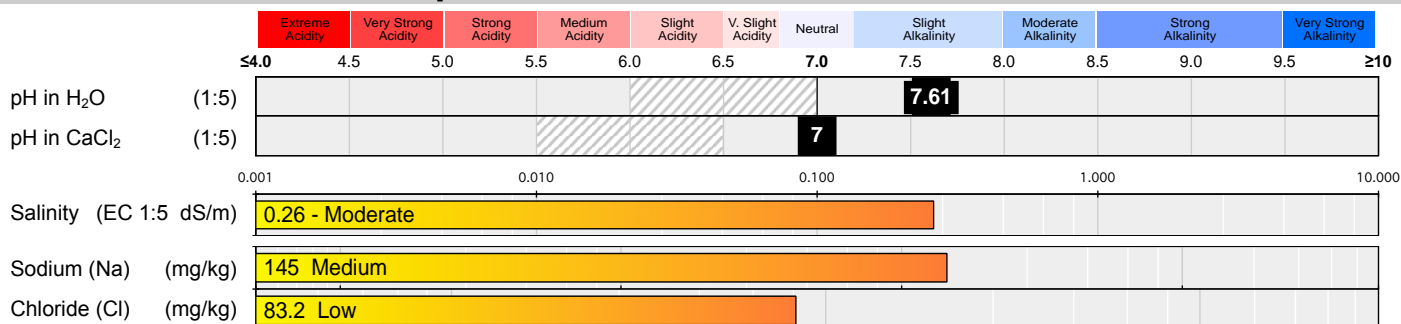
RECOMMENDATIONS

This soil sample submitted by the client was analysed for properties related to healthy plant growth, specifically the rehabilitation of soil to support pasture species. It is slightly alkaline, moderately saline and not sodic. The cation balance is magnesian. The effective cation exchange capacity (eCEC) is moderate, indicating good nutrient retention and holding capacity.

Of the plant available nutrients, N will prove most limiting to plant growth. This should be increased through split urea applications at 10 g/sqm (i.e. 2 x 10 g applications, or 200 kg/ha in total). P and K levels are also low. Apply super phosphate (DAP) and muriate of potash, both at 20 g/sqm (200 kg/ha). Applications of gypsum at 100 g/sqm (1 t/ha) will assist in balancing the cations and preventing any dispersion. This will temporarily inflate the salinity, so leaching should be encouraged to reduce this. These applications are considered the minimum to ensure pasture success. Additionally, future application of a multi purpose NPK fertiliser (such as Dynamic Lifter or Pasture Starter) will ensure adequate nutrition as the pasture establishes.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200 FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

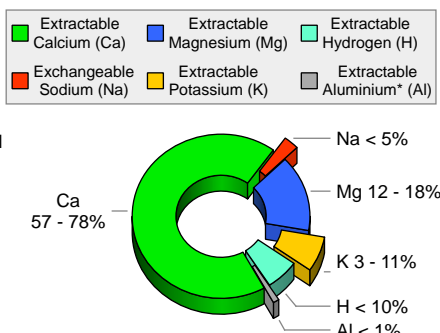
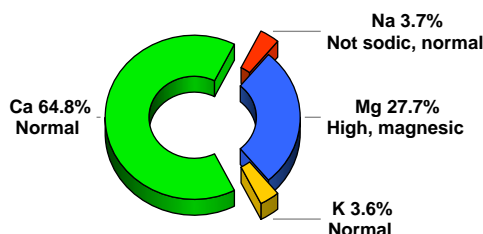
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	2.3	4.1 - 6.0
Comment: Calcium low		
Mg:K	7.7	2.6 - 5.0
Comment: Potassium low		
K/(Ca+Mg)	0.04	< 0.07
Comment: Acceptable		
K:Na	1	N/A
Sodium Absorption Ratio: 0 Low		
Electrochemical Stability Index (ESI): 0.07 Moderate potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
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Batch N^o: 33837Sample N^o: 16

Date Received: 3/3/15

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low	Low	Marginal	Adequate	High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	1.1						0.2	6	5.8
Phosphate-P (PO ₄)	16.8						3.4	12.6	9.2
Potassium (K) †	244						48.7	60.6	11.9
Sulphate-S (SO ₄)	121						24.1	13.6	Drawdown
Calcium (Ca) †	2234						445.7	431.7	Drawdown
Magnesium (Mg) †	579						115.5	44.9	Drawdown
Iron (Fe)	231.9						46.3	110.1	63.8
Manganese (Mn) †	71						14.2	8.8	Drawdown
Zinc (Zn) †	14						2.8	1	Drawdown
Copper (Cu)	3.8						0.8	1.3	0.5
Boron (B) †	1						0.2	0.5	0.3

Explanation of graph ranges:

Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High

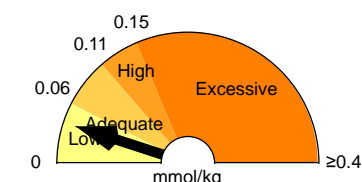
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g⁻¹): **17.2**
Eff. Cation Exch. Capacity (eCEC): **17.2**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **79**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: -
Colour: -
Estimated clay content: **Did not test**
Size: -
Gravel content: -
Aggregate strength: -
Structural unit: **Did not test**
Potential infiltration rate: **Did Not Test**
Permeability (mm/hr): **Did not test**
Calculated EC_{SE} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%)[†]: **3.4 – Very high**
Organic Matter (OM%): **5.7**
Additional comments:

Consultant: Bronwyn Brennan

Authorised Signatory: Declan McDonald

Date Report Generated 15/03/2015

B. Woodward

Declan McDonald

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture-
"Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))



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Biosolids Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89

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Web: www.sesl.com.au

Batch N°: 33837	Sample N°: 1	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESAL Quote N°: Q4235		
Client Order N°:	Sample Name: ANA-North CHPP		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments							
Chemical Contaminants (mg/kg)	Results given on a dry weight basis		A	B	C	D								
	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test							
	Cadmium (Cd)	1.2	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use							
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test							
	Copper (Cu)	13	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use							
	Lead (Pb)	14.4	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use							
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test							
	Nickel (Ni)	19.3	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use							
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test							
Organic Contaminants (mg/kg)	Zinc (Zn)	56	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use							
	DDT/DDD/DDE		-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test						
	Aldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Dieldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Chlordane		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Heptachlor		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	HCB		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Gamma BHC (Lindane)		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Alpha BHC		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
Microbiological Standards (Stabilisation Grade)	PCBs		-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test						
	E.coli		-	<100 MPN ^B /g (dry weight)			Did not test							
	Faecal coliforms		-	<1000 MPN ^B /g (dry weight)			Did not test							
	Salmonella sp.		-	Not detected/50g of final product			Did not test							
	Solids Content % (SR)		-											
	Moisture Content (%)		-											
	Total Nitrogen (TN%)		-											
	Total Kjeldahl N% (TKN)		-											
	NO ₂ present as N (dwb) mg/kg		-											
	NO ₃ present as N (dwb) mg/kg		-											
	NH ₄ present as N (dwb) mg/kg		-											
	Nitrogen Values			Minimum quality grades			Allowable land application use							
				Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal*
				A	A	Unrestricted Use	●	●	●	●	●	●	●	●
				B	A	Restricted Use 1		●	●	●	●	●	●	●
		C	B	Restricted Use 2				●	●	●	●	●		
		D	B	Restricted Use 3					●	●	●	●		
		E	C	Not Suitable For Use							●	●		

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Consultant: *BW Woodward*
Bronwyn Brennan

Authorised Signatory: *Declan McDonald*
Declan McDonald

Date Report Generated
15/03/2015



Biosolids Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89

Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837	Sample N°: 2	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESAL Quote N°: Q4235		
Client Order N°:	Sample Name: ANA-Parnells		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.6	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	22	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	21.5	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	16.9	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	52	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
Microbiological Standards (Stabilisation Grade)	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Nitrogen Values	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Consultant: *BW Woodward*
Bronwyn Brennan

Authorised Signatory: *Declan McDonald*
Declan McDonald

Date Report Generated
15/03/2015



Biosolids Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
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Batch N°: 33837	Sample N°: 3	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESAL Quote N°: Q4235		
Client Order N°:	Sample Name: ANA-Knodlers Lane		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element		Results:	Contaminant Grade				Comments						
Chemical Contaminants (mg/kg)	Results given on a dry weight basis			A	B	C	D							
	Arsenic	(As)	-	≤20	≤20	≤20	≤30	Did not test						
	Cadmium	(Cd)	0.9	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use						
	Chromium	(Cr)	-	≤100	≤250	≤500	≤600	Did not test						
	Copper	(Cu)	7	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use						
	Lead	(Pb)	10.3	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use						
	Mercury	(Hg)	-	≤1	≤4	≤15	≤19	Did not test						
	Nickel	(Ni)	16.3	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use						
	Selenium	(Se)	-	≤5	≤8	≤50	≤90	Did not test						
Organic Contaminants (mg/kg)	Zinc	(Zn)	23	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use						
	DDT/DDD/DDE		-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test						
	Aldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Dieldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Chlordane		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Heptachlor		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	HCB		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Gamma BHC (Lindane)		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Alpha BHC		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.			PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test					
Microbiological Standards (Stabilisation Grade)	E.coli		-	<100 MPN ^B /g (dry weight)				Did not test						
	Faecal coliforms		-	<1000 MPN ^B /g (dry weight)				Did not test						
	Salmonella sp.		-	Not detected/50g of final product				Did not test						
Nitrogen Values	Solids Content % (SR)		-											
	Moisture Content (%)		-											
	Total Nitrogen (TN%)		-											
	Total Kjeldahl N% (TKN)		-											
	NO ₂ present as N (dwb) mg/kg		-											
	NO ₃ present as N (dwb) mg/kg		-											
	NH ₄ present as N (dwb) mg/kg		-											
				Minimum quality grades		Allowable land application use								
				Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal*
				A	A	Unrestricted Use	●	●	●	●	●	●	●	●
			B	A	Restricted Use 1		●	●	●	●	●	●	●	
			C	B	Restricted Use 2				●	●	●	●	●	
			D	B	Restricted Use 3					●	●	●	●	
			E	C	Not Suitable For Use							●	●	

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Consultant: *BW Woodward*
Bronwyn Brennan

Authorised Signatory: *Declan McDonald*
Declan McDonald

Date Report Generated
15/03/2015



Biosolids Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837	Sample N°: 4	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SES L Quote N°: Q4235		
Client Order N°:	Sample Name: ANA Carrington Billabong		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments							
Chemical Contaminants (mg/kg)	Results given on a dry weight basis		A	B	C	D								
	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test							
	Cadmium (Cd)	1.7	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use							
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test							
	Copper (Cu)	29	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use							
	Lead (Pb)	9.1	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use							
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test							
	Nickel (Ni)	60.5	≤60	≤125	≤270	≤300	Grade B - Restricted Use 1							
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test							
Organic Contaminants (mg/kg)	Zinc (Zn)	64	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use							
	DDT/DDD/DDE		-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test						
	Aldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Dieldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Chlordane		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Heptachlor		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	HCB		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Gamma BHC (Lindane)		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
	Alpha BHC		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test						
PCBs		-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test							
Microbiological Standards (Stabilisation Grade)	E.coli		-	<100 MPN ^B /g (dry weight)			Did not test							
	Faecal coliforms		-	<1000 MPN ^B /g (dry weight)			Did not test							
	Salmonella sp.		-	Not detected/50g of final product			Did not test							
Nitrogen Values	Solids Content % (SR)		-											
	Moisture Content (%)		-											
	Total Nitrogen (TN%)		-											
	Total Kjeldahl N% (TKN)		-											
	NO ₂ present as N (dwb) mg/kg		-											
	NO ₃ present as N (dwb) mg/kg		-											
	NH ₄ present as N (dwb) mg/kg		-											
				Minimum quality grades		Allowable land application use								
				Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal*
				A	A	Unrestricted Use	●	●	●	●	●	●	●	●
			B	A	Restricted Use 1		●	●	●	●	●	●	●	
			C	B	Restricted Use 2				●	●	●	●	●	
			D	B	Restricted Use 3					●	●	●	●	
			E	C	Not Suitable For Use							●	●	

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Bronwyn Brennan

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Date Report Generated
15/03/2015



Biosolids Profile

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Batch N°: 33837	Sample N°: 5	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESAL Quote N°: Q4235		
Client Order N°:	Sample Name: ANA-Newport		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.8	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	7	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	24	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	11.3	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	43	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
Microbiological Standards (Stabilisation Grade)	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Nitrogen Values	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Bronwyn Brennan

Authorised Signatory: *Declan McDonald*
Declan McDonald

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15/03/2015



Biosolids Profile

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Batch N°: 33837	Sample N°: 6	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SES L Quote N°: Q4235		
Client Order N°:	Sample Name: ANA-Cheshunt		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.7	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	24	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	8.7	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	54.4	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	63	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
Microbiological Standards (Stabilisation Grade)	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Nitrogen Values	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Consultant: *BW Woodward*
Bronwyn Brennan

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Declan McDonald

Date Report Generated
15/03/2015



Biosolids Profile

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Batch N°: 33837	Sample N°: 7	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SES L Quote N°: Q4235		
Client Order N°:	Sample Name: ANA-Howick		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	3.1	≤3	≤5	≤20	≤32	Grade B - Restricted Use 1
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	22	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	30.1	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	19.5	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	84	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
Microbiological Standards (Stabilisation Grade)	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Nitrogen Values	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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15/03/2015



Biosolids Profile

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Batch N°: 33837	Sample N°: 8	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Catteau	MTW & HVO Mine Sites		
Client Job N°:	SES L Quote N°: Q4235		
Client Order N°:	Sample Name: ANA-Lemington Rd		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
	Results given on a dry weight basis		A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.7	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	24	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	8.9	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	54.6	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	62	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
Microbiological Standards (Stabilisation Grade)	Salmonella sp.	-	Not detected/50g of final product				Did not test
	Solids Content % (SR)	-					
Nitrogen Values	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Biosolids Profile

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Batch N°: 33837	Sample N°: 9	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESAL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-MTO South CHPP		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.7	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	31	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	20.3	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	18	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	61	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
Microbiological Standards (Stabilisation Grade)	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Nitrogen Values	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Bronwyn Brennan

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Declan McDonald

Date Report Generated
15/03/2015



Biosolids Profile

Sample Drop Off: 16 Chilvers Road
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Batch N°: 33837	Sample N°: 10	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-HVOW Plane Dump		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.7	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	26	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	20	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	17.5	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	61	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
Microbiological Standards (Stabilisation Grade)	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Nitrogen Values	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Biosolids Profile

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Batch N°: 33837	Sample N°: 11	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-MTO North Dump		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments					
Chemical Contaminants (mg/kg)	Results given on a dry weight basis		A	B	C	D						
	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test					
	Cadmium (Cd)	1.2	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use					
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test					
	Copper (Cu)	10	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use					
	Lead (Pb)	12.4	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use					
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test					
	Nickel (Ni)	11.7	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use					
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test					
Organic Contaminants (mg/kg)	Zinc (Zn)	68	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use					
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test					
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.		PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test				
Microbiological	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test					
Standards	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test					
(Stabilisation Grade)	Salmonella sp.	-	Not detected/50g of final product				Did not test					
Nitrogen Values	Solids Content % (SR)	-										
	Moisture Content (%)	-										
	Total Nitrogen (TN%)	-										
	Total Kjeldahl N% (TKN)	-										
	NO ₂ present as N (dwb) mg/kg	-										
	NO ₃ present as N (dwb) mg/kg	-										
	NH ₄ present as N (dwb) mg/kg	-										
			Minimum quality grades			Allowable land application use						
			Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal
		A	A	Unrestricted Use	●	●	●	●	●	●	●	●
		B	A	Restricted Use 1		●	●	●	●	●	●	●
		C	B	Restricted Use 2				●	●	●	●	●
		D	B	Restricted Use 3					●	●	●	●
		E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Bronwyn Brennan

Authorised Signatory: *Declan McDonald*
Declan McDonald

Date Report Generated
15/03/2015



Biosolids Profile

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Batch N°: 33837	Sample N°: 12	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESAL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-HVOS Riverview		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments						
Chemical Contaminants (mg/kg)	Results given on a dry weight basis		A	B	C	D							
	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test						
	Cadmium (Cd)	1.3	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use						
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test						
	Copper (Cu)	29	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use						
	Lead (Pb)	32.2	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use						
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test						
	Nickel (Ni)	17.4	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use						
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test						
Organic Contaminants (mg/kg)	Zinc (Zn)	82	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use						
	DDT/DDD/DDE		-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test					
	Aldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Dieldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Chlordane		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Heptachlor		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	HCB		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Gamma BHC (Lindane)		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Alpha BHC		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
PCBs		-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test						
Microbiological	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test						
Standards	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test						
(Stabilisation Grade)	Salmonella sp.	-	Not detected/50g of final product				Did not test						
Nitrogen Values	Solids Content % (SR)		-										
	Moisture Content (%)		-										
	Total Nitrogen (TN%)		-										
	Total Kjeldahl N% (TKN)		-										
	NO ₂ present as N (dwb) mg/kg		-										
	NO ₃ present as N (dwb) mg/kg		-										
	NH ₄ present as N (dwb) mg/kg		-										
			Minimum quality grades			Allowable land application use							
			Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
			A	A	Unrestricted Use	●	●	●	●	●	●	●	●
			B	A	Restricted Use 1		●	●	●	●	●	●	●
			C	B	Restricted Use 2				●	●	●	●	●
			D	B	Restricted Use 3					●	●	●	●
			E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Biosolids Profile

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Batch N°: 33837	Sample N°: 13	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-HVON Carrington		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	11	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	9.3	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	26.6	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	32	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
Microbiological Standards (Stabilisation Grade)	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Nitrogen Values	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Biosolids Profile

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Batch N°: 33837	Sample N°: 14	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESAL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-HVOW Wilton		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
		Results given on a dry weight basis	A	B	C	D	
Chemical Contaminants (mg/kg)	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.2	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	17	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	22.1	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	12.4	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	71	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
	Solids Content % (SR)	-					
	Moisture Content (%)	-					
Microbiological Standards (Stabilisation Grade)	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Biosolids Profile

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Web: www.sesl.com.au

Batch N°: 33837	Sample N°: 15	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-WML TD1		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments						
Chemical Contaminants (mg/kg)	Results given on a dry weight basis		A	B	C	D							
	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test						
	Cadmium (Cd)	1.1	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use						
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test						
	Copper (Cu)	12	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use						
	Lead (Pb)	13.9	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use						
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test						
	Nickel (Ni)	17.2	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use						
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test						
Organic Contaminants (mg/kg)	Zinc (Zn)	48	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use						
	DDT/DDD/DDE		-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test					
	Aldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Dieldrin		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Chlordane		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Heptachlor		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	HCB		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Gamma BHC (Lindane)		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
	Alpha BHC		-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test					
PCBs		-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test						
Microbiological	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test						
Standards	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test						
(Stabilisation Grade)	Salmonella sp.	-	Not detected/50g of final product				Did not test						
Nitrogen Values	Solids Content % (SR)		-										
	Moisture Content (%)		-										
	Total Nitrogen (TN%)		-										
	Total Kjeldahl N% (TKN)		-										
	NO ₂ present as N (dwb) mg/kg		-										
	NO ₃ present as N (dwb) mg/kg		-										
	NH ₄ present as N (dwb) mg/kg		-										
			Minimum quality grades			Allowable land application use							
			Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal ^A
			A	A	Unrestricted Use	●	●	●	●	●	●	●	●
			B	A	Restricted Use 1		●	●	●	●	●	●	●
			C	B	Restricted Use 2				●	●	●	●	●
			D	B	Restricted Use 3					●	●	●	●
			E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Consultant: *BW Woodward*
Bronwyn Brennan

Authorised Signatory: *Declan McDonald*
Declan McDonald

Date Report Generated
15/03/2015



Biosolids Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 33837	Sample N°: 16	Date Instructions Received: 3/3/15	Report Status: <input type="radio"/> Draft <input checked="" type="radio"/> Final
Client Name: AECOM - Newcastle	Project Name: 60340733 - C & A Rehabilitation Monitoring 2015		
Client Contact: Matthieu Cateau	MTW & HVO Mine Sites		
Client Job N°:	SESL Quote N°: Q4235		
Client Order N°:	Sample Name: RHB-WML Swanlake		
Address: PO Box 73	Description: Soil		
HRMC NSW 2310	Test Type: FSC, TOC_DC, M5		

Category	Element	Results:	Contaminant Grade				Comments
Chemical Contaminants (mg/kg)	Results given on a dry weight basis		A	B	C	D	
	Arsenic (As)	-	≤20	≤20	≤20	≤30	Did not test
	Cadmium (Cd)	1.1	≤3	≤5	≤20	≤32	Grade A - Unrestricted Use
	Chromium (Cr)	-	≤100	≤250	≤500	≤600	Did not test
	Copper (Cu)	16	≤100	≤375	≤2000	≤2000	Grade A - Unrestricted Use
	Lead (Pb)	19.9	≤150	≤150	≤420	≤500	Grade A - Unrestricted Use
	Mercury (Hg)	-	≤1	≤4	≤15	≤19	Did not test
	Nickel (Ni)	11.4	≤60	≤125	≤270	≤300	Grade A - Unrestricted Use
	Selenium (Se)	-	≤5	≤8	≤50	≤90	Did not test
Organic Contaminants (mg/kg)	Zinc (Zn)	67	≤200	≤700	≤2500	≤3500	Grade A - Unrestricted Use
	DDT/DDD/DDE	-	≤0.5	≤0.5	≤1.0	≤1.0	Did not test
	Aldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Dieldrin	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Chlordane	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Heptachlor	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	HCB	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Gamma BHC (Lindane)	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	Alpha BHC	-	≤0.02	≤0.2	≤0.5	≤1.0	Did not test
	PCBs	-	ND ^A	≤0.3	≤1.0	≤1.0	Did not test
	E.coli	-	<100 MPN ^B /g (dry weight)				Did not test
	Faecal coliforms	-	<1000 MPN ^B /g (dry weight)				Did not test
	Salmonella sp.	-	Not detected/50g of final product				Did not test
Microbiological Standards (Stabilisation Grade)	Solids Content % (SR)	-					
	Moisture Content (%)	-					
	Total Nitrogen (TN%)	-					
	Total Kjeldahl N% (TKN)	-					
	NO ₂ present as N (dwb) mg/kg	-					
	NO ₃ present as N (dwb) mg/kg	-					
	NH ₄ present as N (dwb) mg/kg	-					
Nitrogen Values							

Note A: No detected PCB's at a limit of detection of 0.2mg PCB/kg biosolids.

Minimum quality grades			Allowable land application use							
Contaminant Grade	Stabilisation Grade	Classification	Home lawns & gardens	Public contact sites	Urban landscaping	Agriculture	Forestry	Soil & site rehabilitation	Landfill disposal	Surface land disposal
A	A	Unrestricted Use	●	●	●	●	●	●	●	●
B	A	Restricted Use 1		●	●	●	●	●	●	●
C	B	Restricted Use 2				●	●	●	●	●
D	B	Restricted Use 3					●	●	●	●
E	C	Not Suitable For Use							●	●

* Restrictions apply to the selection of locations for surface land disposal.

Summary No restrictions to rehabilitation are noted.

Please see Soil Chemistry profile for recommendations.

Table 3.1 Contaminant Acceptance Concentration Thresholds, Table 3.6 Classification of Biosolids Products and Table 3.5 Stabilisation Grade A Microbiological Standards from the DEC NSW Environmental Guidelines: Use and disposal of biosolids products (1997) were used as the reference for chemical and organic contaminant acceptance concentration thresholds and classification. Other acceptance concentration thresholds and classification criteria may apply for other states.

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Consultant: *BW Woodward*
Bronwyn Brennan

Authorised Signatory: *Declan McDonald*
Declan McDonald


Date Report Generated
15/03/2015

Appendix C

Photographic Monitoring Results

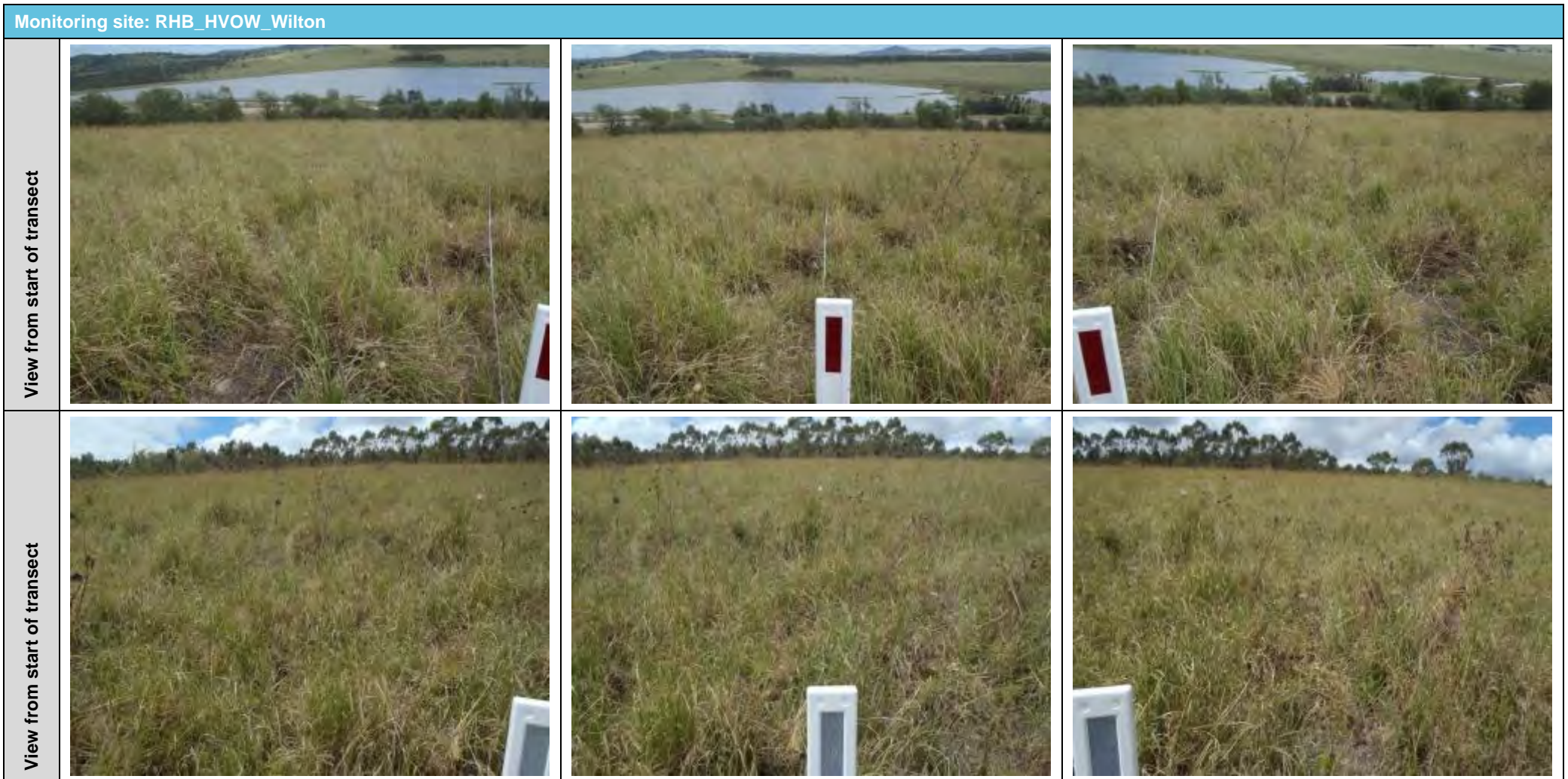
Appendix C Photographic Monitoring Results

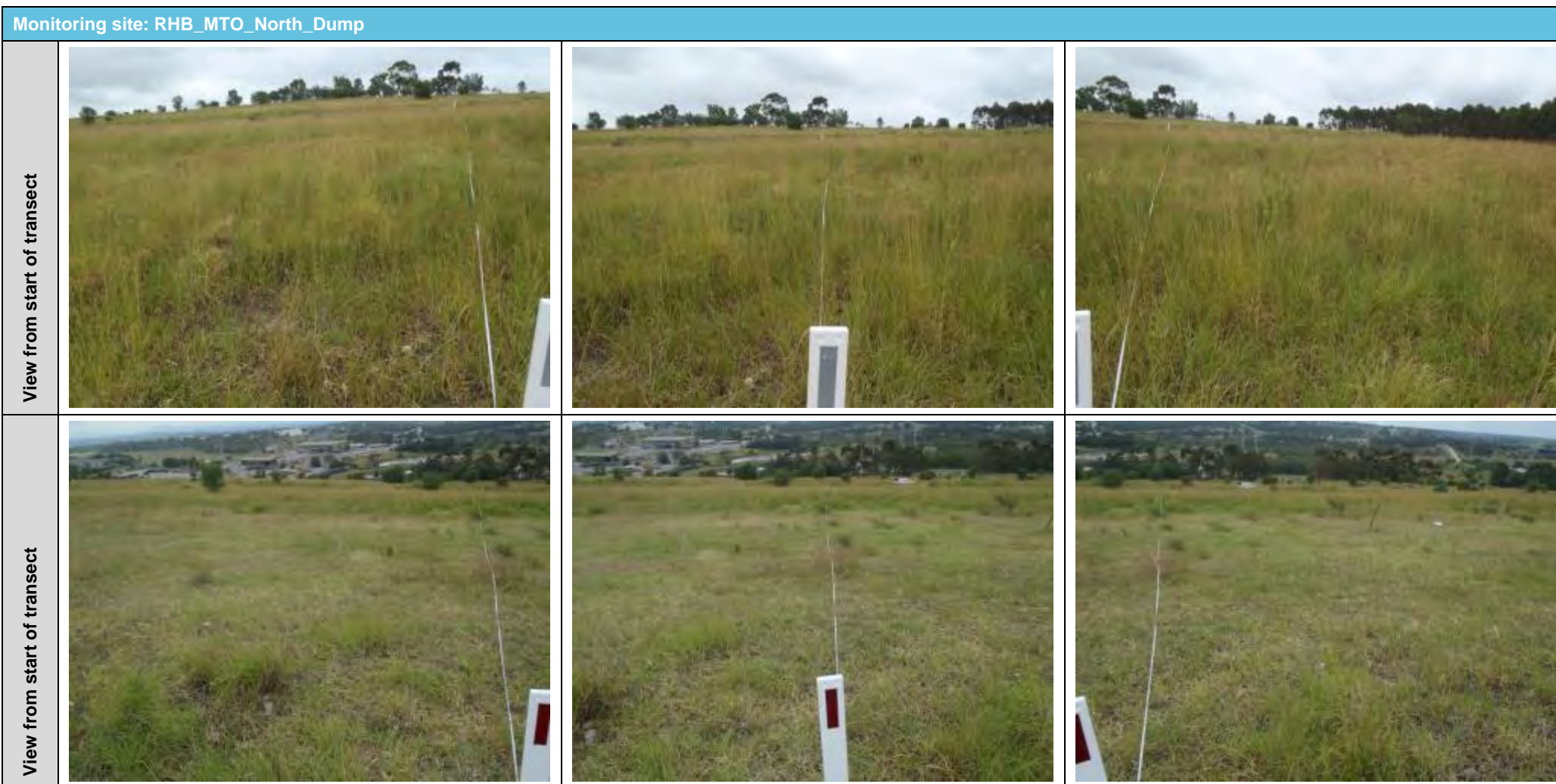
Monitoring site: RHB_HVON_Carrington

View from start of transect			
View from end of transect			



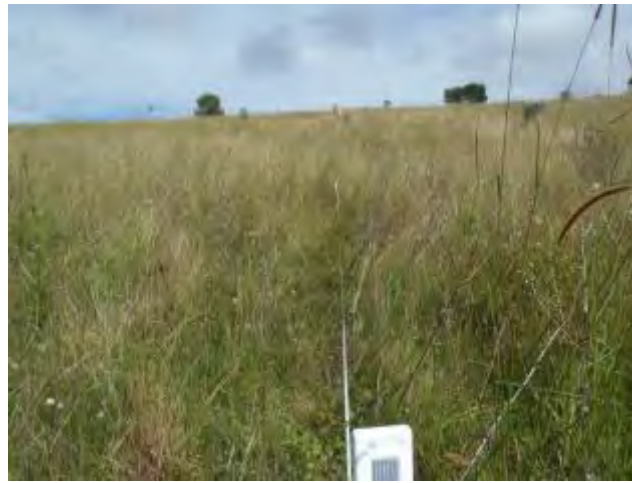




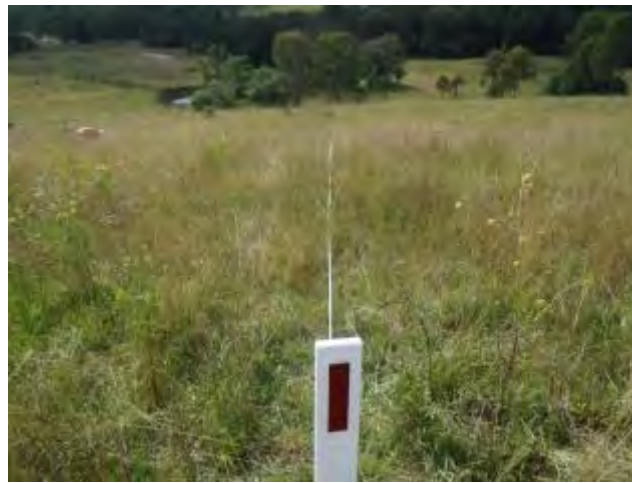


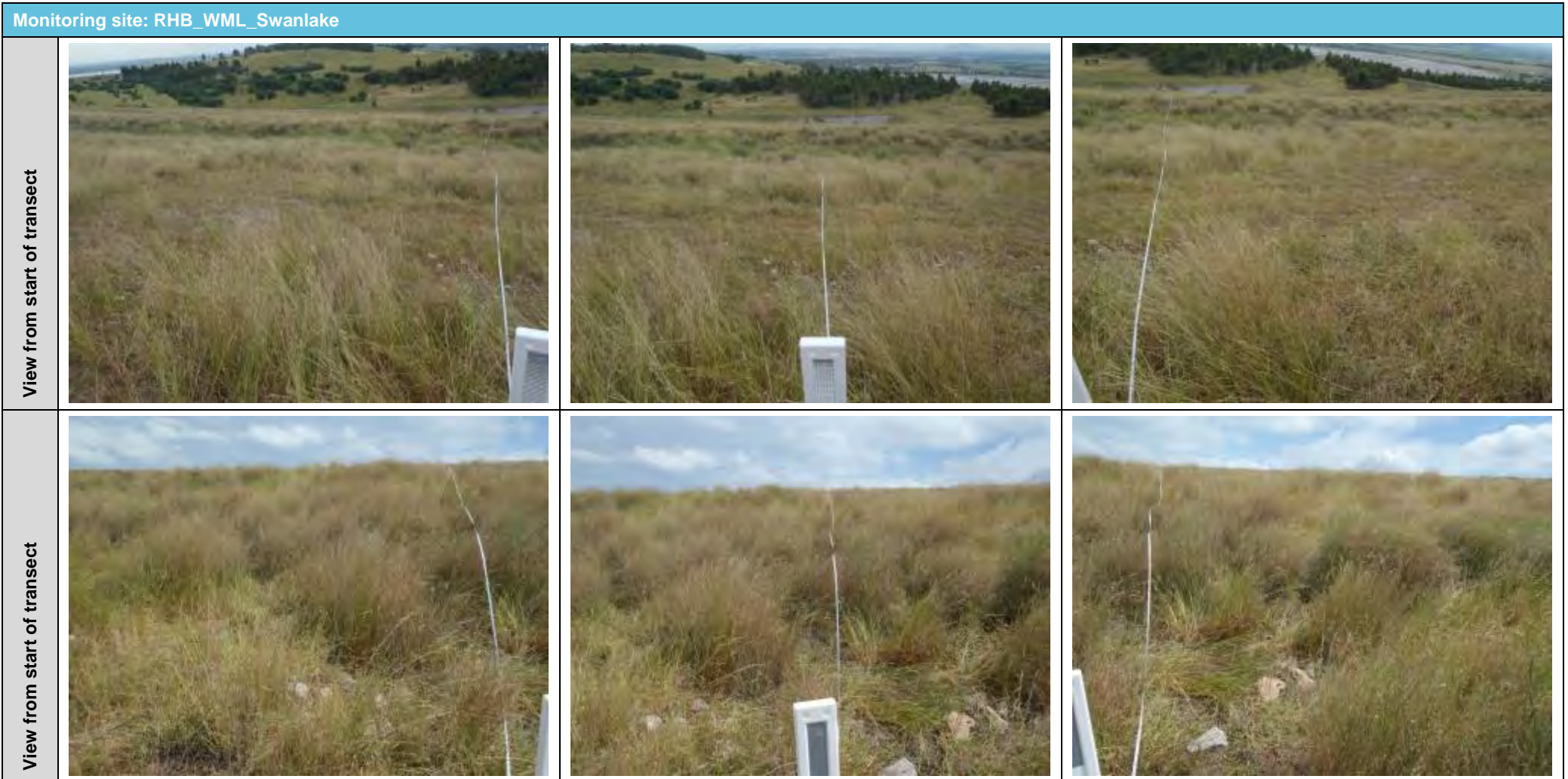
Monitoring site: RHB_MTO_South_CHPP

View from start of transect

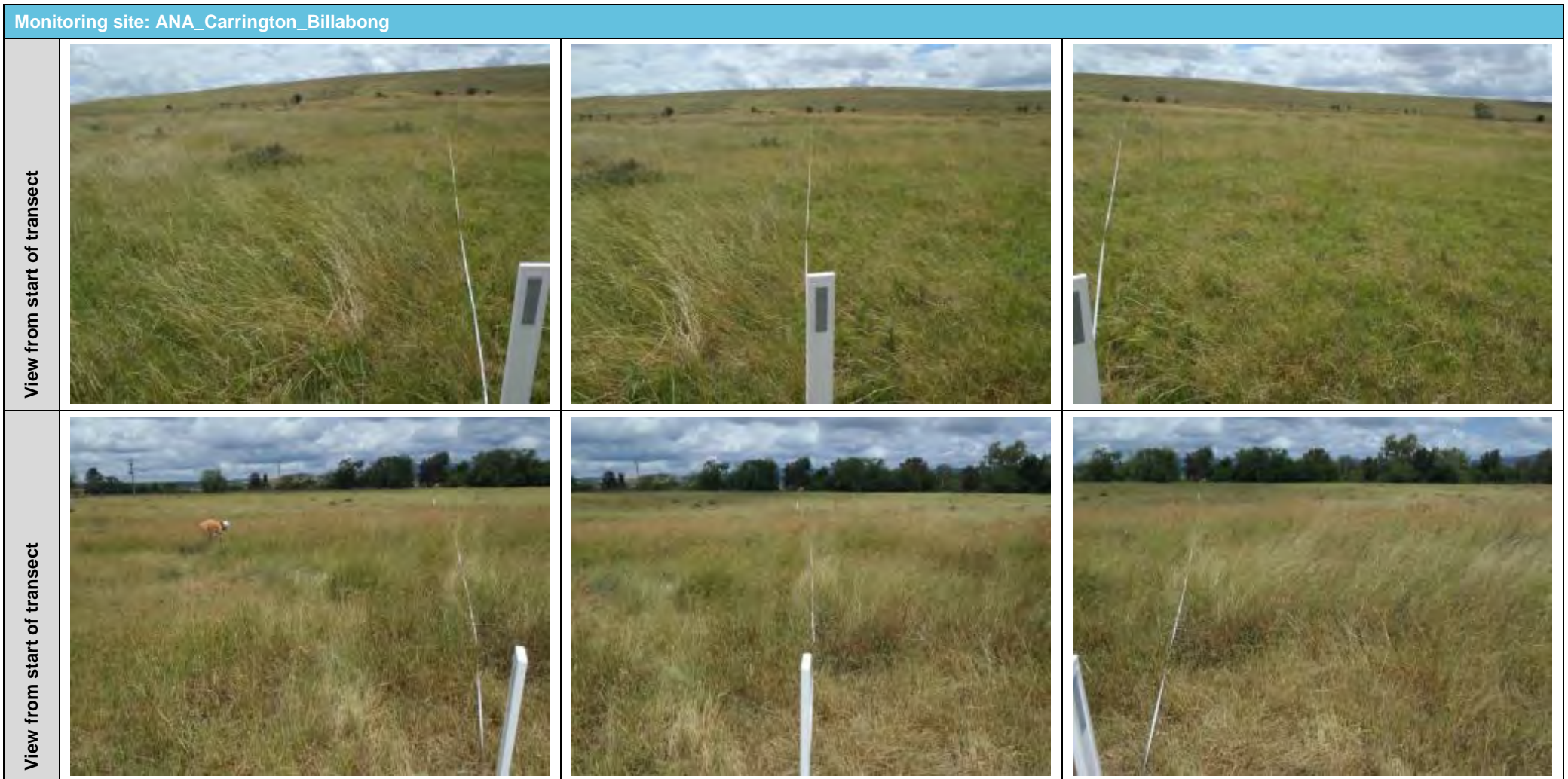


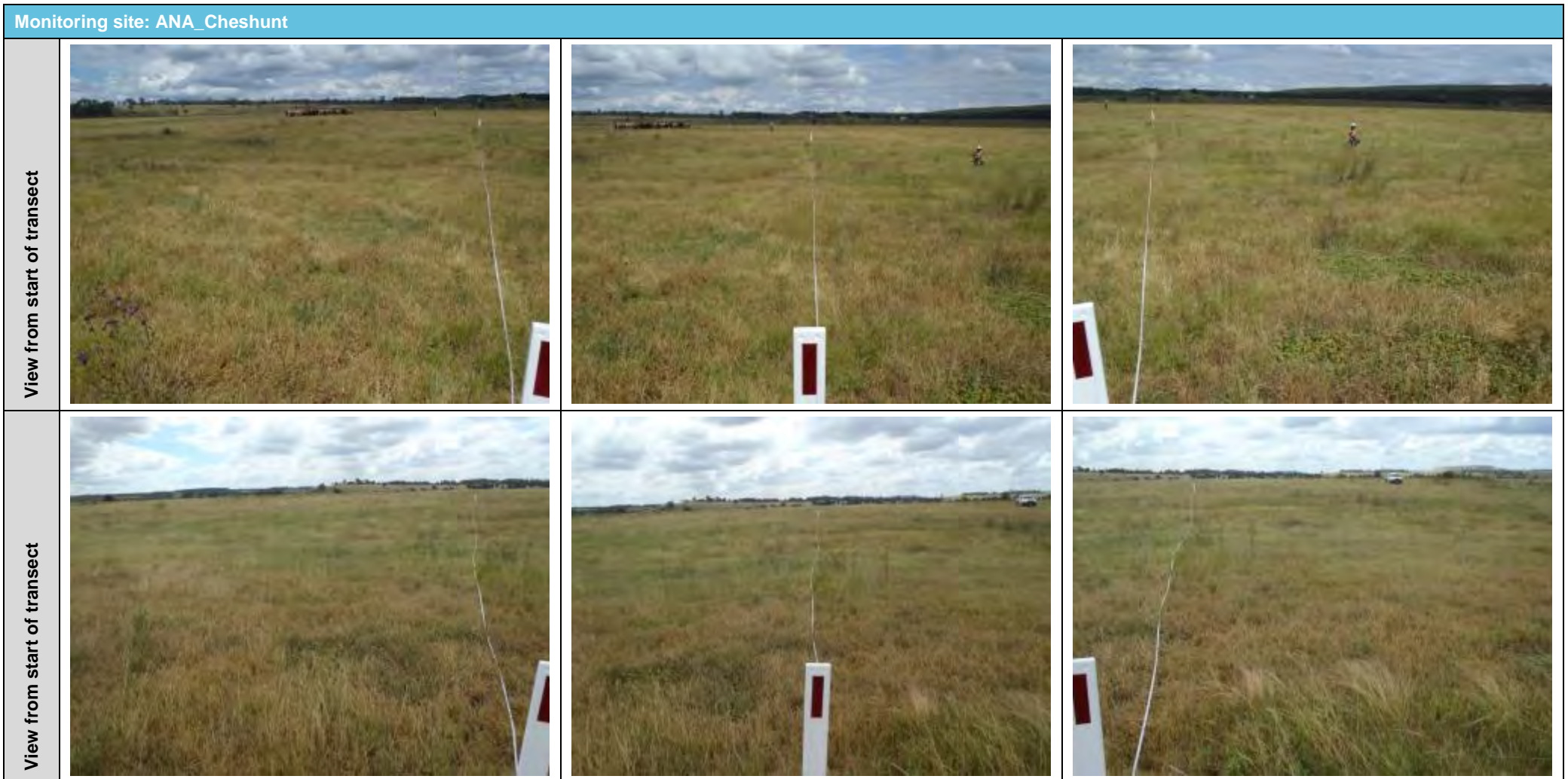
View from start of transect

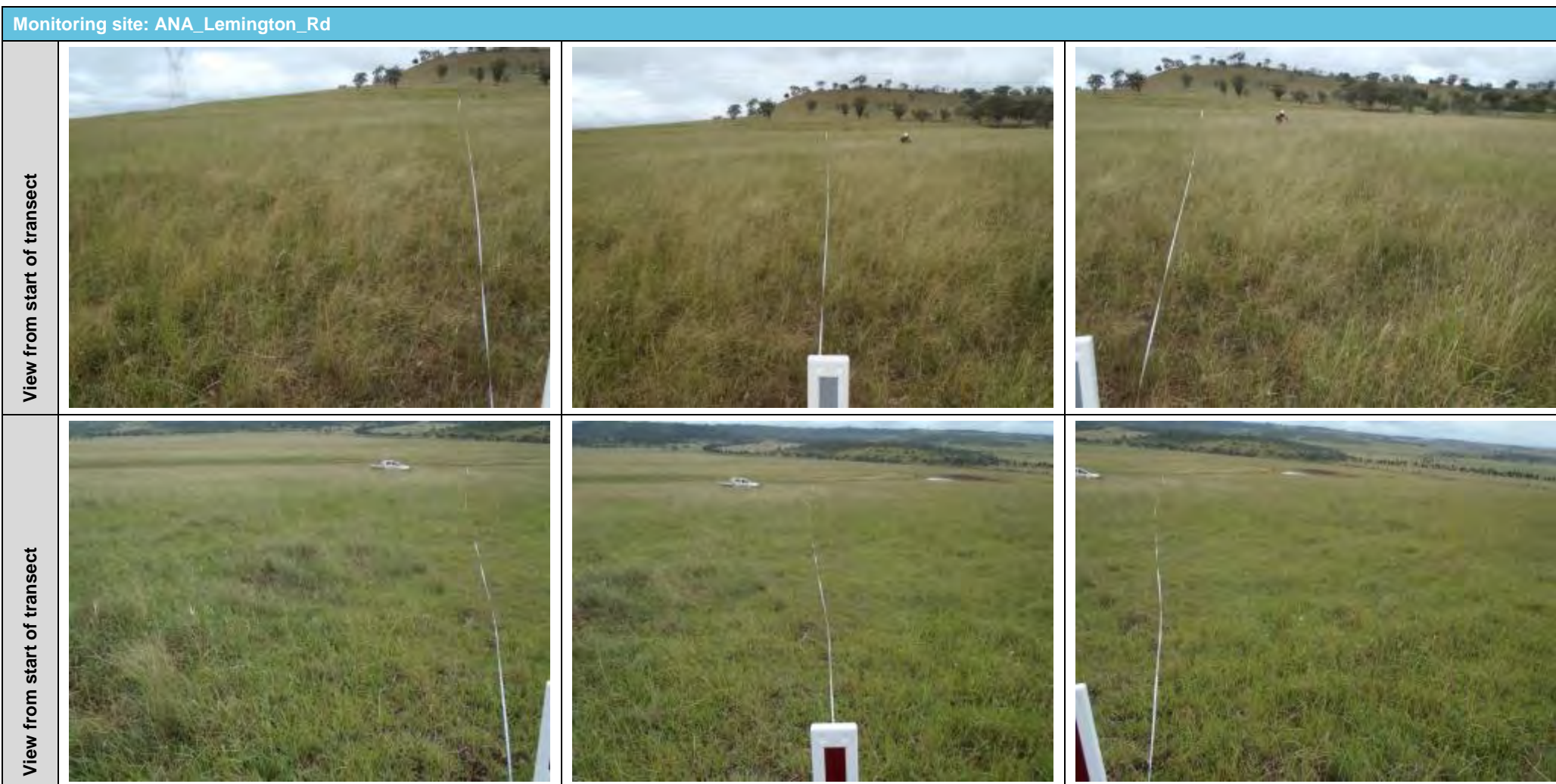






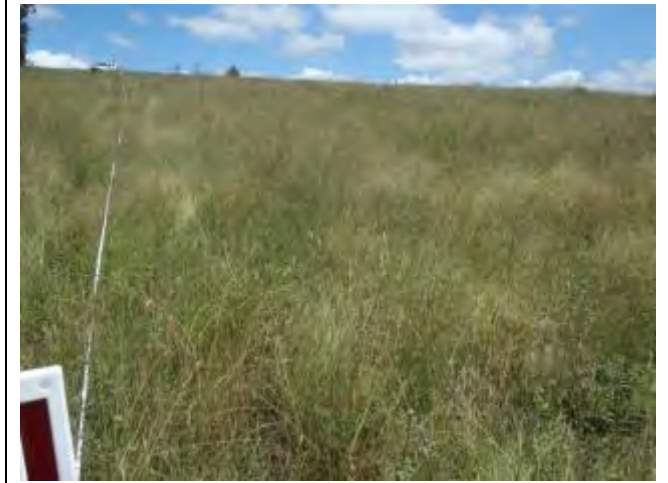
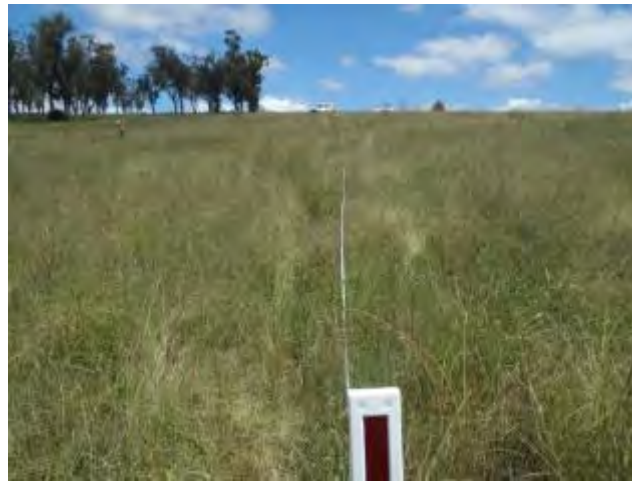






Monitoring site: ANA_Howick

View from start of transect



View from start of transect



Monitoring site: ANA_Parnells			
View from start of transect			
			