Yancoal Australia Ltd
23 May 2019

# Mining Operations Plan

## Mount Thorley Warkworth
## Amendment A (Update for Micro-relief, Performance Criteria Targets, ML1751, ML1752 and EPBC 2009/5081)
## Amendment B (Update for Additional Exploration Activities)

| | | | |
|---|---|---|---|
| Mine Name | Mt Thorley Warkworth | | |
| Company | Yancoal Australia Ltd. | | |
| Operator | Coal & Allied (NSW) Pty Limited (wholly owned subsidiary of Yancoal Australia Ltd.) | | |
| Mining Title & Leaseholder | CL 219, ML 1752 — Mt Thorley Operations Pty. Ltd.<br>CCL 753, ML 1412, ML 1590, ML1751 — Warkworth Mining Limited | | |
| Original MOP | Approved 5 February 2016 | 5 February 2016 to 30 November 2021 | Original |
| Amendment A | Approved 14 December 2018 | 7 September 2018 to 30 November 2021 | Update for Micro-relief Landform, Performance Criteria Targets, ML1751, 1752 and EPBC 2009/5081 |
| Amendment B | | 23 May 2019 to 30 November 2021 | Update for Additional Exploration Activities |
| Reporting Officer | Catherine Lewis | | |
| Date Submitted | 23 May 2019 | | |

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# MOUNT-THORLEY WARKWORTH

## Mining Operations Plan

| | |
|---|---|
| Name of Mine | Mount Thorley Warkworth Operations |
| MOP Commencement Date | 27 November 2015 |
| MOP Completion Date | 31 December 2021 |
| Mining Authorisations (Lease / Licence No.) | CL 219, CCL 753, ML 1412, ML 1590, ML 1751 |
| Name of Authorisation / Title Holder(s) | CL 219 Mount Thorley Operations Pty Ltd<br>CCL 753 Warkworth Mining Limited<br>ML 1412 Warkworth Mining Limited<br>ML 1590 Warkworth Mining Limited<br>ML 1751 Warkworth Mining Limited<br>ML 1752 Mount Thorley Operations Pty Ltd |
| Name of Mine Operator (if different) | Coal & Allied (NSW) Pty Limited (wholly owned subsidiary of Yancoal Australia Ltd.) ~~Coal & Allied Operations Pty Ltd~~ |
| Name and Contact Details of the Mine Manager (or equivalent) | Jason McCallum<br>General Manager Mount Thorley Warkworth Operations<br>PO Box 267 SINGLETON NSW 2330<br>Ph: 02 6570 1501<br>Fax: 02 6570 1599<br>Email: jason.mccallum@yancoal.com.au |
| Name and Contact Details of Environmental Representative | Bill Baxter<br>Environmental Specialist Rehabilitation<br>Mount Thorley Warkworth Operations<br>PO Box 315 SINGLETON NSW 2330<br>Ph: 02 6570 1717<br>Fax: 02 6570 1576<br>Mob: 0488 400958<br>Email: bill.baxter@yancoal.com.au |
| Name of Representative(s) of the Authorisation Holder(s) | Darin (Bill) Baxter |
| Title | Environmental Specialist Rehabilitation<br>Mt Thorley Warkworth |
| Signature | |
| Date | 23/05/2019 |

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*New South Wales*

**STATUTORY DECLARATION**

*OATHS ACT, 1900*

EIGTH SCHEDULE

I, DARIN (BILL) BAXTER, of SINGLETON

in the State of New South Wales, solemnly and sincerely declare as follows:

1. I am the duly appointed ENVIRONMENTAL SPECIALIST REHABILITATION *(management position)* for MOUNT THORLEY WARKWORTH *(mine name)*

2. I am authorised to make this Declaration on behalf of the Lease Holder,
   MOUNT THORLEY OPERATIONS PTY LTD *(name of leaseholder)*,
   A.C.N 000 013 249
   WARKWORTH MINING LIMITED *(name of leaseholder)*,
   A.C.N 001 385 842 and
   ..... *(name of leaseholder)*,
   A.C.N .....

3. All works and activities described in the Mining Operations Plan to which this declaration is attached comply with the conditions of the title of the mining lease (or mining leases) shown in the Mining Operations Plan, and with the conditions of the Development Consent and all other relevant Government Agency approvals and licences granted in respect of them.

4. I confirm that all of the works and activities referred to in the previous paragraph lie wholly within the area shown in the Mining Operations Plan and that the tenements (mining leases, colliery holdings, land ownership) details of those tenements are correct.

**And I make** this solemn Declaration, conscientiously believing the same to be true and by virtue of the provisions of the *Oaths Act, 1990*.

**Subscribed and Declared** at MOUNT THORLEY

in the State of New South Wales this 22nd day of May in

the year 2019

Signature D J Baxter

Before (print name) KERRI ANN ELLIS

Signature K Ellis

Justice of the Peace identification no 201830

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# 1.0 Introduction

This Mining Operations Plan (MOP) amendment (Amendment B) has been prepared to include additional exploration activities specified in Section 2.3

This MOP Amendment will replace ~~Mining Operations Plan (~~MOP~~) amendment (~~Amendment A~~) has been~~ which was prepared to include the following:

- updated final landform to incorporate micro-relief and natural drainage in accordance with the rehabilitation objections set out in Condition 56 and Condition 34 of the planning approvals for Warkworth (SSD-6464) and Mt Thorley (SSD-6464) respectively;
- updated targets for performance criteria based on the results from monitoring of analogue sites;
- inclusion of Mining Leases (ML) 1751 and ML 1752 following granting of these leases on 17 March 2017;
- updates to satisfy federal government approval EPBC 2009/5081 (Variation 23 December 2013) Condition 11 which relates to the submission of a Mine Site Rehabilitation Plan (MSRP).

This Mining Operations Plan (MOP) outlines the proposed operational and environmental management activities planned for Mt Thorley-Warkworth Operations (MTW) for the period through to 31 December 2021.

This MOP has been developed to satisfy Project Approval (SSD-6464) (26 November 2015) Schedule 3 Condition 58 for Warkworth and Project Approval (SSD-6465) (26 November 2015) Schedule 3 Condition 36 for Mt Thorley which both relate to the development of the Rehabilitation Management Plan (RMP). The RMP is required to:

**SSD-6464 Schedule 3 Condition 58 (Warkworth):**

58. The applicant shall prepare a Rehabilitation Management Plan for the development to the satisfaction of the DRE, and carry out the development in accordance with this plan. The plan must:

a) be prepared in consultation with the Department, NOW, OEH, Council and the CCC;

b) be prepared in accordance with any relevant DRE guideline. Including any existing NSW government policy regarding final voids;

c) be submitted to the DRE for approval prior to carrying out any development under this consent;

d) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary);

e) describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including timeframes for achieving specified rehabilitation objectives;

f) includes a mine closure strategy, that details measures to minimise the long term impacts associated with mine closure, including final landform and final voids, final land use and socio-economic issues;

g) include interim rehabilitation where necessary to minimise the area exposed for dust generation;

h) include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and

i) build to the maximum extent practicable on the other management plans required under this consent.

**Planning Approval SSD-6465 Schedule 3 Condition 36 (Mt Thorley):**

36. The applicant shall prepare a Rehabilitation Management Plan for the development to the satisfaction of the DRE, and carry out the development in accordance with this plan. The plan must:

a) be submitted to the DRE for approval prior to carrying out any development under this consent;

b) be prepared in consultation with the Department, NOW, OEH, Council and the CCC;

c) be prepared in accordance with any relevant DRE guideline. Including any existing NSW government policy regarding final voids;

d) describe how the rehabilitation of the site would be integrated with the implementation of the biodiversity offset strategy;

e) Include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary);

f) Describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including timeframes for achieving specified rehabilitation objectives;

g) Includes a mine closure strategy, that details measures to minimise the long term impacts associated with mine closure, including final landform, final land use and socio-economic issues;

h) Include interim rehabilitation where necessary to minimise the area exposed for dust generation;

i) Include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and

j) Build to the maximum extent practicable on the other management plans required under this consent.

This MOP has also been developed to satisfy federal government approval EPBC 2009/5081 (Variation 23 December 2013) Condition 11 which relates to the submission of a Mine Site Rehabilitation Plan (MSRP) to the Department of the Environment and Energy (DoEE). The MSRP is required to:

**Federal Approval EPBC 2009/5081 Variation 23 December 2013) Condition 11 (Warkworth):**

11. The person taking the action must, within 12 months of the Commencement of Construction of Phase 1, and within 12 months of the Commencement of Construction of Phase 2, submit to the Minister for approval a Mine Site Rehabilitation Plan (MSRP) for the progressive rehabilitation and revegetation of no less than 32ha of woodland on mined areas for Phase 1 and 2,303ha of woodland habitat on mined areas for Phase 2. The MSRP must include, at a minimum, the following information:

a. The desired outcomes/objectives of implementing the MSRP

b. Details of the vegetation communities to be rehabilitated and the timing of progressive rehabilitation

c. A process to progressively report to the department the rehabilitation management actions undertaken and the outcome of those actions, and the mechanisms to be used to identify the need for improved management

d. A description of the potential risks to successful management and rehabilitation on the project site, and a description of the contingency measures that would be implemented to mitigate these risks

e. Details of parties responsible for reviewing and implementing the plan

f. Details of long term management and protection of the mine site

MTW is managed by Coal & Allied (NSW) Pty Limited, a wholly owned subsidiary of Yancoal Australia Limited (Yancoal) ~~Coal & Allied Operations Pty Limited (Coal & Allied) which in turn is managed by Rio Tinto Coal Australia (RTCA)~~. MTW is located approximately 14km southwest of Singleton, in the upper Hunter Valley of New South Wales (NSW) (refer to Map 1A).

MTW is an amalgamation of two separate Yancoal ~~Coal & Allied~~ managed coal mining operations; Mt Thorley Operations (MTO) and Warkworth Mining Limited (WML). MTO is a joint venture owned by Yancoal ~~Coal and Allied Operations~~ (80%) and Posco (20%) whilst WML is a joint venture owned by Yancoal ~~Coal & Allied~~ (55.6%), Mitsubishi Development (28.9%), Mitsubishi Materials (6%) and Nippon Steel (9.5%). ~~Coal & Allied is Rio Tinto owned (75.7%).~~ These two mines were integrated into one operation~~, managed by Coal & Allied~~ in February 2004 to form MTW.

This MOP applies to MTW's combined mining tenements, and is intended to provide information on the projected mining and associated activities for MTW operations. An aerial image showing the main "components" of MTW is presented in Map 1B and Map 1C.

## 1.1 History of Operations

WML commenced mining operations in 1981, following the granting of a mining lease in February of the same year. The open cut mine is located within Consolidated Coal Lease No. 753 (CCL 753) and Mining Leases (ML) ML 1412, ML 1590, and ML 1751 which comprises of a total of 4,200 hectares (ha) of land. Since 1981, WML has produced semi-soft coking and thermal coal for domestic and export markets through the operation of a multi-seam, open cut coal mine.

MTO commenced mining operations in 1981 within Coal Lease No. 219 (CL 219) and comprises approximately 1,992ha of land. MTO has produced semi-soft and thermal coal, mainly for the export market.

For the purposes of this MOP, WML will be referred to as "North" and includes infrastructure and facilities within the WML area whilst MTO will be referred to as "South" and includes infrastructure and facilities within MTO area. These are highlighted in Map 2b. The terms WML and MTO are used in a historical context. Development history for the MTW operations is summarised in Table 1.

On 26 November 2015, MTW was granted approval by the Minister for Planning under the Environmental Planning and Assessment Act (EP&A Act) for the continuation of the Warkworth and Mt Thorley Mines. The subsequent development consent allowed for the extension of mining activities generally to the west of the existing operations, maintaining previous production levels of 18 Million tonnes per annum (Mtpa) of Run Of Mine (ROM) coal. This MOP has been prepared to outline mining activities that will comply with the requirements of the amended State Significant Development (SSD) Project Approvals SSD-6464 and SSD-6465 (refer to Appendix A).

**Table 1 History of mining development at MTW**

| Year | Mount Thorley Operations | Warkworth Mining Limited |
|---|---|---|
| 1976 | Authorisation 66 granted. Exploration commences by RW Miller. | Tender for coal lease released by NSW government. CL 205 granted. |
| 1979 | | Environmental Impact Statement (EIS) submitted to Singleton Shire Council (SSC). |
| 1980 | | Development Consent granted by SC for mining operations. State Pollution Control commission approval to develop mine granted. |
| 1981 | Development Consent (DA 80/53) first granted by the (then) Minister for Planning and Environment for the production of 1.1 Mtpa coal.<br>CL 219 granted. | CL 276 granted. Official opening of mine. Overburden removal commenced and first coal shipment dispatched. |
| 1983 | Development Consent (DA 80 – 10059 Pt. 6) first granted by the (then) Minister for Planning and Environment to increase tonnage to 1.7 Mtpa coal. | |
| 1984 | The 1983 Development Consent modified and approved (File No. N94 / 001580 – 10059 Mod. 1) by the (then) Minister for Planning and Environment to increase tonnage to 2.5 Mtpa coal. | |
| 1988 | | DMR approval to commence mining North Pit. |
| 1990 | | CCL 753 issued in respect of CL 205 and CL 276 |
| 1991 | | DMR approval to extend operations in West Pit. |
| 1993 | The 1983 Development Consent modified and approved (DA 32/93 80 – 10059 Mod. 2) by SC to expand the mining area by approximately 50 hectares (ha). | |
| 1994 | | DMR Approval to extend operations in North, South and West Pits. |
| 1995 | | Development consent granted by the (then) NSW Department of Urban Affairs and Planning (DUAP) for expansion of operations to 4.5 Mtpa. |

| Year | Mount Thorley Operations | Warkworth Mining Limited |
|---|---|---|
| 1996 | Development Consent granted (DA 34/95) by the (then) Minister of Urban Affairs and Planning to extend the mine west to Charlton and Wallaby Scrub Roads. The consent allowed for the production of up to 8 Mtpa coal. | |
| 1997 | | Operations commence in Woodlands Pit. Renewal of CCL 753.<br>ML 1412 issued. |
| 1999 | | Second dragline commissioned. |
| 2000 | | Modification to consent granted by DUAP for expansion of operations to 7 Mtpa. |
| 2001 | The 1996 Development Consent was modified (File No. N94/001580 – 10059 Mod. 3) by the (then) Minister for Urban Affairs and Planning to allow for haulage of coal between MTO and WML. | Modification to consent granted by DUAP for an extension of the haul road between WML and MTO. |
| 2002 | The 1996 Development Consent was modified (DA 34 / 95 Mod. 1 (N91 / 00310)) by the (then) Minister for Urban Affairs and Planning to provide for the Abbey Green Project (2 pits), increase Coal Preparation Plant (CPP) production to 10 Mtpa and the transfer of water and reject between MTO and WML. | Modification to consent granted by the (then) NSW Department of Planning for transfer of tailings and water between WML and MTO. |
| 2003 | | Approval for the extension of mining to Wallaby Scrub Road (DA 300-9-2002-i). |
| 2004 | Modification of DA 34 / 95 (DA 34 / 95 Mod 2 File No: 502/02196) to allow modification to rejects and ROM Bins at South CPP.<br>Modification of 2003 (DA 300-9-2002-i M1 File No: S02/02198) to allow modification to rejects and ROM Bins at North CPP.<br>Commonwealth Approval under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC) Approval 2002/629, along with variations EPBC 2002 / 629 Variation 1, EPBC 2002 / 629 Variation 2 & EPBC 2002 / 629 Variation 3. | |
| 2007 | | ML 1590 was granted to Warkworth Mining Limited.<br>Data acquisition for the Coal Seam Methane Pilot Program (CSMPP) commenced. |
| 2009 | Modification of DA 34/95 to allow for an extension of Dam existing mine water management structure (Dam9S). | MOP amendment raise dumps over CD |

| Year | Mount Thorley Operations | Warkworth Mining Limited |
|---|---|---|
| 2010 | | MOP amendment raise dumps over active pit areas |
| | | Application for MOP to dump over existing rehabilitation |
| 2012 | Modification of DA 34/95 to allow for extension of the AGN Pit and associated developments. | New Development Consent DA 09_0202 granted by the Minister for Planning and Infrastructure to allow for continuation of mining activities beyond the previous consent limit and for the extension of mining activities to the west. |
| | | The new DA supersedes the previous Development Consent (DA-300-9-2002-i) which is to be surrendered by the end of December 2012 in accordance with Section 14A of the EP&A Act. |
| 2013 | | Development Consent DA 09-0202 (3 February 2012) disapproved by the Land and Environment Court NSW. Warkworth Mine reverts to operating in accordance with the 2003 development consent (current version from October 2009 modification).<br>Development Consent modification DA-300-9-2002-i (January 2014) granted by the Minister for Planning and Infrastructure to allow for open cut mining in a 350m wide strip within Non Disturbance Area 1.<br>MOP amendment Warkworth Modification 6 350m extension into NDA1 and inclusion of Common Boundary Rehabilitation Plan. |
| 2015 | New Development Consent SSD-6465 (26 November 2015) granted to extend the time for approved mining and continued use of existing mining infrastructure; and allow the transfer of additional overburden from Warkworth Mine to complete the final landform for an additional 21 years. | New Development Consent SSD-6464 (26 November 2015) granted to extend West Pit to the south and west into Saddleback Ridge and then extend both West Pit and North Pit through Wallaby Scrub Road. |
| 2017 | ML 1752 granted to Mt Thorley Operations Pty Limited on 17 March 2017 in the area of and north of Putty Road. | ML 1751 granted to Warkworth Mining Ltd on 17 March 2017 in the area of and west of Wallaby Scrub Road. |

## 1.2 Consents, Authorisations and Licences

MTW operates under a number of different approvals including:

- Development Consents issued by the Department of Planning and Environment (DP&E) or SSC;
- Environment Protection and Biodiversity Conservation (EPBC) Act approval, issued by the Commonwealth Department of the Environment and Energy (DoEE) (formerly Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC));
- Mining tenements issued by the NSW Division of Resources and Geosciences (DRG);
- Mining Operations Plan approved by the Resources Regulator (DP&E-RR) (formerly DRG);
- Environmental Protection Licenses (EPL) issued by the NSW Office of Environment and Heritage (OEH);
- Dangerous Goods licences issued by WorkCover;
- Water licences issued by the NSW Office of Water (NoW);
- Section 87 and Section 90 permits issued by OEH (now Aboriginal Heritage Impact Permits (AHIP)); and
- Dam licences issued by the Dam Safety Committee (DSC).

Current approvals, tenements and MOP for MTW are summarised in Table 2. Current licenses are summarised in Table 3, except water licenses, which are summarised in Table 4. Section 87 and Section 90 Permits are summarised in Table 5. Dam and emplacement area approvals are summarised in Table 6.

**Table 2 MTW Approvals, Tenements and MOP**

| Approval Number | Description | Issue Date | Expiry Date |
|---|---|---|---|
| **Warkworth** | | | |
| SSD-6464 | Warkworth Continuation 2014 | 26 November 2015 (Date of Commencement 15 February 2016) | 15 February 2037 (21 years from Commencement) |
| EPBC 2002/629 | EPBC 2002/629 Variation issued 23 December 2013 | 6 August 2014 | 31 March 2033 |
| EPBC 2009/5081 | EPBC 2009/5081 variation issued 23 December 2013 | 6 August 2014 | 31 March 2033 |
| CCL 753 | Prospecting and Mining Coal | 17 February 2002 | 17 February 2023 |
| ML 1412 | Prospecting and Mining Coal | 11 January 1997 | 10 January 2018 (Renewal pending) |
| ML 1590 | Prospecting and Mining Coal | 27 February 2007 | 26 February 2028 |
| ML 1751 | Prospecting and Mining Coal | 17 March 2017 | 17 March 2038 |
| **Mount Thorley** | | | |
| SSD-6465 | Mt Thorley Operations 2014 | 26 November 2015 (Date of Commencement 15 February 2016) | 15 February 2037 (21 years from Commencement) |
| CL 219 | Prospecting and Mining Coal | 23 September 1981 | 23 September 2023 |
| (Part) ML 1547 | Mining Purposes | Registered to 31/12/2015 | |

| Approval Number | Description | Issue Date | Expiry Date |
|---|---|---|---|
| ML 1752 | Prospecting and Mining Coal | 17 March 2017 | 16 March 2038 |
| **MTW Mining Operations Plan** | | | |
| Mount Thorley Warkworth MOP | | 5 February 2016 | 30 November 2021 |

Yancoal submitted a Mining Lease Application (MLA 548) to cover the Mount Thorley Coal Loader (MTCL) area on 13 November 2017, however at the time of preparing this MOP Amendment the Mining Lease had not been granted. Information related to the MTCL area has therefore not been included in this MOP Amendment but will be included in a subsequent MOP Amendment upon the mining lease being granted.

**Table 3 MTW Licences**

| Licence / Permit No. | Description | Expiry Date |
|---|---|---|
| **Warkworth** | | |
| EPL 1376 | Environmental Protection Licence | 1 December (anniversary)<br>~~15 June 2020 (Review due date)~~ |
| ~~NDG018727~~ | ~~Notification of Dangerous Goods on Premises~~ | ~~No Expiry~~ |
| RML 5061122 | Radiation Management Licence | 02 May 2019 |
| XSTR100160 | Licence to store – *Explosives Act 2003* | 13 November 2018 |
| **Mount Thorley** | | |
| EPL 24 | Environmental Protection Licence | 1 August (Anniversary date)<br>~~16 November 2017 (Review due date)~~ |
| EPL 1976 | Environmental Protection Licence | 1 April (Anniversary date)<br>~~8 January 2020 (Review due date)~~ |
| ~~NDG018727~~ | ~~Dangerous Goods Licence~~ | ~~6 November 2015~~ |
| RML5061110 | Radiation Management Licence | 31 July 2018 |

**Table 4 MTW Water Licences**

| License No. | Type | Purpose | Legislation | Renewal Date |
|---|---|---|---|---|
| WAL10543; WAL10544; WAL963 | Water Access Licence | Water Access Licence | *Water Management Act 2000* | Perpetuity |
| WAL19022 | Water Access Licence | Water Access Licence | *Water Management Act 2000* | 25 February 2023 |
| ~~WAL969~~ WAL18233, WAL18558, | Water Access Licence | Water Access Licence | *Water Management Act 2000* | Perpetuity |
| WAL40464 | Water Access Licence | Mt Thorley Pit Excavation | *Water Management Act 2000* | Perpetuity |
| WAL4045 | Water Access Licence | Warkworth Pit Excavation | *Water Management Act 2000* | Perpetuity |
| 20BL168821; 20BL171729; 20BL171841; 20BL171842; 20BL171843; 20BL171844; 20BL171845; 20BL171847; 20BL171848; 20BL171849; 20BL171850; 20BL171864; 20BL171891; 20BL171892; 20BL171893; 20BL171894; 20BL172272; 20BL172273 | Bore | Monitoring Bore | Part 5 *Water Act 1912* | Perpetuity |

| License No. | Type | Purpose | Legislation | Renewal Date |
|---|---|---|---|---|
| ~~20BL170011; 20BL170012~~ | ~~Bore~~ | ~~Excavation - Mining~~ | ~~Part 5 *Water Act 1912*~~ | ~~26 November 2016~~ |
| 20AL209903 | Diversion Works | Irrigation | Part 2 *Water Act 1912* | 25 February 2023 |
| 20CA209904 | Stream Diversion | Bywash Dams | Water Management Act 2000 | 25 February 2023 |
| 20WA209905 | Stream Diversion | Bywash Dams | Water Management Act 2000 | 31 July 2022 |
| ~~20CW802601~~ | ~~Controlled Work~~ | ~~Block Dam~~ | ~~Part 8 *Water Act 1912*~~ | ~~24 August 2015~~ |
| 20FW213276 | Flood Work Approval | Block Dam | Water Management Act 2000 | 23 August 2020 |

**Table 5 MTW Section 87 and Section 90 Permits**

| Permit No. | Location Description | Issue Date | Expiry Date |
|---|---|---|---|
| **Warkworth** | | | |
| 1103070 | Warkworth Sands – Section 90 Community Collection | 21 July 2009 | Expired – report submitted |
| 1131171 | STAGE 3 Warkworth Extension (DA-300-9-2002-i) | 4 November 2011 | Expired – report submitted |
| **Aboriginal Objects Care & Control Permits** | | | |
| 2863 | AHIP Care and Control Permit (time extension granted 27/08/2010) | 16 January 2008 | 16 January 2016 (now covered under Care Agreement C0001890) |
| C0001890 | HVO and MTW Care Agreement | 3 June 2016 | 2 June 2036 |
| C0001841 | MTW Wollombi Brook Cultural Heritage Conservation Area Care Agreement | 3 June 2016 | 2 June 2036 |

**Table 6 Reject Emplacement Area Approvals**

| Approval | Approval Date | Expiry Date |
|---|---|---|
| **Warkworth** | | |
| Swan Lake Void | 21 October 2002 | N/A |
| Tailings Dam 2 | 22 October 2002 | N/A |
| Tailings Dam 2 – 130RL | 9 December 2003 | N/A |
| Tailings Dam 1 – Section 101 CMHSA 2002 approval to discontinue use of an emplacement area | 22 November 2011 | N/A |

| Approval | Approval Date | Expiry Date |
|---|---|---|
| Notification of High Risk Activity for Tailings Dam 2 capping works | 9 August 2016 | N/A |
| **Mount Thorley** | | |
| Section 126 Variation to Reject Emplacement Area | 20 March 2001 | N/A |
| Section 126 Construction of Reject Emplacement Area Centre Ramp Tailings Storage Facility | 9 April 2001 | N/A |
| Dam Safety Committee Centre Ramp Tailings Storage Facility Stage 2 | 12 February 2004 | N/A |
| Mini Strip 24 Tailings Storage Facility | 8 September 2004 | N/A |
| Section 126 Centre Ramp Tailings Storage Facility Stage 2 | 8 September 2004 | N/A |
| Section 126 Centre Ramp Tailings Facility – Raising Height of embankment | 10 May 2006 | N/A |
| Section 126 Abbey Green South Tailings Facility | 10 May 2006 | N/A |
| Notification of High Risk Activity for Centre Ramp Tailings Facility – Raising Height of Embankment to RL130 | 11 August 2015 | N/A |
| Notification of High Risk Activity for Interim Tailings Storage Facility capping works | 2 March 2015 | N/A |
| Notification of High Risk Activity for Mini Strip Tailings Storage Facility minor capping works | 4 June 2016 | N/A |

## 1.3 Land Ownership

WML and MTO, through Miller Pohang Coal Company Pty Limited, own a majority of the land within MTW and all land subject to this MOP application. The area adjoining the mine is mostly privately owned freehold land, with Coal & Allied holding title over a selected area including a corridor to Wollombi Brook. A schedule of land ownership on, and adjacent to, MTW coal leases is contained in Appendix 1 of the development consents (refer to Appendix A) and shown on **Map 1A**.

### 1.3.1 Agreements

Mt Thorley Operations Pty Ltd currently has a boundary agreement with Bulga Coal Management Pty Ltd that was implemented to allow coal recovery to be maximised and to develop a shared overburden emplacement area along the common boundary between CL 219 and ML 1547. Lands associated with the Mt Thorley Dump Sublease and the Boundary Corridor Sublease (subleases of Part Coal Lease No. 219) were transferred back from Bulga Coal Management to Mt Thorley Operations in 2011, following expiration of the subleases. Lands associated with the Western Area Sublease and the Bulga Mining Sublease (subleases of Part Coal Lease No. 219) were transferred back from Bulga Coal Management to Mt Thorley Operations in 2014 and 2015, respectively. During the period covered by this MOP, lands associated with the Area B Sublease, MTO Sublease and Dam Sublease (subleases of Part Mining Lease No. 1547) are planned to be de-registered and this land transferred back to Mt Thorley Operations ahead of progression of mining and dumping activities at MTW. Regular meetings are held between representatives of MTW and Bulga Coal to discuss operational as well as other issues, e.g. mining title and property affecting both operations.

A Common Boundary Rehabilitation Plan has been developed (refer to Appendix B) to document the proposed operational and environmental management activities for the Common Boundary for the period 2013 to 2016. MTW and Bulga Surface Operations plan to alternately dump overburden in a staged dumping sequence to

construct an integrated final landform for the common boundary area. The attached Common Boundary Rehabilitation Plan has been prepared at the direction of Department of Industry (now DP&E-RR) to be consistent with the requirements of the approved MOPs for both MTW and Bulga Surface Operations (BSO), and form an appendix to both the MTW and BSO MOPs.

The final landform presented in Map 4 of this MOP has been varied from the final landform presented in Figure 4 of the Common Boundary Rehabilitation Plan (Appendix B). The landform change was prompted by a reduction in the quantity of mine spoil to be dumped in the Common Boundary Area due to the cancellation of the mining of Abbey Green North pit. MTW had planned to mine coal from the Abbey Green North pit and use the resulting void as a tailings storage facility, however, lower coal prices have made the Abbey Green North proposal unviable. The Centre Ramp and Loders Pit Tailings Storage Facilities will have sufficient capacity for the currently approved life of mine tailings volumes.

The change to the landform in the Common Boundary area was communicated to BSO representatives on 6th May 2015. The landform was deemed by BSO to be acceptable due to it being integrated with the landform on the BSO side of the lease boundary and the drainage plan outlined in the Common Boundary Rehabilitation Plan. A letter with approval from BSO of the proposed landform change is attached as Appendix D.

## 1.4 Stakeholder Consultation

~~External relations programs and policies are consistent across all Coal & Allied sites, including MTW. Regional/broader community relations programs such as the Coal & Allied Community Development Fund, Corporate Partnership Programme, corporate donations and sponsorships, media liaison and stakeholder consultation are managed by RTCA's Community Relations Department. The objectives of the external relations strategy are to:~~

- ~~Have a robust relationship with our communities of interest;~~
- ~~Effectively contribute to the community's long term sustainability; and~~
- ~~Ensure "reputation capital" is valued and integrated into business processes and decision making.~~

~~As a component of this community strategy, MTW maintains the Near Neighbour Community Relations Strategy (NNCRS). The purpose of this Strategy is to~~ MTW operates a community relations engagement process to identify stakeholders, issues and appropriate management activities to maintain relations between MTW and the local community. All employees and the public are to be involved as legitimate partners in order to create a communicative process. The main objectives are to:

- Ensure MTW consistently builds upon its credibility within the region through a process of engagement and transparency within the ~~neighbouring~~ community;
- Be proactive and focus on an honest and open approach rather than community issues management;
- Build awareness and provide information on current and future plans;
- Ensure all stakeholders are kept well informed and a working relationship is established;
- Address any concerns held by residents and other stakeholders;
- Minimise any disruption and inconvenience to residents and operations;
- Maintain staff motivation and morale; and
- Reduce the number of community concerns caused by the business.

### 1.4.1 Community Consultative Committee

MTW has a Community Consultative Committee (CCC) that provides a forum for important community discussion regarding mine operations and environmental performance. Community representatives act as the point of contact to provide feedback between the mines and the community. Community representatives are asked to relay information from these meetings to their community and in turn, through their representative, the community can raise issues they would like addressed. This CCC is comprised of members from the community, with representatives from ~~Coal & Allied and~~ MTW and Singleton Council.~~Department of Industry (DI),~~

MTW~~Coal & Allied~~ has also implemented a 24-hour ~~Environmental~~Complaints Hotline (1800 656 892) for community issues relating to ~~any of its mines, including~~ MTW. MTW~~Coal & Allied~~ has informed community

members that they may contact MTW at any time to lodge concerns or enquiries regarding its mining operations. A system has been established to ensure an appropriate MTW ~~Coal & Allied~~ representative responds to any complaint lodged.

### 1.4.2 Statutory Authorities

MTW has consulted with DP&E (formerly DRG) ~~and the DI~~ and other authorities regarding the preparation and content of the MOP, see Section 1.4.4. Consultation with these authorities has also occurred during recent approval submissions and environmental assessments (EAs).

Statutory authorities also have the opportunity for ongoing involvement in MTW operations through ~~their representation on the CCC~~ consultation on management plans when material changes occur, and the independent environmental audit of environmental performance required by the development consents.

### 1.4.3 Aboriginal Groups

~~Coal & Allied~~MTW works closely with local Aboriginal people through professional engagement and consultation on cultural heritage management. Company employees also undergo training in Aboriginal cultural awareness. ~~The RTCAAboriginal Relations Unit (External Relations Department) has developed a Cultural Heritage Management System (CHMS) that applies across all RTCAprojects and operations in the Hunter Valley, including MTW.~~

~~Coal & Allied~~MTW has also established the Upper Hunter Valley Cultural Heritage Working Group (CHWG), which is comprised of ~~Coal & Allied~~MTW representatives and representatives from most of the Upper Hunter Valley Aboriginal Community ~~(UHVAC)~~ groups, corporations and individuals. The CHWG was established in September 2005 (by Coal &Allied) so that ~~Coal & Allied~~MTW and the Aboriginal community could develop and implement a new cultural heritage consultation and management process in the Upper Hunter Valley. Through this working group, ~~Coal & Allied~~MTW now has an ongoing consultation process with the Aboriginal community, a regular forum for discussions on all matters pertaining to cultural heritage associated with ~~Coal & Allied~~MTW owned lands, projects and operations in the upper Hunter Valley.

The CHWG has nominated a Cultural Heritage Consultation Committee (CHCC), who worked with Coal & Allied to develop a draft cultural heritage process including community consultation procedures, project work Terms of Reference template, cultural heritage investigations methodologies, and a process for the selection and engagement of Aboriginal corporate entities for project management and administrative coordination. Moreover, the CHCC developed an agreed process for the selection of cultural heritage field officers and technical advisors to conduct the cultural heritage investigations.

~~A series of stakeholder consultation meetings and working group meetings have been conducted between Coal & Allied and representatives of the local Aboriginal community regarding the establishment of the Aboriginal Development Consultative Committee (ADCC). The ADCC has been formed by Coal & Allied and representatives from the local Aboriginal community to provide funding for activities and projects that will benefit the Upper Hunter Aboriginal people. The ADDC aims to develop long term positive relationships between Coal & Allied and the Upper Hunter Aboriginal community and to build the Aboriginal community into the future.~~

### 1.4.4 MOP Preparation

Several meetings have been held between Coal & Allied, DI and DP&E representatives to discuss the preparation of the Accelerated Rehabilitation Plan for Warkworth South Pit. The first meeting was held on 7th March 2014 to discuss the development consent requirements for the MOP/Rehabilitation Management Plan. A further meeting was held on 12 May 2014 to review plans for accelerated rehabilitation in Warkworth South Pit. The main items of discussion were the rehabilitation progress compared with EIS projections and MOP assumptions related to possible future use of the South Pit Void as an underground access portal. In response to feedback from this meeting, Coal & Allied mine planning personnel investigated ways to bring forward dumping of the Centre Ramp in South Pit. An alternative ramp system, to be used for coal access for the final strip, was designed to bring forward dumping of the Centre Ramp by approximately 12 months. The updated rehabilitation progression resulting from this change was presented to DI and DP&E on 19th June 2014. The MOP plans have been developed to be consistent with the accelerated rehabilitation progression in South Pit.

In accordance with Schedule 3 Condition 58(a) and Condition 36(b) of SSD-6464 and SSD-6465 respectively, consultation with DP&E, NOW, OEH, SSC and CCC was conducted in relation to the MOP. Feedback was requested to be provided by the 8th January 2015. Details of this consultation and any feedback is provided below:

**DP&E** – Presentation of MOP to DP&E on 17th December 2015. A concern was raised by DP&E that disturbance areas in the period 2015 to 2017 were 72 ha greater than the disturbance projections in the EIS for the same period. The disturbance associated with installation of an RFS emergency access road accounts for 27ha of this total. This disturbance was not included in the EIS projections even though the commitment to install this access road, upon closure of Wallaby Scrub Road, was included in the EIS. To address the remaining increase in disturbance, MTW ~~have~~ reviewed the MOP disturbance estimates for the period 2015 to 2017 and ~~have~~ reduced the planned disturbance area by 29ha. The revised disturbance estimates for the September 2018 MOP Amendment have resulted in a further decrease in disturbance for the period 2015 to 2017 from 231.1ha to 162.2ha and are included in Table 13.

The updated final landform incorporating micro-relief and natural drainage lines was presented to DRG and DP&E (Resource Assessments & Compliance Division) on 29th August 2017. Positive feedback was received in relation to visual improvements to the final landform. Yancoal also presented the updated landform to members of the Bulga community in conjunction with a rehabilitation tour conducted in September 2017.

MTW MOP Amendment A was provided to DP&E (Resource Assessments) on 7 September 2018. Email correspondence with DP&E feedback was received on 28 September 2018, see Table 7 below for items addressed in the MOP.

**Table 7 DP&E Feedback from MOP Consultation**

| Feedback Issue | Response/ MOP Section |
|---|---|
| Section 6.6 and Section 6.9 – The Department recommends including triggers for remedial action if performance and completion criteria cannot be fulfilled | Resources Regulator will require evidence of achievement of performance criteria prior to progression of rehabilitation to the next phase. Links to the relevant Trigger Action Response Plan line items for Ecosystem and Landuse Establishment are provided in Table 35. |
| Section 6, Section 7 and Section 8 – The Department recommends more specific time frames for the completion of rehabilitation objectives and when monitoring will occur. | The planned progression of rehabilitation phases for the period of the MOP is shown on Map 3A to 3G. The frequency of rehabilitation monitoring is outlined in Section 8.1 and will vary according to the progression of rehabilitation through the various rehabilitation phases. Monitoring will initially be conducted on an annual basis but the interval between monitoring events will be lengthened as sites stabilise. |

**NOW** – Copy of MOP sent to NOW on 7th December 2015, no feedback received to date.

**OEH** - Presentation of MOP to OEH on 17th December 2015 and provision of MOP to OEH in November 2015. ~~No feedback received to date.~~ Feedback letter received from OEH on 29th January 2016, see Table 8 below for specific items addressed in the MOP.

**Table 8 OEH Feedback from MOP Consultation**

| Feedback Issue | Response/ MOP Section |
|---|---|
| Performance indicators and completion criteria will be used to determine if the reconstructed ecosystem is trending towards the analogue sites. It is important to note that many of the completion criteria are considered met if the relevant Performance Indicator shows development/trend towards analogue sites. However, it is difficult to determine at what point the ecosystem will be deemed to be trending enough towards an analogue site. Many of the completion criteria are still to be determined. | Performance Criteria targets have been included in this MOP Amendment. Targets have been based on monitoring results from analogue sites. |
| The recommended species mix omits some plant guilds, such as ferns, ground orchids and parasitic plants. OEH | The species used in seed mixes are able to refined in subsequent MOP's if the target |

| Feedback Issue | Response/ MOP Section |
|---|---|
| suggests that the list of local endemic plant species is able to be refined so that additional species may be included in the rehabilitation. This may be facilitated by advances in propagation and horticultural techniques for more indigenous plants. | species richness levels are not being achieved in rehabilitation areas. Yancoal propose that the plant guilds listed will be more effectively introduced to rehabilitation by vectors other than the added seed mix i.e. seed dispersing birds and fresh topsoil. |
| OEH recommends that consideration is given to the full time frame of monitoring of revegetation and rehabilitation. This is because long-term monitoring is essential to determine: (1) if the planted species mix matches that of the analogue site(s); and (2) if the rehabilitated ecosystem is sustainable over the long term. | The monitoring program outlined in Section 8.0 of this MOP is a long term monitoring program designed to demonstrate that rehabilitation areas have met the performance criteria for all stages of rehabilitation through to Ecosystem Sustainability |
| OEH recommends that proposed use of Landscape Functional Analysis to measure vegetation structure in revegetation and rehabilitation is clarified. | Biobanking Assessment Methodology criteria and other floristic measures outlined in Section 8.1.5 will be used to measure vegetation structure. |
| It is unclear in the MOP if, and how often, the growing medium may be tested for suitability for rehabilitation. | Soil testing frequency outlined in Section 6.8.2. |
| In relation to fire control of revegetation areas, OEH recommends that consideration is given to how the post-fire response to burning may be used to measure the resilience of revegetation. This will help inform how close they may be to becoming a self-sustaining ecosystem. | Yancoal agree that the post-fire monitoring of rehabilitation areas will provide important information on the resilience of the rehabilitation. Section 10.0 has been updated to include research into the effect of fire on rehabilitation. |

**SSC** - Presentation of MOP to SSC on 22nd December 2015. SSC requested further discussions with Coal & Allied on Wallaby Scrub Road closure process and timing. No modification required to MOP.

**CCC** - Presentation of MOP to CCC on 22nd December 2015. CCC requested that MTW investigate rehabilitating the Western side of Mt Thorley when mining in this pit is completed (planned for 2018). This will provide a visual and noise bund for Bulga township from ongoing dumping activities. ~~MTW have agreed to investigate this option and provide a revised rehabilitation progression for Mt Thorley in a MOP Amendment to be submitted by 30th June 2017.~~ MTW have investigated this option but the ability to rehabilitate from the western side is constrained due to the proposed use of the northern end of Loders Pit as a tailings storage facility. The western progression of rehabilitation at Mt Thorley will be investigated further when the design of the Loders Pit tailings storage facility is completed in 2019.

CCC were concerned that the landform height had been raised in the new MOP. Coal & Allied confirmed that the MOP landform was consistent with the landform that had been submitted in the project approval process. Environmental impact assessment (i.e. noise modelling) undertaken during preparation of the EIS had been based on the new landform. No modification required to MOP.

SSC Councillor noted that it was Council's Resolution not close Wallaby Scrub Road. The question was raised if it was possible to re-instate the road in its current location and alignment at end of mine life and whether there could be further consultation with community regarding reinstatement of the road. ~~Coal & Allied responded that it does not intend to consult further on options to relocate or re-instate Wallaby Scrub Road due to a lack of viable options. Alternative routes for Wallaby Scrub Road were examined as part of the Environmental Assessment for the Warkworth Continuation Development Application. These options were found to have unacceptable impacts on ecology and heritage, and would still increase travel times as the relocated road would be longer than the original. To reinstate the road in its current location and alignment is not feasible post mining. The current alignment is through the middle of the final void.~~ Wallaby Scrub Road was assessed thoroughly as part of the Environmental Assessment for the Warkworth Continuation Development Application, and no reinstatement of Wallaby Scrub Road is required proposed for the approved development. No modification required to MOP.

CCC members queried if South Pit Void could be filled when mining is completed to remove a final void. Coal & Allied responded that the South Pit void will be filled, to the greatest extent possible, while still maintaining flexibility for future underground mining access. Complete filling of South Pit void would be reconsidered in the event that this area is not needed for underground mining access.

CCC members asked when visual screening would commence to minimise the long term impacts of the final void (as per SSD-6464 Condition 52). Coal & Allied supplied copies of management plans to community representatives on the CCC. No modification required to MOP.

Any subsequent feedback received from the parties listed above will be incorporated into future MOP Amendments as required.

**DoEE** – An earlier version of the Mount Thorley Warkworth Mining Operations Plan Amendment A was submitted to DoEE on the 2 February 2015 to satisfy the requirement of Condition 11 of federal government approval EPBC 2009/5081 to submit a Mine Site Rehabilitation Plan. Feedback letter received from DoEE on 18th July 2016, see Table 9 below for specific items addressed in the MOP.

**Table 9 DoEE Feedback from MOP Review**

| Feedback Issue | Response/ MOP Section |
|---|---|
| EPBC 2009/5081 Clause 11b<br>Vegetation communities are described however the details of timing have not been included. Please provide details of progressive rehabilitation timing as an appendix to make adherence to condition 11b clear. | Rehabilitation progress during the MOP period is outlined in Section 7.2 and shown on Maps 3A to 3G. Reference included to the rehabilitation progress outlined in the Indicative Mine Plans shown in the Environmental Impact Statements for the Warkworth Continuation 2014 and Mt Thorley Operations 2014. |
| EPBC 2009/5081 Clause 11c<br>This section outlines reporting to be undertaken in keeping with state requirements. However lacks a commitment to report to the Department. | Section 8.2 updated to include requirement to submit the Annual Environmental Review to DoEE. |

## 1.5 Rehabilitation and Post-mining Landuse

Provisions for the rehabilitation of mined areas are attached to Mining Leases in accordance with the *Mining Act 1992* as administered by DP&E. ~~A general requirement of the NSW Planning & Environment is that after rehabilitation, land should have the same land use capability as before mining.~~ Rehabilitation plans and reports are prepared to satisfy the requirements of both Government agencies and other relevant stakeholders. All rehabilitation will be undertaken in consultation with DP&E and other relevant agencies.

Security deposits, usually in the form of a bank guarantee, are lodged with DP&E to ensure that rehabilitation is undertaken. These deposits are progressively reviewed as areas are rehabilitated.

Rehabilitation objectives are integrated into early mine planning to ensure compatibility with site constraints, mining operations, conservation objectives, community expectations, pre-mining land use, final land use, drainage, stability, soils, erosion control and visual compatibility.

# 2.0 Proposed Mining Activities

## 2.1 Asset Register

The main assets split by domain for Warkworth and Mt Thorley are listed in Table 10 and Table 11 below. Areas detailed in Table 10 and Table 11 represent a snapshot of the current disturbance.

**Table 10 Main Assets Split by Domain for Warkworth**

| Domain | Size (ha) | Major Assets | Comment |
|---|---|---|---|
| Final Void | 108.7 | 107.6 ha | 1.1 ha of Final Void rehabilitated. |
| Water Management Area | 20.9 | 20.9 ha | 0 ha of Water Management Area rehabilitated. |
| Infrastructure Area | 75.5 | 75.5 ha<br>North Coal Handling and Preparation Plant (CHPP): CHPP (3 storey), Stacker x 4, Reclaimer x 4, ROM Dump Station x 2, Thickener x 2, Silo Bin x 4, Coal Stockpile Areas, North CHPP Offices and Workshop, Conveyors, Gantries, Transfer Stations.<br>WML Workshop and Admin: Workshop, Warehouse, Fuel Farm, Administration Office, Mining Office, Bath House. | Disconnect and terminate all services i.e. power, water and sewer; contaminated soil treatment from workshops and fuel farm areas; remove carbonaceous material from stockpile areas.<br><br>0 ha of Infrastructure Area rehabilitated. |
| Tailings Storage Facility | 84.3 | 83.9 ha<br>Tailings Dam 1, Tailings Dam 2. | 0.4 ha of Tailings Storage Facility rehabilitated. |
| Overburden Emplacement | 1859.3 | 1346.5 ha | 512.8 ha of Overburden Emplacement rehabilitated. |

**Table 11 Main Assets Split by Domain for Mt Thorley**

| Domain | Size (ha) | Major Assets | Comment |
|---|---|---|---|
| Final Void | N/A | N/A | No final void planned for MTO |
| Water Management Area | 34.6 | 32.9 ha | 1.7 ha of Water Management Area rehabilitated. |
| Infrastructure Area | 99.6 | 94.2 ha<br>South CHPP: CHPP (3 storey), Stacker x 4, Reclaimer x 2, ROM Dump Station x 2, Thickener x 1, Silo Bin x 1, Coal Stockpile Areas, South CHPP Offices and Workshop, Conveyors, Gantries, Transfer Stations.<br>MTO Workshop and Admin: Workshop, Warehouse, Vehicle Service Bay, Fuel Farm, Administration Office, Mining Office. | Disconnect and terminate all services i.e. power, water and sewer; contaminated soil treatment from workshops and fuel farm areas; remove carbonaceous material from stockpile areas.<br><br>5.4 ha of Infrastructure Area rehabilitated. |

| Domain | Size (ha) | Major Assets | Comment |
|---|---|---|---|
| | | | |
| Tailings Storage Facility | 158.6 | 130 ha<br>Centre Ramp Tailings Storage Facility (TSF), Ministrip TSF, Abbey Green South TSF, Eastern Tailings Dam. | 28.6 ha of Tailings Storage Facility rehabilitated. |
| Overburden Emplacement | 927.0 | 659.2 ha | 267.8 ha of Overburden Emplacement rehabilitated. |

## 2.2 Material Production Schedule

The proposed provisional material production schedule for MTW for the period covered by this MOP is shown in Table 12. Further details on the various components of this Schedule are provided in the following sections of the MOP.

**Table 12 Material Production Schedule During the Term of the MOP**

| Material | Unit | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 |
|---|---|---|---|---|---|---|---|---|
| | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| Stripped topsoil | bcm | ~~101,800~~<br>32,900 | ~~69,100~~<br>120,300 | ~~67,800~~<br>74,900 | ~~54,900~~<br>177,200 | ~~62,800~~<br>79,200 | ~~57,800~~<br>49,800 | ~~36,400~~<br>29,200 |
| Total Waste Rock | Mbcm | 103.7 | 106.0 | 104.3 | ~~107.3~~<br>121.8 | ~~108.5~~<br>128.0 | ~~112.7~~<br>124.9 | ~~109.3~~<br>120.7 |
| Ore (ROM coal) | Mt | 16.94 | 17.87 | 17.93 | ~~16.44~~<br>17.19 | ~~17.13~~<br>17.59 | ~~17.37~~<br>17.06 | ~~17.40~~<br>18.00 |
| Processing waste | Mt | 5.56 | 6.23 | 6.38 | ~~5.12~~<br>5.36 | ~~5.17~~<br>5.56 | ~~5.41~~<br>5.09 | ~~5.57~~<br>5.78 |
| Product coal | Mt | 11.38 | 11.64 | 11.55 | ~~11.32~~<br>11.83 | ~~11.96~~<br>12.03 | ~~11.96~~<br>11.97 | ~~11.83~~<br>12.22 |
| Strip Ratio* | bcm/t | 9.1 | 9.1 | 9.0 | ~~9.5~~<br>10.3 | ~~9.1~~<br>10.6 | ~~9.4~~<br>10.4 | ~~9.2~~<br>9.9 |

* Strip ratio expressed as bank cubic metres (bcm) of waste rock per product tonne.

## 2.3 Exploration

### 2.3.1 Past and Proposed Exploration

The MTW area has been explored since the 1940's, however the most significant exploration campaigns were those of the late 1970's managed by the Joint Coal Board for both the then operators of Mount Thorley (R.W. Miller) and Warkworth (Warkworth Mining). This drilling, which formed the basis of feasibility studies for both sites, was conducted down to an approximate 250m square grid in restricted areas.

Subsequent exploration activity at MTW has increased the available data with the pattern of drilling for the open cut now based on a triangular grid at a 250m separation for cored boreholes and 125m for non-cored boreholes. The optimum spacing for this drilling was determined by a geo-statistical study and will continue for open cut mining production within the MOP area.

Additional drilling also commenced in 2011 to define any underground resource potential in the form of a pre-feasibility study, focusing on coal quality, geotechnical properties and gas desorption testing for future underground mine safety. Drilling to assess underground mining potential has initially been drilled on one (1) kilometre grid spacing, with spacing progressing to a five hundred (500) meter grid in some areas.

All exploration at MTW aims to increase resource knowledge through exploration drilling and other exploration techniques such as surface geophysics may be employed when appropriate to increase the overall resource understanding. Detailed testing of all coal seams will continue for all exploration drilling and may consist of coal

quality analysis, gas testing, geophysics, geotechnical testing, in–situ stress testing, spontaneous combustion testing, permeability and finally the installation of piezometers within selected boreholes.

Exploration drilling during the MOP period will generally be limited to areas ahead of mining operations in North Pit and ~~South~~ West Pit, and exploration drilling associated with feasibility studies for potential underground mining at MTW ~~will also be continued during the MOP period~~. Some of the underground holes will be drilled through spoil material in areas previously mined by open cut methods to the ~~. To gain knowledge of~~ underground target seams.

Three drillholes are planned to be drilled within Consolidated Coal Lease 753 to the west of the currently approved West Pit and North Pit extents. Following drilling, permeability/gas testing would be conducted at one of the drill sites. The three drillholes would be converted to vibrating wire piezometers (VWPs) for ongoing groundwater monitoring post geological/geophysical testing.

Drilling within Exploration Licence areas will be subject to the relevant approval process for the relevant exploration licence conditions, outside of the MOP processes.

All exploration drilling activities are reviewed prior to commencement as part of ~~Coal & Allied~~ MTW's Ground Disturbance Permit (GDP) process. Planned borehole locations and access tracks are assessed for environmental, cultural heritage, approval and mining title issues and necessary constraints and conditions are placed on drilling locations for each borehole location.

All boreholes are surveyed and if not required for monitoring purposes are cement sealed on completion. All casing is removed where practicable. However, in isolated holes, this may not be possible requiring the casing to be cut off below ground level. Borehole sites are then rehabilitated to an appropriate standard, as dictated by the GDP.

Pre-production drilling will take place within the nominated Disturbance Limit of this MOP. All other drilling external to the area covered by this MOP, will be conducted under the approved REF process.

### 2.3.2 Estimated Mine Life

The operational mine life of MTW is dependent on current development consents. Approval has been granted for the Warkworth Continuation 2014 and Mt Thorley Operations 2014 projects allowing mining to progress into Saddleback Ridge and through Wallaby Scrub Road. The modified consents for Warkworth and Mt Thorley are valid until 2037. The planned life of MTW mine is therefore until 2037. However, with other potential coal resources, mining may continue beyond this date subject to gaining approval.

## 2.4 Land Preparation

### 2.4.1 Removal of Vegetation

All vegetation clearing is undertaken as a staged operation immediately in advance of mining operations. Vegetation clearing is avoided during the breeding season of identified threatened fauna species in accordance with the Warkworth Mine Biodiversity Management Plan. ~~Coal & Allied *Environmental Procedure 10.2 Flora and Fauna*~~.

Pre-clearing surveys are undertaken to identify important habitats. Habitat trees and appropriate microhabitats such as fallen logs are surveyed and marked to determine if fauna are using them. Any marked trees that show signs of current or recent use are reserved for latest possible removal to encourage fauna to abandon the area of their own accord. Vegetation removal is undertaken in accordance with the Warkworth Mine Biodiversity Management Plan ~~Coal & Allied *Environmental Procedure 5.1 – Disturbance and Rehabilitation*~~.

Following the removal of useable timber for fence posts and habitat features, as well as collection of viable seed for use in rehabilitation, the remaining vegetation is generally mulched and incorporated into the topsoil. Salvaged logs are placed on areas of post mining rehabilitation to form fauna habitat, either as logs on the ground or stag trees. Suitable logs may also be supplied to on-site or off-site projects for the construction of in-stream structures.

Vegetation clearing ahead of mine workings will be kept to a minimum, consistent with the space requirements of the pre-stripping fleet, which is usually about one mining strip (approximately 100 m). Clearing also allows for the establishment of mine infrastructure ahead of the mining operations and may include clearing for haul roads and access tracks, power lines, pipelines, transformers and drainage control structures.

The areas scheduled for disturbance during the term of this MOP are shown in Table 13. Disturbance areas are shown for new disturbance as well as disturbance of rehabilitated areas.

**Table 13 Disturbance Rates 2015-2021**

| Year | Disturbance (ha)* | Rehabilitation Disturbance (ha) | Disturbance (ha)* | Rehabilitation Disturbance (ha) |
|---|---|---|---|---|
| | Mount Thorley | | Warkworth | |
| 2015 | 0 | ~~3.5~~ 0.8 | ~~41.5~~ 30.7 | ~~0.9~~ 1.4 |
| 2016 | ~~0~~ 17.4 | ~~1.4~~ 4.2 | ~~140.4~~ 73.7 | ~~7.2~~ 24.9 |
| 2017 | ~~0~~ 5.8 | ~~19.4~~ 14.0 | ~~49.2~~ 34.5 | ~~4.2~~ 20.6 |
| 2018 | ~~0~~ 31.0 | ~~12.6~~ 17.3 | ~~54.9~~ 121.6 | ~~15.2~~ 7.3 |
| 2019 | ~~0~~ 5.4 | ~~0~~ 2.1 | ~~62.8~~ 68.4 | ~~10~~ 3.3 |
| 2020 | ~~0~~ 9.7 | 0 | ~~57.9~~ 40.1 | 0 |
| 2021 | ~~0~~ 10.7 | 0 | ~~36.4~~ 18.5 | 0 |
| **Total** | **~~0~~ 80.0** | **~~36.9~~ 38.4** | **~~443.1~~ 387.5** | **~~37.4~~ 57.5** |

* New disturbance only

### 2.4.2 Topsoil Management

Topsoil must be stripped and salvaged correctly to maximise its value for re-use in rehabilitation. Where possible, the topsoil from high quality native vegetation areas is directly transported from stripping to rehabilitation areas to maximise the value of the soil seed bank and soil organisms.

#### 2.4.2.1 Topsoil Suitability for Rehabilitation

Previous assessments have characterised the quality, quantity and types of topsoil at MTW, as well as its suitability for use in rehabilitation. Structural and textural properties of soils within the proposed disturbance area are the most significant limiting factors. Six soil types have been identified to occur within the development footprint at MTW, they are described in Table 14.

**Table 14 Soil types present at MTW (extension area)**

| Soil Type | % of area | Description | Topdressing suitability |
|---|---|---|---|
| Brown kurosol | 44.3 | Characterised by an abrupt texture change between dark brown silty/loam surface soil and brown sandy clay loam and yellowish brown medium/heavy clay subsurface layers. | Surface 10cm of topsoil suitable for stripping and reuse in rehabilitation work. Good soil stability due to significant organic content. |
| Red sodosol | 17.9 | Characterised by an abrupt texture change between the dark brown loamy surface soil and the reddish-brown medium clay subsurface soil. | Surface 10cm of topsoil marginally suitable for stripping and reuse in rehabilitation work.<br>Moderate stability and variable sodicity. Better used if mixed with other suitable media. |
| Yellow sodosol | 14.5 | Characterised by an abrupt texture change between the sandy surface soil and the medium-heavy clayey subsurface soil. Subsurface soils may be greyish, brownish or yellowish in colour. | Surface 30cm of topsoil suitable for stripping and reuse in rehabilitation work. |
| Grey sodosol | 15.4 | Associated with subsoil saturation and can be observed on higher slopes where local saturation zones occur.<br>Characterised by an abrupt texture change between the grey-brown sandy-loam surface soil and the underlying grey-pink clayey subsurface soil. | Surface 30cm of topsoil suitable for stripping and reuse in rehabilitation work. |
| Arenic rudosol | 7.0 | Deep sand associated with Warkworth Sands Woodland (WSW) vegetation community. | Topsoil and sub-surface sand only suitable for stripping and reuse in WSW rehabilitation and re-establishment work. |
| Grey kandosol | 0.9 | Characterised by a gradual texture change between the brownish-black surface loam and the underlying greyish-brown sandy clay loam and sandy clay. | Surface 8cm of topsoil suitable for stripping and reuse in rehabilitation work. |

Regular topsoil surveys are carried out. The latest topsoil stockpile reconciliation, conducted in December 2014, indicated topsoil inventories across MTW of 1,174,066 $m^3$.

#### 2.4.2.2 Topsoil stripping

Soil testing will be undertaken to determine what soil amelioration is required prior to re-use for rehabilitation activities. Areas that are planned to be disturbed will be stripped of topsoil prior to disturbance. Advance clearing and topsoil removal is kept to a minimum to reduce dust generation and potential impacts on fauna species. Topsoil will be stripped using appropriately sized earthmoving equipment, preferably track dozers. Where practicable, soil will be stripped when moist, but not saturated; and no stripping will occur in excessively dry or wet conditions. Prior to stripping of topsoil, appropriate controls such as sediment controls will be put in place to prevent off-site loss of subsoil sediments.

#### 2.4.2.3 Topsoil Handling and Management

Stripped soil needs to be managed to prevent erosion and weed infestation, and to ensure that the maximum topsoil reserves are retained for reuse during rehabilitation works.

Where possible, topsoil will be transferred directly from stripping to re-spreading operations, eliminating the need for storage. However in some cases, mining operations dictate that topsoil storage will be necessary for extended periods. Where stockpiling is required, the following procedures will be adopted:

- Stockpiles will be located away from trafficable or mine areas, trees or watercourses and placed on areas of flat topography or along the contour to prevent erosion;
- Good quality topsoil and marginal soil will be stockpiled separately and recorded as such;
- Topsoil stockpiles and volumes will be identified and monitored for weed control;
- Where possible, stockpiles will be limited to a maximum height of 3.0 metres and windrowed to increase surface area; and
- Stockpiles will generally be sown with a cover crop of deep rooting, nitrogen-fixing species such as Lucerne or local Acacia species, to help maintain topsoil viability and minimise erosion and weed infestation if not being reused for prolonged periods.

#### 2.4.2.4 Topsoil Budgeting

Due to the shallow nature of the in situ duplex topsoils there will be a shortfall in the amount of topsoil available for rehabilitation. Trials are being undertaken using a spoil/compost mixture as a growth medium for areas being returned to native vegetation. If native vegetation can be successfully re-established without using topsoil then the available topsoil can be prioritised for use on areas being returned to pasture. Topsoil will also be prioritised for use on areas with potentially hostile spoil properties that make it difficult to establish vegetation.

For the purposes of topsoil budgeting, it is assumed that:

- The primary objective of the mine rehabilitation program is to create a structurally stable landform;
- A secondary objective is to maximise post-mine land capability and restore a productive land use;
- The total area projected as being disturbed over mine life is the area to be rehabilitated;
- The area to be rehabilitated excludes the final voids and areas already rehabilitated; and
- Topsoil is only available from mining areas and rehabilitated areas to be stripped over the mine life.

The area to be rehabilitated over this MOP application period is estimated to be approximately ~~690.8~~ 666.2 ha. Based on an average thickness of 10 cm of topsoil to be spread and the current topsoil reserves, there is sufficient suitable topsoil to provide for the area of rehabilitation. The expected annual topsoil recovery for the period covered by this MOP is provided in Table 12.

## 2.5 Mining

### 2.5.1 Mine Layout

#### 2.5.1.1 Criteria

The design of mining operations at MTW is based on numerous considerations. Factors such as safe working conditions, geology, mining costs, rehabilitation requirements, CPP capacities and environmental factors will influence the design of future operations. External factors such as rail and port capacity can affect coal production but is not constraining production levels at present. Other influencing factors include the need for maximisation of resource recovery, social and economic stimulus, economic viability and local employment, while minimising impact on ecology, water resources, air quality, Aboriginal heritage and transport.

#### 2.5.1.2 Mine planning

The points below summarise the Mine Plan activities for the MOP period:

MTO

- Opening of the Putty Road underpass in late 2017 will allow waste material to be hauled from Warkworth into the MTO lease for emplacement.
- To accommodate this waste, 27.2 ha of disturbance to existing rehabilitation will occur in the northern part of MTO. This will be fully rehabilitated in following years once the waste emplacements have reached approved MOP heights.
- Dragline operations will continue in Loders Pit until ~~early 2018~~ 2019.

- The southern portion of the void will be back filled with waste from Warkworth, while the northern part will used as a future tailings storage facility.
- Excavation of the Abbey Green North pit will not commence during this MOP period.
- Common boundary landform between MTO and Bulga Mine to be constructed and 53.3 ha of rehabilitation will be undertaken in this area during the MOP period.

WML

- Southern end of West Pit strips will be extended to increase strike length of dragline strips.
- Mining of North and West Pit will continue to progress to the west.
- Mining in South Pit is likely to be completed in mid-2017.
- Filling of the South Pit Centre Ramp area was commenced in 2015, allowing for the rehabilitation of the highly visible eastern face in following years.
- Filling of haul road adjacent to Putty Road in the south of WML will commence once the Putty Road underpass opens in late 2017, rehabilitation to occur in following years.
- Capping and rehabilitation of Tailings Dam 2 will occur within the MOP period.
- Mining and construction of the North Out of Pit (NOOP) dam approved by the Warkworth Continuation Project will occur within the MOP period.

### 2.5.2 Mining Method

#### 2.5.2.1 Overview

The proposed mining method within MTW is the same as that currently employed. Large electric face shovels, hydraulic excavators and front-end loaders are utilised to load haul trucks to remove pre-strip and parting material. Draglines are used to expose lowest coal seams. Ancillary equipment in the form of drills, graders, rubber-tyred dozers and water carts will provide the mining equipment with support as required. Coal is extracted by front-end loaders and/or excavators loading haul trucks.

The current mining equipment will continue to be used. In general, changes may occur due to replacement or as technology changes.

#### 2.5.2.2 Overburden and Interburden Material

Overburden removal at MTW is centred on shovel pre-stripping methods and dragline “stripping”. Multiple bench pre-stripping is used to expose shallower coal seams with a combination of dragline and shovel operations to remove lower interburden. Overburden removal operations generally proceed as follows:

- Tree clearing and timber harvesting is carried out under contract. Topsoil removal is carried out under contract using small earthmoving equipment such as a D6 bulldozer with a loader and trucks.
- Overburden is drilled. Generally holes stop short of the coal seams to reduce blast damage to the coal. Hole diameters range from 200mm to 270mm. Drill patterns depend on hole depth and hole diameter but pattern sizes will generally range from 5m x 6m to 10m x 12m.
- The overburden material is blasted according to design parameters specific to the geology, the presence of water, and the type of machine intended to dig the material. Overburden and interburden greater than 2.0m in thickness require fragmentation by drill and blasting.
- Overburden/interburden removal is performed by one of three basic methods:
  - *Shovel / Truck Fleet*: The majority of the uppermost seams in the sequence are exposed using an electric shovel loading 240 and 320 tonne trucks. Overburden waste is hauled to dumps located across the site.
  - *Dragline:* Single or double pass removal of loose overburden into previous strip, leaving a thin layer of material overlying the coal seam.
  - *Dozers*: Dozers will be used to remove thin layers of interburden by directly pushing blasted overburden material into the previous void.

#### 2.5.2.3 Coal

If the coal seam was uncovered by dragline, the thin layer of rock will be cleaned by tracked and wheeled dozers and graders. The coal seams may be blasted, ripped by dozers or free-dug by loaders depending on the nature and thickness of the coal. Front-end loaders will operate with 180 tonne capacity trucks which haul the raw coal to either the North or South CPPs.

#### 2.5.2.4 Rehabilitation

Rehabilitation of the overburden material is considered an integral part of the mining process and will be conducted progressively over the period of the MOP. Proposed rehabilitation methodology and scheduling are discussed further in Section 7.0.

#### 2.5.2.5 Production Schedules and Stripping Ratio

The proposed production schedule and details of yearly planned strip ratios are shown in Table 12.

### 2.5.3 Resource Sterilisation

The proposed mine plan and mining methodology have been developed with a core objective of safely ensuring maximum recovery of all economically feasible coal within the MTW mining areas. Key features of the plan include:

- The extraction of previously uneconomical coal;
- The flexibility afforded by a combined dragline and shovel operation allows the mining of a complex series of coal seams;
- Maximising high coal recovery from thin coal seams; and
- Investigations to identify areas suitable for auger mining and/or underground mining.

Mining operations within the MOP period will not involve the deliberate sterilisation of any coal reserves.

### 2.5.4 Mining Equipment Fleet

The continuation of mining operations at MTW will involve using the existing operational practices and equipment including draglines, shovels, loaders, excavators, dozers and truck fleets. Table 15 provides an indicative schedule of the mine equipment for use at the start of the MOP. As the mine develops, technology improves, as old equipment is replaced and as marketing and economic conditions dictate, additional equipment shall inevitably be acquired or disposed of to meet requirements.

**Table 15 Indicative Equipment Schedule for MTW**

| Equipment Type | Model | Fleet No. |
|---|---|---|
| Dragline | BE 1370WB Dragline<br>P&H 9020 Dragline<br>MARION 8200 Dragline | 1<br>1<br>1 |
| Shovels | P&H 4100 Face Shovel, inc XPC | 3 |
| Excavators | HITACHI EX550 Excavator<br>HITACHI EX3600 Excavator | 2<br>4 |
| Front End Loader | LE-TOURNEAU L1850 Front-end Loader<br>Cat 998 Front-end Loader | 3<br>2 |
| Trucks | CAT 795F, 360t Rear Dump<br>CAT 793, 240t Rear Dump<br>Komatsu 830E, 240t Rear Dump<br>CAT 789C, 190t Rear Dump<br>CAT 785 Water Truck<br>Service Trucks<br>Bulk Fuel Tanker<br>Store Lift-truck | 12<br>9<br>46<br>17<br>7<br>4<br>1<br>1 |
| Dozers | CAT D11 Dozer<br>CAT D11T Dozer<br>CAT TIGER 854 Rubber Tyre Dozer | 6<br>21<br>4 |

| Equipment Type | Model | Fleet No. |
|---|---|---|
| | CAT TIGER 834 Rubber Tyre Dozer | 1 |
| Graders | CAT 16G Grader<br>CAT 16H Grader<br>CAT 16M Grader<br>CAT 24H Grader<br>CAT 24M Grader | 1<br>1<br>2<br>2<br>1 |
| Drills | REEDRILL SKSS<br>REEDRILL SK75i<br>REEDRILL SKSS<br>DRILTECH D75KS, Overburden Drill | 1<br>4<br>1<br>1 |
| Scrapers | CAT 657E | 2 |
| Cable Activities | CAT 992C Cable Reeler | 2 |

## 2.6 Mineral Processing

Coal will be washed in both the North CPP and South CPP in accordance with market requirements.

### 2.6.1 North CCP

The North CPP has a nominal capacity of 6.6 million washed saleable tonnes per annum, additional capacity is available through the North CHPP's bypass facility. This system has not been tested to its maximum capabilities, however historically around 6% of the Run-of-Mine (ROM) coal has been bypassed annually or as high as 1Mt per annum.

The North CPP is a two module plant, each capable of a raw feed rate of 800tph. Raw coal is screened into two sizes, with coarse coal of diameter > 1.4mm treated in a single or two-stage dense medium cyclone circuit and the fine fraction washed in a two-stage spiral process.

The coarse coal circuit relies on relatively simple gravity separation, with coal particles floating in a magnetite and water mixture known as dense medium. The heavier non-coal material sinks while the coal floats. The speed of separation is enhanced for coarse coal particles by pumping the combined dense medium and ROM coal slurry through 1.15 m diameter dense medium cyclones. Products are dewatered in vibrating basket centrifuges prior to stockpiling.

Fine coal is cleaned in a process circuit that does not use a dense medium. It is mixed with water and pumped through classifying cyclones to remove the very fine particles (de-sliming), which generally contain a very high proportion of non-coal materials including clays. The deslimed fines are then fed to spiral separators, which separate materials by gravity, taking advantage of the differing centrifugal effects produced by coal and non-coal particles as they wind their way down the spiral pathways.

Ultra-fine coal from the classifying cyclone overflow is sent to the Beneficiated Dewatered Tailings (BDT) plant, where the coal fraction is separated by a two stage flotation circuit, de-watered and sent to clean coal stockpiles. Reject material is sent to the tailing thickener for dewatering and thickening before being pumped to a final disposal location within the tailings storage facility (refer to Section 2.8.3).

Coarse reject is disposed of in the active mine dumps and "mixed" with normal waste dumping of the mining operations.

The coal is washed in accordance with market requirements at the North CPP, which operates 7 days a week, stopping for maintenance one day every month.

### 2.6.2 South CCP

The South CPP has a nominal capacity of 5.3 million saleable tonnes per annum. ROM coal is delivered by rear dump trucks into two raw coal receival bins. The coal is then broken down to a maximum size of 125mm in two rotary breakers, then stacked by two automatic luffing and slewing rail mounted stackers on a single 70,000 tonne design capacity raw coal stockpile.

The raw coal is reclaimed using a bridge type scraper reclaimer to a 300 tonne surge hopper where the feed is split between two 600 tph CPP modules.

Raw coal is wet screened with the +31.5 mm oversize fraction transferred to a dense medium drum. The drum product is crushed through a double roll crusher before being transferred to the clean coal stockpiles. -31.5 mm fraction is screened at 0.5 w/w mm on de-sliming screens with the -31.5 + 0.5 w/w mm fraction being treated in two stages of dense medium cyclones.

The coarse coal circuit relies on gravity separation, with coal particles floating in a magnetite and water mixture known as dense medium. The heavier non-coal material sinks while the coal floats. The speed of separation is enhanced for coarse coal particles by pumping the combined dense medium and ROM coal slurry through dense medium cyclones. Rejects from the primary DMC stage are rewashed at a higher density in the secondary dense medium cyclone to ensure efficient recovery of combustible material. Products are dewatered in vibrating basket centrifuges prior to stockpiling.

The -0.5 w/w mm undersize materials from the de-sliming screens is pumped through two stages of classifying cyclones to remove the high ash clay slimes prior and to thickening and feeding this material to the flotation circuit for recovery. Reject material is sent to the tailing thickener for dewatering and thickening before being pumped to a final disposal location within the tailings storage facility (refer to Section 2.8.3).

Coarse reject is disposed of in the active mine dumps and “mixed” with normal waste dumping of the mining operations.

The coal is washed in accordance with market requirements at the South CPP, which operates 7 days a week, stopping for maintenance one day every month.

## 2.7 Coal Stockpiles

### 2.7.1 North

ROM coal is delivered from the mine into two raw coal receival hoppers. The coal is then sized through 3 stage Abon crushers to a top size of 50 mm, which is then stacked via two automatic luffing and slewing rail mounted stackers on twin 47,000 tonne design capacity raw coal stockpiles.

Clean coal products are reclaimed from one of two stockpiles at the CPP which have a total design capacity 158,000 tonnes. Two reclaimers are used to feed, via conveyor, the train loading bin at the Mt Thorley Coal Loader (MTCL) facility. Coal is dispatched through this facility by rail to PWCS at Newcastle.

Bypass coal is crushed and sized to 50mm and conveyed around the CPP directly to the product stockpiles.

The North CPP also uses an emergency stockpile (CC8) as required. The raw and product coal stockpiling facilities and operations have not changed since the previous reporting period.

### 2.7.2 South

ROM Coal is delivered from the mine into two raw coal receival hoppers. The coal is then broken down to a top-size of 125 mm in two rotary breakers, then stacked via two automatic luffing and slewing rail mounted stackers on a single 70,000 tonne design capacity raw coal stockpile.

Clean coal products are reclaimed from stockpiles using a bucket wheel reclaimer that feeds the train loading bin at the MTCL facility. Coal is dispatched through this facility by rail to PWCS at Newcastle. The raw and product coal stockpiling facilities and operations have not changed since the previous reporting period.

### 2.7.3 MTW Stockpile Capacity

Manageable stockpile capacity at MTW Mine is shown in Table 16.

**Table 16 MTW CPP Stockpile Capacity**

| Preparation Plant | ROM tonnes capacity | Saleable tonnes capacity |
|---|---|---|
| North | 90,000 | 160,000 |
| South | 80,000 | 320,000 |
| **Total** | **170,000** | **480,000** |

## 2.8 Rock Material Management

### 2.8.1 Mining Overburden

Overburden is the general name of the material that extends from below the topsoil layer to the upper coal seam. Interburden is material that separates all subsequent coal seams. This overburden and interburden material is commonly referred to as spoil. At MTW, the spoil material varies in physical and geochemical properties, in accordance with the geology of the area and the extent of exposure to weathering.

Chemical analyses of MTW spoil materials indicate that, in general, the overburden is slightly sodic and alkaline, but within acceptable ranges for use as a plant growth medium.

As part of the routine mining operations, overburden is placed behind the advancing mining operation to permit the extraction of coal. This overburden removal is generally done by dragline and/or truck and shovel operations. The overburden material is then reshaped and covered with topsoil as part of the rehabilitation process. Once in situ these areas are aerially seeded with a fast germinating and growing cover crop species to mitigate the risk of the area being a dust source.

### 2.8.2 Coarse Rejects

Coarse reject consists predominantly of fine-grained sedimentary rock types with minimal quantities of carbonaceous material. The reject contains no energy, is of no current commercial use and has little propensity for spontaneous combustion. This material has similar properties to overburdens in contact with coal seams and is generally saline and alkaline.

Coarse reject from both CPPs is transported by MTW trucks, and is incorporated within the existing overburden dumps. Any dump or emplacement material which incorporates this coarse reject is ultimately covered by approximately ~~25~~m of inert mine spoil to ensure that it is some considerable vertical distance from any future plant root zones and to reduce the already low potential for spontaneous combustion.

### 2.8.3 Fine Rejects

Fine reject (tailings) is thickened into a solid's density of approximately 20% to 30% by weight and is predominantly fine rock and clay with some coal and flocculent. The fine reject is wet with moderate conductivity.

Total estimated Reject generation from the CPPs is shown in Table 12.

#### 2.8.3.1 North CPP

Fine reject (tailings) from the North CPP is currently pumped via a pipeline to the Centre Ramp Tailings Storage Facility (CRTSF) and the Abbey Green South Tailings Storage Facility (AGSTSF). Tailings storage facilities locations are shown in **Map 2**.

~~A Section 96A modification to~~ The Development Consents allow~~s~~ for the transfer of fine reject (tailings) from the North CPP to the tailings storage facilities to the south and the transfer of mine water throughout the MTW operational area. Existing tailings storage facilities consist of the Centre Ramp and Abbey Green South.

Fine reject (tailings) from the South CPP is currently disposed into the CRTSF and AGSTSF. The capacity of the CRTSF was increased in 2013 by raising the two embankments to 120m RL with overburden material sourced from Loders Pit and the adjacent pit, Abbey Green South. The AGSTSF correspond to the final void from mining activities in Abbey Green South Pit, which were completed in late 2008.

Construction work commenced in 2015 to raise the embankment heights at CRTSF to RL130. It is anticipated that CRTSF RL130 embankments will provide tailings capacity through to 2019.

#### 2.8.3.2 Tailings emplacements

There are six tailings emplacements within the MTW mining area. These are:

- Tailings Dam No. 1, within CL 753, currently nil activity for tailings emplacement. Stage 1 capping complete, Stage 2 capping to final landform design and rehabilitation will be completed during 2015;
- Tailings Dam No. 2, within CL 753, currently nil activity for tailings emplacement. Closure of the Redbank Power Station has resulted in cessation of ash disposal on Tailings Dam 2. Capping and rehabilitation is scheduled to occur during the period of this MOP;
- Centre Ramp Tailings Storage Facility, within CL 219, currently active;

- Ministrip Tailings Storage Facility, within CL 219, currently nil activity for tailings emplacement;
- Abbey Green South Tailings Storage Facility, within CL 219, currently active; and
- Eastern Tailings Dam, within CL 219, currently nil activity for tailings emplacement. Trial of capping procedure commenced in 2015.

The Ministrip TSF has minimal capacity remaining and shall only be utilized for emergency disposal.

#### 2.8.3.3 Tailings Storage Facilities Management

Based on current investigations, the CRTSF, with embankments raised to RL 155, and AGSTSF shall provide MTW with sufficient tailings storage capacity until 2023, this being outside the period covered by this MOP. Beyond this period, the Loders Pit final void will provide sufficient tailings capacity through to the end of the currently approved mine life. The tailings storage and disposal strategy is summarised in Table 17.

**Table 17 MTW Tailings Storage and Disposal Strategy**

| CPP/Pit | Activity | Storage Location | Timing |
|---|---|---|---|
| North and South CPP | Tailings Disposal | CRTSF, to 120m RL | 2016 |
| | | AGTSF | 2020 |
| | | CRTSF, to 130m RL | 2016-2019 |
| | | CRTSF, to 155m RL | 2019-2023 |

### 2.8.4 Sewage Waste

Sewage from the North surface facilities (i.e. administration buildings, workshops, CPP) is treated in a sewage treatment plant, which aerates and clarifies the sewage, before discharging it into maturation ponds. The treated effluent is disposed of on-site by irrigation onto nearby landscaped areas, where it dissipates through transpiration and evaporation. Regular monitoring of the effluent and irrigated soils demonstrates there are no adverse impacts from this operation.

Sewage from the South administration areas is treated in septic tanks and associated transpiration areas. Sewage from remote crib-huts are treated via local “biocycle” systems, or pumped out and disposed of either off-site or in the on-site maturation ponds by licensed contractors.

### 2.8.5 Oil and Grease Waste

A specialised oil and grease storage facility exists at MTW. During 2013, 1,203,625 kg of oil, 91,958 kg of contaminated grease and 118,131 kg of coolant were recycled at MTW by Remondis, ~~Coal & Allied's~~ MTW's currently approved waste disposal contractor. The bulk oils and grease storage facilities are part of the fuel storage facility and meet Australian Standards. All waste hydrocarbons are recycled via a licensed waste hydrocarbon disposal company and are part of the Total Waste Management System (TWMS) developed by ~~Coal & Allied~~ MTW.

### 2.8.6 Total Waste Management System

The management of all industrial and putrescible waste generated on the sites is undertaken in accordance with ~~Coal & Allied's~~ MTW's TWMS, local ordinances and within existing regulatory guidelines. Waste not suitable for recycling is removed by contractors and disposed of at the Singleton Shire Council Landfill. All waste management contractors working at MTW are licensed by OEH.

Waste segregation and recycling is encouraged through providing appropriate recycling facilities. Co-mingle recyclable wastes are removed by licensed contractor to a Materials Recycling Facility at Thornton where wastes are sorted for further recycling.

The TWMS allows for the tracking of wastes by type, weight and cost. The system is automated, with a parallel docketed system remaining in use to meet compliance obligations. Waste statistics at MTW are reported annually in the Annual Environmental Review (AER). The information is used by MTW to identify areas of improvements and track performance against targets.

## 2.9 Other Infrastructure

### 2.9.1 Existing Infrastructure

As MTW is comprised of two previously separate mining operations, the existing infrastructure consists of two different sets of surface facilities, CPP and coal stockpile areas. All facilities are currently utilised in varying capacities.

The former WML infrastructure is located on the eastern edge of the northern half of the mining lease, adjacent to Jerry's Plain Road. Facilities include workshops, vehicle washing facilities, fuel and dangerous goods storages, storage hoppers and crushers, coal stockpiles, the North CPP, bathhouse, general warehouse and offices. A conveyor links the North CPP with the rail loading point, i.e. MTCL. There is also a pipeline and pumping station linking the North CPP to the Centre Ramp Tailings Storage Facility within CL219.

The MTO surface facilities are located in the northeast of the CL 219, adjacent to the Putty Road realignment. The surface facilities consist of administration buildings, coal preparation plant, bathhouse, foreman's assembly/first aid area, workshop/warehouse compound and vehicle service bay, fuel storage facilities, hardstand, washdown bay and water management structures.

The South CPP complex is located on the eastern edge of CL 219 and consists of the coal preparation plant, stockpile areas for raw coal and product coal and a large holding dam. A conveyor system links the product stockpile area with the MTCL.

The MTCL area is located adjacent to the South CPP and consists of a rail loop, train loading facilities and associated sediment control dams.

The MTW mining area is generally bounded by Jerry's Plains Road to the north, Wallaby Scrub Road and Charlton Road to the west, and Bulga Mine to the south. The Putty Road traverses MTW, dividing the former MTO and WML operations.

Haul roads are active within the mining area, which facilitate the movement of coal, overburden, equipment and personnel around the site. Two bridges crossing the Putty Road join the former MTO and WML sites. The smaller bridge is utilized by light vehicular traffic, whilst the large bridge allows for the haulage of coal from the more southern mining areas within MTW to the South CPP and for the return haulage of coarse reject.

Minor field infrastructure includes mobile substations, crib facilities, in pit fuel bay/mobile tankers and fast fill water points. This field infrastructure is located at strategic points throughout the MTW mining area.

A number of water management structures are located throughout the area, including pre-mining sediment control and stock water dams; rehabilitation of disturbed lands, mine water dams, tailings storage facilities, numerous diversion banks and drains and pipelines for the transport of clean and dirty water.

Two high voltage (330kv) transmission lines skirt the eastern and northern edges of the MTW mining area.

Four wells were drilled as part of the CSMPP to test the feasibility of pre-draining coal seams to reduce the impact of fugitive emissions from coal mining. Three wells were located at a site on the eastern side of Wallaby Scrub Road with the other well located to the west of the road. A single flaring tower was located at each of the two sites.

During 2010 all four wells produced gas and the majority of the gas was flared. However, gas volumes produced were below expectations and all four wells were subsequently closed and have been decommissioned, including cement sealing.

Continuation of mining at Warkworth westwards will necessitate the closure of Wallaby Scrub Road during the period of the MOP. An appropriate emergency access road between Putty Road and the Golden Highway will be constructed during ~~2016~~ 2018, prior to the closure of Wallaby Scrub Road.

### 2.9.2 Construction

The integration of MTO and WML to form MTW and the approved extensions of mining at Warkworth and Mt Thorley are planned to maximise the use of existing facilities and minimise the requirement for new infrastructure.

Construction which is planned during the period of this MOP consists of:

- The water management system will vary to suit the advancing mine. Mining and construction of the North Out of Pit (NOOP) dam approved by the Warkworth Continuation Project, in addition to the South Out of Pit

Dam (constructed in 2011) to maintain an adequate storage in times of low rainfall and to reduce the need to pump water from the Hunter River;

- Third crossing of Putty Road, likely to be a double lane underpass;
- Internal haul roads would be constructed in accordance with the requirements of mining operations;
- Emergency access road between Putty Road and the Golden Highway for use by the Rural Fire Service (RFS); and
- Electrical infrastructure and pipeline/pumping infrastructure ahead of the advancing mine.

# 3.0 Forecast Rehabilitation Activities

Rehabilitation will be undertaken progressively across the mined areas. Detailed baseline data from analogue sites will be used to develop and monitor a number of rehabilitation performance measures for specific rehabilitation domains (refer Section 6.0). Specific performance indicators will be measured to demonstrate and guide the implementation and track the progress of rehabilitation. The monitoring of rehabilitation performance will be reported in the AER ~~AEMR~~.

The objectives of the rehabilitation domains of mined areas are to:

- Re-create approximately 2,100 ha of Endangered Ecological Communities (EEC) woodland communities to a standard comparable to similar reference EEC communities;
- Establish approximately 319 ha of woodland/open woodland areas, but not necessarily conforming to any particular vegetation community;
- Recreate 1,423 ha grassland communities with a native component on the residual disturbed mining areas;
- Establish a network of tree corridors to ensure connectivity of woodland community areas;
- Provide additional habitat for threatened species; and
- Create an additional north/south wildlife corridor providing connectivity to other habitat.

The rehabilitation of EEC woodland communities on mined lands will be guided by leading-practice knowledge of rehabilitation and revegetation professionals.

The woodland component of the rehabilitation will form a north/south connecting corridor of vegetation between the existing vegetation to the north of the Warkworth extension area through the rehabilitation areas of Mount Thorley and Bulga mines and remnant vegetation within the Singleton Military Area further south.

Replanting of mine rehabilitation areas will use local native plant species and seed collection programmes to ensure adequate seed is collected from relevant species to ensure species diversity is maintained. Where practical, topsoil will be translocated from proposed mining areas, with minimal stockpiling, in an attempt to maximise the viability of the native seed bank of local ecological communities. With time, the rehabilitation areas will provide additional suitable habitat for native flora and fauna including threatened Woodland Birds, microchiropteran Bats and the Squirrel Glider. Existing rehabilitation and current rehabilitation programmes being undertaken should rapidly provide suitable foraging habitat for these species to utilise.

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# 4.0 Environmental Issues Management

## 4.1 Risk Assessment

The key risks associated with the proposed mining activities at MTW during the term of this MOP have been assessed using the likelihood ratings, maximum reasonable consequence ratings, risk matrix and classifications (*HSEQ Qualitative Risk Assessment*, Rio Tinto – Jan 2008) listed in Table 18, Table 19, Table 20 and Table 21, respectively.

**Table 18 Likelihood Ratings**

| Class | Likelihood | Likelihood Description | Frequency |
|---|---|---|---|
| A | Almost certain | Recurring event during the life – time of the operation / project | Occurs more than twice per year |
| B | Likely | Event that may occur frequently during the life – time of an operation / project | Typically occurs once or twice per year |
| C | Possible | Event that may occur during the life – time of an operation / project | Typically occurs in 1-10 years |
| D | Unlikely | Event that is unlikely to occur during the life – time of an operation / project | Typically occurs in 1-100 years |
| E | Rare | Event that is very unlikely to occur during the life – time of an operation / project | Greater than 100 year event |

**Table 19 Maximum Reasonable Consequence Ratings**

| Class | Consequence | Consequence Description |
|---|---|---|
| 1 | Minor | Near-source confined and promptly reversible impact on-site, with little or no off-site impact expected |
| 2 | Medium | Near-source confined and short-term reversible impact on-site, with little and promptly reversible off-site impact |
| 3 | Serious | Near-source confined and medium-term recovery impact on-site, with near-source confined and short-term reversible off-site impact |
| 4 | Major | Impact that is unconfined and requiring long-term recovery, leaving residual damage on-site with near-source confined and medium-term recovery of off-site impacts |
| 5 | Catastrophic | Impact that is widespread (or unconfined) and requiring long-term recovery, leaving major residual damage on-site with off-site impacts that are unconfined and requiring long-term recovery and leaving residual damage |

**Table 20 Risk Matrix**

| Likelihood | Consequence | | | | |
|---|---|---|---|---|---|
| | 1 - Minor | 2 - Medium | 3 - Serious | 4 - Major | 5 - Catastrophic |
| A – Almost Certain | Moderate | High | Critical | Critical | Critical |
| B – Likely | Moderate | High | High | Critical | Critical |
| C – Possible | Low | Moderate | High | Critical | Critical |
| D – Unlikely | Low | Low | Moderate | High | Critical |
| E – Rare | Low | Low | Moderate | High | High |

**Table 21 Risk Classification**

| Risk Class | Risk Management Response |
|---|---|
| Critical | Risks that significantly exceed the risk acceptance threshold and need urgent and effective attention. |
| High | Risks that exceed the risk acceptance threshold and require proactive management. While proactive actions are undertaken, further risk reduction is impracticable suggesting a need for compensatory measures |
| Moderate | Risks that lie on the risk acceptance threshold and require active monitoring. The implementation of specific safeguards could be used to reduce risks further |
| Low | Risks that are very unlikely and of low consequence, and do not require active management. Nevertheless, some potential for certain risks to occur remains and could require specific monitoring |

Table 22 outlines the key identified risks and associated risk ratings. The ratings assume that the risks are untreated i.e. have not been addressed by specific risk mitigation measures other than routine design and operational practices.

**Table 22 Key risks associated with activities undertaken over the MOP term**

| ISSUE | Exploration | Mine development and mining (surface and underground) | Waste rock emplacement management | Use/maintenance of roads, tracks and equipment | Mineral processing facilities and infrastructure | Ore/product stockpiling and handling | Construction activities incl. earthworks | Tailings impoundment management | Land preparation, vegetation and topsoil | Water management, incl. storm event | Hazardous material & fuel handling spills management | Sewerage | Rubbish removal | Rehabilitation | Rehabilitated lands and remaining features |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Air pollution, dust | H | H | M | H | H | L | M | H | L | - | - | L | H | H | - |
| Erosion and sedimentation | M | M | L | M | M | M | M | - | - | H | - | - | - | H | H |
| Surface water | L | H | M | H | H | H | - | - | M | - | - | L | - | H | - |
| Groundwater | L | - | M | H | - | - | - | - | M | - | - | - | L | - | - |
| Contaminated land | L | L | M | H | - | - | - | - | - | - | M | L | L | - | - |
| Hazardous substances contamination | M | H | M | M | H | H | L | L | - | H | H | - | - | H | - |
| Acid mine drainage | - | L | L | - | - | - | - | L | - | - | - | - | - | - | - |
| Flora and fauna | M | H | H | H | - | - | - | - | - | - | - | - | - | L | L |
| Weeds and pests | - | M | - | M | - | - | - | - | - | - | - | - | - | H | H |
| Blasting | - | - | - | H | - | - | - | - | - | - | - | - | - | - | - |
| Operational noise | L | L | H | H | H | H | M | - | - | - | - | - | - | - | - |
| Visual amenity and lighting | - | - | M | H | - | - | - | - | L | - | - | - | - | - | - |
| Aboriginal heritage | H | H | H | H | - | - | - | - | - | - | - | - | - | L | L |
| European heritage | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Spontaneous combustion | - | - | - | - | - | L | - | L | - | - | - | - | - | - | L |
| Bushfire | M | M | L | L | L | - | - | - | - | - | - | - | - | - | M |
| Mine subsidence | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Methane drainage / venting | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Public safety | L | - | - | M | - | - | - | - | M | L | L | L | - | - | L |

#### ~~4.1.1 Environmental Management System~~

~~The RTCA Health, Safety, Environment and Quality (HSEQ) Management System streamlines current management system requirements from the health, safety and environment disciplines, incorporates current leading practices and supports the Rio Tinto performance standards which are mandatory for all Rio Tinto businesses. The HSEQ Management System provides for the integration of the existing Coal & Allied Safety Management System and Coal & Allied Environmental Management System. This integration streamlines the management activities used to uphold HSE performance.~~

~~The HSEQ Management System enables the operations to apply specific tools that support the implementation, execution and effectiveness of the Rio Tinto health, safety and environmental performance standards. The HSEQ management system is designed on the principles of continuous improvement and generally follows the layout of common international standards (including ISO14001) and the Plan, Do, Check and Review cycle:~~

- ~~Plan identify what is required;~~
- ~~Do implement the activities;~~
- ~~Check monitor performance through checking and corrective action; and~~
- ~~Review evaluate the suitability, adequacy and effectiveness of the system through the management review.~~

~~These steps are subdivided into 17 elements describing the requirements of the system, some of which will be implemented through the Rio Tinto Business Solution (an online information management system).~~

### 4.1.2 Environmental Management Strategy

The current ~~Coal & Allied~~ MTW Environmental Management Strategy (EMS) has been developed in accordance with the requirements of Schedule 5 Clause 1 of the new development consents ~~and the International Standard ISO14001~~. The ~~Coal & Allied~~ EMS was first approved by the (then) NSW Department of Planning (DoP) on 13 April 2005. It was last reviewed and updated in ~~2013~~ 2018.

The EMS is designed so that ~~Coal & Allied~~ MTW can:

- Efficiently manage its environmental issues;
- Ensure compliance with regulatory requirements;
- Continually improve its environmental performance; and
- Satisfy the expectations of stakeholders and the local community.

#### ~~4.1.2.1 Environmental Management Documents~~

~~The EMS is described and explained in a series of documents arranged within the Rio Tinto HSEQ framework that reflects the system model as well as the type of information they contain. These documents are further described in Table 23. All EMS documents are kept on the MTW Site Document register so they are electronically distributed and readily accessible across the organisation.~~

~~Management Strategies, Plans and Monitoring Programmes are prepared as required by development consent / project approval conditions. Where possible, one Coal & Allied Strategy, Plan or Programme has been developed for all operations. The Management Strategies and Plans have been developed with an understanding of the environmental areas that need to be managed and the results of the EAs, including those required for approval.~~

~~Environmental procedures have been established, documented and maintained for all mining related activities that have a potentially significant impact on the environment. Procedures provide details of operation and maintenance of facilities, equipment and machinery where required, and are common across all sites with appendices to describe site-specific details. The HSEQ Management System procedures and related Coal & Allied environmental procedures are listed in Table 23.~~

**Table 23 Management System Standards and Procedures**

| **RTCA HSEQ System** | |
|---|---|
| HSEQ Management Policy and Procedures<br>1 HSEQ Policy<br>2 Legal and Other Requirements<br>3 Hazard Identification and Risk Management<br>4 HSEQ Management Improvement Planning<br>5 Organisation, Accountability and Responsibility<br>6 Training, Competency and Awareness<br>7 Supplier and Contractor Management<br>8 Documentation & Document Control<br>9 Communication and Consultation<br>10 Operational Control<br>11 Management of Change<br>12 Disaster Management and Recovery<br>13 Measuring and Monitoring<br>14 Non-conformance, Incident & Action Management<br>15 Data and Records Management<br>16 Performance Assessment and Auditing<br>17 Management Review | |
| **Rio Tinto Environmental Performance Standards** | **Current Coal & Allied EMS Procedures** |
| E11 Water quality protection<br>E12 Air quality protection<br>E13 Chemically reactive mineral waste control<br>E14 Land disturbance and rehab control<br>E15 Hazardous materials and non-mineral waste control | 3.1 Property Transaction Guidelines (Rio Tinto)<br>4.1 Closure Planning Guidelines<br>5.1 Disturbance and Rehabilitation<br>6.1 Waste Management – Non Mineral<br>6.2 Coarse Rejects and Tailings Disposal<br>7.1 Water Management<br>7.2 Water Discharge<br>8.1 Dust Management CHPP<br>8.2 Dust Management – Mobile Equipment<br>8.3 Spontaneous Combustion<br>9.1 Noise<br>9.2 Blasting (includes air quality and vibration)<br>10.1 Visual Management (includes infrastructure design and lighting management)<br>10.2 Flora and Fauna<br>10.3 Ground Disturbance Permit<br>10.4 Weed Control<br>12.1 Acid Mine Drainage Prevention and Control<br>13.1 Site Contamination Prevention and Control<br>Coal and Allied-09-EWI-SITE-003 Environmental Complaints Line<br>Coal & Allied-10-EWI-SITE-E10-059 Erosion and Sediment Control |

### 4.1.3 Environmental Management Plans

~~In addition to the standards and procedures listed above,~~ Environmental Management Plans (EMPs) are prepared as required by the development consents. These management plans are approved by ~~DRG and~~ DP&E and are reviewed as necessary to ensure they remain relevant.

### 4.1.4 MTW Environment and Community personnel

~~Coal & Allied~~ MTTTW employ ~~have established~~ a team of environmental specialists to establish, implement and audit the requirements of the EMS and EMPs. This team provides comprehensive coverage to ~~all Coal & Allied's~~ MTW's mining operations through ~~a central technical service office and~~ site based personnel supported by a corporate Environment and Community team.

### 4.1.5 Auditing and Inspections

MTW are required by development consents to undertake a three yearly independent environmental audit of development consents and other statutory approvals in consultation with relevant agencies and report the findings to DPE and publicly report on MTW's website. In addition, MTW is required to annually report performance against development consent and EIS predictions in the AER.~~Coal & Allied Environmental Services conduct a number of audits and inspections throughout the year, including regular internal EMS and compliance audits, Rio Tinto compliance audits and other less routine audits.~~ Site based environmental personnel also conduct regular inspections of all work areas.

### 4.1.6 Environmental Reporting

An AER is produced for MTW to fulfil the reporting requirements of SSC, OEH, DoEE and DP&E. This report compiles monitoring results and discusses trends, system changes and responses to any potential issues identified during monitoring. Targets and future initiatives are also identified. Other environmental related reports include regular reporting to OEH, DoEE, CCC, and DP&E.

## 4.2 Risk Management

### 4.2.1 Operational Noise

Operational noise is managed through the MTW Noise Management Plan (NMP). The NMP describes all aspects of noise management at MTW, including:

- Applicable and specific consent and licence conditions, including impact assessment and land acquisition criteria;
- Baseline data;
- Management / mitigation strategies (including both proactive and reactive controls);
- Monitoring requirements and strategy;
- Consultation with relevant stakeholders;
- Roles and responsibilities associated with the implementation of the NMP;
- Measuring the performance of the NMP; and
- Regular reporting

~~The NMP was prepared and submitted to the Director General following granting of Modification 6 to the Warkworth Approval (DA 300-9-2002 i) on 31 March 2014 and approved on 6 August 2014.~~ The Plan has ~~subsequently~~ been revised and submitted to the Secretary for approval to satisfy Project Approval (SSD-6464) Schedule 3 Condition 7 for Warkworth and Project Approval (SSD-6465) Schedule 3 Condition 5 for Mt Thorley.

### 4.2.2 Blasting

Environmental impacts associated with Blasting are managed ~~through Rio Tinto Environmental Performance Standard *E12 Air quality protection*, and~~ in accordance with the MTW Blast Management Plan (BMP). The BMP describes all aspects of environmental management associated with blasting, including:

- Applicable and specific consent and licence conditions, including airblast overpressure and ground vibration criteria, and limitations on blasting frequency;

- Baseline data;
- Management / mitigation strategies (including both proactive and reactive controls);
- Monitoring requirements and strategy;
- Consultation with relevant stakeholders;
- Roles and responsibilities associated with the implementation of the BMP;
- Measuring the performance of the BMP; and
- Regular reporting

The BMP was prepared and submitted ~~to the Director-General following granting of Modification 6 to the Warkworth Approval (DA 300-9-2002-i) on 31 March 2014 and approved on 10 September 2014. The Plan has subsequently been revised and submitted~~ to the Secretary for approval to satisfy Project Approval (SSD6464) Schedule 3 Condition 16 for Warkworth and Project Approval (SSD-6465) Schedule 3 Condition 14 for Mt Thorley.

### 4.2.3 Air Quality

Air quality is managed ~~through Rio Tinto Environment Performance Standard *E12 Air quality protection*,~~ in accordance with the MTW Air Quality and Greenhouse Gas Management Plan (AQMP). The AQMP describes all aspects of air quality management, including:

- Applicable and specific consent and licence conditions, including impact assessment and land acquisition criteria for particulate matter;
- Baseline data;
- Management / mitigation strategies (including both proactive and reactive controls);
- Monitoring requirements and strategy;
- Consultation with relevant stakeholders;
- Roles and responsibilities associated with the implementation of the AQMP;
- Measuring the performance of the AQMP; and
- Regular reporting

The AQMP was prepared and submitted to ~~the Director-General following granting of Modification 6 to the Warkworth Approval (DA 300-9-2002-i) on 31 March 2014 and approved on 6 August 2014. The Plan has subsequently been revised and submitted to~~ the Secretary for approval to satisfy Project Approval (SSD-6464) Schedule 3 Condition 20 for Warkworth and Project Approval (SSD-6465) Schedule 3 Condition 18 for Mt Thorley.

### 4.2.4 Water

Water is managed ~~through Rio Tinto Environment Performance Standard *E11 Water quality protection*,~~ in accordance with the site Water Management Plan (WMP) as approved on 26 June 2015. The Plan has subsequently been revised and submitted to the Secretary for approval to satisfy Project Approval (SSD9494) Schedule 3 Condition 27 for Warkworth and Project Approval (SSD-6465) Schedule 3 Condition 25 for Mt Thorley.

The purpose of the WMP is to provide reasonable and feasible measures to address potential water impacts of the Project as identified in the Approvals and satisfy the relevant conditions of the Approvals. The WMP describes procedures required to ensure compliance with conditions of the Approvals relating to potential water impacts. This WMP also provides a mechanism for assessing water quality and quantity monitoring results.

MTW manages water according to three main objectives:

- Fresh water usage is minimised;
- Impacts on the environment and MTW neighbours are minimised; and
- Interference to mining production is minimal.

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 system; and
- Disposing of water to the environment in accordance with statutes and regulations.

#### 4.2.4.1 Water Management System

The MTW water management system consists of a network of infrastructure (i.e. dams, pipelines, contour banks) to control the movement of water around the site. Water is managed according to type. Water type is determined by catchment source, quality and use. The main types of water managed at MTW include:

- Mine Water
- Runoff Water
- River Water

Water used in coal production at MTW is predominantly saline due to interaction with saline groundwater within coal seams and contact with saline mine spoils. Saline water cannot be released from site except for opportunistic discharges as regulated by the Hunter River Salinity Trading Scheme (HRSTS). The majority of saline mine water is directed to two out of pit storages – Dam 6S (South out-of-pit Dam or "SOOP") and Dam 1N. An additional mine water storage (the North Out of Pit Dam or "NOOP") will be constructed and commissioned during the MOP period. Large mine-water dams have sufficient free-board capacity maintained to prevent overtopping during heavy rainfall events.

#### 4.2.4.2 External Water Supply

MTW seeks to use non-potable sources of water preferentially prior to accessing water from the Hunter River under the Water Sharing Plan. Typically excess water is stored on site, however piping infrastructure is in place to transfer water to/from Hunter Valley Operations via Dam 27S (Lemington Void). Additional sources of poor quality water are also available from the Lemington Underground Bore and under a water transfer agreement in place with the Peabody Wambo mine and Bulga mine.

Mt Thorley Warkworth holds both High and General Security Water Access Licences to withdraw water from the Hunter River. Singleton Shire Council holds a high security water licence (WAL 10543) on behalf of the Mount Thorley Joint Venture Water (MTJV) Supply Scheme. The Council maintains and operates the Scheme to supply raw water, sourced from the Hunter River, to MTW and other joint venturers. MTW's share of the Scheme allocation is a maximum of 1,012 ML/a, based on a 100% Available Water Determination. Should MTW require more water, entitlements can be traded to this licence in accordance with the WMA to increase output through the scheme.

#### 4.2.4.3 Water Discharge

Excess mine water can be released via licensed discharge points into the Hunter River. Licensed discharge points are located on: Dam 9S (MTO) and Dam 1N (WML). Discharges are only allowed during high and flood flow periods in the Hunter River as determined by State Water and NOW. Discharges are regulated by conditions in the site EPLs 1376 and 1976 and by the Hunter River Salinity Trading Scheme Regulation 2000.

#### 4.2.4.4 Surface Water Management

##### 4.2.4.4.1 Surface Water Monitoring

MTW maintains a network of surface water monitoring sites located on mine site dams and surrounding natural watercourses. MTW has built up a large knowledge base from more than 30 years of surface water monitoring providing detailed baseline data of surface water flows and quality in watercourses that could be affected by the project. Results of the surface water quality monitoring at MTW are reported to the CCC and in the AER ~~AEMR~~.

#### 4.2.4.4.2 Clean Water diversions

Clean water diversion structures are employed to divert clean water away from the active pits. Prior to release from site this water is managed to minimise sediment load. Sediment control structures are implemented generally in accordance with *Managing Urban Stormwater Volume: 2E mines and Quarries*.

#### 4.2.4.4.3 Erosion and Sediment Control

A GDP is required for all disturbance activities. Prior to disturbance, appropriate erosion and sediment controls consistent with current best practice standards will be established. Where ground conditions allow, erosion and sediment controls will be designed generally in accordance with the 'Blue Book': Managing Urban Stormwater: soils and construction (Volume 1 and 2E – Mines and Quarries).

Sediment mobilisation and erosion will be minimised by;

- Where practical, diverting runoff from undisturbed catchments around disturbed areas via diversion drains and banks to discharge into natural watercourses;
- Retaining runoff from disturbed areas in sediment dams to settle out suspended sediment with possible treatment prior to discharge back to the natural system;
- Return water back to the mine water system if water quality is not suitable for release;
- Installing appropriate erosion and sediment controls prior to disturbance of any land;
- Limiting the extent of disturbance to the practical minimum and maintaining groundcover;
- Reducing the flow rate of water across the ground on disturbed surfaces;
- Progressively stripping and stockpiling topsoil for later use in rehabilitation and stabilisation;
- Stabilising topsoil stockpiles to minimise erosion;
- Progressively rehabilitating disturbed land to increase ground cover, increase infiltration and reduce erosion potential;
- Constructing drainage controls such as scour protection to improve stability in concentrated flow areas; and
- Restricting access to rehabilitation and non-disturbed areas.

### 4.2.4.5 Groundwater Management

An integrated management approach is employed at MTW to mitigate the potential impacts of mining on the groundwater environment and other groundwater users, including dependent ecosystems.

The key groundwater management measures are:

- Physical water management;
- Groundwater monitoring, data management and reporting;
- Groundwater model revisions and verification of predictions;
- Salinity trading and water sharing; and
- Direct compensation measures.

The groundwater management measures are intended to complement the groundwater monitoring programme detailed in the WMP. Results of the groundwater monitoring at MTW are reported to the CCC and in the AER.

## 4.2.5 Biodiversity

Flora and fauna is managed in accordance with the Warkworth Mine Biodiversity Management Plan ~~Rio Tinto Environmental Performance Standard *E14 Land disturbance and rehab control* and Coal & Allied Environmental Procedures *5.1 Disturbance and Rehabilitation*, *10.2 Flora and Fauna* and *10.3 Ground Disturbance Permit*~~.

MTW implemented the Green Offsets Flora and Fauna Management Plan from the 28 March 2008 to the 9 January 2015, this plan was approved by DoP and DEWHA. To incorporate new offset areas and satisfy the requirements of the DP&E draft Biodiversity Offset Management Plan guidelines a new Flora and Fauna

Management Plan was drafted, to avoid confusion with the previous plan it was named the Local Offset Management Plan (OMP). The Local OMP was approved by DPE on 9 January 2015, and was prepared in consultation with OEH.

As required under Schedule 3 Condition 36 of Project Approval (SSD-6464) for Warkworth, MTW ~~will~~ has developed and implemented a Biodiversity Management Plan that is consistent with the Biodiversity Offset Strategy described in the Warkworth Continuation 2014 EIS. The Biodiversity Offset Strategy for Warkworth includes:

- Securing direct land based offsets - within 3 years of commencement of the development;
- Securing rehabilitation offsets – within 10 years of completion of mining operations;
- Development of performance criteria for regeneration of Warkworth Sand Woodland to ensure successful regeneration in the Northern Biodiversity Area within 15 years from the commencement of the development;
- Preparation of an Integrated Management Plan for the Warkworth Sand Woodland EEC; and
- Contribution of $1 million to the Office of Environment and Heritage (OEH's) 'Saving Our Species – Regent Honeyeater' conservation program.

The Commonwealth Minister for the Environment issued two approvals for the Warkworth Mine, the first in February 2004 (EPBC2002/629) and the second in August 2012 (EPBC2009/5081), under provisions of the *EPBC Act 1999*. These approvals require WML to protect and manage offsets of at least 4,212 hectares to offset the impact upon the Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*) habitat, both are Matters of National Environmental Significance (MNES). Regent Honeyeater was listed as Critically Endangered in July 2015 and the Swift Parrot is listed as Endangered.

To appropriately offset the loss of vegetation and ecological impacts as a result of the Warkworth Mine, a number of Biodiversity Areas (BAs) have been established that provide for the long term protection of forest and woodland, including the following EEC's: Warkworth Sands Woodlands (WSW), Central Hunter Grey Box - Ironbark Woodland and White Box Woodland. Re-establishment of woodlands (including EEC's) will also be undertaken within parts of the BAs to provide a net conservation gain. The offset areas within the BA's, including the rehabilitation areas, are to be legally secured to protect them for the future.

The Commonwealth and State approvals grant permission to impact the same disturbance area. Therefore, some offset areas can be used to satisfy offset conditions for both approvals. The allocation of the offset area by BA and approval is shown in Table 24 below.

**Table 24 Designation of Offset Area for each Environmental Approval**

| Locality | Biodiversity Area | Offset Area (ha) | Environmental Approvals | | | | |
|---|---|---|---|---|---|---|---|
| | | | EPBC 2002/629 | EPBC 2009/5081 Phase 1 | EPBC 2009/5081 Phase 2 | NSW 2003 | NSW 2014 |
| Mine Site | Rehabilitation | 2,100 | | | | | 2,100 |
| Local | Southern (WSW Offset Area) | 117 | | | 117 | 117 | |
| | Southern (Putty Road Area) | 94 | | 94 | | 94 | |
| | Southern | 775 | | | 775 | | 775 |
| | Northern (WSW Offset Area) | 39 | | | 39 | 39 | |
| | Northern | 302 | | | 302 | | 302 |
| | North Rothbury | 41 | | | 41 | | 41 |
| Regional | Goulburn River | 1,066 | 1,066 | | | | 1,066 |
| | Bowditch | 520 | 520 | | | | 520 |

| Locality | Biodiversity Area | Offset Area (ha) | Environmental Approvals | | | | |
|---|---|---|---|---|---|---|---|
| | | | EPBC 2002/629 | EPBC 2009/5081 Phase 1 | EPBC 2009/5081 Phase 2 | NSW 2003 | NSW 2014 |
| | Bowditch | 82 | | | 82 | | 82 |
| | Putty | 378 | | | 378 | | |
| | Seven Oaks | 522 | | | 522 | | |
| | Condon View | 345 | | | 345 | | |
| **Total** | | **6,381** | **1,586** | **94** | **2,601** | **250** | **4,886** |
| **Total** | | | **Commonwealth** | | **4,281** | **NSW** | **5,136** |

WML has ~~three~~ seven current Offset Management Plans (OMP) approved by the relevant regulator, they include the ~~Regional (Goulburn River and Bowditch BA) OMP (2014), Putty Road Offset OMP (2015)~~ Bowditch MP (2017), Goulburn River MP (2017), North Rothbury MP (2017), Putty MP (2017), Seven Oaks MP (2017), Southern MP (2017), and the Local (Southern and Northern BAs) OMP (2015). As part of the process to legally secure the offset areas, new OMPs for each BA ~~will be~~ have been prepared and ~~once~~ most have been approved by the relevant regulator. ~~will supersede any existing OMPs.~~ Approval is still pending for the Northern MP (2017) and the Condon View MP (2018). Once the Northern MP is approved it will supersede the Local OMP, which covered both the Southern and Northern BA's. The OMPs will define the management areas, provide clear conservation objectives, detail the conservation management strategies to be implemented, and the monitoring programmes to measure success.

### 4.2.6 Weeds and Vertebrate Pest Species

Weeds will be managed through ~~Coal & Allied~~ MTW Environmental Procedure *10.4 – Weed Control*.

The management and control of weeds at MTW is underpinned by the Annual Works Schedule (AWS), which lists Weeds of National Significance, noxious and environmental weeds species as identified at MTW, and provides a framework to allow for structured weed management and control across operational and non-operational areas of MTW. Assessment of the impact of weeds across the MTW site is ongoing with the results of the regular monitoring programmes used to update the AWS. Weed treatment control is conducted annually and at other times as determined by seasonal conditions that may promote excessive weed growth, and is reported in the AER ~~AEMR~~.

The management of weeds across the MOP disturbance area will be undertaken in accordance with advice from the Upper Hunter Weeds Authority. This represents a low environmental risk associated with the proposed activities that can be managed with an ongoing inspection and maintenance program.

The management of vertebrate pests follows a Working Vertebrate Pest Action Plan which is updated seasonally based on recommendations from the quarterly Vertebrate Pest Control Reports. This approach allows maximum flexibility to react to sightings, monitoring results, or particular pest infestations and allows customisation of the programme to effectively address these infestations. The quarterly Vertebrate Pest Control Reports provide a basis for all decision making on vertebrate pest control on the site.

Vertebrate Pest species control is undertaken quarterly and may include trapping, baiting and/or shooting. Performance of vertebrate pest species control is reported annually in the AER ~~AEMR~~.

### 4.2.7 Aboriginal Heritage

~~Aboriginal cultural heritage is managed through the Rio Tinto Coal Australia CHMS, which contains a suite of detailed policies and procedures for the effective management of Aboriginal cultural heritage on all Rio Tinto Coal Australia/Coal and Allied owned and managed lands. The CHMS has been developed to ensure that all activities and ground disturbances associated with the company's operations comply with all relevant legislation and statutory regulations governing the management of Aboriginal cultural heritage.~~

At MTW Aboriginal cultural heritage is managed in accordance with the Aboriginal Heritage Management Plan (AHMP) required under Project Approval (SSD6464) Schedule 3 Condition 43 for Warkworth and Project Approval (SSD-6465) Schedule 3 Condition 28 for Mt Thorley. These consents contain detailed conditions for the

management of Aboriginal cultural heritage at MTW including the programmes and policies to be detailed in the HMPs. ~~Coal & Allied~~ MTW provides annual reports on its progress against & compliance with these conditions through the AER ~~AEMR~~ process.

The new project approvals for Warkworth and Mt Thorley require conservation agreements to be established over aboriginal heritage conservation areas adjacent to the project area. Schedule 3 Condition 39 of SSD-6464 requires a Conservation Management Plan and a conservation agreement to be in place for the Wollombi Brook Aboriginal Cultural Heritage Conservation Area prior to carrying out any development to the west of Wallaby Scrub Road. Schedule 3 Condition 27 of SSD-6465 requires a conservation agreement to be in place for the Loders Creek Aboriginal Cultural Heritage Conservation Area within three years of commencement of the development. Both conservation agreements are required to be pursuant to Section 69B of the National Parks and Wildlife Act 1974.

~~Coal & Allied~~ MTW works closely with the local Aboriginal community on all aspects of cultural heritage management. The ~~Coal & Allied~~ MTW Upper Hunter Valley Aboriginal 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~~ MTW and Registered Aboriginal Parties/stakeholders from Upper Hunter Valley Aboriginal community groups, corporations and individuals. On request, the local Aboriginal community is provided access to Aboriginal sites located on ~~Coal & Allied~~ MTW land.

~~Coal & Allied~~ MTW has also constructed and maintain Cultural Heritage Databases and Geographical Information System (GIS) to better manage and protect sites. These include cultural heritage spatial and other data, such as site location, description, assessments, date recorded, associated reports, management provisions and various other details to assist with the management of sites.

A GDP system has also been implemented across ~~Coal & Allied sites~~ MTW. This permit includes cultural heritage considerations and must be completed prior to any disturbance of ~~Coal & Allied~~ MTW land outside current mining operations. During this process, the location of archaeological and cultural heritage sites is conveyed to employees operating in the vicinity and unintentional disturbance of sites is avoided.

There are a number of Aboriginal heritage sites present within the MOP proposed disturbance area. These sites will be managed or salvaged in accordance with development consent and AHMP conditions, ~~and all relevant CHMS procedures~~ and legislative requirements.

### 4.2.8 European Heritage

At MTW European heritage is managed in accordance with the Historic Heritage Management Plan required under Project Approval (SSD6464) Schedule 3 Condition 46 for Warkworth. The Historic Heritage Management Plan for Warkworth includes:

~~Coal & Allied will prepare a Historic Heritage Management Plan to detail management of heritage sites within the Project area. This Plan will be submitted to DP&E prior to carrying out any mining to the west of Wallaby Scrub Road and will include:~~

- archaeological investigations of Wallaby Scrub Road, Well 2 and the former RAAF Base Bulga Complex;
- photographic recording of all historic heritage sites within the disturbance areas prior to disturbance;
- relocation and storage of moveable heritage items;
- protection of the other heritage items outside the disturbance areas;
- developing an interpretation programme of the heritage values of the RAAF Base Bulga Complex and the Great North Road Complex; and
- ongoing consultation with and involvement of relevant historical groups.

### 4.2.9 Visual Amenity and Lighting

~~Visual amenity and lighting will be managed through Coal & Allied Environmental Procedure *10.1 – Visual Management*.~~

A Visual Screening Plan (2016) has been prepared to meet the requirements of Project Approval (SSD6464) Schedule 3 Condition 52 for Warkworth and Project Approval (SSD6465) Schedule 3 Condition 30 for Mt Thorley. ~~Within 6 months of the commencement of development under Project Approval (SSD-6464), Coal & Allied will prepare a tree screening plan~~ The Visual Screening Plan was developed in consultation with SSC to establish

vegetative bunds and/or screening along the boundary of the site including adjoining public roads where appropriate.

General measures to minimise potential impacts on visual amenity include:

- Progressive rehabilitation with grasses and woodland;
- Prioritisation of outer slopes of overburden emplacements, particularly South and Woodlands Pits, to allow early revegetation and provide visual shielding of active mining;
- Installation of visual bunds to screen the development and long term impacts of final voids from external viewers;
- Screen planting, including planting on public lands in consultation with Council and local residents;
- Annual surveys of overburden heights and rehabilitation areas;
- Appropriate placement and use of natural colours for all significant infrastructure; and
- Develop and implement visual impact mitigation measures for elevated properties to the west of the development, upon request by landholders.

In relation to stray light, measures will be implemented to ensure mine lighting is directed appropriately. Control measures include:

- Fixed and mobile floodlights will not be directed towards surrounding residence unless there is significant intervening topography;
- Day and night dumps may be created to assist with reducing lighting impacts; and
- All external lighting complies with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.*

### 4.2.10 Hazardous Substances Contamination

~~Contamination issues are managed through Rio Tinto Environmental Performance Standard *E15 Hazardous materials and non-mineral waste control* and Coal & Allied Environmental Procedure 13.1 – *Site Contamination Prevention and Control.*~~

~~Additionally,~~ MTW manage hazardous material through the ChemAlert system whereby all chemicals used on site are registered through a central database. The central database contains all information contained in the Material Safety Data Sheets (MSDS) and an inventory of chemicals held onsite. The information can be accessed at any computer terminal within the operation and provide guidance on storage, use and disposal.

Hazardous and explosive materials are transported and stored on site in accordance with MTW-10-PROC-H1-221 Hazardous Substances and Dangerous Goods Procedure. ~~the NSW *Coal Mine Health and Safety Act 2002* and supporting *Coal Mine Health and Safety Regulation 2006* as well as the NSW *Explosives Act 2003* and supporting *Explosives Regulation 2005*.~~

The procedures and controls in place minimise the potential for land and water contamination from the handling, storage and disposal of hazardous substances. These controls include storage within properly sealed containers and controlled areas, bunded for medium to long-term storage requirements. These storage and waste receival areas are isolated from clean water catchments to minimise the risk of land or water pollution should an unplanned spill occur.

Small amounts of contaminated material are treated in the bioremediation sites and returned to the spoil dump once reported as appropriately decontaminated.

The response to any accidental spills or ground contamination will be assessed on a case-by-case basis and remediated using biodegradable spill absorbent. The comprehensive site spill response trailer and emergency response procedure for MTW would also be called upon as required. This work will be carried out in accordance with the relevant ~~Coal & Allied~~ MTW Environmental Procedures. Hydrocarbon or chemical spills will also be reported in the mine site incident reporting and management system with corrective and preventative measures taken as appropriate.

### 4.2.11 Spontaneous Combustion

~~Spontaneous combustion will be managed through Coal & Allied Environmental Procedure *8.3 – Spontaneous Combustion*.~~

In general, MTW does not have any ongoing issues with spontaneous combustion. Although considered a low risk, controls will be implemented to reduce the potential for spontaneous combustion outbreaks and will include:

- Identifying and selectively managing waste material susceptible to spontaneous combustion;
- Minimising unplanned coal losses in overburden emplacement areas;
- Maintaining overburden lift heights up to a maximum of 20 metres to increase stability and compaction of the emplacement area;
- Selectively placing carbonaceous material in active dumps where it can be rapidly buried;
- Rapidly and effectively burying carbonaceous material; and
- Not exposing loose sulphurous and carbonaceous material for periods of time that allows heating.

### 4.2.12 Acid Mine Drainage

Acid mine drainage is managed through ~~Rio Tinto Environmental Performance Standard *E13 Chemically reactive mineral waste control* and Coal & Allied Environmental Procedure12.1 – *Acid Mine Drainage Prevention and Control*. MTW also has in place an~~ MTW's Acid Rock Drainage and Mineral Waste Management Plan.

Mineral wastes may pose an environmental risk because of acid drainage, however the potential for acid drainage at MTW is considered low as supported by the findings of an independent review conducted in 2005 (GEM, 2005).

Further testing of overburden and interburden intervals has been conducted between 2008 and 2016 and the results have confirmed that the spoil being mined at MTW is non-acid forming. No further sampling and testing of spoil for ARD potential is planned to occur at MTW given mining will continue in current overburden and interburden intervals that have been tested.

### 4.2.13 Contaminated Land

~~Land contamination is managed through Rio Tinto *Environment Standard E15 Hazardous materials and non-mineral waste control* and Coal & Allied *Environmental Procedure 13.1 – Site Contamination Prevention and Control* and *6.1 – Waste Management Non Mineral*.~~

In contaminated or polluted land, the contaminated soil/material is removed to the designated bioremediation areas, which are maintained and monitored. Stringent planning and management of this mining operation will avoid any contamination or pollution of the land being mined. A Contaminated Sites Register is used to record and ensure follow up of any contamination that occurs on site.

Prior to the cessation of mining activities in the MOP disturbance area, an assessment will be undertaken to determine whether potential contamination issues exist and remediation is required.

### 4.2.14 Bushfire

Bushfire management is undertaken in accordance with the MTW Bushfire Management Plan. The Bushfire Management Plan was last updated in ~~June 2015~~ October 2017 in consultation with SSC and the NSW Rural Fire Services (RFS).

The following controls may be implemented to control the risk associated with bushfire:

- controls, including mowing, slashing, ploughing, flailing and manual removal as required to reduce fuel loads and fire risk in peak seasons;
- grazing licences have been established to allow strategic grazing in rehabilitation areas and other on-site areas to reduce fuel loads;
- fuel reduction requirements will be assessed in consultation with the NSW RFS;
- establishment and maintenance of fire breaks, including around critical infrastructure;
- maintenance of rescue truck and water carts to be available in the event of fires; and

- periodic review, testing and training of relevant personnel in the site Emergency Response Procedure.

#### 4.2.15 Mine Subsidence

No subsidence impacts will occur as a result of the operations, as all current and proposed mining operations at MTW are open cut.

#### 4.2.16 Methane Drainage / Venting

Not applicable to MTW which only includes open cut operations.

#### 4.2.17 Public Safety

Public safety at MTW is managed primarily through the implementation of ~~Coal and Allied~~ MTW safety standards and daily security inspections. Fencing, signposting, restricted access areas, and locked external gates form part of the safety measures to ensure the safety of the public. These measures are implemented according to the mines safety standards and procedures and include audit, inspection, testing and reporting systems.

There is no public access from the mine entrance to pit areas, as part of the restraints to public access, and measures of public safety. It is standard procedure that no blasting occurs within 500m of any public road, unless it is temporarily closed to public access and that should visibility or traffic safety on any public road be compromised by dust, that mining in the area would cease until safe to resume.

All visitors and inducted contractors are required to undertake a visitors induction at the time of sign-in prior to entering the mine site and where necessary will be accompanied by an inducted mine employee.

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# 5.0 Post Mining Land Use

## 5.1 Regulatory Requirements

The regulatory requirements specific to post mining land-use and rehabilitation outcomes at MTW are summarised in Table 25.

Schedule 3 Condition 36 of the Warkworth Project Approval (SDD-6464) requires the preparation of a Biodiversity Management Plan to outline management measures that will be undertaken to: implement the Biodiversity Offsets Strategy outlined in the Warkworth continuation 2014 EIS; and conserve and enhance vegetation and fauna habitat within BA's and within the Project site. The Biodiversity Management Plan is structured to form a directory to all relevant biodiversity management activities that are detailed for BA's and on operational land in the Offset Management Plans and in this MOP, respectively.

Project approval DA 300_09_0202 Mod 6 (January 2014) required the preparation and implementation of an accelerated progressive rehabilitation program for the South Pit area of Warkworth Mine. In response to this requirement, the Accelerated Rehabilitation Plan – Warkworth South Pit was submitted to DP&E and approved in July 2014. The Accelerated Rehabilitation Plan – Warkworth South Pit has been included in this document as Appendix C. A comparison of the planned rehab progression in the Accelerated Rehabilitation Plan versus the MOP rehabilitation forecasts for South Pit area are presented in Section 7.2.4.

**Table 25 Regulatory requirements – Post mining land use**

<table>
<tr><th>Section / Condition</th><th>Area</th><th>Requirement</th></tr>
<tr><td colspan="3">SSD-6464</td></tr>
<tr><td>Schedule 3 Condition 29</td><td>Rehabilitation Offsets</td><td>Within 10 years of the completion of mining operations under this consent, the Applicant shall retire ecosystem credits of a number and class specified in Table 11 to the satisfaction of OEH.<br>Table 11: Ecosystem Credit Requirements.
<table>
<tr><th>Vegetation Community</th><th>Code (BVT)</th><th>Biometric Vegetation Type</th><th>Area (ha)</th><th>Endangered Ecological Community (EEC)</th><th>[a]Credits Required</th></tr>
<tr><td>Central Hunter Grey Box - Ironbark Woodland</td><td>HU817</td><td>Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter</td><td>2,100</td><td>Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC</td><td>11,204</td></tr>
</table>
Note:<br>• [a] Or as otherwise determined by OEH as part of its detailed consideration of credits retirement.<br><br>The retirement of these credits must be carried out in accordance with the NSW Biodiversity Offsets Policy for Major Projects and can be achieved by:<br>(a) retiring credits generated by mine rehabilitation;<br>(b) acquiring or retiring credits under the Biobanking Scheme in the TSC Act;<br>(c) making payments into an offset fund that has been developed by the NSW Government; or<br>(d) providing supplementary measures.</td></tr>
<tr><td>Schedule 4 Condition 56</td><td>Rehabilitation Areas</td><td>The Applicant shall rehabilitate the site to the satisfaction of the DRE. This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in the EIS (and depicted conceptually in</td></tr>
</table>

<table>
<tr><th>Section / Condition</th><th>Area</th><th>Requirement</th></tr>
<tr><td></td><td></td><td>the figure in Appendix 6), and comply with the objectives in Table 13.<br>Table 13: Rehabilitation objectives
<table>
<tr><th>Feature</th><th>Objective</th></tr>
<tr><td>Mine site (as a whole)</td><td>• Safe, stable and non-polluting<br>• Materials (including topsoils, substrates and seeds of the disturbed areas) are recovered, appropriately managed and used effectively as resources in the rehabilitation of the site<br>• Final landforms to:<br>○ sustain the intended land use for the post-mining domains;<br>○ be designed to minimise the visual impacts of the development;<br>○ be in keeping with the natural terrain features of the area;<br>○ be integrated with the rehabilitated landforms of surrounding mines;<br>○ backfill the gap between the two main emplacements in accordance with the dozer (and dragline) option shown on the applicable figure in Appendix 6;<br>○ incorporate micro-relief; and<br>○ incorporate drainage lines consistent with topography and natural drainage where reasonable and feasible</td></tr>
<tr><td>Water quality</td><td>• Water retained on site is fit for the intended land use(s) for the post-mining domains<br>• Water discharged from site is consistent with the baseline ecological, hydrological and geomorphic conditions of the creeks prior to mining disturbance<br>• Water management is consistent with the applicable regional catchment strategy</td></tr>
<tr><td>Final voids</td><td>• Designed as long term groundwater sinks and to maximise groundwater flows across back-filled pits to the final void<br>• Minimise:<br>○ the size and depth of final voids<br>○ the drainage catchment of final voids<br>○ any high wall instability risk<br>• risk of flood interaction for all flood events up to and including the 1% AEP</td></tr>
<tr><td>Biodiversity</td><td>• Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprising local plant species<br>• Vegetation to be established, with the restoration of at least 1,617 hectares of Central Hunter Grey Box – Ironbark Woodland EEC<br>• Size, location and species of native tree lots and corridors are established to sustain biodiversity habitats<br>• Species are selected that re-establishes and complements regional and local biodiversity</td></tr>
<tr><td>Surface infrastructure</td><td>• To be decommissioned and removed, unless the DRE agrees otherwise</td></tr>
<tr><td>Agriculture</td><td>• Land capability classification for the relevant nominated agricultural pursuit for each domain is established and self-sustaining within 5 years of land use establishment (first planting vegetation)</td></tr>
<tr><td>Community</td><td>• Ensure public safety<br>• Minimise the adverse socio-economic effects associated with mine closure</td></tr>
</table></td></tr>
<tr><td>Schedule 3 Condition 57</td><td>Rehabilitation Areas</td><td>The Applicant shall rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim rehabilitation strategies shall be employed when areas prone to dust generation cannot yet be permanently rehabilitated.<br>Note: it is accepted that parts of the site that are progressively rehabilitated may be subject to further disturbance at some later stage of the development.</td></tr>
</table>

| Section / Condition | Area | Requirement |
|---|---|---|
| Schedule 4 Condition 70 | Rehabilitation Areas | The Applicant shall prepare a Rehabilitation Management Plan for the development to the satisfaction of the DRE, and carry out the development in accordance with this plan. The plan must:<br>(a) be prepared in consultation with the Department, NOW, OEH, Council and the CCC;<br>(b) be prepared in accordance with any relevant DRE guideline, including any existing NSW government policy regarding final voids;<br>(c) be submitted to the DRE for approval prior to carrying out any development under this consent;<br>(d) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary);<br>(e) describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including timeframes for achieving specified rehabilitation objectives;<br>(f) includes a mine closure strategy, that details measures to minimise the long term impacts associated with mine closure, including final landform and final voids, final land use and socioeconomic issues;<br>(g) include interim rehabilitation where necessary to minimise the area exposed for dust generation;<br>(h) include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and<br>(i) build to the maximum extent practicable on the other management plans required under this consent. |
| **SSD-6465** | | |
| Schedule 3 Condition 34 | Rehabilitation Areas | The Applicant shall rehabilitate the site to the satisfaction of the DRE. This rehabilitation must be<br>generally consistent with the proposed rehabilitation strategy described in the EIS (and depicted<br>conceptually in the figure in Appendix 5), and comply with the objectives in Table 9. |

<table>
<tr><th>Section / Condition</th><th>Area</th><th>Requirement</th></tr>
<tr><td></td><td></td><td>
Table 9: Rehabilitation objectives
<table>
<tr><th>Feature</th><th>Objective</th></tr>
<tr><td>Mine site (as a whole)</td><td>• Safe, stable and non-polluting<br>• Materials (including topsoils, substrates and seeds of the disturbed areas) are recovered, appropriately managed and used effectively as resources in the rehabilitation of the site<br>• Final landforms to:<br>o sustain the intended land use for the post-mining domains;<br>o be designed to minimise the visual impacts of the development;<br>o be in keeping with the natural terrain features of the area;<br>o be integrated with the rehabilitated landforms of surrounding mines;<br>o incorporate micro-relief; and<br>o incorporate drainage lines consistent with topography and natural drainage where reasonable and feasible</td></tr>
<tr><td>Water quality</td><td>• Water retained on site is fit for the intended land use(s) for the post-mining domains<br>• Water discharged from site is consistent with the baseline ecological, hydrological and geomorphic conditions of the creeks prior to mining disturbance<br>• Water management is consistent with the applicable regional catchment strategy</td></tr>
<tr><th>Feature</th><th>Objective</th></tr>
<tr><td>Biodiversity</td><td>• Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprising local plant species<br>• Vegetation to be established with at least 483 ha of Central Hunter Grey Box - Ironbark Woodland EEC<br>• Size, location and species of native tree lots and corridors are established to sustain biodiversity habitats<br>• Species are selected that re-establishes and complements regional and local biodiversity</td></tr>
<tr><td>Surface infrastructure</td><td>• To be decommissioned and removed, unless the DRE agrees otherwise</td></tr>
<tr><td>Agriculture</td><td>• Land capability classification for the relevant nominated agricultural pursuit for each domain is established and self-sustaining within 5 years of land use establishment (first planting vegetation)</td></tr>
<tr><td>Community</td><td>• Ensure public safety<br>• Minimise the adverse socio-economic effects associated with mine closure</td></tr>
</table>
</td></tr>
<tr><td>Schedule 3 Condition 35</td><td>Rehabilitation Areas</td><td>The Applicant shall rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim rehabilitation strategies shall be employed when areas prone to dust generation cannot yet be permanently rehabilitated.<br><br>Note: It is accepted that some parts of the site that are progressively rehabilitated may be subject to further disturbance at some later stage of the development.</td></tr>
<tr><td>Schedule 3 Condition 36</td><td>Rehabilitation Areas</td><td>The applicant shall prepare and implement a Rehabilitation Management Plan for the development to the satisfaction of the DRE, and carry out the development in accordance with this plan. The plan must:<br><br>a) Be submitted to the DRE for approval prior to carrying out any development under this consent;<br><br>b) be prepared in consultation with the Department, NOW, OEH, Council and the CCC:<br><br>c) Be prepared in accordance with any relevant DRE guideline, including any existing NSW government policy regarding voids ;</td></tr>
</table>

| Section / Condition | Area | Requirement |
|---|---|---|
| | | d) describe how the rehabilitation of the site would be integrated with the implementation the biodiversity offset strategy;<br>e) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary);<br>f) Describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including timeframes for achieving specified rehabilitation objectives;<br>g) include a mine closure strategy, that details measures to minimise the long term impacts associated with mine closure, including final landform, final land use and socio-economic issues;<br>h) Include interim rehabilitation where necessary to minimise the area exposed for dust generation;<br>i) Include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and<br>j) build to the maximum extent practicable on the other management plans required under this consent. |
| | | |
| **EPBC 2009/5081** | | |
| Condition 11 | Rehabilitation Areas | The person taking the action must, within 12 months of the commencement of Construction of Phase 1, and within 12 months of the Commencement of Construction of Phase 2, submit to the Minister for approval a Mine Site Rehabilitation Plan (MSRP) for the progressive rehabilitation and revegetation of no less than 32ha woodland of mined areas for Phase 1 and 2,303ha of woodland habitat on mined areas for Phase 2. The MSRP must include, at a minimum the following information:<br>a. the desired outcomes/objectives of implementing the MSRP<br>b. details of the vegetation communities to be rehabilitated and the timing of progressive rehabilitation<br>c. a process to progressively report to the department the rehabilitation management actions undertaken and the outcome of those actions, and the mechanisms to be used to identify the need for improved management<br>d. a description of the potential risks to successful management and rehabilitation on the project site, and a description of the contingency measures that would be implemented to mitigate these risks<br>e. details of parties responsible for reviewing and implementing the plan |

| Section / Condition | Area | Requirement |
|---|---|---|
| | | f. details of long term management and protection of the mine site<br>The approved MSRP must be implemented. |
| **CL 219, CCL 753, and ML1547** | | |
| Condition 21 | Coal Lease area | If so directed by the Minister the lease holder shall rehabilitate to the satisfaction of the Minister any lands within the subject area which may have been disturbed by the lease holder. |
| Condition 22 | Coal Lease area | Upon completion of operations on the surface of the subject area or upon the expiry or sooner determination of this authority or any renewal thereof, the lease holder shall remove from such surface such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. |
| Condition 23 | Coal Lease area | If so directed by the Minister the lease holder shall rehabilitate to the satisfaction of the Minister and within such time as may be allowed by the Minister any lands within the subject area which may have been disturbed by mining or prospecting operations whether such operations were or were not carried out by the lease holder. |
| **ML1412** | | |
| Condition 22 | Coal Lease area | If so directed by the Minister the lease holder shall rehabilitate to the satisfaction of the Minister any lands within the subject area which may have been disturbed by the lease holder. |
| Condition 23 | Coal Lease area | Upon completion of operations on the surface of the subject area or upon the expiry or sooner determination of this authority or any renewal thereof, the lease holder shall remove from such surface such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. |
| Condition 24 | Coal Lease area | If so directed by the Minister the lease holder shall rehabilitate to the satisfaction of the Minister and within such time as may be allowed by the Minister any lands within the subject area which may have been disturbed by mining or prospecting operations whether such operations were or were not carried out by the lease holder. |
| **ML1590** | | |
| Condition 13 | Coal Lease area | Land disturbed must be rehabilitated to a stable and permanent form suitable for a subsequent land use acceptable to the Director-General and in accordance with the Mining Operations Plan so that:<br>• there is no adverse environmental effect outside the disturbed area and that the land is properly drained and protected from soil erosion.<br>• The state of the land is compatible with the surrounding land and land use requirements.<br>• The landforms, soils, hydrology and flora require no greater maintenance than that in the surrounding land.<br>• In cases where revegetation is required and native vegetation has been removed or damaged, the original species must be re- |

| Section / Condition | Area | Requirement |
|---|---|---|
| | | established with close reference to the flora survey included in the Mining Operations Plan. If the original vegetation was not native, any re-established vegetation must be appropriate to the area and at an acceptable density.<br>• The land does not pose a threat to public safety. |
| **ML1751 and ML1752** | | |
| Condition 2 | Coal Lease area | • Any disturbance resulting from the activities carried out under this mining lease must be rehabilitated to the satisfaction of the Minister. |

## 5.2 Post-Mining Land Use Vision

### 5.2.1 Final Landuse

The final land use objectives at MTW aim to integrate the rehabilitation of mining disturbed areas within the surrounding landscape, with multiple outcomes for sustainable agricultural production, conservation and biodiversity. This includes maximising the biodiversity and connectivity within landscape, through improved management of existing remnants and the establishment of a network of vegetation corridors.

Within the final landform, mining infrastructure within the identified disturbance area would be removed if no longer required and the affected lands rehabilitated. This rehabilitation would be consistent with adjacent vegetation communities.

With this vision, the final land uses within MTW will consist of grazing and native woodland for habitat. This is consistent with the pre-mining land use, goals for protection of threatened species and establishment of wildlife corridors in accordance with the strategies outlined in the *Synoptic Plan for Mine Rehabilitation in the Upper Hunter Valley* (Andrews Neil, 1999).

### 5.2.2 Biodiversity Areas

As part of the proposed Warkworth Continuation approximately 459 ha of forest and woodland communities and 152 ha of grassland communities will require clearing. The following woodland vegetation ECCs under the threatened Species Conservation (TSC) Act will be impacted over the life of the 21 year project as a function of the proposed works:

- Central Hunter Grey Box–Ironbark Woodlands EEC – 372 ha;
- Central Hunter Ironbark–Spotted Gum–Grey Box Forest EEC – 15 ha; and
- Warkworth Sands Woodland EEC – 72 ha.

A number of areas of land were identified as suitable offsets for the proposed Warkworth Continuation and were included in the *Warkworth Continuation 2014 – Environmental Impact Statement* (EMM, 2014). Federal government approvals also require WML to establish BAs to offset the impact upon Matters of National Environmental Significance (MNES) by protecting and managing no less than 4,212 ha of habitat for the Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*).

The broad areas designated as BAs and the associated approvals are listed in Table 26.

**Table 26 Biodiversity Area existing woodland and planned re-establishment areas.**

| Biodiversity Area | Environmental Approval | Locality | Area (ha) | Offset Area (ha) | Woodland (ha) | Re-establishment (ha) |
|---|---|---|---|---|---|---|
| Southern | NSW & EPBC Warkworth Mine | Local | 1,023 | 986 | 688 | 299 |
| Buffer area | NSW Warkworth Mine | Local | 518 | - | - | - |
| Northern | NSW & EPBC Warkworth Mine | Local | 345 | 341 | 123 | 218 |
| North Rothbury | NSW & EPBC Warkworth Mine | Regional | 41 | 41 | 41 | - |
| Bowditch | NSW & EPBC Warkworth Mine | Regional | 607 | 602 | 602 | - |
| Goulburn River | NSW & EPBC Warkworth Mine | Regional | 1,439 | 1,066 | 1,029 | 37 |
| Seven Oaks | EPBC Warkworth Mine | Regional | 523 | 522 | 354 | 168 |
| Putty | EPBC Warkworth Mine | Regional | 379 | 378 | 366 | 12 |
| Condon View | EPBC Warkworth Mine | Regional | 442 | 345 | 345 | - |
| **Total – Warkworth Mine** | | | | **4,281** | **3,548** | **734** |
| ~~Goulburn River~~ | ~~NSW HVO South~~ | ~~Regional~~ | ~~Refer Above~~ | ~~140~~ | ~~-~~ | ~~-~~ |
| ~~**Total – HVO South**~~ | | | | ~~**140**~~ | ~~-~~ | ~~-~~ |

The proposed offsets for Warkworth Mine will equate to a total of 4,281 ha in area, including 3,548 ha of woodland and forest communities. Management plans for the offset areas will aim to re-establish an additional 734 ha of woodland and forest communities in existing grassland communities.

~~The project approval for HVO South (PA 06_0261) granted permission to clear 48 hectares (ha) of remnant native vegetation and 92ha of regrowth. To offset this impact 140ha of Narrow-leaved Ironbark Woodland is to be protected in perpetuity. The offset area to satisfy this condition is located within the Goulburn River BA.~~

## 5.3 Project Rehabilitation Objectives

The objectives of the defined management practices and re-establishment programs is to increase the quality of the vegetation, increase the long term fauna habitat and improve ecosystem function and resilience of up to 2,419 ha of land in a landscape presently being utilised for agricultural purposes or without conservation management initiatives.

The primary rehabilitation objectives for areas of post mined lands are listed in Table 27.

**Table 27 Rehabilitation Objectives**

| Feature | Objective | Source |
|---|---|---|
| Mine Site | Safe, stable and non-polluting | SSD-6464 & SSD-6465 |

| Feature | Objective | Source |
|---|---|---|
| | Restore ecosystem function including maintaining or establishing self-sustaining ecosystems comprising local plant species | SSD-6464 & SSD-6465 |
| Water Quality | Water retained on site is fit for the intended land use(s) for the post-mining domains | SSD-6464 & SSD-6465 |
| | Water discharged from site is consistent with the baseline ecological, hydrological and geomorphic conditions of the creeks prior to mining disturbance | SSD-6464 & SSD-6465 |
| | Water management is consistent with the applicable regional catchment strategy | SSD-6464 & SSD-6465 |
| Rehabilitated Materials | Materials (including topsoils, substrates and seeds of the disturbed areas) are recovered, appropriately managed and used effectively as resources in the rehabilitation of the site | SSD-6464 & SSD-6465 |
| Landforms | Final landforms sustain the intended land use for the post-mining domains | SSD-6464 & SSD-6465 |
| | Final landforms designed to minimise the visual impacts of the development | SSD-6464 & SSD-6465 |
| | Final landforms to be in keeping with the natural terrain features of the area and be integrated with the rehabilitated landforms of surrounding mines | SSD-6464 & SSD-6465 |
| | Final landforms to backfill the gap between the two main emplacements in accordance with the dozer (and dragline) option shown on the applicable figure in Appendix 6 | SSD-6464 |
| | Final landforms to incorporate micro-relief and incorporate drainage lines consistent with topography and natural drainage where reasonable and feasible | SSD-6464 & SSD-6465 |
| Final Voids | Designed as long term groundwater sinks and to maximise groundwater flows across back-filled pits to the final void | SSD-6464 |
| | Minimise:<br>• the size and depth of final voids<br>• the drainage catchment of final voids<br>• any high wall instability risk | SSD-6464 |
| | Minimise risk of flood interaction for all flood events up to and including the 1% Annual Exceedance Probability (AEP) | SSD-6464 |
| Surface infrastructure | To be decommissioned and removed, unless the DRE agrees otherwise | SSD-6464 & SSD-6465 |
| Biodiversity | Establish at least 2,100 hectares of Central Hunter Grey Box – Ironbark Woodland EEC | SSD-6464 & SSD-6465 |
| | Establish approximately 319 ha of trees over grass not conforming to any particular community, creating treed corridors to ensure connectivity of woodland community areas | Warkworth Continuation 2014 EIS and Mount Thorley Operations 2014 EIS |
| | Establish 1,423 ha of grassland | Warkworth Continuation 2014 EIS and Mount |

| Feature | Objective | Source |
|---|---|---|
| | | Thorley Operations 2014 EIS |
| | Size, location and species of native tree lots and corridors are established to sustain biodiversity habitats | SSD-6464 & SSD-6465 |
| | Species are selected that re-establishes and complements regional and local biodiversity | SSD-6464 & SSD-6465 |
| | Create an additional north/south wildlife corridor providing connectivity to other habitat | Warkworth Continuation 2014 EIS and Mount Thorley Operations 2014 EIS |
| | Provide additional habitat for threatened fauna species | Warkworth Continuation 2014 EIS and Mount Thorley Operations 2014 EIS |
| Agriculture | Land capability classification for the relevant nominated agricultural pursuit for each domain is established and self-sustaining within 5 years of land use establishment (first planting vegetation) | SSD-6464 & SSD-6465 |
| | Establish some productive grazing on rehabilitated mine land | SSD-6464 & SSD-6465 |
| Community | Ensure public safety | SSD-6464 & SSD-6465 |
| | Minimise the adverse socio-economic effects associated with mine closure | SSD-6464 & SSD-6465 |

# 6.0 Rehabilitation Planning

## 6.1 Scope

The scope of this MOP in terms of rehabilitation planning only covers those lands located within the MOP's disturbance area. The management of BAs will be undertaken under specific Offset Management Plans, and is excluded from the scope of this MOP. On-site measures that are required to support re-establishment activities in BAs, such as seed collecting, topsoil stripping and fauna habitat salvaging, have been included in this MOP.

## 6.2 Domain Selection

Primary domains can be defined as land management units within the mine site, usually with unique operational and functional purpose and therefore similar geophysical characteristics. Secondary domains are land management units characterised by a similar post mining land use objective.

It is likely that most domains will require a different rehabilitation methodology to achieve the intended post-mining land use. Domains for MTW have been determined in consideration of the specific requirements of the mining location and local environment. The key domains for MTW at the commencement of the MOP as shown in **Map 2** are outlined in Table 28.

**Table 28 Primary and Secondary Domains**

| Primary Domains | Code | Secondary Domains | Code |
|---|---|---|---|
| Final Void | 1 | Final Void | A |
| Water Management Area | 2 | Water Management Area | B |
| Infrastructure Area | 3 | Rehabilitation Area – Grassland | C |
| Tailings Storage Facility | 4 | Rehabilitation Area – Woodland Other | D |
| Overburden Emplacement | 5 | Rehabilitation Area – Woodland EEC | E |

Further information on these domains and the key issues that pertain to their management is provided in the following sections.

### 6.2.1 Infrastructure Area

Existing and proposed infrastructure at MTW are detailed in Section 2.9. MTW currently contains two sets of surface facilities, CPPs and coal stockpile areas, located in the north and south areas, respectively.

### 6.2.2 Tailings Storage Facility

Tailings Storage Facility's (TSFs) are dams or voids to which fine coal rejects from the CPPs are disposed of for settlement and decantation. There are currently six TSFs within the MTW site, with only the CRTSF and AGSTSF being active. New TSFs are constructed or activated as the mine progresses. Refer to Section 2.8.3 for further detail on existing and future TSFs.

### 6.2.3 Water Management Area

A Water Management Area includes components of the network of dams that compose the MTW water management system that is in place to control the movement of water around the site. These include sedimentation, diversion, mine water and water supply dams but exclude TSF's.

### 6.2.4 Overburden Emplacement

Overburden is produced and disposed of within mined out sections of the open cut to create a final landform or designated out of pit emplacement area. Overburden material may be transferred from north to south areas to assist in the creation of the final landform. The placement of overburden occurs with the mine plans for the various MTW pits. Refer to Section 2.5.1 for further details.

### 6.2.5 Final Void

A Final Void is the remnant open pit left at mine closure. A single final void in North and West pits is planned to remain in place at completion of mining.

### 6.2.6 Rehabilitation Areas

The rehabilitation program aims to focus on the progressive rehabilitation of the Central Hunter Grey Box – Ironbark woodlands and derived grasslands on the major overburden emplacements. The rehabilitated lands are divided into:

- Rehabilitation Area – Grassland - grassland communities with a native component on the residual disturbed mining areas;
- Rehabilitation Area – Woodland Other - woodland trees and shrubs within pasture areas, but not necessarily conforming to any particular vegetation community; and
- Rehabilitation Area – Woodland EEC - re-creating Central Hunter Grey Box - Ironbark Woodland EEC and Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC communities.

## 6.3 Domain Rehabilitation Objectives

The rehabilitation objectives for the domains identified in Section 6.2 are defined in Table 29.

**Table 29 Domain Rehabilitation Objectives**

| Domain | Rehabilitation Objective |
|---|---|
| **Primary Domains** | |
| Final Void | Final voids will be used for water storage post-mining. The objective is for the final voids to be safe, stable and non-polluting.<br>So far as is reasonable and feasible, final voids will be designed and constructed to:<br>• minimise the size and depth of final voids;<br>• minimise the drainage catchment of final voids;<br>• minimise high wall instability risk;<br>• maximise groundwater flows across back-filled pits to the void, having regard to their function as long-term groundwater sinks; and<br>• minimise risk of flood interaction for all flood events up to and including the 1% AEP. |
| Water Management Area | The drainage pattern of the final landform will be designed to integrate with the surrounding catchments and will be revegetated to achieve long term stability and erosion control and will be integrated into the final landform and revegetation strategy.<br>Water retained on site is fit for the intended land use.<br>Water quality leaving site is to be in accordance with the EPL water quality criteria.<br>The objective is for the water management areas to be safe, stable and non-polluting. |
| Infrastructure Area | Mining infrastructure within the identified disturbance area will be removed if no longer required and the affected lands rehabilitated.<br>The objective is for the infrastructure areas to be safe, stable and non-polluting. |
| Tailing Storage Facility | Rehabilitated TSFs will be integrated into the final landform and revegetation strategy.<br>The objective is for the tailings storage facility areas to be safe, stable and non-polluting. |
| Overburden Emplacement | Rehabilitated overburden emplacements will be undulating, free draining landforms capable of sustaining the intended land use.<br>Final landforms will incorporate micro-relief and drainage lines consistent with existing topography and natural drainage. |

| Domain | Rehabilitation Objective |
|---|---|
| | The objective is for the overburden emplacement areas to be safe, stable and non-polluting. |
| **Secondary Domains** | |
| Final Void | As per Primary Domain. |
| Water Management Area | As per Primary Domain. |
| Rehabilitation Area – Grassland | Recreating 1,423 ha grassland communities with a native component on the residual disturbed mining areas. |
| Rehabilitation Area – Woodland Other | • Establishing approximately 319 ha of trees and shrubs over grassland areas, but not necessarily conforming to any particular vegetation community.<br>• Establishing a network of tree corridors to ensure connectivity of woodland community areas.<br>• Provide additional habitat for threatened species. |
| Rehabilitation Area – Woodland EEC | • Re-creating approximately 2,100 ha of EEC woodland communities to a standard comparable to similar reference EEC communities.<br>• Establishing a network of tree corridors to ensure connectivity of woodland community areas.<br>• Provide additional habitat for threatened species. |

## 6.4 Performance Criteria, Measures and Indicators

The performance criteria, measures and associated indicators have been developed in accordance with the range of project related documentation i.e. EIS (EMGA Mitchell McLennan (2014a) & EMGA Mitchell McLennan (2014b)), Director General's Report and the Project Approvals. The performance or completion criteria are objective target levels or values that can be measured to quantitatively demonstrate the progress and ultimate success of a biophysical process. These criteria have been developed for each phase of the rehabilitation so that the rehabilitation success can be quantitatively tracked throughout the life of the mine.

The performance measures quantify the rehabilitation and land management program in terms of efficiency or effectiveness and establish the indicative timeframes for completion. The performance indicators are used to define and evaluate the program, typically in terms of making progress towards the development of sustainable ecosystems whilst also providing a framework for the implementation of key activities. These indicators provide the basis for the procedural context of the site work practices. The performance indicators are attributes of the biophysical environment e.g. pH, slope; that can be used to approximate the progression of a biophysical process and can be measured to demonstrate and track the progress of an aspect of rehabilitation towards a desired completion criteria (NSW Trade & Investment September 2013).

The criteria, measures and indicators which provide the framework for this MOP are underpinned by a range of documents which relate to land management. These include industry standards/guidelines, research reports and monitoring reports. The ongoing development of these documents will provide the basis for the review of this MOP with resultant amendments being recorded in documents such as the MTW AER.

There is an element of risk attached to the development of completion or performance criteria, in that it is impossible to predict all of the variables that might influence the recovery or otherwise of those lands which are rehabilitated post mining. Many variables operate at catchment or regional scales, such as river flows and pest outbreaks. Other factors that operate at continental or even global scales, such as climatic influences (including droughts or floods brought about by La Niña and El Niño events), could significantly influence the long-term sustainability of the vegetated lands encompassed by Mt Thorley Warkworth. To this end, the performance measures and associated indicators have been designed to provide an appropriate benchmark or guide against which to assess the management of project lands and the resulting improvements.

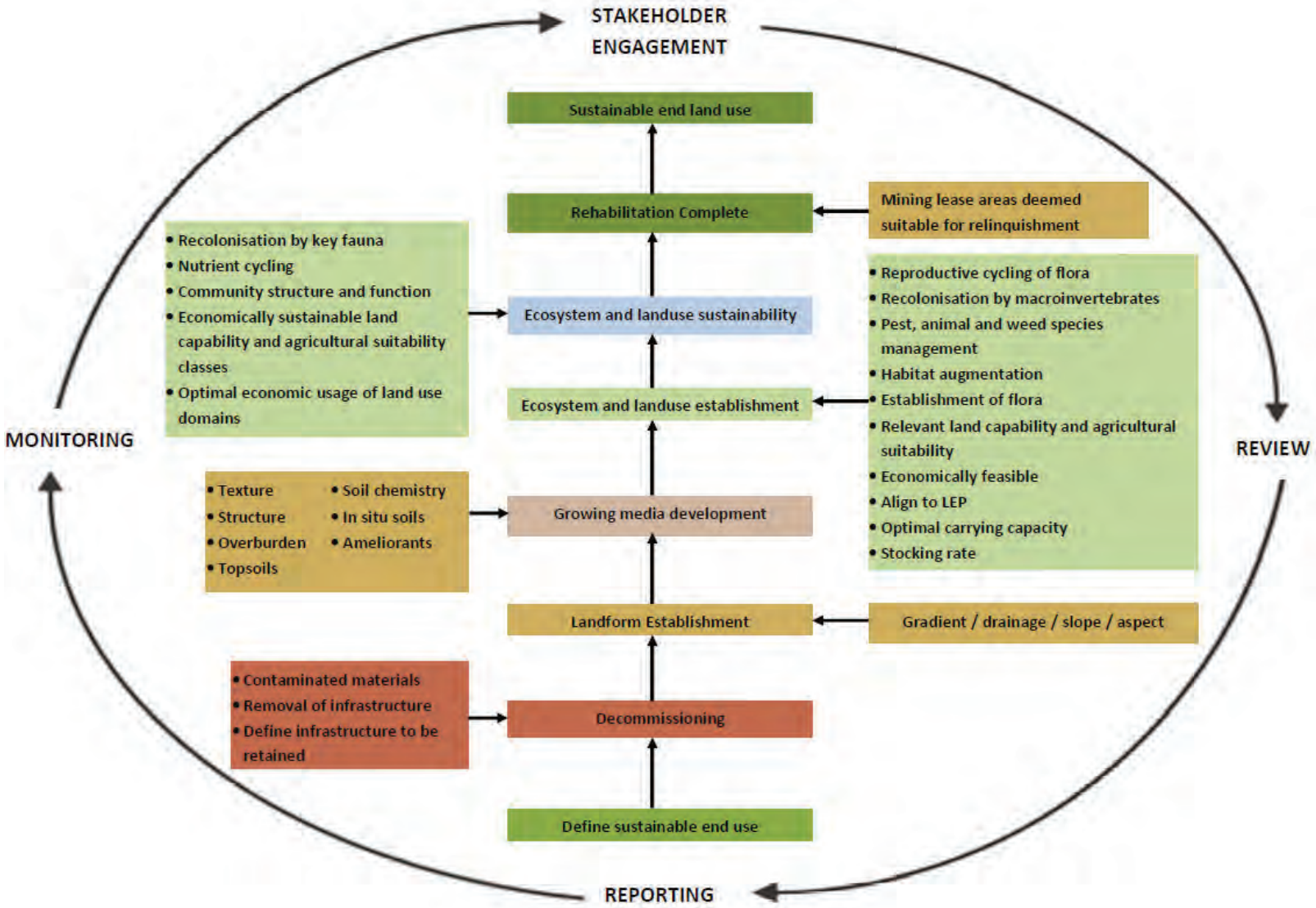
The performance measures and indicators in this MOP are designed to form the basis of the Performance Criteria and provide the ability to track the development of sustainable ecosystems through a series of conceptual stages which are presented in Section 6.5.

## 6.5 Rehabilitation Phases

The ultimate rehabilitation objective for MTW is the development of sustainable ecosystems across the site and in connection with the surrounding landscape. This will be achieved through a series of conceptual stages which are shown diagrammatically in Figure 1 and described as:

- Stage 1: Decommissioning – removal of hard stand areas, buildings, contaminated materials, hazardous materials;
- Stage 2: Landform Establishment – incorporates gradient, slope, aspect, drainage, substrate material characterisation and morphology;
- Stage 3: Growing Media Development – incorporates physical, chemical and biological components of the growing media and ameliorants that are using to optimise the potential of the media in terms of the preferred vegetative cover;
- Stage 4: Ecosystem and Landuse Establishment – incorporates revegetated lands and habitat augmentation; species selection, species presence and growth together with weed and pest animal control / management and establishment of flora; and
- Stage 5: Ecosystem and Landuse Sustainability – incorporates components of floristic structure, nutrient cycling recruitment and recovery, community structure and function which are the key elements of a sustainable landscape.
- Stage 6 – Rehabilitation Complete – landuse and landscape is deemed as suitable to be relinquished from the Mining Lease.

**Figure 1 Conceptual Stages of Sustainable Ecosystem Development**



## 6.6 Decommissioning

In the context of this MOP, decommissioning is the formal process to remove some facet of the mining operation from its active status. The Criteria, Performance Measures and Indicators together with the justification source for this data as it relates to the decommissioning stage are provided in Table 30.

It should be noted that this phase will particularly apply to those domains where the risk of hazardous materials may exist and as such may not apply to some of the domains.

**Table 30 Decommissioning**

| Objective | Performance Indicator | Performance Criteria | Justification/ Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| **Infrastructure Areas** | | | | | |
| Mining infrastructure within the identified disturbance area will be removed if no longer required and the affected lands rehabilitated.<br>The objective is for the infrastructure areas to be safe, stable and non-polluting. | Removal of infrastructure | All buildings, fixed plant and other infrastructure that is not required as part of the post-closure land use will be demolished and removed from the site. | ~~Coal & Allied Environmental Procedure *4.1 – Closure Planning Guidelines*~~<br>~~Coal & Allied Environmental Procedure *13.1 – Site Contamination Prevention and Control*~~<br>~~Rio Tinto Environmental Performance Standard *E15 - Hazardous materials and non-mineral waste control*~~<br>*Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS*<br>CL 219, CCL 753, ML 1412, ML 1547, ML 1590, ML 1751, ML 1752 | | Still in use |
| | Disconnect and terminate services | All redundant services disconnected and terminated. | | | Still in use |
| | Remediation of contaminated soils. | All contaminated soils removed from site or remediated to acceptable contamination levels. | | | Ongoing |
| **Tailing Storage Facility** | | | | | |
| The objective is for the tailings storage facility | Removal of pipelines and pumps and related tailings infrastructure. | All pipelines and pumps and related tailings infrastructure removed from the site. | ~~Coal & Allied Environmental Procedure *4.1 –*~~ | | Completed for TD1 and Eastern TD |

| Objective | Performance Indicator | Performance Criteria | Justification/ Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| areas to be safe, stable and non-polluting. | Remediation of contaminated soils. | All contaminated soils removed from site or remediated to acceptable contamination levels. | ~~*Closure Planning Guidelines*~~<br>~~Coal & Allied Environmental Procedure *13.1 – Site Contamination Prevention and Control*~~<br>~~Rio Tinto Environmental Performance Standard *E15 - Hazardous materials and non-mineral waste control*~~<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS<br>CL 219, CCL 753, ML 1412, ML 1547, ML 1590, ML 1751, ML 1752 | | Ongoing |
| **Water Management Area** | | | | | |
| The drainage pattern of the final landform will be designed to integrate with the surrounding catchments and will be revegetated to achieve long term stability and erosion control and will be integrated into the final landform and revegetation strategy. | Removal of excess sediment. | Removal of excess sediment from the surface dams for future use by the subsequent land owner or alternatively filling the dams if they are no longer required. | ~~Rio Tinto Environmental Performance Standard *E11 - Water quality protection*~~<br>~~Coal & Allied Environmental Procedure *7.2 – Water Management*~~<br>'Blue Book': Managing Urban Stormwater: soils and construction | | Not yet required |
| | Dam reshaping as required. | Re-shaping dams (where required) in accordance with their intended use, this may involve re-sizing, facilitating cattle access or reshaping to enhance habitat functionality for specific fauna species. | | | Not yet required |

| Objective | Performance Indicator | Performance Criteria | Justification/ Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| Water retained on site is fit for the intended land use.<br>Water quality leaving site to be in accordance with the EPL water quality criteria.<br>The objective is for the water management areas to be safe, stable and non-polluting. | Retained water management. | Where dams are to be retained, ensure that drainage structures are designed to capture runoff from sufficient catchment area so that the dam can be utilised for its intended use. | (Volume 1 and 2E – Mines and Quarries)<br>Mine Rehabilitation Handbook (Australian Mining Industry Council 1990)<br>Mine Rehabilitation (Hannan 1995) | | Not yet required |
| | Erosion and sediment controls installed | The installation of appropriate sediment and erosion control measures. | | | Ongoing |
| **Final Void** | | | | | |
| The objective is for the final voids to be safe, stable and non-polluting. | Removal of pipelines and pumps and related pit infrastructure. | All pipelines and pumps and related pit infrastructure removed from the site. | ~~Coal & Allied Environmental Procedure *4.1 – Closure Planning Guidelines*~~<br>~~Coal & Allied Environmental Procedure *13.1 – Site Contamination Prevention and Control*~~<br>~~Rio Tinto Environmental Performance Standard *E15 - Hazardous materials and non-mineral waste control*~~<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS<br>CL 219, CCL 753, ML 1412, ML 1547, ML | | Not yet required |
| | Remediation of contaminated soils. | All contaminated soils removed from site or remediated to acceptable contamination levels. | | | Not yet required |

| Objective | Performance Indicator | Performance Criteria | Justification/ Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| | | | 1590, ML 1751, ML 1752 | | |

## 6.7 Landform Establishment

In the context of this MOP, Landform Establishment are the processes involved to achieve stable landforms including slopes, erosion controls, and drainage lines with integrated landscape features, which are compatible with surrounding landforms, whilst also ensuing that the rehabilitated areas of native vegetation link with undisturbed native vegetation.

The final landform presented in this MOP Amendment has been designed using a geomorphological landform design approach based on alluvial analogues (see Figure 2,

Figure 3 and
Figure 4 below). This means utilising the appropriate characteristics of stable natural alluvial landforms for the design of landforms to be constructed in mining overburden. The overall objective of the landform is to be safe and stable. This will be evaluated using the principle of having no greater management requirements than other land with similar geographical conditions and land use. In terms of erodibility of the landform, it is envisaged that any rilling or gullying that may develop should be "minor" and "minimal", that is, not significantly different to what might be found on similar landforms in the local area.

In practical terms, the performance criteria will be assessed as follows:

- The initial design uses the relationship between catchment area and slope (raised to the factor of 1.5) to compile a Topography Factor (TF). This TF computation is a useful method of assessing erosion risk, but is indicative only since it does not include detailed sediment transport analyses.
- From analyses in the general area and on other sites in the local area, it is expected that areas with various topography factors set out in **Table 1** will require the surface treatments indicated to limit the erosion risk both prior to vegetation establishing and post re-vegetation.

**Table 31 Surface treatment recommendations based on Topography Factor (TF) values.**

| Topography Factor (TF) | Proposed Surface Treatments | Comments |
|---|---|---|
| <20 | Revegetate | Equates to the erosion risk for the overland flow on the current 10m high lifts for the 1v:6h slopes with contour banks. Assumes infiltration rates on bare soil of around 20 to 25mm/hr achieved through surface treatments such as ripping or roughening. Stable once vegetated. |
| 20 < TF < 50 | Revegetate | On most sites in the local area and for most soils, experience indicates limited risk of rilling prior to vegetation establishing unless very erodible soils. Assumes infiltration rates on bare soil of around 20 to 25mm/hr achieved through surface treatments such as ripping or roughening. Stable once vegetated. |
| 50 < TF < 150 | Revegetate but potentially with use of heavy mulch, gravels, or other stabilisers. | Potential for some rilling prior to re-vegetation. Possible use of mulch / gravels / other alternatives for higher risk areas. Some hydromulch techniques offer higher levels of protection. Expected to be stable once vegetated. |
| 150 < TF < 450 | Revegetate but incorporate gravels where necessary. | These values are typically confined to creek lines and represent areas where rilling tends to be limited once vegetation is established but are high risk prior to re-vegetation with some risk of erosion even with vegetation. |
| >450 | Rock Armouring | Drainage lines with the need for rock armouring both in the short to long term. |

Because the erosion risk reduces significantly once vegetation is established, the extent of erosion and/ or rilling on the pre-vegetated surface can and will be used to monitor the values given in Table 31, with the expectation that the values in Table 31 may change both due to additional data obtained during the operational phase and due to variations in the soils used in rehabilitation process. Importantly, the landform design work aims to limit the TF values for areas outside of the drainage lines to generally less than 50, although localised areas in the range of 50 to 150 may occur.
The use of TF as set out above should not be seen as precluding other evaluation methods such as tractive stresses or other indicators, nor the potential use of erosion models or other tools to validate the long-term erosion risk.

Figure 2 3D Representation of Warkworth North Pit Final Landform Incorporating Micro-Relief and Natural Drainage Lines

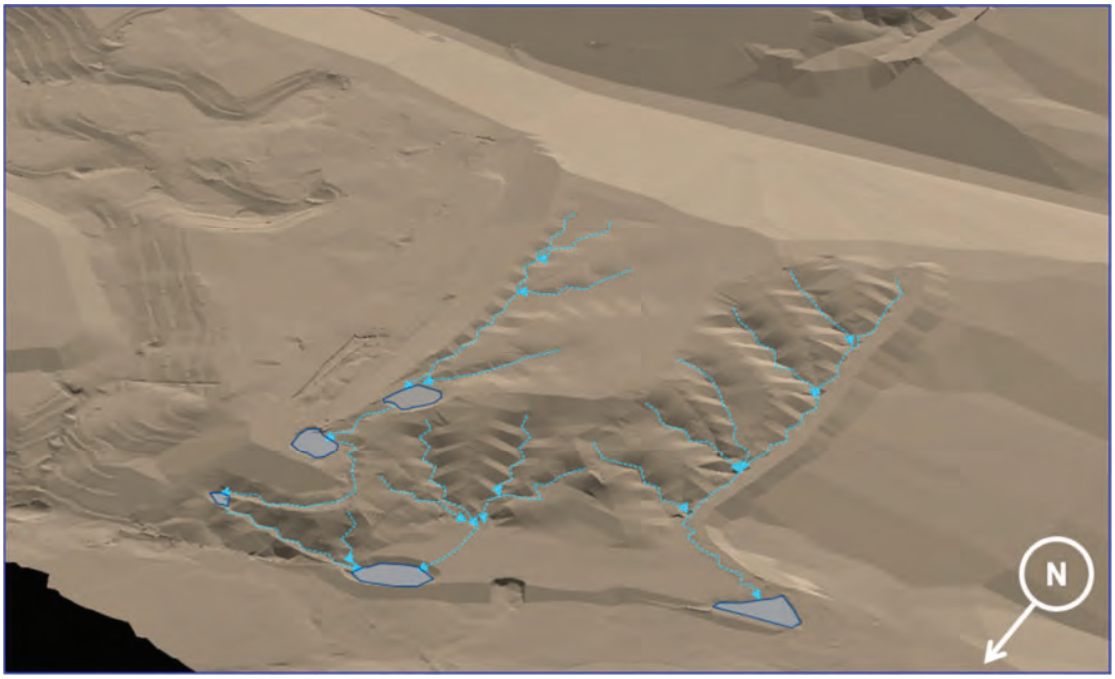


Figure 3 3D Representation of Warkworth West and South Pit Final Landform Incorporating Micro-Relief and Natural Drainage Lines

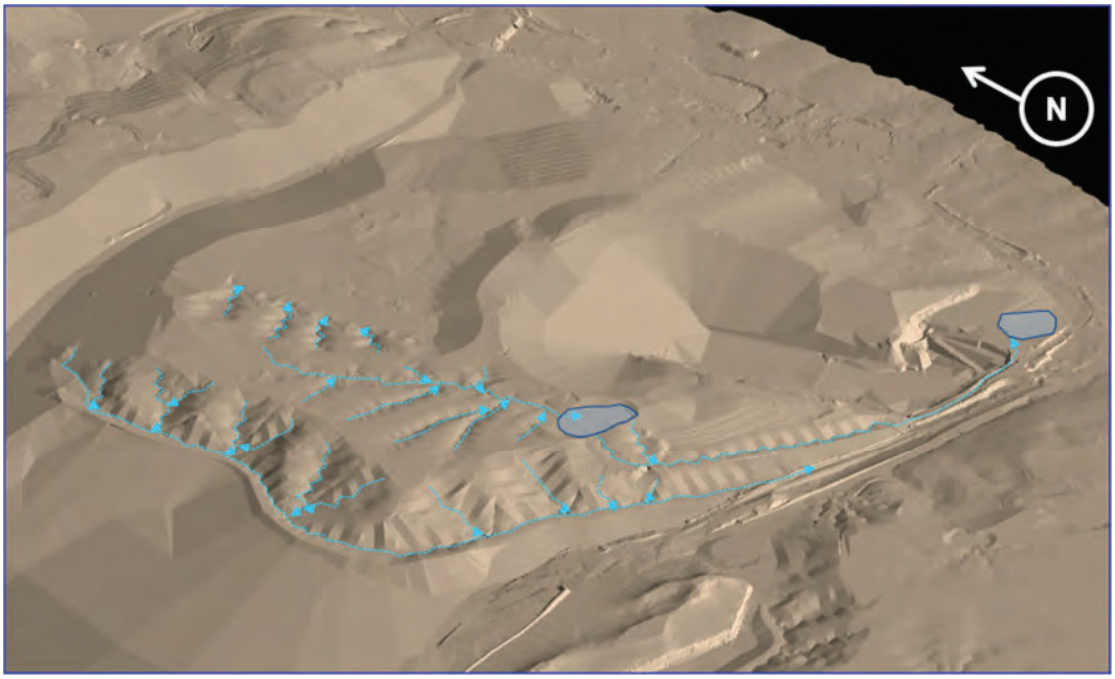
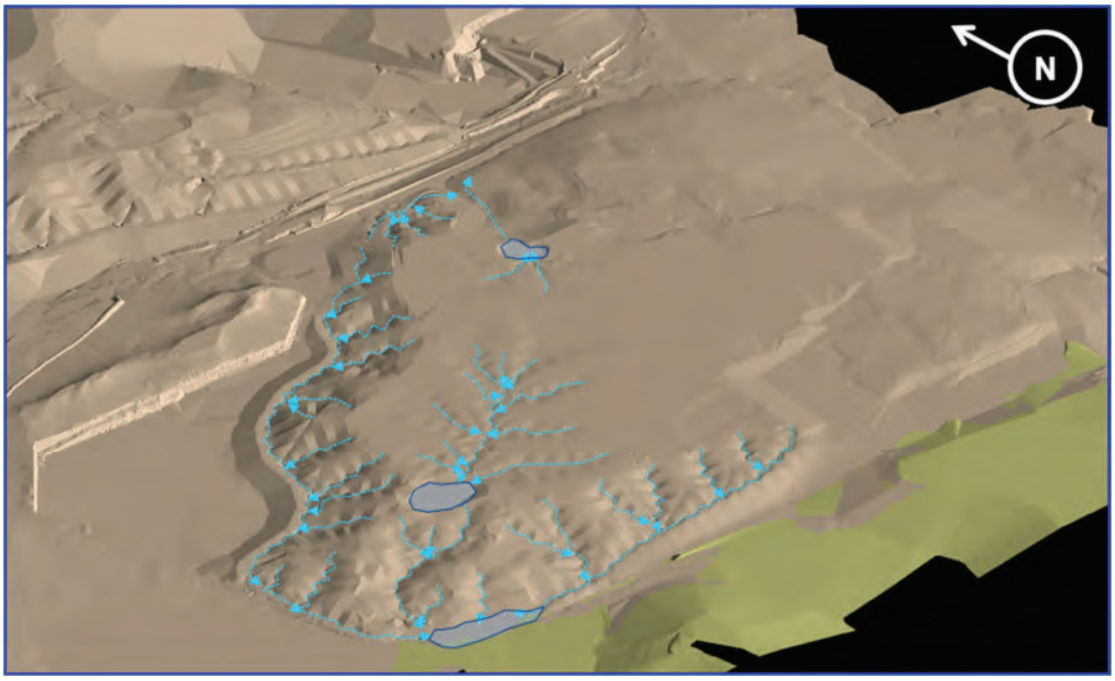



Figure 4 3D Representation of Mt Thorley Loders Pit Final Landform Incorporating Micro-Relief and Natural Drainage Lines



The Criteria, Performance Measures and Indicators, together with the justification source which describe structures and method for this data, as relate to the Landform Establishment Stage, are provided in Table 32 and address:

- Stabilising landforms;
- Minimising erosion;
- Preventing water pollution;
- Preventing access to open pits or other hazardous locations;
- Enhancing visual amenity; and
- Site user, stock and fauna safety.

The final landform and rehabilitation domain types for MTW during the life of the MOP are shown on **Map 4**.

**Table 32 Landform Establishment**

| Objective | Performance Indicator | Performance Criteria | Justification / Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| **Infrastructure Area, Water Management Area, Overburden Emplacement** | | | | | |
| Water quality leaving site is to be in accordance with the EPL water quality criteria. | Sedimentation dams installed. | Sedimentation dams are incorporated into the final landform to collect runoff from rehabilitated areas and the dam capacity is designed to allow time for suspended sediment to settle out. | ~~Coal & Allied Environmental Procedure *10.1 – Visual Management*~~<br>~~Coal & Allied Environmental Procedure *8.3 – Spontaneous Combustion*~~<br>'Blue Book': Managing Urban Stormwater: soils and construction (Volume 1 and 2E – Mines and Quarries)<br>MTW Water Management Plan<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS<br>MTW Acid Rock Drainage and Mineral Waste Management Plan | | Not yet required |
| Final landforms will incorporate drainage lines consistent with existing topography and natural drainage.<br>The objective is for rehabilitated areas to be safe, stable and non-polluting. | Drainage paths and contour drains installed. | Drainage paths and contour drains to be constructed to suitable design standard. | | TARP Item 1 and 6 | Ongoing |
| Rehabilitated overburden emplacements will be undulating, free draining landforms capable of sustaining the intended land use.<br>The objective is for rehabilitated areas to be safe, stable and non-polluting. | Minimisation of constructed slopes for conventional landforms greater than 10 degrees – low walls, ramps and drainage structures. | Landform is generally compatible within the context of the local topography.<br>The landform is to be shaped to ensure overall slopes are 10 degrees or less unless otherwise agreed.<br>Avoidance of straight lines and angular corners in profiles of final landforms.<br>Approvals in place for slopes >18 degrees. | | TARP Item 2, 3 and 4 | Ongoing |
| Rehabilitated overburden emplacements will be undulating, free draining landforms capable of | Geofluv landform slopes stable and compatible with local topography | Landform is generally compatible within the context of the local topography. | | TARP Item 5 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification / Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| sustaining the intended land use.<br>The objective is for rehabilitated areas to be safe, stable and non-polluting. | | Surface treatments described in Table 31 are applied based on Topography Factors calculated from as-built surveys of rehabilitation areas<br>Absence of active rill/gully erosion > 30cm in depth. | | | |
| The objective is for rehabilitated areas to be safe, stable and non-polluting. | Minimise risk of spontaneous combustion. | Absence of carbonaceous material on the surface of the rehabilitation and no active spontaneous combustion areas. | | TARP Item 9 | Ongoing |
| **Final Void** | | | | | |
| The objective is for the final void areas to be safe, stable and non-polluting. | Exposed coal seams will be covered | Exposed coal seams will be covered with five metres of inert materials to prevent spontaneous combustion where practical. | ~~Coal & Allied Environmental Procedure 8.3 – Spontaneous Combustion~~<br>*Mine Rehabilitation (Hannan 1995)* | TARP Item 10 | Not yet required |
| | Long term stability of final void batter slopes. | The final void batter slopes and benching will be designed to ensure the long term stability of the landform. | | TARP Item 7 | Not yet required |
| **Overburden Emplacement** | | | | | |

| Objective | Performance Indicator | Performance Criteria | Justification / Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| The objective is for the overburden emplacement areas to be safe, stable and non-polluting. | Problematic materials will be capped. | Net acid generating materials and coarse rejects will be disposed amongst non-carbonaceous overburden materials and covered with 5 metres of inert materials. | ~~Rio Tinto Environmental Performance Standard *E13 - Chemically reactive mineral waste control*~~<br>~~Coal & Allied Environmental Procedure *12.1 – Acid Mine Drainage Prevention and Control*~~<br>~~Coal & Allied Environmental Procedure *6.2 Coarse Rejects and Tailings Disposal*~~<br>MTW Acid Rock Drainage and Mineral Waste Management Plan | TARP Item 11 | Ongoing |
| Rehabilitated overburden emplacements will be undulating, free draining landforms capable of sustaining the intended land use. | Surface rock removed from rehabilitated land surface | Rocks > 200mm are removed from the surface of rehabilitated lands (exemption for rocks used as habitat features). | ~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~<br>*Mine Rehabilitation (Hannan1995)* | | Ongoing |
| **Tailings Storage Facility** | | | | | |
| Rehabilitated TSFs will be integrated into the final landform and revegetation strategy.<br>The objective is for the tailings storage facility | Tailings storage facilities are capped with overburden and rehabilitated after consolidation of tailings. | Decommissioning and capping of tailings storage facilities in accordance with the approved design ~~approval granted under section 100 of the Coal Mines Health and Safety Act 2002~~ | ~~Rio Tinto Environmental Performance Standard *E15 - Hazardous materials and non-mineral waste control*~~ | | TD1 in process of being capped. |

| Objective | Performance Indicator | Performance Criteria | Justification / Source | Link to TARP | Progress at Start of MOP |
|---|---|---|---|---|---|
| areas to be safe, stable and non-polluting. | TSF capping design to allow for settlement of tailings surface to occur.<br><br>TSF design and management to allow for initial overfilling of the covering material to compensate for expected settlement. | TSF capping design to allow for settlement of tailings surface.<br><br>Capping thickness to be >2m, or as per design by expert tailings consultant. | ~~Coal & Allied Environmental Procedure 6.2 – Coarse Rejects and Tailings Disposal~~<br><br>*MTW Acid Rock Drainage and Mineral Waste Management Plan* | TARP Item 8 | Final capping design for TD1 completed. |

## 6.8 Growing Media Development

In the context of this MOP Growing Media Development incorporates the processes involved to achieve a soil which is capable of supporting a sustainable plant community. It includes consideration of the chemical, physical and biological properties of the media and takes into account issues such as the specialist requirements, e.g. soil ameliorants aligned to the revegetation of the disturbed areas, whilst also incorporating consideration of landuse that may deviate from the traditional post mining landuse.

### 6.8.1 Overburden characterisation

At MTW, overburden material varies in physical and geochemical properties, in accordance with the geology of the area and the extent of exposure to weathering.

Chemical analyses of MTW spoil materials indicate that, in general, the overburden is slightly sodic and alkaline, but within acceptable ranges for use as a plant growth medium.

### 6.8.2 Soil types and suitability

Data derived from the EIS demonstrates the suitability of the soils of the project area in terms of the suitability of these soils for use as top dressing and the stripping depth. The distribution of each soil type across MTW and the suitability of these soils for use as topsoil dressing and the stripping depth are presented in Section 2.4.2.

The growing medium will be tested for suitability for rehabilitation during the Growing Media Development phase to determine the requirement for soil ameliorants. Soil testing will also be carried out at least once during rehabilitation monitoring to determine if the growing medium is consistent with the Performance Criteria outlined in Table 33. Additional soil testing may be required if further amelioration is required.

Industry experience gained from the use of topsoil derived from pasture and returning to native plant communities has demonstrated the potential for these soils to incur land management issues such as erosion and weed incursions. To address these issues the areas returning to native plant communities will, in the main, be based on “enhanced growing media”, the basis being overburden and appropriate ameliorants i.e. organic fertilisers, gypsum and organic matter.

Soil management is fundamental in successful rehabilitation management at MTW. The key objectives for managing the soil landscape (in context of vegetative cover and soil stability) include:

- Minimising bare soil patches, which would be affected by wind and water movement and the introduction and transportation of resources into and out of the system; and
- Favourable nutrient, infiltration and stability characteristics for the nominated vegetation communities.

The Criteria, Performance Measures and Indicators together with the justification source which describe structures and method for this data as relate to the growing media development stage is provided in Table 33.

**Table 33 Growing Media Development**

| Objective | Performance Indicator | Performance Criteria | Justification / Source | Link to TARP | Progress at start of MOP |
|---|---|---|---|---|---|
| **Rehabilitation Areas** | | | | | |
| Soil properties suitable for the establishment and maintenance of selected vegetation species:<br>- Recreating 1,423 ha grassland communities with a native component ;<br>- Establishing approximately 319 ha of trees and shrubs over grassland areas, but not necessarily conforming to any particular vegetation community;<br>- Re-creating approximately 2,100 ha of EEC woodland communities to a standard comparable to similar reference EEC communities. | pH of replaced topsoil to be broadly within the range suitable for targeted species growth. | Pasture - pH >5.5 and <8.5<br>Woodland - pH >5.5 and <8.5 | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~<br>~~Coal & Allied Environmental Procedure *7.1 – Water Management*~~<br>Warkworth Rehabilitation Strategy (2011)<br>What Do All The Numbers Mean? A Guide for the Interpretation of Soil Test Results<br>Reafforestation of Open Cut Coal Mines Using Direct Seeding Techniques (Burns 1987)<br>Analogue Site Monitoring Results from Native Vegetation Rehabilitation Monitoring (Niche 2016 and Niche 2017) | TARP Item 12 | Ongoing |
| | Electrical Conductivity of replaced topsoil to be broadly within the range suitable for plant growth. | Pasture - Electrical Conductivity <2 dS/m<br>Woodland - Electrical Conductivity <2 dS/m | | TARP Item 12 | Ongoing |
| | Runoff water quality to be broadly trending towards less than 1,000µS/cm after 5 years. | Runoff water quality less than 1,000µS/cm after 5 years. | | | Ongoing |
| | Soil Phosphorous levels to be trending towards the range suitable for plant growth. | Pasture - Phosphorous >40ppm<br>Woodland - Phosphorous within levels in analogue sites by Year 5 Target: 1.2 to 13.0ppm | | TARP Item 12 | Ongoing |
| | Organic carbon levels are typical of that of the surrounding landscape, increasing or fall within desirable ranges provided by the agricultural industry. | Pasture - Organic Carbon >1.5%<br>Woodland - Organic Carbon within levels in analogue sites by Year 5 Target: 1.6 to 8.7% | | TARP Item 12 | Ongoing |
| | Cation Exchange Capacity is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry. | Pasture - Cation Exchange Capacity >12 Cmol+/kg<br>Woodland - Cation Exchange Capacity within levels in analogue sites by Year 2 Target: 7.4 to 20.4 Cmol+/kg | | TARP Item 12 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification / Source | Link to TARP | Progress at start of MOP |
|---|---|---|---|---|---|
| | Exchangeable Sodium Percentage (a measure of sodicity) is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry. | Pasture - Exchangeable Sodium Percentage <10%<br>Woodland - Exchangeable Sodium Percentage within levels in analogue sites by Year 2 Target: 0.2 to 8.7% | MTW Water Management Plan | TARP Item 12 | Ongoing |
| | Calcium/Magnesium ratio is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry. | Pasture - Calcium/magnesium ratio >1 and <10<br>Woodland - Calcium/magnesium ratio within levels in analogue sites by Year 2 Target: 0.7 to 2.1 | | TARP Item 12 | Ongoing |
| | Topsoil is spread appropriately in a way that will ensure optimum ecosystem establishment. | Topsoil is re-spread directly onto reshaped landforms where possible.<br>Topsoil is spread to an average depth of 10cm.<br>The location of areas where topsoil is respread is recorded on the site GIS. | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~<br>Warkworth Rehabilitation Strategy (August 2011)<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS<br>Mine Rehabilitation (Hannan 1995) | TARP Item 13 | Ongoing |
| | Ameliorants applied appropriately in a way that will ensure optimum ecosystem establishment. | Soil ameliorants such as gypsum, wood and hay mulch, biosolids, municipal waste composts and other organic wastes are utilised based on soil testing and Waste Regulation 1996 guidelines.<br>Soil ameliorants are incorporated into the growth medium.<br>The location of areas where soil ameliorants are used is recorded on the site GIS. | | | Ongoing |

## 6.9 Ecosystem and Landuse Establishment

In the context of this MOP, Ecosystem and Landuse Establishment incorporates the requirements for:

- The management and control of fire, weed and vertebrate pest species;
- Correct flora species selection in terms of the revegetation programmes - refer Section 7.2.4.2 for details on species lists;
- Management of the derived grasslands of the Central Hunter Grey Box–Ironbark Woodland and/or Central Hunter Ironbark–Spotted Gum–Grey Box Forest EECs with a view to establishing the defined EEC's;
- Development and implementation of techniques that focus on the re-establishment of the Central Hunter Grey Box-Ironbark Woodland and/or Central Hunter Ironbark-Spotted Gum – Grey Box Forest EECs;
- The development of systems to enhance opportunities for nutrient cycling and the development and enhancement of habitat for key fauna species; and
- The optimal use of onsite resources, e.g. woody debris, rock, mulch.

Table 34 summarises the threatened species, populations and ECCs that are to be managed in accordance with the Project Approval.

**Table 34 Threatened species, populations and ECCs recorded or considered likely to occur within MTW extension area**

| **Threatened fauna species** | TSC Act | EPBC Act |
|---|---|---|
| Brown Treecreeper (*Climacteris picumnus*) | V | - |
| Grey-crowned Babbler (*Pomatostomus temporalis*) | V | - |
| Speckled Warbler (*Chthonicola sagittata*) | V | - |
| Hooded Robin (*Melanodryas cucullata*) | V | - |
| Diamond Firetail (*Stagonopleura guttata*) | V | - |
| Glossy Black-cockatoo (*Calyptorhynchus lathami*) | V | - |
| Regent Honeyeater (*Anthochaera phrygia*) | E | E |
| Swift Parrot (*Lathamus discolour*) | E | E |
| Little Lorikeet (*Glossopsitta pusilla*) | V | - |
| Spotted Harrier (*Circus assimilis*) | V | - |
| Varied Sittella (*Daphoenositta chrysoptera*) | V | - |
| Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) | V | - |
| Large-eared Pied Bat (*Chalinolobus dwyeri*) | V | V |
| Eastern Free-tail Bat (*Mormopterus norfolkensis*) | V | |
| Little Bent-wing Bat (*Miniopterus australis*) | V | |
| Large-footed Myotis (*Myotis macropus*) | V | |
| Squirrel Glider (*Petaurus norfolcensis*) | V | - |
| **Endangered Ecological Communities** | | |
| Warkworth Sand Woodlands | E | - |
| Central Hunter Grey Box–Ironbark Woodlands | E | - |
| Central Hunter Ironbark–Spotted Gum–Grey Box Forest | E | - |

V= Vulnerable; E = Endangered

Additional threatened flora species and ECCs are known to occur within the Warkworth extension area, however none of these species/populations are located within the proposed disturbance area and would therefore not be impacted by mining activities. As such, they have not been included in this assessment.

This information has provided the framework for the development of the Criteria, Performance Measures and Indicators for Ecosystem and Landuse Establishment which are provided in Table 35. Monitoring information from analogue sites has been used to inform the target setting process for Performance Criteria in Table 35. ~~Targets for Performance Criteria in Table 31 that haven't been specified in this MOP will be detailed in a MOP Amendment and submitted to DRE by the 31 December 2016. Monitoring information from analogue sites will be used to inform the target setting process.~~

**Table 35 Ecosystem and Landuse Establishment**

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| **All Domains** | | | | | |
| Weeds are controlled to appropriate levels for the establishment and maintenance of selected vegetation species:<br>- Recreating 1,423 ha grassland communities with a native component ;<br>- Establishing approximately 319 ha of trees and shrubs over grassland areas, but not necessarily conforming to any particular vegetation community;<br>- Re-creating approximately 2,100 ha of EEC woodland communities to a standard comparable to similar reference EEC communities. | Weeds are controlled to appropriate levels. | The amount of weeds present is comparable to reference sites or baseline survey. | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~<br>*Noxious Weeds Act 1993*<br>Australian and NSW Weed Strategies<br>TSC Act – Key Threatening Processes | TARP Item 14 | Ongoing |
| | Annual weed inspection. | Annual inspections of Mine lands are undertaken to identify areas requiring the implementation of weed management measures. | | TARP Item 14 | Ongoing |
| | Implementation of weed management measures. | Implementation of appropriate weed management measures which may include mechanical removal, application of approved herbicides and biological control. | | TARP Item 14 | Ongoing |
| | Weed control area records. | Recording of areas where weed control has been conducted in a GIS database which is regularly maintained. | | | Ongoing |
| | Assessment of weed control effectiveness through follow-up inspections. | Follow-up inspections to assess the effectiveness of the weed management measures implemented and the requirement for | | TARP Item 14 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | | any additional management measures. | | | |
| Rehabilitation areas will be capable of sustaining the intended land use.<br><br>Rehabilitation areas to provide additional habitat for threatened species.<br><br>The objective is for all areas to be safe, stable and non-polluting. | Pest animal control undertaken for any declared pest animal species known on the project lands. | Mandatory pest control for any declared pests known to occur on Mine owned land. | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br><br>~~Coal & Allied Environmental Procedure *10.2 – Flora and Fauna*~~<br><br>*Rural Lands Protection Act 1998*<br><br>TSC Act – Key Threatening Processes | TARP Item 24 | Ongoing |
| | Use of appropriate pest control measures. | Use of a range of appropriate pest control measures as determined (e.g. the destruction of habitat, trapping, targeted shooting programs and baiting). | | TARP Item 24 | Ongoing |
| | Assessment of pest animal control effectiveness through follow-up inspections. | Follow-up inspections to assess the effectiveness of control measures implemented and the requirement for any additional control measures. | | TARP Item 24 | Ongoing |
| Vegetation is managed to control fire for the establishment and maintenance of selected vegetation species:<br>- Recreating 1,423 ha grassland | Vegetation is managed to control fire. | Implementation of actions as per the Bushfire Management Plan. | Mount Thorley Warkworth Bushfire Management Plan<br><br>*Rural Fires Act 1997* | TARP Item 15 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| communities with a native component ;<br>- Establishing approximately 319 ha of trees and shrubs over grassland areas, but not necessarily conforming to any particular vegetation community;<br>- Re-creating approximately 2,100 ha of EEC woodland communities to a standard comparable to similar reference EEC communities. | | | | | |
| **Rehabilitation Area** | | | | | |
| Establishment and germination of selected vegetation species:<br>- Recreating 1,423 ha grassland communities with a native component ;<br>- Establishing approximately 319 ha of trees and shrubs over grassland areas, but not necessarily conforming to any | Appropriate provenance rules and planting methods for tube stock planting | Woodland/grassland seed and tubestock supply will preferentially be of local provenance.<br>Seed and tubestock supplied from outside sources will be preferentially of Hunter provenance or from an area within NSW of similar climatic conditions to the Singleton area or as research defines. | ~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~<br>~~Coal & Allied Environmental Procedure *10.2 – Flora and Fauna*~~<br>Warkworth Rehabilitation Strategy (August 2011) | | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| particular vegetation community;<br>- Re-creating approximately 2,100 ha of EEC woodland communities to a standard comparable to similar reference EEC communities. | | Tubestock is to be watered the day before and immediately prior to planting.<br>Seedlings are hardened off before they are planted. | CSIRO Methodology for Ecosystem Function Analysis (EFA) (Tongway, 2004).<br>Analogue Site Monitoring Results from Native Vegetation Rehabilitation Monitoring (Niche 2016 and Niche 2017) and Rehabilitation Monitoring – Grasslands/Pasture Lands (AECOM 2015) | | |
| | Revegetation works aligned to seasonality of rainfall, evaporation and temperature. | Warm season grasses are seeded late spring to autumn. Cool season perennial grasses are planted late autumn-early spring.<br>Tree planting to be undertaken in autumn and spring and after rains to provide adequate soil moisture. | | | Ongoing |
| | The vegetation is developing in structure and complexity comparable to that of the local remnant vegetation | Based on key physical, biological and chemical characteristics the LFA Stability Index provides an indication of the site's stability and that it is comparable to or trending towards that of analogue sites (%).<br>Pasture: 63.2% to 69.2%; | | TARP Item 27 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | | Woodland: 53.9% to 81.8%. | | | |
| | | Based on key physical, biological and chemical characteristics the LFA Infiltration Index provides an indication of the site's infiltration capacity and that it is comparable to or trending towards that of analogue sites (%).<br>Pasture: 29.4% to 37.3%;<br>Woodland: 48.4% to 73.9%. | | TARP Item 27 | Ongoing |
| | | Based on key physical, biological and chemical characteristics the LFA Nutrient Recycling Index provides an indication of the site's ability to recycle nutrients and that it is comparable to or trending towards that of analogue sites (%).<br>Pasture: 24.1% to 30.7%;<br>Woodland: 38.5% to 79.8%. | | TARP Item 27 | Ongoing |
| | | The Landscape Organisation Index | | TARP Item 27 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | | provides a measure of the ability of the site to retain resources and that it is comparable to or trending towards that of analogue sites (%). Pasture: 1.00; Woodland: 0.84 to 1.00. | | | |
| | Predation by herbivores | All plantings at risk of foraging by fauna (rabbits, hares, wallabies and kangaroos) are protected by the pre planting application of deterrent spray, and/or tree guards and/or exclusionary fencing wherever practical. | | | Ongoing |
| Minimise site impact in terms of compaction of soil, the spread of weeds and disturbance to vegetation<br>The objective is for rehabilitation areas to be safe, stable and non-polluting. | No uncontrolled entry of livestock or vehicles. | Vehicle access is restricted to defined access pathways for use by authorised vehicles.<br>The main arterial tracks are maintained in good condition. | ~~Coal & Allied Environmental Procedure *10.3 – Ground Disturbance Permit*~~ | TARP Item 16 | Ongoing |
| | Signage | Key habitat and rehabilitation areas will be fenced or signposted where appropriate to prevent | | TARP Item 16 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | | the uncontrolled entry of livestock and to minimise vehicular traffic during the establishment phase. | | | |
| Habitat augmentation to provide additional habitat for threatened species. | Coarse Woody Debris and rocks | Horizontal placement of hollow logs or small piles of timber and rocks are installed across the site creating cavities for habitat for small ground dwelling mammals and reptiles. | ~~Coal & Allied Environmental Procedure 5.1 – Disturbance and Rehabilitation~~<br>~~Biodiversity Management Plan (2014)~~<br>Warkworth Rehabilitation Strategy (August 2011)<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS | | Ongoing |
| | Drainage depression (frog ponds) creation providing riparian and aquatic habitat | Habitat is developed using common native rushes /sedges in unshaded locations, free from predatory fish, nearby grassland and sheltering sites of vegetation and rocks. | | | Ponds constructed in rehab areas but habitat building not commenced |
| | Plant species selection. | Plant species are used which create suitable habitat for woodland birds e.g. flaky bark, production of small and large sized woody debris, diversity of flowering time.<br>Plant prickly species (e.g. Native Boxthorn) that provide critical | | | Suitable species included in seed mixes. |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | | habitat for certain species. | | | |
| | Provide diversity of habitats to improve biodiversity. | Create areas of open woodland where trees and shrubs are not planted too densely (create "patchiness") and provide relatively large patches of grassland with scattered trees.<br>Create patchwork of dense thickets of shrubs. | | | Ongoing |
| **Rehabilitation Areas – Grassland** | | | | | |
| Establishment of 1,423 ha grassland communities with a native component on the residual disturbed mining areas. | Establishment of 1,423 ha grassland communities with a native component on the residual disturbed mining areas. | 1,423ha of grassland established on rehabilitated mine lands. | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~ | | Ongoing |
| | Species used are compatible with agricultural outcomes. | Species sown are based on those recommended species list from Table 39 (Diversity Native Seeds Scope of Services). | | | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area). | TBD | ~~Coal & Allied Environmental Procedure *10.2 – Flora and Fauna*~~<br>~~Biodiversity Management Plan (2014)~~<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS<br>Warkworth Rehabilitation Strategy (August 2011) | TARP Item 17 | Criteria still to be determined |
| **Rehabilitation Areas – Woodland Other** | | | | | |
| Establishing approximately 319 ha of trees over grassland areas, but not necessarily conforming to any particular vegetation community | Establishing approximately 319 ha of trees over grassland areas, but not necessarily conforming to any particular vegetation community | 319 ha of trees over grassland established on rehabilitated mine lands. | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~<br>~~Coal & Allied Environmental Procedure *10.2 – Flora and Fauna*~~ | | Ongoing |
| | The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area). | 1 to 4 species within a 20m x 20m quadrat. | | TARP Item 18 | Ongoing |
| | The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area). | 4 to 9 species within a 20m x 20m quadrat. | | TARP Item 17 | Ongoing |
| | The density of trees is comparable to that of analogue sites (no./area). | 250 to 3,150 stems per ha | | TARP Item 19 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | Species used are compatible with agricultural or native biodiversity conservation outcomes. | Species sown are based on those recommended species list from Table 39. | ~~Biodiversity Management Plan (2014)~~<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS<br>Warkworth Rehabilitation Strategy (August 2011)<br>Analogue Site Monitoring Results Analogue Site Monitoring Results from Native Vegetation Rehabilitation Monitoring (Niche 2016 and Niche 2017) | | Ongoing |
| **Rehabilitation Areas – Woodland EEC** | | | | | |
| Establishment of 2,100 ha of Central Hunter Grey Box-Ironbark Woodland and / or Central Hunter Ironbark-Spotted Gum-Grey Box Forest on rehabilitated mine lands. | Establishment of 2,100 ha of Central Hunter Grey Box-Ironbark Woodland and / or Central Hunter Ironbark-Spotted Gum-Grey Box Forest on rehabilitated mine lands. | 2,100 ha of Central Hunter Grey Box-Ironbark Woodland and / or Central Hunter Ironbark-Spotted Gum-Grey Box Forest established on rehabilitated mine lands. | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>~~Coal & Allied Environmental Procedure *5.1 – Disturbance and Rehabilitation*~~<br>~~Coal & Allied Environmental~~ | | Ongoing |
| | The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area). | 1 to 4 species within a 20m x 20m quadrat. | | TARP Item 18 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | The number of shrub species comprising the vegetation community is comparable to that of analogue sites (no. species/area). | 4 to 9 species within a 20m x 20m quadrat. | ~~Procedure *10.2 – Flora and Fauna*~~<br>~~Biodiversity Management Plan (2014)~~<br>Warkworth Rehabilitation Strategy (August 2011)<br>Analogue Site Monitoring Results Analogue Site Monitoring Results from Native Vegetation Rehabilitation Monitoring (Niche 2016 and Niche 2017) | TARP Item 18 | Ongoing |
| | The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area). | 4 to 9 species within a 20m x 20m quadrat. | | TARP Item 17 | Ongoing |
| | The number of subshrub species and understorey species (other than grasses) comprising the vegetation community is comparable to that of analogue sites (no. species/area). | 10 to 20 species within a 20m x 20m quadrat. | | TARP Item 17 | Ongoing |
| | The native plant species richness is within 50-100% or exceeds that of analogue sites (no. species/area). | 13 to 41 species within a 20m x 20m quadrat. | | TARP Item 17 and 18 | Ongoing |
| | The density of trees is comparable to that of analogue sites (no./area). | 250 to 3,150 stems per ha | | TARP Item 19 | Ongoing |
| | Species used are compatible with agricultural or native biodiversity conservation outcomes. | Species sown are based on those recommended species list from Table 39. | | | Ongoing |

## 6.10 Ecosystem and Landuse Sustainability

In the context of this MOP, Ecosystem and Landuse Sustainability incorporates the:

- Development of profiles in the growing media aligned to the nominated EECs;
- Sustainable development of the nominated areas of the EECs;
- Vegetation communities capable of withstanding catastrophic events, e.g. bushfire and extensive drought;
- Nutrient cycling;
- Species diversity and abundance for both flora and fauna; and
- Recolonisation of the sites by key indicator species.

Grazing in rehabilitation areas returned to grasslands will be controlled through formal licence agreements with the graziers involved. The typical arrangements under ~~Coal & Allied~~ MTW Licence Agreements include:

- Licence conditions requiring the Licensee to manage the property in accordance with best agricultural and environmental practice i.e. grazing management, bushfire management, weed management and avoidance of vegetation clearing;
- Property inspections by ~~the Specialist – Land Management , Land & Tenements~~ MTW personnel to audit quality of property management; and
- Soil testing to check nutrient and soil carbon levels are being maintained.

The Criteria, Performance Measures and Indicators together with the justification source which describe structures and method for this data as they relate to the Ecosystem and Landuse Sustainability Stage is provided in Table 36. Monitoring information from analogue sites has been used to inform the target setting process for Performance Criteria inTable 36.

**Table 36 Ecosystem and Landuse Sustainability**

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| **Rehabilitation Areas** | | | | | |
| Provide additional habitat for threatened species. | Monitoring of the placement and utilisation of habitat features and artificial roosting/nesting boxes. | Nest boxes will be installed to supplement arboreal habitat.<br>Data on the location and species specificity of each nest box is collected and collated via GIS.<br>Record utilisation of nest boxes. | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>Warkworth Rehabilitation Strategy (August 2011)<br>~~Biodiversity Management Plan (2014)~~<br>Warkworth Continuation 2014 EIS and Mt Thorley Operations 2014 EIS | | Nest boxes installed at Mt Thorley rehabilitation areas |
| Establishing a network of tree corridors to ensure connectivity of woodland community areas. | Vegetation communities in areas of rehabilitation have been designed to enhance connectivity across the site and to adjoining landscape. | Align vegetation communities on areas of rehabilitation to adjacent landscape.<br>GIS data reflects connectivity of vegetation communities. | | | Ongoing |
| **Rehabilitation Area - Grassland** | | | | | |
| Establishment of 1,423 ha grassland communities with a native component on the residual disturbed mining areas. | ~~Weed plant cover (calculated as a percentage of total ground cover) is comparable to that of analogue sites. (% Cover)~~<br>Exotic plant cover (calculated as a percentage of total ground cover and mid storey cover) is within 5-33% or less than that of analogue sites. | Target: 5% to 33% | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>CSIRO Methodology for Ecosystem | TARP Item 14 | ~~Criteria still to be determined~~<br>Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover). | TBD | Function Analysis (Tongway, 2004)<br>Warkworth Rehabilitation Strategy (August 2011) | TARP Item 20 | Criteria still to be determined |
| | The abundance of understorey species (non-weed) per square metre, averaged across the site, provides an indication of the heterogeneity of the site and that the number of non-weed species is comparable to analogue sites (no. species/m2). | TBD | | | Criteria still to be determined |
| **Rehabilitation Area – Woodland Other** | | | | | |
| Establishing approximately 319 ha of trees over grassland areas, but not necessarily conforming to any particular vegetation community | ~~Weed plant cover (calculated as a percentage of total ground cover) is comparable to that of analogue sites. (% Cover)~~<br>Exotic plant cover (calculated as a percentage of total ground cover and mid storey cover) is within 5-33% or less than that of analogue sites. | Target: 5% to 33% | ~~Rio Tinto Environmental Performance Standard *E14 - Land disturbance and rehab control*~~<br>CSIRO Methodology for Ecosystem | TARP Item 14 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover). | Target: 32% to 74% | Function Analysis (Tongway, 2004)<br>Warkworth Rehabilitation Strategy (August 2011)<br>~~Biodiversity Management Plan (2014)~~<br>Biobanking Assessment Methodology (2014)<br>Analogue Site Monitoring Results Analogue Site Monitoring Results from Native Vegetation Rehabilitation Monitoring (Niche 2016 and Niche 2017) | TARP Item 20 | Ongoing |
| | The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no./area). | Target: 1 to 4 species within a 20m x 20m quadrat. | | TARP Item 18 | Ongoing |
| | The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites. | Target: 90% to 100% | | TARP Item 18 | Ongoing |
| | The density of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to analogue sites (no./area). | Target: 50 to 725 stems per ha | | TARP Item 19 | Ongoing |
| | Average trunk diameter (dbh) of the tree population provides a measure of age and growth rate and that it is trending towards that of analogue sites (cm). | Target: 10.8cm to 65cm | | TARP Item 21 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites. | TBD | | TARP Item 22 | Criteria still to be determined |
| | The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites. | TBD | | TARP Item 22 | Criteria still to be determined |
| | The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites. | TBD | | TARP Item 22 | Criteria still to be determined |
| | The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites. | TBD | | TARP Item 23 | Criteria still to be determined |
| | The proportion of over-storey species occurring as regeneration is within 50-100% or exceeds that of analogue sites. | ~~TBD~~ 0.5 to 1.0 | | TARP Item 23 | ~~Criteria still to be determined~~ Ongoing |
| **Rehabilitation Area – Woodland EEC** | | | | | |
| Establishment of 2,100ha of Central Hunter Grey Box-Ironbark Woodland and / or Central Hunter | The percentage of native over storey cover is within the range of ~~50-100%~~ or exceeds that of ~~analogue~~ OEH Benchmark sites. | ~~8%~~ 15% to 50% | ~~Rio Tinto Environmental Performance Standard *E14 - Land*~~ | TARP Item 19 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| Ironbark-Spotted Gum-Grey Box Forest on rehabilitated mine lands.<br>Provide additional habitat for threatened species.<br>Ecosystem health | The percentage of native mid storey cover is within the range of ~~50-100%~~ or exceeds that of ~~analogue~~OEH Benchmark sites. | ~~3%~~ 5% to 60% | ~~*disturbance and rehab control*~~<br>CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004)<br>Warkworth Rehabilitation Strategy (August 2011)<br>~~Biodiversity Management Plan (2014)~~<br>Biobanking Assessment Methodology (2014)<br>Analogue Site Monitoring Results Analogue Site Monitoring Results from Native Vegetation Rehabilitation Monitoring (Niche 2016 and Niche 2017) | TARP Item 19 | Ongoing |
| | The percentage of native ground cover (grasses) is within the range of ~~50-100%~~ or exceeds that of ~~analogue~~ OEH Benchmark sites. | ~~3%~~ 5% to 50% | | TARP Item 20 | Ongoing |
| | The percentage of native ground cover (shrubs) is within the range of ~~50-100%~~ or exceeds that of ~~analogue~~ OEH Benchmark sites. | ~~3%~~ 5% to 10% | | TARP Item 20 | Ongoing |
| | The percentage of native ground cover (other) is within the range of ~~50-100%~~ or exceeds that of ~~analogue~~ OEH Benchmark sites. | ~~3%~~ 5% to 40% | | TARP Item 20 | Ongoing |
| | Exotic plant cover (calculated as a percentage of total ground cover and mid storey cover) is within 5-33% or less than that of analogue sites. | 5% to 33% | | TARP Item 14 | Ongoing |
| | Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover). | 32% to 74% | | TARP Item 20 | Ongoing |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | The abundance of native understorey species per square metre, averaged across the site, provides an indication of the heterogeneity of the site and that the number of native species is comparable to analogue sites ~~(no. species/m2)~~. | 16 to 27 species within a 20m x 20m quadrat | | TARP Item 17 | Ongoing |
| | The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no./area). | 1 to 4 species within a 20m x 20m quadrat. | | TARP Item 18 | Ongoing |
| | The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites. | 90% to 100% | | TARP Item 18 | Ongoing |
| | The density of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to analogue sites (no./area). | 50 to 725 stems per ha | | TARP Item 19 | Ongoing |
| | Average trunk diameter (dbh) of the tree population provides a measure of age and growth rate and that it is trending towards that of analogue sites (cm). | 10.8cm to 65cm | | TARP Item 21 | Ongoing |
| | The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites. | TBD | | TARP Item 22 | Criteria still to be determined |

| Objective | Performance Indicator | Performance Criteria | Justification/Source | Link to TARP | Status at start of MOP |
|---|---|---|---|---|---|
| | The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites. | TBD | | TARP Item 22 | Criteria still to be determined |
| | The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites. | TBD | | TARP Item 22 | Criteria still to be determined |
| | The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites. | TBD | | TARP Item 23 | Criteria still to be determined |
| | The proportion of over-storey species occurring as regeneration is within 50-100% or exceeds that of analogue sites. | 0.5 to 1.0 | | TARP Item 23 | Ongoing |
| | The total length of fallen logs is within 50-100% or exceeds that of analogue sites. | ~~3 to 66m~~ ≥3m within a 20m x 20m quadrat | | TARP Item 25 | Ongoing |
| | The number of hollows / nesting sites is within 50-100% or exceeds that of analogue sites. | ~~1 to 3~~ ≥0.5 within a 20m x 20m quadrat | | TARP Item 26 | Ongoing |

# 7.0 Rehabilitation Implementation

## 7.1 Rehabilitation Status at MOP Commencement

This section describes the status of each domain at the start of this MOP period. This information is also presented graphically in **Map 2**. For this section, the rehabilitation areas domains have been grouped into a single domain. The rehabilitation status of domains that are active, i.e. subject to ongoing mining operations, is not described.

### 7.1.1 Infrastructure Areas

Domain is active.

### 7.1.2 Tailings Storage Facilities

Capping of Tailings Dam No. 1 has been completed during 2015. Stage 1 capping was undertaken by smaller contractor equipment and designed to provide a stabilising cover over the tailings surface to allow larger equipment to be used on long term landform construction in Stage 2 of the capping process.

### 7.1.3 Water Management Areas

Domain is active.

### 7.1.4 Overburden Emplacements

At the end of 2014 the total area of mined land that has been rehabilitated at MTW was 922ha. Areas within CL 753 that have been rehabilitated to date are located along the northern boundary behind the West Pit emplacement areas, the eastern boundary between the CD Pit and Tailings Dam No. 1, the eastern edge of South Pit and the eastern edge of Woodlands Pit.

Rehabilitation areas within CL 219 consist mainly of the eastern edge of the mined area and an area to the south and north of the stockpile areas.

Overburden is placed in active waste emplacement areas for dragline strip areas, or hauled by trucks to emplacement areas behind the mining area for shovel strips. Existing active waste emplacement areas are defined as those that are currently unshaped. These emplacements will be located adjacent to all active mining areas and dominate the central and south-western sections of the MTW mine area.

Overburden is then shaped before rehabilitation activities can take place. Shaped overburden emplacements are generally located behind the unshaped spoil piles for each pit.

#### 7.1.4.1 Landform design

Overburden is shaped and designed to be compatible with adjacent land surfaces. The final landform, as shown on **Map 4**, will be further refined to include micro-relief and incorporate natural drainage. A revised landform ~~will be submitted via a MOP Amendment within 18 months of approval of this MOP~~ incorporating micro-relief and natural drainage lines has been submitted as part of MTW MOP Amendment A.

#### 7.1.4.2 Surface shaping

Following truck dumping activities, the overburden piles are reshaped to form the final landscape. The final landform is designed to be structurally stable without long, unimpeded drainage lines. The conventional ~~final~~ landform slopes are ~~is~~ designed to be slopes of generally less than 10 degrees on outward facing slopes and less than 14 degrees on internally draining slopes i.e. low walls into final voids, ramps etc. The new landform areas that have been designed using a geomorphological landform design approach are designed to limit areas requiring rock lining (as erosion control treatment) to drainage lines.

#### 7.1.4.3 Water Management

Graded banks and contour drains are constructed on conventional slopes in rehabilitated areas to reduce overland flow and direct runoff to waterways or drainage lines. Sediment dams are constructed as required and where possible, runoff water is directed off site once treated for sediment load. These sedimentation dams will be

retained to trap sediment from rehabilitation areas and eventually provide drinking water for stock, native fauna and aquatic habitat.

Drainage from the elevated rehabilitated overburden dumps will be achieved by the use of drainage routes at a slope of 2-10 degrees. Drainage lines are constructed and grassed or rock lined as appropriate. The density of drainage lines in the new landform areas, that have been designed using a geomorphological landform design approach, is based on surveys of analogue drainage lines.

#### 7.1.4.4 Surface preparation

Following surface shaping, rehabilitation areas are contour-ripped and rock-raked prior to any further treatment. Topsoil, where used, is to be spread at a nominal thickness of 100 mm.

Whenever possible, topsoil will be transferred directly from stripping to re-spreading operations to reduce the possibility of structural damage and monitor biological activity and potential. Topsoil is typically spread using D6 sized dozers to minimise structural damage.

#### 7.1.4.5 Soil Treatment

Regular soil analysis is undertaken on re-contoured areas to determine suitable ameliorants for revegetation.

Soil modifiers, such as gypsum, are applied where required to improve topsoil condition. Gypsum and compost material is initially spread and incorporated into the recovered topsoil using an aerator implement.

Revegetation will be undertaken progressively as the surface preparation of mine spoil is completed. At the time of sowing all pasture revegetation areas are treated with up to 400 kg/ha of “Starter 15”, “Grower 11” or equivalent fertiliser.

#### 7.1.4.6 Revegetation

MTW has rehabilitated its lands with a combination of grasslands and woodlands. Grassland areas consist of a range of both native and introduced pasture species and are designed to sustain grazing pressures and improve animal productivity. Native vegetation areas utilise local native tree and shrub species and are designed to increase biodiversity values. Rehabilitation of shelter belts are designed to provide protection for stock and link native bush areas. Shelter belts can consist of a mixture of native and exotic species.

#### 7.1.4.7 Progressive Rehabilitation

In areas returning to post mining landuse of grassland progressive rehabilitation will allow stock to graze new areas when pasture is considered stable. This assessment will be based on the data collected from defined monitoring programmes, which utilises data collected from analogue sites as a basis for comparison to post mined lands. Stock water will be available from various sediment control dams and designated woodland and biodiversity areas will be protected by fencing.

#### 7.1.4.8 Maintenance

All rehabilitation is regularly checked to determine the success of vegetation growth, erosion controls, adequate fencing and appropriate signage. Where vegetation growth is unsatisfactory, the areas will be re-sown as necessary.

Grasslands will be maintained by periodic ~~aerial~~ applications of fertiliser (typically 100 - 250 kg/ha) until they become well established.

Stock grazing will not be commenced until the areas of Grassland are well established and area securely fenced. Stocking rates will be carefully monitored to ensure that the areas are not overgrazed. Vehicular traffic will be generally kept off revegetation areas and restricted to designated access tracks.

Weeds will be controlled using appropriate management techniques, as the company is obliged to control weed growth on site under the *Noxious Weeds Act 1993* (NSW). If weeds occupy greater than twenty percent of ground cover area in rehabilitation, they will be sprayed or controlled by other methods.

### 7.1.5 Final Void

Domain is active.

## 7.2 Proposed Rehabilitation Activities this MOP Period

For each rehabilitation stage discussed in Section 6.0, mining and rehabilitation activities over the term of this MOP are shown in **Map 3A** to **Map 3G**. A description of proposed activities for each domain is provided in the following sections. Rehabilitation rates for the MOP period are described in Table 37 and Table 38. Rehabilitation progress over the life of the Project will be generally in accordance with the Indicative Mine Plans presented in Figure 2.7 to 2.10 of Mount Thorley Operations 2014 Environmental Impact Statement Volume 1 and Figure 2.7 to 2.10 of Warkworth Continuation 2014 Environmental Impact Statement Volume 1.

Disturbance rates for the MOP period are also presented to allow comparisons to be made with rehabilitation rates.

**Table 37 Rehabilitation Rates 2015-2021 - Warkworth**

| Year | New Disturbance Area* (ha) | Rehab Disturbance Area (ha) | Total Disturbance Area (ha) | Total Rehabilitation Area (ha) | Cumulative Rehabilitation Area (ha) |
|---|---|---|---|---|---|
| MOP Start | | | | | ~~596.9~~ 620.8 |
| 2015 | ~~41.5~~ 30.7 | ~~0.9~~ 1.4 | ~~42.4~~ 32.1 | ~~75.7~~ 75.7 | ~~671.7~~ 695.1 |
| 2016 | ~~140.5~~ 73.7 | ~~7.2~~ 24.9 | ~~147.7~~ 98.6 | ~~64.3~~ 48.4 | ~~728.9~~ 718.6 |
| 2017 | ~~20.1~~ 34.5 | ~~4.2~~ 20.6 | ~~24.3~~ 55.1 | ~~62.2~~ 68.9 | ~~786.8~~ 766.9 |
| 2018 | ~~83.3~~ 121.6 | ~~14.8~~ 7.3 | ~~98.1~~ 128.9 | ~~96.3~~ 88.7 | ~~868.3~~ 848.3 |
| 2019 | ~~62.8~~ 68.4 | ~~10.0~~ 3.3 | ~~72.8~~ 71.7 | ~~90.6~~ 37.8 | ~~949.0~~ 882.8 |
| 2020 | ~~57.8~~ 40.1 | 0.0 | ~~57.8~~ 40.1 | ~~58.1~~ 80.3 | ~~1007.1~~ 963.1 |
| 2021 | ~~36.4~~ 18.5 | 0.0 | ~~36.4~~ 18.5 | ~~60.0~~ 90.2 | ~~1067.1~~ 1053.3 |
| **Total** | **~~416.1~~ 387.5** | **~~37.0~~ 57.5** | **~~479.5~~ 445.0** | **~~507.2~~ 490.0** | |

** New disturbance only*

**Table 38 Rehabilitation Rates 2015-2021 – Mt Thorley**

| Year | New Disturbance Area* (ha) | Rehab Disturbance Area (ha) | Total Disturbance Area (ha) | Total Rehabilitation Area (ha) | Cumulative Rehabilitation Area (ha) |
|---|---|---|---|---|---|
| MOP Start | | | | | ~~337.6~~ 316.8 |
| 2015 | ~~0.4~~ 0.0 | ~~3.1~~ 0.8 | ~~3.5~~ 0.8 | 0.0 | ~~334.5~~ 316.0 |
| 2016 | ~~0.0~~ 17.4 | ~~1.4~~ 4.2 | ~~1.4~~ 21.6 | ~~18.3~~ 36.5 | ~~351.4~~ 348.3 |
| 2017 | ~~0.0~~ 5.8 | ~~19.4~~ 14.0 | ~~19.4~~ 19.8 | ~~44.9~~ 55.1 | ~~377.0~~ 389.4 |
| 2018 | ~~0.0~~ 31.0 | ~~13.0~~ 17.3 | ~~13.0~~ 48.3 | ~~21.5~~ 23.9 | ~~385.5~~ 396.0 |
| 2019 | ~~0.0~~ 5.4 | ~~0.0~~ 2.1 | ~~0.0~~ 7.5 | ~~22.7~~ 44.3 | ~~408.2~~ 436.6 |
| 2020 | ~~0.0~~ 9.7 | 0.0 | ~~7.5~~ 9.7 | ~~37.9~~ 11.0 | ~~446.1~~ 449.2 |
| 2021 | ~~0.0~~ 10.7 | 0.0 | ~~0.0~~ 10.7 | ~~29.3~~ 0.0 | ~~475.4~~ 449.2 |
| **Total** | **~~0.4~~ 2.7** | **~~36.9~~ 38.4** | **~~37.3~~ 118.4** | **~~174.7~~ 170.8** | |

** New disturbance only*

### 7.2.1 Infrastructure Areas

The heavy equipment refuelling facility in North Pit North will be relocated during 2016 to allow reshaping of the spoil dump above this area to proceed. Rehabilitation of this area will improve the visual amenity of the north end of Warkworth when viewed from the golden Highway. Apart from the NPN Refuel Facility the remaining existing infrastructure, as described in Section 2.9.1 will remain in place for the period covered by this MOP.

### 7.2.2 Tailing Storage Facilities

Tailings Dam 1 and Tailings Dam 2 are planned to be capped and rehabilitated during the MOP period. The first stage of capping of TD1SF was undertaken by a contractor-owned fleet of articulated trucks and small dozers in accordance with the capping design prepared by Australian Tailings Consultants. Stage 1 capping provided sufficient strength to allow dumping of the Stage 2 capping material by the MTW mining fleet. Rehabilitation of TD1SF is planned to be completed during 2015.

The Ministrip TSF will be capped as part of constructing a third Putty Road crossing which will be used to haul spoil from Warkworth into the Mt Thorley dump areas.

A trial was commenced during 2015 to cap the Eastern Tailings Dam with breaker rock from the South CHPP. The breaker rock has proved to be suitable capping material and its use will continue to complete capping of the TSF during the MOP period. On completion of capping, the Eastern Tailings Dam is planned to be used to replace the additional ROM stockpile area located within the spoil dump at Mt Thorley.

### 7.2.3 Water Management Areas

Water Management Areas will continue to be managed as in the current situation with none to be rehabilitated during the period of this MOP.

### 7.2.4 Overburden Emplacements

Overburden materials will continue to be managed as in the current situation.

Areas to be rehabilitated within the term of this MOP are located on spoil emplacements in the North Pit, Woodlands Pits and South Pit, as shown on **Maps 3A** to **3G**. The Bulga sublease areas called Mt Thorley Dump and Boundary Corridor will be returned to MTW during the term of this MOP. The rehabilitation of the Bulga sub-lease area shall adhere with the appropriate rehabilitation standards specified in the Common Boundary Rehabilitation Plan.

An alternative South Pit coal access has been established so that the existing South Pit Centre Ramp is not required for coal mining of the final Strip 22. This has allowed dumping in the South Pit Centre Ramp area to commence twelve months earlier than originally planned, in November 2015. Dump sequences in the South Pit Centre Ramp area will be prioritised to allow rehabilitation of the eastern face to be undertaken from 2016 to 2018. The rehabilitation of South Pit Centre Ramp together with extensive areas in South Pit North and South Pit South will greatly improve the visual amenity of the south end of Warkworth Pit from Putty Road and the Golden Highway during the MOP term.

Table 3.2 of the Accelerated Rehabilitation Plan Warkworth South Pit (included as Appendix C) details the rehabilitation progression commitments in the Warkworth South Pit area. The Accelerated Rehabilitation Plan forecast total rehabilitation for the period 2014 to 2018 of 164.6 ha in the South Pit Area. The rehabilitation progression forecast in this MOP for the South Pit area is an improvement on the Accelerated Rehabilitation Plan commitment, resulting in ~~210~~ 202.4 ha for the same period.

Rehabilitation of Overburden Emplacement areas will follow the same process detailed in Section 7.1.4 but will incorporate the refinements described below:

#### 7.2.4.1 Soil Treatment

Organics such as composted municipal waste materials may be used in place of chemical fertilisers to enhance soil nutrient and organic levels and improve soil structure. Suitable organic additives may also be used in accordance with industry lead practice and research findings to improve soils in areas to be returned to native vegetation.

#### 7.2.4.2 Revegetation

In order to achieve diversity targets each mix will contain a range of categories based on the following factors:

- plant structure and form (e.g. tree vs. shrub)

- floristics (i.e. spread over a range of plant genera)
- life cycle (e.g. short lived primary coloniser vs. long lived understory shrubs).

Rehabilitation of Woodland areas undertaken since 2011 have included trials of seed mixes aimed at providing a diverse native understorey. 25-30 species of native grasses and other native understorey species were included in the seed mixes to replace exotic grass species used previously to provide erosion protection. Woodland areas to be seeded during this MOP period will continue to include native understorey species with seed mixes being developed in accordance with Table 39. This table includes diversity targets for seed mixes with targets set for minimum number of species/genera to be included for the functional groups in each strata of the target vegetation community.

Table 39 lists the pool of about 130 species from which any given mix of 40-60 species will be selected. The list is compiled from previous studies undertaken for Coal & Allied as well as the vegetation lists for Central Hunter Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest compiled by Peake (2006) and others. It is not an exhaustive list of species recorded from these communities and will be further refined over time.

**Table 39 Species options, minimum number of species, and minimum number of genera for design of individual species mixes.**

| Category | Min. no. species | | Min. no. genera | | Reference list/species pool |
|---|---|---|---|---|---|
| | Woodland Mix | Pasture/ Light Wooded Mix | Woodland Mix | Pasture/ Light Wooded Mix | |
| **Trees** | | | | | |
| Dominant tall trees | 3 | 1 | 3 | 1 | *Eucalyptus blakelyi, Eucalyptus crebra, Eucalyptus fibrosa, Eucalyptus moluccana, Corymbia maculata* |
| Sub-dominant tall trees | 2 | 1 | 1 | 1 | *Angophora floribunda, Eucalyptus albens, Eucalyptus dawsonii, Eucalyptus glaucina, Eucalyptus punctata, Eucalyptus tereticornis* |
| Small trees nitrogen fixing | 2 | 1 | 1 | 1 | *Acacia implexa, Acacia linearifolia, Acacia parvipinnula, Acacia salicina, Allocasuarina leuhmanii,* |
| Small trees non-nitrogen fixing | 2 | 2 | 1 | 1 | *Brachychiton populneus, Bursaria spinosa, Callitris endlicheri, Notelaea microcarpa* |
| **Shrubs/woody climbers** | | | | | |
| Primary colonising and/or short lived Acacias | 2 | 1 | 1 | 1 | *Acacia crassa, Acacia cultriformis, Acacia elongata, Acacia falcata, ~~Acacia leiocalyx,~~ Acacia spectabilis* |
| Long lived and/or understory Acacias | 2 | 1 | 2 | 1 | *Acacia amblygona, Acacia brownii, Acacia decora, Acacia paradoxa~~, Acacia pravifolia~~* |
| Nitrogen fixing shrubs-non-Acacias (*Fabaceae* family) | 3 | 2 | 2 | 1 | *Daviesia genistifolia, Daviesia ulicifolia, Hardenbergia violacea, Indigofera australis, Jacksonia scoparia, Podolobium ilicifolium, Pultenaea microphylla, Pultenaea spinosa* |
| Non-nitrogen fixing shrubs | 4 | 3 | 0 | 0 | *Breynia oblongifolia, Cassinia aculeata, Cassinia arcuata, Cassinia quinquefaria, ~~Clematis glycinoides,~~ Dodonaea viscosa subsp. cuneata,* |

| Category | Min. no. species | | Min. no. genera | | Reference list/species pool |
|---|---|---|---|---|---|
| | Woodland Mix | Pasture/ Light Wooded Mix | Woodland Mix | Pasture/ Light Wooded Mix | |
| | | | | | *Eremophila deserti, Hakea sericea, Kunzea ambigua, Melaleuca decora, Melaleuca nodosa, Melichrus urceolatus, Myoporum montanum, Olearia elliptica, Ozothamnus diosmifolius, Pandorea pandorana, Senna artemesioides subsp. Zygophylla, Spartothamnella juncea* |
| **Subshrubs** | | | | | |
| | 3 | 2 | 0 | 0 | *Atriplex semibaccata, Einadia hastata, Einadia nutans, Einadia polygonoides, Einadia trigonos, Enchylaena tomentosa, Eremophila debilis, Hibbertia obtusifolia, Hovea linearis, Neptunia gracilis, Solanum cinereum~~,~~ ~~Solanum prinophyllum~~* |
| **Forbs** | | | | | |
| | 6 | 5 | 1 | 1 | *Ajuga australis, ~~Arthropodium milleflorum, Arthropodium minus,~~ ~~Asperula conferta, Caesia parviflora,~~ Calocephalus, critreus, Calotis cuneifolia ~~cuneata~~, Calotis lappulacea, Chrysocephalum apiculatum, ~~Commelina cyanea,~~ Desmodium brachypodum, ~~Dichondra repens,~~ Glycine clandestine, Glycine latifolia, Glycine tabacina, Haloragis heterophylla, Haloragis serra, Hypericum gramineum, Mentha satureoides, Podolepis neglecta, Pomax umbellata, Sida corrugata, Swainsona galegifolia, Vittadinia spp. ~~cuneata, Vittadinia sulcata~~, Wahlenbergia spp. ~~communis, Wahlenbergia gracilis~~, Wahlenbergia stricta, Zygophyllum glaucum* |
| **Grasses** | | | | | |
| Grasses primary colonising | 4 | 3 | 4 | 3 | *~~Austrostipa densiflora,~~ Austrostipa scabra, Bothriochloa decipiens, Bothriochloa macra, Chloris truncata, Digitaria spp.~~brownii~~, Panicum effusum* |
| Grasses long term understorey | 5 | 3 | 4 | 3 | *Aristida spp. ~~ramosa~~, Austrodanthonia spp.~~fulva, Austrodanthonia setacea~~, Austrostipa aristiglumis, , Austrostipa bigeniculata, Austrostipa setacea, Capillipedium spicigerum, Chloris ventricosa, Dicanthium sericeum, ~~Dichelachne micrantha,~~ Elymus scaber, Eragrostis spp.~~brownii, Eragrostis leptostachya~~, Eulalia aurea, Heteropogon contortus, Paspalidium distans, Sporobolus creber, Themeda avenacea, Themeda triandra* |
| Grasses long term understorey shade tolerant | 4 | 3 | 1 | 1 | *Austrostipa ramosissima, Austrostipa verticillata, Aristida spp.~~vagans~~, Cymbopogon refractus, Dichelachne crinita, Echinopogon caespitosus, Echinopogon intermedius, Echinopogon ovatus, Entolasia stricta, Imperata cylindrica, Joycea pallida, Microleana stipoides, Oplesminus aemulus, Poa labillardieri* |
| **Monocots other than grasses** | | | | | |

| Category | Min. no. species | | Min. no. genera | | Reference list/species pool |
|---|---|---|---|---|---|
| | Woodland Mix | Pasture/ Light Wooded Mix | Woodland Mix | Pasture/ Light Wooded Mix | |
| | 4 | 3 | 2 | 1 | *Carex appressa, Carex fascicularis, Carex inversa, Cyperus gracilis, Dianella spp.~~caerulea, Dianella longifolia, Dianella revoluta~~, Fimbristylis dichotoma, Gahnia aspera, Juncus usitatus, Lepidosperma laterale, Lomandra confertifolia, Lomandra filiformis, Lomandra longifolia, Lomandra multiflorus* |

Typical species lists and recommended quantities of seed for grasslands and woodland areas are provided in Table 40.

**Table 40 Recommended quantities of seed to be included from each species category**

| | Woodland mix | Pasture/ Light Wooded Mix |
|---|---|---|
| | Approximate Sowing rate kg/ha | |
| **Trees** | | |
| Dominant tall trees | 0.4 | 0.1 |
| Sub-dominant tall trees | 0.1 | 0.05 |
| Small trees- nitrogen fixing | 0.25 | 0.2 |
| Small trees- non-nitrogen fixing | 0.25 | 0.05 |
| *Trees total* | **1.0** | **0.4** |
| **Shrubs** | | |
| Primary colonising and/or short lived Acacias | 0.5 | 0.25 |
| Long lived and/or understory Acacias | 0.5 | 0.25 |
| Nitrogen fixing shrubs-non-Acacias (*Fabaceae* family) | 0.5 | 0.25 |
| Non-nitrogen fixing shrubs | 0.75 | 0 |
| *Shrubs total* | **2.5** | **0.75** |
| **Sub shrubs** | | |
| | 0.5 | 0 |
| **Forbs** | | |
| | **0.5** | **0.1** |
| **Grasses** | | |
| Grasses primary coloniser | 5.0 | 5.0 |
| Grasses long term understorey | 5.5 | 10.5 |
| Grasses long term understorey shade tolerant | 1.5 | 1.5 |
| *Grasses total* | **12.0** | **17.0** |
| **Monocots (other than grasses)** | | |
| | **0.5** | **0.25** |
| **TOTAL** | **17.0** | **18.5** |

Hand seeding or tractor mounted sowing equipment will spread seed as soon as practicable after soil preparation. Areas designated as grasslands are sown to pasture, with a low rate of tree and shrub seed designed to produce a lightly wooded pasture. Tree and shrub species may be used more extensively on the steeper slopes, which are less suitable for grazing. In these areas, belts of grasses may be used to help control erosion during the tree establishment phase. Hydro-mulching or hay mulching may be used for seeding on slopes that are inaccessible to tractors.

Cover crops, suited to the sowing time, are used to provide erosion protection and allow for subsequent weed control prior to sowing the long-term seed mixes.

Trialling of various seeding methods and equipment will be undertaken during the MOP period to allow effective sowing of a diverse native seed mix. The different shapes, sizes and weights of native seed make it difficult to broadcast through traditional sowing equipment so alternative methods, including direct drill machines, have already been tested and proven.

#### 7.2.4.2.1 Revegetation schedule

The areas scheduled for rehabilitation during the term of this MOP are shown on **Maps 3A** to **3G**. The conventional landform rehabilitated slopes constructed under this application will not exceed an overall slope of 10 degrees unless an exemption has been approved. There may be localised steepening of slopes for drainage structures. Slopes will be variable on the new landforms designed using a geomorphological landform design approach. Steeper slopes will tend to be located high in the catchment and be short in length to limit the erosive power of run-off on these slopes.

Variations in the Business Plan may cause changes to the mine plan and consequently the dump plan and eventually the rehabilitation schedule.

## 7.3 Rehabilitation Summary Table

The change in areas of each domain during the MOP period is summarised in Table 41 and Table 42.

**Table 41 Summary of proposed rehabilitation during MOP, split by Primary Domain**

| Primary Domain | Total Area at MOP start[1] (hectares) | Total Area at MOP end (hectares) |
|---|---|---|
| **Final Void** | | |
| *Active* | ~~107.6~~ 111.3 | ~~465.6~~ 472.7 |
| *Decommissioning* | 0 | 0 |
| *Landform Establishment* | 0 | 0 |
| *Growth Medium Development* | 0 | 0 |
| *Ecosystem Establishment* | 0 | 0.1 |
| *Ecosystem Development* | ~~1.1~~ 0.0 | ~~1.1~~ 4.0 |
| *Rehabilitation Complete* | 0 | 0 |
| **Water Management Area** | | |
| *Active* | ~~53.8~~ 66.0 | ~~54~~ 68.6 |
| *Decommissioning* | 0 | 0 |
| *Landform Establishment* | ~~0~~ 6.2 | 0 |
| *Growth Medium Development* | 0 | 0 |
| *Ecosystem Establishment* | 0 | 0 |
| *Ecosystem Development* | 1.7 | ~~1.9~~ 5.2 |
| *Rehabilitation Complete* | 0 | 0 |
| **Infrastructure Area** | | |
| *Active* | 169.7 | ~~169.6~~ 169.2 |
| *Decommissioning* | 0 | 0 |
| *Landform Establishment* | 0 | 0 |
| *Growth Medium Development* | 0 | 0 |
| *Ecosystem Establishment* | 0 | 0 |
| *Ecosystem Development* | 5.4 | ~~5.3~~ 5.9 |
| *Rehabilitation Complete* | 0 | 0 |
| **Tailings Storage Facility** | | |
| *Active* | ~~213.9~~ 181.1 | ~~130.2~~ 131.0 |
| *Decommissioning* | 0 | 0 |
| *Landform Establishment* | ~~0~~ 33.5 | 0 |
| *Growth Medium Development* | 0 | 0 |
| *Ecosystem Establishment* | 0 | ~~0~~ 33.7 |
| *Ecosystem Development* | 29 | ~~112.7~~ 79.0 |

[1] Data source 2014 AEMR.

| Primary Domain | Total Area at MOP start[1] (hectares) | Total Area at MOP end (hectares) |
|---|---|---|
| *Rehabilitation Complete* | *0* | *0* |
| **Overburden Emplacement** | | |
| *Active* | ~~*2005.7*~~ *1,953.2* | ~~*1571.8*~~ *1,614.4* |
| *Decommissioning* | *0* | *0* |
| *Landform Establishment* | ~~*10.6*~~ *36.0* | *0* |
| *Growth Medium Development* | *0* | *0* |
| *Ecosystem Establishment* | ~~*104.2*~~ *84.3* | ~~*89.1*~~ *72.2* |
| *Ecosystem Development* | ~~*780.6*~~ *816.7* | ~~*1320.5*~~ *1,301.2* |
| *Rehabilitation Complete* | *0* | *0* |

**Table 42 Summary of proposed rehabilitation during MOP, split by Secondary Domain**

| Secondary Domain | Total Area at MOP start[2] (hectares) | Total Area at MOP end (hectares) |
|---|---|---|
| **Final Void** | | |
| *Active* | ~~*107.6*~~ *111.3* | ~~*465.6*~~ *472.7* |
| *Decommissioning* | *0* | *0* |
| *Landform Establishment* | *0* | *0* |
| *Growth Medium Development* | *0* | *0* |
| *Ecosystem Establishment* | *0* | *0.1* |
| *Ecosystem Development* | ~~*1.1*~~ *0* | ~~*1.1*~~ *4.0* |
| *Rehabilitation Complete* | *0* | *0* |
| **Water Management Area** | | |
| *Active* | *0* | *0* |
| *Decommissioning* | *0* | *0* |
| *Landform Establishment* | *0* | *0* |
| *Growth Medium Development* | *0* | *0* |
| *Ecosystem Establishment* | *0* | *0* |
| *Ecosystem Development* | *0* | ~~*1.9*~~ *0* |
| *Rehabilitation Complete* | *0* | *0* |
| **Rehabilitation Area - Grassland** | | |
| *Active* | ~~*580.7*~~ *569.0* | ~~*476.5*~~ *510.8* |
| *Decommissioning* | *0* | *0* |
| *Landform Establishment* | ~~*0*~~ *3.2* | *0* |
| *Growth Medium Development* | *0* | *0* |

[2] Data source 2014 AEMR.

| Secondary Domain | Total Area at MOP start[2] (hectares) | Total Area at MOP end (hectares) |
|---|---|---|
| *Ecosystem Establishment* | ~~5.6~~ *17.2* | ~~33.3~~ *33.7* |
| *Ecosystem Development* | ~~557.6~~ *556.5* | ~~661.4~~ *659.8* |
| *Rehabilitation Complete* | *0* | *0* |
| **Rehabilitation Area – Woodland Other** | | |
| *Active* | ~~1544.2~~ *326.8* | ~~1190.3~~ *252.8* |
| *Decommissioning* | *0* | *0* |
| *Landform Establishment* | *0* | *0* |
| *Growth Medium Development* | *0* | *0* |
| *Ecosystem Establishment* | ~~98.6~~ *0.5* | ~~55.8~~ *0* |
| *Ecosystem Development* | ~~246.5~~ *13.8* | ~~698.5~~ *88.4* |
| *Rehabilitation Complete* | *0* | *0* |
| **Rehabilitation Area – Woodland EEC** | | |
| *Active* | ~~318.1~~ *1,474.2* | ~~258.7~~ *1,222.1* |
| *Decommissioning* | *0* | *0* |
| *Landform Establishment* | ~~0~~*72.5* | *0* |
| *Growth Medium Development* | *0* | *0* |
| *Ecosystem Establishment* | ~~0~~ *66.6* | ~~0~~ *72.1* |
| *Ecosystem Development* | ~~12.6~~ *282.5* | ~~78.7~~ *643.3* |
| *Rehabilitation Complete* | *0* | *0* |

# 8.0 Rehabilitation Monitoring and Reporting

## 8.1 Monitoring

### 8.1.1 Timeframes for the Implementation of the Monitoring Program

During the MOP period a monitoring programme will be developed and implemented to assess the recovery of rehabilitation areas across the site. Information from monitoring of analogue sites has been used to inform the setting of targets for performance criteria.

### 8.1.2 Methodology

The monitoring program will be based on the performance indicators outlined in Section 6.4 to Section 6.10 and will utilise methodologies that can provide quantitative data to assess changes occurring over time.

A consistent and quantitative methodology will be implemented and undertaken on a periodic basis, ensuring a satisfactory number of analogue/baseline sites are established to inform target setting. Data from analogue sites will be used to establish target values for key biophysical parameters and indicators related to vegetation diversity/structure and habitat complexity. Permanent quadrats will be established and reassessed at a maximum of two year intervals, at least in the short term, to ensure restorative strategies (i.e. maintenance of soil health, maintenance of ground cover, achievement of suitable species richness etc.) are progressing as desired.

In new revegetation sites, an annual monitoring program will be required as the site rapidly changes and can be vulnerable to effects of climates, pests and diseases. In addition, general inspections for erosion (particularly drainage lines), survival, mortality, weed control and pests will be undertaken more regularly and at least biannually until the sites have become well established. The duration between monitoring periods can be lengthened to five yearly intervals once it has been established that the restorative strategies are appropriate and that conservation objectives are being met. Inspections of drainage lines in rehabilitation areas will be conducted on a quarterly basis during the first year

The monitoring methodology adopted is a standard and simple procedure that can be replicated over any vegetation community or rehabilitation area and allows results to compare similar communities. The methodology uses a combination of:

- Landscape Function Analyses (CSIRO Tongway and Hindley 1996);
- accredited soil analyses and various measures of ecosystem diversity and habitat values (adapted from CSIRO Gibbons 2002) and
- the Biobanking Assessment Methodology - Site Value Score (OEH 2014).

This combination of approaches allows a site to be assessed over time with the resultant data enabling the user to assess the trajectory of the ecosystem being monitored whilst also providing an overall assessment of lands in terms of land capability. In turn, this data can be used to decide if the site is converging on a target functional state or requires further works. An overview of the monitoring methodology is provided in Sections 8.1.3 to 8.1.6 of this report.

### 8.1.3 LFA Methodology

LFA is a methodology used to assess key indicators of ecosystem function including landscape organisation and soil surface condition as a measure of how well the landscape retains and uses vital resources. The indicators used quantify the utilisation of the vital landscape resources of water, topsoil, organic matter and perennial vegetation in space and time.

LFA methodology collects data at two “nested” spatial scales.

- At coarse scale, landscape organisation is characterised. Patches and interpatches, indicators of resource regulation, are mapped at the 0.5 to 100 m scale from a gradient-oriented transect (making sense of landscape heterogeneity); and
- At fine scale, soil surface assessment (soil “quality”) examines the status of surface processes at about the 1-m scale, with rapidly assessed indicators on the patches and interpatches identified at coarse scale.

### 8.1.4 Soil Analyses

Soil samples are to be undertaken using standard soil sampling techniques with a core sampler within the monitoring quadrat. Cores are to be taken at each site and bulked together. Soil samples are to be sent to an accredited laboratory for analysis. Soil analysis consist of assessing the parameters, pH, EC, Available Ca, Mg, K, Ammonia, sulphur, organic matter, exchangeable Na, Ca, Mg, K, H, Al, cation exchange capacity, available and extractable phosphorus, micronutrients (Zn, Mn, Fe, Cu, B), Total Carbon and Nitrogen. To assist in the interpretation of the data a report with analysis and appropriate recommendation is to be provided by the laboratory.

### 8.1.5 Monitoring structural diversity, floristics and other biodiversity attributes

Permanent transects and photo-points will be established to record changes in these attributes over time.

The methodology is to provide quantitative data that measures changes in:

- Floristic diversity including species area curves and growth forms;
- Ground cover diversity and abundance;
- Vegetation structure and habitat characteristics (including ground cover, cryptogams, logs, rocks, litter, projected foliage cover at various height increments);
- Understorey density and growth (including established shrubs, direct seeding and tubestock plantings and tree regeneration);
- Overstorey characteristics including tree density, health and survival; and
- Other habitat attributes such as the presence of hollows, mistletoe and the production of buds, flowers and fruit.

### 8.1.6 Assessment of Site Value

Site Value is the quantitative measure which forms part of the *Biobanking Assessment Methodology* (OEH 2014) and is a quantitative measure of the condition of native vegetation assessed for each vegetation zone. This value can be used to determine the condition of the certain habitat attributes used by threatened species on the site. The calculation of the Site Value Score is determined from the assessment of the data obtained from the defined transect and then compared to benchmark ranges obtained from local reference sites. Details on the scoring and weighting of the site attributes are provided in Table 1 of *Biobanking Assessment Methodology* (OEH 2014).

## 8.2 Reporting

The following reporting will be undertaken in keeping with the requirements of Schedule 5 of the Project Approvals for managing and reporting any incidents, complaints, non-compliances with statutory requirements and exceedance of the impact assessment criteria and / or performance criteria:

- Amendments to the Environmental Management ~~System~~ Strategy which incorporates components of the monitoring and reporting program;
- Incident reporting mechanism;
- Annual Environmental ~~Management Report~~ Review;
- Independent Environmental Audit;
- Community Consultative Committee; and
- Access to information via the project website which is updated regularly.

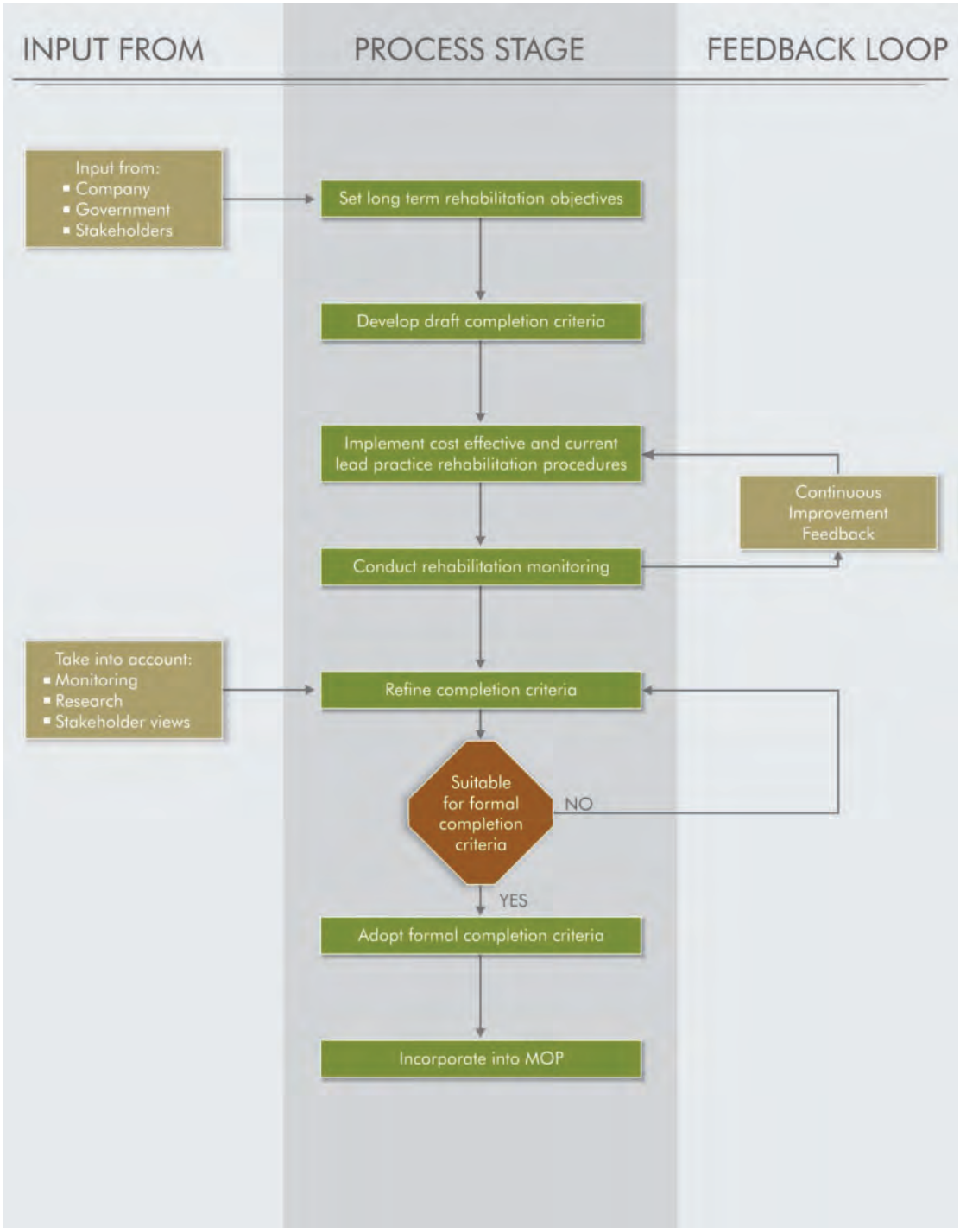
The Annual Environmental Review will be submitted annually to DoEE to meet the mine site rehabilitation reporting requirements of Clause 11c of the Warkworth federal government approval EPBC 2009/5081.

The monitoring, review and implementation of this MOP will be the responsibility of the MTW Environmental Specialist – Rehabilitation with support from the MTW Environment & Community~~al Services~~ team.

Rehabilitation is an iterative process which allows activities to be defined and improved upon throughout the lifetime of the mine. Monitoring of rehabilitation successes and failures will enable lessons learnt in early years of rehabilitation to be applied in subsequent and later years. It will also ensure that continuous improvement in the

site's performance in terms of landscape and landuse is achieved. An example of an iterative, continual improvement approach to mine site rehabilitation which may be implemented is shown in Figure 5 (based on Nichols, 2005).

**Figure 5 Continuous Improvement including Monitoring and Review Process (based on Nichols 2005)**



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# 9.0 Trigger Action Response Plan

The following Trigger Action Response Plan (TARP) identifies the proposed contingencies strategies in the event of unexpected variations or impacts to rehabilitation outcomes. A risk-based approach has been used to assess the potential consequences and mitigation measures in terms of the Consequence Category – Environment.

The key risks associated with site rehabilitation have been assessed using the likelihood ratings, maximum reasonable consequence ratings, risk matrix and classifications (*HSEQ Qualitative Risk Assessment* Rio Tinto (Jan 2008) presented in Section 4.1.

Table 43 outlines the key identified risks and associated risk ratings. The ratings assume that the risks are untreated i.e. have not been addressed by specific risk mitigation measures other than routine design and operational practice.

**Table 43 Key risks associated with site rehabilitation and land management**

| Risk | Risk Rating | Consequence Rating | Risk Classification |
|---|---|---|---|
| Earthquake leading to failure and instability of void walls or TSF embankments. | E | 2 | Low |
| Continuous off-site release of contaminants from mined materials requiring long term management or treatment | C | 3 | High |
| Inadequate or insufficient topsoil to create/enhance the desired ecological communities on offset areas. | C | 3 | High |
| Wind and water erosion | C | 2 | Moderate |
| Inadequate weed and vertebrate pest animal control leading to widespread failure of revegetation or continued sustainability of offset area ecosystems. | C | 3 | High |
| Insufficient or inadequate (incorrect species mix/quality) seed/seedlings for enhancement/rehabilitation of offset areas. Poor establishment success. | C | 2 | Moderate |
| Insect attack diseases etc. | C | 3 | High |
| Lack of follow up maintenance | A | 4 | High |
| Stratification and overturning of void waters leading to environmental impacts. | D | 3 | Moderate |
| Inappropriate bushfire regime leading to widespread failure of revegetation or continued sustainability of offset area ecosystems. | C | 3 | High |
| Spontaneous combustion of coal seam leading to environmental impacts or property damage. | D | 3 | Moderate |
| Major storm event resulting in flooding, geotechnical instability, major erosion and/or widespread damage to rehabilitated areas. | C | 3 | High |
| Severe and/or prolonged drought leading to widespread failure of revegetation. | C | 3 | High |
| Changing climate leading to failure of rehabilitation, failure of environmental management controls and/or inability to attain completion criteria. | C | 2 | Moderate |
| New regulatory requirements or evolving community expectations leading to difficulties negotiating or attaining completion criteria. | C | 3 | High |

The following Trigger Action Response Plan (TARP) identifies the proposed contingency strategies in the event of unexpected variations or impacts to rehabilitation outcomes. A risk-based approach has been used to assess the potential consequences and mitigation measures in terms of the Consequence Category – Environment. Where necessary, rehabilitation procedures will be amended accordingly, with the aim of continually improving rehabilitation standards. ~~Coal & Allied~~ MTW will notify ~~DI~~ DP&E and other relevant stakeholders of any incident resulting in major impacts to rehabilitation. The TARP includes:

- Identification of the principal contributing factors and impacts for each major risk to rehabilitation;
- Identification of upper limits (trigger values) for causes and impacts that are considered to represent an unacceptable level of risk; and
- Identification of appropriate responses to mitigate or remediate the causes and impacts, including a notification protocol.

The TARP provides management responses for lower (first tier) and upper (second tier) trigger values. First tier trigger values identify opportunities for closer monitoring or early intervention that may mitigate potential impacts before notable impact to rehabilitation occurs. Second tier trigger values identify when indicators have reached a threshold that requires more substantive or widespread remedial actions to remediate or mitigate rehabilitation failure.

The TARP is presented in Table 44 below, and will be reviewed and may be revised as conditions at MTW change or new risks to rehabilitation are identified.

**Table 44 Trigger Action Response Plan – Rehabilitation and Closure**

| Aspect/ Category | Item | Element | Trigger | Response |
|---|---|---|---|---|
| Landform Stability | 1 | Water Management Structures | Water management structures (sediment dams, channels, contour banks) erosion &/or scouring | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as amelioration, revegetation or alternative scour protection as required.<br>For significant failures or repeat minor failures conduct review of design criteria and construction standards. |
| | 2 | Conventional Landform Slope Gradient – General | Overall slope grades > 10 degrees unless otherwise agreed. | Undertake a review of the landform design, including survey if required. Undertake re-grading and revegetation of the area, if required. Note, localised steepening of slopes will occur due to contour bank construction etc. |
| | 3 | Conventional Landform Slope Gradient – Ramps | Overall slope grades > 14 degrees unless otherwise agreed. | Undertake a review of the landform design, including survey if required. Undertake re-grading and revegetation of the area, if required. Note, localised steepening of slopes will occur due to contour bank construction etc. |
| | 4 | Conventional Landform Slope Gradient – Low Walls Into Voids | Overall slope grades > 18 degrees unless otherwise agreed. | Undertake a review of the landform design, including survey if required. Undertake re-grading and revegetation of the area, if required. Note, localised steepening of slopes will occur due to contour bank construction etc. |
| | 5 | Geofluv Landform Slope Gradient | Active rill/gully erosion | Undertake a review of the landform design, including survey if required. Undertake re-grading, surface treatment and revegetation of the area, if required.<br>For widespread erosion activity review methods for erosion risk assessment and control measures. |
| | 6 | Geofluv Landform Drainage Lines | Drainage line erosion &/or scouring | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as amelioration, revegetation or alternative scour protection as required.<br>For significant failures or repeat minor failures conduct review of design criteria and construction standards. |

| Aspect/ Category | Item | Element | Trigger | Response |
|---|---|---|---|---|
| | 7 | Batter Slopes – Final Void | Failure of final void batter slopes. | Undertake a review of final void design, including survey if required. Undertake remedial blasting &/or re-grading of the area, if required. |
| | 8 | TSF Final Capping Surface | Settlement of tailings causing ponding of water on TSF capping surface. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as backfilling, reinstating drainage lines and revegetating as required. |
| Spontaneous Combustion | 9 | Carbonaceous Material on Surface of Rehabilitation | Active spontaneous combustion within rehabilitation areas. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as extinguishment by watering, capping with inert material or excavation and removal as required.<br>For widespread spontaneous combustion activity review management measures for carbonaceous material. |
| | 10 | Exposed Coal Seams | Active spontaneous combustion from exposed coal seams. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as extinguishment by watering or flooding or burial with inert material as required.<br>For widespread spontaneous combustion activity review management measures for covering exposed coal seams. |
| Growth Medium Suitability | 11 | Acid Rock Drainage | Evidence of ARD products affecting vegetation establishment. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as capping with inert material and revegetating as required.<br>For widespread ARD activity review management measures for burial of potential ARD producing material. |
| | 12 | Chemical and Nutritional Properties | Soil properties atypical for the surrounding landscape &/or outside desirable ranges provided by the agricultural industry:<br>Pasture Trigger Levels<br>pH <5.5 or >8.5; Electrical Conductivity >2 dS/m; Phosphorous <40ppm; Organic Carbon <1.5%; Cation Exchange Capacity <12 Cmol+/kg; | Engage a consultant to recommend appropriate soil/spoil amelioration. Undertake amelioration and revegetation in accordance with the consultant recommendations as required. |

| Aspect/ Category | Item | Element | Trigger | Response |
|---|---|---|---|---|
| | | | Exchangeable Sodium Percentage >10%; and Calcium/magnesium ratio <1 or >10.<br><br><u>Woodland Trigger Levels</u><br><br>pH <5.5 or >8.5; Electrical Conductivity >2 dS/m; Phosphorous and Organic Carbon not within levels in analogue sites by Year 5; Cation Exchange Capacity, Exchangeable Sodium Percentage and Calcium/magnesium ratio not within levels in analogue sites by Year 2. | |
| | 13 | Growth Medium Depth | Soil depth (topsoil and ameliorates) is less than 100mm in areas in the Growth Medium Development phase. | Top dress with additional suitable topsoil resource and /or ameliorants if required.<br>For repeat topsoil thickness issues conduct review of topsoil placement procedures and operational practices. |
| Vegetation Establishment | 14 | Weed Levels | >10% cover of problematic weed species present in Ecosystem Establishment phase. | Engage land management contractor to control problematic weed using methods such as removal, biological control, herbicide application and slashing. Treatment of infestations as appropriate to the species. Conduct follow-up inspections to assess the effectiveness of weed management measures. |
| | 15 | Bushfire Resilience | Rehabilitation areas not able to recover in a reasonable time from effects of bushfire. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as re-seeding affected area as required.<br><br>Review bushfire management procedures particularly with a view to protecting young rehabilitation areas. |
| | 16 | Uncontrolled Entry of Livestock or Vehicles | Damage to vegetation caused by uncontrolled access by livestock or vehicles. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as fence installation or repairs, maintaining access tracks and sign posting. |

| Aspect/ Category | Item | Element | Trigger | Response |
|---|---|---|---|---|
| | 17 | Understorey Species Diversity | Understorey species diversity atypical compared to analogue sites.<br><br>Trigger levels still to be determined for understorey diversity in Grassland, Woodland – Other and Woodland – EEC areas. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as grazing, controlled burning, soil amelioration, reseeding and fertilising as required.<br><br>For widespread low understorey diversity review seed mix understorey species composition and seeding rates. Review monitoring results to determine rates of successful establishment for various understorey species in seed mixes. |
| | 18 | Tree and Shrub Species Diversity | Tree and shrub species diversity atypical compared to analogue sites.<br><br>Trigger levels still to be determined for tree and shrub diversity in Woodland – Other and Woodland – EEC areas. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as cultivation or spraying to reduce grass competition, reseeding and fertilising as required.<br><br>For widespread low tree and shrub diversity review seed mix tree/shrub species composition and seeding rates. Review monitoring results to determine rates of successful establishment for various tree/shrub species in seed mixes. |
| | 19 | Tree Density | Tree density is outside typical range for analogue sites.<br><br>~~Trigger levels still to be determined for tree density in Woodland – Other and Woodland – EEC areas.~~ | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as cultivation or spraying to reduce grass competition, reseeding (for low density) and thinning (for high density) as required.<br><br>For widespread tree density outside analogue site ranges review seed mix tree species composition and seeding rates. Review monitoring results to determine rates of successful establishment for various tree species in seed mixes. Review seed bed preparation, weed/grass control and sowing procedures. |
| | 20 | Ground Cover | Total ground cover < 70% during Ecosystem Establishment phase. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration, soil aeration, reseeding and fertilising as required.<br><br>For widespread low results for total ground cover review seasonal mixes and seeding rates. |
| | 21 | Tree Growth Rate | Average trunk diameter (dbh) of the tree population measuring growth rate are atypical compared to analogue sites. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration and fertilising as required. |

| Aspect/ Category | Item | Element | Trigger | Response |
|---|---|---|---|---|
| | | | ~~Trigger levels still to be determined for tree growth rate in Woodland – Other and Woodland – EEC areas.~~ | For widespread low results for tree growth rate review soil amelioration and preparation procedures. |
| | 22 | Tree Health | Tree health is atypical compared to analogue sites.<br>Trigger levels still to be determined for tree health in Woodland – Other and Woodland – EEC areas. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration and fertilising as required.<br>For widespread low results for tree health review land management practices with a view to increasing biodiversity to provide habitat for pest insect predators. |
| | 23 | Tree Productive Health and Recruitment | Tree health and recruitment levels are atypical compared to analogue sites.<br>Trigger levels still to be determined for tree productive health and recruitment in Woodland – Other and Woodland – EEC areas. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration and fertilising as required.<br>For widespread low results for tree productive health review land management practices with a view to increasing biodiversity to provide habitat for pollinators. |
| Fauna Recolonisation | 24 | Vertebrate Pest Levels | Vertebrate pest species density increased in annual monitoring events or causing significant damage to rehabilitation. | Consult with relevant government agencies (including OEH) to develop and implement appropriate vertebrate pest control programme. |
| | 25 | Habitat – Fallen Logs | Total length of fallen logs in Woodland – EEC areas is <50% that of analogue sites.<br>~~Target level still to be determined for Woodland – EEC analogue sites.~~ | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as introducing additional fallen timber (consider pruning or thinning standing trees) as required.<br>For widespread low results for fallen logs review land management practices with a view to reducing loss of logs through regular bush fires or fire wood collection. |
| | 26 | Habitat- Hollows | Total length of hollows/ nesting sites in Woodland – EEC areas is <50% that of analogue sites.<br>~~Target level still to be determined for Woodland – EEC analogue sites.~~ | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as introducing stag trees or nest boxes as required. |

| Aspect/ Category | Item | Element | Trigger | Response |
|---|---|---|---|---|
| Ecosystem Function | 27 | Stability, Infiltration and Nutrient Cycling | LFA indices values for stability, infiltration, nutrient cycling or landscape organisation are trending away from the values of analogue sites. | An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration, soil aeration, reseeding and fertilising as required.<br><br>For widespread negative trends for LFA indices review rehabilitation procedures related to soil amelioration and preparation. |

# 10.0 Research and Rehabilitation Trials

## 10.1 Mixed Source Compost Trials

Trials commenced in 2011 using mixed source compost as a soil ameliorant in rehabilitation activities. This material is being assessed against the more traditional chemical fertilisers. The purpose of the trials is to ascertain the effectiveness of compost in both areas of pasture mix and diverse tree / shrub/ understorey native species mix. The material is also being assessed in context of two substrates with topsoiled and spoil areas being used in the trial. Investigations have also being undertaken in relation to the inoculation of the compost stockpiles to mitigate odour nuisance for onsite personnel whilst also improving the agronomic properties of the compost.

## 10.2 Native Understorey Establishment Trials

The native vegetation seed mixes used for rehabilitation activities at MTW were modified in 2011 to include more native understorey species diversity. Trials are also being undertaken in relation to the sowing techniques for the native seed with previous trials of hydro seeding, hand broadcasting and a triple–disc direct drill machine with a native seed box. The direct drill has proved to be the most cost-effective method and has the added benefit of placing seed at the desired depth and providing seed/soil contact rather than broadcasting seed on the surface.

Banded seed mixes have been assessed to determine if sowing separate bands of tree/shrub seed and native understorey seed is more efficient for establishing trees and shrubs with a diverse native understorey. Results of previous trials indicated that banded seed mixes were not more effective at establishing the desired vegetation so the seed mixes being used have all of the various strata combined.

## 10.3 Carlson Regrade Landform Investigation

The purpose of this study is to investigate the effect on dump volume and dump extents (i.e. dump limits and heights) from using the Carlson package to design the landform. It is understood that the benefits of using Carlson Regrade is that it will produce more natural looking landforms with inherent stability, removing the need for contour drains and rock lined drop structures to convey water off slopes.

## 10.4 Fire Trials

Testing the resilience of rehabilitation areas to disturbance by fire will be an important component of understanding the long term sustainability of rehabilitation. MTW will conduct pre-burn and post-burn monitoring of rehabilitation areas to gain information on erosional stability and vegetation recovery following prescribed and/or accidental burning.

## 10.5 Other Research and Trials

Coal and Allied has undertaken, and Yancoal will continue~~s~~ to undertake extensive research into rehabilitating open cut mines in the Hunter Valley. Research is undertaken in conjunction with organisations such as DPI, NSW State Forests and the NSW Minerals Council. Some examples of research undertaken and rehabilitation techniques developed as a result of the research includes:

- Establishing forests by direct seeding into overburden emplacements or CPP reject without topsoil;
- Growing pastures on overburden emplacements with and without topsoil;
- Developing a sustainable pasture mix that provides year round grazing capacity;
- Managing rehabilitated areas so that viable grazing land is maintained;
- Commercial forestry trials;
- Nutrient cycling in rehabilitated mine spoils;
- Phytoremediation treatment of hydrocarbon contaminated soils;
- Trialling the performance of rehabilitation areas as grazing land.

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# 11.0 Review and Implementation

## 11.1 Review

This Section provides the Protocol for periodic review of this MOP. Reviews are conducted to assess the effectiveness of the procedures against the objectives of MOP. The MOP will be reviewed, and if necessary revised, within three months of the submission of an:

- Annual review which has been undertaken as per Schedule 5 – Condition 4 of the Project Approvals;
- Incident report which has been undertaken as per Schedule 5 – Condition 7 of the Project Approvals;
- Audit which has been undertaken as per Condition Schedule 5 – 9 of the Project Approvals; and
- Any modification to the conditions of the Approval.

This MOP may also be revised due to:

- Deficiencies being identified;
- Results from the monitoring and review program;
- Recommendations resulting from the monitoring and review program;
- Changing environmental requirements;
- Improvements in knowledge or technology become available;
- Change in legislation;
- Where a risk assessment identifies the requirement to alter the MOP; and
- Change in the activities or operations associated with MTW Mine.

Any major amendments to the MOP that affect its application will be undertaken in consultation with the appropriate regulatory authorities and stakeholders. Minor amendments to the MOP, such as formatting edits may be made with version control on the ~~Coal & Allied~~ MTW website.

## 11.2 Implementation

Table 45 defines personnel who are responsible for the monitoring, review and implementation of this MOP.

**Table 45 Responsibilities for Implementation of the MOP**

| Title | Responsibility |
|---|---|
| Mine Manager | • Implement the procedures referenced in this MOP.<br>• Undertake training in relevant Management Plans and procedures as required.<br>• Provide resources required and support to implement these procedures.<br>• Construct landforms in accordance with this MOP.<br>• Develop dumping strategies to allow for progressive rehabilitation of mined land. |
| Technical Service Manager | • Implement the procedures referenced in this MOP.<br>• Undertake training in relevant Management Plans and procedures as required.<br>• Provide resources required to implement these procedures.<br>• Develop mine plans to allow for progressive rehabilitation of mined land. |
| Environmental Specialist | • Prepare the relevant Management Plans. |

| Title | Responsibility |
|---|---|
| | • Implement, monitor and review the programs and procedures linked to this MOP.<br>• Consult with regulatory authorities as required.<br>• Undertake monitoring as required.<br>• Undertake maintenance as required.<br>• Provide measures for continual improvement to this MOP and procedures.<br>• Ensure all personnel undertaking works in relation to this MOP are trained and competent.<br>• Report the progress of any rehabilitation and monitoring of biodiversity in the AER ~~AEMR~~. |
| Environment – Advisor | • Provide support for the implementation of the Specialist Environment's responsibilities. |

# 12.0 Rehabilitation Maps

The Rehabilitation Maps are the core of the MOP. These maps assist to describe the full rehabilitation and closure process of the mine site. The maps include:

- Maps 1A – 1C show the landuse prior to the commencement of the MTW operations, whilst also showing current land ownership and relevant cadastre information;
- Map 2 shows the mine domains and the mining features at commencement of the MOP;
- Maps 3A – 3G are a series of maps which show the annual sequence of mining and rehabilitation activities over the term of the MOP; and
- Map 4 shows the proposed post mining land use and landform at the completion of the project.
- Map 5 shows vertical and longitudinal cross section

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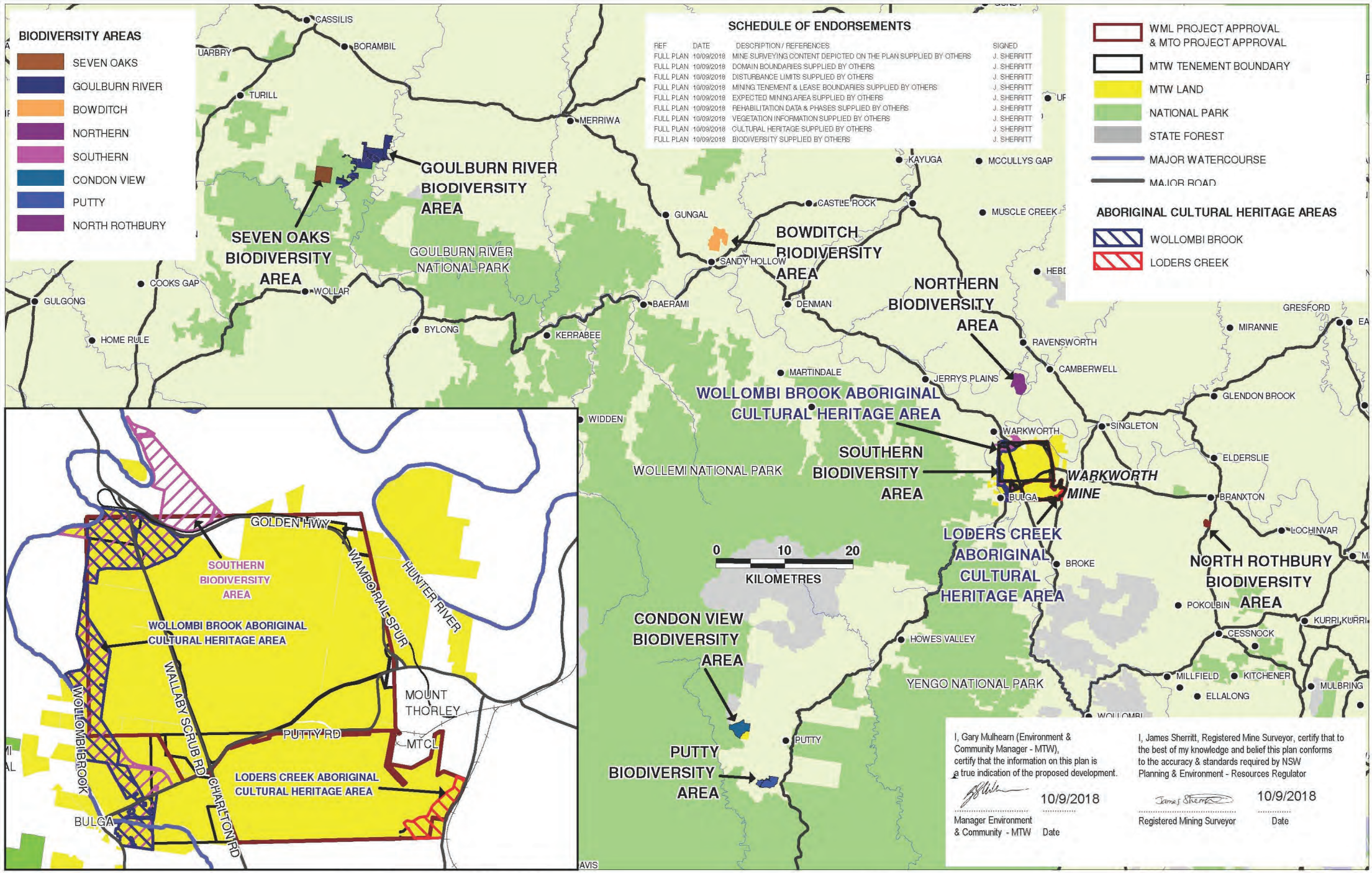


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**Mine Operations Plan 2015**
**Mt Thorley Warkworth**
**Plan 1A - Pre-mining Environment - Project Locality**

| | |
|---|---|
| Date: | 10/09/18 |
| Produced By: | SC |
| Map Size: | A4 Landscape |
| Coordinate System: | MGA94 Zone 56 |
| Revision | 01 |
| Data Source | Various |

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I, Gary Mulhearn (Environment & Community Manager - MTW), certify that the information on this plan is a true indication of the proposed development.

.....10-9-2018.....

Manager Environment & Community - MTW Date

I, James Sherritt, Registered Mine Surveyor, certify that to the best of my knowledge and belief this plan conforms to the accuracy & standards required by NSW Planning & Environment - Resources Regulator

10/9/2018

Registered Mining Surveyor Date

## SCHEDULE OF ENDORSEMENTS

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| FULL PLAN | 10/09/2018 | MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS | J. SHERRITT |
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| FULL PLAN | 10/09/2018 | EXPECTED MINING AREA SUPPLIED BY OTHERS | J. SHERRITT |
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- WML PROJECT APPROVAL & MTO PROJECT APPROVAL
- WARKWORTH SAND SHEET
- BIODIVERSITY AREA
- EXISTING REHABILITATION AT END OF 2014
- FLOOD PRONE LAND - 1:100 YEAR
- MAJOR WATERCOURSE
- PRE MINING CONTOUR (5M INTERVAL)
- SECTION LINE

## Cultural Heritage

- AXE GRINDING GROOVES
- ISOLATED STONE ARTEFACT/S
- ISOLATED STONE ARTEFACT/S / SHELL MATERIAL
- ISOLATED STONE ARTEFACT/S / STONE SOURCE
- OTHER
- SCARRED TREE
- STONE ARTEFACT SCATTER
- STONE ARTEFACT SCATTER / KNAPPING FLOOR
- STONE SOURCE

## Vegetation Communities

- Central Hunter Grey Box - Ironbark Derived Grassland
- Central Hunter Grey Box - Ironbark Grassland
- Central Hunter Grey Box - Ironbark Woodland
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest
- Exotic
- Hunter Lowlands Redgum Forest
- Hunter Valley River Oak Forest
- Hunter Valley Vine Thicket
- Regenerating Central Hunter Grey Box - Ironbark Woodland
- Regenerating Hunter Valley River Oak Forest
- River Red Gum Floodplain Woodland
- Warkworth Sands Grassland
- Warkworth Sands Grassland (2003 Consent)
- Warkworth Sands Woodland
- Warkworth Sands Woodland (2003 Consent)
- White Box Woodland (C/EEC)
- Yellow Box Woodland (C/EEC)

NOTE:
BOUNDARIES SHOWN APPROXIMATE AND SUBJECT TO SURVEY
MAIN AERIAL PHOTO OVER MINE SITE FLOWN JULY 2018

0 1 2 KILOMETRES

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 1B - Pre-mining Environment - Natural Environment

| | |
|---|---|
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| Revision | 01 |
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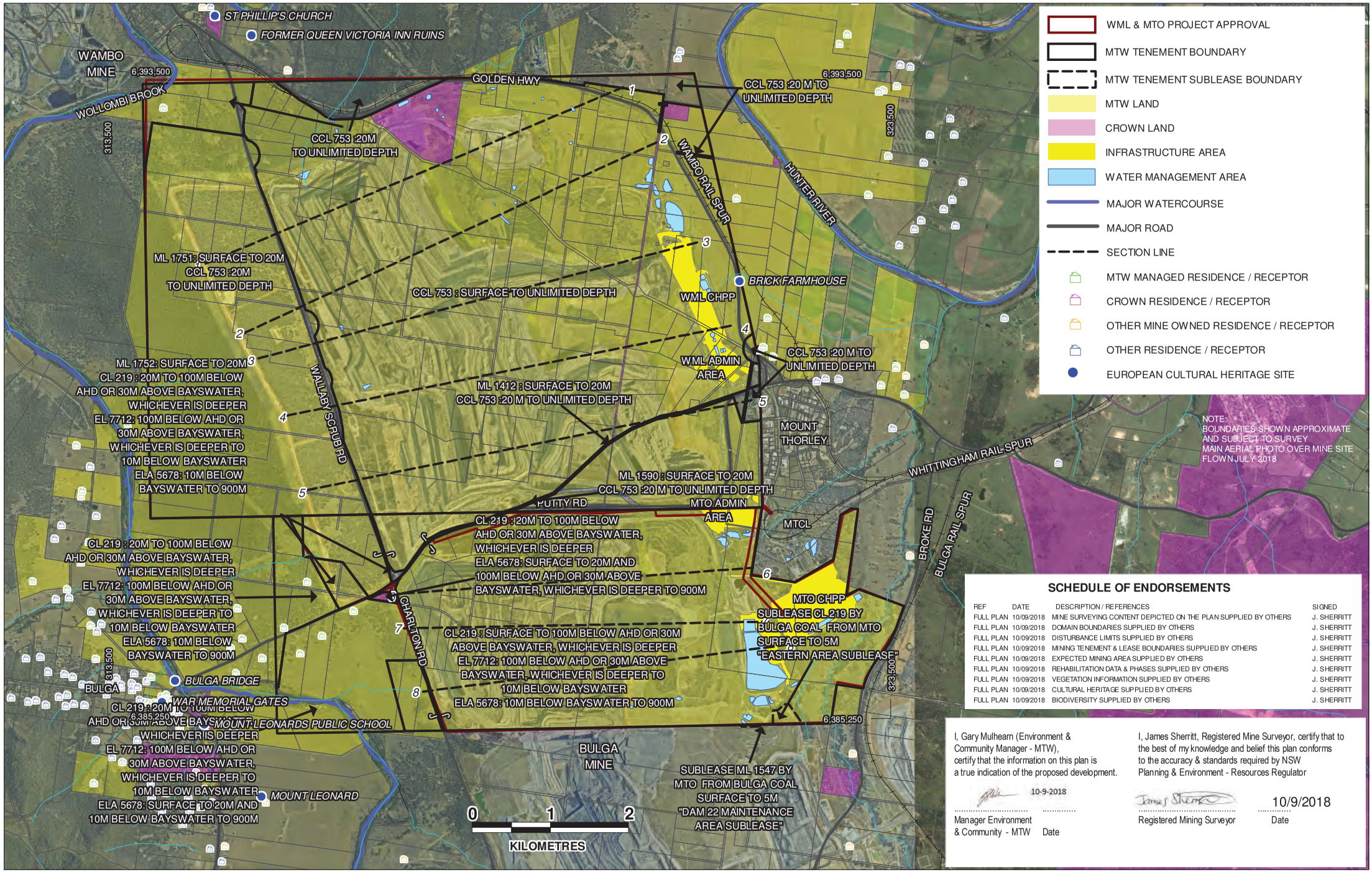


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10-9-2018

Manager Environment & Community - MTW — Date

I, James Sherritt, Registered Mine Surveyor, certify that to the best of my knowledge and belief this plan conforms to the accuracy & standards required by NSW Planning & Environment - Resources Regulator

Registered Mining Surveyor — 10/9/2018 — Date

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 1C - Pre-mining Environment - Built Environment

| | |
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| Revision | 01 |
| Data Source | Various |

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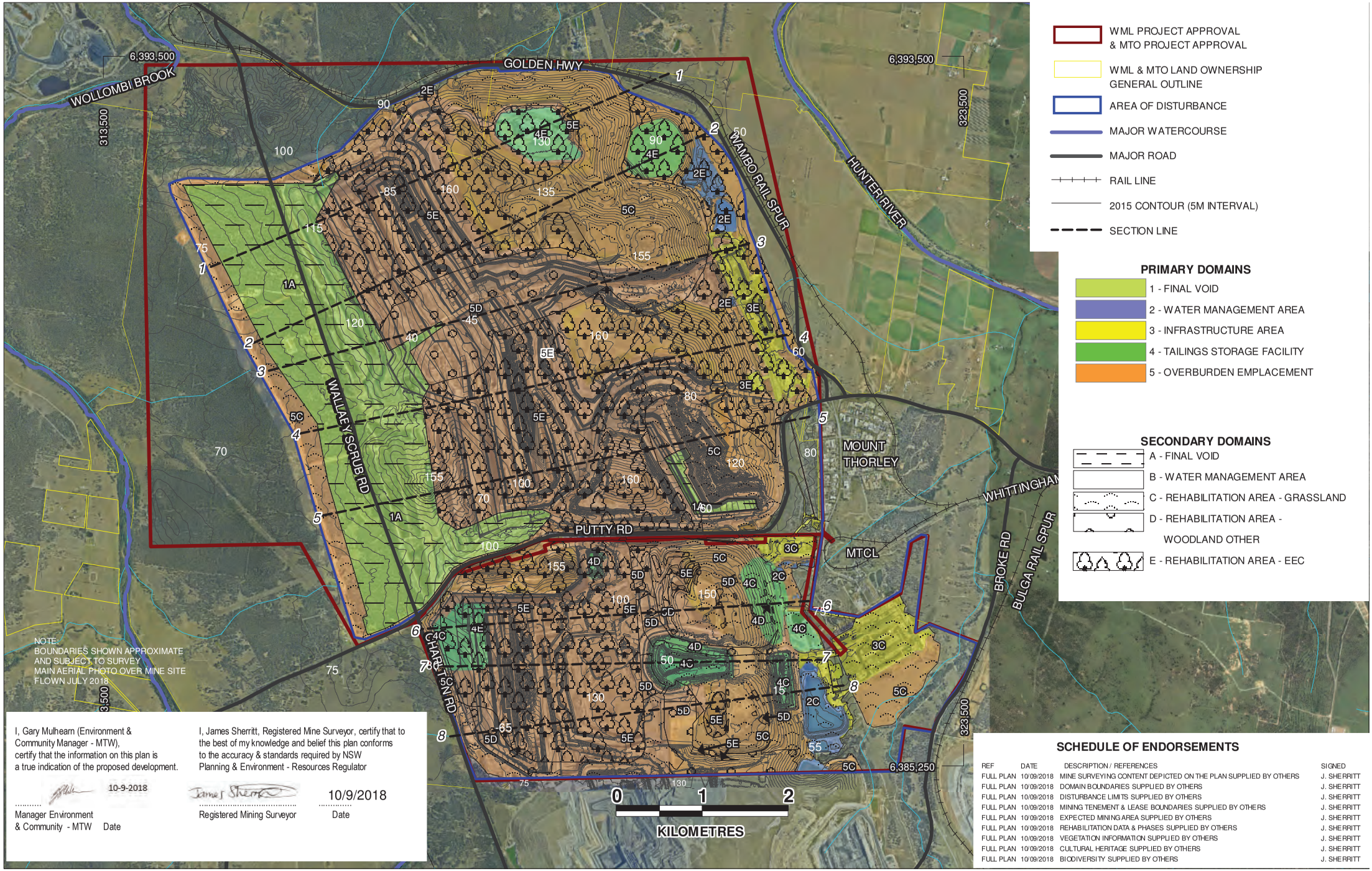


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Registered Mining Surveyor Date

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 2 - Mine Domains

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Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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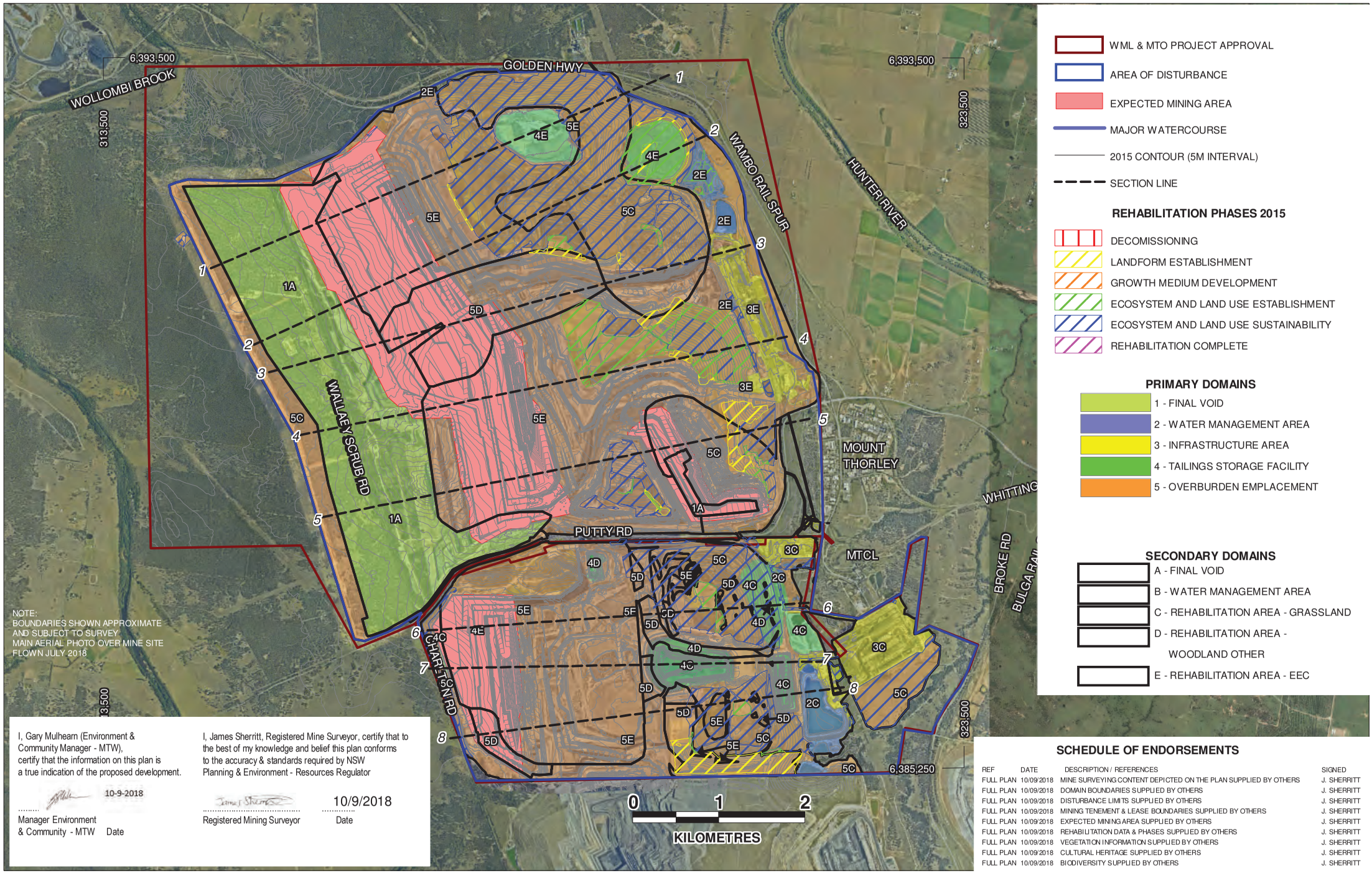


WML & MTO PROJECT APPROVAL

AREA OF DISTURBANCE

EXPECTED MINING AREA

MAJOR WATERCOURSE

2015 CONTOUR (5M INTERVAL)

SECTION LINE

## REHABILITATION PHASES 2015

DECOMISSIONING

LANDFORM ESTABLISHMENT

GROWTH MEDIUM DEVELOPMENT

ECOSYSTEM AND LAND USE ESTABLISHMENT

ECOSYSTEM AND LAND USE SUSTAINABILITY

REHABILITATION COMPLETE

## PRIMARY DOMAINS

1 - FINAL VOID

2 - WATER MANAGEMENT AREA

3 - INFRASTRUCTURE AREA

4 - TAILINGS STORAGE FACILITY

5 - OVERBURDEN EMPLACEMENT

## SECONDARY DOMAINS

A - FINAL VOID

B - WATER MANAGEMENT AREA

C - REHABILITATION AREA - GRASSLAND

D - REHABILITATION AREA - WOODLAND OTHER

E - REHABILITATION AREA - EEC

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10-9-2018

Manager Environment & Community - MTW Date

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Registered Mining Surveyor Date

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 3A 2015 - Mining and Rehabilitation

Date: 10/09/18
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Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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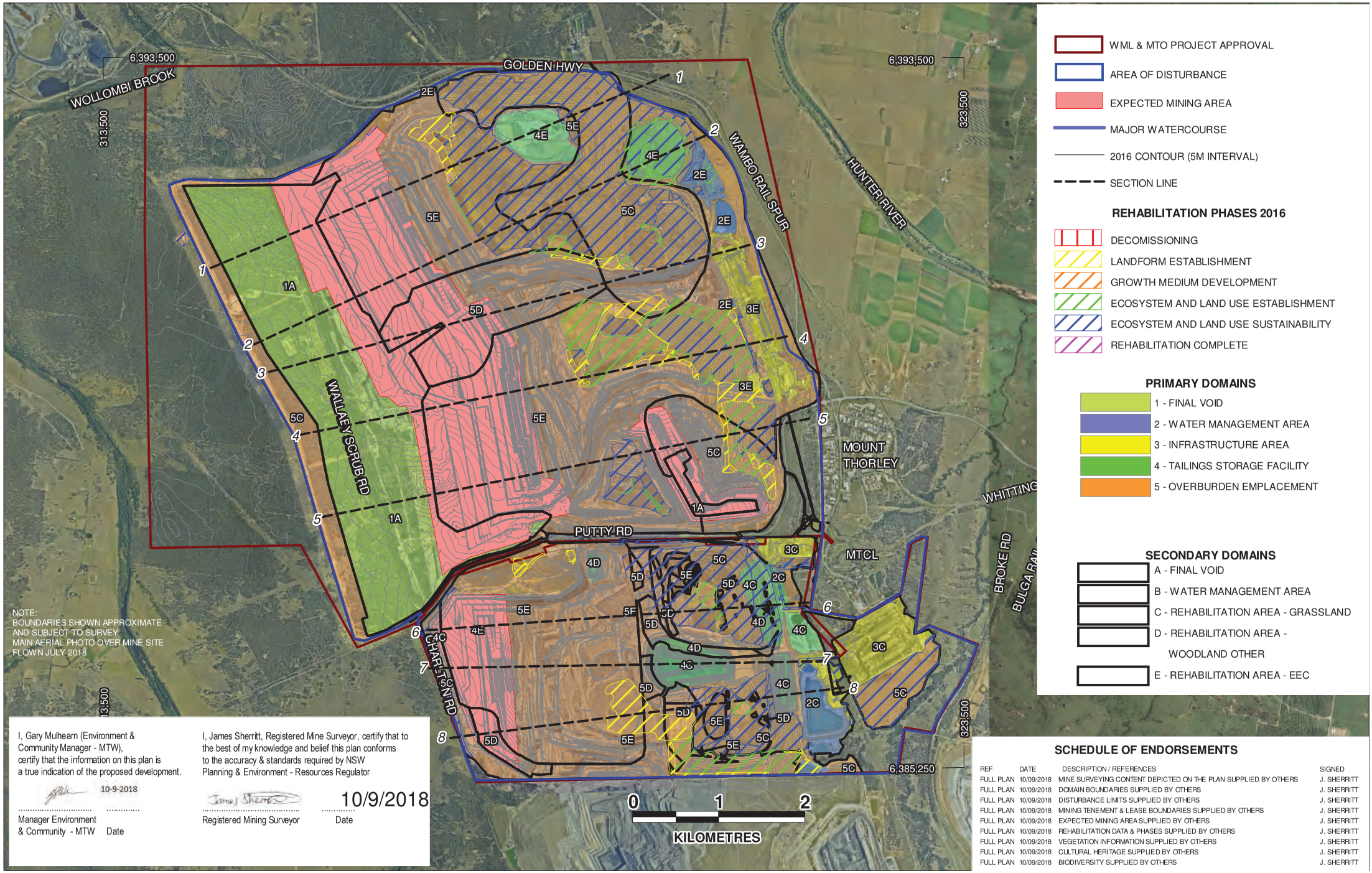


NOTE:
BOUNDARIES SHOWN APPROXIMATE AND SUBJECT TO SURVEY
MAIN AERIAL PHOTO OVER MINE SITE FLOWN JULY 2018

WML & MTO PROJECT APPROVAL
AREA OF DISTURBANCE
EXPECTED MINING AREA
MAJOR WATERCOURSE
2016 CONTOUR (5M INTERVAL)
SECTION LINE

**REHABILITATION PHASES 2016**

DECOMISSIONING
LANDFORM ESTABLISHMENT
GROWTH MEDIUM DEVELOPMENT
ECOSYSTEM AND LAND USE ESTABLISHMENT
ECOSYSTEM AND LAND USE SUSTAINABILITY
REHABILITATION COMPLETE

**PRIMARY DOMAINS**

1 - FINAL VOID
2 - WATER MANAGEMENT AREA
3 - INFRASTRUCTURE AREA
4 - TAILINGS STORAGE FACILITY
5 - OVERBURDEN EMPLACEMENT

**SECONDARY DOMAINS**

A - FINAL VOID
B - WATER MANAGEMENT AREA
C - REHABILITATION AREA - GRASSLAND
D - REHABILITATION AREA - WOODLAND OTHER
E - REHABILITATION AREA - EEC

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10-9-2018

Manager Environment & Community - MTW Date

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Registered Mining Surveyor

10/9/2018

Date

**SCHEDULE OF ENDORSEMENTS**

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 3B 2016 - Mining and Rehabilitation

Date: 10/09/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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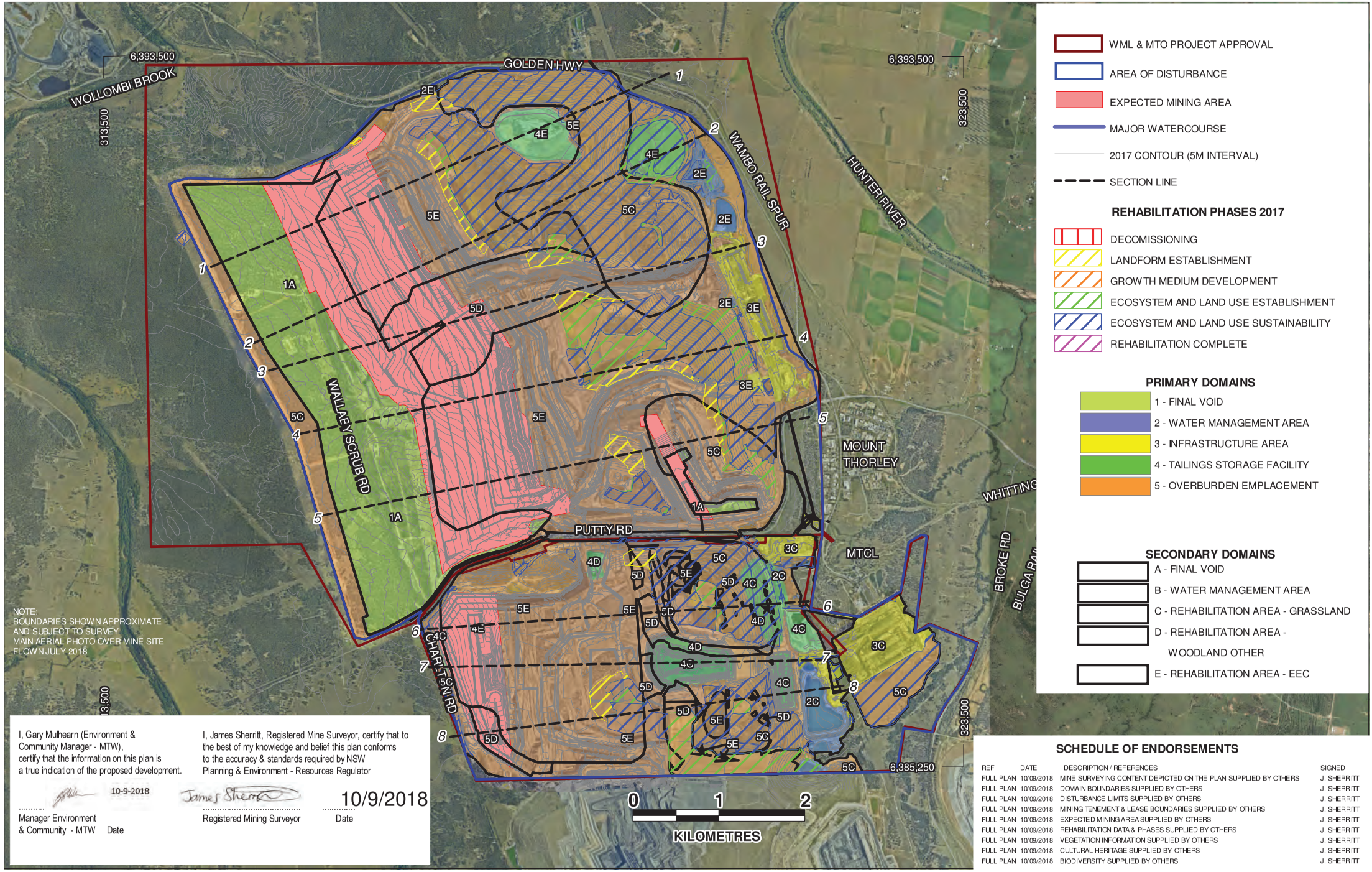


WML & MTO PROJECT APPROVAL

AREA OF DISTURBANCE

EXPECTED MINING AREA

MAJOR WATERCOURSE

2017 CONTOUR (5M INTERVAL)

SECTION LINE

**REHABILITATION PHASES 2017**

- DECOMISSIONING
- LANDFORM ESTABLISHMENT
- GROWTH MEDIUM DEVELOPMENT
- ECOSYSTEM AND LAND USE ESTABLISHMENT
- ECOSYSTEM AND LAND USE SUSTAINABILITY
- REHABILITATION COMPLETE

**PRIMARY DOMAINS**

- 1 - FINAL VOID
- 2 - WATER MANAGEMENT AREA
- 3 - INFRASTRUCTURE AREA
- 4 - TAILINGS STORAGE FACILITY
- 5 - OVERBURDEN EMPLACEMENT

**SECONDARY DOMAINS**

- A - FINAL VOID
- B - WATER MANAGEMENT AREA
- C - REHABILITATION AREA - GRASSLAND
- D - REHABILITATION AREA - WOODLAND OTHER
- E - REHABILITATION AREA - EEC

I, Gary Mulhearn (Environment & Community Manager - MTW), certify that the information on this plan is a true indication of the proposed development.

10-9-2018

Manager Environment & Community - MTW Date

I, James Sherritt, Registered Mine Surveyor, certify that to the best of my knowledge and belief this plan conforms to the accuracy & standards required by NSW Planning & Environment - Resources Regulator

Registered Mining Surveyor

10/9/2018

Date

**SCHEDULE OF ENDORSEMENTS**

| REF | DATE | DESCRIPTION / REFERENCES | SIGNED |
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| FULL PLAN | 10/09/2018 | BIODIVERSITY SUPPLIED BY OTHERS | J. SHERRITT |

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 3C 2017 - Mining and Rehabilitation

Date: 10/09/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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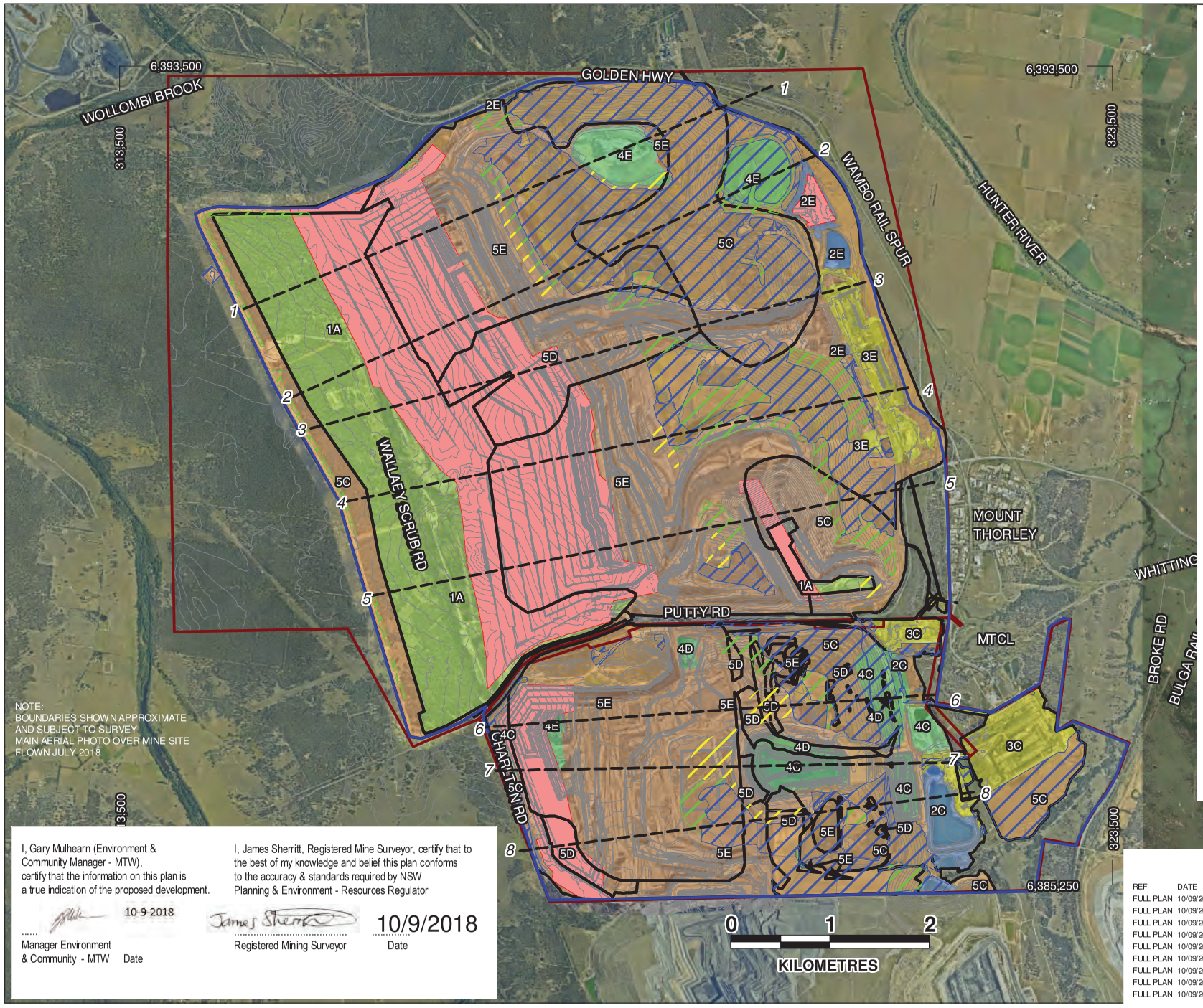


NOTE:
BOUNDARIES SHOWN APPROXIMATE AND SUBJECT TO SURVEY
MAIN AERIAL PHOTO OVER MINE SITE FLOWN JULY 2018

WML & MTO PROJECT APPROVAL
AREA OF DISTURBANCE
EXPECTED MINING AREA
MAJOR WATERCOURSE
2018 CONTOUR (5M INTERVAL)
SECTION LINE

**REHABILITATION PHASES 2018**

DECOMISSIONING
LANDFORM ESTABLISHMENT
GROWTH MEDIUM DEVELOPMENT
ECOSYSTEM AND LAND USE ESTABLISHMENT
ECOSYSTEM AND LAND USE SUSTAINABILITY
REHABILITATION COMPLETE

**PRIMARY DOMAINS**

1 - FINAL VOID
2 - WATER MANAGEMENT AREA
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**SECONDARY DOMAINS**

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Registered Mining Surveyor Date

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 3D 2018 - Mining and Rehabilitation

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Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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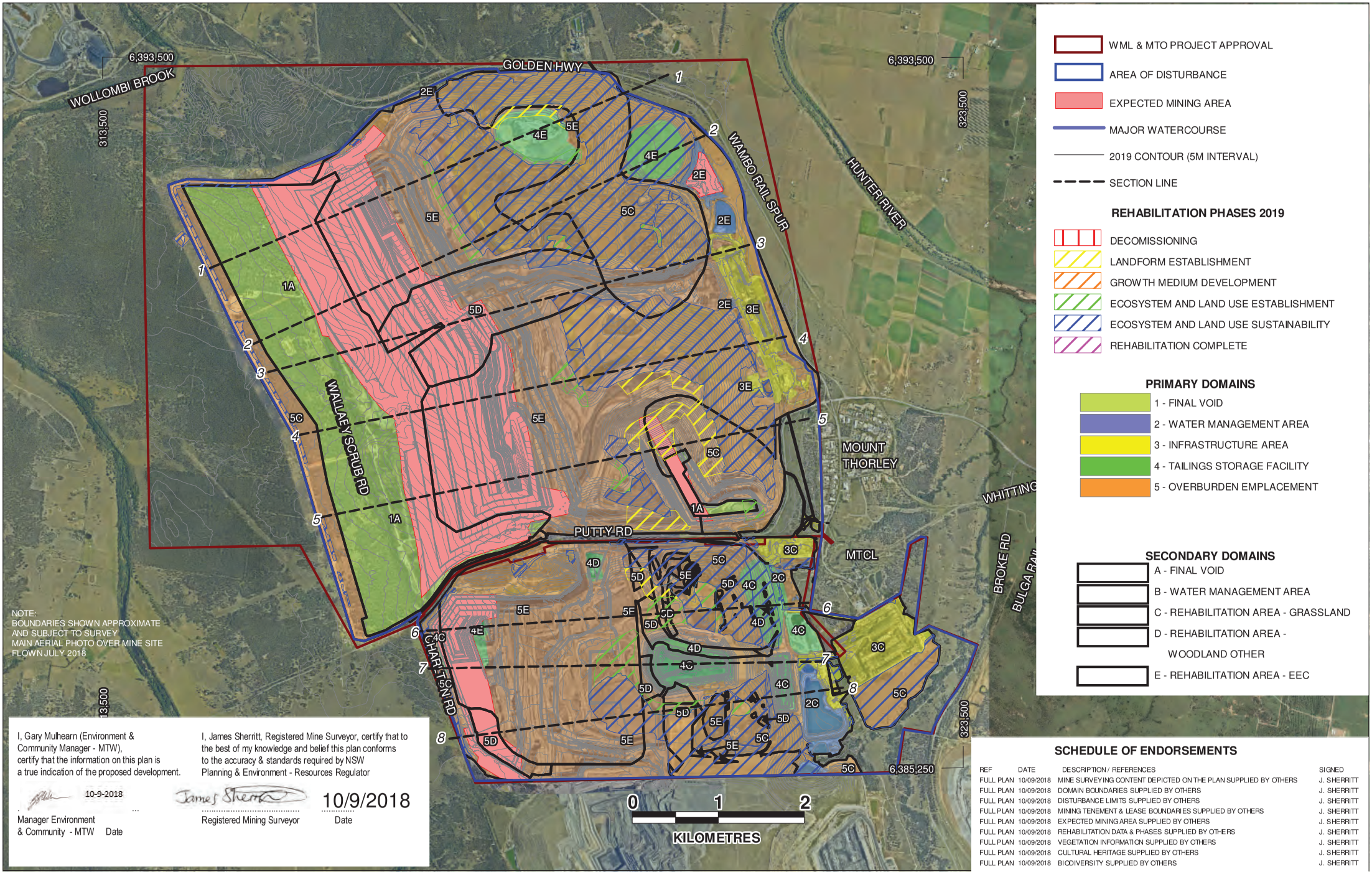


WML & MTO PROJECT APPROVAL

AREA OF DISTURBANCE

EXPECTED MINING AREA

MAJOR WATERCOURSE

2019 CONTOUR (5M INTERVAL)

SECTION LINE

**REHABILITATION PHASES 2019**

- DECOMISSIONING
- LANDFORM ESTABLISHMENT
- GROWTH MEDIUM DEVELOPMENT
- ECOSYSTEM AND LAND USE ESTABLISHMENT
- ECOSYSTEM AND LAND USE SUSTAINABILITY
- REHABILITATION COMPLETE

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James Sherritt

Registered Mining Surveyor

10/9/2018

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 3E 2019 - Mining and Rehabilitation

Date: 10/09/18
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Coordinate System: MGA94 Zone 56
Revision 01
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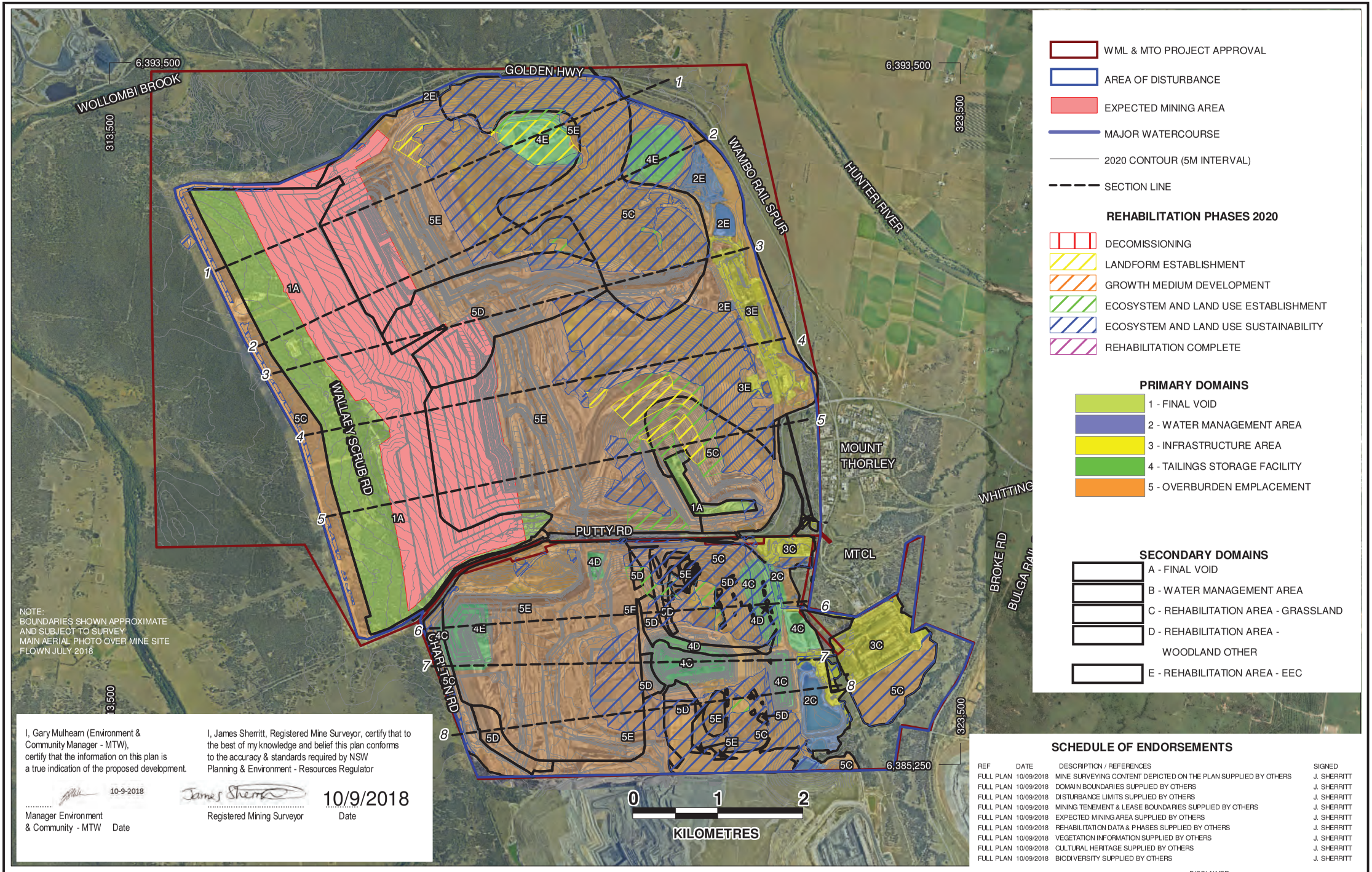


WML & MTO PROJECT APPROVAL
AREA OF DISTURBANCE
EXPECTED MINING AREA
MAJOR WATERCOURSE
2020 CONTOUR (5M INTERVAL)
SECTION LINE

**REHABILITATION PHASES 2020**

DECOMISSIONING
LANDFORM ESTABLISHMENT
GROWTH MEDIUM DEVELOPMENT
ECOSYSTEM AND LAND USE ESTABLISHMENT
ECOSYSTEM AND LAND USE SUSTAINABILITY
REHABILITATION COMPLETE

**PRIMARY DOMAINS**

1 - FINAL VOID
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**SECONDARY DOMAINS**

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 3F 2020 - Mining and Rehabilitation

Date: 10/09/18
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Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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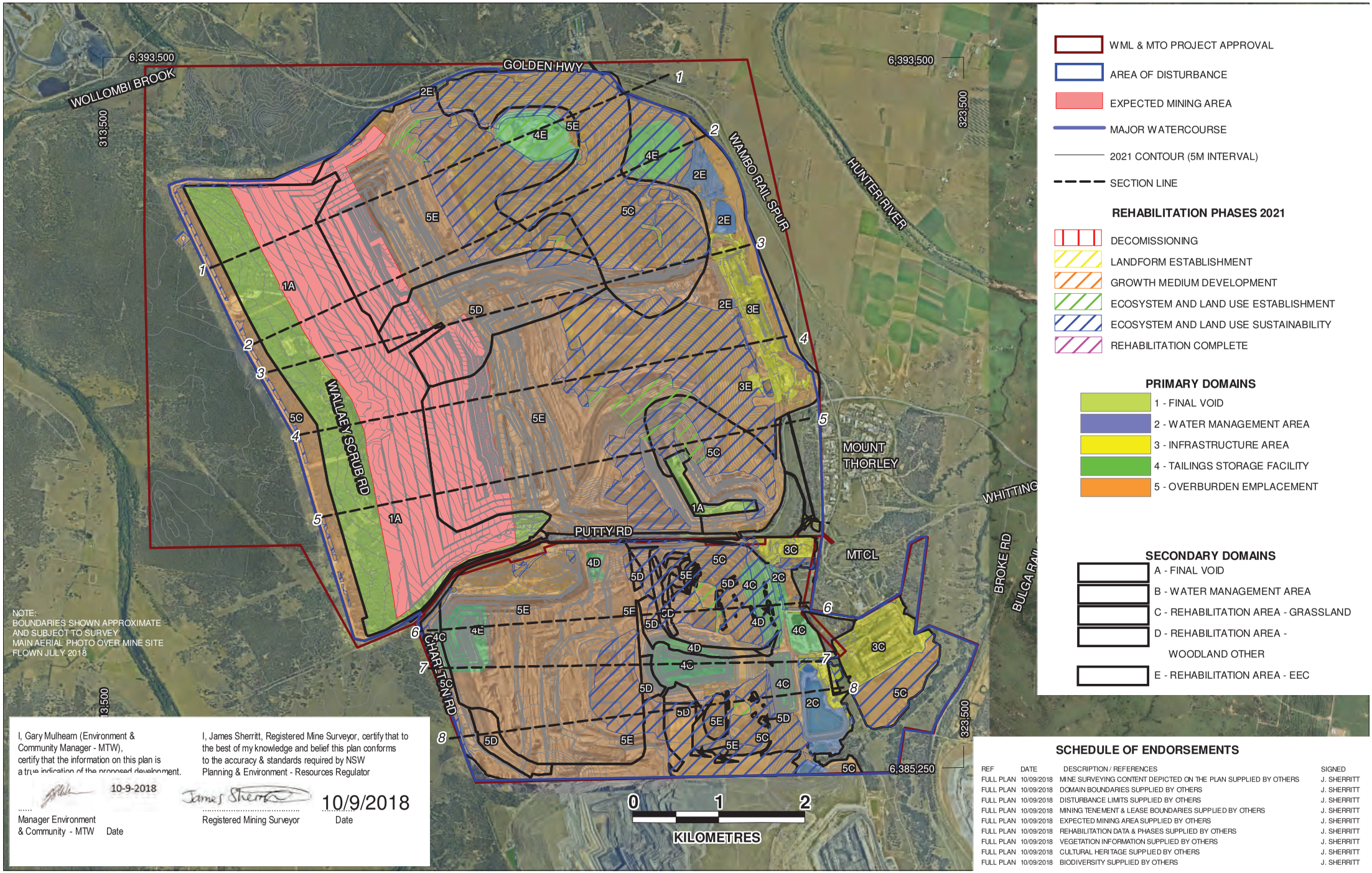


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James Sherritt
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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 3G 2021 - Mining and Rehabilitation

Date: 10/09/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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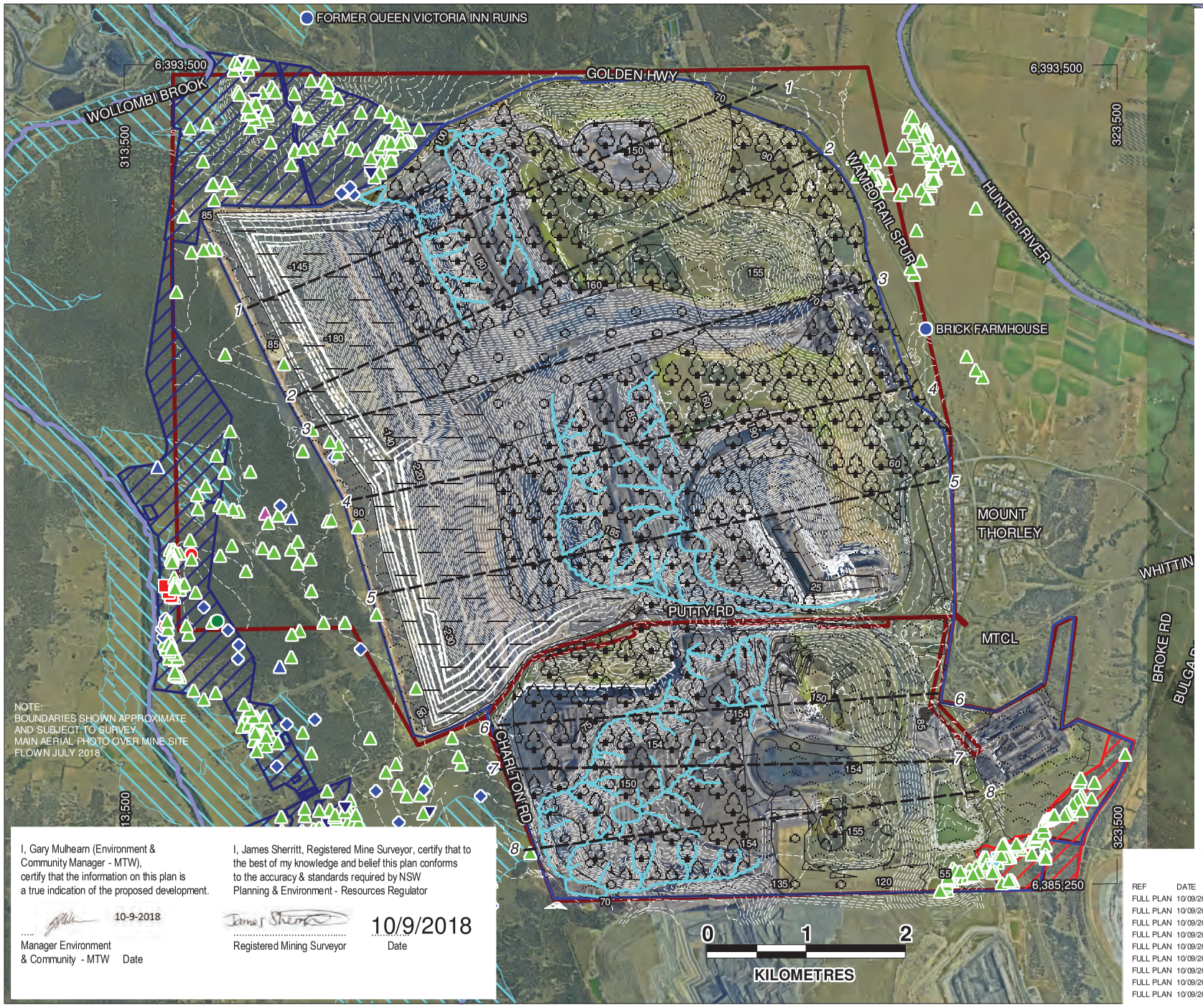


WML PROJECT APPROVAL & MTO PROJECT APPROVAL

AREA OF DISTURBANCE

FLOOD PRONE LAND - 1:100 YEAR

MAJOR WATERCOURSE

FINAL LAND FORM CONTOUR (5M INTERVAL)

SECTION LINE

GEOFLUV DRAINAGE LINES AND DAMS

EUROPEAN CULTURAL HERITAGE SITE

## Cultural Heritage

- AXE GRINDING GROOVES
- ISOLATED STONE ARTEFACT/S
- ISOLATED STONE ARTEFACT/S / SHELL MATERIAL
- ISOLATED STONE ARTEFACT/S / STONE SOURCE
- OTHER
- SCARRED TREE
- STONE ARTEFACT SCATTER
- STONE ARTEFACT SCATTER / KNAPPING FLOOR
- STONE SOURCE

## SECONDARY DOMAINS

- A - FINAL VOID
- B - WATER MANAGEMENT AREA
- C - REHABILITATION AREA - GRASSLAND
- D - REHABILITATION AREA - WOODLAND OTHER
- E - REHABILITATION AREA - EEC

## ABORIGINAL CULTURAL HERITAGE AREAS

- WOLLOMBI BROOK
- LODERS CREEK

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10-9-2018

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N

# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 4 - Final Rehabilitation and Post-mining Land use at end of Planning Approval 2035

| | |
|---|---|
| Date: | 10/09/18 |
| Produced By: | SC |
| Map Size: | A4 Landscape |
| Coordinate System: | MGA94 Zone 56 |
| Revision | 01 |
| Data Source | Various |

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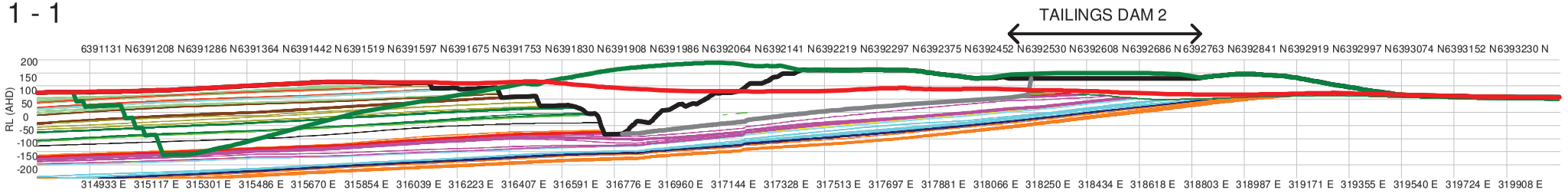
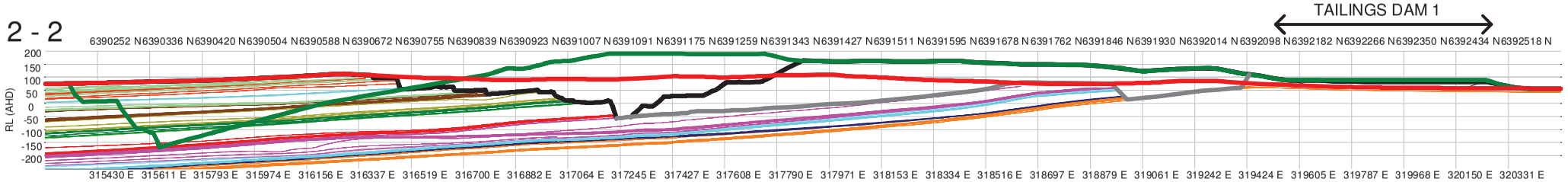
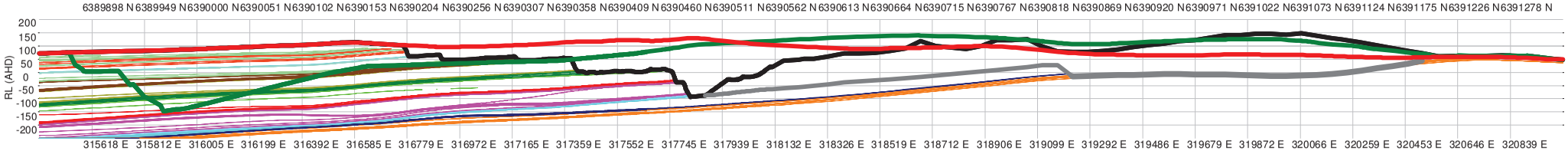
## 1 - 1



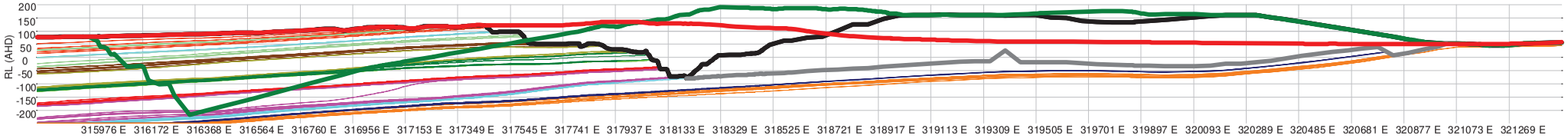

## 2 - 2




## 3 - 3




## 4 - 4




### SEAM LEGEND

- WHYBROW
- REDBANK CREEK
- WAMBO
- WHYNOT
- BLAKEFIELD
- GLEN MUNROE
- WOODLANDS HILL
- ARROWFIELD
- BOWFIELD A-B
- BOWFIELD C-J
- WARKWORTH
- MT ARTHUR
- TOPO (APRIL 2014)
- NATURAL SURFACE (PRE - MINING)
- FINAL MOP
- OPEN CUT FLOOR

I, Gary Mulhearn (Environment & Community Manager - MTW), certify that the information on this plan is a true indication of the proposed development.

10-9-2018

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Registered Mining Surveyor

10/9/2018

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# Mine Operations Plan 2015
# Mt Thorley Warkworth
# Plan 5a - Sections

Date: 10/09/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MGA94 Zone 56
Revision 01
Data Source Various

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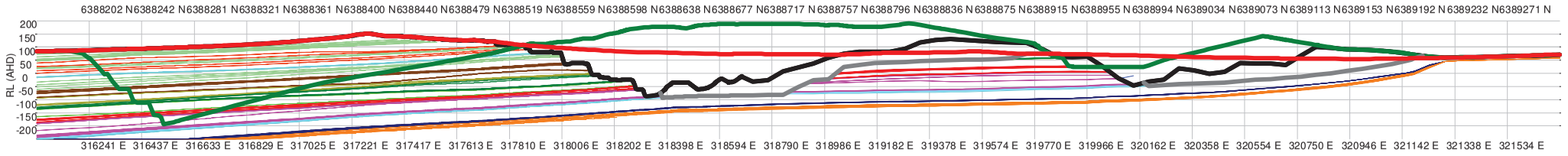
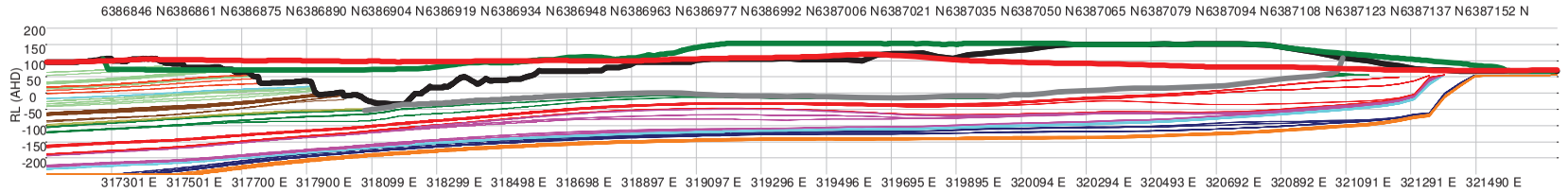
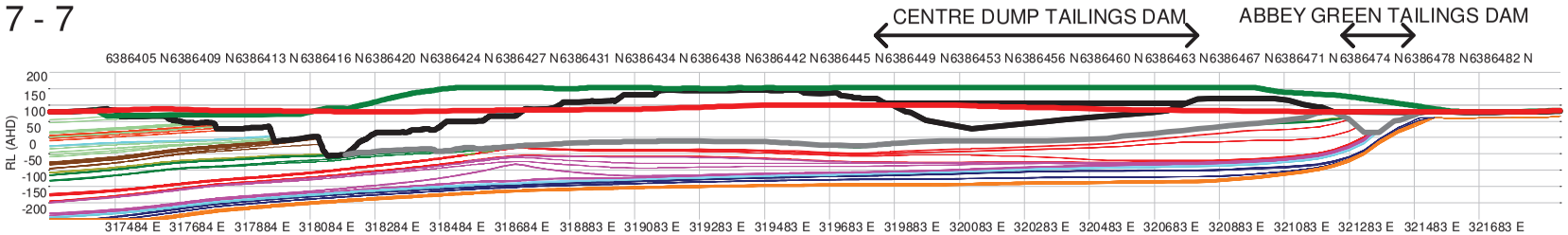
## 5 - 5




## 6 - 6




## 7 - 7

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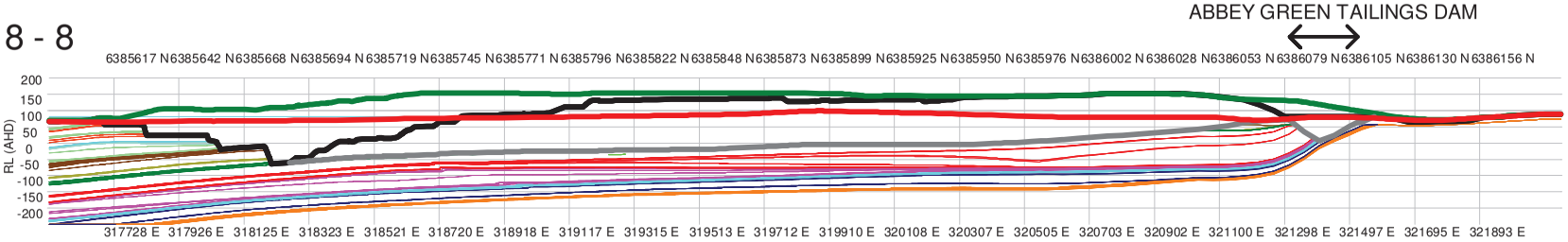


### SEAM LEGEND

- WHYBROW
- REDBANK CREEK
- WAMBO
- WHYNOT
- BLAKEFIELD
- GLEN MUNROE
- WOODLANDS HILL
- ARROWFIELD
- BOWFIELD A-B
- BOWFIELD C-J
- WARKWORTH
- MT ARTHUR
- TOPO (APRIL 2014)
- NATURAL SURFACE (PRE - MINING)
- FINAL MOP
- OPEN CUT FLOOR

I, Gary Mulhearn (Environment & Community Manager - MTW), certify that the information on this plan is a true indication of the proposed development.

10-9-2018

Manager Environment & Community - MTW Date

I, James Sherritt, Registered Mine Surveyor, certify that to the best of my knowledge and belief this plan conforms to the accuracy & standards required by NSW Planning & Environment - Resources Regulator

10/9/2018

Registered Mining Surveyor Date

### SCHEDULE OF ENDORSEMENTS

| DATE | DESCRIPTION / REFERENCES | SIGNED |
|---|---|---|
| 10/09/2018 | MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS | J. SHERRITT |
| 10/09/2018 | DOMAIN BOUNDARIES SUPPLIED BY OTHERS | J. SHERRITT |
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~~Coal & Allied (2015d) MTW Blast Management Plan, last updated 2015.~~

~~Coal & Allied (2015e) MTW Air Quality and Greenhouse Gas Management Plan, last updated 2015.~~

~~Coal & Allied (2015f) MTW Water Management Plan, last updated 2015.~~

~~Coal & Allied *Environmental Procedure 10.1 – Visual Management (includes infrastructure design and lighting management).*~~

~~Coal & Allied *Environmental Procedure 10.2 – Flora and Fauna.*~~

~~Coal & Allied *Environmental Procedure 10.3 – Ground Disturbance Permit.*~~

~~Coal & Allied *Environmental Procedure 10.4 – Weed Control.*~~

~~Coal & Allied *Environmental Procedure 12.1 – Acid Mine Drainage Prevention and Control.*~~

~~Coal & Allied *Environmental Procedure 13.1 – Site Contamination Prevention and Control.*~~

~~Coal & Allied *Environmental Procedure 3.1 – Property Transaction Guidelines (Rio Tinto).*.~~

~~Coal & Allied *Environmental Procedure 4.1 – Closure Planning Guidelines.*~~

~~Coal & Allied *Environmental Procedure 5.1 – Disturbance and Rehabilitation.*~~

~~Coal & Allied *Environmental Procedure 6.1 – Waste Management – Non Mineral.*~~

~~Coal & Allied *Environmental Procedure 6.2 – Coarse Rejects and Tailings Disposal.*~~

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~~Rio Tinto Coal Australia *Environment Standard E13 - Chemically Reactive Mineral Waste Control.*~~

~~Rio Tinto Coal Australia *Environment Standard E13 – Chemically Reactive Mineral Waste Control.*~~

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# 14.0 Acronyms

| | |
|---|---|
| ADCC | Aboriginal Development Consultative Committee |
| AEMR | Annual Environmental Management Report |
| AEP | Annual Exceedance Probability |
| AER | Annual Environmental Review |
| AGN | Abbey Green North |
| AGSTSF | Abbey Green South Tailings Storage Facility |
| AHIP | Aboriginal Heritage Impact Permit |
| AHMP | Aboriginal Heritage Management Plan |
| AQMP | Air Quality and Greenhouse Gas Management Plan |
| AWS | Annual Works Schedule |
| BA | Biodiversity Area |
| BCM | Bank Cubic Metre |
| BMP | Blasting Management Plan |
| BSO | Bulga Surface Operations |
| Coal & Allied | Coal & Allied Operations Pty Limited |
| CCC | Community Consultative Committee |
| CCL | Consolidated Coal Lease |
| CHCC | Cultural Heritage Consultation Committee |
| ~~CHMS~~ | ~~Cultural Heritage Management System~~ |
| CHPP | Coal Handling and Preparation Plant |
| CHWG | Hunter Valley Cultural Heritage Working Group |
| CL | Coal Lease |
| CPP | Coal Preparation Plant |
| CSMPP | Coal Seam Methane Pilot Program |
| CRTSF | Centre Ramp Tailings Storage Facility |
| DoEE | Australian Government Department of the Environment and Energy |
| DoP | NSW Department of Planning (now NSW Planning & Environment) |
| DP&E | NSW Department of Planning and Environment |
| DP&E-RR | Resources Regulator (part of NSW Department of Planning & Environment) (formerly DRG) |
| DSC | Dam Safety Committee |
| DRE | Division of Resources and Energy (part of NSW Trade & Investment) (now Division of Resources and Geosciences) |
| DRG | Division of Resources and Geosciences (part of NSW Department of Planning & Environment) |
| DUAP | NSW Department of Urban Affairs and Planning (now NSW Planning & Environment) |
| EA | Environmental Assessment |
| EEC | Endangered Ecological Community |

| | |
|---|---|
| EFA | Ecological Function Analysis |
| EIS | Environmental Impact Statement |
| EL | Exploration Licence |
| EMP | Environmental Management Plan |
| EMS | Environmental Management Strategy |
| EP&A Act | *Environmental Planning and Assessment Act 1979* |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) |
| EPL | Environmental Protection Licence |
| GDP | Ground Disturbance Permit |
| GIS | Geographic Information System |
| ha | Hectare |
| HSEQ | Health, Safety, Environment and Quality |
| HRSTS | Hunter River Salinity Trading Scheme |
| ML | Mining Lease |
| MOP | Mining Operations Plan |
| MSDS | Material Safety Data Sheets |
| MSRP | Mine Site Rehabilitation Plan |
| MTCL | Mount Thorley Coal Loader |
| MTO | Mount Thorley Operations |
| Mtpa | Million tonnes per annum |
| MTW | Mount Thorley Warkworth |
| NMP | Noise Management Plan |
| NNCRS | Near Neighbour Community Relations Strategy |
| NOW | NSW Office of Water |
| NSW | New South Wales |
| OEH | NSW Office of Environment and Heritage |
| RL | Reduced Level |
| ~~RTCA~~ | ~~Rio Tinto Coal Australia~~ |
| ROM | Run Of Mine |
| SSD | State Significant Development |
| SEWPAC | Commonwealth Department of Sustainability, Environment, Water, Population and Communities |
| SSC | Singleton Shire Council |
| TARP | Trigger Action Response Plan |
| TF | Topography Factor |
| TSC Act | *Threatened Species Conservation Act 1995* (NSW) |
| TSF | Tailings Storage Facility |
| TWMS | Total Waste Management System |
| UHVAC | Upper Hunter Valley Aboriginal Community |

| | |
|---|---|
| VWP | Vibrating Wire Piezometer |
| WML | Warkworth Mine Limited |
| WSW | Warkworth Sands Woodland |

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