

Briefing Paper

Section 75W Modification to Project Approval 06_0311

Mannering Colliery - Extension of Mining Project

August 2011

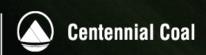


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ABBREVIATIONS

AHIMS Aboriginal Heritage Information Management System

CCC Community Consultative Committee

CCF Coal Crushing Facility

Centennial Coal Company
Centennial Mannering Centennial Mannering Pty Ltd

OEH NSW Office of Environment and Heritage
EARs Environmental Assessment Requirements
DP&I Department of Planning and Infrastructure

EA Environmental Assessment

EARs Environmental Assessment Requirements

EECs Endangered Ecological Communities

EP&A Act Environmental Planning and Assessment Act 1979

EPBC Act Environment Protection and Biodiversity Conservation Act 1999

EPL Environment Protection Licence

GSSE GSS Environmental

LEP Local Environmental Plan

Mannering Colliery

Mt Million tonnes

Mtpa Million tonnes per annum

NGER Act National Greenhouse and Energy Reporting Act 2007

NPW Act National Parks and Wildlife Act 1974
OEH Office of Environment and Heritage

PA 06_0311 Project Approval 06_0311

POEO Act Protection of the Environment Operations Act 1997

ROM Run of Mine

SEPP State Environmental Planning Policy

tph tonnes per hour

TSC Act Threatened Species Conservation Act 1995

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1.0 INTRODUCTION

1.1 Background

Mannering Colliery is an existing underground coal mine located on the southern side of Lake Macquarie, approximately 40 kilometres (km) south of Newcastle in NSW. Mannering Colliery is operated by Centennial Mannering Pty Ltd (Centennial Mannering), a wholly owned subsidiary of Centennial Coal Company (Centennial). Centennial is a wholly owned subsidiary of Banpu Minerals (Singapore) Pte Limited (Banpu).

Mannering Colliery has extracted coal utilising both the bord and pillar and longwall mining methods in the Great Northern and Fassifern coal seams for over 45 years. Mannering produces a thermal coal product which is transported by a dedicated overland conveyor to the Vales Point Power Station for domestic electricity generation.

Mannering Colliery was granted Project Approval (PA 06_0311) by the then Minister for Planning on 12 March 2008 following the submission of the Mannering Colliery Continuation of Mining Environmental Assessment (Hansen Bailey 2007).

1.2 Project Overview

Centennial Mannering are seeking a modification to PA 06_0311 subject to Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act) to:

- Extend its underground mining operations within the Fassifern Seam beyond the existing approved 2008 Project Approval boundary using bord and pillar mining methods (see Figure 1);
- Extend its underground mining operations into the Great Northern Seam using bord and pillar mining methods (see **Figure 1**); and
- Provide full time employment for a total of 170 personnel.

The proposed Project will result in the extraction of approximately 3,200,000 tonnes of Run of Mine (ROM) coal from the Fassifern seam and approximately 1,400,000 tonnes of ROM coal from the Great Northern seam. All mining activities are proposed to be undertaken using bord and pillar mining methods with mining designed to achieve long term stable pillars resulting in less than 20 millimetres of subsidence on the surface.

The proposed combined extraction of coal from the Great Northern and Fassifern coal seams will not exceed the 1.1 Million tonnes per annum (Mtpa) of coal extraction previously assessed and approved. No changes to existing surface infrastructure, coal handling or water management systems are required for the proposed Project and the Project will not extend the life of Mannering Colliery beyond the existing approved 2018 life of mine. Operations will continue to be undertaken 24 hours a day seven days a week.

This Briefing Paper has been prepared by Centennial Mannering to support an application to modify the Mannering Colliery Project Approval and relates to the extension of underground mining at the Mannering Colliery. This Briefing Paper is intended to brief the Department of Planning and Infrastructure (DP&I) and other government agencies considered relevant by the DP&I on the proposed Project, summarise the potential environmental impacts of the proposed Project, identify relevant issues proposed to be addressed in the Environmental Assessment, and provide sufficient information to allow the Director General to issue, if required, appropriately targeted Environmental Assessment Requirements (EARs).

This Briefing Paper therefore includes the following information:

- 1. The Project location and site description (Section 2);
- 2. A description of the current approved operation (Section 3);
- 3. A description of the Project and justification (Section 4);
- 4. The statutory provisions applying to the Project (**Section 5**);
- 5. A preliminary assessment identifying the likely environmental issues associated with the Project (Section 6); and
- 6. The community consultation approach for the Project (Section 7).

1.3 The Applicant

The applicant is Centennial Mannering Pty Limited, a wholly owned subsidiary of Centennial Coal Company (Centennial). Centennial is a wholly owned subsidiary of Banpu Minerals (Singapore) Pte Limited (Banpu), who purchased Centennial in 2010. Mannering produces up to 1.1 Mtpa of ROM coal to supply to the Vales Point Power Station for domestic electricity generation.

Centennial supplies thermal and coking coal to the domestic and export markets, operating ten coal mines in NSW, making it one of the largest underground coal producers in the state. Centennial is a major fuel supplier to the NSW energy industry, fuelling approximately 46 percent of the State's coal fired electricity. Approximately one third of Centennial's coal is sold to the export market and is exported through the Port of Newcastle and Port Kembla in NSW.

Lake Macquarie Wyee Point Mannering Park 0.5 kilometres **LEGEND** Cadastre Proposed Mining - Fassifern Seam Proposed Mining - Gt Northern Seam Development Consent Boundary (06-0311) LOCATION MANNERING Centennial Fassifern Centennial Coal Company Limited FASSIFERN SEAM **Mannering Colliery** THIS DRAWING IS COPYRIGHT. DRAWN **Extension Of** CHECKED **Mining Project** APPROVED PC3779 DATE 17-05-2011 SCALE Refer to scalebar

Figure 1 – Mannering Colliery Extension of Mining Project

2.0 SITE DESCRIPTION

2.1 Site Locality

Mannering Colliery is an existing underground coal mine located on the southern side of Lake Macquarie, approximately 40 kilometres south of Newcastle. The Mannering Colliery Surface Facilities (including administration, workshops and the Mannering Colliery Coal Crushing Facility (CCF)) are located adjacent to the Vales Point Power Station, 3 km south of the township of Mannering Park.

2.2 Project Site

The extension of mining areas proposed for this Project is situated within both the Lake Macquarie and Wyong Local Government Areas (LGAs), and within the West Lake Macquarie and Swansea-North Entrance Mine Subsidence Districts. Mining is to be undertaken within the boundaries of Consolidated Coal Lease (CCL721) held by Centennial Mannering Pty Limited.

2.3 Land Ownership

The proposed extension of mining areas overly both Crown and freehold land. Parts of the proposed mining area underlie Lake Macquarie.

2.4 Existing Land Use

Extensive mining has been undertaken by Mannering Colliery adjacent to the proposed Project areas in both the Fassifern and Great Northern coal seams. Centennial Mannering are currently undertaking mining within the Fassifern seam. Other underground mining operations surrounding Mannering Colliery include the Mandalong Mine and Cooranbong Colliery, Myuna Colliery, Chain Valley Colliery and Munmorah Colliery.

Land uses at the surface above and adjacent to the proposed extension of mining areas include power generation at the Vales Point Power Station and recreational and residential use. Some of the proposed workings lie beneath the Mannering Creek Ash Dam notification area and within the high water level subsidence control zone.

3.0 CURRENT APPROVED OPERATIONS

3.1 Background

Mannering Colliery was granted Project Approval (PA 06_0311) by the then Minister for Planning on 12 March 2008 following the submission of the Mannering Colliery Continuation of Mining Environmental Assessment (Hansen Bailey 2007).

The approved operations of Mannering Colliery include:

- Extraction of up to 1.1 Mtpa of ROM coal;
- Using bord and pillar underground mining techniques;
- Continuing to use existing surface facilities;
- Dispatching coal for transport by conveyor to the Vales Point Power Station; and
- Constructing and using additional minor infrastructure that may be required to service the proposed underground mine workings.

The Mannering Colliery has an approved mine life of ten years with the current PA 06_0311 expiring on 31 March 2018.

3.2 Mining Location

Mining is approved to be undertaken in the Fassifern seam only and within the 2008 Project Approval boundary.

3.3 Mining Method

The mining method implemented at Mannering Colliery is a form of bord and pillar mining where extraction is limited to first workings only. Roadways are driven with pillars created which are not subsequently extracted. Mining is limited to coal which is cut from the first workings roadways. While this mining method extracts less coal than methods implemented at other operations, it has the advantage of long-term pillar stability and therefore avoids any noticeable surface subsidence impacts.

3.4 Mining Equipment

Mannering Colliery utilises range of mining equipment to carry out the bord and pillar mining operations, facilitate men and materials access from the surface to the underground workings and undertake coal handling operations on the Mannering Colliery Surface Facilities Area.

3.5 Coal Handling

Coal is transported from the Mannering Colliery underground workings to the CCF via the drift conveyor. The CCF is a hammer roll design crushing facility and has a capacity of 400 tonnes per hour (tph). It consists of a rotary breaker to decrease the average lump size and remove any rocks or other material.

The coal then passes through screens and crushers to produce a maximum lump size of 50 mm. This is then conveyed to the product bin.

All coal produced by Mannering Colliery is supplied directly to Vales Point Power Station by a dedicated overland conveyor which is operated, maintained and located on land held by Delta Electricity, the owners of Vales Point Power Station.

In periods when the Vales Point Power Station is unable to accept coal deliveries due to scheduled maintenance or conveyor breakdowns, a small ROM coal stockpile (up to 25,000 tonnes) may be utilised on-site.

Reclamation from the stockpile is undertaken with an excavator to load the ROM hopper. At all other times, coal is directly-fed to Vales Point Power Station from the CCF via the dedicated overland conveyor.

3.6 Infrastructure

Current infrastructure facilities at the Mannering Colliery include: administration offices, workshops, the CCF, upcast shaft, downcast shaft, diesel storage facilities, parking facilities, water management infrastructure, bitumen access roads, boreholes and a 25,000 tonne coal stockpile. The Surface Facilities also include a downcast shaft off the Pacific Highway to the south-west of the main Surface Facilities.

3.7 Hours of Operation and Personnel

Mannering Colliery operates up to 24 hours a day, seven days per week and has approval for 90 full time employees.

3.8 Water Management

In accordance with the Mannering Colliery Environment Protection Licence (EPL 191), Centennial Mannering can pump up to four megalitres per day of mine water from its underground coal mining operations to the surface. The water passes through a series of sedimentation ponds before being discharged into wetlands and an artificial unnamed creek. The wetlands are designed to slow the progress of the water to allow the removal of any further finer sediment or other materials before entering Lake Macquarie. Mannering Colliery has discharged water from the site over much of the 48 years the mine has been in operation and the artificial flows comprise the majority of water within the freshwater sections of the creek under normal conditions. Consequently the downstream vegetation has adjusted to the increased flows.

In 2009, and in accordance with Condition 7 of PA 06_0311, Cumberland Ecology were engaged to undertake an assessment of the ecological interactions of mine water discharged from the site with aquatic ecology and the wetlands (and associated vegetation) between mine water discharge points and Lake Macquarie (see Attachment 2). The creek and wetlands provide a number of potential environments for a suite of aquatic and terrestrial flora and fauna species. The eventual decommissioning of Mannering Colliery will lead to the cessation of the discharge of mine water from the site into the creek and associated wetlands. As was determined by Cumberland Ecology, this cessation of mine water discharge will lead to the contraction in size of two Endangered Ecological Communities, the Sydney Freshwater Wetlands in the Sydney Basin Bioregion and Swamp Oak Floodplain Forest of the Sydney Basin Bioregion, listed under the Threatened Species Conservation Act 1995 (TSC Act).

3.9 Traffic and Transport

In November 2008, a Stage 5 Road Safety Audit was conducted by Parsons Brinckerhoff on the intersection of Rutley's Road and the Mannering Colliery Access Road in accordance with Condition 21 of PA 06_0311. Condition 21 specifically states:

The Proponent shall:

- a) complete a road safety audit of the intersection of Rutley's Road and Mannering Colliery Access Road by the end of March 2009;
- b) provide copies of this audit to RTA, WSC and the Director-General within one month of its completion; and
- c) implement any recommendations of this audit, or as otherwise approved by the Director-General'.

The Stage 5 Road Safety Audit (Parsons Brinckerhoff, November 2008) identified a number of safety issues were identified relating to:

- lack of priority control guidance at the intersection;
- lack of delineation guidance at the intersection and Rutley's Road; and
- insufficient width in Rutley's Road to accommodate through and right turning traffic in the northbound carriageway.

In September 2010, Parsons Brinckerhoff were engaged by Centennial Mannering to undertake the design of proposed upgrades to the intersection of Rutley's Road and the Mannering Colliery Access Road to address the safety issues identified by the Stage 5 Road Safety Audit. Further to the Road Safety Audit, internal consultation with Centennial Coal staff revealed a concern with the right turn movement into the Colliery Access Road. Although this is not identified as a safety concern in the Road Safety Audit, Centennial Mannering decided to address staff concerns and proposed a channelised right turn bay as part of the intersection design upgrades. An application, accompanied by final intersection design and construction drawings, was submitted to the Wyong Shire Council in May 2011. Centennial Mannering are waiting on approval from Wyong Shire Council to commence the construction of upgrades to the intersection.

3.10 Noise

Mannering operates in line with noise impact criteria detailed in PA 06_0311. Since 2008 quarterly independent monitoring in accordance with the approved Noise Monitoring Program have indicated compliance with impact criteria at all receptors. No noise complaints have been received by the Colliery. Noise mitigation measures were undertaken by Centennial Mannering on the coal transfer tower by the installation of conveyor belt curtain. As result of the noise mitigation measure implemented, a 4 dB reduction in noise emissions has been achieved.

3.11 Air

In order to determine the effectiveness of the colliery's dust control measures, a network of 5 depositional dust monitoring gauges has been established within the perimeter of the Mannering Colliery Surface Facilities area. An independent consultant collects the samples from the depositional dust gauges and forwards them to ALS for analyses. Samples are taken from the depositional gauges every 28 days as per *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* as administered by the NSW Office of Environment and Heritage. Monitoring results indicate that dust

depositional rates are typically below 1 g/m²/m and comply with the Mannering Colliery Project Approval criteria for air quality.

3.12 Existing Licences and Approvals

Mining operations at Mannering Colliery occur within Consolidated Coal Lease (CCL) 721 and CCL 719. Other mining leases registered within the current colliery holding include parts of CCL 720 and CCL 722 (held by Munmorah Colliery) and CCL 707 (held by Lake Coal). Table 1 lists approvals, leases and licences currently in place at Mannering Colliery.

Table 1 – Mannering Collieries Existing Approvals, Leases and Licences

Reference	Title	Expiry Date
CCL719	Consolidated Coal Lease 719 (including Mannering Surface Facilities	21/09/2009*
CCL720	Consolidated Coal Lease 720	22/01/2006*
CCL721	Consolidated Coal Lease 721 (Including Mannering Surface Facilities)	29/06/2026
CCL722	Consolidated Coal Lease 722	07/02/2019
CCL707	Consolidated Coal Lease 707	21/12/2022
EL6639	Exploration licence	31/07/2012
A441	Authorisation 441	02/06/2011*
A383	Authorisation 383	02/06/2011*
A384	Authorisation 384	02/06/2011*
A372	Authorisation 372	02/06/2011*
Environmental protection Licence (EPL) 191	Issued under Protection of the Environment Operations Act 1997 (POEO Act) for Coal Mining at Mannering within the scale of 500,000 to 2,000,000 tonnes per year. This licence allows the discharge up to 4 Mega litres (ML) of water per day from site via licensed discharge points.	Anniversary 1 January 2012

^{*}Applications for renewal of these leases and authorisations have been submitted to the Department of Trade and Investment, Regional Infrastructure and Services. These titles continue to have effect even though they are past their expiry date as long as a valid application for renewal has been made.

3.13 Environmental Management System

Mannering Colliery has an established Environmental Management System (EMS) that has been developed in accordance with the Centennial Coal Environmental Management System Framework (EMSF) (April 2009). The EMS provides an environmental management framework for all activities and areas managed by Centennial Mannering and have been developed to be generally consistent with the elements of ISO 14001.

As part of this EMS, Centennial Mannering maintains a number Environmental Management Plans (EMP) as outlined in **Table 2.**

Table 2 - Mannering Colliery Environmental Management Plans

Water Management Plan	Noise Monitoring Program
Land Management Plan	Environmental Monitoring Program
Air Quality Management Plan	Energy Savings Action Plan

4.0 PROPOSED MODIFICATION

4.1 Background

Centennial Mannering are seeking a modification to PA 06_0311 subject to Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act) to:

- Extend its underground mining operations within the Fassifern Seam beyond the existing approved 2008 Project Approval boundary using bord and pillar mining methods (see Figure 1);
- Extend its underground mining operations into the Great Northern Seam using bord and pillar mining methods (see Figure 1); and
- Provide full time employment for a total of 170 personnel.

The proposed Project will result in the extraction of approximately 3,200,000 tonnes of ROM coal from the Fassifern seam and approximately 1,400,000 tonnes of ROM coal from the Great Northern seam. All mining activities are proposed to be undertaken using bord and pillar mining methods with mining designed to achieve long term stable pillars resulting in less than 20 millimetres of cumulative subsidence on the surface.

The proposed combined extraction of coal from the Great Northern and Fassifern coal seams will not exceed the 1.1 Mtpa of coal extraction previously assessed and approved. No changes to existing surface infrastructure, coal handling or water management systems are required for the proposed Project and the proposed Project will not extend the life of Mannering Colliery beyond the existing approved 2018 life of mine. Operations will continue to be undertaken 24 hours a day seven days a week.

The area to be mined by the proposed Project will provide access to an improved coal quality resource suitable for the continuation of a coal supply to the Vales point Power Station for electricity generation while allowing for coal from other Centennial operations to be directed to alternative export markets. The proposed Project will provide for ongoing direct and indirect employment opportunities while providing a number of positive flow-on effects to the local, regional and state economies through additional wages and royalties.

4.2 Mining Location

Approval is sought to extend mining in both the Fassifern and Great Northern coal seams as shown in Figure 1. The proposed mining activities encompass an area of approximately 256 hectares, an increase in area of approximately 22 percent above the original Project Approval boundary.

4.3 Mining Method

There are no changes to the proposed mining methods currently approved for use at Mannering Colliery. Mining will continue to be undertaken using bord and pillar mining methods and limited to first workings only.

4.4 Mining Equipment

The Mannering Colliery will continue to utilise a range of mining equipment suitable to carrying out bord and pillar mining operations, facilitate men and materials access from the surface to the underground workings and continue the coal handling operations at Mannering Colliery Surface Facilities Area.

4.5 Coal Handling and Transport

There are no changes proposed to the current approved coal handling infrastructure or coal transport practices currently implemented at the Mannering Colliery. ROM coal will continue to be transported from the underground workings to the CCF via the drift conveyor and supplied directly to the Vales Point Power Station by the dedicated overland conveyor.

4.6 Surface Infrastructure

There are no changes proposed to the existing or approved surface infrastructure at Mannering Colliery as a result of this proposed Project.

4.7 Hours of Operation and Personnel

Mannering will continue to operate 24 hours a day seven days a week. The Project will require an additional 80 full time personnel resulting in a total workforce of 170 full time employees.

4.8 Water Management

The proposed Project will not result in any changes to the existing approved water management system or volumes of water discharged from site. Mannering is currently conducting an extensive 24 month OE&H, pollution reduction program of water quality assessment for metals detected in wastewater discharges in accordance with ANZECC water quality guidelines.

4.9 Traffic and transport

As identified in Section 3.9 of this Briefing Paper, Centennial Mannering is currently waiting on approval from Wyong Shire Council to commence the intersection upgrades following the submission in May 2011 of an application and final intersection design and construction drawings. The proposed works include:

- Widening of the Rutleys Road northbound side to accommodate a channelised right turn intersection (type CHR);
- Widening of return profiles on the entry of the access road to accommodate the turning paths of a 19 m semi-trailer;
- Constructing subsoil drainage at the interface between the existing and proposed pavement;
- Providing signage, guideposts, line marking and retro-reflective pavement markers (RRPM); and
- Removal, replacement and extension of an existing 450 diameter culvert and headwall.

The proposed works far exceed the requirements outlined in the road safety audit and will provide a much safer intersection able to handle the increase in traffic on a shift basis. A Traffic Impact Assessment will be undertaken as part of the Environmental Assessment to confirm the adequacy of the upgraded intersection.

4.10 Additional Licences and Approvals

No additional licences or approvals will be required as a result of the proposed Project.

4.11 Environmental Management System

The Mannering Colliery EMS will be updated if and where required depending on the results of specialist studies undertaken as part of the Environmental Assessment.

5.0 PLANNING CONSIDERATIONS

The Project will be assessed in full consideration of the applicable statutory planning instruments of the Commonwealth and State, as well as associated planning and environmental frameworks. This section describes the statutory planning instruments relevant to the proposed modification, and assesses their implications in relation to the required approval process.

5.1 Commonwealth Legislation

5.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is administered by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as matters of National Environmental Significance (NES). An action that "has, will have or is likely to have a significant impact on a matter of National Environmental Significance" may not be undertaken without prior approval of the Commonwealth Minister, as provided under Part 9 of the EPBC Act.

A complete assessment of whether the Project may have a significant impact on any matters of NES will be undertaken during the Environmental Assessment investigations and preparation. Once this is completed a decision on whether referral to the Commonwealth Minister is required will be made.

5.1.2 National Greenhouse and Energy Reporting Act 2007

The National Greenhouse and Energy Reporting Act 2007 (NGER Act) came into effect on 29 September 2007, and introduces a single national reporting framework for the reporting and dissemination of information about greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations. The first annual reporting period began on 1 July 2008 (Department of Climate Change and Energy Efficiency, 2008). The NGER Act makes registration and reporting mandatory for corporations whose energy production, energy use or greenhouse gas emissions meet specified thresholds. Centennial reports emissions from the corporation which includes those from Mannering Colliery.

5.2 NSW State Legislation

5.2.1 Environmental Planning and Assessment Act 1979

Project Approval (PA 06_0311) was granted by DP&I on 12 March 2008 following the submission of the Mannering Colliery Continuation of Mining Environmental Assessment (Hansen Bailey 2007). Centennial Mannering now seeks a modification to PA 06_0311 pursuant to the provisions of Section 75W of the EP&A Act to allow for the extension of underground mining operations at the Mannering Colliery.

5.2.2 Other NSW State Legislation relevant to the modification

The provisions and requirements of additional NSW legislation will be considered and addressed within the Environmental Assessment. A summary of potentially relevant Acts is included in **Table 3.**

Table 3 – Summary of NSW Legislation Relevant to the Modification

Act	Relevance to the Modification	
Protection of the Environment Operations Act 1997 (POEO Act)	The POEO Act is administered by the NSW Office of Environment and Heritage (OEH) and requires licencing for environmental protection, including waste generation and disposal, water, air and noise pollution. Mannering operates under EPL 191.	
	Under the POEO Act, an EPL is required for premises at which a scheduled activity is conducted. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purposes of the Act.	
	There will be no requirement for Centennial Mannering to seek a variation to the existing EPL 191 as a result of the proposed Project.	
Mining Act 1992	Centennial Mannering currently holds a number of mining leases as is detailed in Table 1 . The proposed mining associated with this Project will be undertaken within CCL721.	
Water Management Act 2000/ Water Act 1912	Centennial Mannering has submitted all relevant water licence applications to support its operations. No additional water licences will be required.	
National Parks and Wildlife Act 1974 (NPW Act)	An archaeological survey will be conducted as part of the Environmental Assessment, which will identify the presence of any known Aboriginal sites, as well as strategies for the management and mitigation of any identified impacts on such sites.	
Heritage Act 1977	The archaeological survey undertaken as part of the Environmental Assessment will also identify any items of heritage significance in the Project area and recommend appropriate management strategies if and where required.	
Threatened Species Conservation Act 1995	The Environmental Assessment will identify any threatened species in the Project Site, as well as strategies for the management and mitigation of impacts.	

5.2.3 State Environmental Planning Policies

The following State Environmental Planning Policies (SEPP's) will be considered as part of the Environmental Assessment for the Mannering Colliery Extension of Mining Project.

5.2.3.1 SEPP (Mining, Petroleum Production and Extractive Industries) 2007

SEPP (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) recognises the importance of mining, petroleum production, and extractive industries within the State. Clause 7 of the Mining SEPP identifies development which can be carried out only with development consent, and includes 'underground mining carried out on any land' and 'facilities for the processing or transportation of minerals' mined from that land or adjoining land. The extension of mining operations at the Mannering Colliery falls within the scope of the developments described in Clause 7 of the Mining SEPP and is therefore permissible with development consent.

Clause 5 of SEPP (Mining) addresses its relationship with other environmental planning instruments, and states that if SEPP (Mining) is inconsistent with any other environmental planning instrument, SEPP (Mining) prevails to the extent of the inconsistency, with the exception of SEPP (Major Development), SEPP 14 Coastal Wetlands and SEPP 26 Littoral Rainforests. Irrespective of the provisions of the Lake Macquarie LEP 2004 and Wyong LEP 1991 the Mannering Extension of Mining Project is permissible with consent.

5.2.3.2 SEPP 44 – Koala Habitat Protection

The aim of State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) is to encourage the 'proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.' Schedule 1 lists the LGAs to which SEPP 44 applies, and requires an investigation be carried out to determine if 'core' or 'potential' koala habitat is present and is likely to be disturbed. Lake Macquarie and Wyong LGAs are listed in Schedule 1 of SEPP 44.

SEPP 44 applies to the extent that a consent authority is restricted from granting development consent from proposals on land identified as core koala habitat without the preparation of a Plan of Management. The potential for the Mannering Extension of Mining Project to impact on land identified as core koala habitat will be considered as part of the preparation of the Environmental Assessment.

5.3 Local Environment Plans

The existing Mannering Colliery Surface Facilities Area is located within the Wyong Shire Council Local Government Area (LGA). The proposed Mannering Colliery extension of mining areas falls within both the Wyong Shire Council and the Lake Macquarie City Council LGA's.

5.3.1 Lake Macquarie Local Environment Plan

The proposed mining area of the Mannering Colliery Extension of Mining Project that falls within the Lake Macquarie LGA is, under the Lake Macquarie Local Environment Plan (LEP) 2004, zoned:

- 1(1) Rural Production;
- 1(2) Rural (Living)
- 2(1) Residential
- 4(1) Industrial (Core)
- 6(2) Tourism and Recreation
- 7(1) Conservation (Primary)
- 7(2) Conservation Secondary;
- 9 Natural Resources; and
- 11 Lake and Waterways

Development for the purposes of a mine is permissible with development consent under the Lake Macquarie LEP 2004 within zones 1(1), 4(1) and 9 however is prohibited within all other zones. Despite

the Lake Macquarie LEP 2004 prohibiting mining within certain zones, the Mining SEPP prevails over the Lake Macquarie LEP 2004 to the event of any inconsistency. Any zoning provision in the LEP that would otherwise operate to prohibit the project therefore has no effect in this case.

5.3.2 Wyong Local Environment Plan

The proposed mining area of the Mannering Colliery Extension of Mining Project that falls within the Wyong Shire Council LGA is, under the Wyong Local Environment Plan 1991, zoned:

- 2(a) Rural;
- 2(b) Scenic Protection;
- 5(a) Special Uses; and
- 6(a) Open Spaces and Recreation.

Development for the purposes of a mine is permissible under the Wyong LEP 1991 within zones 5(a) and 6(a) however is prohibited within all other zones. Despite the Wyong LEP 1991 prohibiting mining within certain zones, the Mining SEPP prevails over the Wyong LEP 1991 to the event of any inconsistency. Any zoning provisions in the LEP that would otherwise operate to prohibit the project therefore has no effect in this case.

6.0 KEY ENVIRONMENTAL ISSUES

6.1 Identification of Environmental Issues

The key project-related issues warranting detailed assessment in the Environmental Assessment will be identified through:

- The existing environmental context of the Project area and surrounding locality;
- The legislative framework applicable to the Project (discussed in Section 5.0);
- A preliminary environmental risk assessment, which has already been completed (see Section 6.1.1);
- The outcomes of consultation to be undertaken with government agencies and other relevant stakeholders; and
- Specialist studies completed as part of the preparation of the Environmental Assessment.

The outcomes of the preliminary environmental risk assessment, including the issues identified for further detailed assessment in the Environmental Assessment, are discussed in section 6.1.1 and 6.2 below. These issues will form the basis of the Environmental Assessment, subject to the outcomes of consultation with government agencies, including the Dirtecotr General's EARS, as well as outcomes of the specialist assessments as they progress.

As there will be no changes to the existing approved infrastructure, no changes to the rate of production and no changes to the existing approved coal handling infrastructure or coal handling techniques, air quality and noise impacts are not expected to change form those impacts assessed within the Mannering Colliery Continuation of Mining Environmental Assessment (Hansen Bailey 2007) and subsequently approved by DP&I in 2008. As such no air and noise impact assessments are proposed to be undertaken for this modification.

6.1.1 Pre-Project Risk Assessment

A preliminary environmental risk assessment was conducted on 14 March 2011 by Centennial and consultants GSS Environmental (GSSE) with the aim of:

- Identifying those issues relating to the Project that represent the greatest risk to the local environment and community; and
- Assisting in setting the level of assessment required to address each identified risk within the Environmental Assessment.

The issues that were specifically assessed in the risk assessment include:

Subsidence
 Surface Water

Flora and Fauna • Social

Aboriginal/Cultural Heritage
 Greenhouse Gas

European Heritage
 Air Quality

Groundwater
 Noise

Once they were identified, the various Project risks were assessed in light of the mitigation measures and management strategies already in place at Mannering (i.e. documented in management plans and operational procedures). Where the risks were considered unacceptable, or a knowledge gap was identified in the information available, specialist consultants will be engaged to undertake further assessments and to present additional mitigation measures that may be required.

A Risk Assessment Report, including a risk register, was prepared to document the outcomes of the risk assessment, and is attached as **Appendix 1**. A summary of the Centennial risk matrix used, and the management requirements in accordance with the Centennial Risk Standard and Risk Matrix is provided in **Table 4**.

Table 4 - Requirements for Management of Risks (Centennial Risk Standard)

Risk Ranking	Risk Category		Generic Management Actions
1 to 4	Е	Extreme	Immediate intervention required from senior management to eliminate or reduce this risk.
5 to 9	Н	High	Imperative to eliminate or reduce risk to lower level by the introduction of control measures. Management planning required at senior level.
10 to 15	S	Significant	Corrective action required, senior management attention needed to eliminate or reduce risk.
16 to 19	М	Moderate	Corrective action to be determined, management responsibility must be specified.
20 to 25	L	Low	Monitor and manage by corrective action were practicable.

The risk assessment did not identify any 'extreme' or 'high' risk environmental issues relating to the Project. One 'significant' issue was identified relating to the increase in GHG emissions and costs to abate greenhouse gas emissions from the site as a result of the proposed Project.

Environmental risks ranked as 'moderate' risks were identified as follows:

- Subsidence being greater than the existing approved 20 mm vertical subsidence limitpredicted;
 and
- Discharge water not meeting EPL or ANZECC water quality criteria;
- Community action or objection.

A summary of the other minor risks (ranked as 'low') and environmental issues to be considered for the Project and included in this Briefing Paper are:

- Impacts to Aboriginal and European heritage sites from subsidence;
- Impacts to Endangered Ecological Communities (EECs), fauna habitat or threatened flora from subsidence;
- Impacts to aquatic fauna or seagrass beds from subsidence;
- Impacts to surface infrastructure from subsidence;
- Impacts to surface waters from subsidence;

- Discharge impacts on creek geomorphology or ecological receptors;
- Impacts to groundwater dependant ecosystems or other groundwater users;
- Impacts from traffic on the local road network;
- Exceedance of air and noise criteria from surface operations;
- Exceedances of air quality criteria from the surface operations; and
- Impacts from increased greenhouse gas emissions as a result of the proposed Project.

Whilst ranked as low risks, further assessments will be carried out for some of these aspects identified above as part of the Environmental Assessment. The assessments will be deigned to confirm the level of risk for the Project and identify, if required, any additional management or mitigation measures to be implemented. Section 6.2 below discusses the areas where further assessments are proposed to be undertaken as part of the Environmental Assessment and identify for other aspects why no further assessment is proposed.

6.2 Identified Environmental Issues

The environmental issues identified during the environmental risk assessment, and how they will be assessed in the Environmental Assessment, are discussed in the sections below.

6.2.1 Subsidence

A detailed subsidence assessment will be undertaken for the Mannering Colliery Extension of Mining Project for inclusion in the Environmental Assessment. The subsidence assessment will include:

- Identification of mine characteristics (depth of cover, geology, mining method, mining height, mine layout and percentage extraction) and how these characteristics influence subsidence levels;
- Identification of known geotechnical constraints to existing and/or proposed mine design;
- A review of previous subsidence predictions from the operation against actual subsidence results;
- Identification of the maximum likely predicted vertical subsidence, tilt and strain.

The outcome of the specialist subsidence assessment will be used to inform the Environmental Assessment. Other specialists use the predictions to determine the consequences of subsidence on sensitive features.

6.2.2 Flora and Fauna

A terrestrial ecological impact assessment will be undertaken as part of the Environmental Assessment. The assessment will involve:

- A review of previous ecological investigations undertaken within and in proximity to the Project Area in addition to database searches within the locality;
- Vegetation community survey and mapping;

- An assessment of the likely threatened flora and fauna to occur within the Project Area
- Identification of mitigation or management measures as required; and
- Identification of any residual environmental risk.

6.2.3 Heritage (Aboriginal and European)

An Aboriginal and European heritage impact assessment will be undertaken as part of the Environmental Assessment and will include:

- · Background research, including:
 - Identify statutory requirements relevant to the proposed Project;
 - Consultation with the Aboriginal community and other interested stakeholders in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010;
 - Literature review of previous archaeological studies relevant to the Project Application Area;
 - o Search of the Aboriginal Heritage Information Management System (AHIMS) database;
 - Assessment of Aboriginal and European archaeological and cultural heritage items identified within the Project Areas; and
 - o Baseline inventory of all Aboriginal heritage sites inside the Project Area.
- Field surveys over accessible areas of the Project Area;
- Identification of mitigation and management strategies to avoid and/or minimise against identified Aboriginal and/or European impacts; and
- Identification of any residual environmental risk.

6.2.4 Groundwater

A groundwater impact assessment will be undertaken as part of the Environmental Assessment and will include:

- A review of any available background hydrogeological and mining data;
- Searches of the NSW Groundwater Bore Database to identify beneficial use of groundwater in the anticipated radius of drawdown;
- Consideration of the ecological assessment report (to be prepared concurrently to the groundwater assessment) to identify possible groundwater dependant ecosystems (GDEs);
- Development of a high level, conceptual hydrogeological model, including the identification of model layers and boundaries, material properties and sources / sinks;
- Construction of a MODFLOW hydrogeological model based on the conceptual model with calibration of the model against available underground water level data;

- Predictive simulations of water level change in the mine workings;
- Identification of potential groundwater impacts of the proposed Project, including impacts on beneficial users and GDEs;
- Development of groundwater management strategies and mitigation measures as required; and
- Identification of any residual environmental risk.

6.2.5 Surface Water

A surface water impact assessment will be undertaken as part of the Environmental Assessment and will include:

- Collection and review of background data;
- Development of a site water balance;
- Analysis of the water quality data collected to determine mine water quality and the potential contaminants associated with any discharge requirements;
- · Determine mitigation or management measures as required; and
- Identify any residual environmental risk.

6.2.6 Social

A social impact assessment will be undertaken as part of the Environmental Assessment to identify impacts of the proposed Project on the community and identify mitigation and management measures as required.

6.2.7 Traffic

Centennial Mannering have undertaken extensive investigations on the safety of the intersection of Rutley's Road and the Mannering Colliery Mine Access Road. Centennial Mannering are currently seeking approval form Wyong Shire Council to commence upgrades to the intersection to address safety issues identified by a Stage 5 Road Safety Audit. A gap analysis will be undertaken as part of the Environmental Assessment to determine the adequacy of the currently proposed intersection upgrades to accommodate the 170 full time employees proposed by this Project.

6.2.8 Greenhouse Gas Emissions

The Mannering Colliery Extension of Mining Project will not result in any increase in coal production above the already approved 1.1 Mtpa and any additional mining equipment required to support the Project and ongoing operation of the Mannering Colliery is unlikely to have any significant increase in greenhouse gas emissions. As such, no greenhouse gas assessment is proposed to be undertaken as part of the Environmental Assessment. In accordance with the conditions of PA 03_0611, Centennial Mannering has developed a Greenhouse and Energy Efficiency Plan in consultation with the Office of Environment and heritage which has been approved by the Director-General for the DP&I. The Plan includes a programme to monitor greenhouse gas emissions from the Mannering Colliery and a framework for investigating and implementing measures to reduce greenhouse gas emissions.

Centennial Mannering will continue to monitor greenhouse gas emissions in accordance with the Greenhouse and Energy Efficiency Plan and report on its greenhouse gas emissions in accordance with the requirements of the NGER Act.

6.2.9 Air Quality

As there will be no changes to the existing approved infrastructure, no changes to the rate of coal production and no changes to the existing approved coal handling infrastructure or coal handling practices, air quality impacts are not expected to change form those impacts already assessed within the Mannering Colliery Extension of Mining Environmental Assessment (Hansen Bailey 2007) and subsequently approved. As such no air quality impact assessment is proposed to be undertaken as part of the Environmental Assessment to support this proposed Project. Monitoring of air quality impacts will continue to be carried out in accordance with the existing approved Air Qquality Management Plan and Environmental Monitoring Programme.

6.2.10 Noise

As there will be no changes to the existing approved infrastructure, no changes to the rate of production and no changes to the existing approved coal handling infrastructure or coal handling techniques, noise impacts are not expected to change form those impacts assessed within the Mannering Colliery Extension of Mining Environmental Assessment (Hansen Bailey 2007) and subsequently approved. As such no noise impact assessment is proposed to be undertaken as part of the Environmental Assessment to support this proposed Project. Noise monitoring at the Mannering Colliery will continue to be undertaken in accordance with the approved Noise Monitoring Plan and Environmental Monitoring Programme.

7.0 STAKEHOLDER AND COMMUNITY CONSULTATION

Centennial will lead the stakeholder and community consultation for the proposed Project. A stakeholder consultation plan will be developed for the Project, and will provide a framework to identify and appropriately consult with stakeholders that may be influenced by or have an interest in the Project. Key stakeholders will include:

- Government;
- Community; and
- Mine staff and employees.

A stakeholder consultation log will be maintained as a record of the consultation activities undertaken, and the contents of this log will be summarised in the Environmental Assessment.

8.0 PROJECT JUSTIFICATION

Mannering Colliery is strategically located in close proximity to the Vales Point Power Station. The areas proposed to be mined by the proposed Project will provide access to an improved coal quality resource suitable for the continuation of a coal supply to the Vales Point Power Station for electricity generation. The proximity and existence of established coal delivery infrastructure provides for ongoing reliable coal supply conditions which in turn reduces the energy demands that would be required for coal to be supplied from other NSW mining operations.

The provision of coal to the Vales Point Power Station from Mannering Colliery will allow for coal from other Centennial operations to be directed to alternative export markets. This in turn provides a more flexible supply of coal from Centennials operations enabling the company to meet changing market demands and contractual obligations.

The proposed Project will provide for ongoing direct and indirect employment opportunities while providing a number of positive flow-on effects to the local, regional and state economies through additional wages and royalties.

9.0 CONCLUSION

Centennial Mannering is seeking approval subject to Section 75W of the EP&A Act for the proposed Project to:

- Extend its underground mining operations within the Fassifern Seam beyond the existing approved 2008 Project Approval boundary using bord and pillar mining methods (see Figure 1);
- Extend its underground mining operations into the Great Northern Seam using bord and pillar mining methods (see Figure 1); and
- Provide full time employment for a total of 170 personnel.

The proposed Project will result in the extraction of approximately 3,200,000 tonnes of ROM coal from the Fassifern seam and approximately 1,400,000 tonnes of ROM coal from the Great Northern seam. All mining activities are proposed to be undertaken using bord and pillar mining methods with mining designed to achieve long term stable pillars resulting in less than 20 millimetres of cumulative subsidence on the surface.

The proposed combined extraction of coal from the Great Northern and Fassifern coal seams will not exceed the 1.1 Mtpa of coal extraction previously assessed and approved in 2008. No changes to

existing surface infrastructure, coal handling or water management systems are required for the proposed Project and the proposed Project will not extend the life of Mannering Colliery beyond the existing approved 2018 life of mine. Operations will continue to be undertaken 24 hours a day seven days a week.

This Briefing Paper is intended to brief the DP&I, and other government agencies considered relevant by the DP&I, on the proposed Project, summarise the potential environmental impacts of the proposed Project, identify relevant issues to be addressed in the Environmental Assessment, and provide sufficient information to allow the Director General to issue, if required, appropriately targeted EARs.



Dyadem Stature for Risk Management:

Risk Assessment Title: Mannering Colliery Extension of Mining Project – Environment and Community Pre-Project Broad Brush Risk Assessment

Version: 1.0 Region: North

Site: Mannering Colliery

Stature Risk Assessment No.: 1000073023

Background

Background

Mannering Colliery (Mannering) is an existing underground coal mine located approximately 40 kilometres (km) south of Newcastle. Mannering is operated by Centennial Mannering Pty Ltd (Centennial Mannering), a wholly owned subsidiary of Centennial Coal Company (Centennial). Centennial is a wholly owned subsidiary of Banpu Minerals (Singapore) Pte Limited (Banpu).

Mannering has extracted coal utilising both the bord and pillar and longwall mining methods in the Great Northern and Fassifern coal seams for over 45 years. Mannering produces ROM coal which is transported via a dedicated overland conveyor to Vales Point Power Station for domestic electricity generation.

Mannering was granted Project Approval (PA 06_0311) by the then Minster for Planning on 12 March 2008 following the submission of the Mannering Colliery Continuation of Mining Environmental Assessment (Hansen Bailey 2007).

Centennial Mannering are proposing to modify the existing Mannering Project Approval to allow for:

- An extension to its underground mining operations within the Fassifern Seam beyond the existing approved site boundary using bord and pillar mining methods;
- An extension to its underground mining operations into the Great Northern Seam, including some areas beyond the existing approved site boundary, using bord and pillar mining methods; and
- An increase in employment levels to provide for a total of 170 full time employees;

All mining activities are proposed to be undertaken using bord and pillar mining methods, with mining designed to achieve long term stable pillars resulting in less than 20 millimetres of cumulative subsidence on the surface.

The proposed combined extraction of coal from the Great Northern and Fassifern coal seams will not exceed the 1.1 million tonnes per annum (Mtpa) previously assessed and approved under PA 06_0311. No changes to existing surface infrastructure or coal handling are required for the proposed Project. ROM coal will continue to be transported by overland conveyor to the Vales Point Power Station. Operations will continue to be undertaken 24 hours a day seven days a week.

Objectives

Objectives

The following Hierarchy of Controls offers a framework for considering the effectiveness of controls. Note that the effectiveness of a control that is intended to reduce a risk decreases from top to bottom of the list. In other words, the closer the control type is to the top of the hierarchy, the more potentially effective the control.

- ·Eliminate the hazard or energy source (do not use the energy)
- •Minimise or replace the hazard or energy source (reduce the amount of energy to a less damaging level or replace the energy with another that has less potential negative consequences)
- ·Control the hazard or energy using engineered devices (ex. Lock outs, chemical containers, mechanical roof support, gas monitors, etc.)
- ·Control the hazard or energy by using physical barriers (ex. machine guarding, warning signs, etc.)
- •Control the hazard or energy with procedures (ex. Isolation procedures, standard operating procedures, etc.)
- •Control the hazard or energy with personal protective equipment (ex. hard hats, boots with toe caps, gloves, safety glasses, welding gear, etc.)
- ·Control the hazard or energy with warnings and awareness (ex. posters, labels, stickers, verbal warnings, etc.)

The objectives of this Risk Assessment is to identify the environment and community risks associated with the proposed extension of mining project at Mannering and to identify knowledge gaps where further information and/or assessment will be required to support an Environmental Assessment for the proposed Project.

Potential Hazards

Potential Hazards

The potential hazards for the proposed Project that were considered as part of this Risk Assessment include:

- Subsidence greater than the existing approved 20 mm vertical subsidence limit;
- Impacts to groundwater, groundwater users and groundwater dependant ecosystems;
- Impacts to surface waters;
- Terrestrial and aquatic ecology impacts;
- Traffic Impacts;
- Air quality impacts;
- Noise impacts;
- Impacts from increases in greenhouse gas emissions; and
- Community impacts.

Boundary Definition

Boundary Definition

This Risk Assessment is a preliminary Risk Assessment aimed to identify knowledge gaps and areas where further assessments will be required. The full extent of environmental risks associated with this project will not be understood until further and more detailed investigations have been undertaken. This risk assessment should be reviewed following the completion of the detailed investigations to ensure all environmental risks associated with the Project have been identified, understood and are at an acceptable level for the company.

Risk Assessment Method

Yes/No	Method
Yes	Workplace Risk Assessment and Control (WRAC)
No	Fault Tree Analysis (FTA)
No	Safety Integrity Level Analysis to Australian Standard 61508 (SIL)
No	Bow Tie Analysis (BTA)
No	Failure Modes and Effects Analysis (FMEA)
No	Hazard and Operability Analysis (HAZOP)

Reference Documents

Document Name	Title	Version	Referenced Document Date
Mannering Colliery Continuation of Mining Environmental Assessment	Environmental Assessment		01-Mar-2007
EPL 191	Environmental Protection Licence		01-Jan-2011
PA 06_0311	Mannering Colliery Project Approval		12-Mar-2008

Venue and Time

Date	Description	Location	Start Time	End Time
1. 10-Mar-2011	Scoping	Fassifern Office	12:00 PM	1:00 PM
2. 14-Mar-2011	Assessment	Mannering Colliery	10:00 AM	12:00 PM
3. 16-Mar-2011	Review	Fassifern Office	10:00 AM	11:00 AM

Team Selection

					Attendance	
Name	Title	Company	E-Mail Address	1. 10-Mar- 2011	2. 14-Mar- 2011	3. 16-Mar- 2011
James Wearne	Environment & Community Coordinator	Centennial Coal	james.wearne@centennialcoal.com.au	Р	Р	Р
Paul Williams	Regional Environmental Coordinator	Centennial Mandalong	paul.williams@centennialcoal.com.au	Р		Р
Anna Walsh	Technical Services- Mandalong Sth Project	Centennial Mandalong	anna.walsh@centennialcoal.com.au		Р	Р
Alan Klein	Mannering Mine Manager	Centennial Mannering	alan.klein@centennialcoal.com.au		Р	Р
Tom Payne	Mining Engineer	Centennial Mannering	tom.payne@centennialcoal.com.au		Р	Р
Andrew Hutton	Principal Environmental Consultant/General Manager	GSS Environmental	hutton@gssenvironmental.com		Р	Р
Eryn Bath	Associate Environmental Planner	GSS Environmental	bath@gssenvironmental.com		Р	Р

WRAC Analysis

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control
Mannering Colliery proposed modification	There is a risk to Mannering from	1.1.a. Geothechnical engineered mine design				A subsidence assessment is to be prepared for the Project focusing on two seam mining and combined subsidence levels
	Subsidence greater than the existing approved 20 mm vertical subsidence limit. ::: Caused by: Cumulative subsidence of Fassifern and Great Northern workings (under	1.1.b. 15 years of detailed subsidence monitoring of mining in two seam areas using a combination of techniques.				predicted for the project where mining overlays proposed or existing workings.
	existing workings or proposed two seam mining) or Inadequate/inflexible mine design or Unidentified geological structures Resulting in:	1.1.c. NSW Department of Industry and Investment (I&I NSW) approval for mine design when mining within the High Water Level Subsidence Control Zone.	D (D)	3 (F)	17 (M)	
	Greater than anticipated surface impacts.	1.1.d. Dam Safety Committee approval for mine design when mining under the Vales Point Power Station ash dam.	'			
		1.1.e. High level of understanding of where major geological structures are.				
		1.1.f. Using bord and pillar mining provides long-term stability and flexible mine design.				
	There is a risk to Mannering from ::: Subsidence :::	1.2.a. Mining to be designed to result in less than 20mm subsidence therefore no surface				Aboriginal and Cultural heritage assessment to be prepared for the project.
	Caused by: Mining in Great Northern and/or Fassifern Seam	impacts.	D (D)	4 (E)	21 (L)	The OEH 2010 Aboriginal Cultural Heritage Consultation Requirements for Proponents to be followed.
	Resulting in: Impacts to Aboriginal heritage sites.					4. Field surveys to be undertaken over publicly accessible areas.
	There is a risk to Mannering from ::: Subsidence :::	1.3.a. Mining to be designed to result in less than 20mm subsidence.	E (D)	5 (E)	25 (L)	5. European heritage assessment to be prepared for the project.
	Caused by:					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control
	Mining in Great Northern and/or Fassifern Seam Resulting in:					6. Field surveys to be undertaken over publicly accessible areas.
	Impacts to European heritage sites.					
	There is a risk to Mannering from ::: Subsidence :::	1.4.a. Mining to be designed to result in less than 20mm subsidence.				7. Terrestrial ecology impact assessment to be prepared for the project.
	Caused by: Mining in Great Northern and/or Fassifern Seam		D (D)	4 (E)	21 (L)	
	Resulting in: Impacts to Endangered Ecological Communities or Impacts to fauna habitat or Impacts to terrestrial flora including threatened species.					
	There is a risk to Mannering from ::: Subsidence :::	1.5.a. Mining to be designed to result in less than 20mm subsidence.				8. Surface water impact assessment to be prepared for the project.
	Caused by: Mining in Great Northern and/or Fassifern Seam		D (D)	4 (E)	21 (L)	
	Resulting in: Impacts to creeks that traverse through the project site					
	There is a risk to Mannering from ::: Subsidence :::	1.6.a. I&I NSW approval for mine design when mining within the High Water Level Subsidence Control Zone.				Aquatic ecology assessment to be prepared for the project.
	Caused by: Mining in Great Northern and/or Fassifern Seam	1.6.b. Mining to be designed to result in less than 20mm subsidence.	D (D)	4 (E)	21 (L)	
	Resulting in: Impacts to aquatic fauna or Impacts to seagrass beds.					
	There is a risk to Mannering from	1.7.a. Mining to be designed to result in less than 20mm	Е	5	25	10. Dam Safety Committee approval required for mining within the Vales Point power station Ash Dam notification area.
	::: Subsidence :::	subsidence.	(D)	(BI)	(L)	,
	Caused by:					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control
	Mining in Great Northern and/or Fassifern Seam					
	Resulting in: Impacts to surface infrastructure (ash dam/transmission lines/underground cables/houses/roads etc).					
	There is a risk to Mannering from	1.8.a. Depositional dust gauges installed.				
	::: Impacts to air quality ::: Caused by:	1.8.b. Approved Air Management Plan.				
	Coal handling operations or New infrastructure	1.8.c. Air model prepared for the 2008 Environmental Assessment	D (D)	4 (E)	21 (L)	
	Resulting in: Exceedances of air quality criteria.	1.8.d. No changes to the existing/approved infrastructure ROM production or coal handling at Mannering Colliery.				
	There is a risk to Mannering from	1.9.a. Quarterly attended monitoring				
	::: Noise impacts ::: Caused by:	1.9.b. Approved Noise Monitoring and Management Plan				
	Coal handling operations or New infrastructure	1.9.c. Noise model prepared for the 2008 Environmental Assessment.	D	5	24	
	Resulting in: Exceedances of noise criteria.	1.9.d. No changes to the existing/approved infrastructure or coal handling at Mannering Colliery.	(D)	(R)	(L)	
		1.9.e. No noise complaints received.				

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control
	There is a risk to Mannering from ::: Loss of groundwater or depressurisation of groundwater aquifers :::	1.10.a. Mining to be designed to result in less than 20mm subsidence therefore no connection with overlying aquifers.				11. Water impact assessment to be prepared for the project and address impacts on Groundwater dependant ecosystems.
	Caused by: Mining in Great Northern and/or Fassifern Seam Resulting in:		D (D)	4 (E)	21 (L)	
	Impacts to Groundwater Dependant Ecosystems (GDEs).					
	There is a risk to Mannering from ::: Loss of groundwater or depressurisation of groundwater aquifers ::: Caused by: Mining in Great Northern and/or Fassifern Seam	1.11.a. Mining to be designed to result in less than 20mm of subsidence	D (D)	4 (R)	21 (L)	12. Water impact assessment to be prepared for the project, including consideration of potential impacts on other groundwater users.
	Resulting in: Impacts to other groundwater users.					
	There is a risk to Mannering from	1.12.a. EPL limit of 4 ML/day of discharge.				13. A hydrogeological model and water balance is to be prepared for the project as part of the water impact assessments
	::: Discharge requirements exceeding current EPL limits for volume :::	1.12.b. Current discharge of 1.2 ML/day.				to confirm the discharge requirements for the Mannering Colliery.
	Caused by:	1.12.c. Don't discharge every day.	D	4	21	
	Increase in mine water discharge requirements	1.12.d. Monitoring undertaken of discharge volumes.	(D)	(E)	(L)	
	Resulting in: Impacts to creek geomorphology or Impacts to ecological receptors.	1.12.e. Ecological assessment of the impacts of mine discharge on an un-named creek completed.				
	There is a risk to Mannering from ::: Discharge of water than does not	1.13.a. Water quality monitoring done at discharge point including monitoring of metals.		4	40	14. Water assessment to be prepared for the project, including an assessment of water quality against EPL and ANZECC criteria.
	meet EPL or ANZECC quality criteria :::	1.13.b. Four settlement ponds on site.	(D)	4 (E)	18 (M)	
	Caused by:	1.13.c. Pollution Reduction				

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	
	Inappropriate/inadequate water management system	Program is currently imposed on the Mannering EPL.					
	Resulting in: Impacts to ecosystem health or Impacts to surface water quality.	1.13.d. Ecological assessment of the impacts of mine discharge on an un-named creek completed					
	There is a risk to Mannering from	1.14.a. Traffic audit completed in 2008 by Parsons Brinckerhoff.				15. A gap analysis is to be undertaken on the adequacy of the Rutleys road and mine access road intersection taking into	
	::: Traffic Impacts ::: Caused by: Increased employee numbers Resulting in:	1.14.b. Concept design for the upgrade of the intersection of Mannering Access Road and Rutleys Road approved by Wyong Shire Council.	D	4	21	consideration the proposed intersection upgrades.	
	Impacts to the local road network or Increasing accidents or Reduced road safety or Traffic delays.	1.14.c. Geotechnical and construction plans currently being developed for the intersection and are to be approved by Wyong Shire Council.	(D)	(R)	(L)	(L)	
		1.14.d. Traffic study done by Parsons Brinckerhoff					
	There is a risk to Mannering from ::: Increases in greenhouse gas emissions :::	1.15.a. NGERS reporting (externally audited)					
	Caused by: Additional mining equipment or Mining in Great Northern and/or Fassifern Seam or Additional mining equipment	1.15.b. No increase in coal production volumes above the currently approved 1.1 Mtpa	D (D)	4 (R)	21 (L)		
	Resulting in: Costs to abate GHG emissions or Increase in GHG emissions from site.	1.15.c. Additional equipment to support the project will result in an insignificant increase in GHG emissions.					
	There is a risk to Mannering from ::: Community action and/or	1.16.a. Mannering Colliery publishes articles in the Lakes Mail (local weekly newspaper).	С			16. Socio-economic assessment, including community profiling, to be done by Lantz Marshall.	
	objection ::: Caused by: Incorrect information or Lack of information or Mining in general	(local weekly newspaper). 1.16.b. Mannering Colliery has a Community Consultative Committee that meets every 3 months		4 (R)	18 (M)	17. Stakeholder Engagement Plan to be developed.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control
	Resulting in: Community complaints or Community enquires or Damage to reputation or Delays in project approval or Submissions against the project.	1.16.c. CCC meeting minutes posted on website.				18. Socio-economic assessment to be prepared for the project.

RISK MANAGEMENT STANDARD

Management Standard-004

				A DE III E III I				one otani	Likelihood				
		CENT	ENNIAL	RISK MATRI	X		A Certain	B Probable	C Possible	D Remote	E Improbable	Description (D)	
					Consequence e event or may represent a cumulative impact over a asonable consequence if there is more than one.			Has Happened within Centennial"	"Could Happen & has happened in non-CEY operations	NotLikely	"Practically impossible	Probability (Pb)	
Rating	Impact to Annual	Personal Injury	Business Interruption	Legal	Parutation (P)	Environment	Frequent incidents	Regular incidents	Infrequent incidents	Unlikely to occur. Very few recorded or known incidents	May occur in exceptional circumstances. Almost no recorded incidents.	Incident Frequency (IF)	
	Business Plan (F)	(PI)	(BI)	(L)	(Ľ)	Reputation (R)	Reputation (R) (E)	Operations – within 3 months	Operations – within 2 years	Operations – within 5 years	Operations – within 10 years	Operations – within 30 years	Operations (Op)
							Project – Every project	Project – Every 2 projects	Project – Every 5 projects	Project – Every 10 projects	Project – Every 30 projects	Project (Pr)	
1. Catastrophic	>\$50m	Multiple Fatalities	> 1month	Prolonged litigation, heavy fines, potential jail term	Prolonged International media attention	Long term impairment habitats/ ecosystem	1 (E)	2 (E)	5 (H)	7 (H)	11 (S)		
2. Major	\$10m - \$50m	Single Fatality	1 week to 1 month	Major breach/ major litigation	International media attention	Long term effects of ecosystem	3 (E)	4 (E)	8 (H)	12 (S)	16 (M)		
3. Moderate	\$1m - \$10m	Serious/ Disabling Injury	1 day to 1 week	Serious breach of regulation. prosecution/ fine	National media attention	Serious medium term environmental effects	6 (H)	9 (H)	13 (S)	17 (M)	20 (L)		
4. Minor	\$100k - \$1m	Lost Time Injury	12 hrs to 1 day	Non-compliance, breaches in regulation	Adverse local public attention	Minor effects to physical environment	10 (S)	14 (S)	18 (M)	21 (L)	23 (L)		
5. Insignificant	<\$100k	First Aid Treatment Only	< 12 hrs	Low level compliance issue	Local complaints	Limited physical damage	15 (S)	19 (M)	22 (L)	24 (L)	25 (L)		

Risk Rating	Risk Category		Generic Management Actions
1 to 4	1 to 4 E Extreme		Immediate intervention required from senior management to eliminate or reduce this risk
5 to 9	H High		Imperative to eliminate or reduce risk to a lower level by the introduction of control measures. Management planning required at senior levels
10 to 15	S	Significant	Corrective action required, senior management attention needed to eliminate or reduce risk
16 to 19	M Moderate		Corrective action to be determined, management responsibility must be specified
20 to 25	L	Low	Monitor and manage by corrective action where practicable

THIS DOCUMENT IS UNCONTROLLED UNLESS VIEWED ON THE INTRANET

		-	OW THE	ANALYSIS - Control Effective			Impact / St	atus / Quali	tv	
	Examples	Description	Rank	Control Category	A >= 80%	B 50 – 80%	C 50 / 50%	D 50 – 20%	= E <= 20%	
TYPE OF CONTROL	Replace electric hand tools with compressed air alternatives in wet conditions	Eliminates a hazard by removal	1.	Elimination of hazard						
	Replace large diameter, heavy cables with smaller ones that are easier to handle manually	Replace element with less risky alternative	2.	Substitution						
	Automatic fire fighting sprinkler systems	An automatic device that operates without intervention by personnel	3.	Engineered without people						
	Fire alarm that sounds & the operator then has to initiate an evacuation	A device that requires personnel to respond to a stimulus	4.	Engineered with people						
	Inspection, maintenance and repair of machinery	A process carried out by personnel	5.	Procedural						
9	Employee made aware of dangers of large moving equipment where the operators have limited vision	Induction training programs	6.	Awareness						

Appendix 2 – Cumberland Ecology (2009) Post Approval Ecological Assessment	

ECOLOGICAL ASSESSMENT OF 'STUDY AREA' MANNERING COLLIERY, LAKE MACQUARIE NSW

Post Approval Ecological Assessment

For:

HANSEN BAILEY

February 2009

Final Report

Cumberland Ecology

PO Box 2474, Carlingford Court 2118



Report No. 8063RP1

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Approved by: David Robertson

Position: Project Director

Dand Robertson

Signed:

Date: 17 March, 2009



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Executive Summary

INTRODUCTION

Under an Environment Protection Licence (No. 191), Mannering Colliery discharges approximately 1 megalitre per day of mine water from its underground coal mining operations into a small area that is partly located within the surface facilities of the colliery itself, on Rutleys Road, Doyalson NSW. Such discharge to the creek has taken place over much of the 45 years the mine has been in operation and the artificial flows comprise the majority of water within the upstream sections of the creek under normal conditions. Consequently the vegetation downstream of the discharge point has adjusted to the increased flows. The purpose of this report is to fulfil Mannering's Project Approval Condition 7 to assess the current flora, fauna and habitat values of the creek and to predict the ecological impacts from the cessation of mine dewatering upon decommissioning of the mine.

The catchment of the creek downstream of the point at which mine water is discharged, and the vegetation within the zone of potential influence of the creek waters, forms the study area for this assessment. The study area includes an artificial wetland and creek designed to slow the flow of water, which is continuously pumped from the Mannering Colliery. The creek's course passes through areas of modified wetland, woodland and forest before entering Lake Macquarie.

METHODS

Prior to commencement of fieldwork, background literature and threatened species databases were consulted to gain an understanding of the types of flora and fauna that had the potential to occur in the study area.

Ecological surveys of the study area were carried out from October to November 2008 to provide baseline information required for this assessment. Flora quadrat and random meander surveys assessed vegetation communities of the study area; while a targeted threatened flora species search was conducted in areas of suitable habitat. A snapshot aquatic survey was conducted assessing the creek and wetland as a habitat resource; collecting details on water quality as well as macroinvertebrate and fish communities. Incidental visual and/or aural surveys of frogs and birds were also conducted during other works.



RESULTS

The vegetation of the study area varies greatly in structure and condition depending on location. The visual effects of various human disturbances are obvious with numerous roads and transmission-line easements crossing the subject land. However, the effects of disturbance on the vegetation communities close to Lake Macquarie are less obvious

The vegetation of the study area was identified as stands and / or mosaics of the following vegetation communities:

- Exotic Rushland;
- Freshwater Wetland;
- Swamp oak-Rushland Forest;
- Coastal Plains Smooth-bark Apple Woodland;
- Coastal Plains Scribbly Gum Woodland;
- Riparian Melaleuca Swamp Woodland;
- Swamp Mahogany-Paperbark Swamp Forest; and
- Mangrove Estuarine Complex.

No threatened flora species have been detected on the subject land although potential habitat does occur for some threatened plants.

A range of fauna habitats occur within the study area potentially providing habitat for a number of threatened fauna species. While not detected during the survey, the subject land contains suitable habitat for a range of threatened species including: Wallum Froglet, a range of microchiropteran bats, Grey-headed Flying-fox, Regent Honeyeater, Swift Parrot, Black Bittern, Australian Painted Snipe and Masked Owl.

The water discharged from the mine and within the creek has chemical properties more consistent with groundwater than stream water. It is far more saline than would be expected for a typical stream and nutrient levels are very low. The alkalinity and hardness of the water are extremely high, indicative of high absorption of mineral content.

The subject land provides a highly modified aquatic habitat of relatively poor water quality (as it relates to aquatic habitat), providing habitat to a low diversity of macroinvertebrates and fish. Only common and widespread macroinvertebrate taxa were identified; while the only fish species identified within the non-estuarine reaches of the creek was the highly invasive species and Key Threatening Process (NSW Scientific Committee, 2004b) Mosquito Fish.



IMPACT ASSESSMENT

The decommissioning of Mannering Colliery will result in the cessation of approximately 1 megalitre of water per day mine water discharge into the Study area. As the artificial flows comprise a high proportion of the overall flow of the creek, cessation of mine water discharge will result in a suite of ecological changes downstream from the discharge point. Much of the present aquatic habitat will be significantly reduced in its extent and in some swamp areas are likely to be replaced by vegetation typical of drier habitats. Swampy habitats that are currently widespread will contract and will in future occupy a much smaller area. However the lower, tidally fed portion of the creek is likely to remain mostly unaffected because it is sustained by tidal inflows from Lake Macquarie. Given the upstream section of the creek is dominated by Plague Minnow and contains a low diversity of common macroinvertebrates mitigation measures to prevent a reduction in wetland size are not considered warranted.

The vegetation Communities Freshwater Wetland and Swamp Oak – Rushland Forest are both expected to contract in size with the cessation of mine water discharge. Both Communities are equivalent to Endangered Ecological Communities (EECs) listed under the TSC Act. The Freshwater Wetland and much of the Swamp Oak – Rushland Forest of the subject land is highly disturbed and the understorey contains a high proportion of the exotic weeds *Juncus acutus* (Spiny Rush) and *Cortaderia selloana* (Pampas Grass). These are the areas of vegetation that will be most affected by the cessation of mine water flow. Since these communities are highly disturbed, largely artificial in nature and suffer from extensive exotic weed infestations, mitigation measures to prevent a reduction in wetland size are not considered warranted. Reduced flows of water may actually have a benefit by reducing the area of significant environmental weeds.

The area of relatively undisturbed Swamp Oak – Rushland Forest adjacent to Lake Macquarie on the southern side of the creek is unlikely to be affected by the cessation of mine water discharge because the of the groundwater influence provided by the lake will provide the necessary environment for continued survival irrespective of the reduction of stream flows. The area on the northern side of the creek to some extent may be reliant on the discharge from Chain Valley Mine.

While not detected during recent surveys, the contraction of the wetland area will result in the loss of potential habitat for the threatened cryptic marsh birds Black Bittern and Australian Painted Snipe as well as a small number of threatened microchiropteran bats. However, with time and succession to drier vegetation types the landscape will become more suited to forest dwelling bird and bat species.

CONCLUSIONS

The decommissioning of Mannering Colliery and associated cessation in mine water discharge will impact upon the vegetation communities Freshwater Wetland and Swamp Oak – Rushland Forest through contraction in the extent of these communities. Both



communities are equivalent to EECs under the TSC Act. It is likely that the additional water has expanded the extent of the wetland vegetation but has resulted in a decline in the quality of vegetation – perhaps due to the high salinity or the other chemical properties of the water. Exotic weed invasion along the Study area is high and dispersal of the weeds has perhaps been increased by the constant flow of water. With the cessation of the mine water discharge the remaining wetland would benefit from the implementation of a weed management practices to control significant weeds such as Spiny Rush and Pampas Grass within what will be a reduced area of riparian habitat. A suggested weed management protocol is provided in this document. The weed management should anticipate successional changes in vegetation type as the area moves from a wetland to a drier environment. Weeds such as Pampas Grass will continue to colonise the area with the cessation of water flow.

No threatened flora have been detected within the study area and all threatened fauna with potential to use the site should be relatively unaffected by the cessation in mine water discharge.

Based on the macroinvertebrate, fish and physico-chemical water property assessments of the unnamed creek the aquatic habitat of the site is in poor condition and the aquatic habitats within it are not of high conservation significance.

A soil sampling regime to test for Acid Sulfate Soils (ASS) should be conducted prior to the closure of the mine. This sampling will determine if the wetland contains ASS and ascertain if caution needs to be taken in the reduction of mine water discharge. The feasibility of a slowly reduced discharge of mine water over an extended period should be considered to control the death of wetland vegetation. This would reduce the potential for the erosion of the possibly acidic sediments and the potential acidification of the down stream environment including Lake Macquarie.

Introduction

1.1 Purpose

Cumberland Ecology has been engaged by Hansen Bailey to conduct an ecological assessment of the study area, partly located within Mannering Colliery, Rutleys Road Doyalson NSW. Under an Environment Protection Licence (No. 191), the colliery discharges approximately 1 megalitre per day of mine water from its underground coal mining operations into the unnamed creek. Such discharges have taken place over much of the 45 years the mine has been in operation and the artificial flows comprise the majority of water within the freshwater sections of the creek under normal conditions. Consequently the downstream vegetation has adjusted to the increased flows.

The mine has received a Project Approval from Department of Planning under Part 3A of the *Environmental Planning and Assessment Act 1979*. Condition 7 of Schedule 3 for the Project Approval requests investigation of the ecological significance of mine water discharge into the study area and associated wetlands between the mine site discharge point and Lake Macquarie. Schedule 3, Condition 7 of the Project Approval states:

- 7. The proponent shall investigate, assess and report on the ecological interactions of mine water discharged from the site with aquatic ecology of the study area and wetlands (and associated vegetation) between mine water discharge points and Lake Macquarie. This report must:
- (a) be prepared in consultation with DECC by suitably qualified expert/s whose appointment/s have been approved by the Director-General;
- (b) be submitted to the Director-General by the end of March 2009; and
- (c) assess the probable alterations in local ecology attributable to previous and proposed mine water discharges and any future cessation of mine water discharge flows.

Appendix A provides correspondence from DECC in relation to the approval of Cumberland Ecology as suitably qualified experts and approval of this report by Department of Planning (DoP). It also includes correspondence with DECC in relation to consultation in relation to the draft plan and final approval from DoP of this Report.



The intent of the condition is to determine the extent to which native flora and fauna are impacted by and/or dependent upon water discharge from the mine. There is potential for threatened and regionally significant flora and fauna to have become dependent upon the discharge of mine water and to be negatively impacted if the mine dewatering stops.

This report presents the results of the ecological investigation conducted to address Condition 7. It summarises the terrestrial and aquatic ecology of Study area and associated wetland and provides an assessment of the potential impacts of the discontinuation of mine water release upon decommissioning of the mine.

1.2 Site Description

Mannering Colliery (Mannering) is an underground coal mine and coal processing plant located on the eastern side of Rutleys Road, Doyalson NSW. The Mannering Colliery surface facilities consist of administration offices; employee amenities; upcast and downcast shafts; diesel storage facilities; and other mine related facilities. Development of Mannering commenced in 1960 and included the construction of an artificial wetland to slow the movement of mine water discharge into Lake Macquarie.

Due to Mannering's close proximity to Lake Macquarie, saline groundwater constantly seeps into the mine. This groundwater, combined with the freshwater required in mine processes, results in the requirement for water to be constantly discharged from the mine, in accordance with Environment Protection Licence 191. The mine water is pumped to the surface where it passes through a series of sedimentation ponds before being discharged into the wetlands. The wetlands are designed to slow the progress of the water to allow the removal of any further finer sediments or other materials before entering Lake Macquarie.

The land on which the wetlands sit slope east and the Study area (the creek) created by the mine water discharge flows into the south west corner of Lake Macquarie. The land to the east of the Mannering site boundary, which contains part of the unnamed creek and wetlands, is the property of Delta Electricity to the shores of Lake Macquarie.

1.3 Terminology

The following terminology is used throughout the report:

- Subject site is defined as the parcel of land owned by Delta Energy, including Mannering Colliery, on which the study area and wetlands relevant to this study;
- Subject land refers to the to the Study area and associated wetlands;
- Study area refers to the subject land and immediate surrounds that may be indirectly affected by the cessation of mine water discharge;



- Locality refers to the land within a 10km radius of the subject site;
- TSC Act abbreviates the Threatened Species Conservation Act 1995;
- ▶ EPBC Act abbreviates the Environment Protection and Biodiversity Conservation Act 1999;
- ▶ EP&A Act abbreviates the Environmental Planning and Assessment Act 1979; and
- Threatened species refers to those flora and fauna species listed as vulnerable, endangered or critically endangered under the TSC Act or EPBC Act.

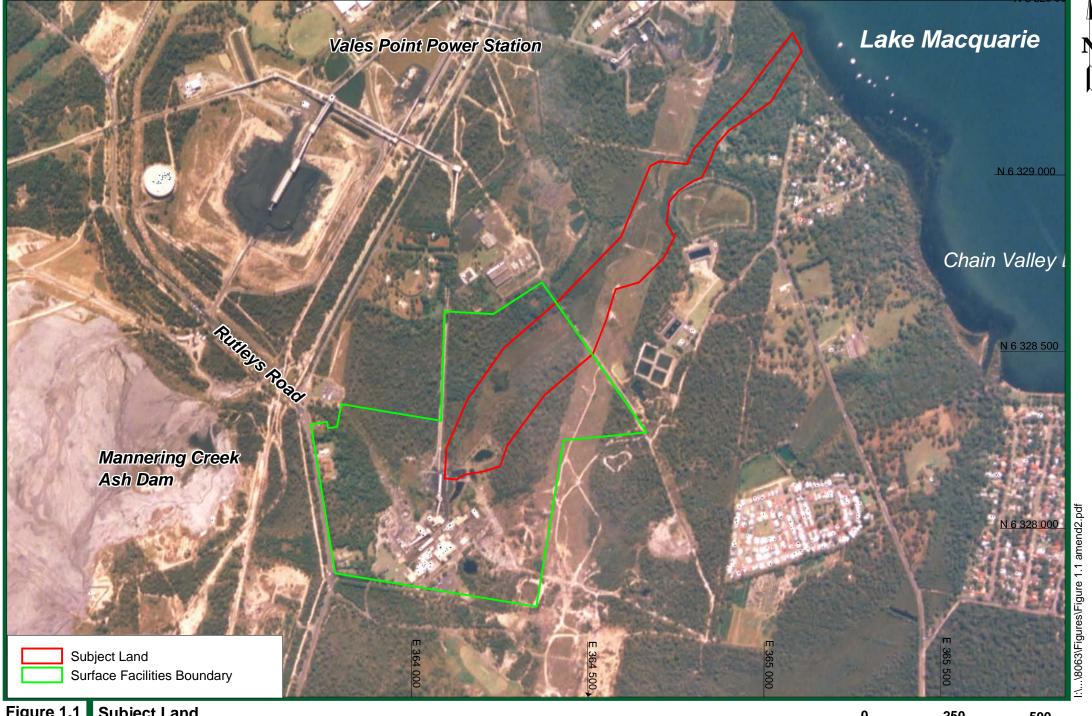


Figure 1.1 Subject Land

Cumberland Ecology

Cumberland Ecology

Methodology

2.1 Literature Review and Database Analysis

An Environmental Assessment of the subject land had previously been undertaken by Hansen Bailey (Hansen Bailey, 2007) however no ecological assessment was conducted as part of the project as no surface disturbance was proposed as part of the Project.

The vegetation mapping of the Lower Hunter and Central Coast Extant Vegetation Community Map and Technical Report (LHCCREMS, 2003) was used to assist in determination of the vegetation communities that occurred on the subject land.

The Atlas of NSW Wildlife (DEC (NSW), 2006) and the EPBC Act Protected Matters Search Tool (DEWHA, 2008) were consulted for records of threatened flora and fauna species and endangered ecological communities listed under the TSC Act and EPBC Act respectively. The Atlas of NSW Wildlife search included all records within 10km and the EPBC Act Protected Matters search included all protected matters that may occur in a 10km radius.

Current and historical aerial photograph analysis allowed comparison of the original condition of the Study area; associated vegetation communities and habitats prior to mine construction to the wetland currently present on the subject site. This comparison allowed the determination of the original configuration of the creek / wetland on the subject lands as well as any significant landform changes attributable to the mine water discharge from Mannering Colliery.

2.2 Flora Survey

The vegetation of the subject land was surveyed following a general inspection in order to obtain an overview of the nature, distribution and variation of the vegetation within the study area on 9th October 2008. Targeted threatened species searches for threatened wetland speceies were conducted on 20th November 2008.

The flora of the subject land was surveyed using quadrats located representatively throughout the subject land. Lists were made of species found when carrying out quadrat and random meander surveys of the site. Specimens of plants not readily identified in the field were collected for later identification. Seven 20 x 20m quadrats were surveyed



(Figure 2.1). The presence and cover abundance of each flora species in the quadrat was recorded according to a modified Braun-Blanquet system as below:

- 1 = rare;
- 2 = occasional;
- > 3 = common but less than 5% cover;
- 4 = very common but less than 5% cover;
- > 5 = 5-25% cover; and
- \rightarrow 6 = 26-50% cover.

Plant community structure, quadrat location and other details including slope, steepness and aspect of slope, and soil and rock details were recorded for most quadrats.

A targeted threatened species survey was undertaken in an effort to determine if any of the threatened flora species with suitable habitat on the subject lands were present. Species that were targeted are outlined in Table 3.1. Surveys were conducted by first identifying suitable habitat for the threatened species followed by conducting thorough searches throughout the areas of habitat.

2.3 Aquatic Survey

An aquatic survey of the Study area and associated wetland on the subject land was undertaken, with data collected on water quality (as it relates to ecology), macrophytes, fish and macroinvertebrates.

The survey was conducted over one day on 9th October 2008 and entailed the following:

- Recording of descriptive information about the nature and extent of aquatic microhabitats at seven stations along the length of the creek;
- Physico-chemical analysis of waters at five sampling stations along the length of the creek including temperature, pH, salinity, turbidity, dissolved oxygen levels, total nitrogen and phosphorous levels, as well as water alkalinity and hardness;
- Sampling of all macrophytes in and adjacent to the entire length of the creek;
- Sweep net samples of freshwater macroinvertebrates using a 250 micron sweep net at seven stations along the length of the creek;
- Sampling of small fish species at seven stations along the length of the creek using collapsible fyke nets; and

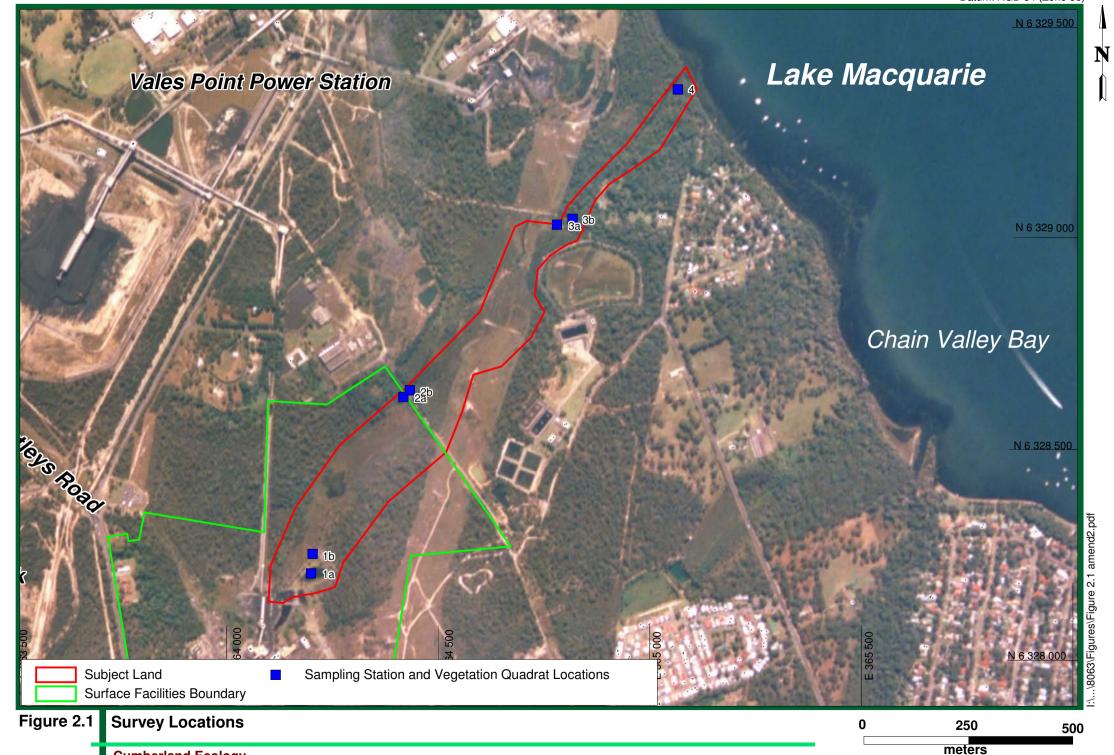


> Sweep net samples of small fishes at seven stations along the length of the creek.

2.4 Aquatic Analysis

Field survey data was analysed in order to:

- > Compare the water quality to ANZECC water quality guidelines; and
- Examine the fish and macroinvertebrate assemblages in the lake and use these to determine the current quality of freshwater habitats.



Cumberland Ecology





Results and Discussion

3.1 Introduction

The vegetation of the subject site varies from areas of brackish wetland with varying levels of exotic weed invasion, through to areas of open forest where exotic weed invasion is apparently low. Levels of disturbance vary from highly disturbed areas adjacent to the mine infrastructure to relatively low in areas adjacent to Lake Macquarie.

The subject land provides an extensive area of wetland adjacent to the creek consisting largely of low, dense sedges and rushes. Saline influences upon the creek become obvious as it moves towards Lake Macquarie with the presence of mangroves and seagrass beds.

3.2 Literature Review and Database Analysis

3.2.1 Database Analysis

A review of the Atlas of NSW Wildlife (DECC (NSW), 2008) database was carried out to determine if any threatened flora and fauna species had been recorded within 10km of the site and a threatened fauna species report generated. An EPBC Protected Matters search was conducted to provide a list of Commonwealth listed threatened fauna and fauna habitat in the locality of the subject site. A number of threatened species were identified having the potential to occur in the area of the subject site; details of these fauna species are supplied in Table 3.1 and Table 3.2 below. Some oceanic fauna species identified in the desktop review were not included in the table due to a lack of suitable habitat within the subject site.

3.2.2 Aerial Photograph Analysis

Review of historical aerial photographs of the Lake Macquarie region taken in 1954 show that a creek or wetland system was present on the subject lands prior to the construction of both Mannering Colliery and Chain Valley Mine (Figure 3.1). The channel currently present at the creek's entry into Lake Macquarie is clearly visible from this photograph and

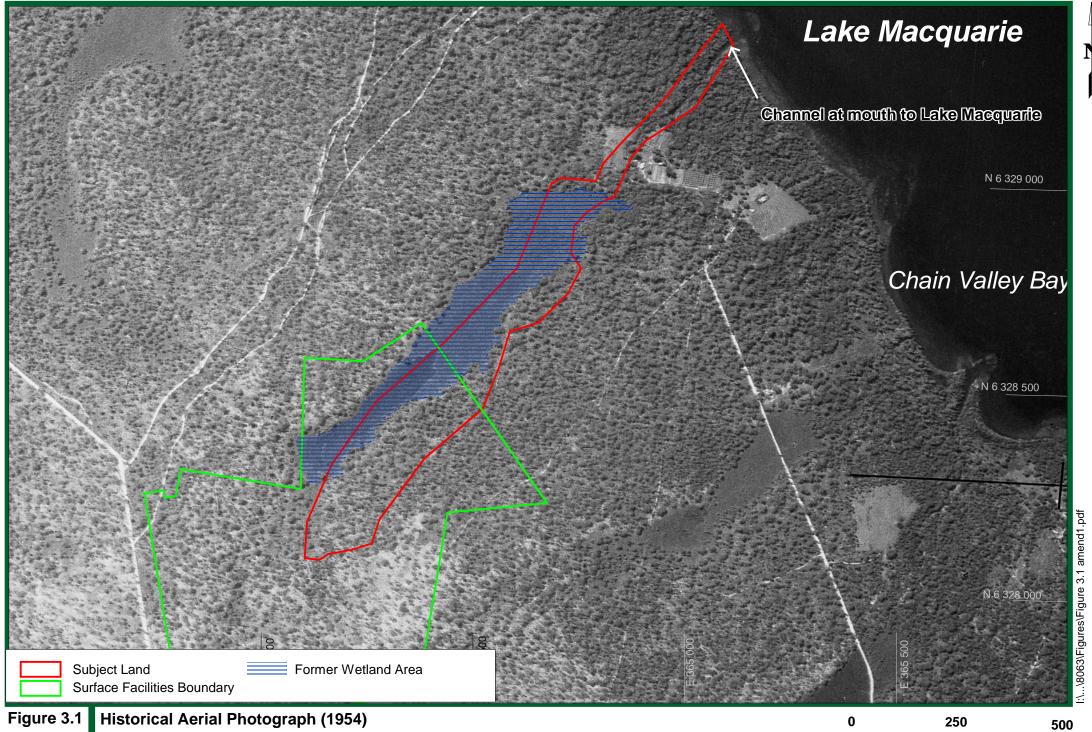


what appears to be a wetland is present in the upper reaches of this channel. It is likely that this treeless wetland drained via the channel into Lake Macquarie or was a saline basin that flooded on the highest tides forming a saltmarsh or similar saline wetland.

In either case, the current creek/wetland system forms a highly modified system that diverges from the original wetland environment. The list below provides reasons as to why the creek and wetland are not considered to be of the same ecological value that they were prior to the construction of the mine:

- While the current wetland may have a similar vegetation structure to the original wetland it, is unlikely that it contained such a high level of exotic weed invasion from species such as *Juncus acutus* (Spiny Rush) and *Cordateria selloana* (Pampas Grass);
- The current wetland is in a slightly different location and is crossed by two road / culvert systems;
- Following the commencement of discharge, the channel of the creek has become eroded from the years of constant water flow from both Mannering Colliery and adjacent industry resulting in siltation of the of the tidal channel at the entrance to Lake Macquarie; and
- The water that is being discharged from Mannering Colliery is brackish and therefore does not provide a suitable environment for many of the typical freshwater creek or stream species the may have inhabited the previous wetland.

However, the mine water discharge has had a positive effect through the siltation of the estuarine channel. The reduced depth of the channel has resulted in the creation of seagrass beds at the channel mouth. Seagrass beds are a known nursery ground for a large suite of estuarine organisms providing shelter during the vulnerable juvenile stage.



ure 3.1 Historical Aerial Photograph (1954)

Cumberland Ecology

0 250 50
meters



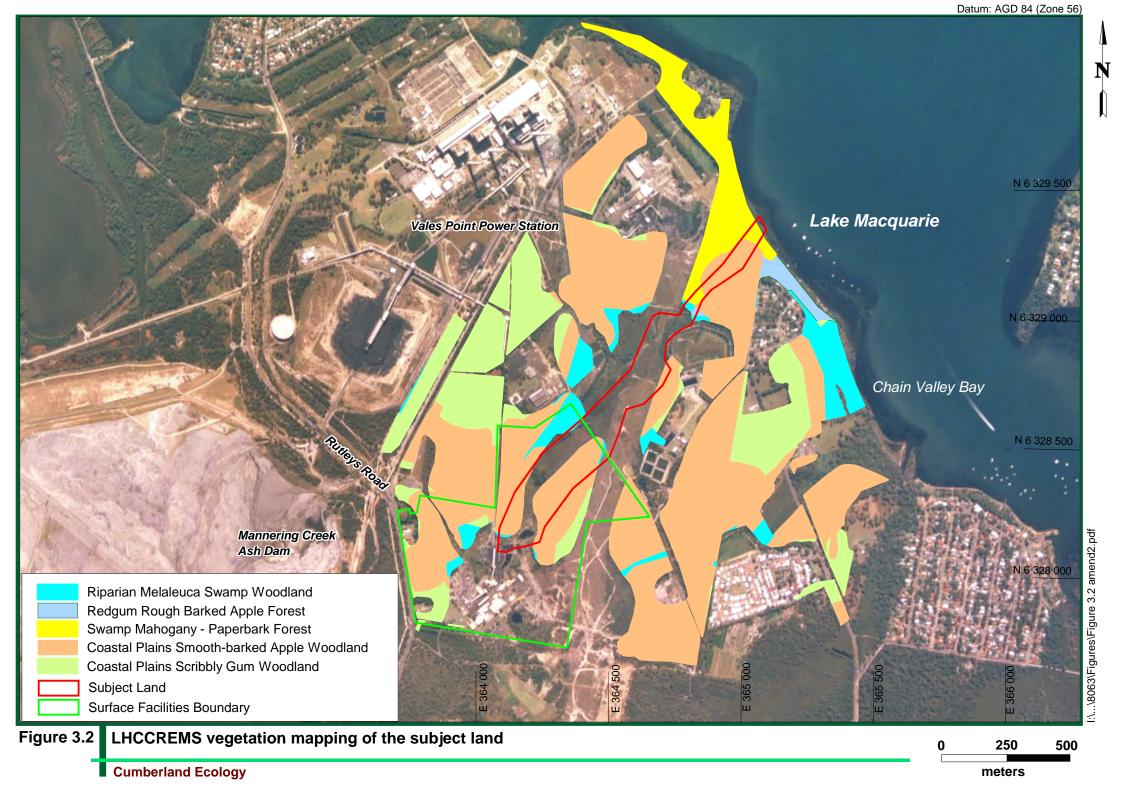
3.3 Vegetation Communities

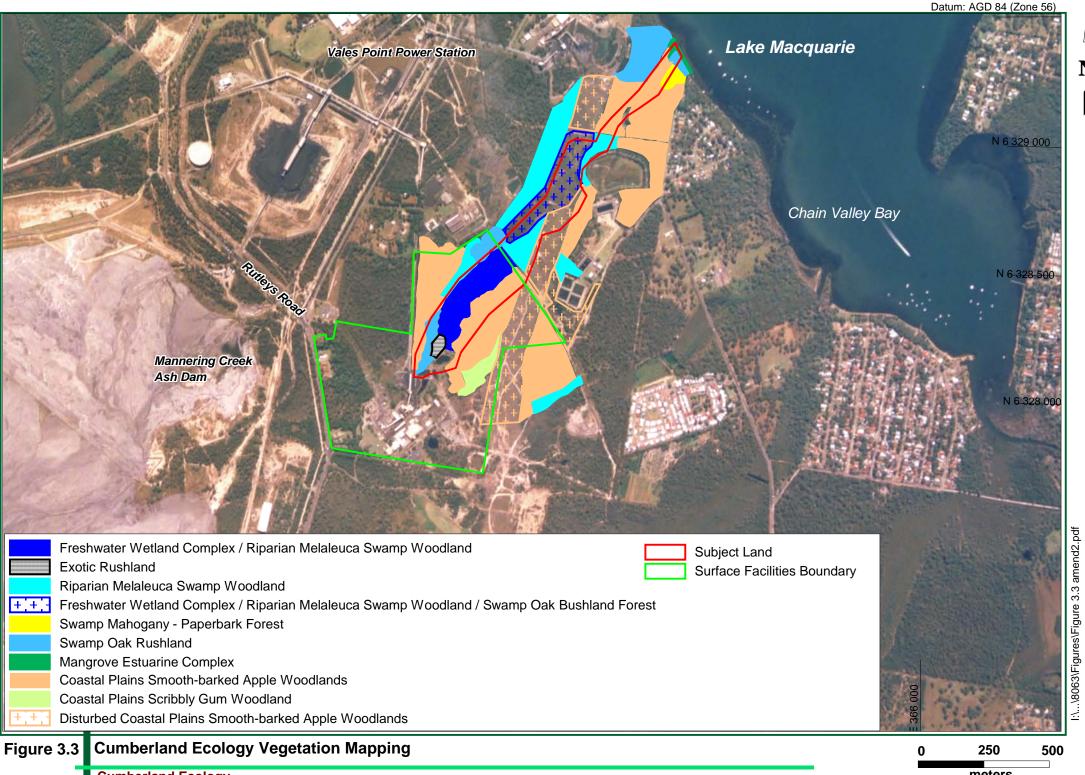
The vegetation communities of the subject site have been identified using vegetation mapping prepared for the Lower Hunter and Central Coast Region (LHCCREMS) (NSW NPWS, 2000) LHCCREMS mapping of the subject land which appears incomplete and inaccurate to what was physically observed by Cumberland Ecology. The vegetation communities as mapped by LHCCREMS are shown in Figure 3.2 while the Cumberland Ecology vegetation mapping is provided in Figure 3.3. Some communities were found by Cumberland Ecology to be a combination or mosaic of described communities and so have been named as a combination of the communities.

The following vegetation communities were recorded by Cumberland Ecology during the current flora survey:

- Exotic Rushland;
- Freshwater Wetland Complex / Riparian Melaleuca Swamp Woodland;
- Freshwater Wetland Complex / Riparian Melaleuca Swamp Woodland / Swamp Oak-Rushland Forest;
- Riparian Melaleuca Swamp Woodland;
- Swamp Oak-Rushland Forest;
- Swamp Mahogany-Paperbark Swamp Forest;
- Mangrove Estuarine Complex;
- Coastal Plains Smooth-barked Apple Woodland; and
- Coastal Plains Scribbly Gum Woodland.

A large portion of the subject site exists as a mosaic of different wetland communities, while further downstream more distinct vegetation communities are present. The aforementioned vegetation communities are described below.





meters



3.3.1 Exotic Rushland

This community is located adjacent to the discharge point of the creek and is dominated by a high proportion of exotic species (see Photograph 3.1). Trees and shrubs are rare but where present, consist of juvenile and adult *Casuarina glauca* (Swamp She-oak). The ground layer is dominated by *Juncus acutus* (Spiny Rush) and to a lesser extent *Cyperus laevigatus* with a Projected Foliage Cover (PFC) of 80%. To a large extent this community is reliant on the discharge of the mine water.



Photograph 3.1 Exotic Rushland dominated by *Juncus acutus* on the subject land

3.3.2 Freshwater Wetland Complex / Riparian Melaleuca Swamp Woodland

This mosaic of wetland communities extends throughout the southwest portion of the creek where it intersects with the eastern Mannering Colliery boundary (Photograph 3.2). This community is equivalent to the endangered ecological community (EEC) *Freshwater wetlands on coastal floodplains of the Sydney Basin* (NSW Scientific Committee, 2004a). Trees are generally not present with the occasional occurrence of *Casuarina glauca* (Swamp She-oak) to a height of 20m. The dominant plants are *Gahnia clarkei* (Sword Grass), *Leptosperum juniperum* (Spiky Tea-tree), *Leptospermum polygalifolium* (Lemon-



scented Tea-tree), Hakea teretifolia (Dagger Hakea), Callistemon citrinus (Crimson Bottlebrush) and Cortaderia selloana (Pampas Grass) to a height of 2m and PFC of 65 – 70%. The dominant groundcovers are Juncus acutus (Spiny Rush), Juncus (Sea Rush), Phragmites australis (Common Reed) and Cyperus laevigatus with a PFC of 85%. This community is largely reliant on discharge from the mine for its survival.

Stags of dead trees, which are assumed to be old, are common throughout the southern portion of this vegetation community (Photograph 3.9; Section 3.7). The dead eucalypts appear to be the result of increased flows of brackish water from the discharge of mine water. This indicates that it is unlikely that the wetland at this southern end of the creek was originally as extensive as it is at present and that the discharge of water has disturbed the original vegetation type within the area. Disturbance effects are obvious as the area has a highly altered soil surface and a fence crossing.



Photograph 3.2 Freshwater Wetland Complex / Riparian Melaleuca Swamp Woodland on the subject land

3.3.3 Freshwater Wetland Complex / Riparian Melaleuca Swamp Woodland / Swamp Oak-Rushland Forest

This mixed community is present along the drainage line of the subject creek between the eastern Mannering Colliery boundary and the area adjacent to the Sewage Treatment plant (Photograph 3.3). Trees and shrubs are rare and occur in isolated patches of mature adults with scattered occurrences of juveniles. The dominant trees are *Casuarina glauca*



(Swamp She-Oak), *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark). They reach a height of 20 m have a projected foliage cover (PFC) of 5 – 15%. The shrub layer is dominated by *Gahnia clarkei* (Sword Grass), *Kunzea ambigua* (Tick Bush) and *Cortaderia selloana* (Pampas Grass) to a height of 3 m and a PFC of 5 – 15%. The ground layer was dominated by *Phragmites australis* (Common Reed) *Cyperus laevigatus*, *Juncus acutus* (Spiny Rush) and *Juncus kruassii* (Sea Rush) to a height of 1.5 m and PFC of 75 – 80%. The effects of human disturbance are obvious with roads, fencing and power line easements crossing this community. Exotic weed invasion is high with stands of *Juncus acutus* (Spiny Rush) and *Cortaderia selloana* (Pampas Grass) common.



Photograph 3.3 Freshwater Wetland Complex / Riparian Melaleuca Swamp Woodland / Swamp oak-Rushland Forest on the subject land

3.3.4 Riparian Melaleuca Swamp Woodland

This community occurs on land directly adjacent to the wetland areas over which mine water flows (Photograph 3.4). The soil has encountered significant previous disturbance and the dominant trees are *Angophora costata* (Smooth-barked Apple), *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Melaleuca linariifolia* (Snow in Summer) to a height of 25m and PFC of 20 – 25 %. The shrub layer is dominated by *Gahnia clarkei* (Sword Grass), *Leptosperum juniperum* (Spiky Tea-tree), *Leptospermum polygalifolium* (Lemon-scented Tea-tree), *Hakea teretifolia* (Dagger Hakea), *Callistemon citrinus*



(Crimson Bottlebrush), *Banksia oblongifolia*, *Banksia robur* (Swamp Banksia) and *Melaleuca thymifolia* to a height of 3m and PFC of 65%.



Photograph 3.4 Riparian Melaleuca Swamp Woodland on the subject land

3.3.5 Swamp Oak-Rushland Forest

This community forms small pockets of vegetation along the length of the study area and larger patches near the creeks entrance into Lake Macquarie (Photograph 3.5). The community is equivalent to the Endangered Ecological Community Swamp oak floodplain forest of the Sydney Basin bioregion (NSW Scientific Committee, 2004c) The small pockets of this vegetation community located along the creek are likely to be reliant upon the minewater discharge for survival. Large areas of this community are present on the northern side of the creek which discharge water from adjacent industry passes across.

The dominant trees are Casuarina Glauca (Swamp She-Oak) and Eucalyptus robusta (Swamp Mahogany). They reach a height of 20 m and have a PFC of 20 – 25%. Shrubs are rare and the ground layer is dominated by Cyperus laevigatus, Juncus acutus (Spiny Rush), Juncus kruassii (Sea Rush) and Sporobolus virginicus (Sand Couch) to a height of 1.5 m and PFC of 50 – 55%. Exotic weed invasion is high with stands of Juncus acutus (Spiny Rush) common.

While the discharge of mine water has caused the contraction of the former vegetation community in this portion of the creek, the discharge has also led to the expansion of the



Swamp oak-Rushland Forest. The increased volume of saline water has led to the ideal conditions for the development of such Swamp-oak Forests. Juvenile *Casuarina glauca* (Swamp She-oak) have colonised this vegetation community while adults are present generally around the permanent water bodies.



Photograph 3.5 Swamp oak-Rushland Forest on the subject land

3.3.6 Swamp Mahogany-Paperbark Swamp Forest

This community is located in a in a small pocket along the eastern side of the creek, adjacent to Lake Macquarie (Photograph 3.6) and is equivalent to the EEC Swamp sclerophyll forest on coastal floodplains of the Sydney Basin bioregion {NSW Scientific Committe 2004 #4078}. The dominant trees are Angophora coststa (Smooth-bark Apple), Eucalyptus robusta (Swamp Mahogany), Glochidion ferdinandi (Cheese Tree), Casuarina Gluaca (Swamp She-Oak), Melaleuca linariifolia (Snow in Summer) and Melaleuca quinquenervia (Broad-leaved Paperbark). Trees reach a height of 25 - 30m with a PFC 45 – 55%. The shrublayer is dominated by Acacia longifolia var. longafolia (Sydney Golden Wattle), Dodenea triquetra (Hop Bush), Gahnia clarkei (Sword Grass) with a PFC of 20 – 25% and a height of 2.5 m. The ground layer is dominated by Lomandra longifolia (Spikyheaded Matt Rush), Dianella caerulea var. producta (Blue Flax Lilly), Blechnum camfieldii and Watsonia bulbillifera (Wild Watsonia).

The effects of past disturbance are present with signs of former clearing, fencing and invasion by exotic garden escapees.





Photograph 3.6 Swamp Mahogany-Paperbark Swamp Forest on the subject land

3.3.7 Mangrove Estuarine Complex

This community lines the banks of Lake Macquarie and the channel of the creek at it's discharge point into Lake Macquarie. The dominant trees are *Avicennia marina* (Grey Mangrove) to a height of 6m. The shrub layer is absent and the ground layer is dominated by *Sporobolous virginicus* (Sand Couch), Juncus *kruassii* (Sea Rush), *Sarcocornia quinqueflora* (Samphire), and *Suaeda australis* (Austral Seablight) with a PFC of 75%. Disturbance effects are present with the siltation of the channel and the constant flow of mine water discharge through the vegetation into the creek.

3.3.8 Coastal Plains Smooth-barked Apple Woodland

This community is found at various locations along the length of the creek and is generally located a short distance away from the direct flow of mine water (Photograph 3.7). The dominant trees are *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark) to a height of 25m and PFC of 40 – 45%. The shrub layer is dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Dodenea triquetra* (Hop Bush), *Gahnia clarkei* (Sword Grass) and *Leptospermum polygalifolium* (Lemon-scented Tea-tree) with a PFC of 50 – 55%. The ground layer is dominated by *Pteridium esculentum* (Bracken), *Themeda australis*



(Kangaroo Grass), *Glycine clandestina* (Twining Glycine), *Dianella caerulea var. producta* (Blue Flax Lilly) and *Lomandra longifolia* (Spiky-headed Matt Rush) with a PFC of 65%.

A highly disturbed form of this community is present under the transmission lines that cross the subject lands.



Photograph 3.7 Coastal Plains Smooth-barked Apple Woodland on the subject land

3.3.9 Coastal Plains Scribbly Gum Woodland

A small area of this community is present at a short distance to the south-west of the Mannering Colliery surface facilities. The dominant trees are *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark) to a height of 20m and PFC of 40 – 45%. The dominant shrubs are *Lambertia Formosa* (Mountain Devil), *Banksia oblongifolia, Persoonia levis* (Smooth Gebung) and *Melaleuca sieberi* (Seiber's Paperbark) with a PFC of 45 %. The ground layer is dominated by *Epacris pulchella* (NSW Coral Heath), *Lomandra obliqua* (Fish Bones), *Dillwynia retorta* (Heathy Parrot Pea) and *Themeda australis* (Kangaroo Grass) with a PFC of 65 %.



3.4 Flora

The full results of the flora quadrat and random meander survey can be found in Appendix B. No threatened flora species were recorded on the subject site, however some threatened species occurring within Lake Macquarie LGA are cryptic and therefore may occur on the subject site but were not detected. Table 3.1 analyses the likelihood of occurrence of each threatened flora species recorded on the subject site that has previously been recorded within the Lake Macquarie LGA.



Table 3.1 HABITAT REQUIREMENTS FOR THREATENED FLORA SPECIES KNOWN TO OCCUR IN THE LOCALITY OF THE SUBJECT SITE

Scientific Name	Common Name	Legal Status	Habitat Requirements	Presence of suitable habitat and Likelihood of Occurrence
Rutidosis heterogama	Heath Wrinklewort	V (TSC Act)	Grows in heath on sandy soils and moist areas in open forest	Suitable habitat on subject lands. Potential to occur.
Tetratheca juncea	Black-eyed Susan	V (TSC and EPBC Acts)	Occurs in areas with open vegetation cover, well drained land, a south-east aspect on clay soils - only in Lake Macquarie.	No suitable habitat on subject lands. Unlikely to occur.
Chamaesyce psammogeton	Sand Spurge	E1 (TSC Act)	Grows on fore-dunes and exposed headlands, often with Spinifex (Spinifex sericeus)	No suitable habitat on subject lands. Unlikely to occur.
Maundia triglochinoides	N/A	V (TSC Act)	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients	Sub-optimal habitat on subject lands. Unlikely to occur.
Prostanthera askania	Cut-leaf Mint-bush	E1 (TSC Act)	Occurs adjacent to drainage lines on flat to moderately steep slopes formed on Narrabeen sandstone and alluvial soils derived from it. Typically in moist sclerophyll forest and warm temperate rainforest communities, and the ecotone between them.	Suitable habitat on subject lands. Limited potential to occur.
Angophora inopina	Charmhaven Apple	V (TSC and EPBC Acts)	Occurs in open woodland on ridges and slopes or sedge woodland along drainage lines.	Suitable habitat on subject lands. Potential to occur.
Callistemon linearifolius	Netted Bottle Brush	V (TSC Act)	Grows in dry sclerophyll forest on the coast and adjacent ranges	No suitable habitat on subject lands. Unlikely to occur.
Eucalyptus camfieldii	Camfield's Stringybark	V (TSC and EPBC Acts)	Poor coastal country in shallow sandy soils	Sub-optimal habitat on subject lands.



Table 3.1 HABITAT REQUIREMENTS FOR THREATENED FLORA SPECIES KNOWN TO OCCUR IN THE LOCALITY OF THE SUBJECT SITE

Scientific Name	Common Name	Legal Status	Habitat Requirements	Presence of suitable habitat and Likelihood of Occurrence	
			overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	Unlikely to occur.	
Eucalyptus parramattensis subsp. decadens	N/A	V (TSC Act)	Occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland.	Suitable habitat on subject lands. Potential to occur.	
Melaleuca biconvexa	Biconvex Paperbark	V (TSC Act)	Grows in moist soil, near streams, coastal districts and adjacent to tablelands	Suitable habitat on subject lands. Potential to occur.	
Acacia bynoeana	Bynoe's Wattle	V (EPBC Act)	Dry sclerophyll forest and heath on sand, sandy clay, often with ironstone gravels.	Sub-optimal habitat on subject lands. Unlikely to occur.	
Syzygium paniculatum	Magenta Lilly Pilly	V (TSC and EPBC Acts)	On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	Sub-optimal habitat on subject lands. Unlikely to occur.	
Caladenia tessellata	Tessellated Spider Orchid	E1 (TSC Act); V (EPBC Act)	Generally found in grassy sclerophyll woodland on clay loam or sandy soils	Sub-optimal habitat on subject lands. Potential to occur.	
Cryptostylis hunteriana	Leafless Tongue Orchid	V (TSC and EPBC Acts)	Occurs mostly in coastal heathlands (wet and	Sub-optimal habitat on subject lands.	



Table 3.1 HABITAT REQUIREMENTS FOR THREATENED FLORA SPECIES KNOWN TO OCCUR IN THE LOCALITY OF THE SUBJECT SITE

Scientific Name	Common Name	Legal Status	Habitat Requirements	Presence of suitable habitat and Likelihood of Occurrence	
			clay) and occasionally in lowland forests.	Potential to occur.	
Diuris praecox	Rough Double Tail	V (TSC and EPBC Acts)	Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey	Sub-optimal habitat on subject lands. Unlikely to occur.	
Genoplesium insignis	Variable Midge Orchid	E1 (TSC Act)	Grows in patches of Themeda australis (Kangaroo Grass) amongst shrubs and sedges in heathland and forest	Sub-optimal habitat on subject lands. Unlikely to occur.	
Rhizanthella slateri	Eastern Australian Underground Orchid	V (TSC Act); E (EPBC Act)	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest	Potential to occur.	
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V (TSC and EPBC Acts)	Occurs on sandy clay loam soils with lateritic ironstone gravels. Found on crests upper slopes or flat plains in low-lying areas between 30-65m ASL	No suitable habitat on subject lands. Unlikely to occur.	



3.5 Fauna Habitats

The subject land provides a number of different habitat types that vary from each other in structure and condition including:

- The creek itself, the ponds it creates and adjacent bank environment;
- The estuarine end of the creek and its entrance to Lake Macquarie;
- Low, dense swamp vegetation with occasional stands of small trees;
- Moist forest with a well developed shrub layer; and
- Open Swamp-oak forest with a low grassy understorey.

The creek and associated swamp / ponded environments provide potential habitat for fish, amphibians and aquatic invertebrates. These areas also provide potential foraging habitat for microchiropteran bats that feed on insects that fly over the water. The lack of significant tree hollows indicates the site is unlikely to provide substantial roosting habitat for these species.

The creek and low dense swamp vegetation provide potential habitat for many aquatic or cryptic birds, reptiles and small cryptic mammals. The estuarine end of the creek also potentially provide suitable foraging habitat for many marine bird species.

The Swamp Mahogany-Paperbark Swamp Forest, with its denser understorey, and the Swamp oak-Rushland Forest, with its open understorey, provide suitable habitat for a suite of birds, reptiles, amphibians and mammals.

3.6 Threatened Fauna Species

3.6.1 Database Review

A review of the Atlas of NSW Wildlife (DECC (NSW), 2008) database was carried out to determine if any threatened species had been recorded within 10km of the site and a threatened fauna species report generated. An EPBC Protected Matters search was conducted to provide a list of Commonwealth listed threatened fauna and fauna habitat in the locality of the subject site. Relevant reports from previous ecological studies of the area were also reviewed. A number of threatened species were identified as having the potential to occur in the area of the subject site; details of these fauna species are supplied in Table 3.2 below. Some marine species identified in the desktop review were not included in the table due to a lack of suitable habitat within the subject site.



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Legal Status Habitat Requirements Presence of Study Area of Occurrents		
Giant Burrowing Frog	Heleioporus australiacus	V (TSC and EPBC Acts)	Found in heath, woodland and open forest with sandy soils.	Sub-optimal habitat on subject lands. Potential to occur.	
Green and Golden Bell Frog	Litoria aurea	E (TSC Act); V (EPBC Act)	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Mosquito Fish (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available	Suitable habitat on subject lands. Unlikely to occur due to large numbers of. <i>Gambusia holbrooki</i> .	
Littlejohn's Tree Frog	Litoria littlejohni	V (TSC and EPBC Acts)	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops	Sub-optimal habitat on subject lands. Unlikely to occur.	
Stuttering Frog	Mixophyes balbus	E (TSC Act); V (EPBC Act)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range	No suitable habitat on subject lands. Unlikely to occur.	
Southern Barred Frog	Mixophyes iteratus	E (TSC and EPBC Acts)	Lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m	Sub-optimal habitat on subject land. Unlikely to occur.	
Wallum Froglet	Crinia tinnula	V (TSC Act)	Wallum Froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country	Sub-optimal habitat on the subject land. Potential to occur.	
Red-crowned Toadlet	Pseudophryne australis	V (TSC Act)	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings	No suitable habitat on subject lands. Unlikely to occur.	
Blue-billed Duck	Oxyura australis	V (TSC Act)	The Blue-billed Duck prefers deep water in large permanent	Sub-optimal habitat on subject	



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			wetlands and swamps with dense aquatic vegetation. Seen in coastal regions in summer and drier years.	lands. Unlikely to occur.
Bush Stone- curlew	Burhinus grallarius	E (TSC Act)	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber	No suitable habitat on the subject lands. Unlikely to occur.
Greater Sand- plover	Charadrius leschenaultii	V (TSC Act)	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks	Uncommon to the area. Unlikely to occur on the subject lands.
Lesser Sand- plover	Charadrius mongolus	V (TSC Act)	Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms	Uncommon to the area. Unlikely to occur on the subject lands.
Sooty Oystercatcher	Haematopus fuliginosus	V (TSC Act)	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries	Sub-optimal habitat on subject lands. Unlikely to occur.
Pied Oystercatcher	Haematopus longirostris	V (TSC Act)	Favours intertidal flats of inlets and bays, open beaches and sandbanks	Suitable habitat on subject lands. Limited potential to occur.
Little Tern	Sterna albifrons	E (TSC Act)	Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers	Sub-optimal habitat on subject lands. Limited potential to occur.
Great Knot	Calidris tenuirostris	V (TSC Act)	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons	Sub-optimal habitat on subject lands. Unlikely to occur.



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
Broad-billed Sandpiper	Limicola falcinellus	V (TSC Act)	Favours sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons	Sub-optimal habitat on subject lands. Limited potential to occur.
Black-tailed Godwit	Limosa limosa	V (TSC Act)	A migratory wading bird that it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland	Sub-optimal habitat on subject lands. Unlikely to occur.
Terek Sandpiper	Xenus cinereus	V (TSC Act)	Has been recorded on coastal mudflats, lagoons, creeks and estuaries in NSW. Rare migrant to SE NSW.	Sub-optimal habitat on subject lands. Unlikely to occur.
Australian Painted Snipe	Rostratula australis	E (TSC Act); V (EPBC Act)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber	Suitable habitat on the subject lands. Potential to occur.
Black Bittern	Ixobrychus flavicollis	V (TSC Act)	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves	Suitable habitat on the subject lands. Potential to occur.
Black-necked Stork	Ephippiorhynchus asiaticus	E (TSC Act)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on intertidal shorelines, mangrove margins and estuaries.	Limited suitable habitat on the subject lands. Potential to occur.
Rose-crowned Fruit-Dove	Ptilinopus regina	V (TSC Act)	Occurs mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful	Sub-optimal habitat on subject lands. Unlikely to occur.
Superb Fruit-Dove	Ptilinopus superbus	V (TSC Act)	Inhabits permanent freshwater wetlands including margins of	Uncommon in SE Australia.



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter- tidal shorelines, mangrove margins and estuaries	Sub-optimal habitat on subject lands. Unlikely to occur.
Osprey	Pandion haliaetus	V (TSC Act)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. Feeds on fish over clear, open water.	Limited suitable habitat on the subject lands. Potential to occur.
Brown Treecreeper	Climacteris picumnus	V (TSC Act)	Dry forest, woodlands and scrubs, paddocks, stumps and margins of denser wooded areas	No suitable habitat. Unlikely to occur.
Diamond Firetail	Stagonopleura guttata	V (TSC Act)	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum <i>Eucalyptus pauciflora</i> Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	Not commonly found in coastal districts. Sub-optimal habitat on subject lands. Unlikely to occur.
Regent Honeyeater	Xanthomyza phrygia	E (TSC and EPBC Acts)	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak	Suitable habitat on the subject lands. Potential to occur.
Grey-crowned Babbler	Pomatostomus temporalis temporalis	V (TSC Act)	Inhabits open Box-Gum Woodlands on the slopes, and Box- Cypress-pine and open Box Woodlands on alluvial plains	No suitable habitat. Unlikely to occur.
Glossy Black- Cockatoo	Calyptorhynchus lathami	V (TSC Act)	Forages on mostly she-oaks but also eucalypts, native cypress and brigalow in forests, woodlands and timbered watercourses, nesting in large hollows, high off the ground	Sub-optimal habitat on the subject lands. Unlikely to occur.
Swift Parrot	Lathamus discolor	E (TSC and EPBC Acts)	Migrates irregularly to the locality in the winter to forage on winter- flowering tree species such as Swamp Mahogany and Spotted Gum	Suitable habitat on the subject lands. Potential to occur.
Turquoise Parrot	Neophema pulchella	V (TSC Act)	Lives on the edges of eucalypt woodland adjoining clearings,	No suitable habitat. Unlikely to



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			timbered ridges and creeks in farmland	occur.
Barking Owl	Ninox connivens	V (TSC Act)	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as <i>Acacia</i> and <i>Casuarina</i> species, or the dense clumps of canopy leaves in large <i>Eucalypts</i>	Sub-optimal habitat on the subject lands. Potential to occur.
Powerful Owl	Ninox strenua	V (TSC Act)	Mountain forest, gullies and forest margins; sparser hilly woodlands; coastal forests, woodlands, scrubs; large trees in gardens	Sub-optimal habitat on the subject lands. Potential to occur.
Sooty Owl	Tyto tenebricosa	V (TSC Act)	Tall, wet forests in sheltered east and south east facing mountain gullies, with dense understorey layer	Sub-optimal habitat on the subject lands. Potential to occur.
Masked Owl	Tyto novaehollandiae	V (TSC Act)	Forests, open woodlands, farmlands with large trees, timbered watercourses, paperbark woodlands, caves; nest in hollow eucalypts, bare sand or earth of caves	Suitable habitat on the subject lands. Potential to occur.
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	V (TSC Act)	Roosts in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Sub-optimal habitat on the subject lands. Potential to occur.
Eastern Freetail- bat	Mormopterus norfolkensis	V (TSC Act)	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures	Suitable habitat on the subject lands. Likely to occur



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
Grey-headed Flying-fox	Pteropus poliocephalus	V (TSC and EPBC Acts)	Rainforest, mangroves, paperbark swamps, wet/dry sclerophyll forests	Suitable habitat on the subject lands. Likely to occur
Large-eared Pied Bat	Chalinolobus dwyeri	V (TSC and EPBC Acts)	Found in well-timbered areas containing gullies. Roosts in caves, crevices in cliffs and old mine workings frequenting low to mid- elevation dry open forest and woodland close to these features	Sub-optimal habitat on the subject lands. Potential to occur.
Eastern False Pipistrelle	Falsistrellus tasmaniensis	V (TSC Act)	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings	Sub-optimal habitat on the subject lands. Potential to occur.
Little Bentwing-bat	Miniopterus australis	V (TSC Act)	Prefer well timbered areas including rainforest, wet and dry sclerophyll forest, <i>Melaleuca</i> swamps and coastal forests. Roosting in caves and eat insects	Suitable habitat on the subject lands. Potential to occur
Eastern Bentwing- bat	Miniopterus schreibersii oceanensis	V (TSC Act)	Prefers forested valleys but also found in rainforests, wet/dry schlerophyll forests, monsoon forests, open woodlands, paperbark forests & open grasslands. Roosting in caves or tunnels.	Suitable habitat on the subject lands. Potential to occur
Large-footed Myotis	Myotis adversus	V (TSC Act)	Most habitats near water, including mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River red gum woodland	Suitable habitat on the subject lands. Potential to occur
Greater Broad- nosed Bat	Scoteanax rueppellii	V (TSC Act)	Cool temperate to tropical moist forests, woodland and rainforest. Prefer moist gullies within mature coastal forest or rainforest. May roost in tree hollows and feed along forest edges or streams.	Suitable habitat on the subject lands. Potential to occur
Eastern Cave Bat	Vespadelus troughtoni	V (TSC Act)	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded	Uncommon in SE NSW. No suitable habitat. Unlikely to



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			roosting in disused mine workings	occur.
Spotted-tailed Quoll	Dasyurus maculatus	V (TSC Act); E (EPBC Act)	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline	Sub-optimal habitat on the subject lands. Unlikely to occur.
Eastern Pygmy- possum	Cercartetus nanus	V (TSC Act)	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred	Sub-optimal habitat on the subject lands. Unlikely to occur.
Yellow-bellied Glider	Petaurus australis	V (TSC Act)	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils	Sub-optimal habitat on the subject lands. Unlikely to occur.
Squirrel Glider	Petaurus norfolcensis	V (TSC Act)	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	Sub-optimal habitat on the subject lands. Unlikely to occur.
Koala	Phascolarctos cinereus	V (TSC Act)	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Sub-optimal habitat on the subject lands. Limited potential to occur.
Rufous Bettong	Aepyprymnus rufescens	V (TSC Act)	Inhabits a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter.	Sub-optimal habitat on the subject lands. Unlikely to occur.
Brush-tailed Rock- wallaby	Petrogale penicillata	E (TSC Act); V (EPBC Act)	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north	No suitable habitat. Unlikely to occur.



Table 3.2 HABITAT REQUIREMENTS FOR THE THREATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
Long-nosed Potoroo	Potorous tridactylus tridactylus	V (TSC and EPBC Acts)	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas.	Sub-optimal habitat on the subject lands. Unlikely to occur.
Broad-headed Snake	Hoplocephalus bungaroides	E (TSC Act); V (EPBC Act)	Inhabits areas with sandstone outcrops of the coast and ranges in an area within approximately 250 km of Sydney. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	No suitable habitat. Unlikely to occur.



3.6.2 Threatened Fauna with Potential to Occur on the Subject Land

Table 3.2 shows that a number of threatened fauna species have suitable habitat and the potential to occur on the subject site, however none of these species were recorded in recent surveys. A discussion of the threatened fauna species considered most likely to use the subject land is considered below.

i. Wallum Froglet (Crinia tinnula)

The Wallum Froglet, also known as the Acid Frog, is found in acidic paperbark swamps and sedge swamps of the coastal 'wallum' country. Large areas of these acidic swamps are located in the locality of the subject site. The neutral pH of the water on the subject lands indicates that the subject site does not provide optimal habitat for the species and at this pH it is unlikely the species will breed successfully. However, given the high occurrence of this species in the locality (DECC (NSW), 2008), this species has potential to occur on the subject lands.

ii. Cryptic Marsh Birds

The subject land provides suitable habitat for the cryptic birds Australian Painted Snipe (*Rostratula australis*) and Black Bittern (*Ixobrychus flavicollis*). Both species inhabit wetlands with permanent bodies of water and adjacent areas of low dense vegetation. Both species have been recorded in the locality and potential breeding habitat exists for these species on the subject lands.

iii. Tree-dwelling Birds

The subject site provides suitable foraging habitat for the following tree-dwelling bird species; Regent Honeyeater (*Xanthomyza phrygia*), Swift Parrot (*Lathamas discolor*) and Masked Owl (*Tyto novaehollandiae*). The subject lands does not provide suitable nesting habitat for any of these species.

iv. Bats

a. Microchiropteran Bats

The subject site provides suitable foraging (in some cases roosting) habitat for the following microchiropteran bat species: Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Little Bentwing-bat (*Miniopterus australis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), Large-footed Myotis (*Myotis adversus*), Greater Broad-nosed Bat (*Scoteanax rueppellii*).



All of these species have been recorded within the locality. The subject lands wetlands provide a breeding ground for insects which in turn provides a foraging area for microchiropteran bats.

b. Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox (*Pteropus poliocephalus*) inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. The subject site supports a number of species which are suitable feed trees for the Grey-headed Flying-fox. These include trees from the Fabaceae, Mimosaceae, Myrtaceae, Proteaceae, Pittosporaceae and Lauraceae families. Whilst the subject land provides suitable foraging habitat for this species no roosting "camps" were observed or are known to occur on it.

3.7 Aquatic Assessment

The aquatic assessment of the Study area on the subject lands was made up of three different components; a visual assessment; a physico-chemical assessment of water properties and a fish and macroinvertebrate assessment. Each type of assessment was conducted at various locations along the length of the creek. The results of each of the assessment types are provided below.

3.7.1 Visual Assessment

i. Station 1a

This station was located within the final sedimentation pond on the Mannering Colliery surface facilities site (Photograph 3.8). Water from within the underground mine is transferred through a series of four sedimentation ponds prior to discharge through the outlet point into the wetlands and the Study area. The final sedimentation pond is of moderate size (approximately 65 m x 35 m) and estimated to be greater than 1.5 m deep. The pond is surrounded with the emergent macrophytes *Phragmities australis* (Common Reed), *Eleocharis sphacelata* and *Juncus acutus* (Spiny Rush), with *Chloris gayana* (Rhodes Grass) present on the bank.





Photograph 3.8 Sampling Station 1a in the sedimentation pond of Mannering Colliery

ii. Station 1b

Located a short distance north east of the discharge point this station constituted a flowing riffle of water through tufts of rushes (Photograph 3.9). *Juncus acutus* (Spiny Rush) was the dominant species with *Juncus krausii* (Sea Rush) in lower abundance. The groundlayer was dominated by *Cyperus laevigatus*. *Casuarina glauca* (Swamp She-oak) was present on the margins of the wetland and scattered seedlings occurred throughout the wetland. A number of dead eucalypts were present within the wetland area which is most likely a response due to the increased influx of saline water. The water depth was approximately 4 cm and the width of the wetland was approximately 30 m.





Photograph 3.9 Sampling Station 1b adjacent to the discharge point (DP1) at Mannering Colliery. Rushland dominated by the exotic Spiny Rush.

iii. Station 2a

This station was a small (< 1 m wide) riffle of water, approximately 10 cm deep, at the edge of the wetland adjacent to a culvert where the water from the wetland passes under a road on the eastern boundary of Mannering Colliery (Photograph 3.10). The vegetation adjacent to the station consisted of Swamp Oak Forest dominated by *Casuarina glauca* (Swamp-oak Forest) and rushland dominated by *Juncus acutus* (Spiny Rush) and *Cyperus laevigatus*.





Photograph 3.10 Sampling Station 2a on the western side of the culvert on Mannering Colliery's eastern property boundary

iv. Station 2b

Located on the other side of the culvert in a deeper pool (approximately 1 m deep), the vegetation at this station was very similar to that at Station 2a. *Casuarina glauca* (Swamp She-oak) was the dominant tree species with *Juncus acutus* (Spiny Rush) and *Juncus krausii* (Sea Rush) dominating the understorey (Photograph 3.11).





Photograph 3.11 Sampling Station 2b located on the eastern side of the culvert on Mannering Colliery's eastern boundary

v. Station 3a

This station is located on the southern side of the track that enters Delta Electricity land from the east off Tall Timbers Road. The station consisted of a small (approximately 3 m x 1 m in size / 40 cm deep) extremely slow moving pool of water through the wetland. The wetland in this area contained a high proportion of exotic weeds including a heavy infestation of *Cortaderia selloana* (Pampas Grass). The dominant tree species were *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Casuarina glauca* (Swamp Sheoak) (Photograph 3.12).





Photograph 3.12 Sampling Station 3a on the northern end of the Freshwater Wetland Complex / Riparian Melaleuca Swamp Woodland / Swamp Oak Rushland Forest vegetation community. Note infestations of Pampas Grass in the background.

vi. Station 3b

Located on the other side of the culvert and track from Station 3a, this station was a fast flowing stream of approximately 30 cm depth and 1.5 m width. The stream bottom in this area was solid stone with a number of large loose rocks within the stream. The vegetation in this area was far more diverse than at other sampling stations and the sampling site was overshadowed by a forest of *Angofera costata* (Smooth-barked Apple), *Allocasuarina torulosa* (Forest Oak), *Glochidion ferdinandi* (Cheese Tree) and *Melaleuca quinquenervia* (Broad-leaved Paperbark) (Photograph 3.13).





Photograph 3.13 Sampling Station 3b on the northern side of the culvert to the north of the Sewage Treatment Plant holding pond

vii. Station 4

This station is located at the estuarine end of the creek and is lined with *Casuarina glauca* (Swamp She-Oak) and *Avicennia marina* (Grey Mangrove) (Photograph 3.14). This is a depositional environment with fine grained sands and mud lining the creek bed. Saltmarsh species dominate the understorey of the adjacent Swamp - Oak Forest. On the northern bank there is a constant steady flow of water from the Swamp - Oak Forest into the channel. The source of this water is most likely from the adjacent industry which has approval to discharge water, as does Mannering.

At the time of sampling, the depth of the creek was approximately 30 cm at mid-tide and had widened to a tidal channel; with width of approximately 15 m. The channel at this location contained a bed of the seagrass *Zostera capricorni* (Eel Grass).





Photograph 3.14 Sampling Station 4 in the estuarine reaches of the creek.

Note seagrass beds partially exposed at mid tide.

3.7.2 Physico-chemical Assessment

The results of the physico-chemical analysis are shown in Table 3.3. In general, temperature, dissolved oxygen and pH are as to be expected for a typical stream. The variability in temperature can be accounted for through the depth of water at which the samples were taken and the level of shading at each particular site. Nutrient levels in the stream are very low while salinity is shown to be far higher than would be expected for a typical creek. These factors can be accounted for by the fact that the creek's main input is groundwater from the mine. Groundwater is typically low in nutrients and in coastal regions often of high in salinity (Matthews, 1982).

Hardness is a measure of the multivalent metal ions, typically calcium and magnesium, which are present in water. Generally these ions are dissolved out of minerals present in geological formations. Household water is typically considered very hard if dissolved metals reach levels greater than 180 mg/L. The hardness of groundwater is known to reach levels in excess of 1000 mg/L. The fact that the creek is fed by groundwater explains the high results for hardness analysis. The extremely high result from Station 4 may be explained by the lower portion of the creek being fed by mine water discharge both Mannering and adjacent mines.



Alkalinity is a measure of the carbonate (CO₃⁻²) and a bicarbonate ion (HCO3-) dissolved in a sample of water and therefore, like hardness, increased values are expected from groundwater samples due to mineral absorption. Alkalinity is a measure of the ability of a water system to resist changes to pH upon the addition of acid. The cause of the reduction in alkalinity downstream from the water source may be due to the acidity released from the eroded wetland soils upstream (National Working Party on Acid Sulfate Soils, 2000).

The low result for dissolved oxygen at Station 3b can be explained by the slow water movement through the wetland upstream. Despite the fast water movement at the sampling station; slow movement through wetlands combined with the oxygen demand from aquatic flora and fauna can cause a significant reduction in dissolved oxygen in aquatic systems.

Table 3.3 RESULTS OF PHYSICO-CHEMICAL WATER ANALYSIS ALONG THE UNNAMED CREEK

	Station 1a	Station 1b	Station 2a	Station 2b	Station 3a	Station 3b	Station 4
Temperature (^O C)	22.6	23.9	22	15.5	23.2	18.2	18.9
Dissolved Oxygen (%)	100	106	88	98	90	65	99
Salinity (μS/cm)	29,500	28,500	27,500	27,500	25,500	25,500	27,000
рН	7.69	7.68	7.68	7.6	7.15	7.69	7.7
Nitrogen (mg/L)	1.5	2.6	1.5	-	-	1.8	1.4
Phosphorus (mg/L)	< 0.05	0.087	<0.05	-	-	< 0.05	< 0.05
Hardness (mg/L)	1200	1200	1100	-	-	1000	2900
Alkalinity (mg/L)	780	776	700	-	-	576	400

Based on these results and their comparison to the factors that the ANZECC Guidelines for Fresh and Marine Water Quality(2000) (ANZECC, 2000) consider, the unnamed creek on the subject land would be considered a slightly to moderately disturbed ecosystem. The ANZECC guidelines however, do not consider the values of alkalinity or hardness. These values are far greater than what would be expected for a typical freshwater stream (Allan, 1995). On consideration of the comparison of these results with the ANZECC Guidelines and extreme values for some components of the physico-chemical analysis (i.e. very high salinity, hardness, and alkalinity as well as very low nutrient levels), the Study area on the subject site must be regarded as a highly modified ecosystem.



3.7.3 Fish and Macroinvertebrate Assessment

i. Fish

The results of the netting for fish (Table 3.4) show that the Mosquito Fish (*Gambusia holbrooki*) was the only species collected in the non-estuarine reaches of the creek in the present survey. Extremely large numbers of this species were collected from the mines sedimentation pond (Station 1a) and at the mouth of Lake Macquarie (Station 4), with sporadic numbers collected along the length of the creek. Mosquito fish were clearly visible in most ponded areas along the length of the creek. The Mosquito Fish is a highly invasive species and a listed Key Threatening Process in NSW (NSW National Parks Wildlife Service, 2003). The Mosquito Fish out competes small native fish species and preys heavily on tadpoles.

Other than Mosquito Fish, the following species were located on the subject lands at Station 4 adjacent to the entrance to Lake Macquarie: Smooth Toad Fish (*Lagocephalus sceleratus*), Decorated Sand-Goby (*Istigobius decoratus*) and Pacific Blue-eye (*Pseudomugil signifier*). All three are common estuarine species in NSW. Given that the four fish species, including one introduced pest species, collected from the seven locations along the length of the creek are common throughout south-eastern Australia, the present survey indicates that the study area on the subject site does not constitute a significant habitat for fish. Therefore, with the cessation of future mine dewatering, the reduced flow of the creek is unlikely to impact upon any important fish habitat.

The lower reaches of the creek support a seagrass bed of *Zostera capricorni*, which is known to provide important nursery habitat for juvenile fish. However, given that this part of the creek is tidally fed it is unlikely this seagrass bed will be affected to a large extent by the reduced flow of the creek.



Table 3.4 RESULTS OF FISH SURVEYS ALONG STUDY AREA

Species	Station 1a	Station 1b	Station 2a	Station 2b	Station 3a	Station 3b	Station 4
Mosquito Fish (Gambusia holbrooki)	> 150	-	38	-	4	1	> 50
Smooth Toad Fish (Lagocephalus sceleratus)	-	-	-	-	-	-	3
Decorated Sand- Goby (Istigobius decoratus)	-	-	-	-	-	-	> 20
Pacific Blue-eye (Pseudomugil signifier)	-	-	-	-	-	-	18

Notes: estimates of numbers of fish species were taken at some stations; actual numbers were not counted to avoid death or injury to the fish.

ii. Macroinvertebrates

Presence absence data of the macroinvertebrate species located during recent the aquatic survey is provided in Table 3.5. No sweep net sample was taken at Station 4 because this station was located in the estuarine reaches of the creek and therefore cannot be directly compared to other stations within the creek or other reference material. The dominant family throughout the length of the creek was *Pomatiopsidae*. This family is a group of gastropod snails that commonly inhabit coastal and inland salt lakes. The highest density of this family was identified in the sediment pond at Station 1a. Given that this family are a group of free spawners and have a free-swimming larval stage, it is likely that this large population at Station 1a is seeding the entire creek with individuals.

Some families of macoinverebrates are intolerant to the poor water quality conditions and therefore are indicative of good water quality. Conversely, common macroinvertebrates are generally able to tolerate the poorer water quality conditions and are found in polluted or modified aquatic ecosystems (Chessman et al., 1997). The results of the macroinvertebrate collection from the subject creek and wetland indicate that the quality of the system provides a poor quality habitat for macroinvertebrates. The subject wetland seems to be dominated by the families Pomatiopsidae and Chironomidae. Pomatiopsidae are common in estuarine environments and inland saline lakes and are present in high numbers due to the saline influence. Chironomidae are a very common family in disturbed or polluted waters that other families are unable to establish.

The maximum number of families identified at any one sampling station was found to be 7. This is very low for a typical stream and indicates that the water quality of the creek may not be high enough to support a high diversity of species. Based on the results of the



macroinverebrate assessment, it seems that the water quality of the subject creek and wetland is poor in its provision of aquatic habitat to marcoinvertebrates.

Table 3.5 MACROINVERTEBRATES RECORDED AT UPPER STATIONS ALONG THE UNNAMED CREEK

Family	Station 1a	Station 1b	Station 2a	Station 2b	Station 3a	Station 3b
Pomatiopsidae	Х	Х	Х	Х	Х	Х
Chironomidae Sp.1	Χ	-	X	X	X	-
Chironomidae Sp.2	Χ	-	Χ	X	X	-
Aeshinidae	X	-	-	-		-
Hydrachnidae	-	Х	-	-		-
Sphaeriidae	-	-	-	-	Х	-
Branchipodidae	-	-	-	-	Х	-
Coenagrionidae	-	-	-	-	Х	-
Tabanidae	-	-	X	X		X
Notonnectidae	-	-	-	-	Х	-
Decopoda	-	-	-	-	-	-

Notes: 1. X denotes the presence of the macroinverebrate family at that site.

Impact Assessment

The potential decommissioning of Mannering Colliery would result in the cessation of mine dewatering and hence the upper reaches of the Study area would cease to flow. The lower reaches of the creek would continue to receive water from Chain Valley Mine. The flow of water in this lower portion of the creek is, however, dependent upon the mine-life of Chain Valley Mine. In either case the cessation of mine water discharge will result in impacts on the ecology downstream.

4.1 Impacts on Endangered Ecological Communities on the Subject Site

4.1.1 Freshwater Wetland Complex and community mosaics

These communities are considered equivalent to the TSC Act listed EEC *Freshwater wetlands on coastal floodplains of the Sydney Basin* (NSW Scientific Committee, 2004a). With the cessation of mine water discharge it is expected that the extent of this community would suffer a significant contraction in size due to the removal of the constant water input. While the community may be considered an EEC, it is not considered of high ecological or conservation value due to its highly disturbed nature, combined with the high exotic weed influence and the community's artificial origin.

4.1.2 Swamp Mahogany-Paperbark Swamp Forest

This community is equivalent to the TSC Act listed EEC Swamp sclerophyll forest on coastal floodplains of the Sydney Basin bioregions (NSW Scientific Committee, 2004d). The swamp Mahogany-Paperbark Swamp Forest on the subject land should not be adversely impacted by the cessation of mine water discharge. For this community to persist, a high groundwater influence is vital (NSW Scientific Committe, 2004). Given the proximity of this community to Lake Macquarie the lake's groundwater influence is most likely sufficient to ensure community's longevity. It is therefore unlikely that the cesssation of mine water discharge from Mannering will impact this EEC equivalent community.



4.1.3 Swamp-oak Rushland Forest

This community is equivalent to the TSC Act listed ECC Swamp oak floodplain forest of the Sydney Basin bioregions (NSW Scientific Committee, 2004c). Much of the Swamp-oak Rushland Forest on the subject lands is present due to the saline water input from the mine water discharge. This is particularly true for the small pockets of the community located further away from Lake Macquarie. With the cessation of mine water discharge, it is expected that the extent of this community would contract in size due to the loss of the important saline water input. Despite being considered an EEC, this community on the subject lands is not considered of high ecological value due to the highly disturbed nature of this community, the high proportion of exotic weeds, the artificial nature of the community and the high proportion of Swamp oak-Rushland Forest in the Lake Macquarie region (LHCCREMS, 2003). It is therefore considered that contraction of this vegetation community through the cessation of mine water discharge would in no way be detrimental to the long-term survival of this vegetation community in the Lake Macquarie region.

The areas of this community located downstream, closer to Lake Macquarie will not be affected by the reduced flow as the saline influence in this region is maintained from Lake Macquarie itself.

4.2 Impacts on Threatened Fauna with potential to use the Subject Site

The results of the Atlas of NSW Wildlife (DEC (NSW), 2006) and the EPBC Act Protected Matters Search Tool (DEWHA, 2008) revealed that the subject land provides suitable habitat for a number of threatened fauna species. No threatened fauna were recorded on the subject land during the recent surveys. Table 3.2 provides an analysis of suitability of habitat and the likelihood of occurrence for each threatened species on the subject lands. The impacts on those species considered likely to occur on the subject lands are discussed in further detail below.

4.2.1 Wallum Froglet (Crinia Tinnula)

The subject site provides suitable foraging habitat for this species. Wallum Froglets, however, require acidic wetland environments for successful breeding. Given the neutral pH of the water in the subject wetland, it is unlikely that the subject lands provide appropriate breeding habitat. Therefore, if the species is present, the subject land is likely to provide habitat to a non-breeding 'sink' population. With the cessation of mine water discharge individuals of this species within the wetland, if present, will be impacted negatively through loss of habitat. However, the population of the frogs within the locality may gain the benefit of losing an area of potential habitat that is of no use for breeding, therefore potentially increasing the future reproductive potential of the population.



4.2.2 Cryptic Marsh Birds

i. Australian Painted Snipe (Rostratula australis)

The Australian Painted Snipe requires areas of wetland with low, dense vegetation such as that found on the subject land. With the cessation of mine water discharge and the subsequent contraction of the wetland vegetation the area of potential habitat for this species would be reduced. The species is known to be nomadic and are not known to permanently reside in any known habitats. This species has been recorded within the locality in the past (DECC (NSW), 2008), hence other suitable habitat exists in nearby areas for this species. Therefore, if necessary, this highly mobile species would relocate to another area of nearby suitable habitat.

ii. Black Bittern (Ixobrychus flavicollis)

Suitable habitat exists on the subject land for the Black bittern. This species requires areas of habitat with permanent bodies of water and dense vegetation. With the cessation of mine water discharge and the resultant loss of upstream water bodies this species could move to areas of permanent water closer to Lake Macquarie or in other nearby locations.

4.2.3 Tree-dwelling Birds

The following tree-dwelling birds are considered to have some potential for using the subject site: Regent Honeyeater (*Xanthomyza phrygia*), Swift Parrot (*Lathamas discolor*) and Masked Owl (*Tyto novaehollandiae*). These species will not be affected by the cessation of mine water discharge as the vegetation communities they inhabit will not be affected by the reduction in water flow.

4.2.4 Bats

i. Microchiropteran Bats

The subject site provides suitable foraging habitat for a suite of microchiropteran bat species. These species could potentially forage on insects over the subject wetland. Therefore, a reduced mine water discharge and the resultant reduction in wetland habitat and insect species could lead to reduced foraging territory. However, these species are highly mobile and typically forage within a range of habitat types. By considering these facts and the large amount of suitable habitat found elsewhere in the locality it is unlikely that the reduced mine water flow will cause a significant impact on these species. With successional change of the vegetation communities upon the cessation of mine water discharge to a woodland or forest community; habitat will be created that is suitable for other threatened bat species more suited to these vegetation types.



ii. Grey-headed Flying-fox

It is considered likely that the Grey-headed Flying-fox will forage on the subject site. However, this species will not be affected by the cessation of mine water discharge as the vegetation communities it inhabits will not be affected by the reduction in water flow.

4.3 Impacts on Aquatic Habitat

The subject site contains a significant area of brackish wetland and estuarine aquatic habitats. With the decommissioning of Mannering Colliery, the discharging of mine water would cease and the extent of the current aquatic habitat would contract significantly. The quality of aquatic habitat on the subject land varies depending upon location.

The upper reaches of the subject land's wetland is anthropogenically constructed and consists of a highly modified system of low quality aquatic habitat. The water quality throughout this section of the stream is more aligned with a groundwater system than a freshwater stream resulting in low and poor diversity of macroinvertebrates. The only fish species identified in this area was the invasive species and Key Threatening Process (NSW National Parks Wildlife Service, 2003) the Mosquito Fish (*Gambusia holbrooki*). Much, if not all, of the aquatic habitat in the upper portion of the Study area and associated wetland will disappear with the decommissioning of the mine. However, recent surveys show that this wetland area constitutes a habitat of low quality and little significance.

The lower, estuarine component of the creek provides reasonable quality habitat despite being subject to significant sedimentation. This area contains a segrass bed which is known to constitute important nursery habitat to juvenile fish. With the cessation of mine water discharge from both Mannering Colliery and Chain Valley Mine this estuarine fed portion of the creek is unlikely to be effected to any great extent. The upper reaches of the channel will become an intertidal zone creating suitable habitat for Coastal Saltmarsh or a Mangrove Complex while the lower reaches of the channel, including the seagrass bed, should remain unchanged.

The physico-chemical analysis of the stream water indicated that there was an acidic influence in the lower reaches of the creek; potentially from the erosion of the accumulated acidic wetland sediments. If these sediments are the cause of this acid influx then with the cessation of mine water discharge and the subsequent death of wetland vegetation there is potential for a highly acidic influx of sediments and water to enter the lower reaches of the subject creek and Lake Macquarie with the next major rain event. These potentially acidic sediments are far more likely to be heavily eroded with the reduction of the wetland vegetation. The feasibility of a slowly reduced discharge of water over an extended period should be considered to control the death of wetland vegetation and hence the potential for sediment erosion and acidification of the waterway.

Conclusions

The subject land consists of an artificial creek and wetland fed by the discharge of mine water. The creek and wetland provide a number of potential environments for a suite of aquatic and terrestrial flora and fauna species. No threatened flora or fauna species listed under the EPBC Act of TSC Act were identified; however endangered ecological communities (EECs) exist within the subject lands.

The eventual decommissioning of Mannering Colliery will lead to the cessation of the discharge of mine water through the Study area and associated wetland. This cessation in mine water discharge will lead to the contraction in size of two of the TSC Act listed EECs Sydney Freshwater Wetlands in the Sydney Basin Bioregion (NSW Scientific Committee, 2004a) and Swamp oak floodplain forest of the Sydney Basin and bioregions (NSW Scientific Committee, 2004c). These vegetation communities are artificially created, highly disturbed in nature and contain a high proportion of exotic weeds and are therefore considered very low quality examples of the EECs. The contraction in size of the EECs is unlikely to mean the loss of these communities.

Upon decommissioning of the mine, it is recommended that weed management be undertaken as per the Weed Management Protocol below with the aim to improve the quality of any remaining areas of EEC.

Weed Management Protocol

The weeds of concern on the subject site are *Juncus acutus* (Spiny Rush) and *Cordarteria selloana* (Pampas Grass). Both species are highly invasive and can be managed using the same methodology as below:

- Seed heads of species should be removed, bagged and taken off-site;
- Bulk root masses should be removed manually;
- Where root masses cannot be removed manually as much vegetative material should be removed and the remainder sprayed with a Glyphosate based herbicide such as 'Roundup Bioactive'.

The persons conducting weed management activities should anticipate successional changes in vegetation type as the area moves from a wetland to a drier environment. Weeds such as Pampas Grass will continue to colonise the area for some time with the cessation of water flow.



The aquatic habitat provided by the subject lands is considered to be of low quality. The water quality analysis indicates the water to be of high salinity, low in nutrients and more consistent with groundwater than stream water. The fish and macroinvertebrate assessments indicated that the creek provides poor quality habitat with low species diversity and that the creek is dominated by common or pest taxa. The cessation in mine water flow will lead to a loss of much of this aquatic habitat on the subject land, however, given the poor quality aquatic habitat it provides to fish and macroinvertebrates, it is considered of relatively low ecological or conservation value.

A soil sampling regime to test for Acid Sulfate Soils (ASS) should be conducted prior to the closure of the mine. This sampling will determine if the wetland contains ASS and ascertain if caution needs to be taken in the reduction of mine water discharge. The feasibility of a slowly reduced discharge of mine water over an extended period should be considered to control the death of wetland vegetation. This would reduce the potential for the erosion of the possibly acidic sediments and the potential acidification of the down stream environment including Lake Macquarie.

Potential habitat for a number of microchiopteran bats as well as the cryptic marsh birds Black Bittern and Australian Painted Snipe will be lost with the cessation of mine water discharge. However, successional vegetation changes will allow for the development of habitat suitable for forest and woodland dwelling bird and bat species.

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Appendix A

Regulatory Correspondence



Contact: Colin Phillips Phone: (02) 9228 6483 Fax: (02) 9228 6466

Email: colin.phillips@planning.nsw.gov.au

Mr Matthew Fellowes Colliery Manager Centennial Mannering PO Box 1000 TORONTO NSW 2283 Our ref:

Dear Mr Fellowes

Mannering Colliery Continuation of Mining Project (06_0311) Appointment of Suitably Qualified Persons

I refer to your letter, dated 1 September 2008, requesting the appointment of suitably qualified persons to produce various monitoring programs and ecological studies required by the Minister's approval for the Mannering Colliery Continuation of Mining Project.

The Department has considered the information provided with your letter and additional information provided by Mr Paul Williams and considers that the proposed persons are suitably qualified and experienced to undertake their nominated tasks. Accordingly, the Director-General has approved:

- Mr Mark Bridges of Bridges Acoustics to prepare a report on potential noise mitigation measures for noisy equipment on the site (condition 2 of schedule 3);
- Mr Mark Bridges of Bridges Acoustics to prepare a noise monitoring program for the project (condition 3 of schedule 3);
- Dr David Robertson, Ms Joanne Ironside and Mr John Whyte of Cumberland Ecology to investigate, assess and report on the ecological interactions of mine water discharged from the site with the ecology of receiving waters (condition 7 of schedule 3);
- Mr Paul Williams of Centennial Coal to develop and prepare a Land Management Plan (condition 14 of schedule 3); and
- Ms Margaret MacDonald-Hill as the independent Chair of the Mannering Community Consultative Committee (condition 8 of schedule 5).

The company's intention to utilise Parsons Brinkerhoff to complete a road safety audit and Energetics to prepare an Energy Action Savings Plan is noted. However, these firms do not need to be appointed by the Director-General for these tasks.

If you have any enquiries on this matter please contact Colin Phillips at the details above.

Yours sincerely

David Kitto Director

Major Development Assessment as Delegate for the Director-General

10/Litto 24/9/08



9 February 2009

Head Regional Operations
Department of Environment & Climate Change
PO Box 488G
NEWCASTLE NSW 2300

Attention: Mr Mitchell Bennett

Dear Mitch,

Mannering Colliery - Ecology Study

Mannering Colliery was issued Project Approval 06_0311 under Part 3A of the *Environmental Planning and Assessment Act 1979* on 12 March 2008. Schedule 3, Condition 7 of the Project Approval requests an investigation of the ecological significance of mine water discharge into the study area and associated wetlands between the mine site discharge point and Lake Macquarie.

Schedule 3, Condition 7 of the Project Approval specifically states:

"7. The proponent shall investigate, assess and report on the ecological interactions of mine water discharged from the site with aquatic ecology of the study area and wetlands (and associated vegetation) between mine water discharge points and Lake Macquarie.

This report must:

- (a) be prepared in consultation with DECC by suitably qualified expert/s whose appointment/s have been approved by the Director-General;
- (b) be submitted to the Director-General by the end of March 2009; and
- (c) assess the probable alterations in local ecology attributable to previous and proposed mine water discharges and any future cessation of mine water discharge flows."

As such, please find attached a copy of the report entitled "Ecological Assessment of 'study area' Mannering Colliery, Port Macquarie NSW Post Approval Ecological Assessment' dated January 2009. Appendix A provides correspondence from Department of Planning (DoP) approving Cumberland Ecology to undertake this work.

It would be appreciated if you could please provide any comments the report to me by 9 March 2009 so that Centennial Mannering may submit the report to DoP for its approval by the end of March. If no written comment is received by this date, Centennial Mannering will assume that DECC does not have any amendments to the report.

Should you have any queries in relation to this letter, please do not hesitate to contact Paul Williams at Centennial Mannering on 02 4973 0944 or me on 02 6575 2003.

Yours faithfully

HANSEN BAILEY

Duners.

Dianne Munro

Principal



Appendix B

Flora Recorded on the Subject Land



Table B.1 FLORA RECORDED ON THE SUBJECT LAND

Family	Scientific Name	Common Name	Form
Avicenniaceae	Avicennia marina var. australasica	a var. australasica Grey Mangrove	
Casuarinaceae	Allocasuarina torulosa	Forest Oak	t
	Casuarina glauca	Swamp Oak	t
Euphorbiaecaae	Glochidion ferdinandi	Cheese Tree	t
Mimosaceae	Acacia parramattensis	Sydney Green Wattle	t
Myrtaceae	Angophora costata	Smooth-barked Apple	t
	Corymbia gummifera	Red Bloodwood	t
	Eucalyptus capitellata	Brown Stringbark	t
	Eucalyptus haemastoma	Scribbly Gum	t
	Eucalyptus robusta	Swamp Mahogany	t
	Melaleuca linariifolia	Snow in Summer	t
	Melaleuca quinquenervia	Broad-leaved Paperbark	t
Santalaceae	Exocarpos cupressiformis	Native Cherry	t
Asparagaceae	Asparagus officinalis*	Asparagus	s
Ericaceae	Epacris pulchella NSW Coral Heath		s
Euphorbiaceae	Ricinocarpos pinifolius	Wedding Bush	s
Mimosaceae	Acacia longifolia var. sophorae	-	s
	Acacia suaveolens	Sweet Scented Wattle	s
Myrtaceae	Callistemon citrinus	Crimson Bottlebrush	s
	Kunzea ambigua	Tick Bush	s
	Leptospernum juniperum	Spiky Tea-tree	s
	Leptospernum polygalifolium	Lemon-scented Tea-tree	s
	Melaleuca sieberi	-	s
	Melaleuca thymifolia		s
Ochnaceae	Ochna serrulata*	Mickey Mouse Plant	s
Proteacea	Banksia oblongifolia	-	S
	Banksia robur	Swamp Banksia	s
	Hakea teretifolia	Dagger Hakea	s
	Lambertia Formosa	Mountain Devil	S
	Persoonia levis	Smooth Gebung	s
Rosaceae	Rosa rubignosa*	Sweet Briar	s
Sapindaceae	Dodonaea triquetra	Hop Bush	s
Adiantaceae	Adiantum aethiopicum	Common Maidenhair	g
	Adiantum hispidulum	Rough Maidenhair	g
Apiaceae	Centella asiatica	Indian Pennywort	g



Table B.1 FLORA RECORDED ON THE SUBJECT LAND

Family	Scientific Name	Common Name	Form
	Hydrocotyle tripartita	Pennywort	g
Asparagaceae	Protasparagus densiflorus* Asparagus Fern		g
Asteraceae	Ageratum houstonianum*		g
	Hypochaeris radicata*	Flatweed	g
	Senecio linearifolius	Fireweed	g
	Senecio madagascariensis*	Fireweed	g
	Sonchus oleraceus*	Common Sowthistle	g
Blechnaceae	Blechnum camfieldii	-	g
Caryophyllaceae	Petrorhagia nanteuilii*	Proliferous Pink	g
Chenopodiaceae	Sarcocornia quinqueflora	Samphire	g
	Suaeda australis	Austral Seablight	g
Cyperaceae	Cyperus eragrostis*	Umbrella Sedge	g
	Cyperus laevigatus	-	g
	Gahnia clarkei	Tall Saw-sedge	g
Davalliaceae	Nephrolepis cordifolia*	Fish-bone Fern	g
Dennstaedtiaceae	Pteridium esculentum Bracken		g
Dreoeraceae	Drosera spathulata	Common Sundew	g
Fabaceae	Dillwynia retorta	Heathy Parrot Pea	
	Trifolium repens*	White Clover	g
Gleicheniaceae	Gleichenia dicarpa	Pouched Coral Fern	g
Goodeniaceae	Scaevola ramosissima	Purple Fan Flower	g
Iridaceae	Watsonia bulbillifera*	Watsonia bulbillifera* Wild Watsonia	
Juncaceae	Juncus acutus*	-	g
	Juncus krausii	Sea Rush	g
	Juncus subsecundus	Finger Rush	g
Lindsaeaceae	Lindsaea linearis	Screw Fern	g
Lomandraceae	Lomandra longifolia	Spiky-headed Mat-rush	g
	Lomandra obliqua	Fish Bones	g
Phormiaceae	Dianella caerulea var. producta	Blue Flax Lily	g
Plantaginaceae	Plantago lanceolata*	Ribwort	g
Poaceae	Chloris gayana*	Rhodes Grass	g
	Cortaderia selloana*	Pampas Grass	g
	Cynodon dactylon	Common Couch	g
	Microlaena stipoides var. stipoides	Weeping Rice Grass	g
	Pennisetum clandestinum*	Kikuyu	g



Table B.1 FLORA RECORDED ON THE SUBJECT LAND

Family	Scientific Name	Common Name	Form
	Phragmites australis	Common Reed	g
	Sporobolus virginicus	Sand Couch	g
	Themeda australis	Kangaroo Grass	g
Primulaceae	Samolus repens	Creeping Brookweed	g
Restionaceae	Empodisma minus	-	g
Zosteraceae	Zostera capricornii	-	g
Fabaceae	Glycine clandestina	Twining Glycine	٧
Pittosporaceae	Billardiera scandens var. scandens	Apple Dumplings	V

Notes: t = tree, s = shrub, g = groundcover, v = vine, * = exotic species

 $Appendix \ C$

Fauna Recorded on the Subject Land



Table C.1 FAUNA RECORDED ON THE SUBJECT LAND

Common Name	Scientific Name		
AMPHIBIANS			
Eastern Common Froglet	Crinea Signifera		
Bibron's Toadlet	Pseudophryne bibroni		
Striped Marsh Frog	Limnodynastes peroni		
BIRDS			
Australian Magpie	Gymnorhina tibicen		
Noisy Miner	Manorina melanocephala		
Silver Gull	Larus novaehollandi		
Red Wattle Bird	Anthochaera carnunculata		
Rainbow Lorikeet	Trichoglossus haematodus		
Spangled Drongo	Dicrurus bracteatus		
Lewin's Honeyeater	Meliphaga lewinii		
REPTILES			
Yellow-faced Whip Snake	Demansia psammophis		
Garden Skink	Lampropholis delicata		
FISH			
Mosquito Fish	Gambusia holbrooki		
Smooth Toad Fish	Lagocephalus sceleratus		
Decorated Sand-Goby	Istigobius decoratus		
Pacific Blue-eye	Pseudomugil signifier		