

Springvale Water Treatment Project

State Significant Development 7592
Environmental Impact Statement

Volume 2 Part 3 - Appendices E to I

September 2016



EnergyAustralia

Centennial Coal

Appendix E Noise and vibration

Springvale Coal Pty Ltd

Springvale Water Treatment Project

Noise and Vibration Impact Assessment

August 2016

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Glossary

Term	Definition
Adverse	Meteorological effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time.
Calm	Where noise enhancing meteorological conditions do not occur at a site for a significant period of time.
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90 per cent of the measurement period.
$L_{Aeq(15hr)}$	The L_{Aeq} noise level for the period 7:00 to 22:00 hours.
$L_{Aeq(9hr)}$	The L_{Aeq} noise level for the period 22:00 to 7:00 hours.
L_{Amax}	The maximum A-weighted sound pressure level occurring in a specified time period.
Noise sensitive receiver	A noise modelling term used to describe a map reference point where noise is predicted. They consist of areas or places potentially affected by noise or vibration including: • a residential dwelling • an educational institution, library, childcare centre or kindergarten • a hospital, surgery or other medical institution • an active (for example sports field, golf course) or passive (for example national park) recreational area • commercial or industrial premises • a place of worship.
Peak particle velocity	Peak particle velocity is the maximum vector sum of three orthogonal time-synchronized velocity components regardless of whether these component maxima occurred simultaneously.
Rating background level	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
Tonality	Noise containing a prominent frequency or frequencies characterised by definite pitch.
VDV	Vibration dose value - As defined in BS6472 – 2008, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).

1. Introduction

1.1 Overview

Springvale Coal Pty Ltd (Springvale Coal) and EnergyAustralia NSW Pty Ltd (EnergyAustralia) propose to develop the Springvale Water Treatment Project (the Project).

Springvale Mine and Angus Place Colliery are underground coal mining operations in the western coalfields of NSW near Lithgow. Operation of the mines includes a water management scheme, which incorporates a series of dewatering bore facilities on the Newnes Plateau to manage safe water levels in the underground workings. The extracted groundwater has a high salinity level and requires treatment prior to reuse or discharge.

EnergyAustralia currently operates the Mount Piper Power Station (MPPS) also located in the Lithgow region approximately eight kilometres from the Springvale pit top. The power station has a high demand for make-up water for use in the cooling tower system, with water currently drawn from the Coxs River and Fish River catchments.

To achieve the salinity discharge limits, Springvale Coal and EnergyAustralia have agreed to work together to investigate and develop a water treatment solution that involves developing a pipeline to transfer extracted mine water from Springvale Mine and Angus Place Colliery to the MPPS and augmentation of the existing water treatment facilities.

The Project involves establishing a pipeline and ancillary facilities to transfer water from the existing dewatering facilities on the Newnes Plateau for treatment and reuse at MPPS.

This Noise and Vibration Impact Assessment (NVIA) assesses the operational and construction noise and vibration impacts from the Project. The NVIA has been assessed to meet the Environmental Assessment Requirements in Table 1-1 for preparation of an Environmental Impact Statement (EIS).

Table 1-1 Environmental Assessment Requirements

Environmental Assessment Requirements	Section addressed
Legislation, policies and guidelines	
Relevant legislation • *Protection of the Environment Operations Act 1997* • *State Environment Planning Policy (Mining Petroleum Production and Extractive Industries) 2007* • *Secretary's Environmental Assessment Requirements* • *EPA Environmental Assessment Requirements*	Section 3.1
Relevant policies and guidelines • *Interim Construction Noise Guideline* (DECC, 2009) • *Assessing Vibration: a technical guideline* (DEC, 2006) • NSW *Industrial Noise Policy* (EPA, 2000) • NSW *Road Noise Policy* (DECCW, 2011)	 Section 3.2.1 Section 3.2.2 Section 3.3 Section 3.4
Noise and Vibration Impacts	
Assessment of the construction noise and vibration impacts in accordance with the *Interim Construction Noise Guideline* and *Assessing Vibration: a technical guideline*.	Section 4.2, Section 4.3
Assessment of the water treatment plant operational noise and vibration impacts in accordance with the NSW *Industrial Noise Policy* and *Assessing Vibration: a technical guideline*.	Section 0, Section 4.5
Assessment of the construction and operational traffic noise impacts in accordance with the NSW *Road Noise Policy*.	Section 4.2.5, Section 4.6
Provision of mitigation options to minimise noise and vibration impacts.	Section 5

1.2 Project description

Groundwater will be removed from Springvale Mine and Angus Place Colliery to provide safe operating conditions for coal extraction. The dewatering requirements vary based upon the location of active extraction operations within the underground mines and is anticipated to peak at around 36 ML/day by 2030.

The Project will involve development of the following elements:

- **Water transfer system** – a water transfer pipeline and booster pump station from the dewatering facilities on Newnes Plateau to the MPPS. Water will be collected from existing dewatering bores and flow into the existing central gravity tank.
- **Water treatment plant** – a water treatment plant at the MPPS designed to treat water for reuse within the MPPS cooling tower or discharge into the Upper Coxs River catchment.

A full description of the Project is provided within Chapter 5 of the EIS.

1.3 Methodology

The following methodology was utilised to assess the potential noise and vibration impacts associated with construction and operation of the Project in order to address the Secretary's environmental assessment requirements:

- identifying sensitive receivers in the area surrounding the Project
- describing the existing noise environment and local meteorology
- establishing noise and vibration assessment criteria at sensitive receiver locations
- assessing the potential construction and operational noise and vibration impacts from the Project
- assessing potential traffic noise impacts from operation and construction
- assessing the potential vibration impacts from the Project
- provide recommendations for reasonable and feasible noise and vibration mitigation measures.

1.4 Report structure

The report is structured as follows:

- **Chapter 1 – Introduction.** This chapter introduces the Project and describes the Project area.
- **Chapter 2 – Existing environment**. This chapter describes the existing environmental values of the study area relevant to the noise and vibration assessment
- **Chapter 3 – Compliance criteria**. This chapter outlines the relevant Commonwealth and State legislation and any guidelines and assessment criteria relevant to construction and operation.
- **Chapter 4 – Assessment of impacts.** This chapter examines the potential environmental impacts associated with the construction and operation of the Project.
- **Chapter 5 – Mitigation measures.** This chapter outlines the proposed mitigation strategies during the construction to manage any identified impacts.
- **Chapter 6 – Conclusion.** This chapter provides a conclusion to the report and presents the next steps in the advancement of the Project.

2. Existing environment

2.1 Sensitive receivers and land uses

2.1.1 Overview

The Project spans from the Newnes Plateau in the eastern portion of the study area through Wallerawang, Lidsdale and Blackmans Flat to the north-west of Lithgow. Portland is located approximately three kilometres to the west of MPPS.

Noise and vibration sensitive receivers are defined based upon the type of occupancy and the activities performed within the land parcel.

The following sensitive receivers have been identified:

- 140 residential receivers have been identified within the study area and are shown in Figure 2-1. These are located in the suburbs of Blackmans Flat, Lidsdale and Wallerawang.
- The Blackmans Flat Cemetery which is considered a passive recreational land use.



Paper Size A3

0 200 400 800 1,200 1,600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- Noise Monitoring Location
- Sensitive Receiver
- Proposed WTP Layout
- Proposed WTP Boundary

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

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Noise monitoring locations, and surrounding sensitive receivers

Figure 2-1

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0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

Sensitive Receiver

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

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Noise monitoring locations, and surrounding sensitive receivers

Figure 2-1A

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LEGEND

◊ Sensitive Receiver Proposed Alignment

Proposed raw water transfer pipeline

Paper Size A3

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Noise monitoring locations, and surrounding sensitive receivers

Figure 2-1B

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2.2 Existing noise environment

Background noise monitoring is required to establish Construction Noise Management Levels. For this assessment background noise levels are not required for establishing the Industrial Noise Policy intrusive criteria as the operational noise emissions are well below the minimum background noise level of 30 dBA at all surrounding receivers (refer to Section 0). A review of previous background noise monitoring has been undertaken *Centennial Western Coal Services Project Noise and Vibration Impact Assessment* (SLR, 24 July 2013) and is summarised as follows:

- Noise monitoring was undertaken at Blackmans Flat from 20 February to 28 February 2012. This location is not significantly affected by noise from the overland conveyor system. Background noise levels are likely to increase for sensitive receivers closer to the conveyor however this location has been considered conservative for establishing noise criteria and has been used for this assessment. Note that background noise levels with contributions from the Springvale Coal Services Site operations have been used. During the day-time period the RBL does not change when Springvale Coal Services Site operations are excluded from measurements. Note that the noise limits in the WCS consent are regularly exceeded at receivers located in Blackmans Flat and Lidsdale.
- Noise monitoring was undertaken at Springvale between December 2010 and September 2012. During this period the background noise levels were influenced by the overland conveyor system and the Wallerawang Power Station. The Wallerawang Power Station is now closed which has the potential to reduce background noise levels. Therefore, this location has been discarded for use in this assessment as background noise levels may have reduced.

A summary of the rating background levels and ambient L_{Aeq} (day, evening and night) noise levels used for this assessment are provided in Table 2-1.

Table 2-1 Summary of the noise levels from monitoring, dBA

Location	Rating background level 90th percentile $L_{A90(15min)}$			Ambient noise levels, $L_{Aeq(period)}$		
	Day	Evening	Night	Day	Evening	Night
Lot 20 Noon Street, Blackmans Flat	37	36	35	50	51	44

2.3 Meteorological conditions

Temperature Inversions

The *Industrial Noise Policy* (EPA 2000) states that inversion effects should be taken into account in the noise assessment if the inversion conditions are predicted for at least 30% of the total night time during winter. For assessment purposes the night time noise assessment period is defined as 10 pm to 7 am. *Centennial Western Coal Services Project Noise and Vibration Impact Assessment* (SLR, 24 July 2013) indicates F Class temperature inversions occur for more than 30% of the time.

Where temperature inversions occur for more than 30 per cent of the time (during any seasonal period assessed between 6 pm and 7 am) the *Industrial Noise Policy* (EPA 2000) recommends that in a non-arid area (rainfall > 500 mm/year) a 3 ºC/100 m with a 2 m/s wind speed from source to receiver should be used for determining noise impacts under adverse weather conditions. The Bureau of Meteorology's Lidsdale State Forest has a reported average annual rainfall of 868 mm/year.

The *Validation of Inversion Strength Estimation Method* (NSW EPA 2014) recommends that the *"Industrial Noise Policy* (EPA 2000) *default should be changed from 3 ºC/100 m to F Class stability"*.

Noise enhancing wind

The *Industrial Noise Policy* (EPA 2000) recommends an adverse weather condition of 3 m/s wind speed from source to receiver with Pasquill Stability Class D atmospheric conditions if those conditions occur for more than 30 per cent of the time in any season in any time period. *Centennial Western Coal Services Project Noise and Vibration Impact Assessment* (SLR, 24 July 2013) indicates winds are a feature of the area for Blackmans Flat. However, at Lidsdale winds were not a feature of the area. For conservatism, an adverse wind has been included at all locations for construction.

3. Compliance criteria

3.1 State legislation

3.1.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* is the key piece of environment protection legislation administered by the NSW Environment Protection Authority (EPA) and establishes a system of environment protection licensing for 'scheduled' activities which have the potential to significantly impact on the environment.

3.1.2 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (SEPP)

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (SEPP) establishes planning controls to encourage sustainable development through the environmental assessment and development of extractive resources. The SEPP refers to the *NSW Industrial Noise Policy* (EPA, 2000) to ensure the cumulative amenity noise level is not greater than acceptable noise levels.

3.1.3 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements with regards to noise include the following:

- an assessment of the construction noise vibration impacts in accordance with the *Interim Construction Noise Guideline* (DECCW, 2009)
- an assessment of the operational noise impacts from the water treatment plant in accordance with the *NSW Industrial Noise Policy* (EPA, 2000)

3.1.4 EPA Environmental Assessment Requirements

The Environmental Assessment Requirements for the Project have been produced by the EPA after a review of the *Centennial Coal/Energy Australia Water Treatment Plant (Project) – Preliminary Environmental Analysis* dated April 2016.

The following requirements were identified in regards to noise:

- the amenity of local residents of Lidsdale, Wallerawang and Blackmans Flat should be protected such that they are not impacted by noise during construction of the pipelines
- an assessment of the potential increase in noise emissions from MPPS due to operation of the proposed water treatment plant.

3.2 Construction

3.2.1 Construction noise

The *Interim Construction Noise Guideline* (DECC 2009) guideline recommends standard hours for construction activities as Monday to Friday: 7am to 6pm, Saturday: 8am to 1pm and no work on Sundays or public holidays. These hours are not mandatory and the *Interim Construction Noise Guideline* (DECC 2009) acknowledges that the following activities have justification to be undertaken outside the recommended standard construction hours assuming that all reasonable and feasible mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

- the delivery of oversized plant or structures that police or other authorities determine to require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours
- works which maintain noise levels at sensitive receivers to below the noise management levels outside of the recommended standard construction hours.

Construction noise management levels at sensitive residential receivers are provided in Table 3-1. The construction noise management levels during recommended standard hours represent a noise level that, if exceeded, would require management measures including the following:

- reasonable and feasible work practices
- contact with the residences to inform them of the nature or works to be carried out, the expected noise levels and durations and contact details.

The management measures are aimed at reducing noise impacts at the residential receivers. However, it may not be reasonable and feasible to reduce noise levels to below the noise affected management level. The noise affected construction noise management levels during recommended standard hours is not intended as a noise limit but rather a level where noise management is required and as such should not be included as a noise limit in the environmental protection license.

Other sensitive receivers relevant to this Project included passive recreational areas (characterised by contemplative activities where benefits are compromised by external noise intrusion) such as Newnes State Forest. The *Interim Construction Noise Guideline* (DECC 2009) noise management level for passive recreational areas is $L_{Aeq(15min)}$ 60 dB(A) which applies when the passive recreational area is being used.

Table 3-1 Residential construction noise management levels, dBA

Time of day	Noise management level, $L_{Aeq(15min)}$	Application
Recommended standard hours	Noise affected: RBL+ 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. • where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • the proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school) for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times
Outside recommended standard hours	Noise affected: RBL+ 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

A summary of the construction noise management levels are provided in Table 3-2.

Table 3-2 Proposal construction noise management levels, dBA

	Construction noise management levels, $L_{Aeq(15\ min)}$				
	Standard construction hours		Outside standard construction hours		
	Noise affected	Highly noise affected	Day	Evening	Night
Residential receivers	47	75	42	41	40
Blackmans Flat Cemetery	60 (When in use)				

Sleep disturbance criteria during construction

The *Interim Construction Noise Guideline* (DECC 2009) also refers to the *Environmental Criteria for Road Traffic Noise* (EPA 1999) for guidance on sleep disturbance from maximum noise level events. This guideline has since been superseded by the *Road Noise Policy* (DECCW 2011). Both guidelines provide a discussion on research into the effects of maximum noise events on sleep disturbance. The *Industrial Noise Policy* (EPA 2000) application notes also provide guidance on sleep disturbance impacts. The results of this research is aimed at limiting the level of sleep disturbance due to environmental noise and concludes that the L_{Amax} or $L_{A1(1min)}$ level of any noise should not exceed the ambient $L_{A90(15min)}$ noise level by more than 15 dB(A) which is consistent with the *Industrial Noise Policy* (EPA 2000) screening test. The *Road Noise Policy* (DECCW 2011) provides further guidance, which indicates that:

- maximum internal noise levels below 50–55 dB(A) are unlikely to cause awakening reactions
- one or two noise events per night with maximum internal noise levels of 65–70 dB(A) are not likely to significantly affect health and wellbeing.

3.2.2 Construction vibration

Human comfort

Vibration is assessed based on the criteria in *Assessing Vibration: a technical guideline* (DEC 2006). *British Standard (BS) 6472 – 2008, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* is recognised by the guideline as the preferred standard for assessing the 'human comfort criteria'. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3-3 for sensitive receivers.

Whilst the assessment of response to vibration in *BS 6472-1:1992* is based on vibration dose value and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak particle velocity, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in *BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration,* as shown below in Table 3-4.

Table 3-3 Human comfort intermittent vibration dose values (BS 6472-1992)

Receiver type	Period[1]	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26

Note 1: Day is between 7am and 10pm and night is between 10 pm and 7 am

Table 3-4 Guidance on effects of vibration levels for human comfort (BS 5228.2 – 2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

Structural damage

Currently, there is no Australian Standard that sets criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* (refer to Table 3-5).

Table 3-5 Guideline values for short term vibration on structures

Type of structure	Guideline values for velocity, (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10
Pipes - steel	100		
Pipes – clay, concrete, reinforced concrete, stressed concrete, metal	80		
Pipes – masonry, plastic	50		

Note 1: At frequencies above 100 Hz the values given in this column may be used as minimum values.

Summary of vibration criteria

A summary of vibration screening criteria is provided in Table 3-6. The criteria are provided as a guide for determining potential human comfort or structural damage impacted buffer distances to determine if further detailed investigation is required. The levels provided in Table 3-6 are recommended screening criteria for the impact assessment. During construction of the Project compliance monitoring should be assed against all criteria in Section 3.2.2.

Table 3-6 Recommended screening vibration criteria

Receiver area	Criteria type	Peak particle velocity screening criteria	
		Day	Night
Residential receivers	Human comfort	1 mm/s	0.3 mm/s
	Structural damage	5 mm/s[1]	

Note 1: Higher magnitude of vibration is acceptable at higher frequencies

3.3 Operational noise

The *Industrial Noise Policy* (EPA 2000) provides guidance on the assessment of operational noise impacts for scheduled items under the *Protection of the Environment Operations Act 1997*. The guidelines include both intrusive and amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the cumulative noise level from all sources near a receiver.

The *Industrial Noise Policy* (EPA 2000) noise criteria are planning levels and are not mandatory limits required by legislation however the noise criteria will assist the determining authority to assess operational noise impacts and establish noise limits in the conditions of consent. Where noise criteria are predicted to be exceeded, feasible and reasonable noise mitigation strategies are assessed.

3.3.1 Intrusive criteria

The intrusive noise criteria controls the relative audibility of operational noise compared to the background level at residential receivers. The intrusive criteria are determined by a 5 dB(A) addition to the rating background level. The *Industrial Noise Policy* (EPA 2000) requires that, *'where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A)'* which results in an intrusive noise criterion of 35 dB(A). The *Industrial Noise Policy* (EPA 2000) application notes recommend that the intrusive noise criteria for the evening period should not exceed the daytime period and the night-time period should not exceed the evening period.

3.3.2 Amenity criteria

The amenity criteria limits the total level of extraneous noise and controls cumulative noise impacts from other industries and developments on all receiver types. The amenity criteria are determined based on the overall acoustic characteristics of the receiver area, the receiver type and the existing level of industrial noise.

Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic.

The amenity criteria aim to limit continual increases in noise levels from industrial noise sources and developments and apply to all industrial noise sources at the receiver location. To prevent cumulative noise level increases above the amenity criteria, the *Industrial Noise Policy* (EPA 2000) provides adjustments to the amenity criteria to set a target level for the Project. The applicable adjustment is scaled as per *Industrial Noise Policy* (EPA 2000) Table 2.2 and is based on the existing level of industrial noise at the receiver location.

3.3.3 Modifying factor adjustments

The *Industrial Noise Policy* (EPA 2000) requires that modifying factor adjustments are added to the measured or predicted noise levels if the noise sources contain tonal, low frequency, intermittent or impulsive characteristics, which have the potential to increase annoyance. The modifying factor adjustments are summarised in Table 3-7.

Table 3-7 Modifying factor adjustments

Factor	Assessment/ measurement	When to apply	Correction[1,2]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz • 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive • 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.	5 dB(A)[2]
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more.	5 dB(A)[2]
Intermittent noise	Subjectively assessed	When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dB(A).	5 dB(A)
Impulsive noise	A-weighted fast response and impulse response	If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.	Apply the difference in measured noise levels as the correction up to a maximum of 5 dB(A)
Duration[3]	If the duration of the noise event in any 24 hour period is as follows: • 1.0 to 2.5 hours then increase the noise criteria by 2 dB(A) day and 0 dB(A) night • 15 minutes to 1 hour then increase the noise criteria by 5 dB(A) day and 0 dB(A) night • 6 minutes to 15 minutes then increase the noise criteria by 7 dB(A) day and 2 dB(A) night • 1.5 minutes to 6 minutes then increase the noise criteria by 15 dB(A) day and 5 dB(A) night • less than 1.5 minutes then increase the noise criteria by 20 dB(A) day and 10 dB(A) night.		

Note 1: Where two or more modifying factors are present the maximum correction is limited to 10 dB(A).

Note 2: Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

Note 3: Duration correction is a negative correction which increases the noise criteria

3.3.1 Sleep disturbance

The *Industrial Noise Policy* (EPA 2000) application notes regarding sleep disturbance recommend that where the $L_{A1(1min)}$ or L_{Amax} exceeds the $L_{A90(15min)}$ by more than 15 dB(A) outside the bedroom window, a more detailed analysis is required.

Sleep disturbance are not anticipated for operation of the proposed development as operational noise sources are generally continuous in nature which do not produce maximum events during the night time period and as such the *Industrial Noise Policy* (EPA 2000) intrusive criteria would be the most stringent criteria.

3.3.2 Operational noise criteria

The operational noise criteria are applicable to the following activities:

- operation of the water treatment plant at Mt Piper Power Station
- operation of the pump station at the gravity tank compound on Newnes Plateau

The intention of the operational noise assessment is to show that the noise levels from these operations do not contribute to the existing industrial noise in the area. As such for conservatism if it can be shown that the operational noise levels are 10 dBA below the amenity noise criteria then the intrusive criteria will be achieved and there will be no cumulative contribution to the amenity criteria.

3.4 Road traffic noise

The *Road Noise Policy* (DECCW 2011) provides traffic noise criteria for residential receivers in the vicinity of existing roads (Table 3-8). The criteria are applied to operational and construction traffic on public roads to identify potential road traffic impacts and the requirement for reasonable and feasible mitigation measures.

The *Road Noise Policy* (DECCW 2011) application notes state that *"for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."*

If road traffic noise increases during operation and construction work is within 2 dBA of current levels then the objectives of the *Road Noise Policy* (DECCW 2011) are met and no specific mitigation measures are required.

Table 3-8 Road traffic noise criteria, $L_{Aeq(period)}$, dB(A)

Type of Development	Day 7am to 10pm	Night 10pm to 7am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{eq(15hr)}$	55 $L_{eq(9hr)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{eq(1hr)}$	50 $L_{eq(1hr)}$

4. Assessment of impacts

The following impacts during the construction and operational phases of the Project will be discussed within this section.

- Construction phase
  - Noise impacts due to construction of the WTP at MPPS
  - Noise impacts due to construction of the pipeline
  - Sleep disturbance impacts on residential receivers
  - Construction traffic impacts
- Operational phase
  - Noise impacts due to operation of the WTP
  - Noise impacts due to operation of the dewatering facilities on Newnes Plateau
  - Operational traffic impacts

4.1.1 Assessment parameters

Noise modelling was undertaken using SoundPlan (v7.4). SoundPlan is a computer program for the calculation, assessment and prognosis of noise exposure. Environmental noise propagation in SoundPlan was calculated using algorithm in *The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities, Report No. 4/81* (CONCAWE, 1981). The CONCAWE algorithm is used to predict the effects of construction and operational noise under defined meteorological stability classes.

The following tasks were undertaken as part of the construction and operational noise impact assessment:

- Noise criteria was determined based on the sensitive receiver type and time of day
- Establishing appropriate site specific conditions for the noise model
- Determining calm and adverse meteorological conditions for the noise model using the CONCAWE algorithm. Further discussion on the meteorological conditions recommended by the *Industrial Noise Policy* (EPA, 2000) are provided in Section 4.1.2
- Identifying the sound power levels of noise generating equipment during the construction and operational phases of the Project
- Determining the construction and operational impacts on sensitive receivers surrounding the Project.

The following noise modelling assumptions were made to establish site specific conditions:

- surrounding land was modelled assuming a mixture of hard and soft ground with a ground absorption coefficient of 0.5
- noise sources for each construction scenario are in some cases modelled at different locations. As such the noise modelling assesses the noise source at multiple locations and takes the maximum L_{Aeq} noise level.
- terrain topography with a ten metre resolution of the study area was used to generate the site used to predict noise levels.
- atmospheric air absorption was based on an average temperature of 10ºC and an average humidity of 70%.

4.1.2 Meteorological conditions

Noise propagation can be enhanced by wind conditions and temperature inversions. The following meteorological conditions were applied:

- **Daytime construction noise predictions:** Adverse meteorological conditions with a Pasquill Stability Class D atmospheric conditions (to represent a moderate temperature inversion) with wind speed of 3 m/s source to receiver.
- **Night-time operational noise predictions:** Adverse meteorological conditions with a Pasquill Stability Class F (to represent a moderate temperature inversion) with 2 m/s wind from source to receiver.

4.2 Construction noise

4.2.1 Construction activities and noise sources

The Project consists of construction of the Water Treatment Plant (WTP) and construction of the water transfer system. Proposed plant and equipment required throughout all stages of construction of the Project were modelled to predict the expected noise levels during construction works. The predicted noise levels are used to assess potential exceedances to the noise management levels at nearby receivers and to determine potential options for mitigation to protect the amenity of the local residences.

The construction activities and equipment used to model different scenarios are summarised in Table 4-1 along with their expected sound power levels. Noise levels for construction equipment have been obtained from *AS2436 – 2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites* and *BS5228-2009 Code of practice for noise and vibration control on construction and open sites Part 1: Noise*. Other equipment may be used, however, it is anticipated that they would produce similar net noise emissions when used concurrently with the equipment listed.

Construction scenarios have been created based on construction equipment operating simultaneously at any given time. Construction of the water transfer system and the WTP have been considered independently. The modelled construction scenarios have been provided in

Table 4-2 and represent the likely stages of construction.

During construction, it is unlikely that all machinery would be operating at the same time during a particular construction stage (assumed in the modelling), but taking a ‘worse-case’ scenario approach helps to identify where mitigation measures may be required.

Table 4-1 Construction activities, equipment and noise levels

Activity	Construction equipment	SWL, dBA	Modelled source height (m)	Source
Pipeline construction (above ground)	Mobile crane	104	2 m	AS2436 Table A1
	Trailer	107	2 m	AS2436 Table A1
Pipeline (below ground)	Trencher	115	1.5 m	BS5228 Table C4.63
	Drilling rig	111	1.5 m	AS2436 Table A1
Site establishment	Truck	107	2 m	AS2436 Table A1
	Generator	99	2 m	AS2436 Table A1
	Hand tools	102	2 m	AS2436 Table A1

Activity	Construction equipment	SWL, dBA	Modelled source height (m)	Source
Bulk earthworks	Excavator (20 Tonne)	107	2 m	AS2436 Table A1
	Truck	107	2 m	AS2436 Table A1
	Compactor	114	2 m	AS2436 Table A1
Pavement construction	Grader	110	2 m	AS2436 Table A1
	Asphalt mill	111	2 m	AS2436 Table A1
	Concrete truck	112	2 m	AS2436 Table A1
Building infrastructure	Mobile crane	104	2 m	AS2436 Table A1
	Hand tools	102	2 m	AS2436 Table A1

Table 4-2 Modelled construction scenarios

Scenario	Activities	SWL, dBA
S1	Pipeline construction – above ground Pipeline construction – below ground	108 116
S2	Site establishment	109
S3	Bulk earthworks	115
S4	Pavement construction	116
S5	Building infrastructure	106

4.2.2 Predicted construction noise levels

Predicted construction noise levels during standard construction hours are provided in Table 4-3. Highlighted cells indicate receivers where the construction noise is expected to be exceeded. Noise contour plots for each construction scenario are presented in Figure 4-1 to Figure 4-5.

Table 4-3 Construction noise levels during standard hours, dBA

Receiver ID	Receiver address	Receiver type	Floor	S1	S2	S3	S4	S5
R001	4- 5 Castlereagh Highway Blackmans Flat	Residential	GF	39	6	12	13	3
R002	8 Castlereagh Highway Blackmans Flat	Residential	GF	47	7	14	15	5
R003	1449 Castlereagh Highway Blackmans Flat	Residential	GF	30	3	10	11	1
R004	1470 Castlereagh Highway Blackmans Flat	Residential	GF	31	3	9	10	0
R005	1563 Castlereagh Highway Blackmans Flat	Residential	GF	40	6	12	13	4
R006	11- 39 View Street Blackmans Flat	Residential	GF	29	3	9	10	1
R007	243 Castlereagh Highway Lidsdale	Residential	GF	31	4	11	12	2
R008	1333 Castlereagh Highway Lidsdale	Residential	GF	39	10	17	18	8
R009	1384 Castlereagh Highway Lidsdale	Residential	GF	35	13	22	23	14
R010	1385 Castlereagh Highway Lidsdale	Residential	GF	35	16	22	23	14
R011	1387 Castlereagh Highway Lidsdale	Residential	GF	35	16	22	23	14
R012	1389 Castlereagh Highway Lidsdale	Residential	GF	35	17	23	24	14
R013	1391 Castlereagh Highway Lidsdale	Residential	GF	35	17	23	24	15
R014	1408 Castlereagh Highway Lidsdale	Residential	GF	34	10	18	19	9
R015	1414 Castlereagh Highway Lidsdale	Residential	GF	34	12	20	21	11
R016	1434 Castlereagh Highway Lidsdale	Residential	GF	33	7	14	15	5
R017	1-3 Duncan St Lidsdale	Residential	GF	65	0	0	0	0
R018	5 Duncan St Lidsdale	Residential	GF	67	0	0	0	0
R019	7 Duncan St Lidsdale	Residential	GF	67	0	0	0	0
R020	9 Duncan St Lidsdale	Residential	GF	67	0	0	0	0
R021	11 Duncan Street Lidsdale	Residential	GF	67	0	0	0	0

Receiver ID	Receiver address	Receiver type	Floor	S1	S2	S3	S4	S5
R022	13 Duncan St Lidsdale	Residential	GF	68	0	0	0	0
R023	15 Duncan St Lidsdale	Residential	GF	68	0	0	0	0
R024	17 Duncan St Lidsdale	Residential	GF	65	0	0	0	0
R025	19 Duncan St Lidsdale	Residential	GF	69	0	0	0	0
R026	21 Duncan St Lidsdale	Residential	GF	67	0	0	0	0
R027	23 Duncan St Lidsdale	Residential	GF	70	0	0	0	0
R028	25 Duncan St Lidsdale	Residential	GF	70	0	0	0	0
R029	1D Ian Holt Drive Lidsdale	Commercial	GF	37	-6	0	1	-9
R030	1D Ian Holt Drive Lidsdale	Commercial	GF	46	0	0	0	0
R031	15 Ian Holt Drive Lidsdale	Residential	GF	45	0	0	0	0
R032	17 Ian Holt Drive Lidsdale	Residential	GF	45	0	0	0	0
R033	32 Ian Holt Drive Lidsdale	Residential	GF	47	0	0	0	0
R034	42 Ian Holt Drive Lidsdale	Residential	GF	45	-5	2	3	-7
R035	50 Ian Holt Drive Lidsdale	Residential	GF	44	-5	1	2	-7
R036	64 Ian Holt Drive Lidsdale	Residential	GF	43	-3	3	4	-6
R037	69 Ian Holt Drive Lidsdale	Residential	GF	44	0	0	0	0
R038	69 Ian Holt Drive Lidsdale	Residential	GF	41	-3	3	4	-5
R039	70 Ian Holt Drive Lidsdale	Residential	GF	42	12	18	19	10
R040	111 Ian Holt Drive Lidsdale	Residential	GF	39	-1	5	6	-4
R041	1305 Ian Holt Drive Lidsdale	Residential	GF	40	-1	5	6	-3
R042	110 Karawatha Drive Lidsdale	Residential	GF	34	10	17	18	8
R043	130 Karawatha Drive Lidsdale	Residential	GF	34	8	15	16	6

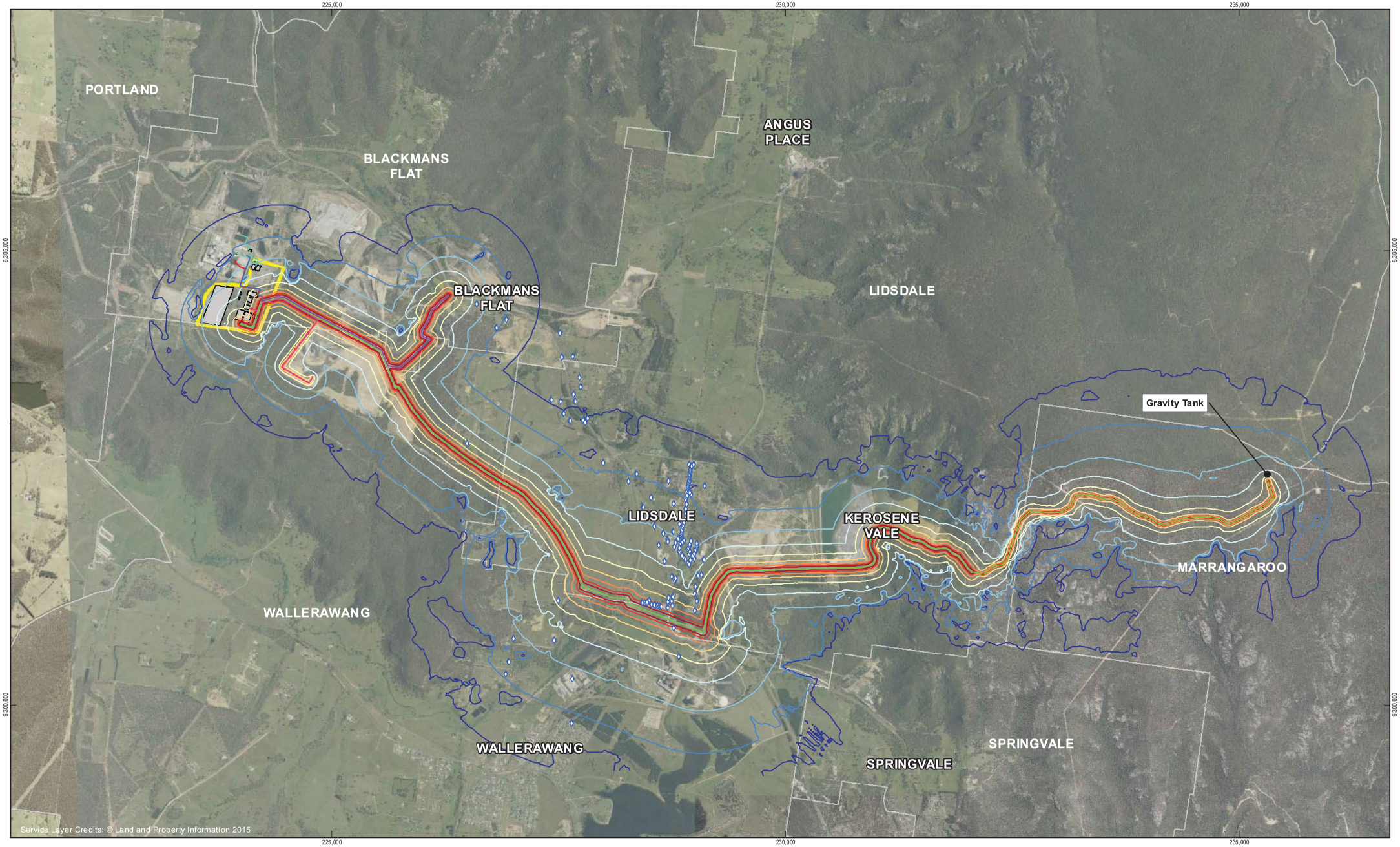
Receiver ID	Receiver address	Receiver type	Floor	S1	S2	S3	S4	S5
R044	41 Maddox Lane Lidsdale	Residential	GF	38	0	0	0	0
R045	1 Neubeck Street Lidsdale	Residential	GF	48	0	0	0	0
R046	2 Neubeck Street Lidsdale	Residential	GF	46	0	0	0	0
R047	3 Neubeck Street Lidsdale	Residential	GF	47	0	0	0	0
R048	4 Neubeck Street Lidsdale	Residential	GF	46	0	0	0	0
R049	4 Neubeck Street Lidsdale	Residential	GF	46	0	0	0	0
R050	5 Neubeck Street Lidsdale	Residential	GF	46	0	0	0	0
R051	6-12 Neubeck Street Lidsdale	Residential	GF	44	0	0	0	0
R052	6 Neubeck Street Lidsdale	Residential	GF	45	0	0	0	0
R053	7-9 Neubeck Street Lidsdale	Residential	GF	46	0	0	0	0
R054	7-9 Neubeck Street Lidsdale	Residential	GF	49	0	0	0	0
R055	8 Neubeck Street Lidsdale	Residential	GF	45	0	0	0	0
R056	10 Neubeck Street Lidsdale	Residential	GF	45	0	0	0	0
R057	11 Neubeck Street Lidsdale	Residential	GF	46	0	0	0	0
R058	13 - 15 Neubeck Street Lidsdale	Residential	GF	45	0	0	0	0
R059	15 Neubeck Street Lidsdale	Residential	GF	45	0	0	0	0
R060	17 Neubeck Street Lidsdale	Residential	GF	44	0	0	0	0
R061	19 Neubeck Street Lidsdale	Residential	GF	44	0	0	0	0
R062	21 Neubeck Street Lidsdale	Residential	GF	44	0	0	0	0
R063	2 Skelly Road Lidsdale	Residential	GF	47	0	0	0	0
R064	4 Skelly Road Lidsdale	Residential	GF	47	0	0	0	0
R065	6 Skelly Road Lidsdale	Residential	GF	47	0	0	0	0

Receiver ID	Receiver address	Receiver type	Floor	S1	S2	S3	S4	S5
R066	8 Skelly Road Lidsdale	Residential	GF	48	0	0	0	0
R067	10 Skelly Road Lidsdale	Residential	GF	52	0	0	0	0
R068	10 Skelly Road Lidsdale	Residential	GF	51	0	0	0	0
R069	40 Skelly Road Lidsdale	Residential	GF	52	0	0	0	0
R070	56 Skelly Road Lidsdale	Residential	GF	54	0	0	0	0
R071	60 Skelly Road Lidsdale	Residential	GF	57	0	0	0	0
R072	70 Skelly Road Lidsdale	Residential	GF	61	0	0	0	0
R073	1 Wolgan Road Lidsdale	Commercial	GF	69	0	0	0	0
R074	10 Wolgan Road Lidsdale	Residential	GF	61	0	0	0	0
R075	10 Wolgan Road Lidsdale	Residential	GF	63	0	0	0	0
R076	13 Wolgan Road Lidsdale	Residential	GF	63	0	0	0	0
R077	13 Wolgan Road Lidsdale	Residential	GF	60	0	0	0	0
R078	18 Wolgan Road Lidsdale	Residential	GF	59	0	0	0	0
R079	19 Wolgan Road Lidsdale	Residential	GF	58	0	0	0	0
R080	25 Wolgan Road Lidsdale	Residential	GF	52	0	0	0	0
R081	29 Wolgan Road Lidsdale	Residential	GF	52	0	0	0	0
R082	35 Wolgan Road Lidsdale	Residential	GF	45	-4	2	3	-6
R083	40 Wolgan Road Lidsdale	Residential	GF	52	0	0	0	0
R084	41 Wolgan Road Lidsdale	Residential	GF	46	0	0	0	0
R085	43 Wolgan Road Lidsdale	Residential	GF	46	0	0	0	0
R086	45 Wolgan Road Lidsdale	Residential	GF	45	0	0	0	0
R087	47 Wolgan Road Lidsdale	Residential	GF	45	0	0	0	0

Receiver ID	Receiver address	Receiver type	Floor	S1	S2	S3	S4	S5
R088	49 Wolgan Road Lidsdale	Residential	GF	45	0	0	0	0
R089	51 Wolgan Road Lidsdale	Residential	GF	44	0	0	0	0
R090	53 Wolgan Road Lidsdale	Residential	GF	44	0	0	0	0
R091	55 Wolgan Road Lidsdale	Residential	GF	44	0	0	0	0
R092	57 Wolgan Road Lidsdale	Residential	GF	44	0	0	0	0
R093	58 Wolgan Road Lidsdale	Residential	GF	45	0	0	0	0
R094	59 Wolgan Road Lidsdale	Residential	GF	43	0	0	0	0
R095	60 Wolgan Road Lidsdale	Residential	GF	45	0	0	0	0
R096	61 Wolgan Road Lidsdale	Residential	GF	43	0	0	0	0
R097	63 Wolgan Road Lidsdale	Residential	GF	43	0	0	0	0
R098	65-67 Wolgan Road Lidsdale	Residential	GF	42	0	0	0	0
R099	68 Wolgan Road Lidsdale	Residential	GF	42	0	0	0	0
R100	69-71 Wolgan Road Lidsdale	Residential	GF	42	0	0	0	0
R101	73 Wolgan Road Lidsdale	Residential	GF	41	0	0	0	0
R102	75 Wolgan Road Lidsdale	Residential	GF	41	0	0	0	0
R103	76 Wolgan Road Lidsdale	Residential	GF	42	0	0	0	0
R104	81 Wolgan Road Lidsdale	Residential	GF	41	0	0	0	0
R105	85 Wolgan Road Lidsdale	Residential	GF	40	0	0	0	0
R106	88 Wolgan Road Lidsdale	Residential	GF	41	-4	3	4	-6
R107	89 Wolgan Road Lidsdale	Residential	GF	40	0	0	0	0
R108	91 Wolgan Road Lidsdale	Residential	GF	40	0	0	0	0
R109	93 Wolgan Road Lidsdale	Residential	GF	38	0	0	0	0

Receiver ID	Receiver address	Receiver type	Floor	S1	S2	S3	S4	S5
R110	95 Wolgan Road Lidsdale	Residential	GF	35	0	0	0	0
R111	97 Wolgan Road Lidsdale	Residential	GF	35	0	0	0	0
R112	99 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R113	101 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R114	103 Wolgan Road Lidsdale	Residential	GF	36	0	0	0	0
R115	105 Wolgan Road Lidsdale	Residential	GF	36	0	0	0	0
R116	107 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R117	109 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R118	111 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R119	113 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R120	115-117 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R121	115-117 Wolgan Road Lidsdale	Residential	GF	37	0	0	0	0
R122	119 Wolgan Road Lidsdale	Residential	GF	37	-6	0	1	-8
R123	121 Wolgan Road Lidsdale	Residential	GF	37	-6	0	1	-8
R124	123 Wolgan Road Lidsdale	Residential	GF	37	-6	0	1	-9
R125	125 Wolgan Road Lidsdale	Residential	GF	37	-6	0	1	-9
R126	127 Wolgan Road Lidsdale	Residential	GF	37	-6	0	1	-9
R127	129 Wolgan Road Lidsdale	Residential	GF	37	-6	0	1	-9
R128	131 Wolgan Road Lidsdale	Residential	GF	37	-6	0	1	-9
R129	133 - 135 Wolgan Road Lidsdale	Residential	GF	37	-7	0	1	-9
R130	Wolgan Road Lidsdale	Residential	GF	39	-6	0	1	-9
R131	Wolgan Road Lidsdale	Residential	GF	49	0	0	0	0

Receiver ID	Receiver address	Receiver type	Floor	S1	S2	S3	S4	S5
R132	6 Pinta Street Wallerwang	Commercial	GF	43	0	0	0	0
R133	57 James Parade Wallerwang	Residential	GF	39	0	0	0	0
R134	91 Brays Lane Wallerawang	Residential	GF	40	-11	-5	-4	-14
R135	133 Brays Lane Wallerawang	Residential	GF	41	-11	-4	-3	-13
R136	137 Brays Lane Wallerawang	Residential	GF	43	-6	0	1	-9
R137	173 Brays Lane Wallerawang	Residential	GF	47	-11	-5	-4	-14
R138	233 Brays Lane Wallerawang	Residential	GF	56	-6	0	1	-9
R139	1411 Castlereagh Highway Wallerawang	Residential	GF	56	17	25	26	16
R140	Main Street Wallerawang	Commercial	GF	54	0	0	0	0



Paper Size A3

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Metres

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Sensitive Receiver
- Proposed WTP Layout
- Proposed WTP Boundary

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

dBA

35 40 45 50 55 60 65 70 75

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EA/CEY Water Treatment Project

Job Number 21-25109
Revision
Date 20 Jul 2016

Scenario 1 - Predicted noise levels, dBA

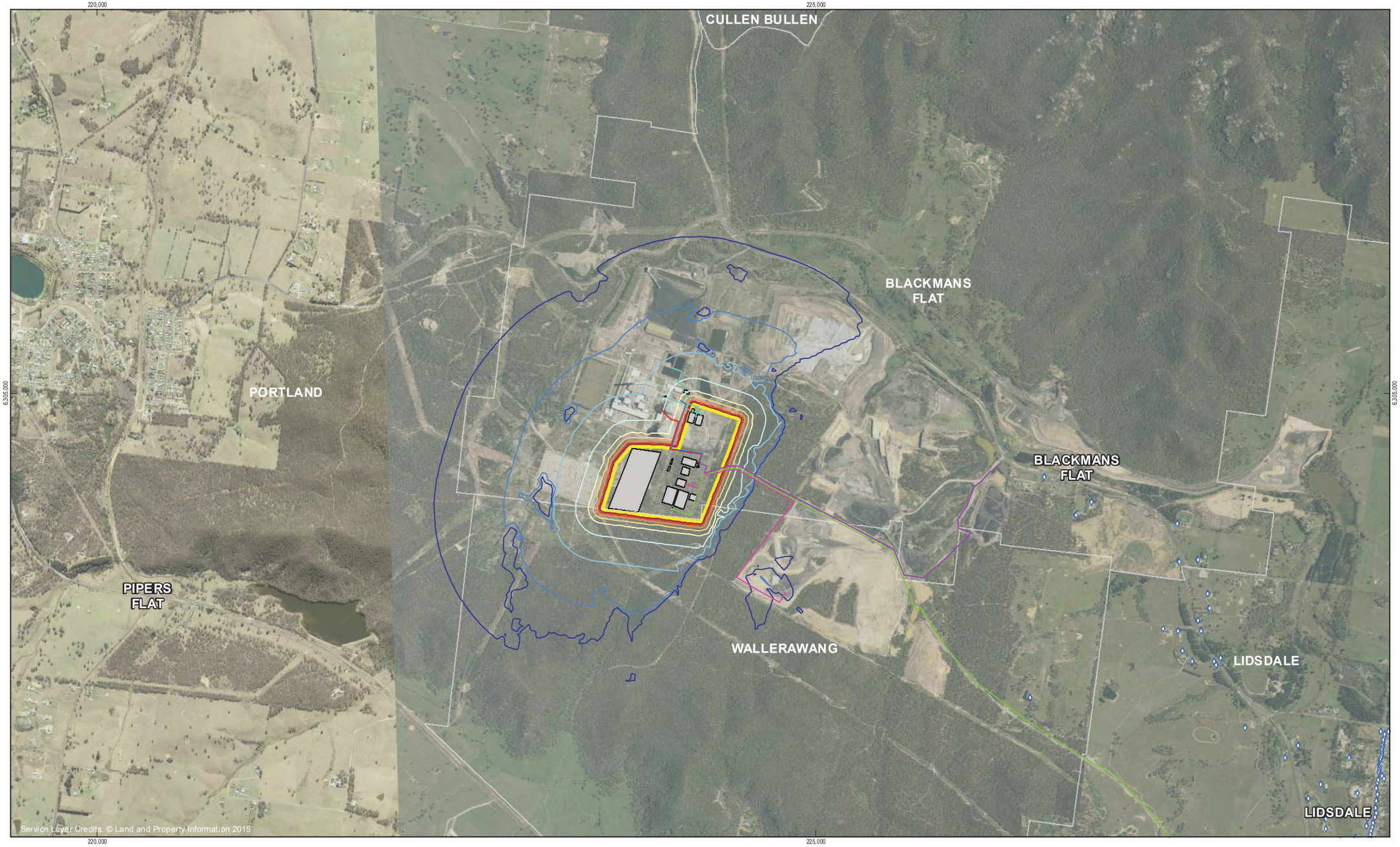
Figure 4-1

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Data source: Aerial Imagery: Sixmaps 2016 (LPI NSW Government) Topographic and Cadastral Data (2012): NSW Department of Lands and NSW LPI. Created by:mking3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Sensitive Receiver
- Proposed WTP Layout
- Proposed WTP Boundary

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

dBA

35 40 45 50 55 60 65 70 75

Centennial Coal and EnergyAustralia
EA/CEY Water Treatment Project

Job Number 21-25109
Revision
Date 20 Jul 2016

Scenario 2 - Predicted noise levels, dBA

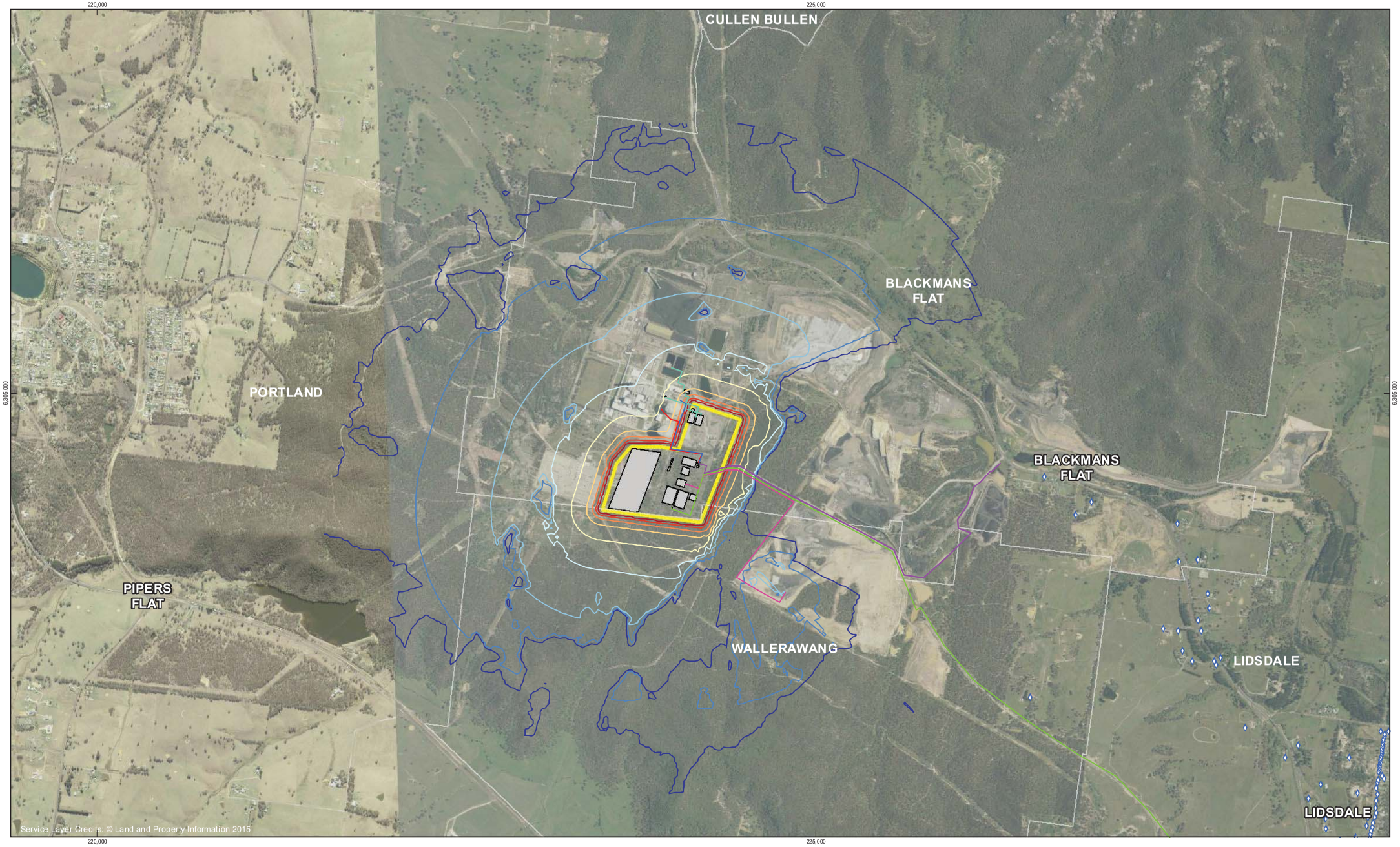
Figure 4-2

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Data source: Aerial Imagery: Sixmaps 2016 (LPI NSW Government) Topographic and Cadastral Data (2012): NSW Department of Lands and NSW LPI. Created by:mking3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Sensitive Receiver
- Proposed WTP Layout
- Proposed WTP Boundary

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

dBA

35 40 45 50 55 60 65 70 75

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EA/CEY Water Treatment Project

Job Number 21-25109
Revision
Date 20 Jul 2016

Scenario 3 - Predicted noise levels, dBA

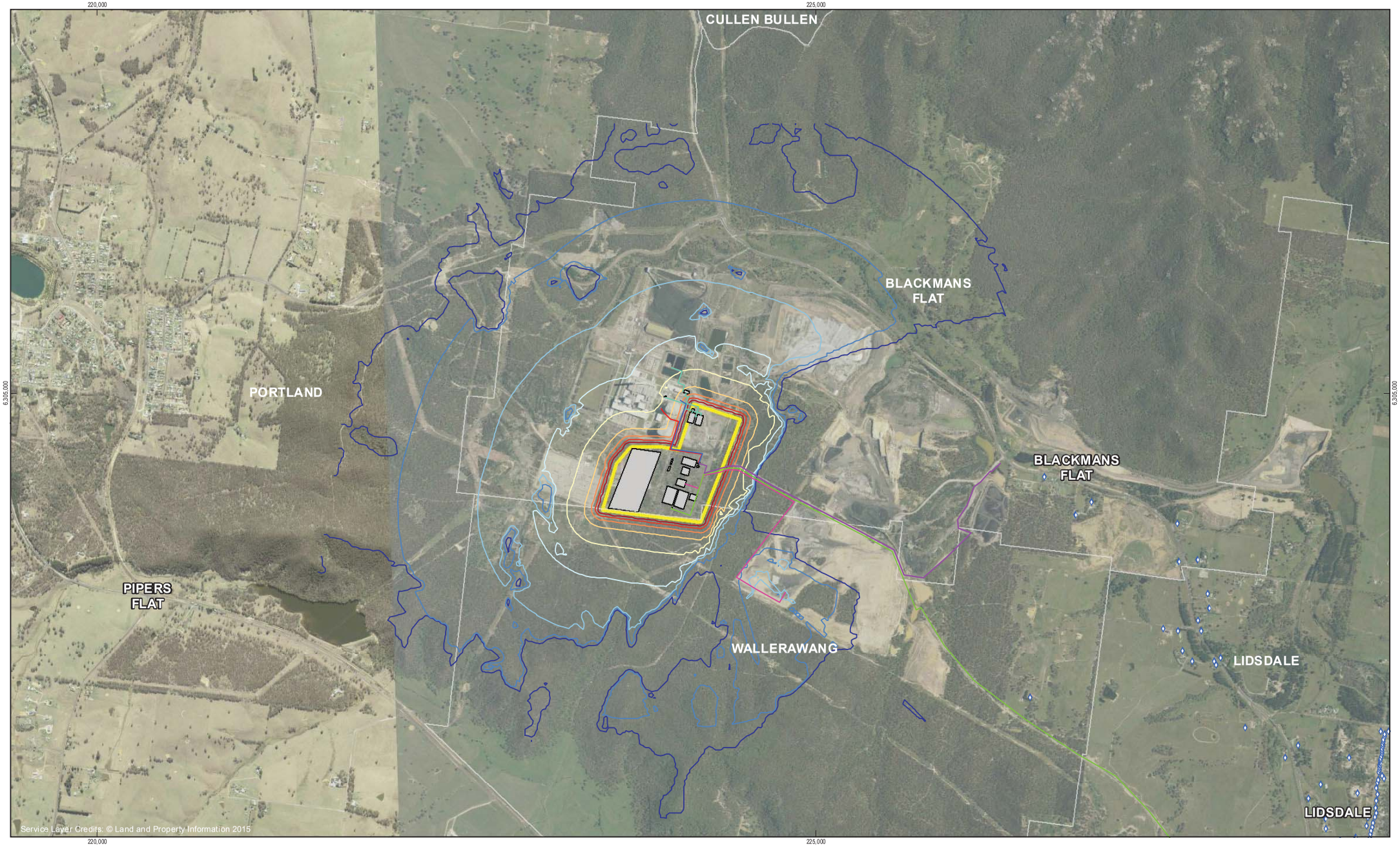
Figure 4-3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Sensitive Receiver
- Proposed WTP Layout
- Proposed WTP Boundary

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

dBA

35 40 45 50 55 60 65 70 75

Centennial Coal and EnergyAustralia
EA/CEY Water Treatment Project

Job Number 21-25109
Revision
Date 20 Jul 2016

Scenario 4 - Predicted noise levels, dBA

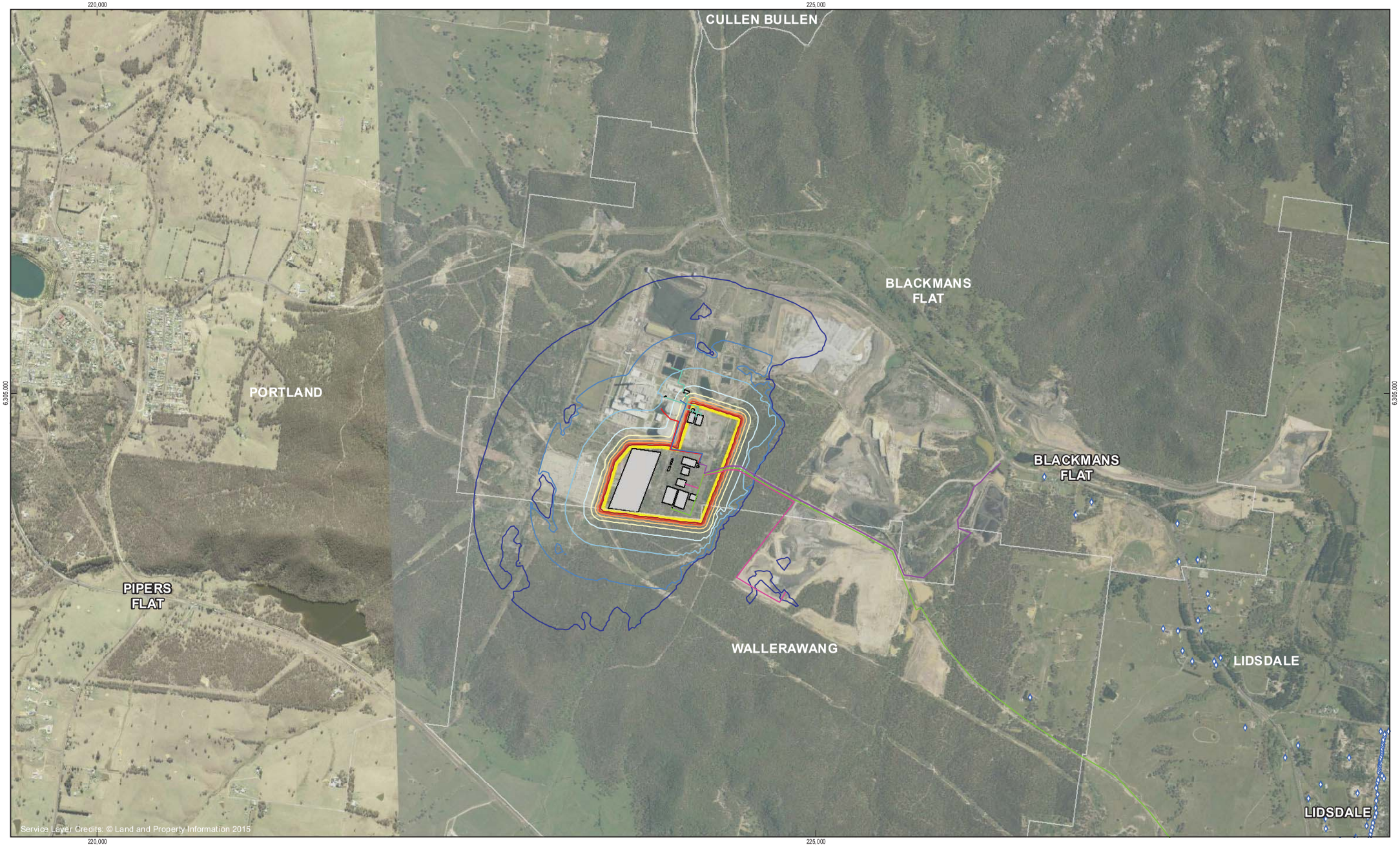
Figure 4-4

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N

LEGEND

- Sensitive Receiver
- Proposed WTP Layout
- Proposed WTP Boundary

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

dBA

35 40 45 50 55 60 65 70 75

Centennial Coal and EnergyAustralia
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Job Number 21-25109
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Date 20 Jul 2016

Scenario 5 - Predicted noise levels, dBA

Figure 4-5

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4.2.3 Assessment of construction noise impacts

Construction noise within the study area can be directly attributed to either construction of the WTP or construction of the water transfer system.

Where the predicted $L_{Aeq(15\ minute)}$ noise level is greater than the noise affected level all feasible and reasonable work practices should be applied, however, it is unlikely that mitigation measures would reduce the predicted noise levels below the management levels. The magnitudes of construction noise levels are dependent on the duration of construction, the type of equipment, location of activities, the surrounding environment's background noise levels and the weather conditions during construction. The predicted noise levels are generally conservative as the construction noise model predicts the worse-case 15 minute scenario and these levels may not represent the actual noise emission experienced by the community throughout the Project construction period.

WTP construction impacts

Noise from construction works at the WTP is predicted to comply with the construction noise management level at all receivers within the study area. The closest sensitive receiver is approximately 2.3 kilometres east of the proposed WTP location. Alternative construction staging for the WTP could differ from the scenarios used in the construction noise model which has the potential to increase noise levels, however, noise impacts would not be expected due to the distance to the surrounding receivers.

Water transfer system construction impacts

Receivers along the water transfer system route would be subject to short-term elevated noise levels during pipeline trenching and construction. Short-term construction work will be typically easier to manage. The ICNG defines short term works as, *'Short-term means that the works are not likely to affect an individual or sensitive land use for more than three weeks in total.'* Average pipeline trenching productions rates are not known at this stage however typically for similar projects sensitive receivers are not be impacted for extended periods.

Pipeline trenching construction noise impacts would also be minimised as work would be undertaken mainly during standard construction hours. Work would be short term in duration and would move progressively along the proposal site, meaning that no one receiver would be impacted for an extended period of time.

Construction of the water transfer system is predicted to temporarily exceed the construction noise management level during standard construction hours at residences located within 650 metres of the construction works. These exceedances are predicted at the following locations:

- **Blackmans Flat:** Castlereagh Highway (1 receiver)
- **Lidsdale:** Duncan Street, Neubeck Street, Skelly Road, Wolgan Road (38 receivers)
- **Wallerawang:** Brays Lane, Castlereagh Highway (3 receivers)

Residential receivers located at Blackmans Flat were not included within the assessment as they are owned by Centennial Coal. Acquisition of the single receiver at Blackmans Flat predicted to exceed noise management level has been requested by Centennial Coal.

Noise impacts are not expected at Blackmans Flat Cemetery as the noise management level for passive recreation areas of 60 dBA is not predicted to be exceeded.

Feasible and reasonable construction noise and vibration mitigation measures have been recommended to manage noise and vibration during construction of the pipelines.

4.2.4 Sleep disturbance

All construction activity is expected to occur during recommended standard hours therefore sleep disturbance impacts are not expected.

4.2.5 Construction traffic impacts

The application notes[1] for the *Road Noise Policy* state that *"for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."* This is also considered to be applicable for construction noise therefore if road traffic noise increases from construction is within 2 dB(A) of current levels then the objectives on the *Road Noise Policy* are achieved.

A significant increase in traffic volumes would be needed in order to increase road traffic noise by 2 dB(A) (a doubling in traffic corresponds to an approximate 3 dB(A) increase).

Construction work on the WTP and pipeline would generate light and heavy vehicle movements associated with employees, deliveries, transportation of machinery, materials and equipment to work sites. Assessment of access routes and expected traffic volumes associated with construction of the WTP and pipeline are provided below.

Traffic for Water Treatment Plant Construction

Access to the WTP would be along Castlereagh Highway and Boulder road. The following traffic volumes are anticipated during construction:

- 25 light vehicles per day
- 10 heavy vehicles per day

The increase in vehicle movements would be limited to the period of construction. Noise level increases due to construction traffic would not be significant when compared with the existing vehicle numbers in the study area.

Traffic for Pipeline Construction

Access to the Newnes Plateau for light vehicles would be via State Mine Gully Road. For heavy vehicles, access would be via existing entries to Newnes State Forest along Chifley Road and Old Bells Line of Road. The Gravity Tank and pipeline construction sites would be accessed from Glowworm Tunnel and Beacroft Track.

Access to the pipeline route in the vicinity of Lidsdale and LDP009 would be along Castlereagh highway. The following traffic volumes are anticipated during pipeline operation:

- 8 light vehicles per day
- 8 heavy vehicles per day

Vehicle movements due to pipeline construction would be localised to the area of pipeline being constructed. Noise level increases due to construction traffic would not be significant when compared with the existing vehicle numbers in the study area.

Traffic required on local roads would be managed in accordance with a traffic management plan. This would be prepared by the contractor and would detail traffic routes for all traffic during the construction phase.

[1] http://www.environment.nsw.gov.au/noise/roadnoiseappnotes.htm 12 December 2012

4.3 Construction vibration

Assessment of vibration has been conducted to determine potential impacts with consideration to structural damage and human comfort criteria. Expected vibration generating activities include compaction during bulk earthworks at the WTP and the use of excavators during construction of the water transfer pipeline.

4.3.1 Vibration source levels

Typical vibration levels for vibration generating equipment associated with the Project are detailed in Table 4-4.

Table 4-4 Vibration generating equipment

Equipment	Peak particle velocity source level (mm/s)	Data reference
Compactor	5 to 7 at 10 m	*Environmental Noise Management Manual (RTA 2001)*
Dozer	2.5 to 4 at 10 m	
Backhoe	1 at 10 m	
Excavator	2.5 at 8 m	Tynan, A.E. *Ground Vibration Damaging effects to Buildings*, Australian Road Research Board 1973
Grader	2.5 at 8 m	

Energy from equipment is transmitted into the ground and transformed into vibration, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- the efficiency of the energy transfer mechanism of the equipment (i.e impulsive; reciprocating, rolling or rotating equipment)
- the frequency content
- the impact medium stiffness
- the type of wave (surface or body)
- the ground type and topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data. Typical rate of vibration attenuation can be calculated from the following regression analysis formula:

$V = kD^{-n}$, *where*

- *V = Peak Particle Velocity*
- *D = Distance*
- *k = site constant (if k is unknown, the site constant can be calculated from the other known parameters)*
- *n = site attenuation exponent*

The value of the site attenuation exponent, n, depends on the soil and ground type, *Construction noise and vibration impact on sensitive premises, Proceedings of Acoustics* (Roberts, 2009) suggests the following values for *n*:

- 1.4 for weak or soft soils such as loose soils, mud, loose beach sand, dune sand and ploughed ground
- 1.3 for competent soils such as most sands, sandy clays, gravel, silts and weathered rock

- 1.1 for hard soils such as dense compacted sand, dry consolidated clay and some exposed rocks
- 1.0 for hard competent rock such as bedrock and freshly exposed hard rock.

Lower values of *n* imply a more efficient vibration transmission rate. Hence, a conservative site attenuation exponent value of 1 has been assumed for this assessment.

4.3.2 Assessment of vibration impacts

Vibration levels at various distances from plant and equipment are provided in Table 4-5. Buffer distances to comply with the recommended vibration screening criteria (refer to Table 3-6) are presented in Table 4-6.

Human comfort impacts are dependent on the type of equipment operating and distance to construction works. For continuous vibration, the recommended screening criteria for human comfort are 1.0 mm/s during the day period.

Compaction activities only occur at the WTP site which is not near any residential receivers. All other activities are located within the human comfort buffer distances therefore no impacts are predicted during standard construction hours.

No vibration impacts are expected due to water transfer system construction activities as there are no receivers within the structural damage buffer distances.

Table 4-5 Typical vibration levels at distances

Equipment	Peak particle velocity (mm/s) at distance						
	10 m	20 m	30 m	40 m	50 m	100 m	200 m
Compactor (WTP site only)	7.0	3.5	2.3	1.8	1.4	0.7	0.4
Dozer	4.0	2.0	1.3	1.0	0.8	0.4	0.2
Backhoe	1.0	0.5	0.3	0.3	0.2	0.1	0.1
Excavator	2.0	1.0	0.7	0.5	0.4	0.2	0.1
Grader	2.0	1.0	0.7	0.5	0.4	0.2	0.1

Table 4-6 Vibration buffer distances to comply with recommended peak particle velocity screening criteria

Equipment	Human comfort buffer distance (m) Screening criteria 1 mm/s	Structural damage buffer distance (m) Screening criteria 5 mm/s
Compactor	70	15
Dozer	40	10
Backhoe	10	2
Excavator	20	5
Grader	20	5

4.4 Operational noise

The main sources of potential noise impacts during operation would be the WTP and the feed pump station. These potential impacts are assessed in the following section. Noise from operation of the raw water booster pump station within the Gravity Tank compound, located on Newnes Plateau, has not been assessed as there are no nearby sensitive receivers.

4.4.1 WTP operational noise

WTP Site layout

An indicative WTP site layout is shown in Figure 4-6. The UF/RO building has been modelled with a height of 8 metres. The adjacent structures located at Mt Piper Power Station have not been included in the noise model.

WTP noise generating equipment

Operational noise source on-site include the Feed Pump station and the RO systems inside the RO building. Sound power levels of the Feed Pump Station and the RO systems are provided in Table 4-7.

Pumps modelled for the UF/RO system are based on the following

- RO HP Pump: 45 kW
- RO Feed Pump: 22 kW
- CIP/Backwash Pump: 7.5 kW

The following shielding structures have been included in the noise model to predict operational noise levels:

- Ultrafiltration/Reverse Osmosis (UF/RO) Building
- Sludge handling facility
- Cooling towers
- Chemical handling facility
- Switch room

The RO building walls were modelled as 1 mm corrugated sheet steel with an R_w value of 25. The building was modelled with a height of 8 metres. The RO high pressure pump and RO feed pump were modelled inside this building and assumed to be operating simultaneously. Internal noise levels inside the RO building was calculated using German Standard *VDI 3760:1996 Computation and Measurement of Sound Propagation in Workrooms*.

A conservative operational noise model with external noise sources was also generated to predict the worse-case noise levels at the nearest sensitive receivers.

Table 4-7 Equipment sound power level, dBA

Equipment	SWL, dBA	Modelled source height (m)	Source
RO HP Pump	79.7	2	Grundfos
RO Feed Pump	86.3	2	Grundfos
CIP/Backwash Pump	86.3	2	Grundfos

4.4.1 Predicted WTP operational noise levels

The maximum predicted noise level during operation of the WTP with external pumps was approximately 8 dBA at the sensitive receivers located at Blackmans Flat. This is due to the low level of operational noise emissions from the WTP and the separation distance to the nearest residential receivers. Operational noise contours are provided in Figure 4-6.

Operational noise impacts were assessed under worse-case meteorological conditions for noise propagation. Operational noise from the WTP is predicted to be insignificant and not expected to cumulatively contribute to the ambient noise environment in the area.



Paper Size A3

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Sensitive Receiver
- Proposed WTP Layout
- Proposed WTP Boundary

Proposed Alignment

- Proposed mine water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline

dBA

35 40 45 50 55 60

Centennial Coal and EnergyAustralia
EA/CEY Water Treatment Project

Job Number 21-25109
Revision
Date 20 Jul 2016

Water treatment plant
Predicted operational noise levels, dBA

Figure 4-6

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4.5 Operational vibration

No operational vibration impacts at the identified sensitive receivers are anticipated as there are no operational vibration sources associated with the Project.

4.6 Operational road traffic noise

Operational work on the WTP and pipeline would generate light and heavy vehicle movements associated with employees and deliveries. Assessment of access routes and expected traffic volumes associated with operation and maintenance of the WTP and pipeline are provided below.

Traffic for water treatment plant operation

Access to the WTP would be along Castlereagh Highway and Boulder road. The following traffic volumes are anticipated during operation:

- 5 light vehicles per day
- 5 heavy vehicles per day

Noise level increases due to operation traffic would not be significant when compared with the existing vehicle numbers in the study area.

Traffic for pipeline operation

Light vehicle access for pipeline operation on Newnes Plateau would be via State Mine Gully Road. Heavy vehicle access would be via Chifley Road and Old Bells Line of Road. The Gravity Tank and pipeline alignments on Newnes Plateau would be accessed via Glowworm Tunnel Road and Beacroft Track.

Access to the pipeline route in the vicinity of Lidsdale and LDP009 would be along Castlereagh highway. The following traffic volumes are anticipated during pipeline operation:

- 10 light vehicles per day

Noise levels due to pipeline operation is not expected to be significant when compared with the existing traffic volumes.

Road traffic noise levels due to operation of the WTP and pipeline are not expected to increase traffic noise levels by more than 2 dBA and would not impact sensitive receivers near the traffic routes.

5. Mitigation measures

5.1.1 Construction mitigation measures

To protect the amenity of local residents of Lidsdale, Wallerawang and Blackmans Flat noise mitigation measures have been recommended to manage noise and vibration during construction of the pipeline.

For construction activities that are undertaken within the recommended standard construction hours (7am to 6pm Monday to Friday and 8am to 1pm Saturday) the work practices in Table 5-1 would be considered where feasible and reasonable where noise levels are predicted to exceed the construction noise management levels.

Table 5-1 Feasible and reasonable work practices

Construction noise and vibration mitigation measure	
Construction mitigation measures	Noise generating construction activities should be undertaken in accordance with the *Interim Construction Noise Guideline* (DECC, 2009). The standard hours for construction work should be in accordance with the Guideline: • 7:00 am – 6:00 pm Monday to Friday • 8:00 am – 1:00 pm Saturdays • no work on Sundays or Public Holidays. Work outside normal hours should only comprise: • the delivery of materials outside normal hours requested by police or other authorities for safety reasons • emergency work to avoid the loss of lives and/or property
	Residences predicted or measured to exceed the construction noise management levels should be notified as to the timing and duration of the construction works and provided with a contact phone number for any complaints or concerns during the construction period.
	Site inductions Inductions for the work crew would include the specific noise issues and mitigation measures required for the site. The induction would include: • all relevant Project specific and standard noise mitigation measures • relevant licence and approval conditions • permissible hours of work • location of any sensitive receivers that may exceed the construction noise management level • construction employee parking areas • designated loading/ unloading areas and procedures • site opening/closing times (including deliveries) • behavioural practices that minimise noise: • avoiding dropping materials from height and avoiding metal to metal contact on material.

Construction noise and vibration mitigation measure	
	The distance between plant and equipment and any sensitive receiver should be maximised where practicable.
	Vehicles, plant and equipment would be regularly maintained and kept in good operating condition. Machines found to produce excessive noise should be removed from site or stood down until repairs or modifications can be made.
	Plant should be turned off when not in use. For example, trucks should not be left idling if not operational.
Vibration	Should any buildings be identified that are located within the structural damage vibration buffer distances identified in Section 4.3.2, a property condition report should be prepared for the premises before and after undertaking the work. Compliance vibration monitoring should also be undertaken during high vibration generating activities where buildings are located within the structural damage buffer distances to confirm vibration criteria are not exceeded.

5.1.2 Operational mitigation measures

Operational noise levels are anticipated to comply with the noise criteria and no operational noise management measures are recommended.

6. Conclusion

Noise and vibration impacts for construction and operational phases of the Springvale Water Treatment Project has been assessed.

Noise from construction works at the WTP is predicted to comply with the construction noise management level at all receivers within the study area as the closest sensitive receivers are located approximately 2.3 kilometres east of the proposed WTP site.

Receivers along the pipeline route would be subject to short-term elevated noise levels during pipeline trenching and construction. Pipeline trenching construction noise impacts are proposed to be undertaken primarily on Newnes Plateau. However, if these activities are expected in Lidsdale then the work would be undertaken during standard construction hours to minimise noise impacts. Work would be short term in duration and would move progressively along the proposal site, meaning that no one receiver would be impacted for an extended period of time. Construction of the pipeline is predicted to temporarily exceed the construction noise management level during standard construction hours at residences located within 650 metres of the construction works. Feasible and reasonable construction noise and vibration mitigation measures have been recommended to manage noise and vibration during construction of the pipelines.

Vibration impacts on human comfort and structural damage have been assessed for construction of the pipeline and no impacts are expected.

Operational noise impacts were assessed under worse-case meteorological conditions for noise propagation. Operational noise from the WTP is predicted to be insignificant and not expected to cumulatively contribute to the ambient noise environment in the area.

Road traffic noise levels due to operation and construction of the WTP and pipeline are not expected to increase traffic noise levels by more than 2 dBA and would not impact sensitive receivers near the traffic routes.

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Appendix F Traffic and access

Springvale Coal Pty Ltd

Springvale to Mount Piper Water Treatment Project

Traffic Impact Assessment

August 2016

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The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 3 & 4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

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Appendix A – Traffic Count Data

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1. Introduction

1.1 Overview

Springvale Coal Pty Ltd (Springvale Coal) and EnergyAustralia NSW Pty Ltd (EnergyAustralia) are seeking consent for the Water Treatment Project (the Project). The Project involves the transfer of water from existing underground mine dewatering facilities for industrial reuse at Mount Piper Power Station (MPPS) to improve environmental outcomes and water quality within the upper Coxs River catchment. GHD Pty Ltd (GHD) was commissioned to prepare a Traffic Impact Assessment (TIA) for the Project.

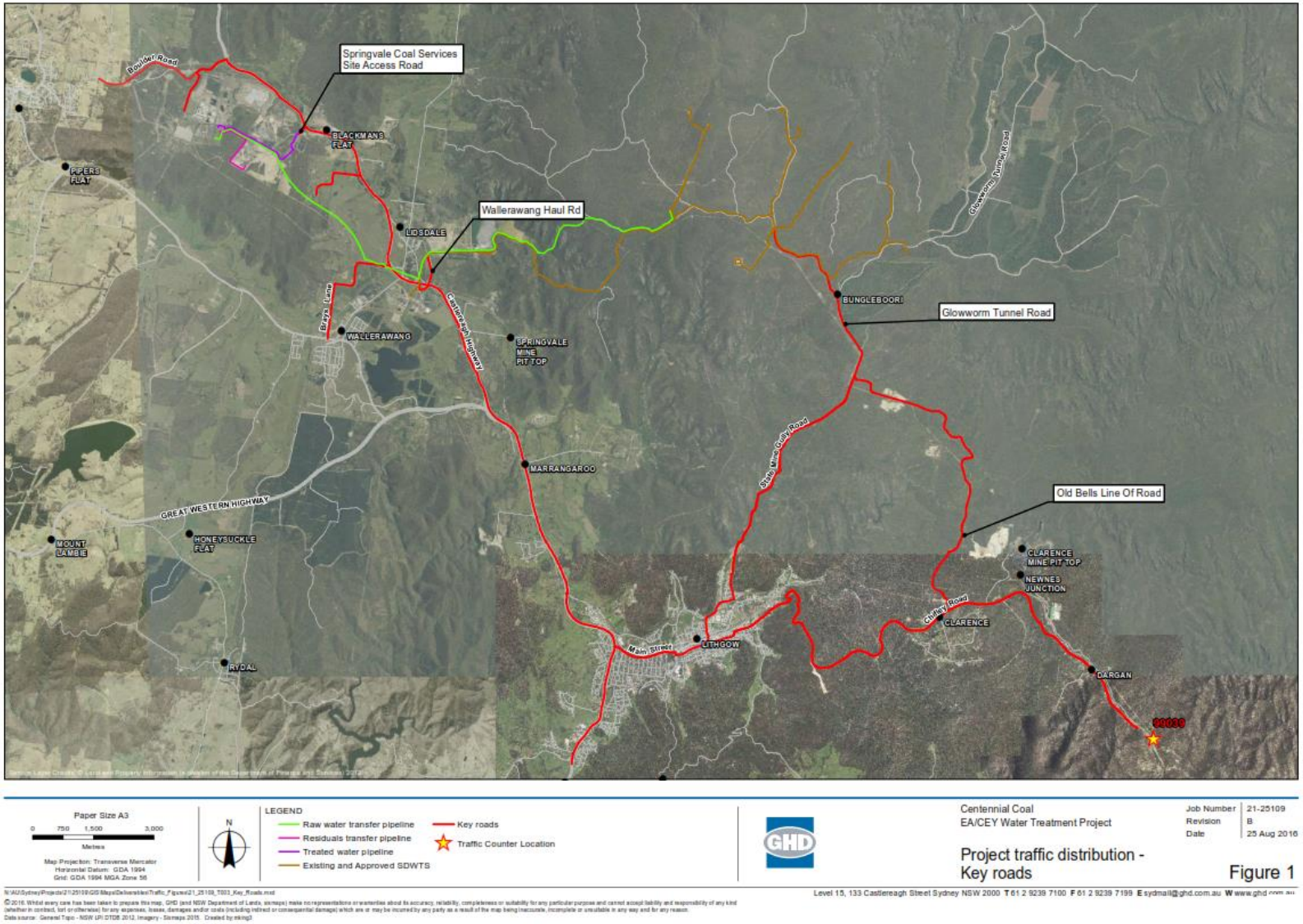
This assessment forms part of an Environmental Impact Statement (EIS) to support a State Significant Development (SSD) application for the Project under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This TIA has been prepared in accordance with relevant statutory conditions and the *Secretary's Environmental Assessment Requirements Application Number SSD 16_7592* (SEARs). It discusses the following:

- Existing conditions – a review of existing road features, adjacent developments, traffic volumes, sight distances and crash data;
- Project – provides details of the project and a review of additional traffic generated as a result of the construction works; and
- Traffic impact assessment – provides an assessment of the performance of the existing intersections (queues, delays, level of service, safety) during construction and operation of the site.

1.2 Study area/location of the Project

The Project is located at western coalfields near Lithgow and extends from the Newnes Plateau to the Mount Piper Power Station. Figure 1 provides the location of the Project in relation to the surrounding road network.

Figure 1 Local Road Network



1.3 Study assumptions and limitations

This report has been prepared by GHD for Springfield Coal Pty Ltd and EnergyAustralia Pty Ltd for inclusion into the EIS and may only be used and relied on by Springfield Coal Pty Ltd and EnergyAustralia Pty Ltd for the purpose agreed as set out in the EIS.

The report is based on information provided by Springfield Coal Pty Ltd and EnergyAustralia Pty Ltd in relation to expected proposed construction and operation activities and the associated expected traffic generation.

This study has been undertaken based on traffic count data provided from the following sources:

- Roads and Maritime Services traffic counts provided from the Roads and Maritime Traffic Volume Viewer website; and
- The *Springvale Mine Extension Project Traffic Impact Assessment* report (2013), prepared by ARC Traffic and Transport.
- The *Springvale Colliery Modification 1 Traffic Impact Assessment (2015),* prepared by ARC Traffic and Transport.

No additional traffic counts were undertaken for this study.

1.4 Secretary's Environmental Assessment Requirements

The following table provides an overview of the requirements for the traffic impact study by RMS and with respect to SEARS and the sections in the report where they have been addressed.

Table 1 Government Agency Requirements

Assessment requirements	Where addressed
For the construction of the treatment plant and associated infrastructure, road transport volumes and vehicle types broken down into:	
• *Origin and destination*	Section 1.1
• *Travel routes, including travel on both private and public roads*	Section 1.2, Section 4.2
• *Peak hours*	Section 2.3
The study is to provide details of projected transport operations including:	
• *Traffic volumes*	Section 4.1
• *Materials to be transported and vehicle types used for transport*	
• *Physical constraints on the haulage route*	Section 2.2
• *Access points to and from the Castlereagh Highway*	Section 4.2
• *Measures to be put in place to ensure a high level of safety for all road users interacting with construction traffic*	Section 4.4

Assessment requirements	Where addressed
Any over size and over mass vehicles and loads expected for the construction and operation of the project.	Section 2.3.2
Temporary and permanent staff numbers (including employees and contractors) and staff parking arrangements during construction and operation of the project.	Section 5.1

1.5 Report structure

Following this section, the report is structured as follows:

- Section 2 Existing conditions;
- Section 3 The proposal;
- Section 4 Construction traffic impact assessment;
- Section 5 Operational traffic impact; and
- Section 6 Summary and conclusions.

2. Existing conditions

This section outlines the existing conditions around the proposal including traffic conditions on roads in the vicinity of the site. This includes the existing transport and accessibility conditions and the existing road network performance.

2.1 Overview

Springvale Coal Pty Ltd (Springvale Coal) and EnergyAustralia NSW Pty Ltd (EnergyAustralia) are proposing the Water Treatment Project (the Project) to improve environmental outcomes and water quality in the Upper Coxs River catchment. The Project is located to the east of Portland and south of Castlereagh Highway.

The Project involves the establishment of a pipeline and ancillary facilities to transfer water from existing dewatering facilities on the Newnes Plateau for treatment and industrial reuse at Mount Piper Power Station (MPPS). A detailed description of the Project is provided in Chapter 5 of Volume 1 in the EIS.

Access to MPPS and the water treatment plant would be via Castlereagh Highway and Boulder Road. Access to the pipeline route in the vicinity of Lidsdale and the proposed new licensed discharge point would be along Castlereagh Highway and Boulder Road. Primary access to the Newnes Plateau for heavy vehicles would exclusively be via Chifley Road and Old Bells Line of Roads and light vehicles will use State Mine Gully Road.

2.2 Existing road network characteristics

This section provides an understanding of the existing road network surrounding the Project.

Roads are classified according to the functions that they perform. The main purpose of defining a road's functional class is to provide a basis for establishing the policies, which guide the management of the road according to their intended service or qualities. Functional road classification involves the relative balance of the mobility and access functions.

In terms of functional road classification, State roads are strategically important as they form the primary network used for the movement of people and goods between regions within Sydney, and throughout the State. State roads are the responsibility of the Roads and Maritime Services to fund, prioritise and carry out works. State roads generally include roads classified as Freeways, State Highways, and Main Roads under the *1993 Roads Act*, and the regulation to manage the road system is stated in the Australian Road Rules (1999).

NSW Roads and Maritime Services define four levels in a typical functional road hierarchy, ranking from high mobility and low accessibility, to high accessibility and low mobility. These road classes are:

- **Arterial Roads** – controlled by RMS, typically no limit in flow and designed to carry vehicles long distance between regional centres.
- **Sub-Arterial Roads** – can be managed by either council or RMS under a joint agreement. Typically, their operating capacity ranges between 10,000 and 20,000 vehicles per day, and their aim is to carry through traffic between specific areas in a sub region, or provide connectivity from arterial road routes (regional links).
- **Collector Roads** – provide connectivity between local sites and the-arterial road network, and typically carry between 2,000 and 10,000 vehicles per day.
- **Local Roads** – provide direct access to properties and the collector road system and typically carry between 500 and 4,000 vehicles per day.

2.2.1 Key roads

Key roads relevant to the Project include:

- Castlereagh Highway
- Boulder Road
- Main Street
- Chifley Road
- Old Bells Line of Road
- State Mine Gully Road / Glowworm Tunnel Road

2.2.2 Castlereagh Highway

Castlereagh Highway (Route No. B55) is a state highway forming part of the Great Western Highway that runs in a north-westerly direction from Marrangaroo to central NSW via Lidsdale. The proposed pipeline traverses Castlereagh Highway south of Lidsdale. Castlereagh Highway provides access to Boulder Road, which provides direct access to MPPS. Castlereagh Highway also provides direct access to several properties east of MPPS and Springvale Coal Services at Noon Street.

Castlereagh Highway has the following characteristics:

- Two-way sealed carriageway, undivided single lane highway in a rural environment;
- Double white continuous lines;
- Sealed shoulders between Boulder Road to approximately 150 m east of overpass over Castlereagh Highway and Coxs River approach to Lidsdale;
- Unsealed shoulders between approximately 150 m east of overpass over Castlereagh Highway to Coxs River;
- Default speed limit of 100 km/h; and
- Annual average daily traffic of 5,786 vehicles per day.

Figure 2 Castlereagh Highway viewed northwards towards Boulder Road



Source: Google Maps (2016)

2.2.3 Boulder Road

Boulder Road is a sub-arterial road that provides a link to Portland town centre from Castlereagh Highway. Boulder Road also provides access to MPPS in two locations.

Boulder Road has the following characteristics:

- Two-way sealed carriageway; predominately contains one lane in each direction and slip lanes where there is access provision to a side road, two lanes in each direction in the vicinity of the Mount Piper Power Station;
- Predominately broken white centrelines with double unbroken centreline at in the vicinity of a steep cliff along the side of the road;
- No road shoulders; and
- Sign posted speed limit of 60 km/h.

Figure 3 Boulder Road viewed northwards towards Castlereagh Highway



Source: Google Maps (2016)

2.2.4 Main Street

Main Street performs as a collector road that provides a link to the town of Lithgow from the Great Western Highway (A32). Main Street runs through the main business strip of Lithgow in a west to east direction and forms part of State Route 59 as it connects to Chifley Road via Mort Street.

Main Street generally has the following characteristics:

- Two-way sealed carriageway with lanes in each direction;
- Solid white centrelines;
- Sealed road shoulders with available on-street parking in select locations;
- Sign posted speed limit of 50 km/h,
- 40 km/h during school hours between Rifle Parade and Academy St in the vicinity of Cooerwull Public School;
- Passes through the business strip of Lithgow.

Figure 4 Main Street viewed westwards towards Great Western Highway



Source: Google Maps (2016)

2.2.5 Chifley Road

Chifley Road is a continuation of the Bells Line of Road which is a sub-arterial road which runs from North Richmond on the north-western outskirts of Sydney to Bell (at the intersection with the Darling Causeway). At this point the road becomes Chifley Road which then travels through the locality of Clarence into Lithgow on the western side of the Blue Mountains. Chifley Road provides a link to Newnes Junction from Lithgow via Clarence.

Chifley Road has the following characteristics:

- Two-way sealed carriageway with one lane in each direction;
- Predominately broken white centreline, but double unbroken line in large bend locations;
- No road shoulders; and
- Sign posted speed limit of 80 km/h eastwards and 60 km/h westwards.

Figure 5 Chifley Road viewed eastwards towards Newnes Junction



Source: Google Maps (2016)

2.2.6 Old Bells Line of Road

Old Bells Line of Road extends from Chifley Road at Clarence and provides access to the Newnes State Forest. Old Bells Line of Road is a well maintained gravel road, which provides primary access for large logging vehicles and heavy vehicles accessing the existing mine dewatering facilities on the Newnes Plateau. Old Bells Line of Road has the following characteristics:

- Unsealed / gravel road, which is approximately 5.5 m wide; and
- Suitable for two-way traffic

2.2.7 State Mine Gully Road / Glowworm Tunnel Road

State Mine Gully Road is a road that provides access to the Newnes State Forest from the north of Lithgow. Glowworm Tunnel Road is a continuation of State Mine Gully Road to the north of where it forms a T-intersection with Old Bells Line of Road. Glowworm Tunnel Road provides access to the Newnes Plateau.

State Mine Gully Road has the following characteristics:

- Sealed road extending north for approximately 1.5 km;
- No line-marking; and
- Suitable for two-way traffic.

Glowworm Tunnel Road has the following characteristics:

- Unsealed / gravel road, which is approximately 4 m wide; and
- Suitable for two-way traffic.

2.2.8 Mayinygu Marragu Trail

Mayinygu Marragu Trail forms a priority controlled T-intersection with Glowworm Tunnel Road, near Bungleboori, and then continues to the north-west.

Mayinygu Marragu Trail has the following characteristics:

- Unsealed / gravel road, which is approximately 5.5 m wide.

2.2.9 Access Tracks

There are a number of minor access tracks located off Mayingu Marragu Trail and Glowworm Tunnel Road. Some of these tracks have been upgraded to provide access to the existing mine dewatering infrastructure as a result of previous projects in Newnes Plateau.

The tracks are around five metres wide and include a track from Maiyingu Marragu Trail, a track located north of Glowworm Tunnel Road and a track located south of Glowworm Tunnel Road. The latter two tracks were constructed to provide access to bores for a previous mining project in Newnes Plateau.

2.2.10 Sunnyside Road

Sunnyside Ridge Road is a forestry road that runs from the intersection with Maiyingu Marragu Trail to the north-west of a service bore. Sunnyside Ridge Road has the following characteristics:

- Unsealed carriageway, which is approximately 6 m wide.

2.3 Existing road network performance

This section provides an understanding of current traffic volumes.

2.3.1 Existing daily and peak hour traffic

Traffic count data was obtained from the following sources:

- NSW Roads and Maritime Services Traffic Volume Viewer website;
- *Springvale Extension Project Traffic Impact Assessment* report (2013) prepared by ARC Traffic and Transport; and
- The *Springvale Colliery Modification 1 Traffic Impact Assessment* (2015), prepared by ARC Traffic and Transport.

Castlereagh Highway

Traffic count data for the Castlereagh Highway was obtained from the *Springvale Colliery Modification 1 Traffic Impact Assessment* (2015), prepared by ARC Traffic and Transport. The peak hour and daily traffic volumes are summarised in Table 2, with a copy of the traffic count data provided at Appendix A.

Table 2 2013 surveyed traffic volumes

Location	AM Peak Hour (vph)		PM Peak Hour (vph)		Daily* (vpd)
	Northbound	Southbound	Northbound	Southbound	
Castlereagh Highway	141	264	225	269	5,786

*Note: *Vpd - Vehicles per day*

Chifley Road

Traffic volumes for Chifley Road were obtained from the NSW Roads and Maritime Services Traffic Volume Viewer website (counter station ID 99037, located approximately 190 m north of Darling Causeway in Bell). The traffic volumes provided are four hour volumes. The 2009 peak hour and daily traffic volumes are summarised in Table 3, assuming the peak hour volumes are a third of the peak four hour volumes, for a conservative assessment.

Table 3 2009 surveyed traffic volumes – Station ID 99037

Location	AM Peak (vph)		PM Peak (vph)		Daily* (vpd)
	Eastbound	Westbound	Eastbound	Westbound	
Chifley Road Period – 4 hour	211	451	372	581	3,059
Chifley Road Period – peak hour	70	150	124	194	

*Note: *Vpd - Vehicles per day*

Newnes State Forest Roads

Traffic count data for the roads within the Newnes State Forest area was obtained from the *Springvale Extension Project Traffic Impact Assessment* report (2013) prepared by ARC Traffic and Transport. This traffic data was surveyed in 2011 during the mid-year school holiday break, using automatic traffic counters.

A summary of the surveyed peak hour and daily traffic volumes is provided in Table 4. The peak hour traffic volumes along these roads are low, with less than 100 two-way traffic movements during peak hours.

Table 4 2011 surveyed traffic volumes

Location	AM Peak Hour (vph)	PM Peak Hour (vph)	Daily* (vpd)
Mine Access Road	13	88	523
Old Bells Line of Road	12	11	104
Glowworm Tunnel Road	9	12	91
Sunnyside Ridge Road	6	5	39

*Note: *Vpd - Vehicles per day*

Based on the existing traffic volumes shown in Table 2, Table 3 and Table 4, all roads within the study area are within expected functional classification as outlined in Section 2.2.

2.3.2 Heavy and light vehicle ratio

Based on 2013 traffic count data from *Springvale Colliery Modification 1 Traffic Impact Assessment* (2015), the heavy vehicle (HV) and light vehicle (LV) usage percentage for the Castlereagh Highway in the study area is shown in Table 5.

Table 5 Heavy vehicle proportion (2013 count data)

Location	LV* %	HV* %
Castlereagh Highway	87%	13%

The most recent available data for the proportion of heavy vehicles at Chifley Road was for 2006. It should be noted that no heavy vehicle count data was available for the 2009 traffic counts. The heavy vehicle percentage for Chifley Road in the study area is shown in Table 7

Table 6 Heavy vehicle proportion (2006 count data) – Station ID 99037

Location	LV* %	HCV* %
Chifley Road	98%	2%

The proportion of heavy vehicles and light vehicles on the access roads within the Newnes State Forest are summarised in Table 9, based on 2011 surveyed traffic data provided from the *Springvale Extension Project TIA* report (2013). Old Bells Line of Road was found to have the highest heavy vehicle proportion, with 38 percent of survey vehicles being heavy vehicles. However, the traffic count data in Table 4 indicates that only 104 vehicles per day were surveyed along Old Bells Line of Road.

Table 7 Heavy vehicle proportion (2011 count data)

Location	LV* %	HCV* %
Old Bells Line of Road	62%	38%
Glowworm Tunnel Road	68%	32%
Sunnyside Ridge Road	79%	21%

2.3.1 Midblock Level of Service Criteria

Roads are to be assessed based with reference to their general traffic caring capacity and traffic demands. Table 4.5 of the Roads and Maritime *Guide to Traffic Generating Developments* (2002) sets out two-way hourly road capacities for two-lane roads for different levels of service, with a design speed of 100 km/hr, based on different terrain types. The capacity assumes a 60/40 directional split of traffic.

The level of service criteria is shown in Table 8. Roads and Maritime generally require Level of Service (LoS) C operations for major roads during weekday peak hours and LoS D for weekend / recreational periods.

Where design speeds of 80 km/hr are used, the resulting capacities are between 85-95% of the figures quoted, depending on the level of service. peak hour flow on two-lane rural roads (veh/hr) (Design speed of 100 km/hr).

Table 8 Peak Hour Flow on two-lane rural roads (veh/h) – Design speed of 100 km/h

Terrain	Level of Service	Percent of Heavy Vehicles			
		0	5	10	15
Level	B	630	590	560	530
	C	1030	970	920	870
	D	1630	1550	1480	1410
	E	2630	2500	2390	2290
Rolling	B	500	420	360	310
	C	920	760	650	570
	D	1370	1140	970	700
	E	2420	2000	1720	1510
Mountainous	B	340	230	180	150
	C	600	410	320	260
	D	1050	680	500	400
	E	2160	1400	1040	820

Source: Roads and Maritime Guide to Traffic Generating Developments (2002)

The LoS criteria shown in Table 8.is based on conditions which are generally represented along the Castlereagh highway, including

- A 60 / 40 split of traffic during peak periods;
- Level terrain;
- Wide traffic lanes with shoulders / side clearances of at least 2 metres in width

Based on the traffic count data provided in Table 2 and Table 5 and the LoS criteria shown in Table 8, the Castlereagh Highway has the.

- Los B during the AM peak with 405 two-way traffic movements and 13 percent heavy vehicles
- Los C during the PM peak with 674 two-way traffic movements and 13 percent heavy vehicles

The above analysis indicates that the current traffic volumes along the Castlereagh Highway operates within the Roads and Maritime recommended operating performance standards.

2.4 Crash analysis

Crash history data for the five-year period from 2009 to 2013 was obtained from Transport for NSW for the study area.

Castlereagh Highway

The section of the Castlereagh Highway between Boulder Road and Wolgan Road is one of the areas of interest and the data is summarised as follows:

There were seven crashes recorded over this section, of these:

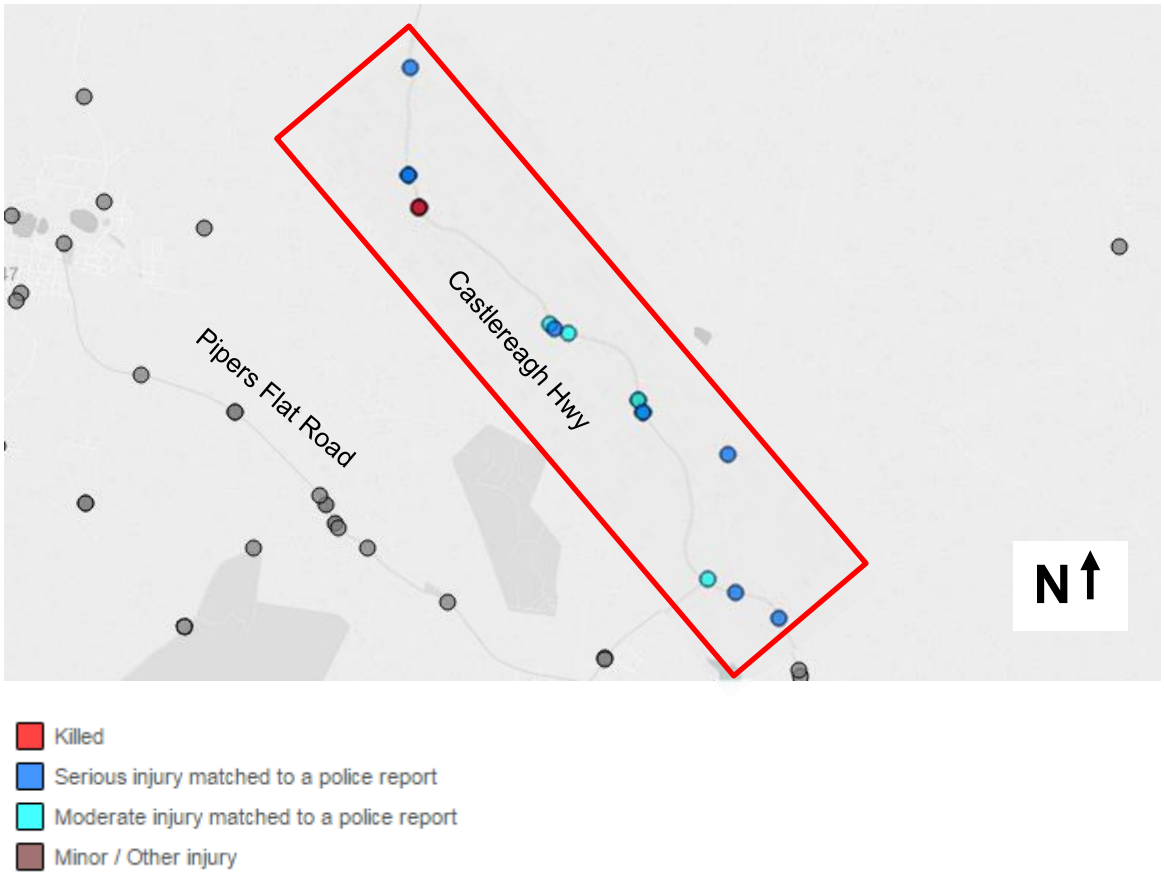
- One (14%) resulted in a fatality;

- Six (86%) resulted in injuries;
- Two (29%) were considered serious injuries;
- Four (57%) were considered moderate injuries; and
- No minor injuries were recorded during this period.

Crashes were fairly scattered along the section of the highway as can be seen in Figure 6. A review of the crash data found the following:

- There were two locations observed which had a concentration of accidents, including.
  - at the bend in the road to the north of Springvale Coal Services (the location of an access road forming an intersection with Castlereagh Highway) to the west of Noon St. Three accidents resulting in moderate to major injuries.
  - to the south of View Street, where two crashes were recorded, which resulted in moderate and major injuries.
- The crash resulting in the fatality occurred at the intersection of Castlereagh Highway and Boulder Road.
- The crash observed at the intersection of Castlereagh Highway and Main Street resulted in a moderate rated injury.
- The general trend shows that the majority of crashes occurred at and around intersection locations.

Figure 6 Crash locations - MPPS study area between 2009 and 2013



Source: Transport for NSW, NSW crash data (2015) – Modified by GHD

Chifley Road

The section of Chifley Road east of Lithgow town centre and Clarence town centre is the second area of interest and the data, shown in Figure 7, and summarised as follows:

There were 23 crashes recorded over this section, of these:

- No crashes (0%) resulted in fatalities;
- 17 (74%) resulted in injuries;
- Seven (30%) resulted in serious injuries;
- 11 (48%) resulted in moderate injuries;
- Six (26%) resulted in minor / other injuries.

There were a high number of crashes clustered in within the western section of Chifley Road. These incidents appear to have occurred near hairpin and road bend locations. In this location, 16 crashes were recorded over the five-year period.

It was also noted that the majority of these accidents resulted in a serious injury. Current traffic calming measures include advisory speed reduction signs and chevron signs through the road bends. The signposted recommended speed through these bends in the road is 35 km/h.

Elsewhere, crashes generally occurred at separate locations dispersed along Chifley Road. These generally occurred at bends in the road, rather than along straight sections of road. The bends in these areas consist of a larger turning radius than the locations of the hairpin-like turns where a number of crashes were observed.

The general trends in this study section shows that crashes happened in curved road segments.

Figure 7 Crash locations - Pipeline study area between 2009 and 2013



Source: Transport for NSW, NSW crash data (2015) – Modified by GHD

Newnes State Forest Roads

Crash data analysis from the *Springvale Mine Extension Project Traffic Impact Assessment* report (2013) indicates that between 2006 and 2011, a total of 16 accidents were recorded along roads within the Newnes State Forest. All of these crashes resulted in injuries, with no fatalities recorded. The report concluded that speed was a factor resulting in the accidents.

Of the crashes recorded during this period:

- Eight crashes occurred on the Old Bells Line of Road, including four to the north of Chifley Road;
- Two crashes were recorded along Glowworm Tunnel Road; and
- One crash was reported on the Maiyingu Marragu Trail, west of the Bungleboori picnic area.

A map showing the crash locations within the NCF is provided at Appendix B.

2.5 Public transport

2.5.1 Bus routes

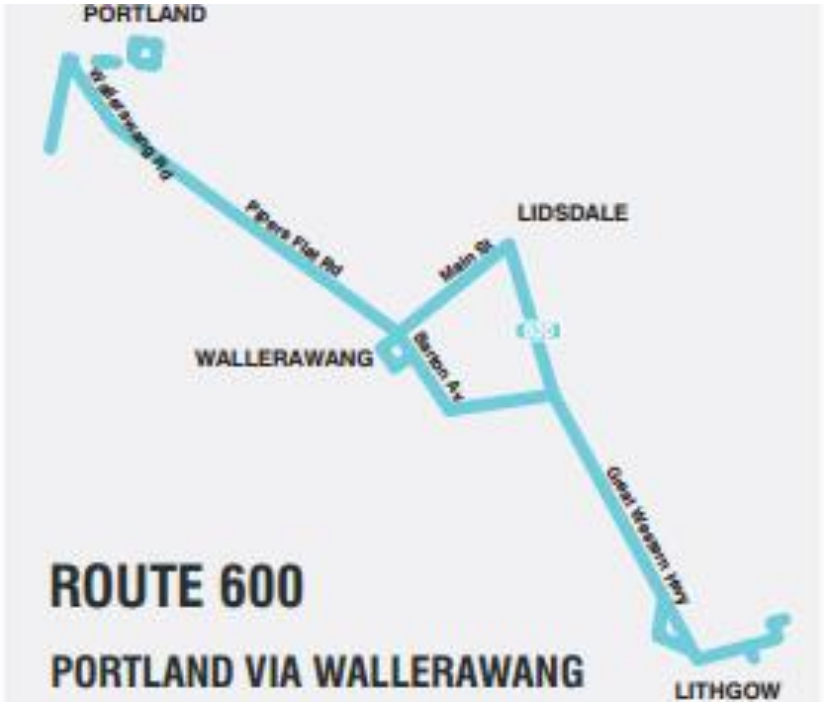
Buses that service this area are a part of the Lithgow Buslines bus service network. Two bus routes service this area. They are the route no. 600 and route no. 636.

Bus route No. 600 travels between Lithgow to Portland via Wallerawang. A diagrammatic map of the route is provided below in Figure 8.

There is approximately one bus service operating every hour from Monday to Friday between 6:30 AM and 6:30 PM. Only two services complete a return trip from Lithgow and back. There are two services on Saturdays, the AM service starts in Lithgow and ends in Portland at the RSL Club stop. The PM service starts at the RSL Club stop in Portland and goes the opposite way.

A copy of the Route no. 600 timetable is provided in Appendix C.

Figure 8 Route 600



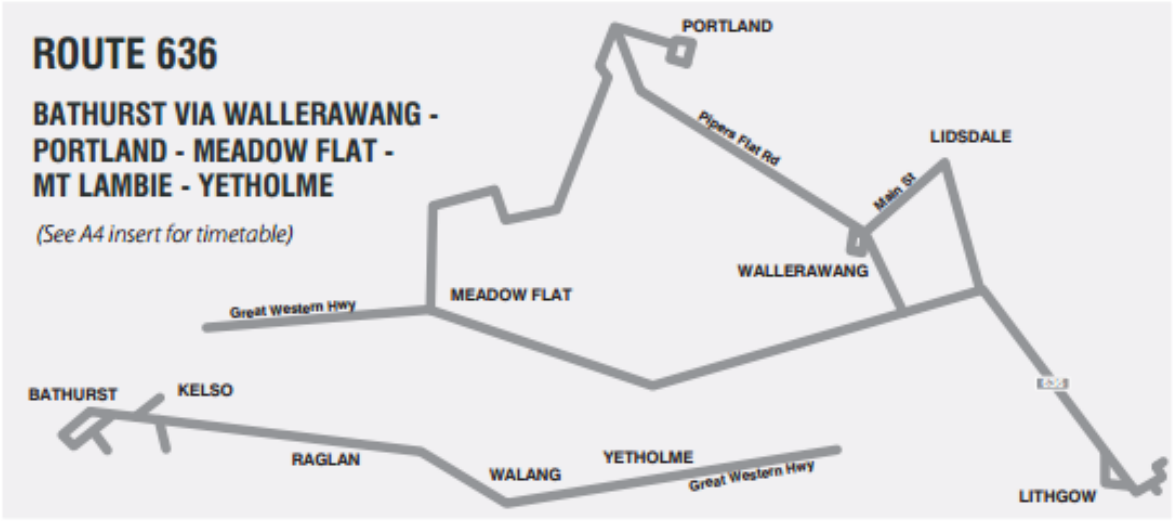
Source: http://www.buslinesgroup.com.au/images/pdf/lithgow/Lithgow.pdf

Bus route No. 636 travels between Bathurst to Lithgow and return. A diagrammatic map of the route is provided below in Figure 9.

There are six services between Lithgow and Bathurst from Monday to Friday made up from three services each way. There is one service in the AM period (7:00 AM to 11:00 AM) starting in Lithgow, arriving in Bathurst and return to Lithgow. In the PM period (1:30 PM to 6:30 PM) there are two services with similar stop destinations to the AM period, that is, starting in Lithgow, arriving in Bathurst and return to Lithgow. There are several stops along the route that are not serviced.

A copy of the Route no. 636 timetable is provided in Appendix C.

Figure 9 Route 636



Source: http://www.buslinesgroup.com.au/images/pdf/lithgow/Lithgow.pdf

2.6 Key findings

The existing traffic volumes on the roads within the study area are within their expected functional road classifications.

The crash analysis demonstrated that while crashes are generally spread out along the construction access routes, there were two locations where crashes were concentrated in a localised area. There were no recorded crashes at the intersection of Boulder Road and the MPPS access.

3. The project

3.1 Project overview

Springvale Coal and EnergyAustralia are proposing to construct the Water Treatment Project (the Project), to improve environmental outcomes and water quality in the Upper Coxs River catchment. The Project involves establishing a pipeline and ancillary facilities to transfer water from the existing dewatering facilities on the Newnes Plateau for treatment and reuse at Muont Piper Power Station.

Traffic movements on the local road network will temporarily increase during the construction phase of the works and will reduce back to only those movements required for maintenance and operational purposes at the completion of the construction phase.

3.2 Proposed construction timeframe

The construction of the water transfer system (pipelines and associated infrastructure) is expected to be undertaken over a 12 month period. Construction of the water treatment plant is expected to be undertaken concurrently, over an 18 month period. The crystalliser has a longer lead time and construction of the crystalliser is expected to take a further 12 months, following completion of construction of the water treatment plant.

3.3 Construction hours

Construction hours are to be consistent with recommended construction hours and are likely to be between 7 am and 6 pm on weekdays and between 8 am and 1 pm on Saturdays. No construction activities would occur on Sundays or public holidays. The recommended standard construction hours are shown in Table 9.

Table 9 Recommended standard hours for construction work

Work Type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

Source: Interim Construction Noise Guideline, Department of Environmental & Climate Change NSW (2009)

**The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.*

4. Construction traffic impact assessment

This section assesses the impacts on the local road network as a result of the construction works associated with the Project.

4.1 Projected traffic generation

Construction hours at the sites are expected to be between 7 am and 6 pm for Monday to Friday and between 8 am and 1 pm on Saturdays (as per Section 3.3). It is assumed that construction workers would arrive and depart based on the hours of construction, which results in the following assumed peak hours

- Weekday AM peak hour between 6 am to 7 am;
- Weekday PM peak hour between 6 pm to 7 pm;
- Weekend AM peak hour between 7 am and 8; and
- Weekend PM peak hour between 1 pm and 2 pm.

It is also assumed that vehicles associated with the transportation of materials would be spread-out throughout the day. To assess the peak hour trips, it has been assumed for a conservative assessment that 20 percent of the trucks transporting materials would arrive and depart in the peak hour and that construction workers would arrive in the AM peak and depart in the PM peak.

The number of proposed construction vehicle movements would depend on the final design and method of construction. However, the expected worst case daily movements for the construction of the mine water transfer system are estimated to be approximately:

- Four heavy vehicles accessing the site per day during the construction period – resulting in eight heavy vehicle movements per day
- Four light vehicles accessing the site per day during the construction period – resulting in eight light vehicle movements per day

The projected traffic generation for the proposal during the construction period of the mine water transfer system is summarised in Table 10.

Table 10 Traffic generation during construction (mine water transfer system construction)

Activity	AM Peak (vtph*)		PM Peak (vtph*)		Daily (vtpd**)	
	In	Out	In	Out	In	Out
Light vehicles	4	0	0	4	4	4
Heavy vehicles	1	1	1	1	4	4
TOTAL	***5***	***1***	***1***	***5***	***8***	***8***

Notes: *1. *(vtph) - vehicles trips per hour*
*2. **(vtpd) – vehicle trips per day*

The expected worst case daily traffic movements for the construction of the water treatment plant is estimated to be approximately:

- Ten heavy vehicles accessing the site per day during the construction period – resulting in 20 heavy vehicle movements per day.
- 25 light vehicles accessing the site per day during the construction period – resulting in 50 light vehicle movements per day.

The projected traffic generation for the proposal during the construction period of the water treatment plant is summarised in Table 11.

Table 11 Traffic generation during construction (water treatment plant)

Activity	AM Peak (vtph*)		PM Peak (vtph*)		Daily (vtpd**)	
	In	Out	In	Out	In	Out
Light vehicles	25	0	0	25	25	25
Heavy vehicles	2	2	2	2	10	10
TOTAL	***27***	***2***	***2***	***27***	***35***	***35***

4.2 Traffic distribution

Based on the expected access routes and for a worst-case assessment, it has been assumed that vehicles will travel to / from the A32 Great Western Highway to the various sites.

Newnes Plateau

In relation to the Newnes Plateau, it has been assumed that light vehicles will travel to / from the Great Western Highway to the site via Main Street, Lithgow Street, Mort Street, Bridge Street and State Mine Gully Road / Glowworm Tunnel Road. Heavy vehicles will be travelling to / from the site via Chifley Road and Bells Line of Roads. Traffic movements associated with the Project is shown in Figure 10.

MPPS

To access the MPPS and water treatment plant site, it has been established that the vehicles will be accessing the site via the B55 Castlereagh Highway and Boulder Road. Both light and heavy vehicles will be travelling via the same route. These traffic movements are shown in Figure 11.

Pipeline Installation

Consideration of the period of installation of the pipeline between LDP009 and MPPS water treatment plant location has also been made as part of this assessment. During this time, construction vehicles (both light and heavy vehicles) associated with the mine water transfer system would access the construction site from Wallerawang Haul Road,Karawatha Drive, Brays Lane and Springvale Coal Services Site Access Road via Castlereagh Highway.

During this construction period, there would be traffic accessing the MPPS and the Pipeline Installation along the Castlereagh Highway. This construction period therefore represents the worst case period in terms of construction vehicles along the Castlereagh Highway.

Figure 10 Project traffic distribution – Newnes Plateau mine water transfer site



Source: Google Maps (2016) - modified by GHD

Figure 11 Project traffic distribution – MPPS and water treatment plant site



Source: Google Maps (2016) - modified by GHD

4.3 Mid-block assessment

During peak delivery of materials to the sites, it is expected that the proposal would generate an additional 16 and 70 vehicle movements per day for the pipeline and water plant sites respectively. The increase in traffic volumes are shown in Table 10 and Table 11.

Daily traffic volumes

Table 12 provides a summary of the expected percentage increase in daily traffic at each of the key roads within the study area as a result of the Project. The assessment has also considered the construction period where the installation of the pipeline between LDP009 and MPPS water would occur. This scenario provides a worst case assessment for construction traffic along the Castlereagh Highway, with construction vehicles associated with both the MPPS water treatment plant and pipeline construction accessing construction sites from the Castlereagh Highway.

Table 12 Expected traffic increase- daily traffic volumes (two-way)

Location	Existing Traffic (vpd)	Existing + Proposal Traffic (vpd)	Increase in Traffic (vpd)	Percentage Increase in Traffic	Vehicles per day (capacity)
Castlereagh Highway	5,786	5,856	70	1%	50,000+
Castlereagh Highway*	5,786	5,872	86	2%	50,000+
Chifley Road	3,059	3,075	16	1%	10,000 – 20,000
Old Bells Line of Road	104	112	8	8%	500 – 4,000
Glowworm Tunnel Road	91	99	8	9%	500 – 4,000
Sunnyside Ridge Road	39	47	8	20%	500 – 4,000

**This scenario takes into account the worst case assessment for Castlereagh Highway, with construction vehicles associated with mine transfer system and the pipeline installation near LDP009.*

Table 12 indicates that the Project would result in an increase in traffic of up to two percent along Castlereagh Highway and Chifley Road during peak construction periods. This small increase in traffic is considered minimal and would fall within typical daily traffic variations.

A higher percentage increase in traffic is expected along the roads within the Newnes State Forest Roads, with an increase of up to 20 percent along Sunnyside Ridge Road. However, these roads have very low surveyed traffic volumes, with around 100 vehicles per day or less accessing these roads. The results indicate that the roads will continue to operate with spare capacity in both the AM and PM peak periods. As these roads operate with spare capacity, it is expected that any cumulative traffic impacts with local forestry operations and/or projects in the area would be accommodated.

Based on this analysis, the project would have acceptable impacts to the daily traffic volumes along the roads within the Study Area. It is expected that all roads would continue to operate well within their functional classification.

Peak hour traffic volumes

A summary of the AM and PM peak hour percentage increase in traffic along the key construction traffic routes in the study area are provided in Table 13 and Table 14.

The Castlereagh Highway is a two-lane two-way highway road (one lane per direction). The Highway Capacity Manual (HCM) 2000 states that the capacity of a two-lane highway is 3,200 passenger cars per hour (pc/h) for both directions of travel combined. For the purposes of this assessment, it has been assumed that the capacity of Chiefly Road is around 900 vehicles in each direction, with a capacity of around 500 vehicles in each direction along the other roads.

Similar to the daily midblock assessment, the expected increase in peak hour traffic along the Castlereagh Highway and Chifley Road is up to nine percent.

The higher percentage increase for the Newnes State Forest Roads, is a result of the current low traffic volumes along these routes, with up to 14 two-way traffic movements along these roads during the peak hour. The small increase in traffic resulting from the proposal is also expected to have minor traffic impacts to these roads.

As mentioned earlier in the report, this expected increase in traffic will only be for the duration of the construction period.

Table 13 Expected traffic increase- AM peak hour volumes (two-way)

Location	Existing Traffic (vph)	Existing + proposal Traffic (vph)	Increase in Traffic (vph)	Percentage Increase in Traffic	Capacity Vehicles per hour (total)
Castlereagh Highway	405	434	29	7%	3,200
Castlereagh Highway*	405	440	35	9%	3,200
Chifley Road	221	223	2	1%	1,800
Old Bells Line of Road	12	14	2	17%	1,000
Glowworm Tunnel Road	9	13	4	44%	1,000
Sunnyside Ridge Road	6	8	2	33%	1,000

**This scenario takes into account the worst case assessment for Castlereagh Highway, with construction vehicles associated with mine transfer system and the pipeline installation near LDP009.*

Table 14 Expected traffic increase – PM peak hour volumes (two-way)

Location	Existing Traffic (vph)	Existing + proposal Traffic (vph)	Increase in Traffic (vph)	Percentage Increase in Traffic	Capacity Vehicles per hour (total)
Castlereagh Highway	674	703	29	4%	3,200
Castlereagh Highway*	674	709	35	5%	3,200
Chifley Road	194	196	2	1%	1,800
Old Bells Line of Road	11	13	2	18%	1,000
Glowworm Tunnel Road	12	16	4	33%	1,000
Sunnyside Ridge Road	5	7	2	40%	1,000

**This scenario takes into account the worst case assessment for Castlereagh Highway, with construction vehicles associated with mine transfer system and the pipeline installation near LDP009.*

Midblock Level of Service Assessment

- Based on the forecast peak hour traffic volumes provided in Table 13 and Table 14 and the LoS criteria shown in Table 8, the Castlereagh Highway is forecast to operate at:
  - Los B during the AM peak with 405 two-way traffic movements and 13 percent heavy vehicles; and
  - Los C during the PM peak with 709 two-way traffic movements and 13 percent heavy vehicles.

  The above analysis indicates that the Castlereagh Highway would continue to operates within the Roads and Maritime recommended operating performance standards.

4.4 Mitigation measures

The following mitigation measures are recommended for the Project and implemented for the construction lifecycle:

- A Construction Traffic Management Plan (CTMP) will be developed to address the following:
  - Management and timing of heavy vehicles on Main Street and Mort Street;
  - Strict speed limits for Project vehicles in line with Forestry Corporation NSW (FCNSW) 60 km/h requirement in the Newnes State Forest in the absence of speed signs on the various access tracks;
  - Designated access routes for heavy vehicles to be clearly highlighted and adhered;
  - Strict compliance with the safety, signage and access requirements as outlined in the Roads and Maritime *Traffic Control at Worksites* for the Project site
  - Clear and separate guidelines for the event of adverse weather conditions
- The CTMP will address the timing of trucks accessing the site to ensure there is sufficient room within the site to accommodate the vehicles.
- Consultation will be undertaken with the Cooerwull Public School and Lithgow Public School to inform them of the construction program and access route (via Main Street).
- The contractor is advised to restrict heavy vehicle movements to and from the proposal within the schools' drop off and pick up times (8 am – 9:30 am and 2:30 pm – 4 pm).

4.5 Key findings

Construction activities would occur over a two-and-a-half-year period.

Based on the current program, the construction at the water treatment plant site will take eighteen months and the installation of the crystalliser is to take a further twelve months.

During the peak construction period there would approximately be eight construction vehicles accessing the site generating 16 vehicle movements per day at the Newnes Plateau pipeline construction site. At the MPPS construction site, 35 vehicles would be accessing the site generating 70 vehicle movements per day.

The assessment has also considered the construction period where the installation of the pipeline between LDP009 and MPPS water would occur. This scenario provides a worst case assessment for construction traffic along the Castlereagh Highway, with construction vehicles associated with both the MPPS water treatment plant and pipeline construction accessing construction sites from the Castlereagh Highway.

The Castlereagh Highway is expected to continue to operate within the Roads and Maritime recommended operating performance standards, at LoS B during the weekday AM peak and LoS C during the weekday PM peak.

A CTMP specific to the site will be developed to manage potential conflicts between the day-to-day construction traffic and general traffic. The CTMP should also address the management of all vehicles associated with the project site.

5. Operational traffic impacts

5.1 Operation of the Project

It is expected that there will be less than 10 heavy vehicle trips per week (vtpw) generated from the day-today operation of the water treatment plant.

Currently the existing operational traffic to the MPPS is 290 staff per day. The expected additional traffic movements during the operation of the Project would be:

- Five heavy vehicles per week accessing the water treatment plant for delivery purposes – resulting in ten heavy vehicle movements per week; and
- Five light vehicles per day accessing the water treatment plant– resulting in ten light vehicle movements per day

These vehicle volumes are less than those expected to be generated during the construction phase of the Project. Approximately five light vehicles and one heavy vehicle per day are predicted during the operational phase.

5.2 Key findings

The Project would generate a low number of additional operational vehicles that would access the water treatment plant and this is deemed to not pose a constraint to the existing site access and impact upon local road users.

6. Summary and conclusions

The following key findings were identified as part of this traffic assessment:

6.1 Existing situation

- The existing traffic volumes on the surrounding road network are within the expected functional classification outlined by RMS.
- Review of the crash history for the surrounding roads indicated that generally crashes were spread along the roads. However, the analysis indicates that there are some locations with crash clusters, including at some intersections on the Castlereagh Highway and tight bends in the road along the Chifley Road construction access route.

6.2 Construction traffic impact

During the peak construction period there would approximately be eight construction vehicles accessing the site generating 16 vehicle movements per day at the Newnes Plateau for construction of the mine water transfer system.

At the water treatment plant construction site, 35 vehicles would be accessing the site generating 70 vehicle movements per day.

The assessment has also considered the construction period where the installation of the pipeline between LDP009 and MPPS water would occur. This scenario provides a worst case assessment for construction traffic along the Castlereagh Highway, with construction vehicles associated with both the MPPS water treatment plant and pipeline construction accessing construction sites from the Castlereagh Highway.

The Castlereagh Highway is expected to continue to operate within the Roads and Maritime recommended operating performance standards, at LoS B during the weekday AM peak and LoS C during the weekday PM peak.

The small increase in traffic associated with the construction activities is expected to have negligible traffic impacts.

6.3 Mitigation measures

A CTMP specific to the Project would be required to be developed to manage potential conflicts between the day-to-day construction traffic and general traffic. All vehicles shall be accommodated on site and managed in accordance with the CTMP.

6.4 Operational impact

The increase in traffic for the proposed operation post construction is projected to be minimal in the scheme of the road network. The small increase in traffic associated with the operation activities for the Project is expected to have a negligible traffic impacts.

6.5 Conclusion

In conclusion, the construction of the Project is not expected to adversely impact the traffic and road safety environment of the surrounding road network if the appropriate mitigation measures mentioned in the report are applied.

Appendices

Appendix A – Traffic Count Data

Job No	N2058
Client	ARC
Road	Castlereagh Hwy - 150m south of access Rd
Location	Lithgow
Site No.	1
Start Date	12-Nov-15
Description	Volume Summary
Direction	Combined

Average Weekday	5,786
7 Day Average	5,503

	Day of Week								
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	7 Day
Time	16-Nov	17-Nov	18-Nov	12-Nov	13-Nov	14-Nov	15-Nov	W'day	Ave
AM Peak	373	413	411	418	433	455	433		
PM Peak	469	497	478	476	550	414	482		
0:00	22	38	54	39	48	37	32	40	39
1:00	9	20	12	13	22	21	30	15	18
2:00	11	14	17	11	15	12	13	14	13
3:00	18	17	21	22	25	14	11	21	18
4:00	39	41	36	38	39	23	9	39	32
5:00	190	174	179	180	184	111	84	181	157
6:00	353	336	334	372	326	184	97	344	286
7:00	288	310	288	303	319	186	109	302	258
8:00	373	413	411	418	412	264	144	405	348
9:00	345	334	315	338	388	327	263	344	330
10:00	367	318	365	358	398	455	332	361	370
11:00	356	305	360	357	433	342	433	362	369
12:00	344	328	320	325	446	414	477	353	379
13:00	443	367	391	383	483	355	422	413	406
14:00	372	383	408	403	500	309	482	413	408
15:00	469	497	478	476	550	336	447	494	465
16:00	425	443	469	450	474	293	414	452	424
17:00	352	360	387	404	496	331	386	400	388
18:00	266	238	261	260	335	229	260	272	264
19:00	162	159	171	164	263	136	182	184	177
20:00	109	107	130	124	209	106	110	136	128
21:00	125	126	134	126	147	91	78	132	118
22:00	50	51	61	82	91	68	47	67	64
23:00	35	32	41	46	59	58	28	43	43
Total	5523	5411	5643	5692	6662	4702	4890	5786	5503

Road	Castlereagh Hwy - 150m south of access Rd
Location	Lithgow
Site No.	1
Start Date	12-Nov-15
Day	Weekday Ave.
Description	Class Summary

M'Cycle & P'Cycle	0%
Cars	87%
LGV	7%
OGV1 & PSV	1%
OGV2	4%

	NB						SB						Combined					
	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total
0:00	0	13	1	0	3	17	0	21	1	0	1	23	0	34	2	0	4	40
1:00	0	5	0	0	4	9	0	5	1	0	0	6	0	10	1	0	4	15
2:00	0	3	0	0	5	9	0	3	1	0	1	5	0	6	1	0	6	14
3:00	0	5	1	0	5	12	0	6	0	0	3	9	0	12	1	0	8	21
4:00	0	14	2	1	4	20	0	16	0	0	2	18	0	29	3	1	6	39
5:00	0	97	15	1	7	119	0	53	3	1	5	62	0	150	18	1	12	181
6:00	1	177	29	2	8	217	1	117	4	1	6	127	2	294	33	2	14	344
7:00	0	101	21	3	7	133	0	153	10	2	5	169	1	254	31	5	12	302
8:00	0	114	18	3	6	141	0	243	12	4	6	264	0	357	30	6	12	405
9:00	1	125	14	4	6	149	2	168	9	5	11	195	3	293	23	9	17	344
10:00	1	130	14	6	7	158	2	177	11	4	9	203	3	307	26	10	16	361
11:00	1	147	16	3	9	176	0	164	8	3	10	186	2	311	24	7	19	362
12:00	1	153	15	2	5	176	1	154	9	3	9	177	2	307	23	6	15	353
13:00	2	196	21	4	6	229	1	160	12	3	8	184	3	357	33	7	14	413
14:00	1	163	14	3	5	186	1	203	12	3	8	227	2	366	26	6	13	413
15:00	1	199	15	3	8	225	3	244	11	2	9	269	3	443	26	5	17	494
16:00	0	191	20	1	8	220	2	213	8	1	8	232	2	404	28	2	16	452
17:00	1	202	13	1	5	221	1	164	7	0	7	179	2	365	20	1	11	400
18:00	1	136	9	0	6	152	2	108	5	0	5	120	3	245	13	0	11	272
19:00	0	89	6	0	5	101	0	76	2	0	5	82	0	165	8	0	10	184
20:00	0	75	6	0	3	85	0	46	1	0	4	50	0	121	7	1	7	136
21:00	0	77	8	0	3	89	0	37	1	0	5	43	0	114	9	1	8	132
22:00	0	34	3	0	2	39	0	25	0	0	2	28	0	59	4	1	4	67
23:00	1	17	1	0	2	21	0	19	1	0	2	22	1	36	2	0	3	43
Total	13	2463	264	37	127	2904	16	2575	127	35	130	2883	29	5038	391	72	257	5786

Job No	N1001
Client	ARC
Road	Private access Rd - to / from Mine
Location	Springvale
Site No.	2
Start Date	20-Feb-13
Description	Volume Summary
Direction	Combined

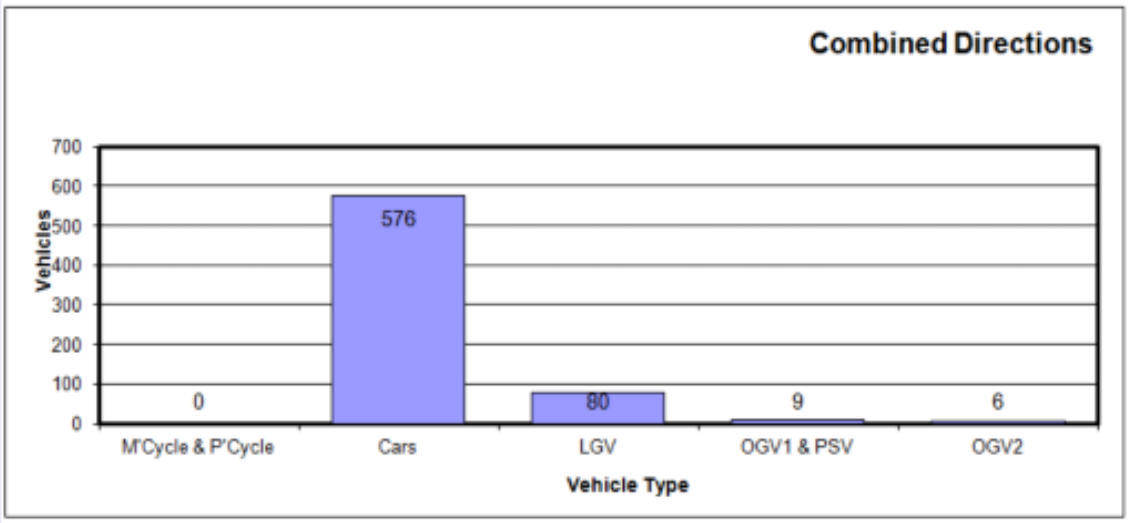
Average Weekday	671
7 Day Average	523

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	25-Feb	26-Feb	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb		
AM Peak	123	120	117	131	74	43	40		
PM Peak	95	96	101	104	45	30	31		
0:00	0	41	40	41	38	0	0	32	23
1:00	0	0	1	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0
3:00	2	1	0	5	2	2	3	2	2
4:00	5	6	8	5	9	4	3	7	6
5:00	123	120	117	131	74	43	40	113	93
6:00	42	28	42	26	31	21	14	34	29
7:00	18	28	32	22	39	1	3	28	20
8:00	18	73	63	63	56	8	1	55	40
9:00	19	25	28	18	25	2	2	23	17
10:00	20	19	20	23	31	2	0	23	16
11:00	23	30	33	35	17	1	0	28	20
12:00	18	28	19	23	21	4	0	22	16
13:00	61	72	63	54	45	10	0	59	44
14:00	21	25	29	25	37	10	6	27	22
15:00	56	54	59	42	23	4	3	47	34
16:00	95	96	101	104	23	2	4	84	61
17:00	18	25	19	15	43	30	17	24	24
18:00	12	13	12	9	33	18	31	16	18
19:00	5	7	4	7	9	4	0	6	5
20:00	3	7	4	7	2	0	2	5	4
21:00	44	40	45	44	0	0	7	35	26
22:00	1	1	5	2	0	1	1	2	2
23:00	3	3	0	4	0	0	1	2	2
Total	607	742	744	705	558	167	138	671	523

Road Private access Rd - to / from Mine
Location Springvale
Site No. 2
Start Date 20-Feb-13
Day Weekday Ave.
Description Class Summary

M'Cycle & P'Cycle	0%
Cars	86%
LGV	12%
OGV1 & PSV	1%
OGV2	1%

	NB (exiting mine)						SB (entering mine)						Combined					
	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total
0:00	0	26	5	0	0	32	0	0	0	0	0	0	0	27	5	0	0	32
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	1	0	0	0	1	0	1	0	0	0	1	0	2	0	0	0	2
4:00	0	1	0	0	0	1	0	6	0	0	0	6	0	6	0	0	0	7
5:00	0	2	0	0	0	2	0	104	7	0	0	111	0	106	7	0	0	113
6:00	0	6	1	0	0	8	0	22	3	0	1	26	0	28	4	0	1	34
7:00	0	5	2	0	1	8	0	16	3	1	0	20	0	21	5	1	1	28
8:00	0	36	6	1	0	43	0	7	4	1	0	12	0	43	10	1	1	55
9:00	0	9	2	1	0	12	0	8	2	1	0	11	0	17	4	1	1	23
10:00	0	8	3	0	0	11	0	7	3	1	0	11	0	15	6	1	0	23
11:00	0	10	3	1	0	14	0	10	3	0	0	14	0	20	5	2	1	28
12:00	0	7	2	0	0	10	0	9	2	0	1	12	0	16	5	0	1	22
13:00	0	12	3	0	1	16	0	39	4	1	0	43	0	51	7	1	1	59
14:00	0	16	3	0	0	19	0	7	2	0	0	9	0	23	4	1	0	27
15:00	0	37	4	0	0	41	0	5	1	0	0	6	0	42	5	0	0	47
16:00	0	73	6	0	0	79	0	4	1	0	0	5	0	77	7	0	0	84
17:00	0	14	2	0	0	16	0	8	1	0	0	8	0	22	2	0	0	24
18:00	0	14	1	0	0	14	0	1	0	0	0	2	0	15	1	0	0	16
19:00	0	4	1	0	0	5	0	2	0	0	0	2	0	6	1	0	0	6
20:00	0	1	1	0	0	2	0	3	0	0	0	3	0	4	1	0	0	5
21:00	0	1	0	0	0	1	0	31	2	0	0	33	0	33	2	0	0	35
22:00	0	1	0	0	0	1	0	1	0	0	0	1	0	2	0	0	0	2
23:00	0	2	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	2
Total	0	285	42	5	3	336	0	291	37	4	3	336	0	576	80	9	6	671



Job No	N649
Client	ARC
Road	Old Bells Line of Road (east of Glowworn Tunnel Rd)
Location	Lithgow
Site No.	3
Start Date	15-Jul-11
Description	Volume Summary
Direction	Combined

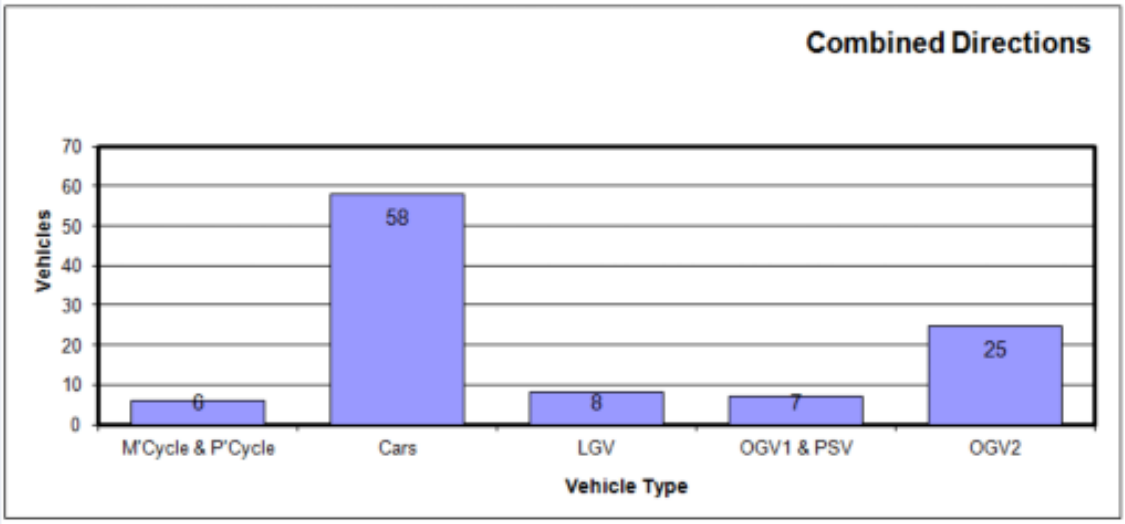
Average Weekday	92
7 Day Average	104

	Day of Week								
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	7 Day
Time	18-Jul	19-Jul	20-Jul	21-Jul	15-Jul	16-Jul	17-Jul	W'day	Ave
AM Peak	11	9	8	15	16	16	24		
PM Peak	11	7	9	14	15	16	27		
0:00	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0
4:00	2	9	2	8	6	0	0	5	4
5:00	9	5	8	9	14	0	1	9	7
6:00	2	0	4	7	6	1	0	4	3
7:00	2	5	5	6	5	2	1	5	4
8:00	11	8	6	15	11	16	9	10	11
9:00	4	3	6	14	16	5	14	9	9
10:00	7	6	4	5	13	8	24	7	10
11:00	8	3	6	10	9	7	13	7	8
12:00	11	7	9	14	15	5	15	11	11
13:00	4	5	9	14	9	13	13	8	10
14:00	2	2	1	10	9	16	19	5	8
15:00	4	1	4	8	5	16	27	4	9
16:00	3	1	3	1	3	12	8	2	4
17:00	2	2	0	3	2	12	9	2	4
18:00	0	0	1	0	0	1	1	0	0
19:00	0	0	0	0	6	2	0	1	1
20:00	0	0	0	0	2	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	7	0	0	1	1
23:00	0	0	0	0	1	0	0	0	0
Total	71	57	68	124	139	116	154	92	104
7-19	58	43	54	100	97	113	153	70	88
6-22	60	43	58	107	111	116	153	76	93
6-24	60	43	58	107	119	116	153	77	94
0-24	71	57	68	124	139	116	154	92	104

Road	Old Bells Line of Road (east of Glowworn Tu
Location	Lithgow
Site No.	3
Start Date	15-Jul-11
Day	7 Day Ave.
Description	Class Summary

M'Cycle & P'Cycle	6%
Cars	56%
LGV	8%
OGV1 & PSV	7%
OGV2	24%

	EB						WB						Combined					
	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total
0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	1	1	2	0	1	0	0	1	2	0	1	0	1	2	4
5:00	0	0	1	1	2	4	0	1	0	0	2	3	0	1	1	1	4	7
6:00	0	0	0	0	0	1	0	0	0	0	2	2	0	0	0	0	2	3
7:00	0	1	1	0	1	3	0	0	0	0	1	1	0	1	1	0	1	4
8:00	1	4	1	2	1	8	0	1	0	0	1	3	1	5	1	2	2	11
9:00	0	2	0	0	2	5	0	2	0	0	2	4	1	4	0	0	3	9
10:00	0	5	0	0	0	6	0	2	0	0	1	3	1	7	0	0	1	10
11:00	1	3	1	1	1	6	0	1	0	0	0	2	1	4	1	1	1	8
12:00	1	2	1	1	1	6	0	2	0	0	2	5	1	4	1	1	3	11
13:00	0	3	0	0	1	5	1	2	0	0	2	4	1	5	0	0	2	10
14:00	0	2	0	0	0	3	0	5	0	0	1	6	0	7	0	0	1	8
15:00	0	2	0	0	0	2	0	6	0	0	0	8	0	8	1	0	0	9
16:00	0	1	0	0	0	1	0	2	1	0	0	3	0	3	1	0	0	4
17:00	0	0	0	0	0	0	0	3	0	0	0	4	0	4	0	0	0	4
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19:00	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	4	28	6	7	10	54	2	30	2	1	15	50	6	58	8	7	25	104



Job No	N649
Client	ARC
Road	Glowworn Tunnel Rd (north of Old Bells Line of Rd)
Location	Lithgow
Site No.	2
Start Date	15-Jul-11
Description	Volume Summary
Direction	Combined

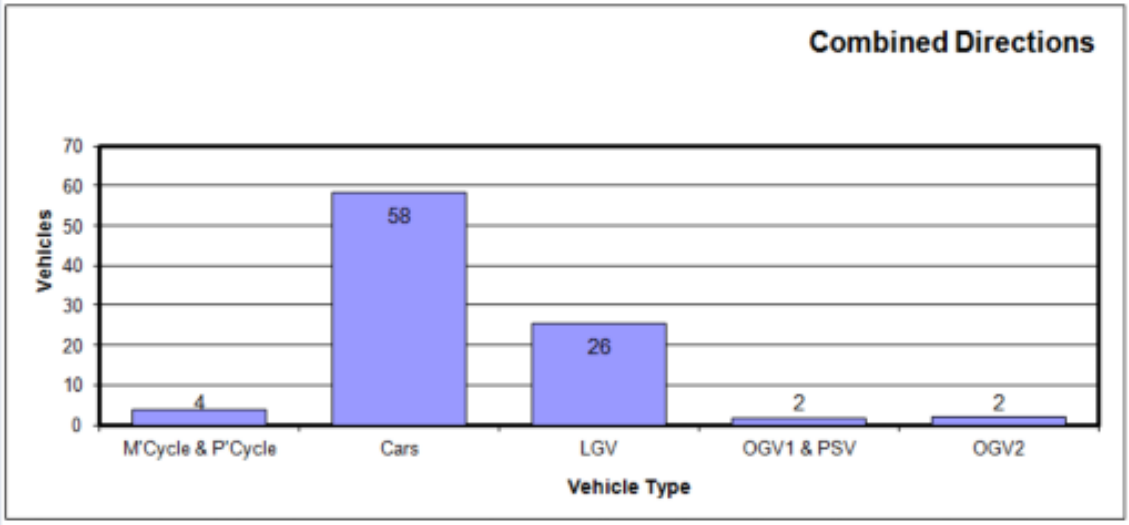
Average Weekday	75
7 Day Average	91

	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	18-Jul	19-Jul	20-Jul	21-Jul	15-Jul	16-Jul	17-Jul		
AM Peak	8	10	8	9	10	10	27		
PM Peak	11	14	9	12	15	30	21		
0:00	1	0	0	0	0	4	0	0	1
1:00	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	2	0	0	0
3:00	3	2	3	7	1	1	0	3	2
4:00	2	2	2	0	3	0	2	2	2
5:00	1	0	0	1	5	2	1	1	1
6:00	0	0	0	0	2	0	0	0	0
7:00	1	5	4	9	5	0	2	5	4
8:00	4	7	8	6	5	5	5	6	6
9:00	2	3	3	2	6	3	5	3	3
10:00	2	10	5	1	7	5	13	5	6
11:00	8	7	1	0	10	10	27	5	9
12:00	4	3	3	4	3	30	21	3	10
13:00	6	6	9	8	11	10	13	8	9
14:00	3	14	3	7	8	8	10	7	8
15:00	11	7	8	12	6	8	12	9	9
16:00	4	4	9	10	15	23	11	8	11
17:00	1	7	0	8	2	6	11	4	5
18:00	1	1	3	2	3	1	8	2	3
19:00	0	1	1	0	1	0	0	1	0
20:00	0	0	0	0	0	0	0	0	0
21:00	3	0	0	0	0	0	3	1	1
22:00	1	0	0	0	0	0	0	0	0
23:00	0	0	0	0	8	0	0	2	1
Total	58	79	62	77	101	118	144	75	91
7-19	47	74	56	69	81	109	138	65	82
6-22	50	75	57	69	84	109	141	67	84
6-24	51	75	57	69	92	109	141	69	85
0-24	58	79	62	77	101	118	144	75	91

Road	Glowworm Tunnel Rd (north of Old Bells Line
Location	Lithgow
Site No.	2
Start Date	15-Jul-11
Day	7 Day Ave.
Description	Class Summary

M'Cycle & P'Cycle	4%
Cars	64%
LGV	28%
OGV1 & PSV	2%
OGV2	2%

	NB						SB						Combined					
	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total
0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	1	1	0	0	2	0	0	0	0	0	0	0	1	1	0	0	2
4:00	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
5:00	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	3	0	0	4	0	0	0	0	0	0	0	0	3	0	0	4
8:00	0	1	4	0	0	5	0	1	0	0	0	1	0	2	4	0	0	6
9:00	0	0	2	0	0	3	0	1	0	0	0	1	0	1	2	0	0	3
10:00	0	2	3	0	0	5	0	1	0	0	0	1	0	3	3	0	0	6
11:00	0	3	2	0	0	5	0	3	0	0	0	4	0	6	2	0	0	9
12:00	1	2	3	0	0	6	0	3	0	0	0	4	1	6	3	0	0	10
13:00	0	1	2	0	0	3	0	5	0	0	0	6	1	6	2	0	0	9
14:00	0	1	1	0	0	3	0	5	0	0	0	5	0	6	1	0	0	8
15:00	0	1	1	0	0	2	0	6	0	0	0	7	0	7	1	0	0	9
16:00	0	3	0	0	0	4	1	6	0	0	0	7	1	9	0	0	0	11
17:00	0	0	1	0	0	1	0	4	0	0	0	4	0	4	1	0	0	5
18:00	0	1	0	0	0	1	0	2	0	0	0	2	0	3	0	0	0	3
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1
Total	2	16	25	1	2	46	2	42	0	0	0	45	4	58	26	2	2	91



Job No	N649
Client	ARC
Road	Sunnyside Ridge Rd
Location	Lithgow
Site No.	1
Start Date	15-Jul-11
Description	Volume Summary
Direction	Combined

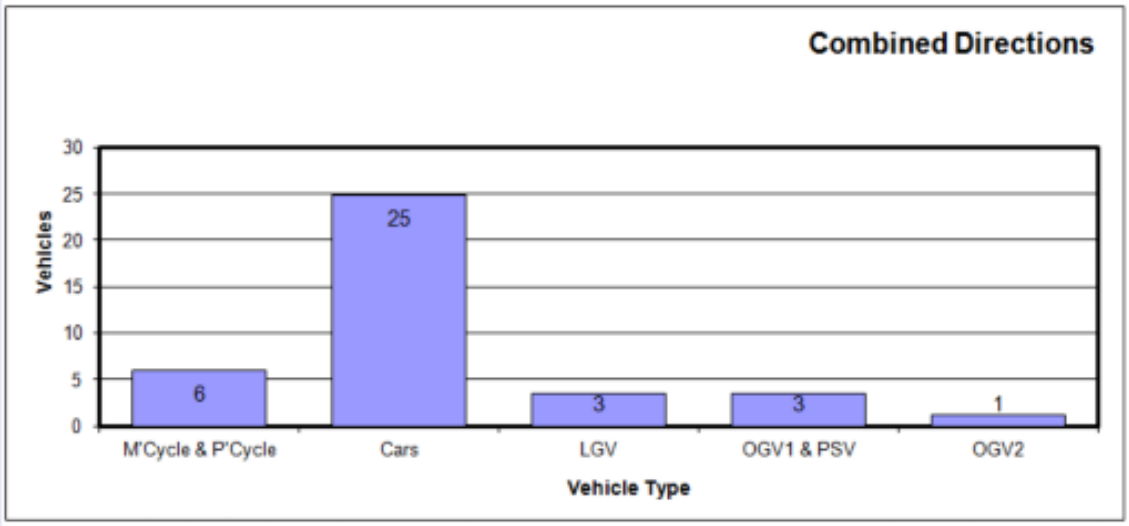
Average Weekday	32
7 Day Average	39

	Day of Week							Ave W'day	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
Time	18-Jul	19-Jul	20-Jul	21-Jul	15-Jul	16-Jul	17-Jul		
AM Peak	7	7	7	6	4	3	19		
PM Peak	5	4	6	7	3	16	12		
0:00	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0
7:00	0	3	3	2	1	1	0	2	1
8:00	1	4	2	6	3	3	0	3	3
9:00	7	3	7	1	1	1	1	4	3
10:00	3	3	4	2	2	0	19	3	5
11:00	1	7	1	1	4	3	16	3	5
12:00	4	2	4	1	3	2	0	3	2
13:00	2	1	5	6	0	1	12	3	4
14:00	1	3	3	7	1	12	8	3	5
15:00	1	4	6	6	1	1	9	4	4
16:00	5	1	4	1	1	16	4	2	5
17:00	0	2	0	2	0	2	3	1	1
18:00	0	0	3	3	0	0	0	1	1
19:00	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	3	0	0	1	0
21:00	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0
Total	25	33	42	38	20	42	72	32	39
7-19	25	33	42	38	17	42	72	31	38
6-22	25	33	42	38	20	42	72	32	39
6-24	25	33	42	38	20	42	72	32	39
0-24	25	33	42	38	20	42	72	32	39

Road Sunnyside Ridge Rd
Location Lithgow
Site No. 1
Start Date 15-Jul-11
Day 7 Day Ave.
Description Class Summary

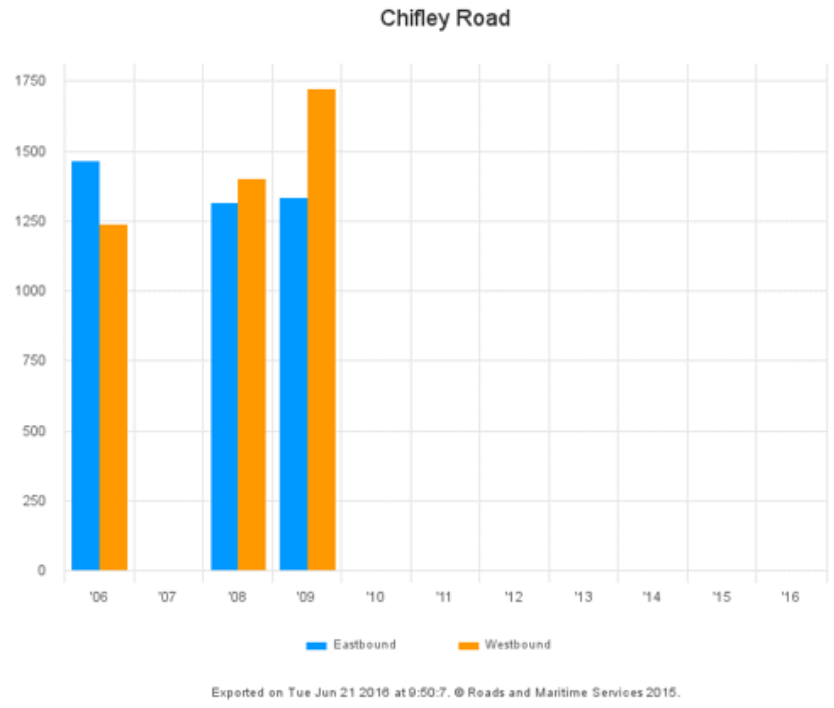
M'Cycle & P'Cycle	15%
Cars	64%
LGV	9%
OGV1 & PSV	9%
OGV2	3%

	NB						SB						Combined					
	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total	M'Cycle & P'Cycle	Cars	LGV	OGV1 & PSV	OGV2	Total
0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1
8:00	0	2	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0	3
9:00	0	1	0	0	0	2	0	1	0	0	0	1	0	2	0	0	0	3
10:00	2	1	0	0	0	3	1	1	0	0	0	2	2	1	0	1	0	5
11:00	0	2	0	0	0	2	2	1	0	0	0	3	2	3	0	0	0	5
12:00	0	1	0	0	0	2	0	0	0	0	0	1	0	1	1	0	0	2
13:00	0	1	0	0	0	2	0	2	0	0	0	2	0	3	0	0	0	4
14:00	0	1	0	0	0	3	0	2	0	0	0	2	1	3	0	1	0	5
15:00	0	1	0	0	0	1	0	2	0	0	0	3	0	3	0	1	0	4
16:00	0	0	0	0	0	1	0	4	0	0	0	4	0	4	0	0	0	5
17:00	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3	11	3	2	0	19	3	14	1	1	1	20	6	25	3	3	1	39



Station ID 99037

YEAR	DIRECTION	VEHICLE TYPE	TOTAL	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
2006	Westbound	Light Vehicles	1225	9	5	6	4	4	7	8	29	41	56	103	120	111	137	131	99	98	77	58	35	29	27	21	10
2006	Westbound	Heavy Vehicles	30			1		1		1	1	1	3		1	2	4	2	2	4		1	1		1	2	2
2006	Westbound	All Vehicles	1241	9	5	4	4	4	4	9	30	42	58	103	121	112	139	133	101	102	77	58	36	29	28	22	11
2006	Eastbound	Light Vehicles	1432	2	3	3	1	4	7	15	27	43	71	101	112	143	135	168	138	133	117	74	56	39	19	12	9
2006	Eastbound	Heavy Vehicles	43			2		1		2	1	2	2	1	3	3	4	3	4	3	3	3	2	1	1	1	1
2006	Eastbound	All Vehicles	1466	2	3	5	1	5	7	16	28	45	73	101	114	145	137	171	142	136	119	77	58	40	19	13	9
2008	Westbound	All Vehicles	1277	6	4	4	6	11	24	45	58	75	82	95	96	98	96	107	108	104	89	59	41	27	19	14	9
2008	Eastbound	All Vehicles	1325	6	4	4	5	10	19	34	50	62	75	87	96	107	112	131	140	132	100	60	37	23	15	9	7
2009	Westbound	All Vehicles	1142	6	4	4	6	10	26	44	55	72	73	83	86	85	81	83	82	78	76	59	45	32	23	19	10
2009	Eastbound	All Vehicles	1375	6	4	4	6	9	16	30	48	61	75	85	95	106	115	134	141	140	108	78	47	29	19	11	8

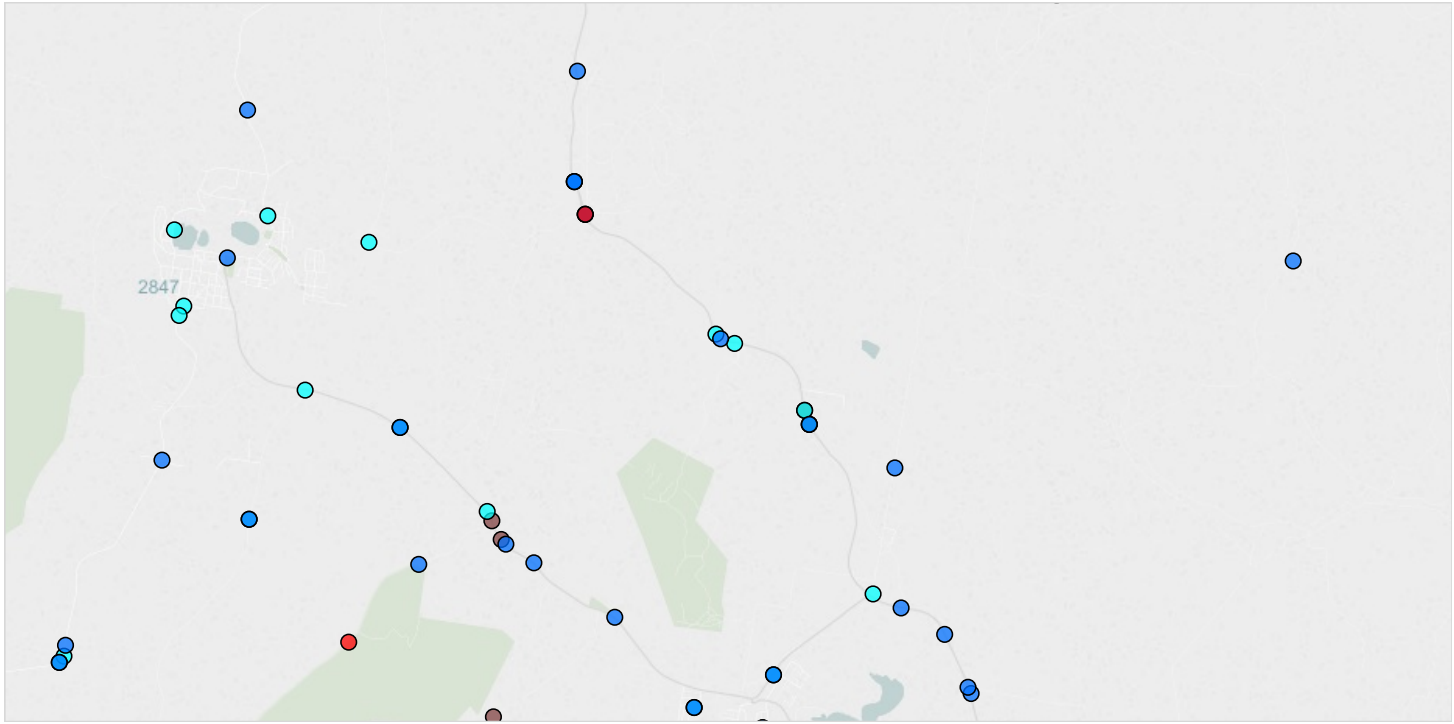


	2006	2007	2008	2009
E	1,466 2.39%	-	1,316 -	1,335 -
W	1,238 1.86%	-	1,401 -	1,724 -
E W	2,704 2.14%	-	2,717 -	3,059 -

Appendix B – Crash Data

Road Users by LGA: Lithgow

(Casualty Severity = All,
Reporting Year of Crash = All)



Select Local Government Area
Lithgow

Select Casualty Severity
(see Help for definitions)

- [x] Killed
- [x] Serious injury matched to a police report
- [x] Moderate injury matched to a police report
- [x] Minor / Other injury

Select Reporting Year
All

- Killed
- Serious injury matched to a police report
- Moderate injury matched to a police report
- Minor / Other injury

A single dot on the map may represent multiple persons sharing the same crash location, where-as the table below shows the entire number of persons and crashes.

Excludes Lord Howe Island crashes.

Excludes crashes involving no people (e.g a run-away vehicle into a parked vehicle)

Casualties	2009	2010	2011	2012	2013
Killed	1	2	5	2	3
Serious injuries matched to police reports	53	42	56	38	44
Moderate injuries matched to police reports	61	53	66	58	60
Minor / Other Injury	16	35	52	20	18

Crashes	2009	2010	2011	2012	2013
Fatal	1	2	5	2	3
Serious injury crashes matched to police reports	40	34	48	32	36
Moderate injury crashes matched to police reports	37	44	44	41	47
Minor / Other	11	16	23	11	8

Help

Last published date: 21 September 2015

NSW GOVERNMENT Transport for NSW

Road Users by LGA: Lithgow

(Casualty Severity = All,
Reporting Year of Crash = All)



Select Local Government Area
Lithgow

Select Casualty Severity
(see Help for definitions)

- [x] Killed
- [x] Serious injury matched to a police report
- [x] Moderate injury matched to a police report
- [x] Minor / Other injury

Select Reporting Year
All

- Killed
- Serious injury matched to a police report
- Moderate injury matched to a police report
- Minor / Other injury

A single dot on the map may represent multiple persons sharing the same crash location, whereas the table below shows the entire number of persons and crashes.

Excludes Lord Howe Island crashes.

Excludes crashes involving no people (e.g a runaway vehicle into a parked vehicle)

Casualties	2009	2010	2011	2012	2013
Killed	1	2	5	2	3
Serious injuries matched to police reports	53	42	56	38	44
Moderate injuries matched to police reports	61	53	66	58	60
Minor / Other Injury	16	35	52	20	18

Crashes	2009	2010	2011	2012	2013
Fatal	1	2	5	2	3
Serious injury crashes matched to police reports	40	34	48	32	36
Moderate injury crashes matched to police reports	37	44	44	41	47
Minor / Other	11	16	23	11	8

Help

Last published date: 21 September 2015

NSW GOVERNMENT Transport for NSW

Appendix C – Bus Routes

LITTLETON & LITHGOW HOSPITAL via Strathlone Estate & Kirkley Gardens — ROUTE 100

	Monday to Friday									Saturday		
	am	am ♿	am ♿	am ♿	pm ♿	pm ♿	pm ♿	pm ♿	pm	am ♿	am ♿	pm ♿
Train Arrives from Sydney	-	***9.08***	-	***(11:05)***	-	***(1:05)***	***(3:05)***	***5.05***	***(5:05)***	***8.42***	-	***(11:10)***
Court House Hotel- Main Street	-	9.20	10.45	11.50	12.45	2.20	4.30	5.15	5.50	8.45	10.02	12.20
Lithgow Railway - opp in Main St at Post Office	-	9.21	10.46	11.51	12.46	2.21	4.31	5.16	5.51	8.46	10.03	12.21
Library- Main Street	-	9.22	10.47	11.52	12.47	2.22	4.32	5.17	5.52	8.47	10.04	12.22
Lithgow Valley Plaza - Bus Shed inside Car Park	-	9.25	10.50	11.55	12.50	2.25	4.35	5.20	5.55	8.50	10.07	12.25
Small Arms Factory - Methven Street	-	9.30	10.55	12.00	12.55	2.30	4.40	5.25	6.00	8.55	10.12	12.30
Rabaul/Lemnos Streets	-	9.33	10.58	12.03	12.58	2.33	4.43	5.28	6.03	8.58	10.15	12.33
Gt Western Hwy/Robinia Drive	6.58	9.35	11.00	12.05	1.00	2.35	4.45	5.30	6.05	9.00	10.17	12.35
Strathlone Estate Loop	6.58	9.35	-	12.05	-	2.35	On Req	On Req	On Req	9.00	10.17	12.35
Kirkley Gardens - Main Entry Kirkley Street	7.01	9.37	11.02	12.08	1.02	2.38	4.47	5.32	6.07	9.03	10.20	12.38
Lithgow Hospital	7.04	9.40	11.05	12.11	1.05	2.41	4.50	5.35	6.10	9.06	10.23	12.41
Treeview Estate	7.05	9.41	11.06	12.12	1.06	2.42	4.51	On Req	On Req	9.07	10.24	12.42
Lemnos/Rabaul Streets	7.07	9.43	11.08	12.14	1.08	2.44	4.53	5.37	6.12	9.09	10.26	12.44
Small Arms Factory - opp in Methven Street	7.10	9.46	11.11	12.17	1.11	2.47	4.56	5.40	6.15	9.12	10.29	12.47
Lithgow Valley Plaza - Bus Shed inside Car Park	7.14	9.51	11.16	12.22	1.16	2.52	5.01	5.43	6.19	9.16	10.34	12.52
Opp Library - Main Street	7.18	9.56	11.21	12.27	1.19	2.55	5.05	5.46	6.22	9.19	10.39	12.55
Lithgow Railway - Main Street at Arcade	7.19	9.57	11.22	12.28	1.20	2.56	5.06	5.47	6.23	9.20	10.40	12.56
Opp Court House Hotel - Main Street	7.20	9.58	11.23	12.29	1.21	2.57	5.07	5.48	6.24	9.21	10.41	12.57
Train to Sydney - Departs	***7.26***	***(11:26)***	***11.26***	***(1:26)***	***1.26***	***(3:26)***	***(5:34)***	-	***(7:35)***	***9.37***	***(11:37)***	***(1:37)***

BOWENFELS via Cooerwull & Lithgow Hospital — ROUTE 200

	Monday to Friday												Saturday			
	am ♿	am	am ♿	am ♿	am ♿	pm ♿	pm ♿	pm ♿	pm ♿	pm ♿	pm ♿	pm ♿	am ♿	am ♿	am ♿	pm ♿
Train Arrives from Sydney	-	***7.08***	-	***(9:08)***	-	***(11:05)***	***1.05***	***(1:05)***	-	***(3:05)***	***5.05***	***(5:05)***	-	***8.43***	***11.10***	***1.10***
Court House Hotel - Main Street	-	7.22	8.55	10.00	11.00	12.05	1.15	1.45	2.28	4.10	5.10	5.50	-	9.20	11.37	1.40
Lithgow Railway - opp in Main St at Post Office	-	7.23	8.56	10.01	11.01	12.06	1.16	1.46	2.29	4.11	5.11	5.51	-	9.21	11.38	1.41
Library- Main Street	-	7.24	8.57	10.02	11.02	12.07	1.17	1.47	2.30	4.12	5.12	5.52	-	9.22	11.39	1.42
Lithgow Valley Plaza - Bus Shed inside Car Park	-	-	9.00	10.05	11.05	12.10	1.20	1.50	2.33	4.15	5.15	5.55	-	9.25	11.42	1.45
Bunnings - Main Street	-	7.25	9.06	10.11	11.11	12.16	1.26	1.56	2.39	4.21	5.21	6.00	-	9.31	11.48	1.51
Musket Parade/Main Street	-	7.26	9.07	10.12	11.12	12.17	1.27	1.57	2.40	4.22	5.22	6.01	8.10	9.32	11.49	1.52
Gt Western Hwy/Tweed Street	7.00	7.30	9.11	10.16	11.16	12.21	1.31	2.01	2.44	4.26	5.26	6.05	8.14	9.36	11.53	1.56
Landa/Tweed Streets	7.04	7.34	9.15	10.20	11.20	12.25	1.35	2.05	2.48	4.30	5.30	6.09	8.18	9.40	11.57	2.00
Caroline Street/Gt Western Hwy	7.09	7.39	9.20	10.25	11.25	12.30	1.40	2.10	2.53	4.35	5.35	6.13	8.23	9.45	12.02	2.05
Lithgow Hospital	7.13	-	9.24	10.29	11.29	12.34	1.44	2.14	-	4.39	5.39	-	8.27	9.49	12.06	2.09
Gt Western Hwy/Main Street- McDonalds	7.16	7.39	9.27	10.32	11.32	12.37	1.47	2.17	2.54	4.42	5.42	6.13	8.30	9.52	12.09	2.12
Lithgow Valley Plaza - Bus Shed inside Car Park	-	-	9.31	10.36	11.36	12.41	1.51	2.21	2.58	4.46	5.46	On Req	8.34	9.56	12.13	2.16
Opp Library- Main Street	7.20	7.41	9.34	10.41	11.40	12.46	1.55	2.26	3.01	4.50	5.50	6.15	8.39	10.00	12.18	2.21
Lithgow Railway - Main Street at Arcade	7.21	7.42	9.35	10.42	11.41	12.47	1.56	2.27	3.02	4.51	5.51	6.16	8.40	10.01	12.19	2.22
Opp Court House Hotel - Main Street	7.22	7.43	9.36	10.43	11.42	12.48	1.57	2.28	3.03	4.52	5.52	6.17	8.41	10.02	12.20	2.23
Train to Sydney- Departs	***7.26***	-	-	***11.26***	-	***1.26***	-	***(3:28)***	***3.26***	***(5:34)***	-	***(7:35)***	***(9:37)***	***(11:37)***	***(1:37)***	***(3:37)***

LEGEND

\# Operates via Ramsay - Redgate & Berry Streets

On Req: On request

♿ Routes so marked will generally be serviced by a fully wheelchair accessible bus. Periodic maintenance may affect availability, please check prior to journey.

School day diversion

SH Operates school holidays



McKELLARS PARK & OAKEY PARK via Hermitage Flat & Morts Estate Hermitage — ROUTE 304

	Monday to Friday							Saturday		
	am ♿	am ♿	am ♿	pm ♿	pm ♿	pm ♿	pm ♿	am ♿	am ♿	pm ♿
Train Arrives from Sydney	-	-	***11.05***	-	***1.05***	***(3:05)***	***5:05***	-	-	***(11:10)***
Opp Court House Hotel- Main Street	-	8.57	11.24	12.48	1.21	4.20	5.52	8.00	10.41	12.45
Lithgow Railway - outside in Railway Parade	-	8.58	11.25	12.49	1.22	4.21	5.53	8.01	10.42	12.46
Albert/Coalbrook Streets	6.57	9.02	11.29	12.53	1.26	4.25	5.57	8.05	10.46	12.50
Sandford Avenue/Crane Road	7.00	9.05	11.32	12.56	1.29	4.28	6.00	8.08	10.49	12.53
Macauley/Laidley Streets	7.02	9.07	11.34	12.58	1.31	4.30	6.02	8.10	10.51	12.55
Macauley/Mount Street turnaround	-	9.09	11.36	-	1.33	4.32	On Req	8.12	10.53	On Req
Macauley/Laidley Streets	7.02	9.10	11.37	12.58	1.34	4.33	6.02	8.13	10.54	12.55
Bells Road turnaround at bus shed	7.07	9.15	11.42	1.03	1.39	4.38	6.07	8.18	10.59	1.00
Inch/Bennett Streets	7.09	9.17	11.44	1.05	1.41	4.40	6.09	8.20	11.01	1.02
Opposite Bus Depot - Donald Street	7.10	9.18	11.45	1.06	1.42	4.41	6.10	8.21	11.02	1.03
Lithgow Workers Club- Tank Street	7.10	9.19	11.46	1.07	1.43	4.42	On Req	8.22	11.03	1.04
Court House Hotel - Main Street	7.11	9.20	11.47	1.08	1.44	4.43	On Req	8.23	11.04	1.05
Lithgow Railway- opp in Main St at Post Office	7.12	9.21	11.51	1.09	1.45	4.44	On Req	8.24	11.05	1.06
Library- Main Street	7.13	9.22	11.52	1.10	1.46	4.45	On Req	8.25	11.06	1.07
Lithgow Valley Plaza - Bus Shed inside Car Park	-	9.25	11.55	1.13	1.49	4.48	On Req	8.28	11.09	1.10
Train to Sydney- Departs	***7.26***	***9.26***	-	***1.26***	-	***(5:34)***	-	***8:33***	***11.37***	***1.37***

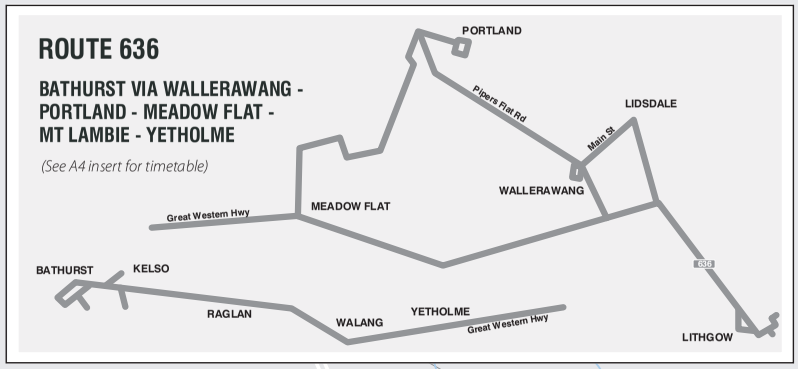
VALE of CLWYDD via Hill Street — ROUTE 500

	Monday to Friday						Saturday		
	am ♿	am ♿	am ♿	pm ♿	pm ♿	pm ♿	am ♿	am ♿	pm ♿
Train Arrives from Sydney	-	***9:08***	***11.05***	***1.05***	***(3:05)***	***5.05***	-	***11.10***	***1.10***
Lithgow Valley Plaza- Bus Shed inside Car Park	-	9.31	11.36	1.51	4.46	5.20	8.25	11.09	1.10
Opp Library- Main Street	-	9.34	11.40	1.55	4.50	5.24	8.29	11.13	1.14
Lithgow Railway- Main Street at Arcade	-	9.35	11.41	1.56	4.51	5.25	8.30	11.14	1.15
Opp Court House Hotel- Main Street	-	9.36	11.42	1.57	4.52	5.26	8.31	11.15	1.16
Chifley Road/Hartley Valley Road	7.05	9.41	11.47	2.02	4.57	5.31	8.36	11.19	1.21
Hartley Valley Road/Mort Street	7.06#	9.42#	11.48	2.03#	4.58	5.32#	8.37#	11.20#	1.22#
Johnson/Whitton Streets	7.09	9.45	11.51	2.06	5.01	5.35	8.40	11.23	1.25
Cooinda Homes	7.12	9.48	11.54	2.09	5.04	5.38	8.43	11.25	1.28
Lithgow Valley Plaza- Bus Shed inside Car Park	-	9.52	11.58	2.13	5.08	5.42	8.47	11.28	1.32
Opp Library- Main Street	7.17	9.56	12.02	2.17	5.12	5.46	8.51	11.31	1.36
Lithgow Railway- Main Street at Arcade	7.18	9.57	12.03	2.18	5.13	5.47	8.52	11.32	1.37
Opp Court House Hotel- Main Street	7.19	9.58	12.04	2.19	5.14	5.48	8.53	11.33	1.38
Train to Sydney- Departs	***7.26***	-	***(1:26)***	***(3:26)***	***5:34***	-	***(9:37)***	***11.37***	***(1:37)***

PORTLAND - LITHGOW via Wallerawang & Return — ROUTE 600

	Monday to Friday												Saturday	
	am	am	am SH	am	am ♿	am ♿	pm ♿	pm ♿	pm ♿	pm ♿	pm ♿	pm ♿	am ♿	pm ♿
Train Arrives Lithgow Railway from Sydney	-	***7.08***	***7.08***	-	-	***11.05***	-	***1.05***	-	-	-	***5.05***	***8.42***	-
Lithgow Workers Club- Tank Street	-	-	-	-	-	11.19	-	1.34	2.50	-	-	5.33	8.55	-
Court House Hotel- Main Street	-	7.43	7.25	-	-	11.20	-	1.35	2.51	-	-	5.35	8.56	-
Lithgow Railway- opp in Main St at Post Office	-	7.44	7.26	-	-	11.21	-	1.36	2.51	-	-	5.36	8.57	-
Library- Main Street	-	7.45	7.27	-	-	11.22	-	1.37	2.52	-	-	5.37	8.58	-
Lithgow Valley Plaza- Bus Shed inside Car Park	-	-	-	-	-	11.26	-	1.40	-	-	-	5.40	9.01	-
Gt Western Hwy/Main Street- opp McDonalds	-	7.48	7.30	-	-	11.29	-	1.43	2.54	-	-	5.43	9.06	-
Lithgow Caravan Park- Cooerwull Road	-	7.50	7.32	-	-	11.31	-	1.45	-	-	-	5.45	9.08	-
Marrangaroo Fields- Gt Western Hwy	-	7.53	7.35	-	-	11.34	-	1.48	2.56	-	-	5.48	9.11	-
Opp Lithgow Correctional Ctre- Gt Western Hwy	-	7.55	7.37	-	-	11.36	-	1.50	2.58	-	-	5.50	9.13	-
Castlereagh Hwy/Wolgan Road	-	8.00	7.42	-	-	11.41	-	1.55	3.13	-	-	5.55	9.17	-
Lidsdale- Bells Corner	-	-	7.44	-	-	-	-	-	-	-	-	-	-	-
Blackman's Flat- Castlereagh Hwy/View St	-	-	7.46	-	-	-	-	-	3.25	-	-	-	-	-
Wallerawang turnoff- Barton Ave/Gt Western Hwy	-	-	-	-	-	-	-	-	3.00	-	-	-	-	-
Wallerawang Bridge	-	8.04	-	-	-	11.46	-	2.00	3.10	-	-	6.00	9.24	-
Wallerawang- Main Street	-	8.03	-	-	-	11.45	-	1.59	3.11	-	-	5.59	9.19	-
Wallerawang- Hume St loop	-	8.07	-	-	-		-	2.03	-	-	-	6.03	9.22	-
Portland RSL Club	-	8.27	7.57	-	9.50	11.56	12.04	2.13	3.42	4.35	5.53	6.13	9.38	12.01
East Portland	6.45	8.30	7.50	-	9.45	11.59	12.00	2.17	3.40	-	-	6.17	-	12.05
Portland Post Office	6.49	-	7.53	-	9.42	11.57	12.03	-	-	-	-	-	-	12.09
Wallerawang- Main Street	7.00	8.03	8.12	8:58	10.05	-	12.22	1.59	4.08	-	-	-	-	-
Wallerawang Bridge	6.59	8.04	8.07	8:57	10.00	-	12.14	2.00	4.07	4.40	6.01	-	-	12.19
Wallerawang- Hume St loop	-	-	8.10	-	10.01	-	12.17	-		-	-	-	-	12.21
Wallerawang turnoff- Barton Ave/Gt Western Hwy	-	-	-	-	-	-	-	-	-	4.45	6.03	-	-	12.21
Blackman's Flat- Castlereagh Hwy/View St	-	8.42	-	-	-	-	-	-	-	-	-	-	-	-
Castlereagh Hwy/Main Street	7.02		8.14	9:00										
Lithgow Correctional Ctre- Gt Western Hwy	7.07	-	8.19	9:05	10.12	-	12.32	-	4.19	4.47	6.05	-	-	12.27
Marrangaroo Fields- Gt Western Hwy	7.09	-	8.21	9:07	-	-	-	-	4.21	4.49	6.06	-	-	12.29
Marrangaroo Fields- Girraween Drive	-	-	8.23	-	10.15	-	12.36	-	-	On Req	On Req	-	-	On Req
Lithgow Caravan Park- Cooerwull Road	7.12	-	8.25	9:09	10.19	-	12.39	-	-	4.52	6.10	-	-	12.31
Gt Western Hwy/Main Street- opp McDonalds	7.14	-	8.27	9:11	10.22	-	12.41	-	4.27	4.55	6.15	-	-	12.34
Lithgow Valley Plaza- Bus Shed inside Car Park	-	-	8.32	On Req	10.26	-	12.45	-	-	On Req	On Req	-	-	On Req
Opp Library- Main Street	7.20	-	8.35	9:16	10.29	-	12.48	-	4.29	4.58	6.18	-	-	12.37
Lithgow Railway- Main Street at Arcade	7.21	-	8.36	9:17	10.30	-	12.49	-	4.30	4.59	6.19	-	-	12.38
Opp Court House Hotel- Main Street	7.22	-	8.37	9:18	10.31	-	12.50	-	4.31	5.00	6.20	-	-	12.39
Train Departs Lithgow Railway for Sydney	***7.26***	-	***(9:26)***	***9:26***	***(11:26)***	-	***1.26***	-	***(5:34)***	***5.34***	***(7:35)***	-	-	***(1:37)***

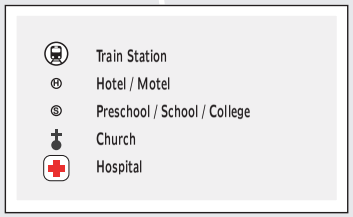
CITY OF LITHGOW











ROUTE 600 & 636
GREAT WESTERN HWY
RTA Depot
Historic Bowenfels Train Station
COBAR PARK
MCKELLARS PARK
HERMITAGE FLAT
STATE MINE GULLY
MORTS ESTATE
OAKY PARK
Marjorie Oval
Lake Pillans Wetlands
Blast Furnace Park
CORNEY TOWN
Jim Monaghan Athletics Track
Tony Luchetti Sportsground
Glanmire Oval
Queen Elizabeth Park
VALE OF CLWYDD
BOWENFELS
POTTERY ESTATE
LITTLETON
LITHGOW
SHEEDYS GULLY
SOUTH BOWENFELS
Endeavour Park
Lithgow Train Station
Lithgow Public School
Lithgow High School
Cooerwull Public School
Lithgow Small Arms Factory Museum
Thales Australia
Lithgow Parkside Motor Inn
Community of Lithgow Integrated Health Facilities Emergency
The University of Notre Dame Australia Lithgow Clinical School
The Scots School
Uniting Church Lithgow
Anglican Church Diocese of Sydney
Seventh-Day Adventist Church
Coast Spiritualist Church
City Council
Lithgow Corps
Church St Al Maste Cr
Presbyterian Church of Australia
Graham Gercken Fine Art Gallery
Zig Zag Public School
State Mine Heritage Park & Railway
Shops
MAIN ST
BELLS RD
MORT ST
CHURCH ST
BENT ST
HILL ST
WHILTON ST
JOHNSON ST
GREAT WESTERN HWY
200
100
304
500
600
636

Lithgow BUSLINES

Effective from 10 December 2014

BATHURST to LITHGOW via Yetholme- Mt Lambie- Meadow Flat- Portland- Wallerawang — ROUTE 636

	Monday to Friday			Saturday		
	am ♿	pm ♿	pm	am Trainlink coach	pm Lithgow Buslines Service	pm Trainlink coach
Bathurst Railway Station- Keppel Street	***8.58***	***3.25***	***4.55***	***10.05***	***11.18***	***12.05***
Bathurst Bus Terminal- Acropole Café Howick St	9.02	3.22	5.02	-	11.20	-
Kelso- Gt Western Hwy	9.07	3.40	5.08	-	11.25	-
Raglan- Gt Westen Hwy- Countrylink Stop	9.12	4.02	5.17	-	11.30	-
Yetholme- Gt Western Hwy	9.21	4.12	5.33	-	11.39	-
Meadow Flat opposite school Sunny Corner Road	9.28	4.19	5.39	-	11.46	-
Mt Lambie- Gt Western Hwy- Countrylink Stop	-	-	-	-	-	-
Portland Post Office	9.42	-	-	-	12.01	-
East Portland	9.45	-	-	-	12.05	-
Portland RSL Club	9.50	4.35	5.53	-	12.09	-
Wallerawang Black Bridge	10.00	4.40	6.01	-	12.19	-
Wallerawang- Main Street	10.05	-	-	-	-	-
Wallerawang- Hume Ave loop	10.01			-	12.21	-
Blackman's Flat- Castlereagh Hwy/View Street	-	-	-	-	-	-
Wallerawang turnoff- Barton Ave/Gt Western Hwy	-	4.45	6.03	-	12.25	-
Lidsdale- Bells Corner	-	-	-	-	-	-
Castlereagh Hwy/Wolgan Road	10.08	-	-	-	-	-
Lithgow Correctional Ctre- Gt Western Hwy	10.12	4.47	6.05	-	12.27	-
Marrangaroo Fields- Girraween Road	10.15	On Request	On Request	-	On Request	-
Lithgow Caravan Park- Cooerwull Road	10.19	4.52	6.10	-	12.31	-
Gt Western Hwy/Main Street- McDonalds	10.22	4.55	6.15	-	12.34	-
Lithgow Valley Plaza- Bus Shed inside Car Park	10.26	On Request	On Request	-	On Request	-
Opposite Library- Main Street	10.29	4.58	6.18	-	12.37	-
Lithgow Railway- Arcade in Main St opp Post Office	10.30	4.59	6.19	11.05	12.38	1.05
Opposite Court House Hotel- Main Street	10.31	5.00	6.20	-	12.39	-
Lithgow Workers Club- Tank Street	10.32	5.01	6.21	-	On Request	-
Train Departs Lithgow Railway to Sydney	***(11:26)***	***5.34***	***(7:34)***	***11.37***	***-***	***1.26***

LITHGOW to BATHURST via Wallerawang- Portland- Meadow Flat- Mt Lambie- Yetholme — ROUTE 636

	Monday to Friday			Saturday	
	am ♿	pm ♿	pm	am Lithgow Buslines Service	pm Trainlink coach
Train Arrives Lithgow Railway from Sydney	***7.08***	***1.05***	***3.05***	***8.42***	***3.30***
Lithgow Workers Club- Tank Street	7.10	1.34	-	8.55	-
Court House Hotel- Main Street	7.11	1.35	3.43	8.56	-
Lithgow Railway- opp in Main St at Post Office	7.12	1.36	3.45	8.57	3.30*
Library- Main Street	7.13	1.37	3.46	8.58	-
Lithgow Valley Plaza- Bus Shed inside Car Park	-	1.40	3.48	9.01	-
Gt Western Hwy/Main Street- opp McDonalds	7.16	1.43	4.00^	9.06	-
Lithgow Caravan Park- Cooerwull Road	7.18	1.45	-	9.08	-
Marrangaroo Fields- Gt Western Hwy	7.20	1.48	4.03	9.11	-
Opp Lithgow Correctional Ctre- Gt Western Hwy	7.22	1.50	4.05	9.13	-
Castlereagh Hwy/Wolgan Road	-	1.55	-	9.17	-
Lidsdale- Bells Corner	-	-	-	-	-
Blackman's Flat- Castlereagh Hwy/View Street	-	-	-	-	-
Wallerawang turnoff- Barton Ave/Gt Western Hwy	7.26	-	4.08	-	-
Wallerawang- Hume Ave loop	-	2.03	-	9.22	
Wallerawang Bridge	7.28	2.00	4.14	9.24	-
Wallerawang- Main Street	-	1.59	-	9.20	-
Portland RSL Club	7.40	2.13	-	9.42	-
East Portland	-	2.17	-	9.38	-
Portland Post Office	-	-	-	-	-
Mt Lambie- Gt Western Hwy- Countrylink Stop	-	-	4.25	-	-
Meadow Flat opposite school Sunny Corner Road	7.55	2.40	4.31^^	9.52	-
Yetholme- Gt Western Hwy	8.02	2.45	4.38	9.57	-
Raglan- Gt Westen Hwy- Countrylink Stop	8.07	2.56	4.48	10.02	-
Kelso- Gt Western Hwy	8.28	2.59	4.51	10.05	-
Bathurst Railway Station- Keppel Street	On Request	3.05	4.55	10.08	4.25
Bathurst Bus Terminal- Acropole Café Howick St	8.45 On Request	3.00	5.00	10.10	-

*	NSW Trainlink Coach Service from Railway Ave- times correct at time of print please check with TrainLink to ensure still current	♿	Routes so marked will generally be serviced by a fully wheelchair accessible bus. Periodic maintenance may affect availability, please check prior to journey.
	Services operated by Trainlink - please check for changes in times	^	Pick up on Gt Western Hwy opposite McDonalds
	Operates school days only	^^	Picks up on Gt Western Hwy opp Meadow Flat School

GHD

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-

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Rev 0	M Tran	O Peel	On file	K Rosen	On file	18/08/2016

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Appendix G Contamination



Springvale Coal Pty Ltd

Springvale Water Treatment Project
Contamination Assessment

August 2016

Executive summary

GHD Pty Ltd (GHD) was commissioned to conduct a preliminary contamination assessment including a desktop study and limited sampling at a portion of the proposed site for the water treatment project (WTP) at the Mount Piper power station (MPPS) located at Lot 363 Boulder Road, Blackmans Flat, NSW.

GHD undertook the field investigations on 2 and 3 June 2016, at the site to assess the nature of soil contamination on-site and assess potential risks posed by the identified contaminants of potential concern.

The subsurface conditions across the site have been observed to comprise of Fill (mine overburden) overlying residual soil (orange/red/brown Clay) then the Illawarra Coal Measures.

Reviews of previous environmental investigation and site settings indicate a potential for contamination on the site in localised areas of fill. Searches identified multiple premises nearby the site with the potential for contaminating activities, such as commercial use of the MPPS and the above ground storage tanks containing diesel located adjacent to the site. However, it was considered that the primary potential sources are the fill deposits present on the site as a result of previous land uses.

The following results were obtained:

- All soil results including previous investigations undertaken by ERM, were below the nominated human health screening criteria.
- No asbestos fibres were identified in the soil samples.
- The preliminary in-situ waste classification of the soil on site is classified as:
  - Proposed WTP site area: general solid waste.
  - Proposed WTP construction laydown area: The area of HA01 and ERM (2014) locations is a mixture of *general, restricted and hazardous solid waste*. Once final design is known this should be reassessed.
  - Proposed salt slurry ponds: general solid waste.

Based on the findings detailed in this report the preliminary conceptual site model provided in **Table 3** has been updated for the site and is considered that none of the source pathway and receptors is complete.

GHD considers that based on the site investigation data there is limited risk to human health during construction of the WTP, and standard PPE would be suitable for the works.

Given the extensively fill material at the site, any site safety or environmental management plans for the construction works should include an unexpected find protocol.

We recommend further sampling of material for waste classification purposes if any material is to be removed off-site.

This executive summary is subject to, and must be read in conjunction with, the remainder of the report, the limitations set out in Section 10 and the assumptions and qualifications contained throughout the report.

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1. Introduction

1.1 Authorisation

Springvale Coal Pty Ltd (Springvale Coal) is seeking consent for the Springvale Water Treatment Project (the Project). The Project involves the transfer of water from existing underground mine dewatering facilities for industrial reuse at Mount Piper Power Station (MPPS) to improve environmental outcomes and water quality within the upper Coxs River catchment.

EnergyAustralia NSW Pty Ltd (EnergyAustralia) owns and operates the MPPS, located about eight kilometres west of the Springvale Mine pit top. The power station has a high demand for make-up water for use in the cooling tower system. Springvale Coal and EnergyAustralia have agreed to work together to develop the Project.

GHD Pty Ltd (GHD) was commissioned to undertake a preliminary contamination assessment including a desktop study and limited sampling at a portion of the proposed site for the water treatment plant (WTP) site at MPPS, located at Lot 363 Boulder Road, Blackmans Flat, NSW, referred to as "the site". A site location plan is provided as **Figure 1, Appendix A**.

1.2 Background

A new WTP is proposed to be located at the MPPS site and integrated with the existing water treatment facilities operating at the site. The areas to be investigated include the proposed water treatment plant area, salt slurry ponds and proposed WTP construction laydown area.

The area for the proposed water treatment process area is a large semi-cleared area with one are that was previously used as a construction laydown area during the construction of the MPPS. The soil in this area is a mixture of "natural' and / or "cut and filled from previous construction or possible past history of "open cut coal mine that was infilled by back-filling and rehabilitation".

This investigation was completed alongside the geotechnical investigation being undertaken as part of the concept design for the Project. This assessment forms part of an Environmental Impact Statement (EIS) to support a State Significant Development (SSD) application for the Project under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The investigation will also be available for proponents tendering for the construction and operation of the Project.

1.3 Objective

The objective of this contamination assessment was to provide information on the current and historical setting of the site in order to assess the potential for contamination sources across the site. The assessment included a limited soil investigation across the site including:

- A preliminary waste classification across the WTP site area for each soil profile; and
- Identification of any contamination that may pose risk to human health in regard to the construction works.

1.4 Scope of work

The scope of works completed by GHD included the following:

- A desktop review of the site's environmental setting including review of published information such as soil, geology and hydrogeology maps, and a search of the NSW Office of Water (groundwater database);
- A review of the provided contamination reports:
  - ERM (2013) NSW Treasury, *Mt. Piper Power Station, Preliminary Environmental Site Assessment, Ref:0194708RP03 Draft*, April 2013
  - ERM (2014) *Delta Electricity, Project Symphony – Mt Piper, Stage 2 Environmental Site Assessment, Ref 0207423RP01*, April 2014
- Preparation of a preliminary conceptual site contamination model of the site to identify the key potential sources, pathways and receptors of potential contamination.
- A site walkover to identify areas of potential contamination based on observation of surface conditions, evidence of current or former potentially contaminating activities and the surrounding built and natural environment.
- Soil sampling from nine locations across the site (GHD_TP212 - GHD_TP219 and HA01), as shown **Figure 2, Appendix A,** to provide a preliminary assessment of contamination concentrations at the site.
- Laboratory analysis of selected soil samples.
- Preparation of this report documenting the findings of the assessment and recommendations regarding the overall suitability of the site, from a contamination perspective, for future construction.

1.5 Limitations

GHD's limitations to the assessment are provided in **Section 10**.

The investigations have been limited to soil sampling. No groundwater sampling has been completed.

GHD were commissioned to undertake a preliminary investigation with limited soil sampling. We note that the scope of works completed in this investigation did not include soil sampling in full accordance with the sampling density detailed in the NSW EPA *Sampling Design Guidelines* 1995. GHD also note that the asbestos assessment comprised asbestos identification analysis only; the investigation has not been completed in full compliance with the NEPM (2013) guidelines for asbestos assessment.

2. Site setting

2.1 Site identification

A site location plan is provided as **Figure 1, Appendix A**. A summary of available information pertaining to the site is presented in **Table 1.**

Table 1 Site identification summary

Information	Details
Site address	Mt Piper Power Station – Lot 363 Boulder Road, Blackmans Flat
Lot and DP	Parts of Lot 2 DP 702619, Lot 1 DP 829065 and Lot 103 of DP 1164619
Geographic Coordinates	-33.36362, 150.03491
Local Government Area	Lithgow City Council
Parish	Lidsdale
County	Cook
Local Land Use Zoning	SP2 Infrastructure
Current Land Use	The investigation area is a fenced off area, which is part of the overall MPPS site.

2.1.1 Site inspection

An experienced environmental scientist from GHD undertook a site inspection on 2 and 3 June 2016. Photographs taken during the site inspection, as referenced below, are provided in **Appendix B.** In summary the following observations were made at the time of inspection:

- The southern portion of the site was vacant, with fencing around the north and western perimeter. The southern area consisted of an unsealed surface with small shrubs and grasses, and mature trees scattered around. No buildings were present on the site at the time of site inspection (**Photographs 1 to 5).**
- The south western portion of the site (proposed construction laydown) consisted of sealed and un-sealed roads (**Photographs 6)**. The area has two large water tanks and two building. One is a possible workshop; the other building belongs to a third party company that leases the building.
- The northern portion of the site is located inside the power station operational area and includes two above ground storage tanks that contain diesel. There was no evidence of visual and or olfactory evidence of contamination.
- The ground in the southern portion of the site is built up compared to the MPPS operational footprint.
- The northern portion of the site generally slopes towards the north, with surface water expected to flow in this direction. The southern part of the site is relatively flat.

2.1.2 Surrounding land use

Land immediately adjacent to the site consists of the following:

- North: Operational area of the power station and water holding ponds. Further north is the Castlereagh Highway and Ben Bullen State Forest.
- East: Buffer lands and the conveyor line through the Springvale Coal Services Site (SCSS). Above ground storage tanks are located to the east of the proposed salt slurry

ponds. Lamberts north ash repository is located further east followed by Blackmans Flat township.

- South: South east of the site is Ben Bullen State Forest and south to south west is forested land.
- West: Transgrid transmission towers and former landfills associated with the Mt Piper Power Station, followed by forested buffer lands and the town of Portland.

2.2 Environmental setting

2.2.1 Topography and drainage

The site is approximately 960 metres Australian height datum (m AHD), according to the *NSW Land and Property Information Spatial Information Exchange*. The topography across the site appears to be sloping generally towards the north. Surface water flow is expected to follow local topography on-site and flow in a northerly direction towards the site boundary into stormwater drainage systems. To the east of the site, the site rises up to approximately 1000 m AHD.

2.2.2 Soils and landscapes

The *Soil Landscapes of the Wallerawang 1:100,000 Sheet map and report (1993),* classifies the soil as disturbed terrain (8931xx) describes the soil and landscape as follows:

- Landscape: made land on various geologies (unconsolidated).
- Soils: Dominated by Anthroposols in disturbed areas. Here most of the original soil has either been removed, buried or greatly disturbed. In gravel pits and quarries bedrock is often exposed whilst in landfill areas of transported earths, sediment and industrial, building and household wastes are found. These areas may be artificially topsoiled or covered by concrete and bitumen.
- Vegetation: Generally completely devoid of original vegetation.
- Limitations: Are dependent on nature of fill material and may include mass movement hazard (subsidence), soil permeability leading to poor drainage, low fertility and toxic material. Care must be taken when these sites are developed. A survey at a suitable scale as well as a geotechnical analysis should be undertaken. Advice from local councils should be sought concerning individual areas of disturbed terrain.

2.2.3 Hydrology

The closest receiving water body from the site is Wangcol Creek, approximately 1.2 km north. This creek flows into the Coxs River approximately 2.5 kilometres east of the site.

2.2.4 Geology

According to the Sydney 1:250,000 *Geological Series Sheet SI 56-5,* the site appears to be underlain by the following geological units outlined in **Table 2**.

Table 2 Published geology

Period	Group	Description
Permian	Cullen Bullen Subgroup of the Illawarra Coal measures	Shale, sandstone, conglomerate, tuff, chert and coal seams.
Permian	Shoalhaven	Shale, sandstone, conglomerate and chert with coal, torbanite seams.

2.2.5 Hydrogeology

The *1:2,000,000 Groundwater in New South Wales, Assessment of Pollution Risk Map* indicates that the site is likely to be underlain by shale, siltstone in other sedimentary basins with a low potential for groundwater movement.

The groundwater environment in the locality can be complex due to past land use. The greatest complexity has been observed located around the MPPS and SCSS operation areas where groundwater is connected to remnant open cut areas, some of which have been backfilled and others remain open. SKM (2010) indicate that following mining (pillar extraction) the connectivity between surface and groundwater can increase up to three times due to changes permeability and storage capacities above the mine. This is supported by observations at SCSS where a number of groundwater recharge areas exist which maintain an influencing factor over discharge volume and quality currently.

The mudstone and siltstone units that are present between the primary coals seams (the Lidsdale and Lithgow seams) and sandstones throughout the profile will significantly retard vertical flow between aquifer units. Much of this material has been extracted through mining activities.

Typical usage of groundwater, regionally, has been limited to stock and not potable, due to the low bore yields and water qualities (SKM 2010).

GHD conducted a review of existing groundwater borehole records using the NSW Water Information Database. The search was conducted to identify registered groundwater boreholes in close proximity and to record information such as use and standing water level. There are no groundwater bores within a 1 km radius of the site on this database apart from three monitoring bores associated with the site.

3. Review of previous reports

3.1 ERM, Preliminary Environmental Site Assessment, April 2013

ERM undertook a preliminary environmental site assessment of the entire MPPS site in 2013. The report summarises the history of the power station and the surrounding environment / receptors to gain an understanding of the past and present land uses in respect to contamination.

The ERM report summaries previous environmental investigations that have been conducted at MPPS. The investigations have been targeted to specific identified sections within MPPS with no comprehensive site wide assessment. These areas included the former landfill sites, the underground fuel storage tanks and groundwater modelling assessment into the proposed extension of the brine conditioned ash placement area at different areas of the site.

The report identified a number of potential contamination sources associated with the operation of the Power Station and recommended a detailed site investigation of these areas. The areas of potential contamination included:

- Former mine and backfilling of operational area
- Former landfills
- Coal storage area
- Electrical transformers
- Water holding ponds
- Workshops
- Mobile plant refuelling area
- Operational and decommissioned underground storage tanks (USTs)
- Operational above ground storage tanks (ASTs) (two x 1.2 mega litre (ML) diesel tanks)
- Current ash repository
- Lamberts North ash repository

The report noted that part of the site has been subject to underground and some open cut mining operations in the past with no other contaminating activities were known.

The report recommended a Stage 2 Environmental site assessment to complete a site wide contamination assessment to gain a baseline understanding of the entire MPPS site.

3.2 ERM, Stage 2 Environmental Site Assessment, August 2014

ERM undertook a stage 2 Environmental Site Assessment across the MPPS. The investigation was targeted to the areas of potential contamination as well as coverage across the MPPS boundary. Soil, sediment and groundwater was collected and analysed and compared against screening criteria to assess the potential risk to human health and the environment.

The main conclusions of the report were no impacts identified in soil, sediment and groundwater that represent a risk to human health and/or the environment based on continued use of the area as a power station. There were some localised areas of contamination at the mobile plant refuelling area and underground storage tank. Heavy metals in soils were identified across the site above the human health and environment screening criteria and is potentially associated with the contributions from former mine workings both from on-site and off-site.

Results associated with the WTP

The area assessed by ERM that is associated with the WTP was called the ML – non-operational areas. The area included buffer land and the former contractor's yards. The report states that the area proposed for the WTP has been extensively mined and partly or full backfilled with mine overburden. The area proposed for the construction laydown area has had soil and groundwater investigation undertaken during 2014 included:

- 16 soil bores to a maximum depth of 0.15 metres below ground level (m bgl), and a further six locations that had to be abandoned due to refusal or service encountered with a maximum depth of 0.75 m bgl; and
- Two groundwater monitoring wells to 25 m bgl.

One groundwater well (ML_MW05) was installed in the area associated with the proposed WTP area to a depth of 19 m bgl and one soil bore (ML-MW02) near the proposed salt slurry ponds to a depth of 0.6 m bgl due to refusal.

The results from this assessment are discussed in **Section 7**.

4. Preliminary conceptual site model

Based on the current information, the following preliminary contamination conceptual site model (CSM) has been developed for the potential on-site sources of contamination.

4.1 Sources

4.1.1 Historical

Based on the historical land use of the site, prior to 1984, the site was previously used for coal mining activities, both open cut and underground. After 1984 the site and surrounding area became part of the MPPS site. The site has been filled in with possible mining overburden and other fill material may be present. The site may have been used to store road/soil material of unknown origin during construction phases for the development of MPPS.

4.1.2 Current

To the south in the non-operational areas the site is vacant partially vegetated land, and the area to the north of the proposed salt slurry ponds has minimal vegetation with no infrastructure present. To the east of this area are two ASTs holding diesel.

Off-site potential sources of contamination include:

- Two 1.25 ML ASTs containing diesel.
- The active operational power station.

4.2 Pathways

The primary pathways by which receptors could be exposed to the sources of contamination outlined above are considered to be:

- Direct contact or inhalation with contaminated shallow soil or dust (including asbestos).
- Ingestion of soils and dust.
- Outdoor inhalation of vapours.
- Vertical and horizontal migration through the unsaturated zone into the saturated zone and horizontal migration within the groundwater.

4.3 Receptors

When evaluating potential adverse health / environmental effects from exposure to a contaminated site, all potentially exposed populations should be considered. For the site, the key populations or receptors of interest are considered to include:

- On-site commercial / industrial workers of the Power Station.
- Intrusive maintenance (utility) and construction workers.
- Soil and groundwater.

4.4 Potential source-pathway-receptor linkages

Based on the current information, the following preliminary contamination conceptual site model (CSM) has been developed for potential on site sources of contamination in **Table 3** below.

Table 3 Preliminary conceptual site model

Potential Source	Potential Contaminants	Potential Pathway	Potential Receptor
Historical Site Users – Fill materials. Two ASTs (off site)	TRH BTEX PAH PCB OPP OCP Phenols Heavy Metals Asbestos	Human exposure: • Ingestion of soils and dust. • Outdoor inhalation of dust. • Dermal contact with soil and dust. • Outdoor inhalation of vapours.	Human: • Persons undertaking construction, demolition and maintenance works. • On-site commercial / industrial workers at the power station
		Environmental exposure: • Surface Water runoff. • Vertical migration through the unsaturated zone into the saturated zone and horizontal migration within the groundwater.	Environmental: • Groundwater on and off site. • Surface water:

TRH – Total Recoverable Hydrocarbons; BTEX – Benzene, Toluene, Ethyl benzene and Xylene; PAH – Polycyclic Aromatic Hydrocarbons; PCB – Polychlorinated Biphenyl's; OPP – Organo-phosphate pesticides; OCP – Organo-chlorine Pesticides; VOC – Volatile Organic Compounds

5. Site investigation guidelines

5.1 Relevant guidelines

The framework for the contamination assessment made herein, was developed in accordance with guidelines "made or approved", by the NSW EPA under Section 105 of the *Contaminated Land Management Act, 1997*. These guidelines include, but are not limited to the following:

- NEPM (1999) *National Environment Protection (Assessment of Site Contamination) Measure*, National Environment Protection Council (NEPC), amended 2013.
- NSW DEC (2006) *Contaminated Sites: Guidelines for NSW Site Auditor Scheme (2nd Edition).*
- NSW EPA (2015) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997.*
- NSW EPA (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.*

Additional guidelines referred to in this report are:

- NSW EPA (2014) *Waste Classification Guidelines Part 1: Classifying Waste.*
- Friebel and Nadebaum 2011, *Technical Report No. 10: Health screening levels for petroleum hydrocarbons in soil and groundwater*.

The investigations were undertaken in accordance with the National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure (NEPM)* (December 2013).

GHD were commissioned to undertake a preliminary investigation with limited soil sampling. We note that the scope of works completed in this investigation did not include soil sampling in full accordance with the sampling density detailed in the NSW EPA *Sampling Design Guidelines* 1995. GHD also note that the asbestos assessment comprised asbestos identification analysis only; the investigation has not been completed in full compliance with the NEPM (2013) guidelines for asbestos assessment.

5.2 Assessment criteria

5.2.1 Soil assessment criteria

Published NEPM screening criteria include health-based investigation levels (HILs) and health screening levels (HSLs). They provide for a range of different exposure settings, which are based on the nature of the use(s) for which the land is currently used and/or its approved use(s). The site is currently zoned for energy generation in an SP2 infrastructure zoning. Therefore, this assessment is based on exposure setting D (commercial/industrial) from herein referred as HIL D or HSL D.

A summary of the soil investigation levels which have been used to assess soil contamination levels is presented in **Table 4**.

Table 4 Adopted soil criteria

Parameter	Soil (mg/kg)			
	HIL D	HSL D 0 - <1 m (Sand)	HSL D 1 - 2 m (Sand)	HSL D 2 - 4 m (Sand)
Arsenic Cadmium Chromium (VI) Copper Lead Mercury (inorganic) Nickel Zinc	3,000 900 3,600 240,000 1,500 730 6,000 400,000	-		-
TRH C_6-C_{10}(F1) TRH C_{10}-C_{16}(F2)	- -	260 NL	370 NL	630 NL
Benzene Toluene Ethylbenzene Xylenes Naphthalene	- - - - -	3 NL NL 230 NL	3 NL NL NL NL	3 NL NL NL NL
Total PAH Carcinogenic PAHs as (BaP TEQ)[1]	4,000 40	-		-
OCP: Aldrin and Dieldrin DDT + DDD + DDE[2] Heptachlor	 45 3,600 50	-		-
Total PCBs	7	-		-
Asbestos	Nil	-		-

1. BaP TEQ – Benzo(a)pyrene toxicity equivalent quotient

2. DDT + DDD + DDE – dichlorodiphenyltrichloroethane + Dichlorodiphenyldichloroethylene+ Dichlorodiphenyldichloroethane

NL = Non limiting

Management Limits and Direct Contact

In accordance with Section 2.9 of Schedule B (1) of the ASC NEPM, consideration of Management Limits is required to be undertaken to assess whether the reported soil conditions have the potential to pose a potential risk to buried infrastructure, present a fire or explosion risk, or result in the formation of non-aqueous phase liquids (NAPL).

CRC Care direct contact for commercial workers and shallow trench intrusive maintenance works have also been assessed, based on the construction works that are required with the WTP.

The adopted management limits (coarse grained soils) and direct contact criteria applicable to the site are shown on **Table 1, Appendix D**.

5.2.1 Waste classification

The NSW EPA (2014), *Waste Classification Guidelines Part 1: Classifying Waste* provides criteria for assessing the appropriate waste classification and subsequent disposal location for solid and liquid wastes.

The classification process for non-liquid wastes focuses on the potential for the waste to release chemical contaminants into the environment through contact with liquids (leachates). The guidelines set different maximum levels of the leachable concentration of each contaminant in order for waste to be classified as general solid or restricted solid waste. If the level exceeds industrial the waste criteria the material is classified as hazardous.

The second test used to complete the assessment is the Specific Contamination Concentration (SCC) test, which determines the total concentration of each contaminant. In the waste sample the guidelines set different maximum levels for the total concentration of each contaminant in order for waste to be classified as inert, solid, or industrial waste. If the level exceeds the industrial waste criteria the material must be classified as hazardous waste.

6. Sampling and analysis programme

6.1 General

The following section provides details of the sampling and analysis programme that was developed to address the objectives and the scope of works for the project.

6.2 Workplace health and safety

GHD developed a site specific health safety and environment (HSE) plan for the site investigation works as part of the overall commitment to provide a healthy and safe working environment for staff and contractors. All work employed appropriate personal protection equipment (PPE).

The HSE plan included a job safety and environment analysis detailing the step by step procedures of all aspects of the works and associated hazards and control measures to be implemented. The HSE plan was read by all GHD personnel and subcontractors and feedback and discussion provided prior to the works commencing. A site specific pre-start safety assessment was conducted each morning before commencing works.

GHD also completed a site inspection prior to on-site intrusive works to finalise the proposed borehole locations, which included the following:

- Accessibility of each location was checked by GHD's site representative; and
- Services clearance was undertaken by a professional underground services locator to further reduce the risk of intersecting subsurface services during the intrusive works, and dial before you dig were also referenced.

6.3 Sampling locations and details

A total of eight test pits (TP212 to TP219) were drilled across the site to assess potential soil contamination. Excavation was undertaken using a 30-tonne excavator. One hand auger was undertaken in the proposed WTP construction laydown area.

The test pits were advanced in accordance with GHD procedures which have been prepared in accordance with industry standards, to depths of up to 6 metres below ground level (m bgl) when bedrock was encountered.

Prior to undertaking intrusive works at the site, the locations were inspected and assessed by a service location contractor engaged by GHD. Utilising Dial Before you Dig (DBYD) utility plans as an indicator of the below ground utilities entering the site, the service locator used a cable avoidance tool and signal generator to scan the proposed exploratory areas for services.

During excavation of the test pits, soil samples were collected at intervals from the surface profile until termination including where changes in the lithology or indications of contamination were observed. Samples were recovered directly from excavator bucket and representative samples were transferred to laboratory prepared sample jars for transfer to the nominated laboratory. Soil lithology was recorded on field logs as a record of the material encountered. Copies of the borehole logs are included in **Appendix C**. The geology encountered during these works is discussed in **Section 7.1.1**.

12 parent soil samples and one duplicate were submitted to the nominated laboratory for analysis for the contaminants of potential concern (CoPC), these contaminants include:

- Heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn).

- Total Recoverable Hydrocarbons (TRH).
- Polycyclic aromatic hydrocarbons (PAH).
- Benzene, toluene, ethyl benzene and xylenes (BTEX).
- Organochloride pesticides (OCPs) / Organophosphate pesticides (OPPs) (subset of samples).
- Polychlorinated biphenyls (PCB) (subset of samples).
- Phenols (subset of samples).
- Volatile organic compounds (VOCs) (subset of samples).
- Asbestos (presence ID).

All spoil material generated from the excavation of the test pits was used to backfill the locations following sampling.

Soil samples were collected at the intervals as detailed on the borehole logs and soils were described in general accordance with the Unified Soil Classification System (USCS), with features such as seepage, discolouration, staining, odours and other indications of contamination being noted.

All samples were screened in the field using a hand held photo-ionisation detector (PID). A PID was used to measure volatile organic concentrations in ambient air and is useful as a preliminary 'check' for the possible presence of volatile contaminants such as BTEX and light fraction TRH species. The results of the PID screen are provided on the logs.

6.4 Quality assurance

6.4.1 Field quality controls

All fieldwork was conducted in general accordance with GHD's procedures which have been prepared in accordance with industry standards, aimed at collecting all environmental samples using a set of uniform and systematic methods, as required by GHD's Quality Assurance system. Key requirements of these procedures were as follows:

- Appropriately trained and experienced staff documented site activities using photographs and notes on standard field forms such as daily and sampling logs.
- Logging procedures - all samples were described using a recognised system.
- Calibration procedures - all field monitoring equipment was appropriately calibrated.
- Sample identification procedures - collected samples were immediately transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers were clearly labelled with a sample number, sample location, sample depth, sample date and sampler's initials. The sample containers were transferred to a chilled cooler for sample preservation prior to and during shipment to the testing laboratory.
- Chain of custody information requirements - a chain-of-custody form was completed and forwarded to the testing laboratory.

As detailed in the GHD field quality control procedures used during the project comprised the collection and analysis of the following:

Blind Duplicates: Comprise a single sample that is divided into two separate sampling containers. Both samples were sent anonymously to the project laboratory. Blind duplicates

provide an indication of the analytical precision of the laboratory, but are inherently influenced by other factors such as sampling techniques and sample media heterogeneity.

Duplicates were assessed by calculating the Relative Percentage Difference (RPD) between the primary and duplicate samples, and the results are discussed in **Section 7**.

6.4.2 Laboratory programme

Laboratory Information

The laboratory used was Eurofins MGT (Sydney) whom adopted their internal procedures and NATA accredited methods in accordance with their quality assurance system.

Laboratory QA/QC

Laboratory quality control procedures used during the project included:

Laboratory Duplicate Samples: The analytical laboratory collects duplicate sub samples from one sample submitted for analytical testing at a rate equivalent to one in twenty samples per analytical batch, or one sample per batch if less than twenty samples are analysed in a batch. A laboratory duplicate provides data on the analytical precision and reproducibility of the test result.

Spiked Samples: An authentic field sample is 'spiked' by adding an aliquot of known concentration of the target analyte(s) prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques. Spiked samples will be analysed for each batch where samples are analysed for organic chemicals of concern.

Certified Reference Standards: A reference standard of known (certified) concentration is analysed along with a batch of samples. The Certified Reference Standard (CRS) or Laboratory Control Spike provides an indication of the analytical accuracy and the precision of the test method and is used for inorganic analyses.

Surrogate Standard / Spikes: These are organic compounds which are similar to the analyte of interest in terms of chemical composition, extractability, and chromatographic conditions (retention time), but which are not normally found in environmental samples. These surrogate compounds are 'spiked' into blanks, standards and samples submitted for organic analyses by gas-chromatographic techniques prior to sample extraction. Surrogate Standard/Spikes provide a means of checking that no gross errors have occurred during any stage of the test method leading to significant analyte loss.

Method Blank: Usually an organic or aqueous solution that is as free as possible of analytes of interest to which is added all the reagents, in the same volume, as used in the preparation and subsequent analysis of the samples. The reagent blank is carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample.

The individual testing laboratory conducted an assessment of the laboratory QC program, internally; however, the results were also independently reviewed and assessed by GHD.

Laboratory duplicate samples should return RPDs within the NEPM acceptance criteria of ±30%. Percent recovery is used to assess spiked samples and surrogate standards. Percent recovery; although dependent on the type of analyte tested, concentrations of analytes and sample matrix; should normally range from about 70-130%. Method (laboratory) blanks should return analyte concentrations as 'not detected'.

7. Site investigation results

7.1 General

Soil analytical results have been compared to the site investigation levels referenced in **Section 5**, and have been used to assess risks to identified receptors for commercial / industrial scenario. **Table 1, Appendix D**, provides a comparison of the analytical data with the appropriate site investigation levels for soil.

7.1.1 Stratigraphy

The soil profile conditions at the site for the preliminary site investigations were relatively consistent in all the test pit locations.

The area proposed for the WTP has been filled with mine overburden with the depth to bedrock varying across the site. **Table 5** shows the stratigraphy encountered in the test pits.

Table 5 Stratigraphy of the test pits

Location	Fill / Natural	Material Description	Depth range (m)	Sampled
TP212	Fill	Top Soil	0-0.1	-
	Fill	Sandy Clayey Gravel	0.1-2.7	Yes
	Fill	Coal with sandy gravel	2.7 - 4	Yes
	Bedrock	Sandstone	4 – not determined	-
TP213	Fill	Sandy Clayey Gravel	0.0 – 2.4	Yes
	Fill	Coal with sandy gravel	2.4-4.0	Yes
	Residual	Sandy Clay	4.0-5.1	-
	Bedrock	Shale	5.1 – not determined	-
TP214	Fill	Sandy Clayey Gravels and Gravelly Clays	0-1.4	Yes
	Fill	Coal with sandy gravels	1.4-2.8	-
	Fill	Sandy Clayey Gravels and Gravelly Clays	2.8- not determined	-
TP215	Fill	Topsoil	0-0.2	Yes
	Fill	Sandy Clayey Gravels and Gravelly Clays	0.2 – 2.7	Yes
	Residual	Clay	2.7 – 3.4	Yes
	Bedrock	Shale	3.4 - not determined	-
TP216	Fill	Sandy Clayey Gravels	0-4.0	Yes
	Residual	Sandy Clay	4.0 to not determined	-
TP217	Fill	Clayey Sand	0-0.6	Yes
	Residual	Clay	0.6-2.3	Yes
	Bedrock	Shale	2.3 - not determined	-
TP218	Fill	Sandy Gravel	0-4.3	Yes
	Bedrock	Shale	4.3 - not determined	-
TP219	Fill	Sandy Clayey Gravel	0-0.6	Yes
	Coal	Lidsdale Coal Seam	0.6-0.9	Yes
	Bedrock	Sandstone	0.9 - not determined	-

Fill materials in the form of mine overburden were identified at all the intrusive investigation locations with fill varying in thickness. Fill material generally consisted of sandy clayey Gravels and gravelly Clays.

The natural clay residual soil profile generally consisted of red orange with grey, low to medium plasticity, firm to stiff.

Underlying the residual soils is Sandstone and Shale of the Illawarra Coal measures.

Detailed soil profile information from the investigation are supplied in the borehole logs provided in **Appendix C**.

7.1.2 Visual and olfactory indications of soil contamination

No visual or olfactory indications of potential contamination were observed. A PID was used to screen for volatiles for samples collected during the preliminary site investigation, with readings ranging from <0.1 to 0.3 ppm.

7.2 Analytical results

7.2.1 GHD results

The soil investigation laboratory results are presented in **Table 1, Appendix D** and laboratory reports are provided in **Appendix E**.

Heavy Metals

Heavy metals concentrations were reported in the majority of samples. However, all concentrations were below the applicable guidelines for risk to human health.

TRH and BTEX

All soil samples reported concentrations of BTEX below the laboratory practical quantitation limit (PQL). TRH concentrations were above the PQL for the heavy end fractions of C_{10} – C_{40}.

In the concentrations that were reported above the PQL, there were no samples that exceeded the applicable guidelines for HSL D. The reported concentrations were in the heavy fraction TRH C_{16} – C_{40} and ranged between:

- C_{10}-C_{16} (Less naphthalene) – 130 – 170 mg/kg at TP212, TP213, TP214 and HA01
- C_{16}-C_{34} – 140 – 1,600 mg/kg at TP212, TP213, TP214, TP216 and HA01.
- C_{34} – C_{40} – 110 – 190 mg/kg at TP212, TP213 and HA01

PAHs

All samples reported concentrations less than the applicable HIL-D and HSL D guideline criteria. The following analytes had concentrations above the PQL:

- Pyrene concentrations ranged 0.6 – 1.4 mg/kg at TP212, TP213, TP214, TP216 and HA01
- Anthracene concentrations ranged 1.2 – 2.5 mg/kg at TP213, TP214
- Benz(a)anthracene concentrations ranged 0.6 – 0.8 mg/kg at TP212, TP213, TP214 and HA01
- Chrysene concentrations ranged 0.6 – 1.0 mg/kg at TP212, TP213, TP214, TP216 and HA01

- Fluoranthene concentrations ranged 0.7 – 1.8 mg/kg at TP212, TP213, TP214, TP216 and HA01
- Phenanthrene concentrations ranged 0.9- 3.2 mg/kg at TP212, TP213, TP214, TP216 and HA01
- PAHs (Sum of total) concentrations ranged 2.8 – 10 mg/kg at TP212, TP213, TP214, TP216 and HA01

OCP/OPP/PCB

All soil samples reported concentrations less than the laboratory PQL.

VOCs

All soil samples reported concentrations less than the laboratory PQL.

Phenols

All soil samples reported concentrations less than the laboratory PQL.

Asbestos

A total of eight near surface fill material were submitted for analysis, all soil samples resulted in no detectable asbestos fragments or fibres in the soil.

7.2.2 ERM (2014) results

Proposed WTP construction laydown area

16 hand augers, two monitoring wells and six abandoned boreholes were completed in the area and surrounding area of the proposed construction laydown area. The soil results from this investigation have been compared to the screening criteria nominated in **Section 5**. The following was noted:

- No asbestos was detected
- All TRH, BTEX, PAHs, metals, phenols, VOCs and PCBs are all below the nominated screening criteria.

Two monitoring wells were installed in this area and depth to groundwater was noted greater than 22 m bgl and therefore will not be encountered during the construction works.

Proposed WTP site area

One groundwater well ML_MW05 was drilled and installed in this area to a depth of 19 m bgl. The soil results from this investigation have been compared to the screening criteria nominated in **Section 5**. The following was noted:

- No asbestos was detected
- All TRH, BTEX, PAHs, metals, phenols, VOCs and PCBs are all below the nominated screening criteria.

Proposed Salt Slurry ponds

One soil bore was attempted in this area ML_MW02 and was abandoned due to refusal. Located adjacent to this area are the above ground storage tanks that contain diesel. Five groundwater monitoring wells were installed in the surrounding area to depths ranging from 13 to 27 m bgl. The groundwater in this area was inferred to be present from 11 – 25 m bgl, under semi-confined conditions within the sandstone and coal strata. The soil results from this

investigation have been compared to the screening criteria nominated in **Section 5**. The following was noted:

- No asbestos was detected
- All TRH, BTEX, PAHs, metals, phenols, VOCs and PCBs are all below the nominated screening criteria.

7.3 Preliminary Waste Classification (In-situ soils)

The concentrations of contaminants were compared to the criteria outlined in **Section 5** of the NSW EPA (2014) *Waste Classification Guidelines, Park 1: Classifying Waste.* The results are summarised in **Table 1, Appendix D.**

Overall, all of the samples fell below the applicable criteria for general solid waste in the proposed WTP site area and potential site of salt slurry ponds. The proposed WTP construction laydown area based on ERM (2014) results has two locations within the boundary of the proposed area and two locations in the surrounding area that exceeds the general solid waste criteria as shown on **Figure 3, Appendix A**. Three locations ML_SB35, ML_SB37 and ML_MW17 are classified restricted solid waste for exceeding nickel. One location ML_SB36 exceeds the general solid waste for chromium and the restricted solid waste for nickel and is therefore classified as hazardous waste. Of note these locations are on the periphery of the boundary of the study and further investigation is required once the final design areas are known. All five locations within the ASTs area exceeded the general solid waste screening criteria for nickel.

It is noted that the lithology of the material identified in these test pits should be similar in composition for the waste classification of the material sampled considered being general solid waste.

All fill material if required to be removed from site from areas near the test pits TP212 to TP219 locations should be disposed to a waste facility licensed to accept *general solid waste.* The area of HA01 and ERM (2014) locations is a mixture of *general, restricted and hazardous solid waste*.

Further detailed waste classification will be required prior to any off-site disposal.

7.4 QA/QC data quality assessment

7.4.1 Field QA/QC

Soil RPDs

As part of the GHD QA/QC programme, one blind duplicate sample was analysed from the fieldworks. Concentrations were reported for heavy metals, TRH and PAHs, however for BTEX, phenols, VOCs OCPs, OPPs, PCBs, reported concentrations below the limit of laboratory reporting and as a result, it was not possible to calculate a RPD for these samples. For analytes with detected concentrations reported, RPDs were within the acceptable range with the exception of one exceedance shown in **Table 2, Appendix D.**

The result is not considered to be significant, and the elevated RPD for is less than 10 times the PQL and marginally over the 30% acceptance criteria.

7.4.2 Laboratory QA/QC

Holding times

All analytes were extracted within the laboratory's technical holding times.

Laboratory program

The NATA certified laboratory utilised for this assessment (Eurofins MGT Sydney) undertook their own quality assurance and quality control procedures for sample analysis. GHD has reviewed the internal laboratory control data provided within the laboratory reports, which are attached as **Appendix E**.

- **Duplicate sample nickel**: The laboratory RPD acceptance criterion has been exceeded for S16-JN06053 (TP213_1.0) with a RPD of 33%
- **Duplicate sample zinc**: The laboratory RPD acceptance criterion has been exceeded for S16-JN06053 (TP213_1.0) with a RPD of 31%

  Both the RPDs for duplicate results are accepted due to passing Eurofins | mgt's internal Acceptance Criteria in laboratory report 503414.

All other method blank results were less than the PQL, and surrogate spike and laboratory control sample recoveries were within laboratory acceptance criteria.

7.4.3 Discussion

The results of the QA/QC programme are considered to provide an acceptable degree of confidence in the analytical program completed. Overall, the analytical data set is considered to be valid and acceptable to base conclusions on the contamination status of the site.

8. Conclusions and recommendations

GHD Pty Ltd (GHD) was commissioned to conduct a preliminary contamination assessment including a desktop study and limited sampling at a portion of the proposed site for the WTP at the MPPS located at Lot 363 Boulder Road, Blackmans Flat, NSW.

GHD undertook the field investigations on 2 and 3 June 2016, at the site to assess the nature of soil contamination on-site and assess potential risks posed by the identified contaminants of potential concern.

The subsurface conditions across the site have been observed to comprise of Fill (mine overburden) overlying residual soil (orange/red/brown Clay) then the Illawarra Coal Measures.

Reviews of previous environmental investigation and site settings indicate a potential for contamination on the site in localised areas of fill. Searches identified multiple premises nearby the site with the potential for contaminating activities, such as commercial use of the MPPS and the above ground storage tanks containing diesel located adjacent to the site. However, it was considered that the primary potential sources are the fill deposits present on the site as a result of previous land uses.

The following results were obtained:

- All soil results including previous investigations undertaken by ERM, were below the nominated human health screening criteria.
- No asbestos fibres were identified in the soil samples.
- The preliminary in-situ waste classification of the soil on site is classified as:
  - Proposed WTP site area: general solid waste.
  - Proposed WTP construction laydown area: The area of HA01 and ERM (2014) locations is a mixture of *general, restricted and hazardous solid waste*. Once final design is known this should be reassessed.
  - Proposed salt slurry ponds: general solid waste.

Based on the findings detailed in this report the preliminary conceptual site model provided in **Table 3** has been updated for the site and is considered that none of the source pathway and receptors is complete.

GHD considers that based on the site investigation data there is limited risk to human health during construction of the WTP, and standard PPE would be suitable for the works.

Given the extensively fill material at the site, any site safety or environmental management plans for the construction works should include an unexpected find protocol.

We recommend further sampling of material for waste classification purposes if any material is to be removed off-site.

9. References

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Department of Primary Industries, Office of Water; NSW Water Information Database http://allwaterdata.water.nsw.gov.au/water.stm

NEPM (1999) *National Environment Protection (Assessment of Site Contamination) Measure*, National Environment Protection Council (NEPC), amended 2013.

NSW EPA (1995) *Sampling Design Guidelines* 1995

NSW Department of Mine, Sydney 1:250,000 *Geological Series Sheet SI 56-5,*

NSW DEC (2006) *Contaminated Sites: Guidelines for NSW Site Auditor Scheme (2nd Edition).*

NSW EPA (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.*

NSW EPA (2015) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997.*

NSW EPA (2014) *Waste Classification Guidelines Part 1: Classifying Waste.*

NSW Land and Property Information Spatial Information Exchange. https://maps.six.nsw.gov.au/

SKM (2010) *Mt Piper Power Station Ash Placement Project. Appendix D, Hydrology and Water Quality*, Sinclair Knight Merz, prepared for Delta Electricity.

10. Limitations

This Contamination Assessment Report

- has been prepared by GHD for Springvale Coal and EnergyAustralia;
- may only be used and relied on by Springvale Coal and EnergyAustralia;
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To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- were limited to those specifically detailed in Section 1.3 of this Report and GHD proposals dated 18 May 2016, document number 21/25109/215164; and
- were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the site conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations."

GHD has prepared this Report on the basis of information provided by Springvale Coal and EnergyAustralia and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work.

GHD expressly disclaims responsibility in connection with the unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information."

No investigations have been undertaken into any off-site conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site.

The opinions, conclusions and any recommendations in this Report are based on information obtained from, and testing undertaken at or in connection with, specific sampling points and may not fully represent the conditions that may be encountered across the site at other than these locations. Conditions at other parts of the site may be different from the site conditions found at the specific sampling points.

Investigations undertaken in respect of this Report were constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this Report.

GHD has considered and/or tested for only those chemicals specifically referred to in this Report and makes no statement or representation as to the existence (or otherwise) of any other chemicals.

Site conditions (including any the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD expressly disclaims responsibility:

- arising from, or in connection with, any change to the site conditions; and
- to update this Report if the site conditions change.

Except as otherwise expressly stated in this Report GHD makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill material has been imported on to the site at any time, or if any buildings constructed prior to the prohibition date of asbestos in Australia, 31 December 2003, have been demolished on the site or material from such buildings disposed of on the site, the site may contain asbestos or ACM.

Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigation carried out prior to this Report. As a result, it is unlikely that the results and estimations expressed or used to compile this Report will represent conditions at any location other than the specific points of sampling. A site that appears to be unaffected by contamination at the time of the Report may later, due to natural causes or human intervention, become contaminated.

Except as otherwise expressly stated in this Report, GHD makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

These Limitations should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report.

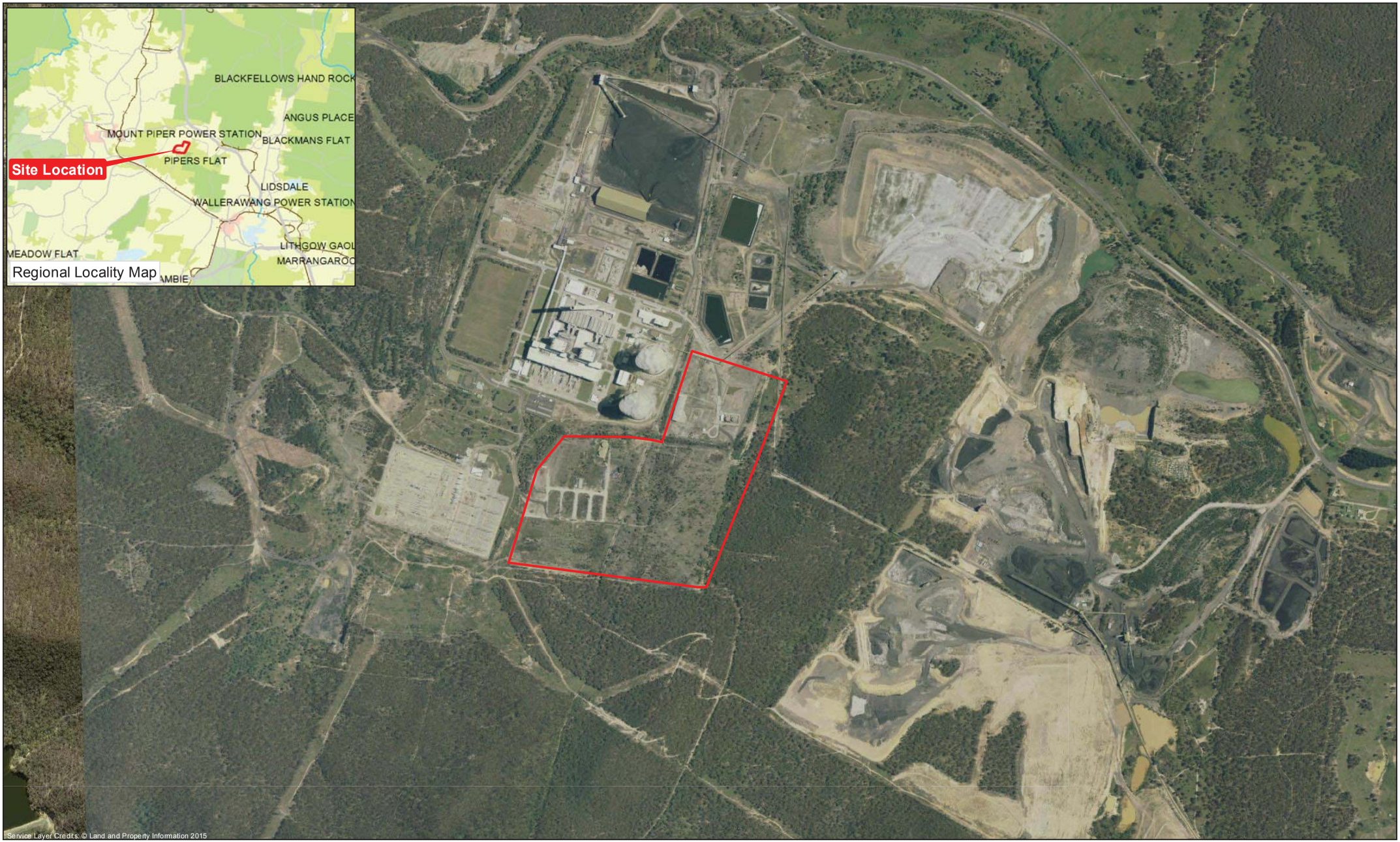
Appendices

Appendix A – Figures

Figure 1 – Site Location Plan

Figure 2 – Site Layout Plan and Sampling Locations

Figure 3 – Exceedances Plan



0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Site Boundary (Approximate)

Centennial Coal
EA/CEY Water Treatment Project
Contamination Assessment

Job Number	21-25109-21
Revision	A
Date	24 Jun 2016

Site Location Plan

Figure 1

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0 20 40 60 80 100
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Site Boundary (Approximate)
- Investigation Areas (Approximate)
- Test Pit Location (GHD, 2016)
- Hand Auger Location (GHD, 2016)

Centennial Coal
EA/CEY Water Treatment Project
Contamination Assessment

Job Number	21-25109-21
Revision	A
Date	24 Jun 2016

Investigation Locations

Figure 2

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Data source: General Topo - NSW LPI DTDB 2012, Imagery - sixmaps 2015. Created by:tnham

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0 20 40 60 80 100
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Site Boundary (Approximate)
- Investigation Areas (Approximate)
- Test Pit Location (GHD, 2016)
- Hand Auger Location (GHD, 2016)
- Monitoring Well Location (ERM, 2014)
- Soil Borehole Location (ERM, 2014)

Waste Classification

- General Solid Waste
- Restricted Solid Waste
- Hazardous Solid Waste

Centennial Coal
EA/CEY Water Treatment Project
Contamination Assessment

Job Number	21-25109-21
Revision	A
Date	24 Jun 2016

Waste Classifications

Figure 3

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Appendix B – Site Inspection Photographs

21-25109-17 Mt Piper Power Station, NSW
Site Inspection Photographs



Photograph 1 – Area for the proposed WTP site.



Photograph 2 – Area for the proposed WTP site.



Photograph 3 – Area for the proposed WTP site.



Photograph 4 – Area for the proposed WTP site near TP214.



Photograph 5 – Area for the proposed WTP site near TP215.



Photograph 6 – Area for the proposed construction laydown with HA01.



Photograph 7 – TP217 soil profile.



Photograph 8 – TP215 soil profile.



Photograph 9 – TP213 soil profile.



Photograph 10 – TP212 soil profile.



Photograph 11 – TP216 soil profile.



Photograph 12 – TP214 soil profile.



Photograph 13 – TP219 soil profile.



Photograph 14 – TP218 soil profile.

Appendix C – Soil Borehole Logs

TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP212

SHEET 1 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
						Note: * indicates signatures on original issue of log or last revision of log			
			0.10			SILT, brown, trace clay (topsoil).	M	L	
		D			GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occasional cobbles and boulders of siltstone and shale (fill).	M	MD	0.1, Compacted
1									
2		D							
			2.70						
		D			GP	COAL, black, sandy gravel, fine to coarse gravel within fine to medium grained sand (fill).	SM-M	L-MD	2.7, Compacted
3									

DRAFT

See standard sheets for details of abbreviations & basis of descriptions

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-25109-17

TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP212

SHEET 2 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
						COAL, as previous.	SM-M	L-MD	
4			4.00			SANDSTONE, grey, fine to medium grained, highly weathered, low to medium strength.	M	-	4.0, Bedrock
		D	4.30			End of Test pit at 4.3 metres. Hard Digging.			
5									
6									

DRAFT

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-25109-17

TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP213

SHEET 1 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		D			GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occasional cobbles and boulders of siltstone and shale (fill).	M	MD	0.0, Compacted
		B							
1									
		D							
2									
			2.40		GP	COAL, black, sandy gravel, fine to coarse gravel within fine to medium grained sand (fill).	SM-M	L-MD	2.4, Compacted
		D							
3									

DRAFT

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-25109-17

TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP213

SHEET 2 **OF** 2

Position: TBA	**Surface RL:** TBC		**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**		**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER		**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
						COAL, as previous.	SM-M	L-MD	
4			4.00		CL-CH	Sandy CLAY, orange yellow, fine to medium grained sand (residual).			4.0, Pilcon Shear Vane Cu ~ 90kPa???
		D							
		D				4.80m, becoming red grey.			
5			5.10						
		D	5.20			SHALE, grey, highly weathered, iron stained joints, very low to low strength.			5.1, Bedrock
						End of Test pit at 5.2 metres. Hard Digging.			
6									

Note: * indicates signatures on original issue of log or last revision of log

DRAFT

See standard sheets for details of abbreviations & basis of descriptions

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-25109-17

TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP214

SHEET 1 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occasional cobbles and boulders of siltstone and shale (fill).	SM	L-MD	0.0, Compacted
		D	0.40		CL	Gravelly CLAY, brown with fine to coarse angular gavel of siltstone, sandstone and shale (fill).	M	St-VSt	
		D	0.80		GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occasional cobbles and boulders of siltstone and shale (fill).	M	MD	
1			1.40		GP	COAL, black, sandy gravel, fine to coarse gravel within fine to medium grained sand (fill).	M-VM	L-MD	1.4, Compacted
2			2.80		GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occasional cobbles and boulders of siltstone and shale (fill).	M	L-MD	2.9, Test pit sides collapsing below about
3									

Note: * indicates signatures on original issue of log or last revision of log

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-25109-17

TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP214

SHEET 2 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		B				Sandy Clayey GRAVEL, as previous.	M	L-MD	2.9m depth
								L	3.6, Not compacted
4									
5									
6			6.00			End of Test pit at 6 metres			

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TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP215

SHEET 1 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log — Comments Observations
						SILT, brown, trace clay (topsoil).	D	-	
			0.20		GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occasional cobbles and boulders of siltstone and shale (fill).	SM	L-MD	0.2, Compacted
		D							
1			1.20		GC	Gravelly CLAY, grey with fine to medium grained sand, with cobbles (fill).	VM	F	
		D							
2			2.70			CLAY, orange brown, with silt and lithorelics of siltstone and shale (residual).	M	VSt	
3									

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Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP215

SHEET 2 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		B				CLAY, as previous.	M	VSt	
			3.40			SHALE, grey with clay seams, extremely to highly weathered, very low to low strength.			3.4, Bedrocks
4		D	4.50			End of Test pit at 4.5 metres.			
5									
6									

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Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP216

SHEET 1 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		D			GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occasional cobbles and boulders of siltstone and shale (fill).	M	L	
1			1.90		GP-GC	COBBLES and BOULDERS, brown, in a sandy gravel matrix (fill).	M	L	1.9, Sides collapsing below 1.9m depth
2									
3									

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Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP216

SHEET 2 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
						COBBLES and BOULDERS, as previous.	M	L	
4			4.00		CL-CH	Sandy CLAY, orange / yellow and grey, fine to medium grained sand (residual).	SM-M	St-VSt	4.0, Pilcon Shear Vane Cu=90, 94 kPa
		D	4.90			End of Test pit at 4.9 metres. .			
5									
6									

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Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP217

SHEET 1 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					SC	Clayey SAND, with fine to coarse angular gravel of sandstone, siltstone and shale, occasional cobbles (fill).	D	L-MD	0.0, Compacted
		D	0.60		CH	CLAY, orange, trace fine sand (residual).	-	VSt-H	
1		D							
			1.20		CH	CLAY, grey and orange grey, some fine sand (residual).			1.2, Original rock fabric recognisable
		B							
2			2.30			SHALE, grey brown, extremely weathered, extremely low strength.	-	VSt-H	2.3, Shale lithorelics in a clay matrix
		D							
3									

Note: * indicates signatures on original issue of log or last revision of log

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Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP217

SHEET 2 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
						SHALE, as previous.	-	VSt-H	
						Becoming low strength.			
			3.50			End of Test pit at 3.5 metres. .			
4									
5									
6									

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Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP218

SHEET 1 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
1		D			GP	Sandy GAVEL, grey brown, trace clay, fine to coarse angular gravel of coal, siltstone in fine to medium grained sand matrix, occasional cobbles and boulders (fill).	SM-M	MD	0.0, Compacted orange sand encountered or east end of test pit. Possible service backfill? TP extended to the west
2		B							
3									

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Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP218

SHEET 2 **OF** 2

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
4						Sandy GRAVEL, as previous.	SM-M	MD	
		D	4.30			SHALE, grey brown, highly weathered, low strength.			4.30, Bedrock
			4.50			End of Test pit at 4.5 metres.			
5									
6									

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TEST PIT LOG SHEET

Client: CENTENNIAL COAL PTY LTD.

Project: EA / CEY WATER TRANSFER PIPELINE

Location: WALLERAWANG - MT PIPER, NSW

HOLE No. GHD-TP219

SHEET 1 **OF** 1

Position: TBA	**Surface RL:** TBC	**Processed:** YL
Method of Exploration: Komotsu PC 300	**Hole Size:**	**Checked:** 20/06/16
Date:	**Logged by:** B. BATCHELDER	**Date:** B.B

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
					GP-GC	Sandy Clayey GRAVEL, grey brown, fine to coarse, angular gravel of siltstone and shale, trace silt, occassional cobbles and boulders of siltstone and shale (fill).	M	MD	
			0.60						
		D				COAL, black, vitreous, slightly weathered, very low to low strength.			0.60, Bedrock (lidsdale seam)
			0.90						
		D	1.00			SANDSTONE, grey, fine to medium grained, extremely weathered, very low strength.			
1						End of Test pit at 1 metres.			
2									
3									

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Appendix D – Summary of Soil Results and QAQC

Appendix d
Table 1
Soil Analytical Results

	Inorganics	Asbestos															Metals								TRH - NEPM 2013						TRH - NEPM 1999					
	Moisture Content (dried @ 103°C)	ACM - Comment	AF - Comment	Approximate Sample Mass	Asbestos from ACM in Soil (%w/w)	FA- Comment	ACM Mass	Mass AF	Mass Asbestos in ACM	Mass asbestos in AF	Mass Asbestos in FA	Mass Asbestos in FA & AF	Mass FA	Asbestos from FA & AF in Soil (%w/w)	Organic Fibres - Comment	Respirable Fibres - Comment	Synthetic Fibres - Comment	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)
	%	Comment	Comment	g	%w/w	Comment	g	g	g	g	g	g	g	%w/w	Comment	Comment	Comment	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	1																	2	0.4	5	5	5	0.05	5	5	20	20	50	50	100	100	20	20	50	50	50
NSW EPA (2014) General Solid Waste CT1 (No Leaching)																		100	20	100		100	4	40								650[#1]				10000[#1]
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)																		400	80	400		400	16	160								2600[#1]				40000[#1]
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil																		3000[#2]	900	3600[#3]	240000	1500[#4]	730[#5]	6000	400000											
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand																																				
0-1m																										260[#9]		NL[#10]								
1-2m																										370[#9]		NL[#10]								
2-4m																										630[#9]		NL[#10]								
>4m																										NL[#10]		NL[#10]								
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse Soil																											700[#11]		1000[#11]	3500	10000					
CRCCare Soil Direct Contact HSL-D Commercial / Industrial																											26000		20000	27000	38000					
CRCCare Soil Direct Contact Intrusive Works																											82000		62000	85000	120000					
SampleCode	**Field_ID**	**Location_Code**	**Sample_Depth (m)**	**Sampled Date**																																	
S16-Jn06065	HA01	HA01	-0.1	03-Jun-16	8.8	1[#3]	1[#3]	75	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	2.9	<0.4	<5	7.1	11	<0.05	9.1	15	<20	<20	370	370	1600	140	<20	230	1300	600	2130
S16-Jn06055	TP212_0.2	TP212	-0.2	03-Jun-16	10	1[#3]	1[#3]	72	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	9.6	<0.4	6.8	20	20	<0.05	18	45	<20	<20	140	140	590	<100	<20	83	460	230	773
S16-Jn06056	TP212_2.9	TP212	-2.9	03-Jun-16	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.9	<0.4	<5	9.9	15	<0.05	15	28	<20	<20	130	130	770	110	<20	150	640	230	1020
S16-Jn06057	QC01	TP212	-2.9	03-Jun-16	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	<0.4	<5	8.6	13	<0.05	14	25	<20	<20	170	170	1000	<100	<20	170	770	270	1210
S16-Jn06052	TP213_0.2	TP213	-0.2	03-Jun-16	-	1[#3]	1[#3]	75	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06053	TP213_1.0	TP213	-1	03-Jun-16	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.8	<0.4	<5	11	16	<0.05	23	44	<20	<20	130	130	560	<100	<20	130	460	180	770
S16-Jn06054	TP213_3.1	TP213	-3.1	03-Jun-16	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.4	<0.4	<5	8.3	9.6	<0.05	6.9	15	<20	<20	180	180	1000	190	<20	110	920	300	1330
S16-Jn06058	TP214_0.2	TP214	-0.2	03-Jun-16	11	1[#3]	1[#3]	72	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	4.9	<0.4	<5	9.6	13	<0.05	16	67	<20	<20	150	150	730	<100	<20	140	560	220	920
S16-Jn06049	TP215_0.2	TP215	-0.2	02-Jun-16	-	1[#3]	1[#3]	93	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06050	TP215_1.2	TP215	-1.2	02-Jun-16	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.9	<0.4	7.9	7.2	20	<0.05	11	24	<20	<20	<50	<50	<100	<100	<20	<20	<50	<50	<50
S16-Jn06051	TP215_3.0	TP215	-3	02-Jun-16	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	<0.4	5.1	24	27	<0.05	19	61	<20	<20	<50	<50	<100	<100	<20	<20	<50	<50	<50
S16-Jn06059	TP216_0.2	TP216	-0.2	03-Jun-16	-	1[#3]	1[#3]	71	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06060	TP216_0.5	TP216	-0.5	03-Jun-16	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.7	<0.4	<5	12	14	<0.05	13	60	<20	<20	<50	<50	140	<100	<20	<20	100	<50	100
S16-Jn06047	TP217_0.2	TP217	-0.2	02-Jun-16	7.6	1[#3]	1[#3]	74	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	7.7	<0.4	6.9	5.9	15	0.1	7.1	15	<20	<20	<50	<50	<100	<100	<20	<20	<50	<50	<50
S16-Jn06048	TP217_1.0	TP217	-1	02-Jun-16	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.6	<0.4	16	12	28	0.11	<5	16	<20	<20	<50	<50	<100	<100	<20	<20	<50	<50	<50
S16-Jn06061	TP218_0.2	TP218	-0.2	03-Jun-16	-	1[#3]	1[#3]	61	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06062	TP218_4.0	TP218	-4	03-Jun-16	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	<0.4	64	33	18	<0.05	19	73	<20	<20	<50	<50	<100	<100	<20	<20	<50	<50	<50
S16-Jn06063	TP219_0.2	TP219	-0.2	03-Jun-16	-	1[#3]	1[#3]	98	0	1[#3]	0	0	0	0	0	0	0	0	1[#2]	1[#1]	1[#3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06064	TP219_0.5	TP219	-0.5	03-Jun-16	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	<0.4	6.5	25	15	<0.05	22	74	<20	<20	<50	<50	<100	<100	<20	<20	<50	<50	<50
Statistical Summary																																								
Number of Results					14	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Number of Detects					14	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	14	0	7	14	14	2	13	14	0	0	7	7	8	3	0	7	8	7	8
Minimum Concentration					7.6	1	1	61	0	1	0	0	0	0	0	0	0	1	1	1	1	2.9	<0.4	<5	5.9	9.6	<0.05	<5	15	<20	<20	<50	<50	<100	<100	<20	<20	<50	<50	<50
Minimum Detect					7.6	1	1	61	ND	1	ND	ND	ND	ND	ND	ND	ND	1	1	1	1	2.9	ND	5.1	5.9	9.6	0.1	6.9	15	ND	ND	130	130	140	110	ND	83	100	180	100
Maximum Concentration					22	1	1	98	0	1	0	0	0	0	0	0	0	1	1	1	1	19	<0.4	64	33	28	0.11	23	74	<20	<20	370	370	1600	190	<20	230	1300	600	2130
Maximum Detect					22	1	1	98	ND	1	ND	ND	ND	ND	ND	ND	ND	1	1	1	1	19	ND	64	33	28	0.11	23	74	ND	ND	370	370	1600	190	ND	230	1300	600	2130
Average Concentration					13	1	1	77	0	1	0	0	0	0	0	0	0	1	1	1	1	7.4	0.2	9.3	14	17	0.036	14	40	10	10	103	103	478	71	10	77	383	158	600
Median Concentration					12.5	1	1	74	0	1	0	0	0	0	0	0	0	1	1	1	1	5.55	0.2	3.8	10.45	15	0.025	14.5	36	10	10	77.5	77.5	350	50	10	46.5	280	102.5	435
Standard Deviation					4.2	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	4.9	0	16	8.3	5.4	0.029	6.1	23	0	0	100	100	495	44	0	77	415	168	669
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Env Stds Comments

#1:No TCLP analysis required
#2:Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability maybe important and should be considered where appropriate (refer Shedule B7).
#3:In the absence of a guideline value for total chromium, chromium VI value adopted
#4:Lead: HILs A,B,C based on blood lead models (IEUBK & HIL D on adult lead model for where 50% bioavailability considered. Site-specific bioavailability should be considered where appropriate.
#5:Elemental mercury: HIL does not address elemental mercury. a site specific assessment should be considered if elemental mercury is present, or suspected to be present.
#6:Total PAHs: Based on sum of 16 most common reported (WHO 98). HIL application should consider presence of carcinogenic PAHs (should meet BaP TEQ HIL) & napthalene (should meet relevant HSL)
#7:Carcinogenic PAHs: HIL based on 8 carc. PAHs & their TEFs (rel to BaP ref Schedule 7) BaP TEQ calc by multiplying the conc of each carc. PAH in sample by its BaP TEF (ref Table 1A(1)) & summing
#8:PCBs: HIL refers to non-dioxin like PCBs only. Where PCB source is known, or suspected at a site, a site-specific assessment of exposure to all PCBs (inc dioxin like PCBs) should be undertaken
#9:To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10:Derived soil HSL exceeds soil saturation concentration
#11:Separate management limits for BTEX & napthalene are not available hence should not be subtracted from the relevant fractions to obtain F1 & F2

Data Comments

#1 No respirable fibres detected
#2 Organic fibres detected.
#3 Nil

Appendix d
Table 1
Soil Analytical Results

	BTEX & MAH									PAH																				Phenols										
	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	1,2,4-trimethylbenzene	Isopropylbenzene	Styrene	Pyrene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(e)pyrene	Benzo[b+j]fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	PAHs (Sum of total) - Lab calc	Benzo(a)pyrene TEQ (zero) - Lab Calc	Benzo(a)pyrene TEQ (half LOR) - Lab Calc	Benzo(a)pyrene TEQ (upper bound) *	2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,4-dimethylphenol	2-chlorophenol	2-methylphenol	2-nitrophenol	3-&4-methylphenol	4-chloro-3-methylphenol	Pentachlorophenol	Phenol
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.1	0.1	0.1	0.1	0.2	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	1	0.5
NSW EPA (2014) General Solid Waste CT1 (No Leaching)	10	288	600			1000			60						0.8											200				8000	40				4000					
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)	40	1152	2400			4000			240						3.2											800				32000	160				16000					
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil																										4000[#6]	40[#7]	40[#7]											660	240000
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand																																								
0-1m	3	NL[#10]	NL[#10]			230																		NL[#10]																
1-2m	3	NL[#10]	NL[#10]			NL[#10]																		NL[#10]																
2-4m	3	NL[#10]	NL[#10]			NL[#10]																		NL[#10]																
>4m	3	NL[#10]	NL[#10]			NL[#10]																		NL[#10]																
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse Soil																																								
CRCCare Soil Direct Contact HSL-D Commercial / Industrial	430	99000	27000			81000																		11000																
CRCCare Soil Direct Contact Intrusive Works	1100	120000	85000			130000																		29000																

SampleCode	Field_ID	Location_Code	Sample_Depth (m)	Sampled Date																																						
S16-Jn06065	HA01	HA01	-0.1	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	1	<0.5	1.7	<0.5	<0.5	<0.5	3.2	7.7	<0.5	0.7	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
S16-Jn06055	TP212_0.2	TP212	-0.2	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	0.8	<0.5	<0.5	<0.5	1.3	3.3	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
S16-Jn06056	TP212_2.9	TP212	-2.9	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	1	<0.5	<0.5	<0.5	1.5	4	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
S16-Jn06057	QC01	TP212	-2.9	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	0.9	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	1.2	<0.5	<0.5	<0.5	1.3	4.8	<0.5	0.7	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
S16-Jn06052	TP213_0.2	TP213	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06053	TP213_1.0	TP213	-1	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	-	-	1.1	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	1.4	<0.5	<0.5	<0.5	1.4	5.9	<0.5	0.6	1.2	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06054	TP213_3.1	TP213	-3.1	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	-	-	0.8	<0.5	<0.5	1.7	0.6	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	1.2	<0.5	<0.5	<0.5	1.8	6.8	<0.5	0.6	1.2	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06058	TP214_0.2	TP214	-0.2	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	-	-	1.4	<0.5	<0.5	2.5	0.6	<0.5	<0.5	<0.5	<0.5	1	<0.5	1.8	<0.5	<0.5	<0.5	2.7	10	<0.5	0.7	1.2	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06049	TP215_0.2	TP215	-0.2	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06050	TP215_1.2	TP215	-1.2	02-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
S16-Jn06051	TP215_3.0	TP215	-3	02-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06059	TP216_0.2	TP216	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06060	TP216_0.5	TP216	-0.5	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	0.7	<0.5	<0.5	<0.5	0.9	2.8	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
S16-Jn06047	TP217_0.2	TP217	-0.2	02-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06048	TP217_1.0	TP217	-1	02-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
S16-Jn06061	TP218_0.2	TP218	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06062	TP218_4.0	TP218	-4	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06063	TP219_0.2	TP219	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06064	TP219_0.5	TP219	-0.5	03-Jun-16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

Number of Results	14	14	14	14	14	14	7	7	7	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	7	7	7	7	7	7	7	7	7	7	7
Number of Detects	0	0	0	0	0	0	0	0	0	8	0	0	3	4	0	0	0	0	8	0	8	0	0	0	8	8	0	14	14	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	ND	1.2	0.6	ND	ND	ND	ND	0.6	ND	0.7	ND	ND	ND	0.9	2.8	ND	0.6	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	1.4	<0.5	<0.5	2.5	0.8	<0.5	<0.5	<0.5	<0.5	1	<0.5	1.8	<0.5	<0.5	<0.5	3.2	10	<0.5	0.7	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1	<0.5
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	2.5	0.8	ND	ND	ND	ND	1	ND	1.8	ND	ND	ND	3.2	10	ND	0.7	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.05	0.05	0.05	0.05	0.1	0.15	0.25	0.25	0.25	0.62	0.25	0.25	0.58	0.36	0.25	0.25	0.25	0.25	0.55	0.25	0.81	0.25	0.25	0.25	1.1	3.3	0.25	0.62	1.2	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5	0.25	0.5	0.25
Median Concentration	0.05	0.05	0.05	0.05	0.1	0.15	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.75	0.25	0.25	0.25	1.1	3.05	0.25	0.6	1.2	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5	0.25	0.5	0.25
Standard Deviation	0	0	0	0	0	0	0	0	0	0.39	0	0	0.71	0.19	0	0	0	0	0.29	0	0.58	0	0	0	0.97	3.3	0	0.043	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Env Stds Comments

#1:No TCLP analysis required
#2:Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability maybe important and should be
#3:In the absence of a guideline value for total chromium, chromium VI value adopted
#4:Lead: HILs A,B,C based on blood lead models (IEUBK & HIL D on adult lead model for where 50% bioavail
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#7:Carcinogenic PAHs: HIL based on 8 carc. PAHs & their TEFs (rel to BaP ref Schedule 7) BaP TEQ calc by mu
#8:PCBs: HIL refers to non-dioxin like PCBs only. Where PCB source is known, or suspected at a site, a site-sp
#9:To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10:Derived soil HSL exceeds soil saturation concentration
#11:Separate management limits for BTEX & napthalene are not available hence should not be subtracted f

Data Comments

#1 No respirable fibres detected
#2 Organic fibres detected.
#3 Nil

Appendix d
Table 1
Soil Analytical Results

SampleCode	Field_ID	Location_Code	Sample_Depth (m)	Sampled Date	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2,3-trichloropropane	1,2-dibromoethane	1,2-dichlorobenzene	1,2-dichloroethane	1,3,5-trimethylbenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	2-butanone (MEK)	4-methyl-2-pentanone (MIBK)	Acetone	Allyl chloride	Bromodichloromethane	Bromoform	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Dichloromethane	Iodomethane	TCE	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Trichlorofluoromethane	Vinyl chloride	Bromomethane	Dichlorodifluoromethane
					VOCs																																					
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	0.05	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
NSW EPA (2014) General Solid Waste CT1 (No Leaching)					200	600	26	24		14			86	10			150	4000							10	2000			120				172		10	14				4		
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)					800	2400	104	96		56			344	40			600	16000							40	8000			480				688		40	56				16		
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil																																										
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand																																										
0-1m																																										
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NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse Soil																																										
CRCCare Soil Direct Contact HSL-D Commercial / Industrial																																										
CRCCare Soil Direct Contact Intrusive Works																																										
S16-Jn06065	HA01	HA01	-0.1	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06055	TP212_0.2	TP212	-0.2	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06056	TP212_2.9	TP212	-2.9	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06057	QC01	TP212	-2.9	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06052	TP213_0.2	TP213	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06053	TP213_1.0	TP213	-1	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06054	TP213_3.1	TP213	-3.1	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06058	TP214_0.2	TP214	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06049	TP215_0.2	TP215	-0.2	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06050	TP215_1.2	TP215	-1.2	02-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06051	TP215_3.0	TP215	-3	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06059	TP216_0.2	TP216	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06060	TP216_0.5	TP216	-0.5	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06047	TP217_0.2	TP217	-0.2	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06048	TP217_1.0	TP217	-1	02-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06061	TP218_0.2	TP218	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06062	TP218_4.0	TP218	-4	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06063	TP219_0.2	TP219	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06064	TP219_0.5	TP219	-0.5	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

Statistical Summary	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2,3-trichloropropane	1,2-dibromoethane	1,2-dichlorobenzene	1,2-dichloroethane	1,3,5-trimethylbenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	2-butanone (MEK)	4-methyl-2-pentanone (MIBK)	Acetone	Allyl chloride	Bromodichloromethane	Bromoform	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Dichloromethane	Iodomethane	TCE	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Trichlorofluoromethane	Vinyl chloride	Bromomethane	Dichlorodifluoromethane
Number of Results	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Number of Detects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	2.5	0.025	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Median Concentration	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	2.5	0.025	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Standard Deviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Env Stds Comments

#1:No TCLP analysis required
#2:Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability maybe important and should be
#3:In the absence of a guideline value for total chromium, chromium VI value adopted
#4:Lead: HILs A,B,C based on blood lead models (IEUBK & HIL D on adult lead model for where 50% bioavail
#5:Elemental mercury: HIL does not address elemental mercury. a site specific assessment should be consid
#6:Total PAHs: Based on sum of 16 most common reported (WHO 98). HIL application should consider prese
#7:Carcinogenic PAHs: HIL based on 8 carc. PAHs & their TEFs (rel to BaP ref Schedule 7) BaP TEQ calc by mu
#8:PCBs: HIL refers to non-dioxin like PCBs only. Where PCB source is known, or suspected at a site, a site-sp
#9:To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10:Derived soil HSL exceeds soil saturation concentration
#11:Separate management limits for BTEX & napthalene are not available hence should not be subtracted f

Data Comments

#1 No respirable fibres detected
#2 Organic fibres detected.
#3 Nil

								OC Pesticides																						OP Pesticides													
								1,2-dichloropropane	1,3-dichloropropane	4-chlorotoluene	Bromobenzene	Bromochloromethane	Chloromethane	4,4-DDE	a-BHC	Aldrin	b-BHC	chlordane	d-BHC	4,4 DDD	4,4 DDT	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Toxaphene	Azinophos methyl	Chlorpyrifos	Coumaphos	Demeton (total)	Diazinon	Dichlorvos	Dimethoate	Disulfoton	Ethoprop	Fenitrothion	Fensulfothion	Fenthion	Malathion	Methyl parathion	Mevinphos (Phosdrin)
								mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL								0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	1	0.2	0.2	2	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
NSW EPA (2014) General Solid Waste CT1 (No Leaching)																																				4													
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)																																				16													
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil																		530								100				50		80	2500	160		2000												
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand																																																
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CRCCare Soil Direct Contact HSL-D Commercial / Industrial																																																
CRCCare Soil Direct Contact Intrusive Works																																																
SampleCode	**Field_ID**	**Location_Code**	**Sample_Depth (m)**	**Sampled Date**																																												
S16-Jn06065	HA01	HA01	-0.1	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
S16-Jn06055	TP212_0.2	TP212	-0.2	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
S16-Jn06056	TP212_2.9	TP212	-2.9	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
S16-Jn06057	QC01	TP212	-2.9	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
S16-Jn06052	TP213_0.2	TP213	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06053	TP213_1.0	TP213	-1	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06054	TP213_3.1	TP213	-3.1	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06058	TP214_0.2	TP214	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06049	TP215_0.2	TP215	-0.2	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06050	TP215_1.2	TP215	-1.2	02-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
S16-Jn06051	TP215_3.0	TP215	-3	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06059	TP216_0.2	TP216	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06060	TP216_0.5	TP216	-0.5	03-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
S16-Jn06047	TP217_0.2	TP217	-0.2	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06048	TP217_1.0	TP217	-1	02-Jun-16	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
S16-Jn06061	TP218_0.2	TP218	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06062	TP218_4.0	TP218	-4	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06063	TP219_0.2	TP219	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06064	TP219_0.5	TP219	-0.5	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical Summary																																																
Number of Results					7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Number of Detects					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Minimum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.2	<0.2	<2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Maximum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration					0.25	0.25	0.25	0.25	0.25	0.25	0.025	0.025	0.025	0.025	0.05	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.1	0.5	0.1	0.1	1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Median Concentration					0.25	0.25	0.25	0.25	0.25	0.25	0.025	0.025	0.025	0.025	0.05	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.1	0.5	0.1	0.1	1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Standard Deviation					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Env Stds Comments

#1:No TCLP analysis required
#2:Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability maybe important and should be
#3:In the absence of a guideline value for total chromium, chromium VI value adopted
#4:Lead: HILs A,B,C based on blood lead models (IEUBK & HIL D on adult lead model for where 50% bioavail
#5:Elemental mercury: HIL does not address elemental mercury. a site specific assessment should be consid
#6:Total PAHs: Based on sum of 16 most common reported (WHO 98). HIL application should consider pres
#7:Carcinogenic PAHs: HIL based on 8 carc. PAHs & their TEFs (rel to BaP ref Schedule 7) BaP TEQ calc by mu
#8:PCBs: HIL refers to non-dioxin like PCBs only. Where PCB source is known, or suspected at a site, a site-sp
#9:To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10:Derived soil HSL exceeds soil saturation concentration
#11:Separate management limits for BTEX & napthalene are not available hence should not be subtracted f

Data Comments

#1 No respirable fibres detected
#2 Organic fibres detected.
#3 Nil

Appendix d
Table 1
Soil Analytical Results

										PCBs						
										Monocrotophos	Parathion	Phorate	Profenofos	Prothiofos	Ronnel	Stirophos	Trichloronate	Arochlor 1016	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Total)
										mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL										2	0.5	0.2	0.2	0.5	0.2	0.5	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
NSW EPA (2014) General Solid Waste CT1 (No Leaching)																								
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)																								
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil																								7[#8]
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand																								
0-1m																								
1-2m																								
2-4m																								
>4m																								
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse Soil																								
CRCCare Soil Direct Contact HSL-D Commercial / Industrial																								
CRCCare Soil Direct Contact Intrusive Works																								
SampleCode	**Field_ID**	**Location_Code**	**Sample_Depth (m)**	**Sampled Date**																				
S16-Jn06065	HA01	HA01	-0.1	03-Jun-16	<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06055	TP212_0.2	TP212	-0.2	03-Jun-16	<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06056	TP212_2.9	TP212	-2.9	03-Jun-16	<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06057	QC01	TP212	-2.9	03-Jun-16	<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06052	TP213_0.2	TP213	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06053	TP213_1.0	TP213	-1	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06054	TP213_3.1	TP213	-3.1	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06058	TP214_0.2	TP214	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06049	TP215_0.2	TP215	-0.2	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06050	TP215_1.2	TP215	-1.2	02-Jun-16	<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06051	TP215_3.0	TP215	-3	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06059	TP216_0.2	TP216	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06060	TP216_0.5	TP216	-0.5	03-Jun-16	<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06047	TP217_0.2	TP217	-0.2	02-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06048	TP217_1.0	TP217	-1	02-Jun-16	<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
S16-Jn06061	TP218_0.2	TP218	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06062	TP218_4.0	TP218	-4	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06063	TP219_0.2	TP219	-0.2	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S16-Jn06064	TP219_0.5	TP219	-0.5	03-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical Summary																								
Number of Results					7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Number of Detects					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration					<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Minimum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration					<2	<0.5	<0.2	<0.2	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Maximum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration					1	0.25	0.1	0.1	0.25	0.1	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Median Concentration					1	0.25	0.1	0.1	0.25	0.1	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Standard Deviation					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Env Stds Comments

#1:No TCLP analysis required
#2:Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability maybe important and should be
#3:In the absence of a guideline value for total chromium, chromium VI value adopted
#4:Lead: HILs A,B,C based on blood lead models (IEUBK & HIL D on adult lead model for where 50% bioavail
#5:Elemental mercury: HIL does not address elemental mercury. a site specific assessment should be consic
#6:Total PAHs: Based on sum of 16 most common reported (WHO 98). HIL application should consider prese
#7:Carcinogenic PAHs: HIL based on 8 carc. PAHs & their TEFs (rel to BaP ref Schedule 7) BaP TEQ calc by mu
#8:PCBs: HIL refers to non-dioxin like PCBs only. Where PCB source is known, or suspected at a site, a site-sp
#9:To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10:Derived soil HSL exceeds soil saturation concentration
#11:Separate management limits for BTEX & napthalene are not available hence should not be subtracted f

Data Comments

#1 No respirable fibres detected
#2 Organic fibres detected.
#3 Nil

Appendix D
Table 2
Duplicate Summary Table

Field Duplicates (soil)
Filter: SDG in('06 Jun 2016')

SDG	6-Jun-16	6-Jun-16	
Field ID	TP212_2.9	QC01	**RPD**
Sampled Date/Time	3/06/2016	3/06/2016	

Chem_Group	ChemName	Units	PQL			
Unassigned	Allyl chloride	mg/kg	0.05	<0.05	<0.05	0
Inorganics	Moisture Content (dried @ 103°C)	%	1	14	15	7
Metals	Arsenic	mg/kg	2	**4.9**	**7**	**35**
	Cadmium	mg/kg	0.4	<0.4	<0.4	0
	Chromium (III+VI)	mg/kg	5	<5	<5	0
	Copper	mg/kg	5	9.9	8.6	14
	Lead	mg/kg	5	15	13	14
	Mercury	mg/kg	0.05	<0.05	<0.05	0
	Nickel	mg/kg	5	15	14	7
	Zinc	mg/kg	5	28	25	11
TRH - NEPM 2013	C6-C10 minus BTEX (F1)	mg/kg	20	<20	<20	0
	C6 - C10 Fraction	mg/kg	20	<20	<20	0
	>C10-C16 minus Naphthalene (F2)	mg/kg	50	130	170	27
	>C10 - C16 Fraction	mg/kg	50	130	170	27
	>C16 - C34 Fraction (F3)	mg/kg	100	770	1000	26
	>C34 - C40 Fraction (F4)	mg/kg	100	110	<100	10
TRH - NEPM 1999	C6 - C 9 Fraction	mg/kg	20	<20	<20	0
	C10 - C14 Fraction	mg/kg	20	150	170	13
	C15 - C28 Fraction	mg/kg	50	640	770	18
	C29 - C36 Fraction	mg/kg	50	230	270	16
	C10 - C36 (Sum of Total)	mg/kg	50	1020	1210	17
BTEX & MAH	Benzene	mg/kg	0.1	<0.1	<0.1	0
	Toluene	mg/kg	0.1	<0.1	<0.1	0
	Ethylbenzene	mg/kg	0.1	<0.1	<0.1	0
	Xylene (o)	mg/kg	0.1	<0.1	<0.1	0
	Xylene (m & p)	mg/kg	0.2	<0.2	<0.2	0
	Xylene Total	mg/kg	0.3	<0.3	<0.3	0
	1,2,4-trimethylbenzene	mg/kg	0.5	<0.5	<0.5	0
	Isopropylbenzene	mg/kg	0.5	<0.5	<0.5	0
	Styrene	mg/kg	0.5	<0.5	<0.5	0
PAH	Pyrene	mg/kg	0.5	0.8	0.9	12
	Acenaphthene	mg/kg	0.5	<0.5	<0.5	0
	Acenaphthylene	mg/kg	0.5	<0.5	<0.5	0
	Anthracene	mg/kg	0.5	<0.5	<0.5	0
	Benz(a)anthracene	mg/kg	0.5	<0.5	0.6	18
	Benzo(a)pyrene	mg/kg	0.5	<0.5	<0.5	0
	Benzo[b+j]fluoranthene	mg/kg	0.5	<0.5	<0.5	0
	Benzo(k)fluoranthene	mg/kg	0.5	<0.5	<0.5	0
	Benzo(g,h,i)perylene	mg/kg	0.5	<0.5	<0.5	0
	Chrysene	mg/kg	0.5	0.7	0.8	13
	Dibenz(a,h)anthracene	mg/kg	0.5	<0.5	<0.5	0
	Fluoranthene	mg/kg	0.5	1	1.2	18
	Fluorene	mg/kg	0.5	<0.5	<0.5	0
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5	<0.5	<0.5	0
	Naphthalene	mg/kg	0.5	<0.5	<0.5	0
	Naphthalene	mg/kg	0.5	<0.5	<0.5	0
	Phenanthrene	mg/kg	0.5	1.5	1.3	14
	PAHs (Sum of total) - Lab calc	mg/kg	0.5	4	4.8	18
	Benzo(a)pyrene TEQ (zero) - Lab Calc	mg/kg	0.5	<0.5	<0.5	0
	Benzo(a)pyrene TEQ (half LOR) - Lab Calc	mg/kg	0.5	0.6	0.7	15
	Benzo(a)pyrene TEQ (upper bound) *	mg/kg	0.5	1.2	1.2	0
Phenols	2,4,5-trichlorophenol	mg/kg	0.5	<0.5	<0.5	0
	2,4,6-trichlorophenol	mg/kg	0.5	<0.5	<0.5	0
	2,4-dichlorophenol	mg/kg	0.5	<0.5	<0.5	0
	2,4-dimethylphenol	mg/kg	0.5	<0.5	<0.5	0
	2-chlorophenol	mg/kg	0.5	<0.5	<0.5	0
	2-methylphenol	mg/kg	0.5	<0.5	<0.5	0
	2-nitrophenol	mg/kg	0.5	<0.5	<0.5	0
	3-&4-methylphenol	mg/kg	1	<1	<1	0
	4-chloro-3-methylphenol	mg/kg	0.5	<0.5	<0.5	0
	Pentachlorophenol	mg/kg	1	<1	<1	0
	Phenol	mg/kg	0.5	<0.5	<0.5	0

Appendix D
Table 2
Duplicate Summary Table

Field Duplicates (soil)
Filter: SDG in('06 Jun 2016')

SDG				6-Jun-16	6-Jun-16	
Field ID				TP212_2.9	QC01	**RPD**
Sampled Date/Time				3/06/2016	3/06/2016	
VOCs	1,1,1,2-tetrachloroethane	mg/kg	0.5	<0.5	<0.5	0
	1,1,1-trichloroethane	mg/kg	0.5	<0.5	<0.5	0
	1,1,2,2-tetrachloroethane	mg/kg	0.5	<0.5	<0.5	0
	1,1,2-trichloroethane	mg/kg	0.5	<0.5	<0.5	0
	1,1-dichloroethane	mg/kg	0.5	<0.5	<0.5	0
	1,1-dichloroethene	mg/kg	0.5	<0.5	<0.5	0
	1,2,3-trichloropropane	mg/kg	0.5	<0.5	<0.5	0
	1,2-dibromoethane	mg/kg	0.5	<0.5	<0.5	0
	1,2-dichlorobenzene	mg/kg	0.5	<0.5	<0.5	0
	1,2-dichloroethane	mg/kg	0.5	<0.5	<0.5	0
	1,3,5-trimethylbenzene	mg/kg	0.5	<0.5	<0.5	0
	1,3-dichlorobenzene	mg/kg	0.5	<0.5	<0.5	0
	1,4-dichlorobenzene	mg/kg	0.5	<0.5	<0.5	0
	2-butanone (MEK)	mg/kg	0.5	<0.5	<0.5	0
	4-methyl-2-pentanone (MIBK)	mg/kg	0.5	<0.5	<0.5	0
	Acetone	mg/kg	5	<5	<5	0
	Bromodichloromethane	mg/kg	0.5	<0.5	<0.5	0
	Bromoform	mg/kg	0.5	<0.5	<0.5	0
	Carbon disulfide	mg/kg	0.5	<0.5	<0.5	0
	Carbon tetrachloride	mg/kg	0.5	<0.5	<0.5	0
	Chlorobenzene	mg/kg	0.5	<0.5	<0.5	0
	Chlorodibromomethane	mg/kg	0.5	<0.5	<0.5	0
	Chloroethane	mg/kg	0.5	<0.5	<0.5	0
	Chloroform	mg/kg	0.5	<0.5	<0.5	0
	cis-1,2-dichloroethene	mg/kg	0.5	<0.5	<0.5	0
	cis-1,3-dichloropropene	mg/kg	0.5	<0.5	<0.5	0
	Dibromomethane	mg/kg	0.5	<0.5	<0.5	0
	Dichloromethane	mg/kg	0.5	<0.5	<0.5	0
	Iodomethane	mg/kg	0.5	<0.5	<0.5	0
	TCE	mg/kg	0.5	<0.5	<0.5	0
	Tetrachloroethene	mg/kg	0.5	<0.5	<0.5	0
	trans-1,2-dichloroethene	mg/kg	0.5	<0.5	<0.5	0
	trans-1,3-dichloropropene	mg/kg	0.5	<0.5	<0.5	0
	Trichlorofluoromethane	mg/kg	0.5	<0.5	<0.5	0
	Vinyl chloride	mg/kg	0.5	<0.5	<0.5	0
OC Pesticides	4,4-DDE	mg/kg	0.05	<0.05	<0.05	0
	a-BHC	mg/kg	0.05	<0.05	<0.05	0
	Aldrin	mg/kg	0.05	<0.05	<0.05	0
	b-BHC	mg/kg	0.05	<0.05	<0.05	0
	chlordane	mg/kg	0.1	<0.1	<0.1	0
	d-BHC	mg/kg	0.05	<0.05	<0.05	0
	4,4 DDD	mg/kg	0.05	<0.05	<0.05	0
	4,4 DDT	mg/kg	0.05	<0.05	<0.05	0
	Dieldrin	mg/kg	0.05	<0.05	<0.05	0
	Endosulfan I	mg/kg	0.05	<0.05	<0.05	0
	Endosulfan II	mg/kg	0.05	<0.05	<0.05	0
	Endosulfan sulphate	mg/kg	0.05	<0.05	<0.05	0
	Endrin	mg/kg	0.05	<0.05	<0.05	0
	Endrin aldehyde	mg/kg	0.05	<0.05	<0.05	0
	Endrin ketone	mg/kg	0.05	<0.05	<0.05	0
	g-BHC (Lindane)	mg/kg	0.05	<0.05	<0.05	0
	Heptachlor	mg/kg	0.05	<0.05	<0.05	0
	Heptachlor epoxide	mg/kg	0.05	<0.05	<0.05	0
	Hexachlorobenzene	mg/kg	0.05	<0.05	<0.05	0
	Methoxychlor	mg/kg	0.2	<0.2	<0.2	0
	Toxaphene	mg/kg	1	<1	<1	0
OP Pesticides	Azinophos methyl	mg/kg	0.2	<0.2	<0.2	0
	Chlorpyrifos	mg/kg	0.2	<0.2	<0.2	0
	Coumaphos	mg/kg	2	<2	<2	0
	Demeton (total)	mg/kg	1	<1	<1	0
	Diazinon	mg/kg	0.2	<0.2	<0.2	0
	Dichlorvos	mg/kg	0.2	<0.2	<0.2	0
	Dimethoate	mg/kg	0.2	<0.2	<0.2	0
	Disulfoton	mg/kg	0.2	<0.2	<0.2	0
	Ethoprop	mg/kg	0.2	<0.2	<0.2	0
	Fenitrothion	mg/kg	0.2	<0.2	<0.2	0
	Fensulfothion	mg/kg	0.2	<0.2	<0.2	0
	Fenthion	mg/kg	0.2	<0.2	<0.2	0
	Malathion	mg/kg	0.2	<0.2	<0.2	0
	Methyl parathion	mg/kg	0.2	<0.2	<0.2	0
	Mevinphos (Phosdrin)	mg/kg	0.2	<0.2	<0.2	0
	Monocrotophos	mg/kg	2	<2	<2	0
	Parathion	mg/kg	0.5	<0.5	<0.5	0
	Phorate	mg/kg	0.2	<0.2	<0.2	0
	Profenofos	mg/kg	0.2	<0.2	<0.2	0
	Prothiofos	mg/kg	0.5	<0.5	<0.5	0
	Ronnel	mg/kg	0.2	<0.2	<0.2	0
	Stirophos	mg/kg	0.5	<0.5	<0.5	0
	Trichloronate	mg/kg	0.2	<0.2	<0.2	0
PCBs	Arochlor 1016	mg/kg	0.5	<0.5	<0.5	0
	Arochlor 1232	mg/kg	0.5	<0.5	<0.5	0
	Arochlor 1242	mg/kg	0.5	<0.5	<0.5	0

Appendix D
Table 2
Duplicate Summary Table

Field Duplicates (soil)
Filter: SDG in('06 Jun 2016')

SDG				6-Jun-16	6-Jun-16	
Field ID				TP212_2.9	QC01	**RPD**
Sampled Date/Time				3/06/2016	3/06/2016	
	Arochlor 1248	mg/kg	0.5	<0.5	<0.5	0
	Arochlor 1254	mg/kg	0.5	<0.5	<0.5	0
	Arochlor 1260	mg/kg	0.5	<0.5	<0.5	0
	PCBs (Total)	mg/kg	0.5	<0.5	<0.5	0
Halogenated Hydrocarbons	Bromomethane	mg/kg	0.5	<0.5	<0.5	0
	Dichlorodifluoromethane	mg/kg	0.5	<0.5	<0.5	0
Chlorinated Hydrocarbons	1,2-dichloropropane	mg/kg	0.5	<0.5	<0.5	0
	1,3-dichloropropane	mg/kg	0.5	<0.5	<0.5	0
	4-chlorotoluene	mg/kg	0.5	<0.5	<0.5	0
	Bromobenzene	mg/kg	0.5	<0.5	<0.5	0
	Bromochloromethane	mg/kg	0.5	<0.5	<0.5	0
	Chloromethane	mg/kg	0.5	<0.5	<0.5	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL))

Appendix E – Laboratory Certificates

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Phone: +613 8564 5000 Fax: +613 8564 5090
Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page ____ of ____

Company Name : GHD Pty Ltd, Sydney	**Contact Name :** Nicole Rosen	**Purchase Order :**	**COC Number :**
Office Address :	**Project Manager :** Helen Milne	**PROJECT Number :** 21/25109/21	**Eurofins | mgt quote ID :** GHD Rates 2016
Level 15, 133 Castlereagh Street, Sydney NSW 2000	**Email for results :** nicole.rosen@ghd.com; helen.milne@ghd.com	**PROJECT Name :** Mt Piper WTP investigation	**Data output format:** ESDAT

Special Directions & Comments :

please use suites where possible

Eurofins | mgt DI water batch number:

Analytes

	Sample ID	Date	Matrix	Asbestos ID	Suite B7 - TRH/BTEX/PAH/8 metals	Suite b15 - OCP/OPP/PCBS	VOC	Phenols speciated	HOLD
1	TP217_0.2	2/06/2016	Soil	X	X				
2	TP217_0.5	2/06/2016	Soil						X
3	TP217_1.0	2/06/2016	Soil		X	X	X	X	X
4	TP217_1.2	2/06/2016	Soil						X
5	TP215_0.2	2/06/2016	Soil	X					
6	TP215_0.5	2/06/2016	Soil						X
7	TP215_1.2	2/06/2016	Soil		X	X	X	X	
8	TP215_3.0	2/06/2016	Soil		X				
9	TP213_0.2	2/06/2016	Soil	X					
10	TP213_0.5	2/06/2016	Soil						X
11	TP213_1.0	2/06/2016	Soil		X				
12	TP213_2.0	2/06/2016	Soil						X
13	TP213_3.1	2/06/2016	Soil		X				
14	TP212_0.2	2/06/2016	Soil	X	X	X	X	X	
15	TP212_0.5	2/06/2016	Soil						X
16	TP212_2.0	2/06/2016	Soil						X

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

Containers:

1LP	250P	125P	1LA	40mL vial	125mL A	Jar	Bag
						X	
						✓	

Sample comments:

Relinquished By: Nicole Rosen - GHD
Date & Time :
Signature: NRosen

Laboratory Staff
Received By: Sean
Date & Time : 6/6 12:12
Signature:

Turn around time
1 DAY ☐ 2 DAY ☐ 3 DAY ☐
5 DAY ☑ 10 DAY ☐ Other:

Method Of Shipment
☐ Courier
☑ Hand Delivered
☐ Postal
Courier Consignment # :

Temperature on arrival:

Report number: 503414

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☑ **Sydney**
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☐ **Melbourne**
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Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Company Name : GHD Pty Ltd, Sydney	**Contact Name :** Nicole Rosen	**Purchase Order :**	**COC Number :**
Office Address :	**Project Manager :** Helen Milne	**PROJECT Number :** 21/25109/21	**Eurofins | mgt quote ID :** GHD Rates 2016
Level 15, 133 Castlereagh Street, Sydney NSW 2000	**Email for results :** nicole.rosen@ghd.com; helen.milne@ghd.com	**PROJECT Name :** Mt Piper WTP Investigation	**Data output format:** ESDAT

Special Directions & Comments :

please use suites where possible

Eurofins | mgt DI water batch number:

	Sample ID	Date	Matrix	Asbestos ID	Suite B7 - TRH/BTEX/PAH/8 metals	Suite b15 - OCP/OPP/PCBS	VOC	Phenols speciated	HOLD.
1	TP212_2.9	2/06/2016	Soil		X	X	X	X	
2	QC01	3/06/2016	Soil		X	X	X	X	
3	TP214_0.2	3/06/2016	Soil	X	X				
4	TP214_0.5	2/06/2016	Soil						X
5	TP214_0.9	3/06/2016	Soil						X
6	TP214_2.0	3/06/2016	Soil						X
7	TP214_3.1	3/06/2016	Soil						X
8	TP216_0.2	3/06/2016	Soil	X					
9	TP216_0.5	2/06/2016	Soil		X	X	X	X	
10	TP216_1.2	2/06/2016	Soil						X
11	TP218_0.2	2/06/2016	Soil	X					
12	TP218_0.5	2/06/2016	Soil						X
13	TP218_4.0	3/06/2016	Soil		X				
14	TP219_0.2	3/06/2016	Soil	X					
15	TP219_0.5	2/06/2016	Soil		X				
16	HA01	2/06/2016	Soil	X	X	X	X	X	

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

Containers:

1LP	250P	125P	1LA	40mL vial	125mL A	Jar	Bag
						K	

Sample comments:

Laboratory Staff

Relinquished By: Nicole Rosen - GHD
Date & Time :
Signature: Nrosen

Received By:
Date & Time : 6/6
Signature:

Turn around time

1 DAY ☐ 2 DAY ☐ 3 DAY ☐
5 DAY ☑ 10 DAY ☐ Other:

Method Of Shipment

☐ Courier
☑ Hand Delivered
☐ Postal
Courier Consignment # :

Temperature on arrival:

Report number:

12/5

Page 2 of 2.

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Site # 1254 & 14271

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NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Sample Receipt Advice

Company name:	**GHD Pty Ltd NSW**
Contact name:	Helen Milne
Project name:	MT PIPER WTP INVESTIGATION
Project ID:	21/25109/21
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Jun 6, 2016 12:12 PM
Eurofins | mgt reference:	**503414**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 1 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8400 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Helen Milne - helen.milne@ghd.com.au.

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	Helen Milne
Report	503414-AID
Project Name	MT PIPER WTP INVESTIGATION
Project ID	21/25109/21
Received Date	Jun 06, 2016
Date Reported	Jun 14, 2016

Methodology:

Asbestos ID	Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques. Bulk samples include building materials, soils and ores.
Subsampling Soil Samples	The whole sample submitted is first dried and then sieved through a 10mm sieve followed by a 2mm sieve. All fibrous matter viz greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) Iron ores - Sampling and Sample preparation procedures is employed. Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis in accordance with AS 4964-2004.
Bonded asbestos-containing material (ACM)	The material is first examined and any fibres isolated and where required interfering organic fibres or matter may be removed by treating the sample for several hours at a temperature not exceeding 400 ± 30°C. The resultant material is then ground and examined in accordance with AS 4964-2004.
Limit of Reporting	The nominal detection limit of the AS4964 method is around 0.01%. The examination of large sample sizes (at least 500 ml is recommended) may improve the likelihood of identifying asbestos material in the greater than 2 mm fraction. The NEPM screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres. NOTE: NATA News, September 2011 – page 34, states, “Weighing of fibres is problematic and can lead to loss of fibres and potential exposure for laboratory analysts. To request laboratories to report information which is outside the scope of AS 4964-2004 and the scope of their accreditation is misleading and is most unwise” therefore such values reported are outside the scope of Eurofins l mgt NATA accreditation as designated by an asterisk.

Project Name MT PIPER WTP INVESTIGATION
Project ID 21/25109/21
Date Sampled Jun 02, 2016 to Jun 03, 2016
Report 503414-AID

Client Sample ID	Eurofins | mgt Sample No.	Date Sampled	Sample Description	Result
TP217_0.2	16-Jn06047	Jun 02, 2016	Approximate Sample 74g Sample consisted of: Brown coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
TP215_0.2	16-Jn06049	Jun 02, 2016	Approximate Sample 93g Sample consisted of: Brown coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
TP213_0.2	16-Jn06052	Jun 03, 2016	Approximate Sample 75g Sample consisted of: Brown coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
TP212_0.2	16-Jn06055	Jun 03, 2016	Approximate Sample 72g Sample consisted of: Grey coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
TP214_0.2	16-Jn06058	Jun 03, 2016	Approximate Sample 72g Sample consisted of: Grey coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
TP216_0.2	16-Jn06059	Jun 03, 2016	Approximate Sample 71g Sample consisted of: Grey coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
TP218_0.2	16-Jn06061	Jun 03, 2016	Approximate Sample 61g Sample consisted of: Brown coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
TP219_0.2	16-Jn06063	Jun 03, 2016	Approximate Sample 98g Sample consisted of: Grey coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.
HA01	16-Jn06065	Jun 03, 2016	Approximate Sample 75g Sample consisted of: Grey coarse grain soil and rocks	No asbestos detected. Organic fibre detected. No respirable fibres detected.

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Asbestos - LTM-ASB-8020	Sydney	Jun 06, 2016	Indefinite

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NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: MT PIPER WTP INVESTIGATION
Project ID: 21/25109/21

Order No.:
Report #: 503414
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jun 6, 2016 12:12 PM
Due: Jun 14, 2016
Priority: 5 Day
Contact Name: Helen Milne

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos Absence /Presence	HOLD	Speciated Phenols	Eurofins | mgt Suite B15	Volatile Organics	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	TP217_0.2	Jun 02, 2016		Soil	S16-Jn06047	X					X	X
2	TP217_1.0	Jun 02, 2016		Soil	S16-Jn06048			X	X	X	X	X
3	TP215_0.2	Jun 02, 2016		Soil	S16-Jn06049	X						
4	TP215_1.2	Jun 02, 2016		Soil	S16-Jn06050			X	X	X	X	X
5	TP215_3.0	Jun 02, 2016		Soil	S16-Jn06051						X	X
6	TP213_0.2	Jun 03, 2016		Soil	S16-Jn06052	X						
7	TP213_1.0	Jun 03, 2016		Soil	S16-Jn06053						X	X
8	TP213_3.1	Jun 03, 2016		Soil	S16-Jn06054						X	X
9	TP212_0.2	Jun 03, 2016		Soil	S16-Jn06055	X		X	X	X	X	X
10	TP212_2.9	Jun 03, 2016		Soil	S16-Jn06056			X	X	X	X	X

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NATA # 1261 Site # 20794

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: MT PIPER WTP INVESTIGATION
Project ID: 21/25109/21

Order No.:
Report #: 503414
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jun 6, 2016 12:12 PM
Due: Jun 14, 2016
Priority: 5 Day
Contact Name: Helen Milne

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos Absence /Presence	HOLD	Speciated Phenols	Eurofins | mgt Suite B15	Volatile Organics	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
External Laboratory												
11	QC01	Jun 03, 2016		Soil	S16-Jn06057			X	X	X	X	X
12	TP214_0.2	Jun 03, 2016		Soil	S16-Jn06058	X					X	X
13	TP216_0.2	Jun 03, 2016		Soil	S16-Jn06059	X						
14	TP216_0.5	Jun 03, 2016		Soil	S16-Jn06060			X	X	X	X	X
15	TP218_0.2	Jun 03, 2016		Soil	S16-Jn06061	X						
16	TP218_4.0	Jun 03, 2016		Soil	S16-Jn06062						X	X
17	TP219_0.2	Jun 03, 2016		Soil	S16-Jn06063	X						
18	TP219_0.5	Jun 03, 2016		Soil	S16-Jn06064						X	X
19	HA01	Jun 03, 2016		Soil	S16-Jn06065	X		X	X	X	X	X
20	TP217_0.5	Jun 03, 2016		Soil	S16-Jn06066		X					
21	TP217_1.2	Jun 03, 2016		Soil	S16-Jn06067		X					

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Sample Detail						Asbestos Absence /Presence	HOLD	Speciated Phenols	Eurofins | mgt Suite B15	Volatile Organics	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
External Laboratory												
22	TP215_0.5	Jun 03, 2016		Soil	S16-Jn06068		X					
23	TP213_0.5	Jun 03, 2016		Soil	S16-Jn06069		X					
24	TP213_2.0	Jun 03, 2016		Soil	S16-Jn06070		X					
25	TP212_0.5	Jun 03, 2016		Soil	S16-Jn06071		X					
26	TP212_2.0	Jun 03, 2016		Soil	S16-Jn06072		X					
27	TP214_0.5	Jun 03, 2016		Soil	S16-Jn06073		X					
28	TP214_0.9	Jun 03, 2016		Soil	S16-Jn06074		X					
29	TP214_2.0	Jun 03, 2016		Soil	S16-Jn06075		X					
30	TP214_3.1	Jun 03, 2016		Soil	S16-Jn06076		X					
31	TP216_1.2	Jun 03, 2016		Soil	S16-Jn06077		X					
32	TP218_0.5	Jun 03, 2016		Soil	S16-Jn06078		X					

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Received: Jun 6, 2016 12:12 PM
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Contact Name: Helen Milne

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail	Asbestos Absence /Presence	HOLD	Speciated Phenols	Eurofins	mgt Suite B15	Volatile Organics	Moisture Set	Eurofins	mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271									
Sydney Laboratory - NATA Site # 18217	X	X	X	X		X	X		X
Brisbane Laboratory - NATA Site # 20794									
External Laboratory									
Test Counts	9	13	7	7		7	14		14

Internal Quality Control Review and Glossary

General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Units

% w/w: weight for weight basis	grams per kilogram
Filter loading:	fibres/100 graticule areas
Reported Concentration:	fibres/mL
Flowrate:	L/min

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
COC	Chain of custody
SRA	Sample Receipt Advice
ISO	International Stardards Organisation
AS	Australian Standards
WA DOH	Western Australia Department of Health
NOHSC	National Occupational Health and Safety Commission
ACM	Bonded asbestos-containing material means any material containing more than 1% asbestos and comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin. Common examples of ACM include but are not limited to: pipe and boiler insulation, sprayed-on fireproofing, troweled-on acoustical plaster, floor tile and mastic, floor linoleum, transite shingles, roofing materials, wall and ceiling plaster, ceiling tiles, and gasket materials. This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.
FA	FA comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).
PACM	Presumed Asbestos-Containing Material means thermal system insulation and surfacing material found in buildings, vessels, and vessel sections constructed no later than 1980 that are assumed to contain greater than one percent asbestos but have not been sampled or analyzed to verify or negate the presence of asbestos.
AF	Asbestos fines (AF) are defined as free fibres, or fibre bundles, smaller than 7mm. It is the free fibres which present the greatest risk to human health, although very small fibres (< 5 microns in length) are not considered to be such a risk. AF also includes small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substatntial degree of damage which increases the potential for fibre release.)
AC	Asbestos cement means a mixture of cement and asbestos fibres (typically 90:10 ratios).

Comments

The samples received were deemed to be too large for AS4964, i.e. more than about 100 g. It was therefore necessary to reduce their size to that which could be thoroughly examined. Valid sub-sampling procedures were applied so as to ensure that the sub-samples to be analysed accurately represented the samples received.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N/A	Not applicable

Authorised by:

Rhys Thomas Senior Analyst-Asbestos (NSW)



Glenn Jackson
National Operations Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

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Certificate of Analysis

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Helen Milne**

Report **503414-S**
Project name MT PIPER WTP INVESTIGATION
Project ID 21/25109/21
Received Date Jun 06, 2016

Client Sample ID			**TP217_0.2**	**TP217_1.0**	**TP215_1.2**	**TP215_3.0**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S16-Jn06047**	**S16-Jn06048**	**S16-Jn06050**	**S16-Jn06051**
Date Sampled			**Jun 02, 2016**	**Jun 02, 2016**	**Jun 02, 2016**	**Jun 02, 2016**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	102	103	104	71
Volatile Organics						
1.1-Dichloroethane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.1-Dichloroethene	0.5	mg/kg	-	< 0.5	< 0.5	-
1.1.1-Trichloroethane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.1.1.2-Tetrachloroethane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.1.2-Trichloroethane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.1.2.2-Tetrachloroethane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.2-Dibromoethane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.2-Dichlorobenzene	0.5	mg/kg	-	< 0.5	< 0.5	-
1.2-Dichloroethane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.2-Dichloropropane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.2.3-Trichloropropane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.2.4-Trimethylbenzene	0.5	mg/kg	-	< 0.5	< 0.5	-
1.3-Dichlorobenzene	0.5	mg/kg	-	< 0.5	< 0.5	-
1.3-Dichloropropane	0.5	mg/kg	-	< 0.5	< 0.5	-
1.3.5-Trimethylbenzene	0.5	mg/kg	-	< 0.5	< 0.5	-
1.4-Dichlorobenzene	0.5	mg/kg	-	< 0.5	< 0.5	-
2-Butanone (MEK)	0.5	mg/kg	-	< 0.5	< 0.5	-
2-Propanone (Acetone)	5	mg/kg	-	< 5	< 5	-
4-Chlorotoluene	0.5	mg/kg	-	< 0.5	< 0.5	-
4-Methyl-2-pentanone (MIBK)	0.5	mg/kg	-	< 0.5	< 0.5	-
Allyl chloride	0.05	mg/kg	-	< 0.05	< 0.05	-

Client Sample ID			TP217_0.2	TP217_1.0	TP215_1.2	TP215_3.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06047	S16-Jn06048	S16-Jn06050	S16-Jn06051
Date Sampled			Jun 02, 2016	Jun 02, 2016	Jun 02, 2016	Jun 02, 2016
Test/Reference	LOR	Unit				
Volatile Organics						
Benzene	0.1	mg/kg	-	< 0.1	< 0.1	-
Bromobenzene	0.5	mg/kg	-	< 0.5	< 0.5	-
Bromochloromethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Bromodichloromethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Bromoform	0.5	mg/kg	-	< 0.5	< 0.5	-
Bromomethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Carbon disulfide	0.5	mg/kg	-	< 0.5	< 0.5	-
Carbon Tetrachloride	0.5	mg/kg	-	< 0.5	< 0.5	-
Chlorobenzene	0.5	mg/kg	-	< 0.5	< 0.5	-
Chloroethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Chloroform	0.5	mg/kg	-	< 0.5	< 0.5	-
Chloromethane	0.5	mg/kg	-	< 0.5	< 0.5	-
cis-1.2-Dichloroethene	0.5	mg/kg	-	< 0.5	< 0.5	-
cis-1.3-Dichloropropene	0.5	mg/kg	-	< 0.5	< 0.5	-
Dibromochloromethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Dibromomethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Dichlorodifluoromethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Ethylbenzene	0.1	mg/kg	-	< 0.1	< 0.1	-
Iodomethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Isopropyl benzene (Cumene)	0.5	mg/kg	-	< 0.5	< 0.5	-
m&p-Xylenes	0.2	mg/kg	-	< 0.2	< 0.2	-
Methylene Chloride	0.5	mg/kg	-	< 0.5	< 0.5	-
o-Xylene	0.1	mg/kg	-	< 0.1	< 0.1	-
Styrene	0.5	mg/kg	-	< 0.5	< 0.5	-
Tetrachloroethene	0.5	mg/kg	-	< 0.5	< 0.5	-
Toluene	0.1	mg/kg	-	< 0.1	< 0.1	-
trans-1.2-Dichloroethene	0.5	mg/kg	-	< 0.5	< 0.5	-
trans-1.3-Dichloropropene	0.5	mg/kg	-	< 0.5	< 0.5	-
Trichloroethene	0.5	mg/kg	-	< 0.5	< 0.5	-
Trichlorofluoromethane	0.5	mg/kg	-	< 0.5	< 0.5	-
Vinyl chloride	0.5	mg/kg	-	< 0.5	< 0.5	-
Xylenes - Total	0.3	mg/kg	-	< 0.3	< 0.3	-
Fluorobenzene (surr.)	1	%	-	108	108	-
4-Bromofluorobenzene (surr.)	1	%	-	103	104	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5

Client Sample ID			TP217_0.2	TP217_1.0	TP215_1.2	TP215_3.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06047	S16-Jn06048	S16-Jn06050	S16-Jn06051
Date Sampled			Jun 02, 2016	Jun 02, 2016	Jun 02, 2016	Jun 02, 2016
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	114	111	104	109
p-Terphenyl-d14 (surr.)	1	%	123	113	103	124
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	< 0.1	< 0.1	-
4.4'-DDD	0.05	mg/kg	-	< 0.05	< 0.05	-
4.4'-DDE	0.05	mg/kg	-	< 0.05	< 0.05	-
4.4'-DDT	0.05	mg/kg	-	< 0.05	< 0.05	-
a-BHC	0.05	mg/kg	-	< 0.05	< 0.05	-
Aldrin	0.05	mg/kg	-	< 0.05	< 0.05	-
b-BHC	0.05	mg/kg	-	< 0.05	< 0.05	-
d-BHC	0.05	mg/kg	-	< 0.05	< 0.05	-
Dieldrin	0.05	mg/kg	-	< 0.05	< 0.05	-
Endosulfan I	0.05	mg/kg	-	< 0.05	< 0.05	-
Endosulfan II	0.05	mg/kg	-	< 0.05	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	-	< 0.05	< 0.05	-
Endrin	0.05	mg/kg	-	< 0.05	< 0.05	-
Endrin aldehyde	0.05	mg/kg	-	< 0.05	< 0.05	-
Endrin ketone	0.05	mg/kg	-	< 0.05	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	-	< 0.05	< 0.05	-
Heptachlor	0.05	mg/kg	-	< 0.05	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	-	< 0.05	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	-	< 0.05	< 0.05	-
Methoxychlor	0.2	mg/kg	-	< 0.2	< 0.2	-
Toxaphene	1	mg/kg	-	< 1	< 1	-
Dibutylchlorendate (surr.)	1	%	-	82	87	-
Tetrachloro-m-xylene (surr.)	1	%	-	76	84	-
Polychlorinated Biphenyls (PCB)						
Aroclor-1016	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1232	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1242	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1248	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1254	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1260	0.5	mg/kg	-	< 0.5	< 0.5	-
Total PCB*	0.5	mg/kg	-	< 0.5	< 0.5	-
Dibutylchlorendate (surr.)	1	%	-	82	87	-

Client Sample ID			TP217_0.2	TP217_1.0	TP215_1.2	TP215_3.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06047	S16-Jn06048	S16-Jn06050	S16-Jn06051
Date Sampled			Jun 02, 2016	Jun 02, 2016	Jun 02, 2016	Jun 02, 2016
Test/Reference	LOR	Unit				
Speciated Phenols						
2.4-Dichlorophenol	0.5	mg/kg	-	< 0.5	< 0.5	-
2.4-Dimethylphenol	0.5	mg/kg	-	< 0.5	< 0.5	-
2.4.5-Trichlorophenol	0.5	mg/kg	-	< 0.5	< 0.5	-
2.4.6-Trichlorophenol	0.5	mg/kg	-	< 0.5	< 0.5	-
Phenol	0.5	mg/kg	-	< 0.5	< 0.5	-
2-Methylphenol (o-Cresol)	0.5	mg/kg	-	< 0.5	< 0.5	-
3&4-Methylphenol (m&p-Cresol)	1	mg/kg	-	< 1	< 1	-
2-Chlorophenol	0.5	mg/kg	-	< 0.5	< 0.5	-
2-Nitrophenol	0.5	mg/kg	-	< 0.5	< 0.5	-
4-Chloro-3-methylphenol	0.5	mg/kg	-	< 0.5	< 0.5	-
Pentachlorophenol	1	mg/kg	-	< 1	< 1	-
Phenol-d5 (surr.)	1	%	-	113	110	-
Organophosphorus Pesticides (OP)						
Azinphos-methyl	0.2	mg/kg	-	< 0.2	< 0.2	-
Chlorpyrifos	0.2	mg/kg	-	< 0.2	< 0.2	-
Coumaphos	2	mg/kg	-	< 2	< 2	-
Demeton (total)	1	mg/kg	-	< 1	< 1	-
Diazinon	0.2	mg/kg	-	< 0.2	< 0.2	-
Dichlorvos	0.2	mg/kg	-	< 0.2	< 0.2	-
Dimethoate	0.2	mg/kg	-	< 0.2	< 0.2	-
Disulfoton	0.2	mg/kg	-	< 0.2	< 0.2	-
Ethoprop	0.2	mg/kg	-	< 0.2	< 0.2	-
Fenitrothion	0.2	mg/kg	-	< 0.2	< 0.2	-
Fensulfothion	0.2	mg/kg	-	< 0.2	< 0.2	-
Fenthion	0.2	mg/kg	-	< 0.2	< 0.2	-
Malathion	0.2	mg/kg	-	< 0.2	< 0.2	-
Methyl parathion	0.2	mg/kg	-	< 0.2	< 0.2	-
Mevinphos	0.2	mg/kg	-	< 0.2	< 0.2	-
Monocrotophos	2	mg/kg	-	< 2	< 2	-
Parathion	0.5	mg/kg	-	< 0.5	< 0.5	-
Phorate	0.2	mg/kg	-	< 0.2	< 0.2	-
Profenofos	0.2	mg/kg	-	< 0.2	< 0.2	-
Prothiofos	0.5	mg/kg	-	< 0.5	< 0.5	-
Ronnel	0.2	mg/kg	-	< 0.2	< 0.2	-
Stirophos	0.5	mg/kg	-	< 0.5	< 0.5	-
Trichloronate	0.2	mg/kg	-	< 0.2	< 0.2	-
Triphenylphosphate (surr.)	1	%	-	70	71	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
Heavy Metals						
Arsenic	2	mg/kg	7.7	4.6	6.9	2.9
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	6.9	16	7.9	5.1
Copper	5	mg/kg	5.9	12	7.2	24
Lead	5	mg/kg	15	28	20	27
Mercury	0.05	mg/kg	0.10	0.11	< 0.05	< 0.05
Nickel	5	mg/kg	7.1	< 5	11	19
Zinc	5	mg/kg	15	16	24	61

Client Sample ID			TP217_0.2	TP217_1.0	TP215_1.2	TP215_3.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06047	S16-Jn06048	S16-Jn06050	S16-Jn06051
Date Sampled			Jun 02, 2016	Jun 02, 2016	Jun 02, 2016	Jun 02, 2016
Test/Reference	LOR	Unit				
% Moisture	1	%	7.6	22	16	13

Client Sample ID			TP213_1.0	TP213_3.1	TP212_0.2	TP212_2.9
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06053	S16-Jn06054	S16-Jn06055	S16-Jn06056
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	130	110	83	150
TRH C15-C28	50	mg/kg	460	920	460	640
TRH C29-C36	50	mg/kg	180	300	230	230
TRH C10-36 (Total)	50	mg/kg	770	1330	773	1020
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	103	91	109	106
Volatile Organics						
1.1-Dichloroethane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.1-Dichloroethene	0.5	mg/kg	-	-	< 0.5	< 0.5
1.1.1-Trichloroethane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.1.1.2-Tetrachloroethane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.1.2-Trichloroethane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.1.2.2-Tetrachloroethane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.2-Dibromoethane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.2-Dichlorobenzene	0.5	mg/kg	-	-	< 0.5	< 0.5
1.2-Dichloroethane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.2-Dichloropropane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.2.3-Trichloropropane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.2.4-Trimethylbenzene	0.5	mg/kg	-	-	< 0.5	< 0.5
1.3-Dichlorobenzene	0.5	mg/kg	-	-	< 0.5	< 0.5
1.3-Dichloropropane	0.5	mg/kg	-	-	< 0.5	< 0.5
1.3.5-Trimethylbenzene	0.5	mg/kg	-	-	< 0.5	< 0.5
1.4-Dichlorobenzene	0.5	mg/kg	-	-	< 0.5	< 0.5
2-Butanone (MEK)	0.5	mg/kg	-	-	< 0.5	< 0.5
2-Propanone (Acetone)	5	mg/kg	-	-	< 5	< 5
4-Chlorotoluene	0.5	mg/kg	-	-	< 0.5	< 0.5
4-Methyl-2-pentanone (MIBK)	0.5	mg/kg	-	-	< 0.5	< 0.5
Allyl chloride	0.05	mg/kg	-	-	< 0.05	< 0.05
Benzene	0.1	mg/kg	-	-	< 0.1	< 0.1
Bromobenzene	0.5	mg/kg	-	-	< 0.5	< 0.5
Bromochloromethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Bromodichloromethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Bromoform	0.5	mg/kg	-	-	< 0.5	< 0.5

Client Sample ID			TP213_1.0	TP213_3.1	TP212_0.2	TP212_2.9
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06053	S16-Jn06054	S16-Jn06055	S16-Jn06056
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Volatile Organics						
Bromomethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Carbon disulfide	0.5	mg/kg	-	-	< 0.5	< 0.5
Carbon Tetrachloride	0.5	mg/kg	-	-	< 0.5	< 0.5
Chlorobenzene	0.5	mg/kg	-	-	< 0.5	< 0.5
Chloroethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Chloroform	0.5	mg/kg	-	-	< 0.5	< 0.5
Chloromethane	0.5	mg/kg	-	-	< 0.5	< 0.5
cis-1.2-Dichloroethene	0.5	mg/kg	-	-	< 0.5	< 0.5
cis-1.3-Dichloropropene	0.5	mg/kg	-	-	< 0.5	< 0.5
Dibromochloromethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Dibromomethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Dichlorodifluoromethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Ethylbenzene	0.1	mg/kg	-	-	< 0.1	< 0.1
Iodomethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Isopropyl benzene (Cumene)	0.5	mg/kg	-	-	< 0.5	< 0.5
m&p-Xylenes	0.2	mg/kg	-	-	< 0.2	< 0.2
Methylene Chloride	0.5	mg/kg	-	-	< 0.5	< 0.5
o-Xylene	0.1	mg/kg	-	-	< 0.1	< 0.1
Styrene	0.5	mg/kg	-	-	< 0.5	< 0.5
Tetrachloroethene	0.5	mg/kg	-	-	< 0.5	< 0.5
Toluene	0.1	mg/kg	-	-	< 0.1	< 0.1
trans-1.2-Dichloroethene	0.5	mg/kg	-	-	< 0.5	< 0.5
trans-1.3-Dichloropropene	0.5	mg/kg	-	-	< 0.5	< 0.5
Trichloroethene	0.5	mg/kg	-	-	< 0.5	< 0.5
Trichlorofluoromethane	0.5	mg/kg	-	-	< 0.5	< 0.5
Vinyl chloride	0.5	mg/kg	-	-	< 0.5	< 0.5
Xylenes - Total	0.3	mg/kg	-	-	< 0.3	< 0.3
Fluorobenzene (surr.)	1	%	-	-	105	108
4-Bromofluorobenzene (surr.)	1	%	-	-	109	106
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	130	180	140	130
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	1.2	1.7	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	0.6	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	0.8	0.7	0.6	0.7
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	1.4	1.2	0.8	1.0

Client Sample ID			TP213_1.0	TP213_3.1	TP212_0.2	TP212_2.9
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06053	S16-Jn06054	S16-Jn06055	S16-Jn06056
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	1.4	1.8	1.3	1.5
Pyrene	0.5	mg/kg	1.1	0.8	0.6	0.8
Total PAH*	0.5	mg/kg	5.9	6.8	3.3	4
2-Fluorobiphenyl (surr.)	1	%	102	106	98	99
p-Terphenyl-d14 (surr.)	1	%	117	115	103	105
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	< 0.1	< 0.1
4.4'-DDD	0.05	mg/kg	-	-	< 0.05	< 0.05
4.4'-DDE	0.05	mg/kg	-	-	< 0.05	< 0.05
4.4'-DDT	0.05	mg/kg	-	-	< 0.05	< 0.05
a-BHC	0.05	mg/kg	-	-	< 0.05	< 0.05
Aldrin	0.05	mg/kg	-	-	< 0.05	< 0.05
b-BHC	0.05	mg/kg	-	-	< 0.05	< 0.05
d-BHC	0.05	mg/kg	-	-	< 0.05	< 0.05
Dieldrin	0.05	mg/kg	-	-	< 0.05	< 0.05
Endosulfan I	0.05	mg/kg	-	-	< 0.05	< 0.05
Endosulfan II	0.05	mg/kg	-	-	< 0.05	< 0.05
Endosulfan sulphate	0.05	mg/kg	-	-	< 0.05	< 0.05
Endrin	0.05	mg/kg	-	-	< 0.05	< 0.05
Endrin aldehyde	0.05	mg/kg	-	-	< 0.05	< 0.05
Endrin ketone	0.05	mg/kg	-	-	< 0.05	< 0.05
g-BHC (Lindane)	0.05	mg/kg	-	-	< 0.05	< 0.05
Heptachlor	0.05	mg/kg	-	-	< 0.05	< 0.05
Heptachlor epoxide	0.05	mg/kg	-	-	< 0.05	< 0.05
Hexachlorobenzene	0.05	mg/kg	-	-	< 0.05	< 0.05
Methoxychlor	0.2	mg/kg	-	-	< 0.2	< 0.2
Toxaphene	1	mg/kg	-	-	< 1	< 1
Dibutylchlorendate (surr.)	1	%	-	-	82	89
Tetrachloro-m-xylene (surr.)	1	%	-	-	114	93
Polychlorinated Biphenyls (PCB)						
Aroclor-1016	0.5	mg/kg	-	-	< 0.5	< 0.5
Aroclor-1232	0.5	mg/kg	-	-	< 0.5	< 0.5
Aroclor-1242	0.5	mg/kg	-	-	< 0.5	< 0.5
Aroclor-1248	0.5	mg/kg	-	-	< 0.5	< 0.5
Aroclor-1254	0.5	mg/kg	-	-	< 0.5	< 0.5
Aroclor-1260	0.5	mg/kg	-	-	< 0.5	< 0.5
Total PCB*	0.5	mg/kg	-	-	< 0.5	< 0.5
Dibutylchlorendate (surr.)	1	%	-	-	82	89
Speciated Phenols						
2.4-Dichlorophenol	0.5	mg/kg	-	-	< 0.5	< 0.5
2.4-Dimethylphenol	0.5	mg/kg	-	-	< 0.5	< 0.5
2.4.5-Trichlorophenol	0.5	mg/kg	-	-	< 0.5	< 0.5
2.4.6-Trichlorophenol	0.5	mg/kg	-	-	< 0.5	< 0.5
Phenol	0.5	mg/kg	-	-	< 0.5	< 0.5
2-Methylphenol (o-Cresol)	0.5	mg/kg	-	-	< 0.5	< 0.5
3&4-Methylphenol (m&p-Cresol)	1	mg/kg	-	-	< 1	< 1

Client Sample ID			TP213_1.0	TP213_3.1	TP212_0.2	TP212_2.9
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06053	S16-Jn06054	S16-Jn06055	S16-Jn06056
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Speciated Phenols						
2-Chlorophenol	0.5	mg/kg	-	-	< 0.5	< 0.5
2-Nitrophenol	0.5	mg/kg	-	-	< 0.5	< 0.5
4-Chloro-3-methylphenol	0.5	mg/kg	-	-	< 0.5	< 0.5
Pentachlorophenol	1	mg/kg	-	-	< 1	< 1
Phenol-d5 (surr.)	1	%	-	-	100	104
Organophosphorus Pesticides (OP)						
Azinphos-methyl	0.2	mg/kg	-	-	< 0.2	< 0.2
Chlorpyrifos	0.2	mg/kg	-	-	< 0.2	< 0.2
Coumaphos	2	mg/kg	-	-	< 2	< 2
Demeton (total)	1	mg/kg	-	-	< 1	< 1
Diazinon	0.2	mg/kg	-	-	< 0.2	< 0.2
Dichlorvos	0.2	mg/kg	-	-	< 0.2	< 0.2
Dimethoate	0.2	mg/kg	-	-	< 0.2	< 0.2
Disulfoton	0.2	mg/kg	-	-	< 0.2	< 0.2
Ethoprop	0.2	mg/kg	-	-	< 0.2	< 0.2
Fenitrothion	0.2	mg/kg	-	-	< 0.2	< 0.2
Fensulfothion	0.2	mg/kg	-	-	< 0.2	< 0.2
Fenthion	0.2	mg/kg	-	-	< 0.2	< 0.2
Malathion	0.2	mg/kg	-	-	< 0.2	< 0.2
Methyl parathion	0.2	mg/kg	-	-	< 0.2	< 0.2
Mevinphos	0.2	mg/kg	-	-	< 0.2	< 0.2
Monocrotophos	2	mg/kg	-	-	< 2	< 2
Parathion	0.5	mg/kg	-	-	< 0.5	< 0.5
Phorate	0.2	mg/kg	-	-	< 0.2	< 0.2
Profenofos	0.2	mg/kg	-	-	< 0.2	< 0.2
Prothiofos	0.5	mg/kg	-	-	< 0.5	< 0.5
Ronnel	0.2	mg/kg	-	-	< 0.2	< 0.2
Stirophos	0.5	mg/kg	-	-	< 0.5	< 0.5
Trichloronate	0.2	mg/kg	-	-	< 0.2	< 0.2
Triphenylphosphate (surr.)	1	%	-	-	72	72
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	130	180	140	130
TRH >C16-C34	100	mg/kg	560	1000	590	770
TRH >C34-C40	100	mg/kg	< 100	190	< 100	110
Heavy Metals						
Arsenic	2	mg/kg	4.8	5.4	9.6	4.9
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	< 5	< 5	6.8	< 5
Copper	5	mg/kg	11	8.3	20	9.9
Lead	5	mg/kg	16	9.6	20	15
Mercury	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	5	mg/kg	23	6.9	18	15
Zinc	5	mg/kg	44	15	45	28
% Moisture	1	%	11	11	10	14

Client Sample ID			QC01	TP214_0.2	TP216_0.5	TP218_4.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06057	S16-Jn06058	S16-Jn06060	S16-Jn06062
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	170	140	< 20	< 20
TRH C15-C28	50	mg/kg	770	560	100	< 50
TRH C29-C36	50	mg/kg	270	220	< 50	< 50
TRH C10-36 (Total)	50	mg/kg	1210	920	100	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	105	88	109	116
Volatile Organics						
1.1-Dichloroethane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.1-Dichloroethene	0.5	mg/kg	< 0.5	-	< 0.5	-
1.1.1-Trichloroethane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.1.1.2-Tetrachloroethane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.1.2-Trichloroethane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.1.2.2-Tetrachloroethane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.2-Dibromoethane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.2-Dichlorobenzene	0.5	mg/kg	< 0.5	-	< 0.5	-
1.2-Dichloroethane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.2-Dichloropropane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.2.3-Trichloropropane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.2.4-Trimethylbenzene	0.5	mg/kg	< 0.5	-	< 0.5	-
1.3-Dichlorobenzene	0.5	mg/kg	< 0.5	-	< 0.5	-
1.3-Dichloropropane	0.5	mg/kg	< 0.5	-	< 0.5	-
1.3.5-Trimethylbenzene	0.5	mg/kg	< 0.5	-	< 0.5	-
1.4-Dichlorobenzene	0.5	mg/kg	< 0.5	-	< 0.5	-
2-Butanone (MEK)	0.5	mg/kg	< 0.5	-	< 0.5	-
2-Propanone (Acetone)	5	mg/kg	< 5	-	< 5	-
4-Chlorotoluene	0.5	mg/kg	< 0.5	-	< 0.5	-
4-Methyl-2-pentanone (MIBK)	0.5	mg/kg	< 0.5	-	< 0.5	-
Allyl chloride	0.05	mg/kg	< 0.05	-	< 0.05	-
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	-
Bromobenzene	0.5	mg/kg	< 0.5	-	< 0.5	-
Bromochloromethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Bromodichloromethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Bromoform	0.5	mg/kg	< 0.5	-	< 0.5	-
Bromomethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Carbon disulfide	0.5	mg/kg	< 0.5	-	< 0.5	-
Carbon Tetrachloride	0.5	mg/kg	< 0.5	-	< 0.5	-
Chlorobenzene	0.5	mg/kg	< 0.5	-	< 0.5	-
Chloroethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Chloroform	0.5	mg/kg	< 0.5	-	< 0.5	-
Chloromethane	0.5	mg/kg	< 0.5	-	< 0.5	-
cis-1.2-Dichloroethene	0.5	mg/kg	< 0.5	-	< 0.5	-
cis-1.3-Dichloropropene	0.5	mg/kg	< 0.5	-	< 0.5	-

Client Sample ID			QC01	TP214_0.2	TP216_0.5	TP218_4.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06057	S16-Jn06058	S16-Jn06060	S16-Jn06062
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Volatile Organics						
Dibromochloromethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Dibromomethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Dichlorodifluoromethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	-
Iodomethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Isopropyl benzene (Cumene)	0.5	mg/kg	< 0.5	-	< 0.5	-
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	-
Methylene Chloride	0.5	mg/kg	< 0.5	-	< 0.5	-
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	-
Styrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Tetrachloroethene	0.5	mg/kg	< 0.5	-	< 0.5	-
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	-
trans-1.2-Dichloroethene	0.5	mg/kg	< 0.5	-	< 0.5	-
trans-1.3-Dichloropropene	0.5	mg/kg	< 0.5	-	< 0.5	-
Trichloroethene	0.5	mg/kg	< 0.5	-	< 0.5	-
Trichlorofluoromethane	0.5	mg/kg	< 0.5	-	< 0.5	-
Vinyl chloride	0.5	mg/kg	< 0.5	-	< 0.5	-
Xylenes - Total	0.3	mg/kg	< 0.3	-	< 0.3	-
Fluorobenzene (surr.)	1	%	109	-	109	-
4-Bromofluorobenzene (surr.)	1	%	105	-	109	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	170	150	< 50	< 50
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.7	0.7	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	2.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	0.6	0.6	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	0.8	1.0	0.6	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	1.2	1.8	0.7	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	1.3	2.7	0.9	< 0.5
Pyrene	0.5	mg/kg	0.9	1.4	0.6	< 0.5
Total PAH*	0.5	mg/kg	4.8	10	2.8	< 0.5
2-Fluorobiphenyl (surr.)	1	%	102	106	100	97
p-Terphenyl-d14 (surr.)	1	%	105	121	112	99

Client Sample ID			QC01	TP214_0.2	TP216_0.5	TP218_4.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06057	S16-Jn06058	S16-Jn06060	S16-Jn06062
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	< 0.05	-
a-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Aldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
b-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
d-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Dieldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan I	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan II	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin ketone	0.05	mg/kg	< 0.05	-	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	< 0.05	-
Methoxychlor	0.2	mg/kg	< 0.2	-	< 0.2	-
Toxaphene	1	mg/kg	< 1	-	< 1	-
Dibutylchlorendate (surr.)	1	%	78	-	67	-
Tetrachloro-m-xylene (surr.)	1	%	99	-	97	-
Polychlorinated Biphenyls (PCB)						
Aroclor-1016	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1232	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1242	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1248	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1254	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1260	0.5	mg/kg	< 0.5	-	< 0.5	-
Total PCB*	0.5	mg/kg	< 0.5	-	< 0.5	-
Dibutylchlorendate (surr.)	1	%	78	-	67	-
Speciated Phenols						
2.4-Dichlorophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2.4-Dimethylphenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2.4.5-Trichlorophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2.4.6-Trichlorophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
Phenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2-Methylphenol (o-Cresol)	0.5	mg/kg	< 0.5	-	< 0.5	-
3&4-Methylphenol (m&p-Cresol)	1	mg/kg	< 1	-	< 1	-
2-Chlorophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
2-Nitrophenol	0.5	mg/kg	< 0.5	-	< 0.5	-
4-Chloro-3-methylphenol	0.5	mg/kg	< 0.5	-	< 0.5	-
Pentachlorophenol	1	mg/kg	< 1	-	< 1	-
Phenol-d5 (surr.)	1	%	108	-	105	-

Client Sample ID			QC01	TP214_0.2	TP216_0.5	TP218_4.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins I mgt Sample No.			S16-Jn06057	S16-Jn06058	S16-Jn06060	S16-Jn06062
Date Sampled			Jun 03, 2016	Jun 03, 2016	Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit				
Organophosphorus Pesticides (OP)						
Azinphos-methyl	0.2	mg/kg	< 0.2	-	< 0.2	-
Chlorpyrifos	0.2	mg/kg	< 0.2	-	< 0.2	-
Coumaphos	2	mg/kg	< 2	-	< 2	-
Demeton (total)	1	mg/kg	< 1	-	< 1	-
Diazinon	0.2	mg/kg	< 0.2	-	< 0.2	-
Dichlorvos	0.2	mg/kg	< 0.2	-	< 0.2	-
Dimethoate	0.2	mg/kg	< 0.2	-	< 0.2	-
Disulfoton	0.2	mg/kg	< 0.2	-	< 0.2	-
Ethoprop	0.2	mg/kg	< 0.2	-	< 0.2	-
Fenitrothion	0.2	mg/kg	< 0.2	-	< 0.2	-
Fensulfothion	0.2	mg/kg	< 0.2	-	< 0.2	-
Fenthion	0.2	mg/kg	< 0.2	-	< 0.2	-
Malathion	0.2	mg/kg	< 0.2	-	< 0.2	-
Methyl parathion	0.2	mg/kg	< 0.2	-	< 0.2	-
Mevinphos	0.2	mg/kg	< 0.2	-	< 0.2	-
Monocrotophos	2	mg/kg	< 2	-	< 2	-
Parathion	0.5	mg/kg	< 0.5	-	< 0.5	-
Phorate	0.2	mg/kg	< 0.2	-	< 0.2	-
Profenofos	0.2	mg/kg	< 0.2	-	< 0.2	-
Prothiofos	0.5	mg/kg	< 0.5	-	< 0.5	-
Ronnel	0.2	mg/kg	< 0.2	-	< 0.2	-
Stirophos	0.5	mg/kg	< 0.5	-	< 0.5	-
Trichloronate	0.2	mg/kg	< 0.2	-	< 0.2	-
Triphenylphosphate (surr.)	1	%	72	-	103	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	170	150	< 50	< 50
TRH >C16-C34	100	mg/kg	1000	730	140	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
Heavy Metals						
Arsenic	2	mg/kg	7.0	4.9	5.7	19
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	< 5	< 5	< 5	64
Copper	5	mg/kg	8.6	9.6	12	33
Lead	5	mg/kg	13	13	14	18
Mercury	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	5	mg/kg	14	16	13	19
Zinc	5	mg/kg	25	67	60	73
% Moisture	1	%	15	11	12	20

Client Sample ID			TP219_0.5	HA01
Sample Matrix			Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06064	S16-Jn06065
Date Sampled			Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit		
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				
TRH C6-C9	20	mg/kg	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	230
TRH C15-C28	50	mg/kg	< 50	1300
TRH C29-C36	50	mg/kg	< 50	600
TRH C10-36 (Total)	50	mg/kg	< 50	2130
BTEX				
Benzene	0.1	mg/kg	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	86	110
Volatile Organics				
1.1-Dichloroethane	0.5	mg/kg	-	< 0.5
1.1-Dichloroethene	0.5	mg/kg	-	< 0.5
1.1.1-Trichloroethane	0.5	mg/kg	-	< 0.5
1.1.1.2-Tetrachloroethane	0.5	mg/kg	-	< 0.5
1.1.2-Trichloroethane	0.5	mg/kg	-	< 0.5
1.1.2.2-Tetrachloroethane	0.5	mg/kg	-	< 0.5
1.2-Dibromoethane	0.5	mg/kg	-	< 0.5
1.2-Dichlorobenzene	0.5	mg/kg	-	< 0.5
1.2-Dichloroethane	0.5	mg/kg	-	< 0.5
1.2-Dichloropropane	0.5	mg/kg	-	< 0.5
1.2.3-Trichloropropane	0.5	mg/kg	-	< 0.5
1.2.4-Trimethylbenzene	0.5	mg/kg	-	< 0.5
1.3-Dichlorobenzene	0.5	mg/kg	-	< 0.5
1.3-Dichloropropane	0.5	mg/kg	-	< 0.5
1.3.5-Trimethylbenzene	0.5	mg/kg	-	< 0.5
1.4-Dichlorobenzene	0.5	mg/kg	-	< 0.5
2-Butanone (MEK)	0.5	mg/kg	-	< 0.5
2-Propanone (Acetone)	5	mg/kg	-	< 5
4-Chlorotoluene	0.5	mg/kg	-	< 0.5
4-Methyl-2-pentanone (MIBK)	0.5	mg/kg	-	< 0.5
Allyl chloride	0.05	mg/kg	-	< 0.05
Benzene	0.1	mg/kg	-	< 0.1
Bromobenzene	0.5	mg/kg	-	< 0.5
Bromochloromethane	0.5	mg/kg	-	< 0.5
Bromodichloromethane	0.5	mg/kg	-	< 0.5
Bromoform	0.5	mg/kg	-	< 0.5
Bromomethane	0.5	mg/kg	-	< 0.5
Carbon disulfide	0.5	mg/kg	-	< 0.5
Carbon Tetrachloride	0.5	mg/kg	-	< 0.5
Chlorobenzene	0.5	mg/kg	-	< 0.5
Chloroethane	0.5	mg/kg	-	< 0.5
Chloroform	0.5	mg/kg	-	< 0.5
Chloromethane	0.5	mg/kg	-	< 0.5
cis-1.2-Dichloroethene	0.5	mg/kg	-	< 0.5
cis-1.3-Dichloropropene	0.5	mg/kg	-	< 0.5

Client Sample ID			TP219_0.5	HA01
Sample Matrix			Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06064	S16-Jn06065
Date Sampled			Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit		
Volatile Organics				
Dibromochloromethane	0.5	mg/kg	-	< 0.5
Dibromomethane	0.5	mg/kg	-	< 0.5
Dichlorodifluoromethane	0.5	mg/kg	-	< 0.5
Ethylbenzene	0.1	mg/kg	-	< 0.1
Iodomethane	0.5	mg/kg	-	< 0.5
Isopropyl benzene (Cumene)	0.5	mg/kg	-	< 0.5
m&p-Xylenes	0.2	mg/kg	-	< 0.2
Methylene Chloride	0.5	mg/kg	-	< 0.5
o-Xylene	0.1	mg/kg	-	< 0.1
Styrene	0.5	mg/kg	-	< 0.5
Tetrachloroethene	0.5	mg/kg	-	< 0.5
Toluene	0.1	mg/kg	-	< 0.1
trans-1.2-Dichloroethene	0.5	mg/kg	-	< 0.5
trans-1.3-Dichloropropene	0.5	mg/kg	-	< 0.5
Trichloroethene	0.5	mg/kg	-	< 0.5
Trichlorofluoromethane	0.5	mg/kg	-	< 0.5
Vinyl chloride	0.5	mg/kg	-	< 0.5
Xylenes - Total	0.3	mg/kg	-	< 0.3
Fluorobenzene (surr.)	1	%	-	109
4-Bromofluorobenzene (surr.)	1	%	-	110
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	370
Polycyclic Aromatic Hydrocarbons				
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.7
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	0.8
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	1.0
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	1.7
Fluorene	0.5	mg/kg	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	3.2
Pyrene	0.5	mg/kg	< 0.5	1.0
Total PAH*	0.5	mg/kg	< 0.5	7.7
2-Fluorobiphenyl (surr.)	1	%	103	109
p-Terphenyl-d14 (surr.)	1	%	131	104

Client Sample ID			TP219_0.5	HA01
Sample Matrix			Soil	Soil
Eurofins | mgt Sample No.			S16-Jn06064	S16-Jn06065
Date Sampled			Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit		
Organochlorine Pesticides				
Chlordanes - Total	0.1	mg/kg	-	< 0.1
4.4'-DDD	0.05	mg/kg	-	< 0.05
4.4'-DDE	0.05	mg/kg	-	< 0.05
4.4'-DDT	0.05	mg/kg	-	< 0.05
a-BHC	0.05	mg/kg	-	< 0.05
Aldrin	0.05	mg/kg	-	< 0.05
b-BHC	0.05	mg/kg	-	< 0.05
d-BHC	0.05	mg/kg	-	< 0.05
Dieldrin	0.05	mg/kg	-	< 0.05
Endosulfan I	0.05	mg/kg	-	< 0.05
Endosulfan II	0.05	mg/kg	-	< 0.05
Endosulfan sulphate	0.05	mg/kg	-	< 0.05
Endrin	0.05	mg/kg	-	< 0.05
Endrin aldehyde	0.05	mg/kg	-	< 0.05
Endrin ketone	0.05	mg/kg	-	< 0.05
g-BHC (Lindane)	0.05	mg/kg	-	< 0.05
Heptachlor	0.05	mg/kg	-	< 0.05
Heptachlor epoxide	0.05	mg/kg	-	< 0.05
Hexachlorobenzene	0.05	mg/kg	-	< 0.05
Methoxychlor	0.2	mg/kg	-	< 0.2
Toxaphene	1	mg/kg	-	< 1
Dibutylchlorendate (surr.)	1	%	-	78
Tetrachloro-m-xylene (surr.)	1	%	-	80
Polychlorinated Biphenyls (PCB)				
Aroclor-1016	0.5	mg/kg	-	< 0.5
Aroclor-1232	0.5	mg/kg	-	< 0.5
Aroclor-1242	0.5	mg/kg	-	< 0.5
Aroclor-1248	0.5	mg/kg	-	< 0.5
Aroclor-1254	0.5	mg/kg	-	< 0.5
Aroclor-1260	0.5	mg/kg	-	< 0.5
Total PCB*	0.5	mg/kg	-	< 0.5
Dibutylchlorendate (surr.)	1	%	-	78
Speciated Phenols				
2.4-Dichlorophenol	0.5	mg/kg	-	< 0.5
2.4-Dimethylphenol	0.5	mg/kg	-	< 0.5
2.4.5-Trichlorophenol	0.5	mg/kg	-	< 0.5
2.4.6-Trichlorophenol	0.5	mg/kg	-	< 0.5
Phenol	0.5	mg/kg	-	< 0.5
2-Methylphenol (o-Cresol)	0.5	mg/kg	-	< 0.5
3&4-Methylphenol (m&p-Cresol)	1	mg/kg	-	< 1
2-Chlorophenol	0.5	mg/kg	-	< 0.5
2-Nitrophenol	0.5	mg/kg	-	< 0.5
4-Chloro-3-methylphenol	0.5	mg/kg	-	< 0.5
Pentachlorophenol	1	mg/kg	-	< 1
Phenol-d5 (surr.)	1	%	-	112

Client Sample ID			TP219_0.5	HA01
Sample Matrix			Soil	Soil
Eurofins l mgt Sample No.			S16-Jn06064	S16-Jn06065
Date Sampled			Jun 03, 2016	Jun 03, 2016
Test/Reference	LOR	Unit		
Organophosphorus Pesticides (OP)				
Azinphos-methyl	0.2	mg/kg	-	< 0.2
Chlorpyrifos	0.2	mg/kg	-	< 0.2
Coumaphos	2	mg/kg	-	< 2
Demeton (total)	1	mg/kg	-	< 1
Diazinon	0.2	mg/kg	-	< 0.2
Dichlorvos	0.2	mg/kg	-	< 0.2
Dimethoate	0.2	mg/kg	-	< 0.2
Disulfoton	0.2	mg/kg	-	< 0.2
Ethoprop	0.2	mg/kg	-	< 0.2
Fenitrothion	0.2	mg/kg	-	< 0.2
Fensulfothion	0.2	mg/kg	-	< 0.2
Fenthion	0.2	mg/kg	-	< 0.2
Malathion	0.2	mg/kg	-	< 0.2
Methyl parathion	0.2	mg/kg	-	< 0.2
Mevinphos	0.2	mg/kg	-	< 0.2
Monocrotophos	2	mg/kg	-	< 2
Parathion	0.5	mg/kg	-	< 0.5
Phorate	0.2	mg/kg	-	< 0.2
Profenofos	0.2	mg/kg	-	< 0.2
Prothiofos	0.5	mg/kg	-	< 0.5
Ronnel	0.2	mg/kg	-	< 0.2
Stirophos	0.5	mg/kg	-	< 0.5
Trichloronate	0.2	mg/kg	-	< 0.2
Triphenylphosphate (surr.)	1	%	-	99
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				
TRH >C10-C16	50	mg/kg	< 50	370
TRH >C16-C34	100	mg/kg	< 100	1600
TRH >C34-C40	100	mg/kg	< 100	140
Heavy Metals				
Arsenic	2	mg/kg	17	2.9
Cadmium	0.4	mg/kg	< 0.4	< 0.4
Chromium	5	mg/kg	6.5	< 5
Copper	5	mg/kg	25	7.1
Lead	5	mg/kg	15	11
Mercury	0.05	mg/kg	< 0.05	< 0.05
Nickel	5	mg/kg	22	9.1
Zinc	5	mg/kg	74	15
% Moisture	1	%	17	8.8

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Jun 07, 2016	14 Day
- Method: TRH C6-C36 - LTM-ORG-2010			
BTEX	Sydney	Jun 07, 2016	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Jun 07, 2016	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Polycyclic Aromatic Hydrocarbons	Sydney	Jun 07, 2016	14 Day
- Method: E007 Polyaromatic Hydrocarbons (PAH)			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Jun 07, 2016	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Metals M8	Sydney	Jun 07, 2016	28 Day
- Method: LTM-MET-3040_R0 TOTAL AND DISSOLVED METALS AND MERCURY IN WATERS BY ICP-MS			
Volatile Organics	Sydney	Jun 07, 2016	7 Day
- Method: E016 Volatile Organic Compounds (VOC)			
Speciated Phenols	Sydney	Jun 07, 2016	14 Day
- Method: E008 Speciated Phenols			
Eurofins | mgt Suite B15			
Organochlorine Pesticides	Sydney	Jun 10, 2016	14 Day
- Method: E013 Organochlorine Pesticides (OC)			
Polychlorinated Biphenyls (PCB)	Sydney	Jun 10, 2016	28 Day
- Method: E013 Polychlorinated Biphenyls (PCB)			
Organophosphorus Pesticides (OP)	Sydney	Jun 07, 2016	14 Day
- Method: E014 Organophosphorus Pesticides (OP)			
% Moisture	Sydney	Jun 06, 2016	14 Day
- Method: LTM-GEN-7080 Moisture			

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Brisbane
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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: MT PIPER WTP INVESTIGATION
Project ID: 21/25109/21

Order No.:
Report #: 503414
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jun 6, 2016 12:12 PM
Due: Jun 14, 2016
Priority: 5 Day
Contact Name: Helen Milne

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos Absence /Presence	HOLD	Speciated Phenols	Eurofins | mgt Suite B15	Volatile Organics	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	TP217_0.2	Jun 02, 2016		Soil	S16-Jn06047	X					X	X
2	TP217_1.0	Jun 02, 2016		Soil	S16-Jn06048			X	X	X	X	X
3	TP215_0.2	Jun 02, 2016		Soil	S16-Jn06049	X						
4	TP215_1.2	Jun 02, 2016		Soil	S16-Jn06050			X	X	X	X	X
5	TP215_3.0	Jun 02, 2016		Soil	S16-Jn06051						X	X
6	TP213_0.2	Jun 03, 2016		Soil	S16-Jn06052	X						
7	TP213_1.0	Jun 03, 2016		Soil	S16-Jn06053						X	X
8	TP213_3.1	Jun 03, 2016		Soil	S16-Jn06054						X	X
9	TP212_0.2	Jun 03, 2016		Soil	S16-Jn06055	X		X	X	X	X	X
10	TP212_2.9	Jun 03, 2016		Soil	S16-Jn06056			X	X	X	X	X

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Melbourne Laboratory - NATA Site # 1254 & 14271														
Sydney Laboratory - NATA Site # 18217						X	X	X	X		X	X	X	
Brisbane Laboratory - NATA Site # 20794														
External Laboratory														
11	QC01	Jun 03, 2016		Soil	S16-Jn06057			X	X		X	X	X	
12	TP214_0.2	Jun 03, 2016		Soil	S16-Jn06058	X						X	X	
13	TP216_0.2	Jun 03, 2016		Soil	S16-Jn06059	X								
14	TP216_0.5	Jun 03, 2016		Soil	S16-Jn06060			X	X		X	X	X	
15	TP218_0.2	Jun 03, 2016		Soil	S16-Jn06061	X								
16	TP218_4.0	Jun 03, 2016		Soil	S16-Jn06062							X	X	
17	TP219_0.2	Jun 03, 2016		Soil	S16-Jn06063	X								
18	TP219_0.5	Jun 03, 2016		Soil	S16-Jn06064							X	X	
19	HA01	Jun 03, 2016		Soil	S16-Jn06065	X		X	X		X	X	X	
20	TP217_0.5	Jun 03, 2016		Soil	S16-Jn06066		X							
21	TP217_1.2	Jun 03, 2016		Soil	S16-Jn06067		X							

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Sample Detail						Asbestos Absence /Presence	HOLD	Speciated Phenols	Eurofins	mgt Suite B15	Volatile Organics	Moisture Set	Eurofins	mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271														
Sydney Laboratory - NATA Site # 18217						X	X	X	X		X	X	X	
Brisbane Laboratory - NATA Site # 20794														
External Laboratory														
22	TP215_0.5	Jun 03, 2016		Soil	S16-Jn06068		X							
23	TP213_0.5	Jun 03, 2016		Soil	S16-Jn06069		X							
24	TP213_2.0	Jun 03, 2016		Soil	S16-Jn06070		X							
25	TP212_0.5	Jun 03, 2016		Soil	S16-Jn06071		X							
26	TP212_2.0	Jun 03, 2016		Soil	S16-Jn06072		X							
27	TP214_0.5	Jun 03, 2016		Soil	S16-Jn06073		X							
28	TP214_0.9	Jun 03, 2016		Soil	S16-Jn06074		X							
29	TP214_2.0	Jun 03, 2016		Soil	S16-Jn06075		X							
30	TP214_3.1	Jun 03, 2016		Soil	S16-Jn06076		X							
31	TP216_1.2	Jun 03, 2016		Soil	S16-Jn06077		X							
32	TP218_0.5	Jun 03, 2016		Soil	S16-Jn06078		X							

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Company Name:	GHD Pty Ltd NSW	**Order No.:**		**Received:**	Jun 6, 2016 12:12 PM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:** **Phone:** **Fax:**	503414 02 9239 7100 02 9239 7199	**Due:** **Priority:** **Contact Name:**	Jun 14, 2016 5 Day Helen Milne
Project Name:	MT PIPER WTP INVESTIGATION				
Project ID:	21/25109/21				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail	Asbestos Absence /Presence	HOLD	Speciated Phenols	Eurofins	mgt Suite B15	Volatile Organics	Moisture Set	Eurofins	mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271									
Sydney Laboratory - NATA Site # 18217	X	X	X	X		X	X		X
Brisbane Laboratory - NATA Site # 20794									
External Laboratory									
Test Counts	9	13	7	7		7	14		14

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs 20-130%

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Volatile Organics							
1.1-Dichloroethane	mg/kg	< 0.5			0.5	Pass	
1.1-Dichloroethene	mg/kg	< 0.5			0.5	Pass	
1.1.1-Trichloroethane	mg/kg	< 0.5			0.5	Pass	
1.1.1.2-Tetrachloroethane	mg/kg	< 0.5			0.5	Pass	
1.1.2-Trichloroethane	mg/kg	< 0.5			0.5	Pass	
1.1.2.2-Tetrachloroethane	mg/kg	< 0.5			0.5	Pass	
1.2-Dibromoethane	mg/kg	< 0.5			0.5	Pass	
1.2-Dichlorobenzene	mg/kg	< 0.5			0.5	Pass	
1.2-Dichloroethane	mg/kg	< 0.5			0.5	Pass	
1.2-Dichloropropane	mg/kg	< 0.5			0.5	Pass	
1.2.3-Trichloropropane	mg/kg	< 0.5			0.5	Pass	
1.2.4-Trimethylbenzene	mg/kg	< 0.5			0.5	Pass	
1.3-Dichlorobenzene	mg/kg	< 0.5			0.5	Pass	
1.3-Dichloropropane	mg/kg	< 0.5			0.5	Pass	
1.3.5-Trimethylbenzene	mg/kg	< 0.5			0.5	Pass	
1.4-Dichlorobenzene	mg/kg	< 0.5			0.5	Pass	
2-Butanone (MEK)	mg/kg	< 0.5			0.5	Pass	
2-Propanone (Acetone)	mg/kg	< 5			5	Pass	
4-Chlorotoluene	mg/kg	< 0.5			0.5	Pass	
4-Methyl-2-pentanone (MIBK)	mg/kg	< 0.5			0.5	Pass	
Allyl chloride	mg/kg	< 0.05			0.05	Pass	
Bromobenzene	mg/kg	< 0.5			0.5	Pass	
Bromochloromethane	mg/kg	< 0.5			0.5	Pass	
Bromodichloromethane	mg/kg	< 0.5			0.5	Pass	
Bromoform	mg/kg	< 0.5			0.5	Pass	
Bromomethane	mg/kg	< 0.5			0.5	Pass	
Carbon disulfide	mg/kg	< 0.5			0.5	Pass	
Carbon Tetrachloride	mg/kg	< 0.5			0.5	Pass	
Chlorobenzene	mg/kg	< 0.5			0.5	Pass	
Chloroethane	mg/kg	< 0.5			0.5	Pass	
Chloroform	mg/kg	< 0.5			0.5	Pass	
Chloromethane	mg/kg	< 0.5			0.5	Pass	
cis-1.2-Dichloroethene	mg/kg	< 0.5			0.5	Pass	
cis-1.3-Dichloropropene	mg/kg	< 0.5			0.5	Pass	
Dibromochloromethane	mg/kg	< 0.5			0.5	Pass	
Dibromomethane	mg/kg	< 0.5			0.5	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Dichlorodifluoromethane	mg/kg	< 0.5			0.5	Pass	
Iodomethane	mg/kg	< 0.5			0.5	Pass	
Isopropyl benzene (Cumene)	mg/kg	< 0.5			0.5	Pass	
Methylene Chloride	mg/kg	< 0.5			0.5	Pass	
Styrene	mg/kg	< 0.5			0.5	Pass	
Tetrachloroethene	mg/kg	< 0.5			0.5	Pass	
trans-1.2-Dichloroethene	mg/kg	< 0.5			0.5	Pass	
trans-1.3-Dichloropropene	mg/kg	< 0.5			0.5	Pass	
Trichloroethene	mg/kg	< 0.5			0.5	Pass	
Trichlorofluoromethane	mg/kg	< 0.5			0.5	Pass	
Vinyl chloride	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Polychlorinated Biphenyls (PCB)							
Aroclor-1016	mg/kg	< 0.5			0.5	Pass	
Aroclor-1232	mg/kg	< 0.5			0.5	Pass	
Aroclor-1242	mg/kg	< 0.5			0.5	Pass	
Aroclor-1248	mg/kg	< 0.5			0.5	Pass	
Aroclor-1254	mg/kg	< 0.5			0.5	Pass	
Aroclor-1260	mg/kg	< 0.5			0.5	Pass	
Total PCB*	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Speciated Phenols							
2.4-Dichlorophenol	mg/kg	< 0.5			0.5	Pass	
2.4-Dimethylphenol	mg/kg	< 0.5			0.5	Pass	
2.4.5-Trichlorophenol	mg/kg	< 0.5			0.5	Pass	
2.4.6-Trichlorophenol	mg/kg	< 0.5			0.5	Pass	
Phenol	mg/kg	< 0.5			0.5	Pass	
2-Methylphenol (o-Cresol)	mg/kg	< 0.5			0.5	Pass	
3&4-Methylphenol (m&p-Cresol)	mg/kg	< 1			1	Pass	
2-Chlorophenol	mg/kg	< 0.5			0.5	Pass	
2-Nitrophenol	mg/kg	< 0.5			0.5	Pass	
4-Chloro-3-methylphenol	mg/kg	< 0.5			0.5	Pass	
Pentachlorophenol	mg/kg	< 1			1	Pass	
Method Blank							
Organophosphorus Pesticides (OP)							
Azinphos-methyl	mg/kg	< 0.2			0.2	Pass	
Chlorpyrifos	mg/kg	< 0.2			0.2	Pass	
Coumaphos	mg/kg	< 2			2	Pass	
Demeton (total)	mg/kg	< 1			1	Pass	
Diazinon	mg/kg	< 0.2			0.2	Pass	
Dichlorvos	mg/kg	< 0.2			0.2	Pass	
Dimethoate	mg/kg	< 0.2			0.2	Pass	
Disulfoton	mg/kg	< 0.2			0.2	Pass	
Ethoprop	mg/kg	< 0.2			0.2	Pass	
Fenitrothion	mg/kg	< 0.2			0.2	Pass	
Fensulfothion	mg/kg	< 0.2			0.2	Pass	
Fenthion	mg/kg	< 0.2			0.2	Pass	
Malathion	mg/kg	< 0.2			0.2	Pass	
Methyl parathion	mg/kg	< 0.2			0.2	Pass	
Mevinphos	mg/kg	< 0.2			0.2	Pass	
Monocrotophos	mg/kg	< 2			2	Pass	
Parathion	mg/kg	< 0.5			0.5	Pass	
Phorate	mg/kg	< 0.2			0.2	Pass	
Profenofos	mg/kg	< 0.2			0.2	Pass	
Prothiofos	mg/kg	< 0.5			0.5	Pass	
Ronnel	mg/kg	< 0.2			0.2	Pass	
Stirophos	mg/kg	< 0.5			0.5	Pass	
Trichloronate	mg/kg	< 0.2			0.2	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.05			0.05	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C10-C14	%	94			70-130	Pass	
LCS - % Recovery							
Organophosphorus Pesticides (OP)							
Fenitrothion	%	73			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	%	94			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	99			70-130	Pass	
Cadmium	%	109			70-130	Pass	
Chromium	%	71			70-130	Pass	
Copper	%	102			70-130	Pass	
Lead	%	103			70-130	Pass	
Mercury	%	107			70-130	Pass	
Nickel	%	91			70-130	Pass	
Zinc	%	96			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S16-Jn05226	NCP	%	86			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH C6-C10	S16-Jn05226	NCP	%	92			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Benzo(g.h.i)perylene	S16-Jn09497	NCP	%	78			70-130	Pass	
Dibenz(a.h)anthracene	S16-Jn09497	NCP	%	73			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S16-Jn09497	NCP	%	75			70-130	Pass	
Spike - % Recovery									
Volatile Organics				Result 1					
cis-1.3-Dichloropropene	S16-Jn05210	NCP	%	72			70-130	Pass	
Iodomethane	S16-Jn05210	NCP	%	92			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	S16-Jn09349	NCP	%	122			70-130	Pass	
4.4'-DDE	S16-Jn09349	NCP	%	126			70-130	Pass	
a-BHC	S16-Jn09349	NCP	%	105			70-130	Pass	
Aldrin	S16-Jn09349	NCP	%	114			70-130	Pass	
b-BHC	S16-Jn09349	NCP	%	98			70-130	Pass	
d-BHC	S16-Jn09349	NCP	%	117			70-130	Pass	
Dieldrin	S16-Jn09349	NCP	%	99			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan I	S16-Jn09349	NCP	%	118			70-130	Pass	
Endosulfan II	S16-Jn09349	NCP	%	117			70-130	Pass	
Endosulfan sulphate	S16-Jn09349	NCP	%	121			70-130	Pass	
Endrin	S16-Jn09349	NCP	%	107			70-130	Pass	
Endrin aldehyde	S16-Jn09349	NCP	%	122			70-130	Pass	
Endrin ketone	S16-Jn09349	NCP	%	107			70-130	Pass	
g-BHC (Lindane)	S16-Jn09349	NCP	%	100			70-130	Pass	
Heptachlor	S16-Jn09349	NCP	%	95			70-130	Pass	
Heptachlor epoxide	S16-Jn09349	NCP	%	112			70-130	Pass	
Hexachlorobenzene	S16-Jn09349	NCP	%	99			70-130	Pass	
Methoxychlor	S16-Jn09349	NCP	%	100			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls (PCB)				Result 1					
Aroclor-1260	S16-Jn05142	NCP	%	127			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	S16-Jn06054	CP	%	97			70-130	Pass	
Cadmium	S16-Jn06054	CP	%	102			70-130	Pass	
Chromium	S16-Jn06054	CP	%	96			70-130	Pass	
Copper	S16-Jn06054	CP	%	98			70-130	Pass	
Lead	S16-Jn06054	CP	%	103			70-130	Pass	
Mercury	S16-Jn06054	CP	%	96			70-130	Pass	
Nickel	S16-Jn06054	CP	%	99			70-130	Pass	
Zinc	S16-Jn06054	CP	%	83			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C10-C14	S16-Jn06055	CP	%	108			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	S16-Jn06055	CP	%	120			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S16-Jn06056	CP	%	97			70-130	Pass	
Toluene	S16-Jn06056	CP	%	94			70-130	Pass	
Ethylbenzene	S16-Jn06056	CP	%	93			70-130	Pass	
m&p-Xylenes	S16-Jn06056	CP	%	91			70-130	Pass	
o-Xylene	S16-Jn06056	CP	%	93			70-130	Pass	
Xylenes - Total	S16-Jn06056	CP	%	92			70-130	Pass	
Spike - % Recovery									
Volatile Organics				Result 1					
1.1-Dichloroethane	S16-Jn06056	CP	%	103			70-130	Pass	
1.1-Dichloroethene	S16-Jn06056	CP	%	93			70-130	Pass	
1.1.1-Trichloroethane	S16-Jn06056	CP	%	101			70-130	Pass	
1.1.1.2-Tetrachloroethane	S16-Jn06056	CP	%	98			70-130	Pass	
1.1.2-Trichloroethane	S16-Jn06056	CP	%	100			70-130	Pass	
1.1.2.2-Tetrachloroethane	S16-Jn06056	CP	%	110			70-130	Pass	
1.2-Dibromoethane	S16-Jn06056	CP	%	89			70-130	Pass	
1.2-Dichlorobenzene	S16-Jn06056	CP	%	81			70-130	Pass	
1.2-Dichloroethane	S16-Jn06056	CP	%	97			70-130	Pass	
1.2-Dichloropropane	S16-Jn06056	CP	%	101			70-130	Pass	
1.2.3-Trichloropropane	S16-Jn06056	CP	%	98			70-130	Pass	
1.2.4-Trimethylbenzene	S16-Jn06056	CP	%	84			70-130	Pass	
1.3-Dichlorobenzene	S16-Jn06056	CP	%	77			70-130	Pass	
1.3-Dichloropropane	S16-Jn06056	CP	%	100			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
1.3.5-Trimethylbenzene	S16-Jn06056	CP	%	86			70-130	Pass	
1.4-Dichlorobenzene	S16-Jn06056	CP	%	75			70-130	Pass	
2-Butanone (MEK)	S16-Jn06056	CP	%	91			70-130	Pass	
2-Propanone (Acetone)	S16-Jn06056	CP	%	118			70-130	Pass	
4-Chlorotoluene	S16-Jn06056	CP	%	80			70-130	Pass	
4-Methyl-2-pentanone (MIBK)	S16-Jn06056	CP	%	115			70-130	Pass	
Allyl chloride	S16-Jn06056	CP	%	89			75-125	Pass	
Bromobenzene	S16-Jn06056	CP	%	86			70-130	Pass	
Bromochloromethane	S16-Jn06056	CP	%	99			70-130	Pass	
Bromodichloromethane	S16-Jn06056	CP	%	92			70-130	Pass	
Bromoform	S16-Jn06056	CP	%	86			70-130	Pass	
Bromomethane	S16-Jn06056	CP	%	72			70-130	Pass	
Carbon disulfide	S16-Jn06056	CP	%	70			70-130	Pass	
Carbon Tetrachloride	S16-Jn06056	CP	%	96			70-130	Pass	
Chlorobenzene	S16-Jn06056	CP	%	92			70-130	Pass	
Chloroethane	S16-Jn06056	CP	%	116			70-130	Pass	
Chloroform	S16-Jn06056	CP	%	101			70-130	Pass	
Chloromethane	S16-Jn06056	CP	%	105			70-130	Pass	
cis-1.2-Dichloroethene	S16-Jn06056	CP	%	91			70-130	Pass	
Dibromochloromethane	S16-Jn06056	CP	%	89			70-130	Pass	
Dibromomethane	S16-Jn06056	CP	%	92			70-130	Pass	
Dichlorodifluoromethane	S16-Jn06056	CP	%	82			70-130	Pass	
Isopropyl benzene (Cumene)	S16-Jn06056	CP	%	94			70-130	Pass	
Methylene Chloride	S16-Jn06056	CP	%	109			70-130	Pass	
Styrene	S16-Jn06056	CP	%	76			70-130	Pass	
Tetrachloroethene	S16-Jn06056	CP	%	82			70-130	Pass	
trans-1.2-Dichloroethene	S16-Jn06056	CP	%	97			70-130	Pass	
trans-1.3-Dichloropropene	S16-Jn06056	CP	%	82			70-130	Pass	
Trichloroethene	S16-Jn06056	CP	%	89			70-130	Pass	
Trichlorofluoromethane	S16-Jn06056	CP	%	93			70-130	Pass	
Vinyl chloride	S16-Jn06056	CP	%	92			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S16-Jn06056	CP	%	94			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	S16-Jn06056	CP	%	108			70-130	Pass	
Acenaphthylene	S16-Jn06056	CP	%	102			70-130	Pass	
Anthracene	S16-Jn06056	CP	%	111			70-130	Pass	
Benz(a)anthracene	S16-Jn06056	CP	%	113			70-130	Pass	
Benzo(a)pyrene	S16-Jn06056	CP	%	87			70-130	Pass	
Benzo(b&j)fluoranthene	S16-Jn06056	CP	%	88			70-130	Pass	
Benzo(k)fluoranthene	S16-Jn06056	CP	%	87			70-130	Pass	
Chrysene	S16-Jn06056	CP	%	99			70-130	Pass	
Fluoranthene	S16-Jn06056	CP	%	112			70-130	Pass	
Fluorene	S16-Jn06056	CP	%	111			70-130	Pass	
Naphthalene	S16-Jn06056	CP	%	111			70-130	Pass	
Phenanthrene	S16-Jn06056	CP	%	125			70-130	Pass	
Pyrene	S16-Jn06056	CP	%	108			70-130	Pass	
Spike - % Recovery									
Speciated Phenols				Result 1					
2.4-Dichlorophenol	S16-Jn06056	CP	%	64			30-130	Pass	
2.4-Dimethylphenol	S16-Jn06056	CP	%	68			30-130	Pass	
2.4.5-Trichlorophenol	S16-Jn06056	CP	%	62			30-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
2.4.6-Trichlorophenol	S16-Jn06056	CP	%	62			30-130	Pass	
Phenol	S16-Jn06056	CP	%	71			30-130	Pass	
2-Methylphenol (o-Cresol)	S16-Jn06056	CP	%	67			30-130	Pass	
3&4-Methylphenol (m&p-Cresol)	S16-Jn06056	CP	%	67			30-130	Pass	
2-Nitrophenol	S16-Jn06056	CP	%	59			30-130	Pass	
4-Chloro-3-methylphenol	S16-Jn06056	CP	%	64			30-130	Pass	
Pentachlorophenol	S16-Jn06056	CP	%	55			30-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C10-C14	S16-Jn09039	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	S16-Jn09039	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	S16-Jn09039	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	S16-Jn09039	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	S16-Jn09039	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	S16-Jn09039	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S16-Jn05231	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S16-Jn05231	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S16-Jn05231	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S16-Jn05231	NCP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls (PCB)				Result 1	Result 2	RPD			
Aroclor-1016	S16-Jn05231	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1232	S16-Jn05231	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1242	S16-Jn05231	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1248	S16-Jn05231	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1254	S16-Jn05231	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1260	S16-Jn05231	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	

Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S16-Jn06053	CP	mg/kg	4.8	5.8	19	30%	Pass	
Cadmium	S16-Jn06053	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	S16-Jn06053	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Copper	S16-Jn06053	CP	mg/kg	11	15	30	30%	Pass	
Lead	S16-Jn06053	CP	mg/kg	16	20	22	30%	Pass	
Mercury	S16-Jn06053	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Nickel	S16-Jn06053	CP	mg/kg	23	16	33	30%	Fail	Q15
Zinc	S16-Jn06053	CP	mg/kg	44	32	31	30%	Fail	Q15
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S16-Jn06054	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S16-Jn06054	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	S16-Jn06054	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	S16-Jn06054	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	S16-Jn06054	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	S16-Jn06054	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	S16-Jn06054	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S16-Jn06054	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	S16-Jn06054	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S16-Jn06054	CP	%	11	12	6.0	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S16-Jn06055	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S16-Jn06055	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	S16-Jn06055	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	S16-Jn06055	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	S16-Jn06055	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	S16-Jn06055	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	S16-Jn06055	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Volatile Organics				Result 1	Result 2	RPD			
1.1-Dichloroethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.1-Dichloroethene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.1.1-Trichloroethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.1.1.2-Tetrachloroethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.1.2-Trichloroethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.1.2.2-Tetrachloroethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.2-Dibromoethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.2-Dichlorobenzene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.2-Dichloroethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.2-Dichloropropane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.2.3-Trichloropropane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.2.4-Trimethylbenzene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.3-Dichlorobenzene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.3-Dichloropropane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
1.3.5-Trimethylbenzene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	

Duplicate									
Volatile Organics				Result 1	Result 2	RPD			
1.4-Dichlorobenzene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2-Butanone (MEK)	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2-Propanone (Acetone)	S16-Jn06055	CP	mg/kg	< 5	< 5	<1	30%	Pass	
4-Chlorotoluene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
4-Methyl-2-pentanone (MIBK)	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Allyl chloride	S16-Jn06055	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Bromobenzene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Bromochloromethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Bromodichloromethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Bromoform	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Bromomethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Carbon disulfide	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Carbon Tetrachloride	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chlorobenzene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chloroethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chloroform	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chloromethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
cis-1.2-Dichloroethene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
cis-1.3-Dichloropropene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibromochloromethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibromomethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dichlorodifluoromethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Iodomethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Isopropyl benzene (Cumene)	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Methylene Chloride	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Styrene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Tetrachloroethene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
trans-1.2-Dichloroethene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
trans-1.3-Dichloropropene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Trichloroethene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Trichlorofluoromethane	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Vinyl chloride	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	S16-Jn06055	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	S16-Jn06055	CP	mg/kg	0.6	0.7	11	30%	Pass	
Dibenz(a.h)anthracene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	S16-Jn06055	CP	mg/kg	0.8	1.0	21	30%	Pass	
Fluorene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	S16-Jn06055	CP	mg/kg	1.3	1.5	20	30%	Pass	
Pyrene	S16-Jn06055	CP	mg/kg	0.6	0.7	13	30%	Pass	

Duplicate									
Speciated Phenols				Result 1	Result 2	RPD			
2.4-Dichlorophenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2.4-Dimethylphenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2.4.5-Trichlorophenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2.4.6-Trichlorophenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2-Methylphenol (o-Cresol)	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
3&4-Methylphenol (m&p-Cresol)	S16-Jn06055	CP	mg/kg	< 1	< 1	<1	30%	Pass	
2-Chlorophenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
2-Nitrophenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
4-Chloro-3-methylphenol	S16-Jn06055	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pentachlorophenol	S16-Jn06055	CP	mg/kg	< 1	< 1	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
Q15	The RPD reported passes Eurofins l mgt's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Nibha Vaidya	Analytical Services Manager
Bob Symons	Senior Analyst-Inorganic (NSW)
Ivan Taylor	Senior Analyst-Metal (NSW)
Rhys Thomas	Senior Analyst-Asbestos (NSW)
Ryan Hamilton	Senior Analyst-Organic (NSW)
Ryan Hamilton	Senior Analyst-Volatile (NSW)



Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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PID Calibration Certificate

Instrument PhoCheck Tiger
Serial No. T-105427

airmet
Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments			
Battery	Charge Condition	✓				
	Fuses	✓				
	Capacity	✓				
	Recharge OK?	✓				
Switch/keypad	Operation	✓				
Display	Intensity	✓				
	Operation (segments)	✓				
Grill Filter	Condition	✓				
	Seal	✓				
Pump	Operation	✓				
	Filter	✓				
	Flow	✓				
	Valves, Diaphragm	✓				
PCB	Condition	✓				
Connectors	Condition	✓				
Sensor	PID	✓	10.6 ev			
Alarms	Beeper	✓	**Low**	**High**	**TWA**	**STEL**
	Settings	✓	50ppm	100ppm	N/A	N/A
Software	Version	✓				
Data logger	Operation	✓				
Download	Operation	✓				
Other tests:						

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No		Instrument Reading
PID Lamp		100ppm Isobutylene	NIST	SY129		100.4ppm

Calibrated by: SB **Sophie Boler**

Calibration date: **25/05/2016**

Next calibration due: **24/06/2016**

GHD

133 Castlereagh St Sydney NSW 2000

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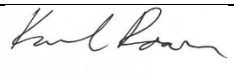
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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	N. Rosen	H. Milne		K. Rosen		05/07/2016
1	N. Rosen	H. Milne		K. Rosen		31/08/2016

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Appendix H Aquatic ecology

Springvale Coal/EnergyAustralia

Water Treatment Project

Aquatic Ecology Impact Assessment

August 2016

Executive summary

Springvale Coal Pty Limited (Springvale Coal) is seeking consent for the Water Treatment Project (the Project). Springvale Coal and EnergyAustralia have agreed to work together to develop the Project. The Project involves the transfer of water from existing underground mine dewatering facilities for industrial reuse at Mt Piper Power Station (MPPS) to improve environmental outcomes and water quality within the upper Coxs River catchment.

This Aquatic Ecology Impact Assessment (AEIA) has been prepared to characterise the existing aquatic ecology within the vicinity of the Project, determine potential impacts of the Project on aquatic ecology and to develop mitigation measures to minimise impacts of the Project on aquatic ecology. An Impact Assessment Area (IAA) has been established to more easily focus the scale of the assessment. The IAA includes the waterways with the highest potential to be impacted by the Project which are:

- Wangcol Creek, downstream of the proposed discharge point.
- Coxs River, between the confluence of Wangcol Creek and Lake Wallace.
- Sawyers Swamp Creek, downstream of LDP009 discharge.

This assessment also considers potential impacts of the Project on groundwater dependent ecosystems (GDEs) through changes to waterways or groundwater within the vicinity of the Project.

Existing aquatic habitats and species present

Wangcol Creek, downstream of the proposed discharge point, is a fourth order stream which is highly degraded due to past land-use activities. Minimal instream habitat remains within the creek and the riparian zone is largely cleared. The water quality within this system is relatively poor, characterised by electrical conductivity (EC) in exceedance of ANZECC (2000) guideline values and dissolved oxygen (DO) below the ANZECC (2000) guideline values for ecosystem protection. These conditions are reflected on the macroinvertebrate community with low diversity and low macroinvertebrate sensitivity (to water pollution) observed at most Wangcol Creek sites. Two native fish species and one invasive fish species has been observed in Wangcol Creek.

Coxs River is a perennial waterway with evidence of moderate to good instream habitat but generally poor riparian vegetation condition. In general, monitoring sites on the Coxs River were found to have macroinvertebrate communities in relatively good condition, despite evidence of elevated EC, compared to ANZECC (2000) guideline values, downstream from the Wangcol Creek and Sawyers Swamp Creek confluences. Site CR6 (downstream from Lake Wallace) appears to support a less diverse macroinvertebrate community, with lower index scores which is generally inconsistent with observed water quality and diversity relationships. Two native fish species and two invasive fish species have been observed across the Coxs River sites.

Sawyers Swamp Creek displayed variable results depending on the monitoring location. The limited data available from upstream of LDP009 indicates higher quality instream and riparian habitat and macroinvertebrate community condition when compared to the site downstream from LDP009. The high EC (median EC of 1,170 µS/cm) discharge from LDP009 is likely to be influencing the macroinvertebrate community downstream of LDP009. No fish have been recorded in Sawyers Swamp Creek.

Presence or likelihood of aquatic threatened species

The Project is unlikely to impose a significant impact on any threatened aquatic fauna species listed under the EPBC Act, TSC Act or the FM Act.

A search of the Protected Matters Search Tool for MNES listed under the EPBC Act identified the potential for three threatened fish, the Macquarie perch (endangered under both the FM Act and EPBC Act), the Murray cod (vulnerable under the EPBC Act) and the Australian grayling (vulnerable under the EPBC Act and protected under the FM Act) to occur within 10 km of the Project Application Area. Given the habitat preferences of these species, the presence of large physical barriers to fish movement within the system and the lack of sightings within the IAA, these fish species unlikely to be present.

A BioNet Atlas search identified the potential for the presence of the endangered Giant Dragonfly, listed as Endangered under the TSC Act within 10 km of the PAA. There are two records of this species within 10 km of the Project, one within Ben Bullen State Forest and one within Newnes State Forest. There are no records of this species within the local waterways relevant to the Project. Based on the outcomes of historic field surveys undertaken by MPR and GHD, habitat availability and the lack of sightings recorded in the Atlas, it is considered highly unlikely that the Giant Dragonfly occur within the IAA.

The threatened Blue Mountains Water Skink was identified as likely to occur in the area. However, there are no records of sighting within the IAA. There are numerous records of this species within 10 km of the PAA. However, RPS (2016) have identified that there is no suitable habitat for this species in the PAA. Therefore, this species is considered to be unlikely to occur.

Presence or likelihood of groundwater dependent ecosystems

No terrestrial GDEs were determined to be associated with the waterways within the IAA. Discussions of any potential terrestrial GDEs associated with the proposed disturbance areas are discussed within the Biodiversity Assessment Report (RPS, 2016).

Stygofauna communities are known to exist within the groundwater environments associated with the Neubecks Coal Project, Springvale Mine and Angus Place Colliery. The monitoring program conducted in relation to the Neubeck Coal Project, which sampled bores located in close proximity to Neubecks Creek and Wangcol Creek within the alluvial groundwater environment, identified obligate stygofauna. However, the alluvial groundwater environment has been identified as discontinuous along Wangcol Creek with soil mapping indicating no alluvial material past the confluence of Wangcol and Neubecks Creek. Therefore, there is limited potential for stygofauna to be present within the PAA.

Impact assessment on aquatic ecology and GDEs

The Project is unlikely to directly or indirectly result in a change to water hydrology or quality that that is of sufficient scale or intensity as to reduce the current or future utility of the water for aquatic ecology. It is likely that there will be some localised changes to macroinvertebrate and/or fish communities as a result of the new discharge into Wangcol Creek and the cessation of discharges to Sawyers Swamp Creek. The water quality of the new discharge will be representative of the background catchment which will be protective of aquatic ecology within Wangcol Creek and waterways downstream. The expected scale and duration of proposed treated water discharges to Wangcol Creek is low, with a maximum increase in water level of 0.2 m based on “worst case” scenario (maximum discharge) on a dry day. Based on the predicted frequency, quality and volume of proposed discharges, there is not expected to be any impacts to aquatic ecology of Wangcol Creek or the Coxs River as a result of the discharge, beyond the natural variation currently exhibited between sampling events. In events where there is no discharge from the Proposed LDP (that is, complete uptake of WTP water by MPPS),

Wangcol Creek may be subject to a slight worsening of water quality (elevated EC) compared to existing conditions through increased discharges from LDP006 as a result of residual transfers (GHD, 2016). Therefore, the aquatic ecology of Wangcol Creek may potentially be impacted downstream of the discharge point during these periods. During periods of discharge from the proposed LDP, LDP006 discharges will be diluted leading to an overall improvement in water quality of Wangcol Creek which is likely to positively influence aquatic ecology.

Due to the larger volume of water in the Coxs River it is unlikely that the proposed new discharges into Wangcol Creek, or any temporary increase in discharge volume from LDP006, during periods of no discharge from the proposed LDP, would lead to measurable changes on the aquatic ecology of this system.

Cessation of 20 to 25 ML/day of mine water discharges, currently with a median EC of 1,170 µS/cm, from LDP009 is expected to have a beneficial effect, overall, on the aquatic ecology of Sawyers Swamp Creek and Coxs River downstream of the Sawyers Swamp confluence. The improved water quality in Sawyers Swamp Creek may allow for habitation by more sensitive taxa, although diversity of macroinvertebrates may be limited by water availability following cessation of discharges. Sawyers Swamp Creek is naturally ephemeral, therefore, the removal of continual mine water discharges will represent a return towards the natural flow regime and, thus, a positive outcome of the Project.

The improvement in water quality that will occur in Sawyers Swamp Creek as a result of cessation of LDP009 discharges will also lead to improvements in water quality within the Coxs River. This is likely to result in improvements to aquatic ecology within the Coxs River. The Project will also reduce the volume of water extraction needed for MPPS operations. If this water allocation is instead returned to the catchment this would benefit aquatic ecology through reestablishment of environmental flows.

No threatened species or habitat for such species are expected to be impacted as a result of the Project. The Project is not predicted to alter the current water quality, recharge of groundwater systems or the hydraulic connectivity between groundwater and surface waters (GHD, 2016). Therefore, no impacts to aquatic GDEs are expected as a result of the Project.

Mitigation measures and monitoring requirements

Direct impacts to aquatic ecosystems have been minimised by using the existing pipeline and infrastructure easements where possible. Direct disturbance to waterways has been limited to:

- The Lamberts Gully channel, which will need to be modified in order to construct the new discharge point adjacent to LDP006.
- The under drilling of Coxs River and localised, temporary impacts to low order waterways along the path of the pipeline.

Cessation of untreated mine water discharges from LDP009 will address existing water quality risks to Sawyers Swamp Creek and the upper Coxs River catchment.

Water quality of Wangcol Creek and Coxs River will be monitored through existing Springvale Coal and EnergyAustralia Surface Water Monitoring Programs as detailed in the Water Resources Impact Assessment (GHD, 2016).

Macroinvertebrate monitoring will be conducted in Wangcol Creek and Coxs River biannually (autumn and spring) for two years following commencement of initial discharge from the new discharge point into Wangcol Creek. The requirement for ongoing macroinvertebrate monitoring beyond this point will be determined depending on the frequency and volume of discharges from the new discharge point over that two-year period and the outcomes of aquatic ecology and water quality monitoring.

Fish monitoring and fish habitat assessment is to be conducted annually for two years following commencement of initial discharge from the new discharge point into Wangcol Creek.

Impacts to groundwater dependent fauna are not expected given that there is not predicted to be any changes to groundwater quality or hydrology as a result of the Project. However, the risk of potential impacts to groundwater dependent fauna will be managed via the existing Springvale Coal and EneryAustralia groundwater monitoring programs as detailed in the Water Resources Impact Assessment (GHD, 2016).

Given the above consideration of potential impacts and proposed mitigation measures, it is considered unlikely that the Project would result in any significant impacts to native aquatic flora and fauna or their habitats or overall aquatic biodiversity values in the locality. As such, no specific offset is considered necessary to compensate for proposed impacts to aquatic habitats, flora or fauna as a result of the Project.

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Glossary

Alkalinity	A measure of the ability of an aqueous solution to neutralise acids. Alkalinity of natural waters is due primarily to the presence of hydroxides, bicarbonates and carbonates. It is expressed in units of mg/L of calcium carbonate ($CaCO_3$).
Aquifer	An underground layer of permeable material from which groundwater can be usefully extracted.
Baseflow	The component of flow in a watercourse that is driven from the discharge of underground water.
Biota	All of the living organisms found in a given area.
Canopy cover	The above-ground portion of a plant community.
Community	An assemblage of organisms occupying a specified location and time, usually interacting with one another.
Community composition	All of the taxa present in a community.
Contaminant	Any physical, chemical, biological or radiological substance capable of producing an adverse effect in a biological system or the natural environment.
Discharge	The quantity of water per unit of time flowing in a stream, for example cubic metres per second or megalitres per day.
Dissolved oxygen	A measure of the amount of oxygen that is dissolved in water.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Electrical conductivity	A measure of the concentration of dissolved salts or ions in water.
Emergent vegetation	A plant or plants rooted underwater that grows above the water surface.
Endemism	Ecologically unique to a defined geographic area.
Ephemeroptera, Plecoptera, Trichoptera taxa index	An index based on the number of taxa of the environmentally sensitive orders Ephemeroptera, Plecoptera and Trichoptera identified in a sample.
Estuarine	A partly enclosed coastal body of brackish water with one or more rivers flowing into it and with a free connection to the open sea.
Geomorphology	Scientific study of landforms, their evolution and the processes that shape them. In this report relates to the form and structure of waterways.
Groundwater	Water occurring naturally below ground level.

Guideline	A numerical concentration or narrative statement that provides appropriate guidance for a designated water use or impact.
Hyporheic	Any physical, chemical, biological or radiological substance capable of producing an adverse effect in a biological system or the natural environment.
Index	Composite value that can give a quick ranking to an ecosystem feature (e.g. a water body), derived via a formula that combines measurements of important ecosystem characteristics; typically used to rank 'health' or naturalness.
Karst	Any physical, chemical, biological or radiological substance capable of producing an adverse effect in a biological system or the natural environment.
Licensed discharge point	A location where the premises discharge water in accordance with conditions stipulated within the site Environmental Protection License.
Macroinvertebrate	An animal species that does not develop a vertebral column that is large enough to be seen without the use of a microscope. These animals generally include insects, crustaceans, molluscs, arachnids and annelids.
Macrophyte	A member of the macroscopic plant life of an area, especially of a large body of water.
Organic carbon	Generally, carbon which is chemically bonded to other carbon atoms, although methane (one carbon atom only) and its derivatives are considered organic.
Organic matter	Matter composed of organic compounds that have come from the remains of once-living organisms such as plants and animals and their waste products.
pH	The value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution.
Phreatic	Relating to or denoting underground water in the zone of saturation (beneath the water table)
Percentile	The value of a variable below which a certain percent of observations fall. For example, the 80th percentile is the value below which 80 percent of values are found.
Rapid bioassessment	A form of biological assessment that uses standardised, cost-effective protocols to provide rapid sample processing, data analysis, reporting and management response. The results from such assessments are likely to be reliable to detect large impacts but not small or minor impacts.
Reach	A defined section of a stream with a uniform character and behaviour.
Richness	The number of species or taxa present (generally applied to a sample or community).

Riparian	Pertaining to, or situated on, the bank of a river or other water body.
Salinity	The dissolved salt content of a body of water or soil.
Sediment	Soil or other particles that settle to the bottom of lakes, rivers, oceans and other waters.
Slightly disturbed ecosystems	A classification used by ANZECC (2000) guidelines applied to ecosystems where there has been a relatively small adverse effect to biodiversity due to anthropogenic activity with largely intact habitats and biological communities.
Stygofauna	Stygofauna are entirely groundwater dependent (obligate) fauna restricted to locations of groundwater discharge or within aquifers.
Taxa	Any group of organisms considered to be sufficiently distinct from other groups to be treated as a separate unit (e.g. species, genera, families).
Taxonomic	An organism's location in the biological classification system used to identify and group organisms with similar physical, chemical and/or structural composition.
Toxicity	The inherent potential or capacity of a substance to cause adverse effects in a living organism.
Tributary	A stream or river that flows into a main river or lake.
Turbidity	A measure of clarity (turbidity) of water. Turbidity in excess of 5 NTU is just noticeable to the average person.
Univariate analysis	Statistical analysis concerned with data collected on one dimension of the same subject.

Abbreviations

AEIA	Aquatic Ecology Impact Assessment
AHD	Australian Height Datum
AUSRIVAS	Australian Rivers Assessment System
BOM	Bureau of Meteorology
CMA	Catchment Management Authority
DO	Dissolved oxygen
DPI	Department of Primary Industries
EA	EnergyAustralia
EC	Electrical conductivity
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPT	Ephemeroptera, Plecoptera, Trichoptera
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater dependent ecosystem
GHD	GHD Pty Ltd
ha	Hectare
km	Kilometre
KTP	Key threatening process
kV	Kilovolt
L	Litre
LDP	Licensed discharge point
LGA	Local Government Area
m	Metre
m bgl	Metre below ground level
m btoc	Metre below top of casing
mg/L	Milligram per litre
ML	Megalitre

ML/day	Megalitre per day
ML/year	Megalitre per year
mm	Millimetre
MMP	Macroinvertebrate Monitoring Program monitoring location
MNES	Matters of National Environmental Significance
MPPS	Mt Piper Power Station
MPR	Marine Pollution Research
Mt	Million tonnes
Mtpa	Million tonnes per annum
NOW	NSW Office of Water
NTU	Nephelometric turbidity unit
OEH	Office of Environment and Heritage
RBA	Rapid bioassessment
RCE	Riparian, channel and environment
ROM	Run of mine
SCSS	Springvale Coal Services Site
SEARs	Secretaries Environmental Assessment Requirements
SIGNAL 2	Stream Invertebrate Grade Number Average Level – Version 2
Springvale Coal	Springvale Coal Company Limited
SSD	State Significant Development
SWL	Standing water level
TSC Act	*Threatened Species Conservation Act 1995*
µm	Micrometre
µS/cm	Microsiemens per centimetre
WM Act	*Water Management Act 2000*
WRIA	Water Resources Impact Assessment
WTP	Water treatment plant
°C	Degree Celsius

1. Introduction

Springvale Coal Pty Limited (Springvale Coal) is seeking consent for the Water Treatment Project (the Project). The Project involves the transfer of water from existing underground mine dewatering facilities for industrial reuse at Mt Piper Power Station (MPPS) to improve environmental outcomes and water quality within the upper Coxs River catchment. GHD Pty Ltd (GHD) was commissioned to prepare an Aquatic Ecology Impact Assessment (AEIA) for the Project. This assessment forms part of an Environmental Impact Statement (EIS) to support a State Significant Development (SSD) application for the Project under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This AEIA has been prepared in accordance with relevant statutory conditions and the *Secretary's Environmental Assessment Requirements Application Number SSD 16_7592* (SEARs).

1.1 Background

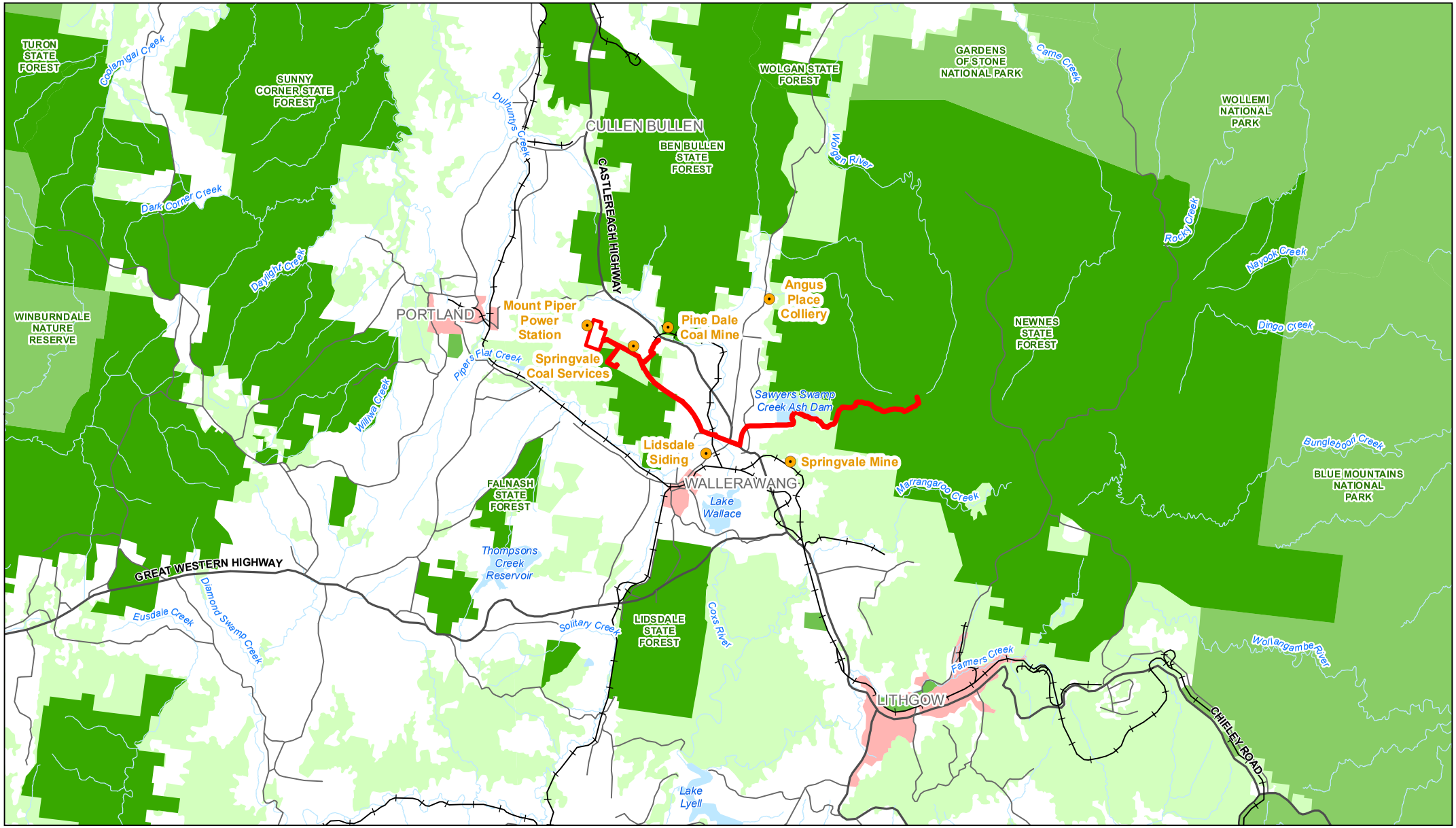
Angus Place Colliery and Springvale Mine are underground coal mining operations in the Western Coalfield of NSW near Lithgow, as shown in Figure 1-1. Angus Place Colliery is located approximately 15 km west of Lithgow and is managed by Centennial Angus Place Pty Ltd (Centennial Angus Place) under a joint venture arrangement between Centennial Springvale Pty Ltd (Centennial Springvale) and Springvale SK Kores Pty Ltd (Springvale SK Kores). Springvale Mine is located approximately 6 km south of Angus Place Colliery and is managed by Springvale Coal under a joint venture arrangement between Centennial Springvale and Springvale SK Kores.

Groundwater inflows into the underground workings at both Angus Place Colliery and Springvale Mine are transferred to the Springvale-Delta Water Transfer Scheme (SDWTS). The SDWTS consists of a pipeline network from existing dewatering facilities on the Newnes Plateau that discharges through Springvale Mine's licensed discharge point (LDP) LDP009 to Sawyers Swamp Creek within the upper Coxs River catchment. Springvale Mine is currently approved to discharge up to 30 ML/day through LDP009. Mine water from Springvale Mine is taken as a priority, with the remaining capacity supplied by mine water from Angus Place Colliery.

MPPS is a coal fired power station owned and operated by EnergyAustralia NSW Pty Ltd (EnergyAustralia), located approximately 17 km north-west of Lithgow and 8 km west of the pit top at Springvale Mine. The power station is one of the greatest users of surface water in the region, due to the significant demand for water required in the cooling water system that is subsequently lost to evaporation. Water for the operation of MPPS is currently supplied from the Coxs River via Lake Lyell and Thompsons Creek Reservoir and is supplemented by the Fish River Water Supply Scheme.

Springvale Mine currently operates under development consent SSD-5594, granted on 21 September 2015 for the Springvale Mine Extension Project. A number of water management performance measures are specified by Schedule 4, Condition 12 of SSD-5594, including the requirement to reduce the electrical conductivity (EC) of mine water discharges to meet the following limits:

- 700 µS/cm (50th percentile), 900 µS/cm (90th percentile) and 1,000 µS/cm (100th percentile) by 30 June 2017.
- 500 µS/cm (90th percentile) by 30 June 2019.



Paper Size A4

0 0.75 1.5 3 4.5 6

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Project application area
- Principal Road
- Secondary Road
- Minor Road
- Existing Rail
- Waterway
- Waterbody
- Built up area
- Recreation area
- Nature Conservation
- State Forest
- Forest or shrub

Springvale Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Locality plan

Figure 1-1

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Data source: Commonwealth of Australia (Geoscience Australia); 250K Topographic Data Series, 2006. Created by: tmorton

1.2 Project objectives

The key objective of the Project is to improve environmental outcomes for the receiving waters in the upper Coxs River catchment. This will be achieved through:

- Treatment of all Angus Place and Springvale mine water to a standard suitable for either industrial reuse or environmental release.
- Maximising reuse of mine water within the MPPS cooling water system.
- Reducing the reliance on extraction of water from the upper Coxs River catchment to meet the demand for make-up water within the MPPS operations.
- Avoiding the volume of untreated mine water to the environment.
- Compliance with water management performance measures required under development consent SSD-5594 for Springvale Mine.

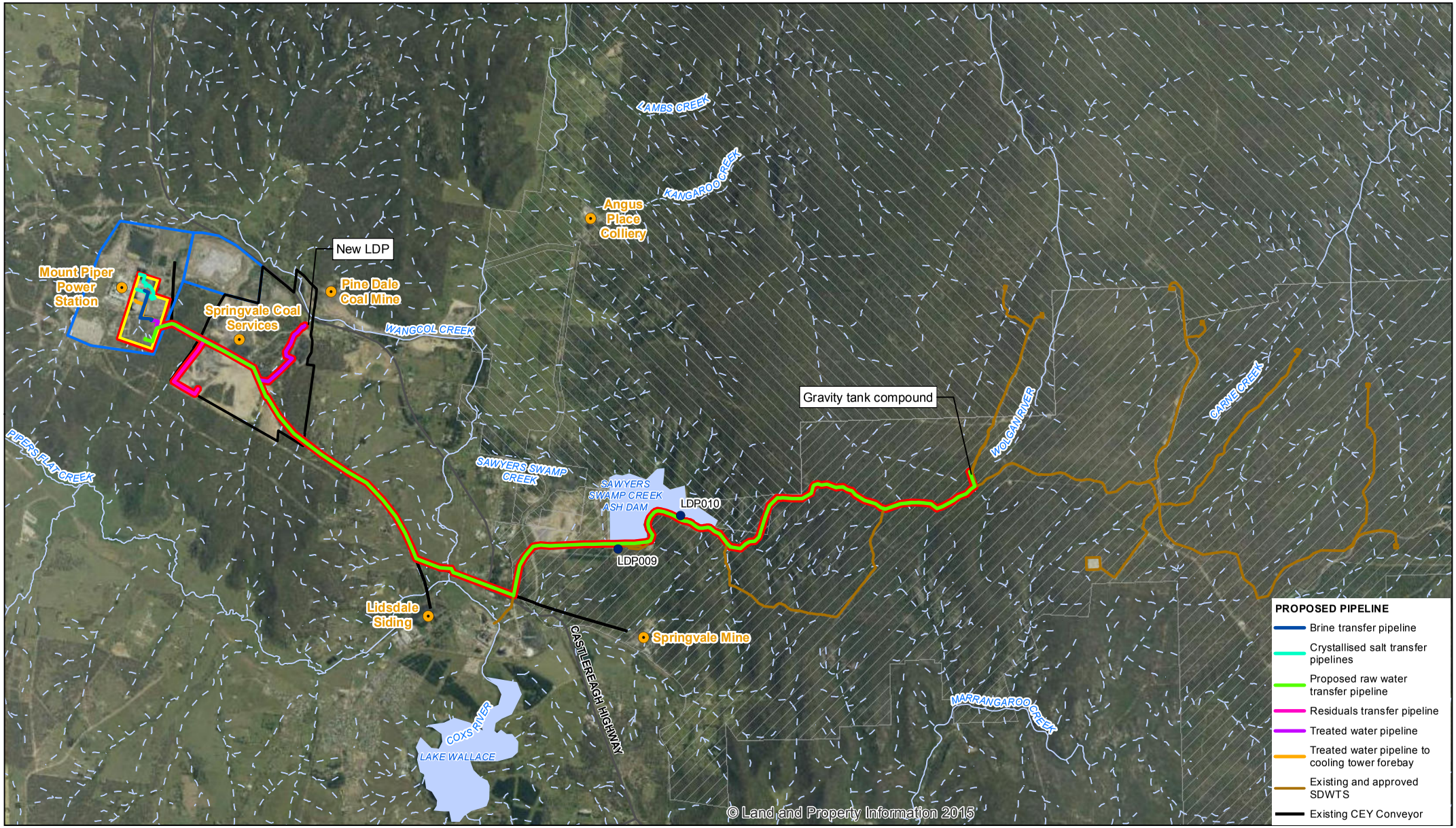
1.3 Project description

An overview of the Project Application Area (PAA) is provided in Figure 1-2. The Project includes the following major elements:

- A system to transfer up to 36 ML/day of dewatered mine water from the existing gravity tank forming part of the approved dewatering facilities on the Newnes Plateau to a new water treatment plant (WTP) to be located at the MPPS site.
- A water treatment plant incorporating desalinisation processes to reduce the salinity in mine water to a standard suitable for either industrial reuse or environmental release.
- Transfer of treated water from the water treatment plant to the MPPS cooling water to contribute to the demand for make-up water.
- Discharge of any excess treated water not able to be reused within the MPPS cooling water system to Wangcol Creek via a new licensed discharge point to be located within the Springvale Coal Services Site (Western Coal Services Project).
- Transfer of residual material from the pre-treatment process to the existing reject emplacement area (REA) at the Springvale Coal Services site (SCSS).
- Transfer of the saline brine stream from the water treatment plant to the MPPS cooling water blowdown system for integration with existing treatment and brine disposal practices.
- Installation of a crystalliser to provide further treatment of the additional salt load generated within the MPPS cooling water blowdown system.

The key aspects of the Project that have the potential to influence the aquatic ecology of waterways in the vicinity of the Project are:

- Treated water discharge (maximum of 32 ML/day) to Wangcol Creek
- Cessation of untreated mine water discharges via LDP009 into Sawyers Swamp Creek



Paper Size A4

0 0.25 0.5 1 1.5 2

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Project application area
- Proposed water treatment site
- Springvale Coal Services Development Consent
- Mount Piper Power Station
- Angus Place Colliery boundary
- Springvale Mining lease boundary
- Principal Road
- Watercourse - Non Perennial
- Watercourse - Perennial

Springvale Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Project overview

Figure 1-2

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Data source: LPI: DTDB/Imagery, 2012, 2015; Centennial: Site location, boundaries, alignment, imagery, 2016. Created by: tmorton

1.3.1 Project water-cycle

A brief explanation of the proposed Project water-cycle is provided in this section to give context regarding possible changes to the aquatic environment that may influence aquatic ecology. A more detailed explanation of the proposed water-cycle is provided in the Water Resources Impact Assessment (GHD, 2016).

The Project will supply water to the MPPS to supplement cooling water demands. The cooling water demand varies depending on power generation, which typically varies diurnally. Future power generation rates cannot be predicted however based on historical conditions power generation typically is above rates that require at least 30 ML/day for cooling water (GHD, 2016). It is likely that as power generation rates increase and decrease any water that is not consumed through re-use at MPPS will be discharged via a new discharge point located at SCSS.

Water supply volumes through the proposed pipeline will vary also over time depending on the predicted groundwater make of both Springvale Mine and Angus Place Colliery. Groundwater volumes are predicted to vary between approximately 17 ML/day to 36 ML/day.

In the event that treatment of water cannot occur, emergency storage locations are available both at MPPS and underground at Angus Place Colliery. Together these emergency storage locations have capacity to manage approximately 12 days of storage. In the event that power generation rates fall to a level where discharges occur via the new discharge location, the rate at which discharges increase and decrease will be controlled in a manner that mitigates rapid changes in water level. It is likely that the operation of plant will operate discharge events at a rate of change less than that observed from rainfall runoff events.

Two waste outputs from the WTP will occur as a result of the Project, one of which is new compared with the other which is already existing. The two waste streams will be the new transfer of residual material to the SCSS Reject Emplacement Area (REA) and the continuation of brine related outputs to the ash emplacement area at MPPS. Waste forms between 11 to 15 % of the water treated by the plant. Typically, this means that at a predicted upper limit of transfer volume at 36 ML/day is only likely to yield 32 ML/day of available water.

The management of these two waste streams are discussed further within the Water Resources Impact Assessment (GHD, 2016) and will be managed as part of the respective Centennial and EnergyAustralia operations.

1.4 Report objectives

This AEIA has been developed to assess the potential aquatic ecological impacts associated with the Project. The purpose of the AEIA is to address the aquatic ecology components of the SEARs as well as the requirements of the *Fisheries Management Act 1994* (FM Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report has been prepared to characterise the existing aquatic ecology within the Project, determine potential impacts of the Project on aquatic ecology and to develop mitigation measures to minimise impacts of the Project on the biodiversity values of the Project. This assessment also considers potential impacts of the Project on groundwater dependent ecosystems (GDEs) through changes to waterways or groundwater within the vicinity of the Project.

1.5 Scope of work

The scope of work for the AEIA included:

- Identify and describe the aquatic habitats and aquatic fauna species present (and likely to be present) in the vicinity of the Project.

- Determine the presence or likelihood of occurrence of groundwater dependent ecosystems (GDEs) in the vicinity of the Project.
- Determine the presence or likelihood of occurrence of aquatic threatened species, populations and ecological communities (and their habitats) listed under the NSW FM Act.
- Determine the presence or likelihood of occurrence of 'Matters of National Environmental Significance' (MNES) pursuant to the EPBC Act, particularly threatened species, threatened ecological communities and migratory species listed under the EPBC Act.
- Assess the likely impacts of the proposed works on the aquatic ecology and GDEs including stygofauna.
- Assess the likely significance of impacts on threatened aquatic biota in accordance with the EP&A Act and the EPBC Act threatened species assessment requirements.
- Develop measures to avoid, minimise and mitigate impacts on aquatic biodiversity values of the PAA.

1.6 Definitions

For the purposes of the AEIA, the following definitions are employed:

- Project Application Area (PAA) – The area encompassing the pipeline routes and the water treatment plant infrastructure required for the Project.
- Site – An aquatic ecology monitoring location.
- Impact Assessment Area (IAA) – section of waterway which is expected to be most strongly impacted by the Project. The Impact Assessment Area is defined as:
  - Wangcol Creek, downstream of the proposed discharge point.
  - Coxs River, between the confluence of Wangcol Creek and Lake Wallace.
  - Sawyers Swamp Creek, downstream of LDP009 discharge.
- Regional Assessment Area – Sites that are not expected to be impacted by the Project. They provide an understanding of waterway health in the region outside the Impact Assessment Area. These include:
  - Coxs River downstream from Lake Wallace to Lake Lyell.
  - Coxs River downstream from Lake Lyell.

1.7 Structure of the report

Table 1-1 provides a description of the structure of the AEIA.

Table 1-1 Report structure

Section	Contents
Section 1 – Introduction	Project overview and scope of works.
Section 2 – Legislation, Policies and Guidelines	Legislative requirements, polices and guidelines relevant to the assessment of the water management and potential surface water impacts.
Section 3 – Site Description	Site location, geology, soils, topography, climate, hydrology and regional context. Sensitive receptors are also identified within this section.
Section 4 – Assessment Methodology	Description of assessment methodology used to assess aquatic biota or GDEs potentially impacted by the Project.
Section 5 – Conservation Significance	Identification of threatened aquatic species, populations and ecological communities of national and state significance that may occur within the PAA.
Section 6 – Existing Environment – Aquatic ecology	Descriptions of aquatic habitats, water quality, aquatic macroinvertebrates and fish identified at selected sites in the Wangcol Creek, Sawyers Swamp Creek and Coxs River catchments.
Section 7 – Existing Environment – GDEs	Description of GDEs known to or likely to occur in the PAA.
Section 8 - Impact assessment – Aquatic Ecology	Potential impacts to identified aquatic ecology as a result of the Project.
Section 9 - Impact assessment – GDEs	Potential impacts to identified GDEs as a result of the Project.
Section 10 – Cumulative Impacts	Description of how the Project will form part of a potential cumulative impact on the Wangcol Creek and Coxs River catchments. This section also includes a description of current projects within the region that potentially contribute a cumulative impact to aquatic ecology.
Section 11 – Avoidance, Mitigation and Management Measures	Description of recommended measures to avoid, minimise or mitigate impacts to aquatic ecology and GDEs as a result of the Project.
Section 12 – Conclusion	Summary of key findings.
Section 13 – References	A list of the reports, scientific publications and other documents referenced within this report.

2. Legislation, policies and guidelines

2.1 Legislation

2.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act, which is administered by the NSW Department of Planning and Environment, is the core legislation relating to planning and development activities in NSW and provides the statutory framework under which development proposals are assessed. The EP&A Act aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

The AEIA forms part of an EIS to support a new development application under Part 4, Division 4.1 of the EP&A Act for the Project. The Minister for Planning and Environment (or delegate, such as the NSW Planning Assessment Commission) is the determining authority for the Project.

The AEIA report supports the Water Resources Impact Assessment in addressing the following component of the SEARs specific to water:

*"**Water** – including an assessment of the likely impacts of the development on the quantity and quality of the region's surface and groundwater resources, particularly having regard to* State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 *and the requirements and recommendations from EPA, DPI, OEH and WaterNSW."*

Specific State government agency requirements from the NSW Environment Protection Authority (EPA), Department of Primary Industries – Office of Water (DPI-Water), Office of Environment and Heritage (OEH) and WaterNSW addressed in the AEIA report are presented in Table 2-1.

Table 2-1 Summary of state government agency requirements relating to aquatic ecology and GDEs

Agency	Elements	Where addressed
DPI-Water	Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.	Water Resources Impact Assessment, This document
DPI-Water	A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework	Section 7 Section 9
DPI-Water	Identify any potential impacts on GDEs as a result of the proposal including: • The effect of the proposal on the recharge to groundwater systems; • The potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and	Water Resources Impact Assessment, Section 7 Section 9

Agency	Elements	Where addressed
	• The effect on the function of GDEs (habitat, groundwater levels, connectivity). Provide safeguard measures for any GDEs.	
OEH	Water and soils The EIS must map the following features relevant to water and soils including: • Groundwater dependent ecosystems.	Section 7
WaterNSW	The potential impacts of any discharges on the water quality of receiving waters and whether there would be any consequences on geomorphology or ecology (flora and fauna) of the receiving watercourses.	Water Resources Impact Assessment, Section 8

Consideration of environmental impact

Section 111(4) of the EP&A Act states that the determining authority must consider the effect of an activity on:

- 'Critical habitat' as defined under the *Threatened Species Conservation Act* 1995 (TSC Act) and FM Act.
- Species, populations or ecological communities, or their habitats (as listed under the TSC Act and FM Act) and whether there is likely to be a 'significant effect' on those species, populations or ecological communities.
- Other protected fauna or protected native plants listed under the *National Parks and Wildlife Act 1974*.

The AEIA addresses the aquatic ecological components of the 'environment' as required under section 111 of the EP&A Act.

Assessment of significance

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the TSC Act and FM Act. The '7-part test' is used to assist in the determination of whether a proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a species impact statement is required.

The AEIA assesses the likelihood of threatened biota listed under the FM Act occurring in the PAA and their potential to be impacted by the Project.

2.1.2 Fisheries Management Act 1994

The objects of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. In particular, this includes:

- To conserve fish stocks and key fish habitats.

- To conserve threatened species, populations and ecological communities of fish and marine vegetation.
- To promote ecologically sustainable development, including the conservation of biological diversity.

and, consistently with those objects:

- To promote viable commercial fishing and aquaculture industries.
- To promote quality recreational fishing opportunities.
- To appropriately share fisheries resources between the users of those resources.
- To provide social and economic benefits for the wider community of New South Wales.
- To recognise the spiritual, social and customary significance to Aboriginal persons of fisheries resources and to protect, and promote the continuation of, Aboriginal cultural fishing.

Key fish habitats

One of the aims of the FM Act is to conserve key fish habitats. These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species.

In freshwater systems, most permanent and semi-permanent rivers, creeks, lakes, lagoons, billabongs, weir impoundments and impoundments up to the top of the bank are considered key fish habitats. Small headwater creeks and gullies (known as first and second order streams) that flow for a short period after rain and farm dams on such systems are generally excluded, as are artificial waterbodies except for those that support populations of threatened fish or invertebrates.

Assessment of significance

The FM Act lists the factors to be addressed in the assessment of significance of impact on threatened species, populations and ecological communities of fish and marine vegetation. Threatened aquatic species are addressed in Section 5 of the AEIA. The classification of fish habitat within waterways in the vicinity of the Project is discussed in Section 6.

2.1.3 Water Management Act 2000

Approval is required under the *Water Management Act 2000* (WM Act) for certain types of developments and controlled activities that are carried out in or near a river, lake or estuary. Four types of controlled activities are recognised:

- Erection of a building or the carrying out of a work.
- Removal of material or vegetation from land, by way of excavation or other means.
- Deposition of material on land as a result of landfill operations or other means.
- Carrying out any other activity that affects the quantity or flow of water in a water source.

Any works proposed within the defined riparian zone of a creek are to be carried out in accordance with the WM Act. Works undertaken on waterfront land (i.e. near a river, lake or estuary) require a controlled activity approval under section 91 of the WM Act, unless defined as exempt. Under section 89J(1) of the EP&A Act, controlled activity approvals are not required for projects that are defined as state significant developments and as such no controlled activity approvals will be required for any aspect of the Project. However, the potential impacts of such

works on instream ecology has been addressed in the AEIA. Impacts of the Project on riparian vegetation are discussed in the Biodiversity Assessment Report (RPS, 2016).

2.1.4 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the EPBC Act, administered by the Commonwealth Department of the Environment, is to ensure that actions likely to cause a significant impact on MNES undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, undertaking, or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Commonwealth Environment Minister (the 'Minister').

The EPBC Act identifies MNES as:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (Ramsar wetlands).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- Nuclear actions (including uranium mining).
- Great Barrier Reef Marine Park.
- A water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act is also relevant to the determination of the ecological value of a GDE. If a GDE contains a threatened species as listed under the EPBC Act, the GDE is then taken to have a higher ecological value.

Potential impacts on any MNES must be subject to assessments of significance pursuant to the EPBC Act *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Department of the Environment, 2013a). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Environment Minister.

The *Significant Impact Guidelines 1.3* (Department of the Environment, 2013b) includes general criteria for whether an action is likely to have a significant impact on water resources, which are for the possibility for direct or indirect changes to:

- The hydrology of a water resource.
- The water quality of a water resource.

According to the *Significant Impact Guidelines 1.3* (Department of the Environment, 2013b), the value of the water resource needs to be confirmed such that impacts from actions can be evaluated on their significance. The guidelines indicate that key factors for evaluating a water resource's value include its utility for all third party users. Third party user categories specific to the Project include:

- Provisioning services (e.g. use by other industries and use as drinking water).
- Cultural services (e.g. recreation and tourism, science and education).
- Supporting services (e.g. maintenance of ecosystem function).

If evidence can be provided that proposed actions would not materially affect the availability and quality for third party users, then the likelihood of an action having a significant impact would be reduced (Department of the Environment, 2013b).

An assessment of whether the Project may have a significant impact on any MNES or on the environment of Commonwealth land was undertaken during the EIS investigations and preparation. The *Significant Impact Guidelines 1.3* (Department of the Environment, 2013b) states that the development of associated infrastructure, such as pipelines and environment protection, monitoring and associated land management activities, that is not part of the extraction process does not need to be referred for its impacts on a water resource. As the Project involves a water transfer and treatment system that is not part of the extraction process of a large coal mining development, it was determined that the Project did not need to be referred under the EPBC Act. An assessment of the Project against the significant impact guidelines has been undertaken as part of the Water Resources Impact Assessment (WRIA) (GHD, 2016).

2.2 Policies

2.2.1 Policy and guidelines for Aquatic Habitat Management and Fish Conservation

The *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation* (DPI, 2013a) are applicable to all planning and development proposals and various activities that affect freshwater, estuarine and marine ecosystems. This document contains:

- General policies for the conservation of fish, marine vegetation and aquatic habitats.
- Descriptions of aquatic habitats, fish and fisheries resources in NSW waters.
- An outline of NSW fisheries legislation.
- Background information, legislation, policy and guidelines that are applicable to activities that may impact on aquatic habitats, including dredging and reclamation (including that involved in laying of pipelines), water front development, water extraction, bridges, roads, causeways, culverts, pipelines, cables or similar structures, water pollution and snag management, harm of selected aquatic habitats and species.
- A description of biodiversity conservation and habitat rehabilitation activities.
- An outline of the requirements for the preparation of environmental planning and assessment documents.

Although the policy does not specifically refer to mining proposals, several guidelines are relevant to this Project, including:

- Instream structures and barriers to fish passage.
- General waterway management.

2.2.2 NSW State Groundwater Policy

The *NSW State Groundwater Policy Framework* document (DLWC, 1997) encouraged the ecological sustainable management of the state's groundwater resources so as to:

- Slow and halt, or reverse any degradation of groundwater resources.
- Ensure long-term sustainability of the systems' ecological support characteristics.
- Maintain the full range of beneficial users of these resources.
- Maximise economic benefit to the region, state and nation.

Three component policies fall under this framework, including:

- NSW Groundwater Quantity Management Policy.
- NSW Groundwater Quality Protection Policy.
- NSW Groundwater Dependent Ecosystems Policy.

The policy for GDEs was designed to protect ecosystems which rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored for the benefit of present and future generations. The policy provides guidance on the protection and management of GDEs. It sets out management objectives and principles to:

- Ensure that the most vulnerable and valuable ecosystems are protected.
- Manage groundwater extraction within defined limits thereby providing flow sufficient to sustain ecological processes and maintain biodiversity.
- Ensure that sufficient groundwater of suitable quality is available to ecosystems when needed.
- Ensure that the precautionary principle is applied to protect GDEs, particularly the dynamics of flow and availability and the species reliant on these attributes.
- Ensure that land use activities aim to minimise adverse impacts on GDEs.

This AEIA discusses the Projects influence on existing GDEs whereas groundwater generally is discussed within the Water Resources Impact Assessment (GHD, 2016).

2.2.3 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy was finalised in September 2012 and clarifies the water licensing and approval requirements for aquifer interference activities in NSW, including the taking of water from an aquifer in the course of carrying out mining.

The Policy outlines the water licensing requirements under the *Water Act 1912* and WM Act. A water licence is required whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity (such as groundwater filling a void), even where that water is not being used consumptively as part of the activity's operation. Under the WM Act, a water licence gives its holder a share of the total entitlement available for extraction from the groundwater source. The WAL must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Sufficient access licences must be held to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased. Many mining operations continue to take water from groundwater sources after operations have ceased. This take of water continues until an aquifer system reaches equilibrium and must be licensed.

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable.

The Level 1 minimal impact considerations for less productive groundwater sources are relevant to the groundwater sources at Centennial sites and are as follows:

- **Water table:** less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant WSP. A

maximum of a 2 m decline cumulatively at any water supply work unless make good provisions should apply.

- **Water pressure:** a cumulative pressure head decline of not more than 40% of the 'post-water sharing plan' pressure head above the base of the water source to a maximum of a 2 m decline at any water supply work.
- **Water quality:** any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. For alluvial water sources, there should be no increase of more than 1% per activity in the long-term average salinity in a highly connected surface water source at the nearest point to the activity.

It is not proposed to modify the existing groundwater extraction activities of Angus Place Colliery or Springvale Mine as part of the Project. During construction works, however, if groundwater is encountered as result of excavation or drilling, the policy would be applicable.

2.3 Guidelines

2.3.1 Risk Assessment Guidelines for Groundwater Dependent Ecosystems

The *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (NOW, 2012a) comprises four volumes and provides a conceptual framework for identifying and assessing ecosystems and worked examples of assessments as well as a discussion on the identification of high probability GDEs and the ecological value of GDEs. Volume 1 of the guidelines provides general material while Volumes 2 through 4 are related specifically to coastal aquifers and are not applicable to this assessment.

3. Site description

3.1 Land use

Land use in the vicinity of the Project consists of residential, coal handling infrastructure, commercial forestry, power generation and national parks. Wallerawang is the closest retail and commercial centre, located approximately three kilometres west of the Springvale Mine pit top and approximately six kilometres from the MPPS.

Extensive mining operations have been undertaken in and around the vicinity of the Project over the past (over 100 years). Commercial forestry occurs within the Newnes State Forest, where the majority of the Springvale Mine dewatering infrastructure is located. Newnes State Forest is approximately 25,000 hectares in size and also supports a number of recreational uses. Public access is permitted in the Newnes State Forest with common recreational activities consisting of motorcycle riding, four-wheel driving, bushwalking, camping, mountain bike riding, canyoning, photography, bird watching and other recreational and adventure activities.

There are a number of national parks and state forests in the region. These include:

- Ben Bullen State Forest, located adjacent to the Project north, north-east and north-west.
- Newnes State Forest, located outside the Project to the east.
- Lidsdale State Forest, located outside the Project to the west.
- Blue Mountains National Park, located outside the Project to the south east.
- Turon State Forest, located outside the Project to the west.

Key operations in the vicinity of the Project include:

- Angus Place Colliery.
- Lidsdale Siding Rail Loading Facility (Lidsdale Siding).
- MPPS.
- Pine Dale Coal Mine.
- Western Coal Services Project.
- Springvale Mine.
- Wallerawang Power Station (decommissioned).

Surrounding sites will be discussed in detail with respect to their operation and their relevance to the Project within Section 3.6. The potential cumulative impact of existing operations is discussed within the Water Resources Impact Assessment (GHD, 2016).

3.2 Topography

The topography around Springvale Mine comprises narrow gorges with high ridgelines and steep-sided slopes of sandstone cliffs. The cliffs rise above incised valleys and hilly areas with relatively flat crests and some spurs with moderately sloped ephemeral drainage lines. Rivers and streams, such as Coxs Creek and Kangaroo Creek, are found in the vicinity.

The proposed pipeline alignment is located partially within the Newnes Plateau, which forms part of the divide between the Coxs River and Wolgan River catchments with elevations ranging from 900 m Australian Height Datum (AHD) to greater than 1,175 m AHD.

The local topography at MPPS and the SCSS is on a northern aspect with elevations ranging from 900 m AHD to 985 m AHD in the south. The catchments of Lamberts Gully and Huon Gully

drain through the SCSS to Wangcol Creek. MPPS similarly also has catchment from the south contributing to Wangcol Creek. The headwaters of Wangcol Creek are up to 1,060 m AHD in the south-west.

3.3 Climate

The climate in the region is typical of a cool temperate mountain climate, characterised by cold winters and warm summers. The highest temperatures occur throughout December, January and February, with the coolest temperatures occurring in July. Snow and/or sleet are common in winter months. Mean daily maximum temperatures range from 25.1 °C in summer to 11.2 °C in winter with mean minimum temperatures ranging from 10.1 °C in summer down to 1.3 °C in winter.

3.3.1 Rainfall

Daily rainfall data was obtained from the Scientific Information for Land Owners (SILO) database operated by the Queensland Department of Science, Information Technology and Innovation. SILO patched point data is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' with interpolations from nearby stations.

The period of rainfall data extended from January 1889 to December 2015 and is summarised as annual totals in Figure 3-1.

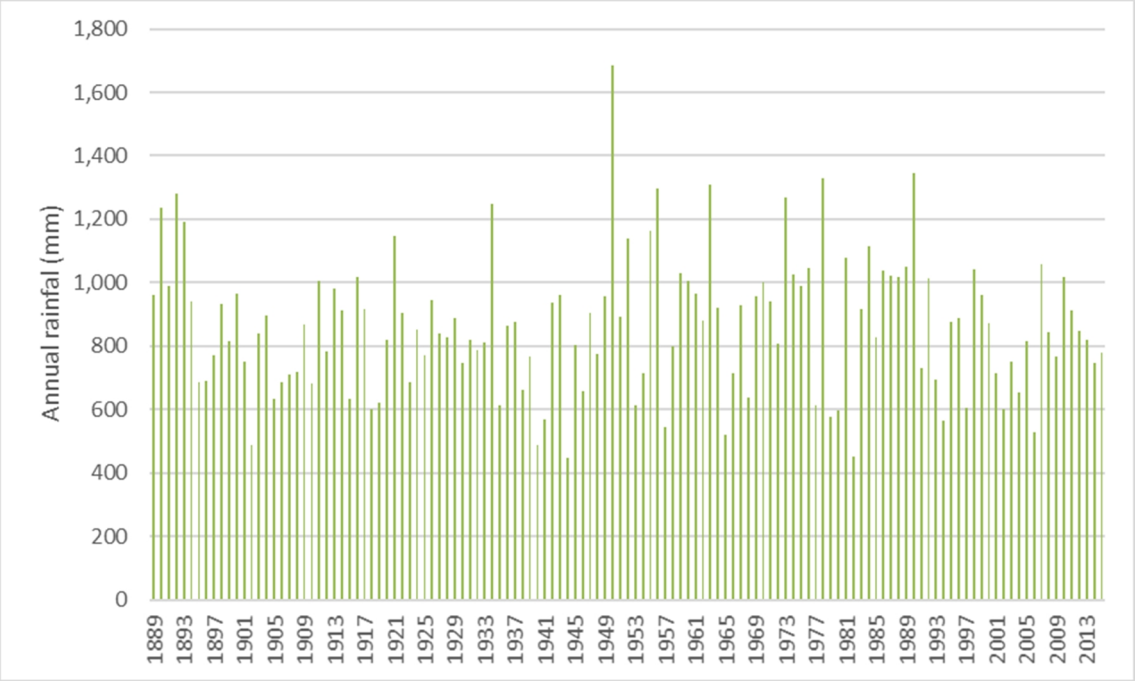


Figure 3-1 Annual rainfall recorded at Lithgow (Birdwood St) Station

The statistics for this rainfall set shown in Figure 3-1 are:

- Minimum annual rainfall – 447 mm in 1944.
- Average annual rainfall – 862 mm.
- Median annual rainfall – 853 mm.
- Maximum annual rainfall – 1,683 mm in 1950.

3.4 Geology

The Project is located in the southern part of the Western Coalfield and on the western edge of the Sydney Basin. The stratigraphy of the region consists of material from the Tertiary, Triassic and Permian periods.

The Sydney Basin is characterised by coal, shale and sandstone sedimentary beds of Permo-Carboniferous age. These form the gently dipping beds of the Illawarra Coal Measures, capped by shale and sandstone from the Wiannamatta and Narrabeen Group (Triassic Period) and Basalt from the Tertiary period.

Directly below the Illawarra Coal Measures lies the silty, coaly sedimentary rocks of the Nile Subgroup and sandy siltstone of the Berry Siltstone.

Basement rocks of Western Sydney are folded Palaeozoic metamorphosed rocks of the Lachlan Fold Belt, Late Carboniferous granites and Early Permian Rylstone Volcanics.

There are seven identified coal seams within this region, listed in descending stratigraphical order as follows:

- Katoomba Seam.
- Middle River Seam.
- Moolarben Seam.
- Upper Irondale Seam.
- Irondale Seam.
- Lidsdale Seam.
- Lithgow Seam.

Seismic activity has been noted along the Coxs River Lineament Fault Zone, a 250 m wide, north-south trending graben structure which follows the valley of Coxs River.

The regional stratigraphy of the Project is further discussed within the Water Resources Impact Assessment (GHD, 2016).

3.5 Water resources

3.5.1 Surface water

Regionally, the Project is located within the upper Hawkesbury River catchment, which includes the greater Warragamba Dam catchment and the upper Coxs River sub-catchment. The Coxs River is a perennial river that drains a catchment area of approximately 1,700 km^2. The river rises within the Ben Bullen State Forest east of Cullen Bullen and flows generally in a south-east direction. The river is bounded to the west by the Great Dividing Range, to the north by the upper Colo River catchment, and to the south by the Wollondilly River catchment. The flow in Coxs River is regulated by two reservoirs, Lake Wallace and Lake Lyell, which are used to supply power generation activities at MPPS. The Coxs River flows into Lake Burragorang (impounded by Warragamba Dam), which is the primary reservoir for drinking water supply to Sydney.

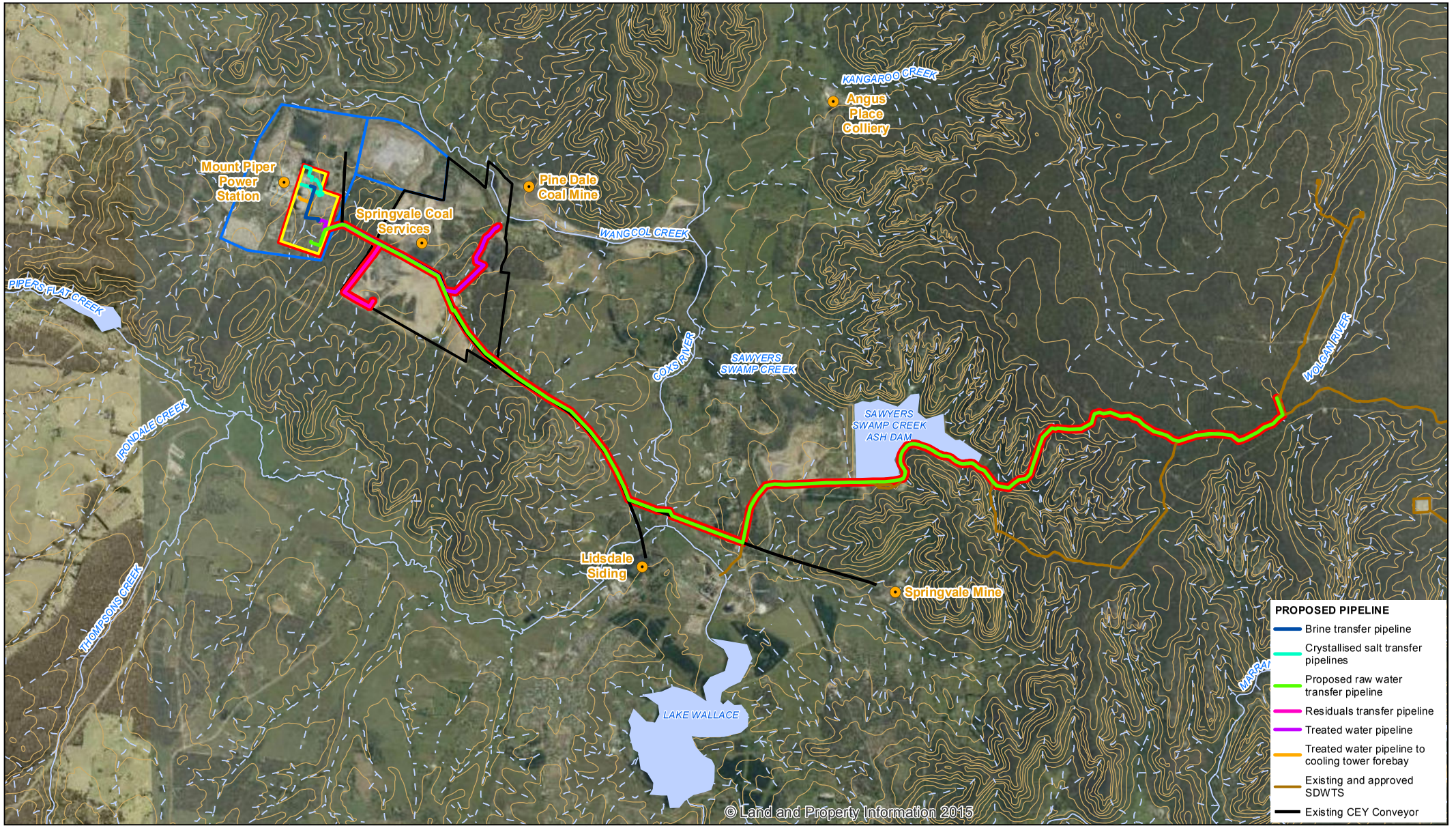
Neubecks Creek flows in a south-west direction into Wangcol Creek. It is an ephemeral creek that rises north of the Project in Ben Bullen State Forest and is characterised by low or zero flow for most of the year. There are currently no mine discharges to this system.

Wangcol Creek is a heavily modified perennial stream located to the north of the MPPS and SCSS. Wangcol Creek drains into the Coxs River approximately three kilometres to the east of

the MPPS. The historic mining operations in the Wangcol Creek catchment have altered the natural flow paths and water chemistry of the system. Diversion within the creek have been undertaken historically for operations such as the Commonwealth Open Cut (around the confluence with Coxs River) and more recently by Pine Dale Coal Mine (mid reach, downstream of SCSS).

Sawyers Swamp Creek is an ephemeral stream located to the east of the Coxs River, below the Sawyers Creek Ash Dam. Sawyers Swamp Creek drains to the Coxs River approximately two kilometres west of the existing Springvale Mine LDP009.

Figure 3-2 presents the watercourses in the vicinity of the Project.



Paper Size A4

0 0.25 0.5 1 1.5 2

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Site location
- Project application area
- Proposed water treatment site
- 20m Contour
- Waterbody
- Watercourse - Non Perennial
- Watercourse - Perennial

Springvale Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Waterways

Figure 3-2

G:\22\0105001\GIS\Maps\Deliverables\Western\Springvale\2125109\AquaticEcology\2125109_AE011_Watercourse_Topography_0.mxd

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Data source: LPI: DTDB/Imagery, 2012, 2015; Centennial: Site location, boundaries, alignment, imagery, 2016. Created by: tmorton

3.5.2 Groundwater

The primary hydrogeological units identified within the Western Coal Services Project (RPS, 2013) and MPPS (SKM, 2010) are defined in Figure 3-1. The mudstone and siltstone units that are present between coals seams (Lidsdale and Lithgow seams) and sandstones throughout the profile will significantly retard vertical flow between aquifer units.

Table 3-1 Hydrogeological units in the west of the Project Application Area

Unit	Features
Quaternary Alluvium	Isolated to Wangcol Creek, discontinuous, very little presence adjacent to MPPS and SCSS. Typically around the confluence of Neubecks and Wangcol Creek.
Triassic Sandstone	Areas of fracturing due to historical underground mining allowing for some vertical connection.
Permian Illawarra Coal Measures	Areas of Lidsdale and Lithgow seam have been mined historically
Marrangaroo Conglomerate	Outcrops to the south
Basal unit comprising the Shoalhaven Group	Outcrops to the south with a high porosity but low permeability

In accordance with the NSW Aquifer Interference Policy and the Greater Metropolitan Region (GMR) WSP, the existing aquifer systems within the PAA are expected to form less productive porous rock aquifer systems associated with the Sydney Basin Coxs River groundwater source.

The groundwater environment present along the pipeline route is less impacted by historical mining and is typically elevated into the Narrabeen group typically comprised of sandstone.

The Groundwater Dependent Ecosystem Atlas (BOM, 2016) indicates limited potential for groundwater dependence along the waterways between Wangcol Creek, downstream of the proposed discharge point, and Coxs River at Lake Wallace and moderate potential at Sawyers Swamp Creek. Groundwater dependence is discussed further in Section 7.

Historically, Wangcol Creek was considered to be ephemeral, however recent level gauging indicates perennial flow due to groundwater influence from shallow aquifers. The results of various site specific hydrogeological investigations (GHD, 2016) suggest periodic connectivity between shallow groundwater aquifers and surface water but limited or no connectivity to deeper aquifers regionally flowing to the north-east. Comparison of groundwater levels to rainfall records identified that groundwater levels are largely reflecting rainfall patterns within alluvial bores and bores monitoring groundwater levels above the Lithgow seam (GHD, 2016).

3.6 Regional setting

The Project sits within a significantly developed catchment with pre-existing industrial and mining land uses. The location of operations in the regional area that may influence water quality and, thus, aquatic ecology is shown in Figure 3-3. A brief overview of these operations is provided below. A detailed description of operations in the region is provided in the WRIA (GHD, 2016).

3.6.1 Wangcol Creek catchment

The operations that contribute to Wangcol Creek are MPPS and SCSS. Prior to 2014, there was water discharge from Pine Dale Coal Mine to Wangcol Creek, downstream of SCSS LDP006, however, the mine is now under care and maintenance and no longer has any active discharges to the creek.

Water required for the operation of MPPS is supplied from the Coxs River via Thompsons Creek Reservoir and is supplemented by the Fish River Water Supply Scheme. Surface water runoff from contributing catchments is directed through a LDP into Wangcol Creek.

The SCSS is a coal processing facility that currently receives coal from Springvale Mine by overland conveyor and provides coal storage, handling and processing functions. Treated excess water is discharged through LDP006 into Wangcol Creek via Lamberts Gully.

3.6.2 Coxs River catchment

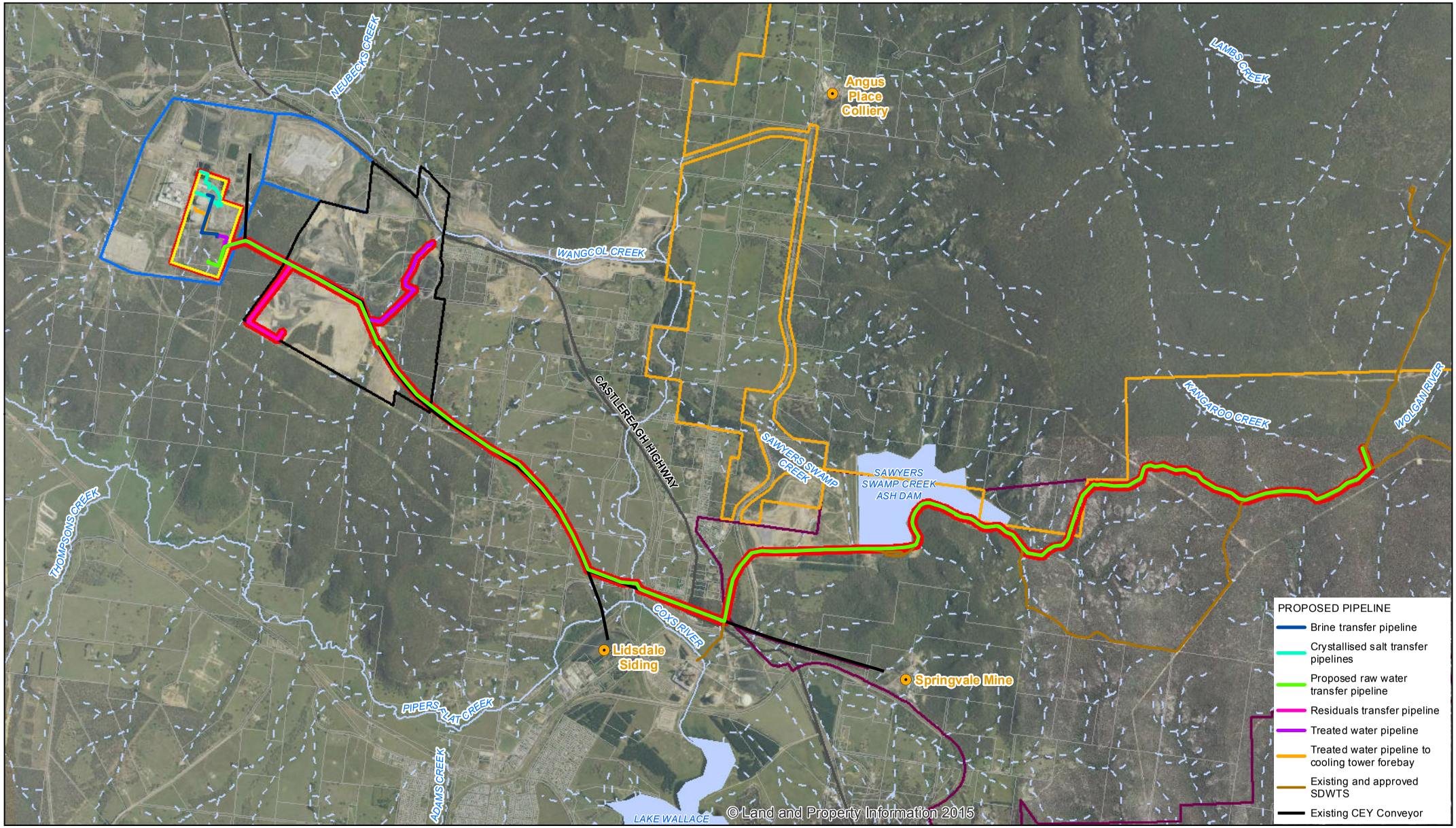
The operations that discharge water to the Coxs River are Angus Place Colliery, located upstream of the confluence with Wangcol Creek, and Lidsdale Siding and Springvale Mine, located downstream of Wangcol Creek. Wallerawang Power Station is also located downstream of the confluence of Wangcol Creek and Coxs River, however, it is currently being decommissioned and does not have an active discharge point.

Excess water from Angus Place Colliery is discharged through LDPs into Kangaroo Creek and Coxs River upstream of the confluence with Wangcol Creek. Mine water from Springvale Mine currently discharges to Sawyers Swamp Creek via LDP009.

3.7 Sensitive receptors

The following sensitive surface and groundwater receptors have been identified:

- GDEs located along Wangcol Creek and Sawyers Swamp Creek.
- Aquatic ecology maintained in local waterbodies, including macroinvertebrate fauna, frogs, macrophytes and algae, fish, semi-aquatic invertebrate species and semi-aquatic mammals.
- Watercourses described in Section 3.5.1, including Wangcol Creek and Coxs River.



Paper Size A4

0 0.2 0.4 0.8 1.2 1.6

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Project application area
- Proposed water treatment site
- Springvale Coal Services Development Consent
- Mount Piper Power Station
- Principal Road
- Angus Place Colliery boundary
- Springvale Mining lease boundary
- Cadastre
- Waterbody
- Watercourse - Non Perennial
- Watercourse - Perennial

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Regional setting of the Project

Figure 3-3

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Data source: LPI: DTDB/Imagery, 2012, 2015. Centennial: Site location, boundaries, 2016. Created by: tmorton

4. Assessment methodology

4.1 Instream ecology

4.1.1 Literature review

A review of relevant available literature, background information and searches of databases was undertaken for threatened aquatic species, populations and aquatic ecological communities recorded within the locality. Information and databases reviewed included:

- Centennial aquatic ecology monitoring reports:
  - *Aquatic Ecology Monitoring: Coxs and Wolgan River Catchments –Autumn 2013* (MPR, 2013), *Spring 2013* (MPR, 2014a), Autumn 2014 (MPR, 2014b), *Spring 2014* (MPR, 2015a), Autumn 2015 (MPR, 2015b) and Spring 2015 (MPR, 2016b).
  - *Centennial West Aquatic Ecology Monitoring: Wangcol and Piper Flat Creeks – Autumn 2015 (MPR, 2015c), Spring 2015 (MPR, 2016a).*
  - *The Neubeck Coal Project: Aquatic Ecology Impact Assessment* (GHD 2014b).
- Raw data records from WaterNSW for annual macroinvertebrate monitoring program (2012 to 2015) for the Mid Coxs River catchment sites.
- Office of Environment and Heritage (OEH) *Atlas of NSW Wildlife* (Bionet) for threatened species, populations and endangered ecological communities listed under the TSC Act and FM Act.
- Department of Primary Industries (DPI) *Threatened and Protected Species – Records Viewer* for records and distribution of threatened and protected species of fish within Lithgow LGA and Hawkesbury-Nepean Catchment Management Authority (CMA).
- Department of the Environment *Protected Matters Search Tool* for MNES listed under the EPBC Act.
- Atlas of Living Australia website at http://www.ala.org.au.

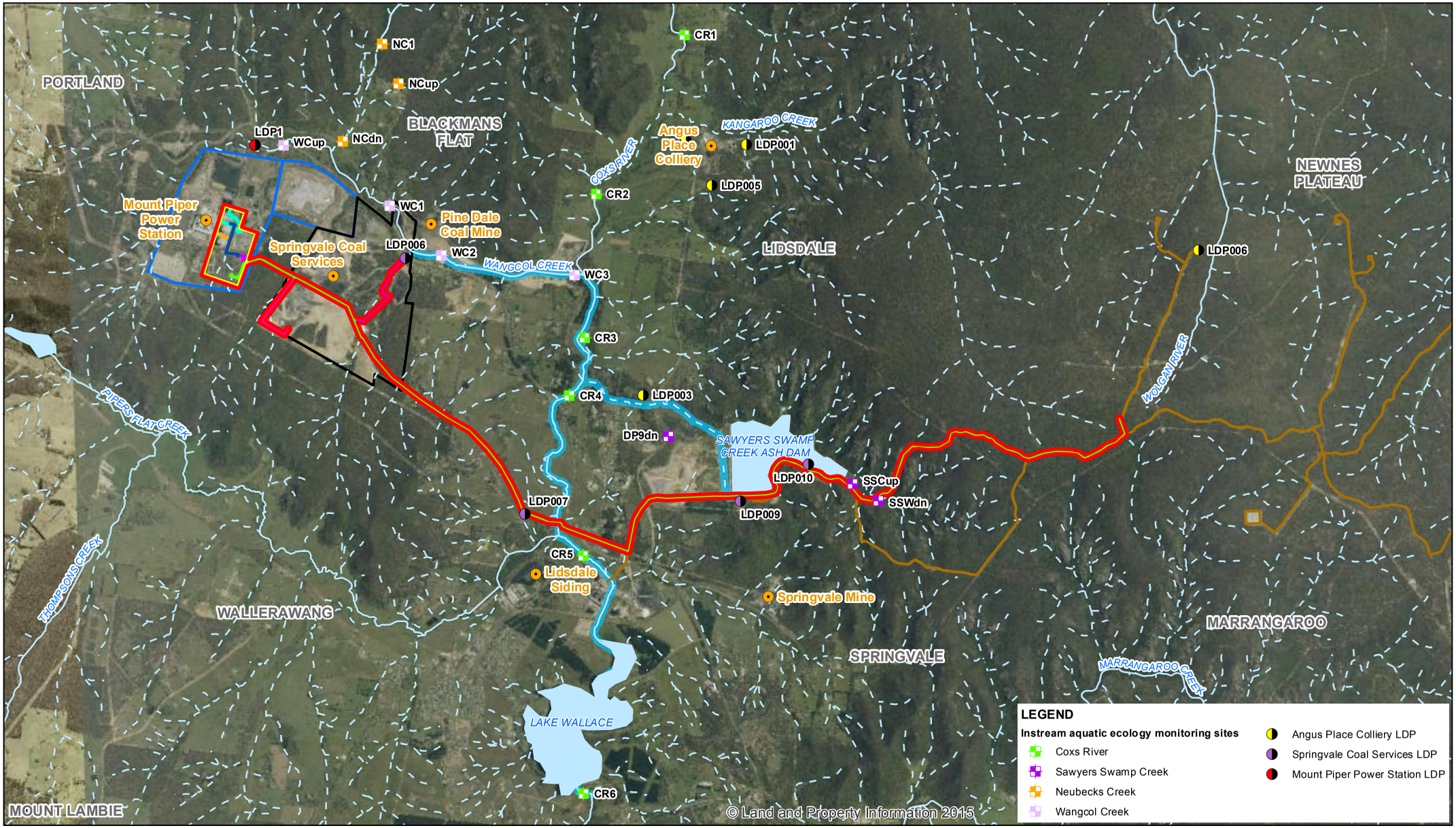
4.1.2 Historic aquatic ecology surveys relevant to the Project

Marine Pollution Research (MPR) has undertaken macroinvertebrate monitoring in the IAA as part of the Centennial West aquatic ecology monitoring program. GHD conducted further macroinvertebrate monitoring at some sites between 2013 and 2014 as part of the Neubeck Coal Project (GHD, 2014b).

Data collected by MPR and GHD between 2011 and 2014 has been used as baseline data for Neubecks Creek (sites NCup, NC1 and NCdn) (MPR 2012; GHD, 2014b). Data collected by MPR and GHD between 2013 and 2015 have been used as baseline data for Wangcol Creek (sites WCup, WC1, WC2 and WC3), Sawyers Swamp Creek (sites SSWdn & SCup and DP9dn) and Coxs River (sites CR1, CR2, CR3, CR4, CR5 and CR6) (MPR 2013; 2014a; 2014b; 2015a; 2015b; 2016a,b,c). The monitoring locations relevant to the IAA and used within the AEIA are shown in Figure 4-1.

GHD has conducted an annual macroinvertebrate survey of the Coxs River catchment on behalf of WaterNSW. Data collected from sites lower in the Coxs River catchment (WaterNSW monitoring locations MMP37 and E086) between 2012 and 2015 have been used as baseline data representative of the wider catchment. The location of WaterNSW macroinvertebrate sites in shown in Figure 4-2.

Based on location, sites were classified as being either ‘background’ sites – those that are not likely to be impacted by any Project activities or ‘baseline’ sites, which provide information on existing conditions at sites that have the potential to be impacted by the Project.



Paper Size A4

0 0.375 0.75 1.5 2.25

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Project application area
- Proposed water treatment site
- Springvale Coal Services Development Consent
- Mount Piper Power Station
- Impact assessment area
- Brine transfer pipeline
- Crystallised salt transfer pipelines
- Proposed raw water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline
- Treated water pipeline to cooling tower forebay
- Existing and approved SDWTS

Centennial Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Location of local instream monitoring sites

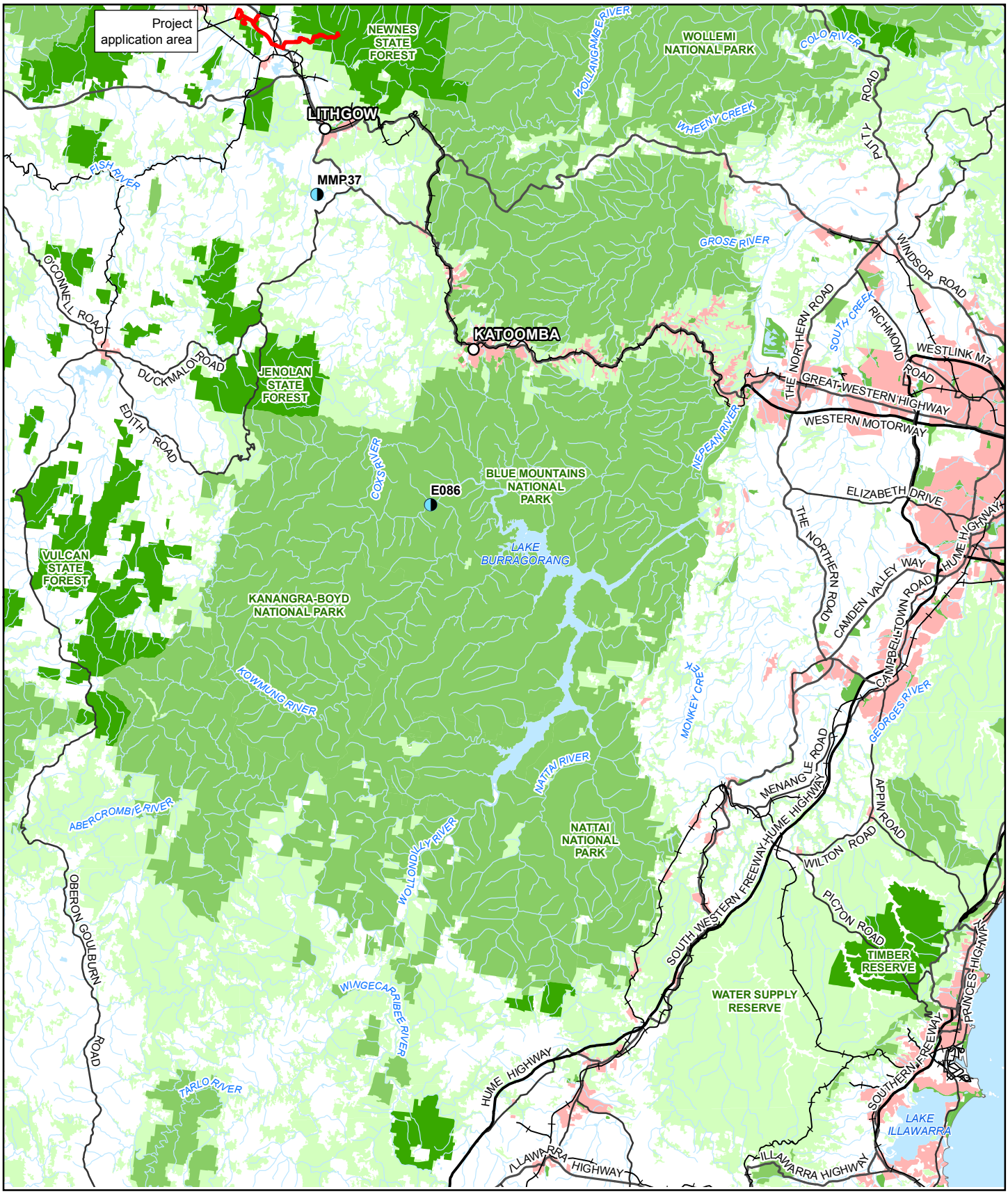
Figure 4-1

G:\22\0105001\GIS\Maps\Deliverables\Western\Springvale\2125109\AquaticEcology\2125109_AE002_InstreamMonitoringLocations_0.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB/Imagery, 2012, 2015. Created by: tmorton, kpsroba



LEGEND

- Instream monitoring site
- Project application area
- Dual Carriageway
- Principal Road
- Secondary Road
- Existing Rail
- Built up area
- Recreation area
- Nature Conservation
- State Forest
- Forest or shrub
- Waterbody
- Waterway

Paper Size A4

0 2,125 4,250 8,500 12,750 17,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Centennial Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Regional instream ecology monitoring sites

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Figure 4-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\0105001\GIS\Maps\Deliverables\Western\Springvale\2125109\AquaticEcology\2125109_AE004_Regional_AquaticMonitoring_Locations_B.mxd

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Data source: LPI: DTDB/Imagery, 2012, 2015. Created by: tmorton, kpsroba

4.1.3 Aquatic survey methods

The survey methods used by MPR and GHD are both focused on macroinvertebrate community composition, habitat assessments, water quality and fish presence. Methods are summarised in the following paragraphs. Methods of habitat assessment varied between studies conducted by GHD and MPR.

Habitat assessment

Field data collected included the range of physical habitat measurements in accordance with the Australian Rivers Assessment System (AUSRIVAS) protocols (Turak *et al.,* 2004). Field data were recorded by professionally qualified and experienced aquatic ecologists and included:

- Site information, water quality and habitat assessment.
- Macroinvertebrate habitat and sample collection.
- Reference condition selection criteria.
- A modified Riparian, Channel and Environment (RCE) Inventory (Chessman *et al.*, 1997).

Field data descriptions were based on visual estimates of characteristics such as streambed composition (percentage of total composition for each substrate category), aquatic and riparian vegetation cover, amount of instream organic material, area of aquatic habitats and canopy cover. The mean width (wetted width in metres), mean depth and sample depth were determined using visual estimation.

The assessment also included sketches of the longitudinal and cross-sectional profiles of the river reach assessed displaying the biological sampling site, location of in situ water quality sampling, riparian zone width, type and height and location where photos were taken. The cross-section includes the approximate bank height, stream width and depth and the approximate height of riparian vegetation.

Stream order was calculated using the Geoscience Australia (2007) 250,000 topographic waterway GIS layer.

The Fairfull and Witheridge (2003) **fish classification system** has been used for classification of fish habitat of the waterways in the Impact Assessment Area (Table 4-1). This system allows for classification of waterways into one of four classes relating to habitat values.

Table 4-1 Fish habitat classification criteria (Fairfull and Witheridge, 2003)

Classification	Characteristics of Waterway Type
CLASS1 Major fish habitat	Major permanently or intermittently flowing waterway (e.g. river or major creek); habitat of a threatened fish species or 'critical habitat'.
CLASS 2 Moderate fish habitat	Named permanent or intermittent stream, creek or waterway with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.
CLASS 3 Minimal fish habitat	Named or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats.
CLASS 4 Unlikely fish habitat	Named or unnamed waterway with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools after rain events (e.g.

	dry gullies or shallow floodplain depressions with no permanent aquatic flora present).

The **Riparian, Channel, and Environmental (RCE) Inventory** (Petersen, 1992) allows a standardised approach to assess the adjacent land, condition of the banks, channel and bed using 13 descriptors/indicators. The RCE Inventory has been modified by Chessman *et al.*, (1997) to suit Australian conditions. The scoring system has been simplified to a range of 0 to 4 for each descriptor. The total score is derived by summing the scores for each descriptor. The maximum possible score for a site is 52. To allow for a more succinct summary of existing conditions the scores calculated for each season have been averaged for each site.

Macroinvertebrates

Field sampling

Field sampling by GHD and MPR following rapid bioassessment (RBA) protocols was undertaken in accordance with the NSW AUSRIVAS sampling and processing manual (Turak *et al.*, 2004). The AUSRIVAS program is a nationally recognised, standardised sampling method used to assess the health of Australian rivers and developed for Australia's National River Health Program.

At each site, the littoral or edge habitat was sampled by sweeping the collecting net along the edge of the stream in areas of little or no current. The net was swept around overhanging terrestrial vegetation, against snags if present, in backwaters and through beds of macrophytes. This process was continued, working upstream against the flow, over approximately 10 m of edge.

The objective of the RBA sorting protocol is to obtain a sample containing as diverse a fauna as possible (and hence provide a useful measure of taxa richness).

Data management

If taxa were too small to identify to family level and order level identification was the lowest resolution obtained, these taxa were retained in the data set only if no other representatives from that group were found in that sample, otherwise they were removed. Microcrustacea (Copepoda, Ostracoda and Cladocera) and Collembola were retained in the data set.

Macroinvertebrate indices

The following macroinvertebrate biotic indices were calculated:

- Taxonomic richness.
- EPT richness.
- SIGNAL 2 biotic index.
- Relative richness.
- NSW AUSRIVAS model.

Taxonomic richness: Taxonomic richness refers to the number of different taxa contained in a sample. A high number of taxa present at a given site can indicate that the site is in good condition and/or has a diverse range of habitats and an abundant food supply. However, in some cases, higher taxa richness can occur at impacted sites due to the provision or enhancement of habitats or food resources that may not occur naturally (e.g. enhanced riffle habitat availability due to altered flow conditions, enhanced periphyton food resource for macroinvertebrate grazing taxa due to increased nutrient levels). Consequently, results for taxa richness value must be assessed on a case-by-case basis and in relation to habitat conditions.

EPT richness (Ephemeroptera, Plecoptera and Trichoptera richness): Some groups of aquatic macroinvertebrates are more sensitive to changes in the aquatic environment than others and it is possible to refine the assessment of river health based on the presence or absence of sensitive taxa. It is generally accepted that three orders of aquatic insects, the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), are among the most sensitive to altered water quality and habitat conditions. The total number of families of EPT taxa can be used to assess degradation of habitat and water quality (Plafkin *et al.*, 1989). The use of this index is based on the premise that undisturbed sites will have relatively greater numbers of EPT than sites in a degraded condition. The use of EPT should be limited to regional or preferably within-catchment comparisons (as in this case), as the composition of the fauna varies between regions and river systems, with some systems naturally having more EPT taxa than others.

SIGNAL-2 biotic index (Stream Invertebrate Grade Number Average Level – Version 2) (Chessman, 2003): SIGNAL-2 is a simple scoring system for macroinvertebrates of Australian rivers. SIGNAL-2 is a biotic index based on pollution sensitivity values (grade numbers) assigned to aquatic macroinvertebrate families that have been derived from published and unpublished information on their tolerance to pollutants, such as sewage and nitrification (Chessman, 1995). Each taxon is assigned a grade from 1 (tolerant) to 10 (sensitive) based on ecotoxicity assessment data.

The average of the grades for each site is used as the SIGNAL-2 score. Those families in a sample for which no grade can be assigned are excluded from the analysis. The calculation of the SIGNAL-2 score has not been weighted in regards to the abundance of organisms.

Relative richness: Relative richness is the percentage of the major taxonomic orders found and has been derived from the presence/absence data for each sample. This measure provides an estimate of the percentage contribution of the major macroinvertebrate orders and allows for a visual representation of the macroinvertebrate community at each site and a pooled total representing the macroinvertebrate community.

NSW AUSRIVAS model: The NSW AUSRIVAS model provides a river health assessment based on predictive models of macroinvertebrate distribution (Turak *et al*., 2004). Physical and chemical data collected at each site is used to determine the predicted (expected) composition of the macroinvertebrate fauna if the site is in an undisturbed or reference condition. The AUSRIVAS assessment compares the macroinvertebrates collected at a site (Observed) to the predicted to occur (Expected) and the ratio derived indicates which band the site will be in. The AUSRIVAS bandings allow an assessment of the level of impact at a site. A summary of the AUSRIVAS bandings is provided in Table 4-2.

On occasion results will be outside of the experience of the model. This occurs when there is no appropriate reference group for comparison to the test sites.

Table 4-2 AUSRIVAS band explanations (Turak *et al.*, 2004)

Band label	Band name	Band description
Band X	More biologically diverse than reference sites.	More taxa found than expected. Potential biodiversity hot-spot. Possible mild organic enrichment.
Band A	Reference condition.	Most/all of the expected families found. Water quality and/or habitat condition roughly equivalent to reference sites. Impact on water quality and habitat condition does not result in a loss of macroinvertebrate diversity.
Band B	Significantly impaired.	Fewer families than expected. Potential impact either on water quality or habitat quality or both, resulting in loss of taxa.
Band C	Severely impaired.	Many fewer families than expected. Loss of macroinvertebrate biodiversity due to substantial impacts on water and/or habitat quality.
Band D	Extremely impaired.	Few of the expected families remain. Extremely poor water and/or habitat quality. Highly degraded.

Fish

Fish surveys were carried out by MPR in conjunction with the macroinvertebrate assessments between 2010 and 2015. MPR used a combination of overnight and spot bait-trapping, dip netting and observation to provide an understanding of fish likely to be present within each waterway. GHD undertook electrofishing at key site in spring 2013, autumn 2014 and spring 2014 as part of the Neubeck Coal Project survey (GHD, 2014b).

WaterNSW macroinvertebrate survey

An annual macroinvertebrate survey has been undertaken at selected sites throughout the Sydney Water Catchment between 2001 and 2013. Two sites surveyed under this monitoring program are relevant to the Coxs River catchment, MMP37 located on the Coxs River downstream of Lake Lyell and E086 located just upstream of Lake Burragorang. More information on these sites and the findings of this survey are provided in Section 6. Data collected from MMP37 and E086 between 2012 and 2015 has been used within this assessment. Field work during this period was undertaken by aquatic ecologists from GHD. Macroinvertebrates were sampled from edge habitat as well as riffle habitat, where available, following AUSRIVAS protocols (Turak *et al*., 2004).

4.2 Groundwater dependent ecosystems (GDEs)

Currently the approach for assessment of GDEs is not well documented or understood however the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems, Volume 1 – The Conceptual Framework* (Serov *et al*., 2012) has recently been developed by NOW and OEH. This presents an approach to GDE identification, classification, ecological valuation and ecological risk assessment for a given activity or potential impact on a groundwater source. This also details a series of steps to identify and infer the level of groundwater dependency and provides a summary of risk assessment guidelines for GDEs.

The guidelines were developed by NOW and OEH to:

- Define GDE types.
- Provide a method for determining the ecological value or an aquifer and associated GDEs.
- Provide a method for developing the risk of an activity to the ecological value of an aquifer and associated GDEs.
- Provide a method for developing management strategies for aquifers and identified GDEs using the risk matrix approach.
- Provide a method to identify the type and location of GDEs within an aquifer or defined area.
- Provide a method for inferring the groundwater dependency of identified ecosystems.
- Describe surface and subsurface activities that threaten aquifers and associated GDEs.

As part of the desktop assessment GHD followed this approach to identify the likelihood and level of dependency of GDEs within the vicinity of the Project. The desktop assessment considered:

- Existing groundwater depths.
- Vegetation mapping.
- Database searches.
- Previous studies in the area (RPS, 2014; GHD, 2014b); and
- The Groundwater Dependent Ecosystems Atlas (BOM, 2016).

The above components were used to identify the likely occurrence and distribution of GDEs that could be affected by the Project.

4.2.1 Subterranean aquatic ecosystems

Ecological requirements of stygofauna

Stygofauna are intricately linked both ecologically and physiologically to the aquifer environment and are adapted to the relative stability of their surroundings. Compared to surface environments, groundwater fluctuates less both in level and physicochemical variables such as EC, temperature and pH (Hancock *et al.*, 2005). Groundwater is also generally lower in DO and has less readily available organic matter than surface water environments (Humphreys, 2002).

In Australia, stygofauna are known from alluvial, limestone, fractured rock and calcrete aquifers (Hancock *et al.*, 2005; Humphreys, 2008). As stygofauna require a space to live, the porosity of the sediments, degree of fracturing or extent of cavity development must be sufficient, as must the connectivity between the living spaces. As yet, few species are known from coal seam

aquifers (although this is changing as further targeted sampling is undertaken in Queensland and NSW).

Preliminary observations in Queensland (Hancock and Boulton, 2008) suggest that the highest stygofauna diversity and abundance occurs in groundwater with EC less than 5,000 µS/cm, although records of some syncarid species and genera of Koonungidae in Victoria and Tasmania are adapted to exist in naturally high EC waters of 33,000 µS/cm (Serov, P. pers. comm.) and stygofauna have been recorded in salinity up to 60,000 mg/L TDS in Western Australia (Moulds, T. pers. comm.). In Queensland, stygofauna have been collected in bores with EC up to 26,000 µS/cm (GHD unpublished). Other variables thought to be favourable for stygofauna are a shallow water table (less than 20 m), moderate concentrations of DO (1 mg/L to 5 mg/L), and pH between 6.5 and 7.5 (Hancock and Boulton, 2008), although this range is considered quite narrow by other specialists (Serov, P. pers. comm.).

Terminology

Subterranean fauna can be classified by the degree to which they are dependent on groundwater. Those that are completely dependent on groundwater are termed stygobites/phreatobites (these animals are the focus in the AEIA) and consist predominantly of crustaceans. Those that rely on groundwater to a lesser extent and can live in mixed surface and groundwater are termed stygoxenes or stygophiles (Marmonier *et al.*, 1993). The distinction is often ambiguous because it is difficult to know the degree of surface/groundwater mixing in an aquifer (Boulton *et al.*, 2003), and the classifications are regularly disputed (Sket, 2010). However, classifications based on affiliation to groundwater can be useful when assessing the conservation status of species and their vulnerability to potential impacts and this report follows the system originally proposed in the mid-1900's for cave-dwelling animals (Hancock *et al.*, 2005):

Stygoxenes are organisms that have no affinities with groundwater systems but occur accidentally in caves and alluvial sediments. Some planktonic groups (calanoida copepoda) and a variety of benthic crustacean and insect species (simulid fly larvae, caenid mayflies) may passively infiltrate alluvial sediments (Gilbert *et al.*, 1994).

Edaphobites are deep soil dwelling (or endogean) species that frequently display troglomorphisms and may sometimes occur in caves. These animals are not classified as stygofauna.

Stygophiles are facultative subterranean species able to complete their whole life cycles both underground and on the surface. Stygophilic species often have populations above and below ground, with individuals commuting between them and maintaining genetic flow between these populations (Trajano, 2001). Examples of stygophiles include some ostracod or copepod species.

Stygobites (stygobionts) are obligate subterranean species restricted to subterranean environments and typically possessing character traits related to a subterranean existence (stygomorphisms) such as reduced or absent eyes and pigmentation and enhanced non-optic sensory structures.

Phreatobites are stygobites (obligate subterranean species) restricted to 'deep' groundwater substrata of alluvial aquifers (Gilbert *et al.*, 1994). All species within this classification have specialised morphological and physiological adaptations.

Stygofauna is an all-encompassing term for all animals that occur in subsurface waters, including hyporheic fauna (Ward *et al.*, 2000).

From a conservation biology perspective, stygobites/phreatobites usually face a higher risk of extinction because they are frequently short range endemic species (Harvey, 2002). As short

range endemic species live only in a small geographical area, any impact on their range can severely reduce their population. In assessing the environmental impact of projects on subterranean species it may become important to distinguish stygobites/phreatobites from other ecological categories of subterranean fauna, but it is still critical that the range of non-stygobites also be assessed, especially in areas where few groundwater biological surveys have been conducted and the likelihood of finding new species is high.

Sampling guidelines

There are currently no specific guidelines for sampling stygofauna in NSW. The criteria outlined in the Western Australian Environmental Protection Authority (WA EPA) guidelines are accepted as current industry best practice in Australia at this time.

Therefore, for this study the Western Australian methodologies were adopted, as detailed in the following two documents:

- *Guidance for the Assessment of Environmental Factors: Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia* (WA EPA, 2007).
- *Environmental Assessment Guideline for Consideration of Subterranean Fauna in Environmental Impact Assessment in Western Australia* (WA EPA, 2013).

The Western Australian (WA) EPA guidelines provide information which the Western Australian EPA considers important when assessing proposals where subterranean fauna is considered a relevant environmental factor.

Stygofauna survey methods

A stygofauna survey has been undertaken by GHD in areas relevant to the Project between 2013 and 2014 (three sampling occasions). This survey was conducted as part of the Neubeck Coal Project (GHD, 2014b). Stygofauna surveys were conducted by GHD in:

- Spring 2013 between 30 September and 3 October 2013.
- Autumn 2014 between 6 and 9 May 2014.
- Spring 2014 between 27 and 30 October 2014.

The stygofauna survey was conducted in accordance with the requirements for baseline surveys undertaken in Western Australia, as defined by guidelines by WA EPA (2007) and WA EPA (2013), with the following minor exceptions:

- Six hauls (where possible) were undertaken at each groundwater bore using a 50 µm mesh net of 40 mm or 150 mm diameter (depending on the diameter of the bore).
- Ideally the net diameter should be about two-thirds of bore diameter. A 150 mm net was used where the bore had a diameter of 300 m.

None of these modifications is expected to reduce the efficacy of the sampling program.

Established standard sampling techniques used in Australia and overseas (Hancock and Boulton, 2008; Dumas and Fontanini, 2001) were adopted and all field equipment was of high quality, well maintained, fully calibrated and operated to manufacturer's specifications. The stygofauna sampling program was conducted by professionally qualified and experienced GHD ecologists.

Three bores were sampled in close proximity to Neubecks Creek and Wangcol Creek, upstream of the proposed discharge point. These bores are considered to be important in establishing the presence of stygofauna in shallow alluvial aquifers associated with Wangcol Creek. The bore details are provided in Table 4-3.

Groundwater bores were selected by GHD for stygofauna sampling by using the following criteria:

- Diameter of 50 mm or greater.
- Intersect the water table.
- Preferably lined and slotted/screened through the water column.
- Vertical (not angled).
- Geographically spread across the proposed mine lease and ideally include reference bores outside the potential zone of impact (i.e. water drawdown zone).
- Cover all hydrogeological units present with a strong emphasis on shallower alluvial aquifers with high water quality (if present).
- Be of varying age, in excess of six months old, and preferably undisturbed (i.e. not regularly pumped or purged).
- Include a high number of bores with an EC less than 5,000 µS/cm (and preferably less than 1,500 µS/cm), a DO concentration greater than 1 mg/L and a pH within the range 6.5 to 7.5 units.

Table 4-3 Characteristics of the bores sampled for stygofauna

Bore ID (previous ID)	MGA Zone 56		Type	Period	Lithology	Mine workings	Drilled depth (m bgl)	Bore drilled	Bore diameter (mm)	Cased depth (m)	Static water level (m btoc)	Sample dates
	Easting	Northing										
Alluvium groundwater												
NGW10_a (NEU1)	225391	6305911	Standpipe piezometer	Quaternary	Alluvial deposit	No	2.2	25/09/12	50	1.2	1.2	01/10/13
											1.37	06/05/14
											2.95	29/10/14
NGW11_a (NEU2)	225317	6305864	Standpipe piezometer	Quaternary	Alluvial deposit	No	4.5	25/09/12	50	2.4	0.74	01/10/13
											0.75	06/05/14
											0.88	29/10/14
NGW12_a (NEU3)	22537	6305791	Standpipe piezometer	Quaternary	Alluvial deposit	No	2.2	25/09/12	50	1.2	1.27	01/10/13
											1.08	06/05/14
											1.38	29/10/14

bgl – below ground level

btoc – below top of casing

N/S – not sampled

N/D – no data

5. Conservation significance

The conservation status of species and communities within the vicinity of the PAA were determined with reference to the following:

- The EPBC Act for national significance.
- The FM Act and TSC Act for state significance.

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats contained within the PAA and IAA. The likelihood of threatened biota occurring in the PAA was assessed based on presence of records from the locality (i.e. within 10 km of the PAA), species distribution and habitat preferences and the suitability of potential habitat present.

Table 5-1 provides a key to the likelihood of occurrence of threatened biota known or likely to occur in the PAA.

Table 5-1 Key to likelihood of occurrence for threatened species

Likelihood	Definition
Likely	Species previously recorded within a 10 km radius of the PAA and suitable habitat occurs.
Possible	Species previously recorded within a 10 km radius of the PAA but only marginal suitable habitat recorded.
	Species not previously recorded within a 10 km radius of the PAA, but the PAA is within the species known distribution and suitable habitat occurs within the PAA.
Unlikely	Species previously recorded within a 10 km radius of the PAA but no suitable habitat recorded.
Nil	Species not previously recorded within a 10 km radius of the PAA, suitable habitat not recorded within the PAA and/or PAA outside species' known distribution.

5.1 Threatened species

A summary of the listed threatened aquatic species that may potentially occur in the PAA is provided in Table 5-2.

The Department of the Environment *Protected Matters Search Tool* indicated three threatened aquatic species have the potential to occur within 10 km of the PAA:

- Murray cod (*Maccullochella peelii peelii).*
- Australian grayling (*Prototroctes maraena*).
- Macquarie perch (*Macquaria australasica*).

The *Atlas of NSW Wildlife* (Bionet) indicated one threatened aquatic species has the potential to occur within 10 km of the PAA which was the Giant dragonfly (*Petalura gigantea*).

Additional species have been identified within the SEARs for consideration including the following:

- Small Pale Grass-lily (*Caesia parviflora* var. minor).
- Black Gum (*Eucalyptus aggregate*).
- Silver-leafed Gum (*Eucalyptus pulverulenta*).
- *Leucopogon fletcheri* subsp. *Fletcheri.*
- Slaty Leek Orchid (*Prasophyllum fuscum*).
- Regent Honeyeater (*Anthochaera Phrygia*).

The likelihood of occurrence of these species in the PAA and potential impacts to these species are assessed as part of the Biodiversity Assessment Report (RPS, 2016). However, Black Gum has been considered as part of the AEIA given the preference of this species for waterlogged soils and the presence within the riparian zone of Wangcol Creek.

The Protected Matters Search identified threatened frog species within the PAA. Frogs and impacts on frogs have not been considered within this assessment. Refer to the Biodiversity Assessment Report (RPS, 2016) for a discussion on potential impacts of the Project on frog species.

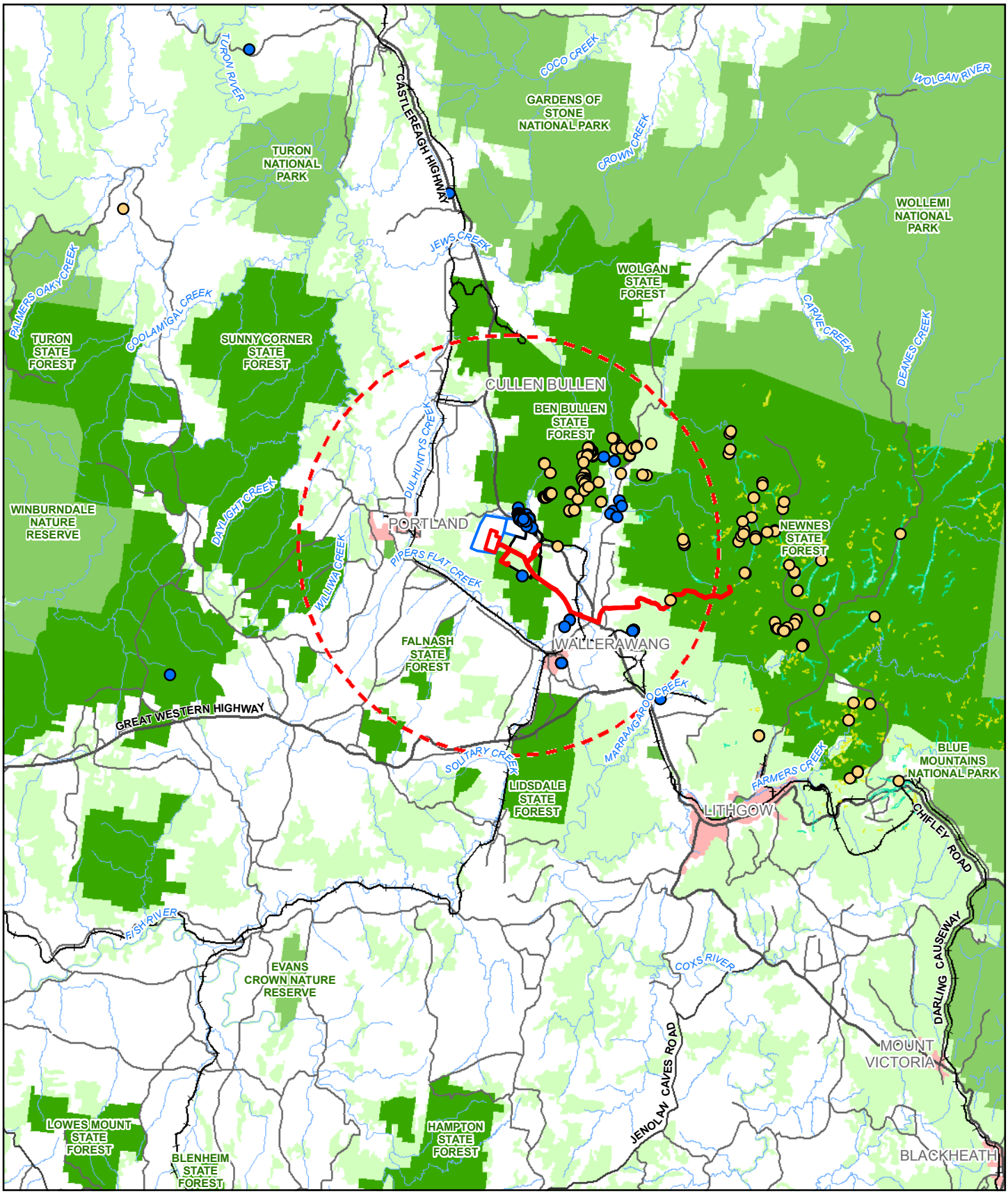
Table 5-2 Listed threatened species potentially occurring within 10 km of the Project Application Area

Common name	Scientific name	Listing*		Preferred habitat	Likelihood of occurrence in the Project Application Area
		FM / TSC Act	EPBC Act		
Plant Species					
Black Gum	*Eucalyptus aggregata*	V (TSC Act)	V	Grows in the lowest parts of the landscape. Grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (*Eucalyptus pauciflora*), Manna or Ribbon Gum (*E. viminalis*), Candlebark (*E. rubida*), Black Sallee (*E. stellulata*) and Swamp Gum (*E. ovata*). Black Gum usually occurs in an open woodland formation with a grassy ground-layer dominated either by River Tussock (*Poa labillardierei*) or Kangaroo Grass (*Themeda australis*), but with few shrubs. Also occurs as isolated paddock trees in modified native or exotic pastures. Many populations occur on travelling stock reserves, though stands and isolated individuals also occur on private land (Department of the Environment, 2016a).	Known to occur
Veronica blakelyi*	*Veronica blakelyi*	V (TSC Act)	-	Distribution limited to the western Blue Mountains in moist areas of eaucalypt forest (OEH, 2016). Associated with Red Box - Grey Gum - stringybark woodland on talus slopes of the western Blue Mountains	Known to occur
Fish Species					

Common name	Scientific name	Listing*		Preferred habitat	Likelihood of occurrence in the Project Application Area
		FM / TSC Act	EPBC Act		
Murray Cod	*Maccullochella peelii*	–	V	Prefer slowly flowing, turbid waters of rivers and streams at low elevations. Also occurs in fast moving, clear rocky upland streams (Allen *et al.*, 2002). This species favours deeper waters around boulders, logs, undercut banks and overhanging vegetation. Small numbers are still present in the Nepean River (NSW) (DPI, 2006a).	Unlikely
Australian Grayling	*Prototroctes maraena*	E (FM Act)	V	The Australian grayling is generally found in clear, moderate to fast flowing waters in both coastal and upper reaches of rivers. This species spends only part of its lifecycle in freshwater, where running ripe specimens have been captured. The species prefers gravel type substrates and often forms aggregations below barriers to upstream migration. The species is relatively uncommon in the coastal drainages of south-eastern Australia, from the Grose River (NSW) to the Hopkins River (Vic.) (Allen *et al*., 2002).	Unlikely
Macquarie Perch	*Macquaria australasica*	E	E	Macquarie perch occur in cool, clear waters of rivers, lakes and reservoirs and prefer slow flowing, deep rocky pools. The species occurs between the middle and upper reaches of the Murray River and its tributaries in NSW and Victoria. Populations from the eastward-flowing Shoalhaven River and Hawkesbury River (NSW) are genetically distinct and may represent an undescribed species (Allen *et al.*, 2002).	Unlikely

Common name	Scientific name	Listing*		Preferred habitat	Likelihood of occurrence in the Project Application Area
		FM / TSC Act	EPBC Act		
Macroinvertebrate species					
Giant Dragonfly	*Petalura gigantea*	V (TSC Act)	–	The giant dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. There are known occurrences in the Blue Mountains and Southern Highlands. They live in permanent swamps and bogs with some free water and open vegetation. Adults spend most of their time settled on low vegetation on or adjacent to the swamp hunting for flying insects. Females lay eggs into moss or other soft vegetation bordering swamps. Larvae dig long branching burrows under the swamp, leaving their burrows at night to feed on insects and other invertebrates on the surface and also use underwater entrances to hunt for food in the aquatic vegetation (OEH, 2015).	Unlikely
Reptile species					
Blue Mountains Water Skink	*Eulamprus leuraensis*	E	E	Species thought to be largely confined to Blue Mountains sedge swamps and Newnes Plateau shrub swamps. Coxs River swamps are other potential habitat (NSW NPWS, 2002)	Unlikely

CE – Critically Endangered
E – Endangered
V – Vulnerable
M – Migratory
P – Protected
*Labelled as Derwentia blakelyi in Figure 5-1



LEGEND

- Project application area
- Springvale Coal Services Development Consent
- Mount Piper Power Station
- 10km buffer
- Existing Rail
- Principal Road
- Secondary Road
- Minor Road
- Waterway
- Built up area
- Recreation area
- Nature Conservation
- State Forest
- Forest or shrub
- Derwentia blakelyi
- Eucalyptus aggregata
- Newnes Plateau Shrub Swamp
- Newnes Plateau Hanging Swamp

Paper Size A4

0 1 2 4 6 8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Centennial Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Threatened flora records within 10 km of the Project site

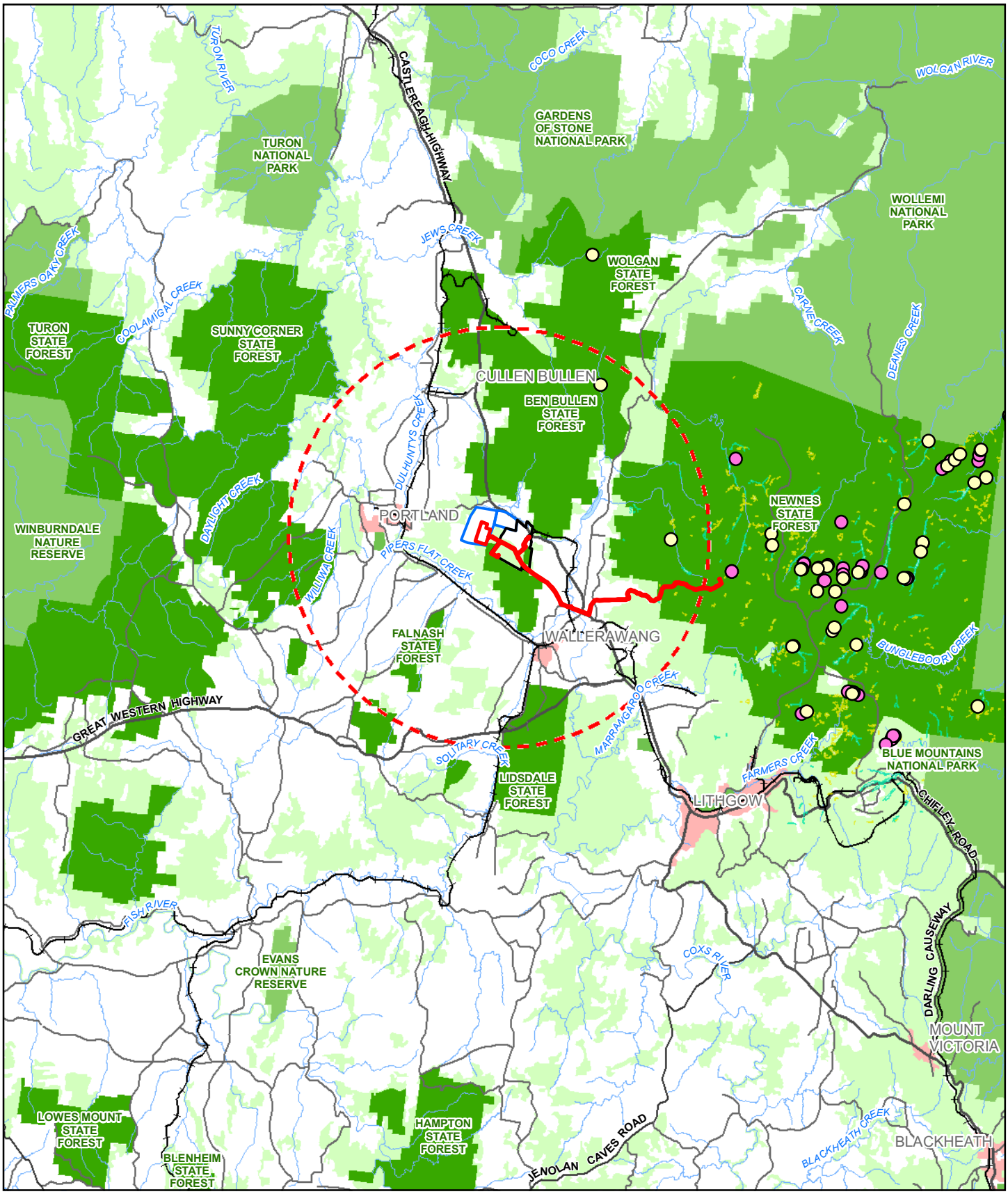
Figure 5-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: OEH: NPWS Wildlife Atlas data. Office of Environment and Heritage (NSW). (Data supplied by OEH Wildlife Threatened species, June, 2016). Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3, 2006.
Created by: tmorton, kpsroba



LEGEND

- Project application area
- Springvale Coal Services Development Consent
- Mount Piper Power Station
- 10km buffer
- Existing Rail
- Principal Road
- Secondary Road
- Minor Road
- Waterway
- Swamp
- Built up area
- Recreation area
- Nature Conservation
- State Forest
- Forest or shrub
- Newnes Plateau Shrub Swamp
- Newnes Plateau Hanging Swamp
- Eulamprus leuraensis
- Petalura gigantea

Paper Size A4

0 1 2 4 6 8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Centennial Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Threatened fauna records within 10 km of the Project site

Figure 5-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\0105001\GIS\Maps\Deliverables\Western\Springvale\2125109\AquaticEcology\2125109_AE006_ThreatenedFauna_0.mxd

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Data source: OEH: NPWS Wildlife Atlas data. Office of Environment and Heritage (NSW). (Data supplied by OEH Wildlife Threatened species, June, 2016). Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3, 2006.
Created by: kpsroba

Murray Cod (*Maccullochella peelii peelii)* is the largest freshwater fish found in Australia and occurs naturally in the waterways of the Murray-Darling Basin in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs. Populations of this species have also been supplemented through hatchery-bred programs and translocation of wild-caught individuals outside their natural distribution range, including the Hawkesbury-Nepean system. Records of this species within the Hawkesbury-Nepean system are, however, all from coastal rivers and represent stocked fish (DPI, 2006a). There are no recorded sightings of this species within 10 km of the PAA.

The Australian Grayling (*Prototroctes maraena*) is a diadromous species (requires access to freshwater and coastal environments to complete its life cycle) and prefers freshwater streams and rivers, especially clear gravelly streams with a moderate flow, as well as estuarine areas. Historically, this species occurred in coastal streams from the Grose River, west of Sydney, southwards through NSW and Victoria (Department of the Environment, 2013b). More recently, species have been recorded on the eastern and southern regions of the Great Dividing Range from Sydney southwards to the Otway Ranges in Victoria (DPI, 2006b); although the DPI *Threatened and Protected Species – Records Viewer* presented no records of this species north of Wollongong. Cardno (2013a) suggest the identification of this species in threatened species searches within the PAA may be a reflection of its historical distribution. There are no recorded sightings of this species within 10 km of the PAA.

Macquarie Perch (*Macquaria australasica*) prefers clear water and deep rocky holes with lots of cover in the form of aquatic vegetation, large boulders, debris and overhanging banks (Department of the Environment, 2013c). A search performed on the online DPI *Threatened and Protected Species – Records Viewer* identified Macquarie Perch as a threatened fish species listed under the FM Act relevant to the Lithgow LGA. This species was initially listed as 'vulnerable' under the FM Act but was revised to 'endangered' in 2008 due to a very large reduction in abundance and geographic distribution within a relevant time frame (FSC, 2008). A wider search of the Hawkesbury-Nepean CMA reported numerous records of Macquarie Perch associated with Wollemi National Park, including three records from 1994 and records from the mid Coxs River in 1994 and 2005. The sightings in the mid Coxs River were observed just upstream of Lake Burragorang (greater than 100 km downstream of the PAA). There are no recorded sightings of this species within 10 km of the PAA.

The current distribution range of the three identified threatened fish species, Murray Cod, Australian Grayling and Macquarie Perch, indicate they are unlikely to occur within the PAA or waterways of the IAA. There are two major fish barriers on the Coxs River downstream of the PAA, Lake Wallace and Lake Lyell, neither of which have fishways installed, hence limiting upstream fish migration potential from the mid Coxs River. There are no records of these species within the IAA. Consequently, an assessment of significance has not been undertaken for these species. No further consideration of these fish species has been given in this assessment.

The Giant dragonfly (*Petalura gigantea*) is listed under the TSC Act to potentially occur within 10 km of the PAA. This species, listed as 'endangered' under the TSC Act, is found along the east coast of NSW from the Victorian border to northern NSW, although not west of the Great Dividing Range. There are known occurrences in the Blue Mountains and Southern Highlands, in the Clarence River catchment and on a few coastal swamps from north of Coffs Harbour to Nadgee in the south (OEH, 2015). Records of the species are present in the Lithgow LGA using a search of the NSW *Atlas of NSW Wildlife* (Bionet) records database. They live in and around permanent swamps and bogs, with adults spending most of their time settling on vegetation along the swamp margins. Females lay eggs in the soft ground, moist litter and humic soils often associated with groundwater seepage areas within appropriate swamp and bog habitats (OEH, 2015). No records have been recorded in the BioNet Atlas of NSW Wildlife (OEH, 2016)

within the extent of the IAA nor has this species been observed by MPR or GHD at any of the monitoring locations in the IAA. RPS determined that no suitable swamp habitat was present within the PAA (RPS, 2016). Further, no swamp habitat is known to be present within Wangcol Creek or the Coxs River, downstream of the Wangcol Creek confluence. Therefore, this species is considered unlikely to occur in the IAA. No further consideration of this species is given in this assessment.

The Blue Mountains Water Skink has been identified in threatened species searches as potentially occurring within 10 km of the PAA. There are numerous records in the vicinity of the PAA or the waterways within the IAA (Figure 5-1). The distribution of this species is confined largely to the Blue Mountains swamps. Coxs River swamps were also listed as potential habitat for this species. There are numerous records of this species within 10 km of the PAA, however, there have been no records in the vicinity of the Coxs River within the extent of the IAA. RPS have identified that there is no suitable habitat for this species in the PAA (RPS, 2016). There are no swamps within the IAA, downstream of the proposed Wangcol Creek discharges that would provide suitable habitat for this species. Therefore, this species is considered to be unlikely to occur and is not considered further in this assessment.

Black Gum has been assessed within the aquatic ecology assessment due to the preference of this species for water logged conditions and the know presence of this species along Wangcol Creek. Black Gum typically grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers (Department of Sustainability and Environment, 2004). A number of records were identified along Wangcol Creek, however, all records are upstream of the proposed discharge point (Figure 5-2). The alluvial groundwater environment has been identified as discontinuous along Wangcol Creek with soil mapping indicating no alluvial material past the confluence of Wangcol and Neubecks Creek (Figure 7-2). Therefore, there is limited potential for this species to be present within the PAA. This species is, therefore, unlikely to be impacted by the Project and is not considered further in this assessment.

Veronica blakelyi have been identified in threatened species searches as potentially occurring within 10 km of the PAA and there is one record of this species in the vicinity of Wangcol Creek, downstream of the discharge point. There will be no impacts to water quality or velocity as a result of the Project that would impact on this species or reduce the potential for this species within the riparian zone of Wangcol Creek.

5.2 Migratory wetland species

The Department of the Environment *Protected Matters Search Tool* indicated four migratory wetland species have the potential to occur within 10 km of the PAA:

- Great Egret (*Ardea alba*).
- Cattle Egret (*Ardea ibis*).
- Latham's Snipe (*Gallinago hardwickii*).
- Osprey (*Pandion haliaetus*).

However, given that the Project is not predicted to reduce wetland or stream habitat (beyond cessation mine water discharges to Sawyers Swamp Creek), no further consideration of migratory species is given in this assessment.

5.3 Threatened populations

No threatened populations listed under the EPBC Act are relevant to aquatic ecosystems within the region.

5.4 Threatened ecological communities

Four threatened ecological communities listed under the EPBC Act were identified as having the potential to occur (may occur) in the PAA. These include:

- Natural Temperate Grassland of the South eastern Highlands (EPBC Act, critically endangered ecological community).
- Temperate Highland Peat Swamps on Sandstone (EPBC Act, endangered ecological community).
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion (EPBC Act, endangered ecological community).
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland (TSC Act and EPBC Act, critically endangered ecological community).

Additionally, the SEARs specifically requested that impacts to the following vegetation communities are considered:

- Blue Mountains Swamps in the Sydney Basin Bioregion.
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregion.
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion.

These threatened ecological communities are not associated with aquatic ecosystems or not present within the waterways of the IAA and therefore have not been considered any further in this assessment. An impact assessment of terrestrial vegetation has been undertaken within the Biodiversity Assessment Report (RPS, 2016).

The vegetation community Mountain Hollow Grassy Fen, has been previously observed as a wetland associated with the confluence of Neubecks Creek and Wangcol Creek (RPS, 2014). This vegetation is commensurate with the TSC Act listed endangered ecological community Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions (RPS, 2014). The location of this EEC is upstream of the proposed discharge point, and, thus, will not be impacted by the Project.

5.5 Key threatening processes

A 'key threatening process' (KTP) is a threatening process specified in Schedule 6 of the FM Act. A 'threatening process' is "a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities". Potentially relevant KTPs to this Project under the FM Act, TSC Act and EPBC Act are listed below.

There are currently eight KTPs listed under the FM Act and of these, the following four are potentially relevant to this Project:

1. Degradation of native riparian vegetation along NSW water courses.
2. Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams.
3. Removal of large woody debris from NSW rivers and streams.
4. The introduction of fish to fresh waters within a river catchment outside their natural range.

There are currently 37 KTPs listed under the TSC Act and of these, the following three are potentially relevant to aquatic ecosystems:

1. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
2. Clearing of native vegetation.
3. Predation by *Gambusia holbrooki* (plague minnow or mosquito fish).

A summary of these KTPs and relevance to the Project is provided in Table 5-3. Relevant KTPs for this Project and specific mitigation measures to minimise potential adverse impacts on the riparian and aquatic environment are discussed in more detail in Section 11.

Table 5-3 Key threatening processes relevant to the Project

Act	Reference no.	Key threatening process	Relevance to the Project	Likelihood/further consideration required
FM Act	1	Degradation of native riparian vegetation along NSW water courses	There will be no degradation of native riparian vegetation along NSW water courses as a result of the proposed discharges. The Project contains a provision for rehabilitation of the riparian zone along Wangcol Creek and key sections of Coxs River. Any degradation of native riparian vegetation due to the construction of the pipeline or the wastewater treatment plant is assessed in the Biodiversity Assessment Report (RPS, 2016).	Low No further consideration required
FM Act	2	Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams	The Project will result in new discharges ranging between 0 and 32 ML/day into Wangcol Creek, with new discharge infrastructure adjacent to the current LDP006 discharge. The Project will result in the cessation of LDP009 discharges into Sawyers Swamp Creek. This represents a change back towards natural flow regime for this system. The likelihood of this KTP being applicable due to Project activities is considered high and will require further consideration in regards to the operational flow regime.	High Yes, refer to Section 8.2

Act	Reference no.	Key threatening process	Relevance to the Project	Likelihood/further consideration required
FM Act	3	Removal of large woody debris from NSW rivers and streams	There is no expectation of physical removal or manipulations of Wangcol Creek or Coxs River as part of the Project. Modifications are planned to the Lamberts Gully channel, however, this channel is already highly disturbed. The likelihood of this KTP being applicable due to Project activities is considered low in consideration of the above and no further consideration is required.	Low No further consideration required
FM Act	4	The introduction of fish to fresh waters within a river catchment outside their natural range	The introduced Mosquito fish (*Gambusia holbrooki*) has been recorded at sites on Coxs River and Wangcol Creek. The introduced Brown Trout (*Salmo trutta*) have been observed at Coxs River sites downstream of Sawyers Swamp Creek. The likelihood of this KTP being applicable due to Project activities is considered low as: • Gambusia already exists within Wangcol Creek and Coxs River • The additional flows are not likely to improve passage to existing fish barriers within the waterways affected. The additional flows may increase the fish habitat within Wangcol Creek and Coxs River between the Wangcol Creek and Sawyers Swamp Creek confluence, temporarily. However, Wangcol Creek does not provide suitable habitat for Brown Trout	Low Yes, refer to Sections 8.2.1, 8.2.2
TSC Act	1	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Refer to FM Act KTP No. 2 for further details. The likelihood of this KTP being applicable due to Project activities is considered high and will require further consideration in regards to the operational flow regime.	High Yes, refer to Section 8

Act	Reference no.	Key threatening process	Relevance to the Project	Likelihood/further consideration required
TSC Act	2	Clearing of native vegetation	Refer to FM Act KTP No. 1 for further details. The clearing of native riparian vegetation in connection with the Project is assessed in the Biodiversity Assessment Report (RPS, 2016).	Not relevant to this assessment, refer to RPS (2016)
TSC Act	3	Predation by *Gambusia holbrooki* (plague minnow or mosquito fish)	The introduced Mosquito fish (*Gambusia holbrooki*) has been recorded at sites on Coxs River and Wangcol Creek. This KTP is related to potential issues associated with predation of tadpoles by the mosquito fish. Frogs and impacts on frogs have not been considered within this assessment. Refer to the Biodiversity Assessment Report (RPS, 2016) for a discussion on potential impacts of the Project on frogs.	Not relevant to this assessment, refer to RPS (2016)

6. Existing environment – aquatic ecology

6.1 Literature review

6.1.1 Monitoring Programs

Aquatic ecology surveys were not undertaken for the purpose of this Project given the availability of long-term aquatic ecology monitoring programs of sites relevant to the proposed action. As part of the Centennial West aquatic ecology monitoring program, MPR have undertaken biannual baseline monitoring of the waterways in the Impact Assessment Area between 2010 and 2016. Data and observations collected at relevant sites in Sawyers Swamp Creek, Wangcol Creek and Coxs River between 2013 and 2015 through this program have been used as the primary source for the establishment of existing aquatic ecology (MPR, 2013; 2014a; 2014b; 2015a; 2015b; 2016a,b,c). This information has been supplemented with data collected by GHD in a survey of macroinvertebrates and fish as part of the Neubeck Project (GHD, 2014b). Baseline data for Neubecks Creek has been sourced from MPR surveys conducted in 2011 (MPR, 2012a) because upstream sites were dry during 2013 and 2014 surveys conducted by GHD.

No threatened or protected invertebrate or vertebrate aquatic species were caught or observed during the surveys undertaken by MPR and GHD (MPR, 2012a; 2013; 2014a,b; 2015a,b,c; 2016a,b; GHD, 2014b).

Macroinvertebrate data was available from the WaterNSW for two sites on the Coxs River downstream of the PAA that has been monitored on an annual basis between 2001 and 2015. Data collected from relevant sites between 2012 and 2015 have been included in this assessment as representative of regional aquatic ecology health.

A summary of instream monitoring sites used as part of this assessment are provided in Table 6-1. The location of instream monitoring sites in relation to the PAA is shown in Figure 4-1 and Figure 4-2.

Table 6-1 Summary of instream monitoring sites used for this assessment

Waterway	Site code	MGA Zone 56		Site classification	Site description and rationale for classification	Current influences from licensed discharge points**	Data range
		Easting	Northing				
Neubecks Creek	NCup	226192	6306720	Background	Located in the upper reaches of Neubecks Creek.	No discharges to creek.	spring 2011, spring 2013, autumn and spring 2014*
	NC1	225982	6307221	Background	Located in the mid reaches of Neubecks Creek.	No discharges to creek.	spring 2011, spring 2013, autumn and spring 2014*
	NCdn	225480	6305993	Background	Located in the lower reaches of Neubecks Creek, approximately 200 m upstream of the confluence with Wangcol Creek. Provides background data for site that will not be impacted by the Project.	No discharges to creek.	2012-2014 (biannually - autumn and spring)
Wangcol Creek	WCup	224733	6305941	Baseline	Located upstream of the confluence of Neubecks Creek. Provides baseline data for site that will not be impacted by the Project.	LDP1 (MPPS) infrequent discharges to Wangcol Creek 0.4 km upstream.	2013-2015 (biannually - autumn and spring)
	WC1	226076	6305175	Baseline	Located approximately 700 m upstream of LDP006 (Springvale Coal Services site). Provides baseline data for site that will not be impacted by the Project.	LDP1 (MPPS) infrequent discharges to Wangcol Creek 2.6 km upstream.	2013-2015 (biannually - autumn and spring)
	WC2	226732	6304547	Baseline	Located approximately 350 m downstream of LDP006 (Springvale Coal Services site). Provides baseline data for site that may be impacted by the Project.	LDP1 (MPPS) infrequent discharges to Wangcol Creek 3.9 km upstream. LDP006 (SCSS) continual discharges to Wangcol Creek 0.5 km upstream.	2013-2015 (biannually - autumn and spring)

Waterway	Site code	MGA Zone 56		Site classification	Site description and rationale for classification	Current influences from licensed discharge points**	Data range
		Easting	Northing				
Wangcol Creek	WC3	228414	6304303	Baseline	Located approximately 250 m upstream of Coxs River. Provides baseline data for site that may be impacted by the Project.	LDP1 (MPPS) infrequent discharges to Wangcol Creek 4.6 km upstream. LDP006 (SCSS) daily discharges to Wangcol Creek 2.6 km upstream.	2013-2015 (biannually - autumn and spring)
Coxs River	CR1	229809	6307337	Background	Located upstream of confluence with Wangcol Creek and LDP001 (Angus Place Colliery). Provides background data for site that will not be impacted by the Project.	Currently no discharges to creek.	2013-2015 (biannually - autumn and spring)
	CR2	228691	6305324	Baseline	Located approximately 1 km downstream of LDP002 (Angus Place Colliery) but upstream of confluence with Wangcol Creek. Provides background data for site that will not be impacted by the Project.	LDP001 (Angus Place Colliery) daily discharges to Kangaroo Creek 2.6 km upstream. LDP002 (Angus Place Colliery) infrequent discharges to Coxs River 1.5 km upstream	2013-2015 (biannually - autumn and spring)
	CR3	228542	6303509	Baseline	Located approximately 1 km downstream of Wangcol Creek confluence. Provides background data for the Coxs River prior to the Project	LDP001 (Angus Place Colliery) daily discharges to Kangaroo Creek 4.7 km upstream. LDP002 (Angus Place Colliery) infrequent discharges to Coxs River 3.6 km upstream LDP006 (SCSS) daily discharges to Wangcol Creek	2013-2015 (biannually – autumn and spring)

Waterway	Site code	MGA Zone 56		Site classification	Site description and rationale for classification	Current influences from licensed discharge points**	Data range
		Easting	Northing				
						3.1 km upstream. LDP001 (MPPS) infrequent discharges to Wangcol Creek 5.6 km upstream	
	CR4	228348	6302775	Baseline	Located approximately 200 m downstream from Sawyers Swamp Creek confluence and approximately 2 km downstream from Wangcol Creek. Provides background data for site that may be impacted by the Project.	LDP009 (Springvale Mine) daily discharges to Sawyers Swamp Creek 3.1 km upstream) LDP001 (Angus Place Colliery) daily discharges to Kangaroo Creek 5.6 km upstream. LDP002 (Angus Place Colliery) infrequent discharges to Coxs River 4.5 km upstream LDP006 (SCSS) daily discharges to Wangcol Creek 4.0 km upstream. LDP1 (MPPS) infrequent discharges to Wangcol Creek 6.5 km upstream	2013-2015 (biannually - autumn and spring)

Waterway	Site code	MGA Zone 56		Site classification	Site description and rationale for classification	Current influences from licensed discharge points**	Data range
		Easting	Northing				
Coxs River	CR5	228529	6300752	Baseline	Located approximately 400 m downstream from Pipers Flat Creek confluence. Provides background data for site that may be impacted by the Project.	LDP009 (Springvale Mine) daily discharges to Sawyers Swamp Creek 5.7 km upstream) LDP001 (Angus Place Colliery) daily discharges to Kangaroo Creek 8.2 km upstream. LDP002 (Angus Place Colliery) infrequent discharges to Coxs River 7.1 km upstream LDP006 (SCSS) daily discharges to Wangcol Creek 6.6 km upstream. LDP007 (SCSS) infrequent discharges to Pipers Flat Creek 1.0 km downstream LDP1 (MPPS) infrequent discharges to Wangcol Creek 9.1 km upstream LDP004 (Lidsdale Siding) infrequent discharges to Pipers Flat Creek 0.6 km upstream	2013-2015 (biannually - autumn and spring)

Waterway	Site code	MGA Zone 56		Site classification	Site description and rationale for classification	Current influences from licensed discharge points**	Data range
		Easting	Northing				
Coxs River	CR6	228533	6297741	Baseline	Located downstream from Lake Wallace	LDP009 (Springvale Mine) daily discharges to Sawyers Swamp Creek 9.7 km upstream) LDP001 (Angus Place Colliery) daily discharges to Kangaroo Creek 12.2 km upstream. LDP002 (Angus Place Colliery) infrequent discharges to Coxs River 11.1 km upstream LDP006 (SCSS) daily discharges to Wangcol Creek 10.6 km upstream. LDP007 (SCSS) infrequent discharges to Pipers Flat Creek 5.0 km downstream LDP1 (MPPS) infrequent discharges to Wangcol Creek 13.1 km upstream LDP004 (Lidsdale Siding) infrequent discharges to Pipers Flat Creek 4.6 km upstream	2013-2015 (biannually - autumn and spring)
Sawyers Swamp Creek	SSWdn	232266	6301445	Background	Located upstream from known discharges into Sawyers Swamp Creek.	Currently no discharges to creek.	Autumn 2013
	SSCup	231939	6301659	Background	Located upstream from known discharges into Sawyers Swamp Creek.	Currently no discharges to creek.	Autumn 2014

Waterway	Site code	MGA Zone 56		Site classification	Site description and rationale for classification	Current influences from licensed discharge points**	Data range
		Easting	Northing				
	DP9dn	229606	6302260	Baseline	Located downstream from LDP009. Currently receives discharge which will cease as part of this Project.	LDP009 (Springvale Mine) daily discharges to Sawyers Swamp Creek directly upstream.	2013-2015 (biannually - autumn and spring)
Regional – Coxs River	MMP37	233006	6284088	Baseline - regional	Located downstream of Lake Lyell which regulates water release. Downstream of all regional projects (see Section 3.6)	LDP009 (Springvale Mine) daily discharges to Sawyers Swamp Creek 34.5 km upstream) LDP001 (Angus Place Colliery) daily discharges to Kangaroo Creek 37 km upstream. LDP002 (Angus Place Colliery) infrequent discharges to Coxs River 35.9 km upstream LDP006 (SCSS) daily discharges to Wangcol Creek 35.4 km upstream. LDP007 (SCSS) infrequent discharges to Pipers Flat Creek 29.8 km downstream LDP1 (MPPS) infrequent discharges to Wangcol Creek 37.9 km upstream LDP004 (Lidsdale Siding) infrequent discharges to Pipers Flat Creek 29.4 km upstream	Spring 2012, Spring 2013, Spring 2014, Spring 2015

Waterway	Site code	MGA Zone 56		Site classification	Site description and rationale for classification	Current influences from licensed discharge points**	Data range
		Easting	Northing				
	E086	245976	6248675	Baseline - regional	Located just upstream of Warragamba Dam. Downstream of all regional projects (see Section 3.6)	LDP009 (Springvale Mine) daily discharges to Sawyers Swamp Creek 116.5 km upstream) LDP001 (Angus Place Colliery) daily discharges to Kangaroo Creek 119 km upstream. LDP002 (Angus Place Colliery) infrequent discharges to Coxs River 117.9 km upstream LDP006 (SCSS) daily discharges to Wangcol Creek 117.4 km upstream. LDP007 (SCSS) infrequent discharges to Pipers Flat Creek 111.8 km downstream LDP1 (MPPS) infrequent discharges to Wangcol Creek 119.9 km upstream LDP004 (Lidsdale Siding) infrequent discharges to Pipers Flat Creek ~111.4 km upstream	Spring 2012, Spring 2013, Spring 2014, Spring 2015

* indicates habitat assessment only as site was dry during survey event.

** does not include Pine Dale Coal Mine LDPs as these points are no longer operational.

6.1.2 Catchment condition

Hawkesbury-Nepean health strategy - 2010

A Hawkesbury-Nepean health strategy on the catchment was delivered in 2010. The strategy acknowledged that the rivers and riparian lands of the Hawkesbury-Nepean are experiencing significant pressure from:

- urban and rural residential development.
- extraction of water for metropolitan water supply and agriculture.
- nutrient input from sewage treatment plants.
- on-site sewage systems and run-off from agricultural and urban areas.
- clearing of riparian lands.

These pressures result in altered aquatic habitat that generally supports less diversity.

The strategy acknowledged that the quality of the water flowing from these catchments is critical to Sydney's drinking water and the health of the Hawkesbury-Nepean catchment. As part of the strategy, a broad range of programs were developed to maintain water quality throughout the catchments. These include licensing polluting premises such as Sewage Treatment Plants, Sustaining the Catchments Regional Plan, establishment of the Sydney Catchment Authority (now WaterNSW), National Parks and world heritage areas in the catchment, and setting water quality objectives.

Consistent water quality objectives have been considered as part of the Water Resources Impact Assessment (GHD, 2016) and this Project, for proposed discharge points.

Sydney Catchment Authority audit - 2013

The audit undertaken by then Sydney Catchment Authority (now WaterNSW) in 2013 identified the Coxs River as a priority sub-catchment. The audit identified that Mining comprises 0.2% of the surface of the catchment with the largest mining area (938 ha) in the Upper Coxs River sub-catchment concentrated around the power generation land uses. The audit reviewed EPL conditions and existing pollution reduction programs which indicated compliance of the period. The audit found that existing LDPs are a source of elevated concentrations of metals into the catchment.

In terms of groundwater environment within the Coxs river catchment, the audit considered that a moderate risk to GDEs was applicable to the Coxs River, Fractured Rock and Sydney Basin groundwater source with higher risks associated in areas of mining land use.

The audit generally concluded that the water quality during the audit period, and the long-term trends in water quality parameters, either in catchment streams or in storages did not indicate unusual changes or trends. The evidence available indicated that the raw water arising in Catchment is generally of good quality, which was regarded as a reflection of the effectiveness of relatively recent catchment management practices.

The audit predicted loads of total nitrogen and phosphorus at 57 tonnes/year and 8.3 tonnes/year, respectively, based on 2010 predictions. A decreasing trend of electrical conductivity from Upper Coxs River was determined during the audit period of approximately 27 µS/cm/year. These trends were also shown in total nitrogen and phosphorus concentrations per year.

The lower portion of Coxs River continues to have one of the highest percentage of native vegetation cover compared with other waterways within the catchment at greater than 90%.

However, the mid portion of Coxs River was identified as a high priority for riparian vegetation improvement.

Fish habitat within the mid and upper portions of the Coxs River were defined as low due to significant barriers to fish migration (online reservoirs). Works to improve fish passage are ongoing.

The audit assessed AUSRIVAS banding as a measure of macroinvertebrate community health. Based on data from 2001 to 2009, the Upper Coxs River sub-catchment had the highest percentage of sites (52.7%) in the severely impaired (Band C) or extremely impaired (Band D) condition (DECCW, 2010).

6.2 Aquatic habitat assessments

Descriptions of aquatic habitats in the IAA and reference waterways are provided below based on observations collected by GHD and MPR during aquatic ecology surveys undertaken in the vicinity of the Project (MPR, 2012; MPR, 2013; 2014a; 2014b; 2015a; 2015b; 2016a,b; GHD, 2014b).

6.2.1 Neubecks Creek

Neubecks Creek is approximately 4.5 km long, with its headwaters originating north of Blackmans Flat. The creek is located north-west of the PAA and joins Wangcol Creek, upstream of the proposed discharge point.

The headwaters of the creek are located within relatively undisturbed bushland. Neubecks Creek is likely to be ephemeral and dependent on rainfall to flow and some sites were dry during the survey periods. The lower reaches of Neubecks Creek have very limited riparian vegetation and included patches of blackberry and terrestrial grasses and sedges. Several unnamed drainage lines flow to Neubecks Creek.

Site NCup

Table 6-2 provides a summary of photographs showing upstream and downstream conditions at site NCup.

The site is a third order stream and has been classified as a Class 4 fish habitat. Site NCup is located in the headwaters of Neubecks Creek.

During the 2013 and the 2014 surveys (GHD, 2014b), the site was dry. The channel is small and undefined and it is likely this site only holds water during periods of rain. Large amounts of leaf litter were observed in the channel. Native open forest, including large snow gum (*Eucalyptus pauciflora*) surround the site.

Table 6-2 Representative photographs of site NCup

Site	September 2013	May 2014	October 2014
NCup facing upstream showing the dry undefined channel			

NCup facing downstream showing the dry undefined channel			

Site NC1

Table 6-3 provides a summary of photographs showing upstream and downstream conditions at site NC1.

The site is a fourth order stream and has been classified as a Class 4 fish habitat. Site NC1 is located 0.5 km downstream of site NCup. The channel is more defined compared to NCup. During the GHD (2014b) surveys this site was dry. A large amount of leaf litter was observed in the channel. Surrounding the site was native open forest, including snow gums.

Table 6-3 Representative photographs of site NC1

Site	October 2013	May 2014	October 2014
NC1 facing upstream showing the dry channel			
NC1 facing downstream showing the dry channel			

Site NCdn

Table 6-4 provides a summary of photographs showing upstream and downstream conditions at site NCdn during 2013 and 2014.

The site is a fourth order stream and has been classified as a Class 3 fish habitat due to the semi-permanent pools observed and the presence of hydrophilic plants including sedges. This site is located immediately upstream of the haul road and the confluence of Neubecks Creek and Wangcol Creek. NCdn is not currently influenced by any discharges. The surrounding land has been cleared and likely used historically for grazing. There is a culvert which allows flow under the haul road. It is likely that part of the channel through the culvert remains dry except following rainfall.

During the 2013 and 2014 GHD (2014b) surveys the site was dominated by pool habitat and slight surface flow was observed in the earlier surveys. There was no flow observed during the spring 2014 survey. This site has low banks (0.2 m high) and a narrow channel, ranging

between 0.5 m and 2 m wide. Instream habitat was dominated by overhanging bank vegetation, detritus, small woody debris and macrophytes. The creek substrate was comprised entirely of silt/clay. The riparian vegetation was limited to pasture grasses, sedges (*Juncus usitatus* and *Eleocharis* sp.), exotic blackberry and scattered willow trees.

Table 6-4 Representative photographs of site NCdn

Site	October 2013	May 2014	October 2014
NCdn facing upstream			
NCdn facing downstream toward the haul road			

6.2.1 Wangcol Creek

Wangcol Creek is approximately 6 km long. Its headwaters are in the far south-west extent of Ben Bullen State Forest, approximately 2 km west of the PAA. Flow rate in Wangcol Creek above this confluence contains a daily volumetric contribution from LDP006 at SCSS and large rainfall event based discharges from LDP1 at MPPS. The Wangcol Creek valley below the confluence with Neubecks Creek has been subject to extensive disturbance related to the mining industry. The creek has been realigned several times to facilitate historical and nearby mining activities and the present channel from LDP006 at SCSS to the confluence with Coxs River is a realignment of the original creek (Cardno, 2013a).

Aquatic habitat in Wangcol Creek is limited and dominated by pools. Substrate comprises fine silt sediments. Riparian vegetation is sparse and mainly consists of terrestrial grasses and sedges along with exotic pines and willows. Bank stability is generally low, due to the limited riparian zone in some parts, and in-situ bank materials.

Site WCup

Table 6-5 provides a summary of photographs showing upstream and downstream conditions at WCup.

The site is a third order stream and has been classified as a Class 3 fish habitat. This site is located upstream of the confluence with Neubecks Creek at the Castlereagh Highway. MPPS is located approximately 300 m upstream of the site, along with LDP1 which is located 0.4 km upstream. A triple cell box culvert allows water to flow under the highway, but is typical drowned by still water within the creek.

During the GHD (2014b) surveys the site was dominated by pool habitat. The banks were relatively low (0.3 m high) and unstable, with artificial substrate and grasses providing limited stabilisation. The width of Wangcol Creek at this site varied between 1.5 m and 3.5 m, with depths of up to 1 m. The substrate comprised fine sediment (silt/clay) with some sand, gravel and pebble. Instream habitat was limited, and consisted of stands of *Typha* sp. and other trailing bank vegetation.

The riparian vegetation was limited to pasture grasses, with no shrubs or trees in the reach of the site. However, some large trees were observed immediately upstream of the site. Emergent macrophytes were present, including *Typha* sp. and *Juncus usitatus.*

Table 6-5 Representative photographs of site WCup

Site	October 2013	May 2014	October 2014
WCup facing upstream towards the highway bridge			
WCup facing downstream beyond the highway bridge			

Site WC1

Table 6-6 provides a summary of photographs showing upstream and downstream conditions at WC1.

The site is a fourth order stream and has been classified as a Class 3 fish habitat. This site is located approximately 50 m upstream of a small causeway which may restrict fish passage during periods of low flow. This site can be influenced by discharges from LDP1 at MPPS (when they occur), which is located 2.6 km upstream. It is also influenced by flows from Neubecks Creek and which flows to Wangcol Creek approximately 1 km upstream of WC1.

During the GHD (2014b) surveys the site was dominated by pool habitat, with slight surface flow observed. The banks were relatively low (0.3 m) and were vegetated with grass and sedge species. The width of the creek at this site was between 1 m and 4 m. The substrate comprised mainly fine sediment (silt/clay) with some sand and gravel. Instream habitat comprised overhanging grasses, macrophytes and some sticks and detritus. A small stand of *Typha* sp. was observed.

The riparian vegetation was limited to pasture grasses and sedges, with limited shrubs or trees in the reach of the site. Emergent macrophytes were present, including *Typha* sp. and *Juncus usitatus.* Green algae belonging to Charophyta were also observed instream.

Table 6-6 Representative photographs of site WC1

Site	September 2013	May 2014	October 2014
WC1 facing upstream			
WC1 facing downstream			

Site WC2

Table 6-7 provides a summary of photographs showing upstream and downstream conditions at WC2.

The site is a fourth order stream and has been classified as a Class 3 fish habitat. Site WC2 is located adjacent to the Pine Dale Coal Mine. This site can be influenced by event based discharges from LDP1 at MPPS, located 3.87 km upstream, and is influenced by daily contributions from LDP006 at SCSS, located immediately upstream (0.5 km).

During the GHD (2014b) surveys the site was dominated by pool habitat, with slight surface flow observed during the surveys. The banks appeared to be artificially stabilised with concrete, which was also present in the stream bed. The banks were approximately 2 m high and the width of the site at this point varied between 0.5 m and 3 m. There was dominant iron precipitate at this site as shown in Table 6-7, likely caused by the discharge of mine affected water upstream of the site. Instream habitat was limited and comprised mainly overhanging bank vegetation. The substrate was comprised mainly silt/clay with some sand, gravel, pebble, cobble and artificial concrete.

The riparian vegetation was considered poor, and consisted of a few tall trees (exotic pine), some shrubs and mostly grasses. There was some *Juncus usitatus* present on both banks. Large cleared gravel areas associated with Pine Dale Coal Mine operations existed beyond the riparian zone.

Table 6-7 Representative photographs of site WC2

Site	October 2013	May 2014	October 2014
WC2 facing upstream showing artificial substrate			
WC2 facing downstream			
WC2 showing abundant iron precipitate			

Site WC3

Table 6-8 provides a summary of photographs showing upstream and downstream conditions at WC3.

The site is a fourth order stream and has been classified as a Class 3 fish habitat. Site WC3 is located immediately upstream of the confluence with Coxs River. At this point the river consists of a large pool (200 m by 400 m). This site is influenced by all operational based discharges within the catchment.

During the GHD (2014b) surveys the site was dominated by pool habitat, with slight surface flow observed during the spring 2013 and autumn 2014 surveys. No flow was observed during the spring 2014 survey with large isolated pools and rocky bars upstream observed to be dry. Immediately downstream of the site banks had been stabilised with concrete. At the site the banks were approximately 2 m high and the channel was relatively straight and varied between 1.5 m and 3.5 m wide. The instream habitat comprised detritus and small woody debris, as well as some overhanging bank vegetation. The substrate was dominated by silt/clay, with some sand.

The riparian vegetation was limited to pasture grasses on the left bank and some exotic pine trees on the right bank and the sedge *Juncus usitatus* was present both.

Table 6-8 Representative photographs of site WC3

Site	September 2013	May 2014	October 2014
WC3 facing upstream			
WC3 facing downstream			

6.2.2 Coxs River

The Coxs River is a major tributary of the Hawkesbury-Nepean River system and is part of the Sydney drinking water catchment. The river extends for approximately 155 km. Land use in the upper part of the catchment is primarily grazing, forestry, power generation and coal mining. The river receives input from a number of LDPs in the upper reaches, including Angus Place Colliery, Springvale Coal Services site, Springvale Mine and Mt Piper Power Station.

Aquatic habitat in the upper catchment is dominated by pool habitat and bed and banks comprised smaller particle sized substrate. Generally, there is little riparian vegetation, likely leading to high erosion potential of stream banks. Further down in the catchment the Coxs River widens and deepens with increased flow including some riffle sections.

Site CR1

Table 6-9 provides a summary of photographs showing upstream and downstream conditions at site CR1.

The site is a fifth order stream and is located upstream from any local LDPs. The land surrounding the site is used for grazing. Surface flow was observed during 2015 surveys (MPR, 2016). Stream width averaged 1.8 m with maximum depths of 1 m recorded.

During the 2015 surveys (MPR, 2016) the substrate comprised mainly fine sediment with some pebbles, gravel and sand. Detritus, submerged and emergent macrophytes (e.g. Jointed rush (*Juncus articulatus*), trailing bank vegetation and undercut banks provided instream habitat. Filamentous algae were also observed in more recent monitoring rounds.

Table 6-9 Representative photographs of site CR1

Site	May 2015	November 2015
CR1 facing upstream		
CR1 facing downstream		

Site CR2

Table 6-10 provides a summary of photographs showing upstream and downstream conditions at site CR2.

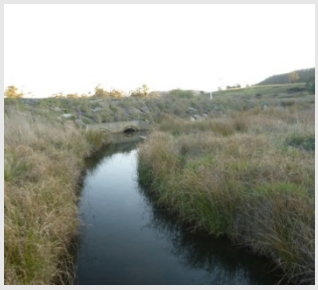
The Coxs River at CR2 is a fifth order stream and has been classified as a Class 2 fish habitat. This site is located immediately upstream of the Mt Piper Haul Road. A twin cell circular culvert allows the creek to flow under the haul road. This site is located upstream of the confluence with Wangcol Creek. Kangaroo Creek discharges to the Coxs River upstream of this site, which also receives discharge from LDP002 at Angus Place Colliery. The land surrounding the site is used for grazing and a small riffle zone immediately upstream of the site serves as a cattle crossing.

The site was dominated by pool habitat, with a small riffle upstream. Some surface flow was observed during the 2013 and 2014 surveys (GHD, 2014b). The banks were low (0.3 m high) and were eroded in sections. The stream width varied between 1 m and 4 m, and was relatively deep for its size (up to 1.5 m deep).

The substrate comprised mainly fine sediment with some gravel and sand. Detritus, submerged and emergent macrophytes, trailing bank vegetation and undercut banks provided instream habitat.

The riparian vegetation of the site was limited to pasture grasses and exotic blackberry with no tree or shrub corridor present. This lack of bank stabilisation has resulted in a high erosional potential for the stream banks of this site. Emergent macrophytes, including Cumbungi (*Typha* sp.), *Eleocharis* sp. and common rush (*Juncus usitatus)* were abundant along the bank. Submerged curly-leaf pondweed (*Potamogeton crispus*) beds were present during all surveys (GHD, 2014b) and filamentous algae was abundant during the 2015 surveys (MPR, 2016).

Table 6-10 Representative photographs of site CR2

Site	September 2013	May 2014	October 2014
CR2 facing upstream			
CR2 facing downstream towards the haul road			

Site CR3

Table 6-11 provides a summary of photographs showing upstream and downstream conditions at site CR3.

The Coxs River at CR3 is a fifth order stream and has been classified as a Class 2 fish habitat. MPR sampled CR3 between 2014 and 2015. The site is located between the inputs of Wangcol Creek and Sawyers Swamp Creek. Instream conditions at this monitoring location are influenced by the former Commonwealth Open Cut mine which includes a large waterbody spanning 320 metres in length and reaches 150 metres wide. Generally, there are no restrictions to fish passage at this site with sections of incised waterway and broad open pools. However, the Lake Wallace and Lake Lyell and other regulated water bodies further downstream provide a barrier to fish passage through the wider catchment.

Surveys undertaken by MPR indicated that the monitoring site has a consistent condition during both autumn and spring monitoring rounds. MPR indicated that water is clear and flowing through site length with a maximum depth to 0.7 m and average depth 0.2 m. The types of edge habitat that observed by MPR during monitoring included trailing bank vegetation, macrophytes (rush (*Baumea rubiginosa*), jointed rush and cumbungi*), charophytes* and detritus.

Sediment was comprised of gravel and sand, with some boulders and cobbles and some fine silt accumulated on the surface. Overburden fill makes up the channel and banks at this site.

Table 6-11 Representative photographs of site CR3 (MPR, 2014b, 2015a, b, d 2016b, c)

Site	Autumn 2014	Spring 2014	Spring 2015
CR3 facing upstream			
CR3 facing downstream			

Site CR4

Table 6-12 provides a summary of photographs showing upstream and downstream conditions at site CR4.

The Coxs River at CR4 is a fifth order stream and has been classified as a Class 2 fish habitat. This site is located at the end of Maddox Lane where there is a small causeway providing a crossing over the river. The surrounding land has been cleared and there are residential properties along Maddox Lane. This site is also influenced by a number of LDPs located upstream.

During the surveys completed by GHD (2014b) the site was dominated by run and pool habitat. The banks were relatively low (1 m high), and unstable, with exotic blackberry and grasses providing stabilisation. Stream width varied between 1.5 m and 5 m and was relatively deep in sections (greater than 1 m). The substrate comprised mainly fine sediment (silt/clay) with some sand and gravel. Detritus, emergent macrophytes and trailing bank vegetation provided instream habitat. Stands of common reed (*Phragmites australis*) and common rush (*Juncus usitatus*) were observed instream and likely provided habitat.

The riparian vegetation of the site was limited to pasture grasses, exotic blackberry with just a few small shrubs and trees observed on the bank, however there was no riparian corridor present. This lack of bank stabilisation has resulted in a high erosional potential for the stream banks of this site. Emergent macrophytes were observed during the spring 2013 and 2014 survey, including common rush (*Juncus usitatus*), umbrella sedge (*Cyperus eragrostis*), jointleaf rush (*Juncus articulates*), common reed (*Phragmites australis*) and soft twig sedge (*Baumea rubiginosa)* were abundant along the bank. The green algae Charophyta were also observed instream at this site. Filamentous algae were abundant during the 2015 surveys (MPR 2016).

Table 6-12 Representative photographs of site CR4

Site	September 2013	May 2014	October 2014
CR4 facing upstream			
CR4 facing downstream towards the Castlereagh Highway			

Site CR5

Table 6-13 provides a summary of photographs showing upstream and downstream conditions at site CR5.

Site CR5 is located on the Coxs River downstream of the Main Street Bridge. The Wallerawang Power Station is located upstream of the site and downstream of the confluence of Wangcol and Pipers Flat Creeks (Cardno, 2013a).

The site is a fifth order stream and has been classified as a Class 2 fish habitat. The surrounding land has been largely cleared and is used for grazing. This site is also influenced by a number of LDPs located upstream on Wangcol Creek, Pipers Flat Creek and Coxs River.

During the GHD (2014b) surveys the site was dominated by pool habitat, with a small riffle upstream towards the Main Street bridge. The stream had an average width of 5 m and bank height of 1.5 m. The banks were steep, eroding and undercut in places, with exotic blackberry and grasses providing stabilisation.

The substrate comprised mainly fine sediment with a mixture of boulders, cobble and rock fragments along the western side of the creek. Detritus, submerged and emergent macrophytes, trailing bank vegetation and undercut banks provided instream habitat.

Stands of emergent macrophytes, including Cumbungi (*Typha* sp.), *Eleocharis* sp. and River Clubrush *(Schoenoplectus validus)* were observed during the autumn 2014 surveys. Changes in aquatic vegetation were observed during the spring 2014 surveys, with only small stands of cumbungi observed instream with isolated common rush on the banks. Submerged curly-leaf pondweed (*Potamogeton crispus*) beds and filamentous algae were observed during the 2014 surveys. Small clumps of filamentous algae were observed during the 2015 surveys (MPR, 2016).

The riparian vegetation of the site consisted of eucalypt trees with isolated willows and blackberry dominating the eastern edge of the downstream section of the site. Exotic grasses dominated the majority of the bank with isolated patches of common rush (*Juncus usitatus)*.

Table 6-13 Representative photographs of site CR5

Site	May 2014	November 2015
CR5 facing upstream towards Main Street bridge		
CR5 facing downstream		

Site CR6

Table 6-14 provides a summary of photographs showing upstream and downstream conditions at site CR6.

Site CR6 is located on the Coxs River downstream of Lake Wallace. The site is a fifth order stream. The surrounding land has been largely cleared and is used for grazing. This site is also indirectly influenced by a number of LDPs located upstream on Wangcol Creek, Sawyers Swamp Creek and Pipers Flat Creek and Coxs River.

MPR (2016) reported that the substrate at this site dominated by bedrock and boulders, with a smaller proportion of cobbles and sand. Both riffle and pool habitat was observed at this site. The banks supported trailing vegetation/grasses, providing stabilisation. Detritus and the emergent macrophyte Water Cress (*Nasturtium officinale*) and undercut banks provided instream habitat. Abundant filamentous algae were observed during the 2015 surveys (MPR, 2016), smothering rocky surfaces.

Table 6-14 Representative photographs of site CR6

Site	May 2015	November 2015
CR6 facing upstream		
CR6 facing downstream		

6.2.1 Sawyers Swamp Creek

Sites SSWdn/SSCup

Table 6-15 provides a summary of photographs showing upstream and downstream conditions at sites SSWdn and SSCup. These sites were selected to provide an understanding of waterway condition upstream from LDP009 on Sawyers Swamp Creek. Site SSWdn was originally selected as a background site by MPR (2013a) but found to be dry in subsequent sampling events. Site SSCup was selected as a replacement background site but was also dry during the majority of sampling events.

Site SSWdn is located on a first order stream with maximum depths of 0.6 m and average depths of 0.2 m (MPR (2013a). Channel substrate was dominated by sand with some boulder outcrops. Orange precipitate blanketed much of the reach and filamentous algae was abundant. No macrophytes were observed.

Site SSCup was surveyed in 2014 by MPR (MPR, 2014a). The reach surveyed was described as being artificial – composed of a series of pools with no flow. Maximum stream width was 2 m and averaged 0.8 m. Maximum depth was 0.5 m, with an average of 0.2 m. Macrophytes present included Jointed Rush and Swamp Clubrush. Substrate was composed of muddy sand and gravel/pebble. Small amounts of filamentous algae were observed.

Table 6-15 Representative photographs of sites SSWdn/SSCup

Site	May 2013 (SSWdn)	May 2014 (SScup)
SSWdn/SSCup facing upstream		
SSWdn/SSCup facing downstream		

Site DP9dn

Table 6-16 provides a summary of photographs showing upstream and downstream conditions at site DP9. This site provides an understanding of waterway condition downstream from LDP009 on Sawyers Swamp Creek.

Site DP9dn is located in a channel that runs through a former open cut mine overburden along the northern edge of the Sawyers Swamp valley floor, and consists of a broad and flat pool basin which leads into a straight Cumbungi filled channel. Maximum stream width reached 7 m and the average width was 1.5 m, the maximum depth reached 1 m, with an average depth of 0.5 m (MPR, 2013). Channel edges supporting dense stands of emergent spike and jointed rushes, grasses (*Carex sp*), Pampas grass (*Cortaderia sp*) and Cumbungi.

Table 6-16 Representative photographs of site DP9dn

Site	May 2014	November 2014
DP9dn facing upstream		
DP9dn facing downstream		

6.3 Riparian, channel and environmental inventory

The following sections summarise the RCE Inventory scores for sites selected for assessment. Mean scores recorded by MPR have been calculated across the three years of monitoring data (MPR, 2013; 2014a; 2014b; 2015a; 2015b; 2016a,b). The RCE scores for each of the sites selected for this assessment are provided in Table 6-17.

6.3.1 Neubecks Creek

Site NCdn, the only site on Neubecks Creek to hold water during the surveys, has received consistent RCE scores between the survey events. The mean RCE score of 30 (RCE% of 57) suggest that the site is subject to moderate degradation. Characteristics that contributed most to this site's score included the land use beyond the riparian zone comprising native and pasture/exotics, relatively stable banks with little undercutting, a deep channel and sediment comprising gravel with little sand or silt.

Sites upstream (NCup and NC1) were graded slightly higher, with RCE scores (based on 2011 data) of 38 (RCE% of 73) and 36 (RCE% of 69) due to increased aquatic vegetation being present and continuous riparian vegetation at these sites.

6.3.1 Wangcol Creek

Mean RCE scores for sites on Wangcol Creek varied along the creek – with the highest mean RCE score being 30 (RCE% of 58) at site WC3 and lowest scores being recorded at site WC with a mean of 25 (RCE% of 48). These scores indicate some level of degradation at all sites.

Site WCup has scored between 26.5 (autumn 2013) and 29.5 (autumn and spring 2014) with a mean(±SD) of 28.3±1.2. The relatively low score was attributed to incompleteness of the riparian strip, a lack of retention devices instream, a lack of riffle/pool sequences, a high

abundance of macrophyte and filamentous algae growth and little or no organic detritus being present.

At site WC1 RCE scores varied between 23 (autumn 2013) and 29 (spring 2013) with a mean(±SD) of 26.3±2.4. This result suggests some level of degradation at this site. The low scores were attributed to incompleteness of the riparian strip, a lack of riffle/pool sequences, a lack of instream retention devices (e.g. logs and rocks) and minimal stream detritus.

At site WC2 RCE scores varied between 23 (autumn 2013 and spring 2014) and 29 (spring 2013) with a mean(±SD) of 25.1±2.3. This result suggests some level of degradation at this site. The low scores were attributed to incompleteness of the riparian strip, a lack of riffle/pool sequences, a lack of retention devices instream and minimal stream detritus.

At site WC3, RCE scores varied between 27 (autumn 2013) and 33 (spring 2013) and a mean(±SD) of 30±2.6. RCE scores for site WC3 were generally higher than other sites surveyed on Wangcol Creek. The increased scores (relative to other sites on Wangcol Creek) were attributed to lower macrophyte or algal coverage, and features of the bank and bed, including firm banks, undercutting on curves and presence of some retention devices in the streams (e.g. rocks and logs).

6.3.2 Coxs River

In the Coxs River RCE scores were found to be relatively consistent between survey events but variation was observed between sites, with scores consistently increasing with distance downstream. The highest mean RCE score was 36.4 (RCE% of 70), calculated for site CR6 and lowest mean score was recorded at site CR2 (21.2; RCE% of 40.7) - indicating moderate to poor condition.

At site CR1, RCE scores varied between 33.5 (autumn and spring 2013) and 34.5 (autumn and spring 2015) with and a mean(±SD) of 34±0.4 suggesting moderate degradation. Positive attributes included a deep natural channel with stable banks, which were countered by negative attributes such as a lack of riffle/pool sequences and a predominantly muddy/silt substrate.

The RCE scores recorded at site CR2 were relatively low with scores between 19 (spring 2014) and 22 (spring 2013 and autumn 2014) and a mean(±SD) of 21.2±1.1 suggesting that this site is severely degraded. The lack of riparian vegetation and instream retention devices and high erosional potential contributed to the low score at this site.

The RCE scores recorded at site CR3 were similar to CR1, and fairly consistent between 2014 and 2015 at scores of 32. The presence of the large water body formed by the commonwealth open cut results in a slightly increased score over CR2 and CR4 but generally the site is consistent with monitoring site conditions both up and downstream.

The RCE scores recorded at site CR4 were also relatively low, with scores between 28 (spring 2013) and 29.5 (autumn and spring 2014) and a mean(±SD) of 29±0.5, suggesting that this site is degraded. The poor condition of riparian vegetation, lack of instream retention devices and the presence of loose and mobile sediment were the main contributors to the scores at this site.

The RCE scores recorded at site CR5 were also relatively low, with scores between 28 (spring 2013) and 29.5 (autumn and spring 2014) and a mean(±SD) of 32.6±0.2, suggesting that this site is moderately degraded but supports improved ecological habitat when compared to sites further upstream. The poor channel form and the presence of loose and mobile sediment were the main contributors to the scores at this site although presence of instream retention devices, less smothering by aquatic macrophytes and algae and increased native vegetation in the riparian zone allowed for better quality habitat than sites further upstream.

The RCE scores recorded at site CR6 ranged between 36 (spring 2015) and 36.5 (all other survey events) and a mean(±SD) of 36.4±0.2, suggesting that this site supports improved

ecological habitat when compared to sites further upstream. A well-formed channel, presence of a riffle/pool sequence and low coverage of loose and mobile sediment were the main contributors to the higher scores at this site.

6.3.1 Sawyers Swamp Creek

In Sawyers Swamp Creek RCE scores were found to be relatively consistent between survey events (where water allowed surveys to be completed) but variation was observed between sites, with scores higher in the upstream reaches of the creek. The highest mean RCE score was 42 (RCE% of 80.8) calculated for site SSWdn, indicating relatively good ecological condition and the lowest score being recorded at site DP9dn (27.6; RCE% of 53) indicating poor condition.

Site SSWdn recorded a relatively high mean±SD RCE score (42±0). The presence of instream logs and rocks, presence of riffle/pool sequences, firm banks with undercutting and stable substrate were the main contributors to the high score at this site.

Site SSCup recorded a relatively low RCE score during the autumn 2014 survey (30.5). An absence of instream logs and rocks, an incomplete riparian vegetation zone, unstable bank structure and an unstable substrate were the main contributors to the low score at this site.

At site DP9dn, RCE scores were consistent across the six sampling events - between 27.5 and 28 with and a mean(±SD) of 27.6±0.2 suggesting a high level of degradation. Negative attributes such as a lack of surrounding vegetation within an industrial zone, a lack of riffle/pool sequences, the absence of instream logs and rocks and a predominantly muddy/silt substrate contributed to the score. Required infrastructure related to dewatering operations has meant that areas of concrete channel, including headwalls and pits consume much of the waterway. The presence of access roads and surface water storages adjacent to the waterway results in an engineered corridor for water to migrate through which is not compatible to habitat.

Table 6-17 RCE Scores (averaged) between 2012 and 2015 (MPR, 2011; 2012a,b; 2013a, b; 2014a,b; 2015a,b; 2016a,b)

Category/Site	Neubecks Creek			Wangcol Creek				Coxs River						Sawyers Swamp Creek		
	NCup	NC1	NCdn	WCup	WC1	WC2	WC3	CR1	CR2	CR3	CR4	CR5	CR6	SSWdn	SScup	DP9dn
1. Land use pattern	4	4	3	3	2	2	2	2	2	2	2	2	2	4	3	1
2. Width of riparian strip of woody vegetation	4	4	2	2	2	2	3	3	1	3	2	2	2	4	3	3
3. Completeness of riparian strip of woody vegetation	4	4	1	1	1	1	2	3	0	2	1	2	1	4	2	4
4. Vegetation of riparian zone	4	3	2	3	3	3	3	3	1	3	2	3	3	4	4	3
5. Stream bank structure	2	2	3	2	2	2	2	4	2	3	2	2	3	2	2	2
6. Bank undercutting	4	2	3	3	2	2	2	3	2	3	3	2	3	3	2	3
7. Channel form	2	4	4	4	3	3	4	4	4	1	4	3	4	4	4	4
8. Riffle/pool sequence	2	2	2	1	2	1	1	2	2	2	3	3	4	4	1	0
9. Retention devices in stream	2	2	1	1	1	0	1	2	1	2	2	3	3	3	0	1
10. Channel sediment accumulations	2	2	2	2	3	3	2	2	2	2	3	3	3	2	2	2
11. Stream bottom	1	1	2	2	2	2	2	1	1	2	2	2	3	3	1	1
12. Stream detritus	3	3	2	2	2	2	2	3	2	3	3	3	3	3	3	2
13. Aquatic vegetation	4	4	3	3	3	3	4	3	2	3	2	3	3	3	4	2
RCE score	38	36	30	28	26	25	30	34	21	32	29	33	36	42	31	28
RCE percentage (%)	73	69	57	54	51	48	58	65	41	61	56	63	70	81	59	53

Note: RCE scores rounded up to whole numbers

6.4 Aquatic vertebrates

A total of five fish species have been caught during aquatic surveys conducted across the IAA and reference waterways between 2010 and 2015 (MPR, 2011; 2012a,b; 2013a, b; 2014a,b; 2015a,b; 2016a,b). These included:

- Three native species – Flat-headed gudgeon (*Philypnodon grandiceps*), Australian Smelt (*Retropinna smoni*) and Mountain galaxias (*Galaxias olidus*).
- Two introduced species – One introduced species, Eastern gambusia (*Gambusia holbrooki*) which is listed as noxious and indicates a KTP of invasive species colonisation is present. The introduced angling species brown trout (*Salmo trutta*) was recorded in the Coxs River. No introduced species of fish were recorded in Neubecks Creek.

Table 6-18 provides a summary of the fish species caught at each waterway. No fish caught within the IAA were listed species under the FM Act or EPBC Act.

Table 6-18 Fish species recorded across the IAA from 2010 to 2015 (MPR, 2011; 2012a,b; 2013a, b; 2014a, b; 2015a, b; 2016a,b; GHD, 2014b).

Waterway	Site	Common name	Scientific name
Neubecks Creek	NCdn only	Mountain galaxias	*Galaxias olidus*
Wangcol Creek	WCup, WC1, WC2 and WC3	Flat-headed gudgeon	*Philypnodon grandiceps*
		Mountain galaxias	*Galaxias olidus*
		Eastern gambusia	*Gambusia holbrooki*
Coxs River	CR1, CR2, CR3, CR4 and CR5	Flat-headed gudgeon	*Philypnodon grandiceps*
		Mountain galaxias	*Galaxias olidus*
		Eastern gambusia	*Gambusia holbrooki*
		Brown trout	*Salmo trutta*
		Australian Smelt	*Retropinna semoni*
Sawyers Swamp Creek	SSWdn, SSCup and DP9dn	No fish collected	

6.5 Macroinvertebrates

The following sub-sections provide a summary of macroinvertebrate community composition and condition, based on standardised biological indices. It is acknowledged that there may be some differences in metric calculation method between GHD and MPR data which may have influenced the comparability of the data across sampling events.

6.5.1 Neubecks Creek

Macroinvertebrate results for the site monitored by GHD in Neubecks Creeks are presented in Table 6-19.

Table 6-19 Macroinvertebrate biological index results for Neubecks Creek sites from 2012 to 2014 (MPR, 2012; GHD, 2014b)

Metric	NCdn					
	Au 12	Sp 12	Au 13	Sp 13	Au 14	Sp 14
Taxa richness	20	22	23	20	15	25
EPT richness	5	4	3	4	1	6
SIGNAL-2 score	4.21	4.40	4.23	4.00	3.23	3.57
O/E50	N/A	N/A	N/A	0.57	0.41	0.94
AUSRIVAS band	N/A	N/A	N/A	B	C	A

N/A – Not available due to the fact that alkalinity and substratum data (required for AUSRIVAS model input) were not collected in those years.

Results for taxa richness and EPT richness are provided in Figure 6-1 and Figure 6-2. An average of 21 macroinvertebrate taxa was calculated for site NCdn across all sampling events with a minimum of 15 taxa (autumn 2014) and maximum of 25 taxa (spring 2014) collected.

An average of four EPT taxa (representing the environmentally sensitive orders (Ephemeroptera, Plecoptera and Trichoptera) was calculated for site NCdn. One EPT taxon was collected in autumn 2014 represented by an unidentified stonefly larva (Plecoptera sp.) with six EPT taxa observed in spring 2014 (two from each EPT order).

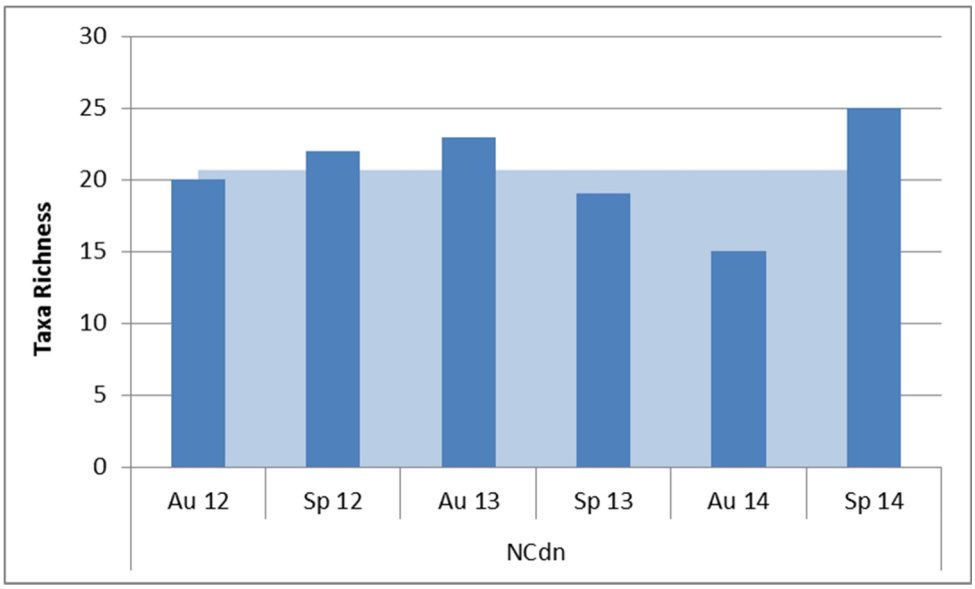


Figure 6-1 **Taxa richness at Neubecks Creek sites between 2012 and 2014. Shaded area provides average across all sampling events**

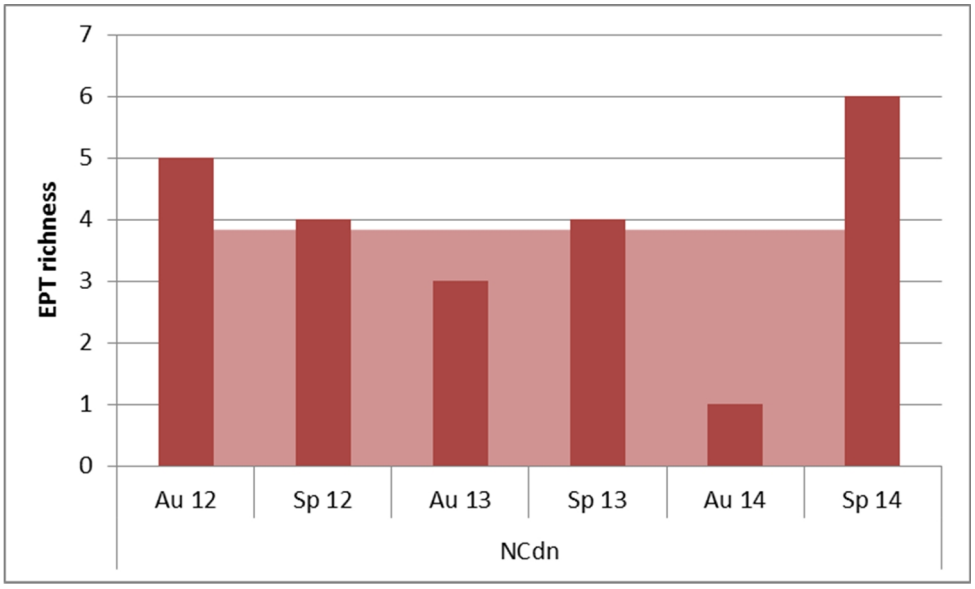


Figure 6-2 **EPT richness at Neubecks Creek sites between 2012 and 2014. Shaded area provides average across all sampling events**

SIGNAL-2 score results for site NCdn on Neubecks Creek are presented in Figure 6-3. Across all sampling events the average SIGNAL-2 score was 3.99, indicating that the site is in poor to moderate environmental condition (Chessman *et al.,* 1997) with the majority of taxa present being tolerant of poor water quality. The maximum SIGNAL-2 score recorded was 4.4 (spring 2012) and minimum was 3.2.

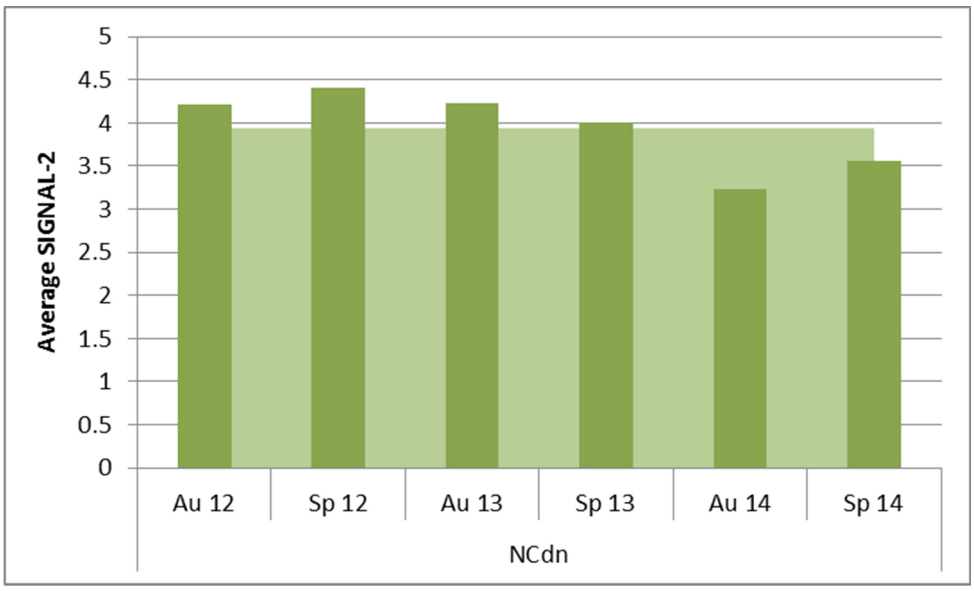


Figure 6-3 **SIGNAL-2 score at Neubecks Creek sites between 2012 and 2014. Shaded area provides average across all sampling events**

AUSRIVAS O/E50 scores for NCdn are presented in Figure 6-4 and have resulted in AUSRIVAS banding ratings ranging between B and C (severely degraded) in autumn 2014 to Band A (similar to reference conditions) in spring 2014. An average score of 0.64±0.3 was recorded between 2013 and 2014.

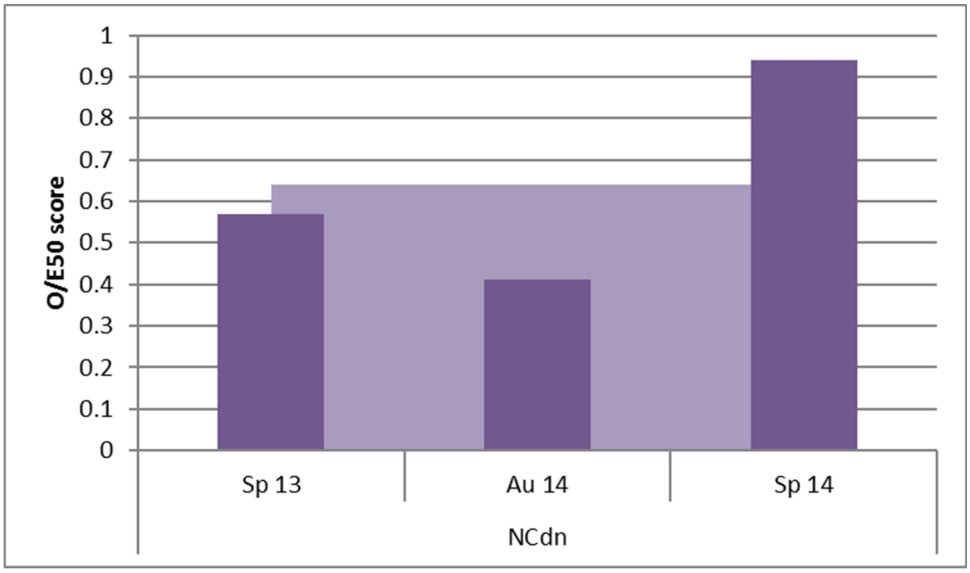


Figure 6-4 **O/E50 score at Neubecks Creek between 2013 and 2014. Shaded area provides average across all sampling events**

6.5.2 Wangcol Creek

Macroinvertebrate biological index results for Wangcol Creek are presented in Table 6-20 and Table 6-21.

Results for taxa richness are provided in Figure 6-5. Across the three years assessed, the greatest taxa richness was recorded at site WC3 (25 taxa; spring 2014) and lowest at site WC2 (five taxa; autumn 2014). Although a degree of variation was observed at all sites, the calculated mean taxa richness for each site indicates that diversity varies considerably between sites. Mean±SD taxa richness (across all sampling events) was 14±3, 20±4, 10±5 and 21±3 for sites WCup, WC1, WC2 and WC3, respectively. These results indicate that site WC2 supports a less diverse community than the other sites on Wangcol Creek.

Results for EPT richness are provided in Figure 6-6. Across the three years assessed the greatest taxa richness was recorded at site WC1 (6 EPT taxa; autumn and spring 2015) and lowest at site WC2 (one taxon; autumn and spring 2013 and autumn 2014). Variation was observed at most sites but the calculated mean number of EPT taxa for each site indicates that diversity also varies longitudinally. Mean±SD taxa richness (across all sampling events) was 3±1, 5±1, 2±2 and 4±1 for sites WCup, WC1, WC2 and WC3, respectively. These results indicate that site WC2 supports a macroinvertebrate community with less sensitive taxa than the other sites on Wangcol Creek.

SIGNAL-2 score results for Wangcol Creek are presented in Figure 6-7. Across the three years assessed the greatest SIGNAL-2 score was recorded at site WC1 (4.95; spring 2015) and lowest at site WC2 (3.14; spring 2014). Variation was observed at most sites but the calculated mean SIGNAL-2 score for each site indicates that diversity also varies longitudinally. Mean±SD SIGNAL-2 scores (across all sampling events) were 3.6±0.1, 4.4±0.4, 3.7±0.6 and 4.0±0.3 for sites WCup, WC1, WC2 and WC3, respectively.

These results suggest that sites WCup and WC2 support a greater proportion of pollution tolerant taxa than sites WC1 and WC3 and that they are likely to have been subject to poor water quality conditions during the historical sampling period.

In general terms, the biological indices suggest that the aquatic ecosystem condition of WC1 and WC3 are better than WCup and WC2.

Table 6-20 Macroinvertebrate biological index results for Wangcol Creek for 2013 to 2015 for sites WCup and WC1

Metric	WCup						WC1					
	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15
Taxa richness	15	15	10	10	13	18	19	19	13	20	24	21
EPT richness	2	4	2	2	4	2	5	4	3	4	6	6
SIGNAL-2 score	3.79	3.73	3.44	3.60	3.75	3.47	4.11	3.95	4.46	4.10	4.61	4.95
O/E50	N/A	0.72	0.61	0.47	N/A	N/A	N/A	0.63	0.66	0.86	N/A	N/A
AUSRIVAS band	N/A	B	B	C	N/A	N/A	N/A	B	B	A	N/A	N/A

N/A – Not available due to the fact that alkalinity and substratum data (required for AUSRIVAS model input) were not collected in those years.

Table 6-21 Macroinvertebrate biological index results for Wangcol Creek for 2013 to 2015 for sites WC2 and WC3

Metric	WC2						WC3					
	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15
Taxa richness	10	6	5	7	17	14	19	23	21	25	18	22
EPT richness	1	1	1	0	3	4	3	4	3	3	4	4
SIGNAL-2 score	3.30	3.33	3.80	3.14	4.13	4.69	4.00	3.82	3.76	3.63	4.35	4.29
O/E50	N/A	0.28	0.16	0.33	N/A	N/A	N/A	0.86	0.74	0.90	N/A	N/A
AUSRIVAS band	N/A	C	C	C	N/A	N/A	N/A	A	B	A	N/A	N/A

N/A – Not available due to the fact that alkalinity and substratum data (required for AUSRIVAS model input) were not collected in those years.

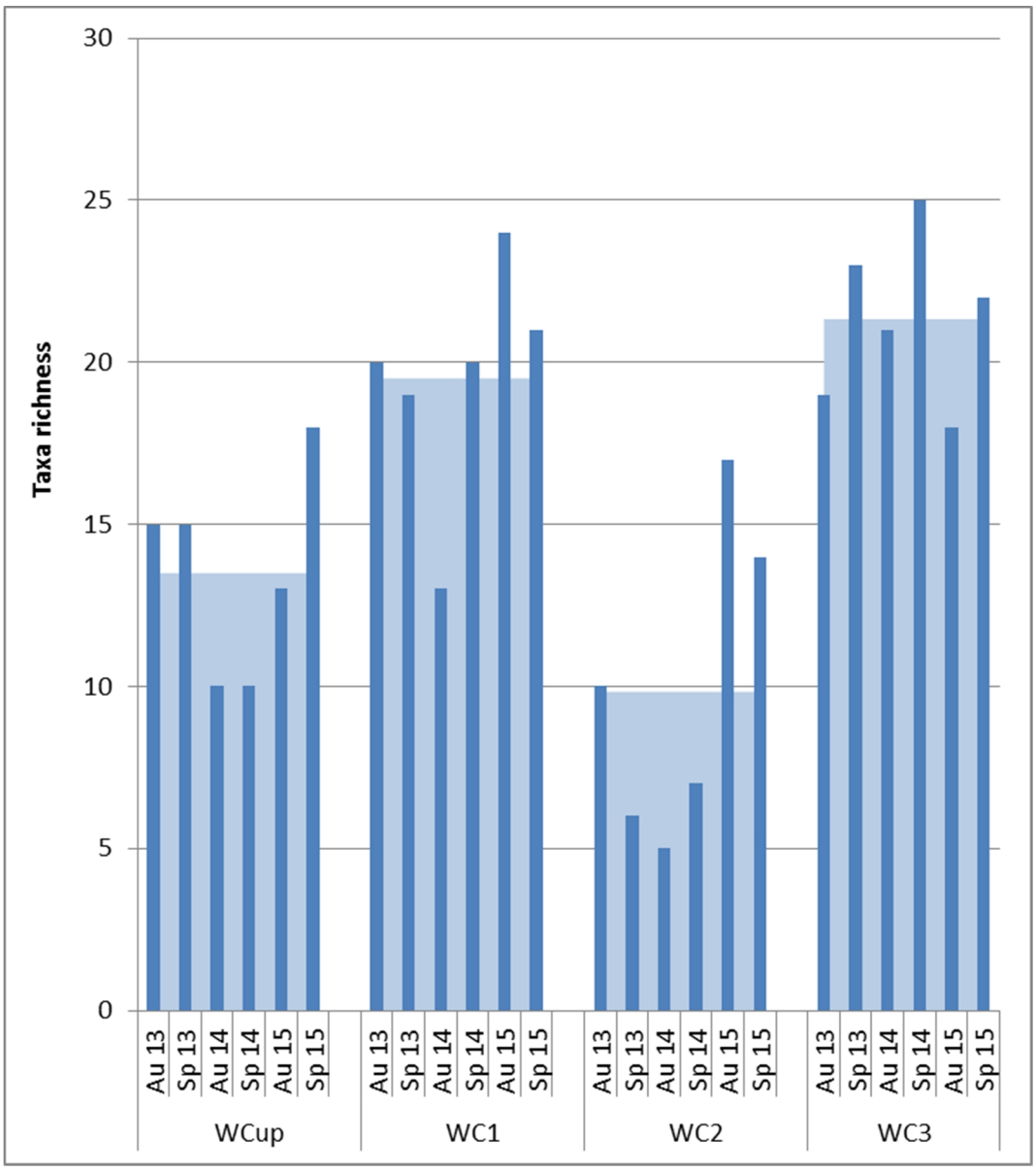


Figure 6-5 **Taxa richness at Wangcol Creek sites between 2013 and 2015. Shaded area provides average across all sampling events**

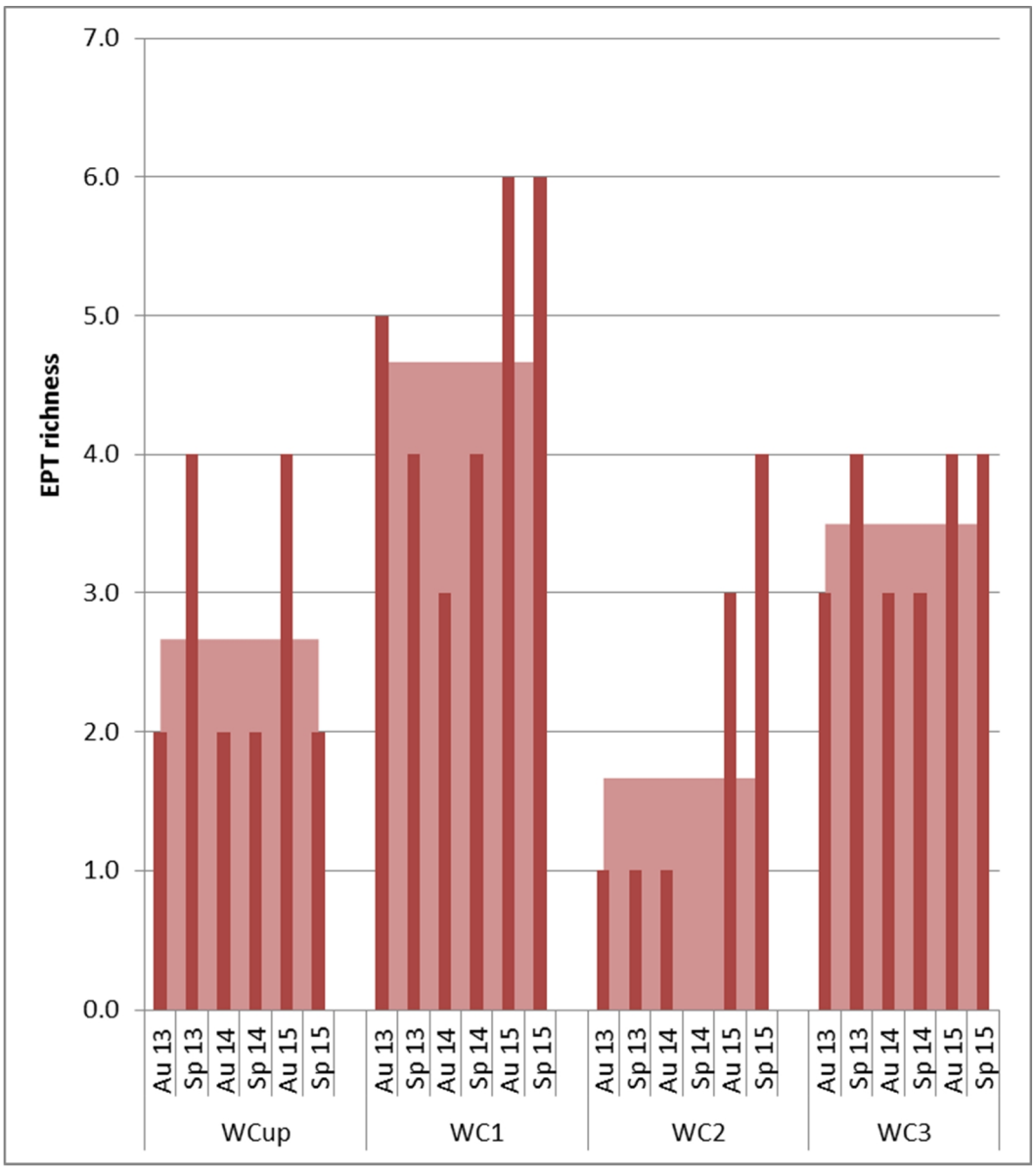


Figure 6-6 **EPT richness at Wangcol Creek sites between 2013 and 2015. Shaded area provides average across all sampling events**

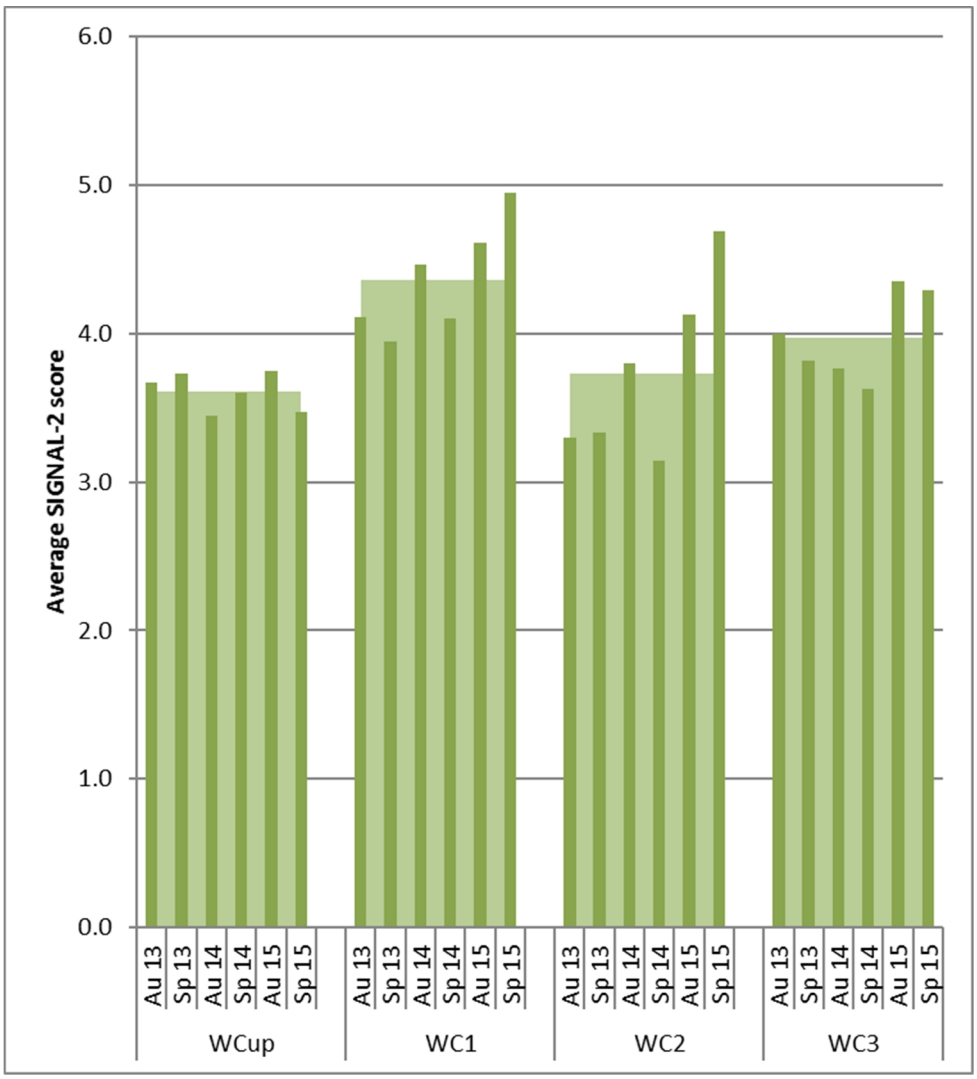


Figure 6-7 SIGNAL-2 score at Wangcol Creek sites between 2013 and 2015. Shaded area provides average across all sampling events

AUSRIVAS O/E50 scores for Wangcol Creek sites are presented in Figure 6-8. Across the three years assessed the greatest OE/50 score was recorded at site WC3 (0.9; spring 2014) and lowest at site WC2 (0.16; autumn 2014). Variation was observed at most sites but the calculated mean OE/50 score for each site indicates that diversity also varies longitudinally. Mean±SD OE/50 scores (across all sampling events) were 0.6±0.1, 0.72±0.1, 0.26±0.1 and 0.83±0.1 for sites WCup, WC1, WC2 and WC3, respectively.

These results indicate that site WC2 has been consistently classified as being severely to extremely impaired and that sites WCup, WC1 and WC3 are also significantly impaired, based on the results of the AUSRIVAS model.

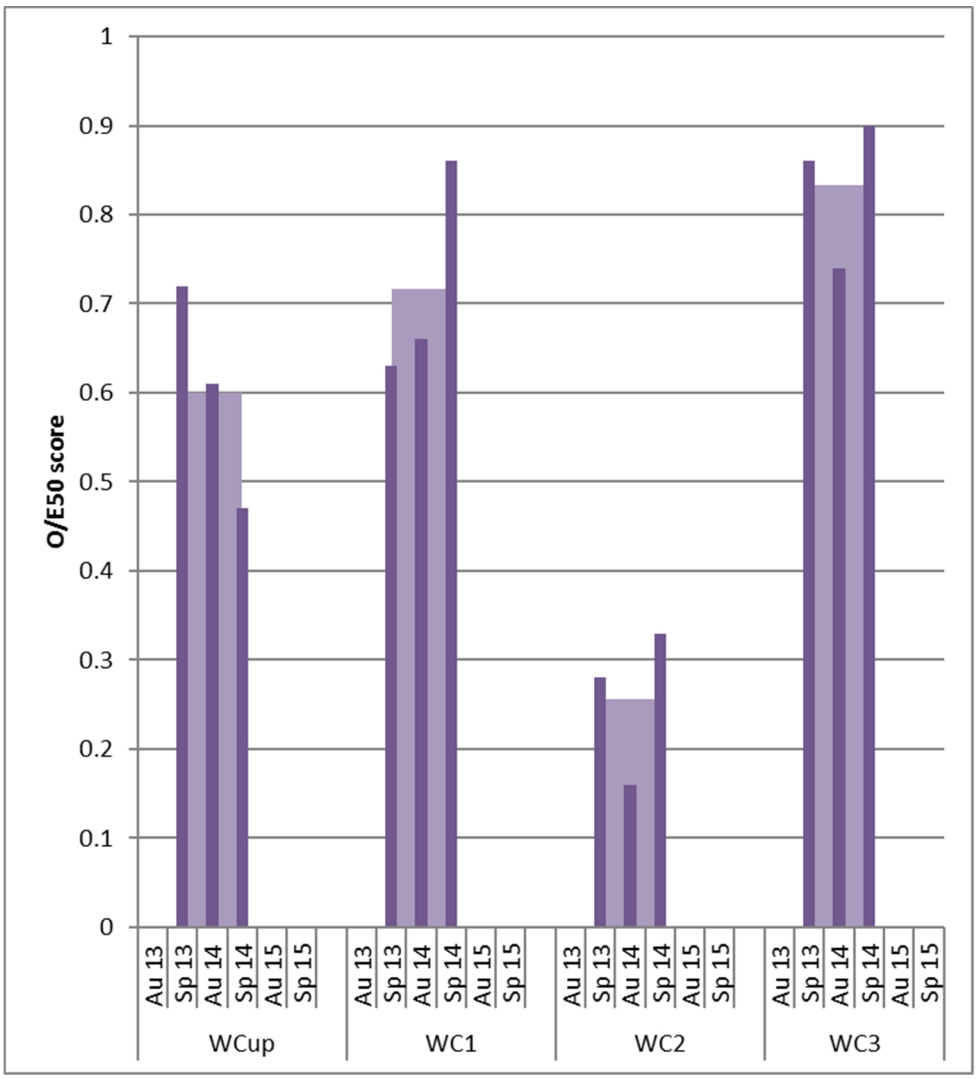


Figure 6-8 O/E50 score at Wangcol Creek sites between 2013 and 2015. Shaded area provides average across all sampling events

6.5.3 Coxs River

Macroinvertebrate biological index results for Coxs River are presented in Table 6-22. Results for taxa richness are provided in Figure 6-9. Across the three years assessed, the highest taxa richness was recorded at site CR1 (32 taxa; autumn 2013) and lowest at site CR2 (17 taxa, spring 2014) and CR6 (17 taxa; autumn 2013, autumn and spring 2015). Although a degree of variation in taxa richness was observed at all sites between seasons, the calculated mean taxa richness for each site indicates a similar range of variation between sites. Mean±SD taxa richness (across all sampling events) was 25±4, 23±2, 22±3, 21±3, 24±3 and 17±4 for sites CR1, CR2, CR3, CR4, CR5 and CR6, respectively. These results indicate that site CR6 supports a less diverse community than the other sites on Coxs River. Results from other sites were similar in the range observed.

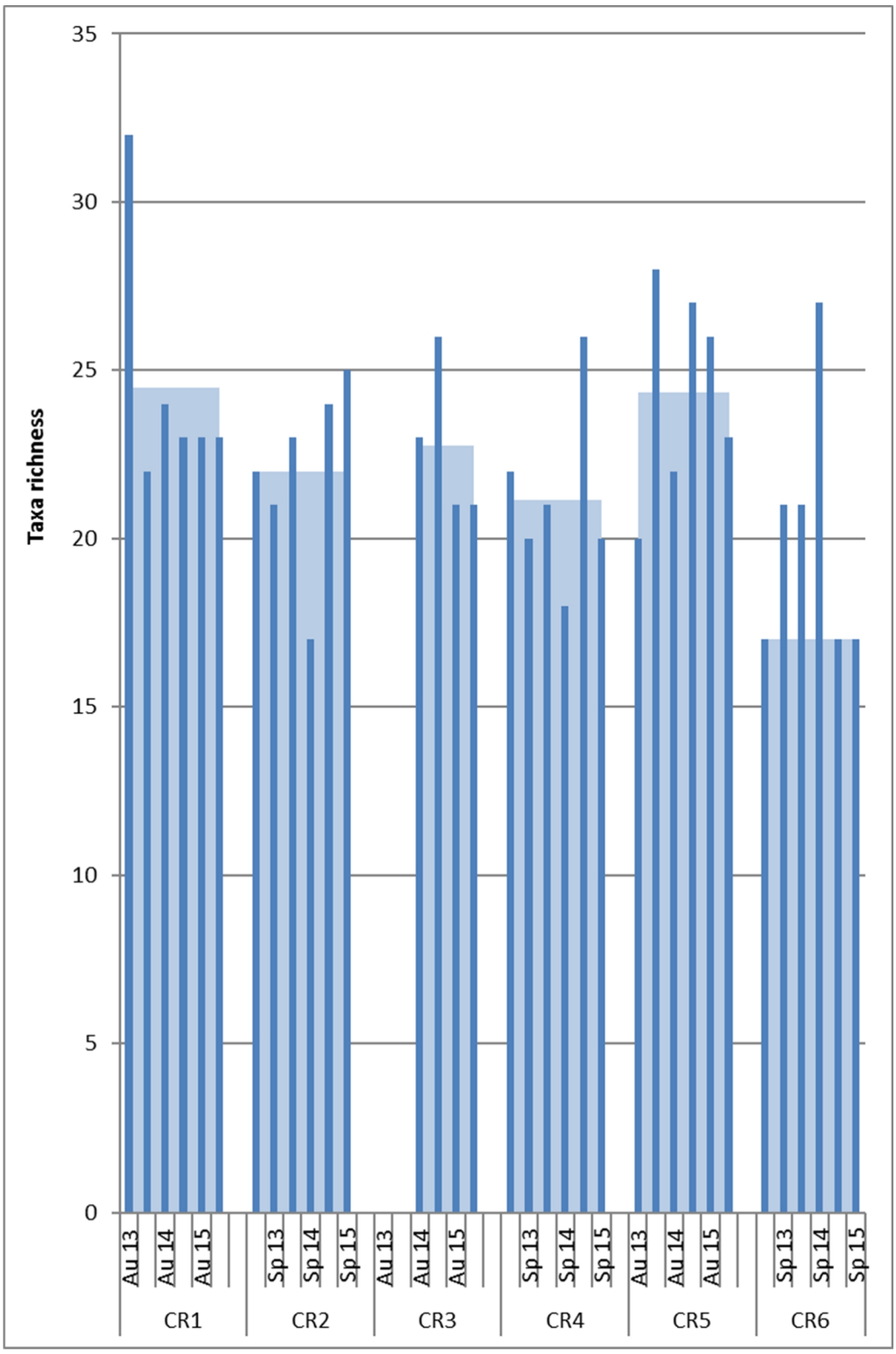


Figure 6-9 **Taxa richness at Coxs River sites between 2013 and 2015. Shaded area provides average across all sampling events**

Table 6-22 Macroinvertebrate biological index results for Coxs River sites CR1, CR2 and CR3 for 2013 to 2015

Metrics	CR1						CR2						CR3			
	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15	Au 14	Sp 14	Au 15	Sp 15
Taxa richness	32	22	24	23	23	23	20	21	23	17	24	25	23	26	21	21
EPT richness	7	2	6	N/A	7	5	7	7	5	2	8	7	6	N/A	7	5
SIGNAL-2 score	4.50	3.95	3.86	3.60	4.05	3.57	4.15	4.57	3.50	3.50	4.52	4.71	3.91	3.88	4.24	4.19
O/E50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.99	0.87	0.73	N/A	N/A	N/A	N/A	N/A	N/A
AUSRIVAS band	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	B	N/A	N/A	N/A	N/A	N/A	N/A

N/A – Not available due to the fact that alkalinity and substratum data (required for AUSRIVAS model input) were not available years or raw taxa counts were not available to calculate EPT score.

Table 6-23 Macroinvertebrate biological index results for Coxs River sites CR4, CR5 and CR6 for 2013 to 2015

Metrics	CR4						CR5						CR6					
	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15
Taxa richness	21	20	21	18	26	20	17	21	22	27	17	17	17	21	21	27	17	17
EPT richness	6	7	3	5	7	8	5	5	7	7	4	5	5	5	5	N/A	4	5
SIGNAL-2 score	4.15	4.37	3.85	4.94	4.04	4.48	3.90	3.27	4.10	4.12	4.04	4.48	3.41	3.37	3.95	3.64	3.64	3.67
O/E50	N/A	0.77	0.78	0.64	N/A	N/A	N/A	N/A	0.87	1.18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AUSRIVAS band	N/A	B	B	B	N/A	N/A	N/A	N/A	A	X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A – Not available due to the fact that alkalinity and substratum data (required for AUSRIVAS model input) were not collected in those years or raw data was not available to calculate EPT score.

Results for EPT richness are provided in Figure 6-10. Across the three years assessed the greatest number of EPT taxa were recorded at site CR2 (eight taxa; autumn 2015) and site CR5 (eight taxa; spring 2015) and lowest at site CR2 (two taxa, spring 2014). Although a degree of variation was observed at all sites, the calculated mean EPT abundances for each site indicates that diversity also varies longitudinally. Mean±SD taxa richness (across all sampling events) was 5±2, 6±2, 6±1, 6±1, 7±0 and 5±0 for sites CR1, CR2, CR3, CR4, CR5 and CR6, respectively. These results indicate that site CR5 supports a greater number of sensitive EPT taxa than the other sites on Coxs River. EPT richness was generally lower at CR6 relative to other sites.

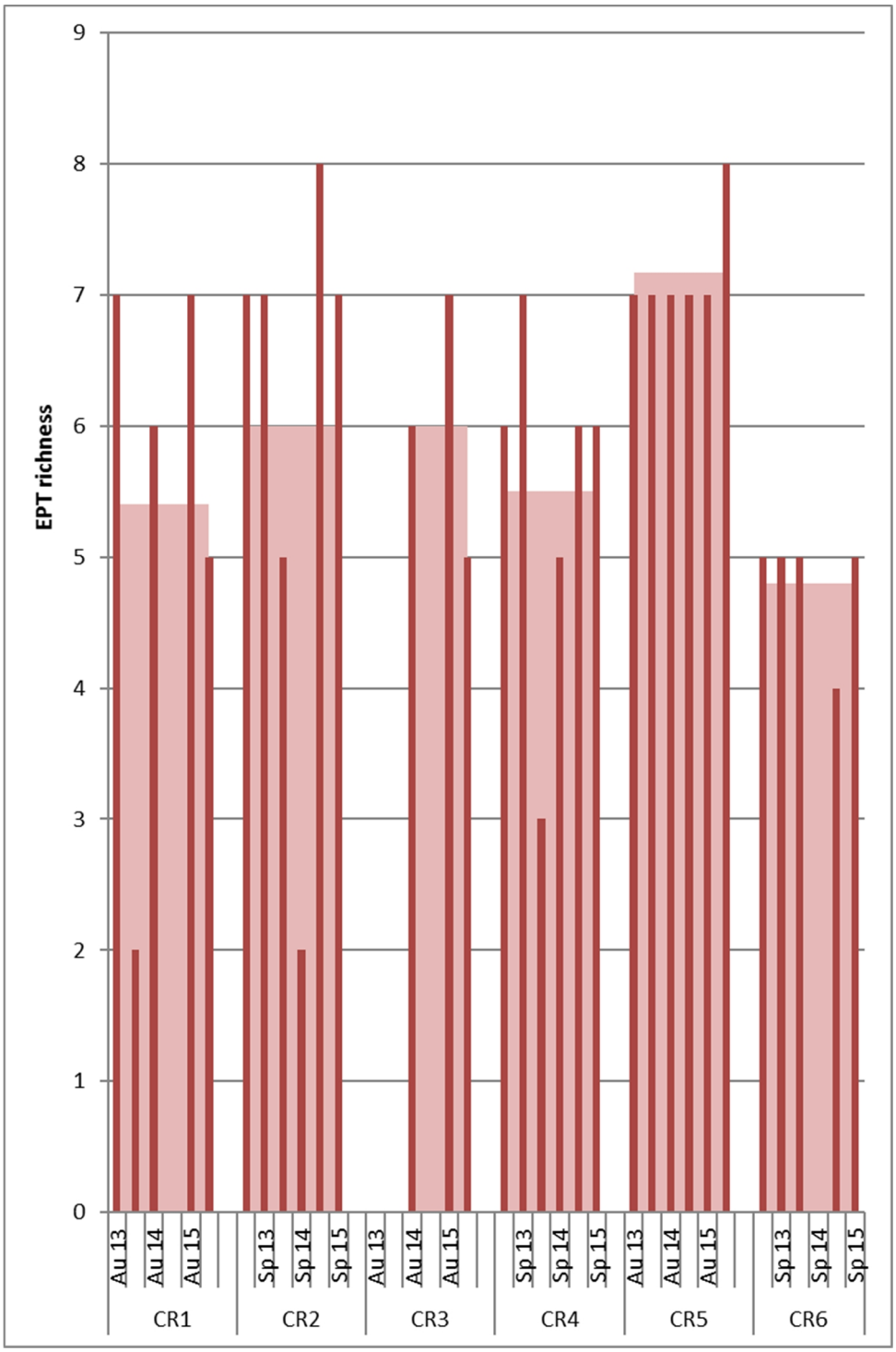


Figure 6-10 EPT richness at Coxs River sites between 2013 and 2015. Shaded area provides average across all sampling events

Results for SIGNAL-2 score are provided in Figure 6-11. Across the three years assessed the highest SIGNAL-2 score was recorded at site CR4 (4.94; spring 2014) and lowest at site CR5 (3.27, spring 2013). Although a degree of variation was observed at all sites, the calculated mean taxa richness for each site indicates that diversity also varies longitudinally. Mean±SD SIGNAL-2 scores (across all sampling events) was 3.92±0.34, 4.16±0.54, 4.05±0.19, 4.30±0.38, 3.98±0.40, and 3.61±0.21 for sites CR1, CR2, CR3, CR4, CR5 and CR6, respectively.

These results suggest that site CR6 supports a greater proportion of pollution tolerant taxa than the other sites on Coxs River. In general, all sites could be classified as being either severely impaired (score of <4) or moderately impaired (scores of 4-5) as per Chessman *et al.* 1997). Results from other sites were similar in their range across the three years of monitoring.

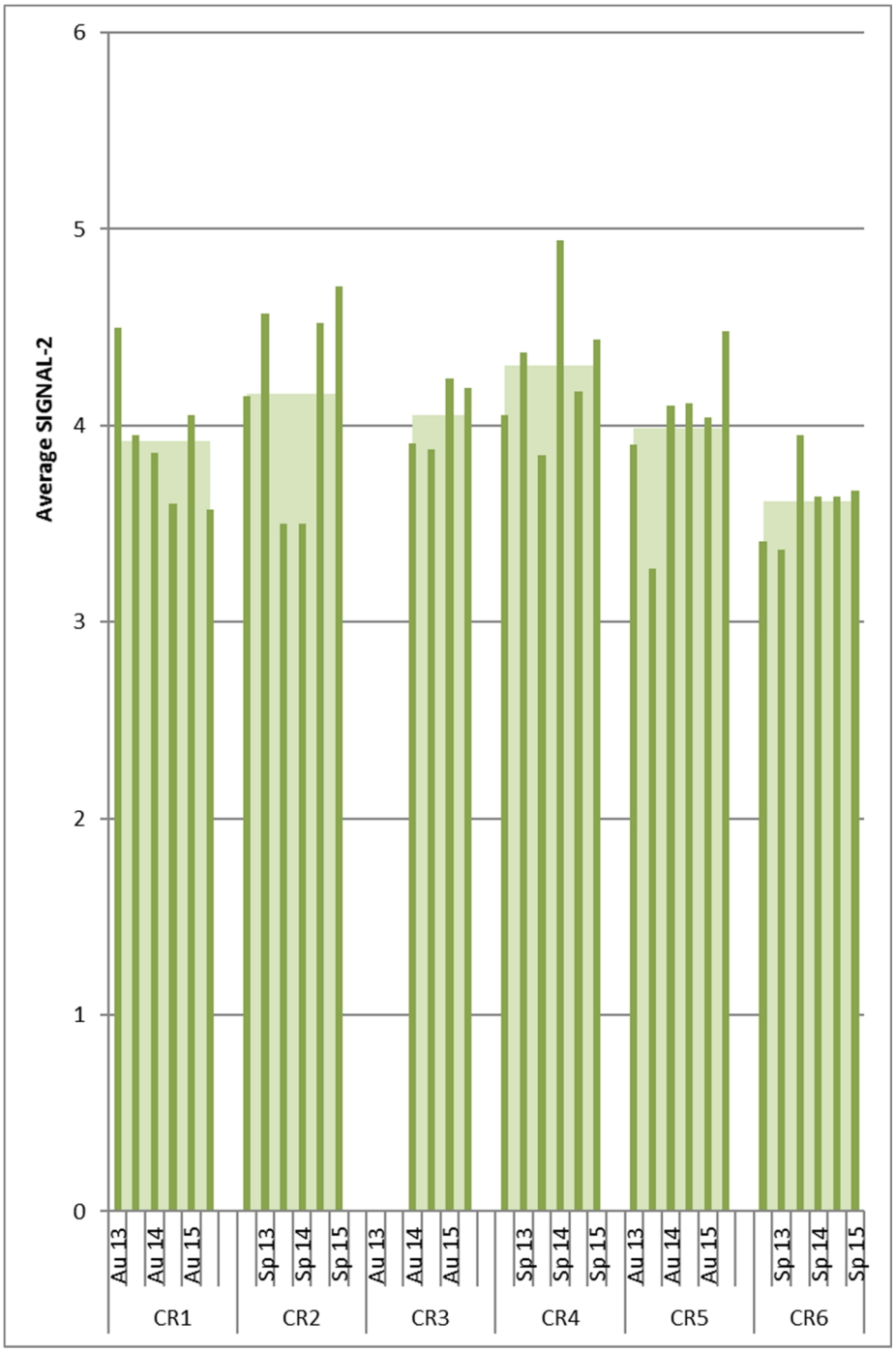


Figure 6-11 SIGNAL-2 score at Coxs River sites between 2013 and 2015. Shaded area provides average across all sampling events

AUSRIVAS OE/50 scores for the Coxs River sites are presented in Figure 6-12. Across the three years assessed the greatest OE/50 score was recorded at site CR5 (1.18; spring 2014) and lowest at site CR4 (0.64; spring 2014). Variation was observed at most sites but the calculated mean OE/50 score for each site indicates that diversity also varies longitudinally. Mean±SD OE/50 scores (across all sampling events) were 0.86±0.13, 0.73±0.08 and 1.03±0.2 for sites CR2, CR4 and CR5, respectively.

These results indicate that sites on Coxs River range from significantly impaired to close to reference condition (OE/50 ~1.0) depending on season sampled.

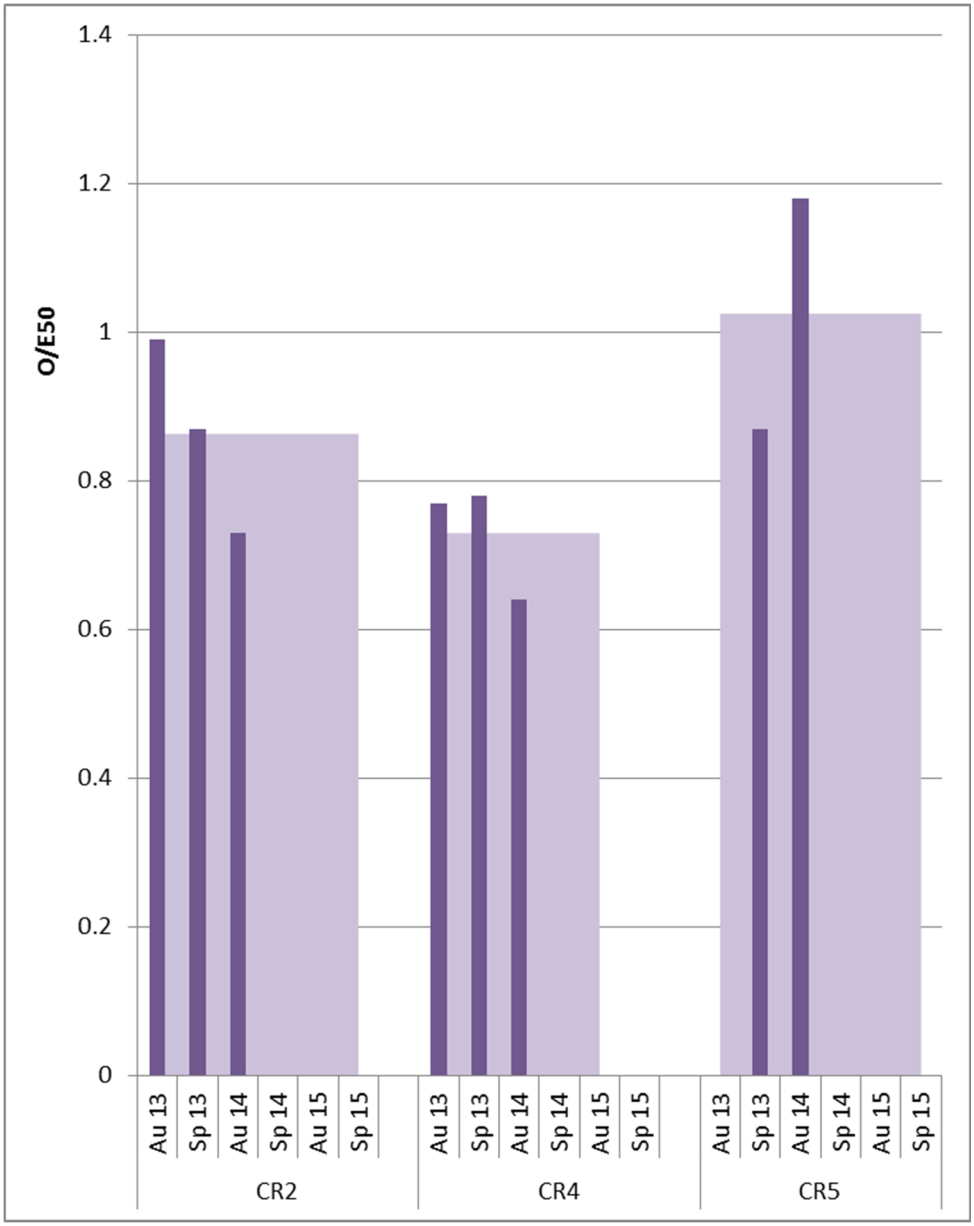


Figure 6-12 O/E50 score at Coxs River sites between 2013 and 2014. Shaded area provides average across all sampling events. Note: O/E50 was not available for CR1 or CR3

6.5.4 Sawyers Swamp Creek

Macroinvertebrate results for Sawyers Swamp Creek are presented in Table 6-24. Results for taxa richness are provided in Figure 6-13. Across the three years assessed the greatest taxa richness was recorded at site DP9dn (24 taxa; autumn 2014) and lowest at site DP9dn (nine taxa, autumn 2013). Site DP9dn displayed obvious variation over the three years assessed, with

the lowest number of taxa collected in autumn and spring 2013 and greatest number in autumn and spring 2014. Mean±SD taxa richness (across all sampling events) was 16±6 for site DP9dn. The single sampling events for sites SSWdn and SSCup recorded 19 taxa from each site. These results indicate that site DP9dn supports a less diverse community than the sites further upstream on Sawyers Swamp Creek.

Table 6-24 Macroinvertebrate biological index results for Sawyers Swamp Creek

Metric	SSWdn	SSCup	DP9dn					
	Au 13	Au 14	Au 13	Sp 13	Au 14	Sp 14	Au 15	Sp 15
Taxa richness	19	19	9	11	24	22	15	14
EPT richness	3	3	2	2	4	N/S	4	5
SIGNAL-2 score	5.53	3.47	3.56	3.82	3.57	4.27	4.00	4.93
O/E50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AUSRIVAS band	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

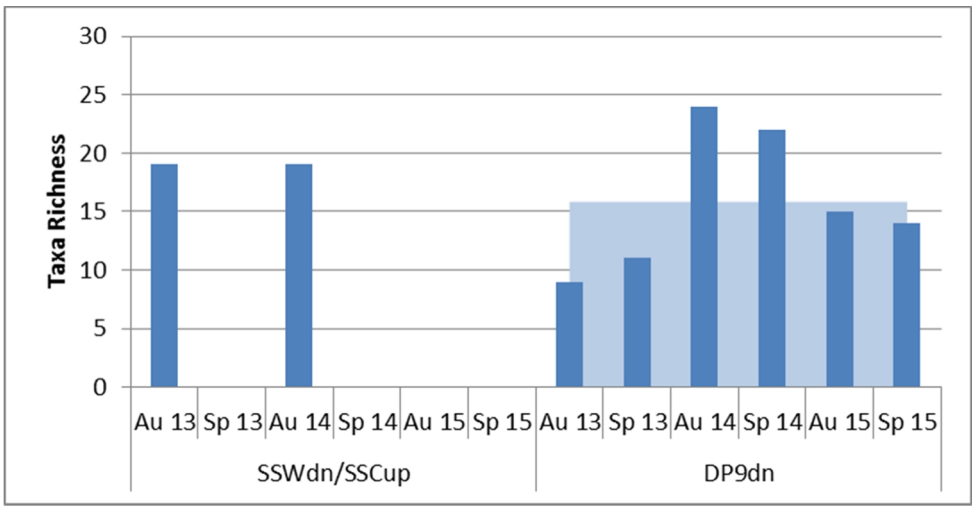


Figure 6-13 Taxa richness at Sawyers Swamp Creek between 2013 and 2015. Shaded area provides average across all sampling events

Results for EPT taxa collected are provided in Figure 6-14. Across the three years assessed the greatest taxa richness was recorded at site DP9dn (five taxa; spring 2015) and lowest at site DP9dn (two taxa, autumn and spring 2013). Site DP9dn displayed obvious variation over the three years assessed, with the lowest number of taxa collected in autumn and spring 2013 and greatest number in spring 2015. Mean±SD EPT richness (across all sampling events) was 3±1 for site DP9dn. The single sampling events for sites SSWdn and SSCup recorded 3 EPT taxa from each site. These results indicate that site DP9dn supports EPT taxa abundances that have varied, depending on year.

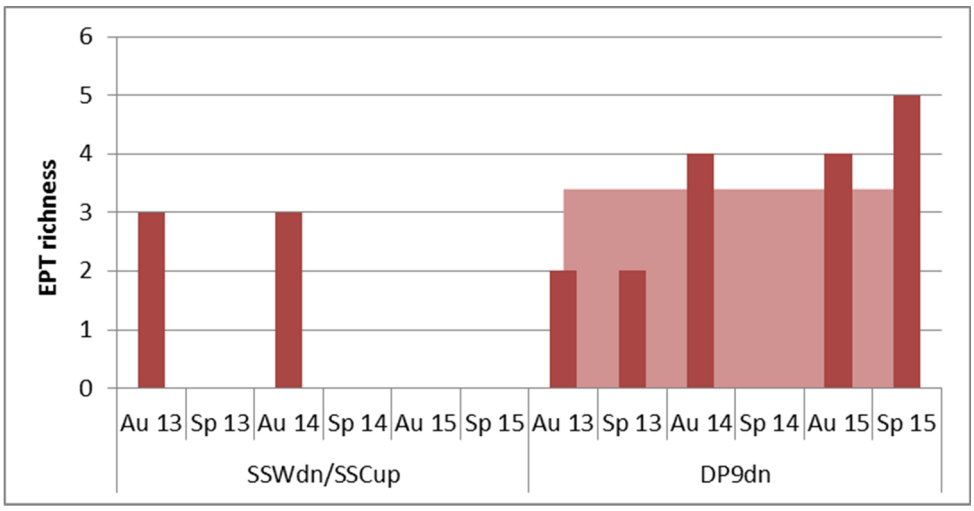


Figure 6-14 EPT richness at Sawyers Swamp Creek between 2013 and 2015. Shaded area provides average across all sampling events

SIGNAL-2 scores for Sawyers Swamp Creek are presented in Figure 6-15. Across the three years assessed the greatest SIGNAL 2 score was recorded at site SSWdn (5.53; autumn 2013) and lowest at site SSCup (3.47, autumn 2014). Site DP9dn displayed fairly consistent results over the three years assessed. Mean±SD SIGNAL 2 score (across all sampling events) was 4.02±0.5 for site DP9dn with the exception of increase observed in the spring 2015 sampling event. The single sampling events for sites SSWdn and SSCup recorded SIGNAL-2 scores of 5.53 and 3.47. These results indicate that sites SSCup and DP9dn support a macroinvertebrate community dominated by pollution tolerant taxa, whereas the limited data for SSWdn suggest that this site supports a community with a higher proportion of sensitive taxa.

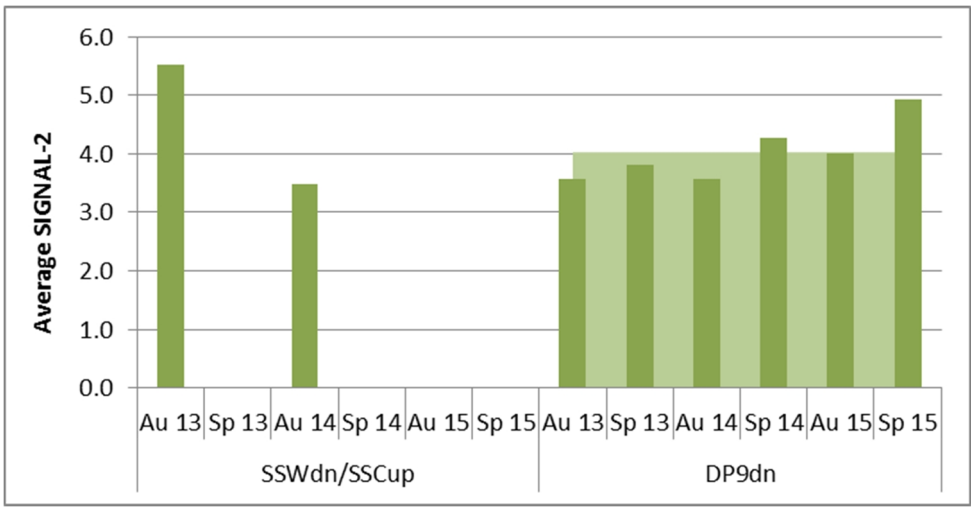


Figure 6-15 SIGNAL-2 scores at Sawyers Swamp Creek between 2013 and 2015. Shaded area provides average across all sampling events

6.5.5 Assessment of relative richness

Graphs displaying the relative number of orders present at each site during autumn and spring 2015 are displayed in Figure 6-16 and Figure 6-17. These graphs provide a comparison of relative richness during 2015, potentially allowing for the identification of differences in terms of orders present.

In autumn 2015 the greatest diversity of orders was recorded from Coxs River site CR4, with 12 orders present. These included Water beetles (Coleoptera), True flies (Diptera), Mayflies (Ephemeroptera), Moth larvae (Lepidoptera), dragonflies/damselflies (Odonata), Stoneflies (Plecoptera), Caddisflies (Trichoptera), Mites (Acarina), Yabbies/shrimps (Decapoda), Oligochaete worms (Oligochaeta), Pea shells (Bivalvia) and Snails (Gastropoda). This contrasted with the lowest number of macroinvertebrate orders being collected from Wangcol Creek site WCup (six orders, represented by Coleoptera, Diptera, Ephemeroptera, True Bugs (Hemiptera), Trichoptera and Decapoda) and Sawyers Swamp Creek site DP9dn (Coleoptera, Diptera, Ephemeroptera, Hemiptera, Trichoptera and Odonata). In general, the Wangcol Creek sites (and the Sawyers Swamp Creek site) supported a lower number of orders when compared to the Coxs River sites.

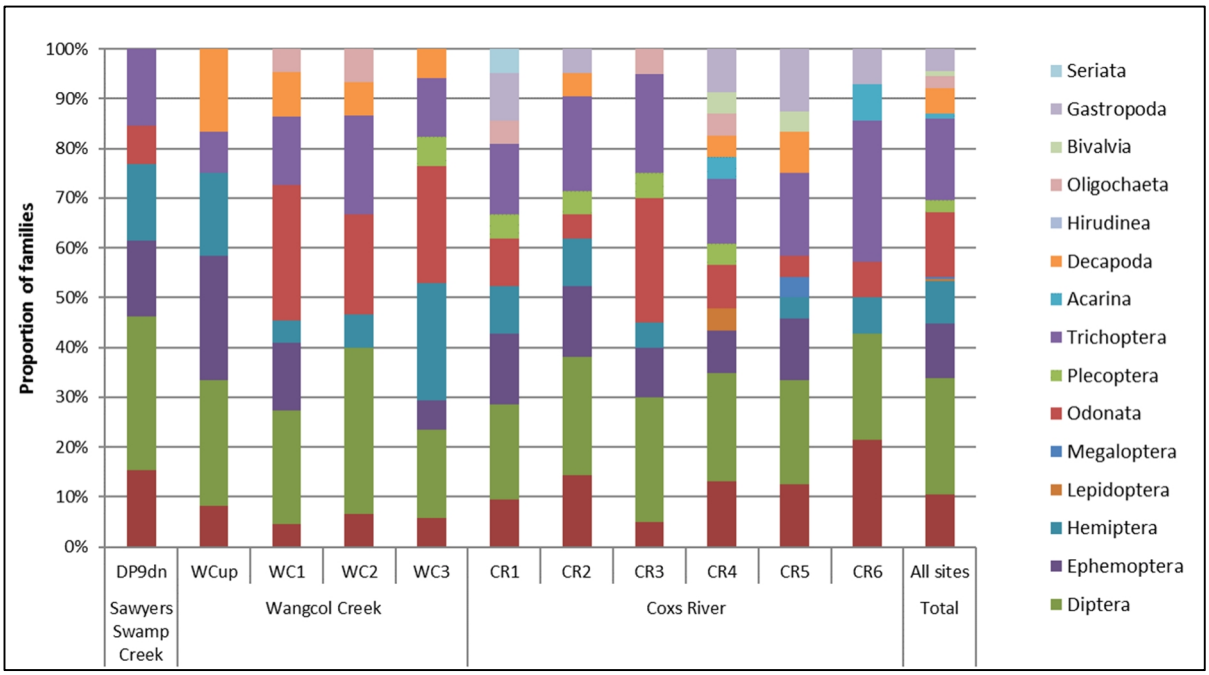


Figure 6-16 Relative richness of macroinvertebrate orders at each site sampled in autumn 2015

In spring 2015 the greatest diversity of orders was recorded from Coxs River site CR5, with 13 orders present. These included Coleoptera, Diptera, Ephemeroptera, Hemiptera, Odonata, Trichoptera, Acarina, Decapoda, Leeches (Hirudinea), Oligochaete worms, Bivalvia and Snails Gastropoda. This contrasted with the lowest number of macroinvertebrate orders (five in total) being collected from Sawyers Swamp Creek site DP9dn (Diptera, Ephemeroptera, Odonata, Trichoptera and Decapoda). Wangcol Creek site WC2 again only supported six orders. In spring there was generally less of a contrast between the Coxs River and Wangcol Creek sites (other than site WC2), with similar levels of diversity observed.

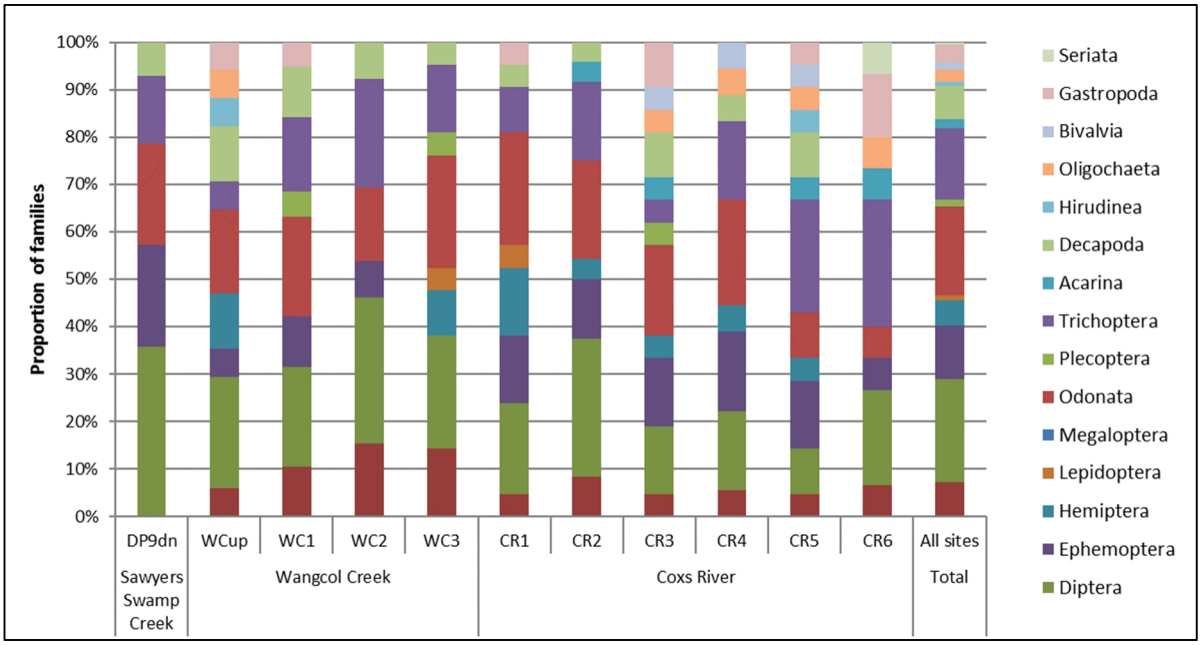


Figure 6-17 Relative richness of macroinvertebrate orders at each site sampled in spring 2015

6.5.6 Regional baseline sites - Lower Coxs River

Results for regional WaterNSW monitoring sites MMP37 and E086 are provided in Table 6-25.

Results for taxa richness are provided in Figure 6-18. Mean±SD number of families collected for site E086 were 22±1 and 21±2 for edge and riffle samples. Mean±SD number of families collected for site MMP37 were 28±6 and 21±4 for edge and riffle samples.

Results for taxa richness are provided in Figure 6-19. Mean±SD number of EPT families collected for site E086 were 6±1 and 9±1 for edge and riffle samples. Mean±SD number of EPT families collected for site MMP37 were 6±1 and 8±2 for edge and riffle samples.

Results for average SIGNAL-2 scores are provided in Figure 6-20. Mean±SD SIGNAL-2 scores for site E086 were 4.4±0.1 and 5.8±0.4 for edge and riffle samples. Mean±SD number of EPT families collected for site MMP37 were 3.9±0.1 and 5.3±0.4 for edge and riffle samples.

Table 6-25 Macroinvertebrate biological index results for Lower Coxs River (Regional baseline sites)

Index	E086								MMP37							
	Sp 12 (edge)	Sp 12 (riffle)	Sp 13 (edge)	Sp 13 (riffle)	Sp 14 (edge)	Sp 14 (riffle)	Sp 15 (edge)	Sp 15 (riffle)	Sp 12 (edge)	Sp 12 (riffle)	Sp 13 (edge)	Sp 13 (riffle)	Sp 14 (edge)	Sp 14 (riffle)	Sp 15 (edge)	Sp 15 (riffle)
Taxa richness	22	22	23	23	23	19	21	18	31	19	19	17	31	26	29	21
EPT richness	5	10	7	9	7	8	6	9	5	7	6	7	7	10	6	7
SIGNAL-2 score	4.6	5.5	4.3	5.7	4.2	5.7	4.5	6.4	3.9	4.7	4	5.5	3.9	5.6	4	5.3

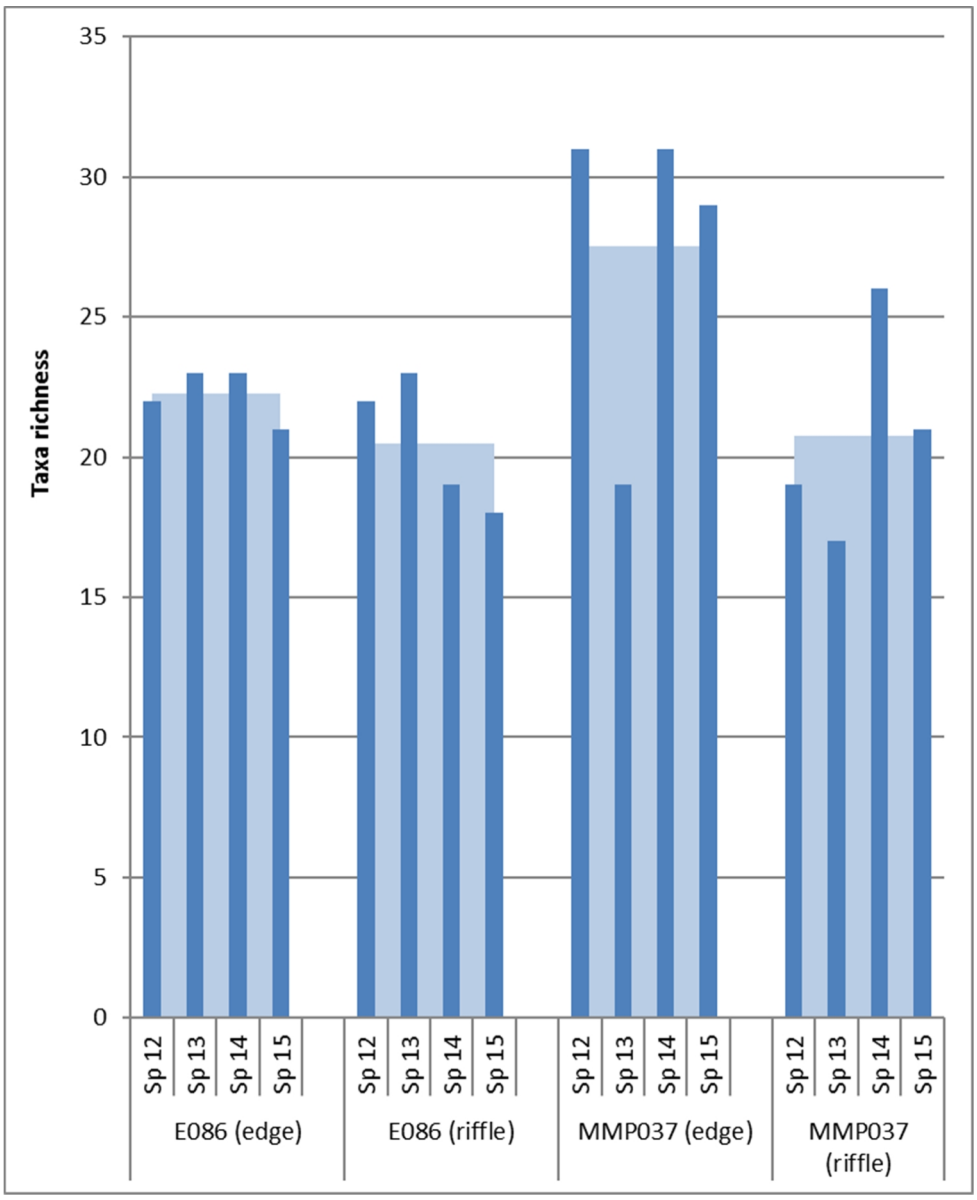


Figure 6-18 Taxa richness at Lower Coxs River between 2012 and 2015. Shaded area provides average across all sampling events

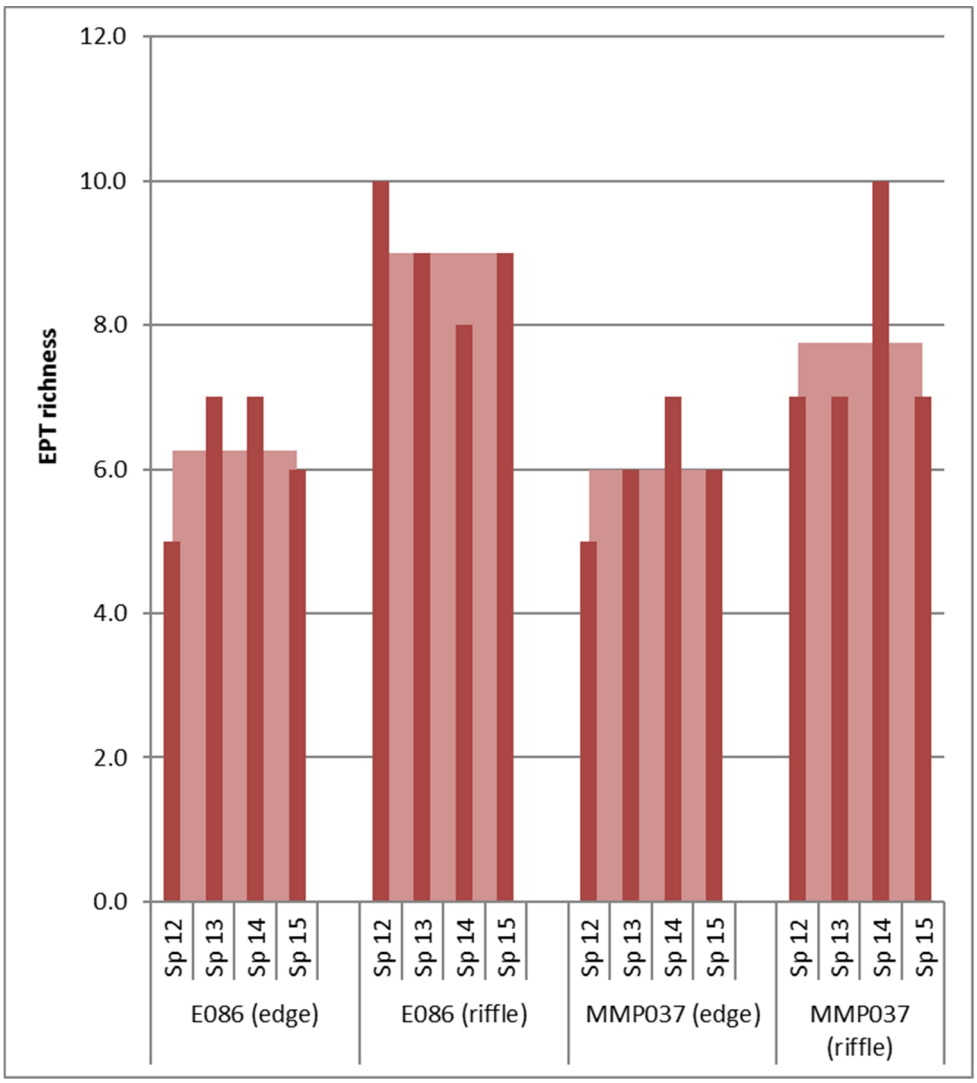


Figure 6-19 EPT richness at Lower Coxs River between 2012 and 2015. Shaded area provides average across all sampling events

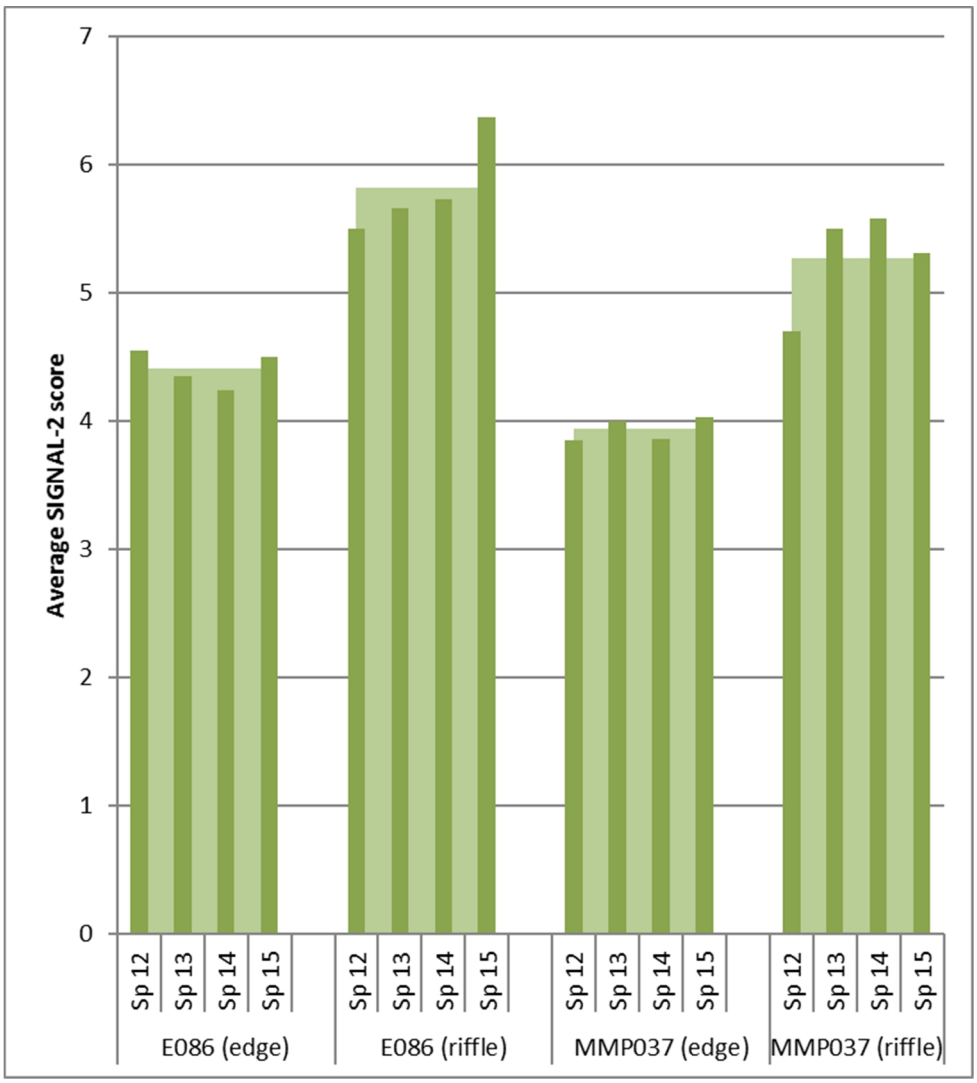


Figure 6-20 SIGNAL-2 scores at Lower Coxs River between 2012 and 2015. Shaded area provides average across all sampling events

6.5.7 Summary of macroinvertebrate community composition

Neubecks Creek

The single site on Neubecks Creek (NCdn) has displayed variable results between 2012 and 2014 in terms of macroinvertebrate taxa richness, with between 15 and 25 taxa recorded. This also applies with respect to EPT richness, where between one and six taxa have been recorded over six monitoring events. SIGNAL-2 scores have been more consistent, ranging from 3.2 to 4.4. Variation across seasons was observed for OE/50 score which ranged from conditions indicating severe degradation of water or habitat quality (autumn 2014) to conditions that are close to reference condition for the region (spring 2014).

Wangcol Creek

The sites located on Wangcol Creek vary in terms of macroinvertebrate community condition. Between 2013 and 2015 Site WC2 and to a lesser extent site WCup have consistently supported very low diversity, low EPT richness, low SIGNAL-2 scores and AUSRIVAS band ratings of severely impaired. Sites WC1 and WC3 have generally supported moderate to high diversity, moderate EPT richness, SIGNAL-2 scores and AUSRIVAS band ratings.

Variation was observed between years in terms of taxa richness but there was no consistent trend. There was some indication that there has been an increase in the number of EPT taxa collected in 2015 which was evident specifically at site WC2. SIGNAL-2 scores indicate that macroinvertebrates in this system are likely to be subjected to poor water quality. However, macroinvertebrate communities located at site WC3 (1.72 km downstream of WC2) showed some sign of recovery with a slightly greater mean SIGNAL-2 score. AUSRIVAS modelling suggested that site WC3 was in a condition similar to reference sites on occasion and had displayed the highest average AUSRIVAS score. This could suggest that there is sufficient dilution of contaminants to facilitate recovery of macroinvertebrate communities at site WC3. Other sites on Wangcol Creek had fewer macroinvertebrate families than expected and were considered to be significantly impaired, especially site WC2.

Coxs River

In general, monitoring sites on the Coxs River were found to have macroinvertebrate communities in relatively good condition. Sites CR1 to CR5 have recorded moderate to high taxa richness, EPT richness and SIGNAL-2 scores and AUSRIVAS ratings have not fallen below Band B (significantly impaired) at sites CR1, CR2 and CR4. However, site CR6 (downstream from Lake Wallace) appears to support a less diverse macroinvertebrate community, with lower index scores.

Between 2013 and 2015 site CR5 recorded AUSRIVAS scores which indicate that this site is of reference condition. Species richness and EPT scores were also relatively higher at site CR5. Variation was observed between years in terms of index results but no noticeable trends were observed at any of the sites monitored.

Sawyers Swamp Creek

Sawyers Swamp Creek was regularly monitored at one site (DP9dn) between 2013 and 2015. Results indicate that this site, downstream from the discharge point LDP009, displayed variable results that ranged from moderate to very low diversity but consistent SIGNAL-2 scores indicative of moderately degraded water quality. Sites upstream from discharge point LDP009 (SSWdn/SSCup) indicate that a more diverse macroinvertebrate community exists when water is present. The RCE inventory scores indicate that sites upstream have higher quality instream and riparian habitat than downstream from discharge point LDP009.

Regional baseline sites (Lower Coxs River)

Results for sites E086 and MMP37 indicate that, in general, the regional monitoring sites on the Coxs River were found to have macroinvertebrate communities in relatively good condition with moderate to high taxa richness, EPT richness and SIGNAL-2 scores, especially in samples collected from riffle habitat.

6.6 Macrophytes

Aquatic vegetation was recorded in all of the waterways within the Project. Macrophytes mainly comprised emergent growth forms, and were dominated by species of *Juncus*, *Typha* and *Eleocharis*. Three types of submerged macrophyte (curly leaf pondweed [*Potamogeton crispus*], Starwort [*Callitriche* sp.] and River buttercup [*Ranunculus inundatus*]) were observed.

No aquatic vegetation recorded within the IAA or reference waterways were listed as threatened under FM Act or EPBC Act. Macrophyte taxa observed at each site by GHD (2014b) and MPR (2014b; 2015a, b, c and d) are shown in Table 6-26.

In the Coxs River the greatest number of macrophytes were recorded from site CR1 (eight taxa), located upstream of the Wangcol Creek confluence. The lowest number of taxa were recorded from sites CR5 and CR6 (five taxa). In Wangcol Creek the greatest number of taxa were recorded at WC1 and WC2 (four taxa) and the lowest number recorded from site WC3 (two taxa). In Sawyers Swamp Creek a greater number of macrophytes were observed at the upstream site SSCup (seven taxa) than at site DP9dn (four taxa).

In general, a greater diversity of macrophytes were therefore observed in the Coxs River, when compared to Wangcol and Sawyers Swamp Creeks.

Table 6-26 Macrophyte taxa observed between 2013 to 2015 (GHD 2014b; MPR 2014b; 2015a, b, c and d)

Family	Common name	Scientific name	NCdn	WCup	WC1	WC2	WC3	CR1	CR2	CR4	CR5	CR6	SSWdn^	SSCup	DP9dn
Emergent growth form															
Cyperaceae	Soft twig sedge	*Baumea rubiginosa*				✓*				✓				✓*	✓*
	Umbrella sedge	*Cyperus eragrostis**								✓					
	Tall spike rush	*Eleocharis sphacelata*						✓*						✓*	
	Spike rush	*Eleocharis sp.*	✓			✓*		✓*	✓						✓*
	River clubrush	*Schoenoplectus validus*						✓*			✓*	✓*			
	Fen sedge	*Carex gaudichaudiana*			✓*	✓*		✓*	✓	✓				✓*	
Juncaceae	Joint leaf rush	*Juncus articulatus**		✓*	✓*		✓*	✓*	✓*	✓		✓*		✓*	✓*
	Common rush	*Juncus usitatus*	✓	✓	✓	✓	✓	✓*	✓	✓					
	Bulbous rush	*Juncus bulbosus*												✓*	
Poaceae	Common reed	*Phragmites australis*								✓		✓*			
Typhaceae	Cumbungi	*Typha sp.*		✓	✓				✓		✓*	✓*		✓*	✓*

Family	Common name	Scientific name	NCdn	WCup	WC1	WC2	WC3	CR1	CR2	CR4	CR5	CR6	SSWdn^	SSCup	DP9dn
Polygonaceae	Knotweed	*Persicaria sp.*						✓*				✓*			
Schrophulariaceae	Blue water speedwell	*Veronica anagallis-aquatica*									✓*			✓*	
Brassicaceae	Watercress	*Nasturtium officinale*									✓*	✓*			
Submerged growth form															
Potamogetonaceae	Curly leaf pondweed	*Potamogeton crispus*	✓						✓*		✓*	✓*			
Plantaginaceae	Starwort	*Callitriche spp.*						✓							
Ranunculaceae	River buttercup	*Ranunculus inundatus*													
Taxa richness			**3**	**3**	**4**	**4**	**2**	**8**	**6**	**5**	**5**	**7**		**7**	**4**
Algae															
	Charophyta				✓	✓*		✓*		✓	✓*				

* indicates records added by MPR (2014b, 2015a, b, c & d)

^ indicates site not surveyed for aquatic macrophytes

6.7 Summary of water quality assessment

The WRIA (GHD, 2016) undertaken for the Project characterised current surface and groundwater quality of the environment specific to the Project. The main outcomes of this included:

- Waterways with the potential to be influenced by the Project were considered to include the wider Coxs River catchment downstream to Lake Burragorang.
- The Project will result in direct changes in water quality within the Coxs River catchment through the cessation of discharges from Springvale Mine LDP009 and intermittent discharge from a new LDP into Wangcol Creek located adjacent to LDP006 discharging into Wangcol Creek via Lamberts Gully.
- Catchment specific guideline values were derived based on water quality from Neubecks Creek given the influences of the MPPS and SCSS on the water of Wangcol Creek. Wangcol Creek quality was more subject to groundwater influences and existing discharges whereas Coxs River was dominated by LDP009 discharges downstream of Sawyers Swamp Creek.

6.7.1 LDP006 (Lamberts Gully/Wangcol Creek)

Currently, water discharges at a rate of approximately 1.29 ML/day from LDP006 into Wangcol Creek. Key components of the water quality of the current LDP006 discharges are:

- Exceedance of ANZECC (2000) guideline values for electrical conductivity (EC) (median of 3,040 µ/cm).
- Low turbidity and TSS (median 9 NTU and 5 mg/L, respectively).
- Near-neutral pH (median 6.8 pH units).
- Concentrations of some metals exceed ANZECC (2000) guideline values (boron, copper, manganese, nickel, zinc).
- Nutrient concentrations below ANZECC (2000) guideline values.
- Extremely hard water (median hardness 1,060 mg/L).
- Elevated sulfate concentrations (median 1,505 mg/L).
- Sodium dominated (relative to other cations).

6.7.2 LDP009 (Sawyers Swamp Creek)

Currently water discharge at a rate of approximately 20 to 25 ML/day from LDP009 into Sawyers Swamp Creek. Key components of the water quality of the current LDP009 discharges are:

- Exceedance of ANZECC (2000) guideline values for electrical conductivity (EC) (median of 1,170 µ/cm) of upland NSW rivers.
- Turbidity and TSS within recommended ANZECC (2000) range for upland NSW rivers (median 4 NTU and 5 mg/L, respectively).
- Near-neutral pH (median 7.8 pH units), within recommended ANZECC (2000) range for upland NSW rivers.
- Concentrations of some metal exceed ANZECC (2000) guideline values (arsenic, zinc).
- Nutrient concentrations generally below ANZECC (2000) guideline values.
- Soft water (median hardness 15.5 mg/L).

- Low sulfate concentrations (median 37 mg/L).
- Sodium dominated (relative to other cations).

6.7.3 Receiving water quality

Water quality varied between the creek systems with Neubecks Creek generally recording the best water quality conditions for those parameters sampled. In Wangcol Creek, EC generally exceeded the ANZECC (2000) guideline value of 350 µS/cm at most sites, with median concentrations of 361 µS/cm, 244 µS/cm, 1,640 µS/cm and 1,930 µS/cm at sites WCup, WC1, WC2 and WC3, respectively. Median pH was within the ANZECC (2000) guideline range at all Wangcol Creek sites and median turbidity also fell below the guideline value at all sites. Total nitrogen concentrations exceeded the ANZECC (2000) guideline value of 0.25 mg/L with a median concentration of 0.3 mg/L at sites WCup and WC1, total phosphorus exceeded the guideline value of 0.02 mg/L with a median concentration of 0.02 and 0.03 mg/L at sites WCup and WC1. The median ammonia concentration was below the guideline value at all Wangcol Creek sites. Elevated dissolved metal concentrations were recorded at Wangcol Creek sites with copper elevated at sites WCup and WC1 (median 0.002 mg/L) and aluminium elevated at site WC1 only (median 0.11 mg/L). Dissolved iron concentrations were found to exceed the ANZECC guideline value of 0.3 mg/L on occasion at site WC1. Orange iron precipitate was also noted instream during all surveys at site WC2 on Wangcol Creek (GHD 2014b). GHD (2014b) reported that dissolved oxygen (DO) concentrations were low during sampling carried out in 2013 and 2014.

In the Coxs River (site CR4) EC generally exceeded the ANZECC (2000) guideline value with a median of 1030 µS/cm. MPR (2015d; 2016b) indicate that low EC (<100 µS/cm) has been recorded consistently in the Coxs River upstream from Wangcol Creek however EC is periodically influenced by Angus Place LDPs. Low turbidity was observed consistently. Median dissolved metal concentrations were generally below ANZECC (2000) guideline values.

No data was available for the site downstream of LDP009 on Sawyers Swamp Creek. However, water quality at downstream monitoring sites within Coxs River is representative of LDP009 discharge quality. Discharges from LDP009 are regulated by discharge limits defined within EPL 3607 which typically are above ANZECC (2000) guideline values.

6.8 Summary of instream ecology

Monitoring data collected at Neubecks Creek indicate that the creek is an ephemeral stream with limited aquatic habitat and riparian vegetation that was dominated by sedges and terrestrial grasses. The creek also has limited riparian shading and instream habitat diversity which provides little in the way of habitat for fish. Where water was available, the creek displayed relatively low salinity and no evidence of significant influence from historical mining which is typical of waterways in the IAA. The macroinvertebrate community has displayed moderate diversity over time.

Wangcol Creek is a third to fourth-order stream which is highly degraded due to past land-use activities. Minimal instream habitat remains within the creek and there is evidence to suggest that site WC2, located closest downstream of the LDP006 discharge, is the most degraded of the sites. Poor water quality (consistently high EC and occasional low DO) was also evident within the creek. These results are reflected on the macroinvertebrate results from monitoring where a low level of diversity was observed, especially at site WC2. Signs of recovery in terms of habitat condition and macroinvertebrate diversity was noted at site WC3, near to the Coxs River confluence.

Coxs River is a perennial waterway with evidence of moderate to good instream habitat but generally poor riparian zone condition in the upper sections of the catchment. Monitoring data indicates that site CR2 has more degraded riparian and aquatic habitat conditions than the other sites on the Coxs River, although this has not necessarily contributed to a more impacted macroinvertebrate community at this site. In general, monitoring sites on the Coxs River were found to have macroinvertebrate communities in relatively good condition, despite evidence of elevated EC downstream from the Wangcol Creek confluence and Sawyers Swamp Creek. Site CR6 (downstream from Lake Wallace) appears to support a less diverse macroinvertebrate community, with lower index scores which is generally inconsistent with observed water quality and diversity relationships.

The macroinvertebrate community of Sawyers Swamp Creek displayed very low to moderate diversity with variability between monitoring location and season. Results indicate that sites upstream from LDP009 have higher quality instream and riparian habitat than downstream from discharge point LDP009. Elevated EC was evident downstream from LDP009 as a result of current discharge activities. Macroinvertebrate diversity was higher at sites upstream of the LDP009, likely due to this combination of factors

Table 6-27 provides a summary of the instream ecology of the IAA and reference waterways.

Table 6-27 Summary of instream ecology results

Waterway	Neubecks Creek	Wangcol Creek	Coxs River	Sawyers Swamp Creek
Water quality and stream type	Ephemeral fourth order stream Sites Ncup and NCdn dry during spring 2013 and 2014 surveys. Flow observed at site NCdn but known to dry to isolated pools Elevated nutrient concentrations Low EC High background concentration of some dissolved metals	Perennial stream (groundwater fed). WCup third order; WC1-WC3 fourth order Series of connected pools, slight surface flow observed during surveys. Elevated nutrient concentrations High EC Some evidence of dissolved metal contamination	Perennial river. Series of connected pools with moderate flow during surveys. High EC downstream from Wangcol Creek	Ephemeral stream. Consistent flow downstream from LDP009 Upper reaches predominantly dry between 2013-2015 High EC downstream from LDP009
Riparian and aquatic habitat	Average RCE% range = 57-73% Moderately degraded due to previous land use impacts such as grazing. Minimal instream habitat remains.	Average RCE% range = 48-58% Highly degraded due to impacts of historical mining and regional industrial activities. Minimal instream habitat remains.	Average RCE% range = 41-70% Moderately degraded due to land use impacts, such as mining and agriculture. Moderate instream habitat present.	Average RCE% range = 53-81% Lower reaches moderately degraded due to land use impacts, such as mining. Upper reaches largely intact. Good instream habitat present at upstream sites. Poor instream habitat downstream of LDP009.
Aquatic flora	Three taxa observed	Two - four taxa observed	Five - eight taxa observed	Four - seven taxa observed.
Vertebrate fauna	One native fish species recorded (Mountain galaxias). No threatened species encountered and none	Two native fish species recorded (Flat-headed gudgeon and Mountain galaxias). One introduced species recorded (Eastern gambusia).	Two native fish species recorded (Flat-headed gudgeon and Mountain galaxias). Two introduced species recorded (eastern gambusia and brown	No fish observed. No threatened species encountered and none expected to occur due to the

Waterway	Neubecks Creek	Wangcol Creek	Coxs River	Sawyers Swamp Creek
	expected to occur due to the highly ephemeral nature of the waterway. Class 3-4 fish habitat.	No threatened species encountered and none expected to occur due to the ephemeral nature of the waterway. Class 3 fish habitat.	trout). No threatened species encountered and none expected to occur in theses reaches of the waterway based on past records and likely distribution. Class 2 fish habitat.	ephemeral nature of the waterway. Class 3 fish habitat.
Macroinvertebrates	Moderate diversity, with some EPT taxa present, moderate SIGNAL 2 scores and AUSRIVAS scores indicating pollution and/or poor habitat. Average taxa richness: 21 Average EPT score: 4 Average SIGNAL-2 score: 4 Average AUSRIVAS score: 0.6	Low to moderate diversity, with some EPT taxa present, moderate SIGNAL 2 scores and AUSRIVAS scores indicating pollution and/or poor habitat. Evidence of improved waterway health at most downstream site (WC3). Results indicate poorest river health at site WC2. Average taxa richness: 10-21 Average EPT score: 2-5 Average SIGNAL 2 score: 3.7-4.4 Average AUSRIVAS score: 0.3-0.7	Moderate to high diversity, including numerous EPT taxa and moderate SIGNAL-2 scores. AUSRIVAS scores indicate moderate to reference condition community present with existing condition likely due to poor water quality. Results indicate good river health at site CR5. Average taxa richness: 21-25 Average EPT score: 5-7 Average SIGNAL 2 score: 3.9-4.3 Average AUSRIVAS score: 0.7-1.0	Low to high diversity, including low numbers of EPT taxa and moderate SIGNAL-2 scores. Evidence of improved waterway health at site upstream of LDP009 (SSWdn). Average taxa richness: 16-19 Average EPT score: 3 Average SIGNAL 2 score: 3-5 Average AUSRIVAS score: n/a

7. Groundwater dependent ecosystems (GDEs)

7.1 Terrestrial GDEs

No terrestrial GDEs were determined to be associated with the waterways within the IAA. Discussions of any potential terrestrial GDEs associated with the proposed disturbance areas are discussed within the Biodiversity Assessment Report (RPS, 2016).

The mapping undertaken on groundwater dependence (Figure 7-1) indicates little or no potential for groundwater interaction associated with the waterways within the IAA. This reflects the disturbed nature of the PAA. The threatened species, Black Gum, which was discussed in Section 5 is known to have a preference for waterlogged conditions and hence does not fulfil the requirement of a GDE as per the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* of being substantially dependent on groundwater.

7.2 Subterranean GDEs

Stygofauna are entirely groundwater dependent (obligate) and are restricted to locations of groundwater discharge or within aquifers. Due to this dependence, stygofauna communities are particularly sensitive to, and can be impacted by, a range of factors that alter groundwater levels such as water pressure, water chemistry and aquifer structure.

7.2.1 Stygofauna in Australia and NSW

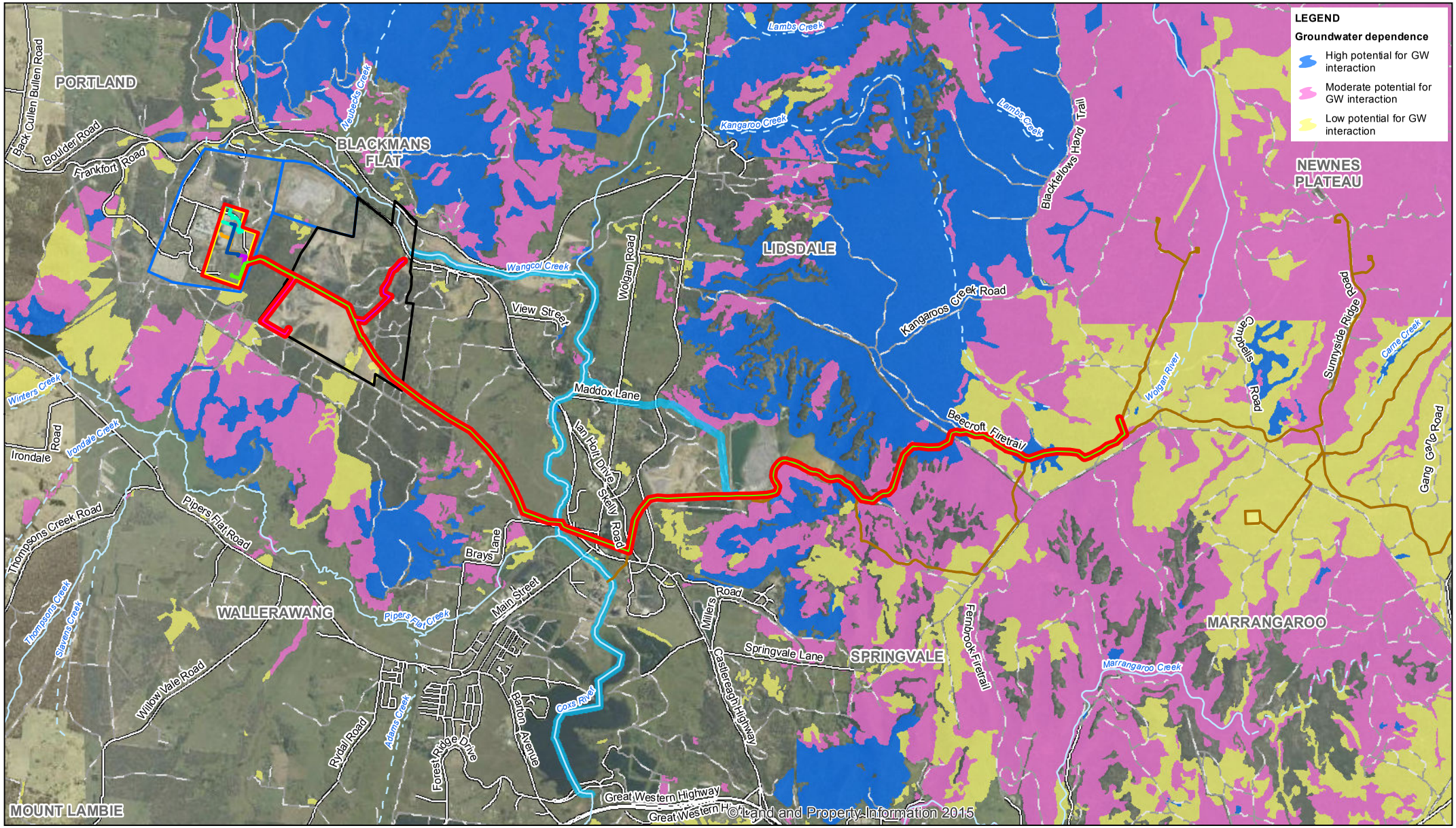
The National Water Commission reported that extensive gaps exist in our knowledge of the distribution, composition and biodiversity value of Australian stygofauna (Richardson *et al.*, 2011). Despite this incomplete inventory it is apparent that stygofauna are present across a variety of Australian subsurface environments and are generally characterised by high diversity and local-scale endemicity.

In NSW there are currently more than 360 taxa that have been collected from approximately 60% of the known cavernous karst systems. Available information on the distribution of stygofauna within NSW aquifers is both sparse and scattered and the need for further work, particularly in the shallow unconsolidated aquifers, has been identified (Serov *et al*., 2012). In NSW, stygofauna have been collected mostly from alluvial aquifers, particularly aquifers with coarse sediments, shallow water tables and low EC (Hancock and Boulton, 2008).

One coal mining area that has a longer history of stygofauna sampling is the Hunter Valley in NSW, where surveys of alluvial aquifers were conducted between 2000 and 2008. Surveys of the groundwater/surface water interface along the Hunter River between Singleton and Glenbawn Dam from 2000 and 2003 found a diverse community of stygofauna (Hancock, 2004).

A follow-up project was carried out from 2004 to 2008 and surveyed groundwater monitoring bores in agricultural areas and on several mine sites of the upper Hunter Valley (Hancock and Boulton, 2008). The latter work found at least 40 taxa new to science (this number is likely to increase since not all specimens have yet been identified to species) and confirmed that stygofauna can exist in areas dominated by coal mining.

Recent stygofauna surveys in Gunnedah and Bengalla (ELA, 2011; ELA, 2013), located in the NSW coalfields which are located within approximately 300 km of the PAA, also support that these areas of NSW can support stygofauna. Six stygofauna taxa were collected from the Bengalla study area.



Paper Size A4

0 0.275 0.55 1.1 1.65 2.2

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Project application area
- Proposed water treatment site
- Springvale Coal Services Development Consent
- Mount Piper Power Station
- Brine transfer pipeline
- Crystallised salt transfer pipelines
- Proposed raw water transfer pipeline
- Residuals transfer pipeline
- Treated water pipeline
- Treated water pipeline to cooling tower forebay
- Existing and approved SDWTS
- Road
- Vehicular track
- Watercourse - Non Perennial
- Watercourse - Perennial

Centennial Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Groundwater dependence

Figure 7-1

G:\22\0105001\GIS\Maps\Deliverables\Western\Springvale\2125109\AquaticEcology\2125109_AE009_GroundwaterDependence_0.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB/Imagery, 2012, 2015. Created by: tmorton, kpsroba

7.2.2 Stygofauna in the regional area

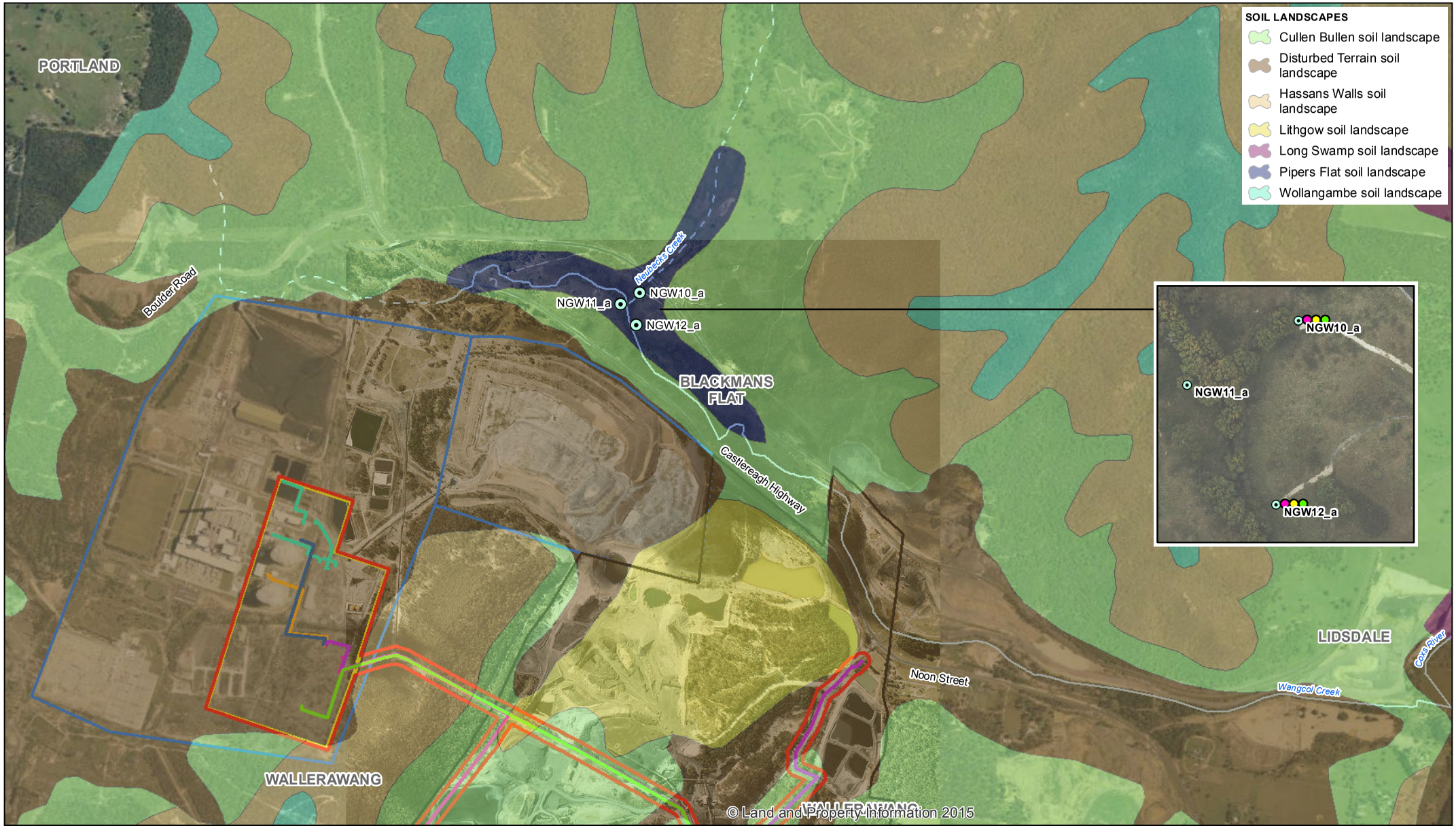
Stygofauna communities have been observed within the groundwater environments associated with the Springvale Mine and Angus Place Colliery (MPR, 2012b; Cardno, 2013b; Cardno, 2013c). The studies revealed the following:

- The pilot survey conducted at Angus Place Colliery (MPR, 2012b; Cardno, 2013b) was undertaken in May 2012 targeting the shallow groundwater below individual swamps and near-surface aquifer in the Banks Wall Sandstone below the PAA. Cardno (2013b) determined that stygofauna were patchy. Two likely stygofauna taxa were collected from the eight bores sampled.
- The pilot survey was conducted at Springvale Mine (MPR, 2012b; Cardno, 2013c) in May 2012. A total of 17 bores were sampled for stygofauna. Cardno (2013c) determined that the occurrence of invertebrates was patchy. Four likely stygofauna were collected from the 17 bores.
- MPR (unpublished data 2012) found five possible stygofauna taxa from eight of the 12 bores sampled within the vicinity of the proposed Neubeck Coal Project.

7.2.3 Stygofauna in the vicinity of PAA

Results of the monitoring program conducted by GHD (2014b) in relation to the Neubeck Coal Project are summarised below. Of particular significance to this assessment are the bores located in close proximity to Neubecks Creek and Wangcol Creek within the alluvial groundwater environment, where obligate stygofauna were collected. The sampled shallow alluvial bores, located in the vicinity of Wangcol Creek and Neubecks Creek, are shown in Figure 7-2.

Their presence in such close proximity to the PAA indicates the potential for stygofauna to be present in alluvial aquifers within the vicinity of the Project. However, these bores are up-gradient of the PAA. Furthermore, the alluvial groundwater environment has been identified as discontinuous along Wangcol Creek with soil mapping indicating no alluvial material past the confluence of Wangcol and Neubecks Creek (GHD, 2016). This is likely due to the high levels of disturbance in the PAA. This would be expected to limit the potential for stygofauna to be present within the PAA.



Paper Size A4

0 70 140 280 420 560 700

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Watercourse - Non Perennial
- Watercourse - Perennial
- Groundwater monitoring bore
- Recorded Stygofauna Spring 2013
- Recorded Stygofauna Autumn 2014
- Recorded Stygofauna Spring 2014

Centennial Coal
EA/CEY Water Treatment Project
Aquatic Ecology Impact Assessment

Job Number 21-25109
Revision 0
Date 12 Aug 2016

Location of groundwater monitoring bores

Figure 7-2

G:\22\0105001\GIS\Maps\Deliverables\Western\Springvale\2125109\AquaticEcology\2125109_AE010_StygoFauna_0.mxd

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Data source: LPI: DTDB/Imagery, 2012, 2015. Created by: tmorton, kpsroba

8. Potential impacts on aquatic ecology

8.1 Scale of assessment

Based on results of water and salt balance modelling undertaken as part of the WRIA (GHD, 2016), the Project is predicted to likely have a varying degree of influence on the aquatic environment at different scales. The highest potential for influence from the Project will be as a result of the potential releases into Wangcol Creek in the event that transferred water is not recycled within MPPS.

Influences of the Project are likely to also occur on the Sawyers Swamp Creek catchment and generally the Coxs River downstream of the confluence with each of these waterways.

The potential influences to these creeks (including the Coxs River between the Wangcol Creek confluence and Lake Wallace) are classified as localised impacts. The influences of the Project on the Coxs River, between Lake Wallace and Lake Burragorang are classified as regional impacts.

8.2 Impacts to water resources

The impacts to aquatic ecology have been characterised through the potential impacts to water resources. This has been assessed against the Projects potential for:

- Hydrological change to waterways downstream of the Project.
- Changes to surface water quality of waterways downstream of the Project.
- Potential impacts to regional waterways.

8.2.1 Changes to hydrology and hydraulics

Wangcol Creek and Coxs River downstream of Wangcol Creek confluence

The Project will result in new intermittent discharges of up to 32 ML/day into Wangcol Creek (GHD, 2016). Discharges from the new discharge point, adjacent to the existing LDP006 at SCSS, will occur in the event that all water transferred to the WTP is not reused as part of cooling water demands at MPPS. Demands at MPPS typically vary with power generation which currently has a diurnal cycle. Historically the power station has required at least 30 ML/day for cooling water. As the proposed transfers from the SDWTS are predicted to vary between 17 ML/day to 36 ML/day and currently average 24 ML/day, a discharge of any significant volume to Wangcol Creek is only likely to occur during a period of WTP maintenance or power plant shut down. Previously, shut-down periods have lasted only 1-2 days. The Project proposes not to discharge untreated water to Wangcol Creek and proposes to maintain emergency storage volumes in the event of any unforeseen circumstance which may lead to the shutting down of the WTP (GHD, 2016).

Wangcol Creek is not considered a high value waterway in terms of fish populations and generally supports a pollution-tolerant macroinvertebrate community that has demonstrated high variability in community condition (based on richness, EPT richness and SIGNAL-2) between sampling events (see section 6.5). This variability in the macroinvertebrate community has been observed both upstream of LDP006 discharges which suggests that environmental conditions are naturally variable within this system and that the macroinvertebrate community responds to these changes. The current macroinvertebrate community in Wangcol Creek is characteristic of the poor habitat, intermittent flows and poor water quality (e.g. elevated salinity) of Wangcol Creek. The current flow regime in Wangcol Creek includes an estimated baseflow contribution of 1.2 ML/day through groundwater inputs associated with recharging underground mining

voids. Based on a Wangcol Creek flow volume and level gauging station (212055), between 1991 and 2010, Wangcol Creek had been dry only sporadically, however since 2010 water in the creek has been maintained (GHD, 2016).

Flow volume data provided from the gauge site suggests that significant flow events have occurred within Wangcol Creek with magnitudes of more than 300 ML/day in the order of 10 times between 1991 and 2015. Less significant flow events (less than 50 ML/day) have occurred more regularly between 1991 and 2015. The WRIA (GHD, 2016) considered the potential effect of a 'worst case' discharge event of 32 ML/day on hydrology and hydraulics within Wangcol Creek. The outcome from these assessments indicated that the likely change in water level in Wangcol Creek as a result of a 'dry day' discharge of 32 ML/day is likely to change the depth of water within the creek from 0.1 to 0.2 metres. This corresponded to a velocity increase of between 0.5 to 1.0 m/s within the creek. In the event of a design rainfall event such as a 1-year Average Recurrence Interval (ARI) event, the influence of discharges decreases further with the proposed 'worst case' discharge being 1.1% of the total flow rate produced within the creek in that event. Further assessment and presentation of gauge data is provided in the WRIA (GHD, 2016).

MPR (2016) reported that a 9-day rainfall event of approximately 46 mm (based on the BOM Lidsdale gauge) in the lead up to the spring 2015 aquatic ecology sampling resulted in flows of approximately 25.6 ML/day at the Wangcol Creek NOW gauge, located upstream of LDP006. With the addition of LDP006 discharge volume, this would have resulted in flows of greater than 25 ML/day downstream of LDP006 which is approaching the proposed maximum discharge rate of 32 ML/day. Macroinvertebrate diversity (taxa richness) following this flow event was reportedly lower at WC2 located downstream of LDP006, when compared to the autumn 2015 event (14 taxa compared to 17 taxa observed in autumn). However, macroinvertebrate sensitivity (SIGNAL-2) at WC2 in spring 2015 was found to be higher than in autumn 2015 and higher than the average calculated over 11 sampling events (MPR, 2016). A corresponding reduction in EC (was observed by MPR in spring 2015 compared to autumn 2015 (from 1,468 to 951 µS/cm), which is likely to be linked to the increased macroinvertebrate sensitivity. This result demonstrates that the proposed maximum discharge rate of 32 ML/day is within the natural experience of the macroinvertebrate community in Wangcol Creek, and although some changes to community composition may occur as a result of such occasional high flow events, impacts to diversity, if they occur, would likely be minor. There is also the potential for improvements to the macroinvertebrate community as a result of the proposed discharges through improved water quality as indicated by the increase in SIGNAL-2 observed in spring 2015.

The geomorphology review of the proposed discharges, as part of the WRIA (GHD, 2016), has suggested that whilst the predicted velocity is below erosion thresholds, it is likely that potential channel adjustment risks will arise with a higher discharge rate maintained over long durations at or close to the maximum proposed discharge rate. However, discharges to Wangcol Creek as a result of the Project will vary daily to seasonally depending on power demands, with discharges on average being much less than the 'worst case' discharge rate. Given this, widespread and systemic channel adjustment along Wangcol Creek downstream of the existing LDP006 is not expected to occur as a result of the Project (GHD, 2016). It is more probable that isolated localised erosion of toe banks may occur depending on the local channel morphology and existing vegetation associations at any point along the creek. Given that erosive processes respond differently dependent on exposure time, the consideration of duration of a 'worse case' was considered. The likelihood of a 'worst case' discharge extending for any significant period of time is low due to the management mechanisms that are to be considered in the overall design of the WTP.

Based on the geomorphology assessment, it is unlikely that the physical characteristics of Wangcol Creek such as substrate type, channel shape and presence of undercut banks will be altered. Therefore, impacts to macroinvertebrates and fish through reduction in instream habitat is not expected as a result of the Project. It is possible that there will be small-scale, temporary changes in velocity-based micro-habitat such as edge or riffle through increased flows during periods of reduced power requirement. However, although specific patches of micro-habitat may be altered in nature i.e. increased water level in previously shallow sections, there is not expected to be any loss of these micro-habitats across the Wangcol Creek system. Therefore, no loss of macroinvertebrate diversity is expected to occur within Wangcol Creek as a result of the changes to the flow regime.

Mountain Galaxias are the only native species observed in Wangcol Creek across the MPR and GHD surveys. Mountain Galaxias have been found to have wide habitat preferences, having been observed within fast-flowing and slower flowing systems. This has been demonstrated by the widespread observation of this species across sites in Neubecks Creek, Coxs River and Wangcol Creek despite vast differences in water availability and flow regime. Therefore, the proposed intermittent discharges into Wangcol Creek are highly unlikely to reduce the distribution of Mountain Galaxias in Wangcol Creek. The additional flows contributed by the proposed discharge is likely to increase fish habitat, if anything, within Wangcol Creek.

The invasive Gambusia have already been recorded in Wangcol Creek and Coxs River and, therefore, there is no risk of this species spreading as a result of the Project. There is a possibility that if flow velocity is increased due to the new discharges, Gambusia may move out Wangcol Creek as they are preferential of ponded water. The temporarily increased flows contributed to Wangcol Creek by the new discharge is not likely to be of a scale that would promote the spread of the introduced Brown Trout upstream into Wangcol Creek, however, there is the possibility of this species to move further upstream in Coxs River. Brown Trout were not observed, in the GHD or MPR studies conducted between 2012 and 2015, further upstream than CR4.

Given the larger volume of water in Coxs River the fluctuations in flow from the proposed discharge point are unlikely to be of a magnitude that would influence the instream ecology of the Coxs River. The Coxs River, at the confluence of Wangcol Creek, is characterised by a lake-like environment created by the past capture of the river into the open cut pit voids of an abandoned Commonwealth Mine. The velocity of water entering the Coxs River from Wangcol Creek would be buffered by the large waterbody located at the confluence.

Given the low frequency of discharges expected, there are not expected to be impacts to the aquatic ecology of Wangcol Creek and the Coxs River as a result of the altered flow regime as a result of the Proposed discharges. The response of the aquatic communities in Wangcol Creek and Coxs River will be monitored as part of the existing aquatic ecology monitoring programs at SCSS, the aim being to determine a discharge and response relationship in order to refine future management of discharge volume.

Sawyers Swamp Creek

The habitat conditions within Sawyers Swamp Creek vary significantly due to the presence of infrastructure and emplacement area. This has resulted in multiple realignments along Sawyers Swamp Creek which not only degrade habitat and riparian vegetation quality, but also increase flow velocities within areas with engineered channel. No fish have been observed within Sawyers Swamp Creek and macroinvertebrate diversity was very low to moderate. The Project proposes to cease LDP009 discharges into Sawyers Swamp Creek. The cessation of discharges to Sawyers Swamp Creek will result in a reduction in water availability and, thus, instream habitat which will likely result in a decline of the macroinvertebrate population during dry periods. However, as this system is naturally ephemeral, the removal of discharges is

considered to be a return towards the natural flow regime and, thus, an acceptable outcome of the Project.

Coxs River, downstream of Sawyers Swamp Creek

At present the Coxs River, receives flows from Sawyers Swamp Creek via discharges from LDP009 of approximately 20 to 25 ML/day. The Project will lead to the cessation of these flows. Macroinvertebrate community condition is improved in Coxs River downstream of the Sawyers Swamp Creek confluence, compared to some sites upstream. However, this is considered to be due to improvements in habitat and riparian vegetation rather than increased water availability. Further, the Coxs River is a perennial river and the cessation of LDP009 discharges will not alter this status. Therefore, the cessation of LDP009 is not expected to impact on the aquatic ecology of Coxs River through changes to hydrology.

It is unlikely that flow rate effects (such as velocity, water depth) will be observed downstream of Lake Wallace of a magnitude that would influence aquatic ecology. This is due to the regulation that not only Lake Wallace provides but also Lake Lyell. This regulation allows for the controlled capture and release of water within specific thresholds defined as part of their function, defined within the respective management licences. This influencing factor is more significant at Lake Lyell with transfers to MPPS to supplement cooling water demands as required.

8.2.2 Changes to water quality

Proposed discharge quality

The new LDP for the Project is proposed to be located on the Lamberts Gully draining to Wangcol Creek. The recommended volumetric discharge limit for the proposed LDP is 32 ML/day, which is based on the maximum discharge specification for the WTP. The recommended water quality limits are provided in the Water Resources Impact Assessment (GHD, 2016) and will be consistent with both consent conditions of SSD-5594 and the recommended guideline values determined as part of the assessment. The recommended guideline values for the Project are provided in Table 8-1.

Table 8-1 Recommended guideline values for the Project to protect the aquatic ecosystem

Parameter	ANZECC (2000) guideline value Units are mg/L unless otherwise specified	SW1 80th percentile values Units are mg/L unless otherwise specified	Additional information for ANZECC (2000) guideline values
Physicochemical parameters			
pH	**6.5–8.0 pH units**	6.4*–7.1 pH units	Recommended site specific guideline value 20th – 80th percentile range. NSW upland river (Table 8.2.8).
Electrical conductivity (EC)	**350 µS/cm (500 µS/cm as per consent conditions of SSD-5594)**	100 µS/cm	NSW upland river (Table 8.2.9).
Total suspended solids (TSS)	**25**	12	NSW upland river (Table 8.2.12).

Parameter	ANZECC (2000) guideline value	SW1 80th percentile values	Additional information for ANZECC (2000) guideline values
	Units are mg/L unless otherwise specified		
Turbidity	25 NTU	**35 NTU**	NSW upland river (Table 8.2.11).
Nutrients			
Ammonia	**0.9**	0.01^	Guideline value for TN in upland rivers (Table 3.3.2) used in place of ammonia guideline values.
Total nitrogen (TN)	0.25	**0.5**	Upland river (Table 3.3.2).
Total phosphorus (TP)	**0.02**	0.01^	
Filterable/dissolved metals			
Aluminium	0.055	**0.24**	Freshwater guideline for 95% species protection (Table 3.4.1). Applies for pH>6.5.
Antimony	–	**0.001^**	No ANZECC guidelines available. ADWG (NHMRC 2016) health guideline value used.
Arsenic	**0.024**	0.001^	Freshwater guideline for 95% species protection for As(V) (Table 3.4.1).
Barium	–	**0.047**	No ANZECC guidelines available.
Boron	**0.37**	0.05^	Freshwater guideline for 95% species protection (Table 3.4.1).
Cadmium	**0.0026**[b]	0.0001^	[a] Freshwater guideline for 95% species protection (Table 3.4.1). [b] Modified for hard water.
Chromium	0.001	–	Freshwater guideline for 95% species protection (Table 3.4.1).
Cobalt	**0.0025**	–	Canadian guideline as recommended by ANZECC (2000a) (Section 8.3.7.1).
Copper	0.0014	**0.004**	Freshwater guideline for 95% species protection (Table 3.4.1).
Iron	0.3	**0.31**	Canadian guideline as recommended by ANZECC (2000a) (Section 8.3.7.1).
Lead	**0.129**	0.001^	[a] Freshwater guideline for 95% species protection (Table 3.4.1). [b] Modified for hard water.
Manganese	**1.9**	0.150	Freshwater guideline for 95% species protection (Table 3.4.1).
Mercury	**0.0006**	0.0001^	
Molybdenum	–	**0.001^**	No ANZECC guidelines available.

Parameter	ANZECC (2000) guideline value	SW1 80th percentile values	Additional information for ANZECC (2000) guideline values
	Units are mg/L unless otherwise specified		
Nickel	**0.125**	0.003	[a] Freshwater guideline for 95% species protection (Table 3.4.1). [b] Modified for hard water. [c] Guideline value for sites with soft water.
Zinc	**0.091**	0.032	[a] Freshwater guideline value for 95% species protection (Table 3.4.1). [b] Modified for hard water.

Bold text indicates the derived trigger value.

– = Indicates insufficient or no data.

[a] Freshwater guideline for 95% species protection (Table 3.4.1) default guideline values already modified for soft water (total hardness 30 mg/L).

[b] Modified for hard water (total hardness 525 mg/L) using Wangcol D/S 50th percentile concentrations as this produced more stringent values, sites assessed against hard water were Wangcol D/S, Wangcol far D/S and LDP006.

c Derived dissolved nickel guideline value for sites with water hardness categorised as soft (< 30 mg/L).

It must be noted that the water quality limits proposed as part of this Project are not applicable to discharges currently undertaken at LDP006 as part of the EPL 3607.

Treatment Technology

The WTP to be developed as part of the Project will utilise a reverse osmosis technology to reduce conductivity and improve overall water quality. In such an effective treatment, there exists the possibility that the treated discharge (if discharged to Wangcol Creek) will be stripped of trace elements and nutrients required for aquatic flora and fauna. As part of the design intent of the treatment plant, the operation of the plant will be such that within the process cycle treated and untreated water will be mixed to achieve a water quality that both meets developed criteria but also mitigates potential toxicity to the receiving environment.

The discharges from LDP006, adjacent to the LDP proposed as part of the Project, somewhat mitigates potential toxicity from 'too clean' water also, however, mixing would occur within Lamberts Gully and its confluence with Wangcol Creek.

The quantification of the resulting water quality from the WTP is to be determined as part of commissioning phases.

As part of the commissioning stage of the WTP, the confirmation of water quality treatment performance will be evaluated along with toxicology testing and the review operational conditions. Much of this stage will be utilised in the development of a final EPL for the Project.

Wangcol Creek and Coxs River downstream of Wangcol Creek confluence

GHD (2016) identified that the LDP006 discharge currently exceeds ecosystem protection guidelines (predominantly due to high EC) and therefore this discharge will have the potential to impact on Wangcol Creek compared to the objectives of the Project. Outcomes from seasonal monitoring suggests that the macroinvertebrate community downstream from LDP006 has been negatively impacted by the SCSS discharge and surrounding land-use historically. As part of the

Western Coal Services Project, SCSS is currently investigating current surface and groundwater quality conditions from the operations.

The Project proposes to discharge periodically into Wangcol Creek. Although the volume and duration of discharges will potentially vary with power generation at MPPS, in the event that discharges do occur, the predicted water quality of the new WTP discharge will be improved when compared to the current LDP006 discharge. Water discharges from the proposed LDP is likely to ameliorate the current influence of LDP006 with improvements predicted in EC above discharges of 2 ML/day. In the event of a large discharge (that is greater than or equal to 30 ML/day) an improvement is predicted for the entire length of Wangcol Creek. Therefore, the Project is likely to improve the condition of aquatic ecology in Wangcol Creek through improvements to water quality, during periods of discharge. These improvements to water quality would be expected to positively influence the aquatic ecology of Wangcol Creek. As previously discussed, the macroinvertebrate community of Wangcol Creek has been previously observed to exhibit improvements in response to reduced EC following rainfall events.

Due to the creation of waste streams from the WTP, in events where no discharge from the Proposed LDP occurs (that is, complete uptake of WTP water by MPPS), Wangcol Creek may be subject to a slight worsening of water quality (elevated EC) compared to existing conditions through increased discharges from LDP006 (GHD, 2016) as a result of residual transfers. Therefore, the aquatic ecology of Wangcol Creek may potentially be impacted downstream of the discharge point during these periods. However, as has been discussed, the aquatic ecology within this system is largely comprised of tolerant taxa which are accustomed to high EC.

As stated previously, there is a possibility that 'worse case' flow events may induce isolated erosive processes leading to an increased sedimentation risk in Wangcol Creek (GHD, 2016). If this is the case, it is likely that increased total suspended solids (TSS) and turbidity may result. Current turbidity levels and TSS concentrations generally meet ANZECC (2000) guideline values in both Wangcol Creek and in the LDP006 discharge. As such, an increase in these parameters due to increased erosion may pose a risk to aquatic ecological values. The potential risk can be effectively mitigated through monitoring and management response plans as detailed in section 11 and the WRIA (GHD, 2016).

Given the larger volume of water in the Coxs River, changes to water quality as the result of the Project are not expected to be of a scale that would negatively impact on the aquatic ecology of the Coxs River downstream of the confluence with Wangcol Creek.

Sawyers Swamp Creek

Removal of LDP009 discharge is likely to have a positive improvement on water quality of Sawyers Swamp Creek. Macroinvertebrate monitoring carried out upstream and downstream from LDP009 indicates that the condition of the macroinvertebrate community is impaired and this may be due to the discharge of mine water with a median EC of 1,170 µS/cm which makes up majority of the water volume at this site. It is expected that macroinvertebrate community health will be improved through the removal of this high EC water, although water availability is likely to limit diversity in this naturally ephemeral system.

Coxs River, downstream of Sawyers Swamp Creek

Cessation of discharges from LDP009 discharge will have positive improvement on water quality of Sawyers Swamp Creek and consequentially Coxs River downstream of the Sawyers Swamp confluence. The WRIA (GHD, 2016) predicted improvements in water quality of the Coxs River from the confluence of Sawyers Swamp Creek, as far downstream as Lake Burragorang based on the scenario of 50% power generation. As part of the WRIA (GHD, 2016), it was demonstrated that projected water quality improvements and reduction of pollution loads are predicted to occur in Coxs River downstream of the Sawyers Swamp Creek

confluence as far downstream as Lake Burragorang. Water quality improvements are expected through reductions in loads of salt and other pollutants. At present, the Coxs River, downstream from Wangcol Creek and Sawyers Swamp Creeks is influenced by elevated EC and this seems to be negatively influencing aquatic ecology in this area. The improvement in water quality is expected to result in improvements in aquatic ecology within the Coxs River downstream of the confluence with Sawyers Swamp Creek.

8.2.3 Impacts to regional waterways

Regional waterways (more so the lower portion of Coxs River) are in better condition in terms of riparian vegetation and waterway condition, compared with those subject to potential impacts from land-use, industry and development.

Proposed discharges from the WTP, if they are required, are likely to have a minimal influence on flow regime within the lower portion of the Coxs River due to the regulating effect of Lake Wallace and Lake Lyell. Operational variation, as a result of power generation, in discharge volume and frequency from the WTP is unlikely to influence this outcome.

Water quality improvements are expected as a result of the Project as far downstream as Lake Burragorang (GHD, 2016). This will largely be achieved through cessation of LDP009 discharges to Sawyers Swamp Creek. This is likely to have a positive influence on the aquatic ecology of the wider catchment to the extent that water quality improvements are observed.

8.3 Impacts on state and national listed biota

The Project is unlikely to impose a significant impact on any threatened fauna or flora species listed under the EPBC Act, TSC Act or the FM Act.

8.4 Key threatening processes

The Project has the potential to contribute to the following KTPs listed under the FM Act and TSC Act due to the alteration to natural flow regimes in Wangcol Creek and Coxs River:

1. Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams.
2. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.

The impact that the Project will have on these KTPs are likely to be minimal as discussed within Section 8.2.1 of this report and the WRIA (GHD, 2016).

8.4.1 Conclusions

The Project is unlikely to directly or indirectly result in a change to water hydrology or quality that that is of sufficient scale or intensity as to reduce the current or future utility of the water for aquatic ecology. It is likely that there will be some localised changes to macroinvertebrate and fish communities as a result of the new discharge into Wangcol Creek and the removal of discharges to Sawyers Swamp Creek. However, the Project is likely to be of benefit, overall, to the Coxs River as a result of improvements in water quality.

No threatened species or habitat for such species are expected to be impacted as a result of the Project.

9. Potential impacts on GDEs

9.1 Terrestrial GDEs

Surface and groundwater activities that alter environmental parameters of GDEs outside of any known natural range will have an adverse impact on the ecosystem and its value (Serov *et al.,* 2012). The *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (NOW, 2012a) within the NSW Groundwater Dependent Ecosystems Policy assesses changes to water quantity, quality, aquifer integrity and biological integrity to determine an overall risk assessment for the Project. In this case, the Project would not result in direct clearing of terrestrial GDEs (RPS, 2016) and changes to existing groundwater quality and/or level are not expected.

The Project is not predicted to have an impact on the recharge of groundwater systems in the PAA or downstream of the Project. The hydraulic connectivity between groundwater and surface waters is not predicted to be altered by the Project. The Project is not predicted to adversely affect the current water quality of the underlying groundwater system (GHD, 2016). Therefore, there is a low risk of impacts to GDEs as a result of the Project.

9.2 Subterranean GDEs

Stygofauna have been found within alluvial groundwater bores located upgradient of the PAA within the Neubeck Coal Project. However, the alluvial groundwater environment has been identified as discontinuous along Wangcol Creek with soil mapping, indicating no alluvial material past the confluence of Wangcol and Neubecks Creek. Therefore, there is limited potential for stygofauna to be present within the PAA.

The Project is unlikely to alter the connectivity and or groundwater conditions. No aquifer storage depletion (water table decline) is expected as a result of the Project. There will be no excavation below the water table. There will be no drawdown of groundwater as a result of the Project. There is not expected to be a change to existing groundwater quality as a result of the Project.

Therefore, even if stygofauna communities exist within the PAA, they are unlikely to be impacted by the Project.

9.3 Conclusion

It has been determined that there is limited potential for stygofauna to be present within the PAA. No changes to groundwater quality or groundwater hydrology are expected to occur as a result of the Project. Therefore, it is unlikely that any GDEs within the vicinity of the Project will be impacted as a result of the Project.

10. Cumulative impacts

The Project will operate within a region where various other projects operate. These are detailed in Section 3.6. The WRIA included a water quality assessment to determine the influence of the Project on water quality of the catchment (GHD, 2016). Improvements in water quality were predicted for the Coxs River as far downstream as Lake Burragorang based on the scenario of 50% power generation (GHD, 2016). Water quality improvements are expected to occur through reductions in loads of salt and other pollutants. The Project will also reduce the volume of mine water discharge into the Coxs River which will result in partial restoration of the natural flow regime. Furthermore, the Project will result in reductions in water extraction requirements of MPPS allowing for greater environmental flows to contribute back to the Coxs River. These predicted improvements in water quality are expected to result in improvements in the aquatic ecology of the Coxs River and the wider catchment.

Due to the creation of waste streams from the WTP, in events where no discharge from the Proposed LDP occurs (that is, complete uptake of WTP water by MPPS), Wangcol Creek may be subject to a slight worsening of water quality (elevated EC) compared to existing conditions through increased discharges from LDP006 (GHD, 2016) as a result of residual transfers. Therefore, the aquatic ecology of Wangcol Creek may potentially be impacted downstream of the discharge point during these periods. This small change in water quality is not expected to be measurable on a regional scale as volumes are minor comparative to benefits from cessation of LDP009 discharges of waterways downstream of Sawyers Swamp Creek.

The assessment of how other operations and Projects within the Coxs River catchment may influence or interact with the outcomes of this Project are discussed within the WRIA (GHD, 2016). Regional assessments have been considered as part of this Project utilising regional aquatic ecology monitoring programs already in place for Springvale Coal.

11. Avoidance, mitigation and management measures

11.1 General

The management of adverse effects arising from the Project has been presented according to the hierarchy of:

1. Avoidance.
2. Mitigation.
3. Offsetting of impacts.

Potential impacts of the Project on aquatic biota, GDEs and their habitats are associated with direct habitat loss (reduced water availability in Sawyers Swamp Creek) and changes to water quality or water quality variability and hydrology in Wangcol Creek (and Coxs River). Mitigation measures have been recommended in order to minimise impacts of the Project on aquatic biota within groundwater, adjacent surface watercourses and downstream environments.

11.2 Avoidance of impacts

Direct impacts to aquatic ecosystems resulting from the Project have been minimised by using the existing pipeline and infrastructure easements where possible. Direct disturbance to waterways has been limited to:

- The Lamberts Gully channel, which will need to be modified in order to construct the new discharge point adjacent to LDP006.
- The under drilling of Coxs River and localised impacts to low order waterways along the path of the pipeline.

Cessation of discharges from LDP009 will address potential water quality risks to Sawyers Swamp Creek and the upper Coxs River catchment.

11.3 Mitigation of impacts

Toxicity based protection limits will be established for water discharged from the proposed discharge point to ensure that the aquatic ecology of Wangcol Creek is protected. These concentration limits will be incorporated into the EPL for the Project and monitored through the Surface Water Monitoring Program (GHD, 2016).

The increased volume and velocity of water in Wangcol Creek has potential to create isolated erosive processes within Wangcol Creek and, as a result, increase turbidity of the water. Elevated turbidity above natural levels may impact on aquatic fauna and flora. Visual inspections of watercourse stability will be undertaken following commencement of discharges, as outlined in the WRIA (GHD, 2016). Water quality, including TSS and turbidity will continue to be monitored under the existing Surface Water Monitoring Program (GHD, 2016). Review of results from this monitoring program will provide an early warning if TSS and/or turbidity of Wangcol Creek increases as a result of the proposed discharges.

Given the elevated concentrations of some pollutants in the existing LDP006 discharge, there is a potential opportunity to improve the overall water quality of Wangcol Creek through dilution using water treated from the proposed WTP.

11.4 Management of impacts

11.4.1 Monitoring

Water quality

Water quality of Wangcol Creek and Coxs River will be monitored through existing Springvale Coal and EnergyAustralia Surface Water Monitoring Programs as detailed in the WRIA (GHD, 2016). Water quality of the WTP discharge will be compared against EPL concentration limits to ensure protection of instream ecology.

Macroinvertebrates

Macroinvertebrate monitoring will be conducted in Wangcol Creek and Coxs River biannually (autumn and spring) for two years following commencement of initial discharge from the new discharge point into Wangcol Creek. The requirement for ongoing macroinvertebrate monitoring beyond this point will be determined depending on the frequency and volume of discharges from the new discharge point over that two-year period and the outcomes of aquatic ecology and water quality monitoring.

The monitoring program seeks to capture the monitoring of the following Project components:

- Wangcol Creek upstream of the proposed discharge.
- Wangcol Creek downstream of the proposed discharge.
- Coxs River upstream of Kangaroo Creek (Angus Place discharges).
- Coxs River downstream of Kangaroo Creek, upstream of Wangcol Creek confluence.
- Coxs River downstream of Wangcol Creek confluence (LDP006 and new discharges), upstream of Sawyers Swamp Creek confluence.
- Coxs River downstream of Sawyers Swamp Creek confluence (LDP009 discharges).

Where possible, previously sampled monitoring sites (such as those specified in Table 6-1) should be resampled following commencement of discharges to allow for comparison to baseline data available for these waterways. Monitoring will include a visual habitat assessment and general assessment of riparian vegetation condition. The macroinvertebrate information collected will be reviewed in conjunction with environmental information such as rainfall, discharge volumes and water quality. Depending on results of the local scale survey, it may be relevant to obtain further data from WaterNSW for regional sites and compare to baseline data provided in this document.

The cessation of discharges to Sawyers Swamp Creek will result in a reduction in water availability and, thus, instream habitat which will likely result in a decline of the macroinvertebrate population during dry periods. However, as this system is naturally ephemeral, the removal of discharges is considered to be a return towards the natural flow regime and, thus, an acceptable outcome of the Project. It is recommended that the macroinvertebrate community of Sawyers Swamp Creek be monitored biannually (autumn and spring) for two years following cessation of discharges to ensure that there are no unintended consequences of the Project on the macroinvertebrate community.

A typical assessment criteria or trigger that can be applied within monitoring program is:

- No change (or improvement) in macroinvertebrate metrics (i.e. taxa richness, EPT richness, SIGNAL-2) between baseline and post-discharge event, beyond natural variation at reference sites.

Fish

Fish monitoring and fish habitat assessment will be conducted annually for two years following commencement of initial discharge from the new discharge point into Wangcol Creek. This monitoring will focus on sites which were classified as having Class 1 (major) or Class 2 (moderate) fish habitat (Fairfull and Witheridge, 2003). The fish assessment will include examination of species composition and abundance classes and the presence of invasive species.

A typical assessment criteria or trigger that can be applied to monitoring programs is:

- No change (or improvement) in the distribution of fish species within impacted waterways between baseline and post-discharge events.

GDEs

Impacts to groundwater dependent vegetation is not expected as a result of the changes to surface water quality and hydrology associated with the Project. Therefore, a groundwater dependent vegetation assessment is not considered to be necessary as part of the ongoing monitoring. Impacts to vegetation due to physical disturbance and associated monitoring requirements are discussed in the Biodiversity Assessment Report (RPS, 2016).

Impacts to groundwater dependent fauna (e.g. stygofauna) as a result of the Project would be expected only if there is a change to groundwater quality or groundwater level within alluvial sources. These changes are not predicted to occur as a result of the Project. However, the risk of potential impacts to groundwater dependent fauna will be managed via the existing Springvale Coal and EneryAustralia groundwater monitoring programs as detailed in the WRIA (GHD, 2016).

11.5 Offsetting of impacts

Given the above consideration of potential impacts and proposed mitigation measures, it is considered unlikely that the Project would result in any significant impacts to native aquatic flora and fauna or their habitats or overall aquatic biodiversity values in the locality. As such, no specific offset is considered necessary to compensate for proposed impacts to aquatic habitats, flora or fauna as a result of the Project.

12. Conclusion

12.1 Methodology

The scope of the current investigation included a review of relevant available literature, background information and searches of wildlife databases as well as aquatic field surveys and data analysis to assess the existing character of the watercourses within the Impact Assessment Area and the potential impacts of the Project on aquatic biodiversity values and in particular, threatened fauna species and their habitats. Threatened species listed under the TSC Act, FM Act and the EPBC Act including fish, plant and macroinvertebrate species as likely to occur in the PAA were considered. The existing environment was established via a desktop assessment given that long-term aquatic ecology monitoring has been carried out at relevant sites on the waterways that have the potential to be impacted by the Project.

The impact assessment considered the following:

- Desktop literature review (including relevant database searches).
- Aquatic habitat assessment.
- Water quality assessment.
- Groundwater quality assessment.
- AUSRIVAS macroinvertebrate sampling.
- Fish sampling.
- Stygofauna sampling.
- Riparian vegetation surveys.

12.2 Summary of key findings

Instream habitat at the sites included in the assessment ranged from low to moderate ecological value. Most sites in the IAA had relatively low macroinvertebrate diversity, dominated by pollution-tolerant taxa. Few native fish were recorded which is to be expected given the competition from exotic noxious species, numerous fish barriers within the system and the low stream order. The existing and ongoing anthropogenic impacts of land use and its influences on riparian and aquatic vegetation, water quality, quantity and flow regime and impacts of invasive fauna remain the key constraints to aquatic ecosystems of the area.

Wangcol Creek is a highly modified fourth order stream located to the north of MPPS and SCSS. This creek has been previously diverted and modified and the riparian zone is in poor condition. Approximately 1.29 ML/day of mine water currently discharges via LDP006 to a small drainage channel known as Lamberts Gully which flows into Wangcol Creek. It is proposed that a new discharge point be constructed adjacent to LDP006 and within the channel of Lamberts Gully. The operation of the discharge point will be required in the event that treated water is not completely reused by MPPS. The water quality of the new discharge will be representative of the background catchment which will be protective and improve aquatic ecology within Wangcol Creek and waterways downstream.

The predicted water quality of discharges from the WTP will be of an improved nature, however, the intermittent nature of the discharges may in themselves represent a source of disturbance for aquatic ecology of Wangcol Creek. The impact that the variable flows into Wangcol Creek will have on aquatic flora and fauna currently inhabiting instream habitats downstream of the proposed discharge will depend on the magnitude and duration of flows. The majority of the

macroinvertebrate families and fish observed in Wangcol Creek are pollution-tolerant. Further, the small order streams in the vicinity of the PAA are ephemeral and, therefore accustomed to fluctuations in flow. Historic monitoring within Wangcol Creek has indicated that the maximum discharge rate of 32 ML/day is of a similar magnitude to natural flow events experienced in the system and the aquatic ecology community has not been strongly impacted as a result. Therefore, the aquatic ecology communities of Wangcol Creek are expected to be robust against the changeable nature of the proposed discharges and the maximum flow rate proposed, given that discharges are expected to be infrequent. The buffering capacity of the WTP considered within its design will seek to mitigate the severity of operational changes.

Water quality of the upper Coxs River sub-catchment is strongly influenced due to the current mine discharge quality and volume. The Coxs River sub-catchment forms part of the Hawkesbury/Nepean catchment which is within the Sydney drinking water catchment. Currently, an average of approximately 20 to 25 ML/day of flocculated water is currently discharged from Springvale Mine and Angus Place Colliery into Sawyers Swamp Creek, which flows into the Coxs River. Sawyers Swamp Creek currently supports a relatively degraded macroinvertebrate community, due to the LDP009 discharge, amongst other disturbances. There is the potential for short-term impacts to the aquatic ecology of Sawyers Swamp Creek due to the cessation of discharges from LDP009 and the resultant reduction of the water, and thus habitat, within the creek. However, given the impaired quality of current discharges into this creek, and the improvements to aquatic ecology of the wider catchment that would result from the Project, the short-term impacts to Sawyers Swamp Creek are considered to be acceptable. Further, the cessation of mine water discharge into Sawyers Swamp Creek represents a return to the natural flow regime of this system. Improvements to water quality in Sawyers Swamp Creek are expected following cessation of LDP009 discharges and this is likely to result in improvements in macroinvertebrate community health.

The Coxs River supports a moderate to high diversity of macroinvertebrates and has the potential to support a range of fish species, based on habitat assessments. However, diversity is currently limited compared to reference streams due to poor water quality in the catchment, particularly high EC. Water modelling indicates that the Project will result in a benefit in water quality, particularly reduced EC, for the Coxs River at the confluence with the Sawyers Swamp Creek (GHD, 2016) and further downstream. The cessation of untreated mine discharge from LDP009 provides an opportunity for improvements to the aquatic ecology of the Coxs River catchment through improvements to water quality.

12.2.1 Groundwater dependent ecosystems

Monitoring in the area indicated the potential for stygofauna to be present upgradient of the PAA. However, the Atlas of Groundwater Dependent Ecosystems identified limited or low potential for groundwater dependence within the PAA or IAA. There is unlikely to be changes to current groundwater quality of volumes as a result of the Project. Therefore, even if GDEs were present within the PAA, it is unlikely that they would be impacted by the Project.

12.2.2 Threatened species

A search of the *Protected Matters Search Tool* for MNES listed under the EPBC Act identified potential habitat may occur within the locality for three threatened fish, the Macquarie perch (endangered under both the FM Act and EPBC Act), the Murray cod (vulnerable under the EPBC Act) and the Australian grayling (vulnerable under the EPBC Act and protected under the FM Act). Given the habitat preferences of these species, the presence of large physical barriers to fish movement within the system and the lack of sightings within the IAA, these fish species are not expected to be present. There is the potential for the Macquarie Perch to be present

within the Regional Assessment Area although as this is greater than 100 km downstream of the PAA, impacts are not expected.

A BioNet Atlas search identified the potential for the presence of the endangered Giant Dragonfly, listed as Endangered under the TSC Act within 10 km of the PAA. There are two records of this species within 10 km of the Project, one within Ben Bullen State Forest and one within Newnes State Forest. There are no records of this species within the local waterways relevant to the Project. Based on the outcomes of the field surveys undertaken by MPR and GHD, habitat availability and the lack of sightings recorded in the Atlas, it is considered highly unlikely that the Giant Dragonfly occur within the IAA. Therefore, the Giant Dragonfly is unlikely to be impacted by the Project.

The threatened Blue Mountains Water Skink was identified as likely to occur within 10 km of the PAA. However, there are no records of this species in the IAA. Further, RPS (2016) have determined that there is no suitable habitat for these species within the PAA. Therefore, the Blue Mountains Water Skink is unlikely to be impacted by the Project.

On the basis of the assessments undertaken, it is concluded that the Project is unlikely to impose a significant impact on any threatened aquatic fauna species listed under the EPBC Act, TSC Act or the FM Act and therefore a species impact statement is not required for the Project.

12.2.3 Summary

No impacts to threatened species or GDEs are expected due to the Project. There will be potential impacts and benefits to the Coxs River catchment due to the Project. Cessation of LDP009 discharge into Sawyers Swamp Creek will benefit both Sawyers Swamp Creek and Coxs River through improvements to water quality and a return towards more natural flow regimes. There is the potential for localised impacts to the aquatic ecology of Wangcol Creek at times due to the proposed discharge. However, given that this system is already highly modified, the low volume and frequency of discharges predicted and the tolerant taxa that dominate this system, the potential impacts to Wangcol Creek are considered to be minor, given the potential for wider scale improvements to the aquatic ecology of the catchment.

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Appendix I Economic impact assessment

Springvale Water Treatment Project

Economic Impact Assessment

Springvale Coal Pty Ltd
EnergyAustralia NSW Pty Ltd

August 2016

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EXECUTIVE SUMMARY

- This Economic Assessment addresses a proposal by Springvale Coal and EnergyAustralia to develop the Springvale Water Treatment Project (SWTP). The Project will allow Springvale Coal to meet its regulatory obligations under its existing consent SSD-5594. Concurrently, it will allow EnergyAustralia to reuse mine water at Mount Piper Power Station (MPPS), permitting reduction in its demand on environmental water sources, and improving water quality in the Upper Coxs River catchment.
- This economic assessment has been prepared to comply to the greatest practicable extent with DPE's *Guidelines for the economic assessment of mining and coal seam gas proposals* (December 2015), in the context of the ancillary nature of the Project, and its comparatively limited scale.
- Broadly, the Project involves the development of infrastructure for the transfer of water from existing underground mine dewatering facilities at Springvale Mine, for industrial reuse at MPPS.
- There are two Project alternatives, being two optional routes for the pipeline component of the Project (Northern and Southern routes). The Applicant is proposing the Northern route as its preferred option. Quantitative assessment of the options, principally in the form of comparison of bio-banking credits, indicates that the Northern route will impose less notional cost on the community.
- Overall, the modified Cost-Benefit Analysis (CBA) indicates that the social, economic and environmental effects of the Project as assessed are likely to provide a modest benefit to the local economy, as a consequence of the limited duration of the construction stage and the likelihood of a largely non-resident workforce. The operations stage of the SWTP will also be of limited effect, as it represents the continuation of activity that is similar to the existing, and will generate no additional longer-term employment. Given the scale of capital investment, a short-term stimulus to the broader economy is also identified, as the goods and services required for the completion of the Project are produced and procured.
- Local Effects Analysis (LEA) indicates that the Project can be considered as consistent with local and regional economic interests and environmental outcomes. The SWTP will not place unmanageable demands on local infrastructure and services. Existing localised environmental/biophysical, public infrastructure and amenity effects and features are similar to those for the Project as proposed, and thus the Project will have little cumulative impact, with the notable exception of improvements to water resources in the catchment.
- As the Project entails capital investment to meet regulatory compliance obligations and its construction and operational stages are likely to result in beneficial social, economic and environmental outcomes, SWTP is suitable for approval, development and operation.

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ABBREVIATIONS

ABS:	Australian Bureau of Statistics
BCR:	Benefit-Cost Ratio
CPI:	Consumer Price Index (ABS)
CBA:	Cost-Benefit Analysis
DPE:	Department of Planning and Environment (NSW)
EIS:	Environmental Impact Statement
EPA:	Environment Protection Authority
FTE:	Full Time Equivalent (employment)
GVA:	Gross Value Added
I/O:	Input/Output
LCC:	Lithgow City Council
LDP:	Licenced Discharge Point
LEA:	Local Effects Analysis
LGA:	Local Government Area
ML	Megalitre/s
MPPS:	Mount Piper Power Station
Mtpa:	Million tonnes per annum
NPV:	Net Present Value
PV:	Present value
SEARs:	Secretary's Environmental Assessment Requirements
SEPP:	State Environmental Planning Policy
SLA:	Statistical Local Area
SMEP:	Springvale Colliery Mine Extension Project
SSD:	State Significant Development
SWTP:	Springvale Water Treatment Project
tpa:	Tonnes per Annum
WPI:	Wage Price Index (ABS)

1. ECONOMIC ASSESSMENT: PURPOSE AND APPROACH

This economic impact assessment relates to a proposal to develop the Springvale Water Treatment Project (SWTP). The Project involves the transfer of water from existing underground mine dewatering facilities for industrial reuse at the Mount Piper Power Station (MPPS). The Project aims to improve environmental outcomes and water quality in the Upper Coxs River catchment.

The Project is State Significant Development under the *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP). The Applicant proposes to seek development consent for the Project under Part 4 Division 1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Secretary's Environmental Assessment Requirements (SEARs) issued 6 May 2016 for this project (the Project) require that the following specific issues be addressed:

- Water (surface and groundwater);
- Noise (construction-related and water treatment plant operating noise);
- Biodiversity;
- Land (specifically land use compatibility);
- Heritage (Aboriginal and historic)
- Transport (specifically construction-related traffic);
- Waste (specifically brine and sludge);
- Visual impacts;
- Air quality.

It is noted that the SEARs do not require a specific economic assessment. It is considered that this recognises that the Project will not have significant direct economic consequences in respect of the operations of either Springvale Coal and EnergyAustralia. The Project is however a consent requirement for Springvale Mine under its current approval. This economic assessment is adjunct to the consultation requirement, to the extent that issues raised in the consultation process may require qualitative and/or quantitative definition.

Consistent with the DPE guidelines to the extent that they may be applied, the approach to this assessment is to estimate the direct economic benefits and costs of the Project, as they relate to the State, regional and local communities, employing:

- A Cost-Benefit Analysis (CBA) to assess the impacts of the Project at State (NSW) level, which is necessarily modified due to the nature of the Project;
- A Local Effects Analysis (LEA) to assess the localised impacts, particularly those relating to certain environmental, social and economic outcomes that are likely to be concentrated in the local and/or regional community.

This report seeks to address these requirements by providing a 'triple bottom line' reporting focus on the social, economic and environmental outcomes of the Project, based on both quantitative and qualitative assessments of relevant effects.

2. PROJECT BACKGROUND AND JUSTIFICATION

2.1 Applicant

Springvale Mine is owned by Centennial Springvale Pty Limited (50%) and Springvale SK Kores (50%) as participants in the Springvale unincorporated joint venture. Springvale Mine is operated by Springvale Coal Pty Ltd for and on behalf of the joint venture partners. Springvale Coal is the Project applicant for the purposes of this development application.

2.2. Project background

Springvale Coal Pty Ltd (Springvale Coal) and EnergyAustralia NSW Pty Ltd (EnergyAustralia) are proposing the Springvale Water Treatment Project (the Project or SWTP), to improve environmental outcomes and water quality in the Upper Coxs River catchment. The Project involves transfer and treatment of water from existing underground mine dewatering facilities for industrial reuse at MPPS.

The Springvale Mine and Angus Place Colliery are underground coal mining operations in the western coalfields of NSW, near Lithgow. Operation of the mines includes a water management scheme, which incorporates a series of dewatering bore facilities on the Newnes Plateau to manage safe water levels in the underground workings. Springvale Mine is currently approved to discharge up to 30 ML/day of mine water through the mine's licenced discharge point 9 (LDP009) to Sawyers Swamp Creek in the Upper Coxs River catchment.

State Significant Development consent no. 5594 was granted for Springvale Mine Extension Project on 21 September 2015 (Springvale MEP SSD Consent). The conditions of consent include a series of water management performance measures, which includes the requirement to reduce salinity in mine water discharges at LDP009 in line with the following improvement program, where salinity is expressed as electrical conductivity (EC):

- 700 µS/cm EC (50th percentile), 900 µS/cm EC (90th percentile), 1,000 µS/cm EC (100th percentile) by 30 June 2017.
- 500 µS/cm EC (90th percentile), by 30 June 2019.

EnergyAustralia owns and operates MPPS, located about eight kilometres west of the Springvale Mine pit top. The power station has a high demand for make-up water for use in the cooling water system. Water is currently drawn from the Coxs River and Fish River water supply schemes and the MPPS operates as a zero discharge site with no release of water or by-products from the cooling tower system to receiving waters.

Springvale Coal and EnergyAustralia have agreed to work together to develop the Project. The Project involves establishing a pipeline and ancillary facilities to transfer water from the existing dewatering facilities on the Newnes Plateau for treatment and reuse at MPPS. The Project will achieve improved environmental outcomes for the catchment and meet the water quality performance measures for mine water discharges required under the Springvale MEP SSD Consent.

2.3 Project objectives

The key objectives for the Project are to improve environmental outcomes for the receiving waters in the Upper Coxs River catchment. This will be achieved through:

- treating all mine water prior to either industrial reuse or environmental release;
- maximising the reuse of mine water within the MPPS cooling water system;
- reducing the reliance on water extraction from the catchment to meet the demand for make-up water within the MPPS operations;
- minimising the volume of treated water released to the environment;
- compliance with water management performance measures required under the Springvale MEP SSD consent.

2.4 Description of proposed Project

In order to address these water management performance measures required under the SSD-5594 consent, the Project involves the establishment of a pipeline to transfer water from existing dewatering facilities on the Newnes Plateau for treatment and reuse at MPPS. The Project includes the following major elements:

- A system to transfer up to 30 ML/day of mine water from the existing gravity tank forming part of the approved dewatering facilities on the Newnes Plateau to a new water treatment plant to be located at the MPPS site;
- A water treatment plant incorporating desalination processes to reduce salinity in mine water to a standard suitable for either industrial reuse or environmental release;
- Transfer of treated water to the MPPS cooling water system to contribute to the demand for make-up water;
- Discharge of any excess treated water not able to be reused within the MPPS cooling water system via new licensed discharge point located within the Springvale Coal Services site for environmental release to Wangcol Creek;
- Transfer of residuals from the water treatment plant to the Springvale Coal Services site for emplacement within the existing reject emplacement area;
- Transfer of the saline brine stream from the new desalination facilities to the MPPS cooling water blowdown system for integration with existing treatment and brine disposal practices;
- Installation of a crystalliser to provide further treatment of the additional salt load generated within the MPPS cooling tower blowdown system.

3. PROJECT ECONOMIC ANALYSIS – COST BENEFIT ANALYSIS (CBA)

3.1 Focus of analysis

The CBA component of this analysis presents the State-level implications of the Project. The LEA addresses the environmental and social impacts, along with relevant economic aspects of the project, which are concentrated in the Lithgow City Council (LCC) Local Government Area (LGA) and broader regional communities [1].

3.2 Discussion of approach to CBA

This report aims to provide information that will allow the community to consider the Project in the context of social, economic and biophysical factors that are relevant to it, as required under the EP&A Act. This approach is consistent with the aims of the 2015 guidelines, which state in part that, 'as for many environmental impacts and some social impacts, the aim is to value them as they would be valued in money terms by the individuals who experience them' (DPE 2015:3). The Project is not a direct source of production-related economic benefit, but rather a matter of regulatory compliance in respect of Springvale Mine's consent conditions, which imposes a cost on the parties involved. As such the application of the CBA approach to an assessment of this Project can only be achieved in a limited sense.

In this context, the CBA will combine a limited amount of quantitative data with specialist consultant's qualitative assessments of the Project to produce an overview of the economic effects of the Project. To this extent, the application of familiar structures such as Net Present Values (NPVs) and Benefit Cost Ratios (BCRs) is inappropriate in the current case.

3.3 Discussion of Project alternatives

There are two discrete elements of the Project, being;

- The water transfer system (pipelines and associated infrastructure); and
- The water treatment plant at MPPS.

The water treatment plant will be built-for-purpose and as such is not subject of alternative approaches that have bearing on the social, economic or environmental effects of the Project. Conversely, there are two alternatives to construction of the pipeline works. These essentially represent a choice between two alternative routes for the pipeline, which for the purposes of convenience are hereafter referred to as the Northern and Southern corridors.

3.4 Project-related economic evaluation – CBA

3.4.1 Assessment of beneficial economic effects

A key source of economic benefit in relation to this Project relates to the direct employment created by the capital works program. Given the specialised nature of the Project, it is

[1] For the purposes of the current DPE guidelines (2015), the relevant community is the ABS Statistical Local Area (Level 3) [SLA3] of Lithgow-Mudgee.

expected that a significant part of the Project workforce will be sourced from outside the local region, thus reducing any effects in the local and regional economy. Furthermore, ordinarily construction-related positions may be considered as having an economic value of zero from the perspective of the broader economy, on the basis that in the absence of a specific project, workers would be otherwise employed on alternative works. This approach is adopted in the present analysis. However, to provide an indication of the scale of the works and the benefit that will accrue to worker households, Table 1 displays relevant data.

Table 1: Direct employment effects[2] – Springvale Water Treatment Project construction

Project component	Duration	FTE	Indicative employee income (total $)
Pipeline infrastructure	12 months	20	$1.5 million
Water treatment plant	18 months	30	$3.3 million

Additionally, further employment across the broader economy would be supported through the production of goods and services required to complete the Project. From the perspectives of Lithgow and the surrounding region, this is expected to entail some localised benefit, for example;

- Accommodation and hospitality services for the non-resident workforce;
- Supply of materials for the Project (e.g. non-specialised construction materials [e.g. ready-mixed concrete] etc.)
- Procurement of services (e.g. plant & equipment hire) for the Project.

Given the relatively short duration of the Project and the precise composition of the comparatively small work force, such effects, although representing beneficial stimuli in the local and regional economies, would be of limited scale and remain indeterminate at this point.

3.4.2 Assessment of social, economic and environmental effects

As noted in Section 1, SEARs for this Project were issued by DPE on 6 May 2016 and require consideration of the following effects;

- Water (surface and groundwater);
- Noise (construction-related and water treatment plant operating noise);
- Biodiversity;
- Land (specifically land use compatibility);
- Heritage (Aboriginal and historic)
- Transport (specifically construction-related traffic);
- Waste (specifically brine and sludge);
- Visual impacts;
- Air quality.

[2] Based on average wage level for a number of occupations relevant to the Project sourced from Commonwealth Government Job Outlook website (2014 data); and ABS Wage Price Index (WPI) Mar 2015 – Mar 2016). Present value at Treasury/DPE central discount rate of 7%.

The distribution of these impacts varies across communities. For example, some impacts such as those on noise and air quality would be mainly apparent to residents in the immediate vicinity of Project works and/or operations, were this relevant. Potential impacts on the water catchment on the other hand may notionally be more widely distributed. The approach taken to assessment of these effects takes these distributive aspects into consideration.

It should also be recognised that some of the effects identified in the SEARs and discussed subsequently may be viewed differently by various parties. This unquantified element of social impact may be described as the 'intrinsic value'[3] of certain impacts or effects, as attributed by individual stakeholders. This aspect can be highly individualised and subjective and consequently may not be accurately quantified, as the assessments developed in this report may not align with individual stakeholders' values.

Although the DPE guidelines (2015) allow for a combination of quantitative and qualitative appraisal methods for various effects, the following assessment is largely qualitative in nature. Furthermore, despite the assessment process requiring monetised assessments where practicable (refer to Section 3.2 above), the current Project is generally not conducive to such an approach. This is chiefly a consequence of a combination of the following factors:

- the limited duration of the construction program and associated effects;
- the purposive beneficial outcomes of the Project (i.e. improvements in water use management and water quality) are widely distributed and form a comparatively small part of the much broader catchment, which is subject to numerous simultaneous processes that may alter its contributory effects;
- The majority of the Project works will be carried out in areas that are either (a) at significant distances from the nearest potential receivers or (b) located on lands that are already used for similar purposes, and thus do not represent significantly disruptive land use. As a result, in regards to most of the effects examined, the likely impacts are of such limited scale that further quantification is not practicable.
- Further valuation of quantitative measures (such as biodiversity credits) is not practicable on the information currently available at this stage of the Project.

Table 2 provides a summary of the assessment required under the SEARs for this Project. The table also includes a summary of the economic aspects of the Project. From the perspective of compliance with the current DPE guidelines, Figures 1 and 2 respectively identify the Lithgow-Mudgee SA3 for reference and the Lithgow LGA for comparison.

[3] James Marshall & Co. (2014), Springvale Mine Extension Project Social Impact Assessment, James Marshall & Co, March 2014.

Figure 1: Lithgow-Mudgee SA3

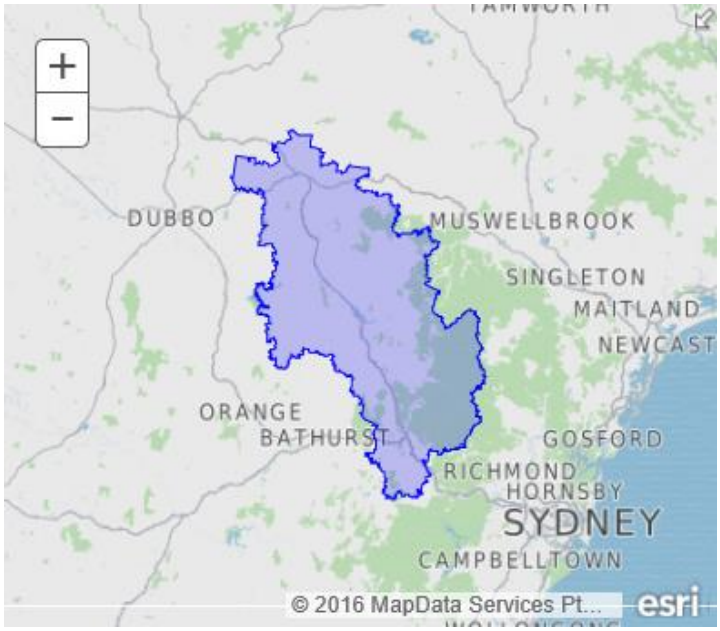


Figure 2: Lithgow LGA



Source: ABS Census Data 2016(b).

The SA3 has a land area of approximately 1.6 million hectares (Ha), and a population density of 2.8 persons/km^2 (2011 data; ABS 2016). By comparison, the population density of NSW at the same point was 9 persons/km^2. Lithgow LGA has a land area of approximately 451,000 Ha and a population density of 4.6 persons/km^2

Table 2: Summary assessment of economic and environmental effects – Springvale Water Treatment Project

Impact	Environmental Assessment Commentary	Benefits	Costs	Mitigation/treatment
Economic effects **Consultant:** **Aigis Group**	In meeting the consent conditions of the Springvale Mine Extension, the Project will support the economic benefit associated with continued operations. The Project will create 20 FTE positions over 12 months (pipeline construction) and 30 FTE over 18 months (WTP construction), with associated economic benefit over the period.	The majority of the Project workforce may not be resident in the region. However, positive economic impacts may be anticipated through activity in: • Accommodation and hospitality services for the workforce; • Supply of materials for the Project (e.g. construction materials etc.) • Procurement of services (e.g.) plant & equipment hire for the Project.	Nil assessed	Not applicable
Water resources (Surface water & groundwater) **Consultant:** **GHD**	**Construction** 1. Construction of the plant and pipeline route will create temporary water quality risks. Risks from disturbance activities mitigated through erosion & sediment controls. 2. There are unlikely to be any aquifer interference activities as part of the Project. **Operations:** 1. Assessment of surface and groundwater users indicated that it was unlikely that the project would directly influence the viability of existing basic landowner rights. 2. The Project would generally benefit surface water users upstream of Lake Wallace through improved water quality. The locations of users were such that, the removal of flow volumes from the waterway was unlikely to directly influence the availability of water from licensed users upstream of Lake Wallace. There are no known groundwater users likely to be impacted by the Project's operation.	Improvement in catchment water quality (as noted). Reduced drawdown of environmental sources by MPPS. Neutral effect on water users or landowner rights.	Nil assessed – specific effects positive or neutral.	Construction-stage mitigation strategies detailed in Water Resources Impact Assessment, Section 9, *Avoidance, mitigation and management strategies*

Impact	Environmental Assessment Commentary	Benefits	Costs	Mitigation/treatment
Noise & vibration **Consultant: GHD**	1. Construction noise at the WTP is predicted to comply with the construction noise management level at all receivers within the study area. Closest sensitive receivers are located approximately 2.3 kilometres east of the proposed WTP site. 2. Construction stage is predicted to temporarily exceed the construction noise management level during standard construction hours at residences located within 650 metres of the construction works. 3. Vibration impacts assessed for construction of the pipeline, no impacts are expected. 4. Operational noise is predicted to be insignificant. No cumulative impacts assessed. 5. Road traffic noise levels due to operation and construction of the WTP and pipeline not expected to increase by more than 2dBA. No impact on sensitive receivers near the traffic routes.	Nil assessed – effects insignificant due to distance between works and nearest sensitive receivers	Nil assessed – effects insignificant due to distance between works and nearest sensitive receivers	Refer to GHD (2016:45), Section 5, Mitigation measures, pp.45-46.

Impact	Environmental Assessment Commentary	Benefits	Costs	Mitigation/treatment
Biodiversity **Consultant:** **RPS**	The Project would result in 27.84 ha of vegetation disturbance. Potential impacts on: • 2 EECs • 2 threatened flora species • 1 threatened fauna species	Avoidance of one threatened flora species identified in Project Area. Opportunities to avoid impacts are proposed to reduce impacts (i.e. pre-clearance surveys to avoid threatened plants and hollow-bearing trees). Preservation of offset areas.	27.84ha clearing for northern [preferred] pipeline alignment; 31.44 ha clearing for southern alignment. Effects equivalent to 1097 ecosystem credits and 90 species credits (northern/preferred) and 1,245 ecosystem and 86 species credits (southern), based on NSW BioBanking Assessment Methodology *Framework for Biodiversity Assessment.*	Refer to Biodiversity Assessment Report Sections 5.1 - 5.3, *Avoidance, Minimisation & Mitigation* (RPS 2016:23-24). Biodiversity Offset Strategy.

Impact	Environmental Assessment Commentary	Benefits	Costs	Mitigation/treatment
Land **Consultant: Assessment based on material from MSEP EIS**	The Project would not have any significant impact on any land uses in the vicinity of the Project, including power generation, operating mines, commercial forestry or future mineral resources exploration in the area. **Construction** 1. The erosion hazard of the Project Application area varies from low to extreme. High erosion risk is typically associated with the steeper areas of the Study Area located in pockets off the Newnes Plateau. 2. The majority of the mine water transfer system route has been previously disturbed from either an existing pipeline or conveyor systems. Highest erosion risk is likely to be elevated transitions from the Newnes Plateau Sawyers Swamp Creek. 3. The assessment concluded that there is limited risk to human health during construction of the water treatment plant. **Operations** 1. There would be minimal soil disturbance activities during operation of the Project. 2. Operation of the Project would not increase the extent of ground disturbance at the water treatment plant. Therefore, there would continue to be limited risk to human health due to potential soil/fill contamination during operation of the Project.	Nil assessed – changes assessed as not significant	Nil assessed on successful implementation of avoidance, minimisation and mitigation recommendations – land use effects not significant, no effects on human health anticipated.	Refer to EIS – Other Environmental Matters, Section 1.1.3

Impact	Environmental Assessment Commentary	Benefits	Costs	Mitigation/treatment
Heritage (Aboriginal & historic) **Consultant: RPS**	1.The curtilage of one historic heritage item extends into the Project area, but the heritage buildings are outside the Project Area. Proposed works will have minor visual impact. 2. One unlisted heritage item, European Surveyor's Tree (EST JN1) abuts Project area, unlikely to be directly impacted by works. 3. Seven registered Aboriginal sites: AHIMS #45-1-0210; AHIMS #45-1-0218; AHIMS #45-1-0237, AHIMS #45-1-2758, AHIMS # 45-1-2721, AHIMS #45-1-2723, AHIMS # 45-1-2724within 30 metres of disturbance area boundary.	All items to be preserved on adoption of RPS recommendations	Minor visual impact to one historical heritage item only.	1. Limit works to nominated 20m x 20m area at curtilage to ensure minor visual impact only. 2. Protective barrier as relevant installed around EST JN1, and marked as 'No Go Zone'. 3. Protective barriers as relevant installed around sites, and each site marked as 'No Go Zone'.
Transport/traffic **Consultant: GHD**	The construction of the Project is not expected to adversely impact the traffic and road safety environment of the surrounding road network if the appropriate mitigation measures mentioned in the report are applied. Construction stage: • 16 vehicle movements per day at the Newnes Plateau for construction of the mine water transfer system. • At the water treatment plant construction site, 35 vehicles would be accessing the site generating 70 vehicle movements per day. Operations stage: The small increase in traffic associated with the operation activities for the Project is expected to have a negligible traffic impacts.	Nil assessed due to minimal impacts.	Nil assessed due to minimal impacts. Costs associated with operation of vehicles (air quality, noise etc.) assessed in relevant effects reports.	A CTMP specific to the Project would be required to be developed to manage potential conflicts between the day-to-day construction traffic and general traffic. All vehicles shall be accommodated on site and managed in accordance with the CTMP.

Impact	Environmental Assessment Commentary	Benefits	Costs	Mitigation/treatment
Waste **Consultant:** **GHD**	**Project construction** All waste generated by the Project during construction would be classified and managed in accordance with the NSW EPA (2014) "Waste Classification Guidelines" and relevant regulatory requirements of the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) and POEO Act. **Operations** Key waste streams generated during Project operation: • Brine concentrate/crystals from the water treatment plant and crystalliser; • Residuals from the water treatment plant (slurry/sludge). All waste classified and managed in accordance with the NSW EPA (2014) Waste Classification Guidelines and requirements of the WARR Act and POEO Act. There is no change to brine ash co-disposal practices proposed as part of the Project. The residuals stream arises from the removal of solids from the raw mine water as part of the pre-treatment process at the water treatment plant. The residuals stream can adequately be accommodated within the approved 12.5 million m^3 capacity of the REA.	Operation of the WTP will increase the amount of water available for MPPS use, and reduce water drawdown from environmental sources.	Nil assessed – construction wastes disposed of as described. Disposal of operations waste from WTP (two streams) consistent with current practice.	In accordance with the WARR Act, waste management during construction and operation of the Project would adopt the principles of the waste hierarchy.

Impact	Environmental Assessment Commentary	Benefits	Costs	Mitigation/treatment
Visual **Consultant: Centennial internal**[4]	Views of the proposed infrastructure are generally limited along the majority of the Project Application Area, restricted by the undulating landscape or vegetation. Limited views of infrastructure for users of Castlereagh Highway, Wolgan Road and Skelly Road. Pipeline infrastructure on Newnes Plateau would be buried, trenched or bored and would not be visible except for ancillary infrastructure Impact assessment identifies Project as being of negligible to low visual impact.	Nil assessed due to limited extent of impacts	Nil assessed due to limited extent of impacts	Refer to EIS – Other Environmental Matters, Section 1.7.3
Air quality **Consultant: Assessment based on material from MSEP EIS**	Dust emissions would be intermittent in nature. The potential for impacts from dust would affected by weather conditions (e.g. wind), the soil conditions and construction site management. The majority of potentially dust generating activities during construction would be located a significant distance from any sensitive receivers. Plant/vehicle emissions would not contribute appreciably to surrounding pollutant levels given the small volumes of pollutants emitted from vehicle exhausts. The operation of the Project is not expected to generate any significant air emissions.	Nil assessed – any effects short term and not significant	Nil assessed – any effects short term and not significant	Refer to EIS, Other environmental matters, Section 1.4.3.

[4] The method was adapted from *Environmental Impact Assessment Practice Note – Guideline for Landscape Character and the Visual Impact Assessment and Guidelines for Landscape Visual Impact Assessment* (RMS 2013).

3.5 Sensitivity analyses – alternative project options

The two feasible Project alternatives, in the context of the Project's status as a matter of regulatory compliance, have been identified as the Northern and Southern corridors. The economic implications of each option are similar in terms of employment effects and other economic benefit. The key element governing the selection of the Northern corridor as the preferred pipeline route is the avoidance and or minimisation of impacts to the greatest practicable extent in the context of carrying out a Project which is effectively mandatory based on Springvale Mine's consent conditions. This being the case, and taking into consideration the nature of the assessed effects disclosed in Table 2, detailed sensitivity analyses are essentially impractical with respect to this assessment. However, given that minimisation of impacts is a key determinant of the Applicant's decision to adopt the Northern corridor, the comparison of biodiversity credits assessments (Table 2) provides some sense of the range of possible outcomes for the two alternatives.

4. LOCAL EFFECTS ANALYSIS (LEA)

4.1 Approach

The LEA guidelines (2015) also provide for the consideration of population groups in assessments, which are defined thus; '*for practical reasons of measurement and identification, the analysis should include local effects that accrue to those people ordinarily resident in the locality at the time of the proposal*' (2015:5). In short, certain impacts may be concentrated among much smaller population groups. For example, effects such as those on noise are assessed on a more localised basis than the SA3 level. These latter impacts remain part of the broader CBA, as they represent the affected part of the NSW community.

4.2 Discussion of localised environmental impacts

The following factors indicate that the localised environmental impacts of the effects detailed in Table 2 are likely to be limited:

- The construction stage is of limited duration (18 months overall, with the two components of the Project developed concurrently);
- The pipeline works are largely at a significant remove from sensitive receptors;
- The treatment plant works are located on the MPPS site and are unlikely to impact on third parties;
- Comprehensive avoidance, minimisation and mitigation initiatives will be adopted in respect of construction and operations stages of the Project;
- A key objective of the Project is the improvement of environmental outcomes, which is expected to be achieved.

4.3 Discussion of regional economic effects

As has been detailed in the CBA, it is expected that the relatively specialised nature of both key components of the Project will result in a significant part of the workforce originating beyond the region. Although the composition and origin of the workforce is understandably unclear at this point, the presumption of a limited local workforce would accordingly reduce the effects of a labour surplus, or the component of local employees' incomes spent in the

local and regional economy. Similarly, from an operations perspective there is no increase in long-term employment associated with the Project, thus negating any labour surplus attributable to new employment. Nevertheless, as was identified in Section 3.4.1, there are a number of likely sources of local economic benefit, particularly those associated with the accommodation and provisioning of the workforce, and procurement of goods and services required for the Project that may be conveniently and competitively sourced within the immediate Lithgow area.

There are no identifiable negative economic effects anticipated. The relatively short duration of the construction stage of the Project is unlikely to affect the regional labour market on the bases noted above in respect of workforce attributes. Operationally, the Project entails the continuation of similar activities as are currently conducted, and therefore should not impose any foreseeable economic costs on the community.

4.3.1 Community consultation

Due to the extent of its operations and supporting projects in the Lithgow Region, Centennial Coal has a continuing community engagement program in operation. This program entails consultation with the broader stakeholder community, which includes the company's workforce, the resident regional community, business networks and representative groups such as the business chamber, economic development committee and various levels of government. Focused consultation is also undertaken with individuals and households which may be specifically affected by Centennial operations. This permits continuous monitoring of operational effects, and community attitudes to those effects and operations more generally.

Consultation addresses the social, economic and environmental elements of interest to the community. Environmental and social effects are addressed in the relevant specialist reports comprising parts of the Project EIS, and are also assessed in the relevant sections of this report. With respect to the economic effects which have been raised during the consultation process, the following issues relevant to the Project were identified:

- The importance of ongoing secure employment, both direct employment and that supported in the regional economy.
- Positive flow-on effects to other business of Centennial's operations.

The proposed Project has positive implications for both of these aspects of community concern. Although, as noted, the Project is of limited duration and may only result in a limited level of indirect economic activity, this remains a positive contribution in the context of a regional economy of this scale.

4.3.2 Social impacts

As is the case with economic effects, the social impacts of the Project are expected to be positive, although of limited magnitude. Given Project duration and the expected non-resident composition of the majority of the Project workforce, the additional demand on social infrastructure and services will be accommodated within existing regional capacity. In this respect the Project will be of largely neutral social impact.

The positive element of social impact revolves around the core objectives of the Project. The improvement in catchment water quality and the reduction in reliance on environmental sources by MPPS is likely to be beneficial to specific users (such as landowners) who rely on the local catchment resource, and more broadly by the communities which are also served by the catchment.

4.5 Extended economic impacts

A quantitative indication of the broader effects of the Project can be derived using input-output (I/O) multipliers. The methodology is a commonly-used approach to providing an approximation of the economic effects of one industry's activities across the rest of the economy[5]. There are certain limitations to the application of I/O multipliers. These are also acknowledged by ABS[6]. The practical effect of these limitations is that the output of multiplier analysis can only be considered as *indicative* of outcomes that may result from economic stimuli.

The relatively modest localised economic effects of the Project have been acknowledged. However, the Project is of significant scale in terms of capital outlays, and as such will have positive stimulatory effects across the broader economy, as the goods and services required for successful completion are produced and procured. Multipliers for construction activity based on the most recently available ABS I/O tables from the National Accounts (2012/2013) are presented in Table 3.

Table 3: Type 2A multipliers – heavy & civil engineering construction

Description	Multiplier value
Output Multiplier – heavy & civil engineering construction	3.147
Gross Value Added Multiplier – heavy & civil engineering construction	3.871
Income Multiplier – heavy & civil engineering construction	3.736
Employment Multiplier – heavy & civil engineering construction	10.355

It is reiterated that these multipliers can only provide an indication of the possible stimuli of the Project. However, it is evident that the construction sector relies on a variety of other industries to provide the necessary goods and services to support its activities. On measures of economic contribution these multipliers indicate that the works required for this Project are likely to produce effects of three to four times the value of the Project. Supported employment in these associated industries is a further benefit, particularly in the context of a capital project of the scale of the present proposal.

[5] A detailed discussion on interpretation and limitations of multiplier analysis is included in ABS Cat No 5246.0; *Information Paper Australian National Accounts Introduction to Input-Output Multipliers*;
[6] For example, ABS Cat No 1301.0, *Year Book Australia, 2002*

5. ADDITIONAL REQUIREMENTS

5.1 Cumulative impacts

The construction stage of the Project will have negligible cumulative effect on the area, due largely to its limited duration. In the operations stage, the Project will have the effect of reducing certain environmental effects (e.g. water resource impacts) and will have negligible cumulative effect with respect to others (such as noise), as it effectively represents activity that is consistent with the existing.

With respect to the new infrastructure required, this is designed to be sympathetic to its surroundings where appropriate (e.g. on the Newnes Plateau, where the pipeline will largely be below-surface). In other areas, the infrastructure is consistent with existing infrastructure and is designed to replicate such infrastructure (e.g. use of existing corridors etc.), with the objective of further reducing its effects.

5.2 Intra-generational and intergenerational equity

On the basis of its beneficial effects on water resources in the region and the broader catchment, the Project is expected to result in a marginal improvement in respect of the interests of present and future communities. All other effects are assessed as being marginal in magnitude and/or duration.

6. CONCLUSION

The Project will support Springvale Coal's achievement of its regulatory compliance requirements in respect of its current approval (SSD-5594). In partnering with EnergyAustralia to permit reuse of mine water output to contribute to MPPS's water demands, a mutually beneficial outcome is achieved for the two partnering parties. Furthermore, the Project will provide environmental and social benefit to the local and broader communities, due to its underlying objectives of improving water resource management in the area and the broader catchment.

The economic implications of both the construction and operational stages of the Project are positive, although of limited scale and duration with respect to the local and regional economies. From the perspective of the broader economy, of NSW in particular, a capital project of this scale will have further positive economic effects over the course of its construction.

The largely qualitative valuations of the various environmental matters considered in this economic assessment indicate that they are unlikely to be sources of significant negative impacts. To the extent that some impacts may occur, particularly during the construction phase, comprehensive avoidance, minimisation and mitigation initiatives are proposed to address these effects. Based on the nature of the Project and the experience of the partnering parties in developing and operating similar infrastructure, the proposed strategies will be effective in achieving their objectives.

The SWTP is a significant capital project for the partnering parties. By its nature it will have beneficial economic effects during its development. In the longer-run operational stage this assessment concludes that on balance, the combined social, economic and environmental effects of the Project will be positive. As such the Project is suitable for approval, development and operation.

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Cover photos: Rock Formations on Newnes Plateau and Coxs River

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