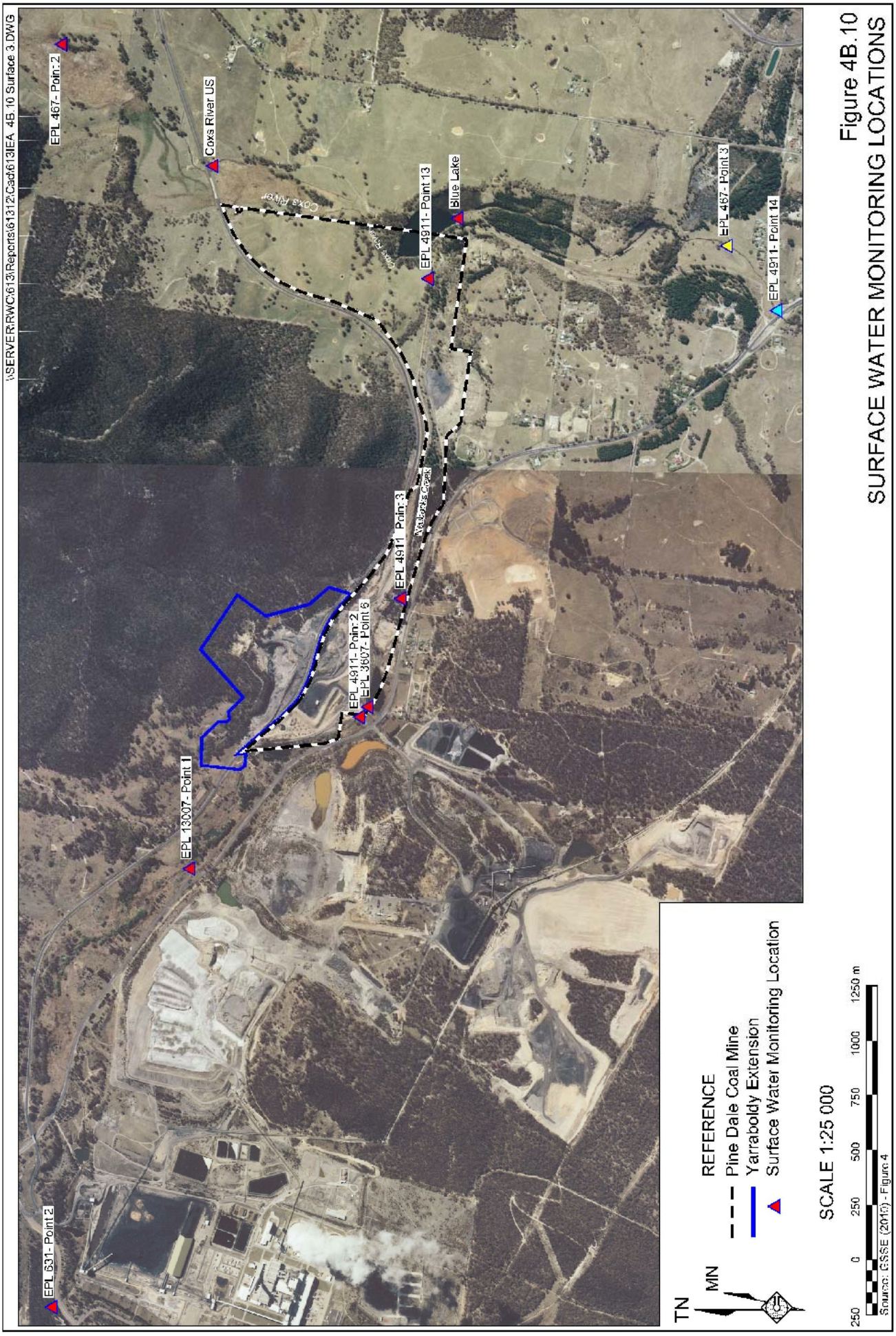


Figure 4B.10
SURFACE WATER MONITORING LOCATIONS

- The Blue Lake (downstream of the Project Site and the existing Pine Dale Coal Mine).
- The Existing Dam B (located within the Yarraboldy Extension area and provides data from undisturbed catchment within the Project Site).

Table 4B.5 presents water quality data recorded from 2006 to 2009.

Table 4B.5
Surface Water Quality*

Location	PH		EC (uS/cm)		TSS (mg/L)		Sulphate (mg/L)		Filterable iron (mg/L)	
	2006 - 2008	**2009**	**2006 - 2008**	**2009**	**2006 - 2008**	**2009**	**2006 - 2008**	**2009**	**2006 - 2008**	**2009**
Neubecks Creek Upstream *(EPL Point 2)*	6.4 - 7.3 (10)	7.3 (2)	302 - 1030 (10)	1058 (2)	3.8 - 6 (10)	3.5 (2)	162 - 715 (10)	520 (2)	0.26 - 0.44 (10)	0.26 (2)
Neubecks Creek Downstream *(EPL Point 3)*	7.0 - 7.6 (12)	7.0 (2)	749 - 1449 (12)	1153 (2)	5 - 8 (12)	156 (2)**	444 - 715 (12)	688 (2)	0.47 - 0.7 (8)	0.4 (2)
Coxs River Upstream	-	8.3 (1)	-	1013 (1)	-	22 (1)		48.3 (1)	-	0.36 (1)
Coxs River Downstream *(EPL Point 14)*	-	8.3 (2)	-	1021 (2)	-	11 (2)		254 (2)	-	0.12 (2)
Blue Lake	-	8.5 (1)	-	1028 (1)	-	19 (1)		133 (1)	-	0.05 (1)
Existing Dam B	-	6.8 (1)	-	70 (1)	-	13 (1)		4 (1)	-	0.56 (1)

Source: Modified after GSSE (2010) – Tables 5 to 9

* Numbering in ( ) records the number of samples averaged

These data indicate the following trends in recent background water quality.

- pH values within Neubecks Creek and Existing Dam B have been in the range 6.8 – 7.3 i.e. slightly acidic to almost neutral, while the Coxs River and the Blue Lake presents a slightly more alkaline environment.
- Both the Coxs River and Neubecks Creek are characterised by electrical conductivity (EC) / levels ranging from 300 – 1400 uS/cm. Higher conductivity is assumed to be a result of the surrounding land use practices and discharges. EC levels within the natural catchment of Existing Dam B are much lower (69 uS/cm) as would be expected in a small, relatively undisturbed catchment.
- Concentrations of Total Suspended Solids (TSS) within Neubecks Creek and the Coxs River are generally low with the majority of samples recording a value less than 20 mg/L. A single results of 302 mg/L recorded at Neubecks Creek Downstream in 2009 is not considered representative of TSS in the catchments.
- Average sulphate concentrations as high as 715 mg/L were recorded in Neubecks Creek upstream, and most likely are a result of the land use practices within the upstream catchment. As expected, sulphate levels within Existing Dam B are much lower.

- Filterable iron levels vary considerably throughout the local water bodies. The highest levels were recorded in Existing Dam B while the lowest were recorded in the Blue Lake. This variation is likely to be associated with a range of physiochemical factors including differences in pH and localised geochemical effects.

4B.2.2.4 Mine Inflow Water Quality

The groundwater assessment (see Section 4B.1) records that at least 8 800ML of groundwater is present within the old Wallerawang Colliery underground workings adjacent to the Yarraboldy Extension area, and that approximately 24ML of this groundwater is contained within the footprint of the proposed Yarraboldy Extension area. It is projected that this water would be intercepted in the later stages of first year of mining and continuation of mining operations would require minor dewatering of the groundwater. Modelling by Aquaterra (2010) predicts groundwater inflows following dewatering would occur at indicative rates of approximately $0m^3$ (nil) per day in the first year of mining increasing to approximately $20m^3$ per day in the second year of mining.

Sampling of groundwater from within the old Wallerawang Colliery underground workings and in-put sump was undertaken by Aquaterra on 27 April 2010 at two sites – within the Old Shaft and Bore P6. The results of this sampling analysis are presented in **Table 4B.6**.

Table 4B.6
Preliminary Mine Void Water Quality Data

	Old Shaft	Bore P6	In-pit Sump
pH	6.2	6.3	6.09
Conductivity (µS/cm)	785	868	820
Turbidity (NTU)	40	24	1
Dissolved Iron (mg/L)	0.87	<0.05	388
Total Iron (mg/L)	12.3	0.67	0.1
Source: Modified after GSSE (2010) – Table 10			

These limited results indicate that groundwater from within the underground workings is potentially characterised by elevated turbidity levels and iron content in comparison to background surface waters.

Water quality within the in-pit sump is generally equivalent to, or better than water quality in the surrounding catchments. In-pit water was found to be characterised by lower filterable iron, sulphate, TSS and electrical conductivity to surrounding surface waters and has a near neutral pH. The results suggest that that if discharge of in-pit water to adjacent surface waters was to occur, the impact on the surface water quality would be negligible, although it should be recognised that these results are based on a single sample and further analysis may be warranted in the future.

4B.2.2.5 Discharge Data

Monitoring of surface water at three licensed discharge points – LDP4, LDP5, LDP13 – are requirements of Environment Protection Licence (EPL) 4911. However, data could only be collected from LDP4 and LDP5 sites as LDP13 site did not show any discharge in the 2008 – 2009 reporting period. It should also be noted that no discharge has been observed from LDP5 since October 2005. **Table 4B.7** presents water quality data from sites LDP4 and LDP5.

Table 4B.7
Average Discharge Water Quality at LDP4*[1] and LDP5*[2]

Parameter	LDP4				LDP5
	2006	2007	2008	2009**	2006
pH	3.1	3.9	3.8	-	3.7
Conductivity (us/cm)	1599	867	766	-	645
TSS (mg/L)	6.8	11.4	34	-	Not detected
Sulphate (mg/L)	719	430.2	250.6	-	281
Filterable Iron (mg/L)	13	5.6	2.1	-	2.66
Total Oil and Grease (mg/L)	*	Not Detected	Not Detected	-	Not detected

*Average not detailed. Highest sample was 4mg/L, below the current detection limit.
** Data not available.
1. Wallerawang Colliery No. 1A Mine Entry
2. Wallerawang Colliery Punch Mine Entry LDP5

Source: GSSE (2010), Tables 12 and 13

Additional water sampling was conducted by GSSE in 2009 during the preparation of the Surface Water Assessment for the Project. Laboratory analysis for a broad range of analytes was undertaken including major anions and cations, heavy metals, nitrites, nitrates and phosphorus in addition to the parameters required by EPL conditions. Samples were collected from strategic monitoring locations including Existing Dam B, the Blue Lake, Neubecks Creek Upstream, Neubecks Creek Downstream, Coxs River Upstream, and the in-pit sump. **Table 4B.8** presents a summary of the monitoring data for which results were recorded above detection limits.

Table 4B.8
2009 Surface Water Monitoring Data

Analyte all as (mg/L)	ANZECC guideline	Existing Dam B	Coxs River upstream	Blue Lake	Neubecks Creek Upstream	Neubecks Creek Downstream	Coxs River Downstream	In-Pit sump
Chlorine	NS	3.39	4.92	11.8	55.5	60.7	18.6	14.1
Fluorine	NS	0.16	0.72	0.64	0.16	0.1	0.65	0.16
Total alkalinity	NS	29	499	450	125	32	239	92
Arsenic	(III) 0.024 (V) 0.013	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cadmium	0.0002	<0.0001	<0.0001	0.014	0.0001	0.0003	0.002	0.0003
Copper	0.0014	<0.001	<0.001	<0.001	<0.001	0.002	0.006	<0.001
Cobalt	NS	<0.001	<0.001	0.002	0.005	0.022	0.006	0.096
Manganese	1.9	0.291	0.056	0.066	5.21	3.27	1.19	1.34
Nickel	0.011	0.002	0.003	0.01	0.031	0.066	0.059	0.406
Aluminium	0.055[1]	0.18	0.56	0.1	0.03	0.31	0.07	<0.01
Zinc	0.008	<0.005	0.006	0.006	0.009	0.089	0.032	0.065
Total Nitrogen	0.25	1.9	0.4	6.7	0.6	0.1	0.4	0.5
Total Phosphorus	0.02	<0.01	<0.01	7.39	0.03	<0.01	0.01	0.26

[1] – For pH >6.5, unspecified for pH < 6.5, NS = Not Specified Source: Modified after GSSE (2010) – Table 14

These results indicate high variability in background water quality parameters and that water from within the in-pit sump is of equal or better quality than background water quality in relation to the majority of analytes.

4B.2.3 Existing Surface Water Management

The surface water management measures currently in place within the Yarraboldy Extension area are understood to be remnants of former mining operations. Currently, all surface water including dirty water runoff from disturbed areas and all clean water inflow from the adjacent Ben Bullen State Forest in theory reports to the old Wallerawang Colliery underground workings via LDP5 (see **Figure 4B.9**). However, no discharges have been observed at this site since 2006.

Surface water management measures in place within the Yarraboldy Extension area include the following.

- Existing Dam A (clean water) – the dam wall/embankment is located immediately upstream from the former Yarraboldy Open Cut Mine (see **Figure 4B.9**). This embankment across the natural gully line effectively acts to form what is usually a dry dam to catch ephemeral clean water flows.
- Existing clean water diversion bank – a contour bank is located to the west/southwest of Existing Dam A, as shown in **Figure 4B.9**, and is understood to capture surface flows from the adjacent hill to the northwest of the dam and diverts flows into Existing Dam A.
- Existing Dam B - an existing farm dam ('clean water') is located in the central eastern section of the Yarraboldy Extension area (see **Figure 4B.9**). The dam receives surface water runoff from the adjacent undisturbed catchment which extends northeast into the Ben Bullen State Forest. This dam is considered likely to hold water permanently year round in typical conditions.
- EPL LDP5 (Punch Mine Entry, discharge to underground workings) - LDP5 lies within the existing former Yarraboldy Open Cut Mine void at an entry to the old Wallerawang Colliery underground mine workings (see **Figure 4B.9**). The discharge into groundwater, when it occurs, includes clean water flows/overflows from the upper catchment and existing clean water dams above this area.
- The remainder of the natural catchment in the Yarraboldy Extension area (primarily the northern sections) currently exist as natural ephemeral drainage lines generally with no formed bed or banks.

The above-mentioned man-made controls (dams and diversions) are understood to currently capture the vast majority of clean water generated from the local catchment and it is unlikely that significant volumes of clean water would flow into Neubecks Creek from the Project Site.

4B.2.4 Potential Surface Water Impacts and Criteria

4B.2.4.1 Potential Surface Water Impacts

The activities identified during the construction/establishment and operational phases of the Project with the potential to impact on surface waters would be:

- construction of the amenity bund;
- relocation/construction of the new stockpiling/crushing area;
- initial site establishment;
- coal extraction activities;
- overburden extraction and emplacement;
- activity associated with the office and amenities;
- stockpiling and crushing activities;
- product transportation and vehicular access; and
- machinery maintenance activities.

The manner in which these activities may impact upon surface water quality and quantity may include (but not be limited to) the following.

- Elevated turbidity within surface water runoff.
- Entrainment of coal fines within surface water runoff.
- Potential for elevated mineral and nutrient content in surface water runoff.
- Potential for increased salinity within surface water runoff.
- Potential for elevated levels of hydrocarbon associated with the workshop.
- Changes in clean water flows reporting to surrounding watercourses.
- Potential for further alteration to the existing hydrologic regime (noting the substantially disturbed existing regime including the Blue Lake and flows from surrounding land uses).

The contaminants of concern during decommissioning and rehabilitation are likely to be similar to those identified for the site establishment and operations phases of the Project, with the exception that the quantity of these contaminants would decrease substantially as rehabilitation work progresses and revegetation is successfully established.

4B.2.4.2 Surface Water Quality Impact Criteria

The surface water quality of water discharged off site would be in accordance with criteria encapsulated in the following.

- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000)
- Water quality goals nominated in the Environment Protection Licence 4911

4B.2.5 Water Management Measures and Operational Safeguards

4B.2.5.1 Introduction

The principal objectives of surface water management within the Yarraboldy Extension area are to:

- design and manage flows in accordance with best practice so that water flows leaving the Project Site result in neutral to beneficial effect on water quality in the receiving waters of Neubecks Creek and Coxs River immediately downstream of the mine;
- segregate clean and dirty water flows;
- minimise overland flow across disturbed areas; and
- manage surface water appropriately in order to meet the Project's water usage requirements.

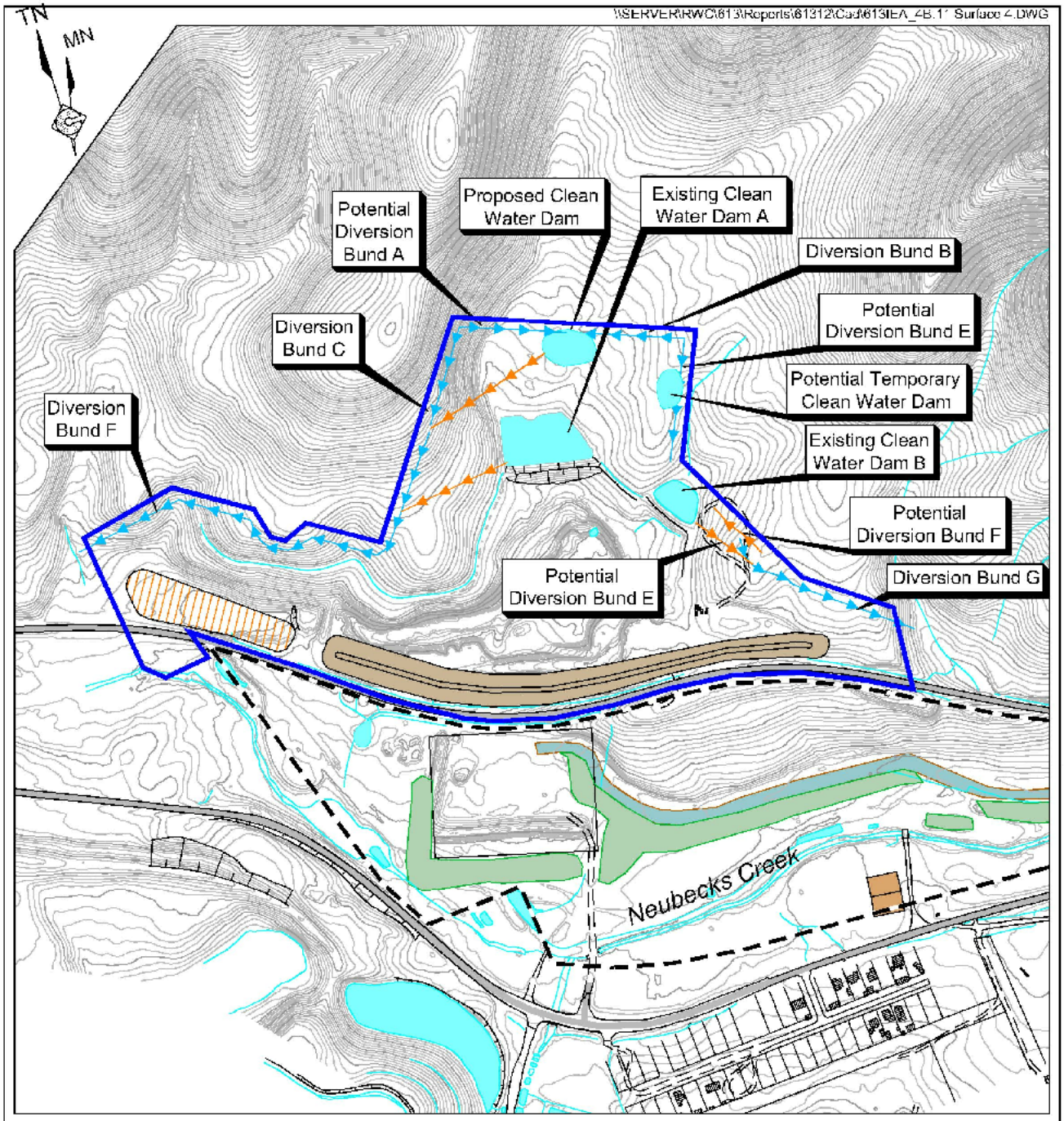
The proposed water management system would continue to operate in accordance with the conditional requirements of EPL4911 and maintain and utilise the existing surface water discharge location at LDP13 when required, and use LDP4 for discharge into the underground workings.

A Site Water Management Plan (SWMP) would be prepared following project approval reflecting the conditions of the project approval and modified EPL4911 to ensure that all appropriate issues and control measures identified through the approval process are incorporated in the plan. The SWMP would be developed in accordance with the Blue Book (Volume 1 and Volume 2E), and would be largely based upon the mitigation measures outlined in this subsection.

4B.2.5.2 Clean Water Management

Clean water diversions would be constructed wherever possible upstream of the disturbance area (but within the Project Site boundary) to direct natural clean waters around the Project Site and into natural ephemeral drainage lines which ultimately flow downstream into Neubecks Creek. This would also minimise the runoff that would be managed within the Project Site and the internal dirty water management system. The proposed clean water management infrastructure is shown in **Figure 4B.11**.

Clean water collected during substantial rainfall events within the two Existing Dams A and B would be pumped through diversion bunds into downstream clean water diversions which feed into nearby natural drainage lines that flow into Neubecks Creek. These discharges would occur via culverts beneath the Private Coal Haul Road and associated diversion swales between the Private Coal Haul Road and Neubecks Creek. The drainage lines would be periodically inspected after significant rainfall events by the site personnel to ensure the drainage lines remain stable.



REFERENCE

- Pine Dale Coal Mine
- Yarraboldy Extension
- Contour (Interval = 1m)(m AHD)
- Creek / Drainage Line
- Potential Overburden Storage Area
- Power Line
- Existing Amenity Bund
- Proposed Amenity Bund
- Building
- Diversion Bank
- Pump / Pipe Required

SCALE 1:8 000

100 0 100 200 300 400 m

Source: GSSE (2010) - Figure 8

Figure 4B.11
PROPOSED CLEAN WATER MANAGEMENT INFRASTRUCTURE

Clean water run-off from the Ben Bullen State Forest (central drainage line management with catchment area of approximately 77ha) would be captured in Clean Water Dam A using potential Diversion Bunds A and B. The ephemeral Existing Dam A will be retained throughout site development and will act to provide additional storage should the Clean Water Dam A overflow during a large rainfall event. The captured clean water would subsequently be pumped to Diversion Bunds C and E using float-activated high-flow pumps. These diversion bunds would then convey clean water around the disturbance area into existing drainage lines and eventually to Neubecks Creek.

On the western boundary of the Yarraboldy Extension area (western boundary clean water management with catchment area of approximately 35ha) clean water would be captured by the proposed clean water Diversion Bund C running north to south adjacent to the boundary down into the stockpile and crushing area. This diversion bund would link up to Diversion Bund D into the benches. Diversion Bund D would receive flow from Diversion Bund C and would convey flows around the northern boundary of the stockpile/crushing area to an unnamed natural drainage line to the west of the Yarraboldy Extension area.

On the eastern boundary, a diversion bund (Diversion Bund E) may be constructed (if required by site operations). Otherwise a natural drainage depression running along this boundary would act as the clean water management structure for the eastern boundary of the Project Site. Existing Dam B (approximate catchment area of 7.8ha) would be retained throughout the early stages of the Project and would act to capture and moderate clean water flows from the small drainage line and adjacent Diversion Bunds E and F. Existing Dam B may also receive clean water pumped from the Proposed Clean Water Dam A, however, it is anticipated that the majority of clean water from the proposed Water Dam A would be pumped to diversion bunds along the western boundary to avoid double handling. Clean water captured within Existing Dam B would be pumped to Diversion Bund G for subsequent discharge off site.

4B.2.5.3 Operational Dirty Water Management

Dirty water diversions and sediment basins will be used for the management and capture of sediment-laden or dirty water generated from disturbed areas within the Yarraboldy Extension area as a result of rainfall/runoff. Since the Yarraboldy extension area has a relatively small disturbed catchment area, the dirty water would be easily managed.

Revegetation of all formed surfaces, such as shaped overburden emplacement areas, long-term soil stockpiles and drainage lines would occur to help reduce the amount of potential contaminants in runoff from disturbed areas and hence generation of dirty water. This would also reduce the dependence on the sediment controls and help improve water quality.

An effective revegetation, maintenance and monitoring program would be implemented for the site including all monitoring as required under EPL4911 both on the site and in adjacent watercourses.

Figure 4B.12 displays the proposed dirty water management measures to be adopted throughout the operational mine life. Each of the controls is outlined as follows.

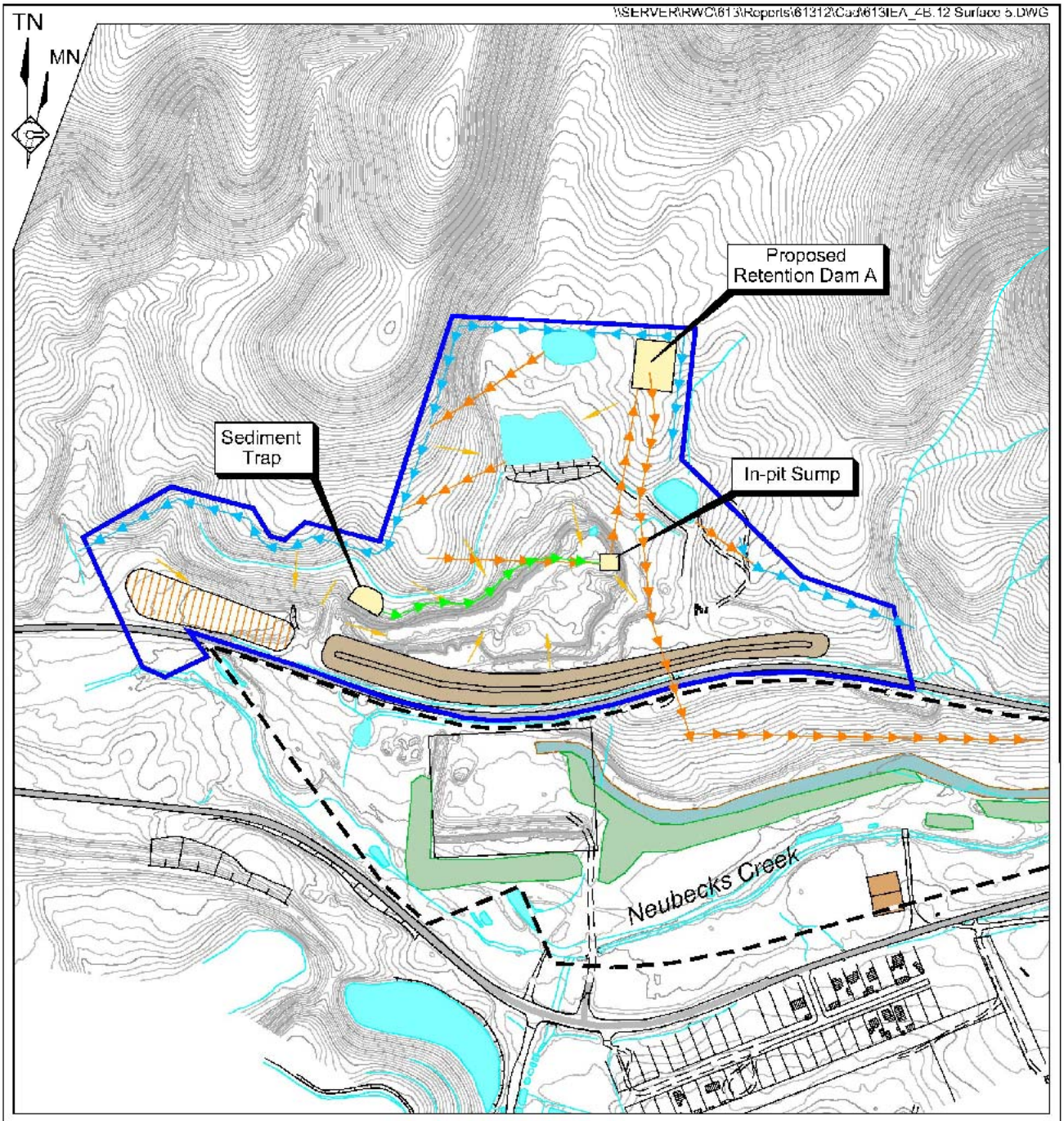


Figure 4B.12
PROPOSED DIRTY WATER MANAGEMENT MEASURES

Active Mining Area

In the active mining area, the capture of dirty water will be conducted using contour banks in a manner which would minimise the potential for concentrated and/or unstable overland flow. The dirty water would be treated within sediment basins (primarily the in-pit sump and then Retention Dam A) to reduce the sediment load prior to water re-use or off site discharge, if required via licensed discharge points.

During the final months of extraction activity when mining activities approach the location of Retention Dam A an additional dam would be constructed within the previously mined area of the Yarraboldy Extension, and all water would be transferred to this dam prior to decommissioning of the Retention Dam A and mining through the area.

Coal Crushing, Stockpiling and Maintenance Area

A small sediment trap would be constructed to capture rainfall/runoff from the crushing/stockpiling and maintenance area and help to remove coal fines which may become entrained in surface flows. Overflow from the sediment trap would be directed to the in-pit sump through the use of a small, temporary dirty water diversion. Where required, flows from other sections of the disturbance area would be conveyed to the in-pit sump utilising similar measures.

Additionally, an oil/water separating unit would be required to receive and treat potentially contaminated surface water runoff from the workshop area and wash down bay. The clarified water would then be incorporated into the dirty water management system.

Dirty Water Re-use

Dirty water captured within the disturbance area would be re-used on site where possible for dust suppression activities, such that the Yarraboldy Extension area will operate as a targeted nil-discharge site. If discharge is required following significant rainfall events, water would be pumped to the existing sediment dams within the Pine Dale Coal Mine footprint before being discharged to Neubecks Creek via LDP13. Discharge would be undertaken in accordance with the discharge criteria outlined under EPL4911. Appropriate water treatment methods may be utilised where necessary to meet discharge criteria.

Dirty water used for dust suppression would be preferentially sourced from either the in-pit sump, Retention Dam A or a designated water-cart refilling station depending upon site requirements at the time.

In-pit Drainage

Water generated within the open cut pit (primarily as a result of rainfall/runoff and groundwater seepage) would be managed within the open cut via in-pit sumps. Dirty water runoff within the extraction area would be directed to and contained within these in-pit sumps until it is necessary to pump the water to Retention Dam A. The in-pit sump would be progressively re-located as the active mining area advances.

Erosion and Sediment Control Structures

Temporary erosion and sediment control structures would be installed during the establishment and construction phase of the Project (including sediment fencing, sand bags and check dams) to minimise the discharge of sediment-laden water from newly disturbed areas. This would include during the establishment and re-shaping activities associated with the new crushing and stockpiling area. The sediment control structures would be maintained to ensure the design capacities are maintained for optimum settling rates throughout the life of the Project.

Groundwater Inflows

Approximately 24ML of groundwater within the old Wallerawang Colliery underground workings is associated with the Yarraboldy Extension area. This groundwater would be managed as dirty water and would be pumped to the proposed Retention Dam A when required by mining operations. The predicted groundwater inflow/seepage from the exposed coal seams would be directed to the in-pit sump and would also be managed in accordance with dirty water management as outlined above. If groundwater is identified to have physiochemical characteristics which do not meet environmental discharge criteria, and environmental discharge is anticipated, the capture and treatment within a separate water treatment system would be undertaken. If investigations identify groundwater quality to be an issue and discharge of groundwater inflow is required as part of the Project, the Proponent would consult with the DECCW to discuss potential further investigations, discharge criteria and monitoring as may be required.

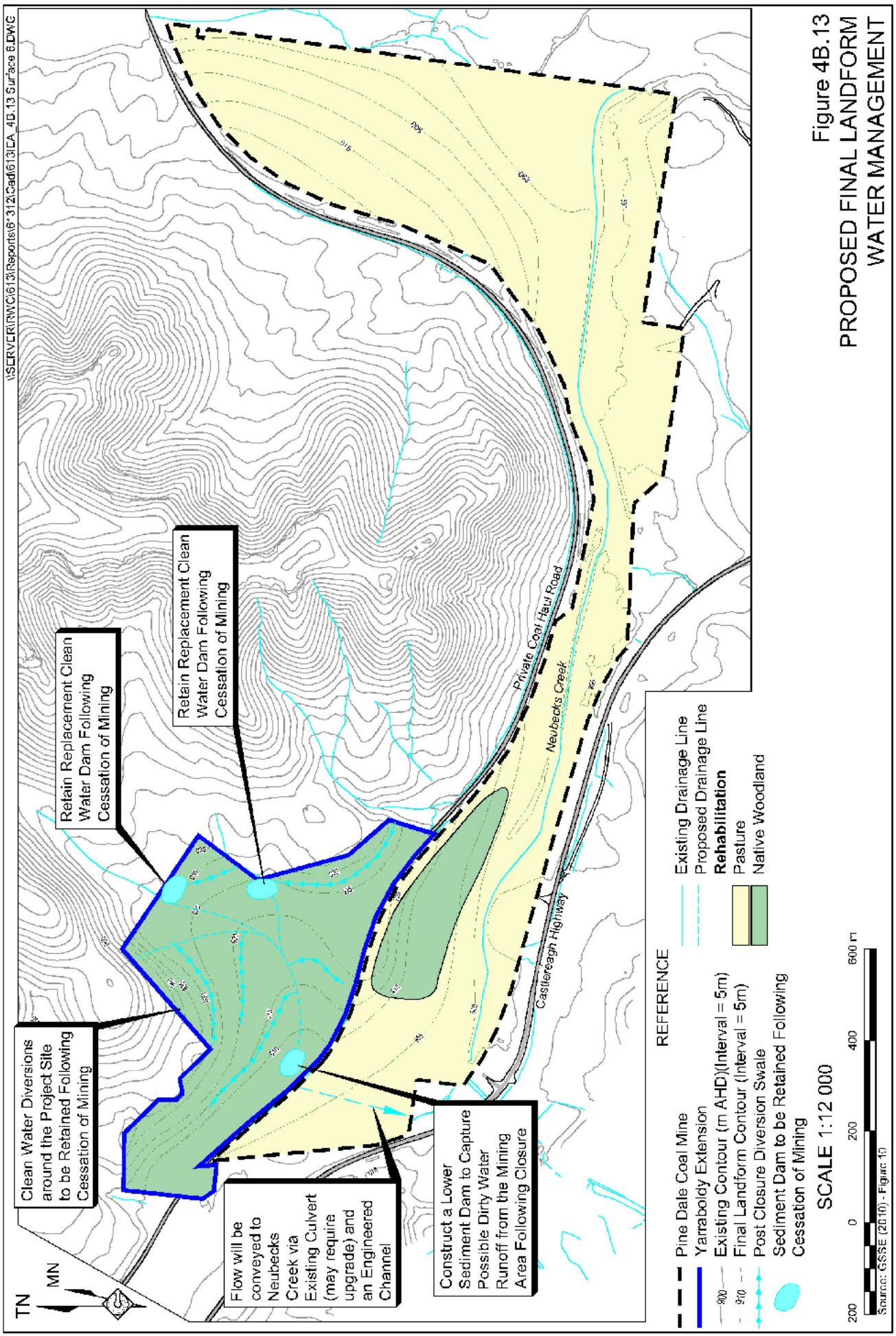
By implementing and maintaining the proposed clean and dirty water management measures for the Project it is anticipated that there would be at least a neutral impact upon groundwater.

4B.2.5.4 Rehabilitation Stage Water Management

The final landform within the Yarraboldy Extension area would be designed to generally recreate the natural drainage catchments as closely as possible, and would be predominantly free-draining although sediment retention dams would remain in place until a stable landform is achieved, and after which the dams may remain as clean water dams.

The final landform design of the Yarraboldy Extension area would include rehabilitation of ephemeral watercourses in accordance with the *Rehabilitation Manual for Australian Streams* (LWRRDC and CRCCH). The final landform would be revegetated in accordance with a Rehabilitation Management Plan and, where required, additional stabilisation measures such as contour banks, check dams and rock armouring, designed in accordance with the *Blue Book Volume 2E*, would be utilised to achieve land stability.

In the unlikely event that disturbance of Neubecks Creek occurs as a result of the Project, rehabilitation would be undertaken in accordance with the *Rehabilitation Manual for Australian Streams* to emulate a naturalised system with a Category 2 riparian corridor. The proposed final landform and associated water management structures for the Yarraboldy Extension area is presented in **Figure 4B.13**.


\\SERVER\RWC\613\Reports\6*312\Cad\613EA_4B.13 Surface 6.DWG
Figure 4B.13
PROPOSED FINAL LANDFORM
WATER MANAGEMENT
Retain Replacement Clean Water Dam Following Cessation of Mining
Retain Replacement Clean Water Dam Following Cessation of Mining
Clean Water Diversions around the Project Site to be Retained Following Cessation of Mining
Flow will be conveyed to Neubecks Creek via Existing Culvert (may require upgrade) and an Engineered Channel
Construct a Lower Sediment Dam to Capture Possible Dirty Water Runoff from the Mining Area Following Closure
Private Coal Haul Road
Neubecks Creek
Castlereagh Highway
TN
MN
REFERENCE
Pine Dale Coal Mine
Yarraboldy Extension
Existing Contour (m AHD)(Interval = 5m)
Final Landform Contour (Interval = 5m)
Post Closure Diversion Swale
Sediment Dam to be Retained Following Cessation of Mining
Existing Drainage Line
Proposed Drainage Line
Rehabilitation
Pasture
Native Woodland
SCALE 1:12 000
200 0 200 400 600 m
Source: GSSE (2010) - Figure 10

A series of diversion bunds would be constructed around the final landform to reduce the potential for concentrated overland flow and allow a stable landform to develop. These diversion bunds would be constructed in accordance with the appropriate design criteria detailed in (GSSE, 2010). The clean water dams would be retained on the site for ongoing use throughout the rehabilitation phase. An additional sediment basin may be constructed to capture and treat runoff from the rehabilitation area following construction of the various water management structures.

It is proposed to convey flows beneath the Private Coal Haul Road using culverts. Further investigation would be undertaken post-Project approval to confirm capacities and if required, appropriate measures identified to maintain stable flows under the Private Coal Haul Road to Neubecks Creek via clean water diversion swales through the previously mined areas within the Pine Dale Coal Mine footprint.

4B.2.5.5 Site Water Usage Management

The majority of water used within the Yarraboldy Extension area would be for dust suppression (estimated by site personnel to be 75ML/annum) along internal access roads and other areas where dust is generated. Dust suppression would utilise dirty water sourced from either the in-pit sump, the proposed Retention Dam A or a designated water cart refilling station and would be preferentially sourced based on specific requirements of mining operations. During periods of low water supply additional water may be sourced from within the old Wallerawang Colliery underground workings.

4B.2.5.6 Potable Water Supply

Potable water requirements of the proposed Project would to be minimal and would be managed in accordance with water use procedures of the existing Pine Dale Coal Mine. Potable water would continue to be transported in from off site as required to supplement mains water used on site for ablutions.

4B.2.6 Site Water Balance for Yarraboldy Extension

4B.2.6.1 Introduction

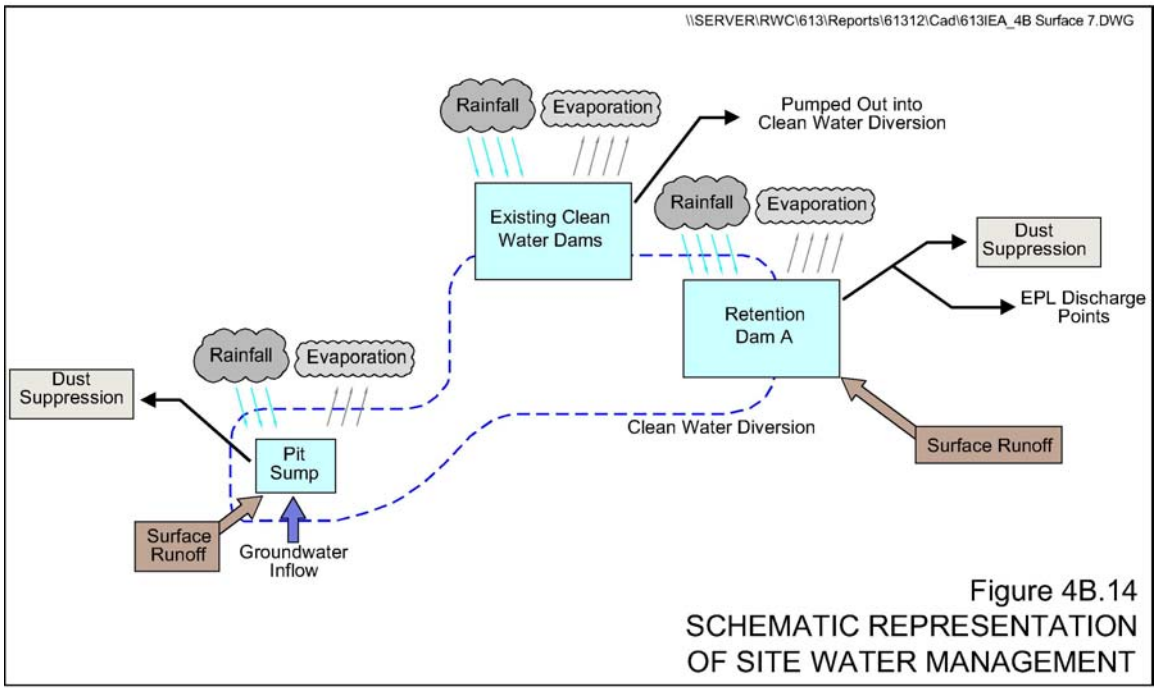
The site water balance for the proposed Yarraboldy Extension is based on the proposed water management infrastructure discussed in Section 4B.2.5. The water balance has been calculated on an annual basis, and compares site water usage demands against potential water storage availabilities for the Yarraboldy Extension area. A schematic representation of the proposed site water management, inputs and outputs is provided as **Figure 4B.14**.

4B.2.6.2 Water Sources

Rainfall Run-off

Rainfall runoff from the proposed areas of disturbance has been determined using the following statistical annual rainfall measured at the Bureau of Meteorology Station at Lidsdale (Maddox Lane). This station was chosen due to its close proximity to the Project Site.

- Annual 10th percentile (dry year): 462.8 mm.
- Annual 50th percentile (average year): 500.7 mm.
- Annual 90th percentile (wet year): 942.2 mm.



It is noted that only dirty water associated with the Yarraboldy Extension area was considered for the water sources originating as rainfall runoff. Clean water inflow from the adjacent Ben Bullen State Forest was not included in the water balance. The areas within the dirty water catchments are:

- the mining disturbance area including the former Yarraboldy Open Cut Mine and those lands proposed to be mined throughout the Project;
- the proposed crushing/stockpiling and maintenance facility, which is to be located within the western end of the proposed Yarraboldy Extension area;
- those parts of the amenity bund which would drain into the disturbance area; and
- parts of the Private Coal Haul Road assumed to drain into the disturbance area.

Groundwater Inflow

Following initial dewatering of the underground workings (in approximately Year 2 of mining) there would be groundwater seepage into the active mining area throughout the remaining mine life. Preliminary estimates of groundwater inflow to the active mining area, from both the existing underground workings and associated rock strata have yielded data presented in **Table 4B.9** This data was determined as part of the groundwater assessment for this Project (Aquaterra, 2010).

Table 4B.9
Preliminary Open Cut Inflow Estimates

Indicative Mining Stage	Estimated Pit Inflow (m^3/day)		Total
	Surface Water	Groundwater	
Site establishment	44.7	0	44.7
Year 1 Mining	15.4	0	15.4
Year 2 Mining	15.5	20.4	35.8
Source: Aquaterra (2010) – Table 16			

The assessment adopted a conservative approach and utilised the groundwater inflow from the second year of mining as input to the water balance model.

4B.2.6.3 Water Losses and Usage

Evaporation

The evaporative losses from the pit sump and associated dams within the dirty water management system were calculated with the following assumptions.

- In the absence of site specific data, annual evaporation was conservatively estimated to be approximately 1350mm/yr (Bureau of Meteorology's Bathurst Agricultural Station).
- The average annual evaporation loss has been multiplied by a factor of 0.7 to account for the fact that the dams would not always be full and that available data is pan evaporation; and
- The estimated surface area of the dirty water dams has been estimated as 0.53ha, including both the proposed Retention Dam A and the in-pit sump.

The mean evaporation loss for the site has been calculated as follows.

*Evaporation loss = (Surface Area of the dam when full) * (yearly evaporation) * 0.7*

The combined annual average evaporation from the dirty water system has been estimated as **2.4**ML.

Water usages

The vast majority of water on the site would be used dust suppression activities undertaken within the active extraction area, the stockpile and crushing area and along internal access roads where required.

Dust suppression activities are anticipated to consume approximately 75ML of dirty water per year sourced from dirty water sediment basins/sumps within the Yarraboldy Extension area.

Site discharges

No off-site discharges to surface waters have occurred since October 2005. All discharges during this period have been to the underground workings. This information has been reflected in the Site Water Balance Model.

4B.2.6.4 Site Water Balance Results

Table 4B.10 presents the results of the annual site water balance for average, dry and wet years.

Table 4B.10
Annual Site Water Balance

	Annual Site Water Balance (ML)		
Year of operation	Average Year	Dry Year	Wet Year
2nd Year of operation	-3	-15	52

Results from the indicative annual site water balance, based on conservative assumptions and input, indicate that the Yarraboldy Extension area will operate on average (and in dry years) as a net water deficit site (water user). The deficit would be met by extracting groundwater from the old Wallerawang Colliery underground workings.

In 'wet' years, the site would be a net water generator (surplus) and options would include the discharge of water via LDP13 and/or LDP4, if and when required.

4B.2.6.5 Proposed Water Management Strategies

Based on the annual site water balance recorded in **Table 4B.10** the following would be implemented.

- The proposed Retention Dam A would be built to meet or exceed the minimum specified design sizes.
- The mine plan and the pit would be designed to maximise potential for in-pit water storage, should it be required during high rainfall events.
- If multiple sediment dams are constructed, water would be promptly transferred from sediment basins lower in the treatment chain to sediment basins higher in the treatment chain to ensure the lower basins have capacity to store rainfall events.
- If required, controlled discharge of water would be undertaken in accordance with EPL4911 when total site storage levels are above 90%. This would provide the capacity to contain more rainfall events and reduce potential for wet weather discharges and/or flooding of the active pit.

While a discharge-free operation is to be maintained at the Yarraboldy Extension in average and dry years, if a controlled discharge of water is required, it would preferentially be undertaken during dry weather (i.e. when dams approach full conditions) in order to allow for adequate settlement of sediment to be achieved prior to discharge.

4B.2.7 Assessment of Impacts

4B.2.7.1 Introduction

Following the adoption of the water management, controls and mitigation measures identified in Section 4B.2.5, the impacts on surface water within and beyond the Project Site have been assessed as described below. The overall conclusion is that there will be minimal impacts of the Project on the surface water catchments, local drainage, and surface water quantity and quality. The surface assessment study has found that the cumulative impacts of the project on the health of the surrounding water environment would likely be environmentally beneficial.

One of the Director-General's Requirements specified for the Project was to model impacts of runoff from the Project Site using the MUSIC software package. This package was primarily developed to assess runoff from urban catchments, and so was considered inappropriate at the Project Site. However, a qualitative approach, based on water quality monitoring data, the nature of the proposed development, and the rehabilitation to be undertaken has been used in determining and assessing the potential Project-related impacts on surface water. This approach is an accepted approach for assessing impacts to surface water associated with the mining industry within a rural environment, such as the Yarraboldy Extension area.

4B.2.7.2 Impacts on Surface Water Catchments

The final landform created following the completion of mining activities and rehabilitation of the Project Site would be equivalent in topography and vegetation to that of the current undisturbed areas. There may be minor changes to the total catchment areas to Neubecks Creek, however, any change would be minimal and have no impact on the total catchment of Coxs River and the Warragamba Dam catchment.

4B.2.7.3 Impacts on Surface Water Local Drainage

The potential impacts of the Project on the local drainage will be minimal due to the mitigation measures that will be implemented. The final landform within the Yarraboldy Extension area would be designed to generally recreate the natural drainage catchments as closely as possible, thereby allowing free flow over the Project Site. This would be done by construction of a series of diversion bunds to reduce the potential for concentrated overland flow and allow water discharge off site. Stable flows beneath the Private Coal Haul Road will be conveyed using culverts for subsequent flows into Neubecks Creek via clean water diversion swales.

4B.2.7.4 Impacts on Surface Water Quantity

The site water balance model for the Project Site illustrates that the Yarraboldy Extension area will operate on average (and in dry years) as a net water-deficit site. There will be no discharge of water off site. In this case the water deficit would be met by extracting groundwater from the old Wallerawang Colliery underground workings.

In 'wet' years, the site would be a net water generator. Discharge of surplus water off site would include options of discharging water via LDP13 and/or LDP4, if and when required. The diversion bunds at the Project Site would assist in separating and restoring clean water flows to Neubecks Creek during rainfall events.

Overall the potential impacts of the Project through the site establishment, operational and rehabilitation phases would be minimal on the surface water quantity being discharged off site.

4B.2.7.5 Impacts on Surface Water Quality

The proposed operating strategy for water management at the Project Site has been designed to capture all operational "dirty" water and direct it to a sediment dams for capture and treatment. Sediment-laden surface runoff from the rehabilitation area following construction of the various water management structures would also be treated in the sedimentation basins, prior to being pumped into storage dams for use in dust-depression activities. Treatment of water on site means that water that would be discharged from the storage dams off site, if required, would not compromise the quality of water in Neubecks Creek.

4B.2.8 Surface Water Monitoring Program

4B.2.8.1 Introduction

The proposed surface water monitoring program for the Yarraboldy Extension would be a continuation of current monitoring undertaken at the existing Pine Dale Coal Mine with the exception of minor changes outlined below. The monitoring program would include a program to monitor the following.

- The performance of and quality of water being discharged off site.
- Surface water quality immediately upstream and downstream of LDP13 on Neubecks Creek.
- Background water quality in surrounding watercourses including Neubecks Creek, the Coxs River and the Blue Lake.

The main objectives of the surface water monitoring program would be to ensure that:

- water management measures implemented as part of the Project are functioning in accordance with the proposed design criteria; and
- where surface water requires off-site discharge, water quality complies with the water quality goals nominated in the EPA Licence 4911.

4B.2.8.2 Sampling Locations and Frequencies

Monitoring would be undertaken in accordance with ANZECC/ARMCANZ 2000 Guidelines. The same monitoring locations as in the Environment Protection Licence 4911 would continue to be monitored with the exception of the Punch Mine Entry location (through LDP5) which would be removed as a result of the proposed Yarraboldy Extension.

Table 4B.11 details the proposed locations and frequency for the proposed surface water monitoring. The parameters analysed would be consistent with the EPL4911, namely, pH, electrical conductivity, oil & grease, turbidity, total suspended solids, filterable iron concentration, and sulfate ion concentration.

Table 4B.11
Monitoring Locations and Frequency

Monitoring Location*	Type of Monitoring Point	Frequency	Sampling Method
Point 2	Baseline and discharge monitoring	*Quarterly during discharge* *Daily during discharge for pH, EC and turbidity*	Grab sample for oil & grease, TSS, turbidity, iron and sulfate concentrations. Probe for pH and electrical conductivity measurements.
Point 3	Baseline and discharge monitoring	*Quarterly during discharge* *Daily during discharge for pH, EC and Turbidity*	
LDP 4	Discharge monitoring (to underground)	*Quarterly during discharge*	
LDP 13	Discharge monitoring (to surface waters)	*Quarterly during discharge* *Daily during discharge for pH and EC*	
Point 14	Baseline and discharge Monitoring	*Quarterly* *Daily during discharge for pH, EC and Turbidity*	

* See **Figure 4B.10**
Source: Modified after GSSE (2010) – Table 18

4B.2.8.3 Reporting of Monitoring Data

A suitably qualified and/or trained person would manage the Monitoring Program, including the recording/dissemination of results.

All relevant water quality data would be reported in the Annual Environmental Management Report, and made available to relevant stakeholders. In the event that an exceedance is identified in the Monitoring Program, the exceedance would be reported to the relevant agencies in accordance with the requirements of EPL4911.

4B.3 FLORA

The flora assessment for the Project was undertaken by Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC, 2010b). The full assessment is presented as Part 4 of the *Specialist Consultant Studies Compendium*. Relevant information from the assessment is summarised in the following subsections.

4B.3.1 Introduction

Based on the risk analysis undertaken by R.W. Corkery & Co Pty Limited for the Project (Section 3.3 and **Table 3.7**) the potential impacts on flora requiring assessment and their unmitigated risk rating are as follows.

- Disturbance to native vegetation / habitat within and outside the Project Site (low).
- Reduction in species diversity (high).
- Threatened vegetation stress/health (low).
- Reduced local and regional species biodiversity (high).

In addition, the Director-General's Requirements issued by the DoP identified "Biodiversity" as one of the key issues that requires assessment at the Project Site. The assessment of impacts on biodiversity is required to include the following.

- Evaluation of the extent of native vegetation within the Project Site.
- An accurate estimate of any Project-related impacts on vegetation.
- A detailed assessment of the potential impacts on terrestrial or aquatic threatened species, populations, ecological communities or their habitats.
- A detailed description of the measures that would be implemented to avoid or mitigate impacts on biodiversity.
- Determination if an offset strategy is required to ensure the project maintains or improves the biodiversity values of the region in the medium to long term (in accordance with NSW and Commonwealth policies).
- The flora assessment was undertaken in accordance with the draft *Guidelines for Threatened Species Assessment under Part 3A of the Environmental Planning and Assessment Act 1979* (DEC, 2005) and relevant guideline documents and planning policies.

The following subsections describe and assess the existing threatened species and their habitat, identify the ecological management issues, proposed controls, safeguards and mitigation measures for the threatened species and their habitat.

4B.3.2 Study Methodology

4B.3.2.1 Desktop Assessment

The desktop component of the flora assessment involved a review of flora surveys and assessments previously conducted in the vicinity of the Project Site, a search of DECCW's 'Atlas of NSW Wildlife' for endangered flora species, endangered ecological communities, endangered populations and critical habitat. A stereoscopic interpretation of 1: 25 000 scale colour airphotos to determine vegetation community features and boundaries for field sampling was also undertaken. The photos used were Wallerawang (1: 25 000 scale) Run 10, Prints 20, 21 and 22, flown 10 October 2006 by the Lands Department and Bathurst (1: 25 000 scale) Run 10, Prints 74 and 75 flown 25 September 1993 by the Land Information Centre, Bathurst.

The following previous studies were used for compilation of flora species likely to be present within the Project Site.

- Benson and Keith (1990) – A description of vegetation of the Wallerawang 1: 100 000 Map Sheet area. Two vegetation communities were identified.
  - Unit 10g - Scribbly Gum – Stringybark Woodland.
  - Unit 10h - Tablelands Grassy Woodlands Complex.

- 2004 Pine Dale Coal Mine *Environmental Impact Statement* Flora Study (GCNRC 2004). Two vegetation communities of relevance to the proposed Yarraboldy Extension area were identified.
  - **Community 1** – Cleared and Disturbed Areas.
  - **Community 6** – *Eucalyptus sparsifolia* (Narrow-leaf Stringybark) - *Eucalyptus macrorhyncha* (Red Stringybark) - *Eucalyptus dives* (Broad-leaved Peppermint) - *Eucalyptus rossii* (Scribbly Gum) Community.
- 2006 Study of the Vegetation of the Western Blue Mountains, prepared by the former Department of Environment and Conservation (DEC, 2006a, 2006b and maps). Three separate native vegetation communities were found to occur within or adjacent to the Project Site.
  - **Community 1** - **MU 11** - Tableland Gully Snow Gum – Ribbon Gum Grassy Forest.
  - **Community 2** - **MU 33** – Tableland Broad-leaved Peppermint – Brittle Gum – Red Stringybark Grassy Open Forest.
  - **Community 3** - **MU 37** – Coxs Permian Red Stringybark – Brittle Gum Woodlands.
- Pine Dale Coal Mine Stage 1 and 2 Extension (GCNRC, in press), identified four separate vegetation communities in the area that includes the proposed Yarraboldy Extension area. The vegetation communities identified are as follows.
  - **Community 1** – Stringybark (*Eucalyptus sparsifolia, Eucalyptus macrorhyncha*) – Scribbly Gum (*Eucalyptus rossii*) Forest;
  - **Community 3** – Mountain Gum (*Eucalyptus dalrympleana*) Forest; and
  - **Community 4** – Open Cleared Lowlands;
  - **Community 5** – Disturbed Lands.

Descriptions of communities identified in the above-noted studies have been described in more detail in GNRC, (2010).

4B.3.2.2 Field Surveys

The different landforms and vegetation communities identified through stereoscopic airphoto interpretation were sampled in the field to ascertain the variation in species density and composition within these communities. A total of ten sampling sites (Quadrats of area 50m x 50m) were mapped within the Project Site and at each of these sites, species composition data were recorded.

Field sampling across the Project Site was carried out on 30 April 2009, 15 June 2009, 6 October 2009 and 15 April 2010.

4B.3.3 Existing Vegetation

4B.3.3.1 Vegetation Communities of the Project Site

Most of the Project Site beyond the 10ha of disturbance associated with the old Yarraboldy Coal Mine has been partially modified by forestry operations in the past, although a good cover of native tree, shrub and ground cover species generally exists. Small areas have been modified from their original condition by clearing for agricultural purposes.

No threatened flora species were recorded during field observations and there are no past records of any threatened flora species within the Project Site. There are no endangered ecological communities, endangered flora populations or occurrences of critical habitat recorded within the Yarraboldy Extension area.

Four vegetation communities were identified within the Project Site, each of which has been mapped and are presented in **Figure 4B.15**

- **Community 1 – Stringybark (*Eucalyptus sparsifolia*, *Eucalyptus macrorhyncha*)**
  – Scribbly Gum (*Eucalyptus rossii*) Forest

  Tree cover is dominated by *Eucalyptus rossii* (Scribbly Gum), *Eucalyptus sparsifolia* (Narrow-leaf Stringybark) with *Eucalyptus rubida* subsp. *rubida* (Candlebark), *Eucalyptus bridgesiana* (Apple Box), *Eucalyptus polyanthemos* (Red Box) and *Pinus* sp.* (Pine)

  Shrub cover includes *Acacia dealbata* (Silver Wattle), *Bursaria lasiophylla* (Hairy Native Blackthorn), *Bursaria spinosa* (Native Blackthorn), *Cassinia arcuata* (Chinese Shrub), *Hibbertia obtusifolia, Persoonia laurina* subsp. *laurina* (Golden Geebung), *Rosa rubiginosa** (Briar Rose), *Rubus* sp.* (Blackberry) and *Monotoca scoparia.*

  Ground cover species recorded include *Acaena* sp. (Bidgee Widgee), *Ajuga australis* (Australian Bugle), *Austrodanthonia sp., Cymbonotus lawsonianus* (Australian Bear's-ear), *Centaurium* sp.(Centaury), *Centella asiatica, Dianella revoluta, Geranium* sp., *Helichrysum scorpioides* (Tufted Everlasting), *Hypochaeris radicata** (Flatweed), *Lomandra glauca* (Pale Matrush), *Plantago gaudichaudi, Poa* sp., *Senecio diaschides* (Gully Groundsel), *Hypericum gramineum* (Small St John's Wort), *Stackhousia viminea* (Slender Stackhousia), *Austrostipa rudis* subsp. *nervosa* (Tall Speargrass), *Viola betonicifolia* (Purple Violet) and *Wahlenbergia* sp.(Bluebell).

- **Community 2 – Mountain Gum (*Eucalyptus dalrympleana*) Forest**

  Tree cover in the forest area is dominated by *Eucalyptus dalrympleana* (Mountain Gum) with *Eucalyptus polyanthemos* (Red Box) and *Eucalyptus macrorhyncha* (Red Stringybark) and *Eucalyptus rossii* (Scribbly Gum) on the margins.

  Shrub cover includes *Cassinia laevis* (Cough Bush), *Hibbertia obtusifolia*, *Leucopogon lanceolatus, Acacia ulicifolia* (Prickly Moses), *Persoonia laurina* subsp. *laurina* (Golden Geebung) and *Dillwynia phylicoides*.

  Two vines were recorded. These were *Clematis aristata* (Traveller's Joy) and *Clematis glycinoides (*Forest Clematis).

  Ground cover comprised *Ajuga australis* (Australian Bugle), *Cheilanthes sieberi* (Rock Fern), *Cirsium vulgare** (Spear Thistle), *Lomandra glauca* (Pale Matrush), *Oxalis* sp.* (Wood Sorrel), *Pteridium esculentum* (Bracken), *Brachyscome scapigera* (Tufted Daisy), *Austrostipa rudis* subsp. *nervosa* (Tall Speargrass) and *Viola betonicifolia* (Purple Violet).

- **Community 3 – Open Cleared Lowlands**

  This community occurs around the base of the hills within the Project Site. The area is predominantly cleared of tree and shrub vegetation but in some areas trees are present as scattered individuals or in clumps. Observations in a number of locations in the vicinity indicated that a range of native and introduced groundcover species occur within this community.

  Trees recorded were *Eucalyptus pauciflora* (Snow Gum), *Eucalyptus rossii* (Scribbly Gum), *Eucalyptus rubida* subsp. *rubida* (Candlebark) and *Eucalyptus mannifera* (Brittle Gum).

  The main shrub species recorded were *Acacia dealbata* (Silver Wattle), *Cassinia sp., Rosa rubiginosa** (Briar Rose) and *Rubus fruticosus** (Blackberry).

  Ground cover, dominated by introduced species, included *Arrhenatherum elatius* (False Oatgrass), *Bromus molliformis** (Silky Brome), *Helichrysum scorpioides* (Tufted Everlasting), *Panicum simile* (Two-colour Panic), *Poa* sp. (Tussock Grass), *Senecio madagascariensis** (Fireweed) and *Themeda australis* (Kangaroo Grass).

- **Community 4 – Disturbed Lands**

  Tree cover comprises seedlings and generally young plants of *Eucalyptus sparsifolia* (Narrow-leaf Stringybark), *Eucalyptus rossii* (Scribbly Gum), *Eucalyptus rubida* subsp. *rubida* (Candlebark), *Eucalyptus pauciflora* (Snow Gum) and *Eucalyptus polyanthemos* (Red Box). The tree seedlings and saplings are scattered throughout the disturbed areas amongst regenerating shrubs and groundcover species.

  Planted specimens of *Eucalyptus bicostata* (Eurabbie) and *Pinus* sp.* (Pine) are also present in areas where there appears to have been previous human habitation.

  Shrubs represented in the disturbed areas include regenerating *Acacia dealbata* (Silver Wattle), *Acacia nana* (Small Red-leaved Wattle), *Bursaria lasiophylla* (Hairy Native Blackthorn) (odd young plant), *Cassinia arcuata* (Chinese Shrub), *Hibbbertia obtusifolia* (Grey Guinea Flower), *Rosa rubiginosa** (Briar Rose) and *Rubus* sp.* (Blackberry).

  Ground cover comprises *Acaena novae-zeylandiae* (Bidgee-Widgee)., *Aristida jerichoensis var. jerichoensis* (Wiregrass), *Austrodanthonia tenuior* (Wallaby Grass) , *Cheilanthes sieberi* (Rock Fern), *Cirsium vulgare** (Spear Thistle), *Conyza* sp.* (Fleabane), *Dittrichia graveolens** (Stinkwort), *Anthoxanthum odoratum** (Sweet Vernal-grass), *Eragrostis curvula** (African Lovegrass), Helichrysum scorpioides (Tufted Everlasting), *Hypericum perforatum** (St Johns Wort), *Hypochaeris radicata** (Flatweed), *Panicum simile* (Two-colour Panic), *Paspalum dilatatum** Paspalum), *Poa* sp. (Tussock Grass), *Hypericum gramineum* (Small St John's Wort), *Solanum nigrum** (Black-berry Nightshade), *Austrostipa rudis* subsp. *nervosa* (Tall Speargrass) and *Themeda australis* (Kangaroo Grass). The native groundcover species are very much in the minority in terms of abundance.

A complete listing of the groundcover species within the Project Site is contained in Table 2 of GCNRC (2010b).

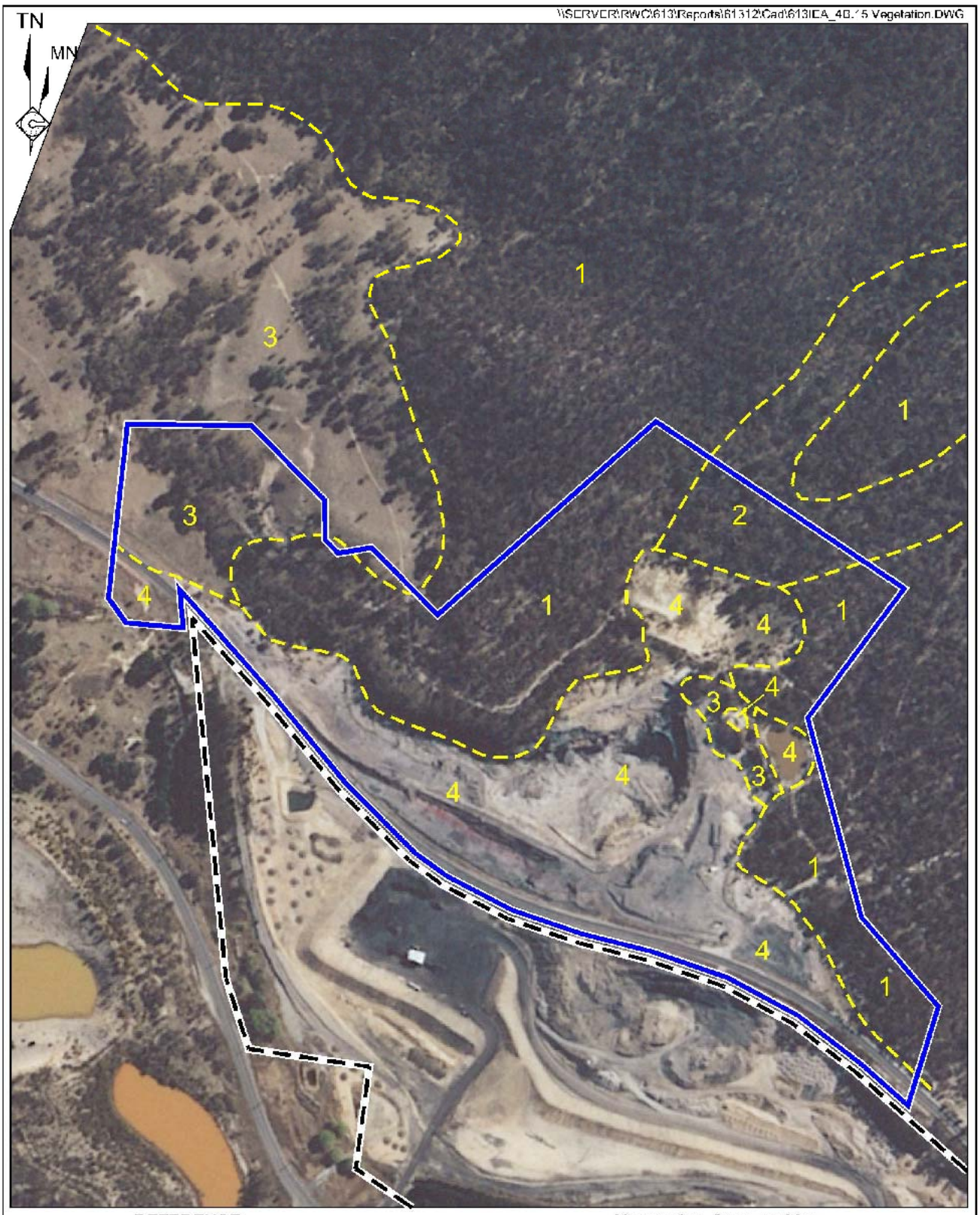


Figure 4B.15
VEGETATION COMMUNITIES

4B.3.3.2 Noxious Weeds

Four species listed as Noxious Weeds for Lithgow Local Government Area (Upper Macquarie County Council) were recorded within the Project Site.

- African Lovegrass* (*Eragrostis curvula*) (W4*)
- Blackberry* (*Rubus fruticosus* aggregate species) (W4*)
- Briar Rose* (*Rosa rubiginosa*) (W4*)
- St John's Wort* (*Hypericum perforatum*) (W4*)

All four species fall under W4 Weed category in accordance with the *Noxious Weeds Act 1993* classification as indicated below. All four species of weeds would require continuous monitoring of infestations and control of any plants that appear with appropriate herbicides.

*W4 Weed Category - *The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.*

4B.3.3.3 Koala Habitat

The Project Site is situated within the Lithgow City Local Government Area. Schedule 1 of SEPP 44 lists the Lithgow City Local Government Area as one to which the Policy applies and requires identification of any potential Koala habitat in the Project Site.

Native vegetation of types listed in Schedule 2 of SEPP 44 which provide potential Koala habitat has not been identified within the Project Site. As such, SEPP 44 considerations are not applicable to the Project.

4B.3.4 Conservation Significance

4B.3.4.1 NSW *Threatened Species Conservation (TSC) Act 1995*

Threatened Species (TSC Act)

A search of the NSW Atlas of Wildlife determined that five threatened species under the TSC Act could be potentially occurring within a 20km radius around the Project Site. The threatened species identified were:

- *Derwentia blakelyi* (vulnerable);
- *Eucalyptus cannonii* (vulnerable);
- *Eucalyptus pulverulenta* (vulnerable);
- *Genoplesium superbum* (endangered); and
- *Persoonia marginata* (vulnerable).

The field survey of the Project Site did not record the presence of any threatened species previously recorded from the region surrounding the Yarraboldy Extension area. Detailed investigations of the likelihood of these species occurring at the Project Site were conducted and the results have been reported in GCNRC (2010b).

Endangered Ecological Communities (TSC Act)

Two critically Endangered Ecological Communities, 38 Endangered Ecological Communities and three Vulnerable Ecological Communities have been identified in the NSW Atlas of Wildlife as potentially occurring in the vicinity of the proposed Yarraboldy Extension area.

None of the Endangered / Threatened Ecological Communities listed under the TSC Act as likely to occur within the Project Site (or predicted to occur there), were recorded during the field survey. This information has been verified using the present field survey data and the mapping and community descriptions provided by DEC (2006a, 2006b).

Endangered Populations (TSC Act)

Two endangered populations have been identified in the NSW Atlas of Wildlife as potentially occurring within the target area. These are:

- *Pultenaea villifera Sieber* ex DC. population in the Blue Mountains Local Government Area; and
- *Keraudrenia corrolata* var. *denticulata* in the Hawkesbury Local Government Area.

Neither of these endangered populations were identified in the field survey of the Project Site.

Critical Habitat (TSC Act)

No critical habitat was recorded on the 1:100 000 Bathurst (8831) and Wallerawang (8931) Map Sheets or within the Project Site.

4B.3.4.2 Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act)

A listing of Threatened Species and Threatened Ecological Communities likely to occur within a 10km radius of the Project Site was obtained from the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) Database in an EPBC Act Protected Matters Report. Additionally, details of any World Heritage Properties or Wetlands of International Significance with the vicinity were obtained.

Detailed investigations of the likelihood of these species occurring at the Project Site were conducted and the results have been reported in GCNRC (2010b).

Threatened Species (EPBC Act)

The following Threatened Species under the EPBC Act have been recorded or predicted to occur within the region around the Project Site or are predicted to occur there.

- *Apatophyllum constablei.*
- *Boronia deanei.*
- *Eucalyptus macrorhyncha subsp. cannonii.*
- *Eucalyptus pulverulenta.*
- *Pomaderris brunnea.*
- *Prasophyllum sp. Wybong* (C.Phelps ORG 5269).
- *Pultenaea glabra.*
- *Thesium australe.*

The field survey did not identify the presence of any of these species within the Project Site.

Endangered Ecological Communities (EPBC Act)

Two Critically Endangered Ecological Communities listed under the EPBC Act are likely to occur within the target area. These are:

- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (listed as Critically Endangered); and
- Temperate Highland Peat Swamps on Sandstone (listed as Endangered).

The field survey did not record the presence of either of these communities within the Project Site.

Critical Habitat (EPBC Act)

There is no Critical Habitat present within the Yarraboldy Extension area.

Nearby World Heritage Properties

The Protected Matters Report indicates the Project Site is in the proximity of the Greater Blue Mountains Area NSW World Heritage Site. However, the Proposed Yarraboldy Extension area is not in a location where mining activities would impact on the Greater Blue Mountains Area NSW World Heritage Site.

Associated Wetlands of International Significance

The Project Site is not located within the same catchment as the Macquarie Marshes Nature Reserve (Ramsar Site) and so any mining activities within the Project Site would not impact on this Ramsar site.

4B.3.4.3 Seven Part Test

The proposed Yarraboldy Extension was assessed in accordance with the Seven Part Test, and the results have been reported in Table 3 of the specialist flora document GCNRC (2010b). The assessments and field survey observations concluded that none of the threatened flora species recorded or predicted to occur in the wider region around the Yarraboldy Extension area do occur within the Project Site. Consequently, preparation of a Referral (EPBC Act) would not be required for the Project nor is an assessment under the EPBC Act guidelines required.

4B.3.5 Assessment of Impacts

The Project would have minimal impact on the threatened or endangered vegetation. The following conclusions have been reached from the assessments conducted in conjunction with field surveys.

- No threatened (TSC Act) plant species have been previously recorded within the study area and none were recorded during the field survey.
- No threatened (EPBC Act) plant species have been previously recorded within the study area and none were recorded during the field survey.
- Despite predictions and records that indicated that a number of threatened flora species might be likely to occur within the site, none of these were recorded.
- There are no occurrences within the Project Site of endangered flora populations listed in the Schedules of the TSC Act or under the EPBC Act.
- There are no endangered or critically endangered ecological communities recorded within the Project Site. Consequently it is concluded that none would be affected by the Project and that there would be no significant impact on the habitat of any endangered ecological community.
- There is no critical habitat listed for the study area or its environs.

GCNRC (2010b) concluded there would be no significant impact on threatened (TSC Act, EPBC Act) flora species, endangered ecological communities, endangered flora populations (listed in the Schedules of the TSC Act or under the EPBC Act) or critical habitat as a consequence of the proposed Yarraboldy Extension.

The Project would have impacts on four Key Threatening Processes, namely:

- clearing of native vegetation;
- removal of dead wood and dead trees;
- loss of hollow-bearing trees; and
- bushrock removal.

Clearing of native vegetation is listed as a Key Threatening Process under the NSW TSC Act and land clearing is similarly listed under the Commonwealth EPBC Act. The other three Key Threatening Processes are listed in the Schedules of the TSC Act.

Clearing of native vegetation has been a process that has occurred within the Project Site for many years as a consequence of its use for mining and forestry purposes. Removal of dead wood and dead trees and loss of hollow-bearing trees have also occurred within the Project Site in the past.

It is unknown if the area has been subject to bushrock removal in the past.

The proposed development of the Yarraboldy Extension would accelerate the operation of all four processes in the initial stages of the Project.

4B.3.6 Design Features, Operational Safeguards, Mitigation Measures and Offset Strategies

Minimal operational safeguards, mitigation measures and offset strategies would need to be implemented for the Project since the flora assessment for the Project has concluded that no threatened plant species, endangered flora populations, endangered or critically endangered ecological communities and critical habitat exist within the Project Site. It has therefore been concluded that none of the above would be affected by the proposed Yarraboldy Extension and that there will be no significant impact on the habitat of any endangered ecological community.

However, to minimise impacts of removal of native vegetation, removal of dead wood and dead trees, loss of hollow-bearing trees and bushrock removal, two operational safeguards would be implemented. It is proposed to save the fallen logs and tree trunks and branches and to replace them on the rehabilitated landscape at the cessation of mining and to replant the rehabilitated land with native tree and shrub species representative of those that would be cleared. Over time, these actions would compensate for the impact of the initial removal.

Any bushrock that may be present on the surface of the areas to be cleared at the Project Site would be saved with the topsoil and re-spread during the rehabilitation phase to ensure that the Project Site is returned to its near-original groundcover.

4B.4 FAUNA

The fauna assessment for the Project was undertaken by Ecotone Ecological Consultants (Ecotone Ecological Consultants, 2010). The full assessment is presented as Part 5 of the *Specialist Consultant Studies Compendium*. This subsection presents a summary of the contents of the fauna assessment report.

4B.4.1 Introduction

Based on the risk analysis undertaken by R.W. Corkery & Co Pty Limited for the Project (Section 3.3 and **Table 3.7**) the potential impacts on fauna requiring assessment and their **unmitigated** risk rating are as follows.

- Loss of threatened fauna habitat (Extreme).
- Reduced species diversity (high).
- Disturbance leading to local reduction of threatened aquatic fauna (low).
- Disturbance leading to regional reduction of threatened aquatic fauna (moderate).

In addition, the Director-General's Requirements issued by the DoP identified "Biodiversity" as one of the key issues that requires assessment at the Project Site. The assessment of impacts on biodiversity is required to include the following relating to fauna.

- A detailed assessment of the potential impacts on terrestrial or aquatic threatened species, populations, ecological communities or their habitats.
- A detailed description of the measures that would be implemented to avoid or mitigate impacts on biodiversity.
- Determination if an offset strategy is required to ensure the project maintains or improves the biodiversity values of the region in the medium to long term (in accordance with NSW and Commonwealth policies.

The following sub-sections describe and assess the existing threatened species and their habitat, identify the ecological management issues, proposed controls, safeguards and mitigation measures for the threatened species and their habitat.

4B.4.2 Study Methodology

4B.4.2.1 Desktop Assessment

The desktop component of the fauna assessment involved a review of fauna surveys and assessments previously conducted in the vicinity of the Project Site, a search of DECCW's 'Atlas of NSW Wildlife' for threatened fauna species, populations and critical habitat within the Bathurst (8831) and Wallerawang (8931) 1:100 000 map sheets and a search for matters protected under the EPBC Act, including threatened and migratory species, within 10km of the Project Site.

The following previous studies were also used for compilation of fauna species likely to be present at the Project Site.

- Fauna Assessment for the Pine Dale Coal Mine (Countrywide Ecological Service, 2004).
- Draft Terrestrial Fauna Impact Assessment for the Proposed Pine Dale Coal Mine Stage 1 and 2 (Ecotone Ecological Consultants, 2009).
- Flora and Fauna Survey and Assessment Mt Piper Power Station Perimeter Lands and Thompsons Creek Dam (Ecotone Ecological Consultants, 1996).

4B.4.2.2 Field Surveys

Field surveys targeting the Yarraboldy Extension area were undertaken by Ecotone Ecological Consultants between 12 and 17 April 2010 with a supplementary survey targeting trapping of small and medium arboreal mammals undertaken by LesryK Environmental Consultants between 31 May and 4 June 2010.

Sampling techniques included walking traverses, tree hollow assessment, Koala feed tree and scat searches, diurnal bird census, reptile and frog searches, spotlight, call broadcast, Elliot and harp trap surveys and use of Anabat ultrasonic bat call detectors. The locations of the various survey techniques are shown in **Figure 4B.16**.

Further details regarding survey technique and effort are provided in Ecotone Ecological Consultants (2010).

4B.4.3 Results

4B.4.3.1 Fauna Species

Based on the review of previous studies and database searches, 54 species of threatened or migratory fauna species and one preliminary listed threatened species were recorded, predicted or are considered to have some potential to occur within the locality. Of these, 39 are considered to have a moderate to high possibility or are known to occur within the Yarraboldy Extension area (see **Table 4B.12**)

During the field survey, a total of 73 species of vertebrate fauna were positively identified including four species of frogs, six reptiles, 18 mammals and 45 species of birds. Of these species, three are listed as vulnerable under the TSC Act (Scarlet robin, Gang-gang cockatoo and Grey-headed flying-fox) and one as vulnerable under the EPBC Act (Grey-headed flying-fox). Two of the species are introduced species (Rabbit and Pig). No species listed as migratory under the EPBC Act were recorded.

An additional six species of insectivorous bats were identified with "possible" or "probable" confidence by analysis of calls recorded by Anabat call detectors. Of these six species, four are listed as vulnerable under the TSC Act (Large-eared pied bat, Eastern bent-wing bat, Eastern cave bat and Yellow-bellied sheath-tail bat) and one as vulnerable under the EPBC Act (Large-eared pied bat).

Despite searches, no Koala scats were observed nor did any scratch marks on the trunks of trees resemble the characteristic scratch mark made by the Koala. **Figure 4B.17** shows the locations of threatened fauna species recorded during the survey.

4B.4.3.2 Endangered Populations

No endangered fauna populations have been identified as occurring or likely to occur within the locality and none were recorded.

4B.4.3.3 Fauna Habitat and Wildlife Corridors

The area is not identified as a regional biodiversity corridor or a potential priority fauna habitat by the Regional Biodiversity Corridor and Priority Fauna Habitats map of the Hawkesbury-Nepean catchment (HNCMA, 2007). The Yarraboldy Extension area also does not provide a link between two or more discrete forested areas at the local scale, although animals in transit may move more readily along the bottom of the hills adjoining the Yarraboldy Extension area than over them, and therefore the site may represent a route for some local fauna movement.

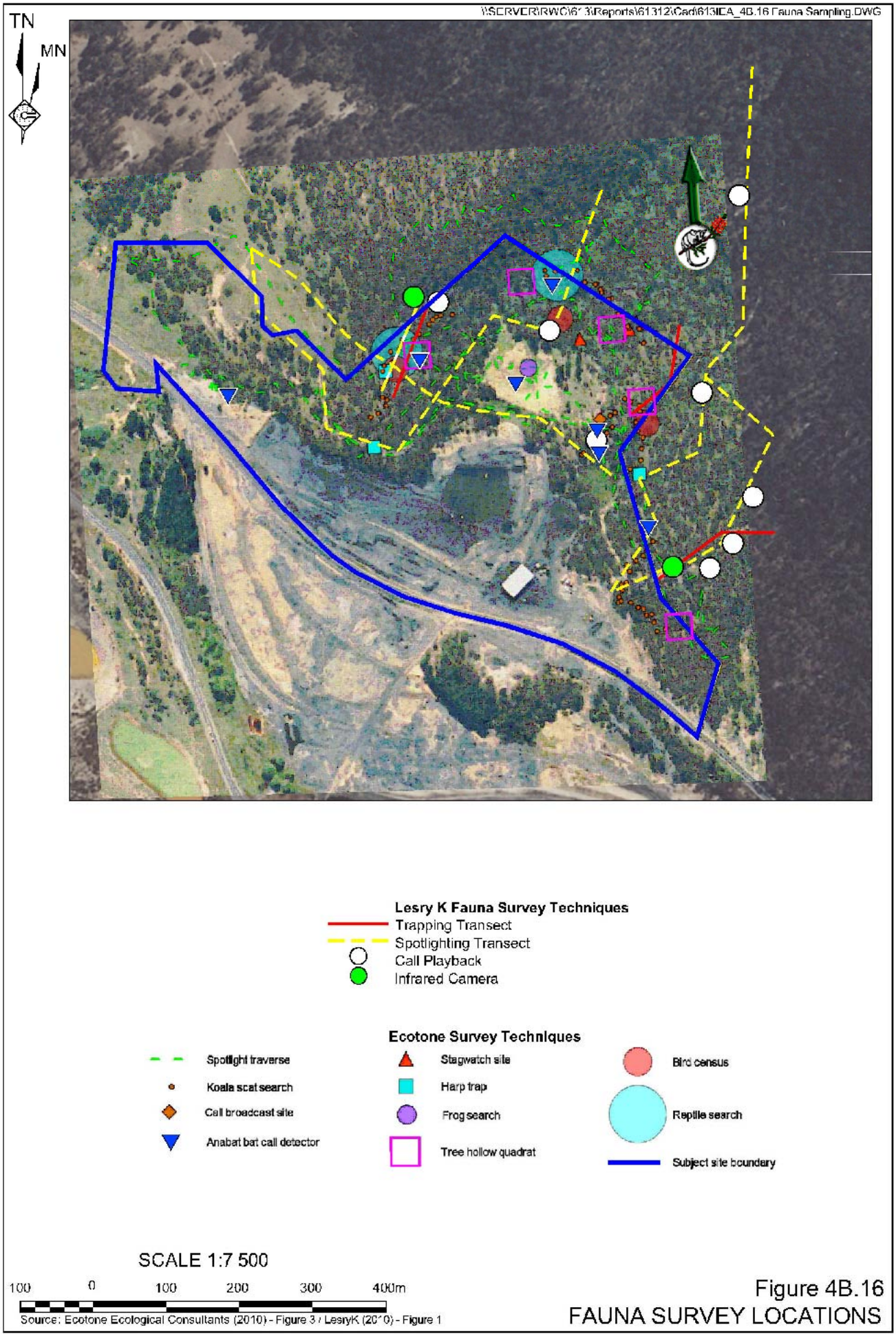


Figure 4B.16
FAUNA SURVEY LOCATIONS

Table 4B.12
Threatened Fauna Species with Potential to Occur within the Extension Area

Scientific Name	Common Name	Status (TSC)	Status (EPBC)	Potential to Occur in Subject Site
Litoria aurea	Green and golden bell frog	V	V	Low
Calyptorhyncus lathami	Glossy black-cockatoo	V	-	Moderate
Lophoictinia isura	Square-tailed kite	V	-	Moderate
Hieraeetus morphnoides	Little eagle	V	-	High
Haliaeetus leucogaster	White-bellied sea-eagle	-	M	High
Callocephalon fimbriatum	Gang-gang cockatoo	V	-	Known
Glossopsitta pusilla	Little lorikeet	V	-	High
Climacteris picumnus victoriae	Brown treecreeper	V	-	Moderate
Pyrrholaemus sagittatus	Speckled warbler	V	-	Moderate
Melanodryas cucullata cucullata	Hooded robin	V	-	Low-Moderate
Daphoenositta chrysoptera	Varied sittella	V	-	High
Stagonopleura guttata	Diamond firetail	V	-	High
Grantiella picta	Painted honeyeater	V	-	Moderate
Melithreptus gularis gularis	Black-chinned honeyeater	V	-	High
Xanthomyza phrygia	Regent honeyeater	E	E	High
Petrocia phoenicea	Flame robin	V	-	Moderate
Petroica boodang	Scarlet robin	V	-	Known
Lathamus discolor	Swift parrot	V	E	Moderate
Neophema pulchella	Turquoise parrot	V	-	Moderate
Artamus superciliosus	White-browed woodswallow	P(V)	-	Moderate
Apus pacificus	Fork-tailed swift	-	M	Moderate
Ninox connivens	Barking owl	V	-	High
Ninox strenua	Powerful owl	V	-	High
Tyto novaehollandiae	Masked owl	V	-	High
Hirundapus caudacutus	White-throated needletail	-	M	High
Meraps ornatus	Rainbow bee-eater	-	M	High
Monarcha melanopsis	Black-faced monarch	-	M	Moderate
Rhipidura rufifrons	Rufous fantail	-	M	Moderate
Myiagra cyanoleuca	Satin flycatcher	-	M	Moderate
Chalinolobus dwyeri	Large-eared pied bat	V	V	High
Falsistrellus tasmaniensis	Eastern false pipistrelle	V	-	High
Miniopterus schreibersii oceanensis	Eastern bent-wing bat	V	-	High
Mormopterus norfolkensis	East-coast freetail bat	V	-	High
Myotis macropus	Large-footed myotis	V	-	Low
Saccolaimus flaviventris	Yellow-bellied sheath-tail bat	V	-	Moderate
Scoteanax rueppellii	Greater broad-nosed bat	V	-	High
Vespadelus troughtoni	Eastern cave bat	V	-	Moderate
Pteropus poliocephalus	Grey-headed flying-fox	V	V	Known
Phascolarctus cinereus	Koala	V	-	Low
Petaurus norfolcensis	Squirrel glider	V	-	High
Dasyurus maculatus	Spotted-tailed quoll	V	E	High
Paralucia spinifera	Purple copper butterfly	E	V	High

V = Vulnerable, E = Endangered, M = Migratory, P(V) = Preliminary determination (Vulnerable).
Source: Ecotone (2010) – Table 9

During the field survey, ten fauna habitat types were identified within the Yarraboldy Extension area as follows and shown on **Figure 4B.18**.

- Snow gum low open forest (1.3ha).
- Red gum-Peppermint open forest (4.2ha).
- Red gum-Peppermint-Stringybark open forest (1.2ha).
- Re-growth woodland (0.6ha).
- Wetlands (1.0ha).
- White gum open forest (0.8ha).
- Mountain gum tall open forest (1.3ha).
- Red gum-Box-Stringybark open forest (4.5ha).
- Mixed grassland/shrubland (2.1ha).
- Disused coal mine and bare earth (9.8ha).

A tree hollow assessment was completed for each habitat type containing hollows and is summarised in **Table 4B.13**. The assessment found relatively high densities of hollow bearing trees throughout most of the wooded habitats which cover approximately half of the Yarraboldy Extension area.

The mixed grassland and shrubland (2.1ha), re-growth woodland (0.6ha) and disused coal mine (10ha) contained no trees or logs with hollows. However, Ecotone Ecological Consultants (2010) considers that the former mine workings entry located at the base of the Yarraboldy Open Cut could provide potential roosting habitat for certain bats.

The wetland habitats identified consisted of two water bodies, namely an excavated dam with a surface area of approximately 0.2ha and one shallow, ephemeral wetland covering approximately 0.8ha.

The banks of the dam were mainly vegetated with plant species that occurred in the adjoining forest habitat, with the exception of a small moist area of herbs and occasional sedges along part of the wetland edge. Two very small occurrences of Bulrush (<5 m^2 combined) existed within the water body.

The shallow, ephemeral wetland occurred in the central northern part of the Yarraboldy Extension area, immediately behind an earth wall which had been constructed across the main gully that drains into the Yarraboldy Open Cut Mine. This wetland had an estimated depth of up to 0.3m. The water body was fringed with herbs, grasses and occasional sedges growing in moist sediment.

No running streams, water flow channels or vegetation recognisable as riparian vegetation occur in Yarraboldy Extension area. Furthermore, none of the vegetation was considered to constitute a groundwater dependent ecosystem.

A fish survey was not conducted but the artificial nature of the water bodies and the distance from natural bodies of water makes it unlikely that the dam and wetland area would be occupied by native fish.

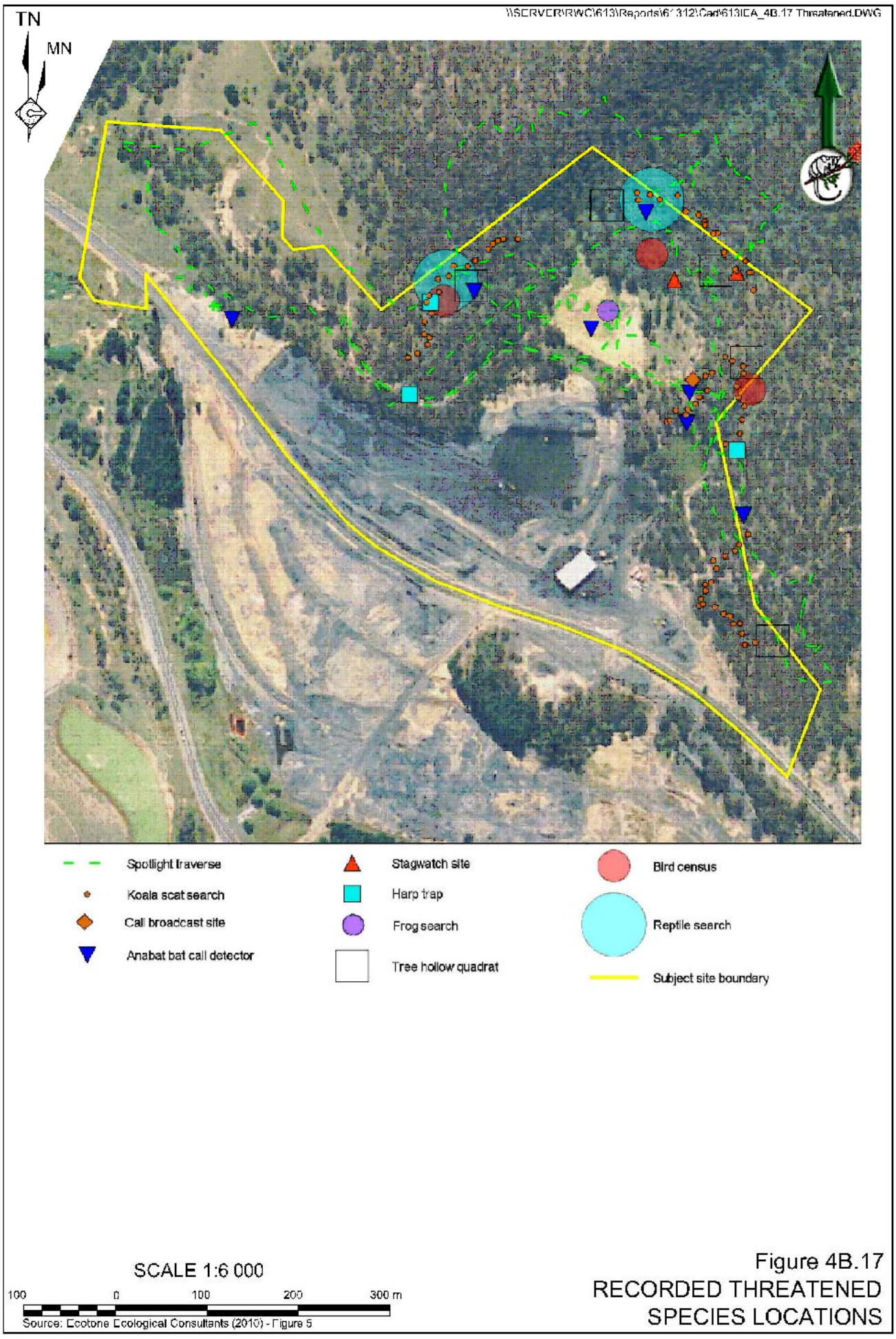


Figure 4B.17
RECORDED THREATENED SPECIES LOCATIONS

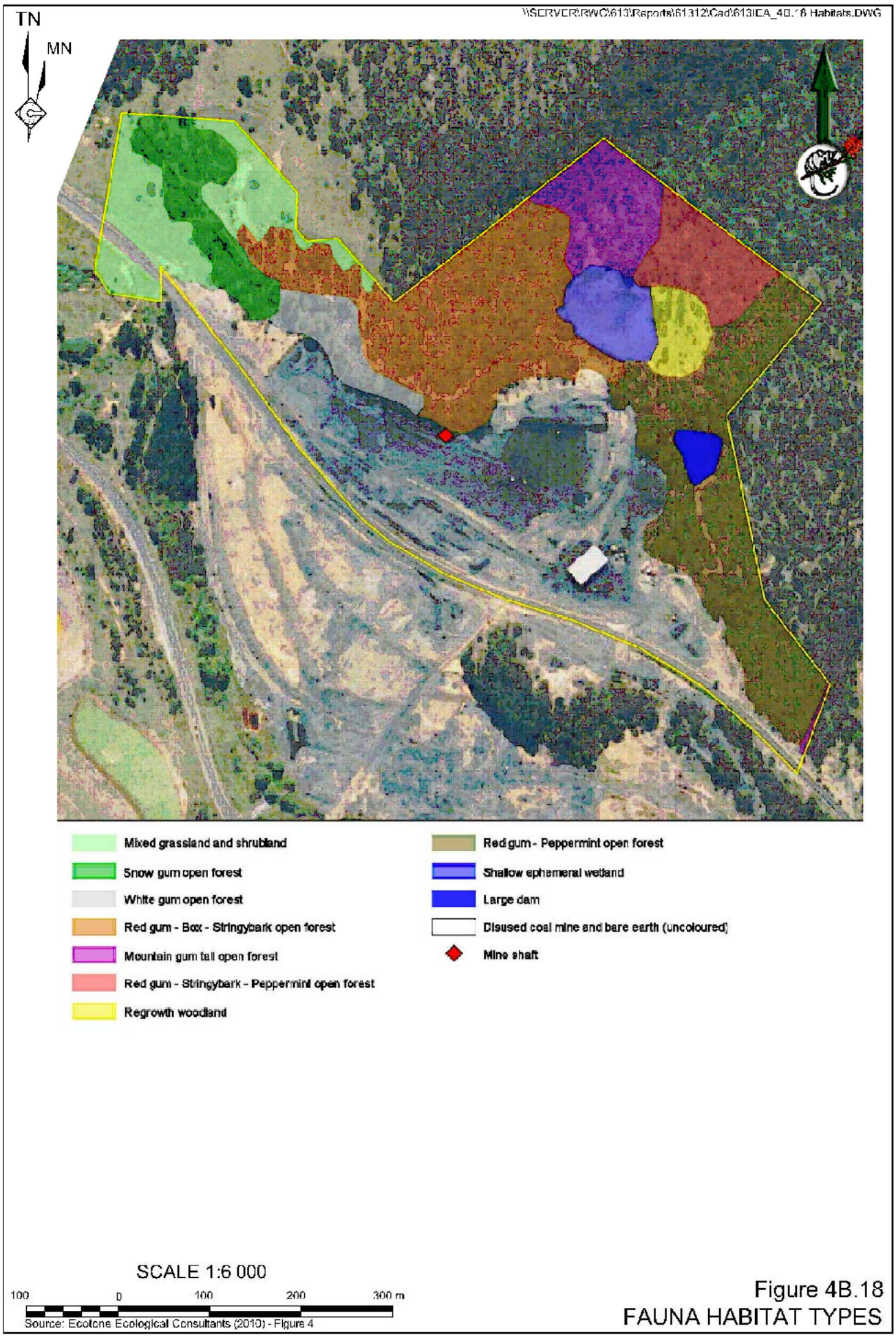


Figure 4B.18
FAUNA HABITAT TYPES

Table 4B.13
Results of Tree Hollow Assessment

Habitat	Sample Area	No. of Hollow-bearing Trees	Largest Hollow Diameter	Notes
Snow gum low open forest	entire extent (1 ha)	7	<10 cm	Mostly <5 cm diameter
White gum open forest	entire extent (0.9 ha)	7	<10 cm	Mostly < and around 5 cm diameter
Red gum-Box-Stringybark open forest	0.25 ha	19	>40 cm	Mostly <10 cm, many >10 cm diameter
Ribbon gum tall open forest	0.25 ha	14	25 cm	Mostly <5 cm, several 5-10 cm and few >10 cm diameter
Red gum-Peppermint-Stringybark open forest	0.25 ha	13	20 cm	Mostly < and around 5 cm but good range of sizes (up to >40 cm in this habitat ex-quadrat)
Red gum-Peppermint open forest	0.25 ha	25	40 cm	Mostly <5 cm, many 5-10 cm, several > 10 cm, few > 30 cm
	0.25 ha	9	15 cm	Mostly <5 cm, some 5-10 cm (re-growth forest)
Re-growth woodland	Entire extent (0.6 ha)	0	-	Re-growth, no mature trees

Source: Ecotone (2010) – Table 8

4B.4.4 Biodiversity Management Strategy and Management Measures

Although it is not possible to further avoid impacts from the proposed clearing, as discussed in Section 2.3.4, the principle of avoiding impacts has been taken into consideration during the environmental planning process whereby the location of the extension area has been centred over an area previously disturbed by open cut coal mining activities. Specifically, 10ha of the 27ha extension area is bare earth whilst much of the surrounding forest and woodland area has previously been disturbed to varying extents.

In order to further reduce the potential impacts of the proposed extension, a Flora and Fauna and Rehabilitation Management Plan would be developed as part of the overall biodiversity management strategy. These plans would be developed in consultation with the DECCW prior to any clearing activities within the forest or woodland areas.

The Flora and Fauna and Rehabilitation Management Plan would provide for the following mitigation and management measures.

- A survey to determine the presence of breeding/nesting native fauna within the woodland and forest areas by a suitably trained or qualified person prior to undertaking clearing, within several days prior to all vegetation clearing works. This survey would be undertaken by inspection of trees from the ground and by searches for other evidence of nesting, particularly by threatened bird species.
- A suitably experienced person to be present on site during tree clearing works to rescue and release native fauna that are unable to escape to adjacent forest. Should any injured fauna be located they would be taken to a wildlife rehabilitation organisation, such as WIRES, or to veterinary surgeon with native fauna experience.

- A procedure for blocking the entrance to the underground mine entry within the Yarraboldy Open Cut Mine at a time when bats that could potentially utilise the entrance are least likely to be inside.
- Recovery, where practicable, of tree hollows through cutting and salvage during clearing works and installation on trees in adjoining forest.
- Transplanting of the approximately 20 Bursaria plants occurring in the eastern part of the extension area adjacent to an existing Bursaria patch. Works would be directed by a suitably qualified horticulturalist or bush regenerator.
- Monitoring of the occurrence and behaviour of larvae, attendant ants and adults of the Purple copper butterfly in patches of Bursaria adjacent to the Yarraboldy Extension area to demonstrate that the mining activities are not having a significant effect on the life cycle of this species.
- Installation of artificial next boxes of a range of sizes and designs and salvaged hollows on trees in adjoining forest during vegetation clearing works.
- Weed management to control noxious and invasive weeds from invading rehabilitated areas and the surrounding forest.
- A revegetation plan incorporating the following provisions.
  - Salvage of live tree trunks greater than 30cm in diameter and storage and redistribution as fallen logs over rehabilitation areas prior to revegetation.
  - Mulching of vegetative material not required for other purposes, storage and redistribution over rehabilitation areas.
  - Salvage of dead tree trunks and logs, storage and redistribution over rehabilitation areas prior to revegetation.
  - Planting of clumps of *Bursaria spinosa* subspecies *lasiophylla* grown from locally collected seed in the rehabilitation areas to provide potential habitat for the Purple copper butterfly.
  - Planting of a diverse range of native plant species grown from locally collected seed throughout the rehabilitation areas at densities determined to be appropriate by a suitably qualified person.

The Proponent is also committed to establishing a biodiversity offset in consultation with DECCW and DoP within 18 months of Project Approval. The offset would ideally include like for like vegetation to that which would be cleared as a result of the Project and may potentially include a research project(s) as agreed with DECCW.

4B.4.5 Assessment of Impacts

An assessment of impacts has been completed by Ecotone Ecological Consultants (2010) for all threatened or migratory species recorded or potentially occurring within the proposed extension area (see **Table 4B.12**) in accordance with Part 3A of the EP&A Act, the EPBC Act and relevant guidelines.

It was assessed that the proposed extension would impact directly on the habitat of several threatened fauna species through the removal of foraging, roosting and nesting resources which could potentially cause displacement of individual animals into adjacent forest and, possibly, mortality of some individual fauna.

However, based upon assessment under the relevant TSC Act and EPBC Act guidelines, it was concluded that these impacts are unlikely to have a significant effect on any of the threatened fauna species considered.

It was also assessed that the proposed extension would not sever an existing link between two discrete habitat patches, and on a broad scale would have a negligible impact on habitat connectivity. At a site scale, habitat would be removed from around the edges of the lower slopes of two ridges, as well as from the gully separating them which would make movement between these two ridges more energetically expensive. However, rehabilitation of this habitat following mining would effectively replace, and expand, this connectivity for most forest-dependent species in the medium term.

As there are no areas of recommended critical habitat or declared critical habitat within the proposed Yarraboldy Extension area none would be adversely affected.

In relation to the maintenance or improvement of biodiversity values, although there would be a net increase in vegetation within the extension area, the biodiversity values of the extension area would remain relatively low for some period of time. However, this would be mitigated through the establishment of the biodiversity offset area. Therefore, the overall biodiversity values would be maintained in the short term and enhanced in the long term as the rehabilitated areas mature.

4B.4.6 Conclusion

The proposed extension would result in the removal of approximately 14ha of native forest, 2ha of grassland/shrubland, 1ha of artificial wetland and 10ha of un-rehabilitated open cut coal mine. This includes known habitat for three threatened fauna species and potential habitat for a number of additional threatened and migratory species.

A number of measures designed to mitigate these impacts are included as part of the proposed extension. If these management measures are implemented, it is unlikely that the proposed extension would affect any threatened or migratory species in such a way that would result in a significant impact under the considerations provided by Part 3A of the EP&A Act or the EPBC Act. Additionally, no critical habitat, as defined by the TSC Act and the EPBC Act, would be affected. Therefore, it is not necessary to refer this matter to the Federal Environment Minister. With the implementation of the proposed biodiversity offset, it is also assessed that the Project would meet the maintain or improve principle for biodiversity values.