Enhance Place Pty Limited
ABN: 31 077 105 867

Water Management Plan

for the

Pine Dale Coal Mine

(Including the Yarraboldy Extension)

August 2015

Revision History				
Version	**Revision Date**	**Reason for Revision**	**Author**	**Authorised by:**
1	June 2011	First edition	RW Corkery & Co	Hilton Goldfinch
2	August 2015	Care and Maintenance	Coleen Milroy	Graham Goodwin

APPENDICES

FIGURES

TABLES

ACRONYMS USED THROUGHOUT THIS REPORT

AEMR	-	Annual Environmental Management Report
ANZECC	-	Australian and New Zealand Environment and Conservation Council
DECCW		Department of Environment, Climate Change and Water
DPE	-	Department of Planning and Environment
WMP	-	Water Management Plan
OEH	-	Office of Environment and Heritage

1. INTRODUCTION

This Water Management Plan (WMP) for the Pine Dale Coal Mine, incorporating the Yarraboldy Extension, ("the mine") has been prepared in accordance with *Schedule 3 Condition 27* of Project Approval 10_0041 and the document *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th eds.* (Landcom, 2004) and *Volume 2E Mines and Quarries* (DECC, 2008).

The WMP incorporates:

- the predicted site water balance (Section 6);
- a Surface Water Management Plan (Section 7); and
- a Groundwater Management Plan (Section 8).

Table WM1 provides further detail relating to the coverage of the specific requirements of *Schedule 3 Condition 27*.

The WMP has been prepared in conjunction with RPS Aquaterra and GSS Environmental and in consultation with the Office of Water and Heritage (OEH) – formerly Department of Environment, Climate Change and Water (DECCW) and the NSW Office of Water (NOW).

The WMP builds upon and refines the water management concepts in the *Environmental Assessment* prepared for the Yarraboldy Extension and has been prepared for the life of the mine. However, following the commencement of mining the WMP will be reviewed on an annual basis and, if required, updated to reflect any changes to water management requirements and operational experience. Any updates to the WMP will be submitted to the Department of Planning and Environment (DPE) for endorsement.

The Pine Dale Mine has been placed on care and maintenance following cessation of all coal extraction in April 2014. While in Care and Maintenance, Pine Dale will continue to meet environmental approvals and obligations. This environmental management plan has been modified to reflect the current reduced impact consistent with the care and maintenance term. Rehabilitation activities are proposed during the care and maintenance term only. The current Water Management Plan in accordance with Schedule 3 CoA 27, including surface and groundwater monitoring, will remain in place for the duration of the care and maintenance term.

2. SCOPE

The scope of the WMP applies to the mine, incorporating ML 1569, ML 1578, and MLA 375, and covers all activities during the care and maintenance term which may impact on, or influence a risk to noise emission management. The purpose of the WMP is to:

a) Describe site water balances (Section 6.0);

b) Detail the surface water management plan (Section 7.0);

c) Describe the water management system (Section 7.3);

d) Detail the erosion and sedimentation control plan (Section 7.4);

e) Describe the management of potentially acid generating material (Section 7.5);

f) Detail the surface water monitoring program (Section 7.6);

g) Describe the surface water assessment criteria and trigger levels (Section 7.6.2);
h) Describe surface water monitoring, locations, parameters and frequency (Section 7.6.3);
i) Detail inspections and maintenance (Section 7.6.4);
j) Detail channel stability and stream health monitoring (Section 7.6.5);
k) Describe surface water protocol for response measures (Section 7.7);
l) Describe the groundwater management plan (Section 8.0);
m) Identify groundwater monitoring locations, parameters and frequency (Section 8.2);
n) Describe the groundwater assessment criteria and trigger levels (Section 8.3);
o) Identify the groundwater response measures (Section 8.4);
p) Describe the data management protocol (Section 9.0);
q) Describe the process for reporting, review and validation (Section 10);
r) Describe responsibilities and accountabilities (Section 11);

3. OBJECTIVES

In accordance with *Schedule 3 Condition 27* of PA 10_0041, this Surface Water Management Plan (SWMP) incorporates the following.

- The objectives of site water management (see Section 7.2)
- A description of the water management system on site (see Section 7.3).
- An erosion and sediment control plan (see Section 7.4).
- Measures to manage potentially acid generating material (see Section 7.5).
- A program to monitor surface water flows and quality (see Section 7.6).
- A plan to respond to any exceedances in the performance criteria caused by the mine (see Section 7.7).

In accordance with *Schedule 3 Condition 27* of PA 10_0041, this Groundwater Management Plan (GMP) incorporates the following.

- A program to monitor groundwater inflows, levels and quality to the open cut mining operation (see Section 8.2).
- Groundwater impact assessment criteria and trigger levels (see Section 8.3).
- A program to monitor any potential impacts to the baseflow of Neubecks Creek and any surrounding registered groundwater bores (see **Tables WM7** and **WM10**).
- A plan to respond to any exceedances in the performance criteria and offset the loss of any base flows to Neubecks Creek caused by the mine (see Section 8.4).

4. SITE LOCATION AND DESCRIPTION

The Pine Dale coal mine is owned and operated by Enhance Place Pty Ltd (Enhance Place), located approximately 17 kilometres north-west of Lithgow and 5km north of Wallerawang in New South Wales (see **Figure BF1**).

Extractive open cut mining operations ceased in April 2014 when Approved mineable resources were exhausted. Rehabilitation activities are currently being undertaken consistent with the Approved Care and Maintenance Mining Operations Plan.

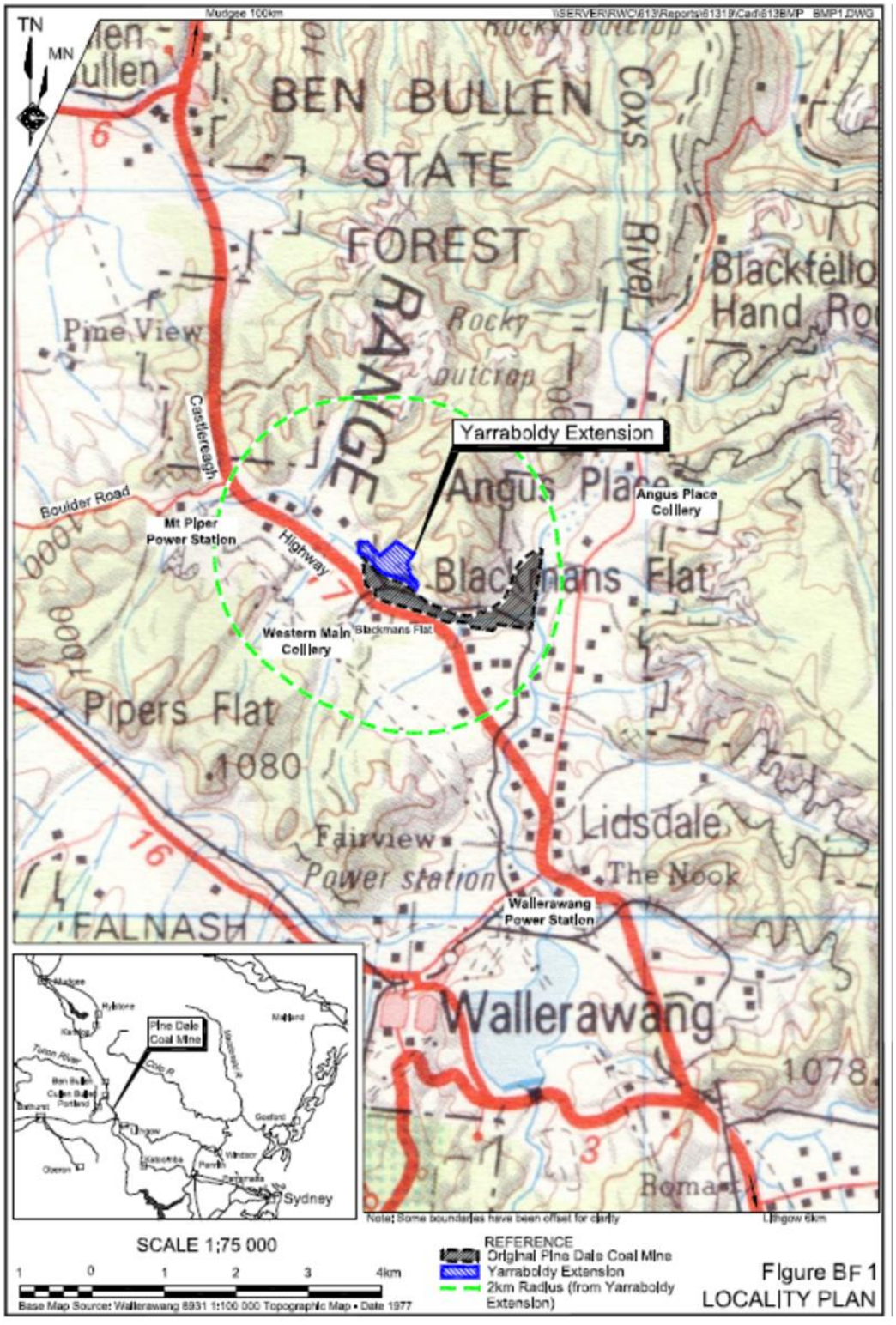


Figure BF1 Locality Plan

5. APPROVAL REQUIREMENTS

Other conditional requirements within PA 10_0041 relevant to water include the following are detailed below in Table 1.

Ref	Project Approval Condition
Water Discharges Schedule 3 Condition 23	*The Proponent shall ensure that all surface water discharges from the site comply with the discharge limits (both volume and quality) set for the project in any EPL.*
Baseflow Offsets Schedule 3 Condition 24	*The Proponent shall offset the loss of any baseflow to the surrounding watercourses and/or associated creeks caused by the project to the satisfaction of the Director-General.* *Notes: This condition does not apply if the baseflow losses are negligible. Offsets should be provided via the retirement of adequate water entitlements to account for the loss attributable to the project.*
Compensatory Water Supply Schedule 3 Condition 25	*The Proponent shall provide a compensatory water supply to any owner of privately-owned land whose water entitlements are adversely impacted (other than an impact that is negligible) as a result of the project, in consultation with NOW, and to the satisfaction of the Director-General.* *The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent to the loss attributed to the project. Equivalent water supply must be provided (at least on an interim basis) within 24 hours of the loss being identified.* *If the Proponent and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Director-General for resolution.* *If the Proponent is unable to provide an alternative long-term supply of water, then the Proponent shall provide alternative compensation to the satisfaction of the Director-General.*
Baseline water monitoring plan Schedule 3 Condition 26	*The Proponent shall prepare and implement a Baseline Water Monitoring Plan for the project to the satisfaction of the Director-General. This plan must:* (a) *be prepared in consultation with DECCW and NOW by suitably qualified and experienced persons whose appointment has been approved by the Director-General;* (b) *be submitted to the Director-General for approval by the end of February 2011; and* (c) *include programs for:* • *consultation with other industries in the vicinity of the mine to gather existing surface water data;* • *intensive baseline monitoring to be conducted for the first 6 months of site establishment to provide detailed data on surface water flows/levels and quality in creeks and other waterbodies that could be affected by the project (including the Neubecks Creek, the Blue Lake and the Coxs River).*
Water management plan Schedule 3 Condition 27	*The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan mustbe prepared in consulatation with OEH and NOW by suitably qualified and experienced persons whose appointment has been approved by the Director-General, and submitted to the Director-Generalfor approval by the end of April 2011.* *In addition to the standard requirements for management plans (see Condition 2 of*

Ref	Project Approval Condition
	Schedule 5), this plan must include: *(a) a Site Water Balance that:* • *includes details of:* - *sources and security of water supply;* - *water use on site; and* - *reporting procedures; and* • *describes what measures would be implemented to minimise potable water use on site.* *b) a Surface Water Management Plan, that includes:* • *a detailed description of the water management system on site, including the:* - *clean water diversion systems;* - *erosion and sediment controls; and* - *water storages;* • *a plan for identifying, extracting, handling, and the long-term storage of potentially acid forming materials on site;* • *detailed plans, including design objectives and performance criteria, for:* - *reinstatement of drainage lines on the rehabilitated areas of the site; and* - *control of any potential water pollution from rehabilitated areas of the site;* • *performance criteria for the following, including trigger levels for investigating any potentially adverse impacts on:* - *the water management system;* - *surface water quality in creeks and other water bodies that could potentially be affected by the project (including Neubecks Creek, the Blue Lake and Coxs River);* - *the stream health, vegetation health and channel stability of water bodies that could potentially be affected by the project* • *a program to monitor:* - *the effectiveness of the water management system;* - *surface water flows and quality in creeks and other water bodies that could potentially affected by the project;* - *the stream health, riparian vegetation health and channel stability of creeks and other water bodies that could potentially affected by the project;* • *a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the project; and* *(c) a Groundwater Management Plan, which includes:* • *groundwater assessment criteria, including trigger levels for investigating and potentially adverse groundwater impacts;* • *a program to monitor:* - *groundwater inflows to the open cut mining operation* - *the impacts of the project on;* o *baseflows to Neubecks Creek;* o *any groundwater bores on privately owned land; and* • *a program to validate the groundwater model for the project, and calibrate it to site specific conditions; and* • *a plan to respond to any exceedances of the performance criteria, and offset the loss of any baseflow to Neubecks Creek caused by the project.*
Table 1	

6. SITE WATER BALANCE

6.1 INPUTS

The water balance considers rainfall runoff generated during low (annual 10th percentile), average (annual 50th percentile) and high (annual 90th percentile) rainfall years. The rainfall data has been obtained from the Bureau of Meteorology monitoring station at Lidsdale (Maddox Lane) (Station No. 063132), which is considered to be the most representative long term data set of the mine site. Rainfall is as follows.

- Annual 10th percentile (dry year): 500.7mm
- Annual 50th percentile (average year): 762.8mm
- Annual 90th percentile (wet year): 942.2mm

For the purposes of the water balance the water catchment constitutes the entire Yarraboldy Extension area (27ha), however, variable runoff coefficients have been used for each stage of mining based on the expected area of rehabilitation, open cut pit and unmined land. The estimated runoff generated during average, wet and dry years during each stage of the mine is detailed in **Table WM2**.

Table WM1
Annual Average Dirty Catchment Surface Water Runoff

Indicative Mining Stage	Runoff (ML)		
	Dry Year	Av Year	Wet Year
0 to 6 months	19.5*	29.5*	36.5*
6 to 18 months	45	68	85
18 to 30 months	54	83	102
*Runoff values displayed for 6 month period.			

Table WM3 presents the groundwater inflows to the open cut predicted from groundwater investigations. In the event of significant differences in the volume of groundwater inflows into the open cut are experienced, the water balance will be revised.

Table WM2
Open Cut Inflow Estimates

Indicative Mining Stage	Estimated Pit Inflow (m^3/day)
0 to 6 months	44.7
6 to 18 months	29.7
18 to 30 months	30.4

In addition to these inflows up to a maximum of approximately 24ML of groundwater located within the existing former Wallerawang underground workings will also be dewatered during mining. Dewatering will be undertaken progressively during the active mining period. Accordingly, a rate of approximately 9.6ML/yr has been utilised within the water balance calculations across the 2.5 years of active mining. It is noted that actual volumes of water within the workings may be in the order of 7.4ML or less. Therefore, for management purposes, a separate water balance is also provided assuming the workings are completely dry.

6.2 OUTPUTS

Dust suppression will be the primary on-site water use with annual average usage estimated to be approximately 75ML with slightly more water used during dry years and less in wet years. All water used for dust suppression will be non-potable water sourced from the dirty water system or Wallerawang Underground Workings.

It is assumed that the only other loss will be evaporation from Water Retention Dam A and in-pit sump. Evaporation losses have been calculated based on average yearly evaporation being 1 350mm. with a factor of 0.7 applied for variations in the water level of the dam (i.e. it will not always be full). The combined annual average evaporation is estimated as 5ML.

6.3 WATER BALANCE

The water balance for average, wet and dry years assuming 24ML of water is contained within the underground workings is presented in **Table WM4** whilst a water balance assuming dry workings is presented in **Table WM5**.

Table WM3
Water Balance Assuming 24ML of Water within Underground Workings

Inputs and Outputs		Dry Year (ML)	Avg Year (ML)	Wet Year (ML)
INPUT	**0 to 6 months ***	32.5	42.5	49.5
	6 to 18 months	65.4	88.4	105.4
	18 to 30 months	74.7	103.7	122.7
OUTPUT (annual):		87.5	80	72.5
BALANCE	**0 to 6 months ***	**-11.3**	**2.5**	**13.3**
	6 to 18 months	**-22.1**	**8.4**	**32.9**
	18 to 30 months	**-12.8**	**23.7**	**50.2**
* The input and balance values for site establishment are displayed for the six month period not annual				

Table WM4
Water Balance Assuming Dry Underground Workings

Inputs and Outputs		Dry Year (ML)	Avg Year (ML)	Wet Year (ML)
INPUT	**0 to 6 months ***	27.7	37.7	44.7
	6 to 18 months	55.8	78.8	95.8
	18 to 30 months	65.1	94.1	113.1
OUTPUT (annual):		87.5	80	72.5
BALANCE	**0 to 6 months ***	**-16.1**	**-2.3**	**8.5**
	6 to 18 months	**-31.7**	**-1.2**	**23.3**
	18 to 30 months	**-22.4**	**14.1**	**40.6**
* The input and balance values for site establishment are displayed for the six month period not annual				

As can be seen in **Tables WM4** and **WM5**, there is an excess of water in wet years and a deficit in dry years. During average rainfall, depending on the volume of water within the underground workings, for the first 18 months of operation the balance may be in slight excess or deficit. However, during months 18 to 30 an excess of water is expected during average rainfall due to the increase in groundwater inflows. If required, excess water will be discharged through the licenced discharge point LDP13 to Neubecks Creek. Any additional water required during dry years will be pumped from the underground workings down dip of the Yarraboldy Extension Area in accordance with groundwater licences 10BL604437 and 10BL604438.

Dust suppression has been the primary on-site water use with annual average usage estimated to be approximately 75ML. However, due to the ongoing rehabilitation of the site during the Care and Maintenance period the average usage has been greatly reduced. As such there will be limited water use during the Care and Maintenance period with water predominately used for maintenance and rehabilitation activities.

6.4 WATER LICENCING AND SECURITY

All surface water runoff collected within the Yarraboldy Extension Area will be classified as 'dirty' water which is exempt from harvestable right calculations under the *NSW Dams Policy 1999*. Where practicable, all clean water will be diverted around areas of disturbance into existing drainage lines. Further detail of surface water management is provided in Section 7.

Groundwater may be intercepted within the underground workings during formation of the open cut area and, if required, pumped from the underground workings as make up water for dust suppression in the event of a water deficit (see Section 6.3). Licences have been issued for these activities to obtain up to 200ML per year of groundwater from the open cut area and Wallerawang Underground Workings. These groundwater licences, 10BL604437 and 10BL604438, are valid until 11 April 2016 (ie. following completion of the approved Yarraboldy Extension).

6.5 MEASURES TO REDUCE WATER USE / LOSS

The principal measures to reduce water use or loss, particularly potable water, will include the following.

- Avoidance of unnecessary or excessive use of the water cart.
- Use of 'dirty' water for dust suppression and any machinery washdown etc (ie. water runoff captured from disturbed areas or dewatered from the underground workings).

7. SURFACE WATER MANAGEMENT PLAN

7.1 INTRODUCTION

The mine is located in the Neubecks Creek catchment which is a sub-catchment of the Upper Coxs River, which in turn is part of the greater Warragamba Dam catchment. Natural drainage within the Yarraboldy Extension Area is generally to the south and southeast following the natural topography toward the receiving waters of Neubecks Creek.

A Care and Maintenance Risk Assessment (CMRA) has been undertaken for the Care and Maintenance term (Pine Dale Mine, 2014). Surface water pollution was generally identified to be a low risk due to minimal machinery being operated at the site. Machinery will be utilised for rehabilitation activities only during the care and maintenance term. In the event that heavy vehicles are required for planned activities or maintenance works and the haul road is used, the water cart will be made available. The water cart will draw water from designated water fill points as per this plan. Two areas considered a medium risk were waste rock emplacement management and tailings impoundment management. Water management including storm event contingency was considered a high risk for erosion and sediment minimisation. However, existing topsoil stockpiles are used in the rehabilitation of the site. Permanent diversion of clean water from above the disturbed areas and containment of runoff from disturbed areas is managed by sediment basins and temporary control measures including contour banks, drains and silt-stop fences. As mining activities have now ceased no potential adverse surface or groundwater impacts are anticipated during the Care and Maintenance term.

The current surface water management system will remain in place for the duration of the care and maintenance term and will be managed in accordance with this plan.

A detailed summary of baseline surface water quality and flows will be provided through the Baseline Water Monitoring Program and is not presented within the SWMP.

7.2 OBJECTIVES

The principal objectives of site water management are as follows.

- 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.
- To ensure the segregation of “dirty” water from “clean” water, with “dirty” water directed to and detained in appropriate water management structures.
- Manage surface water and groundwater inflows appropriately in order to meet the mines water usage requirements.
- To maximise the use of “dirty” water and groundwater from the Wallerawang Underground Workings for dust suppression in order to minimise the need for discharge.

- To minimise erosion and sedimentation during site establishment and construction and from all operational and rehabilitated areas of the mine site.
- To monitor the effectiveness of surface water controls and ensure all relevant water quality criteria are met.

7.3 WATER MANAGEMENT SYSTEM

7.3.1 Water Catchments

For management purposes, the water runoff has been divided into the following two classes.

(i) **"Clean" water -** surface runoff from undisturbed catchments or relatively undisturbed by mining, processing or related activities.

(ii) **"Dirty" water -** surface runoff from disturbed catchments such as the active mine area, processing area, run-of-mine (ROM) and product stockpiles, and rehabilitated areas (until stabilised), all of which could produce significant concentrations of suspended sediment.

Figure WM1 presents catchments relevant to the mine, identified as Catchments C1 to C11 and D1. Catchments C1 to C11 are clean water catchments whilst Catchment D1 is a dirty water catchment. Details of catchments relevant to the currently approved mining operations are as follows.

- Catchment C1 – 81.7ha
- Catchment C2 – 0.4ha
- Catchment C3 – 20.5ha
- Catchment C11 – 38.4ha
- Catchment D1 - 27ha

7.3.2 Clean Water Management

Clean water management will focus upon intercepting and diverting clean water flows and avoiding uncontrolled water flows over disturbed areas. This will be achieved primarily through the use of various diversion bunds and clean water retention dams constructed at strategic locations (see **Figure WM2**).

The majority of clean water will enter the Yarraboldy Extension Area from the north via Catchment C1. Diversion Bunds A and B will be constructed to direct this water to Clean Water Dam A which will be constructed within the central drainage line adjacent the northern boundary. The existing Dam A will be retained during site establishment and approximately the first year of mining before operations mine through this area.

Clean water captured within existing Dam A or the constructed Clean Water Dam A will be pumped to Diversion Bunds C and D on the western boundary. Diversion Bund C is situated on steep topography and will require additional stabilisation in steeper areas. Diversion Bund D will be located on a bench excavated on the northern boundary of the crushing and stockpiling area.

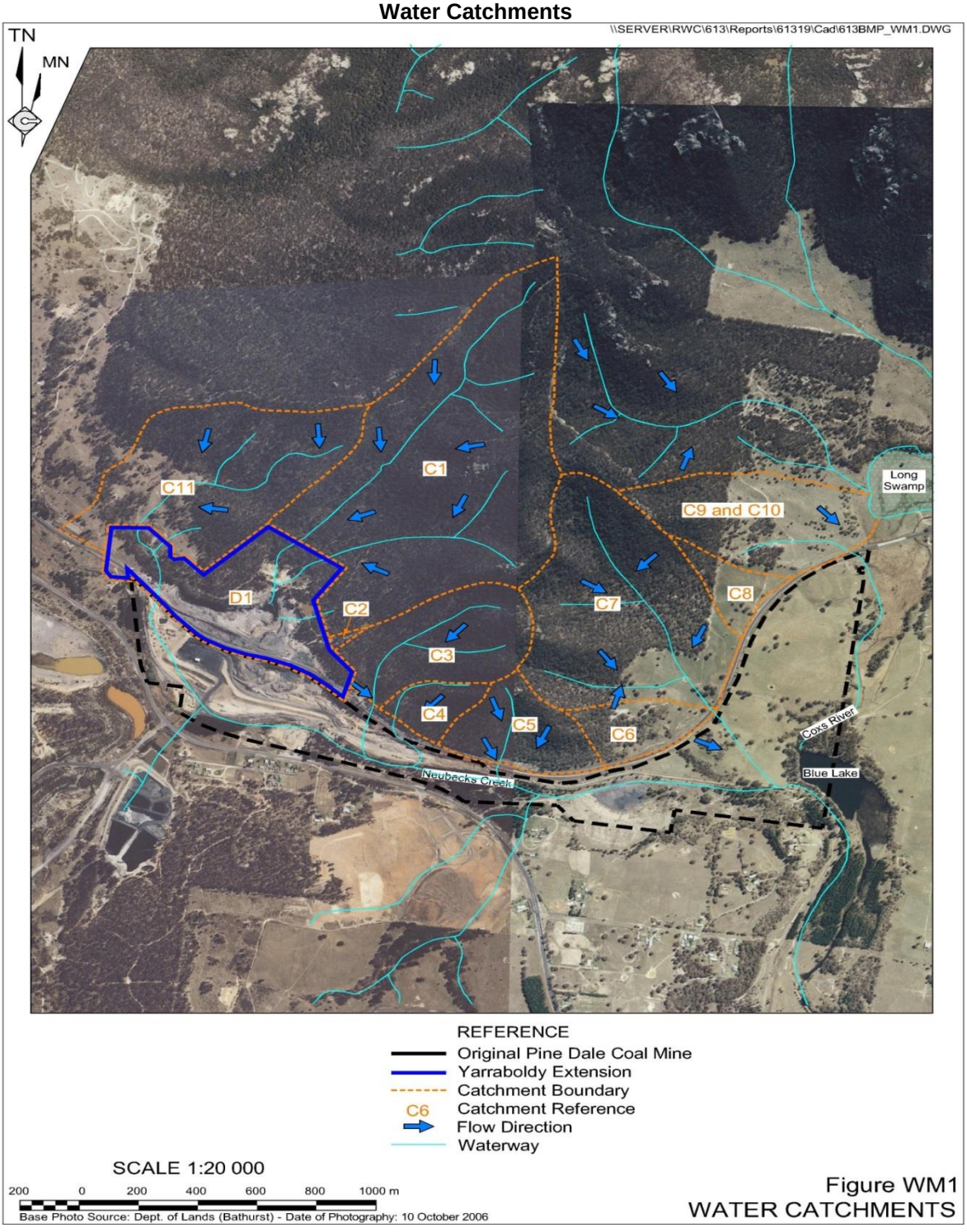
On the eastern boundary of the Yarraboldy Extension Area Diversion Bunds E, F and G will be constructed as required. Existing Dam B will be retained as a clean water dam with clean water pumped as required to Diversion Bund G. Existing Dam B will be mined through during the first year of mining. When this occurs, a small sump will be constructed within this drainage

line to attenuate flows from the adjacent clean water catchment and provide a basin for pumping from. Once mining has progressed through, the area will be backfilled and a replacement dam constructed (Clean Water Dam B). Clean water captured within the newly constructed Clean Water Dam B will initially be treated as dirty water until the soil stabilises.

Diverted clean water flows will report to existing drainage lines which convey water to a table drain adjacent the Private Coal Haul Road and subsequently to culverts beneath the Private Haul Coal Road before entering Neubecks Creek.

In order to protect the active mining area from inundation in the event of an overflow of the clean water dams, temporary primary and secondary diversion drains will be constructed upstream of the active mining area to divert any overflow water from this dam into the dirty water management system.

Figure WM1
Water Catchments



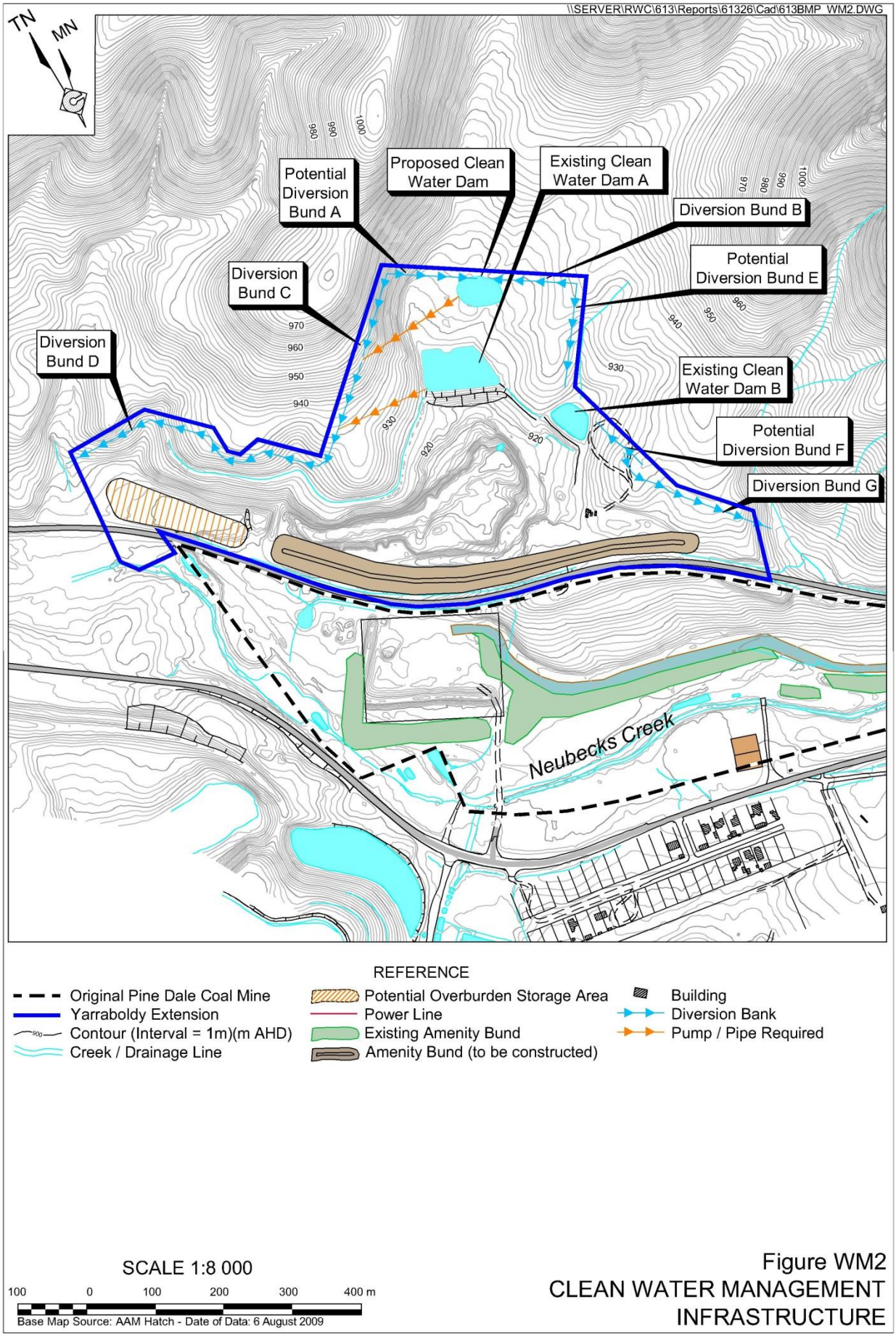


Figure WM2
CLEAN WATER MANAGEMENT INFRASTRUCTURE

Further details regarding the design of the various clean water management structures are provided as follows.

Diversion Bunds A, B, D, F and G

Diversion bunds will be constructed generally in accordance with *Blue Book Standard Drawing SD 5-6* (Landcom 2004) with the following minimum design specifications.

- Channel grade of approximately 1%.
- Height of the bank providing at least 400mm freeboard.
- Channel width should be at least 3m.
- Circular, parabolic or trapezoidal channel.
- Channel side slopes constructed to 3H:1V
- A level spreader (or sill) will be constructed at the bank discharge point on Diversion Bunds D and G to reduce the risk of erosion at this point, as per *SD 5-6*.
- Within ten days of construction a cover crop will be sown to prevent erosion of the bank and drain.

The diversion bunds will be designed to convey the 20 year Annual Recurrence Interval (ARI) storm event, as recommended by the Volume 2E of the *Blue Book.*

It is noted that temporary diversion bunds utilised for primary and secondary water diversion around the active mining area and during soil stripping and land preparation activities and will be constructed based on these same principles.

It is noted that, as Diversion Bund D will be constructed on a bench, infall drainage will be maintained during the construction of the bench and a channel grade of no greater than 1% to ensure stability.

Diversion Bunds C and E

Diversion Bunds C and E will generally be constructed in the same manner as the other diversion bunds, however, additional stabilisation and management structures will be required due to their location on steeper terrain. Stabilisation will include rock armouring or similar erosion control with the use of drop structures and check dams where required.

Clean Water Dam A

Clean Water Dam A will be constructed with a minimum holding capacity of 15ML (equivalent to a 5 year ARI 12hr storm event with a catchment area of approximately 76.6ha). Following rain events, clean water will be pumped out of the dam to Diversion Bund C via a pipeline (see **Figure WM2**) so as to maintain a 15ML receiving capacity. A stabilised level spillway will also be constructed to provide for controlled overtopping in the event of an extreme event which exceeds the design capacity. To reduce the risk of overtopping, the pump will operate using a level sensor / float. Primary and secondary water diversion structures will also be constructed above the active high wall for safety purposes. In the event of an overflow, the water would report to the mine's dirty water management system.

Clean Water Dam B

Existing Dam B incorporates a catchment area of approximately 7.8ha. Once the existing dam is mined through, the replacement Clean Water Dam B will be constructed with a minimum holding capacity of 3.5 ML (equivalent to 5 year ARI 12hr storm event with a catchment area of approximately 7.8ha). Following rain events, clean water will be pumped out of the dam to Diversion Bund G via a pipeline (see **Figure WM2**) so as to maintain a 3.5ML receiving capacity. Similarly, a stabilised level spillway will also be constructed to provide for controlled overtopping in the event of an extreme event which exceeds the design capacity.

7.3.3 Dirty Water Management

Dirty water management will focus upon the catchment and transfer of dirty water at non-erosive velocities to appropriate water storages. The principal controls for dirty water will be an in-pit sump, a retention dam and sediment trap (see **Figure WM3**).

The in-pit sump will be maintained within the open cut area and all in-pit drainage, including any groundwater inflows, will be directed to the sump. The location of the sump will vary depending upon the phase of mining and prevailing water management requirements; however, due to the dip of the Lithgow Seam, drainage is expected to generally occur to the northeast.

A retention dam (Retention Dam A) will be constructed in the northeastern corner of the Yarraboldy Extension area at the commencement of operations. When the in-pit sump is required to be dewatered, the dirty water will be pumped via piping to Retention Dam A. Retention Dam A will constitute the principal dirty water storage and sedimentation dam for settlement.

Retention Dam A was removed in recent mining. When the mine reaches its final shape an additional dam will be constructed within a previously mined area and all water transferred to this dam. Currently water is free draining into the old underground workings.

Runoff from the crushing and stockpiling area will be captured in the Sediment Trap, with water collected here to be pumped via a pipeline to the in-pit sump on an as needs basis (see **Figure WM3**). Water from the in-pit sump will then be pumped as needed to the Retention Dam A for storage and, where possible, re-use onsite.

Further details regarding the design of the various the dirty water management structures are provided as follows.

Sediment Retention Dam A

Sediment Retention Dam A will be used as a storage dam and sediment basin, accepting and containing dirty water runoff and groundwater inflows pumped out of the in-pit sump. The dam will be constructed using compacted clay material with a minimum holding capacity of 15ML. The dam sizing provides for the necessary capacity to control sediment loads within the entire Dirty Water Catchment and clean water Catchment C2 for a conservatively high rainfall event (5 day, 95th percentile rainfall) and assuming Class D dispersive soils.

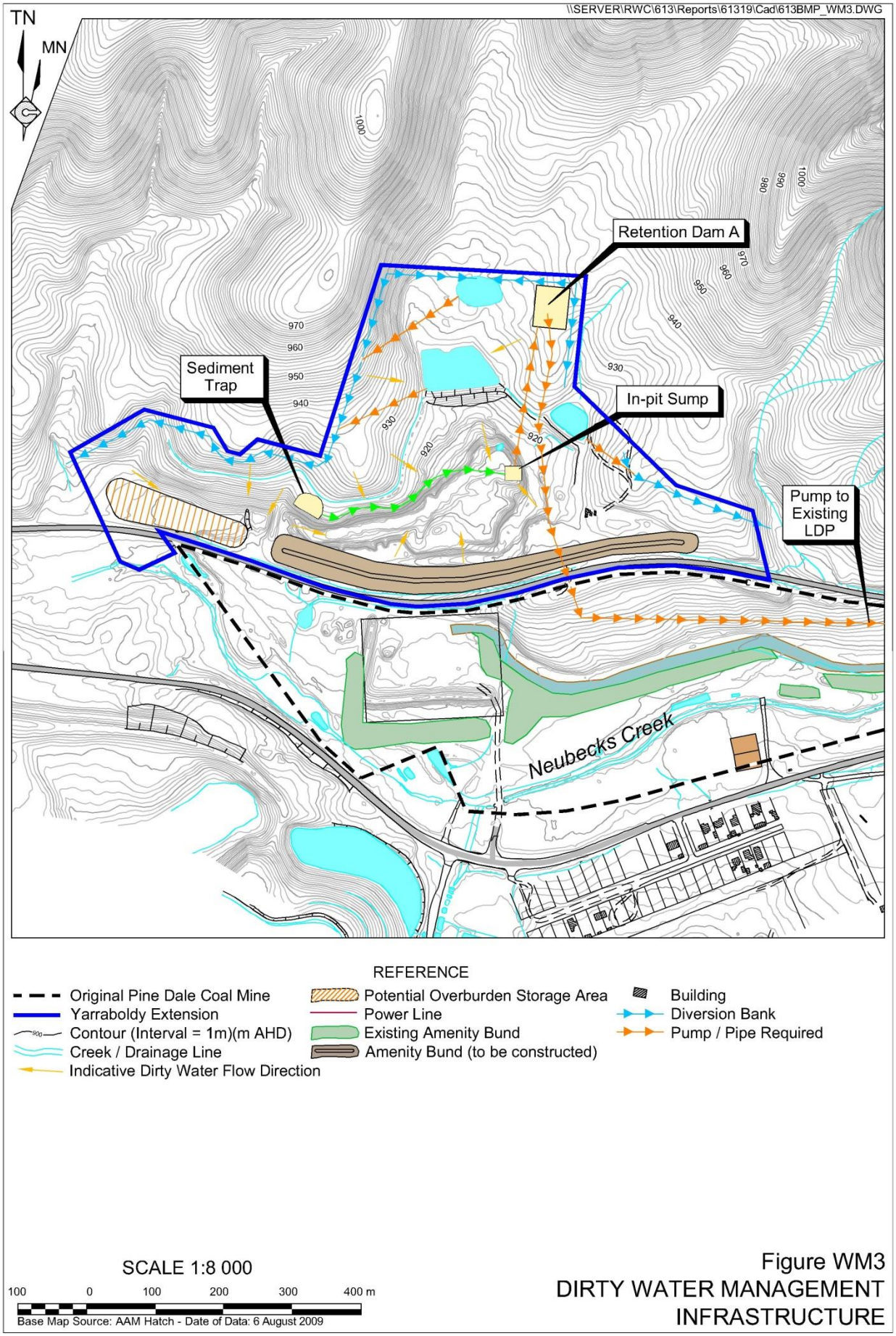


Figure WM3
DIRTY WATER MANAGEMENT INFRASTRUCTURE

Similar to the clean water dams, a stabilised level spillway will be provided in the event of an overflow. However, Sediment Retention Dam A has a very small catchment and primarily accepts water pumped from the in-pit sump. If discharge is required following significant rainfall events to maintain capacity in the dam to accept water from the in-pit sump, water can be pumped to the existing sediment dams within the Pine Dale Coal Mine footprint before being discharged to Neubecks Creek via LDP13. Regular inspections will be undertaken of Sediment Retention Dam A during pumping of water from the in-pit sump to the dam and pumping rates adjusted accordingly so as to prevent an uncontrolled overflow from the dam. All discharge via LPD13 will be undertaken in accordance with the discharge criteria outlined in EPL4911 and at a maximum rate of 15ML per day.

7.3.4 Re-establishment of drainage lines

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 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), and the *Draft Guidelines for Designing Stable Drainage Lines on Rehabilitated Mine Sites,* formulated by the former NSW Department of Land and Water Conservation (1999), as well as the *Guidelines for Controlled Activities – In-Stream Works* (DWE, 2008) (DWE guidelines). 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.

Keys design elements of channel establishment works include the following.

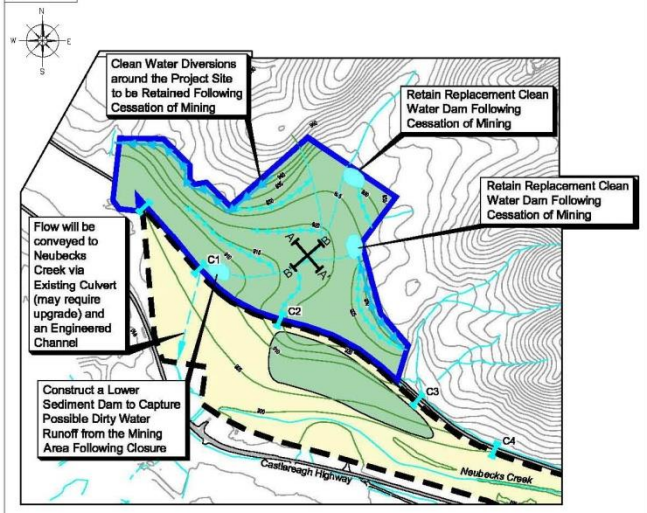
- Implementation of effective temporary erosion controls to provide for the short-term stabilisation of the channel.
- Design and construction of the stream channel so that it would be stable for the long-term and minimises the potential for the migration of any erosion upstream or downstream.
- Use of natural meanders instead of straight lines to reflect natural stream characteristics.
- Where there are high erosive forces (such as high flow velocity or steep grades) the channel bed should be rock lined, where required, and constructed in accordance with the Blue Book, including the placement of appropriately sized rocks above a filter layer of suitable geotextile.
- Packing of soil in between rocks to allow sedges and grasses to be established within the channel to provide for long-term channel stability.

A detailed plan for the re-instatement of the main drainage lines through the final landform, incorporating the elements listed above, is presented in **Figure WM4**. The drainage lines have been designed to convey a 1 in 2 year ARI event in the low flow channel, and a 1 in 100 year ARI event across the wider section.

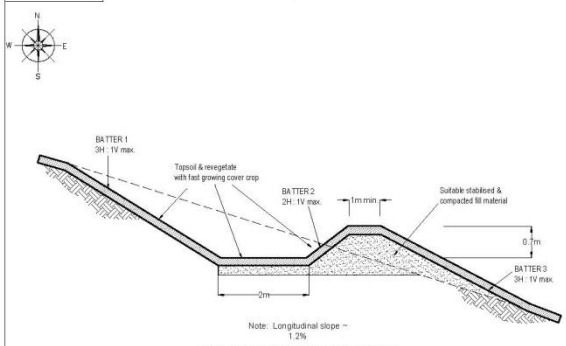
Following earthworks and channel establishment, a riparian corridor will be established. In accordance with the Department of Water and Energy's *Guidelines for Controlled activities – Riparian Corridors,* this riparian corridor will be established with a vegetated core riparian zone (CRZ) of approximately 20m measured horizontally and at right angles to the flow from the top of both 'banks' on the drainage line. Key design elements of the riparian corridor establishment include the following.

- Implementation of effective temporary erosion controls to provide for the short-term stabilisation of the riparian corridor.
- Restoration of naturally occurring soil to the riparian corridor (i.e. as stripped from area pre-disturbance).
- Restoration of a vegetated riparian corridor along the stream channel (20m from 'top of bank'). This will involve establishment of a diverse range of locally occurring vegetation species, as follows.
    - Revegetation of the channel toe and lower bank section with low-growing, multi-trunked plants with matted roots to bind the surface and maximise erosion control, such as *Leptospernum parvifolium.*
    - Revegetation of the mid-upper bank section with medium sized plants with good root systems and larger canopies to shade the stream, such as Acacia species, for example *Acacia dealbata, A buxifolia, A rubida, A decurrens, A penninervis,* and *A spectabilis (all locally occurring species)*
    - Revegetation of the top of bank with larger trees with deep root systems such as a range of Eucalyptus species.
- Establishment of a full range of vegetation types, including trees, shrubs and grass covers.
- Maintenance of the rehabilitated riparian corridor for two years after initial rehabilitation.

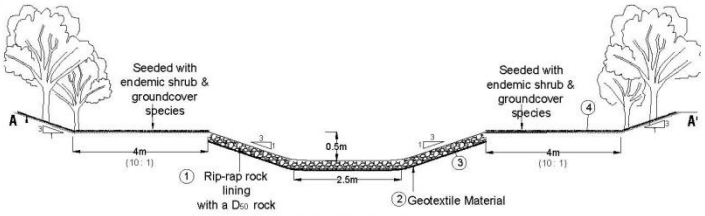
PLAN VIEW



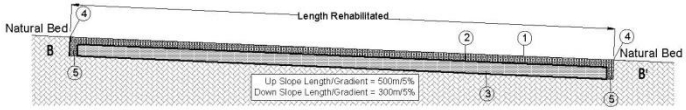
CROSS SECTION Indicative Diversion Channel Design



CONTOUR BANK CROSS SECTION
(showing minimum dimensions)



CROSS SECTION A - A'
Not to scale
(for numbering description refer to Cross Section Notes below)



LONG SECTION B - B'
Not to scale
(for numbering description refer to Long Section Notes below)

Plan Section Notes (Additional)

Rock "Rip-Rap" is a flexible armouring that can adjust to accommodate potential differential settling, while still remaining stable.

Short-term erosion & sediment control will be established prior to the commencement of construction, and will remain in place through the construction period and until the area is adequately stabilised. This will include:

- Upstream catch dam and diversion works to remain in place until adequate vegetation is established and riparian corridor is considered adequately stable.
- Downstream sediment dams to remain in place to capture and treat any sediment laden run-off.
- A non-persistent annual crop cover (as recommended in Table 9.4 of the "Blue Book") will be established or appropriate mulch spread over the channel until vegetation becomes established.
- Straw bales and sediment fencing will be installed where necessary.

Rehabilitated area will be monitored & maintained for a minimum of 2 years after the practical completion of works or until minimum 80% survival rate for all plantings is achieved.

Cross Section Notes

1. Rock-lined (Rip-Rap) compound channel, with a base width of approximately 2.5 metres. Use well graded durable host rock. Topsoil placed between the rocks to allow sedges & grasses to be established.
2. A suitable geotextile material is to be laid between the compacted overburden material and rock rip-rap.
3. Maximum channel bank grade 3:1 (H:V).
4. Topsoil layer re-spread from stockpiled topsoil.
5. Riparian revegetation to include channel and 20 metres from bank, including:
   - Revegetation of the channel toe or lower bank section should be undertaken with low-growing, multi-trunked plants with matted roots to bind the surface and maximise erosion control.
   - Revegetation of the mid-upper bank section should be undertaken with medium-sized plants with good root systems and larger canopies to shade the stream, such as Acacia species.
   - Revegetation of the top of the bank should be undertaken with larger trees with deep root systems, such as a Eucalyptus species.

Long Section Notes

1. Rock-lined (Rip-Rap) compound channel, with a base width of approximately 2.5 metres. Use well graded durable host rock. Topsoil placed between rock to allow sedges & grasses to be established.
2. A suitable geotextile material is to be laid between the compacted overburden material and rock rip-rap.
3. Compacted overburden material.
4. Finished bed level will match to existing level at upstream and downstream.
5. Rock cut-off wall at upstream and downstream end of channel keyed in 1 metre deep.

LEGEND

- Pine Dale Coal Mine
- Yarraboldy Extension
- Existing Contour (m AHD)(Intercal = 5m)
- Final Landform Contour (Interval = 5m)
- Post Closure Diversion Swale
- Sediment Dam to be Retained Following Cessation of Mining
- Existing Drainge line
- Proposed Drainage Line
- Clean Water Diversion
- Culvert Location and Reference

Rehabilitation

- Pasture
- Native Woodland

FIGURE WM4

Indicative Design For Rehabilitated Drainage Lines

Project:	Pine Dale Coal Mine Yarraboldy Extension
Client:	R.W.Corkery & Co.
File:	WM4_RWC13-002_RehabDrainageLines_110630
Projection:	MGA Zone 56

Version:	Date:	Author:	Checked:	Approved:
1	30/06/11	LH	BL	NA

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Base Map Source - R.W.Corkery

7.4 EROSION AND SEDIMENTATION CONTROL PLAN

7.4.1 Introduction

This Erosion and Sediment Control Plan (ESCP) identifies activities for the construction and operational phases of the mine that could cause soil erosion and / or generate sediment and describes the erosion and sediment control and management measures to be implemented. For the purposes of sediment and erosion control, prior to the completion of rehabilitation and relinquishment of the Mining Leases, the mine will be considered to remain 'operational'.

It is noted that many of the water management structures outlined within Section 7.3 are equally applicable for the minimisation of erosion and sedimentation and details have not been repeated.

7.4.2 Sources of Erosion and Sedimentation

7.4.2.1 Construction

During construction, erosion and sedimentation could potentially result directly or indirectly from:

i. surface water runoff over exposed surfaces, e.g. cleared areas such as the crusher and stockpile area, amenity bund etc; and

ii. surface water runoff from non-stabilised water management structures.

Winds with elevated speeds may also result in erosion of finer material during clearing and soil stripping activities, and from exposed surfaces and stockpiles.

7.4.2.2 Operations

During the operational phases, erosion and sedimentation could potentially result directly or indirectly from:

i. surface water runoff from areas disturbed in advance of, and during mining;

ii. surface water runoff from soil stockpiles prior to placement for rehabilitation or establishment of a vegetative cover (for stockpiles with durations greater than 3 months);

iii. surface water runoff from rehabilitated areas prior to full stabilisation; and

iv. discharges of water at erosive velocities.

Elevated winds may also result in erosion from exposed surfaces.

7.4.3 Erosion and Sediment Control Management

Section 7.3 contains detail on the clean water diversions, dirty water capture and sediment retention dams which form a fundamental component of the erosion and sediment control on site.

The following best management practices will be implemented to reduce potential erosion and sediment generation.

Mine Planning Considerations

- Where practicable, areas cleared ahead of mining will be restricted to that required for the next 6 to 12 months of mining.
- The boundaries of the extension area will be clearly defined to ensure that ground disturbing activities are limited to within this area.
- Where applicable, prior to the commencement of ground disturbing activities, downstream sediment catchment / erosion control measures will be constructed / installed.
- Whenever possible, water captured within the in-pit sump will be allowed time to settle before being pumped to Sediment Retention Dam A.

Handling Soils

- Soil stripping areas will be clearly defined and marked prior to commencement and the grass and shrub layer stripped with the soil.
- The topsoil will be preferentially transferred directly to the rehabilitation area or placed in designated stockpile areas.

Soil Stockpiling

- Topsoil stockpiles will be constructed no higher than 2m and subsoil stockpiles no higher than 3m with a slope of 1:2 (V:H) and the stockpile surface left roughened. It is noted that the stockpile heights (which aim to preserve the biological integrity of the soil) do not relate to any clayey overburden to be utilised within rehabilitation.
- Stockpiles to be retained for a period of greater than 3 months which have not naturally established a groundcover will be seeded with a non-persistent cover crop.

Soil Respreading

- Before soil respreading, the ground surface will be scarified or ripped along the line of the contour to break any compacted and smooth surfaces and assist in keying the respread soil.
- The respread soils will be left with a roughened surface and sown with a groundcover mix as soon as possible to stabilise the soils.

Additional Erosion and Sediment Protection

Additional sediment controls will be installed as required to reduce the velocity of flows and, therefore, reduce the potential for erosion within channels, re-established drainage lines and at transfer points. Additional sediment protection may include the use of the following.

- Sediment Fencing

  Sediment (silt) fencing consisting of geotextile filter fabric supported by steel wire and steel posts will be utilised in areas where the:

- the area draining to the fence is 0.6 ha or less;
- the maximum slope gradient behind the fence is 1:2 (V:H); and
- the maximum slope length behind the fence is 60m.

Sediment fences will generally be installed prior to disturbance activities (e.g. down slope of the amenity bund during construction and maintained until stabilisation of the bund).

- Straw Bale Filters and Check Dams

  In the event that additional erosion control is required at the outlet of a drain or across a swale or channel of a diversion bund, a temporary barrier of straw bales laid end to end across the direction of flow may be utilised to reduce the water velocity and capture sediments. Check dams may also be utilised consisting of rock material. Check dams would primarily be utilised to reduce the velocity of water to prevent erosion rather than as sediment retention structure.

- Rock Armouring and Jute Mesh

  In the event additional erosion controls are required, other options that will be considered include the use of rock armouring, whereby a channel or outlet is effectively lined with appropriately sized aggregate material to provide a physical barrier to erosion. Similar to rock armouring, jute mesh, a biodegradable erosion control blanket, may be installed, particularly where vegetation growth is preferable.

7.5 MANAGEMENT OF POTENTIALLY ACID GENERATING MATERIAL

7.5.1 Washery Rejects and Surface Materials

Historic washery operations were undertaken within the Wallerawang Colliery Pit Top area (incorporating the Pine Dale Coal Mine and Yarraboldy Extension Area) with coarse and fine reject material placed on and near the surface in a number of areas. As a result of washing coal, fines are separated and any fine pyritic materials are concentrated increasing the risk of the reject material becoming acid generating. Some inappropriate placement and rehabilitation measures adopted by former operators of the Wallerawang Colliery resulted in revegetation problems. As a result of remediation works completed by the Company, these areas are now being successfully rehabilitated.

Testing of this material was undertaken as part of the studies for the original Pine Dale Coal Mine to determine the net acid generation potential. Testing was also undertaken within the eastern part of the, now, Yarraboldy Extension Area but not the remaining Yarraboldy Extension Area due to a briquetting operation being undertaken at that time. It was determined that the removal (and burial within the Pine Dale Coal Mine open cut) or covering of this material with inert overburden to form a water shedding cover was an appropriate rehabilitation and management measure.

No on-site coal washing is proposed to be undertaken during the term of this MOP and therefore no additional fines will be generated. However, similar to the areas within the

existing Pine Dale Coal Mine, any existing washery rejects or carbonaceous material remaining within the Yarraboldy Extension Area from historic operations will be placed at least 5m beneath the surface of the final landform.

Additionally, pH testing will be undertaken of any areas within the Yarraboldy Extension Area that do not appear to contain rejects or carbonaceous material but are currently bare or contain very little vegetation or groundcover. Testing will include field pH tests of at least 10 samples per hectare undertaken on a grid pattern. In the event that the pH of the material in these areas is less than 5.0 it will be treated as potentially acid producing and managed in the same manner as the washery rejects.

Similarly, pH testing of rehabilitated areas will be undertaken at a rate of 10 samples per hectare to confirm that the pH is above 5.0 and that these materials have not been placed near the surface.

7.5.2 Overburden and Interburden Materials

Experience at the Enhance Place Open Cut and Pine Dale Open Cut mines indicates that the overburden and interburden materials do not present an acid mine drainage problem. However, testing was also undertaken on samples collected from drilling of two piezometers located north of the Yarraboldy Extension area (RCA, 2010). The result of this testing recorded that the siltstone above the Middle River Seam (recorded elevation 955m AHD) and carbonaceous shales within / above the Lithgow Seam (recorded elevation 886m AHD) have high chromium oxidisable sulphur and net acidities. These strata could potentially result in acid generation if not managed appropriately. It is noted that the Middle River Coal Seam and upper strata are not likely to be encountered during mining within the Yarraboldy Area. It is also noted that, sandstone below the Lithgow Seam also recorded high chromium oxidisable sulphur and net acidity, however, this strata will not be disturbed.

When encountered, the strata identified as being potentially acid producing (principally carbonaceous shales associated with the Lithgow Seam) will be selectively stripped during mining and placed at the base of the open cut with a water shedding cover of inert overburden. Alternatively, the potentially acid producing strata will be mixed with the other strata which are identified as having a sufficiently high acid neutralising capacity to neutralise any acid produced. In this case, additional sampling and testing will be undertaken to confirm the ratio of the neutralising strata which is required to be mixed with the potentially acid producing strata. In both cases, no potentially acid generating materials will be placed within 5m of the surface of the final landform.

7.6 SURFACE WATER MONITORING PROGRAM

7.6.1 Introduction

This Surface Water Monitoring Program for the mine site includes a:

- surface water quality monitoring program;
- surface water management inspection and maintenance program; and

- program to monitor the stream health, vegetation health and channel stability of Neubecks Creek.

The principal objectives of the Surface Water Monitoring Program are to:

- monitor the effectiveness of the surface water and soil and erosion control measures and ensure appropriate maintenance is undertaken; and
- demonstrate that the mining operations are not having adverse effects upon the water quality within Neubecks Creek or resulting in erosion or sedimentation within the creek and subsequently impacting upon vegetation health. These combined factors will provide an assessment of any impacts upon 'stream health'.

7.6.2 Surface Water Assessment Criteria and Trigger Levels

Impact assessment criteria for surface water discharged from the licensed discharge point LPD13 are stipulated in Environment Protection Licence 4911. Concentration limits for Total Suspended Solids (TSS), pH and Oil and Grease are stipulated (see **Table WM6**).

Table WM5
Surface Water Assessment Criteria

Parameter	Unit	100% concentration limit
Total Suspended Solids	mg/L	30*/50#
Oil and Grease	mg/L	10
pH	dimensionless	6.5 – 8.5
* Discharged to Surface Water # Discharged to Underground Workings		

A series of surface water samples were collected over a 3 year period in association with the Baseline Water Monitoring Plan for the purpose of further defining water quality trigger levels. Baseline data collection for surface water was completed in July 2013 and the derived trigger levels have been submitted to OEH and NOW for review and comment.

The ANZECC guidelines provide that where the long term background concentrations already exceed the ANZECC (2000) default values, the application of site specific trigger values may be appropriate. The recommended approach for developing site specific trigger values for slightly to moderately disturbed ecosystems is to use the ANZECC (2000) 80th percentile method using site specific monitoring data. This approach aims to develop conservative, site specific trigger values which are used as a means of improving water quality within the slightly to moderately disturbed ecosystem. However, using the 80th percentile approach of defining site-specific trigger values may not adequately reflect the water quality dynamics of the immediate Neubecks Creek catchment area, given its 100 year history of mining and disturbance.

Due to the temporal trending of the data set, the range of operating conditions observed at the site during the data collection period, and the effects of extraneous factors such as climate and seasonal variability, the 90th percentile was used for the review of water quality trigger values. The use of the 90th percentile as a trigger value was more

appropriate for the Pine Dale Mine site due to the nature of disturbance at the site and the range of monitoring data collected over the three year period. This methodology is compliant with the arbitrary choice of defining trigger values for physical and chemical stressors for moderately disturbed ecosystems, as outlined in Section 3.3.2.4 of ANZECC (2000). Although this is a slightly less conservative approach than the use of the 80th percentile method, the resulting trigger values will be acceptable to maintain water quality at the site.

A review of the water quality monitoring data for pH was undertaken using the 20th percentile and the 90th percentile values in order to establish a suitable minimum to maximum pH range for each water monitoring location. Upon examination, it was determined the resulting maximum (90th percentile) pH value for each surface water site was approximately equal to a pH value of 8.0 pH units. It was therefore proposed the site specific pH range be derived using the 20^{th} percentile (as a minimum value) and a maximum value of 8.0 pH units for all site surface waters.

In addition to pH, EPL 4911 also presents concentration limits for Total Suspended Solids (30mg/L) and Oil & Grease (10mg/L) for the Licenced Discharge Point (LDP13). In an effort to streamline the surface water assessment criteria, it is proposed these concentration limits be implemented for all site surface waters. Due to the variability of Electrical Conductivity concentrations observed across the water monitoring locations, site specific Electrical Conductivity trigger values were determined for each surface water monitoring site using the 90th percentile of the dataset.

Site specific trigger levels are presented in Table WM7.

The assessment criteria will also be reviewed at least annually to ensure that the most appropriate criteria are being applied.

7.6.3 Monitoring Locations, Parameters and Frequency

Surface water monitoring locations are presented in **Figure WM5** whilst **Table WM7** outlines the monitoring frequency and the parameters to be analysed for each monitoring location. The frequency of monitoring and parameters measured will be reviewed regularly to ensure that only meaningful data is being collected.

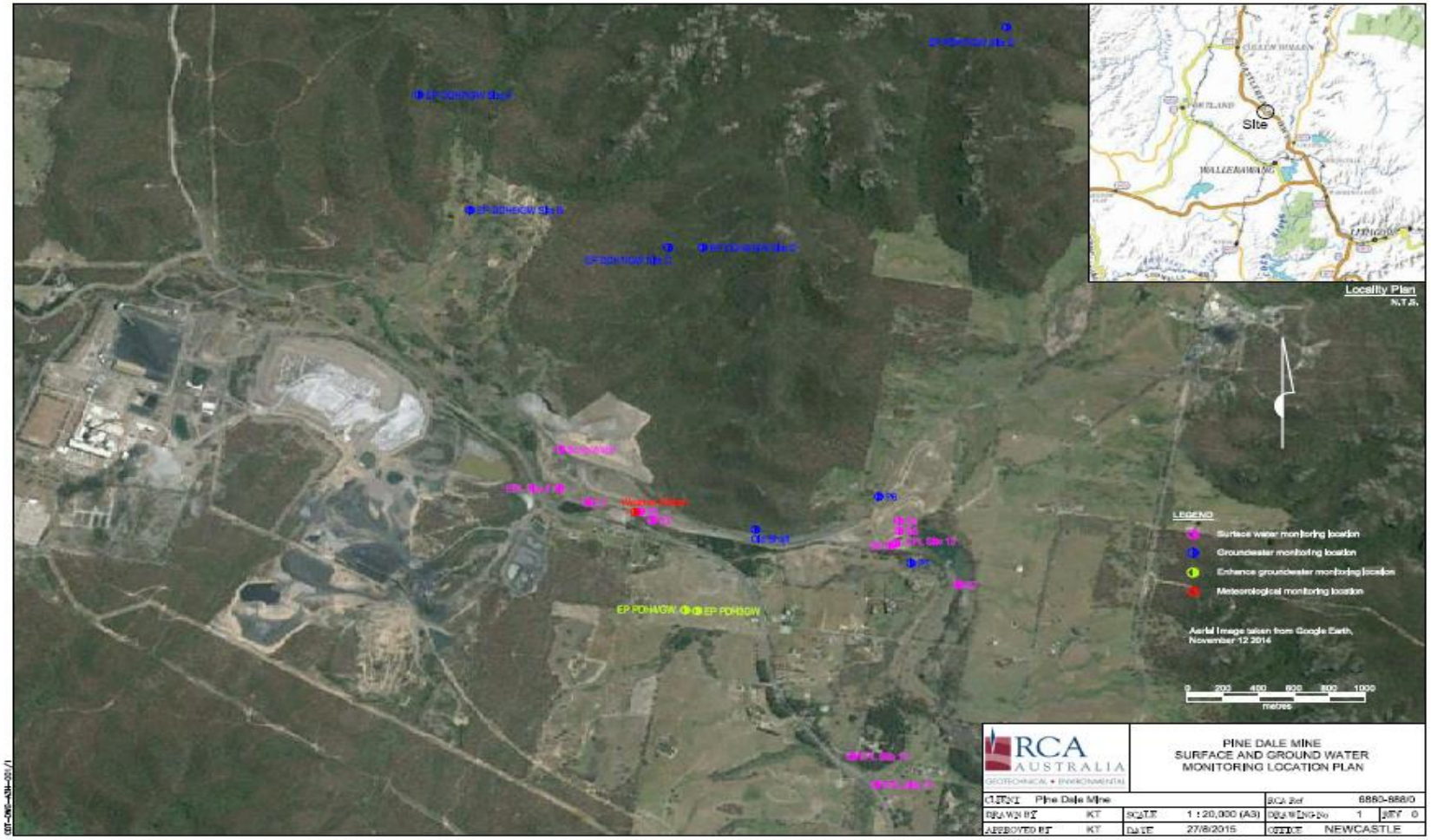
Table WM6
Surface Water Monitoring

Surface Water Monitoring Site	Easting	Northing	Frequency	Parameters	Trigger Levels - pH, TSS, O&G	Trigger Levels EC (µS/cm)
Neubecks Creek U/S of EnergyAustralia flow gauge EPA Point 2	226857	6304633	Daily during discharge ay EPA point 13	pH, EC, turbidity	pH 7.1 - 8.0 TSS 30mg/L O&G 10mg/L	2055
			Quarterly	pH, EC, turbidity, TSS, sulfate, filterable Fe		
Coxs River downstream of the Neubecks creek confluence EPA Point 14	228177	6302698	Daily During Discharge at EPA Point 13	pH, EC, turbidity	pH 7.5 - 8.0 TSS 30mg/L O&G 10mg/L	1166
			Quarterly	pH, EC, turbidity, TSS, sulfate, filterable Fe		
Discharge point – concrete lined section EPA Point 13 (LDP 13)	228374	6304302	Daily During Discharge	pH, EC, turbidity, TSS, sulfate, filterable Fe, oil & grease	pH 6.5 - 8.0 TSS 30mg/L O&G 10mg/L	Nil
Lamberts Gully D/S S1	226458 (approx)	6304579 (approx)	Monthly	Water levels, pH, temp, EC, turbidity,	pH 6.2 - 8.0 TSS 30mg/L O&G 10mg/L	2325
			Quarterly	DO, TSS, oil and grease, major ions, dissolved metals (Fe, Mn, Ni, Co, Zn)		

Neubecks creek at the bridge (Site office) S2	226803	6304519	Quarterly	Water levels	Nil	Nil
Neubecks Creek EPA S3 Point 3	226870	6304453	Daily during discharge at EPA Point 13	pH, EC, turbidity	pH 6.4 - 8.0 TSS 30mg/L O&G 10mg/L	2223
			Monthly	pH, temp, EC, turbidity		
			Quarterly	DO, TSS, oil and grease, major ions, sulfate, dissolved metals, (Fe, Mn, Ni, Co, Zn)		
Coxs river u/s of Blue lake S4	228432	6304453	Quarterly	pH, temp, EC, turbidity	pH 7.3 - 8.0 TSS 30mg/L O&G 10mg/L	957
			Quarterly	DO, TSS, oil and grease, major ions, dissolved metals (Fe, Mn, Ni, Co, Zn)		
Blue lake u/s of Neubecks creek confluence S5	228440	6304347	Quarterly	pH, temp, EC, turbidity	pH 7.0 - 8.0 TSS 30mg/L O&G 10mg/L	1013
			Quarterly	DO, TSS, oil and grease, major ions, dissolved metals (Fe, Mn, Ni, Co, Zn)		
Neubecks Creek d/s of discharge point S6	228415	6304305	Monthly	pH, temp, EC, turbidity	pH 6.7 - 8.0 TSS 30mg/L O&G 10mg/L	1941
			Quarterly	DO, TSS, oil and grease, major ions, dissolved metals (Fe, Mn, Ni, Co, Zn)		

Coxs River d/s of Neubecks creek confluence S7	228592	6303756	Monthly	pH, temp, EC, turbidity	pH 6.8 - 8.0 TSS 30mg/L	1007
			Quarterly	DO, TSS, oil and grease, major ions, dissolved metals (Fe, Mn, Ni, Co, Zn)	O&G 10mg/L	

Figure WM5
Surface Water Monitoring Locations



7.6.4 Inspections and Maintenance

Regular inspections of all water management (erosion and sediment control) structures of the site together with Neubecks Creek and its riparian corridor will be undertaken. Inspections will be undertaken on a monthly basis and following a rainfall event of >25mm/24hr. The inspections of on-site water management structures will record the following details.

- Remaining storage volume within in-pit sump and Sediment Retention Dam A.
- Water colour within the in-pit sump and Sediment Retention Basin (e.g. highly turbid, brown, clear etc).
- Presence of oily film.
- The general condition of the water management structures including any areas of active erosion and level of sedimentation.

Details of each inspection will be recorded on the inspection sheet (see **Appendix 1**).

Where erosion and sediment control structures have lost up to 20% capacity due to the accumulation of material, the accumulated material will be removed such that the specified capacities are maintained.

In areas where active erosion has/is occurring, consideration will be given to installation of additional erosion and sediment controls as described in Section 7.4.3 or the need to upgrade the structure.

The visual inspections of Neubecks Creek will be undertaken at locations where clean water is diverted to the creek and downstream of the discharge point to ensure both the clean water diversions and discharge does not result in erosion or scouring of the bed or banks of Neubecks Creek and subsequent impact on riparian vegetation. Photographs will be taken during each inspection and details recorded on the inspection sheet (see **Appendix 1**). Further details on the monitoring program for Neubecks Creek is provided below in Section 7.6.5.

7.6.5 Channel Stability and Stream Health Monitoring

A program to monitor the channel stability, stream health, and vegetation health will be conducted to ensure mining operations are not having adverse effects upon Neubecks Creek. The program will involve undertaking a visual assessment of the creek, and utilising the results of this visual observation to make an assessment of the channel stability and stream health against the CSIRO's *Ephemeral Stream Assessment* protocol.

A series of GPS controlled monitoring points will be established at three selected sites along the creek (downstream of the clean water diversion, mid-stream and downstream of the licenced discharge point) to photograph, document and assess existing landscape features including erosion, vegetation and stability characteristics. From this, a photographic record of the stream will be established over time. At each monitoring point location, a number of natural characteristics will be recorded, as follows.

- Written descriptions of the stream at each of the photographic points, focussing on evidence of erosion and exposed soils.

- Documented locations and dimensions of notable erosive or depositional features.
- Cross sections (profile survey).

Each of these features will be initially recorded to establish baseline information for the creek. Subsequent surveys will then compare results with the baseline survey.

The assessment component of the survey will utilise the CSIRO *Ephemeral Stream Assessment* protocol for ephemeral drainage lines (CSIRO, undated). This assessment protocol incorporates visual indicators to determine the erosion state of the drainage line. The indicators produce a rating which ranks each location from actively eroding through to very stable.

The assessment uses four main classes of indicators to evaluate the degree of stream-bed condition, as follows.

- The type and condition of the vegetation present, if any.
- The shape and profile of the drainage line and type and condition of materials on the drainage line floor.
- The nature of the drainage line wall materials.
- The nature of the stream bank bordering flats and/or slopes and regulation of lateral flow into the drainage line.

The indicators produce a rating based on a scoring system (presented in **Table WM8**), and the combined total of the indicators rank each location from very actively eroding through to very stable. This enables an assessment to be made as to whether the section of creek changes from the baseline survey.

This assessment will be undertaken at six monthly intervals, or following a significant flow event within the creek (typically equating to the 20 year Average Recurrence Interval (ARI) Storm Event – 127mm rainfall in 24hr period).

Table WM7
Classification of different drainage line states (CSIRO)

Activity Rating (%)	Classification	Discussion of Classification
80 +	Very Stable	Drainage line is very stable and likely to be in original form. It is able to withstand all flow velocities that have previously occurred in this area and only minimal monitoring is required, predominantly after high flow events, to ensure condition does not deteriorate.
70-80	Stable	Drainage line is stable. It is important to assess this zone in relation to the other classifications and define whether this zone is moving from potentially stabilising to a more stable form, or if it is deteriorating from a very stable form. The nature of this relationship will identify the type of monitoring required.
60-69	Potentially Stabilising	Drainage line is potentially stabilising. Ongoing monitoring is required while rehabilitation works are not needed in the immediate future.

50-59	Active	Drainage line is actively eroding and remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.
< 50	Very Active	Drainage line is very actively eroding and immediate remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.

Table Source: CSIRO Ephemeral Stream Assessment (CSIRO, undated)

7.7 SURFACE WATER RESPONSE MEASURES

A protocol for the investigation, notification, and mitigation of any identified exceedances of the impacts on surface water quality is presented in **Table WM9**. The table also provides the impact assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts. If an impact is detected, guidelines for appropriate action outlined in the tables will be followed. All impacts and follow-up actions will be documented.

Table WM8
Trigger Action Response Plan for Surface Water Management Plan

Monitoring Location	Location Description	Monitoring Parameter and Potential Environmental Impact	Sampling Parameter	Trigger Level indicating Potential Impact	Action Required	Follow Up Actions	Reporting Protocol
Neubecks Creek – concrete lined section (EPA Point 13)	Surface water discharge sites	Water quality changes over time due to mining activities. Discharge volumes. Exceedance resulting in potential erosion / scouring of stream bed / banks.	**Field Water Quality Tests**: pH, EC and turbidity. **Visual Field Inspections** **Laboratory Testing and Analysis**: TDS, oil and grease, major ions and dissolved metals (see **Table WM7**). The analytes monitored will be reviewed on an annual basis and revised as required.	During discharge: • pH <6.5 and >8.5 • >30mg/L TSS • >10mg/L Oil & Grease • >10% increase EC, TDS, or dissolved metals above maximum recorded background levels The water quality trigger levels will be reviewed on an annual basis. Visual inspections indicate erosion / scouring of Neubecks Creek downstream of the discharge point / clean water diversion areas (activity rating <59).	Do not discharge water / cease discharge immediately. Record total volume of water discharged (if applicable).	If required, condition water to be discharged and confirm compliance with water quality criteria prior to discharge. Install additional water erosion protection / energy dissipation measures to reduce water velocity before entering Neubecks Creek. Reduce volume of discharge. Continue monitoring of in-stream monitoring sites.	Where discharge of water which does not meet compliance criteria has occurred, DECCW and NOW will be notified in writing within 7 business days of the discharge. Further reporting of results from follow-up sampling / inspections of both in-stream sites and discharge waters will be provided to DECCW and NOW.
Neubecks Creek (EPA Point 3) S3	Downstream monitoring sites	Water quality changes over time due to mining activities.		• >10% increase above recorded maximum background levels for any water quality parameters. • pH <6.4 and >8.0 • EC >2223 µS/cm • >30mg/L TSS (EPL13) • >10mg/L Oil & Grease • >10% increase EC, TDS, or dissolved metals above maximum recorded background levels	Continue to monitor and assess water quality data, establish trends over time, and quantify trends using statistical methods when sufficient data have been collected. Correlate data trends in datasets and / or anomalies with mining activities. Establish links (if any) between water quality and climatic conditions (e.g. rainfall). Determine a causal link (if any) between trends in water quality data and mining activities. Include review against upstream monitoring sites.	If a deterioration of water quality occurs over time and an impact from the mining activities is clearly demonstrated, a suitably qualified consultant will be contracted to review any mitigation measures already in place and / or propose additional mitigation measures.	All monitoring results will be reported within the AEMR. DECCW and NOW will be notified in writing within 7 business days of the receipt of the monitoring results. Where it is demonstrated that the mining activities have resulted in the changes to water quality, further reporting of results from follow-up verification sampling campaigns and any mitigation measures to be implemented will be provided to DECCW and NOW.
Blue lake u/s of Neubecks creek confluence S5 Neubecks Creek d/s of discharge point S6 Coxs river d/s of Neubecks creek confluence (EPA Point 14)	Downstream monitoring sites	Water quality changes over time due to mining activities.		• >10% increase above recorded maximum background levels for any water quality parameters. • pH <7.0 and >8.0 (S5) • pH <6.7and >8.0 (S6) • pH <7.5 and >8.0 (EPL14) • EC >1013µS/cm (S5) • EC >1941 µS/cm (S6) • EC >1166 µS/cm (EPL14) • >30mg/L TSS (all)	Continue to monitor and assess water quality data, establish trends over time, and quantify trends using statistical methods when sufficient data have been collected. Correlate data trends in datasets and / or anomalies with mining activities. Establish links (if any) between water quality and climatic conditions (e.g. rainfall). Determine a causal link (if any) between trends in water quality data and mining activities. Include	If a deterioration of water quality occurs over time and an impact from the mining activities is clearly demonstrated, a suitably qualified consultant will be contracted to review any mitigation measures already in place and / or propose additional mitigation measures.	All monitoring results will be reported within the AEMR. DECCW and NOW will be notified in writing within 7 business days of the receipt of the monitoring results. Where it is demonstrated that the mining activities have resulted in the changes to water quality, further reporting of results from follow-up verification sampling campaigns and any mitigation measures to be implemented will be provided to

Monitoring Location	Location Description	Monitoring Parameter and Potential Environmental Impact	Sampling Parameter	Trigger Level indicating Potential Impact	Action Required	Follow Up Actions	Reporting Protocol
				• >10mg/L Oil & Grease (all) • >10% increase EC, TDS, or dissolved metals above maximum recorded background levels	review against upstream monitoring sites.		DECCW and NOW.
Neubecks Creek U/S of Delta Electricity flow gauge (EPA Point 2) Lamberts Gully D/S S1 Coxs river u/s of Blue lake S4	Upstream monitoring sites	"Background" water quality. No impacts from mining activities.		• pH <7.1 and >8.0 (EPL2) • pH <6.2and >8.0 (S1) • pH <7.3 and >8.0 (S4) • EC >2055µS/cm (EPL2) • EC >2325 µS/cm (S1) • EC >957 µS/cm (S4) • >30mg/L TSS (all) • >10mg/L Oil & Grease (all) >10% increase EC, TDS, or dissolved metals above maximum recorded background levels	Nil	Nil	All monitoring results will be reported within the AEMR.
Neubecks creek at the bridge (Site office) S2 Meteorological Station Creek Flow Sensor	Baseflow monitoring site	Reduction in base flows to Neubecks Creek due to mining activities.	Water levels	10% change in water levels above the minimum recorded during baseline monitoring	Investigate the cause of change in water levels and assess the volumes Establish the trend between the upstream point Lamberts Gully D/S and downstream Neubecks Creek (at the bridge).	Should dewatering be found to be causing the change in water levels, discharge into the creek of the same volume should be regulated under the EPA licence conditions	All monitoring data will be reported within the AEMR

8. GROUNDWATER MANAGEMENT PLAN

8.1 INTRODUCTION

A Care and Maintenance Risk Assessment (CMRA) has been undertaken for the Care and Maintenance term (Pine Dale Mine, 2014). Groundwater pollution was identified as a low risk and as mining activities have now ceased no potential adverse groundwater impacts are anticipated during the Care and Maintenance term.

The current groundwater management system will remain in place for the duration of the care and maintenance term and will be managed in accordance with this plan.

A detailed summary of baseline groundwater quality and quantity will be provided through the Baseline Water Monitoring Program and is not presented within the GMP.

It is noted that the GMP has also been prepared to meet the conditions of groundwater licences 10BL604437 and 10BL604438, issued by NOW, which require preparation of a GMP.

8.2 MONITORING LOCATIONS, PARAMETERS AND FREQUENCY

A total of 13 locations will be monitored for groundwater quality and / or groundwater levels. These locations are presented on **Figure WM5**. **Table WM10** provides a summary of the type of monitoring point, licence number, strata targeted, parameters to be measured and frequency of monitoring for each monitoring location. The frequency of monitoring and parameters measured will be reviewed regularly to ensure that meaningful data is being collected.

Monitoring will continue for a period of 2 years after mining has ceased.

All bores will be purged prior to sampling until continuous monitoring of the pH and salinity indicates that the quality of water sampled from the bore has stabilised. This will require removal of at least three bore volumes of groundwater before sampling.

It is noted that monitoring sites EP DDH7/GW and EP PDH3/GW are up-gradient and will provide 'background' data to assist in distinguishing whether any identified trends are mine related.

It is also noted that there are no licensed private groundwater bores located within the predicted zone of influence surrounding the Yarraboldy Extension mining operations. Therefore no private groundwater bores have been included within the monitoring program.

During care and maintenance term annual groundwater inflows will be not be required to be calculated utilising the recorded volumes of water pumped out of the in-pit sump (see Table WM10) and the annual rainfall records recorded by the on-site weather station which will be used to estimate the surface water input to the sump. Groundwater inflows volumes will effectively be considered to be the volume pumped from the sump minus the estimated surface water inflows.

8.3 GROUNDWATER CRITERIA AND TRIGGER LEVELS

8.3.1 Groundwater Quality

ANZECC (2000) recommends that, wherever possible, site-specific data is used to define trigger values for physical and chemical factors which can adversely impact the environment. However, the default values provided by ANZECC (2000) can be used where there is insufficient baseline data available. Although ANZECC (2000) applies to surface water systems, due to the absence of guidelines which provide specific criteria for groundwater, ANECC (2000) is commonly applied for groundwater.

The approach recommended by ANZECC (2000) for developing site-specific trigger values for slightly to moderately disturbed ecosystems is to formulate trigger values based on the 80th percentile of the site-specific monitoring data. The objective of this approach is to develop conservative, site-specific trigger values for use as a means to improve water quality in slightly to moderately disturbed ecosystems.

This approach to the defining of site-specific trigger values does not account for the water quality variability due to the properties of the aquifers present in the region. It is considered that applying an 80th percentile trigger value may not adequately reflect the water quality dynamics of the region and may initiate investigations into groundwater quality that can be associated with natural water quality variations.

A more appropriate approach involves the statistical analysis of baseline monitoring data to determine trigger values that consider the water quality properties of the main aquifer type, with trigger values developed for the hardrock/coal measures aquifer. The trigger would occur if a change in water quality occurs from the baseline data.

The baseline monitoring results collected to date indicate that, despite fluctuations in some water quality parameters, groundwater quality has remained relatively consistent at each monitoring location throughout the period of monitoring. In particular, the groundwater monitoring program has indicated that baseline concentrations of pH and electrical conductivity in the underlying aquifers are generally outside of the ANZECC (2000) default trigger values for upland rivers in slightly disturbed ecosystems in south-east Australia.

As discussed in Section 7.6.2, a review of the water quality monitoring data for pH was undertaken using the 20th percentile and an upper pH limit of 8.0 pH units to establish a suitable minimum to maximum pH range for each water monitoring location. Using this methodology, the site specific pH range for groundwaters has been derived using the 20th percentile (as a minimum value) and a maximum value of 8.0 pH units.

Due to the variability of Electrical Conductivity concentrations observed across the water monitoring locations, site specific Electrical Conductivity trigger values were determined for each groundwater and surface water monitoring site using the 90th percentile of the dataset.

The baseline water quality data for pH and electrical conductivity has been analysed as recommended by ANZECC (2000) for developing trigger values for pH and electrical conductivity. The derived trigger levels are presented in **Table WM10**.

The trigger levels will also be reviewed least annually to ensure that the most appropriate criteria are being applied.

8.3.2 Groundwater Levels

A trigger for investigation of groundwater levels (the effect on groundwater users) will occur if a drop of over 10% within the rolling three month period occurs in saturated aquifer thickness (based on minimum reported baseline values) as a result of activities associated with the Yarraboldy Extension.

In accordance with the methodology provided in the Approved WMP, revised groundwater trigger levels were determined for each groundwater bore based on the minimum reported baseline water level minus 10% of the saturated aquifer thickness. A review of each groundwater bore's water level trigger was undertaken using the minimum water levels recorded during the monitoring period encompassing January 2011 to December 2014. Groundwater trigger levels for each monitoring bore are presented in **Table WM10**.

Should the water monitoring parameters exceed the trigger level or if there is a significant increase outside the normal fluctuation levels in the rate of rise or fall in aquifer water levels compared to the preceding 12 months, then an assessment by a suitably qualified specialist will be conducted. The investigation will assess if the observed groundwater level change is exclusively induced by activities associated with the mine or due to other potential factors, such as low rainfall, variation in climate, increased groundwater usage by a private user, or an altered rainfall / recharge relationship. The assessment will consider if potential mitigation measures need to, or can be adopted.

The trigger levels were not developed for the Lithgow Seam as this seam will be dewatered during mining activities. However, the water level monitoring in this seam needs to continue to assess the impact of dewatering on the environment. The dewatering will be undertaken under the water access licences 10BL604437 and 10BL604438 in order to enable safe working conditions during mining operations.

The trigger values for groundwater levels will be reviewed periodically.

Table WM9
Groundwater Monitoring

Groundwater Monitoring Site	Site type	Strata targeted	Northing	Easting	Frequency	Parameters	pH & EC Trigger Levels	Water Level Triggers (m AHD)
Bore P6	Standpipe Piezometer	Wallerawang Underground workings	228225	6304734	Monthly	Water levels, pH, temp, EC, turbidity, DO, TSS, oil and grease, major ions, dissolved metals (Fe, Mn, Ni, Co, Zn)	pH 6.2 - 8.0 EC 1180 µS/cm	887.9
Bore P7 (10BL165933)	Standpipe Piezometer	Lithgow Seam	228456	6304253	Monthly	Water levels, pH, EC	pH 6.3 - 8.0 EC 852 µS/cm	883.28
					Quarterly	Water levels, pH, EC, major ions, Fe		
EP DDH3/GW Bore C VW (10BL603588)	Vibrating wire Piezometer	Irondale, Lidsdale, Lithgow Seam and Marrangaroo	226911	6306523	Monthly	Water Levels	Nil	Irondale 909.4 Lidsdale 891.78 Marangaroo 889.76
EP DDH4/GW Bore D (10BL603588)	Standpipe Piezometer	Middle River Seam	227132	6306531	Monthly	Water Levels	pH 6.8 - 8.0 EC 608 µS/cm	940.61
					Quarterly	pH, temp, EC, TDS, major ions, metals: As, Cd, Cr, Cu, Ni, Pb, Zn and Fe		
EP DDH5/GW Bore B VW (10BL603588)	Vibrating wire Piezometer	Sandstone, Irondale, Lidsdale & Lithgow Seams	225663	6306772	Monthly	Water Levels	Nil	Sandstone 921.23 Irondale ND**

								Lidsdale 899.23
EP DDH6/GW Bore E VW (10BL603588)	Vibrating wire Piezometer	Irondale & Lithgow Seams	228994	6308259	Monthly	Water Levels	Nil	Irondale 884.67
EP DDH7/GW Bore A (10BL603588)	Standpipe Piezometer	Middle River Seam	225313	6307639	Monthly	Water Levels	pH 6.5 - 8.0 EC 326 µS/cm	954.4
					Quarterly	pH, temp, EC, TDS, major ions, metals: As, Cd, Cr, Cu, Ni, Pb, Zn and Fe		
EP PDH1/GW Bore C (10BL603588)	Standpipe Piezometer	Lithgow Seam	226911	6306523	Monthly	Water Levels	pH 6.9 - 8.0 EC 490 µS/cm	889.25
					Quarterly	pH, temp, EC, TDS, major ions, metals: As, Cd, Cr, Cu, Ni, Pb, Zn and Fe		
EP PDH3/GW Enhance Bore (10BL603591)	Standpipe Piezometer	Lithgow Seam	227176	6303772	Monthly	Water Levels	NA	891.06
EP PDH4/GW Enhance Bore (10BL603591)	Standpipe Piezometer	Old underground workings	227097	6303780	Monthly	Water Levels	NA	890.95
EP PDH7/GW Bore E (10BL603588)	Standpipe Piezometer	Middle River Seam	226740	6305137	Quarterly	Water Levels	pH 5.5 - 8.0 EC 151 µS/cm	938.43
					Monthly	pH, temp, EC, TDS, major ions, metals: As, Cd, Cr, Cu, Ni, Pb, Zn and Fe		
Old Ventilation Shaft	Mine shaft	Wallerawang Underground workings	227524	6304399	NA - dewatering not required	Water levels, pH, temp, EC, turbidity	pH 6.3 - 8.0 EC 908 µS/cm	888.46
					Monthly	Water levels, pH, temp, EC, turbidity		
					Quarterly	DO, TSS, oil and grease, major ions, dissolved metals (Fe, Mn, Ni, Co, Zn)		

The Bong (10BL604438)	Underground opening – sampled from water pumped to the Water Cart Dam	Wallerawang Underground workings	227693	6304322	NA - dewatering not required	Flow (measured by flowmeter), water levels, pH, EC, turbidity	pH 5.8 - 8.0 EC 1157 µS/cm	Nil
					Monthly	Water levels, pH, EC, turbidity		
					Quarterly	Major ions, metals: As, Cd, Cr, Cu, Ni, Pb, Zn and Fe		

** ND – No Data. Bore is depressurised (water level has dropped below bore sensor installation height).

8.4 GROUNDWATER RESPONSE MEASURES

8.4.1 Groundwater Levels and Quality

A protocol for the investigation, notification, and mitigation of any identified exceedances of the impacts on groundwater levels is presented in **Table WM13,** while the corresponding protocol for the impacts on groundwater quality is presented in **Table WM14**. The tables also provide the groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts.

In summary, in the event of unforeseen impacts the following protocol will be implemented.

- Conduct a preliminary review of the nature of the impact, including:
  - any relevant monitoring data; and
  - current mine activities and land use practices.
- Commission of an investigation by an appropriate qualified expert into the unforeseen impact to confirm cause and effect and consider relevant options for amelioration of impact(s) as appropriate.
- Prepare an action plan in consultation with the appropriate regulatory agency.
- Mitigate causal factors where possible.
- Implement additional monitoring as necessary to measure the effectiveness of the controls implemented.

Table WM10
Trigger Action Response Plan for Groundwater Management Plan – Groundwater Levels

Monitoring Location	Monitoring Parameter and Potential Environmental Impact	Sampling Parameter	Trigger Level indicating Potential Impact	Action Required	Follow Up Actions	Reporting Protocol
P7 EP DDH3/GW EP DDH4/GW EP DDH5/GW EP DDH6/GW EP DDH7/GW EP PDH7/GW	Groundwater level decrease in aquifers other than Lithgow Seam.	Standing water level, atmospheric pressure, rainfall.	A 'significant' decrease in water level / saturated aquifer thickness in any one or a number of monitoring locations. A 'significant' decrease will be considered as one which might include such events as: • a decline of over 10% below minimum reported water levels within a rolling 3 month period (**Table WM12**); or • a sudden decrease where the rate of fall exceeds the typical seasonal rate of decrease in background water level data These water level trigger values will be reviewed periodically.	Investigate results and trends, considering any mitigating factors where applicable. Correlate observed trends with mining activities and climatic conditions (eg rainfall). Determine whether any changes in water levels may be due to mining activities. Continue to monitor and assess water level data from all monitoring locations, establish trends and quantify trends (eg. calculations of correlation co-efficient) using statistical analysis methods, if necessary. If three (3) consecutive values are outside the background trends initiate the follow up action.	If some or all of the water level decreases observed in the monitoring program are assessed to be due to impacts from mining operations: • engage a hydrological consultant to reassess the degree and extent of impact; and • where appropriate, implement appropriate mitigation measures and / or alternative water supply to the affected user to the extent their supply is impacted.	All monitoring results will be reported within the AEMR. However, if at any time it assessed that monitoring exceeds the trigger levels, OEH, NOW and any affected user will be notified in writing within 7 business days of the receipt of the monitoring results. Where it is demonstrated that the mining activities have resulted in the changes to groundwater levels, further reporting of results from follow-up verification sampling campaigns and any mitigation measures to be implemented will be provided to OEH, NOW and any affected user.

Table WM11
Trigger Action Response Plan – Groundwater Quality

Monitoring Location	Monitoring Parameter and Potential Environmental Impact	Sampling Parameter	Trigger Level indicating Potential Impact	Action Required	Follow Up Actions	Reporting Protocol
P6 P7 EP DDH4/GW EP DDH7/GW EP PDH1/GW EP PDH3/GW EP PDH4/GW EP PDH7/GW EP PDH8/GW Old ventilation shaft The Bong	Possible groundwater quality changes over time that may be due to the approved mining activities.	**Field Water Quality Tests**: pH, EC, TDS and temperature. **Laboratory Testing and Analysis**: major ions and dissolved metals (see **Table WM10**). The analytes monitored will be reviewed on an annual basis and revised as required.	Continued exceedance of the derived groundwater quality triggers will act as a prompt for further investigations (see **Table WM10**). The water quality trigger levels will be reviewed periodically.	Confirm the timing and general location of the exceedance. Confirm the meteorological conditions at the time of the exceedance. Identify any potential contributing factors based on the established trends. Assess the monitoring results against background trends to identify any anomalies or causes. If the exceedance is not attributable to mining activities, the routine monitoring program will be assessed for its effectiveness. Correlate data trends in datasets and / or anomalies with mining activities. Establish any links with decreasing water quality with decrease in groundwater levels. Compare groundwater quality data from all bores with the nearest surface water monitoring site(s).	If a deterioration of water quality occurs over time and / or geochemical anomalies are detected and an impact from the mining activities is clearly demonstrated, a suitably qualified consultant will be contracted to review any mitigation measures already in place and / or propose additional mitigation measures. Where mitigation and management strategies have been implemented additional monitoring and regular reviews will be undertaken to measure the effectiveness of the strategies.	All monitoring results will be reported within the AEMR. However, if at any time it assessed that monitoring exceeds the trigger levels, OEH, NOW and any affected user will be notified in writing within 7 business days of the receipt of the monitoring results. Where it is demonstrated that the mining activities have resulted in the changes to groundwater quality, further reporting of results from follow-up verification sampling campaigns and any mitigation measures to be implemented will be provided to OEH, NOW and any affected user.

The outcomes of this protocol will be reported in the AEMR. The implementation of any mitigation measures will be undertaken in consultation with DPE, NOW and OEH and will be reported in the AEMR.

Where a trigger value is exceeded, the Proponent would initially undertake additional monitoring to determine whether the exceedance relates to error or interim change in groundwater quality and if it is due to activities associated with the proposed Yarraboldy Extension or some other cause. Additional monitoring after this may involve increasing the frequency of monitoring for laboratory analysis and/or increasing the frequency of field analysis.

8.4.2 Impact on Baseflow in Neubecks Creek

Loss of groundwater contribution to the Neubecks Creek from the surrounding aquifers due to dewatering for Yarraboldy open cut has the potential to reduce the flow and cause impact on the surrounding environment. Continued monitoring of water levels in the Neubecks Creek and monitoring bores EP PDH8/GW, The Bong and Old Shaft will be undertaken as part of the Groundwater Monitoring Program (see **Table WM10**).

In the event that the monitoring program identifies reduction in baseflow to Neubecks Creek, the following responses will be implemented.

- Initiate an investigation by suitably qualified personnel into the cause(s) and extent of the reduction in groundwater contribution.
- Where appropriate, identify contingency measures such as replacing the loss of baseflow by discharging intercepted volume back into the Neubecks Creek. This measure will be further discussed following the assessment of surface water – groundwater connectivity (after 6 months of baseline monitoring is completed)

8.4.3 Impacts on Private Groundwater Bores

There are no licenced groundwater supply bores within 1500m radius from the Yarraboldy Extension Area boundary, well outside the predicted area of influence.

In the event that a complaint is received from a landowner regarding the loss of a groundwater supply, in accordance with *Schedule 3 Condition 25* an investigation will be initiated. If the initial investigations conclude the Company has potentially contributed to the event(s), the following steps will also be implemented:

- provide a copy of the landowner complaint to NOW and DPE and inform both agencies of the intention to conduct an independent review;
- commission an independent review including investigation of:
  - relevant groundwater flow rates, groundwater availability and meteorological conditions over the relevant period of record;
  - any changes to surrounding land use that may have affected groundwater flow rates and quality over time; and
  - whether the event(s) is/are attributable solely to the Company.

- provide a copy of the independent review report to the landowner, NOW and DPE;
- if the investigation concludes that the event(s) are attributable to the Company then appropriate mitigation and management strategies, where relevant, will be developed and implemented which may include:
  - rehabilitation of the bore/well supply by deepening; or
  - replacement of the water supply with water of suitable quality and quantity (eg. through installation of rainwater tanks) or other agreed compensation; and
- where mitigation and management strategies have been implemented additional monitoring and regular reviews will be undertaken to measure the effectiveness of the strategies undertaken.

9. DATA MANAGEMENT PROTOCOL

The protocol to be adopted for data management is as follows.

- **Water Quality and Levels Data**

  Develop and maintain an electronic database of water quality indicators given as outlined in **Tables WM7** and **WM10**, and results of sampling campaigns to allow compilation of time series datasets. Progressive charting of data allows observations of changes in water quality and levels over time. Graphical representations of data can identify anomalies in data trends more clearly, for remedial actions.

- **Meteorological Data**

  Develop and maintain an electronic rainfall, temperature and water level / flow database to assist with the analysis of data on water quality and levels.

This 'in-house' recording system which will be developed and maintained will be updated on a monthly basis. The system will also include explanations of any emerging trends in data and possible explanations for anomalous data. The aim of this system is to regularly assess any changes in water quality or levels at all monitoring locations over time and respond to any changes accordingly.

10. REPORTING, REVIEW AND VALIDATION

All surface water and groundwater monitoring results and site inspection data will be presented within each AEMR, any trends over time reported and the meaningfulness of the data reviewed. All groundwater extraction data such as volumes and rates and the extent of aquifer depressurisation will be compared with the predictions. This will include an annual review by a qualified groundwater consultant to validate the recorded data against the groundwater model predictions and to determine any need to recalibrate the groundwater model (in accordance with the groundwater access licences 10BL604437 and 10BL604438). The outcomes of this review will also be reported within the respective AEMR.

Additionally, throughout the reporting period, monitoring results will be reviewed monthly by the Company to ensure that results are compliant with the applicable criteria and if any trigger response actions are required. Should any trigger response actions be required, the DECCW and NOW will be notified within 7 business days of receiving the results.

During Care and Maintenance term all reporting requirements will remain. On completion of mining operations the Company will engage the independent expert, approved by the office, to undertake audit on groundwater conditions, all monitoring records, reports and any related impacts.

11. RESPONSIBILITIES AND ACCOUNTABILITIES

The information contained within the WMP is available to all members of the workforce, particularly those responsible for undertaking inspection, taking samples, handling and reviewing documentation or organising external party monitoring. The responsible workforce will be made aware of the procedures through training and, where appropriate, at regular toolbox talks / meetings.

The ultimate responsibility for the implementation of the WMP and reporting of the monitoring results is the Manager Mining Engineering.

Table WM15 outlines the accountable positions and tasks relating to the WMP for the Pine Dale Coal Mine.

Table WM12
Accountable Positions and Tasks (Water Management)

Position	Accountable Task
Manager Mining Engineering	– Ensure that all water management and sediment and erosion control structures have been constructed to the appropriate standard. – Coordinate water quality and flow monitoring in accordance with this plan. – Undertake (or delegate) monthly inspections of water management and erosion and sediment control structures. – Undertake (or delegate) inspections of Sediment Retention Dam A during pumping of water to the dam to prevent uncontrolled overflows. – Ensure that, in the event that discharge is required, water quality meets the required water quality criteria. – Coordinate review and reporting of recorded water quality and flow monitoring
All employees	– Report any failure of water management and erosion and sediment control structures. – Report any areas of active erosion or sedimentation.
The Company Conducting Water Monitoring	– Undertake water quality and flow monitoring in accordance with this monitoring plan and relevant Australian Standards. – Inform Manager Mining Engineering immediately should any non-compliances against applicable quality or quantity criteria be identified.

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Appendix 1

Water Management and Erosion and Sediment Control - Inspection Sheet

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Site Inspection Summary Report – Erosion & Sediment Controls

Inspection Details: Date: Time: Inspection Completed by: Position: Form # ____ of:____

Inspection Triggered By: ☐ *Routine Inspection* ☐ *Rainfall potentially causing runoff (incl>25mm/24hrs)* ☐ *Opportunistic Report* ☐ *Other:* _____

Issues Requiring Attention:

Control Type	Control ID #	Chainage (km)	Photo #	Issue & Corrective Action Required *(see over page for further comments*)*	Priority (marked with X)	Due Date	Completion Status
Eg Sediment Fence	***Eg 26***	***Eg 8.4km***	***Eg 1-3***	***Example:** Sediment fence trap full of sediment and could overflow.* → *Requires sediment removal asap.*	*x HIGH o MEDIUM o LOW*	***Eg 28/5/06***	***Eg Not Completed***
					o HIGH o MEDIUM o LOW		
					o HIGH o MEDIUM o LOW		
					o HIGH o MEDIUM o LOW		
					o HIGH o MEDIUM o LOW		
					o HIGH o MEDIUM o LOW		

DISTRIBUTION: A copy of this report has been sent to:

☐ Mining Contractor ☐ Manager Mining Engineering ☐ Other(s): _____

_____

Outstanding Issues:

Control Type	Control ID Number	Chainage (km)	Photo #	Issue & Corrective Action Required	Priority (marked with X)	Due Date	Completion Status
					o HIGH o MEDIUM o LOW		
					o HIGH o MEDIUM o LOW		

** **Signed & Dated:**

Inspection Attachments (eg Photos) & Further Comments / Details Where Required