WATER MANAGEMENT PLAN

Edition	Rev.	Comments	Author	Authorised By	Date
1	0	2011 Rocglen Extension Project Review	GSSE	Danny Young	March 2012
	1	PA 10_0015 MOD 2	M Woodhead	J Johnson	November 2015
	2	Review following 2016 IEA	M Whitten	J Conomos	October 2016
	3	Review following 2016 AR	M Whitten	J Conomos	March 2017
	4	Review following 2017 AR	E Clements	J Conomos	May 2018

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1.0 INTRODUCTION

1.1 Background

The Rocglen Coal Mine (RCM) is located approximately 28km north of Gunnedah, and 10km west of the former Canyon Coal Mine (formerly Whitehaven) (**Figure 1**). The mine site covers an area of approximately 460 hectares.

The mine was initially approved on the 15th April 2008 under PA 06_0198 with a minor modification granted in May 2010 to address highwall stability issues. Whitehaven submitted a Project Application, and accompanying Environmental Assessment, under Part 3A of the *Environmental Planning and Assessment Act 1979* in March 2011. PA 10_0015 was issued on the 27th September 2011 and allows for additional extraction of up to 5 million tonnes of coal at a maximum recovery rate of 1.5 million tonnes per annum (ie. increased projected life of the operation for coal extraction by up to four years).

A minor modification was approved in November 2014 relating to Coal Transport, a second modification was approved in August 2015 allowing changes to coal reject haulage to the site, and a third modification was approved in February 2017 to allow increased coal haulage during calendar year 2017.

1.2 Purpose and Objectives

The purpose of the Water Management Plan (WMP) is to:

- Guide the management of surface and groundwater resources throughout the operational life of the mine, including through site rehabilitation;
- Address the relevant conditions of the Project Approval;
- Address the relevant commitments made within the Environmental Assessment; and
- Address legislative requirements and guidelines relevant to the Surface Water Management Plan (SWMP).

The WMP incorporates the following components as required by Project Approval PA 10_0015:

- Site Water Balance (Section 3.0);
- Surface Water Management Plan (Section 4.0); and
- Groundwater Management Plan (Section 5.0)

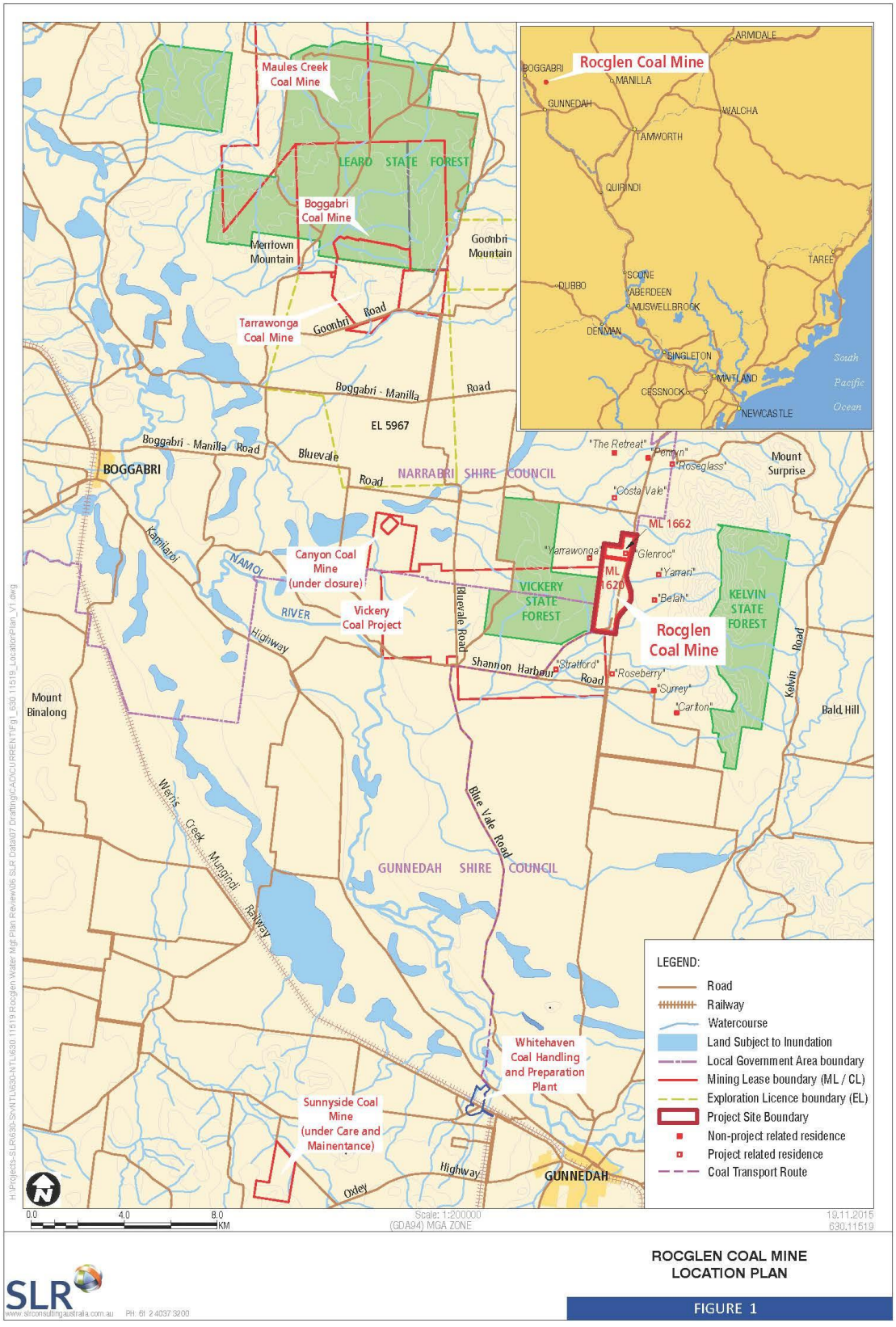


Figure 1: Location Plan

2.0 SUMMARY OF STATUTORY APPROVAL REQUIREMENTS

2.1 Requirements of the Water Management Plan

2.1.1 Project Approval (PA10_0015)

This WMP has been prepared in accordance with Project Approval PA 10_0015 Schedule 3, Condition 22 which stipulates the WMP must address the requirements listed in **Table 1**.

Table 1 - Coverage of Requirements in Schedule 3, Condition 22 of PA 10_0015

Requirement	Coverage
22. *The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must be prepared in consultation with EPA, DPI-Water and DRE by suitably qualified and experienced persons whose appointment has been approved by the Secretary, and submitted to the Secretary for approval by the end of February 2012. This Plan must include:*	
(a) *A Site Water Balance that:*	3.0
• *Includes details of:*	
- *Sources and security of water supply;*	3.4
- *Water use on site;*	3.2.1
- *Water management on site;*	3.4
- *Any offsite water transfers;*	3.2.3
• *Describes what measures would be implemented to minimise water use on site; and*	3.5
• *Is to be updated each year during the annual review.*	3.6
(b) *a Surface Water Management Plan, that includes:*	4.0
• *a detailed description of the water management system on site, including the:*	4.2
- *clean water diversion systems;*	4.3
- *erosion and sediment controls; and*	4.4
- *water storages;*	4.6
• *detailed plans, including design objectives and performance criteria, for:*	4.0
- *reinstatement of drainage lines on the rehabilitated areas of the site; and*	4.7.2
- *control of any potential water pollution from rehabilitated areas of the site;*	4.7.3
• *performance criteria for the following, including trigger levels for investigating any potentially adverse impacts on:*	4.0
- *the water management system;*	4.9.3
- *surface water quality in Driggle Draggle Creek or the unnamed creek to the south of the site;*	4.9.3
- *the health of any riparian vegetation in Driggle Draggle Creek or the unnamed creek to the south of the site*	4.9.6
• *a program to monitor:*	
- *the effectiveness of the water management system;*	4.9.7

Requirement	Coverage
- *surface water flows and quality in Driggle Draggle Creek and the unnamed creek to the south of the site;*	4.9.4 & 4.9.6
- *the health of any riparian vegetation in Driggle Draggle Creek or the unnamed creek to the south of the site; and*	4.9.6
• *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*	4.10
(c) *a Groundwater Management Plan, which includes:*	5.0
• *performance criteria, including trigger levels for investigating any potentially adverse groundwater impacts;*	5.4.3
• *a program to monitor:*	5.4
- *groundwater inflows to the mining operations;*	5.4.5
- *the impacts of the project on any alluvial aquifers;*	5.4.4
- *the seepage/leachate from water storages, backfilled voids, and the final void on site;*	5.4.4
• *a program to validate the groundwater model for the project, and calibrate it to site specific conditions; and*	5.4.6
• *a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse groundwater impact.*	5.5
In addition, the standard requirements for Management Plans apply, which stipulate that all plans include:	
(a) *detailed baseline data;*	4.9.2 & 5.4.2
(b) *a description of:*	
• *the relevant statutory requirements (including any relevant approval, license or lease conditions);*	2.0
• *any relevant limits or performance measures/criteria;*	4.9.3 & 5.4.3
• *the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;*	4.9.3 & 5.4.3
(c) *a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;*	4.0 & 5.0
(d) *a program to monitor and report on the:*	
• *impacts and environmental performance of the project;*	4.0 & 5.0
• *effectiveness of any management measures (see (c) above);*	4.0 & 5.0
(e) *a contingency plan to manage any unpredicted impacts and their consequences;*	4.10.1 & 5.5.5
(f) *a program to investigate and implement ways to improve the environmental performance of the project over time;*	4.10.3, 5.5.6 & 7.0
(g) *a protocol for managing and reporting any:*	
• *incidents;*	6.1
• *complaints;*	5.5.3 & 6.2
• *non-compliances with statutory requirements; and* • *exceedances of the impact assessment criteria and/or performance criteria; and*	4.10.2 & 5.5.2
(h) *a protocol for periodic review of the plan.*	7.0

2.1.2 Environment Protection Licence (EPL 12870)

Table 2 outlines the EPL conditions relevant to water management on site at Rocglen Coal Mine:

Table 2- Relevant EPL Conditions

<table>
<tr><th>Requirement</th><th>Coverage</th></tr>
<tr><td>P1.3 The following points referred to in the table below are identified in this licence for the purposes of the monitoring and/or setting of limits for discharges of pollutants to water from the point…</td><td>Table 10</td></tr>
<tr><td>L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997</td><td>-</td></tr>
<tr><td>L2.1 For each monitoring/discharge point or utilisation area specified in the table/s below (by a point number), the concentration of a pollutant discharges at that point, or applied to that area, must not exceed concentration limits specified for that pollutant in the table.</td><td>4.10.2</td></tr>
<tr><td>L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.</td><td>4.9.3</td></tr>
<tr><td>L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table/s.</td><td>-</td></tr>
<tr><td>L2.4 Water and/or Land Concentration Limits

POINT 11, 12
<table>
<tr><th>Pollutant</th><th>Units of Measure</th><th>50 percentile concentration limit</th><th>90 percentile concentration limit</th><th>3DGM concentration limit</th><th>100 percentile concentration limit</th></tr>
<tr><td>Oil and Grease</td><td>Milligrams per litre</td><td></td><td></td><td></td><td>10</td></tr>
<tr><td>pH</td><td>pH</td><td></td><td></td><td></td><td>6.5-8.5</td></tr>
<tr><td>Total Suspended Solids</td><td>Milligrams per litre</td><td></td><td></td><td></td><td>50</td></tr>
</table></td><td>4.9.3</td></tr>
<tr><td>L2.5 The Total Suspended Soilds concentration limits specified for Point 11 and 12 may be exceeded for water discharges provided that:
(a) The discharge occurs solely as a result of rainfall measured at the premises that exceeds 38.4 millimetres over any consecutive five day period immediately prior to the discharge occurring: and
(b) All practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store run off from a 38.4 millimetre, 5 day rainfall event.
Note: 38.4mm equates to the 5 day 90%ile rainfall depth for Gunnedah sourced from Table 6.3a Managing Urban Stormwater: Soils and Construction Volume 1: 4th edition, March 2004.</td><td>4.9.3</td></tr>
<tr><td>M2.1 Water and or Land Monitoring Requirements
Please see page 14-15 of EPL12870 for details.</td><td>Table 10</td></tr>
<tr><td>R2 Notification of Environmental Harm
Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with requirements of Part 5.7 of the Act.</td><td>4.10.2</td></tr>
<tr><td>R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.</td><td>4.10.2</td></tr>
<tr><td>R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.</td><td>4.10.2</td></tr>
</table>

2.2 Key Legislation, Policies and Guidelines

A number of legislative requirements, government policies and guidelines relating to water management have been considered in the preparation of this WMP.

2.2.1 Key Legislation

Key items of legislation which have been considered in the preparation of this WMP include the following

- The *Protection of the Environment Operations (POEO) Act, 1997*;
- The *Water Act, 1912*; and
- The *Water Management Act, 2000*.

2.2.2 Policies and Guidelines

Key policies and guidelines which are relevant to the preparation and implementation of this WMP include:

- ANZECC, Australian and New Zealand Guidelines for Fresh and Marine Water Quality (the "ANZECC Guidelines"), October 2000;
- Department of Environment and Conservation, Approved Methods for the Sampling and Analysis of Water Pollutants in NSW, March 2004;
- Managing Urban Stormwater: Soils and Construction (the *Blue Book*), Volume 1 and Volume 2E - Mines and Quarries (Landcom, 2004 and Department of Environment and Climate Change (DECC), 2008;
- Namoi Catchment Action Plan 2010-2020, 2013;
- Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources, 2003;
- Water Sharing Plan for the NSW Murray-Darling Basin Porous Rock Groundwater Sources, 2011;
- NSW Water Quality and River Flow Objectives, September 1999;
- NSW State Rivers and Estuaries Policy; and
- NSW Farm Dams Policy.

3.0 SITE WATER BALANCE

The information presented below is a summary of the water balance presented in the Environmental Assessment for the *Rocglen Coal Mine Extension Project*. For more detailed information on the water balance refer to the Environmental Assessment (GSSE, 2011).

3.1 Water Sources (Model Inputs)

3.1.1 Rainfall

The water balance utilised long term historical rainfall data from the Boggabri BOM Station (No. 55044), which was found to have high correlation with the meteorological data collected at the Rocglen

meteorological station commissioned in 2009. Where gaps were identified, data from the nearby Gunnedah Pool BOM (No. 055023) station was utilised.

The statistical dry, median and wet years from the Boggabri Station are:

- Dry year (10th percentile) – 392 mm;
- Median year (50th percentile) – 578 mm; and
- Wet year (90th percentile) – 752 mm.

A number of catchment areas were delineated based on varying catchment characteristics and expected differences in runoff characteristics as follows:

- Clean area (undisturbed);
- Partially disturbed areas, which are those largely undisturbed by mining but with a small amount of disturbance (i.e. 10% disturbed), such as roads or other minor infrastructure located within them;
- Predominantly disturbed areas (i.e. >50% disturbed), which are those containing a mixture of clean and disturbed areas;
- Loose spoil emplacement, which has high infiltration;
- Shaped spoil emplacement, which has lower infiltration than loose spoil; and
- Mine extraction pit and hardstand, which has high runoff potential.

The large clean water catchment to the east of the site is diverted around the mine and has therefore not been included in the water balance. This runoff could potentially be harvested and utilised for operational activity however, Whitehaven would need to ensure any water extracted is within the Maximum Harvestable Right Dam Capacity (MHRDC).

The MHRDC of the mine is determined by the following calculation:

MHRDC = Mine Site Area (ha) x Multiplier Value (0.07)

The MHRDC has been calculated to be approximately 32.2 ML based on a mine site area of 460ha.

The total maximum capacity of all existing clean water storage dams is below the MHRDC of 32.2 ML. Hence no licences are required for these existing clean water dams.

Dirty water, or sediment detention, dams are not included in the volume held against the MHRDC on the basis that these dams would be considered excluded works under Schedule 1 (clause 4) of the Water Management (General) Regulation, 2011. This would be on the basis that these sediment dams will prevent the contamination of downstream water sources, and potentially provide water for dust suppression and irrigation for the rehabilitation of disturbed mining areas.

Note: Dirty water is defined as surface runoff from disturbed catchments such as the active mine area and overburden emplacement, ROM and product coal stockpiles, soil and subsoil stockpiles and rehabilitated area (until stabilised), all of which could contain sediments (GSSE 2010).

3.1.2 Groundwater (From Bores)

Whitehaven has two existing groundwater bore licenses for the purposes of mining with a combined total allocation of 120 ML. Water extracted from these bores is pumped to the Bore Pump Dam.

3.1.3 Groundwater (from Mine Pit)

In theory, the mine pit could intercept groundwater which would enter the site water management system, however, in practice there has been negligible inflow into the open cut pit and there is negligible inflow predicted for future operations (Douglas Partners, 2010).

3.1.4 Other

Water has been trucked to site in the past to supplement the water supply during extended dry periods. Whilst this has not been included within the water balance model, in practice this is an option available to Rocglen should onsite water supply be insufficient for continued operations.

3.2 Water Losses (Model Outputs)

3.2.1 Water Usage

The majority of water required on the site is utilised for dust suppression activities, including in the crushing and screening process. Up to 90ML of water may be required for operational activity during an average year. A nominal amount of potable water and water for ablutions is required on-site and will continue to be trucked in from an external source.

3.2.2 Evaporation

Evaporation from open water bodies (sediment dams) is considered to be another main source of water loss from the system. For the purposes of the water balance, evaporation is assumed to be consistent with the historical data recorded at the Gunnedah Resource Centre BOM Station (No. 55024). Evaporation varies throughout the year depending upon the month and the surface area of the water storages on any given day.

3.2.3 Off Site Transfers (Discharges)

The water balance assumes that discharge occurs when the runoff volume exceeds the available storage capacity during a rainfall event. This is consistent with the current EPL which permits wet

weather discharge from Licensed Discharge Point (LDP) 11 and LDP 12. In practice, Whitehaven may also discharge (after effective water treatment) during dry periods to dewater dams.

Historic evidence indicates that the mine is a generally dry site, however short periods of high rainfall pose a risk of uncontrolled discharge. Where required, the following measures will be implemented to reduce the potential for uncontrolled discharge:

- Sediment dams will be enlarged in order to provide an opportunity to detain and treat additional dirty water prior to discharge;
- Dirty water collected in sediment dams lower in the treatment chain will be transferred to dams higher in the system to ensure the lower sediment dams have sufficient capacity to contain more rainfall events;
- Use of the open cut pit for the temporary storage of dirty water runoff during periods of high rainfall; and
- Controlled discharge (of treated water) may be undertaken to maintain sufficient capacity on site.

3.3 Water Balance

The water balance results for the mining year scenario (Year 5 of the expanded operation – current MOP year) are presented in**Table 3.**

Table 3 - Water Balance Results for the Year 5 – Current MOP Year (Annual Summaries)

	Description	Dry (ML/year)	Median (ML/year)	Wet (ML/year)
Water Source (Inputs)	Rainfall Runoff	110	200	290
	Bore Use	0 (*)	0 (*)	0
Water Losses and Usage (Outputs)	Evaporation (from dams)	40	50	60
	Water Usage (dust suppression including crushing)	90	90	85
	Discharged (wet weather)	10	50	115
Balance (Input-Output)	Change in water storage on site (**)	-30	+10	+30

Note (*) A wide scatter in the bore usage occurred, with 35 ML used in one very dry year, and 15 ML in one relatively median year.
Note (**) Change in water storage is calculated from other data, rather than being read from the trend line.

The overall results of the water balance indicate that the site water management is fairly well balanced with adequate water for dust suppression supplied through the rainfall runoff collected in sediment basins. This supply can be supplemented by bore water if required during drier years, although the modelled water usage is fairly low in comparison to the license entitlement of 120 ML/year.

The reliance on bore water is expected to decrease as the mine progresses due to an increase in rainfall runoff captured in sediment basins which is associated with an increase in the area of shaped overburden emplacements that have a higher runoff potential than loose emplacement areas.

As sufficient water for operational activity will be available through rainfall runoff collected in sediment dams, and through extraction of bore water, additional sources of water supply are not expected to be required.

An annual water balance review will be undertaken to validate the model with actual data.

The water balance model indicates likely annual discharges of 2 to 6 days (on average) per year, varying up to 12 days (on average) per year during wet years, with volume discharged estimated to be as follows:

Table 4 – Environmental Assessment Predicted Discharges from Site (Year 5 Scenario)

Table 15 - Predicted Discharges from Site Year 5 Scenario

	Description	Dry	Median	Wet
Number of Discharge Days per Year	Where rain was more than 38.4mm in 5 days	1 Days (from 0 to 2 days)	4 Days (from 0 to 5 days)	10 Days (from 2 to 14 days)
	Where rain was less than 38.4mm in 5 days	0 Days (from 0 to 2 days)	2 Days (from 0 to 5 days)	4 Days (from 1 to 10 days)
	Total Number of Days Per Year	**1 Days** (from 0 to 3 days)	**6 Days** (from 0 to 9 days)	**14 Days** (from 2 to 22 days)
Total Volume Discharged (per year)		**10 ML** (from 0 to 40 ML)	**50 ML** (from 0 to 105 ML)	**125 ML** (from 15 to 180 ML)

The events where discharge occurred, but the design criteria was not exceeded, were all as a result of a combination of the following factors:

- A high rainfall period had preceded the day of discharge so that dams were at full capacity before the event occurred; and
- There was a substantial rainfall event (but still under 38.4 mm) in a short period of 1 to 2 days.

There is likely to be from 2 to 4 discharge events per year while the number of discharges predicted for the Year 5 and Year 10 scenarios is slightly higher than predicted by the *Blue Book*.

3.4 Water Management, Security and Supply

Water transfers onsite are managed through both mobile and stationary pumping infrastructure. Water is transferred between the various storage dams as required to ensure the sediment dams have sufficient available capacity to capture subsequent rainfall events. Mobile water carts are used for dust suppression of disturbed areas.

The majority of water required for operational activity is sourced from the onsite surface water management system, with additional water sourced from licensed bores or clean water dams if required. As a last resort, water may be trucked in from offsite to supplement the operational water demand.

Water sourced for operational activities is used in the following order of preference:

- Mine Water (via Mine Water Dam);
- Dirty water from the sediment basins, preferentially sourced from the basins with higher TSS readings;
- Licensed bores (via Bore Pump Dam);
- Clean water harvested from the adjacent clean water catchment (via storage dams); and
- Water occasionally trucked in from off-site as required.

3.5 Measures to Reduce Water Loss/Usage

The site does not operate a coal washery, and has a reduced water demand compared to some other mining operations. The principal measures to reduce water use and water loss will include the following:

- Avoiding un-necessary use of the water cart and dust suppression equipment;
- The Bore Pump Dam will not be kept full at all times, thereby reducing evaporation from the surface;
- Bore water will only be pumped into the Bore Pump Dam (and subsequently used on site) when storage levels within the Mine Water Dam and dirty water dams fall to levels that would constrain site operations due to insufficient water for dust suppression purposes.

3.6 Water Balance Review

An update of the site water balance will be undertaken on an annual basis as part of the Annual Review, or following any new or modified approval conditions relevant to water management or where there is any change to the operations which are likely to materially change potential impacts.

4.0 SURFACE WATER MANAGEMENT PLAN

4.1 Principles and Objectives

On-site water management principles and objectives include the following:

- Containment of runoff from open cut areas by directing this water into in-pit sumps;
- Pumping excess water from the in-pit sumps into the Mine Water Dam;
- Directing sediment-laden runoff from disturbance areas and rehabilitated areas into designated sediment control dams;
- Installing temporary erosion and sediment control devices as required (i.e. sediment fences, sand bag weirs) to minimise the discharge of sediment laden water from newly disturbed areas;
- Diverting clean water runoff unaffected by the operations away from disturbed areas and off-site, where possible;
- Maintaining sediment control structures to ensure that the designed site capacity is maintained;
- Implementing an effective revegetation and maintenance program for the site; and
- Management of dirty water dams in accordance with the *Blue Book.*

4.2 Overview of Water Management System

The site lies along the central crest of the valley floor between the hills of the Vickery State Forest (to the west) and the Kelvin State Forest (to the east). The general site layout is shown on Figure 2. For the purposes of water management at Rocglen, surface water is considered in terms of three separate surface flows based on the source of runoff and the potential contaminants the runoff may contain:

- Clean Water Catchment – Catchment areas which are relatively undisturbed by mining activities;
- Dirty Water Catchment – Disturbed catchments such as overburden emplacement areas and stockpile areas which may contain suspended sediment. Runoff of potential “coal contact” water is captured by sediment dams SD3 and Dam ‘B’. Additional monitoring of these dams receiving potential “coal contact” water will be undertaken to establish if there is any potential for material impact on surface water quality; and
- Mine Water Catchment – The catchment of the open cut pit which may potentially be generating saline runoff water.

Most runoff from clean water catchment areas is prevented from entering the dirty water system or the mine water system. Runoff from dirty water catchment areas is directed into sediment basins and storage dams and utilised for dust suppression on site, with some water discharged from site in accordance with the conditions of EPL 12870. Runoff from the southern area of the site ultimately reports to SD3 (LDP 11) while runoff from the northern area of the site reports to Dam B (LDP 12). Mine water consists of rainfall runoff from within the pit catchment, and groundwater inflow into the pit. Mine

water is stored within the pit and out of pit within the mine water dams, and is isolated from the clean water and dirty water management systems. Mine water is used primarily for dust suppression on site.

The general layout of the site water management system is shown on Figure 3.

4.3 Clean Water Management

Clean water runoff from the Vickery State Forest to the west of the site, and north of SB17, is diverted around the disturbance area to Driggle Draggle Creek in the north. The nominal amount of clean water inflow entering the site to the south of SB17 will report into the dirty water management system and be discharged through LDP11 at SD3.

Clean water runoff from the agricultural lands to the east of the site are diverted around the site via clean water diversion channels running along the eastern side of the Wean Road re-alignment. The location of all clean water diversion channels is shown on Figure 3.

The clean water diversion channels are designed to convey the 20 year Annual Recurrence Interval (ARI) storm event, as recommended by Volume 2E of the *Blue Book* for temporary drainage controls, where the duration of disturbance is greater than 3 years.

4.4 Dirty Water Management

4.4.1 Sources of Erosion and Sedimentation

There are a number of activities which will be undertaken throughout the operational life of the mine which have the potential to cause soil erosion and generate sediment unless adequate control measures and practices are implemented. Erosion or sedimentation may potentially result from any of the following:

- Surface runoff from areas disturbed as a result of vegetation or topsoil removal;
- Surface runoff from areas disturbed as a result of mining activity;
- Surface runoff from topsoil or subsoil stockpiles prior to establishment of an adequate vegetative cover;
- Surface runoff from rehabilitation areas prior to the establishment of a suitable ground cover;
- Excessive surface water runoff velocity within drainage lines and on disturbed surfaces; and
- Elevated winds.

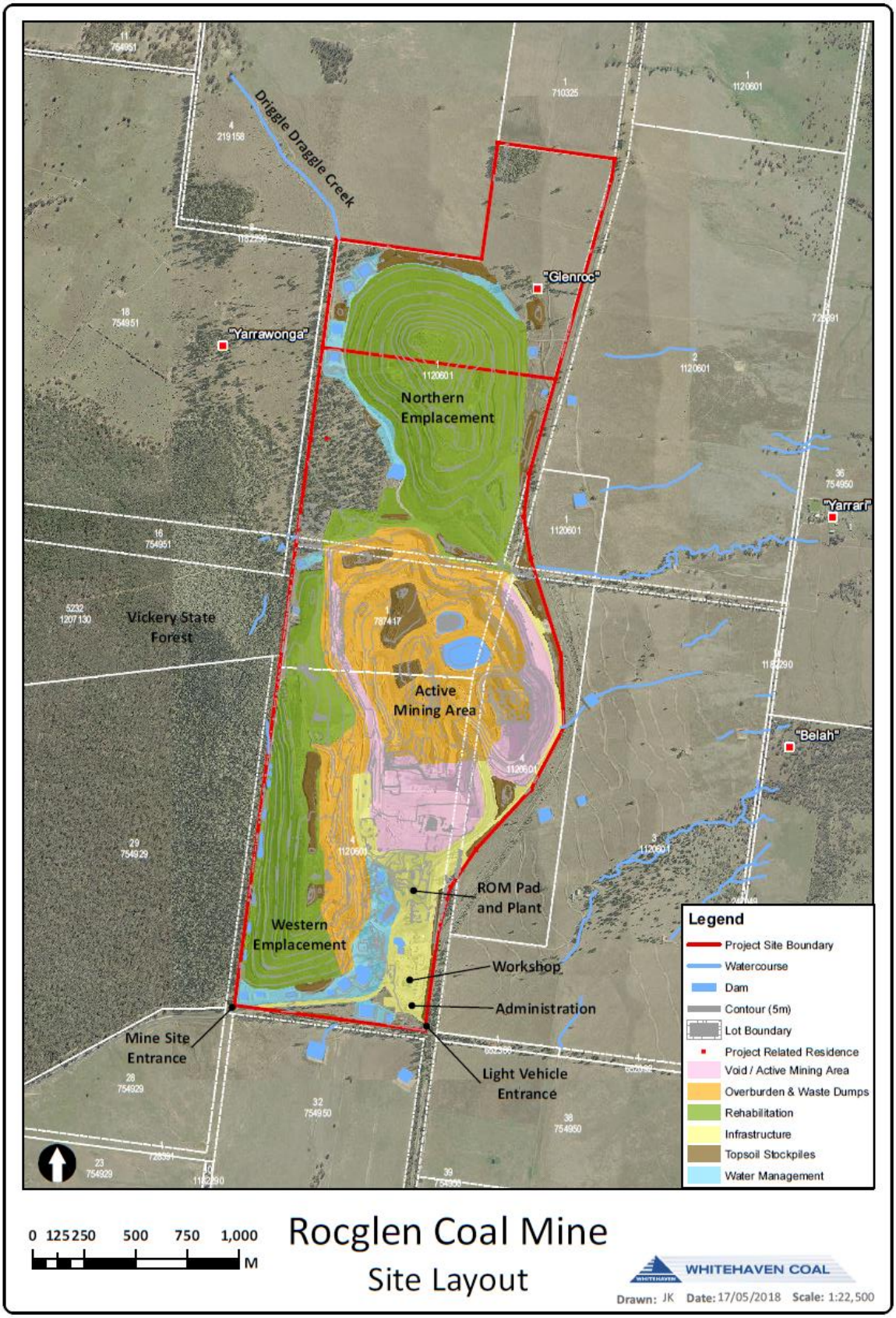


Figure 2: Site Layout

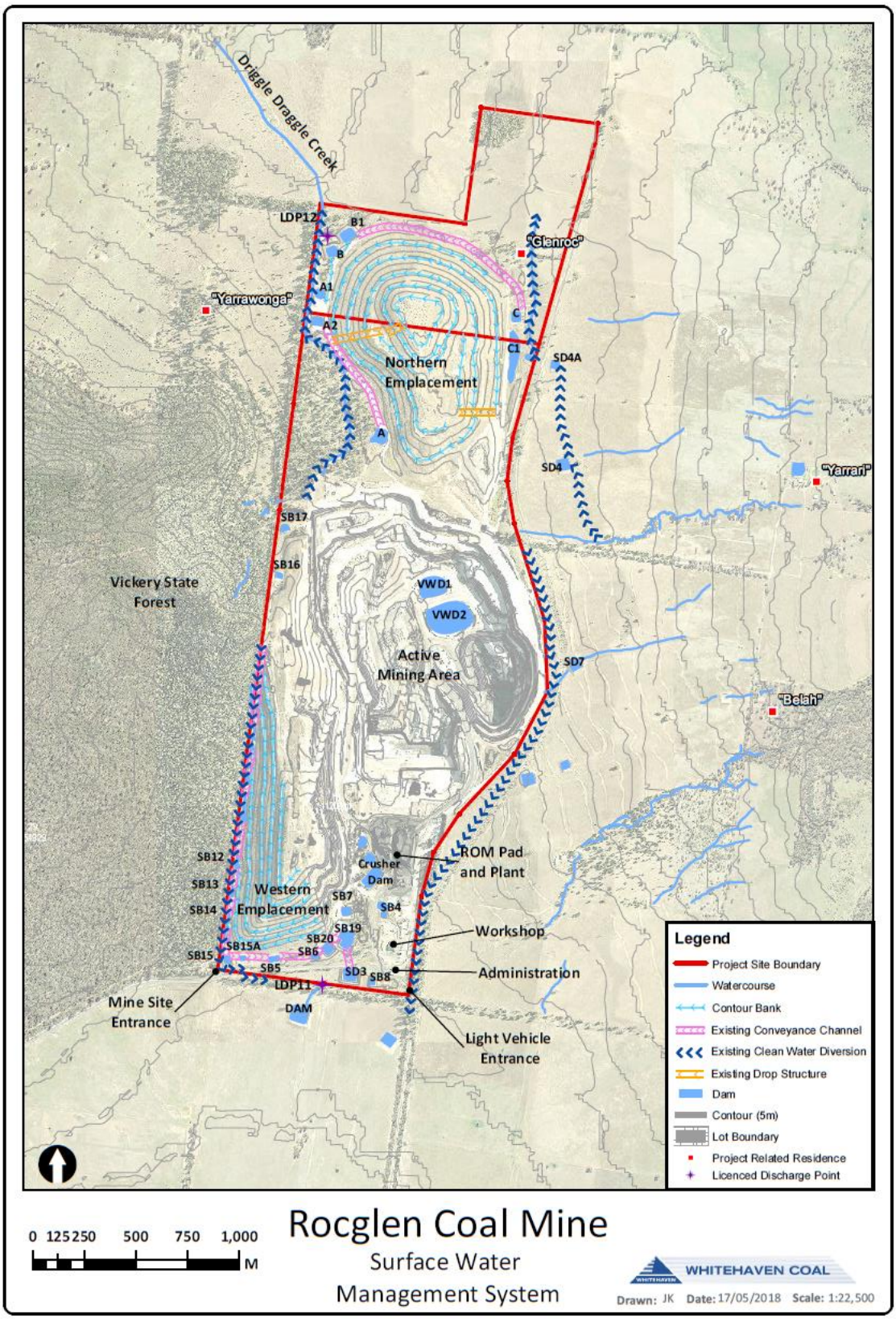


Figure 3: Surface Water Management System - Current

4.4.2 Dirty Water Management System

The dirty water management system is based around a series of sediment basins to allow for the settlement of sediment in runoff from disturbance areas. Rainfall runoff collected in the basins is re-used for dust suppression as required, with any excess water discharged offsite via Storage Dam 3 (LDP 11) or Dam B (LDP 12) - provided the water is of an acceptable quality following treatment. A series of dirty water diversion channels constructed around the site will ensure dirty water is conveyed at non erosive velocities to the sediment basins for treatment. The general layout of the site water management system is shown on Figure 3.

Runoff from site south of the watershed is collected by water management structures and ultimately directed to SD3 (LDP 11). Runoff from the site north of the watershed will report to Dam B (LDP12). LDP 11, located on the outlet of SD3, and LDP 12, located below the outlet of Dam B, allow for the discharge of water according to the conditions stated in EPL 12870, and controlled discharge will occur only when the water parameter conditions stated in EPL 12870 are met. Dirty water diversion channels and clean water diversion bunds ensure that dirty water is captured in the site water management system, and also prevent clean water from being captured by the system. Runoff from the workshop area is directed into an oil/water separator before being directed to one of the adjacent sediment basins. This water will be directed into small sumps prior to entering the dirty water management system, and ultimately reporting to SD3.

4.4.3 On-going Erosion and Sediment Management Practices

The water management structures described in Section 4.4.2 and as presented on Figure 3 have been designed to convey surface runoff at non erosive velocities and will act as the major erosion and sediment control (ESC) measures for the mine. In addition to these structures, Whitehaven will also adopt the following ESC management practices to further reduce the potential for adverse erosion or sedimentation developing:

- Installation of all ESC and water management structures prior to any ground disturbance taking place;
- Land disturbance will be minimised by clearing the smallest practical area of land ahead of disturbance activities;
- Disturbance areas which will not be actively utilised will be revegetated as soon as practical, following completion of works in that area;
- Where practical, disturbance areas will be shaped such as to provide a free draining surface to direct dirty water runoff into the relevant sediment dams;
- Where localised flooding or ponding occurs, access will be restricted until such time as the ground is no longer waterlogged in order to reduce the potential for additional sediment mobilisation;
- If erosion is identified on the rehabilitating landform or in the operational area, it will be repaired as required and reported annually. Areas previously rehabilitated will be inspected regularly to ensure rehabilitation works are effective; and

- Where necessary, temporary ESC measures will be utilised to prevent and/or reduce the potential for adverse erosion developing. Temporary ESC structures and management practices will be constructed in accordance with the construction principles presented in the *Blue Book* and may include sediment fences, check dams, surface protection and advanced revegetation methods such as hydromulching.

4.4.4 Sediment Dam Management

Due to the highly dispersive nature of subsoil in some areas of the site (Cunningham, 2007), elevated TSS in surface runoff is considered to be a significant issue; in addition to the major ESC structures and management measures outlined above, Whitehaven will adopt additional management measures (where deemed necessary) to reduce the potential of dirty water discharge including:

- Sediment dams are to be desilted when practicable and required to maintain a maximum storage capacity onsite;
- Sediment dams will be drawn down following rainfall to provide available storage capacity for subsequent rainfall events, with draw down achieved by:
    - Transfer of water to the Mine Water Dam or other water storages on site; or
    - Controlled discharge of treated water (e.g. settled and/or flocculated).
- Draw down and controlled discharge would occur such that:
    - Dam B and SD3 are fully drawn down (within 5 days of the rainfall event) where practically possible; and
    - All other dams are drawn down as much as practically possible to minimise inflows from upstream storages into Dam B and SD3, thereby maintaining storage capacity.
- Use of a flocculant to help settle suspended solids prior to discharge offsite.
- Use of Floc Blocs, gypsum, and other chemical methods of flocculation have been trialled on site, and from these trials it is clear that TSS concentrations can be adequately reduced via chemical flocculation.

Where adequate reduction in total suspended soils is not being achieved through existing flocculation practices, alternative methods will be investigated. Through ongoing mitigation of this issue, other management measures may be identified and adopted for the management of this issue. Any TSS mitigation measures identified in future will be documented in any future updated WMP.

4.4.5 "Coal Contact" Water Management

Water that has come into contact with coal (coal contact water) may be contaminated with dissolved salts and metals. Following advice from the EPA, Rocglen Coal Mine has identified that dirty water dam SD3 and Dam 'B' may contain coal contact water runoff. As such, these dams have been reclassified as "dirty water dams with potential coal contact water". This change in interpretation is as directed by the Department of Planning & Environment (DP&E dated 24th October 2014) and Environment Protection Authority (EPA dated 13th October 2014, EPA dated 21st August 2015) despite

the previous approvals (PA 10_0015 & MOD 1-2) and EPL 12870 approving the coal stockpile catchments to be within dirty water discharge catchments.

It is noted that the mine water dams can also be considered to contain coal contact water; however, these dams are managed separately as detailed in Section 4.5.

Table 5 presents the list of dams potentially affected by coal contact water and their relevant storage capacities.

4.5 Mine Water Management

Runoff from within the open cut pit is directed into the void water dams where it is contained and pumped for dust management purposes. These dams are clay lined and are confined within the pit.

4.6 Water Storages

Effective management of surface water runoff relies heavily on the use of dams for the detention of dirty water as well as mine water. The sections below outline the water storages which will form part of the surface water management system as well as the design criteria and parameters which apply to the construction of sediment dams.

4.6.1 Sediment Dam Design

Sediment dams have been designed according to the guidelines and procedures presented in *Volume 1 and 2E (Mines and Quarries)* of the *Blue Book* for the minimum criteria for Type D/F sediment dams. The general parameters which remain consistent for the design of all sediment dams on site are as follows:

- Design Storm of 5 Days, 90th Percentile - based on the minimum design criteria presented in Table 6.1 of Volume 2E (Mines and Quarries) of the Blue Book and the existing EPL, which recommends adopting a 90th percentile design storm event when designing a Type D/F basin where the duration of disturbance will be greater than 3 years. For the Gunnedah region, the 5 day, 90th percentile rainfall depth is 38.4 mm.
- Volumetric Runoff Coefficient of 0.64 – this reflects the Blue Book soil hydrologic group D which has a very high runoff potential. Group D soils are fine-textured (clay) and are surface sealed. The coefficient is also in line with the default runoff characteristic presented in Volume 2E (Mines and Quarries), which recommends using soil hydraulic group D in the absence of site-specific data.
- Soil Classification of Type D (dispersive) – based on the soil survey study undertaken for the site (Cunningham, 2007), the soils have been classified as dispersive.
- Soil Erodibility Factor (K factor) of 0.05 - based on the conservative default criteria presented in the Blue Book. It should be noted that the soil survey study undertaken for the site (Cunningham, 2007) suggested a value of 0.035.

- Rainfall Erosivity Factor of 1500 – based on the site location on the rainfall erosivity maps presented in Appendix B of Volume 1 of the Blue Book.

The design of sediment dams assumes conservative ground cover management factors (C-factors) based on anticipated percentage ground cover (assumed to vary from between 0 – 50%) and the amount of disturbance within the sediment dam catchment.

4.6.2 Summary of Water Storages and Sediment Dams

A summary of all water storage and sediment dams which will form part of the site water management system throughout the operational phase and during final landform are presented in . The capacity of some dams will change throughout the life of the mine due to changing water management requirements as detailed in . General dam locations (excluding those to be removed) are shown on Figure 3. Additional dams may be constructed and/or existing dams enlarged according to site water management requirements.

Table 5 - Water Storage and Sediment Dams

Dam ID	Storage Capacity (ML)
Clean Water Dams	
SD4	4.8
SD4A	1.8
Dam	9.8
Dirty Water Dams (Sediment Dams)	
SB4	1.8
SB5	1.7
SB6	1.2
SB7	3.7
SB8	1.1
SB12	1.2
SB13	1.3
SB14	1.2
SB15	1.6
SB15a	2.5
SB16	0.6
SB17	1.7
SB19	17.3
SB20	6.7
SD3 [#1]	8.4
Existing Dam/Crusher Dam	11.6
Dam ‘D’	2
Dam ‘A1’	4.6
Dam ‘A2’	3.3
Dam A	5.5

Dam ID	Storage Capacity (ML)
Dam 'C'	5.8
Dam C1	9
Dam 'B' #1	5.0
Dam B1	8.3
Other Storage Dams	
In-pit Storages	118.7

Notes:
#1. Dirty water dam potentially receives coal contact water.

The majority of these dams were considered within the water balance model with exception of the clean water dams. In practice, the open cut pit will also provide substantial additional water storage capacity during heavy rainfall events. Future annual water balance assessments, and any updating of water model, will incorporate all storages.

4.7 Site Rehabilitation Management

Rehabilitation of disturbed areas are undertaken in accordance with the site Mining Operations Plan (2015), and will be undertaken progressively throughout the mine life. Rehabilitation will include design and management of the final void as well as re-establishment of drainage lines and revegetation of disturbance areas.

4.7.1 Rehabilitation Design Objectives and Performance Criteria

The ultimate objective of rehabilitation for the Rocglen Coal Mine is to create a low maintenance, geotechnically stable and safe landform, which blends in with the surrounding landscape, and is not prone to erosion or degradation through the erosive forces of flowing water. Specific performance criteria for rehabilitation is described in the site's Mining Operations Plan (MOP).

The performance of water management for the final landform, including the final void and shaped emplacement areas, will be determined through visual site inspections and on-going monitoring. Water quality within sediment dams receiving runoff from the rehabilitation areas, and within the final void, will provide the key performance indicator for the success of rehabilitation and post mining water management. As water will be discharged offsite following effective rehabilitation, the water quality targets listed in Section 4.9.3 will be adopted as the key performance criteria for rehabilitation.

4.7.2 Reinstatement of Drainage Lines

Impacts

The following drainage lines will be impacted on by the Rocglen Coal Mine:

- The head waters of Driggle Draggle Creek (first order); and
- Upper section of the central drainage line (second order).

Approximately 1 km of the head water drainage line of Driggle Draggle Creek has been impacted by the Northern Emplacement Area. The drainage line is currently heavily disturbed through past clearing practices associated with agricultural production, combined with the construction of sediment basins and storage dams along the drainage line.

The upper section of the central unnamed drainage line where it exits Vickery State Forest has been impacted upon by the open cut pit. The drainage line has been diverted north into Driggle Draggle Creek via diversion drains and dams.

Mitigation Measures

The upper section of the central drainage line has been permanently diverted into Driggle Draggle Creek, allowing for the passage of clean water northwards around the open cut pit and the Northern Emplacement Area. The permanent diversion joins the existing alignment of Driggle Draggle Creek immediately downstream of the disturbance areas and Dam B. The majority of the central drainage line which is not within the emplacement areas will be reinstated as close as possible to its original alignment.

All drainage lines which are impacted upon by the mining operation are either in the upper reaches of the catchment or have been disturbed by historical agricultural activities and are not considered to be of conservation significance. Despite this, those sections of drainage lines impacted by mining operations will be rehabilitated following completion of mining.

Rehabilitation would seek to achieve a long-term enhancement of the ecological value of the drainage lines through the restoration of natural hydraulic conditions, and appropriate revegetation of a riparian corridor. The approved final landform drainage design for the Rocglen Coal Mine is shown in Figure 4.

The full details of drainage line rehabilitation works will be incorporated into a Closure Mining Operations Plan to be prepared prior to mine closure. Works within the restored drainage lines will be generally undertaken in accordance with Section 5.3.3 of *Managing Urban Stormwater: Soils and Construction* Volume 1 and the *'Guidelines for Controlled Activities – In-Stream Works'* (DWE, 2008) for watercourse rehabilitation and riparian zone rehabilitation. Key design elements of channel establishment works include:

- Implement effective temporary erosion controls to provide for the short-term stabilisation of the channel;
- Design and construct the stream channel so that it would be stable for the long-term and minimise the potential for the migration of any erosion upstream or downstream;
- The central drainage line will be re-instated as a compound channel with a main channel conveying the small to medium flows, and a floodplain used to convey the high overbank flows;
- The main channel forming part of the re-instated central drainage line will be generally trapezoidal in shape with 3:1 (H:V) bank batters;
- The floodplain forming part of the re-instated central drainage line will utilise the post-mining land surface to form a wide floodplain channel bed with a low slope such that erosive forces in the floodplain are reduced;

- Natural meanders will be used 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 will 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; and
- Soil will be packed in between rocks to allow sedges and grasses to be established within the channel to provide for long-term channel stability.

Following earthworks and channel establishment, a riparian corridor will be established with a minimum width of 10m, measured horizontally and at right angles to the flow from the top of both banks on the streams. Key design elements of the riparian corridor establishment include:

- Implement effective temporary erosion controls to provide for the short-term stabilisation of the riparian corridor;
- Restore naturally occurring soil to the riparian corridor (i.e. as stripped from area pre-disturbance);
- Restore a vegetated riparian corridor along the stream channel (10m from top of bank);
- Establish a diverse range of locally occurring vegetation species;
- Establish a full range of vegetation types, including trees, shrubs and grass covers;
- No exotic species will be introduced; and
- Maintain the rehabilitated riparian corridor for two years after initial rehabilitation.

Where drainage lines on site are still largely intact and are not being actively eroded, major channel establishment works will not be undertaken, however, an attempt will be made to revegetate the channels with riparian vegetation.

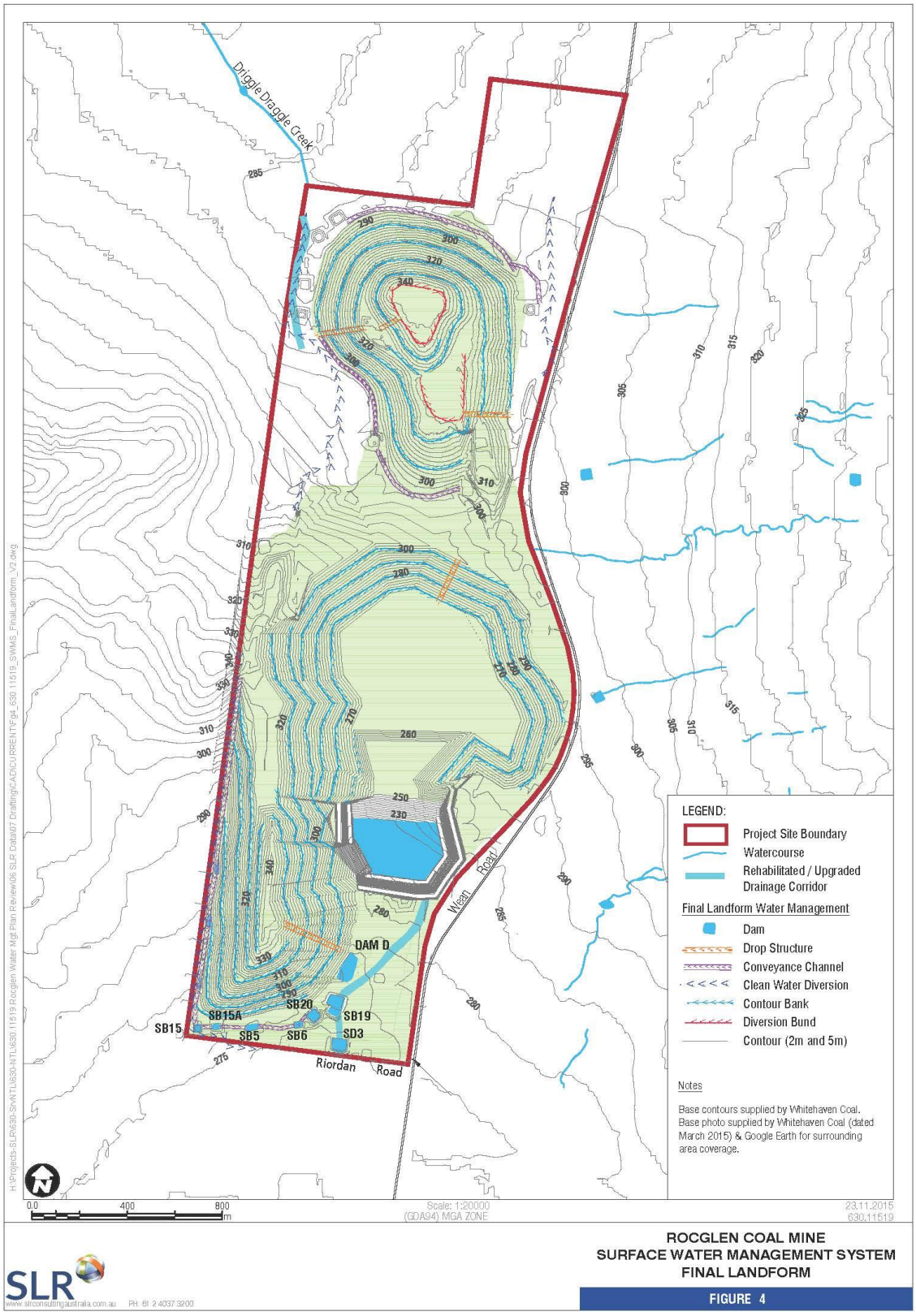


Figure 4: Surface Water Management System – Final Landform

4.7.3 Control of Runoff from Rehabilitation Areas

Following shaping of the overburden emplacements, a series of contour banks and rip rap lined drop structures have been constructed around the batter slopes to ensure runoff is safely conveyed down the batter slopes and into the adjacent dirty water diversion channels. These structures will be progressively constructed as shaping and rehabilitation is undertaken. Contour banks and drop structures will be constructed in accordance with the general design principles as outlined within the *Blue Book,* and detailed design undertaken where required to ensure these structures are capable of conveying the runoff generated from the design rainfall event. The proposed water management structures for the final landform are detailed on Figure 4.

Where practicable, water management structures such as contour banks and drains are constructed with longitudinal gradients that permit the transfer of water at non-erosive velocities (e.g. 1:200 (V:H)). Consequently, specialised rehabilitation treatments should generally not be required. Similarly, rock lined drains constructed on the slopes of the emplacements and final void will be retained and allowed to revegetate naturally. However, in the event that unacceptable levels of erosion i.e. erosion to a level that prohibits vegetation establishment and/or drain functionality, are observed, fast growing species identified as having a particular soil conservation application and/or specialised treatments such as bitumen/jute meshing or rock lining will be utilised to mitigate the potential impacts.

The planting of trees and other vegetation around the various water management structures will enhance the filtration ability of these structures and surrounding areas and minimise the potential for erosion, as well as encouraging their use by native fauna.

Until such time as suitable vegetation cover is established on rehabilitation areas, and surface water runoff is verified to be of a suitable quality for release to the surrounding environment, all runoff from these areas will continue to be considered as dirty water and will be retained onsite for reuse or treatment and discharge. As such, sediment dams will remain in use following the completion of mining and will be maintained as per the requirements of the *Blue Book*.

4.8 Potable Water Supply and Sewage Disposal

Potable water will be sourced and transported by water tanker from the Gunnedah and/or Boggabri town water supplies when required.

Sewage will continue to be disposed of by one or a combination of the following two methods:

- A bio-cycle (or equivalent) system with effluent irrigation onto undisturbed areas of the ‘Belmont’ property, and/or
- Storage and pump-out systems, with pump outs and disposal undertaken by a licensed waste disposal contractor to an approved sewage treatment plant.

4.9 Surface Water Monitoring Program

4.9.1 Introduction

To ensure continuous functionality of the surface water management system and to assist Whitehaven in identifying any potential issues with the system, an on-going surface water monitoring program will be implemented for the mine, inclusive of water quality and stream health monitoring programs.

4.9.2 Baseline Water Quality Monitoring Data

Due to the ephemeral nature of the drainage lines surrounding the mine site (including the un-named central drainage line and Driggle Draggle Creek), limited baseline data was collected prior to the existing mining approval in 2008. The data includes six samples taken along different locations of the un-named central drainage line and one sample from Driggle Draggle Creek and is presented below in .

Table 6 - Baseline Local and Project Site Water Quality (2002)

Parameter	Unit	Sample Site							ANZECC Guidelines[3]
		BS[1]-1	WW[2]-1	WW-2	WW-3	WW-4	WW-5	WW-6	
Total Phosphorus	mg/L	4.7	NR	96.0	97.2	98.7	102.3	NR	0.02
Nitrogen (Nitrate)	mg/L	<0.01	NR	6	2	4	5	NR	0.7
Sulphate	mg/L	11	1	10	9	9	8	1	-
Bicarbonate	mg/L	41	48	81	96	107	73	50	-
Chloride	mg/L	56	2	6	4	5	8	3	-
Cadmium	mg/L	<0.001	NR	<0.001	<0.001	<0.001	<0.001	NR	0.00084
Lead	mg/L	<0.001	NR	0.02	0.02	<0.001	0.02	NR	0.02584
Zinc	mg/L	0.01	NR	0.02	0.02	0.01	0.02	NR	0.0312
Copper	mg/L	0.006	NR	<0.01	0.01	0.01	0.01	NR	0.00546
Manganese	mg/L	0.008	NR	0.15	0.05	0.12	0.20	NR	1.9
Iron	mg/L	29	5	13	8	7	19	20	-
Potassium	mg/L	27	5	14	9	13	5	5	-
Sodium	mg/L	43	11	12	13	14	42	19	-
Magnesium	mg/L	3	2	5	10	5	4	2	-
Calcium	mg/L	8	6	12	12	19	9	5	-
Conductivity	us/cm	360	98	151	165	185	154	98	30-350
pH	--	6.9	6.8	8.8	8.4	9.1	8.4	7.8	6.5-8.0

[1]BS – Sample from Un-named Central Drainage Line

[2]WW – Sample from Driggle Draggle Creek

[3] Key default trigger values presented in ANZECC 2000 for slightly disturbed upland rivers in NSW (refer to Section 4.3.3). Heavy metals based on hard water (120-179 mg$CaCO_3$/L)

The most relevant water quality guidelines for the area in the absence of more baseline data is the default trigger values presented in Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) for slightly disturbed upland rivers in NSW. The one baseline water quality sample taken from the un-named drainage line showed that there were high amounts of total phosphorous and conductivity levels slightly above ANZECC guidelines.

The samples taken along Driggle Draggle Creek showed a high nutrient load, with high phosphorous and nitrate readings. The water was also slightly alkaline with four of the six readings above the ANZECC pH guideline of 8.0. Whilst the data is limited, it does show slightly alkaline water quality in the region along with high nutrient levels. Total Suspended Solids (TSS) was not sampled for during the baseline water quality monitoring round.

4.9.3 Impact Assessment Criteria and Trigger Levels

Environment Protection Licence

Impact assessment criteria for surface water are only relevant to water actually discharged from the site. EPL 12870 contains two LDPs for wet weather discharge. The concentration limits set in EPL 12870 for both discharge locations are presented in .

Table 7- Concentration Limits for LDP 11 and LDP 12 (EPL 12870)

Pollutant	Unit of Measure	100th percentile Concentration Limit
Oil and Grease	mg/L	10
pH	pH	6.5 – 8.5
Total Suspended Solids	mg/L	50*

** The total suspended solids concentration limits may be exceeded for water discharge provided that:*

- *The discharge occurs solely as a result of rainfall measured at the premises that exceeds 38.4 mm over any consecutive 5 day period immediately prior to the discharge occurring; and*
- *All practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store rainfall runoff from a 38.4 mm, 5 day rainfall event.*

Whilst there are no concentration limits for Conductivity and Total Organic Carbon, these parameters also have to be monitored at the LDPs. There are no volumetric limits on the LDPs.

While no concentration limits are specified, there are also requirements under EPL 12870 to monitor the pollutant concentration at various sites within and surrounding the site, as well as annual monitoring of numerous heavy metals in the Mine Water Dam.

NSW Water Quality and River Flow Objectives

*NSW Water Quality and River Flow Objectives w*ere established by the NSW Government in September 1999 for the majority of NSW catchments. Eleven water quality objectives (WQOs) were developed for NSW rivers and estuaries and these provided guideline levels to assist water quality planning and

management. According to the Namoi River Objectives, the streams located within and reporting to the site are classified as “Uncontrolled Streams”.

There are numerous WQOs for “Uncontrolled Streams” within the Namoi catchment depending upon the environmental values within the area. The most relevant of these objectives for the site are - (a) aquatic ecosystems (maintaining or improving the ecological condition of water bodies and their riparian zones over the long term) and (b) livestock water supply (protecting water quality to maximise the protection of healthy livestock).

The aquatic ecosystem objective is directly in-line with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) default trigger values for slightly disturbed ecosystems in south-east Australia. These values are presented below in 8.

The livestock water supply objective is based on four key indicators. These indicators and their numerical trigger values are summarised below in .

Table 8 - Livestock Water Supply Guidelines for Uncontrolled Streams in the Namoi Catchment

Indicator	Numerical Criteria (trigger values)
Algae and Blue-Green Algae	Increased risk when Microcystins >11 500cells/mL and/or >2.3µg/L expressed as microcystin-LR toxicity equivalents
Salinity (electrical conductivity)	For no adverse effect – Poultry at 0 - 2985 µS/cm Dairy Cattle 0 - 3731 µS/cm Beef Cattle, Pigs, Horses at 0 - 5970 µS/cm Sheep 0 - 7462 µS/cm
Thermotolerant coliforms (faecal coliforms)	<100 thermotolerant coliforms per 100 mL (median value)
Chemical contaminants	See Table 4.3.2 of ANZECC Guidelines

The trigger values for livestock water supply are significantly higher than the trigger values for aquatic ecosystems. Whitehaven is seeking to comply with the more conservative aquatic ecosystem trigger values.

ANZECC Guidelines

Water quality monitoring results for downstream watercourses (Driggle Draggle Creek and the unnamed creek to the south of the site) will be assessed, for each monitoring event, against key default trigger values presented in and sourced from the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).

Table 9 - Key Default Trigger Values for Slightly Disturbed Upland NSW Rivers (ANZECC 2000)

Indicator	Trigger Value
pH*	6.5 – 8.0
Conductivity (µS/cm)*	30 - 350
Turbidity (NTU)	2 - 25
Total Phosphorus (µg/L)	20
Total Nitrogen (µg/L)	250
Dissolved Oxygen (% saturation)	90 -100%
Aluminium (mg/L)*	0.055
Cadmium (mg/L)	0.0005[1]
Copper (mg/L)	0.004[1]
Lead (mg/L)	0.014[1]
Nickel (mg/L)	0.028[1]
Zinc (mg/L)	0.020[1]

1. Range based on lower 85% saturation limit and typical water temperature range 13- 20°C
2. Trigger values for the slightly disturbed lowland river aquatic ecosystems
3. Modified trigger levels, factored based on typical moderate water hardness (60-119 mg/L as $CaCO_3$)

* Parameters monitored

Water quality monitoring is undertaken in accordance with Table 10. Whitehaven currently adopts the concentration limits stated in EPL 12870 as the assessment criteria for pH and Total Suspended Solids (TSS) as opposed to the ANZECC Guidelines. It does however adopt the ANZECC upper limit of 350 µS/cm for conductivity and notes the default trigger values for numerous other indicators presented in the ANZECC guidelines in Table 9. In the event of trigger values for the monitored parameters included in being exceeded, a review of upstream water quality results will be undertaken, along with a general review of the water management practices undertaken on site.

4.9.4 Surface Water Monitoring Locations and Frequency

The monitoring locations, pollutants to be monitored and the required frequency are detailed in Table 10, with the position of these monitoring locations detailed on Figure 5.

Table 10 - Surface Water Monitoring Locations

Identification	Type of Monitoring Point	Pollutants	Frequency	Sampling Method
LDP 11 (SD3)	Wet Weather Discharge	Conductivity (µS/cm) Oil and Grease (mg/L) Total Organic Carbon (mg/L) Total Suspended Solids (mg/L) pH	*Special Frequency 1 (all)*	In situ Grab sample Grab sample Grab sample In situ
LDP 12 (Dam B)	Wet Weather Discharge		*Special Frequency 1 (all)*	
Driggle Draggle Creek to the north of the Project Site	Baseline Data and Wet Weather Discharge (downstream of site)		*Special Frequency 2 (all)*	
Un-named drainage channel to the south of the Project Site	Baseline Data and Wet Weather Discharge (downstream of site)		*Special Frequency 2 (all)*	
Dam SD7 (eastern side of Project Site)	Baseline Data (upstream of site)		*Special Frequency 2 (all)*	
Mine Water Dam	Water Quality	Aluminium Arsenic Bicarbonate Chloride Conductivity Iron Manganese Oil and Grease Sodium Total Organic Carbon Total Suspended Solids pH	Yearly Yearly Yearly Yearly Quarterly Yearly Yearly Quarterly Yearly Quarterly Quarterly Quarterly	Grab sample Grab sample Grab sample Grab sample In situ Grab sample Grab sample Grab sample Grab sample Grab sample Grab sample In situ

Special Frequency 1 – means the collection of samples as soon as practicable after each discharge commences and in any case not more than 12 hours after each discharge commences.

Special Frequency 2 – means the collection of samples quarterly (in the event of flow during the quarter) at a time when there is flow and as soon as practicable after each wet weather discharge from LDP 11 and LDP 12 commences and in any case not more than 12 hours after each discharge commences.

4.9.5 Additional Operational Monitoring

Internal Dams Surface Water Quality and Monitoring

In addition to the monitoring required under EPL 12870, Whitehaven will also undertake surface water monitoring for internal dams within the mine site. This additional monitoring will allow the performance of the surface water management system to be assessed for various areas around the mine site, with additional controls targeting these potential problem areas to be implemented. It will also allow for the monitoring of salt and alkalinity in dams collecting water from subsoils.

"Coal Contact" Dams Water Quality and Monitoring

As directed by the EPA (EPA letter dated 21st August 2015), where runoff from coal contact areas is captured in storage dams designed for sediment control, Rocglen Coal Mine will need to establish whether the discharge from these structures contains pollutants that pose a risk of non-trivial harm to human health and/or the environment. As directed by the EPA, trivial versus non-trivial pollutant concentrations can be defined with reference to the default trigger values for toxicants and physical/chemical stressors in the ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. If a pollutant exceeds the relevant trigger value, it can be considered that it poses a risk of non-trivial harm to human health and/or the environment.

At this stage there is insufficient water quality data available for dams SD3 and Dam 'B' to make an assessment against the ANZECC trigger values and to ascertain the risk associated with regard to the impact of coal contact water discharged from Rocglen Coal Mine on human health or the receiving environment. Rocglen Coal Mine will implement a monitoring program to address this data deficiency. This monitoring program is proposed to be quarterly and will include sampling of waters from SD3 and Dam 'B' for parameters including the physio-chemical parameters pH, EC, TSS, organic nutrients, dissolved metals and oil and grease.

It is not possible to provide a definitive timeline to gather sufficient data for a robust analysis of the potential impact of coal contact water. Notwithstanding this, once sufficient data becomes available and on completion of detailed analysis, Rocglen Coal Mine will consult with the EPA in regard to the outcomes of the monitoring.

4.9.6 Channel Flow and Riparian Vegetation Monitoring

Whilst the continuation of water quality monitoring is necessary for the site, volumetric flow monitoring at the Driggle Draggle Creek monitoring point and the southern drainage channel monitoring point is not warranted due to these drainage lines being ephemeral and not flowing regularly enough to warrant the establishment and maintenance of flow gauging stations within those drainage lines. Rather, it is anticipated that monitoring of water quality during wet weather discharges would be sufficient to inform Whitehaven of the potential impacts associated with any site discharges.

A program to monitor creek line channel stability and health of riparian vegetation within Driggle Draggle Creek and the unnamed creek to the south of the site will be undertaken throughout the mine life. The monitoring will be undertaken along a short length of the downstream watercourses in the event of a

flow. General observations of stream health will be recorded during the quarterly water quality monitoring for these watercourses. RCM will look at engaging a suitable, qualified person to conduct the required channel monitoring.

Monitoring of water quality occurs during the quarterly surface water sampling (if water is present in the channels), and also in the instance of flow as a result of a discharge. Monitoring of the drainage lines would include:

- Documenting general observations of water quantity and quality;
- Documenting locations and dimensions of significant erosive or depositional features so that any subsequent changes can be evaluated quantitatively;
- Establishing multiple photographic points at representative locations, so that photos can be taken over multiple inspections in a repeatable manner;
- Written descriptions of the stream at each of the photographic points, focussing on evidence of erosion and exposed soils; and
- Documenting general indicators of stream health, including abundance of flora and fauna.

Results of monitoring data will be reviewed and compared to previous rounds of monitoring to assess whether there is any degradation of the riparian vegetation or stream channel. Where degradation or adverse erosion is occurring, additional investigations will be undertaken to assess whether the impacts may be associated with the operation of the mine and ameliorative actions undertaken as required.

4.9.7 Inspections and Maintenance

Regular inspections are undertaken for all water management and erosion and sediment control structures throughout the mine life. Inspections are undertaken monthly or following a significant rainfall event of >20mm in 24 hours. Various information, such as the general condition of dams, evidence of overflow, condition of downstream catchments, water colour, evidence of eroding surfaces and approximate retained dam capacity is recorded as required.

Where water management structures or erosion and sediment control structures have lost capacity due to excessive sediment build up or scouring is identified, rectification works are undertaken to ensure the structures have sufficient capacity to handle any subsequent rainfall events.

4.9.8 Data Recording

Recording of monitoring data is undertaken in accordance with the requirements outlined within EPL 12870. Whitehaven will collate and maintain an up to date database of surface water quality monitoring data for all sampling at the mine. Monitoring results are interpreted as they are received in order to ensure appropriate operational guidance on maintaining water quality within the desired parameters.

The results will also be compared to relevant site operations and meteorological conditions to further interpret the results. This comparison between samples, between sampling periods and against other

factors will assist in identifying whether the activities on the site are in fact affecting the water quality of the local catchment.

Results of surface water quality monitoring are reported in the Annual Review (AR). The results will also be made available to the Community Consultative Committee (CCC) members on a regular basis.

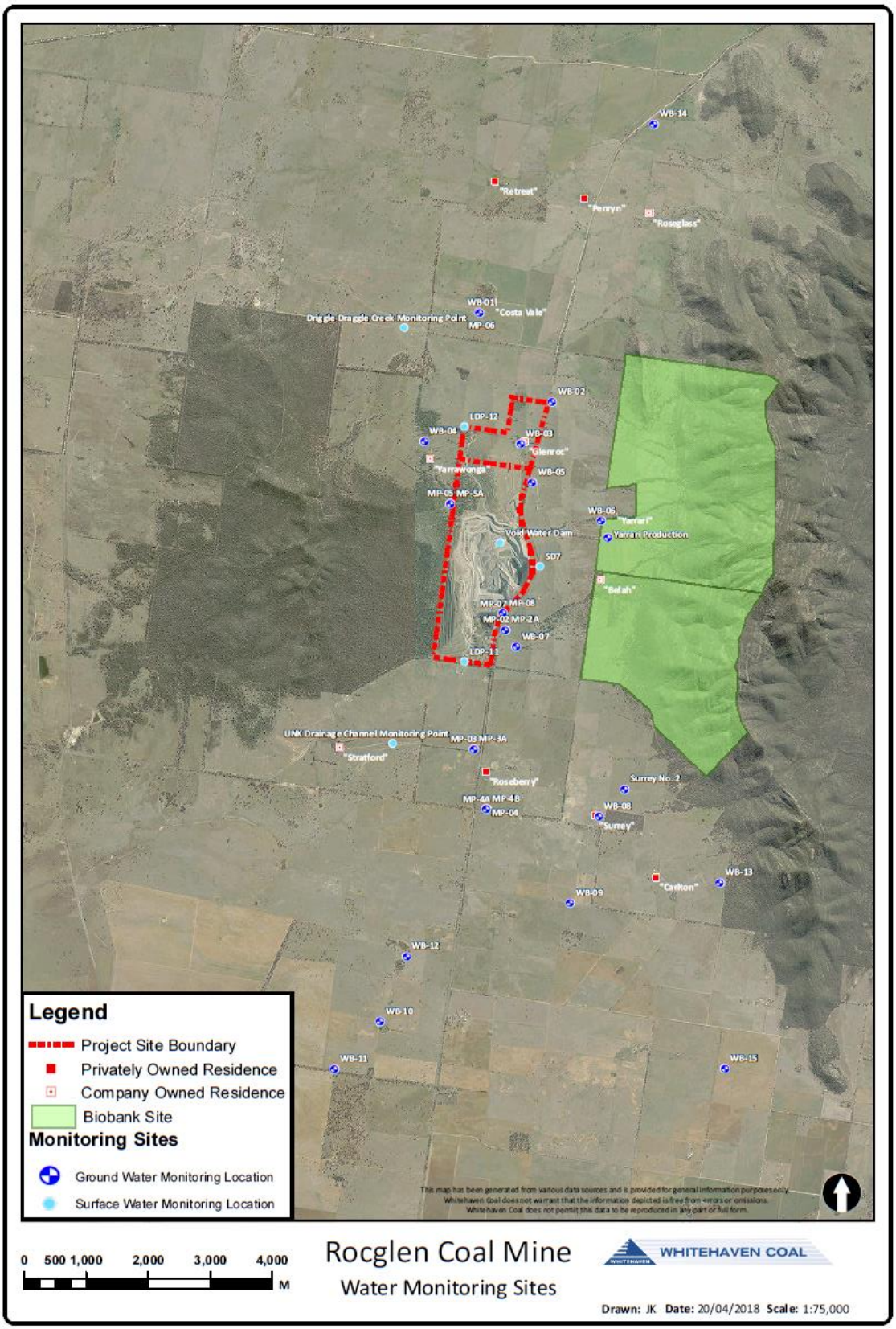


Figure 5: Surface and Groundwater Monitoring Locations

4.10 Surface Water Response Plan

4.10.1 Unforeseen Impacts

The potential for unforeseen impacts associated with the continued operation of the Rocglen Coal Mine are generally considered to be quite low, however, in order to protect against any unforeseen environmental impacts associated with the mine, the following procedure will be followed:

a) Review the unforeseen impact inclusive of any available monitoring data and existing operational activities or catchment activities which may potentially have contributed to the unforeseen impact;
b) An investigation will be commissioned by suitably qualified persons to determine the nature and extent of the impact;
c) Ameliorative action measures will be developed based on the results of investigations into the impact; and
d) Additional monitoring will be implemented where relevant to measure the effectiveness of any improvement measures implemented.

4.10.2 Identification, Notification and Mitigation of Identified Exceedances or Non Compliances

Any exceedance of discharge criteria or non-compliance with statutory requirements will trigger an immediate investigation to determine the cause of the exceedance/non-compliance and preparation of a corrective action plan to re-establish or introduce additional appropriate controls as necessary. Re-sampling may be undertaken to verify results in exceedance of the performance criteria.

In the event that an exceedance in surface water quality criteria is identified, the exceedance will be reported to the relevant government agencies in accordance with the requirements of EPL 12870 and PA 10_0015, with subsequent actions being taken by Whitehaven to mitigate these and prevent reoccurrence.

Any mitigation required will be done in consultation with the relevant government agencies, with the mitigation actions determined at that time, as relevant to the exceedance. Where mitigation is not feasible or cannot be achieved, Whitehaven will seek to offset or compensate for any environmental harm caused.

4.10.3 Continual Improvement

Ongoing review of water quality monitoring data for the site will assist in determining where there are any noticeable trends towards non-compliant parameter levels at the monitoring sites. Note that coal contact water is monitored through routine surface water sampling as well as discharge sampling. This information is used to modify, if necessary, work practices or scheduling of equipment to ensure that future non-compliances are avoided.

Similarly, ongoing review of general environmental inspection data will provide Whitehaven with the opportunity to identify any potential trends toward degradation of water management infrastructure and

provide the opportunity to introduce corrective management practices to ensure continued improvement of the water management system.

5.0 GROUNDWATER MANAGEMENT PLAN

5.1 Principles and Objectives

The Groundwater Management Plan describes the control measures designed to minimise the impact of the Rocglen Mine Expansion on surrounding groundwater aquifers. The control measures are outlined in the Groundwater Monitoring Program (Section 5.4) and the Groundwater Response Plan (Section 5.5).

Groundwater management reporting is designed to comply with the Project Approval, and provide stakeholder access to relevant groundwater quality data. Key stakeholders include Whitehaven, state and local government agencies and the local community.

The objectives of the Groundwater Management Plan include:

- Definition of performance criteria (levels, yield, and quality) including trigger levels for investigating any potentially adverse groundwater impacts;
- A program to monitor groundwater inflows, impacts to alluvial aquifers and potential for seepage/leachate from various areas of the site;
- A program to validate and further develop the groundwater model for the project and calibrate to site specific conditions; and
- A plan to respond to any exceedances of the performance criteria and mitigate/offset any impacts to groundwater.

5.2 Current Approvals and Licences

NSW Office of Water have issued the following licences in relation to groundwater:

- Aquifer Interference Licence 90BL254684 has been converted to a Water Management Act 2000 licence and replaced by 90WA832698 (Issued June 2013): Annual allocation of 700 megalitres for the potential interception of groundwater within the open cut pit;
- Licences 90BL255816 and 90BL255249 have been converted to Water Management Act 2000 licences and have been replaced by 90WA822541, with the entitlement converted to 90AL822540;
- There is a Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003, amended 27 June 2008. This Water Sharing Plan identifies and regulates groundwater sources within the alluvial aquifer of the Namoi River floodplain. Consultation with NSW Office of Water indicates groundwater resources of the Namoi Alluvium are fully allocated. The Water Sharing Plan indicates that there are no high priority groundwater dependent ecosystems within the alluvium. Also relevant to the project site is the Water Sharing Plan for the NSW Murray-Darling Basin Porous Rock Groundwater Sources 2011.

5.3 Hydrogeological Overview

Rocglen is located within the Maules Creek Formation of Permian age and mines coal from the Glenroc Seams (Upper and Lower) and (mainly) from the Belmont Seam.

Alluvium associated with the Namoi River and tributaries borders ML 1620 to the north and also exists approximately 2 km south and southwest of the limit of the mining area. Groundwater resources in the area are utilised primarily for stock watering.

The geology in close proximity to the mine is disturbed by folding and faulting. The Mooki Thrust which forms the margin of the Gunnedah Basin is located a few kilometres east of the mine. Several smaller faults with near vertical displacements of up to 150 m surround the mine.

Within the Maules Creek Formation, groundwater is more prevalent in the coal seams than in the intervening interburden sediments. Laboratory analysis of groundwater samples shows that quality is spatially highly variable. This is probably a function of the amount of faulting in the area restricting groundwater flow.

Additional details of the hydrogeological conditions and predicted impacts of mining are presented in the Rocglen Extension Project EA with the groundwater assessment prepared by Douglas Partners (2010).

5.4 Groundwater Monitoring Program

5.4.1 Introduction

To ensure the continued protection of groundwater resources Whitehaven will implement a comprehensive Groundwater Monitoring Program (GMP) throughout the remaining operational life of the mine. The GMP includes a description of groundwater resources, baseline data, trigger levels, monitoring methodology, requirements for data analysis, reporting and updating of the groundwater model.

5.4.2 Baseline Groundwater Data

Groundwater levels and groundwater quality parameters (pH, EC and TDS) have been measured routinely at a number of bores both within and external to the Rocglen Coal Mine since 2008. Groundwater level and quality data collected from the bores is summarised in **Table 11**. pH, EC and TDS are the main parameters of interest and limited data has been collected for various other parameters (metals, cations, and anions). Full details of each monitoring bore, including relevant licence details are included in Appendix 1.

Table 11 - Groundwater Monitoring Data (2008-2017)

	2008-2014		2015-2017		2008-2014		2015-2017		2008-2014		2015-2017		2008-2014		2015-2017	
Bore ID	Depth to Water (m)				Field pH				Field EC (µS/cm)				TDS			
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
MP-2	8.17	14.70	11.06	12.93	6.72	7.40	6.8	7.3	3720	5240	4850	5140	2960	3770	3310	38900
MP-2A	11.30	16.80	11.94	14.10	5.3	7.0	7.0	7.3	1340	4490	3060	3540	1970	3090	1930	2150
MP-3	9.06	>18.3 *	No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry	
MP-3A	22.25	22.38	22.11	22.30	7.48	8.1	7.7	8.0	1225	1305	1251	1340	761	834	685	806
MP-4	22.62	>24.16 *	No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		Not Data –Bore Dry		No Data – Bore Dry	
MP-4A	29.12	29.36	20.05	29.32	6.8	7.1	7.2	7.7	3210	3690	3820	4420	2270**		2130	2420
MP-4B	25.20	26.06	25.66	25.96	7.3	7.5	7.6	7.9	2890	2960	2920	3060	1720**		1630	2390
MP-5	52.9	>55.43 *	No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry		No Data – Bore Dry	
MP-5A	63.00	76.79	78.22***	78.76***	7.0	7.33	No Data – Bore Dry		2710	3010	No Data – Bore Dry		1540	1720	No Data – Bore Dry	
MP-6	7.91	8.34	8.17	9.14	5.47	7.4	7.5	7.6	2360	4120	1810	2110	1490	5000	1110	1400
MP-7	15.50	15.82	15.87	16.35	6.8	7.0	6.9	7.1	2850	3830	2990	3120	1670	2270	1600	1770
MP-8	15.79	16.28	16.10	16.58	4.73	6.9	6.8	7.1	1430	4200	4190	4480	1610	2720	2650	2940
WB-1	7.78	8.95	7.52	8.31	7.93	8.08	Windmill Over Bore		1450	1996	Windmill Over Bore		932	1050	Windmill Over Bore	
WB-2	15.73	19.54	15.38	16.22	7.1	8.7	7.3	8.6	1821	3430	2470	3400	1290	2320	1620	2230
WB-3	7.8	23.72	7.44	7.98	6.95	8.28	Pump Over Bore		2360	4480	Pump Over Bore		2480	2750	Pump Over Bore	
WB-4	Casing sealed		Pump Over Bore		7.03	7.91	Pump Over Bore		3160	3680	Pump Over Bore		2710**		Pump Over Bore	
WB-5	4.23	22.93	10.9	19.4	6.45	8.20	7.4	7.8	4880	8400	6920	8926	4290	5680	4480	5410
WB-6	20.42	25.08	Windmill Over Bore		Unable to Sample		Windmill Over Bore		Unable to Sample		Windmill Over Bore		Unable to Sample		Windmill Over Bore	
WB-7	2.96	41.75	11.44	12.89	7.18	8.11	Windmill Over Bore		2060	3120	Windmill Over Bore		1320	2420	Windmill Over Bore	
WB-8	29.77	49.32	27.95	29.32	8.2**		Pump Over Bore		2240**		Pump Over Bore		1210**		Pump Over Bore	
WB-9	23.78	25.58	22.99****	23.79****	7.17	8.27	7.3****	7.7****	902	1261	1120****	1240****	417	780	682****	708****
WB-10	13.75	16.47	13.88	14.22	6.68	7.93	6.9	7.1	1685	2300	1972	2210	1220	1370	1310	1380
WB-11	15.32	18.73	17.25	20.05	7.05	8.37	7.3	8.0	865	1550	948	1780	474	1010	520	1030
WB-12	12.73	13.23	13.08	13.22	7.07	8.71	8.2	9.1	873	2152	1350	1823	556	1180	776	990
WB-13	33.22	42.40	31.40	44.76	6.77	7.1	7	7.2	3410	3730	3290	3600	2390	2510	2350	2660

	2008-2014		2015-2017		2008-2014		2015-2017		2008-2014		2015-2017		2008-2014		2015-2017	
Bore ID	Depth to Water (m)				Field pH				Field EC (µS/cm)				TDS			
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
WB-14	10.16	22.9	12.97	23.00	7.6	7.8	7.5	7.8	1150	1315	1238	1350	751**		668	806
WB-15	27.62	30.14	26.88	31.97	6.9**		7.0	8.0	1389**		1189	1460	-	-	740	862
Yarrari Production	49.90	55.24	Pump Over Bore		6.9	7.52	6.9	7.1	2780	4030	3420	3640	1900	2330	2120	2480
Surrey 2	32.74	38.13	31.62	34.29	6.92	7.6	7.1	7.4	1520	3420	3120	3460	1000	1910	1920	1950

Notes:
EC – Electrical Conductivity
TDS – Total Dissolved Solids
** Bore Dry*
*** One reading only*
**** Depth readings up to March 2017 (only slimy grey mud)*
***** Results only up to March 2016 (windmill over bore)*

It should be noted that there were no monitoring results prior to 2008, with the data provided above based on monitoring results obtained between 2008 and 2017.

It should also be noted that, as indicated in the AEMR/ARs prepared to date, groundwater levels in privately owned bores have differed substantially when measured immediately following water being drawn down to fill water storage points for stock use.

Baseline groundwater conditions are described in detail in the Hydrogeological Assessment for the Rocglen Coal Mine Expansion Project (Douglas Partners, 2010).

5.4.3 Groundwater Assessment Criteria

Groundwater impact assessment criteria can be described as trigger levels, which if triggered would lead to a response in terms of more frequent monitoring, further investigation and, if required, remedial action. The Groundwater Response Plan contains details of all responses relating to each impact assessment criteria.

Groundwater impact assessment criteria are contained in below, and show trigger levels for groundwater levels and quality (pH, EC, TDS).

Table 12 - Trigger Levels for Groundwater Quality and Quantity

Potential Impact	Parameter	Trigger Value
Groundwater Level	Drawdown	The larger of: a) 10% greater than observed from baseline monitoring, or b) 20% greater than model prediction*; or b) 2 m greater than model prediction. If three or more alluvial bores exceed the above in one round of monitoring OR Any bore exceeds the above for three consecutive readings
Groundwater Quality	pH	If recorded value is 10% greater than the maximum of baseline data for two consecutive readings or, for pH, more than 1 pH unit less than or greater than the minimum and maximum baseline data, respectively, for two consecutive readings
	EC	
	TDS	

Notes

** Groundwater model developed during Hydrogeological Assessment (Douglas Partners, 2010).*

Trigger levels have been designed to identify if measured readings vary significantly from baseline data or modelled predictions detailed in the hydrogeological assessment. The groundwater model will also be verified annually as discussed below.

Due to the high variability in data, the trigger values will be reviewed annually to continually revise and improve the environmental performance of the project over time. The annual review will also include a summary table of the full suite of groundwater quality parameters.

5.4.4 Groundwater Monitoring Locations and Frequency

Monitoring of groundwater levels and groundwater quality parameters is undertaken at the bores listed in .

Additional bores recommended in the hydrogeological assessment (Douglas Partners, 2010) have also been included in the monitoring program. Recommendations made in the hydrogeological assessment, and now completed, with respect to groundwater monitoring include:

- Bores MP 4 and MP 5 to be deepened to at least 10 metres below the water table.
- A bore to be drilled adjacent to Bore MP 4 to a depth at which the base of the alluvium is intersected. This adjacent bore will be completed as a monitoring bore in the Maules Creek Formation and have a pressure transducer/datalogger installed for continuous water level monitoring;
- A bore to be drilled adjacent to Bore WB 1, to a depth at which the base of the alluvium is intersected. This adjacent bore will be completed as a monitoring bore in the Maules Creek Formation and have a pressure transducer/datalogger installed for continuous water level monitoring; and
- A pair of piezometers to be installed immediately to the south of the expanded open cut pit, one in the Belmont Seam and one in the alluvium/weathered conglomerate. Hydraulic testing shall be undertaken on the bore in the alluvium/weathered conglomerate to allow refinement of the groundwater model.

Groundwater bore locations are shown on Figure 5.

All monitoring bores have been surveyed for location and level (both ground level and the level of the Reference Point (RP) from which the groundwater levels are measured).

A cross-section showing the formations, monitoring bores, screen intervals and groundwater levels is provided in Appendix 2.

Monitoring of water levels and water quality parameters will be undertaken in accordance with the monitoring schedule in . Chemical speciation will also be undertaken in all bores twice yearly, as shown in .

Table 13 - Groundwater Bore Monitoring Schedule

Bore	Frequency	Parameters
All bores	Quarterly	Water Level, Temperature, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Iron
MP-2a (Mine Site) MP-3a ("Stratford") MP-4a ("Surrey Lane") MP-5a ("Yarrawonga") MP-6 ("Costa Vale")	Continuous	Pressure transducers/dataloggers installed for the continual monitoring of Water Levels. The instruments will be downloaded every 3 months.
All bores	Six Monthly	Water Level, Temperature, pH, EC, TDS, TSS, Filtered Iron, Chloride, Total Phosphorus, Aluminium, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Nickel, Vanadium, Zinc and Mercury, Ammonia as Nitrogen (N), Nitrite as N, Nitrate as N, NOX as N. Major Cations: Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na) Major Anions: Chloride (Cl), Sulphate (SO4), Hydroxide Alkalinity as CaCO3, Carbonate Alkalinity as CaCO3, Bicarbonate Alkalinity as CaCO3

The monitoring schedule shown in allows water levels and quality of groundwater to be assessed in terms of impacts on the alluvium associated with the Namoi River and tributaries to the north and south of the site and private groundwater bores. Impacts will be managed in accordance with the Groundwater Response Plan.

Monitoring of the regional groundwater levels and quality in the alluvial and Maules Creek Formation aquifers will be maintained for the entire mining period, and will continue post mining to monitor for potential seepage from the final void. The requirements for post mining monitoring will be reviewed at completion of mining.

5.4.5 Groundwater Inflows to Mining Operations

Due to the complex and varying nature of the Rocglen active mining face it is difficult to quantitatively assess the volume of groundwater inflow into the pit. The following two methods are used to estimate groundwater inflows to the mining operations:

- Whitehaven will monitor the volume of water pumped out of the pit. If this coincides with a period of low or no rainfall, this will be used directly as a measure of groundwater inflow. If this occurs during periods of rainfall the site water balance model will be used to estimate the rainfall runoff component and, by subtraction, estimate the groundwater inflow; and
- Monitored bore water levels are used to estimate groundwater gradients towards the open cut pit, by triangulation. Estimated gradients would be used together with estimates of strata

permeability to calculate groundwater flow rates toward the pit. This would be estimated annually as part of the groundwater model verification.

5.4.6 Groundwater Model Verification

The groundwater model calibrated in the Hydrogeological Assessment (Douglas Partners, 2010) will be validated on an annual basis once this management plan is endorsed. It is intended that the model validations will be undertaken so that they can be incorporated into the annual review completed each year. The predictions will be compared to the groundwater level and mine inflow data results collected during the monitoring program. Should monitored readings exceed the trigger values in , the response protocol outlined in the Groundwater Response Plan will be followed.

5.5 Groundwater Response Plan

5.5.1 Introduction

This Groundwater Response Plan describes the response procedures for managing groundwater if or when trigger levels are exceeded, in accordance with relevant statutory requirements and the PA 10_0015). This Groundwater Response Plan provides procedures for exceedance of trigger levels, complaints from nearby users, and measures for excessive leakage from alluvial aquifers.

The objective of this Groundwater Response Plan is to present a set of procedures to be followed and actions for implementation should the groundwater trigger levels be exceeded.

5.5.2 Identification, Notification and Mitigation of Identified Groundwater Exceedances or Non-Compliances

Groundwater monitoring data is continually reviewed, and where exceedances to the trigger values occur, the following procedure will be adopted. It should be noted that due to the high variability in data, the trigger levels are reviewed annually to continually revise and improve the environmental performance of the project over time.

Groundwater exceedance procedure:

1. Check and validate the data which indicates an exceedance of the assessment criteria / trigger level (as soon as possible and within 7 days).
2. Notify NSW Department of Planning and Environment (DP&E) and any other relevant agency as soon as practicable after becoming aware of an incident.
3. A preliminary investigation will be undertaken to identify the cause and determine whether changes to the groundwater management system are required. This will comprise analysis of the exceedance result, baseline groundwater monitoring, current monitoring results in the vicinity of the exceedance, meteorological conditions of the period, current site activities and adjacent land use activities, including pumping from nearby irrigation bores.
4. A preliminary investigation report of the exceedance is to be prepared and submitted to the DP&E and any other relevant agency within 7 days of the date of the incident..

5. Any further investigations recommended by the preliminary investigation report will be conducted in consultation with DP&E and any other relevant departments (timeframe to be determined in consultation with DP&E).
6. Remedial measures will be developed in consultation with DP&E and any other relevant department and implemented in response to the outcomes of the investigations (timeframe to be determined in consultation with DP&E).
7. In emergency situations water will be supplied to the impacted landholder within 7 days of the exceedance, at least on an interim basis, until investigations are completed.
8. Additional monitoring would be implemented to measure the effectiveness of contingency measures where necessary (timeframe to be determined in consultation with DP&E).

5.5.3 Procedure to address Complaints from Nearby Groundwater Users

In the event that a complaint is received from nearby groundwater users, the following procedure will be followed:

1. Check and validate the nature of the complaint within 24hrs of receipt.
2. Where the complaint is potentially attributable to Rocglen's mining operations, DP&E and any other relevant department is to be notified within 7 days of receipt of the complaint (where practical).
3. An investigation will be undertaken to establish the cause and mitigation measures to improve the groundwater supply to the affected property (within 28 days of complaint).
4. In the event that the investigation identifies an adverse impact to the existing groundwater supply due to Rocglen operations, Rocglen Coal Mine will investigate appropriate remedial and contingency measures (timeframe to be determined in consultation with landholder, DP&E and any other relevant department). The details of the contingency measures (including water source) will be determined in consultation and agreement with the affected landholder.
5. In emergency situations water will be supplied to the impacted landholder within 7 days of the exceedance, at least on an interim basis, until investigations are completed.

5.5.4 Measures for Groundwater Leakage from Namoi River Alluvium

The groundwater model prepared for the Hydrogeological Assessment for the Rocglen Coal Mine Expansion Project (Douglas Partners, 2010) indicates that drawdown on the surrounding groundwater system as a result of the mining operation is expected to be limited in the future. Due to the many faults in the vicinity of the mine and generally low permeability of the Maules Creek Formation strata, hydraulic connectivity with the Namoi River Alluvium is considered to be limited, however there is some uncertainty regarding the leakage which will occur from the Namoi Alluvium. The purpose of installation of additional monitoring wells in the Alluvium is to refine the estimate of leakage from the Namoi Alluvium.

The groundwater monitoring program and trigger levels are designed to identify potential leakage from the Namoi River Alluvium in excess of predictions. Potential impacts to the Namoi River Alluvium will also be monitored in the annual groundwater model validation and predictions updated, as necessary.

If predicted or observed leakage from the Namoi Alluvium exceeds the existing groundwater interference licences, mitigations may include:

- Obtain additional water allocations under the water sharing plan;
- Review mining plan to reduce potential impacts; and
- Install hydraulic barrier to reduce leakage.

5.5.5 Unforeseen Impacts

The potential for unforeseen impacts associated with the continued operation of the Rocglen Coal Mine are generally considered to be quite low, however, in order to protect against any unforeseen environmental impacts associated with groundwater, the following procedure will be followed:

a) Review the unforeseen impact inclusive of any available monitoring data and existing operational activities or catchment activities which may potentially have contributed to the unforeseen impact;
b) An investigation will be commissioned by suitably qualified persons to determine the nature and extent of the impact;
c) Relevant and appropriate ameliorative action measures will be developed based on the results of investigations into the impact;
d) Prepare an action plan in consultation with the appropriate regulatory agency; and
e) Additional monitoring will be implemented where relevant to measure the effectiveness of any improvement measures implemented.

The implementation of any mitigation measures will be undertaken in consultation with the appropriate regulatory agency and will be reported in the Annual Review.

5.5.6 Continual Improvement

Ongoing review of groundwater monitoring data will assist in determining where there are any noticeable trends towards non-compliant parameter levels at the monitoring sites. This information is used to modify, if necessary, work practices or scheduling of equipment to ensure that future non-compliances are avoided.

Similarly, ongoing review of general environmental inspection data will provide Whitehaven with the opportunity to identify any potential trends and provide the opportunity to introduce corrective management practices to ensure continued improvement.

6.0 INCIDENTS AND COMPLAINTS

6.1 Incidents

Incidents will be managed and reported in accordance with requirements of the Project Approval, EPL, Pollution Incident Response Management Plan and relevant environmental management plans.

6.2 Complaints Handling

Whitehaven will handle any complaints in accordance with the requirements of the site EMS and the Surface Water and Groundwater Response Plans. This includes the operation of a telephone complaints line for the purposes of receiving any complaints from the general public in relation to activities conducted at the premises or in relation to operation of the mine.

Detailed records of all complaints are kept and maintained for at least five years after the complaint was made.

7.0 DOCUMENT REVIEW AND CONTINUOUS IMPROVEMENT

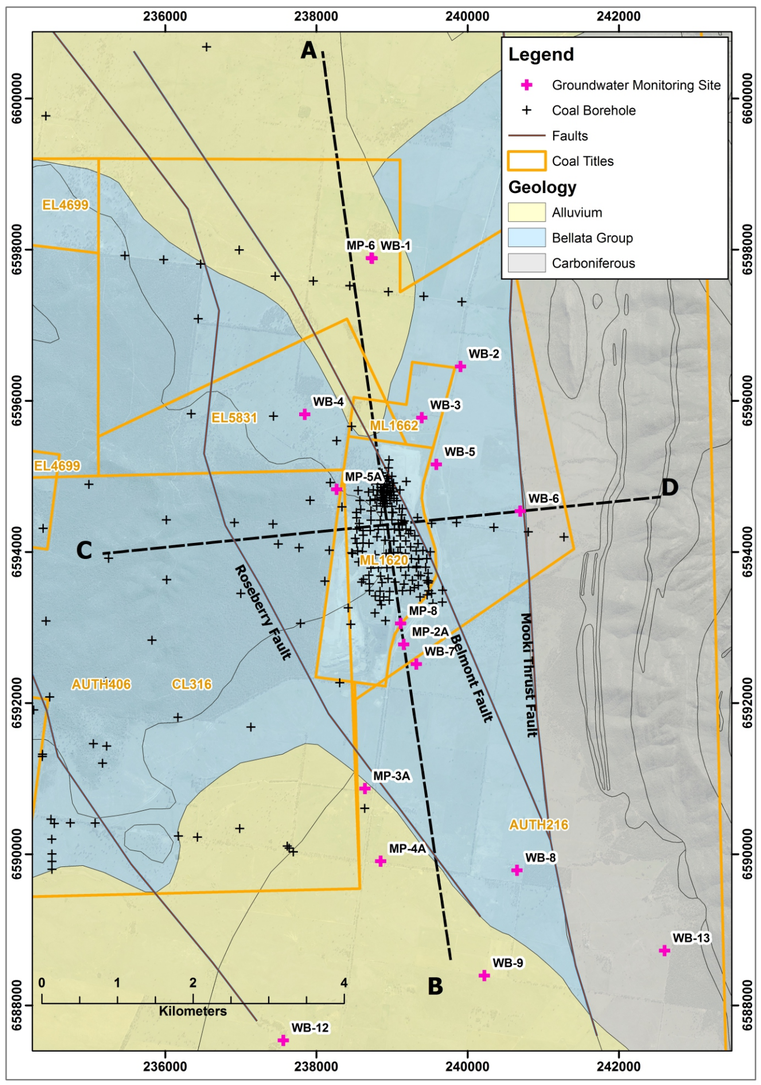
This document will be reviewed in accordance with the requirements of Condition 4 Schedule 5 of PA 10_0015.

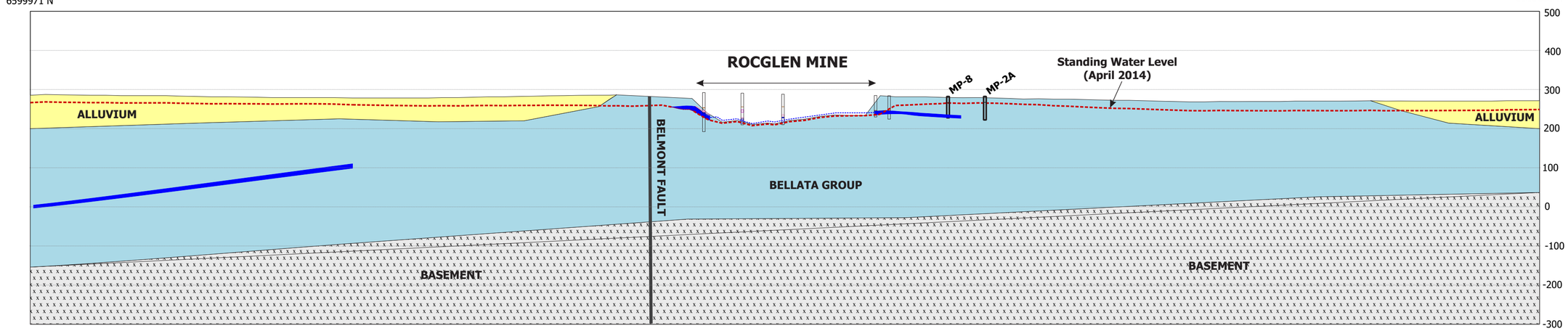
RCM will investigate and implement ways to improve the environmental performance of the project over time. This will be achieved by keeping abreast of best practice in the industry for water monitoring and controls and reporting on outcomes of water monitoring annually in the Annual Review.

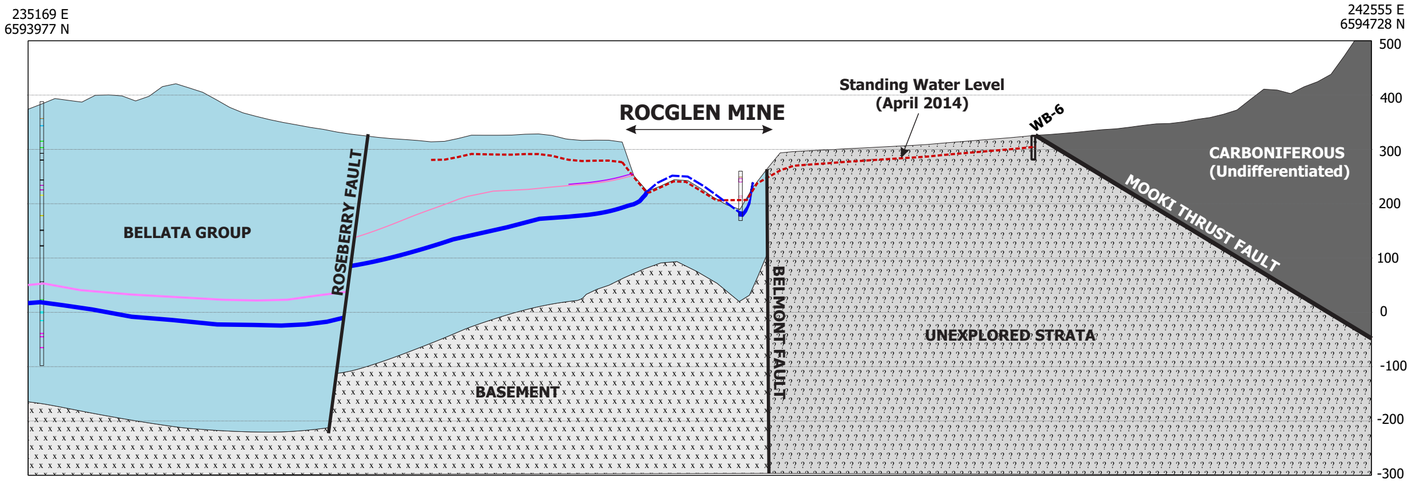
APPENDIX 1: Monitoring Bore Details

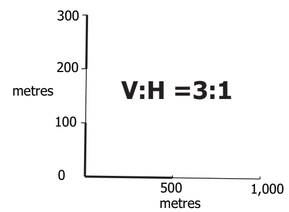
Site ID	Registered Number	Licence Number	Completion Date	Easting MGA-56	Northing MGA-56	RL AHD (Top of Casing)	Screen Top (mbgl)	Screen Base (mbgl)	Drilled Depth (mbgl)	Location	Landowner	County	Parish	Lot No.	DP No.	Interval Monitored
MP-1	GW968533	90BL254855	14/09/2008	238941.38	6595440.66	290.71	50.0	55.0	55.0	Glenroc	Whitehaven Coal Mining	Nandewar	Tulcumba	1	1120601	Conglomerate
MP-2	GW968534	90BL254856	14/09/2008	239156.00	6592782.91	283.47	31.0	32.0	33.0	Rocglen Coal Mine	Whitehaven Coal Mining	Nandewar	Tulcumba	4	1120601	Gravel
MP-2A		90BL256103	15/12/2012	239156.50	6592782.91	282.32	45.0	51.0	60.0	Rocglen Coal Mine	Whitehaven Coal Mining	Nandewar	Tulcumba	4	1120601	Conglomerate
MP-3	GW968535	90BL254857	14/09/2008	238649.00	6590865.98	266.61	13.0	17.0	18.0	Stratford	Whitehaven Coal Mining	Nandewar	Tulcumba	41	754950	Alluvium
MP-3A		90BL256108	16/12/2012	238641.27	6590867.45	265.61	43.5	49.5	56.0	Stratford	Whitehaven Coal Mining	Nandewar	Tulcumba	41	754950	Conglomerate
MP-4	GW968536	90BL254858	14/09/2008	238838.01	6589909.13	271.00	19.0	24.0	24.0	Surrey Lane	Gunnedah Shire	Nandewar	Tulcumba	40	754950	Alluvium
MP-4A		90BL256140	15/09/2013	238859	6589896	271.00	57.0	61.0	72.0	Surrey Lane	Gunnedah Shire	Nandewar	Tulcumba	40	754950	Alluvium
MP-4B		90BL256141	02/11/2013	238851	6589906	271.00	54.0	48.0	54.0	Surrey Lane	Gunnedah Shire	Nandewar	Tulcumba	40	754950	Alluvium
MP-5	GW968537	90BL254859	14/09/2008	238268.62	6594816.78	305.97	50.0	51.0	55.0	Yarrawonga	Whitehaven Coal Mining	Nandewar	Vickery	18	754951	Conglomerate
MP-5A		90BL256106	10/12/2012	238262.80	6594812.48	305.19	69.0	75.0	78.4	Yarrawonga	Whitehaven Coal Mining	Nandewar	Vickery	18	754951	Sandstone
MP-6		90BL256105	14/12/2012	238726.76	6597887.56	282.76	48.0	54.0	60.0	Costa Vale	Whitehaven Coal Mining	Nandewar	Wean	2	219158	Siltstone
MP-7		90BL256104	12/12/2012	239108.92	6593043.35	282.11	32.0	38.0	42.0	Rocglen Coal Mine	Whitehaven Coal Mining	Nandewar	Tulcumba	4	1120601	Conglomerate
MP-8		90BL256102	13/12/2012	239113.63	6593052.14	282.19	42.0	48.0	54.4	Rocglen Coal Mine	Whitehaven Coal Mining	Nandewar	Tulcumba	4	1120601	Conglomerate
WB-1	GW000743		01/06/1921	238738.00	6597885.00	286	54.9	54.9	70.4	Costa Vale	Whitehaven Coal	Nandewar	Wean	2	219158	Black Shale
WB-2	GW050395	90BL111536		239906.00	6596452.00	306			36.6	Roseberry	Ron Rennick	Nandewar	Tulcumba	2	1120601	Unknown
WB-3	GW050166	90BL110883	1/1/1899	239394.00	6595776.00	301			18.3	Glenroc	Whitehaven Coal Mining	Nandewar	Tulcumba	1	1120601	Alluvium
WB-4	GW045621	90BL104367	01/01/1930	237847.00	6595819.00	297			10.0	Yarrawonga	Whitehaven Coal Mining	Nandewar	Vickery	18	754951	Unknown
WB-5	GW011066	90BL004169	01/12/1954	239586.00	6595157.00	306	42.7	44.2	47.9	Roseberry	Ron Rennick	Nandewar	Tulcumba	2	1120601	Black Shale
WB-6	GW044068	90BL102845	01/12/1974	240696.00	6594539.00	328	38.4	39.0	43.6	Yarrari	Whitehaven Coal Mining	Nandewar	Tulcumba	36	754950	Black Shale
WB-7	GW022319	90BL013922	01/06/1964	239321.00	6592514.00	281	44.2	46.0	52.4	Roseberry	Ron Rennick	Nandewar	Tulcumba	3	1120601	Conglomerate
WB-8	GW052958	90BL107181	01/01/1980	240654.00	6589786.00	282	45.0	45.2	53.0	Surrey	Rod Barnes	Nandewar	Tulcumba	37	754950	Conglomerate
WB-9	GW020461	90BL013449	01/04/1963	240222.00	6588393.00	277			39.0	Carlton	W. Sales	Nandewar	Yarrari	131	754956	Unknown
WB-10	GW012307		01/02/1959	237137.00	6586489.00	268		126.5	21.0	Brolga	Warren Nicholls	Nandewar	Brentry	2	219575	Unknown
WB-11	GW900794	90BL155179	01/01/1960	236405.00	6585725.00	266			48.0	Brolga	Warren Nicholls	Nandewar	Brentry	2	219575	Unknown
WB-12	GW013284	90BL007678	01/01/1920	237562.00	6587535.00	269		18.3	22.0	Brolga	Warren Nicholls	Nandewar	Brentry	2	219575	Unknown
WB-13	GW020456	90BL013495	01/01/1925	242606.00	6588722.00	321		56.4	79.3	Carlton	W. Sales	Nandewar	Yarrari	171	754956	Unknown
WB-14	GW013742	90BL008965	01/01/1960	241547.00	6600916.00	324			53.3	Barock	Rod Barnes	Nandewar	Wean			Unknown
WB-15	GW014085	90BL009607	01/01/1959	242682.00	6585730.00	290			39.0	Kahana	David Torrens	Nandewar	Yarrari			Unknown
Yarrari Production	GW044069	90BL102847	01/12/1974	240803.00	6594267.00	333		101.0	61.0	Yarrari	Whitehaven Coal Mining	Nandewar	Tulcumba	36	754950	Unknown
Surrey No 2				241072.00	6590225.00	296				Surrey	R.Barnes	Nandewar	Tulcumba	37	754950	Unknown

APPENDIX 2: Groundwater Monitoring Cross Section









ROCGLEN PROJECT

GROUNDWATER MONITORING
LOCATION OF SITES

Author: JRO
07/08/2014

WHITEHAVEN COAL