WATER MANAGEMENT PLAN

Edition	Rev.	Comments	Author	Authorised By	Date
1	0	Initial Document	NMPL	C Davies	Aug 2008
	1	Care and maintenance & format update	J Hodgkins	D Young	Nov 2013
	2	PA 06_0308 MOD1	T Dwyer	J Johnson	Feb 2016

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ACRONYMS USED THROUGHOUT THIS DOCUMENT

ANZECC	-	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
DP&E	-	Department of Planning and Environment
DPI-Water	-	Department of Primary Industries - Water
DRE	-	Division of Resources and Energy
EC	-	Electrical Conductivity
EMS	-	Environmental Management System
EPA	-	Environment Protection Authority
EPL	-	Environment Protection Licence
GWMP	-	Groundwater Monitoring Program
LDP	-	Licenced Discharge Point
ML	-	Mining Lease or Megalitres
NMPL	-	Namoi Mining Pty Ltd
NATA	-	National Association of Testing Authorities
PA	-	Project Approval
SWL	-	Standing Water Level
SWMP	-	Surface Water Monitoring Program
WAL	-	Water Access Licence
WMP	-	Water Management Plan

1 INTRODUCTION

The Sunnyside Coal Mine is located approximately 15km west of Gunnedah and 2km north of the Oxley Highway (Figure 1). The mine was developed by Namoi Mining Pty Ltd (NMPL) as an open cut mining operation. NMPL is a 100% subsidiary company of Whitehaven Coal Ltd.

The mine site is located within the area of 234 ha covered by Mining Lease (ML 1624), and operates under Project Approval (PA 06_0308 MOD 1), and Environment Protection Licence (EPL 12957). Mining operations at the Sunnyside Coal Mine were suspended in late November 2012, and the mine is currently in care and maintenance

The Water Management Plan (WMP) was originally prepared by NMPL with assistance from Colin Davies (Carbon Based Environmental) and Andrew Dawkins (Geoterra) as the suitably qualified experts in relation to surface and groundwater assessment.

This WMP has been prepared in accordance with Conditions 22-27 of Schedule 3 of PA 06_0308 MOD 1, and reflects the current care and maintenance status of the site.

The WMP incorporates the following components as required by Project Approval PA 06_0308 MOD 1:

- Site Water Balance (Section 3.0);
- Erosion and Sediment Control Plan (Section 4.0);
- Surface Water Monitoring Program (Section 5.0);
- Groundwater Monitoring Program (Section 6.0); and
- Groundwater Contingency Plan (Section 7.0).

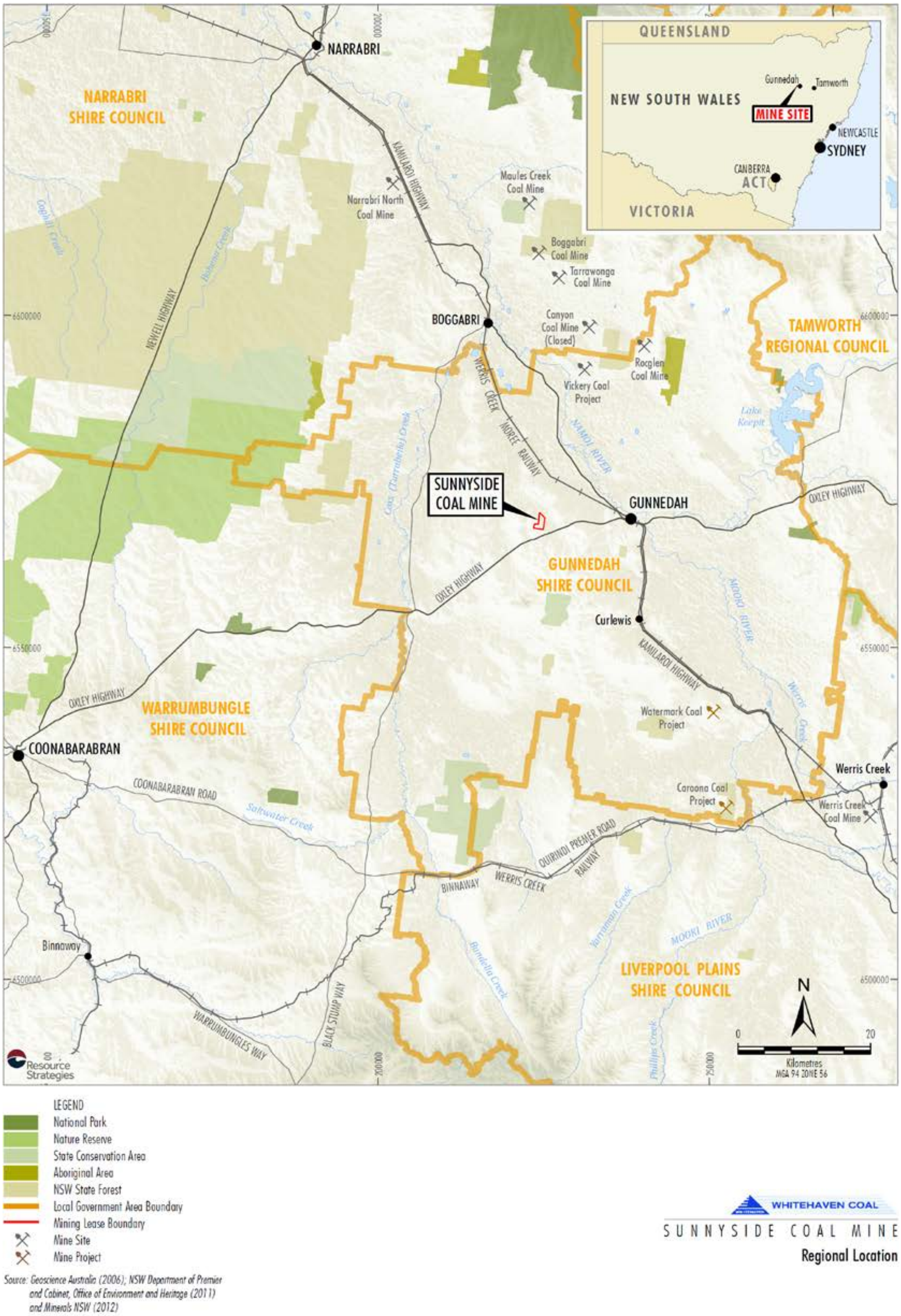

Figure 1 - Regional Location

2 SITE WATER BALANCE

2.1 Sources and Security of Water Supply

The primary objective in managing the quantity of water captured/discharged on the mine site is to ensure sufficient water is captured to meet the operational requirements of the proposal. The capture of dirty water is maximised such that clean water captured and used by the mine remains within the maximum harvestable right for the mine site.

Based on the harvestable rights for the project site, NMPL could capture and use 26.32 megalitres (ML) per annum (ML/pa) of clean surface water. NMPL also holds Water Access Licence (WAL) 29537 that licences the extraction of up to 120 ML of groundwater in any given calendar year.

The water required by the Project when operational is between 75 and 100ML/yr depending on the seasonal conditions. To date the harvestable right for the project has provided part of the water requirement with the remaining maximum water requirement for the project 73.68ML being obtained from a combination of the following three sources:-

- Capture of dirty water which flows over exposed surfaces within the Project Site.
- Extraction of groundwater from one or more existing or constructed bores.
- From groundwater and surface water retained within the mine void.

None of these sources has been assessed as part of the Project Site maximum harvestable right.

2.2 Water Use Onsite

When operational water use on site is limited to dust suppression, ablutions and potable supply. Ablutions and potable water are trucked in from off site. Operational water needs are preferentially sourced from the on-site sediment basins and surface and groundwater flows into the open cut.

During care and maintenance the only potential onsite water use is for dust suppression.

2.3 Water Management Onsite

For management purposes, the water within the mine site has been divided into four classes.

"Clean" water – surface runoff from catchments undisturbed or relatively undisturbed by mining or related activities and rehabilitated catchments. All surface water emanating from the final landform will be clean.

"Dirty" water – surface runoff from disturbed catchments such as the mine area and overburden emplacement, run-of-mine (ROM) and product coal stockpiles, soil and subsoil stockpiles and rehabilitated area (until stabilised), all of which could contain sediments. Dirty water used to supply the water requirements of the mine site is captured within the "disturbed area" and "open cut" catchments.

"Contaminated" water – surface runoff which could potentially contain hydrocarbons or other chemical contaminants.

"Pit" water – water from the open cut which will be retained in sumps or pumped to segregated storages specifically for storage of pit water.

Water that has come into contact with coal (coal contact water) may be contaminated with dissolved salts and metals. Following advice from the EPA, Sunnyside Coal Mine has identified that dirty water dams SB4, SB5 and SD4 (licensed discharge point) may contain coal contact water runoff (Figure 2). 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 06_03008 and EPL 12957 approving the coal stockpile catchments to be within dirty water discharge catchments.

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, Sunnyside Coal Mine will need to establish whether the discharge from SD4 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 SD4 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 Sunnyside Coal Mine on human health or the receiving environment. Sunnyside Coal Mine will implement a monitoring program to address this data deficiency. This monitoring program is proposed to include sampling of waters from SD4 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, Sunnyside Coal Mine will consult with the EPA in regard to the outcomes of the monitoring.

2.3.1 Clean Water

The diversion of clean waters away from disturbed areas reduces the potential for erosion and contamination. Diversion, collection and storage of "clean" water has been achieved using a series of diversion banks, waterways and storage dams which were constructed prior to surface disturbance activities within the adjacent upslope catchments.

The clean water catchment area south of the open cut area has been directed around the most easterly edge of the open cut area, such that no clean water enters the open cut.

The design for all structures has been consistent with the requirements of *Managing Urban Stormwater, Soils and Construction Manual* (Landcom 2004), or its latest version.

All structures will be inspected following significant storm events to ensure the structures have been able to sustain those flow velocities.

2.3.2 Dirty Water

Dirty water structures collect water that may have suspended solids concentrations that would be outside the range of those prescribed by EPA guidelines, presented in Table 1.

Table 1 – Discharge Parameter Limits

Parameter	100th Percentile Limit
pH	6.5 to 8.5
Suspended Solids (mg/l-)	≤ 50
Total Oil and Grease(mg/l-)	≤ 10

Catch banks/drains have been constructed to divert potentially sediment-laden waters into sediment basins below sites that can potentially generate significant quantities of sediment laden water.

The sediment basin locations are presented in Figure 2. They store and settle out potentially sediment laden waters as directed by the constructed catch banks.

Sediment Basins are managed to ensure retention of sufficient capacity to reduce the potential for discharge off site. The management practices to be employed to ensure this is achieved are as follows:

- Preferential sourcing of dirty water for dust suppression purposes. Preference is given to sourcing water from the discharge points. Each discharge dam has a water level gauge for monitoring water levels.
- Each sediment basin will have a marker indicating 25% sediment storage capacity level, to enable clean out of basins upon reaching that storage mark.
- Regular water quality analysis to assess effectiveness of sediment system (refer Section 4). Where sediment levels are determined to be at greater levels than discharge limits, consideration will be given to ameliorative measures including use of flocculants, and increase in sizing or additional sediment basin construction.

As recommended in the Blue Book Landcom guidelines, sediment basin capacity has been calculated on a 90%ile 5 day storm event. Application of this measure results in an overall required sediment basin capacity of 35.3ML.

Calculation of settling zone volume, storage zone volume and total basin volume for the dirty water catchment is presented in Table 2.

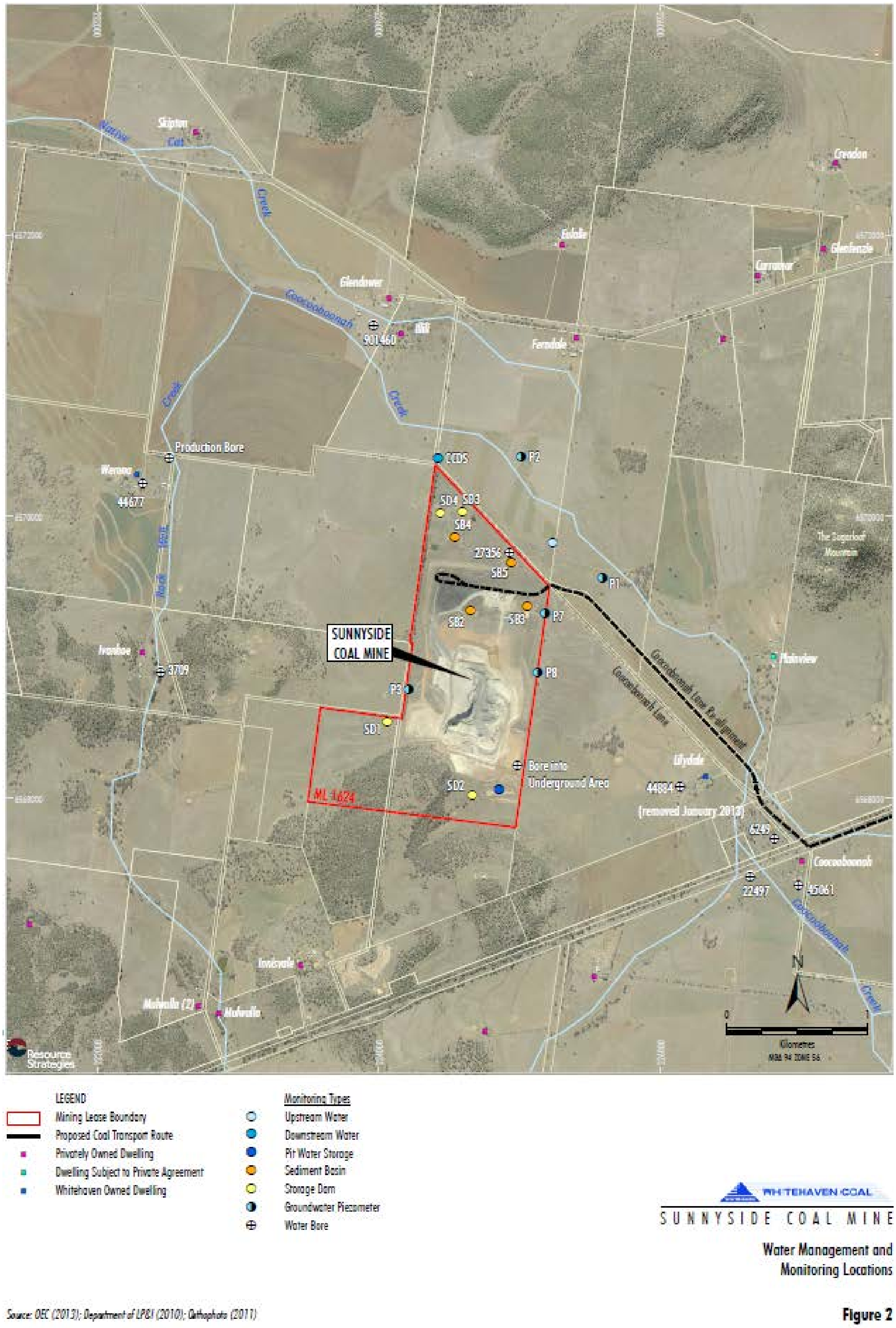

Figure 2 - Water Management Structures

Table 2 - Sediment Basin Design Capacity (90%ile 5 day storm event)

Site	Volumetric runoff coefficient	Rainfall depth (mm)	Total Catchment Area (ha)	Settling Zone Volume (ML)	Sediment Storage Volume (12 month) (ML)	Total Basin Volume (ML)
Disturbed dirty water area	0.64	39	109	26.8	8.5	35.3

This quantity of water can be captured in any number of basins of suitable dimensions that totals 35.3ML capacity. The indicative catchment areas and available volumes of sediment basins are shown in Table 3.

Table 3 - Sediment Basin Catchment Areas and Available Volumes

Structure ID	Catchment Area Total contributing (ha)	Available Volume (m3)
SB2	40	7,200
SB3	20	6,700
SB4	70	10,300
SB5	90	7,000
Total Volume	-	31,200

The final sediment basin in the chain, SB4, spills into SD3 and SD4 which have a combined available volume of 19.3ML. This capacity ensures there is always storage basins with capacity greater than 35.3ML to achieve the 90th %ile 5 day event criteria.

2.3.3 Contaminated Water

Water that discharges from areas where mine plant, equipment and vehicles may be used or serviced may potentially contain hydrocarbons. These areas on the project site include:

- Any fuel, oil and grease storage; and
- Refuelling bays.

These areas are managed by the following means.

- All water from these areas would be directed to oil separators and containment systems for subsequent removal.
- Storage tanks would have an impermeable surface and bunding so as to contain at least 110% of the storage capacity of the largest tank.
- All hydrocarbon products are securely stored.

2.3.4 Pit Water

No active management, other than water quality monitoring, of pit water is currently undertaken as the site is in care and maintenance.

2.3.5 Site Water Balance

A site water balance was prepared to assess whether sufficient surface water is available for capture onsite during dry years for the water requirements outlined, and if significant discharge would be required in wet years.

NMPL obtain the bulk of the mine water supply from pit inflows which were predicted to average 374ML/year. These predicted pit inflows did not occur, and the expected need for discharge of surface water from the Project Site under all types of rainfall years given such pit inflow has not eventuated.

During dry years (10th percentile rainfall), the water available from a combination of dirty water, void groundwater inflow, and clean water sources would be sufficient to meet operational water requirements.

Should discharges become more prevalent than experienced to date, the following management measures will be considered:

- Construction of additional sediment basins or enlargement of existing sediment basins.
- Flocculation of sediment basins to acceptable discharge level of water quality to expedite the draining of basins.

2.4 Measures to Minimise Water Use

Whilst the site has had access to water via the means described above, operations were managed to minimise water use on the project site as much as possible. The measures that were adopted to assist include:

- Minimising the extent of exposed surfaces as much as possible;
- Regular road maintenance in pit to minimise dust lift off from dump truck operations;
- Minimise number of vehicular access points on site to reduce potential for dust lift off;
- Targeting of areas most conducive to dust lift off by site water cart;
- Sealing site access road and coal transport route;
- Standing down from operations during significantly dry and windy conditions where site water carts are ineffective in controlling dust lift off;
- Progressive rehabilitation of construction areas including road verges, drainage paths, site facilities areas to establish groundcover and reduce potential for dust lift off;
- Progressive rehabilitation of waste emplacements to establish groundcover and reduce potential for dust lift off; and

- Ongoing monitoring of site conditions to determine any additional requirements which may include consideration to application of dust suppression agents in site water to provide for enhanced dust minimisation and water saving techniques.

2.4.1 Water Balance Review

A review of the site water balance will be undertaken prior to the re-commencement of any mining operations.

3 EROSION AND SEDIMENT CONTROL PLAN

3.1 Introduction

In accordance with Condition 24 Schedule 3, this Erosion and Sediment Control Plan (ESCP) is consistent with the requirements of the Department of Housing's *Managing Urban Stormwater: Soils and Construction Manual* (Landcom, 2004), or its latest versions. All erosion and sediment control structures have been constructed or erected in accordance with the recommendations identified in the relevant standard drawing and construction notes of Landcom (2004).

3.2 Sources of Erosion and Sedimentation

Erosion and sedimentation could potentially result directly or indirectly from:

- Surface water runoff from areas disturbed in advance of, and during mining;
- Surface water runoff from topsoil, subsoil and overburden stockpiles and emplacements prior to rehabilitation;
- Surface water runoff from the coal processing area;
- Surface water runoff from rehabilitated areas prior to full stabilisation;
- Discharges of water at erosive velocities; and
- Runoff from roads at erosive velocities.

Surface runoff from areas prior to their final rehabilitation is considered the primary potential source of erosion and sedimentation during care and maintenance.

3.3 Erosion and Sediment Control Measures

NMPL will remain vigilant in managing erosion and sedimentation on the mine site and, by only discharging water which satisfies the criteria identified within the EPL (refer Section 4.3.1), will minimise the potential for migration of sediments to downstream waters.

Although all structures have been designed in accordance with the requirements of *Managing Urban Stormwater, Soils and Construction Manual* (Landcom 2004) or its latest version, the following additional procedures and management practices will be implemented to further reduce the risk of erosion and sedimentation.

- Any structure required to control erosion and sedimentation will be constructed or installed prior to the commencement of activities in that area.
- Areas on the mine site without some form of vegetation cover will be minimised.
- As part of a surface water monitoring program, water flowing from the nominated discharge points will be sampled for suspended sediments.
- All surface water flows from flumes will flow to sediment basins.

3.4 Erosion and Sediment Control Structures

The structures presented on Figure 2 are the primary erosion and sediment control structures that direct and control the velocity of surface water and prevent uncontrolled flows and discharges of water. As the final landform was created, additional erosion controls in the form of contour banks and rock or grass-lined flumes, were progressively constructed.

The contour banks on the sloped surfaces of the final landform direct surface water flows to a number of flumes which control the flow of water off the constructed final landform and therefore assist in reducing erosion and maintaining the long term stability of the landform.

It is the preference of NMPL to construct the flumes with a grass substrate. However, if rock flumes are deemed more appropriate, these will be constructed with >80% of rock with a diameter of at least 200mm and to the following design.

- Channel width >1m.
- Bank height >500mm
- Channel parabolic in shape
- Excavated batters of 1:4 (V:H) or shallower.

All design works for erosion and sediment control are in accordance with the requirements of *Managing Urban Stormwater, Soils and Construction Manual* (Landcom 2004) or its latest version.

3.5 Monitoring and Maintenance of Erosion and Sediment Control Structures

The erosion and sediment control structures will be inspected monthly, or after a rainfall event of >25mm/24hr, to assess their success in preventing erosion, identify signs of potential erosion and determine the retained capacity, especially within the sediment basins.

The erosion and sediment control structures will be cleaned of accumulated sediment material (or extended or replaced) as soon as practicable when 25% capacity is lost due to the accumulation of material such that the specified capacities are maintained.

If, following heavy rain, erosion is identified on the final rehabilitated landform, it will be remediated using one or a combination of the following:

- Filling the erosion channels
- Cross-ripping (along the contour) to assist infiltration
- Installation of additional controls, eg banks sown with a non-persistent cover crop.

Areas previously identified as exhibiting erosion and treated to prevent further erosion will be monitored on a minimum monthly basis or following a rainfall event of >25mm over 24 hours.

4 SURFACE WATER MONITORING PROGRAM

4.1 Introduction

This Surface Water Monitoring Program (SWMP) has been prepared in accordance with Condition 25 Schedule 3 of PA 06_0308 MOD 1 and includes:

- Provision of baseline data on surface water flows and quality in adjoining creeks and that could be affected by the project;
- Surface water impact assessment criteria;
- A program to monitor the impact of the project on surface water flows and quality; and
- Procedures for reporting the results of this monitoring.

4.2 Baseline Surface Water Quality

Table 4 lists those field pH and electrical conductivity measurements recorded by Whitehaven Coal Mining as described in GeoTerra (2008).

Table 4 - Surface Water Quality

Site	Date	Electrical Conductivity (µS/cm)	pH
Coocooboonah Creek “Plain View”	22.10.06	960	6.13
Coocooboonah Creek (after rain)	03.11.06	272	7.64
“Sunnyside” Dam 1	24.01.08	324	8.71
“Sunnyside” Dam 2	24.01.08	330	9.07
“Sunnyside” Dam 3	24.01.08	234	9.06
“Sunnyside” Dam 4	24.01.08	236	9.17
Source: GeoTerra (2008) - Table 5.			

Essentially, the surface water has low electrical conductivity and above neutral pH. Detailed baseline data on surface water flows and quality in creeks and other water bodies that could be affected by the project is presented in the project Environmental Assessment (2008).

4.3 Surface Water Impact Assessment Criteria

4.3.1 Environment Protection Licence

Impact assessment criteria for surface water are only relevant to water actually discharged from the site. EPL 12957 contains two Licence Discharge Points (LDPs) for wet weather discharge. The concentration limits set in EPL 12957 for both discharge locations are presented in Table 5.

Table 5 - Concentration Limits for Licenced Discharge Points

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.

There are also requirements under EPL 12957 to monitor pollutant concentrations in Coocooboonah Creek upstream and downstream of potential mine influence.

4.3.2 ANZECC Guidelines

Downstream and upstream water quality monitoring results are assessed, for each monitoring event, against key default trigger values presented in Table 6 and sourced from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000).

Table 6 - 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 $CaCO_3$)

Whitehaven currently adopts the concentration limits for discharge waters stated in EPL 12957 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 of discharge waters.

In the event of trigger values for any of the indicators included in Table 6 being reached, a review of upstream water quality results will be undertaken, along with a general review of the water management practices undertaken on site.

4.4 Surface Water Monitoring

NMPL has implemented a surface water monitoring program to enable appropriate auditing and management of surface water quality. The frequency of monitoring reflects the parameters to be monitored, the locations to be monitored and the potential for environmental impact. Table 7 presents the monitoring schedule to be implemented.

Table 7 - Surface Water Monitoring Schedule

Location	Parameter	Frequency
Storage Dams SD3 and SD4	Electrical Conductivity, pH, Total Suspended Solids, Total Oil and Grease, Total Organic Carbon	Once when discharging water
Pit Void water	Electrical Conductivity, pH, Total Suspended Solids, Total Oil and Grease, Total Organic Carbon, Total Metals, Nutrients	Annually Prior to discharge into underground workings
Upstream and downstream of the Project Site's runoff into Coocooboonah Creek.	Electrical Conductivity, pH, Total Suspended Solids, Total Oil and Grease, Total, Metals, Nutrients. Total Organic Carbon.	Once discharging from the site

Total Metals will include Iron (Fe), Copper (Cu), Zinc (Zn), Lead (Pb), Arsenic (As), Cadmium (Cd), Aluminium (Al), Mercury (Hg), Molybdenum (Mo), Manganese (Mn) and Nickel (Ni). Nutrients will include Total Phosphorus and Total Nitrogen.

The monitoring results are reviewed on an annual basis and the frequency, locations and/or parameters re-assessed to ensure meaningful data is being collected.

4.5 Reporting of Monitoring Results

NMPL collates surface water analysis data and maintains an up to date record of analysis results. These results are interpreted by NMPL as they are received in order to ensure appropriate operational guidance on maintaining water quality within desired parameters.

The results of water quality analysis will be reported in the Annual Review and will be made available to the Community Consultative Committee.

In the event that an exceedance in surface water quality criteria is identified, the exceedance will be reported to the relevant agencies in accordance with Conditions 3 and 4 Schedule 5 of PA 06_0308 MOD 1 and Condition R2 of EPL 12957.

5 GROUNDWATER MONITORING PROGRAM

5.1 Introduction

This Groundwater Monitoring Program (GWMP) has been developed in accordance with Condition 26 Schedule 3 of PA 06_0308 MOD 1, and includes a Groundwater Contingency Plan (refer section 7), as required by Condition 27 Schedule 3 of PA 06_0308 MOD 1.

5.2 Groundwater Model

Golder Associates Pty Limited (Golders) undertook groundwater modelling to assess the likely impact of the Sunnyside Coal Project on the local groundwater.

The report of their assessment is included as Appendix 5 in GeoTerra (2008) and the following summarises the relevant information from their study. GeoTerra (2015) concluded that *"Groundwater monitoring conducted since 2008 during the operational life of the Sunnyside Coal Mine supports the predictions of the 2008 Groundwater Assessment (e.g. limited change in groundwater levels and no impacts at private bores)."*

Post Mining Pit Void Water Levels

The combined groundwater inflow and surface water capture in the pit would not generate a pit void lake, as there is insufficient inflow to raise the pit water level above the proposed basal level of 305m AHD.

Potential Impact on Local Streams

It is not anticipated that stream flow in Coocooboonah Creek or Rock Well Creek would be affected by mining as the cone of groundwater depression from the void does not extend as far as the creek channels.

Potential Impact on the Namoi River and its Associated Alluvial Groundwater Resources

Groundwater drawdown from mining the proposed Sunnyside Pit would not extend significantly into or within the alluvium of Coocooboonah Creek, and would not extend into the alluvium of Native Cat Creek, Rock Well Creek or tributaries of the Namoi River.

Mining the Sunnyside open cut to date has not affected river flow or groundwater supplies associated with the Namoi River alluvium.

Potential Impact on Groundwater

Dewatering associated with the Sunnyside pit is not anticipated to have an adverse impact on groundwater quality within the Hoskissons Seam, or the strata over or underlying the Seam.

No adverse effect is anticipated on the surface water quality in Coocooboonah Creek and other streams due to groundwater movement as the Sunnyside cone of depression does not extend as far as the creek channel. Depressurisation in the basement strata under or near the creek is not anticipated due to the isolated dewatering of the Hoskissons Seam.

No adverse effect is anticipated on water quality within Rock Well Creek as depressurisation of the Hoskissons Seam is not anticipated to sufficiently propagate up through strata above the Hoskissons Seam to the creek bed.

Potential Salt and Contaminant Migration Pathways

It is not anticipated that an increase in salinity levels in Coocooboonah Creek would occur due to leakage of groundwater out of the proposed pit or abandoned underground working. This is a result of the pit forming an inward cone of depression and the underground workings to the south being mostly dry.

It is also anticipated that no contaminants would be transported off site via the groundwater system due to the inward flowing cone of depression. Off-site migration of contaminants via the surface water system should be contained within the mine dirty water system.

Potential Impacts on Groundwater-Dependent Ecosystems

No groundwater-dependent ecosystems (GDEs) have been identified within the Sunnyside Project Site, and therefore there are no anticipated adverse effects on GDEs in the study area.

Private Bore and Well Groundwater Levels, Yield and Quality

A total of 24 stock and domestic bores, one irrigation bore and eight piezometers are registered within a 3km radius of the Sunnyside open cut as shown in Table 8.

These bores have yields ranging up to 0.9L/sec. The depth of the stock and domestic bores range from 12.2m to 85.3m. Three bores (GW27356, 45097 and 45098) are on the “Sunnyside” property.

The registered bores directly west and southwest of the proposed open cut pit have their water supply intakes located stratigraphically above the Hoskissons Seam, those to the west of and down dip of the subcropping Hoskissons Seam generally obtain supplies from either or both the Hoskissons and Melville Seams, whilst those to the east of the Hoskissons Seam Subcrop generally obtain water from the Upper and or Lower Melville Seams.

Table 8 - Registered Bore Data

Bore	Registered Use	Drilled	Depth	Water Intersection	Drilled Standing Water Level	Yield	Aquifer Intake
INTAKE ABOVE HOSKISSONS COAL SEAM							
3706	Stock	1940	15.2	9.1 / 13.4-15.2	6.4	0.4	Sandstone
3709	Stock	1940	37.5	36.6	19.2	0.46	Shale
3715	Stock	1940	45.1	30.5 / 42.1	? / 28.7	0.04 / 0.2	Shale / sandstone
8810	Stock?	N.A.	53.3	N.A.	N.A.	N.A.	N.A.
15665	Stock	1957	24.4	15.8-16.1	12.2	0.03	Basalt

16789	Stock	1961	23.2	16.8-17.1 / 18.9-21.3	12.2/12.2	0.06 / 0.51	Conglomerate
901803	Stock Domestic Irrigation	N.A.	58	N.A.	N.A.	N.A.	N.A.
966680	Piezometer	1990	5.4	N.A.	N.A.	N.A.	N.A.
966681	Piezometer	1990	2.1	N.A.	N.A.	N.A.	N.A.
967523	Stock domestic	1997	42.36	N.A.	N.A.	N.A.	N.A.
INTAKE WITHIN HOSKISSONS COAL SEAM							
22497	Stock	1965	45.7	28.7-32.1	24.4	0.25	? / coal
44677	Stock Domestic	1926	75.9	N.A.	15.2	N.A.	? / coal
45098	Stock Domestic	1965	44.2	26.5 / 39.6-40.8	N.A.	N.A.	? / coal
INTAKE BENEATH HOSKISSONS COAL SEAM AND / OR WITHIN MELVILLE COAL SEAM							
6249	Stock	N.A.	70.7	68.9	20.7	0.25	Sandstone / coal
17082	Stock	1947	24.4	N.A.	N.A.	N.A.	? / coal
27356	Stock	1966	35.4	27.1 / 31.4-33.5	27.1 / 24.7	0.01 / 0.63	Shale / coal
44580	Stock Domestic	1977	34.0	N.A.	18.0	N.A.	? / coal
44581	Stock Domestic	1977	35	N.A.	18.0	N.A.	? / coal
44884	Stock domestic	?	73.2	N.A.	N.A.	N.A.	? / coal
44885	Domestic	1976	36.6	N.A.	15.3	N.A.	? / coal
45013	Stock	?	76.2	N.A.	N.A.	N.A.	? / coal
45061	Stock	N.A.	84.1	N.A.	N.A.	N.A.	? / coal
45044	Stock domestic	1942	34.1	14.6 / 34.1	N.A.	N.A.	? / coal
45045	Stock	1965	62.5	61	N.A.	N.A.	? / coal
45097	Stock Domestic	1934	85.3	54.9 / 85.3	N.A.	N.A.	? / coal
48701	Stock Domestic	1978	61.0	N.A.	45.7	0.51	? / coal
901460	Stock Domestic	1920	34	N.A.	16.0	N.A.	? / coal
Note: N.A. DPI-Water data not supplied Shading indicates bore in use as at 2008							
Source: GeoTerra (2008) – Table 1							

The 27 bores and piezometers were all installed between 1920 and 1997 with groundwater generally extracted by low flow windmills, and to a lesser degree, submersible pumps.

Five of the 27 bores and the two piezometers are no longer used. Of the remainder, 14 are low, variable yield windmills, and 6 obtain water by submersible pumps.

Water quality ranges from 6.61 to 9.37pH and 1,704µS/cm to 8,440µS/cm electrical conductivity.

All water is extracted from the fractured basement aquifers, with no inspected bores obtaining groundwater from the alluvium of Coocooboonah Creek or Rock Well Creek.

The majority of groundwater in the Rock Well Creek catchment is obtained from basement fractured rocks rather than valley fill alluvium. Standing water levels ranged from 4.9m to 28.7m below surface.

5.3 Groundwater Chemistry

DPI-Water data presented in Table 9 shows that groundwater in the Sunnyside area has low to moderate salinity within the basement fractured rock aquifers, with electrical conductivity values of between 510µS/cm and 10,080µS/cm and pH between 3.81 and 8.7.

Table 9 - DPI-Water, Groundwater Quality Data

Piezometer (G W)	Sample Date	Source Aquifer	pH	EC (µS/cm)
3706	23/6/76	Sandstone	7.6	6800
6249	2/6/76	Sandstone	8	3700
8810	23/6/76	N.A.	7.7	7100
16789	1961, 1976, 1992	Conglomerate / N.A.	6.4 / 7.6 / 3.81	10080 / 510 / 1116
22497	22/6/76	Melville Coal Seam	6.7	4100
27356	2/6/76	Shallow Marine Facies / Melville Coal Seam	6.7	3900
44884	2/6/76	N.A.	8.7	2680
44885	2/6/76	Gunnedah Formation?	7.1	4400
45013	1976 / 1992	N.A.	7.9 / 6.9	6000 / 1470
45044	2/7/76	Gunnedah Formation? / Melville Coal Seam?	7.4	6100
45045	2/7/76	Melville Coal Seam? / Lower Delta Plain Facies?	8.7	1640
45061	22/6/76	N.A.	7.9	4200
ANZECC			6.5 – 7.5	30 – 350
Notes 1.ANZECC 2000 - default trigger values for SE Australian Upland Rivers. Shading indicates exceedance of these trigger values.				
Source: GeoTerra (2008) – Table 2				

The results of baseline field assessments of piezometer and coal bore water quality are shown in Table 10.

Table 10 - Baseline Groundwater Quality

Bore	Date	Electrical Conductivity (µS/cm)	pH
Gunnedah Alluvial Formation			
P1	3/11/06	12580	7.72
P2	3/11/06	18680	9.05
Digby Formation, Goran Conglomerate and Upper Delta Plain Facies			
GW3715	3/11/06	/	/
Hoskissons Coal Seam			
P3	3/11/10/06	7480	7.30
P4	3/11/06	6450	7.40
P5	3/11/06	4560	7.10
Sun 43C	21/10/06	4660	6.65
Sun 44C	21/10/06	2260	6.93
Sun 45C	21/10/06	3780	7.01
Sun 46C	21/10/06	3240	7.12
Sun 47C	21/10/06	4380	6.84
Sun 48C	21/10/06	12290	6.62
Sun 52	21/10/06	8500	6.84

Sun 61	21/10/06	4560	7.19
DDH185	21/10/06	12650	6.91
Shallow Marine Facies and Melville Coal Seam			
GW27356	3/11/06	6170	6.61
GW45045	3/11/06	5310	8.23
GW45098	3/11/06	8440	6.80
P6	3/11/06	5490	7.09
P7	3/11/06	7330	6.99
Sun 38	3/11/06	11430	6.84
Sun 39	21/10/06	2500	7.87
Shallow Marine Facies Melville Coal Seam and Lower Delta Plain Facies			
Sun 57	21/10/06	5380	7.17
Sun 58	21/10/06	3860	7.11
Sun 59	21/10/06	7100	7.02
Sun 60	21/10/06	8350	6.85
P8	20/10/06	8350	6.85
Source: GeoTerra (2008) – Table 6			

The major ions present in baseline bore water samples are shown in Table 11 and Table 12.

Table 11 - Baseline Groundwater (Major Ions mg/L)

Bore	pH	EC µS/cm	TDS	Na	Ca	K	Mg	Cl	F	HCO3	SO4	Tot N	Tot P
Quaternary Alluvium													
P1	7.6	12580	11900	3350	9.5	6	62	580	0.37	4870	380	15	1580
P2	8.7	18680	17000	5210	39	12	225	420	1.0	6720	335	<0.1	3920
Hoskissons Coal Seam													
P3	7.2	7480	3350	710	155	34	260	1420	0.59	1303	220	0.9	0.15
P4	7.9	5030	2450	700	76	55	93	610	.64	1330	200	1.7	9.5
P5	7.2	4870	2150	540	90	46	115	660	0.95	1160	56	11.0	0.01
45098	7.0	8440	3850	830	160	42	300	1700	0.86	1120	220	<0.1	0.02
No.5 Ug	8.1	5420	3180	908	102	9.4	102	1150	1.47	1060	<2	1.3	0.07
Shallow Marine Facies, Lower Delta Plain Facies and Melville Coal Seam													
P6	7.5	5490	2690	690	92	32	180	1120	0.6	1070	93	4.9	0.08
P7	7.2	3860	3360	790	130	19	245	1480	0.37	1010	200	4.5	0.02
P8	7.1	7100	4590	800	255	21	365	1600	0.3	720	1080	0.5	0.08
27356	6.8	6170	2800	485	155	18	255	1110	0.59	900	240	1.1	0.02
45097	7.8	2630	1440	555	9.4	3.4	7.1	490	3.2	760	<2	0.5	0.01
Coocooboonah Creek													
	7.3	272	135	3.8	12	32	12	20	<0.1	120	4	1.3	2.1
ANZECC *	6.5-7.5	30 – 350	-	-	-	-	-	-	-	-	-	0.25	0.02

* ANZECC default trigger values for risk of adverse effects from physical and chemical stressors in SE Aust. Upland Rivers (Shading indicates values outside ANZECC 2000 criteria)
Source:GeoTerra (2008) – Table 7

Table 12 - Baseline Groundwater (Filtered Metals mg/L)

Bore	Cu	Pb	Zn	Ni	Fe	Mn	AsTot	SeTot
Quaternary Alluvium								
P1	0.018	0.002	0.012	0.03	0.44	0.14	0.02	<0.01
P2	0.065	0.054	1.3	0.15	19	2.5	0.14	<0.01
Hoskissons Coal Seam								
P3	0.004	0.003	0.006	<0.01	0.02	0.02	<0.01	<0.01
P4	0.002	<0.001	0.009	0.03	<0.01	0.04	0.02	<0.01
P5	0.005	0.003	0.009	<0.01	0.01	0.06	<0.01	<0.01
45098	0.003	<0.001	0.009	<0.01	<0.01	0.06	<0.01	<0.01
No.5 Ug	0.0008	<0.00005	0.013	0.001	0.03	0.001	<0.001	<0.001
Shallow Marine Facies, Lower Delta Plain Facies and Melville Coal Seam								
P6	0.002	<0.001	0.011	<0.01	<0.01	<0.01	<0.01	<0.01
P7	0.002	<0.001	0.014	<0.01	<0.01	0.03	<0.01	<0.01
P8	0.004	<0.001	0.046	<0.01	<0.01	2.1	0.01	<0.01
27356	0.003	<0.001	0.005	<0.01	0.03	0.09	<0.01	<0.01
45097	0.006	<0.001	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Coocooboonah Creek								
	0.005	0.002	0.025	<0.01	2.6	0.12	<0.01	<0.01
ANZECC	0.0014	0.0034	0.008	0.011	-	1.9	0.024(III) / 0.013(V)	0.011
NOTES : ANZECC 95% trigger values for toxicants (Shading indicates values outside ANZECC 2000 criteria)								
Source: GeoTerra (2008) – Table 8								

5.4 Groundwater Flow

Due to its confined nature and 2º to 3º dip to the south and west of the pit, groundwater flow within the Hoskissons Seam is down dip along the seam to the southwest, into the hills, with a modification due to topographical effects to the east giving an overall south-easterly flow direction within the pit area.

Groundwater flow in the combined, underlying Shallow Marine Formation, Melville Seams and Lower Delta Plain Facies is to the northwest, which is in the opposite direction to the Hoskissons Seam and conforms to the influence of topography.

The flow pattern represents a combination of:

- Recharge within the hills to the southwest of the open cut, with gravity driven flow from the hills to the valleys;
- Flow down dip in confined lithologies to the southwest, with modification for topographical effects; and
- Unconfined flow to the northeast then north-northwest along the Coocooboonah Creek and Rock Well Creek valleys.
- Flow within the area would also be modified by the effect of strata dislocation from faulting;
- Possible flow along higher permeability faults; and
- The reduction in Hoskissons Seam and overburden permeability due to the presence of weathered doleritic sills and dykes.

5.5 Groundwater Monitoring Program

A groundwater monitoring program has been conducted within the Mine Lease area since October 2006. The proposed monitoring program is outlined in Table 13.

The groundwater monitoring program would be extended beyond the active mine life in order to assess the potential long term change in groundwater re-pressurisation and water quality, with the program continuing for a period agreed with the DPI-Water and DRE after closure of the relevant mining operations.

All bores used for groundwater monitoring are licensed.

5.5.1 Groundwater Levels and Groundwater Quality

The monitoring program has emphasis on capturing data from piezometers and bores located in the vicinity of surface water systems, open cut pit, abandoned underground workings, and the predicted drawdown area.

Bores are measured for Standing Water Level (SWL), field pH and electrical conductivity (EC) on a quarterly basis. Groundwater samples are collected on a six monthly basis and analysed for major ions (TDS, Na, K, Ca, Mg, Cl, HCO3, NO3, SO4 and hardness) and selected filtered (0.45μm) metals including Iron (Fe), Copper (Cu), Zinc (Zn), Lead (Pb), Arsenic (As), Cadmium (Cd), Aluminium (Al), Mercury (Hg), Manganese (Mn), Boron (B), Barium (Ba), Beryllium (Be), Cobalt (Co), Chromium (Cr), Nickel (Ni), Selenium (Se), Vanadium (V), at a NATA registered laboratory.

Table 13 - Groundwater Monitoring Program

Location	Parameters	Frequency
Coocooboonah Ck Alluvium Bores P1 and P2	Manual SWL, field pH, EC Detailed Analysis	Annual
Hoskinson Coal Seam Bore P3	Manual SWL, field pH, EC Detailed Analysis	Annual

Shallow Marine Facies and Melville Seam Bores P7 and P8	Manual SWL, field pH, EC Detailed Analysis	Annual
Potential Drawdown Bore intake above Hoskinsons Seam Bore 3709 Ivanhoe	Manual SWL, field pH, EC Detailed Analysis	Annual
Potential drawdown intake within Hoskinson seam Bores 22497 Coocooboonah and 44677 (and production bore) "Werona"	Manual SWL, field pH, EC Detailed Analysis	Annual
Potential drawdown intake beneath Hoskinson seam or within Melville seam Bores 44884 and 6249 "Lilydale"	Manual SWL, field pH, EC Detailed Analysis	Annual
Bores 27356, 45061, and 901460	Manual SWL, field pH, EC Detailed Analysis	Annual

5.5.2 Assessment and Reporting

Monitoring results obtained from the groundwater monitoring program are collated and assessed by NMPL personnel. Monitoring results are made available to the Community Consultative Committee. Monitoring results are also presented in the Annual Review.

6 GROUNDWATER CONTINGENCY PLAN

6.1 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. 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.

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

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 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 department as soon as practicable (within 7 days after becoming aware of the exceedance).
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 department (within 28 days 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).

6.3 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 (as soon as possible and within 7 days).
2. Where the complaint is potentially attributable to Sunnyside's mining operations, DP&E and any other relevant department are 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 Sunnyside operations, Sunnyside 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 and in accordance with Schedule 3 Condition 27(c) of PA 06_0308 MOD 1.
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.

6.4 Unforeseen Impacts

The potential for unforeseen impacts associated with the continued operation of the Sunnyside 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:

1. 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;
2. An investigation will be commissioned by suitably qualified persons to determine the nature and extent of the impact;
3. Relevant and appropriate ameliorative action measures will be developed based on the results of investigations into the impact;
4. Prepare an action plan in consultation with the appropriate regulatory agency; and
5. 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.

7 INCIDENTS AND COMPLAINTS

7.1 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.

7.2 Complaints

Whitehaven will handle any complaints in accordance with the requirements of the site EMS. 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.

8 DOCUMENT REVIEW AND CONTINUOUS IMPROVEMENT

This document will be reviewed in accordance with the requirements of Condition 5A Schedule 5 of PA 06_0308 MOD 1.

9 REFERENCES

ANZECC, 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

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