Sydney
Construction
Materials

Water Management Plan

Newnes Junction Sand & Kaolin Extraction Project

January 2011

SCM01-001

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICIES

1.0 INTRODUCTION

1.1 Background

Newnes-Kaolin Pty Ltd, trading as Sydney Construction Materials (SCM), proposes to develop an open pit operation to extract friable quartzose sandstone at Newnes Junction, on the Newnes Plateau approximately 10 km east of Lithgow (see **Figure 1**). SCM proposes to transport the sandstone off-site by rail for processing of the constituent minerals - kaolin and silica sand. Off-site processing will yield fully graded construction sand for the manufacture of ready mixed concrete, a range of high-purity silica specialty sands, and a range of refined kaolin products. The general layout of the operation is shown on **Figure 2**.

With total estimated reserves of over 20Mt, the pit life is expected to exceed 21 years. Approximately 1.1Mt per annum will be extracted on average, with a maximum expected of 1.4Mtpa. Areas adjacent to the quarry have been extensively quarried/mined for construction sands and coal.

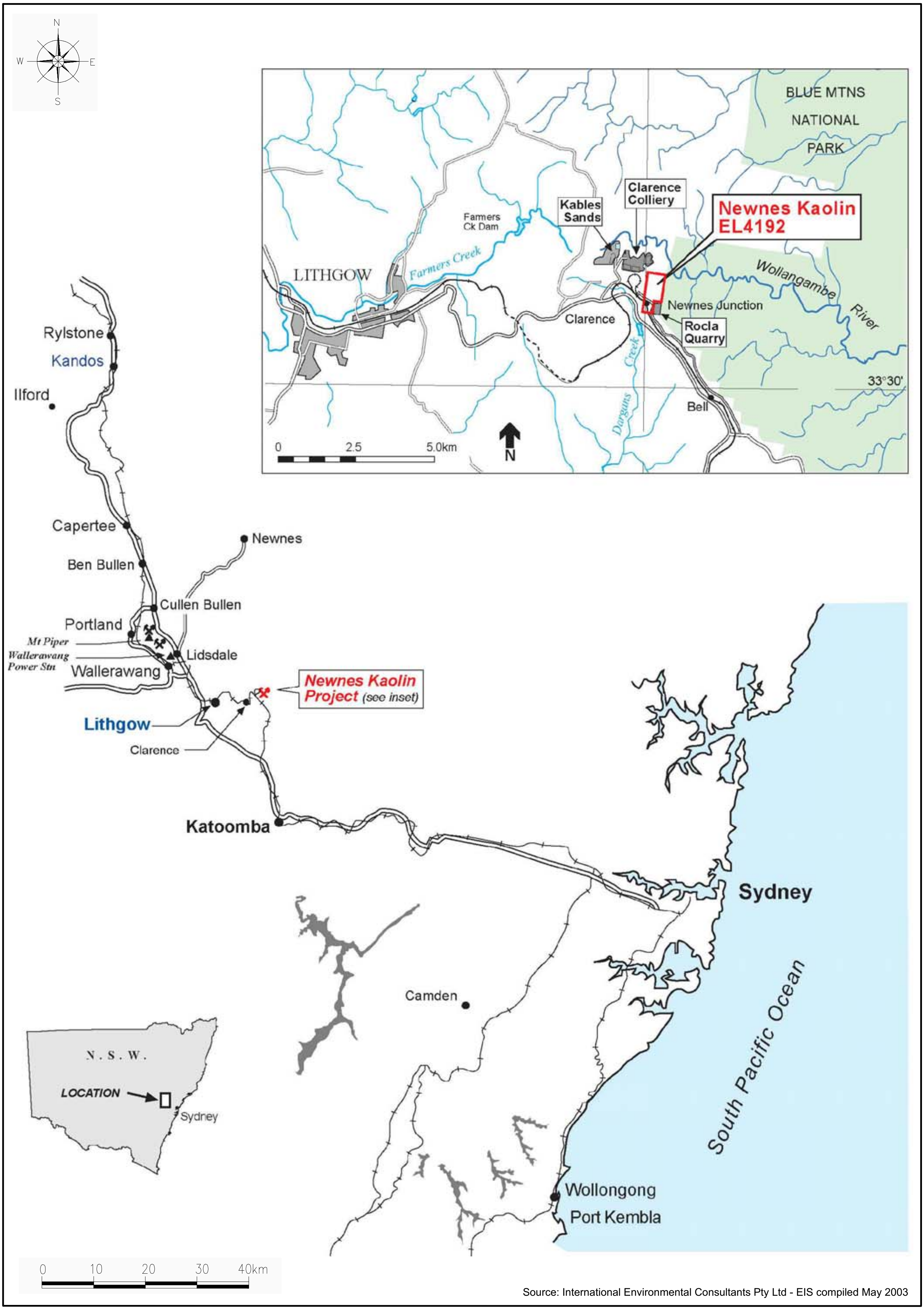
The quarry operation will be located on the ridgeline between the Rocla Quarry (adjacent to the south) and the Clarence Colliery pit top (adjacent to the northwest). The proposed disturbance area is approximately twenty five (25) hectares. Bordering the east of the site is the Blue Mountains National Park (BMNP), which is part of the Greater Blue Mountains World Heritage Area, containing the headwaters of the Wollangambe and Coli Rivers wilderness areas. The proximity to, and importance of, the BMNP has been a driver for conservative and sustainable water and soil management for the development. This resulted in the principle underlying design criteria set by SCM to protect potential receiving waters.

Development Consent for the proposed operation of a kaolin mining and sand quarrying operation was issued in 2006 under Section 80 of the *Environmental Planning and Assessment Act 1979*. The following Surface Water Assessment has been prepared to comply with Conditions 16 - 23 of the Development Consent (DA 329-7-2003 23).

1.2 Overview of Operations

The resource at the site comprises friable sandstone which breaks down readily into its constituent minerals, including kaolin, silica and for the most part, sand. The operation is an open cut sand/kaolin mining operation on a 25 hectare portion of the site. The project includes the following key components:

- Clearing of vegetation and removal and stockpiling of topsoil using bulldozers;
- Extracting up to 20.6 million tonnes of friable sandstone;
- Utilisation of a surface miner and self loading scrapers for material extraction and transport;
- Storage of extracted material in covered stockpiles;
- Dust suppression using watercarts;
- Delivery of the material to the Clarence rail loop for transport to Sydney for crushing and processing/kaolin recovery;
- Producing 1.4 million tonnes of extracted material a year, including up to 1.28 million tonnes (Mt) of sand and 119,000 Mt of kaolin a year (only sand will be produced for the first 5 years);
- Operating the mine/quarry for a period of approximately 20 years;
- Creation of an acoustic barrier between the operation and the township of Newnes Junction; and
- Progressively rehabilitating the pit benches, and ultimately rehabilitating the open cut void to form a free draining wetland.

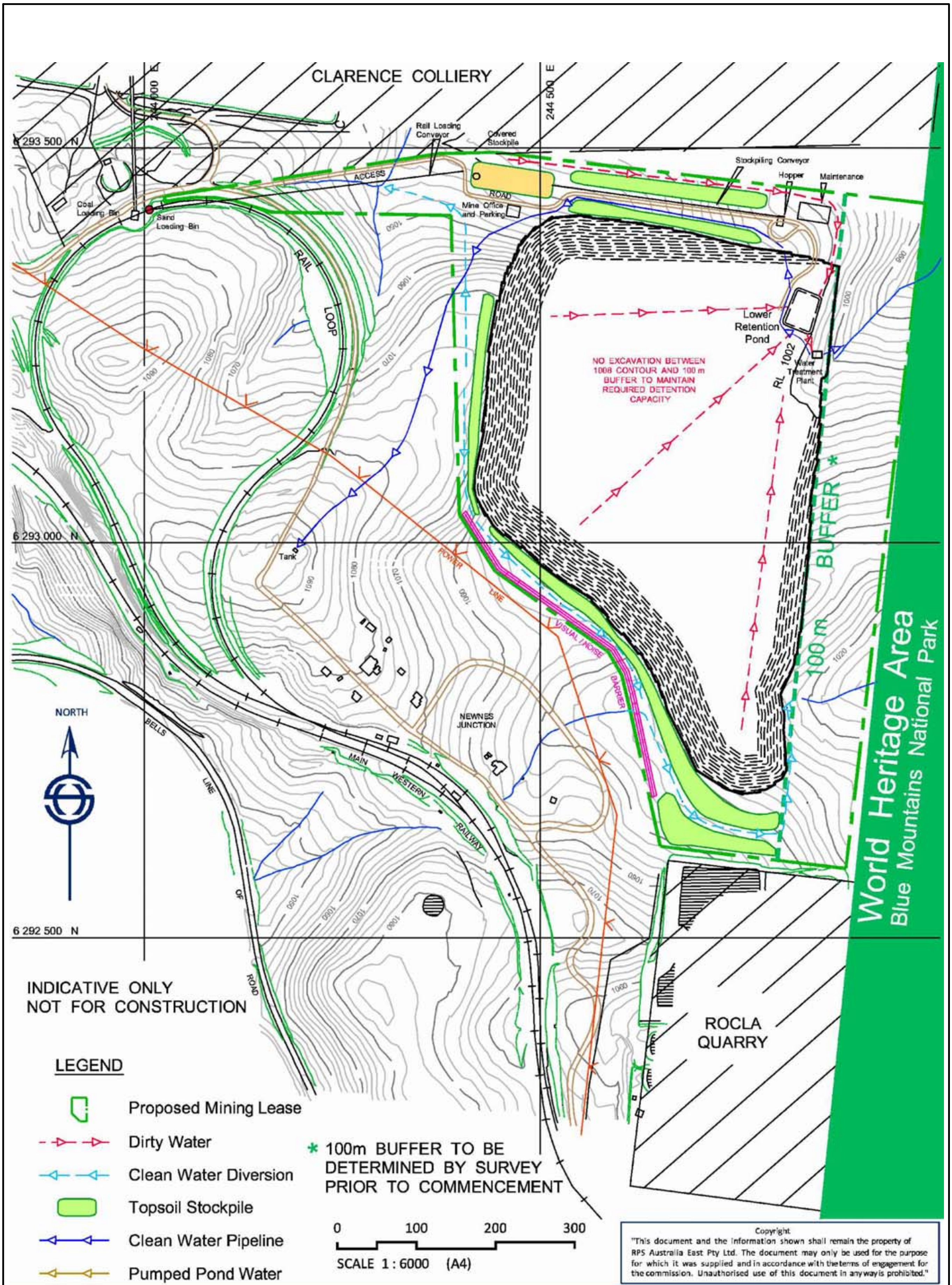


Source: International Environmental Consultants Pty Ltd - EIS compiled May 2003

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Regional Locality Plan

Figure 1



Source: RPS Group December 2010

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Site Layout

Figure 2

From the Clarence Colliery rail loop, the raw material is transported by rail to an industrial site in the Greater Sydney Metropolitan Area for crushing, processing and recovery of products including building sand, specialty sands, gravels and kaolin.

1.3 Purpose & Objectives

The Water Management Plan (WMP) for the project has been prepared to guide the management of water resources through the construction and operational life of the project, including through site rehabilitation. The WMP has been prepared in accordance with Development Consent Conditions 16 to 23. The WMP contains the following key items to address specific Development Consent requirements:

- a Water Balance (see **Section 4**) to address Condition 19;
- a Soil and Water Management Plan (see **Section 5**) to address Condition 20;
- a Surface Water Monitoring Program (see **Section 6**) to address Condition 21; and
- A Groundwater Monitoring Program (see **Section 7** and **Appendix A**) to address Condition 22.

The principal objectives of the WMP are as follows.

- To ensure the segregation of "dirty" water from "clean" water, where "dirty" water is defined as that which has passed over disturbed or contaminated surfaces (and therefore likely to have elevated concentrations of parameters such as suspended solids) and "clean" water is that which flows onto the quarry operations and is directed away from disturbed surfaces, Dirty water will be directed to and detained in sediment basins prior to re-use or treatment. There will be no uncontrolled discharge of dirty water from the site during operational and rehabilitation phases of the project. Dirty water would be preferentially reused onsite for operational activity. A water treatment plant would be constructed as part of the Project to process dirty water once the water level within the sediment basins exceed the design capacity. This processed 'clean' water would be either transferred via pipeline to a storage tank located on the hilltop to the west of the pit (for supply to the local village) or discharged to adjacent drainage lines in accordance with the conditions of the yet to be issued EPL. This water would be preferentially transferred to the water storage tank.
- To divert clean water around the site by clean water diversion channels;
- To maximise the reuse of water for dust suppression purposes and minimise the necessity to harvest run-on water;
- To minimise erosion and sedimentation from all active and rehabilitated areas of the project site;
- To monitor the effectiveness of surface water controls and to ensure all relevant surface quality criteria are met.
- The groundwater monitoring program (Aquaterra, 2010) has been prepared for inclusion within the overall WMP and has been prepared in accordance with environmental condition 22, stipulated in Section 3 of the Project Approval under Section 75J of the Environmental Planning and Assessment Act 1979. The principle objectives of the groundwater monitoring program are as follows:
    - To monitor the impacts of the project upon regional groundwater levels and quality;
    - To monitor the impacts of the Project upon the groundwater supply of potentially affected landowners;
    - To monitor the impacts on groundwater dependant ecosystems and riparian vegetation; and
    - To monitor the impacts on baseflow in downstream water bodies.

2.0 REGULATORY REQUIREMENTS

2.1 Development Consent

Table 1 provides a list of the Development Consent conditions that relate to water management of the site, and identifies where they have been addressed within this document

Table 1 - Development Consent Requirements

<table>
<tr><th>Item</th><th>Details of Requirements</th><th>Location in document where addressed</th></tr>
<tr><td>Groundwater and Surface Water Licensing</td><td>The Applicant is required to obtain licences and permits for the development under the Protection of the Environment Operations Act 1997 and the Water Act 1912.</td><td>2.2</td></tr>
<tr><td>Water Discharges and Limits</td><td>16. The Applicant shall design and maintain its water management system to retain on site at least the 1 in 100 year 72 hour storm event for all disturbed areas of the site, at all stages of the development.

17. The Applicant shall ensure that all water discharges from the site do not exceed the criteria in Table 7: 4 Incorporates DEC GTA 9

Table 7: Water discharge impact assessment criteria
<table>
<tr><th>Pollutant</th><th>100 Percentile Concentration Limit</th></tr>
<tr><td>Total suspended solids</td><td>15 mg/L</td></tr>
<tr><td>Biological oxygen demand</td><td>20 mg/L</td></tr>
<tr><td>Oil and grease</td><td>10 mg/L</td></tr>
</table>

Note: In addition to these criteria, the Applicant is required to ensure that any discharge complies with the requirements of the Clean Waters Regulation 1972, including the requirements of the Prescribed Classes of Waters and the restricted substance concentration limits in schedule 2 of that Regulation.</td><td>5.3

5.5

N/A – the Clean Waters Regulation Act was repealed by the POEO Act with all relevant legislation contained therein.</td></tr>
<tr><td>Monitoring and Management</td><td>18. Prior to carrying out any development, the Applicant shall prepare and subsequently implement a Water Management Plan for the development, to the satisfaction of the Director-General, the DNR, the DEC and the DEH. This plan must be prepared by a suitably qualified hydrogeologist and hydrologist whose appointment/s have been approved by the Director-General, and shall include:

a) a Water Balance;
b) a Soil and Water Management Plan;
c) a Surface Water Monitoring Program; and
d) a Groundwater Monitoring Program.</td><td>4
5
6
7 (and Appendix A)</td></tr>
</table>

	19. The Water Balance shall: a) include details of all water extracted (including water make), dewatered, transferred, used and/or discharged by the development; and b) describe measures to minimise water use by the development.	5.2 4.6
	20. The Soil and Water Management Plan shall: a) be consistent with the requirements of the Department of Housing's *Managing Urban Stormwater: Soils and Construction* manual; b) describe the location, function, and capacity of soil and water management and control structures during construction, stabilisation and operational stages; c) identify construction and operational activities that could cause soil erosion and generate sediment; d) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters; e) define procedures for managing water releases from the site; and f) define procedures for the maintenance of soil and water management structures over time.	5.2 5.3 5.1 5.3 & 5.4 5.4 5.5.9
	21. The Surface Water Monitoring Program shall include: a) detailed baseline data on surface water flows and quality in waterbodies that could potentially be impacted by the development, including the Wollangambe River and its tributaries; b) surface water and stream health impact assessment criteria; c) a program to monitor surface water flows and quality; d) a program to monitor water releases from the site; e) a program to monitor bank and bed stability; and f) a protocol for the investigation, notification and mitigation of identified exceedances of the surface water and stream health assessment criteria.	3.1 6.2 6.3 6.3 6.4 8.2
	22. The Groundwater Monitoring Program shall include: a) detailed baseline data on ground water levels and quality, based on statistical analysis, to benchmark the pre-mining natural variation in groundwater levels, yield and quality; b) groundwater impact assessment criteria; c) a program to monitor: • regional groundwater levels and quality; • impacts on the groundwater supply of potentially affected landowners; • impacts on base-flow in downstream water bodies; • impacts on groundwater dependent ecosystems and riparian vegetation; and d) a protocol for the investigation, notification and mitigation of identified exceedances of the groundwater impact assessment criteria. Incorporates DEC and DNR GTA 10	3.2 (and Appendix A) 7.1 (and Appendix A) 7.3 (and Appendix A) 8.2 (and Appendix A)
Reporting	23. Each year from the date of this consent, the Applicant shall:	

	a) review, and if necessary update, the Water Management Plan; and b) report the results of this review in the AEMR, including: • the results of monitoring; • details of the review for each sub-plan; • amendments to the sub-plans; and • details of the measures undertaken/proposed to address any identified issues.	8.1 8.1

2.2 Environment Protection Licence

While it is stipulated that there would be no uncontrolled discharge from the site whatsoever, controlled discharge of fully treated clean water to the adjacent ephemeral watercourse may be undertaken as part of the Project. Consequently, an Environmental Protection Licence (EPL) under the Protection of the *Environment Operations Act 1997* (POEO Act) will be required for the controlled discharge of treated water at the Project Site. At the time of issue of this WMP, SCM has not applied for an EPL. When an EPL has been issued for the Project Site, the relevant licence conditions will be incorporated into the WMP.

2.3 Relevant Legislation

A number of legislative requirements, government policies and guidelines relating to water management have been considered in the preparation of this WMP. The key items of legislation are as follows:

2.3.1 The Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is relevant to the Project as it contains requirements relating to the prevention of the pollution of waters. In this regard the discharge of water from the Project Site will need to be controlled to an agreed standard to reduce the potential for pollution of the receiving waters. The Proponent does not have an existing EPL and will be required to apply for one under the POEO Act for the discharge of water from site.

2.3.2 The Water Act 1912 and Water Management Act 2000

The Water Act 1912 and the Water Management Act 2000 (WM Act) contain provisions for the licensing of water capture and use. Under the WM Act, consideration must be made as to whether any dams proposed as part of site water management require licensing. There are currently no ‘clean’ water dams proposed for the Project as all clean water would be diverted around the Project Site. There are ‘dirty’ water dams proposed for the purpose of erosion and sediment control, however these are exempt from the licensing requirements as they are specifically for use as pollution control dams.

2.3.3 The Environment Protection and Biodiversity Conservation Act 1999

Approval has been granted under the *Environment Protection and Biodiversity Conservation Act 1999* for the project. The key conditions of the approval which are relevant to the preparation and implementation of this WMP are:

2. *The person taking the action must submit for the Minister's approval a plan to monitor and mitigate the impacts of water discharges on the GBM WHA. The plan must include:*

    a. *the description of a water management system to retain on-site at least a 1 in 500 years 72 hour storm event for all disturbed areas of the site at all stages in development;*

    b. *a water quality program to monitor and control water releases from the site such that water is treated and not released unless it is at ANZEEC Code Standards;*

    c. *an incident reporting schedule to report any breach of the water management system with details of; immediate action to be taken; notification to the Department of the Environment and Heritage (DEH) within 24 hours; and a report to DEH with 7 days;*

    d. *methods to minirnise soil erosion;*

    e. *the development and implementation of a monitoring program including performance criteria against which the effectiveness of this plan can be measured; and* *f. a process to review and report on this plan.*

The above conditions have been fully addressed within this document. At present the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) is responsible for the implementation of the *Environment Protection and Biodiversity Conservation Act 1999*.

2.4 Guidelines

Key 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; and

- 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.

3.0 EXISTING WATER QUALITY AND KEY ISSUES

There are no major permanent water courses through the site, however, two minor ephemeral creeks occur on the site. Both of these creeks form part of the upper tributaries of the Wollangambe River, which flows into the Colo River.

The hill and ridge system that contains the site forms part of a catchment that generally drains eastward into the BMNP and the headwaters of the Wollangambe River (feeding into the Colo River and Hawkesbury River system). The Colo River, and its tributaries (including the Wollangambe River), have been recognised as “wild and scenic” rivers under section 61 of the *National Parks and Wildlife Act, 1974* (DECCW, 2009). These rivers are important in that they are of significant conservation value, and are popular recreational areas.

Consequently, the water quality for controlled discharges would need to meet the ANZECC default trigger values for slightly disturbed upland streams for physical stressors and the ANZECC *95% Protection of Species* trigger values for toxicants. As detailed by the ANZECC guidelines, background water quality data would be utilised to guide the application of appropriate trigger values.

Existing groundwater levels were determined to be between 2 m and 25 m from the ground surface within the project site (IEC, 2003). When the mining operation intersects the groundwater table, groundwater flow would be directed into the pit and be incorporated into the dirty water treatment system. As such the relevant assessment criteria are considered to be those applicable to surface waters (ANZECC 95% protection of aquatic ecosystems)

The water quality criteria for surface water are discussed in **Section 3.1**, and the criteria for groundwater are discussed in **Section 3.2.**

3.1 Surface Water Quality

As defined in the preliminary Environmental Impact Statement (EIS) (International Environmental Consultants Pty Ltd (IEC Pty Ltd), 2003) for the project site. Water quality within the upper reaches of the Wollangambe River (into which site waters flow) is primarily controlled by runoff from:

- Vacant Crown Land;
- Industrial areas within the catchment, including Clearance Colliery and Rocla Quarry. These sites have controlled discharges into the Wollangambe system and water management systems in place to minimise their impact;
- The Main Western Railway at the top of the ridge; and
- The township of Newnes Junction including dirt roads, septic systems and cleared areas.

Existing water quality in the Wollangambe River is generally good, naturally low in pH (4.5 to 5.5), iron, manganese and suspended solids, as shown in **Table 2**. This data has been adapted from the EIS for the project (International Environmental Consultants Pty Ltd., 2003).

Table 2 - Background Surface Water Quality for Wollangambe (International Environmental Consultants Pty Ltd., 2003).

Parameter	Units	Sampling Location	
		Wollangambe River Upstream of Newnes Kaolin	Wollangambe River Downstream of Newnes Kaolin
Calcium mg/L	mg/L	1.3	0.8
Chloride mg/L	mg/L	9.0	6.0
Specific Conductance	µS/cm	31	27
Iron (total)	mg/L	0.06	0.39
Iron (filterable)	mg/L	<0.05	<0.05
Potassium	mg/L	0.9	1.4
Langelier Saturation	--	-6.7	-6.9
Magnesium	mg/L	0.7	0.4
Manganese (total)	mg/L	<0.05	<0.05
Manganese (filterable)	mg/L	<0.05	<0.05
Sodium	mg/L	4.8	2.9
pH	--	4.5	4.5
Total Sulfur (as SO_4)	mg/L	3.7	2.3
Total Dissolved Solids	mg/L	20	15
Total Hardness (as $CaCO_3$)	mg/L	6.1	3.6
Acidity			
to pH 3.7 (as $CaCO_3$)	mg/L	<1	<1
to pH 8.3 (as $CaC0_3$	mg/L	4	4
Alkalinity			
CO_3 (as $CaCO_3$)	mg/L	<1	<1
HCO_3 (as $CaCO_3$)	mg/L	2	2
OH (as $CaCO_3$)	mg/L	<1	<1

Additional background water quality samples were collected by ALS/ACIRL (Lithgow office) on the 8th July 2010. Samples were taken from the ephemeral watercourses proposed to be disturbed by the project at locations downstream from the Project Site. During the site visit, ALS/ACIRL also inspected the upstream reach of the southern ephemeral drainage line (South Drain U/S) with the intention of obtaining a water quality sample however; there was no flow in the upstream reach of this drainage line and sampling was not possible. The results from this sampling are presented in **Table 3** with the location of these sampling points discussed in **Section 7** as part of the ongoing surface water monitoring program.

Table 3 - Background Surface Water Quality for Ephemeral Streams.

Parameter	Units	Sampling Location			
		South Watercourse D/S (SW1)		North Watercourse D/S (SW2)	
		Total	Dissolved*	Total	Dissolved*
pH	--	5.85	--	5.33	--
EC	uS/cm	25	--	26	--
TSS	mg/L	4	--	4	--
Oil & Grease	mg/L	<5	--	<5	--
BOD	mg/L	<2	--	<2	--
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001
Beryllium	mg/L	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.006	0.072	0.052	0.008
Cadmium	mg/L	<0.0001	<0.0001	0.0002	<0.0001
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.002	0.038	0.062	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001
Nickel	mg/L	<0.001	0.002	0.001	<0.001
Lead	mg/L	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.008	0.032	0.059	0.009
Manganese	mg/L	0.016	0.009	0.004	0.004
Iron	mg/L	0.06	<0.05	<0.05	<0.05
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
* Applicable to metals only					

The data in **Table 2** and **Table 3** forms the baseline data for characterisation of existing water quality within drainage lines which may be impacted by the proposed development. Based on the locality of the Project Site and the potential impacts that may be associated with the Project, it is considered that the data presented in **Table 3** should be used as the primary baseline data for measuring the potential impacts of the development and that future water quality monitoring should be undertaken at the same sampling locations as discussed in **Section 6**.

3.2 Groundwater

An assessment of hydrogeology for the site was undertaken as part of the EIS process (refer section 6.4.8 of the EIS (IEC, 2003)), which considered both hydraulic and water quality issues and potential impacts. The assessment report for the proposed development, issued by the Department of Planning, identified that the original EIS contained insufficient Hydrogeological information and required further information on flow and water quality impacts in the Wollangambe River.

Consequently, a supplementary groundwater assessment was undertaken to adequately define groundwater quality within the proposed development site to a level acceptable to the Department of Planning (Kalf and Associates and the Water Research Laboratory UNSW, December 2004).

Additional groundwater quality samples were taken by Aquaterra in June 2010 to further characterise the quality of groundwater in the vicinity of the Project Site.

3.2.1 Preliminary Groundwater Data

The EIS detailed groundwater onsite to occur in both primary and secondary structures in the Triassic sandstone geology being supplied entirely by infiltration and recharge to a shallow groundwater system in the upper sandstone. This aquifer is distinct from additional and much deeper aquifer zones beyond 100-200m and more within the underlying Permian coal measure strata. Varying depths to ground water can be expected across the site ranging from 2m to 25m below ground surface (bgs). These depths are consistent with seepages in the lower lying gullies that cross the western boundary of the site. In summary, the predominant groundwater flow occurs in an easterly to north-easterly direction with some groundwater being re-directed towards the Rocla sand quarry to the south. Beyond the main western railway line groundwater flow would be generally in a south-westerly direction toward Dargans Creek. Expected groundwater quality was inferred from sampling of groundwater seepage within the existing Rocla Quarry, as presented in **Table 4**.

Table 4 - Preliminary Groundwater Quality (IEC, 2003)

Parameter/Analyte	Units	Sampling Location		Fresh Groundwater**
		Ponded Groundwater Sample 1*	Ponded Groundwater Sample 2*	
Calcium	mg/L	5.0	1.9	1.9
Chloride	mg/L	11.0	11.0	10.0
Specific Conductance	µS/cm	60	30	35
Iron (filterable)	mg/L	<0.05	<0.05	<0.05
Potassium	mg/L	1.5	1.4	0.9
Langelier Saturation	-	-0.4	-5.3	-0.6
Magnesium	mg/L	0.7	0.4	1.1
Manganese	mg/L	0.11	0.09	0.06
Sodium	mg/L	9.0	3.7	5.4
pH	-	9.2	5.3	4.6
Total Sulphur (as SO4)	mg/L	3.6	1.8	8.7
Total Dissolved Solids (TDS)	mg/L	40	20	20
Total Hardness (as CaCO3)	mg/L	15.5	6.6	9.2
Total Suspended Soilds (TSS)	mg/L	10	27	1350
Acidity				
to pH 3.7 (as $CaCO_3$)	mg/L	<1	<1	<1
to pH 8.3 (as $CaCO_3$)	mg/L	<1	4	20
Alkalinity				
CO3 (as $CaCO_3$)	mg/L	4	<1	<1
HCO3 (as $CaCO_3$)	mg/L	17	6	6
OH (as $CaCO_3$)	mg/L	<1	<1	<1

* Ponded groundwater samples were taken from abandoned tailings dams within the adjacent Rocla quarry pit.
** Fresh groundwater sample was collected from a surface seep at the base of the quarry wall within the Rocla Quarry

The EIS details existing groundwater quality from the shallow aquifer system in the area is variable, but generally very good with low to moderate salinity, low dissolved solids, generally low metals (with the exception of slightly elevated manganese which will require removal to meet discharge criteria), and variable pH typical of 'soft' water. The material to be quarried at the site was detailed to be well above the aquifer used for domestic water supply to Clarence Village as well as a commercial bottled drinking water company. Expected groundwater quality is shown in **Table 5** below.

3.2.2 Additional Groundwater Quality Data

Subsequent to the submission of the EIS in 2003, additional groundwater quality data was obtained through a field investigation and drilling program initiated and completed in November 2004 by Kalf and Associates and the Water Research Laboratory of UNSW. The drilling program, at three sites around the periphery of the proposed development, included the construction of two bores at each site, one shallow and one deep. The sites were designated as the North-West (NW), North-East (NE) and Southern bore (piezometer) sites. For the purposs of this report, these sites have been labelled GW1, GW2 and GW3 respectively. Shallow bores were drilled to approximately 18 m depth while the deep bores were drilled to approximately 54 – 60 metres depth and water quality samples were obtained at each location. All bores produced very little groundwater make during the drilling process. Results of this groundwater sampling are presented in **Table 5**.

Table 5 - Additional groundwater quality data (Kalf & Associates and Water Research Department UNSW, November 2004)

Parameter	Units	Sampling Locations		
		NW60 (GW1A)	NE60 (GW2A)	S54 (GW3A)
Temperature	^0C	15.3	17.1	16.5
pH	--	4.1	4.4	6.2
EC	uS/cm	30.6	40.5	150
Ca	mg/L	<1	<1	25
Mg	mg/L	<1	<1	<1
Na	mg/L	9	10	11
K	mg/L	<1	<1	9
SO4	mg/L	<1	<1	8
Cl	mg/L	11	12	15
Fe	mg/L	<0.01	1.09	0.02
Mn	mg/L	0.02	0.08	0.05
Total Cations	--	0.47	0.54	2.03
Total Anions	--	0.32	0.34	1.86
Anion/Cation difference	--	0.15	0.2	0.17
Alkalinity (as $CaCO_3$)	mg/L	<1	<1	64

The results indicate that groundwater was generally of very low salinity and was acidic. Groundwater chemistry was similar for NW60 (GW1A) and NE60 (GW2A) piezometers, but S60 (GW3A) groundwater was dominated by a high alkalinity and consequently, higher EC and pH. A maximum iron concentration of 1.1 mg/L observed in NE60 (GW2A) may be attributed to drill casing lost down the hole, since iron concentrations of <0.02 mg/L were observed in the other bores.

This data compares well with the expected groundwater quality presented in **Table 4**.

3.2.3 Sampling by Aquaterra (June 2010)

Supplementary groundwater samples were obtained in June 2010 by Aquaterra from within the monitoring bores established by Kalf and Associates in 2004. Samples were taken from within the shallow and deep bores for the Northeast (NE(GW2)), Northwest (NW(GW1)) and Southern (S(GW3)) bore groups.

Results of this monitoring data are presented in **Table 6.**

Table 6 - Groundwater Quality Data (Aquaterra, 2010)

Parameter	Units	Sampling Locations					
		NW60 (GW1A)	NW17.5 (GW1B)	NE60 (GW2A)	NE17.5 (GW2B)	S54 (GW3A)	S17.5 (GW3B)
pH*	--	5.1	4.75	5.17	4.65	5.45	5.31
EC*	uS/cm	32.9	NS	39.2	NS	48.6	NS
TDS*	mg/L	31	216	30	176	45	41
Ca	mg/L	<1	<1	<1	<1	2	3
Mg	mg/L	<1	<1	<1	<1	<1	<1
Na	mg/L	3	3	3	3	5	5
K	mg/L	<1	<1	<1	<1	<1	<1
SO4	mg/L	<0.50	0.61	0.71	1.17	<0.50	0.97
Cl	mg/L	4.48	4.21	5.85	6.04	4.95	6.88
Fe	mg/L	0.10	6.82	<0.05	9.72	0.61	0.19
Mn	mg/L	0.008	0.011	0.021	0.095	0.008	0.009
Total Cations	--	0.13	0.12	0.15	0.15	0.3	0.37
Total Anions	--	0.2	0.17	0.18	0.19	0.28	0.46
Alkalinity (as $CaCO_3$)	mg/L	4	2	<1	<1	7	12

It is proposed to install a new piezometer, W (GW4A) about 550 m to the west of the proposed pit which will measure groundwater levels outside the zone of predicted drawdown. At the time of writing this report W(GW4A) was not yet installed and groundwater quality data from W (GW4A) was not available.

3.2.4 Assessment of Groundwater Quality

The following assessment of groundwater quality data has been adapted from the most recent groundwater assessment (Aquaterra, 2010) and provides a review of all groundwater monitoring to date.

Salinity

Groundwater salinity is generally very low, ranging from 31 – 216 mg/L. These values are consistent with groundwater salinities determined from other nearby sources, viz:

- Pit seepages obtained from the neighbouring Rocla Quarry revealed a salinity range from 20 – 40 mg/L (Kalf & Associates, 2004); and
- Existing licensed bores west of the site, which classified groundwater salinities as being fresh (i.e. <500 mg/L)

The low EC values and low Cl^- ion values (4 – 7 mg/L) are attributed to high rainfall recharge and potentially low residence times.

pH

pH ranges from 4 – 6 in all samples and is expected in environments with fresh rainfall signatures and aquifers with low carbonate content.

Dissolved Metals

Comparison of the analysis for dissolved metals against ANZECC guideline values for the 95% protection of species (ANZECC, 2000), shows a small number of exceedances of the guidelines values , listed as follows:

- The copper guideline value of 0.0014 mg/L was exceeded in NW17.5 (0.02mg/L) and NE17 (0.002 mg/L)
- The zinc guideline value of 0.008 mg/L was exceeded in NW17.5 (0.028 mg/L)

Dissolved iron concentrations were relatively high in NE17.5 and NW17.5 (6.8 – 9.7 mg/L, compared to the other groundwater samples (<0.6 mg/L), although no ANZECC guideline value is set. This and other dissolved metal exceedances are consistent with the unbuffered status of groundwater sampled in the area.

Nutrients

Sampling for nutrients revealed concentrations for Total Nitrate that exceed the default trigger level (0.9 mg/L) for freshwater ecosystems (ANZECC, 2000) in piezometer S54 (1.84 mg/L).

Elevated levels of Total Phosphorus (TP) were measured in NW17.5 (0.53 mg/L) and NE17.5 (0.66 mg/L), whilst elevated levels of Total Nitrogen (TN) were measured in S54 (2.2 mg/L).

4.0 WATER BALANCE

In order to verify the performance of the proposed water management system, a daily water balance model was developed specifically for this site. The detail in this section is an extract of the information contained in the water balance prepared as part of the Surface Water Management Plan (Hughes Trueman, 2004). The model accounts for all the important water related processes occurring on the site including.

- Runoff from the disturbed area that contributes water to the retention pond,
- Rainfall onto, and evaporation from, the water surface in the retention pond,
- Extraction of water for dust suppression purposes,
- Pumping water for treatment and discharge once the water level in the retention pond was above the designated storage zone.

The water balance is based on the project stages described in **Section 5.3**

In the model, extraction of water for dust suppression was assessed on the basis of climatic conditions. Dust suppression watering was assumed to occur on all days except when cumulative rainfall exceeded evaporation. Using this method, the assessed annual volume of water required for dust suppression at the end of Stage 4 is 18.5 ML/year, which is slightly more than the average of 50,000 L/day (18 ML/year) documented in the EIS.

Pumping water for treatment and discharge was assumed to occur whenever the water level in the retention pond was above the designated storage zone. Treatment was assumed to occur at a rate of 1 ML/day.

4.1 Climatic Data

The following climatic data was obtained from the Bureau of Meteorology for use in the water balance analysis:

- **Rainfall**

Lithgow (Station number 63224)	1/4/1889 – 18/5/2005 (1/1/1940 – 31/5/1965) missing (88 years complete)

- **Pan Evaporation**

Bathurst Agricultural Research Station (63005)	1/1/1973 – 31/12/2003 (31 years)

Table 7 below summarises the monthly rainfall and evaporation data for the area. It can be seen that average rainfall is fairly uniformly distributed throughout the year, while evaporation, as expected, shows distinct summer dominance.

Table 7- Monthly and Annual Rainfall and Evaporation

Month	Rainfall (mm)				Evap
	Average	Percentile			Average
		10%	50%	90%	(mm)
1	92.9	25.4	79.8	176.4	181
2	84.3	12.1	65.6	175.3	133
3	85.1	22.1	68.8	155.8	124
4	63.9	11.6	50.6	128.7	86
5	65.1	18.1	46.8	131.2	60
6	67.4	17.5	53.3	145.4	51
7	67.9	15.0	51.3	140.3	56
8	62.9	15.9	46.6	116.5	77
9	59.4	20.4	53.5	104.7	99
10	67.2	19.5	58.9	133.6	137
11	69.6	18.0	65.4	139.2	154
12	75.6	18.6	65.2	143.6	178
Year	859	623	860	1,087	1,336

For water balance modelling purposes, the 30 year period 1973 to 2002 was adopted due to the fact that both rainfall and evaporation records were available for the whole period. In order to verify the fact that this period is representative of the longer term records a number of checks were carried out on the annual total rainfall as well as rainfall sequences from 1 day to 60 days duration. **Table 8** and **9** summarise the statistics for these two periods. For comparative purposes **Table 9** also includes the 50 and 100 year ARI rainfall estimates for Newnes Junction derived from the rainfall intensity:duration data contained in Volume 2 of *"Australian Rainfall & Runoff"* (1987) and the 500 year ARI which was estimated using the IFD calculation procedure in accordance with Book II of *Australian Rainfall & Runoff* (2001).

Table 8 - Highest Rainfall Years in the Lithgow Record

Year	Rainfall (mm)
1990	1363.1
1978	1345.0
1973	1296.5
1893	1266.0
1934	1229.9

Table 8 shows that three of the top five rainfall years at Lithgow are included in the period 1973 -2002 which has been adopted for water balance analysis.

Table 9 - Maximum Cumulative Rainfall (mm) over Consecutive Days

Days of	Historic Record		Australian Rainfall & Runoff		
Rainfall	1889-2004	1973-2002	50 year ARI	100 year ARI	500 year ARI
1	179	179	195	214	-
2	268	268	252	273	-
3	310	310	279	307	405
4	332	332	-	-	-
5	338	338	-	-	-
10	342	342	-	-	-
15	359	359	-	-	-
20	360	360	-	-	-
30	385	385	-	-	-
45	465	461	-	-	-
60	595	488	-	-	-

The data in **Table 9** shows two noteworthy features:

- The rainfall during the period 1973 – 2002 contains the highest periods of rainfall for durations up to 30 days that occurred in the whole historic record. Meaning that, the period 1973 – 2003 contains rainfall data that is representative of the wettest periods that have been recorded at Lithgow.
- For a three day rainfall event, the 1973 – 2004 historic record contains a sequence of wet days that are slightly above the three day 100 year ARI rainfall derived from "Australian Rainfall and Runoff". It follows that if the water management system can accommodate the runoff from the 1973 – 2002 historic rainfall sequence it could also cope with the 100 year ARI three day rainfall.
- The 500 year ARI rainfall exceeds any in the historic record, and a separate analysis needs to be undertaken to assess whether this can be retained on-site.

4.2 Stormwater Runoff

For runoff estimation purposes, a rainfall/runoff model developed by the CRC for Catchment Hydrology (Mudgway et al, 1997) has been adopted for this site. The advantage of this model is that it specifically accounts for variation in the impervious fraction of the catchment. The model results mimic the real world and exhibit a variation in the volumetric runoff coefficient depending on the daily rainfall, a small proportion of rainfall is converted into runoff in a low rainfall day and a high proportion on a very wet day. For modelling purposes, it has been assumed that the disturbed area catchment draining to the retention pond will act as though it was 90% impervious. With this degree of imperviousness, the model predicts a volumetric runoff coefficient of 0.85 for a rainfall of 100 mm/day. This is higher than the value of 0.80 adopted for determination of sediment zone capacity and indicates that the adopted model can be expected to generate large volumes of runoff from heavy storms that would test the ability of the water management system to store runoff without uncontrolled discharge.

4.3 Groundwater Seepage

In line with the findings of the groundwater study (Kalf & Associates 2003), the long term groundwater seepage into the pit has been taken to be 0.2 ML/day, of which it has been assumed that half would evaporate from the face of the high wall. For water balance modelling purposes, it has also been assumed that the seepage rate is approximately proportional to the area of the exposed high wall. Two scenarios for groundwater contribution have been assessed:

- Groundwater seepage is ignored (ie the most critical conditions for running short of water for dust suppression and vegetation establishment purposes).
- Groundwater seepage is included in the analysis (ie the most critical conditions where water levels in the retention ponds and pit are likely to be highest).

4.4 Water Balance Analysis

The water balance model has been run for the site preparation stage and all four stages of the extraction process, in order to assess the ability of the water management system to:

- Retain all runoff within the site and only allow discharge by means of pumped water for treatment;
- Provide a high degree of reliability for supply of water for dust suppression and vegetation establishment purposes.

For each stage of the project the catchment area included in the model includes the working extraction pit area, the high wall, the soil stockpile areas to the west of the pit and the haul road and conveyor area. A summary of the main statistics for each Stage of extraction is provided in **Table 10** for situations in which flow from groundwater seepage is ignored.

Table 10 - Summary of Performance of the Water Management System

Stage>	Prep	1	2	3	4
Catchment area (ha)	16.5	17.0	24.5	26.9	27.2
Effective percentage impervious	50%	90%	90%	90%	90%
Pan factor	0.85	0.85	0.85	0.85	0.85
Dust suppression area	1.5	3.0	3.0	3.0	3.0
Discharge treatment rate (ML/day)	1	1	1	1	1
Minimum storage for treatment to occur	12.6	16.8	17.5	18.0	18.0
Width of pit storage area (m)	50	150	280	350	350
Length of pit storage area (m)	300	400	400	400	600
Average runoff (ML/year)	38.8	61.0	87.9	96.5	97.4
Total pond volume (ML)	42	42	50	50	22.5
Water Consumed for Dust Suppression (ML/year)	9.3	18.6	18.5	18.5	18.5
Days per year watering for dust suppression occurs	124	124	125	125	125
Water treated for discharge (ML/year)	20.2	33.1	58.1	66.7	68.7
Days per year water treated for discharge	20.2	33.1	58.1	66.7	68.7
Maximum storage in record (ML)	44.4	52.8	76.6	85.8	87.5
Maximum storage area (ha)	1.45	3.08	4.69	5.42	8.90
Maximum water depth above pond (m)	0.48	0.77	1.17	1.35	1.48
Maximum days water level above pond level	5	14	29	37	74
Minimum storage in record (ML)	0	0	0	0	0.8
Average days empty per year	2.1	1.6	0.8	0.4	0.0
Note: The catchment areas and pit dimensions in this water balance are based on the extraction footprint approved under the Development Consent. The currently proposed footprint will be slightly smaller due to the 100 meter buffer zone required under the EPBC Act approval. However, GSSE considers that the water balance does not need to be updated at this time as it is sufficient to demonstrate the expected performance of the water management system.					

The summary statistics in **Table 10** show that for all stages the water management system has sufficient capacity to provide the estimated water required for dust suppression and vegetation establishment and that during all stages the total storage capacity of the site will be in excess of the rainfall (based on the 30 year period 1973 to 2002), which demonstrates that the site can retain rainfall runoff on-site and prevent uncontrolled discharge draining into the adjoining World Heritage Area for this rainfall.

The maximum in-pit water storage occurred in Stage 4 (maximum depth of ponded water above the edge of the retention pond would be about 1.5 m) corresponding to a maximum volume of excess stored water of about 65 ML. It is noted that it would take eight weeks of operation of the treatment plant to remove all water from the section of the working area that had been inundated (about 9 ha).

As noted in **Section 4.1** the 500 year ARI rainfall exceeds any in the historic record. The capacity of the project to retain this event is discussed in **Section 4.7**.

4.5 Annual re-calculation of water balance

The Annual Environmental Management Report (AEMR) provides for an annual re-calculation of the water balance. The AEMR will review all water extracted, transferred, used and/or discharged off site. This Water Balance will be updated following submission of the AEMR to reflect any changes in the water balance identified in the review process.

4.6 Measures to minimize water use of the development

The water balance developed for the site by Hughes Trueman (2004) indicated that during all stages of mining the development will have sufficient water stored to provide the estimated water required for operational activities. As such, water demand will be satisfied by dirty water runoff generated onsite even during extended periods of dry weather and it is not anticipated that an application for a groundwater extraction licence, nor clean water capture will be required.

The proposed design of the extraction pit suggests that water used on the site for dust suppression will essentially be used within a closed system such that water dispersed for dust suppression across the site would theoretically drain back to the main Retention Pond, minus evaporative losses. Product stockpiles cannot be actively sprayed and will instead be covered to reduce water needs for dust suppression. In addition, product extraction will involve ripping and primary crushing with secondary crushing and processing undertaken offsite. As such, there will be limited water use associated with product extraction and primary processing.

As detailed in the EIS, should the site run low on water during periods of extended dry weather, additional water will be trucked in from offsite to accommodate the needs of the operation. Based on the results of the site water balance such measures are not anticipated.

4.7 On-Site Retention of Extreme Storm Events

The water balance results in **Section 4.4** demonstrate that the water management system has sufficient capacity to retain rainfall runoff on-site for the historical rainfall (based on the 30 year period 1973 to 2002) which also demonstrates capacity to retain to 100 year ARI event.

The capacity of the project to retain 500 year ARI rainfall has been separately assessed by GSSE and is documented within the letter report contained in **Appendix C**. It should be noted that the pit volumes used in the assessment are based on a revised pit layout which maintained a 100 m buffer to the World Heritage Area, and also included a reduced excavation footprint in the north-east corner of site which enabled an effective bund (i.e. low wall) to be maintained along the entire eastern boundary and a significant increase in pit volume retention for Stage 4.

Based on the results of the above investigations, the water management system proposed (in conjunction with the revised pit layout) is sufficient to fully contain the runoff from a 1 in 500 year 72 hour rainfall event for all stages in development. A comparison of runoff and total storages available is shown in **Table 11**. The results show that in all stages the total available storage exceeds the runoff volume.

Table 11 - Comparison Between Storage Volume and 500 year ARI 72 Hour Design Storm Volume

Development Stage	Total Available Storage (Pit, Lower Retention Pond and Main Retention Pond) ML	Runoff Volume (500yr ARI 72hr) ML
Prep	36.9	33.4
1	103.2	62.0
2	178.0	82.0
3	240.0	88.9
4	821.5	88.9

5.0 SOIL AND WATER MANAGEMENT PLAN

The purpose of the following Soil and Water Management Plan (SWMP) section is as follows:

- to describe the location, function, and capacity of soil and water management and control structures during construction, stabilisation and operational stages;
- to identify construction and operational activities that could cause soil erosion and generate sediment;
- to describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;
- to define procedures for managing water releases from the site; and
- to define procedures for the maintenance of soil and water management structures over time.

5.1 Potential Impacts of the Development

There are a number of activities commonly associated with open cut mining which can potentially impact upon the quality and quantity of surface water flow within the surrounding environment. IEC (2003) identify two key disturbed areas for which dirty water runoff requires to be controlled. The first contains the mine and internal access roads from the crusher to the various mine benches. The second consists of the stockpile and infrastructure areas.

The following aspects of the proposed development have been identified as having potential to impact upon surface water quality and quantity within and surrounding the Project Site.

Construction Phase

- Construction of access and haul roads;
- Excavation for the installation of the crushing facility;
- Preparation for siting of buildings;
- Compaction of building sites;
- Preparation of footings for conveyor;
- Building erection and fitout;
- Installation of plant and equipment;
- Erection of conveyor system; and
- Commissioning of plant and equipment.

Operation and Decommissioning

- Product extraction activities including ripping, excavating and pushing;
- Overburden/topsoil extraction and emplacement;
- Stockpiling and processing activities;
- Product loadout and transportation;
- Decommissioning and removal of site infrastructure; and

- Machinery maintenance activities.

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

- Elevated turbidity within surface water runoff;
- Entrainment of clay fines within surface water runoff;
- Elevated mineral and nutrient content in surface water runoff;
- Elevated salinity within surface water runoff;
- Elevated levels of hydrocarbon associated with the maintenance area;
- Changes in clean water flows reporting to surrounding watercourses; and
- Altered hydrologic regime.

5.2 Objectives of the SWMP

Given the significant sensitivity of the site's soils to erosion processes and the sensitivity of the potential receiving waters of the National Park, the principal objective of soil and water management for the project is to ensure that there is no uncontrolled discharge of water from the site whatsoever, and that the controlled water quality leaving the site meets the appropriate quality standards. This objective is intrinsic to erosion and sedimentation designs and controls for the project which have been designed in accordance with the Blue Book Volume 1 and 2.

The principle design aspect of the development to achieve this goal is the use of accurate surface miner machinery to create *infall* benches to drain all dirty water into the pit only and eliminate out-of-pit runoff. Dirty water is then processed through primary and secondary retention ponds for settling of coarse sediments prior to transfer to a tertiary water treatment plant that will remove fine suspensions of sediment to a quality suitable for controlled release into the creeks leaving the site into the BMNP. The design of the retention system and the onsite pit-storage capacity has been designed to more than withstand the rainfall of the 100 year ARI, 72 hour duration (3 day) storm event and ensure no uncontrolled offsite discharge in such an event. Exposed slopes are not planned between the quarry pit and the National Park to further reduce potential for runoff and erosion issues.

This extensive level of sediment treatment and control is complimented by a number of minor erosion and sediment controls and management processes to minimise the amount of sediment entering the dirty water system and hence requiring treatment. This will be achieved by implementing the following controls:

- Conducting best practice land clearing procedures for all proposed disturbance areas;
- Separating *undisturbed* runoff from *disturbed* runoff where possible to minimise and isolate the amount of disturbed or "dirty water" runoff;
- Directing sediment-laden runoff into designated sediment control retention ponds and the water treatment plant;
- Diverting "clean water" runoff unaffected by the operations upstream into natural depressions;
- Constructing the haul road and working pit face with effective surface drainage;
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments;
- Implementing an effective revegetation and maintenance program for the site; and
- Maintaining the proposed 50m buffer between the quarry pit and the National Park boundary.

5.3 Overview of Progressive Development & Water Management

An overview of the water management controls associated with each stage of development for the quarry is described in the sub-sections below. This is based on the Surface Water Management Plan for the site (Hughes Trueman, 2004). Further detail on the controls is contained in **Section 5.5**. The proposed site development and water management infrastructure for the various stages of site development are shown in **Figures 3 – 9.**

5.3.1 Site Preparation Stage

This stage will involve the establishment of the site infrastructure and the commencement of operations. The water management infrastructure proposed as part of Site Establishment are shown on **Figure 3**. Water management infrastructure to be implemented during site establishment include the following:

- Construction of a small in-pit retention pond to collect runoff from the working surface for transfer by pumping to the main retention pond located outside the pit;
- Construction of a main retention pond (32 ML) in a location and with sufficient capacity to subsequently serve Stage 1 of the extraction process;
- Construction of a lower retention pond (10 ML) located so as to collect runoff from the haul road and maintenance facility;
- Construction of a clean water diversion channel located on the ridge above the high wall. This diversion channel will convey clean runoff from the hillside above the pit into the creek channel located towards the southern end of the final pit extremity;
- Construction of a water treatment plant capable of treating 1 ML/day to a suitable standard for discharge to the BMNP and for use in the village of Newnes Junction;
- Construction of a pipeline from the treatment plant to a storage tank located on the hilltop to the west of the pit. This tank will act as a reservoir for water supply to the village; and
- Construction of a collection drain along the 1032 m contour to divert runoff from the hillside into the main retention pond for provision of water for dust suppression during the early stages of quarry development.

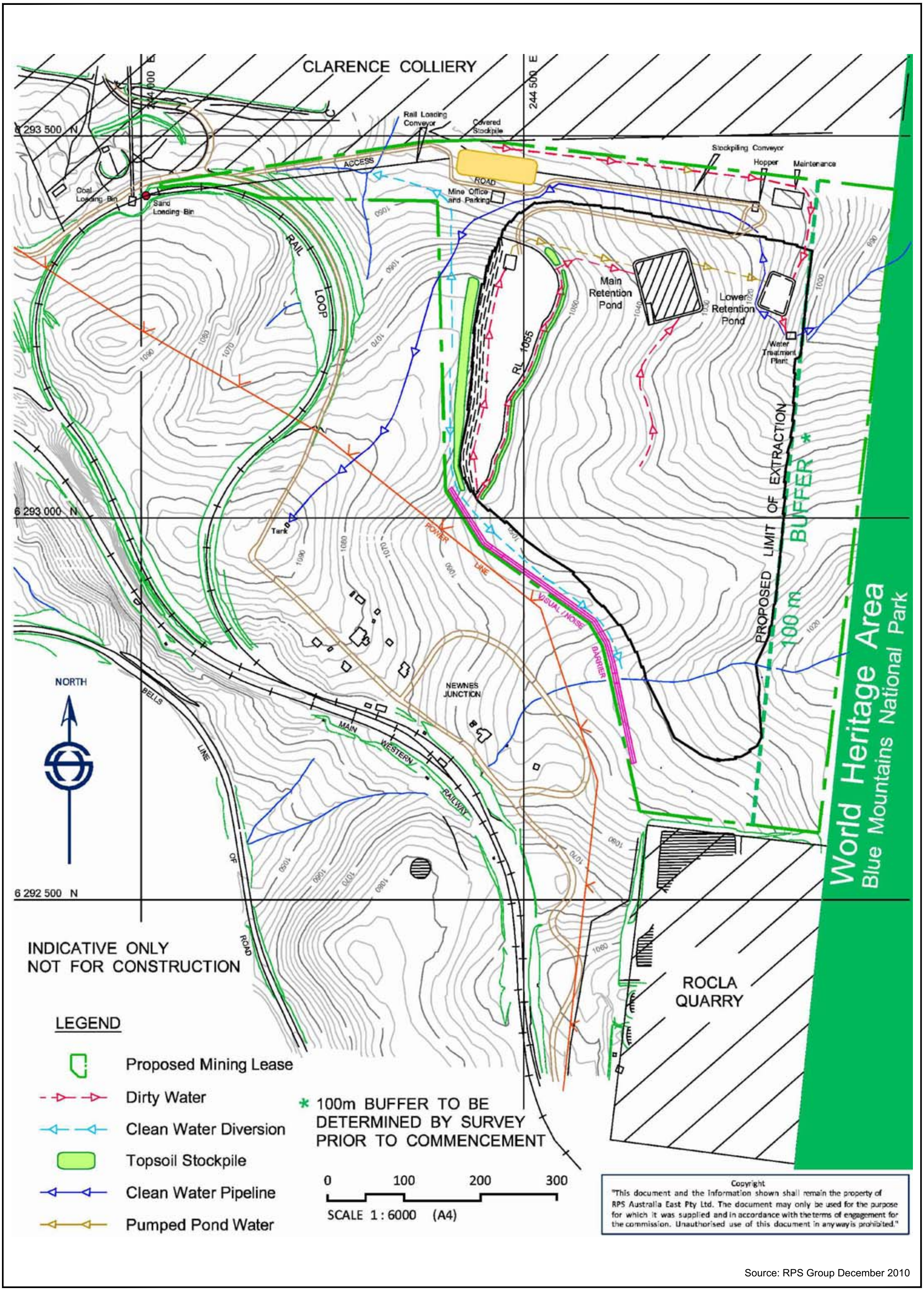
5.3.2 Stage One

Stage 1 will involve the downward excavation of the working area as product is extracted and the consequent expansion of the excavation area. During this stage, the water management system will remain essentially the same as for the Site Preparation Stage. The main difference will be an increase in the available storage capacity within the excavation pit to retain runoff from extreme storms. The proposed layout and water management infrastructure to be implemented during Stage 1 of the development is shown in **Figure 4**.

The proposed extraction method creates a series of windrows of excavated material as the surface miner passes over the pit floor. These windrows are then collected by a scraper which delivers the material to the stockpiling area. This process essentially creates a series of absorption banks on the leading edge of the pit. The banks will reduce runoff velocity during rainfall. They will be constructed along the contour (essentially north to south) and therefore perpendicular to the natural flow of water (east to west). The windrows will act as "contour banks" that will reduce slope lengths of uninterrupted slope and hence reduce the erosion capacity of overland flow. This will reduce the erosion potential within the working area and reduce the overall solids loading entering the retention ponds.

The main retention pond will be retained at a total capacity of 32 ML and the lower retention pond will be retained at a total capacity of 10 ML.

Water will continue to be drawn from the lower retention pond for dust suppression and treatment as described for the Site Preparation Stage. Similarly, water will be transferred from the in-pit retention pond to the main retention pond except when there is a risk of overflow from the main retention pond. When water level rises above the design storage zone level in the main retention pond, water will be pumped for treatment and discharge to restore the water level to the designated storage level as soon as practical after a storm.



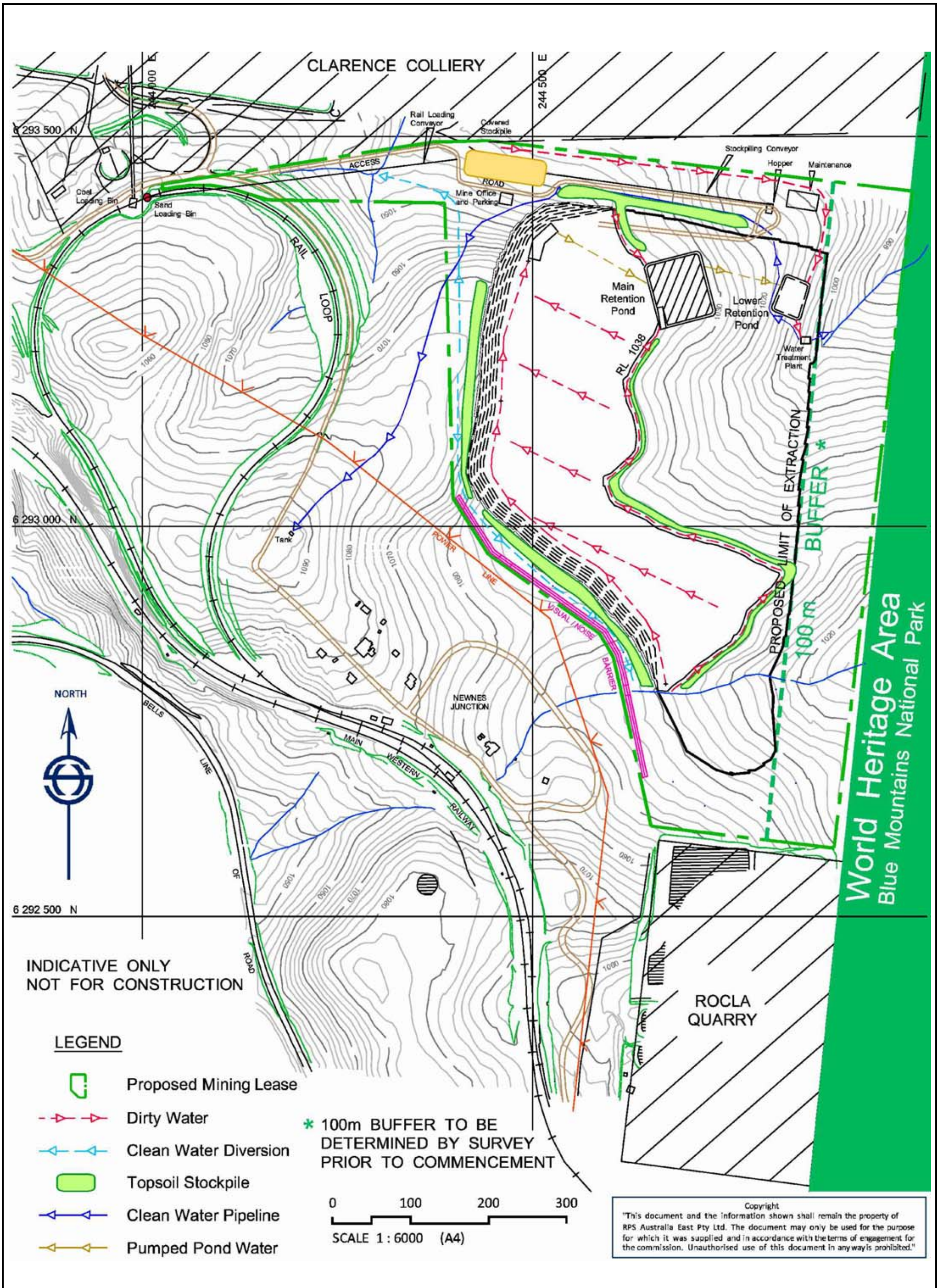
Source: RPS Group December 2010

To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Quarry Development - Site Preparation

FIGURE 3



Source: RPS Group December 2010

To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Quarry Development
- End of Stage 1 Excavation

FIGURE 4

5.3.3 Stage Two

At the completion of Stage 2, the working area will have expanded to about 18 ha. The proposed layout and water management infrastructure to be implemented during stage 2 of the project are presented in **Figure 5**. This stage will involve the following alterations to the water management facilities:

- Construction of a new main retention pond (45 ML capacity) in the north western corner of the excavation; and
- Extension of the clean water diversion channel around the southern end of the pit and then linking back to the southern creek that drains to the BMNP.

The enlargement of the excavation area will provide increased in-pit water storage capacity.

The main retention pond will continue to be operated in a manner that seeks to restore the water level to the design storage level as soon as practicable after a storm.

The leading edge windrowed topsoil system will continue throughout this stage to prevent sediment leaving the site.

5.3.4 Stage Three

The main change to occur between the end of Stage 2 and the end of Stage 3 will be a further lowering of the working area and a corresponding increase in the excavation area. The water management facilities will remain the same as for Stage 2. The total available water storage within the pit will be increased. The proposed layout and water management infrastructure to be implemented during stage 3 of the project are presented in **Figure 6**.

5.3.5 Stage Four

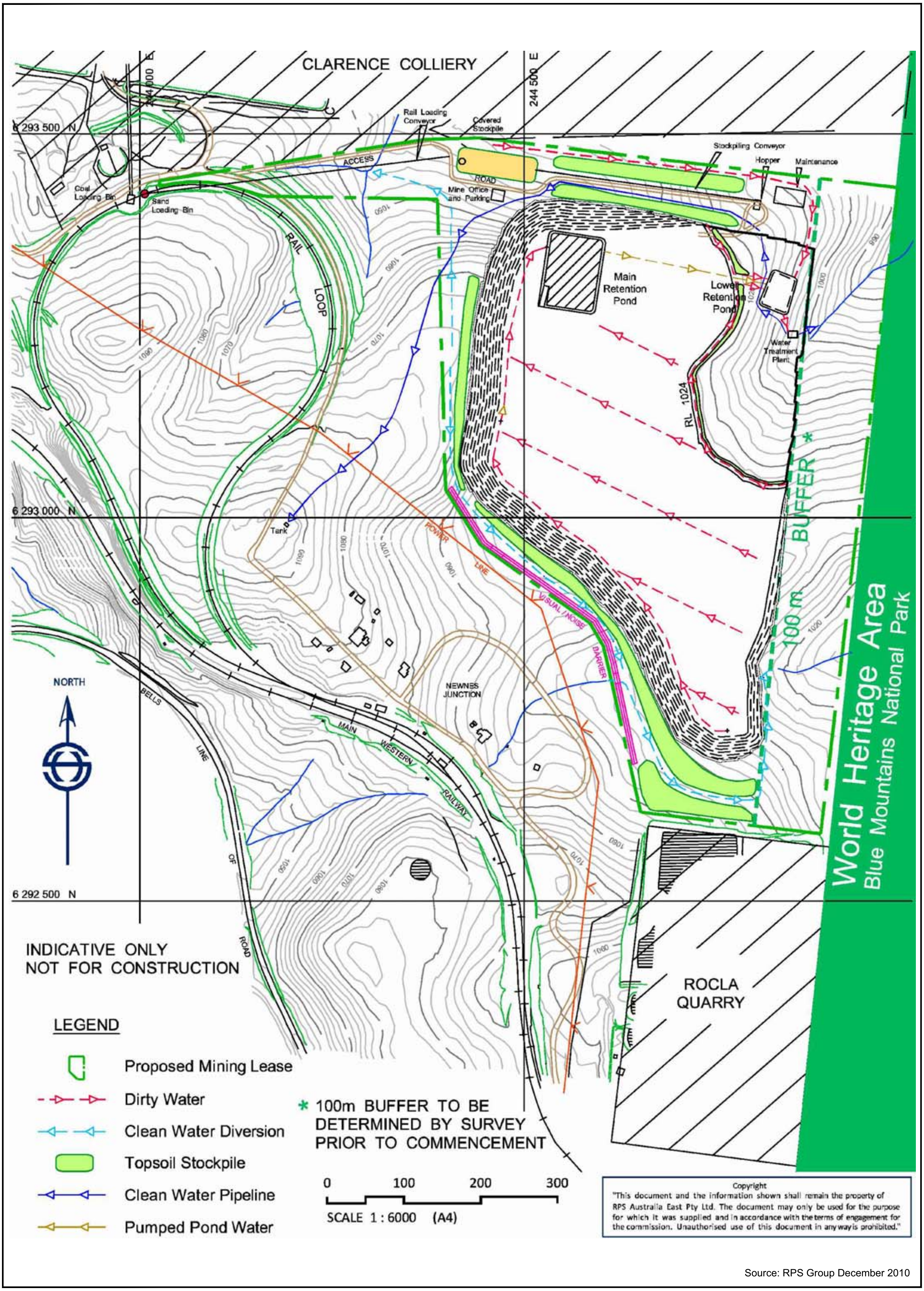
During Stage 4 the extent of the pit will not increase significantly. The main changes will be the lowering of the base of the pit and the gradual reworking of the slope of the floor so that, by the end of Stage 4, the pit will slope towards the north eastern corner in preparation for final rehabilitation and the provision of a free draining outlet from the site after rehabilitation is complete. In order to preserve sufficient in-pit water storage capacity to retain all runoff from exceptionally heavy storms, material in the north-east corner of site will not be excavated which enables an effective bund (i.e. low wall) to be maintained along the entire eastern boundary. The proposed layout and water management infrastructure to be implemented during stage 4 of the project are presented in **Figure 7**.

The main changes in the water management system during Stage 4 will be:

- The pre-existing low level retention pond on the eastern side of the pit will be enlarged to provide sufficient capacity (22.5 ML) to meet the water supply requirements;
- For this final stage of operations only, and in order to minimise any backfilling required of the retention pond prior to rehabilitation of the site, no separate provision will be made for a sediment settlement zone within the retention pond. Any water in excess of the water storage requirements will be allowed to pond in the pit. While this may cause some interruption to mining operations, it will only affect a small area of the pit in the lowest portion. The ability of the treatment plant to treat and discharge 1 ML/day will allow normal operations to be restored rapidly;
- Drainage from the stockpiling conveyor and maintenance facilities will continue to be directed into the enlarged retention pond;
- As the surface level is gradually altered to slope towards the east, the former main retention pond will be subsumed as the extraction of material occurs from the area surrounding the retention pond;
- All water for dust suppression and treatment will be sourced from the remaining retention pond.

5.3.6 Rehabilitation and Final Landform

The Rehabilitation and Landscape Management Plan (RLMP) has been prepared by GSSE in conjunction with this SWA and is presented under separate cover. As described in the RLMP the topography of the final landform will consist of a large number of small, stepped sandstone benches formed in an amphitheatre configuration around the final void. Until such time that extraction has ceased, rehabilitation will occur around the perimeter of the pit only along the sandstone benches, and will not involve the pit floor. The quarry benches would be constructed with infall drainage and direct flow to engineered drop structures.



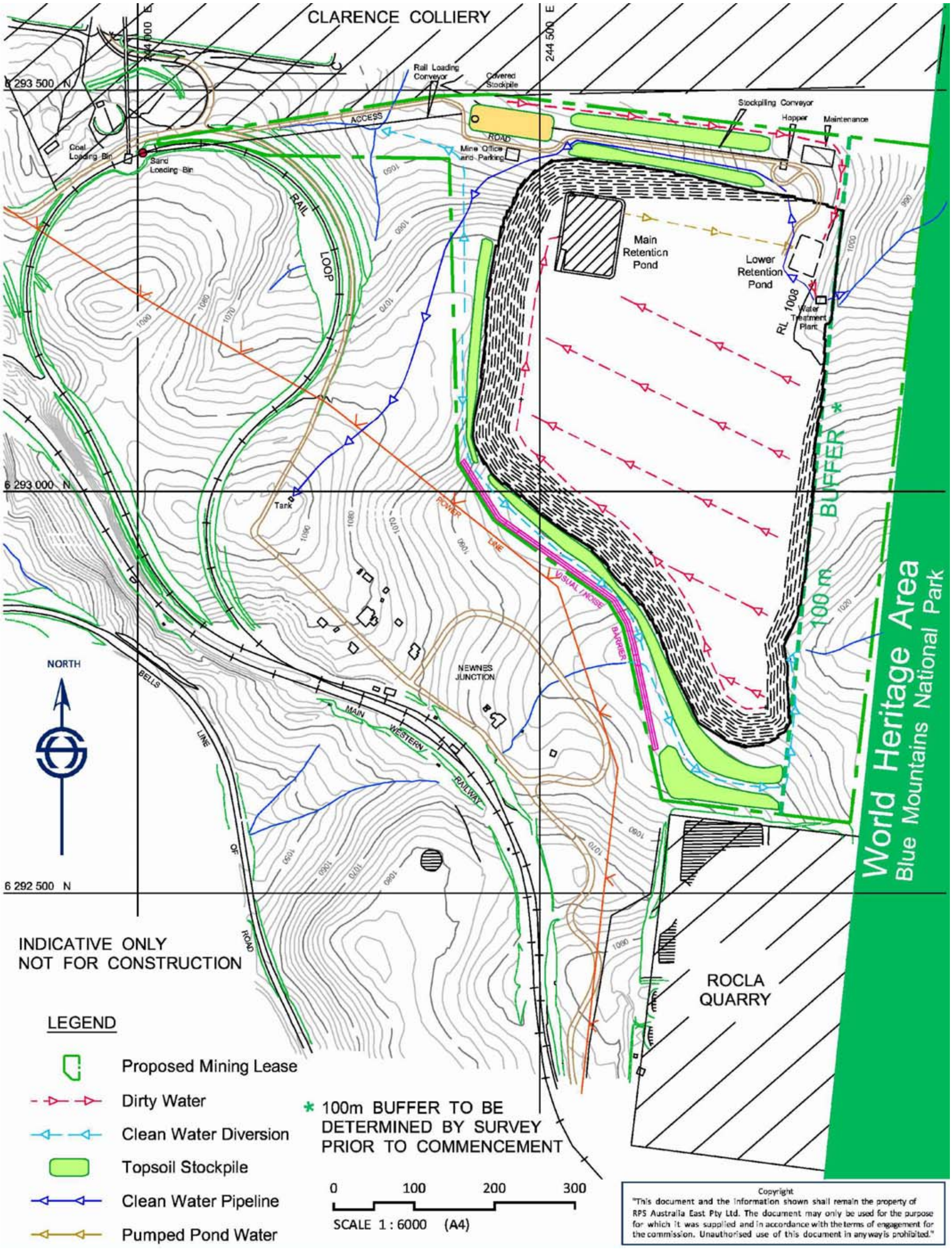
Source: RPS Group December 2010

To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Quarry Development - End of Stage 2 Excavation

FIGURE 5



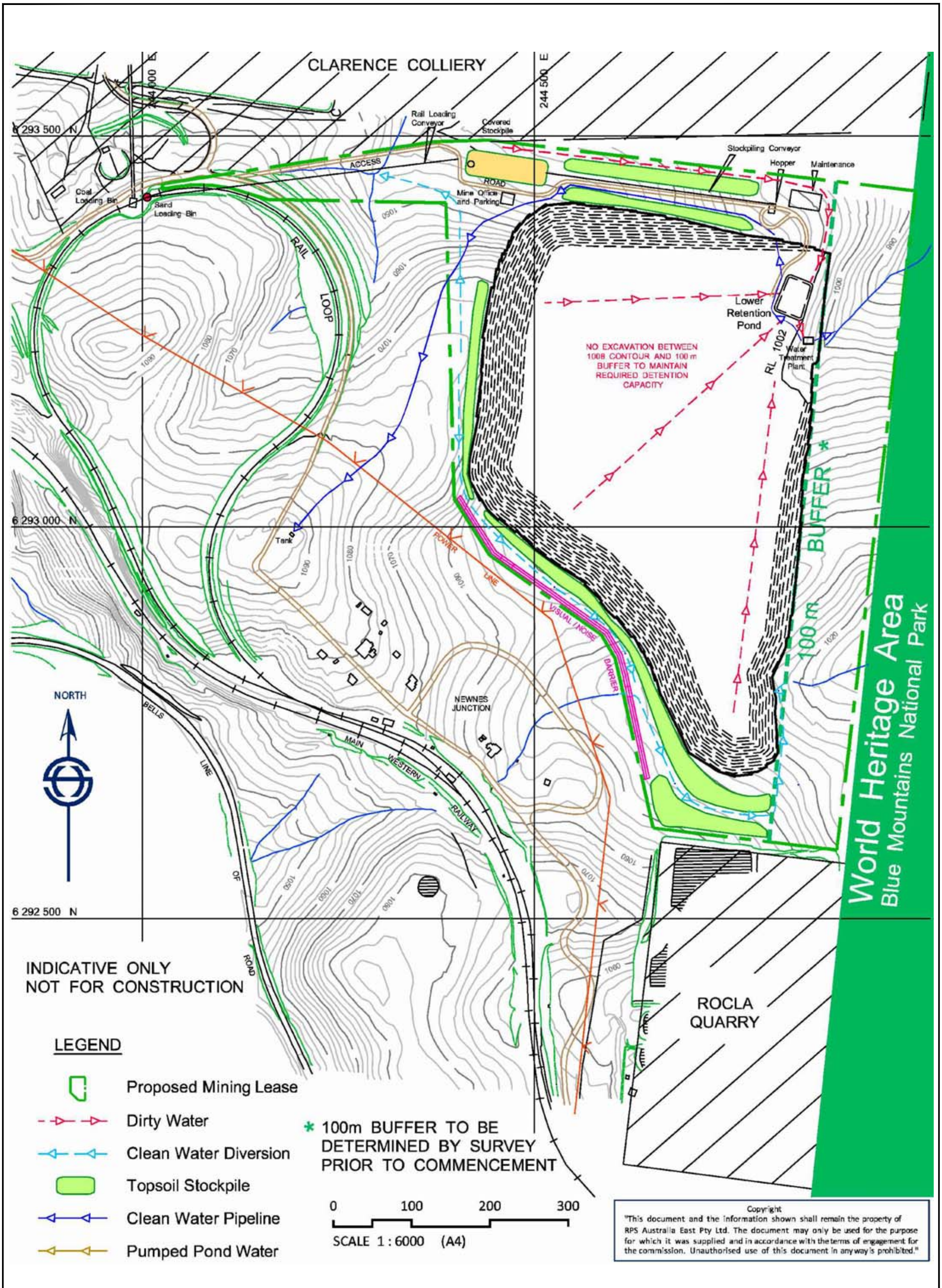
Source: RPS Group December 2010

To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Quarry Development
- End of Stage 3 Excavation

FIGURE 6



Source: RPS Group December 2010

To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Quarry Development
- End of Stage 4 Excavation

FIGURE 7

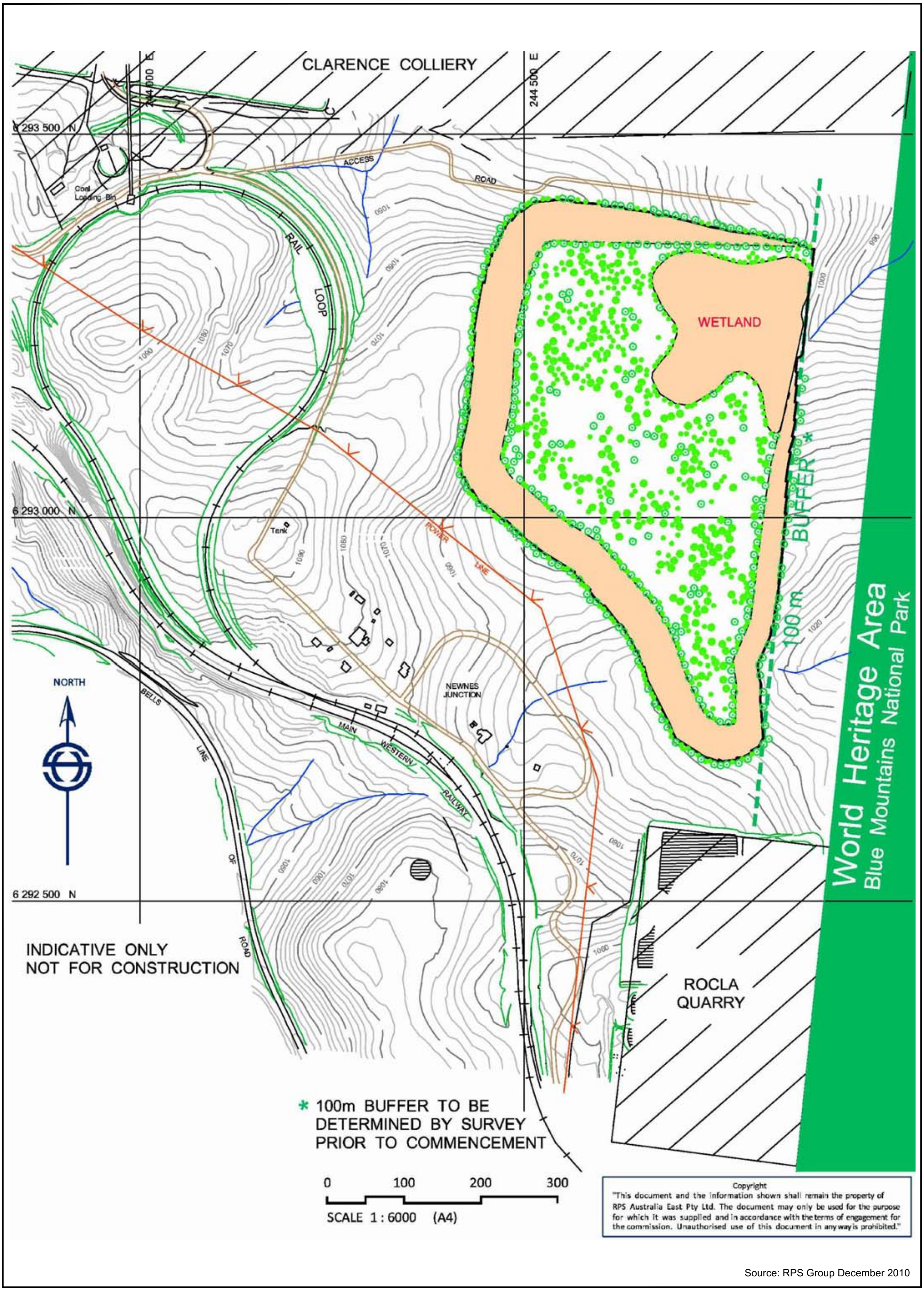
The base of the pit will be graded to be a free draining landform with all disturbed areas to be topsoiled and revegetated. The pit floor will be vegetated with appropriate native species to create a stable, free draining wetland. The wetland will be formed as a shallow depression with the low point in the location of the final retention pond in the north east corner of the pit (see **Figure 8**).

As described in the Quarry Plan (MineConsult, 2004), the quarry design enables all water flows on completion of quarrying to be contained within the quarry void. When the final rehabilitation is complete, and vegetation well established and the final landform stable, it will be possible to construct a channel from the near quarry floor to the small creek channel in the north. Flow will therefore be re-established directly to the water course. Previously, no flows other than those discharged by the water treatment plant would have taken place.

5.4 Water Management Procedures

This section provides a broad summary of the water management procedures which will be adopted for the project. These procedures will be maintained throughout the life of the project with various changes and upgrades undertaken at key stages of the project as described in **Section 6.3**. The key water management procedures are as follows:

- Runoff collected in the small in-pit retention pond will be pumped to the main retention pond for storage and settlement of coarse sediments. The exception to this would be in the event of an extreme rainfall event when the main retention pond was approaching full capacity. Under these circumstances, water would be allowed to temporarily pond within the working area. Under no circumstances would sediment laden water from the working area be transferred to the main retention pond so as to cause an overflow of untreated water from the main retention pond.
- Full treatment of water to the appropriate level will be achieved through the use of both mechanical (settling) and chemical (flocculation) treatment. The primary mechanical treatment will occur within the in-pit sumps where the larger sand particles will be captured. Secondary mechanical treatment will occur in the retention ponds where finer particles will be captured.
- Water in the main retention pond will be retained and pumped as required to the lower retention pond and used for dust suppression purposes. If the capacity of the main retention pond rises above the design storage level, water would be pumped to the water treatment plant (via the lower retention pond) and treated to an appropriate level. Maintaining the water level in the retention ponds below the design level ensures that appropriate sediment settlement is allowed to occur.
- The slowest settling and most mobile particles would consist of the finest Kaolin clays which will be removed by chemical processes in the water treatment plant. A number of separate processes would be used to appropriately treat the dirty water. The chemical treatment process would include flocculation and coagulation to remove the finer kaolin clays.
- Additional processes, including pH adjustment and addition of an oxidising agent such as potassium permanganate would be used in conjunction with a filtration process to remove elevated manganese levels.
- The water treatment plant would be fully automated for both start up and operation. The treatment plant would be relocated during the early stages of mining, however the plant capacity would remain constant at approximately 1ML/day.
- Treated water from the water treatment plant would be preferentially transferred to a water storage tank on a hilltop to the west of the pit for water supply to the local village. Alternatively, treated water may be released to the adjacent ephemeral watercourse draining to the Wollangambe River. Where discharge is required, it would be undertaken in accordance with the conditions of a (yet to be issued) EPL.
- Where offsite discharge is required treated water would be discharged to the ephemeral watercourse via a rip rap lined channel. As described in **Section 7**, discharge of treated waters to the ephemeral watercourse would trigger monitoring which would be undertaken in accordance with the conditions of the (yet to be issued) EPL for the mine. This monitoring data would be supplemented by ambient water quality monitoring undertaken as part of the project.
- Runoff from the haul road and conveyor will be collected in the lower retention pond. As such, water from the lower retention pond will be given first priority for reuse for dust suppression or



Source: RPS Group December 2010

To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Quarry Development - Final Rehabilitation

FIGURE 8

treatment with treated water either discharged (to the adjacent ephemeral water course) or reused (transferred to the water storage tank). The decision to reuse or discharge treated water will be based on site requirements at the time.

5.5 Soil and Water Controls

A number of soil and water management measures and controls are proposed to be implemented throughout the project to assist in water management for the Project. The location of these water management measures during various stages of the project are shown in Figures 3 – 8. A schematic of the proposed water management measures in presented in **Figure 9**.

5.5.1 Minimal Disturbance

Land disturbance will be minimised by clearing the smallest practical area of land for the shortest possible times. This will be achieved by:

- limiting the cleared width to that required to accommodate excavation within the quarry area and haul road corridor; and
- programming the works so that only the areas which are actively being excavated are cleared, therefore limiting the time the areas are exposed and limiting the potential for erosion and sedimentation.

General vegetation clearing and soil stripping will not be undertaken until earthwork operations are ready to commence and all proposed erosion and sediment control measures are implemented. All operations will be planned to ensure that there is no damage to any trees and pasture areas outside the limits to be cleared.

5.5.2 Management of Soil Stockpiles

A number of soil stockpiles will be established around the western and northern edges of the pit. Both open and covered stockpiles will be utilised where relevant to operations. Due to material characteristics, handling requirements require the main resource stockpile (of around total 12,000t split into two areas of premium and standard grade product) located to the north of the site near the loader to be fully covered by a protective roof over the entire stockpile area.

Stockpiles will be protected with sediment fencing and planted with a sterile cover crop (annual species) to ensure stabilisation. Surface drainage in the vicinity of the stockpiles will be configured so as to direct any runoff into the pit. As previously outlined, the surface of the pit is designed to control all runoff as infall to the dirty water management system (ponds and treatment plant), with no uncontrolled discharge from the pit.

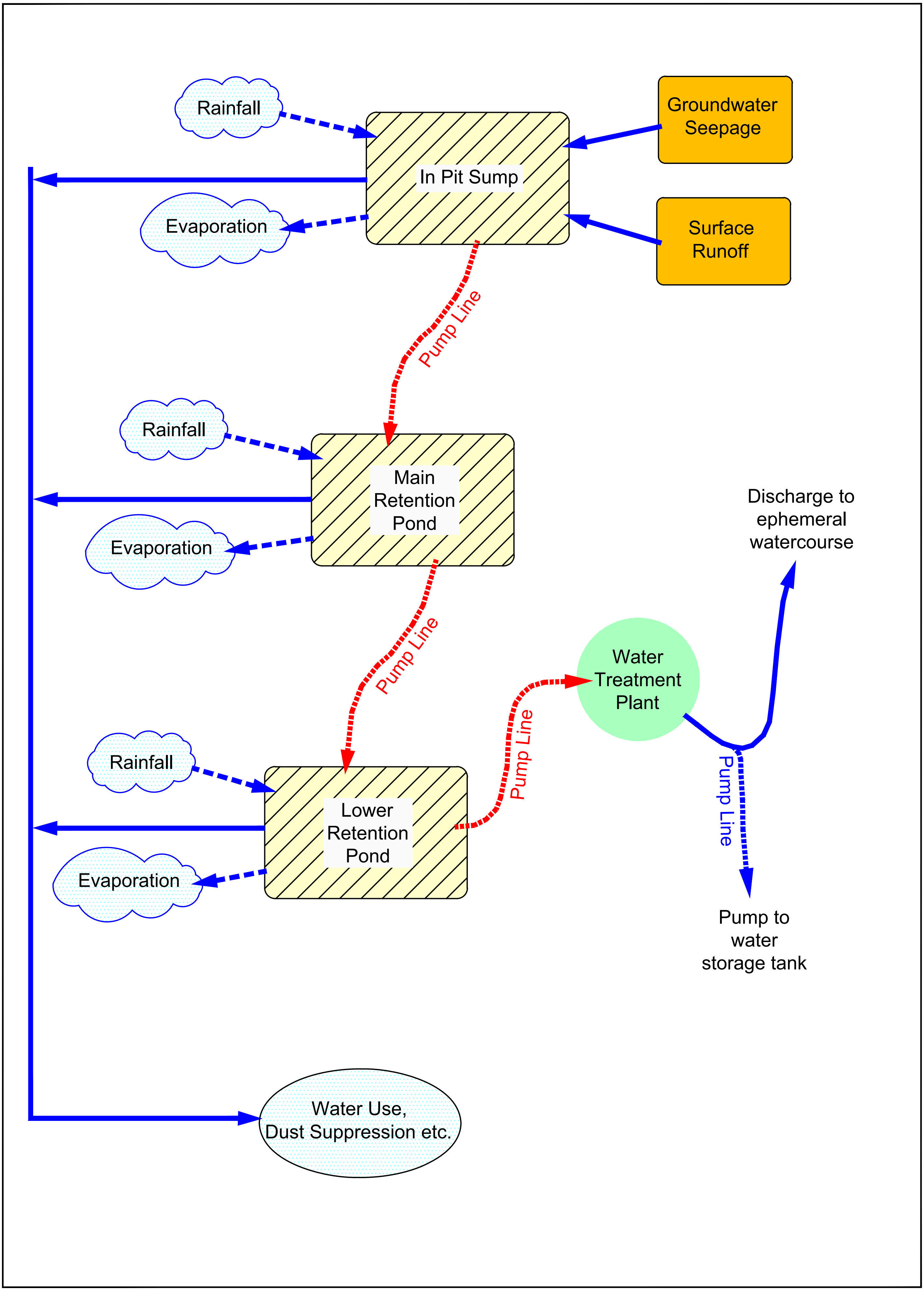
Topsoil stripping within the disturbed area will be undertaken when the soil is in a slightly moist condition thus reducing damage to soil structure. The soil materials will not be stripped in either a dry or wet condition. Stripped material will be placed directly onto the disturbed areas and spread immediately if excavation sequences, equipment scheduling and weather conditions permit.

If longer term stockpiling (i.e. greater than 6 months) is required, a maximum stockpile depth of two (2) metres will be maintained to preserve viability and reduce soil deterioration. Soil stockpiles will be sown with the sterile cover crop (annual species).

Where the stockpile is not wholly contained within the “closed loop” water management system, temporary sediment control measures such as sand bags and silt fences will be used to prevent sediment from leaving the area. Stockpiles will be placed in areas so as to avoid impediment of natural localized drainage lines and minimise the likelihood of water ponding against the stockpile.

Topsoil will be re-spread in the reverse sequence to its removal, so that the organic layer, containing any seed or vegetation, is returned to the surface. Topsoil will be spread to a minimum depth of 50 mm on 3:1 or steeper slopes and to a minimum depth of 100 mm on flatter slopes. Re-spreading on the contour will aid runoff control and increases moisture retention for subsequent plant growth.

Re-spread topsoil will be levelled to achieve an even surface, avoiding a compacted or an over-smooth finish.



To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Water Management Schematic

FIGURE 9

5.5.3 Clean Water Diversion Works

Two sections of clean water diversion banks will be utilised as permanent mitigation controls on the site to minimise erosion and divert run-on water around the disturbed areas, reducing the amount of water which would require treatment within the dirty water system.

The first section of diversion channel will be constructed during the initial stage of site preparation. It will run in a southerly direction approximately parallel to the western edge of the pit, and discharge into the downstream section of the southern ephemeral drainage line that will be disturbed by the proposed operations. This channel will intercept clean runoff from a catchment area of approximately eight (8) hectares located to the west of the pit.

The second section of channel will be constructed as part of Stage 2 works and will represent an extension of the first clean water diversion. This diversion will act to convey clean water flow around the southern end of the extraction area once the southern ephemeral drainage line is mined through. This diversion bund will service a total catchment area of approximately 16 Ha.

Both channels will be designed to convey the 100 year ARI peak flow for the catchment concerned (approximately 4 m^3/s and 6.5 m^3/s, respectively). The routes of both channels will require excavation in rock and in some places the channel will need to be cut 2-3 m deep in order to achieve a satisfactory grade.

The clean water diversions will convey water in a stepwise fashion around the Project Site with varying grades along the length of the diversion channels. Along some sections, such as where the clean water diversions run over ridgetops or traverse the contour, the slope of the channel would be approximately 1%.

At grades of less than 2% the clean water diversions could be adequately reinforced using jute mesh or bitumen. At grades over 2% and up to 10% (9% for Section 2 due to the higher flow), the channels will require to be reinforced with a durable, competent rock rip rap to prevent soil erosion and prevent scour of the friable sandstone. In some locations the natural topography where clean water diversions are required presents grades in excess of 10% (9% for Section 2). In these locations some earthworks may be required to create lower grades however; where this cannot be achieved, drop structures may be required to convey clean water flows down the slope. All completed clean water diversion banks will be topsoiled and sown with sterile cover crops. The minimum design criteria for the proposed clean water diversion banks are detailed in **Table 12**.

Table 12 – Minimum Design Criteria for Clean Water Diversions

Clean water Diversion	Estimated peak flow (m^3/s)	Slope (%)	Side slope	Base Width (m)	Height (m)	Lining	Rock Size (D_{50}) (mm)
Section 1	4	1	3%	2	1.1	Jute Mesh	N/A
		5	3%	2	1	Rock Rip Rap	439
		10*	3%	2	0.9	Rock Rip Rap	736
Section 2	6.5	1	3%	3	1.1	Jute Mesh	N/A
		5	3%	3	1.1	Rock Rip Rap	486
		9*	3%	3	1	Rock Rip Rap	750
* Where grades exceed these values, appropriate drop structures may be required							

Whilst the recommended minimum height varies from 0.9 to 1.1 mm diversion channels will be constructed with a height of at least 1.6 metres to allow significant freeboard to accommodated high flow events.

Additional clean water diversion works may be required around the highwall in the north west of the Project Site to divert clean water run-on away from the highwall and the area of the Mine Office and soil stockpile (see **Figures 3 – 8**). There may be a limited catchment area reporting to this diversion and the methods used to divert clean water (including the dimensions of any proposed diversion bank) will be determined by local site conditions during site establishment. In-Pit Water Management

Through the use of accurate surface mining machinery, infall drainage of the pit floor and quarry benches will be constructed to contain runoff to the internal dirty water control system throughout all stages of active quarrying. The only exception will be the final phase of Stage 4 when the site is prepared for the final landform wetland design requiring outfall drainage with runoff reporting to a designed wetland.

The benched terraces will be developed to discharge water in a controlled fashion to the next bench using stabilised drop-down structures. Drop-down structures will be constructed between each of the benches to provide controlled drainage of water down slope toward the pit floor and into the dirty water management system. The drop structures will be stabilised using concrete slurry ("shotcrete") to prevent erosion of the terraces. Once shotcreted, the drop structure areas will become far more competent and remain stable in the long term.

The terraced walls will have slopes equal to or greater than eighty (80) degrees to minimise the amount of rainfall on them and the erosion risk over the long term. Each bench will be progressively rehabilitated to reduce erosion and improve aesthetics by proving visual screening of the quarry walls.

All water collecting inside the pit area during the initial stages of quarrying will report to a minor in-pit retention pond (de-watering pond) located in the northwest corner of the pit. Dirty water will be pumped to the Main Retention Pond**.**

During Stages 2 to 4, all pit water will report directly to the Main Retention Pond which is located in-pit during those stages.

5.5.4 Quarry Haul Roads

The quarry haul road will be constructed to ensure surface drainage is optimised and stabilised thereby reducing roadside erosion and sedimentation. Cross-fall drainage structures and mitre drainage will be implemented for the entire length of the haul road. Ramp gradients will be no greater than 10% to allow use in wet weather. Crowning will generally be implemented on any steeper sections of the haul road. Outfall drainage will be constructed where the road traverses small fill batter areas and in-fall drainage will occur where the road traverses larger fill batter areas.

Mitre drains will be constructed to take water from the shoulders or table drains of the haul road to the Main Retention Pond or Lower Retention Pond where relevant.

Road runoff will be intercepted at regular intervals to reduce runoff velocity in each mitre drain. Drain spacing will not exceed fifty (50) metres. Drain outlets will be ponded using silt fencing and sand bags to ensure effective sediment control at the periphery of the small haul road.

5.5.5 Sediment Control

Runoff from the quarry area will report to the dirty water management system consisting of retention ponds and treatment plant. The Main Retention Pond and Lower Retention Pond will be responsible for optimising the retention of sediment carried in stormwater runoff prior to final removal of unsettleable sediment (e.g. colloidal) suspensions by the Water Treatment Plant prior to either offsite discharge or transfer to the water storage on the hill to the west.

The Main Retention Pond will serve as:

- the main collection point for stormwater runoff;
- the storage for supply of water for dust suppression requirements; and
- the primary settlement pond for water that will be pumped to the Lower Retention Pond and then to the Water Treatment Plant for treatment to a standard suitable for use by the Newnes Plateau village or release into the natural creek system.

Both retention ponds (and associated in-pit storage) have been designed in accordance with the:

- Most conservative scenario using "Blue Book" Type F and Type D soils (where finer suspensions of solids have the most stringent requirements for settling);
- To contain and treat sediment laden water for the most conservative "Blue Book" Volume 2 criteria ,being the 95th percentile 20 day rainfall event; and
- To contain water using the conservative criteria of the 100 year ARI, 72 hour storm event.

The capacity of the ponds increases in each stage of quarry development in response to increased disturbed catchment area and water treatment requirements, and is described in significant detail in the

Surface Water Management Plan (Hughes Trueman, 2004). Extracts of designs from that plan are contained in the following sections.

5.5.5.1 Design of the Main Retention Pond

The main retention pond will serve as a storage reservoir for on-site water needs and as a primary settlement pond for water that will subsequently be treated prior to discharge from the site, or reuse by the Newnes Plateau village. Excess runoff from that retained within the retention pond will be temporarily stored within the extraction area and accumulated pit water will be prevented from draining off-site due to the large storage capacity.

Four different water and sediment storage zones have been designed. In sequence, starting from the bottom of the retention pond, these are:

Sediment storage zone - that has been designed in accordance with the “Blue Book”. The required settlement storage capacity, allowing for retention of all sediment over the life of the retention pond, will increase in proportion to the disturbed area with a requirement of 2.5 ML (2,500 m3) at the end of Stage 4 of extraction.

Water storage zone - which has been designed to provide sufficient capacity to provide for the on-site water needs. The required volume has been established using a long term water balance analysis (see **Section 4**). The required storage volume at the end of Stage 4 of extraction is 18 ML.

Sediment settlement zone - which has been designed on the basis of settlement basins for Type F or Type D soils as set out in the “Blue Book”. The adopted design criteria for this component of the retention pond are the most conservative listed, namely:

- 20 day 95th percentile rainfall 135 mm
- Volumetric runoff coefficient 0.8
- The design capacity of the sediment settlement zone for the end of Stage 3 is 22 ML.

Surcharge zone - which will accommodate all excess runoff from the site in the event of extreme rainfall events. Runoff will be temporarily stored within the pit above the level of the top of the retention pond. The adequacy of the pit to accommodate the excess runoff is demonstrated by the water balance analysis provided in **Section 4.4** and **Section 4.7.**

The capacity of the main retention pond will increase progressively as extraction progresses, as shown in **Table 13**.

Table 13 - Main Retention pond Capacity for Various Stages of Extraction

	Quarry Development Stage				
	Preparation	1	2	3	4
Disturbed Area (ha)	1.6	10.0	18.0	20.4	20.9
Sediment storage zone (ML)	0.5	2.5	2.5	2.5	2.5
Water storage zone (ML)	13.0	16.0	17.5	18.0	18.0
Sediment settlement zone (ML)	1.7	10.8	19.5	22.0	2
Required pond capacity (ML)	20.2	31.3	40.0	42.5	20.5
Proposed pond capacity (ML)	32	32	45	45	22.5
Note: The catchment areas are based on the extraction footprint approved under the Development Consent. The currently proposed footprint will be slightly smaller due to the 100 meter buffer zone required under the EPBC Act approval. However, the dam sizes have not been revised as the larger dams will provide increased protection.					

5.5.5.2 Design of the Lower Retention Pond

The lower retention pond will act as the capture point for runoff from the area immediately north of the pit. This area contains the haul road leading to the main office, stockpile area, the stockpiling conveyor, the maintenance area and topsoil stockpiles. The total area draining to the lower retention pond will not change significantly throughout the life of the project and is approximately 3.5 ha. The lower retention pond will also act as a balancing storage for water transferred from the Main Retention Pond.

Water retained in the lower retention pond will be preferentially sourced for providing:

- water for dust suppression,
- water for treatment and transfer offsite to the water storage tank for use in the local village,
- water for treatment and off-site discharge to the ephemeral watercourse

The capacity of the lower retention pond will be 10 ML comprising:

- 7.2 ML temporary holding capacity to accommodate runoff from the contributing catchment resulting from a 100 year ARI, 72 hour storm (307 mm of rainfall);
- 2 ML balancing storage for water transferred from the main retention pond. This is equivalent to two days' pumping to the treatment plant;
- 0.8 ML allowance for sediment accumulation.

This volume also adequately accommodates the runoff volume produced by the 95th percentile 20 day rainfall event (approximately 4ML). As the lower retention pond will act as the primary distribution point for serving various water needs, the water level will be maintained at a low level in order to maintain the design capacity for runoff capture. In the event of a 100 year ARI, 72 hour storm, it would only require 7 days operation of the treatment plant to restore the design capacity to the pond.

5.5.5.3 Water Treatment Plant

The slowest settling, most mobile particles in the runoff from the extraction area will be those that consist of the finest kaolin clays (IEC, 2003). The surface water treatment plant will be designed to include a number of chemical processes to extract the fine clays and will be capable of treating around 1 ML of dirty water per day. The treatment plant would be relocated during the early stages of mining, however the plant capacity would remain constant at approximately 1ML/day.

In order to achieve maximum efficiency from the treatment plant, settlement of the coarser sediment fractions will primarily occur within the in-pit sump and the Main Retention Pond. The water treatment plant would be fully automated for both start up and operation and will incorporate several processes, including coagulation and flocculation to remove finer clays and colloidal suspensions. Through these combined processes, the water treatment plant will meet the required discharge standard of 15 mg/L of suspended solids. Additional processes, including pH adjustment and addition of an oxidising agent such as potassium permanganate would be used in conjunction with a filtration process to remove elevated manganese levels which occur naturally in rocks within the region.

The treatment plant will be operated periodically, when the design capacity of the Main Retention Pond is exceeded following heavy rainfall. Treated water from the water treatment plant would be preferentially transferred to a water storage tank on a hilltop to the west of the pit for water supply to the local village. Alternatively, treated water may be discharged to the adjacent ephemeral watercourse draining to the Wollangambe River. Where required, discharge to the ephemeral watercourse would be via a rip rap lined channel and would be undertaken in accordance with the conditions of a (yet to be issued) EPL. As described in **Section 7**, discharge of treated waters to the ephemeral watercourse would trigger monitoring which would be undertaken in accordance with the conditions of the (yet to be issued) EPL for the mine.

5.5.6 Additional Erosion & Sediment Controls

The current proposed extraction method creates a series of windrows of excavated material as the surface miner passes over the pit floor. These windrows are then collected by a scraper which delivers the material to the stockpiling area. This process essentially creates a series of absorption banks within the pit, which will reduce runoff velocity during rainfall. The windrows will be constructed along the contour (essentially north to south) and therefore perpendicular to the natural flow of water (east to west). The windrows will serve several purposes including:

- Act as "contour banks" that will reduce slope lengths of uninterrupted slope and hence reduce the erosion capacity of overland flow. This will reduce the erosion potential within the working area and reduce the overall solids loading entering the retention ponds; and
- Pond water behind the bank and allow settling of the coarser sand fraction.

Silt fencing will be installed downslope of the entire length of the windrowed material. Prior to any construction work onsite (including clearing of vegetation, soil stripping or access road construction), temporary erosion and sedimentation control structures will be put in place. Additional control works including, but not limited to, sediment filter fencing, sand bag sediment filters and revegetation will be employed. These will be particularly used during construction of drainage line crossings or other activities near depressions. Silt traps will be constructed downstream of each crossing and remain in place (and be regularly inspected for functionality) for the life of the quarry.

Sediment filter fencing and sandbag weirs will be installed in the longitudinal drainage adjoining the roads / disturbed areas and will be in advance of, and in conjunction with, earthworks to prevent contaminated water leaving the site. The weirs will be installed at fifty (50) metre intervals.

The filter fabric used in the silt fences will have a permeability coefficient of about 0.02m/s to allow sufficient flow during minor storms without water buildup, and have a retention efficiency of at least 75%. Having two fences in parallel will increase the overall retention efficiency.

Sand bag sediment filters will be used "as required" during the construction of drainage and road works, however the use of sand bags will be limited to situations only where erosion and sediment control is required for a short period (i.e. maximum of three (3) months).

Any batters will be constructed to minimise exposed areas and minimise potential for surface erosion. Batters that may require treatment include those on access roads and other construction areas, and as these areas may be steep and erodible, stabilization, revegetation and rehabilitation works will be undertaken quickly to minimise erosion. Hydromulching will be used to immediately protect underlying fill material from wind and water erosion. Hydromulching applications will typically consist of sterile annual grasses (to eliminate weed issues for the nearby National Park), bitumen or polymer binder, seed and fertiliser. Materials used in hydromulching are biodegradeable and decompose to form a beneficial organic humus.

All the controls referred to above would be installed in accordance with standard "Blue Book" requirements.

5.5.7 Maintenance Area

A small maintenance area will be established near the eastern end of the conveyor. This area will include a workshop for maintenance of machinery and re-fuelling facilities. All maintenance work will be conducted within the workshop. The fuel storage area will be appropriately bunded in accordance with DECCW requirements and Australian Standard (AS1940) requirements for spill containment.

The hardstand area outside the workshop and adjacent to the refuelling facility will be sealed and graded so as to drain all runoff to an oil and grease trap before discharging into the drainage system connected to the lower retention pond.

5.5.8 Maintenance of Surface Water Controls

Site drainage and sediment control structures will be inspected regularly after runoff events (>20mm of rain) to check for scouring of diversion drains and accumulation of materials in sediment traps (e.g. silt fences & sand bags) and settling dams. Sediment control structures will be de-silted when the design capacity of the structure has been reduced by 30% (or as necessary). All scouring of drains will be stabilised as soon as possible.

5.6 Changes to Hydraulic and Hydrologic Flow Regimes

5.6.1 Surface Water

As described above in **Section 6.3,** all clean water flowing onto the Project Site is proposed to be diverted around the disturbance areas and into existing drainage lines. This will result in a large area of clean catchment being diverted around the site and into the natural drainage system rather than being held in the site water management system.

As a result of the diversions, only runoff that lands within the proposed water management system of the Project Site will be contained for pollution control. This equates to an area of approximately 20.9 ha at the full extent of the mining operation. This should help maintain ephemeral flows and sediment movement patterns in the watercourses downstream of the Project Site. The proposed treatment and discharge of dirty waters will also help to maintain flow regimes in the downstream watercourse.

5.6.2 Groundwater

The specialist consultants studies undertaken as part of the Environmental Impact Statement (IEC, 2003) suggest that during excavation of the pit, the shallow aquifer and local water table would be intersected, and as quarrying progresses, water make would flow into pit voids. Whilst water table levels would ultimately stabilise by reaching equilibrium when quarrying depth stabilizes at the end of quarrying, the creation of a drawdown zone during quarrying would cause groundwater flow directions to be directed toward the pit. IEC (2003) suggest that outside of this zone of influence groundwater flow directions would remain unaffected. Consequently it was not expected that the development would have any hydraulic effect on the Clarence Village system. Any significant drawdown influence was expected to be restricted to within approximately 500m or so of the pit under maximum development. IEC (2003) indicate that final pit inflow is expected to be approximately 0.2ML/day, with a major proportion of that lost to evaporation from the high walls.

Numerical modelling undertaken by Kalf and Associates (2004) indicated that the groundwater system would reach equilibrium within 2 years of the completion of mining and that the proposed development will only influence the water table locally while still allowing the majority of deeper groundwater to reach the river drainage system.

5.7 Rehabilitation Monitoring

Revegetation works will be monitored in order to assess success, effectiveness of techniques, and fine tune rehabilitation methodologies to ensure that a suitable vegetation community is established in the open pit area. A number of aspects of the rehabilitation program will be required to be monitored and inspected to help ensure a successful result. Both quantitative (eg stem density measurements) and qualitative (eg photographic records and inspections) monitoring and assessment will be undertaken.

It is noted that some mortality is expected for a proportion of tree and shrub revegetation seedlings, providing benefits of nutrient and organic decomposition to the soil. Changes in stand composition will occur as direct-seeded stands are initially very dense, with numbers declining rapidly over the first five years as quick-growing and short-lived species (such as Acacias) die out and as more dominant canopy species emerge. As tree seeded stands mature the ratio of different species changes. The initial fast-growing understorey species provide useful functions in stabilising soils, shading out weeds and assisting in nitrogen and organic buildup in soils to encourage long-living canopy species to emerge.

Eventually the stand will thin even further as individual eucalypt species dominate over others. Stem densities will show decline quickly during this process. In the first five years stem densities may decline from around 20,000 to 5,000 stems per hectare.

Rehabilitation is addressed in greater detail within the Rehabilitation and Landscape Management Plan (GSSE, 2010).

6.0 SURFACE WATER MONITORING PROGRAM

6.1 Introduction and objectives

SCM is committed to ensuring that surface water meets the required water quality objectives outlined in the DGRs as shown in **Table 1**. As such, this surface water monitoring program has been designed to meet the specific requirements of the DGRs. The objectives of this surface water monitoring program are to ensure that:

- dirty water is adequately being directed to and detained in sediment basins.
- no uncontrolled discharge occurs from the site during operational and rehabilitation phases of the project.
- any discharge will only be by means of controlled flow from the water treatment plant.
- clean water is adequately being directed away from the site by clean water diversion channels.
- the quality of the surrounding water bodies are not impacted due to site operations.

Water bodies that may be impacted by site operations are outlined in **Section 4.**

In addition to the above requirements the DGR's also specify that discharges associated with the Project must comply with the *Clean Waters Regulation 1972,* including the requirements of the Prescribed Classes of Waters and the restricted substance concentration limits in schedule 2 of that Regulation. However; it is noted that this regulation was repealed under the POEO Act and all relevant legislation regarding the protection of waters is now contained within the POEO Act.

6.2 Water Quality Assessment Criteria

The relevant assessment criteria are those provided in the development consent conditions and as presented in **Table 14**.

Table 14 - Surface Water Assessment Criteria

Pollutant	Unit of Measure	100% concentration limit
Total Suspended Solids	mg/L	15
Oil & Grease	mg/L	10
BOD	Mg/L	20

The recorded values for BOD, Total Suspended Solids (TSS) and Oil and Grease will be compared to these criteria. The recorded values for all other parameters will be plotted to identify any trends over time. DECCW will be notified in the event of increasing levels of any parameter or exceedance of the assessment criteria. In addition, and as described in **Section 3**, results of water quality monitoring would also be compared against the relevant ANZECC guideline criteria where applicable.

6.3 Surface Water Monitoring Frequency and Location

Ongoing surface water monitoring would be undertaken within ephemeral watercourses immediately downstream from the Project Site. The watercourses chosen for ongoing monitoring are those for which the headwaters will be disturbed by the project. If any offsite surface water impacts occur, these drainage lines represent the location that impacts would occur. These drainage lines will also convey any waters discharged to the Wollangambe River.

To ensure the impacts associated with the project are adequately represented the proposed monitoring locations will be in the immediate vicinity of the locations from where baseline water quality samples were obtained. Monitoring will be undertaken for the parameters specified in the DGRs including pH, EC, TSS, selected metals, oil and grease and BOD.

It is proposed to sample the background waters weekly during controlled discharges and monthly at other times utilising field sampling techniques and grab samples where laboratory analysis is required. Samples of the water quality within the sediment control dams on site will also be taken prior to discharge to ensure that the water quality is suitable before it is released.

Table 15 identifies the monitoring point locations, frequency of monitoring and the parameters to be assessed. **Table 16** identifies the mode of sampling and units of measurement for the parameters to be sampled. The location of all surface water points is presented on **Figure 10**.

Table 15 - Surface Water Monitoring Locations, Frequency & Parameters

Monitoring Site	Monitoring Frequency	Parameters
Discharge Point from Water Treatment Plant (licence to be acquired)	Prior to controlled discharge	*Water quality including, but not limited to,* Total Suspended Solids Oil & Grease pH Electrical Conductivity, Selected Metals BOD
Receiving Waters downstream from the development (Sites SW1 and SW2)	Weekly during controlled discharge and Monthly at other times	
Dirty water dams (including Main Retention Pond and Lower Retention Pond)	Quarterly	

Table 16 - Surface Water Parameters

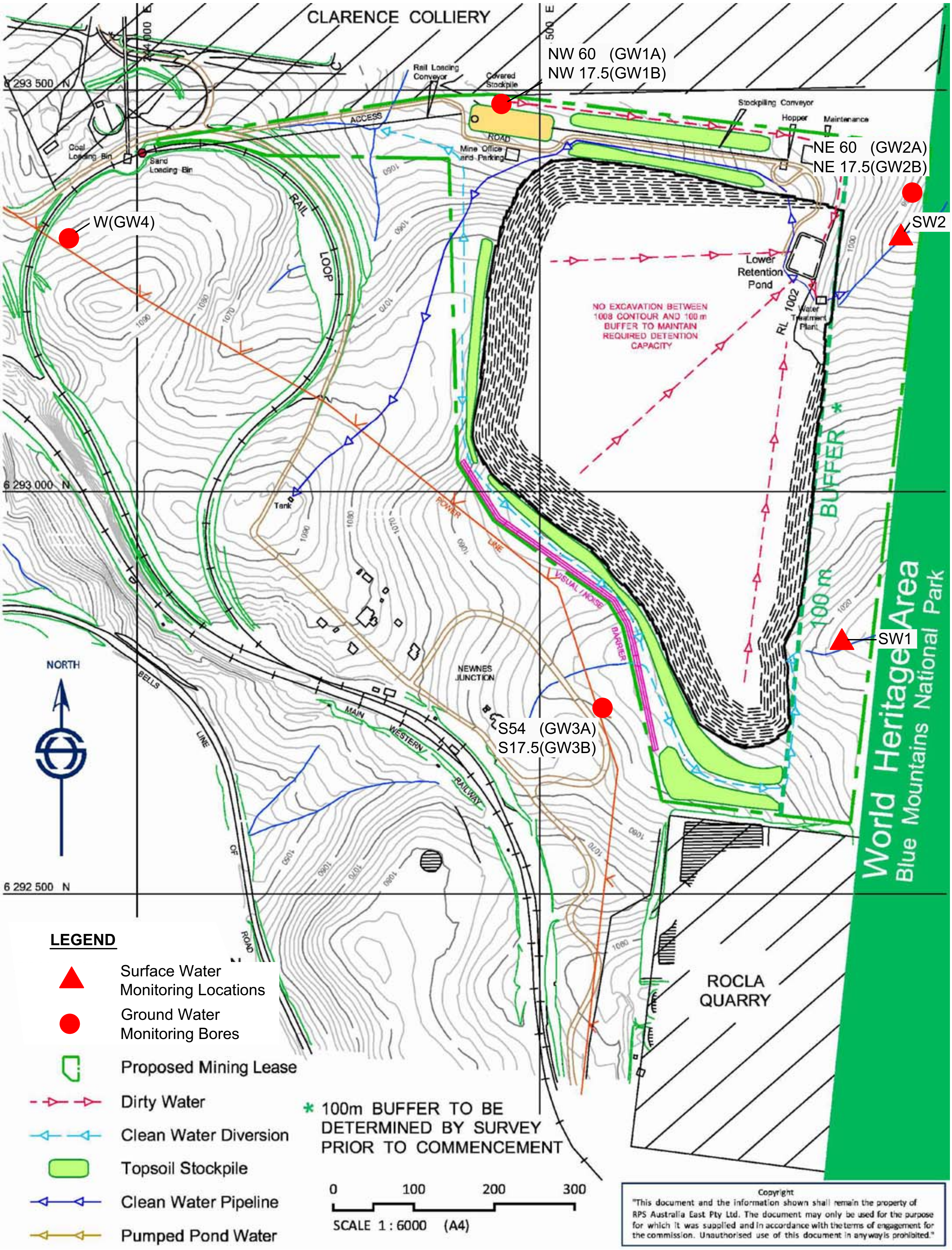
Pollutant	Unit of Measure	Sampling Method
Total Suspended Solids	mg/L	Grab sample
Oil & Grease	mg/L	Grab sample
pH	-	Grab sample
Conductivity	µS/cm	Grab sample
Selected Metals	mg/L	Grab sample
Biochemical Oxygen Demand	mg/L	Grab Sample
Note: Sampling will be undertaken in accordance with the Department of Environment and Conservation, Approved Methods for the Sampling and Analysis of Water Pollutants in NSW, March 2004		

Any additional monitoring requirements contained within the Environmental Protection Licence to be issued for the site will be incorporated into this surface water monitoring program as part of the review process and any amendments detailed according to the audit and review process identified in **Section 10.**

6.4 Creekline Channel Stability and Health

In conjunction with the water quality monitoring program, a program to monitor creekline channel stability and health would also be undertaken throughout the life of the project. The monitoring would be undertaken along the downstream ephemeral watercourses, for a length of 50 metres downstream from the water quality monitoring sites SW1 and SW2. General observations of stream health will be recorded during the monthly water quality monitoring for these watercourses..

Monitoring at the nominated locations would include:



Source: RPS Group December 2010

To be printed A4

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Proposed Quarry Development
- Surface Water Monitoring Locations

FIGURE 10

- 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.

Prior to the commencement of mining, further consideration will be given to the use of the CSIRO Ephemeral Stream Assessment procedures for channel stability. Other assessment methods such as RCE (Riparian, Channel and Environmental Inventory) will also be considered.

6.5 Management of ESC Structures

Monitoring of the various water management structures will form part of the overall surface water monitoring program. Visual inspection of sediment basins, clean water diversions, pipelines, waterways and associated water management infrastructure will be undertaken on a regular basis to ensure that these structures are in a stable condition and are functioning as per their intended design. This monitoring will also extend to temporary erosion control works (e.g. siltation fences and sand bags). Inspection of the water management structures should also be undertaken following significant rainfall events which may cause damage to the structures. Where the water management infrastructure is not operating as intended, appropriate remedial works will be undertaken to ensure these structures remain functional as detailed in **Section 5.5.9**.

7.0 GROUNDWATER MONITORING PROGRAM

7.1 Introduction and Objectives

This section presents an overview of the groundwater monitoring program developed by Aquaterra (2010), to be implemented throughout the life of the proposed project. The groundwater monitoring program has been developed to meet the specific requirements of the development consent conditions outlined in **Table 1** of this report. For the full groundwater report and figures, refer to **Appendix A**.

As part of the groundwater monitoring program, Aquaterra provided an analysis and assessment of all groundwater monitoring data available for bores developed specifically for the project. This included an assessment of groundwater samples taken by Kalf and Associates (2004) and samples taken by Aquaterra in June 2010. All relevant baseline groundwater quality data and the assessment by Aquaterrra is presented in **Section 3.2**.

In addition to site specific data, Aquaterra also report on groundwater levels obtained from three groundwater bores owned and monitored by the Clarence Colliery adjacent to the Project Site.

7.2 Groundwater Assessment Criteria

7.2.1 Mine Inflow Rates

Mine inflow rates and associated drawdown in the regional groundwater will be assessed against the results of numerical modelling undertaken by Kalf and Associates (2002 and 2004) and baseline monitoring data from monitoring bores including those owned and monitored by the proponent and those on adjacent lands (Clarence Colliery). An observed groundwater inflow rate that is 100% in excess of the predicted inflow rate at any stage during the mine life, sustained for three consecutive months would trigger a response plan as detailed in **Section 3.3** of the groundwater monitoring program (see **Appendix A**).

7.2.2 Mine Inflow Water Quality

Mine inflow water would emanate from the quarry walls and would be directed to in-pit sediment basins. Aquaterra (2010) suggest that mine water inflow quality would be difficult to quantify due constantly changing conditions such as dry periods, heavy rainfall and moving quarry extraction area. The salinity and pH of pit water would be monitored throughout the mine life. An observed increase or decrease in salinity by more than 50% outside the baseline range sustained over a consecutive six month period would require a response action as detailed in **Section 3.3** of the groundwater monitoring program (see **Appendix A**).

7.2.3 Impacts to Baseflows

There are no major permanent watercourses near the site, only the ephemeral watercourses as discussed in **Section 3**. The Hydrogeological assessment undertaken by Kalf and Associates (2004) concluded that the operation would not ‘measurably influence surface water runoff and baseflow within the Wollangambe River due to the relatively small size of the catchment’ and that the operation would only influence the water table locally, allowing the deeper groundwater to reach the river drainage system. The supplementary study also concluded that the water table drawdown would not affect local vegetation as plants rely mainly on soil moisture (Kalf and Associates, 2004).

Kalf and Associates (2004) Predicted drawdown within monitoring piezometers within the Project Site of between 10 m – 15 m as a result of the operation.

Specific groundwater trigger levels have been established for piezometers located close to the pit (where local drawdown impacts are predicted) and piezometers outside the zone of influence (where no drawdown impacts are expected) as follows:

- For piezometers (NW(GW1), NE(GW2) and S(GW3)) located within the 500 m zone of influence, observed drawdown substantially greater than those predicted by modelling (10 m – 15 m) may indicate a greater impact upon regional groundwater and would require a response action as detailed in **Section 3.3** of the Aquaterra report (see **Appendix A**).
- For piezometers (W(GW4)) located outside beyond the zone of influence, a declining trend in groundwater levels which is not attributed to climatic conditions could indicate an unexpected impact to groundwater levels by the operation and would require a response action as detailed in **Section 3.3** of the Aquaterra report (see **Appendix A**).

7.2.4 Impacts to Licensed Users

There are no active licensed groundwater bores located in close proximity to the proposed operation. All existing bores within the locality are located in the Clarence Village. Specific monitoring bores located outside the predicted zone of influence, including W(GW4A) located 550 m to the west of ML19, will be maintained to detect unexpected impacts which may originate beyond the predicted zone of influence. Additional data will be obtained from existing Clarence Colliery monitoring network may also be used to monitor regional groundwater levels.

For piezometers outside the predicted zone of influence a declining trend in groundwater levels which is not attributable to climatic conditions could indicate an unexpected impact by mining operations and would require a response action, as detailed in **Section 3.3** of the Aquaterra report (see **Appendix A**).

7.3 Groundwater Monitoring Frequency and Locations

The proposed groundwater monitoring program that will be implemented for the Newnes Kaolin mining operation will be a continuation of the monitoring which has recently commenced at the Project Site and will be integrated with the proposed surface water monitoring program detailed in **Section 6**.

The proposed groundwater monitoring locations, frequency of monitoring and parameters to be sampled are detailed in **Table 17**. Key aspects of the groundwater monitoring program include the following:

- Daily measurement of water levels in the existing network of piezometers (NW(GW1), NE(GW2) and S(GW3) and planned piezometer W(GW4) to be monitored through the life of the project.
- Quarterly collection of water samples from all standpipe piezometers and the pit sump/seepages for laboratory analysis of EC, TDS and pH.
- Biannual collection of water samples from all standpipe piezometers and the pit sump / seepages for laboratory analysis of a broader suite of parameters including:
    - Physical properties (EC, TDS and pH);
    - Major cations and anions (Ca, Mg, K, Cl, $SO_{4,}$ HCO_3 and $C)_3$);
    - Nutrients; and
    - Dissolved metals.
- If pumping from the pit is required, record pump time to estimate the volume of mine water pumped from the open cut mine.

Table 17 - Groundwater Monitoring Locations and Frequency

Monitoring Site	Groundwater level monitoring frequency	Groundwater quality monitoring frequency	Purpose
NW60 (GW1A)	Daily (Logger)	Quarterly: TDS, EC, pH Biannually: Major ions, Metals, Nutrients	Obtain baseline data (including possible existing groundwater influences from Clarence Colliery to the north) and monitor drawdown/water quality impacts within the predicted zone of influence.
NW17.5 (GW1B)			
NE60 (GW2A)			
NE17.5 (GW2B)			
S54 (GW3A)			Obtain baseline data (including possible existing groundwater influences from Rocla Quarry to the south) and monitor drawdown/water quality impacts within the predicted zone of influence.
S17.5 (GW3B)			
W(GW4)			Obtain baseline data and monitor impacts outside the predicted zone of influence
In-Pit Sump	Volume (when pumped)	*Quarterly: TDS, EC, pH *Biannually: Major ions, Metals, Nutrients DS, EC, pH	Determine groundwater inflow volumes and groundwater inflow quality
* Or obtain sample if significant inflows are observed			

For existing monitoring bores (NW(GW1), NE(GW2) and S(GW3)) water quality samples are available from 2004 (see **Section 3.2**) while daily groundwater level monitoring at these bores (by logger) commenced in June 2010.

In addition, data obtained from the existing Clarence Colliery groundwater monitoring network, such as piezometers CLRP4 and CC113 located more than 1 km to the west, may also be used to monitor any groundwater impacts that would occur closer to the township of Clarence.

8.0 DATA RECORDING AND REPORTING

The SCM Environmental Officer, or nominated environmental representative/consultant, will be required to check the results of all monitoring received from the laboratory for accuracy, i.e. check there has been no typographical error or mixing up of samples. The results of monitoring will then be entered onto a database or spreadsheet where the results can be compared between relevant sites and between sampling periods. Any non-compliant results, trends, or statistically significant differences can then be determined.

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 and assist in identifying the need to adjust any of the site-based water control measures.

8.1 Annual Environmental Monitoring Report

In accordance with Condition 23 of the Development Consent, each year from the date of consent the Proponent will undertake the following:

a) review, and if necessary update, the Water Management Plan; and

b) report the results of this review in the AEMR, including:
- the results of all surface water and groundwater monitoring;
- details of the review for each sub-plan;
- amendments to the sub-plans; and
- details of the measures undertaken/proposed to address any identified issues.

The AEMR would be provided to all relevant stakeholders including, but not limited to, SEWPAC, DECCW and NOW.

8.2 Identification, Notification and Mitigation of Identified Exceedances

The results of water monitoring are to be analysed and reviewed within 7 days of receiving the results.

Results Compliant with Criteria and Objectives

Compliant results are simply recorded in the surface water monitoring database/spreadsheet and charts/graphs updated to include the new data. A review of the updated charts will assist in determining whether there are any noticeable trends towards non-compliant parameter levels at the monitoring sites. This information should be used to modify, if necessary, work practices or scheduling of equipment to ensure that future non-compliances are avoided.

Results Non-compliant with Criteria and Objectives

Any exceedance of discharge criteria will trigger an immediate investigation to determine the cause of the exceedance and preparation of a corrective action plan to re-establish or introduce additional appropriate controls as necessary. Whenever possible, the water will be re-sampled to verify the non-compliant result.

For any breach of the water management system the SEWPAC is to be notified of the breach, and any immediate action to be taken, within 24 hours and provided with a report with 7 days. The DECCW is to be notified within 7 days of the any non-compliant result against the conditions of an EPL and subsequent actions being taken by the Company to mitigate these and prevent reoccurrence.

The report to DECCW and SEWPAC will:

1. describe the date, time and nature of the exceedance/incident;
2. identify the cause (or likely cause) of the exceedance/incident:
3. describe what action has been taken to date; and
4. describe the proposed measures to address the exceedance/incident.

Any mitigation required will be done in consultation of the relevant government agencies, with the mitigation actions determined at that time, as relevant to the exceedance.

9.0 ROLES AND RESPONSIBILITIES

The SCM Environmental Officer will be responsible for

- overseeing the implementation of this WMP;
- investigating water complaints and/or enquiries;
- co-ordinating additional water monitoring as required;
- managing the water quality of retention ponds such that should any water leave the site due to a high rainfall event, it does not cause pollution to any receiving waters; and
- providing adequate training to employees and contractors regarding their requirements under this WMP.
- consulting with the relevant government departments as required and providing the relevant information/reports to all stakeholders as necessary.

The SCM (or his delegate) is responsible for:

- delegating tasks associated with this WMP when the Environmental Officer is absent; and
- providing adequate resources to implement this WMP.

9.1 Training

It will be the responsibility of the SCM environmental officer to provide training to SCM staff and contractors on water management. The training should include a review of this WMP.

Specific training should be provided to operators and site contractors prior to undertaking site development.

General training should be given to all staff to ensure that water management structure and features are properly managed at the site.

10.0 AUDITS AND REVIEW

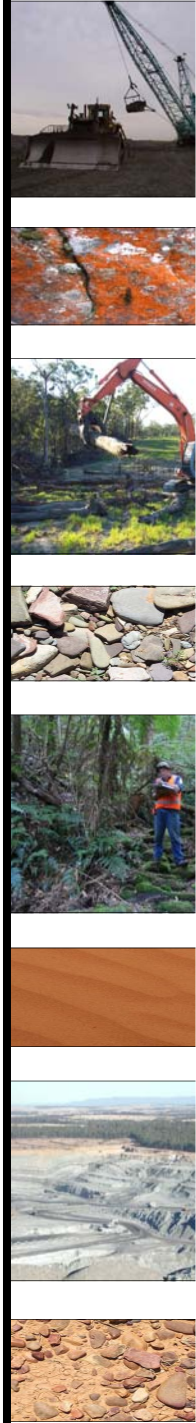
The SCM Environmental Officer or nominated delegate is required to provide a review of this WMP on an annual basis from the date of the development consent. The WMP would also be reviewed following any new or modified approval conditions relevant to water management or when there is any change to the operations such that it is likely to change the impacts.

The primary purpose of the review is to assess the effectiveness of the established controls (including review of the monitoring data) against the performance criteria established in the WMP and overall WMP objectives, and to ensure compliance with all new and existing statutory approvals.

If any updates to the WMP are required as an outcome of the review, the updated WMP will be issued to NSW Office of Water and SEWPAC for approval. The details of this review and any amendments to the WMP will also be reported in the AEMR.

11.0 REFERENCES

- ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
- Aquaterra (2010) *Newnes-Kaolin Pty Ltd – Groundwater Monitoring Plan*
- Department of Environment and Climate Change (2008) *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries*.
- Department of Environment and Climate Change (2010) *National Parks and Wildlife Act - Protected Areas – Wild Rivers*
- Department of Environment and Conservation (March 2004) *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW*
- Department of Water and Energy (DWE) *Guidelines for Controlled Activities – Riparian Corridors and In-stream works.*
- GSS Environmental (October 2004) *Soil and Water Management Plan – Newnes Junction Sand and Kaolin Extraction Project*
- International Environmental Consultants Pty Ltd (May, 2003) *Environmental Impact Assessment – Multi-Commodity Sand Extraction and Kaolin Project*
- Kalf & Associates and the Water Research Laboratory UNSW (December 2004) *Hydrological Impact – Newnes Kaolin Proposed Open Cut*
- Landcom (2004) *Managing Urban Stormwater: Soils and Construction – Volume 1, 4th Edition*.
- NSW Department of Planning (2006) *Development Consent – Newnes Kaolin Project*
- NSW Water Resources Council (1993) *NSW State Rivers and Estuaries Policy.*
- Sydney Construction Materials (March 2005) *Newnes Junction Sand and Kaolin Extraction Proposal – Additional Information Requested by DIPNR*



APPENDIX A

Water and Environment

NEWNES-KAOLIN PTY LTD - GROUNDWATER MONITORING PROGRAM	
Prepared for	Newnes-Kaolin Pty Ltd
Date of Issue	22 September 2010
Our Reference	S92 014c

As part of Aquaterra's commitment to the environment this PDF has been designed for double sided printing and includes blank pages as part of the document.

aquaterra

GROUNDWATER MONITORING PROGRAM	
Prepared for	Newnes-Kaolin Pty Ltd t/a Sydney Construction Materials
Date of Issue	22 September 2010
Our Reference	S92 014c

GROUNDWATER MONITORING PROGRAM

	Date	Revision Description
Revision A	5-7-2010	First Draft
Revision B	20-8-2010	Second Draft
Revision C	22-9-2010	Final Report

	Name	Position	Signature	Date
Originator	J van den Akker	Senior Hydrogeologist		22-9-2010
Reviewer pp	Milo Simonic	Principal Hydrogeologist		22-9-2010

	Location	Address
Issuing Office	Sydney	Suite 902, Level 9 North Tower, 1-5 Railway Street Chatswood NSW 2067 Tel +61 2 9412 4630 Fax +61 2 9412 4805

CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1 BACKGROUND

Newnes Kaolin Pty Limited (NKPL) proposes to develop an open pit operation to extract friable sandstone at Newnes Junction (ML19), on the Newnes Plateau some 10 km east of Lithgow, between the existing Clarence Colliery and Rocla Quarry (**Figure 1.1**)

The proposed open cut operation covers an area of 25 ha, adjacent to three existing quarry / mine operations. An estimated 23.7 Mt of reserves will be extracted over the next 21 years.

Mine planning is based on a gradual increase over the initial ten years of pit operation until full production is reached in approximately year 11. Extraction will proceed in a north to south direction, to a reduced level (RL) of 990 m.

A final void will remain at the end of mining and will contain a large number of small benches forming a terraced, vegetated landscape. The base of the pit will be graded to be free-draining with all disturbed areas to be topsoiled and re-vegetated. A small wetland will result in the area occupied by the final retention pond (International Environmental Consultants, 2005).

The quarry design enables all water flows at completion of quarrying to be contained within the quarry void. When the final rehabilitation is complete, and vegetation well established and the landform stable, it will be possible to place a channel from the near quarry floor to the small creek channel in the north and re-establish flows directly to the water course (International Environmental Consultants, 2005).

1.2 OBJECTIVES

The Groundwater Monitoring Program is intended for inclusion in an overall Water Management Plan for the proposed Newnes Kaolin mine. The Groundwater Monitoring Plan has been prepared in accordance with Environmental Condition 22, stipulated in Schedule 3 of the Project Approval, under Section 75J of the Environmental Planning Assessment Act 1979. These conditions are addressed under Sections 2 and 3 of this report and are as follows:

22) The Groundwater Monitoring Program shall include:

a) detailed baseline data on ground water levels and quality, based on statistical analysis, to benchmark the pre-mining natural variation in groundwater levels, yield and quality;

b) groundwater impact assessment criteria;

c) a program to monitor:

- *regional groundwater levels and quality;*
- *impacts on the groundwater supply of potentially affected landowners;*
- *impacts on baseflow in downstream waterbodies;*
- *impacts on groundwater dependent ecosystems and riparian vegetation; and*

d) a protocol for the investigation, notification and mitigation of identified exceedances of the groundwater impact assessment criteria.

1.3 POTENTIAL GROUNDWATER IMPACTS

A Groundwater Assessment was undertaken in 2002 (Kalf and Associates, 2002) and subsequently revised following a drilling investigation in 2004 (Kalf and Associates, 2004) to assess key groundwater issues for the proposed open cut mining and rehabilitation at Newnes Junction.

The objective of the groundwater assessment was to determine the groundwater impacts using simplified numerical modelling. A single layer MODFLOW-SURFACT groundwater model was developed to assess:

- pre mining (steady state) groundwater conditions,

- drawdown influences to existing licensed bores and base flow impacts to the Wollangambie River,
- pit inflow; and
- post mining conditions.

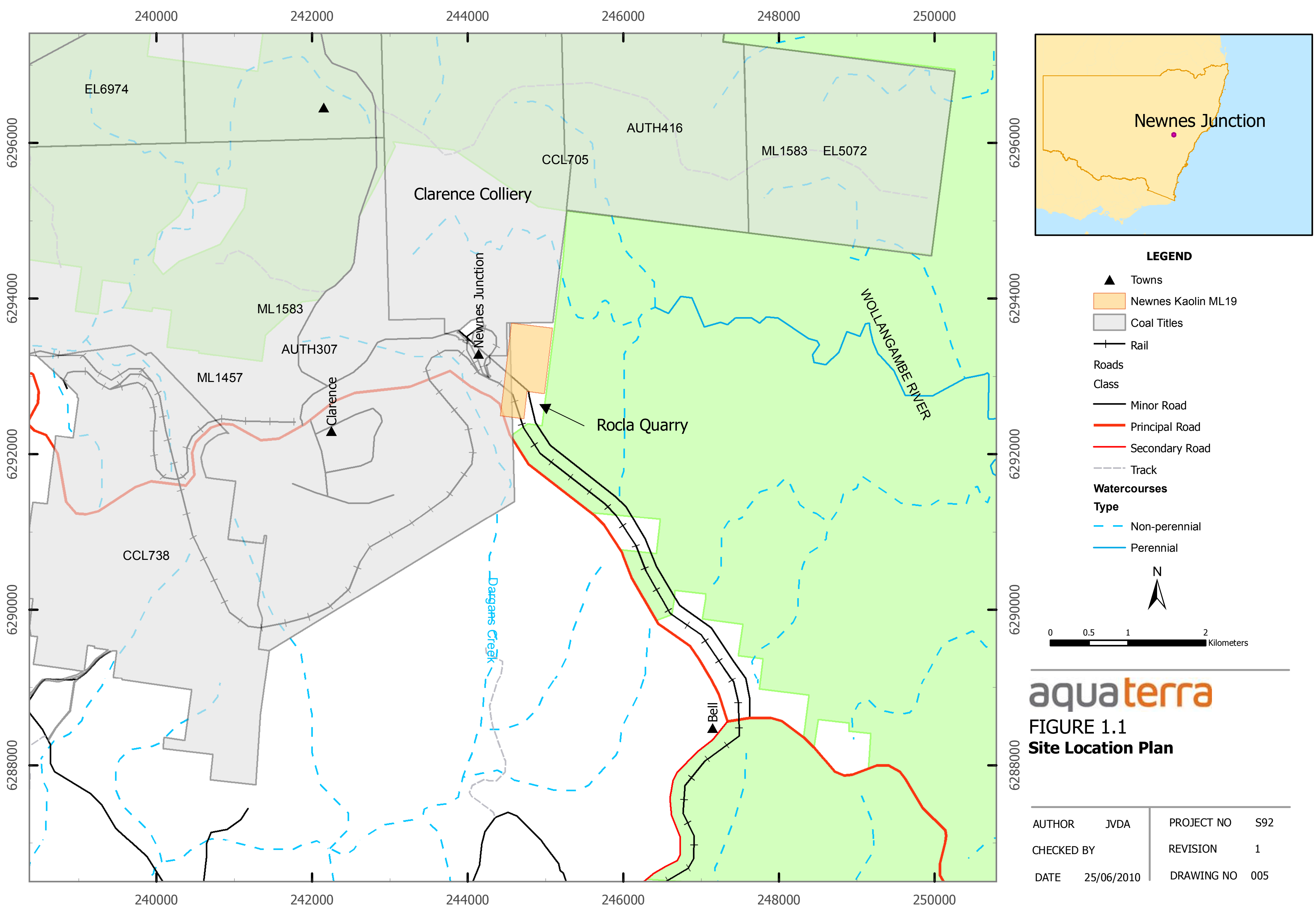
Numerical model simulation of the proposed mining over a 20 year period indicates that the groundwater system would reach equilibrium two years after mining stops (Kalf and Associates, 2004). The development of open cut will form a localised sink into which groundwater originating in the sandstone aquifer will flow and this will induce a localised cone of groundwater drawdown. The groundwater model predicts that the open-cut pit will only influence the water table locally but will still allow the majority of deeper groundwater flow to reach the river drainage system and therefore not impact base flows (Kalf and Associates, 2004).

Mining at the site will have no influence on the groundwater system at the Clarence village as its groundwater is well beyond the 500m drawdown influence of the proposed open-cut.

Inflow to the pit is unlikely to exceed 0.8 ML/day with much less inflow likely, averaging 0.2 ML/d during the mining operation.

Some years after mining ceases the pit will behave as a flow-through system and become an elevated wetland zone.

The Rocla quarry which was established in the 1970s indicates that water table drawdown around the pit has not influenced vegetation species surrounding the pit as these plants rely mainly on soil moisture conditions for survival. The same conditions are expected to apply to the proposed pit with no adverse influence on vegetation surrounding the pit.



aquaterra

FIGURE 1.1
Site Location Plan

AUTHOR	JVDA	PROJECT NO	S92
CHECKED BY		REVISION	1
DATE	25/06/2010	DRAWING NO	005

2 GROUNDWATER MONITORING

2.1 BASELINE DATA

The available groundwater baseline data include recent monitoring records from Newnes Kaolin as well as the neighboring Clarence Colliery mine.

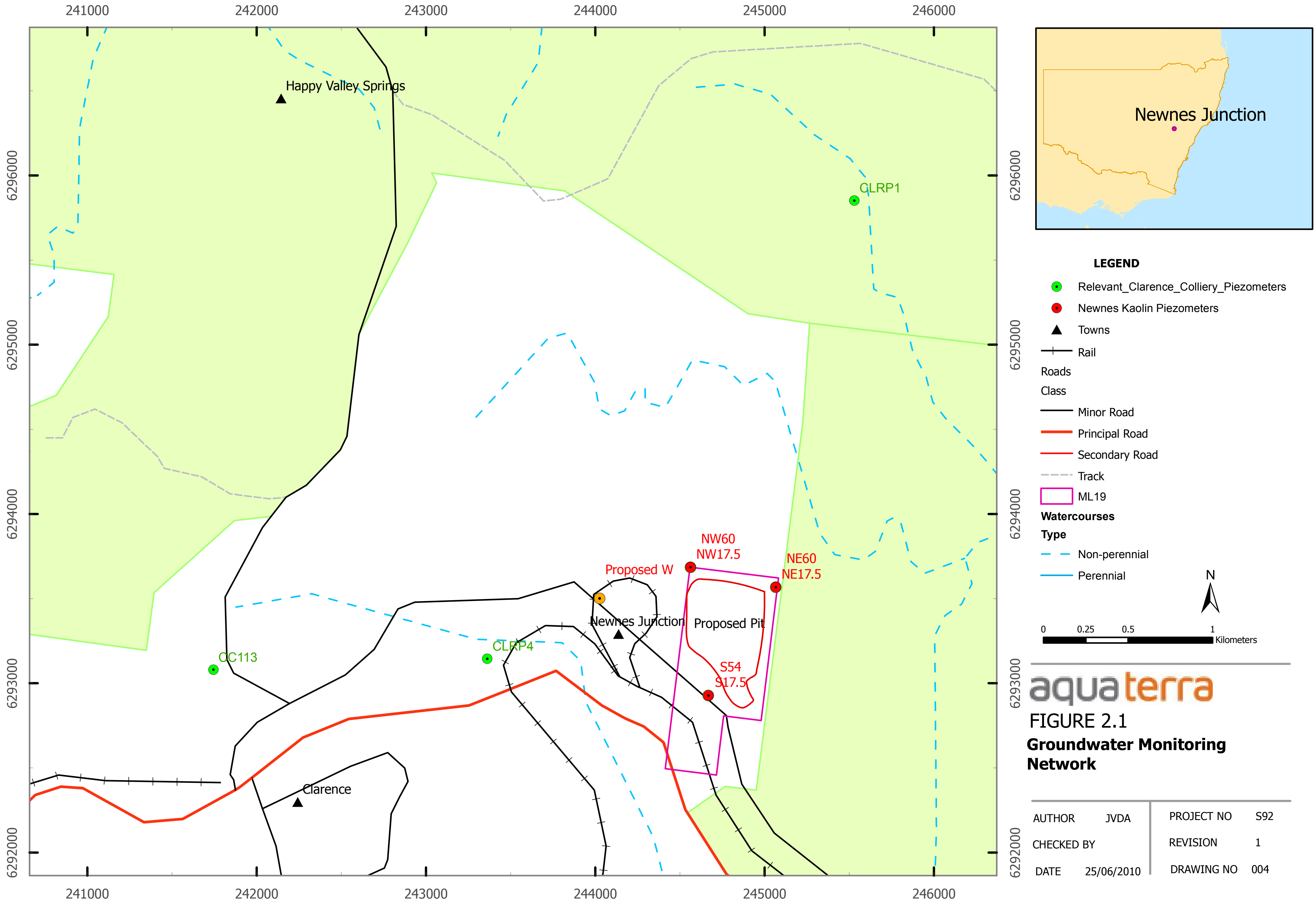
The Newnes Kaolin groundwater monitoring network includes 7 piezometers across 4 sites (**Figure 2.1, Table 2.1**). Piezometers are standpipes which target the Narrabeen Sandstone and allow monitoring for both water level and water quality. Monitoring sites NW, NE and S are located around the periphery of the proposed pit. Piezometer S54 and S17.5 are located in between the proposed Newnes Pit and the existing Rocla pit and will monitor potential impacts from both mining operations (as drawdown impacts may mutually interfere). A planned piezometer ('W') will be established about 550 m to the west of the proposed pit, following the DPI's approval of the Review of Environmental Factors. This piezometer will measure groundwater levels outside the zone of predicted drawdown.

Routine groundwater monitoring at the Newnes Kaolin site commenced in June 2010. Since that time groundwater levels have been recorded daily via water level transducers and two sets of groundwater samples were taken to analyse groundwater quality. All available monitoring data are presented in **Appendix A.1** and **A.2**.

In addition there are four existing regional piezometers (known as CLRP1, CLRP4, CLRP7, CC113) which are owned and monitored by Clarence Colliery. These bores also target the sandstone aquifer and monitor groundwater levels between Clarence Colliery and Clarence Village (**Figure 2.1**). Groundwater monitoring at Clarence Colliery has been conducted routinely since 2004.

Table 2.1: Monitoring piezometers

Bore ID	Easting (WGS84)	Northing (WGS84)	Surface RL	Installed	Depth (m)	Screen Interval	Monitoring Data since
NW60	244563	6293686	1037	2004	59.93	15-60	17/06/2010
NW17.5				2004	17.55	14.5-17.5	17/06/2010
NE60	245066	6293569	995	2004	60.35	15-60	17/06/2010
NE17.5				2004	17.53	14.5-17.5	17/06/2010
S54	244668	6292930	1059	2004	53.91	24-54	17/06/2010
S17.5				2004	17.02	14.5-17.5	17/06/2010
W	TBC	TBC	TBC	2010	TBC	TBC	



241000
242000
243000
244000
245000
246000
6296000
6295000
6294000
6293000
6292000
Happy Valley Springs
GLRP1
NW60
NW17.5
NE60
NE17.5
Proposed W
Newnes Junction
Proposed Pit
CLRP4
CC113
S54
S17.5
Clarence
Newnes Junction
LEGEND
Relevant_Clarence_Colliery_Piezometers
Newnes Kaolin Piezometers
Towns
Rail
Roads
Class
Minor Road
Principal Road
Secondary Road
Track
ML19
Watercourses
Type
Non-perennial
Perennial
N
0
0.25
0.5
1
Kilometers
aquaterra
FIGURE 2.1
Groundwater Monitoring Network
AUTHOR JVDA
CHECKED BY
DATE 25/06/2010
PROJECT NO S92
REVISION 1
DRAWING NO 004

2.1.1 GROUNDWATER LEVELS

Groundwater levels for the deep and shallow bores in the project area range from 8 to 40m below ground level and generally follow the topography, with an inferred groundwater flow direction to the north east (**Figure 2.2**). The shallow bore water levels indicate a difference in head of about 1.3 m in the S piezometers and 29 m in the NE piezometers (**Figure 2.2**). The higher groundwater level in the shallow piezometers may represent a perched water table above the ironstone band(s).

Due to the relatively short period groundwater levels have been monitored on site, the natural groundwater variations and potential influence from neighboring mining activities have not been captured yet. Continuous groundwater monitoring measurements obtained over the next 12 months, prior to mining at NKPL will be evaluated in detail to establish whether groundwater levels on site have been influenced from the Rocla quarry to the south or Clarence Colliery to the north or both.

Longer term hydrographs are available from the bores in the neighboring Clarence Colliery network, which monitor the same sandstone aquifer. In particular, bores CLRP4 and CLRP1, located approximately 2 km north and 1 km west, respectively, of the proposed pit (**Figure 2.1**), were included in the Clarence Colliery network to show seasonal trends, presumably away from the mining extraction area. However, due to the long period of time mining has occurred on the site (more than 50 years), there is no direct evidence to suggest whether mining has influenced groundwater levels in the sandstone aquifer.

The hydrographs from CLRP1 and CLRP4 have been responding to rainfall variability (shown as the cumulative deviation of rainfall) since monitoring for the Clarence Colliery began. CLRP1 shows that's groundwater levels can fluctuate by up to 5 m over the long term. CLRP1 also shows a downward trend between 2005 and 2007, during periods of below average rainfall. A recharge response from a major rainfall event in June 2007 was also evident (**Figure 2.3**).

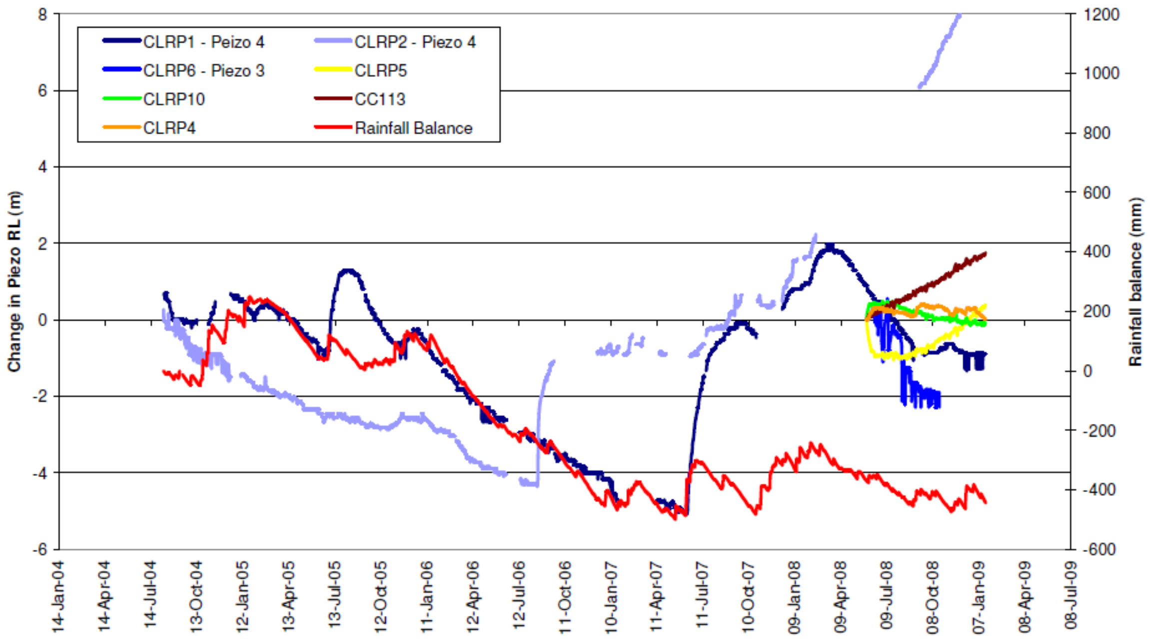
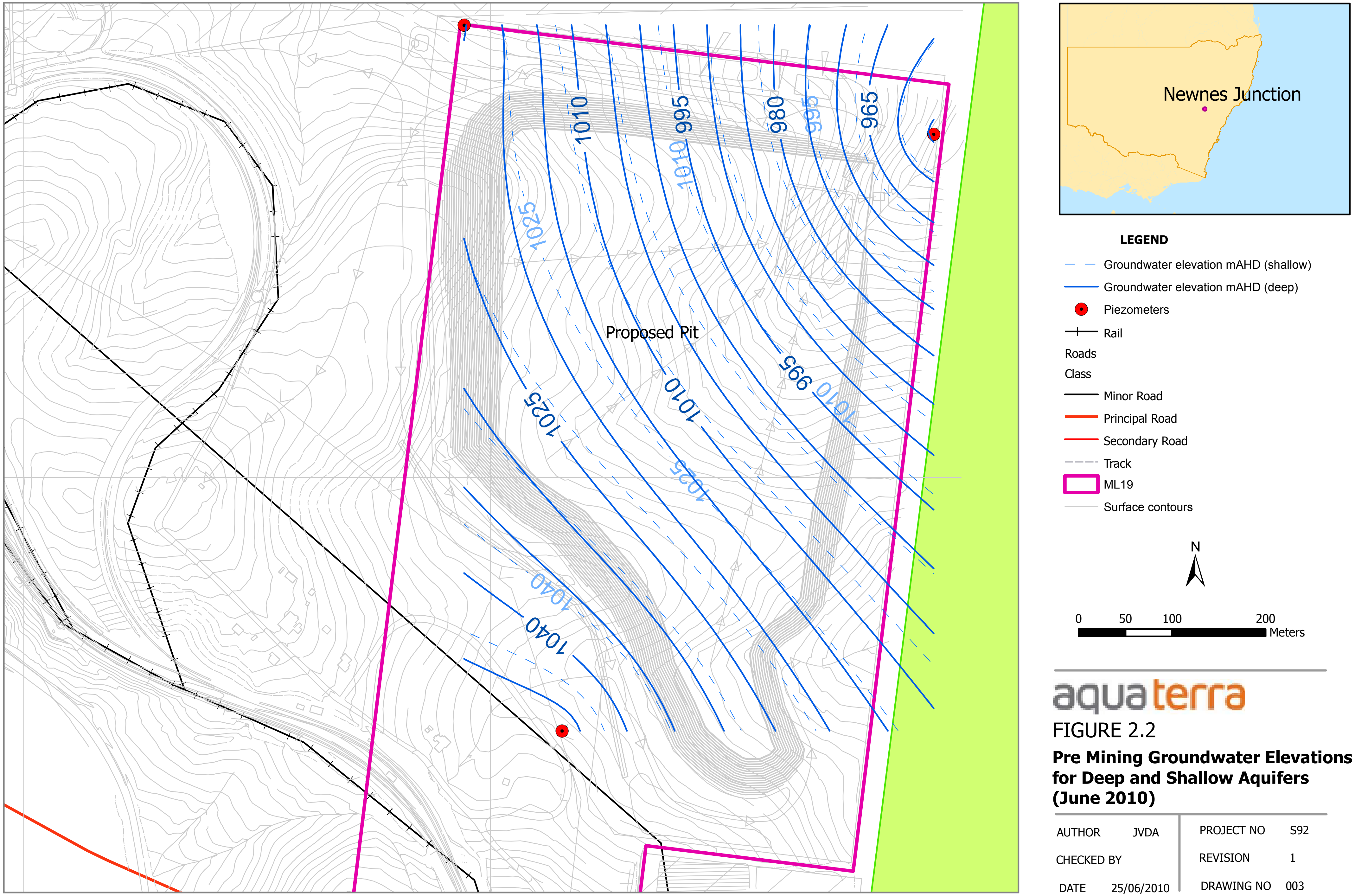


Figure 2.3: Hydrograph responses for Clarence Colliery monitoring piezometers (Source: Clarence Colliery, 2009)



aquaterra

FIGURE 2.2

Pre Mining Groundwater Elevations for Deep and Shallow Aquifers (June 2010)

AUTHOR	JVDA	PROJECT NO	S92
CHECKED BY		REVISION	1
DATE	25/06/2010	DRAWING NO	003

2.1.2 GROUNDWATER QUALITY

Groundwater samples were collected from a number of Newnes standpipes in 2004 and again in June 2010 and submitted to a NATA-accredited laboratory ALS for detailed chemical analysis. Electrical conductivity (EC) and pH were measured in the field at the time of sampling. Ongoing water quality monitoring is being undertaken to establish pre-mining baseline conditions.

The laboratory analysis results for groundwater samples collected to date are presented in **Appendix A.2** and the relevant water quality characteristics of groundwater within the ML19 area are summarised below.

Salinity

Groundwater salinity is very low, ranging from 31 – 216 mg/l. These values are consistent with groundwater salinities determined from other nearby sources, viz:

- pit seepages obtained from the neighbouring Rocla Quarry revealed a salinity range from 20 to 40 mg/l (Kalf and Associates, 2002); and
- existing licensed bores west of the site, which classified groundwater salinities as being 'fresh' (i.e. <500 mg/l).

The low EC values and low Cl^- ion values (4 to 7 mg/l) are attributed to high rainfall recharge and potentially low residence times.

pH

pH ranges from 4 to 6 in all samples and is expected in environments with fresh rainfall signatures, and aquifers with low carbonate content.

Dissolved metals

Comparison of the analysis results for dissolved metals, against the ANZECC guideline values for the 95% protection of freshwater species (ANZECC, 2000), shows a small number of exceedances of the guideline values, listed as follows:

- The copper guideline value of 0.0014 mg/L was exceeded in NW17.5 (0.02mg/l) and NE17 (0.002 mg/l).
- The zinc guideline value of 0.008 mg/L was exceeded in NW17.5 (0.028mg/l).

Dissolved iron concentrations were relatively high in NE17.5 and NW17.5 (6.8 to 9.7mg/l), compared to the other groundwater samples (<0.6mg/l), although no ANZECC guideline value is set. This and other dissolved metal exceedances are consistent with the unbuffered status of groundwater sampled in the area.

Nutrients

Sampling for nutrients revealed concentrations for Total Nitrate that exceed the default trigger level (0.9 mg/l) for freshwater ecosystems (ANZECC, 2000) in piezometer S54 (1.84 mg/l).

Elevated levels of Total Phosphorus (TP) were measured in NW17.5 (0.53mg/l) and NE17.5 (0.66mg/l), whilst elevated levels of Total Nitrogen (TN) were measured in S54 (2.2 mg/l).

2.2 IMPACT ASSESSMENT CRITERIA

2.2.1 MINE INFLOW RATES

The pit inflow rates towards the end of mining are predicted by the model to average 0.2 ML/d (2.3 L/s), and reach a maximum rate of 0.8 ML/d (9 L/s), but the major proportion of inflow will be lost to evaporation from the high walls of the pit and storages within the floor of the pit (Kalf and Associates, 2002 and Kalf and Associates, 2004).

If a mine inflow rate is substantially higher than predicted by the model may it indicate a greater impact on groundwater levels outside the predicted zone of influence.

An observed inflow rate that is 100% in excess of the predicted inflow rate at any stage during the mine life, sustained for 3 consecutive months would trigger a response plan as detailed in **Section 3.3** of this report.

Water in the pit will be derived from a combination of inputs such as groundwater inflow and rainfall/surface water runoff. Hence, long term monitoring of all components of the pit water balance (i.e. rainfall, sump discharge) is required to ascertain groundwater inflow.

It is proposed to monitor the volumes of water extracted by pumping from pit sumps estimated from pump times and pump capacity. This data can be evaluated over time, by comparing pumped discharges during rainy and dry periods, to differentiate between groundwater inflows and rainfall runoff.

2.2.2 MINE INFLOW WATER QUALITY

Surface water runoff from disturbed areas (such as the stockpile area) will be directed into the pit and flow towards a sediment control dam. Therefore as the pit water will be a mixture of both surface water runoff and groundwater inflows, the actual water chemistry of groundwater inflow alone may be difficult to determine.

Long term water quality monitoring of all components of the pit water balance (i.e. runoff and sump discharge) is required to ascertain the actual chemistry of groundwater inflow. This data can be evaluated over time, by comparing the water quality of the sump water (or pumped discharge) during rainy and dry periods, to differentiate between groundwater inflows and surface water runoff.

A rapid change to a significantly lower or higher salinity at any time might indicate a sudden increase of groundwater inflows into the mine. Likewise a sudden change to the average pH of the mine inflow water may indicate the interception of a new source of inflow or change in the groundwater regime.

The salinity and pH of pit water will be monitored throughout the mine life. An observed increase or decrease in salinity by more than 50 percent outside the baseline range sustained over a consecutive 6 month period would require a response action as detailed in **Section 3.3** of this report.

2.2.3 IMPACTS TO BASEFLOWS, GROUNDWATER DEPENDANT ECOSYSTEMS AND RIPARIAN VEGETATION

There are no major permanent watercourses and associated groundwater dependant ecosystems near the site, however two minor ephemeral creeks transect the site (**Figure 1.1).** Surface water flows in the creeks only naturally occur seasonally, with water derived from surface water runoff during high rainfall events.

The two northern creeks form part of the upper tributaries of the Wollangambe River, which flows into the Colo River. At the closest points, the creeks are located 500 m to 1000 m down-gradient of the pit, beyond the predicted zone of groundwater influence.

The hydrogeological assessment concluded that the proposed operation would not 'measurably influence surface water runoff and baseflow in Wollangambe River due to the relatively small size of the catchment', and that the proposal would only influence the water table locally, allowing the majority of deeper groundwater to reach the river drainage system.

The supplementary study also concluded that the water table drawdown would not affect local vegetation as plants rely mainly on soil moisture (Kalf and Associates, 2004). The Rocla quarry which was established in the 1970's indicates that water table drawdown around the pit has not influenced vegetation species surrounding the pit as these plants rely mainly on soil moisture conditions for survival. The same conditions are expected to apply around the proposed pit where the water table ranges from 9 to 41m below ground level.

The open cut pit will only influence the water table locally, with groundwater levels located in piezometers around the pit perimeter (S, NW and NE) predicted to record drawdown of 10 to 15 m (Kalf and Associates, 2004). Specific monitoring piezometers, such as the proposed piezometer 'W', will be maintained to detect any unforeseen impacts to groundwater levels outside the predicted zone of influence.

Specific groundwater trigger levels have been established for piezometers located close to the pit (where local drawdown impacts are predicted) and piezometers located outside the zone of influence (where no drawdown impacts as a result mining are expected), viz:

- For piezometers (NE, NW and S) located within the 500 m zone of influence, observed drawdowns substantially greater than predicted by the model (10 to 15m) may indicate a greater impact on regional groundwater and would require a response action, as detailed in **Section 3.3** of this report.
- For piezometer (W) located beyond the zone of influence, a declining trend in groundwater levels which is not attributed to climatic conditions could indicate an unexpected impact to groundwater levels by mining operations and would require a response action, as detailed in **Section 3.3** of this report.

All piezometers are being monitored (and will continue to be monitored) to benchmark pre-mining variations.

2.2.4 IMPACTS TO LICENCED USERS

In the study area, existing groundwater abstraction is limited to stock or domestic use around the township of Clarence.

A search of NOW groundwater database revealed no active licensed bores in close proximity to ML19. All the existing bores are located around the township of Clarence which is more than1.8 km away and thus beyond the predicted 500 m cone of drawdown influence of the proposed open cut.

Although mining at the site is predicted to have no influence on the groundwater system at Clarence Village, specific monitoring piezometers (i.e piezometer W located 550 m to the west of ML19) will be monitored to detect any unexpected impacts which may originate beyond the predicted cone of drawdown.

In addition, data obtained from the existing Clarence Colliery groundwater monitoring network, such as piezometers CLRP4 and CC113 located more than 1 km to the west, may also be used to monitor any groundwater impacts that would occur closer to the township of Clarence.

For piezometers outside the predicted zone of drawdown a declining trend in groundwater levels which is not attributed to climatic conditions could indicate an unexpected impact by mining operations and would require a response action, as detailed in **Section 3.3** of this report.

These piezometers are being monitored (and will continue to be monitored) to establish baseline trends in response to ambient influences.

2.3 MONITORING PROGRAM

The groundwater monitoring program that has recently commenced on the proposed Newnes Kaolin mine will be continued. It will also be integrated with the surface water monitoring program.

The groundwater monitoring program is outlined in **Table 2.2** and its key aspects include:

- Daily measurement of water levels in the existing network of piezometers (NW, NE, S and W) to be monitored through the life of the project.
- Quarterly sampling of all standpipe piezometers and the pit sump/seepages, for analysis of electrical conductivity (EC), total dissolved solids (TDS) and pH.
- Biannual collection of water samples from all standpipe piezometers and the pit sump/seepages for laboratory analysis of a broader suite of parameters
  - Physical properties (EC, TDS and pH)
  - Major cations and anions (Ca, Mg, Na, K, Cl, SO_4, HCO_3 and CO_3)
  - Nutrients
  - Dissolved metals.
- If pumping from the pit is required, record pump time to estimate the volume of mine water pumped from the open cut mine.

Table 2.2: Groundwater monitoring frequency

Bore ID	Installed	Depth (m)	Screen Interval (m)	Data since	Groundwater monitoring frequency	Water quality monitoring frequency	Purpose
NW60	2004	59.93	15-60	17/06/2010	Daily (logger)	Quarterly: TDS, EC, pH Biannual: Major ions, Metals, Nutrients	Obtain baseline data (including possible existing groundwater influences from the Clarence Colliery to the North) and monitor drawdown/water quality impacts within the predicted zone of influence.
NW17.5	2004	17.55	14.5-17.5	17/06/2010	Daily (logger)	Quarterly: TDS, EC, pH Biannual: Major ions, Metals, Nutrients	
NE60	2004	60.35	15-60	17/06/2010	Daily (logger)	Quarterly: TDS, EC, pH Biannual: Major ions, Metals, Nutrients	
NE17.5	2004	17.53	14.5-17.5	17/06/2010	Daily (logger)	Quarterly: TDS, EC, pH Biannual: Major ions, Metals, Nutrients	
S54	2004	53.91	24-54	17/06/2010	Daily (logger)	Quarterly: TDS, EC, pH Biannual: Major ions, Metals, Nutrients	Obtain baseline data (including possible existing groundwater influences from the Rocla Quarry to the south) and monitor drawdown/water quality impacts within the predicted zone of influence.
S17.5	2004	17.02	14.5-17.5	17/06/2010	Daily (logger)	Quarterly: TDS, EC, pH Biannual: Major ions, Metals, Nutrients	
W	2010	TBC	TBC	TBC	Daily (logger)	Quarterly: TDS, EC, pH Biannual: Major ions, Metals, Nutrients	Obtain baseline data and monitor impacts outside the predicted zone of influence
Pit Sump	-	-	-		Volume (when pumped)	*Quarterly: TDS, EC, pH *Biannual: Major ions, Metals, Nutrients DS, EC, pH	Determine groundwater inflow volumes and groundwater inflow quality

* Or obtain sample if significant inflows are observed.

2.4 REPORTING PROCEDURES

The following information will be included in the Annual Environmental Management Report (AEMR) in accordance with Condition 23 Schedule 3 of the Project Approval.

According to the Schedule each year from the date of this consent, the Applicant shall:

a) review, and if necessary update, the Water Management Plan; and

b) report the results of this review in the AEMR, including:

- the results of monitoring;
- details of the review for the Groundwater Monitoring Plan;
- amendments to the Groundwater Monitoring Plan; and
- details of the measures undertaken/proposed to address any identified issues.

3 GROUNDWATER RESPONSE PLAN

3.1 CONTINGENCY MEASURES

In the event of any adverse impacts or water quality degradation defined in Section 2 beyond predictions in the EIS, Newnes Kaolin Pty Ltd will:

- commission an assessment of the causes,
- develop a staged response program satisfactory to DoP to mitigate the adverse impacts, and
- attempt to establish and implement measures to limit further adverse impact.

The identification process and response protocols to potential adverse outcomes are provided in the trigger action response plan (TARP) outlined in **Table 3.1**. The responses proposed incorporate a staged assessment and development of management measures deemed appropriate for each individual event should it occur.

The EIS predictions and more recent monitoring data will provide the basis for trigger levels and take into account predicted responses to mining. Preliminary specific trigger levels have been designed to alert Newnes Kaolin Pty Ltd to observed parameter responses which are outside of normal variation and/or predicted responses, or where observed parameter values do not follow anticipated trends.

3.2 TRIGGER ACTION RESPONSE PLAN

The Trigger Action Response Plan (TARP) provides appropriate triggers and corresponding response actions for prevention or mitigation of adverse impacts to nearby water users or the natural environment as a result of mining.

The monitoring program outlined in **Section 2** has been designed to detect changes to groundwater levels, groundwater quality or inflow rates, or to indicate that an abnormal condition relating to mining has developed.

The first objective of the TARP is to benchmark the natural variation in groundwater levels and quality from the existing groundwater monitoring network.

Pre mining baseline conditions will be characterised over the next 12 months, leading up to the commencement of mining.

After baseline conditions are established, trigger levels will be revised for particular impacts at which a response is needed, and to help define an appropriate response in each case. The trigger levels detailed in **Table 3.1** are based on existing data or predicted responses to mining and currently serve as an indication.

Aspects assessed to be at risk are summarised in **Section 1.3** of this report and fully explored in the Hydrogeological Assessment Report (Kalf and Associates, 2004) and the EIS (International Environmental Consultants, 2005). These include both predicted and unpredicted impacts, and include:

- Groundwater level
- Groundwater quality
- Base flow and vegetation
- Groundwater users (private bores)
- Cumulative impacts

3.3 RESPONSE ACTION

In the event of any exceedance detailed in **Sections 2.2.1** to **2.2.3** above, the following response action would be initiated:

- Initiate immediate review of circumstances leading to exceedance event, including results of monitoring.
- Assessment undertaken to determine the likely reason(s) for the exceedance.
- If assessed as being caused by the mining operation, and it is further assessed to be likely to cause an adverse impact on an existing beneficial or environmental use of surface water or groundwater, then an appropriate preventative and/or remedial strategy would be recommended, which may comprise:
  - Additional monitoring;
  - Provision of alternative water supply or other negotiated agreement with landholders if found to be adversely impacted; or
  - (If appropriate) no change to operations.
- The above response program would be carried out in consultation with NOW and DII-Minerals.

Table 3.1: Trigger Action and Response Plan (TARP)

Aspect	Parameter	Frequency	Purpose	Trigger	Action	Responsibility	Timing	Purpose
Groundwater monitoring	Groundwater level in piezometers	Daily: logger Quarterly: manual	To provide baseline water level data and to identify any water level impacts due to mining	Piezometers: An additional drawdown of 5 m relative to the predicted EIS drawdown in groundwater levels, which is not attributed to climatic conditions	Repeat water level monitoring to confirm. Refer the matter to an independent hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week.	Inform agencies of baseline assessment and monitoring. Identify, investigate and report on impacts to groundwater levels.
	Groundwater quality in piezometers	Quarterly: pH, EC, TDS Biannual: Major Cationsand Anions, Nutrients & Dissolved metals	To provide baseline water quality data and to identify any groundwater quality impacts due to mining	An observed increase in salinity by more than 50% outside the max baseline range, sustained over a consecutive 6 month period or other parameter in excess of pre mining conditions	Repeat groundwater sampling to confirm. Refer the matter to an independent hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week	Inform agencies of baseline assessment and monitoring. Identify, investigate and report on impacts to groundwater quality.
Base flow	Groundwater level in piezometers	Daily: logger Quarterly: manual	To identify any baseflow impacts to the streams	Piezometer S, N, NE: An additional drawdown of 5 m relative to the predicted EIS drawdown, which is not attributed to climatic conditions Piezometer W: A drawdown of 5 m outside of pre-mining baseline levels, which is not attributed to climatic conditions	Repeat water level monitoring to confirm. Refer the matter to an independent hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week	Identify, investigate and report on impacts to stream flow.
	Groundwater quality in piezometers	Quarterly: pH, EC, TDS Biannual:	Identify any water quality impacts to the streams	An observed increase in salinity by more than 50% outside the max baseline range or other parameter in excess of pre mining conditions	Repeat groundwater sampling to confirm. Refer the matter to an independent hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week	Identify, investigate and report on impacts to stream water quality.

Aspect	Parameter	Frequency	Purpose	Trigger	Action	Responsibility	Timing	Purpose
		Cations, Anions, Nutrients & Dissolved metals						
Existing licensed groundwater bores	Groundwater level in piezometers	Daily: logger Quarterly: manual	To identify any water level impacts to existing users	Piezometer S, N, NE: An additional drawdown of 5 m relative to the predicted EIS drawdown, which is not attributed to climatic conditions Piezometer W: A drawdown of 5 m outside of pre-mining baseline levels, which is not attributed to climatic conditions	Repeat water level monitoring to confirm. Refer the matter to an independent hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week	Ensure adequate groundwater levels are maintained to existing users
	Groundwater quality in piezometers	Quartely: pH, EC, TDS Biannual: Cations, Anions, Nutrients & Dissolved metals	Identify any water quality impacts to existing groundwater users	An observed increase in salinity by more than 50% outside the max baseline range or other parameter in excess of pre mining conditions	Repeat groundwater sampling to confirm. Refer the matter to an independent hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week	Identify, investigate and report on water quality impacts to existing users

Aspect	Parameter	Frequency	Purpose	Trigger	Action	Responsibility	Timing	Purpose
Mine inflows	Flow rate	Record duration/rate of pump events	Identify unexpected high mine inflows and determine whether this will impact on groundwater levels off site	An observed inflow rate 100% in excess of the predicted EIS inflow rate at any stage during the mine life sustained for 3 consecutive months	Refer the matter to an hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week	Identify, investigate and report on drawdown impacts to existing users and creeks
	Water quality	Quarterly: pH, EC, TDS Biannual, unless a sudden increase in flows are encountered): Cations, Anions, Nutrients & Dissolved metals,	Identify whether a new source of groundwater inflows have been intercepted	An observed increase in salinity by more than 50% outside the baseline range, sustained over a consecutive 6 month period	Refer the matter to an hydrogeologist for review	Newnes Kaolin Environmental Officer	Inform relevant agencies within 7 days. Investigation initiated within 1 week	Identify, investigate and report on water quality impacts and determine whether a new source of inflows has occurred

4 REFERENCES

ANZECC, 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Clarence Colliery, 2009. *Clarence Colliery Partial Extraction 700 SMP Area Environmental Monitoring Program (Approval Condition 13)*, May 2009.

International Environmental Consultants, *2003. Newnes Kaolin Mine Environmental Impact Statement*, 2003.

International Environmental Consultants, *2005. Newnes Kaolin Mine Supplementary information. Prepared for the Environmental Impact Statement*, 2005.

Kalf and Associates, 2002. Hydrogeological *Assessment of Proposed Newnes Junction Kaolin Pit*, 2002.

Kalf and Associates, *2004. Supplementary Information - Hydrogeological Impact Report*, 2004.

APPENDIX A.1 BASELINE GROUNDWATER LEVELS

Groundwater levels

mbsp= metres below standpipe, mbgl = metres below ground level.

Piezometer	**NW60**		**NW17.5**		**NE60**		**NE17.5**		**S54**		**S17.5**		**W40**	
Easting (WGS84)	244563		244563		245066		245066		244668		244668			
Northing (WGS84)	6293686		6293686		6293569		6293569		6292930		6292930			
Elevation (GPS)	1037		1037		995		995		1059		1059			
Piezo Depth (mbgl)	59.93		17.545		60.345		17.53		53.91		17.02			
Standpipe height (magl)	0.52		0.36		0.44		0.39		0.54		0.42			
Depth of Diver (mbgl)														
Diver Serial Number														
Groundwater Levels	**mbsp**	**mbgl**	**mbsp**	**mbgl**	**mbsp**	**mbgl**	**mbsp**	**mbgl**	**mbsp**	**mbgl**	**mbsp**	**mbgl**	**mbsp**	**mbgl**
24/11/2004	14.88	14.38	9.67	9.17	42.9	42.4	13.47	12.97	18.1	17.6	16.5	16	-	-
17/06/2010	12.19	11.67	8.77	8.41	41.44	41.0	14.075	13.685	12.58	12.04	11.17	10.75	-	-
28/07/2010	12.44	11.92	8.99	8.63	42.15	41.71	13.86	13.47	12.75	12.21	11.37	11.17	-	-

aquaterra

APPENDIX A.2 BASELINE GROUNDWATER CHEMISTRY

Groundwater quality field parameters

Piezometer	NW60			NW17.5			NE60			NE17.5			S54			S17.5			W40			Rocla Quarry		
Easting (WGS84)	244563			244563			245066			245066			244668			244668						Pit Seepage		
Northing (WGS84)	6293686			6293686			6293569			6293569			6292930			6292930								
Depth (mbgl)	59.93			17.545			60.345			17.53			53.91			17.02								
Standpipe (magl)	0.52			0.36			0.44			0.39			0.54			0.42								
Groundwater Quality	**EC (uS/cm)**	**TDS (mg/l)**	**pH**	**EC (uS/cm)**	**TDS (mg/l)**	**pH**	**EC (uS/cm)**	**TDS (mg/l)**	**pH**	**EC (uS/cm)**	**TDS (mg/l)**	**pH**	**EC (uS/cm)**	**TDS (mg/l)**	**pH**	**EC (uS/cm)**	**TDS (mg/l)**	**pH**	**EC (uS/cm)**	**TDS (mg/l)**	**pH**	**EC (uS/cm)**	**TDS (mg/l)**	**pH**
6/06/2000																						35		4.6
24/11/2004	30.6		4.1	-		-	40.5		4.4	-		-	150		6.2	-		-						
17/06/2010	32.9	**31**	5.1		**216**	**4.75**	39.2	**30**	5.17		**176**	**4.65**	48.6	**45**	5.45		**41**	**5.31**						
27/7/2010	142	95	5.1	296	198	5.1	88	59	5.09	36.8	25	5.04	51.2	34	5.21	33.4	22	5.4						

Bold values = ALS laboratory results

In Australia

Perth
Suite 4
125 Melville Parade
Como WA 6152
Tel +61 8 9368 4044
Fax +61 8 9368 4055
perth@aquaterra.com.au

Adelaide
Ground Floor
15 Bentham Street
Adelaide SA 5000
Tel +61 8 8410 4000
Fax +61 8 8410 6321
adelaide@aquaterra.com.au

Sydney
Suite 9
1051 Pacific Highway
Pymble NSW 2073
Tel +61 2 9440 2666
Fax +61 2 9449 3193
sydney@aquaterra.com.au

Echuca
Unit 1
213 Anstruther Street
Echuca VIC 3564
Tel +61 3 5480 3140
Fax +61 3 5480 3140
echuca@aquaterra.com.au

In Europe

Lewes
Cobbe Barns
Beddingham, Lewes
East Sussex BN8 6JU
United Kingdom
Tel +44 1273 858 223
Fax +44 1273 858 229
lewes@aquaterra.uk.com

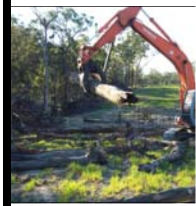
Dublin
Sandyford
PO Box 11580
Dublin 18
Ireland
Tel +35312069920
Fax +35312069920
dublin@aquaterra.ie

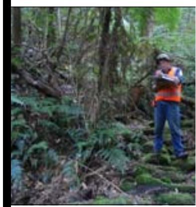
In Mongolia

Ulaanbaatar
701 San Business Center
8th khoroo
Sukhbaatar District
Ulaanbaatar
Mongolia
Tel +976 95854921
ub@aquaterra.mn

aquaterra
Water and Environment








APPENDIX B

ANALYSIS AND TESTING REPORT

REPORT TO : Clarence Sand Quarry
Suite 701, 100 Christie Street
St Leonards, NSW 2065
Attn: Ron Goldbery

REPORT ON : **WATER ANALYSIS**
July 2010

AUTHORISATION : Order No. N/A

REPORT No 24003085

SAMPLED BY : S. Slaven

SAMPLED ON: 08/07/2010

PREPARED BY : A. Hernández

DATE REPORTED : 19th July, 2010

Electrical conductivity, pH andTSS analyses performed at ACIRL Lithgow, Unit 3, 16 Donald St, Lithgow, N.S.W. 2790.

The remaining water analyses performed at ALS Environmental, 277-289 Woodpark Rd, Smithfield, N.S.W 2164.

Adriana Hernández
Environmental Scientist

WATER ANALYSIS AND TESTING REPORT

Clarence Sand Quarry

Analyte grouping/Analyte	Units	South Drain u/s	South Drain d/s	North Drainage
Date sampled		8/07/2010	8/07/2010	8/07/2010
Comments		Dry, no flow	Clear, low flow	Clear, low flow
ph	ph unit	_	5.85	5.33
Electrical Conductivity	uS/cm	_	25	26
Total Suspended Solids	mg/L	_	4	4
Temperature	C	_	9.4	10.2
Dissolved Metals by ICP-MS				
Arsenic	mg/L	_	<0.001	<0.001
Beryllium	mg/L	_	<0.001	<0.001
Barium	mg/L	_	0.072	0.008
Cadmium	mg/L	_	<0.0001	<0.0001
Chromium	mg/L	_	<0.001	<0.001
Copper	mg/L	_	0.038	<0.001
Cobalt	mg/L	_	<0.001	<0.001
Nickel	mg/L	_	0.002	<0.001
Lead	mg/L	_	<0.001	<0.001
Zinc	mg/L	_	0.032	0.009
Manganese	mg/L	_	0.009	0.004
Iron	mg/L	_	<0.05	<0.05
Mercury	mg/L	_	<0.0001	<0.0001

WATER ANALYSIS AND TESTING REPORT

Clarence Sand Quarry

Analyte grouping/Analyte	Units	South Drain u/s	South Drain d/s	North Drainage
Total Metals by ICP-MS				
Arsenic	mg/L	_	<0.001	<0.001
Beryllium	mg/L	_	<0.001	<0.001
Barium	mg/L	_	0.006	0.052
Cadmium	mg/L	_	<0.0001	0.0002
Chromium	mg/L	_	<0.001	<0.001
Copper	mg/L	_	0.002	0.062
Cobalt	mg/L	_	0.001	<0.001
Nickel	mg/L	_	<0.001	0.001
Lead	mg/L	_	<0.001	<0.001
Zinc	mg/L	_	0.008	0.059
Manganese	mg/L	_	0.016	0.004
Iron	mg/L	_	0.06	<0.05
Mercury	mg/L	_	<0.0001	<0.0001
Oil & Grease	mg/L	_	<5	<5
Biochemical Oxygen Demand	mg/L	_	<2	<2

METHOD OF WATER ANALYSIS

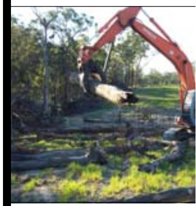
TEST	METHOD	LABORATORY	
		ACIRL Lithgow	ALS Sydney
Dissolved Metals by ICP-MS	EG020F		X
Total Metals by ICP-MS	EG020T		X
Dissoved Mercury by FIMS	EG035F		X
Total Recoverable Mercury by FIMS	EG035T		X
Electrical Conductivity uS/cm	CBM 544	X	
pH value	CBM 544	X	
Total Oil & Grease mg/L	EP020		X
Total Suspended Solids (mg/l)	CBM 503	X	

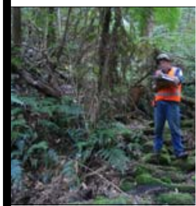
In accordance with "Standard Methods for the Examination of Water & Wastewater" APHA, AWWA, WEF 21st Edition 2005, and Water & Wastewater Examination Manual (V. Dean Adams)

ACIRL Report No: 24003085
ALS Report No: ES1013476

Preservation procedures in accordance with AS/NZS 5667/1 1998 when sampled by ACIRL staff unless otherwise stated.








APPENDIX C

Managing Director:
ROD MASTERS
M Sc, Dip App Sci. (Agric) Dip Geo

General Manager:
ANDREW HUTTON
B Nat Res, M.Bus Env Man.

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Senior Project Managers:
CRAIG BAGNALL
B E (Env) (Hons)

CHAD STOCKHAM
B E (Env) (Hons)

NICOLE ARMIT
B.E (Env) (Hons), M.Env.Law

GSSE REF NO SCM01-003

29th November 2010

Att: Ron Goldbery
Sydney Construction Materials
3 Karingal Court
Marsfield NSW 2122

Dear Ron,

RE: Newnes Junction Sand & Kaolin Extraction Project

GSSE has investigated the ability of the proposed project to comply with Condition 2a of the *EPBC Act* approval dated 22nd August 2006. Condition 2a requires that the water management system must retain on-site at least a 1 in 500 year 72 hour storm event for all disturbed areas of the site at all stages in development.

The 1 in 500 year 72 hour rainfall depth for the site is estimated to be 405mm (average intensity 5.62mm/hr). This was estimated using the IFD calculation procedure in accordance with Book II Australian Rainfall & Runoff (2001). To determine the runoff volumes GSSE assumed a runoff coefficient of 0.5 for site preparation stage and 0.9 for operation stages, and that the runoff from all disturbed areas would be contained on-site. The estimated runoff volumes are displayed below.

RUNOFF VOLUMES

Development Stage	Catchment Area (all disturbed areas) Ha	Runoff Volume (500yr ARI 72hr) ML
Prep	16.5	33.4
1	17	62.0
2	22.5	82.0
3	24.4	88.9
4	24.4	88.9

The pit volumes were calculated by RPS based on a revised pit layout which maintained a 100 m buffer to the World Heritage Area, and also included a reduced excavation footprint in the north-east corner of site which enabled an effective bund (i.e. low wall) to be maintained along the entire eastern boundary and a significant increase in pit volume retention for Stage 4. The catchment areas are based on the revised staged layouts shown in the drawings by RPS dated 25/11/2010 (ref: 105716-14A). The estimated available pit volumes are displayed below.

PIT VOLUMES

Development Stage	Available Pit Volume ML
Prep	9.6
1	88.0

2	**160.0**
3	**225.0**
4	**819.0**

GSSE also assumed there would be maximum runoff storage available in the lower retention pond, and only minimal runoff storage available in the main retention pond. Available runoff storage in the main retention pond was determined as the total pond capacity minus the sediment storage zone and water supply storage zone. The estimated available retention pond storages are displayed below.

RETENTION POND VOLUMES

Development Stage	Available Lower Retention Pond Storage ML	Available Main Retention Pond Storage ML	Total Available Retention Pond Storage ML
Prep	**10.0**	**17.3**	**27.3**
1	**10.0**	**5.2**	**15.2**
2	**10.0**	**8.0**	**18.0**
3	**10.0**	**5.0**	**15.0**
4	**0.0**	**2.5**	**2.5**

Based on the results of the above investigations, the water management system proposed (in conjunction with the revised pit layout) is sufficient to fully contain the runoff from a 1 in 500 year 72 hour rainfall event for all stages in development. A comparison of runoff and total storages available is shown below. The results show that in all stages the total available storage exceeds the runoff volume.

STORAGE VOLUME V RUNOFF VOLUME

Development Stage	Total Available Storage (Pit, Lower Retention Pond and Main Retention Pond) ML	Runoff Volume (500yr ARI 72hr) ML
Prep	36.9	33.4
1	103.2	62.0
2	178.0	82.0
3	240.0	88.9
4	821.5	88.9

Based on the above, GSSE is satisfied the Newnes Junction Sand & Kaolin Extraction Project is able to comply with Condition 2a of the *EPBC Act* approval dated 22nd August 2006. The final Water Management Plan for the project will incorporate the details above.

Please contact me on 0407 288 970 or 02 4929 3039 if you required any further information in relation to the above.

Regards,

Chad Stockham
Associate
Environmental Engineer

GSS Environmental