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Karuah East Quarry Project

Water Management Plan

Report Number 630.11235-R4

December 2015

Karuah East Quarry Pty Limited
PO Box 3284
Thornton NSW 2322

Version: Revision 0

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Karuah East Quarry Project

Water Management Plan

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Reference	Status	Date	Prepared	Checked	Authorised
630.11235-R4	Revision 0	1 December 2015	Nathan Archer	Chris Jones	Chris Jones
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630.11235-R4	Revision 0	14 September 2015	Nathan Archer	Chris Jones	Chris Jones

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Karuah East Quarry Pty Ltd (Karuah East, the Proponent) to prepare a Water Management Plan (WMP) to satisfy the requirements of the Project Approval (PA 09_0175) granted on 17 June 2014 for the Karuah East Quarry Project (the Project).

The WMP has been prepared with reference to the following documents:

- *Environmental Assessment Report – Proposed Karuah East Hard Rock Quarry* prepared by ADW Johnson Pty Ltd dated 31 January 2013 (hereafter referred to as the EA);
- *Preferred Project Report – Proposed Karuah East Quarry* prepared by ADW Johnson Pty Ltd dated 30 July 2013 (hereafter referred to as the PPR);
- *Surface Water Assessment – Hard Rock Quarry Karuah East, NSW* prepared by GSS Environmental (GSSE, now SLR) dated 2 November 2012 (hereafter referred to as the SWA);
- *Revised Surface Water Assessment – Hard Rock Quarry Karuah East, NSW – MP 09_0175* prepared by GSS Environmental (GSSE, now SLR) dated July 2013 (hereafter referred to as the revised SWA);
- *Proposed Karuah East Hard Rock Quarry, Groundwater Study – Groundwater Impact Assessment* prepared by Coffee Geotechnics dated 26 November 2012 (hereafter referred to as the GWA);
- Project Approval 09_0175;
- Environment Protection Licence (EPL) 20611; and
- Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2E, Mines and Quarries (the Blue Book) (DECC, 2008).

1.1 Consultation for this Management Plan

This WMP has been prepared as per Schedule 3 Condition 21 of the Project Approval (PA) which required this plan to be prepared in consultation with the Department of Primary Industries – Water (DPI-Water, formally NSW Office of Water) and the Environment Protection Authority (EPA).

A copy of the WMP was provided to DPI - Water and the EPA for comment on 15 September 2015. DPI Water (Mitchell Isaacs) replied to Karuah East in a letter dated 23 September 2015 stating they have reviewed the WMP and have no further comment regarding the plan.

A full copy of this response from DPI-Water is attached as **Appendix A1**.

The EPA (Karen Marler) responded to Karuah East by email on 14 October 2015 stating that they do not approve management plans. They responded that:

The EPA encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, the EPA does not review these documents as our role is to set environmental objectives for environmental management, not to be directly involved in the development of strategies to achieve those objectives.

A full copy of this response from EPA is attached as **Appendix A2**.

Karuah East consulted with the EPA during the application for an EPL for the Project.

The WMP was submitted to the DP&E for review on 16 October 2015. The WMP has been updated to incorporate all comments received. The DP&E's review is attached as **Appendix A3**.

2 STATUTORY REQUIREMENTS

2.1 Relevant Legislation and Guidelines

The key legislation and guidelines applicable to water management are:

- The Water Act 1912 and the Water Management Act 2000;
- Water Management (General) Amendment (Aquifer Interference Regulation 2011) under the Water Management Act 2000;
- State Environmental Planning Policy (SEPP) 14 – Coastal Wetlands;
- Protection of the Environment Operations Act 1997;
- Hunter – Central Rivers Catchment Action Plan 2006;
- Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2E, Mines and Quarries (the Blue Book) (DECC, 2008);
- NSW State Rivers and Estuaries Policy;
- NSW Farm Dams Policy;
- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ 2000);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000);
- Australian Drinking Water Guidelines (ADWG) (AHMRC 2011); and
- NSW Department of Primary Industries (DPI) – Water – previously the Office of Water (NOW) – Guidelines for Riparian Corridors (controlled activities).

2.2 Project Approval Requirements

The WMP forms part of the Environmental Management Strategy (EMS) for the project and has been prepared in accordance with the operating conditions provided in Schedule 3 Condition 21 of the PA and as summarised in **Table 1**.

Table 1 Project Approval (PA 09_0175) Requirements

Condition	Requirement	Relevant Section
Schedule 3 – Environmental Performance Conditions		
18	The Proponent shall ensure it has sufficient water during all stages of the project, and if necessary, adjust the scale of quarrying operations on site to match its available supply.	The water balance has been designed to ensure sufficient water capacity for the Project.
19	The Proponent shall comply with the discharge limits in any EPL, or with Section 120 of the POEO Act.	See Section 8.1.1 of this report.
Water Management Plan		
21	The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must:	This document will be sent to DP&E for approval
21(a)	Be prepared in consultation with EPA and NOW by a suitably qualified and experienced person/s whose appointment has been approved by the Secretary;	This document was sent to EPA and NSW Department of

Condition	Requirement	Relevant Section
		Primary Industries (DPI) – Water (see **Section 1.1**). The management plan team was appointed by DP&E on 22/7/2015.
21(b)	Be submitted to the Secretary for approval prior to the commencement of construction activities;	This document was sent to Council and EPA for comment on 15 September 2015 (see **Section 1.1**)
21(c)	Include:	
	(i) A Site Water Balance that includes details of: • Sources and security of water supply, including contingency planning; • Water use on site; and • Measures that would be implemented to minimise use of clean water and maximise recycling of dirty water on the site;	Section 7
	(ii) A Surface Water Management Plan, that includes: • Baseline data on surface water flows and quality in the water courses that could be affected by the project; • A detailed description of the surface water management system on the site, including the design objectives and performance criteria for the: - clean water diversions - erosion and sediment controls - water storages (including Maximum Harvestable Rights requirements); and - control of water pollution from areas of the site that have been rehabilitated; • Surface water impact assessment criteria, to be developed following analysis of baseline data, including trigger levels for investigating any potentially adverse surface water impacts; • A program to monitor: - Any surface water discharges; - The effectiveness of the water management system; - Surface water flows and quality in local watercourses; and - Ecosystem health of local watercourses; and • An assessment of appropriate options to improve storage and retention times in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom);	Section 6 Section 8
	(iii) A Groundwater Monitoring Program that includes: • Baseline data of groundwater levels surrounding the site; • Groundwater impact assessment criteria, to be developed following analysis of baseline data, including trigger levels for investigating any potentially adverse groundwater impacts; and • A program to monitor and/or validate the impacts of the project on groundwater resources; and	Section 5 Section 8.2
	(iv) A Surface and Ground Water Response Plan that describes the measures and/or procedures that would be implemented to: • Respond to any exceedances of the surface water impact assessment criteria and groundwater impact assessment criteria; and	Section 9 Appendix A - TARP

Condition	Requirement	Relevant Section
	• Mitigate and/or offset any adverse impacts on surface water and groundwater resources located within and adjacent to the site.	
Schedule 5 – Environmental Management, Reporting and Auditing		
Management Plan Requirements		
3	The Proponent shall ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include:	Whole of document
3(a)	Detailed baseline data	Section 4 and 5
3(b)	A description of: • The relevant statutory requirements (including any relevant approval, licence or lease conditions); • Any relevant limits or performance measures/criteria; and • The specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;	Section 2
3(c)	A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	Section 6-9
3(d)	A program to monitor and report on the: • Impacts and environmental performance of the project; and • Effectiveness of any management measures (see (c) above);	Section 8 Section 8.2.4
3(e)	A contingency plan to manage any unpredicted impacts and their consequences;	Section 9 Appendix A
3(f)	A program to investigate and implement ways to improve the environmental performance of the project over time;	Section 10
3(g)	A protocol for managing and reporting any: • Incidents; • Complaints; • Non-compliances with statutory requirements; and • Exceedances of the impact assessment criteria and/or performance criteria; and	Section 10 EMS
3(h)	A protocol for periodic review of the plan.	Section 10.4

2.3 Environment Protection Licence Requirements

The EPA regulates the operations conducted at the Project site through an Environment Protection Licence (EPL 20611) issued under the *Protection of the Environment Operations Act 1997 (POEO Act*).

There are several conditions relating to water management in the EPL which have been covered under this WMP. Specific conditions relating to water management are summarised below:

Table 2 Summary of EPL Requirements

Condition Number	Summary of Condition	Comment/Section Covered in this Plan
P1.3	Summary of the three licensed discharge points associated with the Project	Section 6.1.2
L1.1	General condition relating to Protection of the Environment Operations Act 1997	General environmental management condition. All operations at site are to be undertaken in accordance with the PEO Act legislation.

Condition Number	Summary of Condition	Comment/Section Covered in this Plan
L2.4	Outlining LDP criteria	Section 8.1.1
M2.3	Summary of monitoring frequency for discharge events	Section 8.1.2

There are other conditions in the EPL relating to incident management and reporting which are included in this management plan.

2.4 Water Extraction Licences

There are no extraction licenses associated with the Karuah East Project.

3 PROJECT DESCRIPTION

3.1 Overview

Hunter Quarries currently extract hard black andesite material from its existing quarry operation on adjoining lands. Approval was granted for this designated development on the adjoining land (Lot 21 DP 1024341, Lot 11 DP 1024564 and Lot 12 DP 1024564) by the Minister as State Significant Development on 3rd June 2005 (DA265/10/2004).

The existing Karuah Quarry currently operates under development approval DA 265/2004 and is approved to extract up to 500,000 tonnes per annum (tpa) of 'andesite' basalt material suitable for use as road base, construction aggregate and concrete batching, among various other applications.

Following exploratory works adjacent to the existing approved quarry, additional resource has been identified to the east on land owned by the Proponent (Project site). On 17 June 2014, the approval (09_0175) was granted by the Planning Assessment Commission on behalf of the Minister for Planning and Environment for the extraction of this additional resource through the development of Karuah East, a stand-alone operation to the existing quarry. Federal Approval (EPBC 2014/7282) was granted for Karuah East under the Environment Protection and Biodiversity Conservation Act (EPBC Act 1999) on 20 March 2015.

3.2 Project Site

The Project site is located on Lots 12 and 13 DP 1024564, off the Pacific Highway, approximately 3 km north of Karuah NSW.

The approved Project includes the following key elements:

- Staged extraction of approximately 29 million tonnes of "andesite" over a 20 year timeframe;
- Extraction of up to 1.5 million tonnes of andesite material per year;
- Removal and stockpiling of an estimated 380,000 m^3 of overburden (approximately 750,000 tonnes) from the quarry extraction area in accordance with the Rehabilitation Plan prepared for the project. Removal of overburden is not included in the proposed extraction rate of 1.5 million tonnes of andesite annually;
- Haulage of up to 1.5 million tonnes of andesite per year from the site to market by 25 to 30 tonne haul trucks via the Pacific Highway;
- Up to 216 truck loads per day (at maximum production);
- Implementation of water management and erosion and sediment control works to ensure no loss of sediment, dust minimisation and to control discharges from the site to ensure that all discharges are within acceptable volumetric and water quality criteria;

- Roadworks to secure access to the site including upgrade & extension of Blue Rock Lane, realignment of Andesite Road & Blue Rock Lane intersection and adjust road markings at Branch Lane & Andesite Road intersection;
- Employment of 28 on-site staff;
- Construction of new haul road and access through adjoining RMS land;
- Staged clearing;
- Drilling and blasting activities;
- Loading and hauling of extracted material;
- Crushing and screening of extracted material;
- Stockpiling of material on-site; and
- Location of plant on Lot 13 comprised of office buildings, workshops, parking areas, crushing plant, wash plant, weigh bridge and product storage areas.

Figure 1 presents the Project site plan and layout. A location of key water management features associated with the Project is outlined in **Figure 4**.

N

LANE

BRANCH

4
D.P.838128

5
D.P.838128

10
D.P.1032636

PROPOSED
QUARRY (14.4 Ha)

201
D.P.1042537

13
D.P.1024564

1
D.P.1032636

EXISTING
VEGETATION TO BE
RETAINED

EXISTING
DAMS

CRUSHING
PLANT

EXISTING HOUSE
& SHED

11
D.P.1024564

14
D.P.1024564

12
D.P.1024564

EXISTING
VEGETATION TO BE
RETAINED

2
D.P.1032636

202
D.P.1042537

21
D.P.1024341

26
D.P.1024341

27 D.P.1024341

ENTRANCE ROAD

MAIN OFFICE &
CARPARK

1 D.P.719493

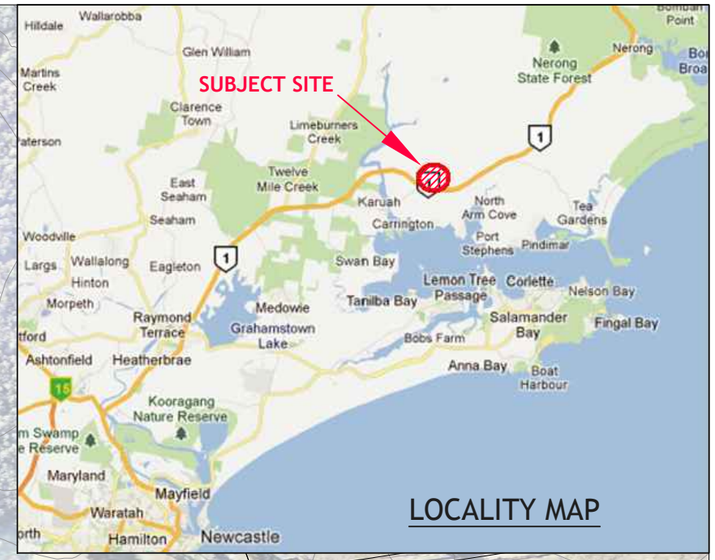
PACIFIC

16 D.P.1024564

HIGHWAY

17 D.P.1024564

18 D.P.1024564



0m 50 100 200 400

Bar Scale 1: 8000 (A3)

(R) RIGHT OF CARRIAGEWAY 10 WIDE (DP.838128)
(S) EASEMENT FOR OVERHEAD POWER RETICULATION 10 WIDE (DP.838128)

NOTE:
Data within this drawing was provided by ADW Johnson 2015 for use in SLR report. Some edits to original ADW drawing have been made by SLR for clarity.
Background aerial photograph sourced from NearMap

LEGEND

- PUBLIC ROAD ACCESS (THE BRANCH LANE)
- EXISTING QUARRY ACCESS (ANDERSITE ROAD)
- EXISTING ACCESS ROAD (BLUE ROCK LANE)
- PROPOSED ACCESS ROAD (BLUE ROCK LANE) EXTENSION
- PROPOSED PRIVATE ACCESS WITHIN LOT 12
- PROJECT APPROVAL AREA
- ADJACENT LOT BOUNDARIES
- PROPOSED DISTURBANCE AREA

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Karuah East Quarry - Site and Locality Plan

FIGURE 1

4 EXISTING SURFACE WATER ENVIRONMENT

4.1 Rainfall / Climate

The PA Area is situated in the Karuah River Valley within the temperate climatic zone of eastern Australia. The climate in the region is characterised by humid sub-tropical weather with warm summers and mild winters and no definitive dry season (Bureau of Meteorology (BOM), 2010).

Long term climate statistics have been sourced from the Tahlee (Carrington (Church Street)) BOM station (station number 61072), located approximately 4.5 km from the PA Area, which has operated since 1887. Data collected from this station show the highest temperatures occur throughout December, January and February, with the coolest temperatures occurring in July. Autumn, winter and spring are generally mild.

Low pressure systems pass at regular intervals bringing milder temperatures and winds from the southerly quadrant. The climate is also strongly influenced by oceanographic factors due to the close proximity to the coast (BOM, 2010). The climate is highly variable being influenced by substantial mountain ranges to the west.

Whilst rainfall is reasonably well distributed throughout the year; there is a slight peak in autumn and early winter and marginally lower rainfall in spring. On average, June is the wettest month of the year and September is the driest. **Table 3** contains the rainfall statistics for the 10th percentile (dry), 50th percentile (average) and 90th percentile (wet) rainfall years from the Tahlee BOM station.

Table 3 Annual Rainfall Statistics (BOM station No. 61072)

Statistic	Rainfall
10th Percentile (dry year)	829 mm
50th Percentile (median year)	1154 mm
90th Percentile (wet year)	1630 mm

Given the long term data available from the Tahlee BOM station and the location in close proximity to proposed location of the quarry, it is considered suitable for the undertaking of a detailed water balance for the Project, as well as in the design of appropriate sediment and erosion control structures for the site. A meteorological station will be installed for the Karuah East Project to meet the requirements of Condition M1 of the EPL.

4.2 Topography

The PA Area is situated in the Karuah River Basin, on the south east facing slopes of a small mountain up to 150 m AHD and associated ridgeline falling to the south. Regional topography is irregular being defined by isolated mountains and ridges up to 170 m AHD falling steeply to tidal mudflats adjacent to the Karuah River and rolling hills and ridges further from the Port Stephens estuary. Elevations within the PA Area range from 40 to 150 m AHD, with slopes ranging from approximately 4% in the lower areas up to 40% in the upper slopes of the PA Area.

4.3 Surrounding Land Uses

The PA Area is located within a predominantly rural environment, and is closely surrounded by forested areas. To the north beyond the edges of this forested area lie predominantly agricultural and grazing lands. The Pacific Highway is situated immediately to the south of the PA Area, beyond which lies an extensive forested area surrounding an adjacent mountain. There are also SEPP 14 listed coastal wetlands and tidal mudflats surrounding Yalimbah and Bulga Creeks adjacent to this mountain, downstream of the PA Area. The Karuah Nature Reserve and Port Stephens – Great Lakes Marine Park are also downstream of the PA Area. The existing Karuah Hard Rock Quarry and processing area is located immediately to the west of the PA Area.

A number of small access trails traverse the PA Area and adjacent lands. There is also an existing powerline easement running north to south following the ridgeline through Lot 13.

The closest urban development lies approximately 3 km to the south east comprising of the suburbs of Carrington, Tahlee and North Arm Cove. These suburbs lie beyond the northern ridgelines of the adjacent mountain and are not within the line of sight of the development.

4.4 Soils / Geology

A Soil Assessment of the PA Area was conducted by GSSE as part of the preparation of the Environmental Assessment for the Project. This assessment identified three (3) soil types within the PA Area; Brown Chromosols, Red Dermosols and Leptic Tenesols.

The Brown Chromosol soil unit generally consists of sandy loams overlying a clay subsoil. These weak to moderately structured soils range from slightly acid to moderately acid at depth and are non-saline. The topsoil and subsoil are non-sodic. These soils cover approximately a third of the PA Area and are present on the lower slopes to the south.

The Red Dermosol soil unit generally consists of dark yellowish brown to yellowish red clay, and are slightly acidic with low fertility. The topsoil and subsoil are sodic to moderately sodic, and are non-saline. These Dermosols exist throughout the site, covering approximately 15% of the PA Area.

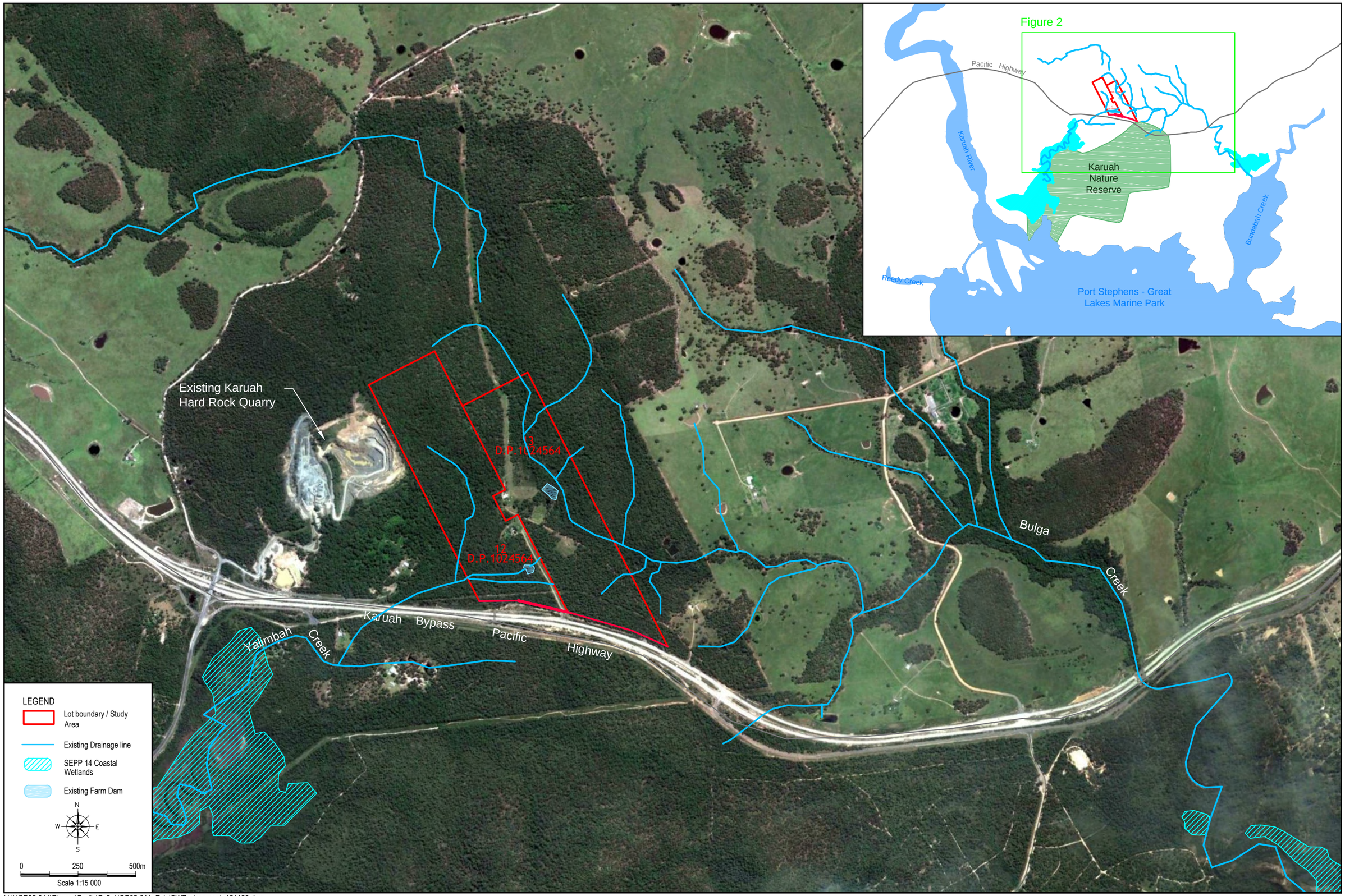
The Leptic Tenosol soil unit covers over half of the PA Area, and consists of shallow, moderately drained sandy clay loams which have developed on crests and slopes around the Area. These soils are moderately to slightly acidic, are non-saline and fertility is low to very low, and are predominately in the proposed extraction area for the quarry.

In regional geology terms, the rock being quarried belongs to the Myall Block in the Tamworth Belt of the New England Orogen. The site forms part of what is known as the Nerong Volcanics, which are carboniferous siliceous volcanic flows of the rhyolitic and dacitic ignimbrites with occasional flows of tuffaceous sandstone and conglomerate.

4.5 Surface Hydrology

4.5.1 Regional Hydrology

The PA Area lies within the Karuah River / Great Lakes catchment which covers an approximate 4,500 km^2. The catchment is bordered by the Manning River catchment to the north and the Hunter River to the south and west. The system comprises three (3) major systems including the Karuah River, the Great Lakes system and the Myall River. Major tributaries of the Karuah / Great Lakes system include the Wallamba, Wallingat, Wang Wauk and Coolongolook Rivers which drain to Wallis Lake. The Karuah River flows for approximately 90 km from the foothills of the Barrington Tops mountain range to the Port Stephens estuary, discharging an approximate 1,500,000 ML per year (Department of the Environment, Water, Heritage and the Arts, 2010). The existing surface water management in the area is outlined in **Figure 2**.



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GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Existing Surface Water Environment

FIGURE 2

The Karuah and Myall Rivers run roughly parallel within adjacent valleys, reflecting the topographic features of the regional catchment with strong north-south trending ridgelines in the upper catchment. Rolling ridges and floodplains dominate the lower catchment of the Karuah River which is characterised by wide river valleys. The upper reaches of these rivers are dominated by narrow, steep sided valleys and mountainous terrain. The valleys of the Karuah and Myall Rivers rise slowly westward from the coast with elevations reaching up to 800 m in the North West margin of the catchment.

4.5.2 Local Hydrology

The existing surface water environment within and surrounding the PA Area is illustrated on **Figure 2**.

The PA Area is situated along a ridge top in the upper catchments of the Yalimbah and Bulga Creeks. The catchment divide lies along the ridge top running north-south through the PA Area. Yalimbah Creek lies to the south west of the PA Area and flows into Port Stephens via SEPP 14 listed wetlands, which are located approximately 1 km downstream of the PA Area, as illustrated on **Figure 2**. Bulga Creek flows to the east of the PA Area through agricultural land before also flowing into Port Stephens via SEPP 14 listed wetlands, approximately 3.5 km downstream of the PA Area.

The proposed extraction area is characterised by a mostly steep, heavily forested landscape. The majority of this area lies within the Yalimbah Creek catchment draining to the south west, with only a small portion of the area draining to the east and into the Bulga Creek catchment. The land where the office facilities, processing area and stockpiles are proposed for construction comprises mostly open pasture with scattered stands of eucalyptus, and lies within the Bulga Creek catchment.

Three (3) ephemeral first order watercourses (according to the Strahler numbering system) lie within the western half of the PA Area (Lot 12), named ephemeral drainage lines 1, 2 and 3 for the purposes of this assessment, as labelled on **Figure 4**. These drainage lines meander through the predominantly forested catchment of the area. They have an intermittent low flow channel with poorly defined bed and banks, two (2) flowing in a westerly direction, and one (1) to the south west, ultimately joining Yalimbah Creek.

4.6 Existing Surface Water Quality

Baseline water quality data was obtained during the GSSE site visit in August 2010. Water sampling was undertaken in accordance with the *Australian Guidelines for Water Quality Monitoring and Reporting* (PIMC & NRMMC, 2000). Samples were taken from within the second order drainage line in the east of the PA Area and the adjacent farm dam. A sample was also obtained from within the existing farm dam in Lot 12. Results of this preliminary baseline water quality sampling are presented in **Table 4.**

Table 4 Results of Baseline Water Quality Sampling

Parameter	Unit	Sample Site			ANZECC Guidelines[3]
		Farm Dam – Lot 13[1]	Second Order Drainage Line	Farm Dam – Lot 12[2]	
pH (Field)	--	5.92	5.58	6.20	6.5 – 8.5
Conductivity (Field)	uS/cm	51	200	85	125 – 2200
Conductivity (Lab)	uS/cm	67	232	100	125 – 2200
Total Dissolved Solids	mg/L	58	205	174	
Total Phosphorus	mg/L	0.04	0.1	0.05	0.025
Ammonia	mg/L	0.14	0.15	0.09	0.02
Nitrogen (Nitrate)	mg/L	1.1	0.3	0.7	0.350
Total Hardness (as $CaCO_3$)	mg/L	5	28	14	--
Oil & Grease	mg/L	<10	<10	<10	--
Arsenic	mg/L	<0.001	<0.001	<0.001	0.024
Cadmium	mg/L	<0.0001	0.0001	<0.0001	0.0002
Calcium	mg/L	<1	3	2	--
Chromium	mg/L	<0.001	<0.001	0.002	0.001
Copper	mg/L	0.002	0.001	0.009	0.0014
Lead	mg/L	<0.001	0.001	0.002	0.0034
Magnesium	mg/L	1	5	2	--
Manganese	mg/L	0.011	0.028	0.05	1.9
Nickel	mg/L	0.001	0.001	0.002	0.011
Potassium	mg/L	3	2	2	--
Sodium	mg/L	11	33	13	--
Vanadium	Mg/L	<0.01	<0.01	<0.01	--
Zinc	mg/L	0.013	0.071	0.012	0.0312

[1]Existing farm dam adjacent the second order ephemeral drainage line within Lot 13

[2]Existing farm dam located within Lot 12

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

EPL criteria for oil and grease, pH and TSS are outlined in **Section 8.1.2**.

The results of water quality sampling indicate that water quality within the catchment is characterised by a slightly low pH and reasonably low conductivity. Ammonia levels were elevated above ANZECC criteria at all sample locations. In addition, nutrient levels (nitrogen and phosphorus) were above ANZECC criteria in both farm dams, with phosphorus levels also high in the second order drainage line; these results most likely reflective of impacts from agricultural activities in the regional area. The rest of the parameters tested were generally within ANZECC guidelines. Additional sampling will be undertaken prior to the commencement of quarrying operations.

4.7 Existing Flow Regimes

All existing drainage lines that report to or lie within the PA Area are ephemeral in nature and do not support permanent flow, although ponding was observed within the second order drainage line in the east of the PA Area and within all existing farm dams visited during the site visit. It is anticipated that the ephemeral drainage lines would support reasonable flow during high rainfall periods.

4.8 Surface Water Features of Conservation Significance

During the previous site visits it was noted that there was substantial and well established riparian vegetation surrounding the existing ephemeral drainage lines within the PA Area, particularly the second order drainage line within the east of the PA Area. The nature of this riparian vegetation warrants conservation in line with the conservation criteria detailed within the '*Guidelines for Controlled Activities – Riparian Corridors*'. In accordance with these guidelines, a 20m core riparian zone, as well as a 10m vegetated buffer, will be maintained along this water course.

5 EXISTING GROUNDWATER CONDITIONS

An investigation of the existing groundwater conditions at the project was undertaken by Coffey Geotechnics Pty Ltd as part of the EA (Coffey 2012). The key findings are summarised below:

5.1 Bore Installation

Four (4) groundwater bores were installed for the groundwater study for the EA at the locations presented in **Figure 3**. Groundwater levels/inflows were recorded during drilling and the bore holes were developed after the completion of drilling.

Measured bore data including bore locations, ground elevations, bore depths, screen intervals, screen formation, and standing groundwater levels. The Statement of Commitments outlines that prior to commencement of works, further investigation of groundwater conditions will be conducted in consultation with DPI Water. The WMP was sent to DPI Water on 15 September 2015, with the DPI Water not advising on any additional groundwater monitoring wells during the review of the then draft WMP.

5.2 Aquifers and Recharge

The map 'Hydrogeology of Australia' (Australian Water Resources Council and Department of Resources and Energy, 1987) indicates that the Project site is located within an area of which the principal aquifer can be described as fractured or fissured aquifer of low-moderate productivity. This is consistent with the observed site geology based on drilling, which indicates groundwater within fractured volcanic rock.

Diffuse groundwater recharge is likely to occur by infiltration of rainfall, and the shallow stony loams probably allow reasonable recharge rates. More focussed recharge may occur in topographic depressions where surface runoff can pool.

5.3 Groundwater Levels

Standing water levels recorded at the bore holes ranged from about 12 mbgs (metres below ground surface) to 30 mbgs. Reduced groundwater levels at the bores range from 20.57 mRL to 33.61 mRL. **Figure 3** shows the bore locations and groundwater level data.

Time-series groundwater levels were recorded at BH205, BH207 and BH208 using pressure transducers equipped with data loggers. Head values were measured hourly during the period from 4 May 2010 to 18 August 2010 to study the temporal fluctuations of groundwater levels as part of the EA. Groundwater levels observed over the 106 day monitoring period at BH205 varied between 32.78 mRL and 33.69 mRL (change of 0.91m). Levels observed at BH207 varied between 20.51mRL and 20.85 mRL (change of 0.35m). Levels observed at BH208 varied between 33.15 mRL and 35.26 mRL (change of 2.11m). Further testing of groundwater levels will be undertaken prior to commencement of quarrying operations.

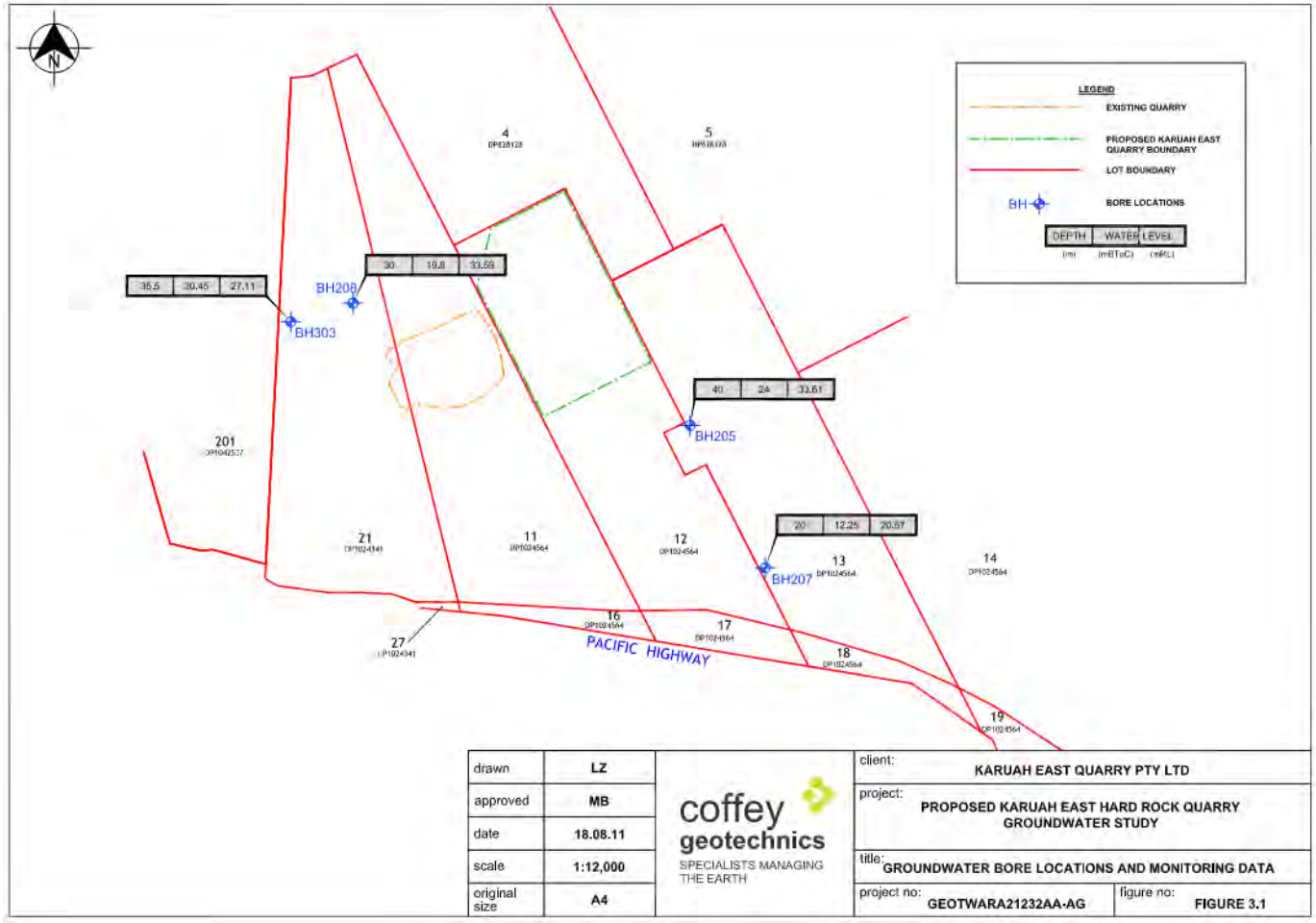

Figure 3 Groundwater Locations from the EIS

5.4 Groundwater Quality

Baseline groundwater quality data was collected during May 2010 at bores BH205 and BH207 and November 2010 at BH205. All groundwater sampling was carried out in accordance with standard quality assurance procedures.

Groundwater quality monitoring results indicated that chlorine and sodium concentrations in the groundwater sample from bore 207 exceeded ANZECC guidelines for human consumption, otherwise the groundwater is considered generally "fresh" (Coffey, 2012). Some metal concentrations in the sampled groundwater exceed the ANZECC guidelines for freshwater and therefore the groundwater seepage should not be discharged into the freshwater environment without appropriate treatment and approval.

The groundwater quality data is presented in **Table 5** and will be used as baseline values to compare with groundwater samples collected during and after the quarrying operations.

Table 5 Groundwater Quality Data

Parameter	LOR	BOH GW205	BOH GW207	BOH GW303	BOH GW205	ANZECC	ANZECC	NHMRC
	SGS 2010	May 2010	May 2010	Nov 2010	Nov 2010	Human Consumption	Freshwater	Drinking water (Health)
Laboratory Analytical results (mg/L)								
pH (unit)		7.4	7.4	6.3	7.0	-	-	-
TDS		670	1540	600	660	-	-	-
Total Alkalinity		200	200	62	180	500		
Nitrate (as N)		0.52	<0.005	0.014	<0.005	-	-	50
Ammonia		0.24	0.10	0.04	0.01	-	0.9	-
Chloride	0.05	260	760	140	210	400	-	-
Sulphate	0.1	55	66	20	130	400	-	-
Calcium	0.1	20	36	3.2	51	-	-	-
Magnesium	0.1	16	41	5.2	18	-	-	-
Potassium	0.2	6	1.8	1.9	2.3	-	-	-
Sodium	0.1	220	500	100	170	300	-	-
Arsenic	0.001	<0.001	0.003	0.002	<0.001	-	-	0.007
Cadmium	0.0001	<0.0001	<0.0001	0.0002	<0.0001	-	0.0002	0.002
Copper	0.001	0.008	<0.001	0.003	0.001	-	0.0014	2
Dissolved Iron	0.005	0.16	0.9	0.039	0.017	0.3	-	-
Lead	0.001	0.003	<0.001	<0.001	0.001	-	0.0034	0.01
Manganese	0.001	0.11	0.44	0.12	0.45	0.1		
Dissolved Mercury	0.0001	<0.0001	<0.0001	0.0002	0.0002	-	0.0006	0.001
Nickel	0.001	0.005	0.005	0.002	0.001	-	0.011	0.02
Zinc	0.001	0.13	0.079	0.008	0.02	-	0.008	
BTEX in water								

Parameter	LOR	BOH GW205	BOH GW207	BOH GW303	BOH GW205	ANZECC	ANZECC	NHMRC
	SGS 2010	May 2010	May 2010	Nov 2010	Nov 2010	Human Consumption	Freshwater	Drinking water (Health)
Laboratory Analytical results (mg/L)								
Benzene	0.5	<0.5	<0.5	<0.5	<0.5	-	950	1
Ethylbenzene	0.5	<0.5	<0.5	<0.5	<0.5	-	-	300
Toluene	0.5	<0.5	<0.5	<0.5	<0.5	-	-	800
Total Xylenes	1.5	<1.5	<1.5	<1.5	<1.5	-	-	600
Organochlorine Pesticides								
Chlordane*	0.2	<0.2	<0.2	<0.2	<0.2	-	0.08	1
DDT*	0.2	<0.2	<0.2	<0.2	<0.2	-	0.01	20
Endrin*	0.2	<0.2	<0.2	<0.2	<0.2	-	0.02	
G (Lindance)	0.2	<0.2	<0.2	<0.2	<0.2	-	0.2	20
Hetachlor	0.2	<0.2	<0.2	<0.2	<0.2	-	0.09	0.3
Methoxychlor	0.2	<0.2	<0.2	<0.2	<0.2	-		300
Organophosphorus Pesticides								
Azinophos methyl*	0.2	<0.20	<0.20	<0.20	<0.20	-	0.02	3
Chlorpurifos*	0.2	<0.2	<0.2	<0.2	<0.2	-	0.01	10
Diazinon*	0.5	<0.5	<0.5	<0.5	<0.5	-	0.001	3
Dichlorvos	1	<1	<1	<1	<1	-		1
Ethion	0.2	<0.2	<0.2	<0.2	<0.2	-		3
Fenitronthion	0.2	<0.2	<0.2	<0.2	<0.2	-	0.2	10
PAHs in water								
Benzo[a]pyrene	0.5	<0.50	<0.50	<0.50	<0.50	-		0.01
Naphthalene	0.5	<0.50	<0.50	<0.50	<0.50	-	16	

6 WATER MANAGEMENT SYSTEM

6.1 Surface Water Management System

6.1.1 Overview

The principle objective of the proposed surface water management at the quarry, as detailed in the EA and Revised SWA, will be to segregate clean and dirty water flows and to minimise surface flows across disturbed areas. The key water management strategies proposed to be adopted across the PA Area to achieve this objective are summarised as follows:

- Water generated within the active quarry extraction area, primarily as a result of rainfall/runoff, will be managed within the extraction area via an in-pit sump. Water will be directed to and contained within the in-pit sump until it is necessary to pump the water out so as to not impede quarrying activities. This water will be pumped into a rock lined table drain adjacent to the main haul road, from where it will flow via a rock lined drop structure to Dam 1.
- Dirty water generated from disturbed areas, such as the processing and stockpile areas, as a result of rainfall/runoff will be captured and diverted into sediment dams for reuse in processing activities, or to reduce sediment load prior to discharge if required.
- As much water as possible collected in the extraction area and/or dirty water dams will be re-used for processing and dust suppression purposes. Water will be preferentially used on-site to minimise the need for offsite discharge and the chance of pollution to downstream waterways.
- Clean water diversions will be constructed wherever possible upstream of disturbance areas to minimise the amount of dirty water to be contained and treated within the dirty water management system. It is noted however, that given the location of the quarry at the top of the ridgeline, the need for diversions will be limited.
- Progressive rehabilitation of all formed surfaces, such as quarry benches and long-term soil stockpiles, will occur wherever possible to help reduce the amount of total suspended solids (TSS) in runoff from disturbed areas. It is noted that given the nature of quarrying these opportunities will be limited, however will be undertaken wherever possible.
- Sediment control structures will be maintained to ensure the design capacities are maintained for optimum settling rates.
- Implementation of an effective revegetation, maintenance and monitoring program for the site.

6.1.2 Summary of Licensed Discharge Points

There are three licensed discharge points associated with the Karuah East Project. These are outlined in **Table 6** below as per EPL Condition P1.3:

Table 6 Karuah East Licensed Discharge Points

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Discharge to waters	Discharge to waters	The discharge point from Dam 1 as shown on the plan titled "Proposed Surface Water Management Plan - Figure 3", which is filed as part of EPA document DOC15/253402.
2	Discharge to waters	Discharge to waters	The discharge point from Dam 2 as shown on as shown on the plan titled "Proposed Surface Water Management Plan - Figure 3", which is filed as part of EPA document DOC15/253402 .
3	Discharge to waters	Discharge to waters	The discharge from Dam 3 as shown on the plan titled "Proposed Surface Water Management Plan - Figure 3", which is filed as part of EPA document DOC15/253402.

See **Figure 4** in this report for surface water monitoring locations.

6.1.3 Surface Water Management Measures

For the purpose of the WMP the PA Area has been divided into the four (4) main catchment areas shown in **Table 7**. These catchments are classified as dirty water management areas. The rest of the PA Area will remain clean water catchments with water flowing offsite.

Table 7 Catchment Areas of the PA Area

Catchment Name	Site area reporting to catchment	Catchment Area (ha)
Quarry extraction area	Quarry extraction area	14.40
Dam 1 catchment	Crushing plant and product stockpiles	7.54
Dam 2 catchment	Product stockpiles and office infrastructure area	1.25
Dam 3 catchment	Product stockpiles	2.40

The surface water management measures to be implemented in each of these catchment areas to ensure the effective management of surface water on-site and to minimise the risk of any offsite impacts on surface water are described in the sections below and presented in **Figure 4**.

Powerline Easement
SW1
Haul Road
13
D.P.1024564
Quarry Extraction Area
In-pit Sump
Sediment Fence
Bund
Proposed DP1
Existing Farm Dams to be Upgraded
Dam 1
Crushing Plant
Existing House & Shed
Bund
SW2
12
D.P.1024564
SW4
Existing farm dam
SW3
Proposed LDP3
Dam 3
TRUCK PARKING
Proposed LDP2
MAIN OFFICE & CARPARK
ENTRANCE ROAD
ENTRANCE ROAD
Dam 2
WB OFFICE & 2x WEIGHBRIDGES

LEGEND

- Culvert
- Lot boundary
- Proposed dam
- Existing Farm Dam
- Existing Drainage line
- Riparian corridor
- Drop structure
- Clean Water Diversion drain
- Dirty Water Diversion drain

Catchment Areas

- Quarry extraction area (Stage 5)
- Dam 1
- Dam 2
- Dam 3

SW3 ⊗ Proposed Surface Water monitoring points.

N W E S

0 50 100 150 200m

V:\633.10196\Figures\CAD\Current\Fg3_HQP05-008_SWPlan_130710_MS.dwg
To be printed A3

Proposed Surface Water Management Plan

FIGURE 4

A3E/Landscape, 10/07/2013 5:01:46 PM, MarinSkoljarev

6.1.4 Quarry Extraction Area

Runoff generated within the active quarry extraction area will be directed into an in-pit sump where it will be contained and pumped out as required so as not to impede quarrying activity. A bund and sediment fence will be maintained along the southern boundary of the quarry as illustrated in **Figure 4**, to minimise the risk of sediment being washed downstream of the quarry.

The quarry floor will be managed in such a way so as to direct all runoff to the in-pit sump. The location of this sump will change as quarrying progresses; however it will generally be located in the south east corner of the quarry as illustrated in **Figure 4**. Water collected in the in-pit sump will be pumped out as required into a rock lined table drain adjacent to the main haul road. The water will flow down this drain to the main dirty water dam, Dam 1, via a rock lined drop structure.

6.1.5 Dam 1 Catchment (crushing plant and product stockpiles)

The existing farm dam will be upgraded and used as a sediment dam (Dam 1). The crushing plant area will be graded such that runoff from this area will flow into Dam 1. Water for haul road and stockpile dust suppression, as well as for the crushing plant will be sourced from Dam 1. A diversion bund will be constructed along the eastern boundary of this catchment area, to direct runoff from the area into Dam 1.

Dam 1 will be the primary dirty water dam for treating water in the crushing plant and product stockpile area. Water for haul road and some stockpile dust suppression as well as for the crushing plant will be sourced from Dam 1.

6.1.6 Dam 2 Catchment (product stockpiles and office infrastructure area)

A second sediment dam, Dam 2, will be constructed adjacent to the main haul road to capture runoff from this area. Water collected in Dam 2 will be re-used for dust suppression on the product stockpiles.

6.1.7 Dam 3 Catchment (product stockpiles)

A third sediment dam, Dam 3, will be constructed in the north east corner of the southern stockpile area. Water collected in Dam 3 will be re-used for dust suppression on the adjacent product stockpiles.

6.1.8 Surface Water Management – Final Landform

Dams 1, 2 & 3 will remain in place for post-mining landuse (such as farming practices) subject to consultation with relevant government agencies in relation to licensing conditions at that time. If deemed necessary by the relevant government agency, the dams will be removed. These dams are outlined in the final landform figure in the Landscape and Rehabilitation Management Plan.

6.1.9 Dam Design

The required volumes for the dams were calculated in the Revised SWA and are summarised in **Table 8** Dam design requirements have been calculated in accordance with the guidelines and procedures presented in Volume 1 and 2E (Mines and Quarries) of the Blue Book for Type D/F sediment dams.

Table 8 Summary of Proposed Dams

Dam	Sediment Zone (ML)	Settling Zone (ML)	Additional water storage capacity (ML)	Total Capacity (ML)
Dam 1	3.4	5.4	3.6	12.4
Dam 2	0.4	0.9	0	1.3
Dam 3	0.6	1.7	0	2.3

Dams should be constructed in accordance with Standard Drawing SD 6-4 from the 'Blue Book', which applies to Type D/F soils, as reproduced in **Appendix B**.

6.1.10 Management and Maintenance of Dams

In the event that water is required to be discharged offsite, the water will be tested prior to discharge to ensure appropriate discharge criteria are met (see EPL discharge criteria – **Section 8.1.2**). Where this is not the case, water will be treated, for example through the use of chemical flocculation, to achieve suitable water quality requirements.

An inspection of the sediment dams will be undertaken as part of the routine site environmental inspection program or following significant rainfall. Information such as the general condition of the dam, evidence of overflow, condition of downstream catchments, water colour, evidence of eroding surfaces and approximate retained capacity will be recorded during the monthly inspection. During key construction activities environmental inspections will be every second week.

6.1.11 Drainage Lines

A sediment fence will be installed along the downstream side of the entire southern face of the quarry as a sediment control measure to minimise the transport of any sediment into the remaining section of the first order drainage line to the south of the extraction area.

This drainage line will be reinstated as close as possible to its original path following completion of extraction activities at the quarry as part of the final rehabilitation of the site. Drainage line rehabilitation works will generally be undertaken in accordance with Section 5.3.3 of the *Blue Book* (Volume 1) and the *'Guidelines for Controlled Activities – In-Stream Works'* (DWE, 2008) for watercourse rehabilitation and riparian zone rehabilitation as follows:

- Implement temporary erosion controls to provide for the short-term stabilisation of the channel;
- Design and construct the stream channel so that it will be stable for the long-term and minimises the potential for the migration of any erosion upstream or downstream;
- The drainage line will be re-instated as a compound channel with a main channel conveying the small to medium flows, and a floodplain used to convey the high overbank flows;
- The main channel forming part of the re-instated central drainage line will be generally trapezoidal in shape with 3:1 (H:V) bank batters;
- Natural meanders will be used instead of straight lines to reflect natural stream characteristics;
- Where there are high erosive forces (such as high flow velocity or steep grades) the channel bed will be rock lined where required and constructed in accordance with the 'Blue Book', including the placement of appropriately sized rocks above a filter layer of suitable geotextile; and
- Soil will be packed in between rocks to allow sedges and grasses to be established within the channel to provide for long-term channel stability.

The existing riparian corridor illustrated in Figure 4 will be maintained and where required. Key design elements include:

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

6.2 Erosion and Sediment Control

Erosion and sediment control at Karuah East will be undertaken in accordance with the 'Blue Book' (Volume 1 and 2). The intent of the erosion and sediment controls are to minimise the generation of sediment on the site and its transport around and offsite.

6.2.1 Sources of Erosion and Sediment

Runoff from disturbed areas of the site will be the primary sources of erosion and sediment. The disturbed areas that will generate sediment laden runoff include:

- Ground disturbed during site construction including:
    - Private access road;
    - Product stockpile, crusher and infrastructure areas;
    - Internal haul roads;
    - Initial extraction area;
- Ground disturbed ahead of material excavation;
- Active quarry working face and pit areas;
- Product stockpile areas;
- Overburden and topsoil stockpile areas;
- Workshop areas; and
- Areas under rehabilitation.

Erosion and sediment controls will be implemented by Karuah East across the project site during all phases of the quarry including construction, operations, maintenance and rehabilitation.

6.2.2 Construction

Sediment laden runoff from disturbed areas during construction will be managed by implementing the following erosion and sedimentation control principles:

- Temporary erosion and sediment controls as outlined in **Section 6.2.3**.
- Conducting best practice land clearing procedures for all proposed disturbance areas;
- Minimising the disturbance footprint;
- Coordinating construction sequences to minimise exposure of disturbed soils to the elements;
- Separate/diversion of upslope 'clean' water catchment runoff prior to land disturbance;

- Ensuring sediment-laden runoff is treated via designated sediment control devices;
- Appropriate storage of topsoil stockpiles in areas away from roadways and other drainage lines;
- Revegetation of disturbed areas as soon as possible following the completion of construction activities; and
- Implementing an effective maintenance period.

6.2.3 Temporary Erosion and Sediment Controls

Additional works including, but not limited to, sediment filter fencing, straw bale sediment filters and revegetation will be employed. Temporary sediment controls will be constructed to intercept sediment laden runoff prior to discharge into the natural drainage system.

Straw bales or silt fencing will be used where required during the construction of drainage and road works. Their use will be limited however, to situations where erosion and sediment control is required for a short period (i.e. maximum of three (3) months).

The sediment control techniques used during this project will generally include, but not be limited to, the following:

- Strategically placing silt fencing, straw bales or similar;
- Removing accidental spills of soil or other materials on access roadways or gutters before each day's work is complete; and
- Minimising on-site vehicle activity during wet weather or when the site is muddy.

6.2.4 Operations

In addition to the above, the following management practices will be implemented during the operational phase of the project:

- The maximum limits of clearing will be clearly marked out prior to clearing activities commencing. Ground disturbance will be avoided outside of the marked areas, vehicles movements will be restricted to designated tracks, and existing clearings will be utilised as turnaround areas and laydown sites where possible;
- Haul roads will be constructed to ensure surface drainage is optimised and the road surface stabilised, thereby reducing roadside erosion and sedimentation. Cross-fall drainage techniques such as crowning, in-fall and outfall drainage will be implemented for the entire length of the haul road; and
- Progressive rehabilitation of all formed surfaces, such as quarry benches and long term soil stockpiles, will occur wherever possible to reduce the amount of total suspended solids (TSS) in runoff from disturbed areas.

6.2.5 Rehabilitation

The following principles will be used for erosion and sediment control on site during rehabilitation:

- Ensure progressive rehabilitation is completed as soon as possible;
- Implement key erosion and sediment and sediment controls in rehabilitation areas including:
    - Drainage channels;
    - Contour banks;
    - Sediment basins; and
    - Sediment fencing.

- Rehabilitation activities will be undertaken within the dirty water catchment, with water draining from rehabilitated areas to sediment dams onsite.
- Management of rehabilitation areas in accordance with the *Landscape and Rehabilitation Management Plan.*

Disturbed areas which are not available for final rehabilitation will be temporarily rehabilitated where practical. Additional erosion control measures such as the application of hydromulch will be considered, particularly in drainage lines and areas of temporary rehabilitation. Sugar cane (or other) mulch as slurry provides cover for the soil to improve pasture growth and/or modifying the soil surface to control erosion. The mulch also has the effect of protecting the soil surface against raindrop impact, improving the micro-environment for seed, reducing evaporation losses and assisting in the control of surface erosion caused by overland water flow.

6.2.6 Maintenance of Erosion and Sediment Controls

During key construction activities environmental inspections will be undertaken every second week and when the site is operational inspections will be undertaken monthly by the Quarry Manager. Inspections will ensure that all the water management controls are functioning as designed and required. The Quarry Manager will also ensure that any contractor's onsite are operating within the environmental controls as required for their activities. These inspections will cover the drop structure, drainage lines, sediment fencing and the sediment dams. Event based inspections will be completed when greater than 25mm of rainfall has been recorded. The Quarry Manager also completes a daily operational inspection of the area. When required the Quarry Manager will seek the advice of the Contract Environmental Officer or surface water specialist.

Where significant erosion is observed to be occurring on a regular basis, additional controls would be constructed generally in accordance with the "Blue Book".

6.3 Groundwater Management Measures

The groundwater management measures to be implemented to minimise groundwater impacts during the construction and operation of the project are as follows:

- Benches and the pit floor will be graded to promote drainage toward the entrance to the pit;
- Minor seepage and ponding water from excessive rainfall will be managed by conventional drainage measures within the quarry such as periodic pumping out to the surrounding drainage controls. Water will be retained on site for quarry operations and for environmental mitigation;
- Only emergency vehicles repairs will be carried out onsite and any major vehicle repairs/maintenance will occur offsite;
- Refuelling will be undertaken in a designated non-permeable (compacted clay or concrete) area;
- Runoff water from the Project site will be collected and monitored for environmental mitigation to prevent chemicals and hydrocarbon pollutants such as petroleum, diesel, and oil seeping into the groundwater system;
- Handling and storage of fuel and oil within the project site will be in accordance with Australian Standards, AS 1940-2004 (Storage and Handling of Flammable and Combustible Liquids) and NSW Work Cover 2005 Code of Practice for Storage and Handling of Dangerous Goods to reduce the risk of any spills or environmental release. Above ground storage in a bunded facility will be used;

- Safety Data Sheets (SDS) will be kept in the site safety system for all chemicals used on site. The SDS's will contain information on the environmental impacts of the use of certain chemicals and include detail on emergency response, clean up and disposal. Handling and storage of all chemicals within the project site will be in accordance with Dangerous Goods Act 1975 (NSW), and Australian standards, including AS 1940-2004 (Storage and Handling of Flammable and Combustible Liquids); and
- Quarry rehabilitation will use spoil, and clean fill fit for purpose and in accord with relevant statutory requirements.

6.4 Maximum Harvestable Right Dam Capacity

The maximum harvestable right dam capacity (MHRDC) of the PA Area is determined by the following calculation:

MHRDC = PA Area (ha) x multiplier value (0.11)

The MHRDC has been calculated to be approximately 8.2 ML based on the PA Area of 74.3 ha.

The proposed dam designs incorporate 8 ML of additional storage capacity (Dam 1) which is within the MHRDC for the property (assessed as 8.2 ML). As such no licences are required for the proposed surface water capture.

7 SITE WATER BALANCE

A Site Water Balance was completed by GSSE as part of the EA (2012) and revised for the PPR (2013).

Site water calculations were undertaken for two (2) scenarios, namely:

- Scenario 1 – based on the expected disturbance footprint during Stage 2 of quarry operations (ie a quarry footprint of 7.7 ha or 50% of total disturbance area); and
- Scenario 2 – based on maximum disturbance area within the proposed quarry footprint.

The site water balance applies to the whole Project Area, with the exception of the water for the office amenities, which will be trucked to site and maintained as a separate system from the overall site water management. Amenities water usage will be monitored during construction and the first year of operations to determine actual water requirements.

The water balance is a pre-operational estimate and calculated based on the best available data. Operational requirements and annual production rates have not been finalised, therefore the development of a detailed annual water balance model is not feasible at this stage. Water usage will be monitored during construction and the first year of operations to determine actual water usage. It is anticipated that after the first year of operations there will be sufficient data to revise the water balance model and prepare a detailed annual site water balance.

7.1 Site Water Balance Model

The water balance model was developed for the full 110 years of available data (as of 2013). An annual summary of this model was produced from which trend-lines were developed. These trends were used to estimate the water balance results for a probable dry year (10^{th} percentile rainfall), median year (50^{th} percentile rainfall) and wet year (90^{th} percentile rainfall).

7.2 Water Sources (Model Inputs)

7.2.1 Rainfall Runoff

Rainfall

Long term historical rainfall data was sourced from the Tahlee (Carrington, Church Street) BOM station (station number 61072), which is located approximately 4.5 km from the PA Area and has operated since 1887.

110 years (1900 to 2009) of rainfall data was utilised from the Tahlee BOM Station.

The statistical analysis of the data for the Tahlee Station shows:

- 10th Percentile year (dry year): 829 mm;
- 50th Percentile year (median year): 1154 mm;
- 90th Percentile year (wet year): 1630 mm;

Catchment Areas

Catchment areas were delineated based on runoff characteristics. The following catchments were defined and areas estimated:

- Quarry extraction pit, which is assumed to have high runoff;
- Dam 1 Catchment (including the crushing plant, haul road and product stockpile areas);
- Dam 2 Catchment (including the product stockpiles, haul road and office infrastructure areas); and
- Dam 3 Catchment (including the product stockpiles)

These areas are assumed to be highly disturbed and therefore have high runoff. The catchment areas of the PA Area are presented in **Figure 3**.

It is noted that no clean water catchments have been incorporated into the water balance. The quarry is located on the top of a ridgeline and as a result very little clean water will flow into the PA Area. However, for clean water catchments that do report into the PA Area, clean water diversions will be put into place to divert this water away and prevent it entering the disturbed parts of the PA Area. It is also assumed that all areas within and immediately surrounding the crushing, stockpile and office areas will be disturbed and as such are treated as dirty water catchments in the water balance.

Runoff Coefficients

Rainfall runoff was calculated by estimating an initial loss (in mm), followed by a loss consisting of a constant fraction of the remaining rainfall for that day (as described with *Australian Rainfall and Runoff Book 2*).

7.2.2 Groundwater

As presented in **Section 5** the typical groundwater RL at the proposed quarry site is greater than 10 m below the planned quarry base. Excavation in the quarry is therefore not anticipated to intersect the groundwater surface. As such, groundwater has not been included in the water balance as an input into the system.

7.3 Water Losses and Usage (Model Outputs)

7.3.1 Evaporation

Long term historical evaporation data was not available from the Tahlee BOM station. Evaporation data was therefore sourced from the nearest station to measure this data; Williamtown BOM Station (No. 061078). Average monthly evaporation rates have been used within the water balance model, so that the daily evaporation rate varies throughout the year depending on the month. The volume of the evaporation also varies based on the estimated surface area of the water storages (which is relative to the volume of water storages) on each day.

7.3.2 Water Usage

Approximately 22ML per year is estimated to be required to meet the water demands of the quarry. Water will be required for the following uses:

- Haul road dust suppression;
- In the crushing plant and wash plant;
- Pug mill; and
- Dust suppression on the product stockpiles.

The water demands associated with these uses, and comments on how they are incorporated into the water balance, are provided in **Table 9**.

Table 9 Predicted Water Usage

Water Demand	Predicted Annual Usage (ML)	Estimated Daily Usage (ML)	Comments
Haul road dust suppression	5	0.0137	Haul road dust suppression is predicted to be approximately 5ML/year; however it only occurs in the water balance on days with less than 5mm of rain. Where more than 5mm rain is received, it is assumed dust suppression is not required on the haul roads.
Crushing plant	0.9	0.0025	Water and a foaming dust control agent are to be used in the crushing plant (including grinding and screening), and hence minimal water usage will be required for dust suppression purposes in the plant. A small amount of water usage has been assumed in the water balance for dust suppression at 2.5kL/day.
Pug mill	1.84	0.005	Water usage based on an estimated product throughput in the pug mill of 100,000 tpa, and a water requirement of 20L/t of product. 8% of this water recycled, 92% going out with the product.
Wash Plant	0.55	0.0015	Assumes 15% of product to go through wash plant. At this rate, wash plant predicted to run 3 times /day using approximately 10,000L per wash, totally 30 kL. 95% of this water recycled, and 5% of water goes out with product = 1500L/day.

Water Demand	Predicted Annual Usage (ML)	Estimated Daily Usage (ML)	Comments
Product stockpile sprays	13.87	0.038	Assumes dust suppression applied to 2 stockpiles (fine aggregates only), at 8L/s for 2hrs per day, 4 months of the year. For the purposes of the water balance, this usage has been averaged over 12 months.
TOTAL	**22.17**	**0.06**	

The estimated water usage for operation of the quarry has been developed based on tonnes of production and averaged over 365 days. However, the quarry will not operate on Sundays and public holidays, and as such will only operate for 265 days per year. As these non-operational days are distributed regularly throughout the year, the assumption of averaging water usage throughout the year is considered to adequately represent operation with regard to the water balance.

The water demands detailed in **Table 9** are sourced from on-site water storages (sediment basins); unless storages are below the equivalent of one weeks' worth of water usage (also considering evaporation processes) in which case the water balance indicates a water shortage. When this occurs water will need to be sourced from off site.

All water usage will be monitored across the site to enable an update of the water balance using actual metered water usage data after 12 months of operation.

7.3.3 Site Discharges

The water balance assumes that discharges occur when the volume of water exceeds the onsite storage capacity. Licensed Discharge Points are associated with the site, with this outlined in Section 6.1.2 of this *Water Management Plan*. The Licensed Discharge Points associated with the project are LDP001 (Dam 1), LDP002 (Dam 2) and LDP003 (Dam 3).

It is also assumed that controlled releases from site are undertaken from the main water storage Dam 1 located in the crushing plant area. These releases are required to maintain the sediment basins in accordance with Blue Book requirements, which require sediment dams to be pumped out once the remaining storage falls below the required settling zone. Water quality in the sediment dams is to be monitored prior to release to ensure it is of an acceptable water quality for discharge.

With regards to the operation and maintenance of the dams, Dam 2 will be preferentially dewatered to Dams 1 and 3. This is so as to limit the risk of uncontrolled discharge during wet weather from this dam, due to the sensitive receiving environment downstream of Dam 2. It is assumed that a LDP will be required at Dam 2; however this will only be required as a wet weather discharge point.

7.4 Storages

The water balance model assumes that the dirty water dams (sediment basins) are maintained such that the settling zone and the additional 3.6 ML proposed in Dam 1 is available for water storage during a rainfall event. Three dams are proposed; Dam 1, to be located within the catchment of the crushing plant, Dam 2, within the western side of the southern stockpile catchment area and Dam 3, within the eastern side of the southern stockpile catchment area. These dams and their maintained available storage are shown in **Table 10**. The available storage is the total volume of the dams, minus the required settling zone volume and the additional 3.6 ML in Dam 1. This assumes that the dams remain pumped down to the sediment zone storage level to ensure that the settling zone (and any addition volume within the dams) is always available to manage runoff from the next rainfall event. Any additional storage obtained during the construction of these dams would also further enhance the storm runoff buffering and would reduce the need to source water from external sources.

Table 10 Water Storages (assumed within water balance model)

Dam	Total Storage Capacity (ML)	Sediment Zone Storage (ML)
Dam 1	12.4	3.4
Dam 2	1.2	0.4
Dam 3	2.3	0.6
TOTAL	**15.9**	**4.4**

The in-pit sump within the quarry will be sized at all times to prevent discharge to the downstream drainage line in the event of pump failure. This in-pit sump has conservatively not been accounted for in the water balance. However, in practice the in-pit sump would serve as an additional water storage area during large rainfall events, thus further reducing the likelihood of uncontrolled discharges from Dam 1. In the water balance it is assumed that runoff collected in the pit is pumped out into Dam 1 and released under controlled conditions. This is to allow for the sump to be maintained in a dry state so that it does not impede on operational activities.

All dams and associated water management structures are shown on **Figure 4**.

7.5 Water Balance Results

Water balance results are presented for the two (2) separate stages of quarry activities described in **Section 7.1**. It is noted that the disturbance footprint for the infrastructure area remains the same for both scenarios.

The water balance results for the selected scenarios are presented in the following sections.

7.5.1 Scenario 1 – Stage 2

The predicted water balance totals for dry, median and wet years has been estimated and is shown in **Table 11.**

Table 11 Indicative Water Balance Results for Stage 2 Scenario (Annual Summaries)

	Description	Dry (ML/year)	Median (ML/year)	Wet (ML/year)
Water Source (Inputs)	Rainfall Runoff (r^2 = 0.9479)	44	71	111
Water Losses and Usage (Outputs)	Evaporation (from dams) (r^2 = 0.6308)	3	3	4
	Water Usage (dust suppression including crushing) (r^2 = 0.6597)	20	19	19
	Discharged (wet weather) (r^2 = 0.2091)	4	10	22
	Controlled Release (r^2 = 0.8948)	24	48	82

Water Supply

The results of the water balance model demonstrate that:

- Rainfall runoff captured in sediment basins on-site will provide for the majority of water demand; and

- Additional sources of water are anticipated to be required for the Stage 2 Scenario (varying from 0.4 - 1.4 ML per year depending on whether it is a dry or wet year). It is envisaged that this water would be trucked in as required. However, it is noted that this is based on the assumption that controlled discharges will take place from the site, and the conservative assumption that no water storage is available in the quarry extraction area. However, at times throughout the year depending on the sequence of quarrying activities there would be opportunities to store water in the in pit sump, reducing the volume of controlled discharge required and hence reducing the water deficit on site.

Discharges from Site

The overall average of all rainfall years assessed in the water balance for the Stage 2 Scenario shows that on average there will be 1 day of uncontrolled discharge per year discharging an estimated total of 10 ML of sediment laden water. However, these discharge events occurred when the dam design criteria (i.e. rain of 90.6 mm in 5 days in accordance with the 'Blue Book' requirements) was exceeded.

That controlled discharge of treated (e.g. flocculated) water be undertaken when total site storage levels are above 4.3ML, which would provide the capacity to contain more rainfall events and reduce wet weather discharges (this assumes the dams are built to the capacities presented in **Table 10**); and

This is consistent with the Blue Book, which states that dams are designed to spill 1-2 times per year. It is also noted that the actual discharge frequency is expected to be less given there will be some capacity for water storage in the in-pit sump during large rainfall events, as discussed above.

As expected in dry years the likelihood of discharge decreases, and in wet years the likelihood increases. Interpretation of the results suggests the following likely discharges (and range of discharges) for the dry, median and wet years (shown in **Table 12**).

Table 12 Predicted Discharges from Site for Stage 2 Scenario

Description		Rainfall Year		
		Dry	Median	Wet
Number of Uncontrolled Discharge Days per Year	Total Number of Days Per Year (r^2 = 0.1071)	**0.5 Days**	**1 Day**	**2 Days**
Total Volume Uncontrolled Discharge (per year)		**4 ML**	**10 ML**	**22 ML**
Total Volume Controlled Released (per year)		**24 ML**	**48 ML**	**82 ML**
Total Discharged		**28 ML**	**58 ML**	**104 ML**

7.5.2 Scenario 2 – Stage 5 Full Extraction

The predicted water balance totals for dry, median and wet years has been estimated and is shown in **Table 13**.

Table 13 Indicative Water Balance Results for the Stage 5 Scenario (Annual Summaries)

Description		Dry (ML/year)	Median (ML/year)	Wet (ML/year)
Water Source (Inputs)	Rainfall Runoff (r^2 = 0.956)	67	107	165
Water Losses and Usage (Outputs)	Evaporation (from dams) (r^2 = 0.7076)	3	3	4
	Water Usage (dust suppression including crushing) (r^2 = 0.6611)	20	19	19
	Wet weather discharge (r^2 = 0.4282)	2	10	30
	Controlled Release Water (r^2 = 0.8583)	45	74	115

The primary change in the water balance results for Stage 5 compared to Stage 2 is the increase in rainfall runoff, which is a result of the increase in the disturbance area associated with the quarry, and hence an increase in runoff to be managed in the surface water management system.

Water Supply

The results of the water balance model predict that:

- Rainfall runoff captured in sediment basins on-site will provide for the majority of water demand; and
- Additional sources of water are anticipated to be required for the Stage 5 Scenario during the dry and median year (varying from 0.4 - 1.7 ML per year depending on whether it is a dry or median year). It is envisaged that this water would be trucked in as required. However, at times throughout the year depending on the sequence of quarrying activities there would be opportunities to store water in the in pit sump, reducing the volume of controlled discharge required and hence reducing the water deficit on site. No additional water sources are predicted during the wet year.

Discharges from Site

The overall average of all rainfall years assessed in the water balance for the Stage 5 Scenario shows that on average there will be 2 days of uncontrolled discharges per year discharging an estimated 10 ML in total of sediment laden water. These discharge events occurred when the dam design criteria (i.e. rain of 90.6 mm in 5 days) was exceeded. In addition to this estimate, it is predicted there will be approximately 39 days of controlled release per year, where a total of 74 ML will be released under controlled conditions, within 5 days of a rainfall event and when suitable water quality in achieved.

This is consistent with the Blue Book, which states that dams are designed to spill 1-2 times per year. It is also noted (as discussed above) the actual discharge frequency is expected to be less given that there will be some capacity for water storage in the in-pit sump during large rainfall events.

As expected in dry years the likelihood of discharge decreases, and in wet years the likelihood increases. Interpretation of the results suggests the following likely discharges (and range of discharges) for the dry, median and wet years (shown in **Table 14**).

Table 14 Representative Discharges from Site for Stage 5 Scenario – dry, median and wet years

Description		Dry	Median	Wet
Number of Uncontrolled Discharge Days per Year	Total Number of Days Per Year (r^2 = 0.49)	**0.5 Days**	**2 Days**	**6 Days**

Total Volume Uncontrolled Discharge (per year)	**2 ML**	**10 ML**	**30 ML**
Total Volume Released (per year)	**45 ML**	**74 ML**	**115 ML**
Total Discharged	**47 ML**	**84 ML**	**145 ML**

As illustrated in the table above, the volume of water discharged offsite increases as the annual rainfall increases.

7.6 Conclusions of Water Balance

The overall results of the water balance indicate that runoff captured in sediment basins on-site will provide for the majority of water demand however, a small amount of water may be required from external sources during dry times. Where additional water is required to meet demand, water will be trucked in from the adjacent Hunter Quarries site if available; alternatively it will be sourced from an external supplier.

The site will implement management practices to flocculate and undertake controlled release of treated water off-site when dam levels are high and do not provide adequate storage capacity for buffering runoff from significant rainfall events. The model indicates that discharges are likely to occur for 1 and 2 days in average rainfall years in Stages 2 and 5 respectively, and controlled releases are likely to occur from 25 to 39 days on average per year.

7.7 Recommendations of Water Balance

It is recommended that:

- The proposed dams are built to at least the specified sizes, and made larger (deeper, not total disturbance area) where practical in consultation with DPI Water, in particular with regard to dam licencing requirements, to provide additional storage in order to further reduce the risk of uncontrolled discharge and the need to obtain water from alternative sources (i.e. trucked in). Increasing the total storage will provide enhanced opportunities to detain and treat water prior to controlled release (see below);
- That controlled discharge of treated (e.g. flocculated) water be undertaken when total site storage levels are above 4.3 ML, which would provide the capacity to contain more rainfall events and reduce wet weather discharges. This assumes that dams are built to the capacities presented in this report, i.e. Dam 1 – 12.4ML, Dam 2 – 1.27ML and Dam 3 – 2.28ML. It is the controlled release of treated water during dry weather that will have the most significant impact on reducing the potential for discharge of sediment laden water. Whilst the overall discharge volumes will not change significantly, discharge in a controlled manner allows adequate settlement of sediment to be achieved prior to release; and
- All water usage is monitored across the site to enable an update of the water balance using actual metered water usage data after 12 months of operation. Water usage is one of the key model inputs of the water balance, and hence calibration of the model against actual usage is critical to ensure the water balance accurately reflects the operation of the quarry.

8 WATER MONITORING PROGRAM

8.1 Surface Water Monitoring Program

The Surface Water Monitoring Program will monitor onsite surface water quality upstream and downstream of the site, and the effectiveness of the Water Management Plan, including:

- The results of surface water monitoring undertaken during quarrying operations at Karuah East will be compared against the baseline data collected as part of the Surface Water Assessment;
- A baseline ecological health condition assessment of Yalimbah Creek will be undertaken prior to commencement of operations, and monitoring of Yalimbah Creek will continue as part of the annual ecological monitoring of offset areas;
- The following parameters (see **Table 15 and 16** below) will be measured at each monitoring location via collection of a grab sample. The recorded values for the parameters measured will be assessed as a minimum against baseline water quality results as well as the ANZECC trigger values presented below, and plotted to identify any trends over time. The OEH will be notified in the event of increasing levels of any parameter; and
- The range of parameters measured will be reviewed following the first 12 months of monitoring and a diagnostic set of parameters adopted for ongoing monitoring.
- Discharge monitoring is outlined in **Section 8.1.2**.

8.1.1 Surface Water Monitoring Locations

Surface water monitoring locations will be as follows:

- Dam 1;
- Dam 2;
- Dam 3;
- SW 1 & SW 2 - Existing second order drainage line (within Lot 13 flowing along the eastern boundary of the PA Area); both upstream and downstream of the quarry;
- SW 3 - Existing drainage line downstream of Dam 2; and
- SW 4 - Existing drainage line downstream of the quarry extraction area.

8.1.2 Discharge Criteria

The EPL requires that water quality is to meet the water quality parameters in **Table 15** during discharge events from LDP001, LDP002 and LDP003.

Table 15 Licensed Discharge Points - Criteria

Pollutant	Units of Measure	100 percentile concentration limit
Oil and Grease	Milligrams per litre	5 and/or non - visible
pH	pH	6.5 - 8.5
Total suspended solids	Milligrams per litre	40

The EA Statement of Commitments referred to several other water quality parameters being tested during the first twelve months of operations. The ANZECC Guidelines provide guidance criteria which are outlined in **Table 16** below:

Table 16 Water Quality Data - ANZECC Guidelines

Parameter	Unit	ANZECC Guidelines[1]
Conductivity (Field)	uS/cm	125 – 2200
Conductivity (Lab)	uS/cm	125 – 2200
Total Dissolved Solids	mg/L	-
Total Phosphorus	mg/L	0.025
Ammonia	mg/L	0.02
Nitrogen (Nitrate)	mg/L	0.350
Total Hardness (as CaCO3)	mg/L	--
Arsenic	mg/L	0.024
Cadmium	mg/L	0.0002
Calcium	mg/L	--
Chromium	mg/L	0.001
Copper	mg/L	0.0014
Lead	mg/L	0.0034
Magnesium	mg/L	--
Manganese	mg/L	1.9
Nickel	mg/L	0.011
Potassium	mg/L	--
Sodium	mg/L	--
Vanadium	mg/L	--
Zinc	mg/L	0.0312

Note 1 - Key default trigger values presented in ANZECC 2000 for slightly disturbed upland rivers in NSW.. Heavy metals based on hard water (120-179 mgCaCO3/L)

Water quality results will be compared against the guidance criteria in **Table 16**. The water quality parameters listed in **Table 16** above will be tested monthly for the first year of operations and are not required to be sampled during discharge events (see **Table 15** for discharge parameters).

8.1.3 Surface Water Monitoring Frequency

Dams 1, 2 and 3 will be monitored monthly for the first year of operations as per **Table 15** and **16** to determine a diagnostic set of analytes adopted for ongoing monitoring. Following determination of appropriate analytes, monitoring will be undertaken biannually to determine ongoing compliance with the water quality performance criteria.

SW 1-4 will be tested biannually (when flowing) during operations to determine ongoing compliance with the water quality performance criteria.

SW2 and SW3 will be tested within 24 hours any discharge (Section 3 Statement of Commitments).

Discharge sampling requirements of LDP001, LDP002 and LDP003 are outlined in Condition M2.3 of the EPL, and repeated in **Table 17** below:

Table 17 Discharge Monitoring Frequency

Pollutant	Units of measure	Frequency	Sampling Method
Oil and Grease	Milligrams per litre	Special Frequency 1	Visual Inspection
pH	pH	Special Frequency 1	Grab samples
Total suspended solids	Milligrams per litre	Special Frequency 1	Grab samples
Turbidity	Nephelometric turbidity units	Special Frequency 1	Grab samples

Note: For the purposes of the table above 'Special Frequency 1' means:

(a) within 12 hours prior to any controlled discharge; and

(b) daily during a controlled discharge; or

(c) daily during any uncontrolled discharge.

Following discussions with the EPA any testing pre and during discharge will be undertaken by a hand held water meter, as it takes up to five days to get a NATA accredited sample from a laboratory tested. Samples will be collected and sent to a NATA accredited laboratory for analysis daily during discharge.

8.1.4 Reporting

Karuah East will collate surface water analysis data and maintain an up to date record of analysis. These results will be interpreted as they are received in order to ensure appropriate operational guidance on maintaining water quality within desired parameters.

Monitoring results will be made available to the public on the Karuah East website on a monthly basis.

The results of water quality analysis will be reported in the Annual Review.

In the event that an exceedance in surface water quality criteria is identified, the exceedance will need to be reported to the relevant agencies in accordance with the requirements of the EPL.

8.2 Groundwater Monitoring Program

8.2.1 Groundwater Monitoring Plan

Monitoring of groundwater levels and groundwater quality will be conducted prior to the start of quarry operations. The existing monitoring bores at BH205, BH207, BH208 and BH303 will be used for monitoring groundwater of the quarry area.

New monitoring bores will be installed if any existing monitoring bores are destroyed during the quarry operations, or are subject to general failure. As previously outlined in **Section 5.1**, the Statement of Commitments outlines that prior to commencement of works, further investigation of groundwater conditions will be conducted in consultation with DPI Water. The WMP was sent to DPI Water on 15 September 2015, with the DPI Water not advising on any additional groundwater monitoring wells during the review of the then draft WMP.

8.2.2 Groundwater Levels

Groundwater levels will be monitored on a quarterly basis to identify any adverse impacts arising from the operation of the quarry in the future, and to identify long-term groundwater level trends.

8.2.3 Groundwater Quality

Groundwater samples will be collected for laboratory analysis on a 6-monthly basis. The groundwater quality results will be laboratory analysed for the parameters below and compared to background water quality results. The groundwater sampling will be carried out by an experienced groundwater professional or environmental scientist in accordance with Australian sampling standards.

The basic analyte and parameter suite applies to all samples. The additional extended analytic suite should apply annually together with the basic suite.

Basic Analytes and Parameters – 6 monthly (every sample):

- pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS); Alkalinity;
- Total nitrogen, total phosphorus;
- Major ions, calcium, magnesium, sodium, potassium, chloride, sulphate, carbonate, bicarbonate;
- Total Petroleum Hydrocarbon (TPH); and
- BTEX (benzene, toluene, ethyl benzene, exylene). Additional Analysis – 12 monthly (every second sample only):
- Nutrient suite: total nitrogen, nitrate, total Kjeldahl nitrogen, total phosphorus, phosphate;
- Metals (arsenic, cadmium, chromium, copper, lead, zinc, nickel, manganese, mercury, total iron, filterable iron);
- Polycyclic Aromatic Hydrocarbon (PAH); and
- Organophosphorus pesticides, phenoxy acid herbicides.

8.2.4 Monitoring Program Summary

The recording date, time and parameters of monitoring data will be collected and tabulated. All original laboratory reports will be maintained on file. Monitoring records will be kept until the closure stage of the quarry.

Monitoring results will be made available to the public on the Karuah East website on a monthly basis.

Table 18 presents a summary of the monitoring point locations, the type of monitoring, and the frequency of sampling.

Table 18 Summary of Water Monitoring Requirements

Monitoring Focus/Parameter	Monitoring sites (refer Figure 4)	Frequency	Criteria/Guidelines	Responsibility	Reference / Comments
Surface Water					
Water quality	Dam1, Dam2, Dam 3	Monthly (see **Table 16** for parameters). Also discharge monitoring (see **Table 17** for parameters).	EPL ANZECC Guidelines	Quarry Manager	See **Table 16 and 17** of this Management Plan EPL GSSE Revised Water Assessment (2013)
	SW1, SW4	# Monthly (if creek flowing)			
	SW2, SW3	# Monthly (if creek flowing) and within 24 hours of any discharge.			
Erosion and sediment control	All noted erosion and sediment control structures.	Monthly and after significant rainfall events.			
Ecological health assessment of Yalimbah Creek	Yalimbah Creek	Prior to commencement of operations and annually			
Groundwater					
Groundwater levels	BH205, BH207, BH208 and BH303	Quarterly	No criteria	Quarry Manager	GSSE Revised Water Assessment (2013)
Groundwater quality	BH205, BH207, BH208 and BH303	6 monthly	No criteria		

It should be noted that presence of water in drainage lines does not necessarily indicate the water is flowing at the site. Stagnant water will not be sampled at SW 1-4, with only 'flowing water' sampled.

9 SURFACE AND GROUNDWATER RESPONSE PLAN

A multi-tiered surface and groundwater Trigger Action Response Plans (TARPs) have been developed to manage any possible adverse impacts on surface water from Karuah East operations. The TARP is included as **Appendix A** and outline trigger levels and response actions to be enacted in the event that such impacts are experienced.

10 REPORTING AND REVIEW

10.1 Monthly Reporting

Monitoring results associated with EPL criteria (discharge results) will be recorded on the website in the monthly environmental report to assess compliance against EPL criteria. Reporting will be undertaken in accordance with the EPA *Guidelines for Publishing of Pollution Monitoring Data*.

10.2 Annual Review

Results from the surface water and groundwater monitoring undertaken in accordance with this WMP will be reported in the Annual Review with an analysis against the relevant impact assessment criteria.

By the end of March each year the quarry will submit to the Secretary a report reviewing the annual environmental performance of the project. The contents of the required report are detailed in Schedule 5 Condition 4 of the PA.

10.3 Non – Conformance Response Procedure

In the event of a measured exceedance of the relevant water criteria (eg. discharge water quality is outside the EPL criteria range) or an incident relating to water management the following actions will be undertaken:

1. The situation will be investigated to determine causes of non - compliance;
2. The appropriate Karuah East personnel will be informed of any corrective actions taken or complaint received;
3. A full and complete record of the incident, actions and sign-off by an authorised person will be recorded in a log book;
4. The appropriate Karuah East personnel shall notify the Secretary and any other relevant agencies as soon as practicable, after becoming aware of the incident (taking into account relevant averaging periods for the relevant water criteria); and
5. Within 7 days of the incident, the appropriate Karuah East personnel shall provide the Secretary and any relevant agencies with a detailed report of the incident.

Schedule 5 Condition 7 of the PA requires:

The Proponent shall immediately notify the Secretary and any other relevant agencies of any incident that has caused, or threatens to cause, material harm to the environment.

For any other incident associated with the project, the Proponent shall notify the Secretary and any other relevant agencies as soon as practicable after the Proponent becomes aware of the incident. Within 7 days of the date of the incident, the Proponent shall provide the Secretary any relevant agencies with a detailed report on the incident, and such further reports as may be requested.

Where a significant pollution incident occurs which causes an impact on material harm, reference will also be made to the Karuah East Pollution Incident Response Management Plan (PIRMP) for procedures relating to management of pollution incidents.

10.4 Periodic Review

The WMP shall be reviewed and revised and/or updated, in accordance with Schedule 5 Condition 5 of the PA, within three (3) months of any of the following:

- The submission of an annual review;
- The submission of an incident report;
- The submission of an audit; and
- Any modification to the conditions of the PA.

Review of the WMP will also take place if monitoring records indicate that it is warranted or in the event of any significant change to operations or water management procedures at the quarry.

The Karuah East management team will discuss and review the status of all management plans on an annual basis, but unless required all site environmental management plans will be reviewed and updated every three years.

Any modifications to the WMP will be undertaken in consultation with the appropriate government agencies.

APPENDIX A1

CONSULTATION WITH DPI-WATER REGARDING WMP

Department of Primary Industries
Water

Contact: Tim Smith
Phone: 02 6229 7307
Email: tim.smith@dpi.nsw.gov.au

Our ref: ER20592 / OUT15/26466
Your Ref: PA 09_0175

Karuah East Quarry Pty Ltd
PO Box 3284
THORNTON NSW 2322

23 September 2015

Attn: Blake Almond

Dear Sir/Madam,

Re: Karuah East Quarry Project – Water Management Plan

Thank you for your correspondence dated 15 September 2015 regarding the completion of the Water Management Plan as per Schedule 3, Condition 21 of the Project Approval for the Karuah East Quarry Project.

The NSW Department of Primary Industries – Water (DPI Water) has reviewed the Water Management Plan (WMP) and has no further comment regarding the plan.

Should you have any further queries in relation to this submission please do not hesitate to contact Tim Smith on (02) 6229 7307.

Yours sincerely

Mitchell Isaacs
Manager Strategic Stakeholder Liaison

APPENDIX A2

CONSULTATION WITH EPA REGARDING MANAGEMENT PLANS

From: Karen Marler [mailto:Karen.Marler@epa.nsw.gov.au]
Sent: Wednesday, 14 October 2015 12:53 PM
To: Blake Almond
Cc: Peter Jamieson; Jocelyn Karsten; EPA RSD Hunter Region Mailbox; Christopher Jones
Subject: RE: Karuah East Quarry Project - Management Plans [EPA]

Hi Blake, the EPA does not approve management plans. In response to requests regarding consultation on management plans we provide the following standard response..

The Environment Protection Authority (EPA) encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, the EPA does not review these documents as our role is to set environmental objectives for environmental management, not to be directly involved in the development of strategies to achieve those objectives.

Regards

K

Karen Marler
Head Regional Operations Unit - Hunter| **NSW Environment Protection Authority** |
☎: (02) 49086803 | Mobile ☎: 0409 606 368 | 🖷: (02) 49086810|🖱: karen.marler@epa.nsw.gov.au

APPENDIX A3

DP&E COMMENTS ON DRAFT WMP

Water Management Plan (WMP)

Under Schedule 3, Condition 21 of the Project Approval 09_0175, KEQ is required to prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. Refer to the table below for the applicable approval requirements, the relevant sections in the submitted MP and the Department's review comments.

09_0175 Requirement	Section	Review Comment	Further Action
The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must:			
(a) be prepared in consultation with the EPA and NOW by suitably qualified and experienced person/s whose appointment has been approved by the Secretary;	Section 1.1	SLR appointment approved 22 July 2015. The Department recommends consultation with agencies to be provided in an Appendix of the management plan.	Please provide EPA and DPI Water consultation correspondence.
(b) be submitted to the Secretary for approval prior to the commencement of construction activities;	Section 2.2	Requirement has been met satisfactorily.	NFA
(c) include: *(i) a Site Water Balance that includes details of:* • *sources and security of water supply, including contingency planning;* • *water use on site; and* • *measures that would be implemented to minimise use of clean water and maximise recycling of dirty water on the site;*	Section 7	• The amount of water required for the office amenities should still be stated, including its source to substantiate the use of the separate system. • Contingencies need to be provided for meeting water demand. E.g. would it be trucked from the adjacent quarry during shortfalls etc.? (pg 27) • Table 9 – please confirm if the figures for the crushing plant are inclusive of screening and/or grinding activities. • It would be good to see average usage per year across all years of the 30 year life, but could group certain years (e.g. Years 3-5 etc.).	
(ii) a Surface Water Management Plan, that includes: • *baseline data on surface water flows and quality in the watercourses that could be affected by the project;* • *a detailed description of the surface water management system on the site, including the design objectives and performance criteria for the:* ○ *clean water diversions;* ○ *erosion and*	Section 4,6 & 8	• Rehabilitated areas are mentioned as a source of erosion and sediment control (6.2.1). Please explain why rehabilitation would cause erosion/sedimentation? Is this referring to the construction of bunds, rather than the rehabilitation itself? • Please ensure the design objectives and performance criteria for control of water pollution from areas of the site that have been rehabilitated is included. • Section 8.1.3 – monitoring for the first year only is not acceptable. After the first year, the water quality monitoring should be undertaken biannually to annually if water quality is meeting the performance criteria.	

09_0175 Requirement	Section	Review Comment	Further Action
sediment controls; ○ *water storages (including Maximum Harvestable Rights requirements); and* ○ *control of water pollution from areas of the site that have been rehabilitated;* • *surface water impact assessment criteria, to be developed following analysis of baseline data, including trigger levels for investigating any potentially adverse surface water quality impacts;* • *a program to monitor:* ○ *any surface water discharges;* ○ *the effectiveness of the water management system;* ○ *surface water flows and quality in local watercourses; and* ○ *ecosystem health of local watercourses; and* • *an assessment of appropriate options to improve storage and retention times in accordance with Managing Urban Stormwater: Soils and Construction (Landcom);*			
(iii) a Groundwater Monitoring Program that includes: • *baseline data of groundwater levels surrounding the site;* • *groundwater impact assessment criteria, to be developed following analysis of baseline data, including trigger levels for investigating any potentially adverse groundwater impacts; and* • *a program to monitor and/or validate the impacts of the project on groundwater resources;*	Section 4,6 & 8	Requirement has been met satisfactorily.	NFA

09_0175 Requirement	Section	Review Comment	Further Action
and			
((iv) a Surface and Ground Water Response Plan that describes the measures and/or *procedures that would be implemented to:* • *respond to any exceedances of the surface water impact assessment criteria and groundwater impact assessment criteria; and* • *mitigate and/or offset any adverse impacts on surface water and groundwater resources located within and adjacent to the site.*	Appendix A	Requirement has been met satisfactorily.	NFA
Other Comments			
	Section 3.2	Paragraph 3 – replace “Minister for Planning and Environment” with “Planning Assessment Commission”.	Amend text.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
Surface Water Monitoring/Discharge Events	Trigger	Levels within Surface Water Impact Assessment Criteria.	Isolated exceedance of EPL criteria from discharge events.	Actual or potential material harm to the environment from discharge events.
	Response	Continue Surface Water Monitoring Program.	Contact DP&E and EPA to report the non - compliance and prepare an incident report. See Section 10.3 for timings. Investigation of cause by Quarry Manager. Continue Surface Water Monitoring Program, with additional monitoring as required.	Immediately notify DP&E and EPA (also other relevant authorities) and enact the PIRMP Immediate application of remediation measures (as required) to prevent any actual material harm to the environment or prevent further actual or potential material harm to the environment. Review of Site Water Management Plan and related procedures to prevent reoccurrence. Continue Surface Water Monitoring Program with additional monitoring as required.
Failure of Dam or water management structure	Trigger	Inspections identify no structural issues associated with dams or water management structure.	Isolated structural issue associated with water management structures. Minor issue	Major failure of water management structure.
	Response	Continue inspection and maintenance program.	Investigate issue. Repair as soon as possible. Liaison with specialist if required. Structural assessment of all dams at site.	Report under the PIRMP guidelines. Undertaken initial repair works to prevent water discharging offsite. Water testing. Repair as soon as possible. Liaison with specialist. Structural assessment of all dams at site.
Groundwater quality	Trigger	No significant change in groundwater quality.	Minor deterioration in ground water quality	Major change in groundwater quality over successive months
	Response	Continue Groundwater Monitoring Program	Immediately notify DP&E, DTIRIS, EPA, SCA (for catchments within their control), potentially affected landowners and/or	Liaison with the EPA and DPI Water. Additional monitoring.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
			existing or future tenants. Investigation of cause by Quarry Manager and application of appropriate mitigation measures. Continue Surface Water Monitoring Program, with additional monitoring as required.	
Ground water level	Trigger	No significant change in groundwater levels.	Minor change in groundwater levels	Major change in groundwater levels or change in flora not explained by weather patterns or mining activities.
	Response	Continue Groundwater Monitoring Program	Continue Groundwater Monitoring Program, with additional monitoring as required.	Liaison with the EPA and DPI Water. Undertake investigation. Additional monitoring. Engage a hydrogeologist to assist.