WATER QUALITY IMPACT ASSESSMENT

Martin Creek Quarry Extension Project

1 September 2016

Prepared by

James McMahon

Principal Environmental Scientist

JM Environments
0427 893 668
37 Tooke St
COOKS HILL NSW 2300
ABN 67 166 341 288

EXECUTIVE SUMMARY

JM Environments (JME) was commissioned by Buttai Gravel Pty Ltd (the proponent) to prepare a Water Quality Impact Assessment for the Martins Creek Quarry Extension Project (the project). Martins Creek Quarry (the quarry) is an existing hard rock quarry located at Station Street Martins Creek within Dungog Shire Council Local Government Area as shown in Figure 1. The Martins Creek Quarry is currently located within lands identified as Lots 5 and 6 DP242210, Lot 42 DP 815628, Lot 1 DP 1006375 and Lot 1 DP 204377.

The quarry is a high quality hard rock source (Andesite) and was originally developed by the NSW Government in 1914 to supply materials for the North Coast rail line and has continued to supply rail construction materials to present times. Buttai Gravel Pty Ltd took ownership of the quarry from December 2012.

The Martins Creek Quarry Extension Project involves:

- extracting up to 1.5 million tonnes of hard rock material per annum;
- expanding into new extraction areas and clearing approximately 35.4 hectares of vegetation;
- increasing the hours of operation for quarrying to 6am – 6pm (Monday to Saturday), processing to 6am - 10pm (Monday to Saturday), mixing and binding to 4:30am - 10pm (Monday to Friday) and 4:30am - 6pm (Saturdays), stockpiling, loading and dispatch of road transport to 5:30am - 7pm (Monday to Saturday) and train loading to 24 hours per day, 7 days per week;
- consolidating existing operations and approvals; and
- rehabilitating the site.

The project is to be assessed as a State Significant Development under Section 78A (8A) of the Environmental Planning and Assessment Act 1979 (EP&A Act). As such, an Environmental Impact Statement (EIS) is required to support the application for project approval. This Water Quality Impact Assessment (WQIA) will form part of the EIS.

The objectives of the WQIA were to:

- assess the current surface water and groundwater quality;
- assess potential impacts on the surface and groundwater quality by the extension of the quarry; and
- provide mitigation measures to manage potential impacts on the surface and groundwater quality by the extension of the quarry
- develop a conceptual hydrogeological model of the quarry;

In order to achieve the above objectives, the following scope of work was undertaken:

- Review of the Secretary Environmental Assessment Requirements (SEARS);
- Summarise the relevant legislations and guidelines noted in the SEARS-attachment 1;
- Surface water quality monitoring, collecting field parameters (pH, EC, DO, redox) and laboratory samples for total suspended solids (TSS) and TPH from two onsite water

dams and two samples from the Paterson River (upstream and downstream from the quarry)

- A search of registered bores within the Project site and surrounding lots from NSW Water Information Database;
- Installation of monitoring wells in the areas of the proposed quarry extension;
- Survey of the boreholes to establish bore and groundwater levels to reduced levels;
- Groundwater sampling to assess the background groundwater quality;
- Monitoring groundwater levels to assess the temporal variation of groundwater levels;
- Hydraulic testing to estimate the hydraulic conductivity values; and
- Preparation of a detailed site water balance.

The streams that will be affected by the proposed quarry extension are very minor headwater drainage lines that are ephemeral in nature and only flow for short periods after heavy rainfall. There was no volumetric flow data for these streams and little baseline water quality information to help quantify the potential impacts. Because a negligible amount of water is proposed to be used on site there will be minimal impact on flow regimes downstream of the proposed quarry extension.

Total suspended solids are likely to be the key water quality parameter requiring management throughout the life of the quarry to ensure the water quality in downstream watercourses is not impacted. A number of surface water management and mitigation measures are recommended by this Surface Water Assessment to ensure that the potential risk of any adverse off-site surface water impacts is minimised. This includes directing dirty water runoff into suitably sized sediment basins, use of water from the sediment basins for operational activities and the use of chemical flocculants to help decrease settlement times where required.

A water balance model was developed for the quarry, and modelled four representative stages of the quarry life; Scenario 1, which represents the current disturbance footprint of the quarry, Scenario 2 which represents the interceptions of a second order stream 5 years after the approval of the quarry extension, Scenario 3 which represents the interceptions of a second and third order stream 10 years after the approval of the quarry extension and Scenario 4, which represents the quarry at full extraction and disturbance footprint near the end of life of the quarry. The water balance indicates that the site would be relatively balanced, with sufficient water available for reuse in dry periods and some wet weather discharges following large rainfall events.

Based on the estimated water usage associated with the operation of the quarry, the overall results of the water balance indicate that the site is likely to have excess water supply through the rainfall runoff captured in sediment basins.

The model also indicates likely annual wet weather discharges of 9 days per year in Scenarios 1-3 and 3 days in Scenario 4, and controlled releases to occur for approximately 22 days in Scenarios 1-4, assuming an average rainfall year. However, it is considered likely that the wet weather discharges will be less as in practice, the eastern-pit sump could provide additional storage following heavy rainfall events, and sediment basins will be managed to achieve controlled release (after flocculation) to ensure there is available capacity in these basins to store runoff prior to a rainfall event.

If the surface water management and mitigation measures identified and discussed within this WQIA are implemented and maintained, it is anticipated that there would be minimal impact on surface water downstream of the quarry as a result of the proposed extension to the quarry.

Site observation and the installation and sampling of monitoring well indicates that the groundwater has been intercepted in the western pit. Modelling indicates that groundwater seepage into the pit is limited by the rate of infiltration/percolation of surface water into the subsurface. Extension of the quarry is not planned to further intercept the underlying aquifer. Little or no further impact on groundwater is anticipated by extension of the quarry. A groundwater licence under Section 5 of the Water Act 1912 for the groundwater seepage into the quarry has been granted by the NSW Office of Water.

The Hunter Estuary Wetlands are approximately 57km from the quarry. It is unlikely that the quarry, it is current capacity or its proposed expansion will have a significant impact, if any, upon the wetlands.

RECORD OF DISTRIBUTION

No. of copies	Report File Name	Report Status	Date	Distributed to:	Initials
1 pdf	JME4061 Water Quality Impact Assessment	Draft	19 November 2015	Site R&D Portal	SM
1 pdf	JME4061 Water Quality Impact Assessment	Draft	21 November 2015	Site R&D Portal	SM
1 pdf	JME4061 Water Quality Impact Assessment	Final	2 March 2016	Site R&D Portal	SM
1 pdf	JME4061 Water Quality Impact Assessment	Revision 1	1 September 2016	Site R&D Portal	SM

Revision 1 replaces and supersedes previous versions of the is report.

CONTENTS

ATTACHMENTS

Figure 1:	Site Location Plan
Figure 2:	Streams Proposed to be Intercepted
Figure 3:	Groundwater Well Location Plan
Figure 4:	Surface Water Catchment Plan
Summary Table 1	
Appendix A	Laboratory Documentation
Appendix B	Sediment and Erosion Blue Book Summaries
Appendix C	Groundwater Licence

1 INTRODUCTION

1.1 Project Overview

JM Environments (JME) was commissioned by Buttai Gravel Pty Ltd (the proponent) to prepare a Water Quality Impact Assessment for the Martins Creek Quarry Extension Project (the project). Martins Creek Quarry (the quarry) is an existing hard rock quarry located at Station Street Martins Creek within Dungog Shire Council Local Government Area as shown in Figure 1. The Martins Creek Quarry is currently located within lands identified as Lots 5 and 6 DP242210, Lot 42 DP 815628, Lot 1 DP 1006375 and Lot 1 DP 204377.

The quarry is a high quality hard rock source (Andesite) and was originally developed by the NSW Government in 1914 to supply materials for the North Coast rail line and has continued to supply rail construction materials to present times. Buttai Gravel Pty Ltd took ownership of the quarry from December 2012.

The Martins Creek Quarry Extension Project involves:

- extracting up to 1.5 million tonnes of hard rock material per annum;
- expanding into new extraction areas and clearing approximately 35.4 hectares of vegetation;
- increasing the hours of operation for quarrying to 6am – 6pm (Monday to Saturday), processing to 6am - 10pm (Monday to Saturday), mixing and binding to 4:30am - 10pm (Monday to Friday) and 4:30am - 6pm (Saturdays), stockpiling, loading and dispatch of road transport to 5:30am - 7pm (Monday to Saturday) and train loading to 24 hours per day, 7 days per week;
- consolidating existing operations and approvals; and
- rehabilitating the site.

The project is to be assessed as a State Significant Development under Section 78A (8A) of the Environmental Planning and Assessment Act 1979 (EP&A Act). As such, an Environmental Impact Statement (EIS) is required to support the application for project approval. This Water Quality Impact Assessment (WQIA) will form part of the EIS.

1.2 Objectives

The objectives of the WQIA were to:

- assess the current surface water and groundwater quality;
- assess potential impacts on the surface and groundwater quality by the extension of the quarry; and
- provide mitigation measures to manage potential impacts on the surface and groundwater quality by the extension of the quarry
- develop a conceptual hydrogeological model of the quarry;

1.3 Scope of Work

In order to achieve the above objectives, the following scope of work was undertaken:

- Review of the Secretary Environmental Assessment Requirements (SEARS);

- Summarise the relevant legislations and guidelines noted in the SEARS-attachment 1;
- Surface water quality monitoring, collecting field parameters (pH, EC, DO, redox) and laboratory samples for total suspended solids (TSS) and TPH from two onsite water dams and two samples from the Paterson River (upstream and downstream from the quarry)
- A search of registered bores within the Project site and surrounding lots from NSW Water Information Database;
- Installation of monitoring wells in the areas of the proposed quarry extension;
- Survey of the boreholes to establish bore and groundwater levels to reduced levels;
- Groundwater sampling to assess the background groundwater quality;
- Monitoring groundwater levels to assess the temporal variation of groundwater levels;
- Hydraulic testing to estimate the hydraulic conductivity values; and
- Preparation of a detailed site water balance.

2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Table 1 provides a summary of the Secretary Environmental Assessment Requirements (SEARs) while Table 2 provides a summary of the Environmental Assessment Requirements (EARs) provided by other government agencies relating to surface water and groundwater. Tables 1 and 2 also indicate where the specific issues have been addressed within this assessment report.

Table 1: Secretary Environmental Assessment Requirements

Agency	Requirements relevant to surface water and groundwater	Item is addressed in:
Department of Planning and Environment	An assessment of the potential impacts of the development on: • the quantity and quality of regional water supplies; • regional water supply infrastructure; and • effected licensed water users.	 Section 5.4 Section 5.4 Section 5.5
	a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; an assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives;	Section 8
	identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*	Section 6.7 Section 7.6.5
	demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP)	Section 6.7.2
	a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo.	Section 8.4.3

	a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts.	Section 5.4 and 6.6.4

Table 2: Environmental Assessment Requirements (EARs) provided by other government agencies

Agency	**Requirements relevant to surface water and groundwater**	**Relevance/issues**
Dungog Shire Council	The Applicant should be required to prepare and implement a Site Water Management Plan for the development, which incorporates:	
	• a detailed description of the proposed water management system	Section 6.4
	• Detailed assessment (including modelling) of the potential surface and groundwater impacts,	Section 6 and Section 7
	• a site water balance	Section 8
	• an Erosion and Sediment Control Plan;	Section 6.2.3
	• a Surface Water Control and Monitoring Program	Section 6.7.4
NSW Office of Water	Details of water proposed to be taken (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.	Section 8.3.1
	Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).	Section 6.7.2
	The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.	Section 6.7.2
	A detailed and consolidated site water balance.	Section 8
	A detailed assessment against the NSW Aquifer Interference Policy (2012) using the NSW Office of Water's assessment framework.	Section 7.6.5
		This WQIA

	Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts. Full technical details and data of all surface and groundwater modelling, and an independent peer review. Proposed surface and groundwater monitoring activities and methodologies. Proposed management and disposal of produced or incidental water. Details surrounding the final landform of the site, including final void management (where relevant) and rehabilitation measures. Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts. Consideration of relevant policies and guidelines.	This WQIA
NSW EPA	Water management issues associated with the proposal (surface water, impacts on receiving environments and general water usage) Describe the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges.	This WQIA Section 8

3 LEGISLATION POLICIES AND GUIDELINES

Table 3 contains a review of legislation, polices, plans and guidelines that are potentially relevant to the project.

Legislation	Objective/purpose	Relevance/issues
Water Act 1912	Under the Water Act 1912 you must have a water licence or authority to: • Take water from a stream or river via a pump or other work for all purposes other than for basic landholder rights. • Capture surface water from rainfall runoff in a farm dam with a storage capacity greater than the calculated Maximum Harvestable Right Dam Capacity for the property from river flow in a dam (any size) located on a river or stream. • Extract groundwater via any type of bore, well, spear point or groundwater interception scheme for all purposes except to take water from an aquifer under a basic landholder right.	There are three existing dams on site for the management of surface water in accordance with EPL 1378 Dam 1 manages water from crushing plant area Dam2 manages water from administration area Dam3 manages water from West pit Dam 4 (proposed) manages water from the proposed east pit Groundwater is not planned to be used for production. Groundwater has been intercepted during quarrying activities and an aquifer interference licence has been applied for in October 2015.
Water Management Act 2000	Water Management Act 2000 recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water licences from land. The main tool the Act provides for managing the State's water resources are water sharing plans. These are used to set out the rules for the sharing of water in a particular water source between water users and the environment and rules for the trading of water in a particular water source.	The provisions of the Water Act 2000 are not applicable to this application as no dams are being constructed apart from those required under EPL1378.

The Protection of the Environment Operations Act 1997 (POEO Act)	The object of the POEO Act is to achieve the protection, restoration and enhancement of the quality of the NSW environment. The Act repealed and consolidated a number of existing Acts to rationalise, simplify and strengthen the regulatory framework for environmental protection in NSW. The activities listed in Schedule 1 to the POEO Act (broadly, activities with potentially significant environmental impacts) require an environmental protection licence (EPL). EPL are issued in respect of scheduled development work (i.e. development of a site that would require a licence), premises based activities and non-premises based activities. Licences can also be issued to regulate water pollution from activities that are not in Schedule 1. Such licences can provide protection against prosecution for water pollution if the licence conditions are complied with. The EPA will issue all licences and are usually subject to conditions. Licences can control the air, noise, water and waste impacts of an activity. Licences are ongoing but subject to review at least once every five years and can be varied, suspended or revoked.	Hard rock quarrying is noted in Schedule 1 of the POEO Act under "Extractive activities". The existing quarry is currently operating under EPL licence No. 1378.
Policy	**Summary**	**Relevance/issues**
NSW State Groundwater Policy Framework Document	The Goal for the management of groundwater in New South Wales is: To manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. It is the policy of the NSW Government to encourage the ecologically sustainable management of the State's groundwater resources, so as to: • Slow and halt, or reverse any degradation of groundwater resources; • Ensure long term sustainability of the systems ecological support characteristics; • maintain the full range of beneficial uses of these resources;	Groundwater has been intercepted during quarrying activities and an aquifer interference licence has been applied for in October 2015.

	• Maximise economic benefit to the Region, State and Nation. Adoption of the State Groundwater Policy means that the sustainability of groundwater resources and their ecosystem support function will be given explicit consideration in resource management decision making. NSW groundwater management policies and practices will be consistent with the aims of the National Strategy for Ecologically Sustainable Development (ESD), the Inter-Governmental Agreement on the Environment (IGAE), the National Water Quality Management Strategy (NWQMS) and the Council of Australian Governments (COAG) water reform agenda. The policies and practices will be in line with NSW government directions for natural resource management. The State Groundwater Policy objectives will be achieved through application of the resource management principles listed below. An ethos for the ecologically sustainable management of groundwater resources should be encouraged in all agencies, communities and individuals who own, manage or use these resources, and its practical application facilitated. • Non-sustainable resource uses should be phased out. • Significant environmental and/or social values dependent on groundwater should be accorded special protection. • Environmentally degrading processes and practices should be replaced with more efficient and ecologically sustainable alternatives. • Where possible, environmentally degraded areas should be rehabilitated and their ecosystem support functions restored. • Where appropriate, the management of surface and groundwater resources should be integrated. • Groundwater management should be adaptive, to account for both increasing understanding of resource dynamics and changing community attitudes and needs.	

	• Groundwater management should be integrated with the wider environmental and resource management framework, and also with other policies dealing with human activities and land use, such as urban development, agriculture, industry, mining, energy, transport and tourism.	
NSW State Groundwater Quality Protection Policy	The Groundwater Quality Protection Policy is specifically designed to protect our valuable groundwater resources against pollution. Adoption of this Policy, means that the sustainability of groundwater resources and their ecosystem support functions will be given explicit consideration in resource management decision making. NSW groundwater management policies and practices will be consistent with the aims of other national and State policies. These include: • the National Strategy for Ecologically Sustainable Development (ESD), • the Inter-Governmental Agreement on the Environment (IGAE), • the National Water Quality Management Strategy (NWQMS), • the Council of Australian Governments (COAG) water reform agenda; • NSW Water Reforms; and • NSW government policy directions for natural resource management. The Policy objectives will be achieved by applying the management principles listed below. 1 All groundwater systems should be managed such that their most sensitive identified beneficial use (or environmental value) is maintained. 2. Town water supplies should be afforded special protection against contamination.	Groundwater has been intercepted during quarrying activities and an aquifer interference licence has been applied for in October 2015.

	3. Groundwater pollution should be prevented so that future remediation is not required. 4. For new developments, the scale and scope of work required to demonstrate adequate groundwater protection shall be commensurate with the risk the development poses to a groundwater system and the value of the groundwater resource. 5. A groundwater pumper shall bear the responsibility for environmental damage or degradation caused by using groundwaters that are incompatible with soil, vegetation or receiving waters. 6. Groundwater dependent ecosystems will be afforded protection.	
NSW State Groundwater Quantity Management Policy\	The objectives for managing groundwater quantity NSW are: • to achieve the efficient, equitable and sustainable use of the state's groundwater; • to prevent, halt, or reverse degradation of the State's groundwaters, and their dependent ecosystems; • to provide opportunities for development which generate the most cultural, social and economic benefits to the community, region, State and nation, within the context of environmental sustainability; and • to involve the community in the management of groundwater resources.	Groundwater has been intercepted during quarrying activities and an aquifer interference licence has been applied for in October 2015.
Plan	**Objective/purpose**	**Relevance/issues**
Water Sharing Plan for the Paterson Regulated River Water Source 2007	The objectives of this Plan are to: (a) protect the natural seasonal variation of low flows during dry periods, (b) protect the initial flow in natural freshes,	No water is drawn from the Patterson River for the site. Interruption of sites ephemeral streams will be minimised by collecting the water into sediment control dams and sumps and returned to environments under EPL licence No. 1378.

	(c) protect a high proportion of moderate and high flows, (d) protect a high proportion of the natural inundation pattern and distribution of floodwaters supporting natural wetland and floodplain ecosystems, (e) mimic natural flow variability of medium and high flows, (f) maintain rates of rise and fall of river heights within their natural bounds for medium and high flows, (g) provide a reserve of water that can be used to assist in management of critical environmental contingencies, (h) contribute to maintenance of estuarine processes and habitats, (i) contribute to maintenance of the ecological condition of this water source and its riparian areas over the longer term, (j) mitigate the impacts of instream structures, (k) mitigate downstream water quality impacts of storage releases, (l) maintain water supply priority for basic rights for domestic and stock access licences at all times, (m) maintain a highly reliable supply of water to towns to meet the existing and potential population needs of urban communities, (n) provide clarity of rights for holders of regulated river (high security) access licences, (o) provide a defined level of water supply access to the irrigation industry, (p) provide clarity of access to supplementary water, (q) contribute to protection of recreational and tourism opportunities, and (r) recognise priority for traditional water rights of Aboriginal people.	

Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)	This document assists in the development of Groundwater Monitoring and Modelling Plans (GMMPs). These plans are required as a standard condition of licence for exploration (drilling) under the Mining Act 1992 and Petroleum (Onshore) Act 1991. This document also provides industry users with information about the NSW Aquifer Interference Policy (AIP) and other regulatory requirements under the Water Act 1912 and the Water Management Act 2000, as they relate to mineral and petroleum prospecting. The purpose is to provide information that will assist with the design of a groundwater (and associated surface water) monitoring programs that ensure the required data and information for: • hydrogeological conceptualisation • assessment of baseline and regional conditions • time series data for any future groundwater model calibration.	noted.
State Water Management Outcomes Plan	The aim of the Water Management Act 2000 (the Act) is to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The Act provides for the establishment of this State Water Management Outcomes Plan (SWMOP) to set out the over-arching policy context, targets and strategic outcomes for the development, conservation, management and control of the State's water sources. This SWMOP is expected to: • improve the quality of water sources and the health, productivity and diversity of their dependent ecosystems, • increase the economic value of water extracted from water sources and used, and	noted.

	• protect the long term interests of regional communities.	
Guidelines	**Objective/purpose**	**Location where addressed within this Report**
Australian Groundwater Modelling Guidelines	The objective of the Australian groundwater modelling guidelines is to promote a consistent and sound approach to the development of groundwater flow and solute transport models in Australia. It builds on existing guidelines (Murray–Darling Basin Commission 2001) that have been adopted throughout Australia in recent years. While it is acknowledged that the term groundwater modelling refers to a variety of methods, the guidelines focus on computer-based numerical simulation models. The guidelines should be seen as a point of reference and not as a rigid standard. They seek to provide direction on the scope and approaches common to modelling projects. The continual evolution of modelling techniques through adaptation and innovation is not only acknowledged, but encouraged. It is recognised there are other approaches to modelling not covered in these guidelines and that such approaches may well be appropriate and justified in certain circumstances.	Noted
Office of Water Guidelines for Controlled Activities (2012)	Under the Water Management Act 2000 (WM Act) an approval is required to undertake controlled activities on waterfront land, unless that activity is otherwise exempt. Controlled activities include the carrying out of building work, such as erecting buildings and other structures, and the installation of infrastructure. They also include excavating or depositing material. Waterfront land is the bed of any river, lake or estuary and any land within 40 metres of the highest bank of the river, the lake shore or the mean high water mark of the estuary.	A controlled activity approval is not required if the controlled activity is to be undertaken in accordance with any mining, crown lands or western lands lease, licence, permit.

Australian and New Zealand Guidelines for Fresh and Marine Water Quality	The primary objective of the Australian National Water Quality Management Strategy (NWQMS) (ANZECC & ARMCANZ 1994) is based on ecologically sustainable development of water resources. The main objective of the Guidelines for fresh and marine water quality is intended to support this overall objective: • to provide an authoritative guide for setting water quality objectives required to sustain current or likely future environmental values for natural and semi-natural water resources in Australia and New Zealand.	Guidelines were used to establish surface water and groundwater parameters in the water quality assessment . See section 5.6 and 7.5.3.
National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)	This document reviews the overall management of sewerage systems and specifically addresses effluent management. It has been developed as a basis for a common and national approach throughout Australia.	It is assumed that pump out portable toilets will be used into the future. Buttai Gravel will be responsible for the sewage to be disposed of at a Hunter Water sewage disposal site. Hunter Water will be responsible for the overall effluent quality of Hunter Water sewage treatment plants.

4 AGENCY CONSULTATION

Three meetings with the NSW Office of Water were held to discuss the proposed project. The consultation minutes are presented in the consultation report of the EIS.

5 EXISTING ENVIRONMENT

5.1 Rainfall

The project site is located in the Paterson River Valley which is in a Temperate Climate area with warm to hot wet summers and low winter rainfall with no dry season. Rainfall data were recorded at Paterson Post Office (5-6km south of the project site), dating back to 1901 until 1992. Weather data has been recorded at Tocal AWS (9-10km south of site) from 1967 until present. A meteorological weather station has been present on site since 2012 and a second station added in 2013.

The long term data from Tocal AWS (47 years, 1967-2015) indicates the highest average rainfall occurs in February (121.5mm) and the lowest average rainfall occurs in August (37.2mm). The 10th percentile (dry year) annual rainfall is 720mm, the mean annual rainfall is 938.8mm and the 90th percentile (wet year) annual rainfall is 1,175.5mm.

5.2 Topography, Geology and Soils

A review of the NSW Land and Property Information's online topology map indicated the project site is located on the south west facing slopes of a ridge line/small mountain up to 150mAHD.

The Department of Mines Newcastle Geology Map (1:250,000, First edition 1966) indicated the project site is underlain with the Carboniferous Gilmore Volcanics Martins Creek Andesite Member Group. The borelogs from the resource assessment drilling undertaken by Rail Corp in 2007 and VGT in 2015 confirms that it is predominately underlain with andesite.

The NSW Department of Land and Water Conservation's Newcastle Soils Landscape Series Sheet 9232 indicates the project site is on the boundary of the Ten Mile Road and the Birdsview Colluvial Soil Groups.

The Ten Mile Road Soil Group is on the western portion of site and described as undulating low hills on Carboniferous sediments and acid volcanics in the Medowie Lowlands and Clarence Town Hills regions. The local relief is 40-80m with elevations of 70-150m with slopes of 5-10%. The soils of the Ten Mile Group are moderately deep (55cm) to deep (>200cm) well to imperfectly drained brown Soloths, yellow Soloths and shallow well drained (<45cm) Bleached Loams and Lithosols. The limitations of the Ten Mile Soil Group are high water erosion hazard, localised shallow soils, high run on and seasonal waterlogging, strongly to extremely acid soils of low fertility.

The Birdsview Soil Group is on the eastern portion of the site and is described as rolling to steep hills on Carboniferous sediments in the Paterson Mountains region. Slopes are up to 45%, local relief is 100-260m and the elevation is up to 300m. The soils of the Birdsville Soil group are moderately deep (80-120cm), well drained Yellow Podzolic Soils with shallow (20-30cm), well drained Bleached Loams and Lithosols on stony ridge crests and deep (>200cm), well drained Red Podzolic Soils where siltstones and deeply weathered polymictic conglomerates outcrop. The soils of the Birdsville Soil group have the following qualities and limitations: steep slopes, mass movement hazard (localised), rock outcrop (localised), water erosion hazard, high run on, foundation hazard (localised) and shallow soils (localised).

5.3 Vegetation

Conacher Environmental recently undertook a Biodiversity Assessment Report for the proposed development. The report was based on preliminary field investigations on 9 July 2014 and a review of the previously completed investigation undertaken by Umwelt (2009) and Ecotone Ecological Consultants (2011).

The investigation identified a number of broad habitat types on the subject site. These are:

- Dry Sclerophyll Forest;
- Wet Sclerophyll Forest;
- Rainforest; and
- Cleared / Disturbed Land.

Although there are no Endangered Ecological Communities specifically listed with the Dungog Local Government Area, the following communities have suitable habitat mapped within the subject site:

- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions; and
- Lowland Rainforest on Floodplain in the NSW North Coast Bioregion.

5.4 Surface Hydrology

The project site lies within the Paterson/Allyn Rivers catchment area. The catchment area of the Paterson River and Allyn River are approximately 277km^2 and 367km^2 respectively. The Paterson and Allyn rivers rise in Barrington Tops National Park and Chichester State Forest and flow in a south-easterly direction. Based on the average annual rainfall at Tocal, 938.8mm, approximately 605 gigalitres of rainfall is received in the Paterson/Allyn Rivers catchment area each year.

The Paterson River rises in the Barrington Tops National Park, west by north of Careys Peak, and flows generally south and southeast, joined by six minor tributaries including the Allyn River at Vacy, before reaching its confluence with the Hunter River between Hinton and Morpeth. Lostock Dam is located on the Paterson River near the township of Lostock (48 kilometres from its source) and algal growth within the dam can impact downstream water quality.

The river is tidal to above the village of Paterson and below Vacy. The river system courses through the fertile farming land of the Paterson and Allyn River Valleys and the Patersons Plains; descending 933 metres over its 151 kilometres course. The dominant non-agricultural land use in the catchment is timber production and the major agricultural industries are dairying, beef cattle and poultry production.

Drainage within the quarry site is collected into three sediment dams. Dam1 is located to the west of the administration buildings. Dam 1 collects water from the processing and sales area. Dam 1 has an estimated capacity of 13ML and is fitted with a manually operated flocculent dosage system for the treatment of total suspended solids. Dam 1 is a licensed water discharge point under EPL1378. Dam 2 collects water from the southern work compound area of the quarry. Dam 2 has a capacity of 0.9ML. The water in Dam 2 can be discharged under EPL1378 but is generally pumped to Dam 1 for treatment and discharged. Water in the western pit is collected in the western pit sump, Dam 3 which has an estimated capacity of 456ML. Dam 3 is either pumped to a holding dam for discharge under EPL1378 or pumped directly to discharge under EPL1378. Water from the holding dam is used is for dust suppression on haul roads and some product stockpiles.

Storm water up gradient of the existing processing area is drained by an unnamed second order ephemeral stream to the north of the eastern pit and an unnamed third order ephemeral stream to the east of the eastern pit that flow around and converge to the north of the existing processing area. The ephemeral stream would flow after sufficient rainfall to the southwest, passing through a culvert under the main haul road, to the west of Station Street and discharge into the Paterson River.

A first order ephemeral steam and a second order stream drain storm water up gradient of the western pit and would flow after sufficient rainfall to the west to discharge into the Paterson River.

5.5 Current Surface Water Users

A search of the NSW Department of Primary Industry NSW Water Register indicates there are 369 Water Access Licences (WAL) with a total of 25,525.9 ML/year allocated in the Paterson Regulated River Source, the Paterson/Allyn Rivers Water Source and the Paterson River Tidal Pool Water Source area.

The following properties are downstream of surface water flows from the quarry and have a WAL for irrigation;

- Lot 14 DP 249257, WAL 14703;
- Lot 15 DP 249257, WAL 14702;
- Lot 16 DP 249257, WAL 14781;
- Lot 17 DP 249257, WAL 14782; and
- Lot 18 DP 249257, WAL 14780.

5.6 Existing Surface Water Quality

The existing water quality was collected by JME on 4 and 18 February and 4 March 2015. Prior to sampling, January had received 153.2mm of rainfall which is above the average 110.7mm. 40mm of rain had fallen on 28 January. During the sampling period, February had received 36.2mm of rainfall which was below the average of 117.5mm. The quarry was operating under typical conditions with rock being extracted from the western pit. Dam 1, the standing water in the main pit (Dam3), the Allyn River near the junction with the Paterson River and the Paterson River at the Gostwyck Bridge were sampled (See Figure 2). The water quality results are summarised in **Tables 4-7**.

Table 4: Discharge Dam 1 Existing Water Quality Summary Table

Analyte	Units	Date	
		4/2/2105	18/2/2015
Dissolved Oxygen	ppm	7.42	7.35

pH		8.07	7.79
Electrical Conductivity	µS/cm	357	529
Redox Potential	mV	-14	99
Total Suspended Solids	mg/L	70	57
Total Recoverable Hydrocarbons	µg/L	<700	<700

Table 5: Dam 3 Existing Water Quality Summary Table

Analyte	Units	Date
		4/2/2105
Dissolved Oxygen	ppm	6.54
pH		7.83
Electrical Conductivity	µS/cm	489
Redox Potential	mV	-32
Total Suspended Solids	mg/L	47
Total Recoverable Hydrocarbons	µg/L	<700

Table 6: Allyn River Existing Water Quality Summary Table

Analyte	Units	Date		
		4/2/2105	18/2/2015	4/3/2015

Dissolved Oxygen	ppm	-	6.88	8.15
pH		6.71	6.42	7.81
Electrical Conductivity	µS/cm	148	268	155
Redox Potential	mV	54	87	95
Total Suspended Solids	mg/L	16	<5	
Total Recoverable Hydrocarbons	µg/L	<700	<700	

Table 7: Patterson River Existing Water Quality Summary Table

Analyte	Units	Date		
		4/2/2105	18/2/2015	4/3/2015
Dissolved Oxygen	ppm	7.16	7.25	8.31
pH		7.11	6.97	7.55
Electrical Conductivity	µS/cm	218	306	200
Redox Potential	mV	39	127	76
Total Suspended Solids	mg/L	16	<5	
Total Recoverable Hydrocarbons	µg/L	<700	<700	

The NSW Department of Primary Industries electrical conductivity data (2002-2016) for the Paterson River at the Gostwyck Bridge indicates the average EC is 280 µS/cm with a standard deviation of 72 µS/cm indicating that the data collected by JME was representative of the longer water quality for the Paterson River at the Gostwyck Bridge.

The results of the existing water quality sampling indicate that the water caught on site is slightly caustic with a moderate level of suspended solids whereas the Paterson/Allyn River system water quality is slightly acidic with little suspended solids. Comparison of the upstream data collected from the Allyn River compared to the downstream data collected from the Paterson River indicates that the existing quarry operation is not having a discernible effect on the water quality of the Paterson/Allyn River system.

6 SURFACE WATER IMPACTS AND PROPOSED MANAGEMENT MEASURES

The primary objective of surface water management at the quarry is to minimise the disturbance of the natural volume of flows from first, second and third order streams that will be intercepted by quarrying operations. Doing so will minimise the generation of sediment laden water caused by storm water flowing over the open quarry faces.

6.1 Existing Surface Water Management System

The quarry has an existing surface water management system as summarised below:

- Storm water from the western quarry area is collected Dam3. Dam 3 is pumped out to a holding dam to discharge under EPL1378 or used for dust control via a water cart.
- Storm water from the existing production area is collected in Dam1. The water in Dam1 is treated for suspended solids and pH balanced prior to discharge into an unnamed ephemeral creek south west of the site under EPL1378.
- Storm water from the administration area is collected in Dam 2. Dam 2 usually is pumped back to Dam 1 for treatment prior to discharge but Dam2 is also a licensed discharge point under EPL1378.
- Storm water collected up gradient of the production area flows through site, between the production area and the western quarry.
- Offsite discharge of surface water quality is regulated under EPL1378.

The current surface water dam capacities are:

- Dam1 capacity is 13ML;
- Dam2 capacity is 0.9ML; and
- Dam3 (western pit) capacity is 456ML.

6.2 Proposed Surface Water Management System

The final quarry design includes the interception of a first and second order streams in the western pit and the interception of a second and third order stream in the eastern pit, as shown in Figure3.

6.2.1 Proposed Production Area Surface Water Management

The surface water of the production and administration area will be managed by the current Dam 1 and Dam 2 system. The catchment of this area is not planned to increase throughout the lifetime of the quarry. However the catchment of this area gradually decreases from about 15 years past approval as the eastern pit extends into the productions area hence a portion of the surface from the production area will be captured in the eastern pit void.

6.2.2 Proposed West Pit Surface Water Management

The catchment of the first and second order streams intercepted by the western pit is approximately 21ha. Approximately 5 hectares of this catchment is proposed to be quarried. Surface water flow from this catchment will be collected in Dam 3. Excess surface water in the sump will be discharged offsite under the requirements of EPL1378.

6.2.3 Proposed East Pit Surface Water Management

The central section of the eastern pit is proposed to be quarried prior to intercepting the second and third order streams. A quarry void (Dam 4) of approximately 19,300m^3 will be created before the second order stream is intercepted. The void will be extended to approximately 96,400m^3 in around 5 years from approval. Quarry operations will intercept the third order stream around 10 years from approval and the void will be approximately 460,000m^3. The surface water collected in Dam 4 will be discharged to a rock lined drain that feeds to the downstream bed of the intercepted stream. A new discharge point from Dam 4 for EPL1378 must be obtained prior to discharging water offsite.

Progressive Erosion and Sediment Controls Plans (PESCPs) will be developed and implemented throughout the life of the quarry. The PESCPs will be updated to provide current detail regarding the location and installation of control measures. As their name implies, these are developed as the project progresses and as site conditions evolve and flow paths are altered, e.g. the reshaping of clean water drainage lines.

The PESCP must include details of the following where relevant:

- scour protection measures for haul roads and access tracks when these are an erosion hazard due to either their steepness, soil erodibility or potential for concentrating runoff flow;
- measures for stabilising temporary drains;
- measures to minimise erosion during construction of embankments;
- measures to minimise erosion and control sedimentation from stockpiles;
- methods of constructing batters to assist the retention of topsoil on the batter slopes;
- measures to temporarily trap sediment in median areas at regular intervals;
- controls in runoff flow paths to reduce flow velocities and minimise the potential for erosion;
- measures for controlling waste water discharge from the quarry from dewatering, blasting, drilling, washing vehicles and plant and any other activities which add pollutants to water; and

- measures to be put in place during an extended shut-down of the quarry or when rainfall above a certain trigger level is predicted;

6.3 Required Sediment Dam Capacity

The required volume for Dam1 to act as a sediment dam without flocculation was calculated for the current production/administration configuration using the “Blue_Book_Spresdsheet_V8” spreadsheet supplied by the Centre for Environmental Training Pty Ltd.

The settling zone capacity designed to capture Type D and Type F soils was determined from the 95-percentile, 5-day rainfall depth using the following inputs:.

- Cv is a volumetric runoff coefficient, defined as that proportion of rainfall that runs off as stormwater and was conservatively set at 0.79
- A is the catchment area of the basin (hectares) (current production area = 13Ha)
- R (95%ile, 5 day) is the 5-day total rainfall depth (mm) that is not exceeded in 95 percent of rainfall events. The nearest location listed in Table 6.3a of Volume 1 of the Blue Book is Cessnock which has a 95% day rainfall depth of 63.0mm
- Re = 2250 based on Study Area’s location on the rainfall erosivity maps presented in Appendix B of Volume 1 of the Blue Book
- K = Soil Erodibility Factor (K factor) of 0.05 - based on the conservative default criteria presented in the Blue Book
- A 228-metre slope length (east-west) and a gradient of 8%; and
- A storage (soil) zone of 2months (default).

The “Blue_Book_Spresdsheet_V8” spreadsheet indicated the required capacity of Dam 1 (together with Dam2) is 988m^3 for sediment storage and 6,470m^3 for water settling volume for a combined volume of 7,458m^3 (~7.5ML). Dam 1 has a current capacity of approximately 13ML. Based on the calculated capacities for a sediment basin, Dam 1 has spare capacity to act as a sediment basin for the production area.

6.4 Management and Maintenance of Sediment Dams

The required capacity for the sediment dams is based on the assumption that the water within the settling zone will be pumped out within 5 days of a rain event. This will allow for maximum storage of runoff when the next rainfall event occurs and minimises the chances of an uncontrolled discharge off-site.

In the event that water is required to be released offsite, the water will be tested daily during the controlled release to ensure appropriate discharge criteria are met, such as Total Suspended Solids (TSS) below a concentration of 50mg/L as dictated by EPL1378.

6.5 Impact on Water Sources

The majority of surface water required on the site is for dust suppression activities on the haul roads and product stockpiles. Currently, only storm water from Dam 3 is used for haul road dust suppression. A minor amount of water is required for site activities e.g. dust suppression and sand washing. It is proposed that this water will be sourced from the sediment dams/voids. Hence the majority of surface water collected on site will be discharged under the EPL1378 therefore little impact on downstream surface water sources is expected.

There is a potential for the uncontrolled discharge of water, following significant rainfall events, to release sediment laden (turbid water) to the Paterson River. A significant rainfall event occurred in April 2015. 529.7mm of rain was recorded against an average 88.8mm in April. 418mm of rain was recorded for 21 and 22 April 2015. Following the storms, the quarry was required to pump out the captured water in order to extract emergency supplies to repair the local public roads damaged by the storm. The pump out was sanctioned by the NSW EPA. Turbidity data was collected from the quarry and from the Paterson River at the Gostwick Bridge on 24 April 2015 over an eighteen-hour period. Turbidity in quarry water ranged from 470-499NTU. Whereas turbidity at the Gostwick Bridge ranged between 559-611NTU. Based on this data, it appears that the water that was discharged had lower suspended solids than the receiving waters of the Paterson River.

6.6 Drainage Lines

6.6.1 Impacts

As discussed earlier, the disturbances to local drainage lines are:

- The interception of first and second order ephemeral streams by the northward extension of the West Pit; and
- The interception of a third and second order ephemeral stream by the quarrying the East Pit.

The first and second order streams catchment up gradient of the western pit is about 21.4Ha and is therefore a relatively small catchment when compared to the 644km^2 catchment of the Paterson and Allyn Rivers and as such there will be negligible impact on the flows of the river system. Given the relatively large capacity of the West Pit, uncontrolled releases of sediment laden water are considered very unlikely. However, this small catchment does act as a source for farm dams to the west, between the rail line and the Paterson River and these will be supplied water via discharges under EPL1378.

Similarly, the second and third order stream to be disturbed by quarrying the East Pit also has a relatively small catchment. These streams flow through the current quarry operation. With the proposed collection and treatment of storm water it is anticipated that there will be little impact on the environmental flows from the eastern pit. However, it is anticipated that water would be discharged into this drainage line from Dam 1 and the proposed Dam 4. Surface water monitoring will therefore be undertaken to ensure water discharged is of an appropriate water quality.

Importantly with regards to impacts on water quality, as can be seen from the water balance results (see section 7) the majority of discharges from the quarry will be as a result of controlled releases. And, as described above in Section 5.4, water will be tested prior to controlled release to ensure that appropriate discharge criteria are met.

6.6.2 Mitigations Measures

Progressive Erosion and Sediment Controls Plans (PESCPs) will be developed and implemented throughout the life of the quarry. The PESCPs will be updated to provide current detail regarding the location and installation of control measures. As their name implies, these are developed as the project progresses and as site conditions evolve and flow paths are altered, e.g. the reshaping of clean water drainage lines.

The PESCP must include details of the following where relevant:

- scour protection measures for haul roads and access tracks when these are an erosion hazard due to either their steepness, soil erodibility or potential for concentrating runoff flow;
- measures for stabilising temporary drains;
- measures to minimise erosion during construction of embankments;
- measures to minimise erosion and control sedimentation from stockpiles;
- methods of constructing batters to assist the retention of topsoil on the batter slopes;
- measures to temporarily trap sediment in median areas at regular intervals;
- controls in runoff flow paths to reduce flow velocities and minimise the potential for erosion;
- measures for controlling waste water discharge from the quarry from dewatering, blasting, drilling, washing vehicles and plant and any other activities which add pollutants to water; and
- measures to be put in place during an extended shut-down of the quarry or when rainfall above a certain trigger level is predicted;

6.7 LICENSING REQUIREMENTS

6.7.1 Water Access Licence

The existing dams and proposed Dam 4 in the eastern pit will serve as sedimentation control dams and are required by regulation to prevent contamination of a water source, in this case the Paterson River. This requirement satisfies *Special dams which are not included in harvestable right calculations Dot Point 3 of the DAMS IN NSW Do you need a licence?* Brochure published May 2015 by the Department of Primary Industries-Office of Water. On this basis a water access licence is not required for the sediment dams.

6.7.2 Water Sharing Plan for the Paterson Regulated River Water Source 2007

The Water Sharing Plan for the Paterson Regulated River Water Source 2007 (WSP) includes rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading in the plan area. The WSP allows for the following water share components:

• Domestic and Stock access licences:	41ML/year;
• Local Utility access licences:	75ML/year;
• Regulated River (high security) access licence:	190 unit shares (currently 1share = 1ML)
• Regulated River (general security) access licences:	9,565 unit shares;
• Supplementary water access licence:	756 unit shares

The water balance (See Section 8) indicates the quarry in its current configuration intercepts approximately 373ML/year (with average rainfall) of surface water. Allowing for dust suppression usage and evaporation from quarry dams and sumps the water balance predicts that 308ML/year would be discharged from the quarry. That is 65ML/year of surface water is currently excluded from the Paterson/Allyn River catchment due the presence of the quarry. This is approximately 0.01% of the estimated runoff in the Paterson/Allyn River catchment in an average rainfall year.

The water balance (See Section 8) indicates the quarry extension will intercept approximately 1,198ML/year (with average rainfall) of surface water in its final and most expansive stage. Allowing for dust suppression usage and evaporation from quarry dams and sumps the water balance predicts that 981ML/year will be discharged from the quarry. That is 217ML/year of surface water will be excluded from the Paterson/Allyn River catchment due the presence of the quarry. This is approximately 0.04% of the estimated runoff in the Paterson/Allyn River catchment in an average rainfall year.

A review of the NOW WAL online register indicated that 1933.1 ML/year (of an available 9565.1ML/year) of Regulated River (General Security) allocation was used in the financial year 2014/2015. Therefore the extension of the quarry is unlikely to effect the water security of WAL holders.

6.7.3 EPL1378 Discharge Points

The results of the water balance, as presented further below in **Section 8**, indicate that the quarry would need to discharge surface water to the surrounding environment which it currently does so under EPL1378. These discharge points will remain licensed for the life of the quarry. A new discharge point will be required to be added to the licence when Dam 4 is excavated.

6.7.4 Surface Water Monitoring

Surface Water Monitoring will be conducted in accordance with EPL1378 (including amendments).

6.8 Cumulative Impacts

As discussed below in **Section 8**, the predicted uncontrolled discharges following a wet weather event in exceedance of the design criteria are predicted to be minimal, with only 3 discharge days predicted in the Final scenario in an average rainfall year. Assuming the proposed surface water management measures as described in this section are followed, particularly in relation to maintenance of the sediment dams, the cumulative impacts of the quarry on water resources in the region are expected to be minimal.

7 GROUNDWATER IMPACT ASSESSMENT

7.1 Objective

A hydrogeological assessment of the proposed quarry extension has been undertaken to assess the potential impacts to local groundwater associated with the proposed development. The objectives of the hydrogeological assessment of the proposed quarry operations are:

- development of a conceptual hydrogeological model of the andesite aquifer;
- quantification of hydrogeological properties of the fractured andesite unit to assess the anticipated groundwater contribution to the total water budget;
- assessment of the potential for impacts to the local groundwater users and sensitive environmental receptors; and
- assessment of the hydrochemical properties of the groundwater to determine the water quality and suitability of groundwater use in quarry activities.

7.2 Scope of Works

The methodology undertaken for the hydrogeological assessment includes:

- review of available environmental and geological data for the site;
- department of NSW Office of Water database search to identify the local groundwater users within or surrounding the andesite aquifer;
- Four falling head (slug tests) in groundwater wells across the site;
- analysis of four groundwater samples for water chemistry and field parameters;
- calculation of likely groundwater volumes and groundwater travel times across the site; and
- development of a conceptual groundwater model of the proposed quarry site.

7.3 Methodology

7.3.1 Desktop Study

Available information such as geology, topography and previous studies were assessed and a preliminary conceptual site model was developed prior to commencement of field work. The desktop study included a NOW bore database search to identify local groundwater users. In addition, a review of lithological logs from the diamond cores that were obtained during drilling was performed to assess fracture density with depth and identify vertical intervals likely to comprise significant water- bearing zones.

7.3.2 Field Investigation

Four groundwater wells were installed using a drill rig fitted with an air hammer. The location Monitoring Well MW1 was selected to assess the hydraulic connectivity (recharge) of the western quarry void with the local groundwater. The location of Monitoring Well MW2 was to assess the hydraulic connectivity of the Dam 1 with the local groundwater. The location of Monitoring Well MW3 was selected to assess the hydraulic depth in the production area. The location of MW4 was selected to provide assess the hydraulic connectivity (seepage) with the western void. The groundwater wells were sampled for water quality on 18 March 2015 and 16 August 2016. Rainfall summaries preceding the sampling events are summarised in Table 8.

Table 8: Rainfall Data Preceding Groundwater Monitoring Events

Monitoring Date	12 Months	3 Months	1 Month
18 March 2015	919.9mm	414.1mm	36.2mm
16 August 2016	1045.4mm	162.8mm	51.1mm

Field parameters including Electrical Conductivity (EC), Dissolved Oxygen (DO), Oxidation-Reduction Potential (ORP), temperature and pH were monitored during purging of the boreholes. The groundwater wells were purged using a QED Sample Pro pump™ low flow sampling system until the field parameters stabilised. Once the water quality parameters had stabilised, a water sample was collected for major ion and metals analysis. Major ions included: Calcium (Ca^{2+}), potassium (K^{+}), magnesium (Mg^{2+}), sodium (Na^{+}), chloride (Cl^{-}) and sulphate (SO_4^{2-}), and bicarbonate (HCO^{3-}), and metals including arsenic (As), cadmium (Cd), chromium total (Cr), copper (Cu), iron total (Fe), manganese (Mn), nickel (Ni), lead (Pb), zinc (Zn) and mercury (Hg).

Slug test analysis was conducted on the installed four groundwater wells on 18 March 2015 to estimate the hydraulic conductivity of the aquifer system.

Falling head slug tests were performed by raising the water level within the groundwater wells by the introduction of water and the recovering water level was measured using an interface probe and a stop watch. Water levels were monitored for time periods that ranged from 10 minutes to 22 minutes, depending on the recharge conditions.

The short term (11-30 August) variability in the depth to groundwater was assessed using Troll® data loggers placed in each well. A Baro Troll® data logger was placed in monitoring well MW1 to correct the water depths for changes in barometric pressure.

7.3.3 Data Assessment and Reporting

A conceptual model was developed for the groundwater resource contained within the andesite aquifer system, based on the desktop study, preliminary and field investigations. These results are presented and discussed in the following sections, and the conclusions and recommendations were based on this reported data.

7.4 Hydrogeology

The andesite unit comprises a low-yielding fractured aquifer. Groundwater appears to occur within several zones of fracturing present at depth within the andesite formation, which occurs at approximately 15 to 30 m below ground surface [bgs].

7.5 Groundwater Investigation Results

7.5.1 Groundwater Flow Direction

The depth to groundwater at the site ranges from 6.07 mbgs (MW2) to 14.78 mbgs (MW4). The static water depth in the boreholes was above the depth that groundwater was encountered during drilling indicating confined aquifer conditions within the water-bearing horizon. A groundwater flow map (potentiometric map) was developed based on hydraulic head data obtained from the groundwater wells (refer to Figure 4), which indicates that the groundwater flow direction generally follows the topography. The data indicate a regional groundwater gradient of 0.05-0.03 m/m dipping in a south westerly direction.

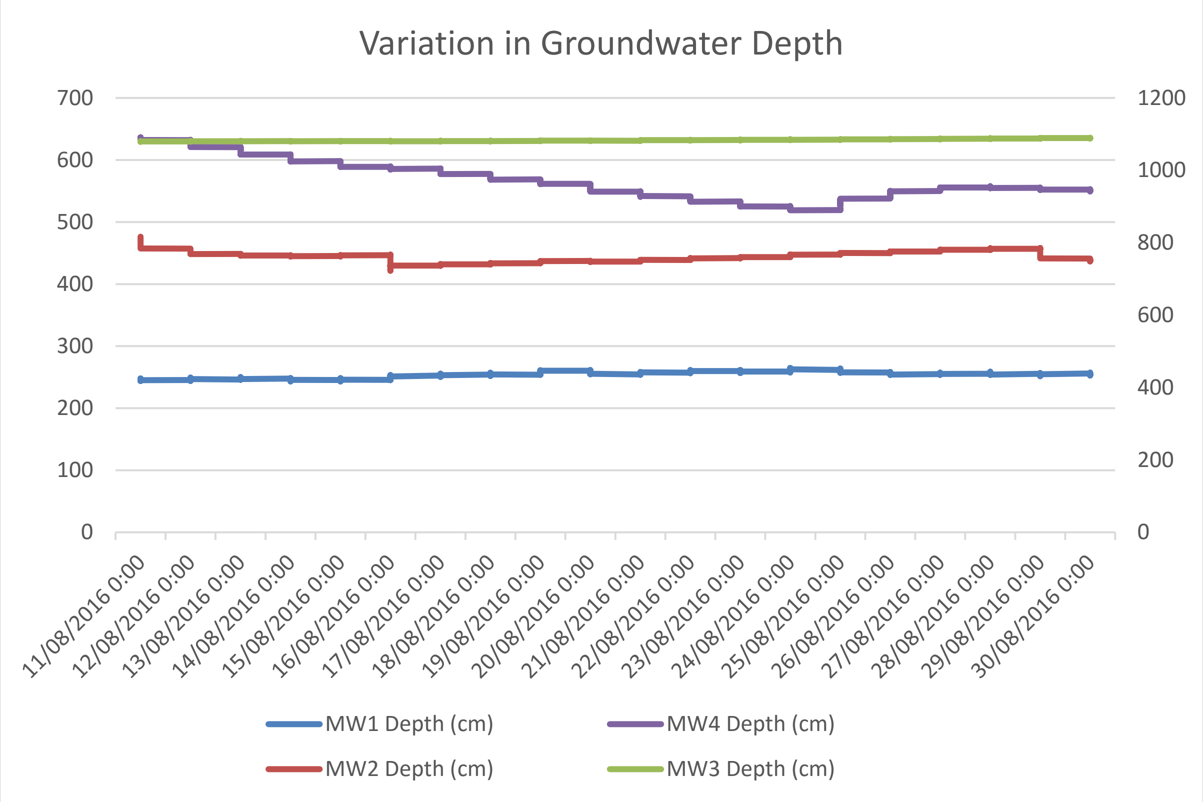
7.5.2 Depth to Groundwater

A summary of the depth to groundwater is presented in Table 9

Table 9 Summary of Groundwater Depth

Borehole	18 March 2015	11 August 2016	16 August 2016
MW1	17.47	16.82	16.75
MW2	6.07	5.691	6.26
MW3	11.97	13.90	12.87
MW4	14.78	17.55	18.04

A summary of the ground water depth variation between 11 August and the 30 August is shown in Graph 1. 44.4mm of rain fall was recorded at Tocal from 3 to 7 August and 15.6mm of rainfall was recorded from 23 to 27 August.



The Depth (cm) is the depth the Troll logger is placed below the groundwater level.

7.5.3 Hydraulic Testing

A summary of the falling head test data is presented in Table 10 below.

Table 10 Summary of Slug Test Results

Borehole	Borehole depth (mbgs)	SWL[1] (mbgs)	SWL RL (m)	Hydraulic conductivity (m/s)[2]
MW1	24.1	17.47	35.40	1.15E-05
MW2	14.4	6.07	41.27	2.43E-05
MW3	24.0	11.97	44.04	1.32-04
MW4	48.1	14.78	62.24	5.70E-05

1. SWL = Static water level measured prior to hydraulic testing.
2. Based on Hvorslev analysis of time-recovery data.

The hydraulic conductivity values ranged from 1.15x10^{-5}m/s (MW1) to 1.32x10^{-4} m/s (MW2) with an average of 4.1x10^{-5} m/s. Based on the observed data the most permeable water-bearing zone in the formation appears to correlate with the weathered sandstone/andesite interface found in MW2.

7.5.4 Water Quality Sampling and Analysis

Groundwater samples were collected using a QED Sample Pro pump™ low flow sampling system standard operating procedures from groundwater wells MW1-MW4 and submitted to a NATA accredited analytical laboratory (SGS Australia Pty Ltd) for the specified analyses. The laboratory results for groundwater sampling are presented Summary Table 1 (attached) and the laboratory documentation is located in Appendix A.

7.5.5 Field Water Quality Parameters

Field parameters including EC, pH, ORP, DO and temperature were recorded during groundwater sampling. EC values ranged from 1.6 mS/cm (MW2) to 3.44 mS/cm (MW3) indicating the groundwater is brackish. Total Dissolved Solids (TDS) ranged from 1,100 mg/L (MW1) to 1,900mg/L (MW3).

Groundwater pH was relatively neutral with samples ranging from 6.71 (MW4) to 7.23 (MW4). These results are indicative of natural groundwater influenced by water-rock interaction. ORP values range from +43 mV (MW2) to +68mV (MW4).

7.5.6 Laboratory Results

The groundwater samples were analysed for dissolved metals and the observed concentrations were assessed with reference to the ANZECC (2000) guideline values for 95% protection level for a fresh water ecosystem protection.

The concentrations of dissolved metals in the groundwater samples indicate that the groundwater contains slightly elevated concentrations of nickel (only inMW2) and zinc (MW1-MW4) with respect to the ANZECC (2000) guideline values and are therefore not likely to be suitable for potable use.

Elevated concentrations of manganese may increase the potential for fouling of reticulation systems, which will be considered in the water management system developed for quarry operations.

A summary of the field parameters and laboratory result are in Summary Table 1. (attached)

7.5.7 Major Ions

Major cations and anions were analysed to delineate different hydrochemical water types. They were also used as a guide to determine whether groundwater is suitable for drinking water or for use in quarrying operations.

The concentrations of the major ions are moderately elevated, and suggest water-rock interactions that are generally characteristic of local to intermediate groundwater systems (e.g. limited groundwater residence time relative to typical regional groundwater flow systems in similar lithologies).

7.5.8 Overview of Groundwater Chemistry

Analysis of metals and major ions suggests that groundwater present within the rock formations is not suitable for drinking water purposes. High concentrations of metals such as iron and manganese together with elevated concentrations of major ions such as Ca^{2+} and Mn^{2+} may influence the reuse options for groundwater in quarry operations, particularly with regards to the potential for fouling in water reticulation systems.

7.6 Discussion of Groundwater Results

7.6.1 Water Types

The hydrogeochemical groundwater types were evaluated using a Piper Trilinear diagram to assess the similarities or differences in chemical composition between water samples collected from different exploration holes (and domestic well) across the site. Groundwater from the site appears to be sodium/potassium dominated cation system and HCO_3^- and Cl^- type waters (*Diagram 1*).

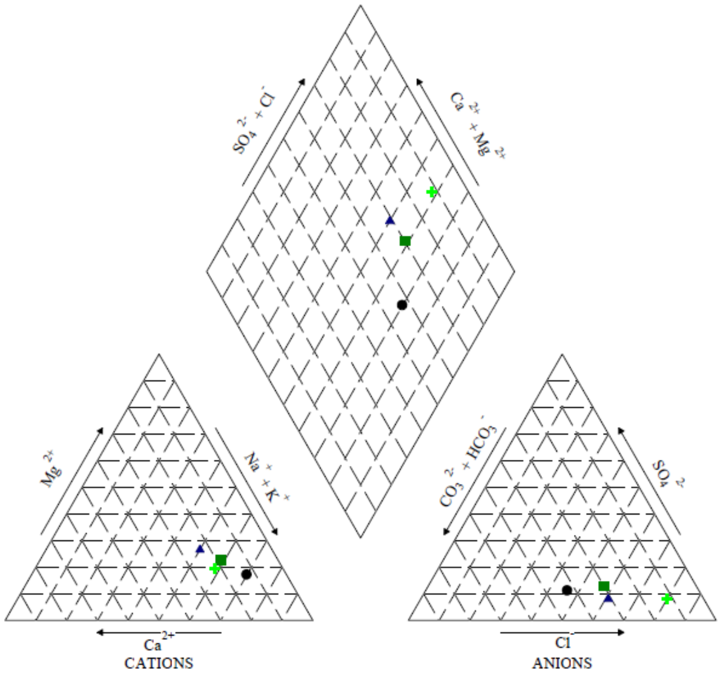


Diagram 1: Piper Trilinear Diagram

In a groundwater system with a well-connected fracture system, a similar chemical signature would be expected between the various sampling locations. The results from this investigation suggest that a variety of water types exist within this fractured system, and therefore the various discrete water-bearing zones may be poorly connected.

7.6.2 Groundwater Occurrence

Occurrence

Groundwater is likely to be present within sandstone/meta sandstone zones at various depths within the andesite formation. The variability in the chemical signature of the various water samples collected indicates a degree of spatial heterogeneity in the water quality contributed from the various fracture zones. Based on the heterogeneous groundwater chemistry results and the low values of hydraulic conductivity calculated for the bores, these sandstone/meta sandstone zones are most likely localised and there does not appear to be evidence of a significant vertical or lateral hydraulic connection between the various fracture zones across the site.

Recharge and Discharge Zones

Recharge is likely to occur via direct infiltration across the landscape, in areas where fractured and weathered bedrock is exposed at the land surface or where the overburden is thin, and discharge is likely to occur towards the ephemeral creeks that surround the proposed quarry extension.

Recharge rates were calculated according to Cl^- concentrations in groundwater, using the chloride mass balance technique (Murphy et al., 1996). This technique uses Cl^- input from rainfall infiltration as a conservative tracer for distinguishing downward soil-water flux in an aquifer. Recharge rates were estimated by comparing measured Cl^- concentrations of the observed groundwater sample with the likely concentration of rainfall recharge. The recharge rate (R) for the catchment were calculated using the following equation:

$$R = \frac{average\ annual\ precipitation\ x\ Cl\ concentration\ in\ precipitation}{Cl\ concentration\ in\ groundwater}$$

The deepest groundwater sample obtained from MW3 was used to quantify rainfall recharge. Data obtained from the Bureau of Meteorology indicate that the average yearly precipitation for the area is approximately 939 mm/yr. The mean annual Cl^- concentration in rainfall was estimated from Table 10 of *Nutrient Inputs from Rainfall in New South Wales State Forests* (Forest Research and Development Division, State Forests of New South Wales, December 1996) which lists chloride concentration as 0.192meqL^{-1} (6.72mg/L) at Muswellbrook. The observed Cl^- concentration in groundwater sample MW4 (deepest drill hole) was 670 mg/L. Therefore, an average annual recharge rate of approximately 9mm/year was calculated. The fracture rock aquifer in the western pit is assumed to be recharged from the surrounding up gradient unquarried area which is approximately 36 hectares. Therefore, the recharge rate for this aquifer is estimated to be 32.4ML/year.

Groundwater Migration Rates

Groundwater travel times across the site were calculated using the following equation for the average linear velocity of groundwater travelling through a porous medium (Fetter, 1994):

$$V_x=K/n_e \times dh/dl \quad \text{equation 3}$$

Where: Vx is the average linear velocity;

- K is the hydraulic conductivity;
- dh/dl is the hydraulic gradient across the site; and
- ne is the effective porosity of the aquifer, which is estimated to be 10% for crystalline fractured bedrock units (Domenico and Schwartz, 1990).

Considering the average hydraulic conductivity of the fractured bedrock was calculated at 4.10x10-5 m/s with an average hydraulic gradient of 0.03m/m, the average linear velocity of groundwater across the site was calculated at 1.8x10-6m/s or 57m/year.

The estimated volume of groundwater discharge to the quarry void can be calculated using the average linear velocity of groundwater flow calculated in the previous section, and making assumptions on the thickness of the various water-bearing zones. Using the observed 1 metre for the average thickness of the fractured/jointed water bearing zones, then the discharge rate is:

$$Q = Vx \times A$$

Where:

- Q is the total groundwater flux;
- Vx is the average linear velocity; and
- A is the cross-sectional area through which groundwater discharges

Using this relationship, a discharge rate of 0.16m3/day per metre of exposed fracture zone was calculated. It was estimated that the linear distance of exposure of the softer underlying rock is approximately 600m, then a total groundwater seepage volume of approximately 34.2 ML/year was calculated.

It should be noted that fractured rock aquifers exhibit a large degree of spatial heterogeneity, and that this calculation would need to be refined on the basis of field observations during quarrying operations.

7.6.3 Current Groundwater Use

A search of the NSW Office of Water database of registered bores within a 5 km radius of the proposed quarry location indicated a total of 6 registered wells. The nearest well is approximately 1.5km south of site. Its authorised purpose is waste disposal (presumably septic toilet). Given the nature of the regional fractured rock aquifer it is considered unlikely that the quarry extension will have an impact on registered groundwater users.

7.6.4 Impact Identification

Quarrying is proposed to continue in the western pit over the next thirty years. Due to the fractured nature of this rock aquifer it is anticipated that the aquifer will not have a large storage. It has been demonstrated by the groundwater in monitoring well MW5 being approximately 20m above the current quarry floor, a steep groundwater gradient has developed adjacent to the quarry pit as a result of groundwater drainage. This indicates that significant drawdown of groundwater will be limited to the immediate vicinity of the pit.

The quarry pit would comprise a permanent groundwater sink and reduce groundwater levels in the immediate vicinity of the quarry. However, the limited extent of water level drawdown that is anticipated should have a negligible impact on neighbouring groundwater users, especially considering that the closest registered well to the site is located approximately 1.5 km from the proposed pit footprint.

Investigations to date have not identified the presence of groundwater dependent ecosystems in the vicinity of the proposed quarry extension area.

7.6.5 NSW Aquifer Interference Policy

The purpose of the Aquifer Interference Policy ("the AI Policy") is to explain the role and requirements of the Minister administering the Water Management Act 2000 ("the Minister") in the water licensing and assessment processes for aquifer interference activities under the Water Management Act 2000 and other relevant legislative frameworks.

The Water Management Act 2000 defines an aquifer interference activity as that which involves any of the following:

- the penetration of an aquifer,
- the interference with water in an aquifer,
- the obstruction of the flow of water in an aquifer,
- the taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations, and
- the disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

It has been demonstrated that the quarry both in its current and future operational uses intercepts a fractured rock aquifer. A water licence is required under the Water Management Act 2000 whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity.

The fracture aquifer that is intercepted by the quarry does not (and is unlikely to in the future) contain water supply works that can yield water at a rate greater than 5L/sec and is such is considered to be a "less productive" groundwater source.

The interference of the aquifer is considered to have a minimal impact because:

- there are no high priority groundwater dependent ecosystems; or high priority culturally significant sites listed in the schedule of the WSP within 40m of the quarry;
- there are no water supply works effected by interference of the aquifer; and
- the groundwater quality is not expected to lower the beneficial use category beyond 40m from the quarry.

7.6.6 Groundwater Monitoring

The following groundwater monitoring measures will be adopted during quarrying activities:

- establishment of a monitoring network using up to eight selected exploration boreholes around the periphery of the quarry pit to assess the actual extent of groundwater drawdown over time;
- monitoring of water levels quarterly prior to commencement of quarrying and over the life of the quarry;
- water quality sampling for major ion chemistry, TDS and dissolved metals on an annual basis; and
- monitoring the water quality of the pit seepage water to assess suitability for use in quarry processes, in the event that sufficient groundwater volume is encountered.

7.7 Conclusion of Groundwater Results

Groundwater at the proposed development site occurs in discrete fracture zones, the most significant of which is the interface between the overburden and more competent underlying andesite. The hydrogeological and hydrochemical assessment indicates that there is limited hydraulic connection between fracture zones, both vertically and laterally across the site, suggesting that groundwater occurs in localised and potentially discontinuous fracture horizons. As such, significant water level drawdown caused by quarrying is expected to be constrained to the immediate vicinity of the pit, and as such is not anticipated to result in a significant impact to either local groundwater users or potential groundwater fed ecosystems in the area.

8 SITE WATER BALANCE

8.1 Introduction

This section presents the site water requirements and available water storage against water availability to assess a water balance for the Project. Site water balance calculations were undertaken for four scenarios;

- Scenario 1, which is based on the current disturbance footprint of quarry operations,
- Scenario 2, which assumes the proposed eastern pit has been quarried and the second order stream has been intercepted;
- Scenario 3, which assumes the proposed eastern pit has been extended to intercept the third order stream; and
- Scenario 4, which assumes the quarrying operations are nearing completion. The western pit has intercepted two first order stream and the eastern pit has been extended through the production area.

The results are formulated from rainfall data collected in the region and the results are presented for dry, median and wet rainfall conditions.

JME used Microsoft Excel to develop a detailed daily time step water balance taking into account the available daily rainfall records for over 47 years of historical data. For the establishment of the water balance model, JME assumed generic runoff coefficients using appropriate references (including the Blue Book and Australian Rainfall and Runoff) and previous experience. Limited site rainfall records were available and were not complete enough to use. Data from Tocal AWS was used.

The site water balance applies to the whole Study Area, with the exception of the water for the office amenities, as this is trucked to site and is maintained as a separate system from the overall site water management.

8.2 The Model

The water balance model was developed for the 47 years of available data. An annual summary of this model was produced. These summary results were used to estimate the water balance results for a probable dry year (10th percentile rainfall), median year (50th percentile rainfall) and wet year (90th percentile rainfall).

8.3 Water Sources (Model Inputs)

8.3.1 Rainfall Runoff

Long term historical rainfall data was sourced from the Tocal AWS BOM station (station number 61250), located approximately 9.2 km south from the Study Area, and which has operated since 1967.

47 years (1967 to 2014) of rainfall data was utilised from the Tocal BOM Station. The statistical analysis of the data for the Tocal Station shows:

- 10th Percentile year (dry year): 720 mm
- 50th Percentile year (mean year): 938.8 mm
- 90th Percentile year (wet year): 1,175.5 mm

JME have assigned different areas based on their different catchment areas. The catchments with scenario 1 and scenario 2 estimated catchment areas are presented in Table 11

Table 11: Catchment Area Summary

Western Pit Catchment		Eastern Pit Catchment			Production Area	
Scenario 1-3	Scenario 4	Scenario 1	Scenario 2	Scenario 3-4	Scenario 1-3	Scenario 4
37 Ha	69.3 Ha	0 Ha	40.3 Ha	81.7 Ha	13ha	9.87

These areas are also conservatively assumed to be highly disturbed and therefore have high runoff. The catchment areas of the Study Area are shown in Figure 5.

It is also assumed that all water collected within the Eastern and Western Catchments will be treated as clean water catchments in the water balance.

The rainfall runoff coefficient of 0.79 was adopted for the water balance. This reflects the Blue Book soil hydrologic group D which has a very high runoff potential.

It was assumed that it takes five days following a rainfall event for the suspended solids in the sediment basin to settle to be below 50mg/L without treatment and can be pumped off site at rate of 5ML/day. Hence 5 consecutive days without rain were required before controlled discharges. Should the capacity of the dam be exceeded it was assumed that an uncontrolled discharge of captured runoff continued to occur until five consecutive days of dry weather allowed for the dam to be pumped down.

The volume of water used for dust suppression, 57ML/year, was supplied by Buttai Gravel and it is assumed to either evaporate or infiltrate/percolate into the ground surface. The daily average use was used, regardless of rainfall or not. Monthly evaporation rates were obtained from the Tocal AWS (BOM website) and were averaged to a daily rate regardless of rain or not.

The outputs from the rainfall runoff modelling are summarised in Table 12.

Table 12: Quarry Rainfall Runoff Estimate

Current	Dry Year	Average Year	Wet Year
Total run off	267	373	464
Evaporation from Dams	2.8	3.1	2.4
Controlled discharges	259	299	448
Uncontrolled Discharges	3ML	10.8	6.4
Water to be pumped out	2.1ML	61	7.7
5 Year	Dry Year	Average Year	Wet Year
Total run off	483	673	839
Evaporation from Dams	4.6	9.2	7.6
Controlled discharges	461	638	786
Uncontrolled Discharges	3	9.8	6.4
Water to be pumped out	13.8	17	39.2
10 year	Dry Year	Average Year	Wet Year
Total run off	704	981	1,242
Evaporation from Dams	11.8	13	10.3
Controlled discharges	572	812	1,044
Uncontrolled Discharges	3	9.8	6.4
Water to be pumped out	117	147	182
Final	Dry Year	Average Year	Wet Year
Total run off	860	1,199	1,756
Evaporation from Dams	47	50	41
Controlled discharges	702	990	841
Uncontrolled Discharges	-	2.5	-
Water to be pumped out	110	157	875

The uncontrolled discharges shown in Table 10 emanate from Dam 1. After quarrying is completed it is expected that the eastern and western void will fill with water and discharge at the current and proposed EPL1378 points.

The model was calibrated against controlled discharge data from 2 July 2014 and 28 February 2015 provided by Buttai Gravel and rainfall data downloaded from the BOM website. 52ML of rainfall was predicted to be collected in Dam 1 which is similar in volume to a median year for the same period of time. The model predicted 49 ML of controlled discharges and the actual discharges were 41 ML. The difference in these results scan be accounted for in water stored on site. Hence the modelling result are considered usable for assessing future discharge volumes.

8.3.2 Groundwater

The Groundwater Assessment presented in Section 6 indicates that the estimated annual groundwater discharge rate is 32.4ML/year. This discharge has been observed as damp areas upon the existing quarry face. No pooled water or surface water flow was observed by JME as a result of groundwater discharge.

8.3.3 Hunter Water Potable Water

23ML/year or 80kL per day is currently used for production and it is anticipated that this will increase with a direct relationship with production hours. Hence 115ML/year of potable water is assumed to be used when the quarry has reached full production.

8.4 Water Losses and Usage (Model Outputs)

8.4.1 Evaporation

Long term historical evaporation data was available from the Tocal BOM station. 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 form on the estimated surface area of the water storages (which is relative to the volume of water storages) on each day.

8.4.2 Water Usage

Approximately 80ML 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 13.

Table 13: - Predicted Water Usage

Water Demand	Current Annual Usage (ML)	Predicted Annual Usage ML	Comments

Haul road dust suppression	57	68.4	Water usage is related to operational hours. The quarry extension will increase haul road dust suppression by approximately 20%
Crushing plant	0.9	1.13	Water usage is related to operational hours. The increase in production hours will increase stockpile dust suppression by approximately 25%
Pug mill	1.5	2.19	Assumes that water usage is proportional to operational hours. Proposed increase in pug mill operational hours is approximately 46%
Wash Plant	10.1	12.62	Assumes that water usage is proportional to operational hours.
Product stockpile sprays	10.5	13.25	Assumes dust suppression is proportional to operational hours.
TOTAL	74.49	114.92	

The predicted water usage for operation of the quarry has been developed based on current 500,000 tonnes/year and predicted 1,500,000 tonnes/year of production and averaged over 365 days.

8.4.3 Site Discharges

The water balance assumes that discharges occur when the volume of water exceeds the onsite storage capacity.

It is also assumed that controlled releases from site are undertaken from sediment control Dam 1 located in the crushing plant area, sediment control Dam 3 located in the western pit and the proposed sediment control Dam 4 in the proposed eastern pit. Discharges from Dam 1 (including Dam 2) 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. Discharges from Dam 3 and Dam 4 are required to enable quarrying operations in these areas. Water quality in the sediment dams will be monitored during releases to ensure it is of an acceptable water quality for discharge. The total annual discharge has been estimated for 4 scenarios during the quarry's operations, and these are presented in Table 10.

With regards to operation and maintenance of the Dams, Dam 2 will be preferentially dewatered to Dam 1. This is to limit the risk of uncontrolled discharge during wet weather from this dam, due to the sensitive receiving environment downstream and limited storage capacity of Dam 2. However, it should be noted that Dam 2 is a licensed discharge point under EPL1378

8.4.4 Storages

The water balance model assumes that the dirty water dams (sediment basins) are maintained such that the settling zone is available for water storage during a rainfall event. Four dams are proposed to be used for sediment control. Existing Dam 1 is located within the catchment of the crushing plant, and Dam 2, within the catchment of the product stockpiles and the office infrastructure area. These dams and their maintained available storage are shown in Table 10. Dam 3 is the current sump of the Western Pit and Dam4 is the proposed sump of the Eastern Pit. The available storage is the total volume of the dams, minus the required settling zone volume. This assumes that the dams remain pumped down to a level that ensures the settling zone is always available to manage runoff from the next rainfall event.

Table 14: - Water Storages (assumed within water balance model)

Dam	Storage Capacity (ML)	Calculated Required Sediment Storage* (ML)	Calculated Water Settling Storage*	Calculated Total Sediment Basin Volume
Dam 1 and 2	13.9	0.99	6.47	7.46
Dam 3	456	31.5	34.5	66
Dam 4†	96.4	0.22	19.1	19.3
Dam 4#	460	1.2	45.1	46.3

* Copy of sediment basin spreadsheet is shown in Appendix B

† Proposed sump of the eastern pit at year 5.

Proposed sump of the eastern pit at year 10.

The in-pit sump within the western quarry (Dam 3) and eastern quarry (Dam 4) are unlikely to overtop and in practice the in-pit sumps could 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 Dam 3 and Dam 4 is clean water and is held for a maximum of three days following a rainfall event >1mm. Water in Dam 1 and two is presumed to be dirty water that is treated with a flocculant and is also held for a maximum of three days following a rainfall event of >1mm. As far as practical the western and eastern quarry sump will be maintained in a dry state so that it does not impede on operational activities.

The dams are shown on Figure 5.

8.5 Water Balance Results

Water balance results for the quarry are presented for four separate stages of quarry activities. Firstly, the water balance model was run based on the current disturbance footprint. The second stage models surface water when quarrying in the eastern pits has commenced and the second order stream has been intercepted. It is noted that the disturbance footprint for the infrastructure area remains the same for both scenarios. The third stage is based on the quarry layout at 10 years and the fourth stage is based near the end of the proposed quarry in thirty-years time. The eastern pit water balance was calculated using a five day and a three day (with flocculants) settling period for suspended solids in the sediment dams to assess the effectiveness of the current treatment system.

The water balance results for the selected stages are presented in the following sections. Plots showing daily rainfall and volume and dates of modelled uncontrolled discharges are in Appendix D.

8.5.1 Water Balance Summaries

The predicted water balance totals for the current layout for dry, median and wet years are shown in Table 15.

Table 15: – Indicative Water Balance Results for Stage 1 (Annual Summaries)

	Description	Dry (ML/year)	Median (ML/year)	Wet (ML/year)
Water Source (Inputs)	Rainfall Runoff	267	373	464
	Potable Water (Hunter Water)	23	23	23
	Groundwater Seepage	32.4	32.4	32.4
Total Inputs		322.4	428.4	519.4
Water Losses and Usage (Outputs)	Evaporation (from dams)	2.8	3.1	2.4
	Evaporation of groundwater	32.4	32.4	32.4
	Controlled Discharges/stored on site	200	299	389
	Uncontrolled Discharges	2.9	9.8	6.4
	Dust suppression	57	57	57
	Transported with product	2.3	2.3	2.3
Total Outputs		297.4	403.6	489.5

The predicted water balance totals for the 5 years after approval for dry, median and wet years are shown in Table 16.

Table 16: – Indicative Water Balance Results for Stage 2 (Annual Summaries)

	Description	Dry (ML/year)	Median (ML/year)	Wet (ML/year)
Water Source (Inputs)	Rainfall Runoff	483	673	839
	Potable Water (Hunter Water)	29	29	29
	Groundwater Seepage	32.4	32.4	32.4
Total Inputs		544.4	734.4	900.4
Water Losses and Usage (Outputs)	Evaporation (from dams)	4.7	7.7	7.6
	Evaporation of groundwater	32.4	32.4	32.4
	Controlled Discharges	392	568	786
	Uncontrolled Discharges	2.9	9.8	6.4
	Dust Suppression	68.4	68.4	68.4
	Transported with product	6.9	6.9	6.9
Total Outputs		507.3	693.2	907.7

The predicted water balance totals for the 10 years after approval for dry, median and wet years are shown in Table 17.

Table 17: – Indicative Water Balance Results for Stage 3 (Annual Summaries)

	Description	Dry (ML/year)	Median (ML/year)	Wet (ML/year)
Water Source (Inputs)	Rainfall Runoff	704	981	1243
	Potable Water (Hunter Water)	29	29	29
	Groundwater Seepage	32.4	32.4	32.4
Total Inputs		765.4	1042.4	1304.4

Water Losses and Usage (Outputs)	Evaporation (from dams)	11.1	13	10
	Evaporation of groundwater	32.4	32.4	32.4
	Controlled Discharges	563	812	1044
	Uncontrolled Discharges	2.9	9.8	6.4
	Dust Suppression	68.4	68.4	68.4
	Transported with product	6.9	6.9	6.9
Total Outputs		684.7	942.5	1168.1

The predicted water balance totals for the final layout after approval for dry, median and wet years are shown in Table 18.

Table 18: – Indicative Water Balance Results for Stage 4 (Annual Summaries)

	Description	Dry (ML/year)	Median (ML/year)	Wet (ML/year)
Water Source (Inputs)	Rainfall Runoff	859	1199	1756
	Potable Water (Hunter Water)	29	29	29
	Groundwater Seepage	32.4	32.4	32.4
Total Inputs		920.4	1260.4	1817.4
Water Losses and Usage (Outputs)	Evaporation (from dams)	46	50	40
	Evaporation of groundwater	32.4	32.4	32.4
	Controlled Discharges	702	979	841
	Uncontrolled Discharges	0	2.5	0

	Dust Suppression	68.4	68.4	68.4
	Transported with product	6.9	6.9	6.9
Total Outputs		855.7	1139.2	988.7

8.5.2 Water Supply

The results of the water balance model indicate that rainfall runoff captured in sediment basins will provide adequate water for haul road dust suppression quarry. Potable water will be continued to be used for production due to client specifications. The current water main(s) can supply 36.5ML/year (100kL/day). Hence there is sufficient supply of potable water for the predicted increase in potable water use.

8.5.3 Discharges from site

The average rainfall year assessed in the water balance for the Scenario 1-3 shows that on average there will be one event of 9 days in February of uncontrolled discharge per year discharging an estimated total of 9.8 ML of water from Dam1 (and Dam2). The median rainfall year chosen was 1981. The rainfall in February (282mm) was more than double the average recorded rainfall (117.5mm). However, these discharge events occurred when the dam design criteria (i.e. rain of 63.0 mm in 5 days) was exceeded. This is consistent with the Blue Book, which states that dams are designed to spill. However, it is noted that the Blue Book estimates an overflow frequency of 1 to 2 overflow events per year for dams designed to the 95th percentile criteria.

In addition to this estimate, there will be approximately 22 days of controlled releases per year, where 299 ML is currently released under controlled conditions, increasing to:

- 568ML after 5 years;
- 811ML after 10 years;

9 HUNTER ESTUARY WETLANDS

The Hunter Estuary wetlands Ramsar site consists of two components:

- Kooragang Nature Reserve, listed under the Ramsar Convention in 1984 (and now part of Hunter Wetlands National Park); and
- the Hunter Wetlands Centre Australia, which was added to the Ramsar site in 2002.

The wetlands are situated on the northern edge of Newcastle and are approximately 60km downstream from the quarry. The website http://www.environment.nsw.gov.au/wetlands/HunterEstuaryWetlands.htm lists the principal threats to the wetlands as:

- changes in tidal range due to dredging, drainage works, and the installation and operation of flood mitigation structures;
- changes in the freshwater/saltwater balance due to drainage works;

- introduced animals and plants; and industrial development on lands adjoining the Ramsar site.
- Changes in the tidal range and to the freshwater/saltwater balance have resulted in an expansion of mangroves and a decrease in saltmarsh, an important foraging and roosting habitat for migratory shorebirds.
- Introduced animals such as dogs, foxes, cats and black rats prey on native birds.
- The principal introduced plants are bitou bush (Chrysanthemoides monilifera), alligator weed (Alternanthera philoxeroides), water hyacinth (Eichornia crassipes) and pampas grass (Cortaderia selloana).

Freshwater is supplied to the wetlands by the Hunter River system which includes the Paterson River. The Hunter river catchment is approximately 21,500 square kilometres. The project site lies within the Paterson/Allyn Rivers catchment area. The catchment area of the Paterson River and Allyn River are approximately 277km^2 and 367km^2 respectively. The Paterson River discharges around 190ML/day to over 3,000 ML/day after rainfall events. Based on the modelling discussed in Section 8, the highest modelled uncontrolled discharge is 9-10ML over a nine-day period after significant rainfall. Therefore, it is considered that the uppermost contribution of uncontrolled discharges to the Patterson River after significant rainfall is around 0.03% of the volume. The first and second order streams that are proposed to intercepted are ephemeral and, as such, the expansion of the quarry is expected quarry to have no significant impact on the hydrological regime of the Paterson River.

Because the quarry and the proposed expansion have no significant effect on the Patterson River water quality and flow, it is also unlikely that:

- areas of wetlands would be destroyed or substantially modified;
- there would be substantial and measurable changes to the hydrological regime of the wetlands,
- the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland would be affected;
- a substantial and measurable change in water quality of the wetlands would occur;
- invasive species that may be harmful to the ecological character of the wetlands, would be introduced or spread as a result of the development.

10 CONCLUSION

The streams that will be affected by the proposed quarry extension are very minor headwater drainage lines that are ephemeral in nature and only flow for short periods after heavy rainfall. There was no volumetric flow data for these streams and little baseline water quality information to help quantify the potential impacts. Because a negligible amount of water is proposed to be used on site there will be minimal impact on flow regimes downstream of the proposed quarry extension.

Total suspended solids is likely to be the key water quality parameter requiring management throughout the life of the quarry to ensure the water quality in downstream watercourses is not impacted. A number of surface water management and mitigation measures are recommended by this Surface Water Assessment to ensure that the potential risk of any adverse off-site surface water impacts is minimised. This includes directing dirty water runoff into suitably sized sediment basins, use of water from the sediment basins for operational activities and the use of chemical flocculants to help decrease settlement times where required.

A water balance model was developed for the quarry, and modelled four representative stages of the quarry life; Scenario 1, which represents the current disturbance footprint of the quarry, Scenario 2 which represents the interceptions of a second order stream 5 years after the approval of the quarry extension, Scenario 3 which represents the interceptions of a second and third order stream 10 years after the approval of the quarry extension and Scenario 4, which represents the quarry at full extraction and disturbance footprint near the end of life of the quarry. The water balance indicates that the site would be relatively balanced, with sufficient water available for reuse in dry periods and some wet weather discharges following large rainfall events.

Based on the estimated water usage associated with the operation of the quarry, the overall results of the water balance indicate that the site is likely to have excess water supply through the rainfall runoff captured in sediment basins.

The model also indicates likely annual wet weather discharges of 9 days per year in Scenarios 1-3 and 3 days in Scenario 4, and controlled releases to occur for approximately 22 days in Scenarios 1-4, assuming an average rainfall year. However, it is considered likely that the wet weather discharges will be less as in practice, the eastern-pit sump could provide additional storage (temporarily until pumped to Dam 1) following heavy rainfall events, and sediment basins will be managed to achieve controlled release (after flocculation) to ensure there is available capacity in these basins to store runoff prior to a rainfall event.

If the surface water management and mitigation measures identified and discussed within this WQIA are implemented and maintained, it is anticipated that there would be minimal impact on surface water downstream of the quarry as a result of the proposed extension to the quarry.

Site observation and the installation and sampling of monitoring well indicates that the groundwater has been intercepted in the western pit. Modelling indicates that groundwater seepage into the pit is limited by the rate of infiltration/percolation of surface water into the subsurface. Extension of the quarry is not planned to further intercept the underlying aquifer. Little or no further impact on groundwater is anticipated by extension of the quarry. A groundwater licence under Section 5 of the Water Act 1912 for the groundwater seepage into the quarry was granted by NOW and is attached in Appendix C.

The Hunter Estuary Wetlands are approximately 57km from the quarry. It is unlikely that the quarry, it is current capacity or its proposed expansion will have a significant impact, if any, upon the wetlands.

Figures

Notes:

1) Google Earth

2) Subject Site 🟩

N

Client

Buttai Gravel

PROJECT TITLE: **Martins Creek Quarry Extension**

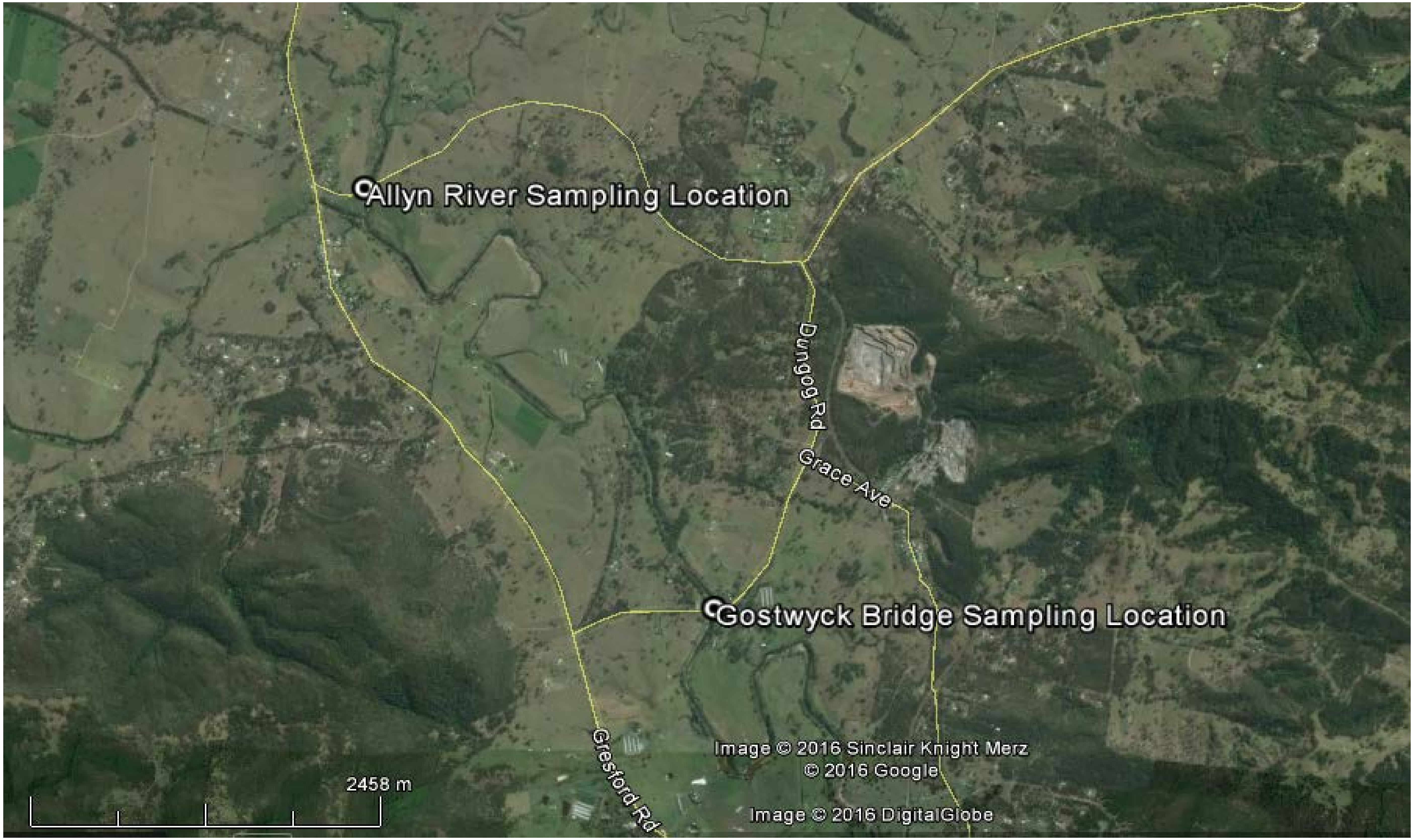
PROJECT:	JME4061	DESIGNED:	JMc
DWG #:	1	DRAWN:	JMc
REVISION:	1		
SCALE:	NTS	STATUS:	NFC
DATE:	19/11/2015		

FIGURE TITLE:

Project Location Plan

FIGURE NUMBER: **1**

ENVIRONMENTS



Notes:
1) Google Earth
2) Subject Site 🟩

Client
Buttai Gravel

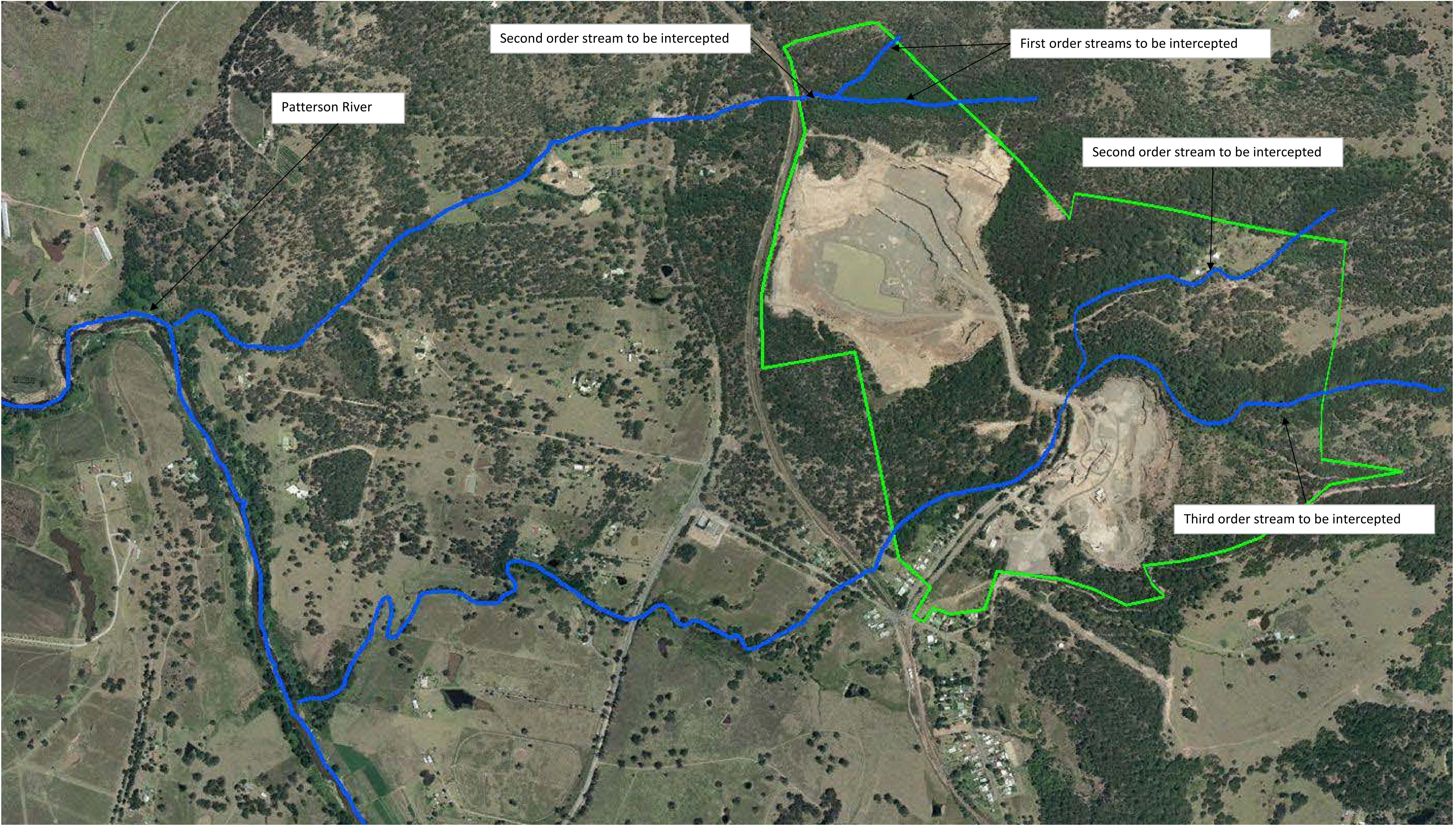
PROJECT TITLE: **Martins Creek Quarry Extension**

PROJECT:	JME4061	DESIGNED:	JMc
DWG #:	1	DRAWN:	JMc
REVISION:	1		
SCALE:	NTS	STATUS:	NFC
DATE:	19/11/2015		

FIGURE TITLE:
Surface Water Sampling Location Plan

FIGURE NUMBER: **2**

ENVIRONMENTS



Notes:

1) Google Earth

2) Subject Site 🟩

Client

Buttai Gravel

PROJECT TITLE: **Martins Creek Quarry Extension**

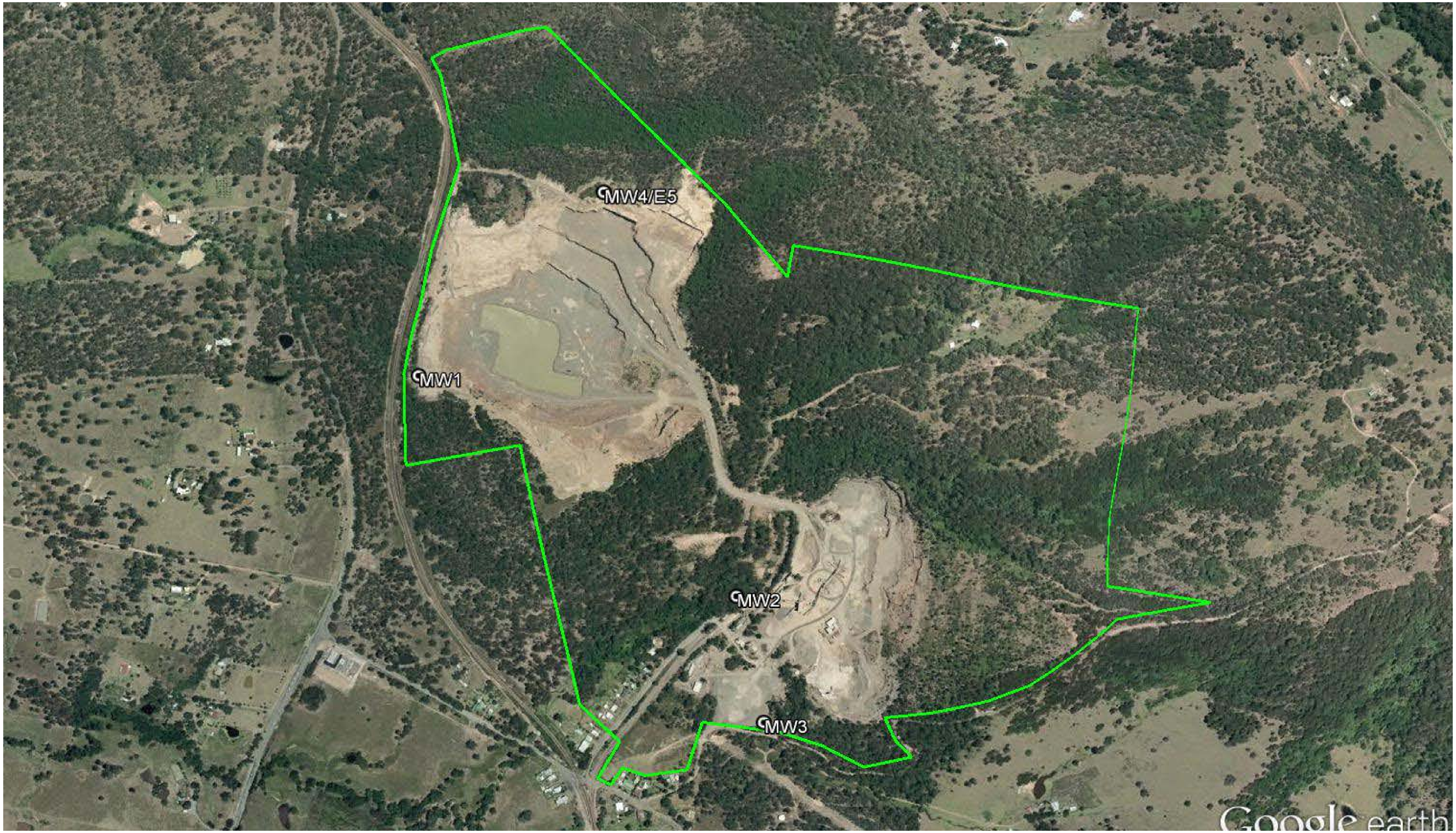
PROJECT: JME4061
DWG #: 1
REVISION: 1
SCALE: NTS
DATE: 19/11/2015

DESIGNED: JMc
DRAWN: JMc
STATUS: NFC

FIGURE TITLE:
Stream Interception Plan

FIGURE NUMBER: **3**

ENVIRONMENTS



Notes:

1) Google Earth

2) Subject Site 🟩

Client

Buttai Gravel

PROJECT TITLE: **Martins Creek Quarry Extension**

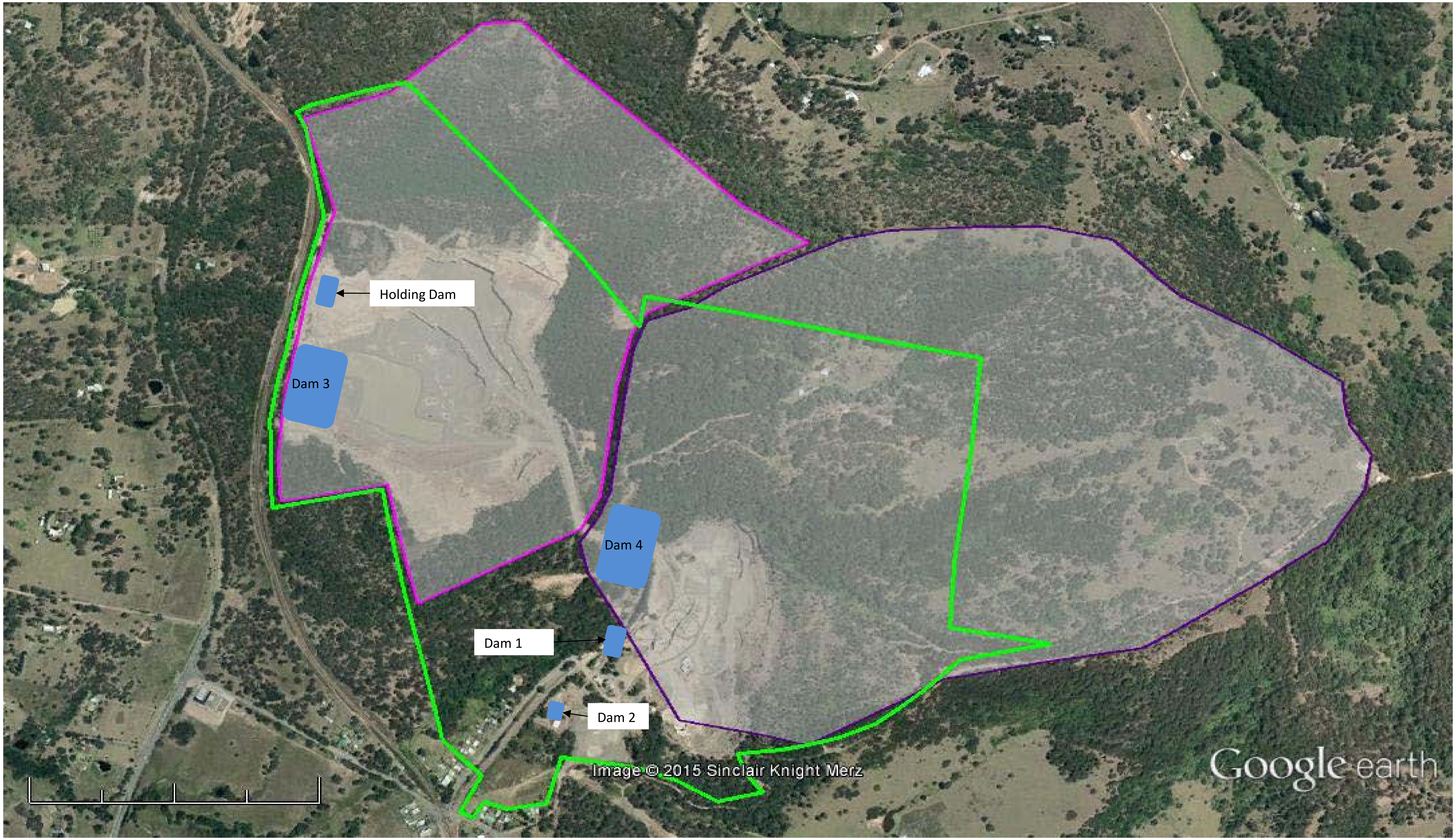
PROJECT:	JME4061	DESIGNED:	JMc	
DWG #:	1	DRAWN:	JMc	
REVISION:	1			
SCALE:	NTS	STATUS:	NFC	
DATE:	19/11/2015			

FIGURE TITLE:

Monitoring Well Location Plan

FIGURE NUMBER: **4**

ENVIRONMENTS



Notes:
1) Google Earth
2) Subject Site ▭
3) Weatern Pit Catchment ▭
4) Eastern Pit Catchment ▭

N

Client
Buttai Gravel

PROJECT TITLE: **Martins Creek Quarry Extension**

PROJECT:	JME4061	DESIGNED:	JMc
DWG #:	1	DRAWN:	JMc
REVISION:	1		
SCALE:	NTS	STATUS:	NFC
DATE:	19/11/2015		

FIGURE TITLE:
Surface Catchment Plan

FIGURE NUMBER: **5**

JM ENVIRONMENTS

Summary Table 1

Laboratory Summary Table 1

			Description **Sample Date** **Matrix**	MW1 18/3/2015 Water **Result**	MW1 16/8/2016 Water **Result**	MW2 18/3/2015 Water **Result**	MW2 16/8/2016 Water **Result**	MW3 18/3/2015 Water **Result**	MW3 16/8/2016 Water **Result**	MW4 18/3/2015 Water **Result**	MW4 16/8/2016 Water **Result**	QC4 18/3/2015 Water **Result**	% RPD	QC6 16/8/2016 Water **Result**	% RPD
Analyte Name	**Units**			**Field Parameters**											
Dissolved Oxygen	ppm			**2.66**	**0.23**	**2.85**	**2.4**	**2.29**	**0.29**	**4.72**	**1.23**	**Duplicate of**		**Duplicate of**	
Conductivity	µS/cm			**2140**	**934**	**1600**	**1424**	**3440**	**2700**	**2720**	**2273**	**MW2**		**MW2**	
pH				**7.23**	**7.03**	**6.85**	**6.9**	**6.97**	**6.91**	**6.71**	**7.17**	18/3/2015		16/8/2015	
ORP	mV			**62**	**91**	**43**	**141**	**63**	**42**	**68**	**94**				
Temperature	°C			**17.2**	**21.6**	**20.7**	**18**	**21.8**	**20.4**	**20.8**	**20**				
Analyte Name	**Units**	**Reporting Limit**	**95% Protection**	**Laboratory Results**											
Nitrate	mg/L	0.005	0.7	**18**	**6.8**	**0.068**	**0.17**	**0.039**	<0.005	**14**	**38**	**0.10**	38%	**0.17**	0%
Chloride	mg/L	1	-	**300**	**96**	**490**	**410**	**730**	**740**	**670**	**470**	**500**	2%	**410**	0%
Sulfate	mg/L	1	-	**100**	**40**	**150**	**190**	**130**	**140**	**93**	**80**	**150**	0%	**190**	0%
Nitrite	mg/L	0.005	0.1	**0.030**	**0.016**	<0.005	<0.005	<0.005	<0.005	**0.011**	**0.82**	<0.005	0%	<0.005	0%
TKN	mg/L	0.05	-	<0.05	**0.27**	**0.19**	**0.30**	**0.34**	**0.42**	<0.05	**0.29**	**0.12**	45%	**0.30**	0%
Total Nitrogen	mg/L	0.05	-	**18**	**7.0**	**0.26**	**0.47**	**0.38**	**0.42**	**14**	**39**	**0.22**	17%	**0.47**	0%
Total Phosphorus	mg/L	0.01	0.02	**0.16**	**0.05**	**0.14**	**0.01**	**0.32**	**0.07**	**0.12**	**0.26**	**0.15**	7%	<0.01	0%
Bicarbonate Alkalinity	mg/L	5		**480**	**300**	**440**	**460**	**640**	**670**	**170**	**230**	**450**	2%	**470**	2%
Carbonate Alkalinity	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	0%	<1	0%
Total Alkalinity	mg/L	5	-	**390**	**250**	**360**	**380**	**520**	**550**	**140**	**190**	**370**	3%	**390**	3%
Ammonia	mg/L	0.005	0.9	**0.013**	**0.01**	**0.023**	**0.01**	**0.27**	**0.11**	**0.024**	<0.01	**0.025**	8%	<0.01	0%
Total Dissolved Solids	mg/L	10	2000	**1100**	**550**	**1400**	**1400**	**1900**	**1900**	**1700**	**1400**	**1400**	0%	**1400**	0%
Calcium, Ca	mg/L	0.1	1000	**52**	**14**	**95**	**76**	**160**	**180**	**110**	**130**	**91**	4%	**76**	0%
Magnesium, Mg	mg/L	0.1	-	**42**	**12**	**70**	**59**	**110**	**96**	**68**	**39**	**71**	1%	**59**	0%
Sodium, Na	mg/L	0.1	-	**320**	**180**	**340**	**340**	**390**	**400**	**330**	**290**	**350**	3%	**330**	3%
Potassium, K	mg/L	0.2	-	**1.8**	**0.6**	**2.5**	**2.6**	**3.3**	**2.5**	**1.2**	**1.0**	**2.7**	8%	**2.5**	4%
Aluminium, Al	µg/L	5	55	**7**	<5	<5	<5	**5**	<5	**9**	<5	<5	0%	<5	0%
Arsenic, As	µg/L	1	13	<1	**1**	<1	<1	**1**	<1	<1	**1**	<1	0%	<1	0%
Chromium, Cr	µg/L	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0%	<1	0%
Cadmium, Cd	µg/L	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%
Copper, Cu	µg/L	1	1	**2**	**7**	**1**	**3**	<1	**2**	**4**	<1	<1	0%	**3**	0%
Iron, Fe	µg/L	5	-	**9**	<5	<5	<5	<5	**10**	**8**	<5	<5	0%	<5	0%
Manganese, Mn	µg/L	1	1900	**320**	**10**	**660**	**480**	**400**	**540**	**21**	**62**	**670**	2%	**630**	27%
Nickel, Ni	µg/L	1	11	**6**	**15**	**59**	**7**	**5**	**46**	**9**	**4**	**15**	119%	**7**	0%
Lead, Pb	µg/L	1	3	<1	<1	<1	<1	<1	<1	<1	<1	<1	0%	<1	0%
Zinc, Zn	µg/L	5	8	**12**	**12**	**13**	**36**	**11**	**10**	**18**	**8**	**9**	36%	**33**	9%
Mercury	mg/L	0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0%	<0.0001	0%

Appendix A

Laboratory Documentation

ANALYTICAL REPORT

WORLD RECOGNISED
ACCREDITATION

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	5
Date Started	06 Feb 2015

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE135916 R0**
Report Number	0000102490
Date Reported	12 Feb 2015
Date Received	05 Feb 2015

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES

Deanne Norris Organic Chemist	Ly Kim Ha Organic Section Head	Miliana Colati Inorganics & Metals Technician

		Sample Number	SE135916.001	SE135916.002	SE135916.003	SE135916.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	04 Feb 2015	04 Feb 2015	04 Feb 2015	04 Feb 2015
		Sample Name	Dam 1	Dam 3	Upstream	Downstream
Parameter	**Units**	**LOR**				

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434/AN410

Parameter	Units	LOR	SE135916.001	SE135916.002	SE135916.003	SE135916.004
TRH C6-C10	µg/L	50	<50	<50	<50	<50
TRH C6-C9	µg/L	40	<40	<40	<40	<40

Surrogates

Parameter	Units	LOR	SE135916.001	SE135916.002	SE135916.003	SE135916.004
Dibromofluoromethane (Surrogate)	%	-	115	118	122	118
d4-1,2-dichloroethane (Surrogate)	%	-	117	116	117	116
d8-toluene (Surrogate)	%	-	93	92	93	92
Bromofluorobenzene (Surrogate)	%	-	81	81	78	80

VPH F Bands

Parameter	Units	LOR	SE135916.001	SE135916.002	SE135916.003	SE135916.004
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403

Parameter	Units	LOR	SE135916.001	SE135916.002	SE135916.003	SE135916.004
TRH C10-C14	µg/L	50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200
TRH C10-C36	µg/L	450	<450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650	<650

TRH F Bands

Parameter	Units	LOR	SE135916.001	SE135916.002	SE135916.003	SE135916.004
TRH >C10-C16 (F2)	µg/L	60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114

Parameter	Units	LOR	SE135916.001	SE135916.002	SE135916.003	SE135916.004
Total Suspended Solids Dried at 103-105°C	mg/L	5	70	47	16	16

Parameter	Units	LOR	Sample Number: SE135916.005 Sample Matrix: Water Sample Date: 04 Feb 2015 Sample Name: QC1

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434/AN410

Parameter	Units	LOR	SE135916.005
TRH C6-C10	µg/L	50	<50
TRH C6-C9	µg/L	40	<40

Surrogates

Parameter	Units	LOR	SE135916.005
Dibromofluoromethane (Surrogate)	%	-	121
d4-1,2-dichloroethane (Surrogate)	%	-	120
d8-toluene (Surrogate)	%	-	87
Bromofluorobenzene (Surrogate)	%	-	81

VPH F Bands

Parameter	Units	LOR	SE135916.005
Benzene (F0)	µg/L	0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403

Parameter	Units	LOR	SE135916.005
TRH C10-C14	µg/L	50	<50
TRH C15-C28	µg/L	200	<200
TRH C29-C36	µg/L	200	<200
TRH C37-C40	µg/L	200	<200
TRH C10-C36	µg/L	450	<450
TRH C10-C40	µg/L	650	<650

TRH F Bands

Parameter	Units	LOR	SE135916.005
TRH >C10-C16 (F2)	µg/L	60	<60
TRH >C16-C34 (F3)	µg/L	500	<500
TRH >C34-C40 (F4)	µg/L	500	<500

Parameter	Units	LOR	Sample Number SE135916.005 Sample Matrix Water Sample Date 04 Feb 2015 Sample Name QC1
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114			
Total Suspended Solids Dried at 103-105°C	mg/L	5	59

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB071942	mg/L	5	<5	11%	104%

TRH (Total Recoverable Hydrocarbons) in Water Method: ME-(AU)-[ENV]AN403

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
TRH C10-C14	LB071688	µg/L	50	<50	87%
TRH C15-C28	LB071688	µg/L	200	<200	96%
TRH C29-C36	LB071688	µg/L	200	<200	92%
TRH C37-C40	LB071688	µg/L	200	<200	NA
TRH C10-C36	LB071688	µg/L	450	<450	NA
TRH C10-C40	LB071688	µg/L	650	<650	NA

TRH F Bands

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
TRH >C10-C16 (F2)	LB071688	µg/L	60	<60	93%
TRH >C16-C34 (F3)	LB071688	µg/L	500	<500	97%
TRH >C34-C40 (F4)	LB071688	µg/L	500	<500	87%

Volatile Petroleum Hydrocarbons in Water Method: ME-(AU)-[ENV]AN433/AN434/AN410

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
TRH C6-C10	LB072045	µg/L	50	<50	0%	99%
TRH C6-C9	LB072045	µg/L	40	<40	0%	99%

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Dibromofluoromethane (Surrogate)	LB072045	%	-	113%	2%	96%
d4-1,2-dichloroethane (Surrogate)	LB072045	%	-	114%	2%	97%
d8-toluene (Surrogate)	LB072045	%	-	95%	1%	98%
Bromofluorobenzene (Surrogate)	LB072045	%	-	82%	3%	99%

VPH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Benzene (F0)	LB072045	µg/L	0.5	<0.5	0%	NA
TRH C6-C10 minus BTEX (F1)	LB072045	µg/L	50	<50	0%	101%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN083	Separatory funnels are used for aqueous samples and extracted by transferring an appropriate volume (mass) of liquid into a separatory funnel and adding 3 serial aliquots of dichloromethane. Samples receive a single extraction at pH 7 to recover base / neutral analytes and two extractions at pH < 2 to recover acidic analytes. QC samples are prepared by spiking organic free water with target analytes and extracting as per samples.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is not corrected for Naphthalene.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Petroleum Hydrocarbons (TPH) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents .
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependant on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN433/AN434/AN410	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	This analysis is not covered by the scope of accreditation.
**	Indicative data, theoretical holding time exceeded.
^	Performed by outside laboratory.
LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
QFL	QC result is below the lower tolerance
-	The sample was not analysed for this analyte
NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

STATEMENT OF QA/QC PERFORMANCE

SE135916 R0

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	5

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	SE135916 R0
Report Number	0000102491
Date Reported	12 Feb 2015

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

Sample counts by matrix	5 Water	Type of documentation received	COC
Date documentation received	5/2/2015	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	2.1°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice	Samples clearly labelled	Yes
Complete documentation received	Yes		

HOLDING TIME SUMMARY

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Dam 1	SE135916.001	LB071942	04 Feb 2015	05 Feb 2015	11 Feb 2015	10 Feb 2015	17 Feb 2015	11 Feb 2015
Dam 3	SE135916.002	LB071942	04 Feb 2015	05 Feb 2015	11 Feb 2015	10 Feb 2015	17 Feb 2015	11 Feb 2015
Upstream	SE135916.003	LB071942	04 Feb 2015	05 Feb 2015	11 Feb 2015	10 Feb 2015	17 Feb 2015	11 Feb 2015
Downstream	SE135916.004	LB071942	04 Feb 2015	05 Feb 2015	11 Feb 2015	10 Feb 2015	17 Feb 2015	11 Feb 2015
QC1	SE135916.005	LB071942	04 Feb 2015	05 Feb 2015	11 Feb 2015	10 Feb 2015	17 Feb 2015	11 Feb 2015

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Dam 1	SE135916.001	LB071688	04 Feb 2015	05 Feb 2015	11 Feb 2015	05 Feb 2015	17 Mar 2015	12 Feb 2015
Dam 3	SE135916.002	LB071688	04 Feb 2015	05 Feb 2015	11 Feb 2015	05 Feb 2015	17 Mar 2015	12 Feb 2015
Upstream	SE135916.003	LB071688	04 Feb 2015	05 Feb 2015	11 Feb 2015	05 Feb 2015	17 Mar 2015	12 Feb 2015
Downstream	SE135916.004	LB071688	04 Feb 2015	05 Feb 2015	11 Feb 2015	05 Feb 2015	17 Mar 2015	12 Feb 2015
QC1	SE135916.005	LB071688	04 Feb 2015	05 Feb 2015	11 Feb 2015	05 Feb 2015	17 Mar 2015	12 Feb 2015

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Dam 1	SE135916.001	LB072045	04 Feb 2015	05 Feb 2015	11 Feb 2015	11 Feb 2015	23 Mar 2015	12 Feb 2015
Dam 3	SE135916.002	LB072045	04 Feb 2015	05 Feb 2015	11 Feb 2015	11 Feb 2015	23 Mar 2015	12 Feb 2015
Upstream	SE135916.003	LB072045	04 Feb 2015	05 Feb 2015	11 Feb 2015	11 Feb 2015	23 Mar 2015	12 Feb 2015
Downstream	SE135916.004	LB072045	04 Feb 2015	05 Feb 2015	11 Feb 2015	11 Feb 2015	23 Mar 2015	12 Feb 2015
QC1	SE135916.005	LB072045	04 Feb 2015	05 Feb 2015	11 Feb 2015	11 Feb 2015	23 Mar 2015	12 Feb 2015

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	Dam 1	SE135916.001	%	40 - 130%	81
	Dam 3	SE135916.002	%	40 - 130%	81
	Upstream	SE135916.003	%	40 - 130%	78
	Downstream	SE135916.004	%	40 - 130%	80
	QC1	SE135916.005	%	40 - 130%	81
d4-1,2-dichloroethane (Surrogate)	Dam 1	SE135916.001	%	60 - 130%	117
	Dam 3	SE135916.002	%	60 - 130%	116
	Upstream	SE135916.003	%	60 - 130%	117
	Downstream	SE135916.004	%	60 - 130%	116
	QC1	SE135916.005	%	60 - 130%	120
d8-toluene (Surrogate)	Dam 1	SE135916.001	%	40 - 130%	93
	Dam 3	SE135916.002	%	40 - 130%	92
	Upstream	SE135916.003	%	40 - 130%	93
	Downstream	SE135916.004	%	40 - 130%	92
	QC1	SE135916.005	%	40 - 130%	87
Dibromofluoromethane (Surrogate)	Dam 1	SE135916.001	%	40 - 130%	115
	Dam 3	SE135916.002	%	40 - 130%	118
	Upstream	SE135916.003	%	40 - 130%	122
	Downstream	SE135916.004	%	40 - 130%	118
	QC1	SE135916.005	%	40 - 130%	121

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Number	Parameter	Units	LOR	Result
LB071942.001	Total Suspended Solids Dried at 103-105°C	mg/L	5	<5

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB071688.001	TRH C10-C14	µg/L	50	<50
	TRH C15-C28	µg/L	200	<200
	TRH C29-C36	µg/L	200	<200
	TRH C37-C40	µg/L	200	<200

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Number		Parameter	Units	LOR	Result
LB072045.001		TRH C6-C9	µg/L	40	<40
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	113
		d4-1,2-dichloroethane (Surrogate)	%	-	114
		d8-toluene (Surrogate)	%	-	95
		Bromofluorobenzene (Surrogate)	%	-	82

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE135782.001	LB071942.015	Total Suspended Solids Dried at 103-105°C	mg/L	5	46.25000000	63.74999999	18	11

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE135916.001	LB072045.010		TRH C6-C10	µg/L	50	<50	<50	200	0
			TRH C6-C9	µg/L	40	<40	<40	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.7	5.8	30	2
			d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.8	5.7	30	2
			d8-toluene (Surrogate)	µg/L	-	4.7	4.6	30	1
			Bromofluorobenzene (Surrogate)	µg/L	-	4.0	3.9	30	3
		VPH F Bands	Benzene (F0)	µg/L	0.5	<0.5	<0.5	200	0
			TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	200	0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB071942.002	Total Suspended Solids Dried at 103-105°C	mg/L	5	100	100	80 - 120	104

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB071688.002		TRH C10-C14	µg/L	50	1000	1200	60 - 140	87
		TRH C15-C28	µg/L	200	1100	1200	60 - 140	96
		TRH C29-C36	µg/L	200	1100	1200	60 - 140	92
	TRH F Bands	TRH >C10-C16 (F2)	µg/L	60	1100	1200	60 - 140	93
		TRH >C16-C34 (F3)	µg/L	500	1200	1200	60 - 140	97
		TRH >C34-C40 (F4)	µg/L	500	520	600	60 - 140	87

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB072045.002		TRH C6-C10	µg/L	50	940	946.63	60 - 140	99
		TRH C6-C9	µg/L	40	810	818.71	60 - 140	99
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	4.8	5	60 - 140	96
		d4-1,2-dichloroethane (Surrogate)	µg/L	-	4.9	5	60 - 140	97
		d8-toluene (Surrogate)	µg/L	-	4.9	5	60 - 140	98
		Bromofluorobenzene (Surrogate)	µg/L	-	4.9	5	60 - 140	99
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	µg/L	50	650	639.67	60 - 140	101

MATRIX SPIKES

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

MATRIX SPIKE DUPLICATES

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

FOOTNOTES

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

*	Non-accredited analysis.
-	Sample not analysed for this analyte.
^	Analysis performed by external laboratory.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

ANALYTICAL REPORT

NATA
WORLD RECOGNISED
ACCREDITATION

CLIENT DETAILS		LABORATORY DETAILS	
Contact	James McMahon	Manager	Huong Crawford
Client	JM ENVIRONMENTS	Laboratory	SGS Alexandria Environmental
Address	37 TOOKE STREET COOKS HILL NSW 2300	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	(Not specified)	Telephone	+61 2 8594 0400
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499
Email	james@jmenvironments.com	Email	au.environmental.sydney@sgs.com
Project	**JME4061**	SGS Reference	**SE136423 R0**
Order Number	**JME4061**	Report Number	0000103694
Samples	3	Date Reported	26 Feb 2015
Date Started	20 Feb 2015	Date Received	19 Feb 2015

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES

Deanne Norris Organic Chemist	Ly Kim Ha Organic Section Head	Miliana Colati Inorganics & Metals Technician

		Sample Number	SE136423.001	SE136423.002	SE136423.003
		Sample Matrix	Water	Water	Water
		Sample Date	18 Feb 2015	18 Feb 2015	18 Feb 2015
		Sample Name	Dam 1	Upstream	Downstream
Parameter	Units	LOR			

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434/AN410

TRH C6-C10	µg/L	50	<50	<50	<50
TRH C6-C9	µg/L	40	<40	<40	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	116	116	118
d4-1,2-dichloroethane (Surrogate)	%	-	117	115	112
d8-toluene (Surrogate)	%	-	90	88	89
Bromofluorobenzene (Surrogate)	%	-	85	85	82

VPH F Bands

Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403

TRH C10-C14	µg/L	50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200
TRH C10-C36	µg/L	450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650

TRH F Bands

TRH >C10-C16 (F2)	µg/L	60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114

Total Suspended Solids Dried at 103-105°C	mg/L	5	57	<5	<5

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB072808	mg/L	5	<5	7 - 26%	101%

TRH (Total Recoverable Hydrocarbons) in Water Method: ME-(AU)-[ENV]AN403

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
TRH C10-C14	LB072579	µg/L	50	<50	86%
TRH C15-C28	LB072579	µg/L	200	<200	96%
TRH C29-C36	LB072579	µg/L	200	<200	96%
TRH C37-C40	LB072579	µg/L	200	<200	NA
TRH C10-C36	LB072579	µg/L	450	<450	NA
TRH C10-C40	LB072579	µg/L	650	<650	NA

TRH F Bands

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
TRH >C10-C16 (F2)	LB072579	µg/L	60	<60	92%
TRH >C16-C34 (F3)	LB072579	µg/L	500	<500	97%
TRH >C34-C40 (F4)	LB072579	µg/L	500	<500	98%

Volatile Petroleum Hydrocarbons in Water Method: ME-(AU)-[ENV]AN433/AN434/AN410

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
TRH C6-C10	LB072689	µg/L	50	<50	0%	100%	100%
TRH C6-C9	LB072689	µg/L	40	<40	0%	100%	101%

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Dibromofluoromethane (Surrogate)	LB072689	%	-	108%	1 - 2%	100%	101%
d4-1,2-dichloroethane (Surrogate)	LB072689	%	-	110%	1%	103%	107%
d8-toluene (Surrogate)	LB072689	%	-	95%	1 - 2%	87%	87%
Bromofluorobenzene (Surrogate)	LB072689	%	-	90%	2 - 3%	93%	94%

VPH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Benzene (F0)	LB072689	µg/L	0.5	<0.5	0%	NA	NA
TRH C6-C10 minus BTEX (F1)	LB072689	µg/L	50	<50	0%	102%	102%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN083	Separatory funnels are used for aqueous samples and extracted by transferring an appropriate volume (mass) of liquid into a separatory funnel and adding 3 serial aliquots of dichloromethane. Samples receive a single extraction at pH 7 to recover base / neutral analytes and two extractions at pH < 2 to recover acidic analytes. QC samples are prepared by spiking organic free water with target analytes and extracting as per samples.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is not corrected for Naphthalene.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Petroleum Hydrocarbons (TPH) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents .
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependant on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN433/AN434/AN410	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	This analysis is not covered by the scope of accreditation.
**	Indicative data, theoretical holding time exceeded.
^	Performed by outside laboratory.

LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
QFL	QC result is below the lower tolerance
-	The sample was not analysed for this analyte
NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

STATEMENT OF QA/QC PERFORMANCE

SE136423 R0

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	SE136423 R0
Report Number	0000103695
Date Reported	26 Feb 2015

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

Sample counts by matrix	3 Waters	Type of documentation received	COC
Date documentation received	19/2/2015	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	7.6°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice	Samples clearly labelled	Yes
Complete documentation received	Yes		

HOLDING TIME SUMMARY

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Dam 1	SE136423.001	LB072808	18 Feb 2015	19 Feb 2015	25 Feb 2015	25 Feb 2015	04 Mar 2015	25 Feb 2015
Upstream	SE136423.002	LB072808	18 Feb 2015	19 Feb 2015	25 Feb 2015	25 Feb 2015	04 Mar 2015	25 Feb 2015
Downstream	SE136423.003	LB072808	18 Feb 2015	19 Feb 2015	25 Feb 2015	25 Feb 2015	04 Mar 2015	25 Feb 2015

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Dam 1	SE136423.001	LB072579	18 Feb 2015	19 Feb 2015	25 Feb 2015	18 Feb 2015	30 Mar 2015	25 Feb 2015
Upstream	SE136423.002	LB072579	18 Feb 2015	19 Feb 2015	25 Feb 2015	18 Feb 2015	30 Mar 2015	25 Feb 2015
Downstream	SE136423.003	LB072579	18 Feb 2015	19 Feb 2015	25 Feb 2015	18 Feb 2015	30 Mar 2015	25 Feb 2015

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Dam 1	SE136423.001	LB072689	18 Feb 2015	19 Feb 2015	25 Feb 2015	23 Feb 2015	04 Apr 2015	25 Feb 2015
Upstream	SE136423.002	LB072689	18 Feb 2015	19 Feb 2015	25 Feb 2015	23 Feb 2015	04 Apr 2015	25 Feb 2015
Downstream	SE136423.003	LB072689	18 Feb 2015	19 Feb 2015	25 Feb 2015	23 Feb 2015	04 Apr 2015	25 Feb 2015

SURROGATES

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	Dam 1	SE136423.001	%	40 - 130%	85
	Upstream	SE136423.002	%	40 - 130%	85
	Downstream	SE136423.003	%	40 - 130%	82
d4-1,2-dichloroethane (Surrogate)	Dam 1	SE136423.001	%	60 - 130%	117
	Upstream	SE136423.002	%	60 - 130%	115
	Downstream	SE136423.003	%	60 - 130%	112
d8-toluene (Surrogate)	Dam 1	SE136423.001	%	40 - 130%	90
	Upstream	SE136423.002	%	40 - 130%	88
	Downstream	SE136423.003	%	40 - 130%	89
Dibromofluoromethane (Surrogate)	Dam 1	SE136423.001	%	40 - 130%	116
	Upstream	SE136423.002	%	40 - 130%	116
	Downstream	SE136423.003	%	40 - 130%	118

METHOD BLANKS

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Number	Parameter	Units	LOR	Result
LB072808.001	Total Suspended Solids Dried at 103-105°C	mg/L	5	<5

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB072579.001	TRH C10-C14	µg/L	50	<50
	TRH C15-C28	µg/L	200	<200
	TRH C29-C36	µg/L	200	<200
	TRH C37-C40	µg/L	200	<200

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Number		Parameter	Units	LOR	Result
LB072689.001		TRH C6-C9	µg/L	40	<40
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	108
		d4-1,2-dichloroethane (Surrogate)	%	-	110
		d8-toluene (Surrogate)	%	-	95
		Bromofluorobenzene (Surrogate)	%	-	90

DUPLICATES

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE136423.002	LB072808.012	Total Suspended Solids Dried at 103-105°C	mg/L	5	<5	6	106	26
SE136481.001	LB072808.020	Total Suspended Solids Dried at 103-105°C	mg/L	5	6.4999999999	7.0000000000	89	7

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE136291.003	LB072689.006		TRH C6-C10	µg/L	50	<50	<50	200	0
			TRH C6-C9	µg/L	40	<40	<40	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.6	5.5	30	2
			d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.6	5.6	30	1
			d8-toluene (Surrogate)	µg/L	-	4.6	4.6	30	1
			Bromofluorobenzene (Surrogate)	µg/L	-	4.3	4.4	30	2
		VPH F Bands	Benzene (F0)	µg/L	0.5	<0.5	<0.5	200	0
			TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	200	0
SE136423.001	LB072689.017		TRH C6-C10	µg/L	50	<50	<50	200	0
			TRH C6-C9	µg/L	40	<40	<40	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.8	5.7	30	1
			d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.8	5.8	30	1
			d8-toluene (Surrogate)	µg/L	-	4.5	4.4	30	2
			Bromofluorobenzene (Surrogate)	µg/L	-	4.2	4.1	30	3
		VPH F Bands	Benzene (F0)	µg/L	0.5	<0.5	<0.5	200	0
			TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	200	0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB072808.002		Total Suspended Solids Dried at 103-105°C	mg/L	5	100	100	80 - 120	101

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB072579.002		TRH C10-C14	µg/L	50	1000	1200	60 - 140	86
		TRH C15-C28	µg/L	200	1200	1200	60 - 140	96
		TRH C29-C36	µg/L	200	1200	1200	60 - 140	96
	TRH F Bands	TRH >C10-C16 (F2)	µg/L	60	1100	1200	60 - 140	92
		TRH >C16-C34 (F3)	µg/L	500	1200	1200	60 - 140	97
		TRH >C34-C40 (F4)	µg/L	500	590	600	60 - 140	98

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB072689.002		TRH C6-C10	µg/L	50	950	946.63	60 - 140	100
		TRH C6-C9	µg/L	40	820	818.71	60 - 140	100
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.0	5	60 - 140	100
		d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.2	5	60 - 140	103
		d8-toluene (Surrogate)	µg/L	-	4.3	5	60 - 140	87
		Bromofluorobenzene (Surrogate)	µg/L	-	4.6	5	60 - 140	93
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	µg/L	50	650	639.67	60 - 140	102

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

QC Sample	Sample Number		Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE136291.005	LB072689.009		TRH C6-C10	µg/L	50	950	<50	946.63	100
			TRH C6-C9	µg/L	40	820	<40	818.71	101
		Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.0	5.3	5	101
			d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.4	5.5	5	107
			d8-toluene (Surrogate)	µg/L	-	4.4	4.4	5	87
			Bromofluorobenzene (Surrogate)	µg/L	-	4.7	4.3	5	94
		VPH F Bands	Benzene (F0)	µg/L	0.5	49	<0.5	-	-
			TRH C6-C10 minus BTEX (F1)	µg/L	50	650	<50	639.67	102

MATRIX SPIKE DUPLICATES

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

*	Non-accredited analysis.
-	Sample not analysed for this analyte.
^	Analysis performed by external laboratory.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.
①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

ANALYTICAL REPORT

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	2
Date Started	11 Mar 2015

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE136991 R0**
Report Number	0000105138
Date Reported	13 Mar 2015
Date Received	06 Mar 2015

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES

Deanne Norris
Organic Chemist

Ly Kim Ha
Organic Section Head

Miliana Colati
Inorganics & Metals Technician

		Sample Number	SE136991.001	SE136991.002
		Sample Matrix	Water	Water
		Sample Date	04 Mar 2015	04 Mar 2015
		Sample Name	Upstream	Downstream
Parameter	Units	LOR		

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434/AN410 Tested: 11/3/2015

TRH C6-C10	μg/L	50	<50	<50
TRH C6-C9	μg/L	40	<40	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	116	115
d4-1,2-dichloroethane (Surrogate)	%	-	113	111
d8-toluene (Surrogate)	%	-	93	93
Bromofluorobenzene (Surrogate)	%	-	93	87

VPH F Bands

Benzene (F0)	μg/L	0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	μg/L	50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 9/3/2015

TRH C10-C14	μg/L	50	<50	<50
TRH C15-C28	μg/L	200	<200	<200
TRH C29-C36	μg/L	200	<200	<200
TRH C37-C40	μg/L	200	<200	<200
TRH C10-C36	μg/L	450	<450	<450
TRH C10-C40	μg/L	650	<650	<650

TRH F Bands

TRH >C10-C16 (F2)	μg/L	60	<60	<60
TRH >C16-C34 (F3)	μg/L	500	<500	<500
TRH >C34-C40 (F4)	μg/L	500	<500	<500

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 12/3/2015

Total Suspended Solids Dried at 103-105°C	mg/L	5	7	<5

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB073703	mg/L	5	<5	0 - 5%	120%

TRH (Total Recoverable Hydrocarbons) in Water Method: ME-(AU)-[ENV]AN403

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
TRH C10-C14	LB073461	µg/L	50	<50	84%
TRH C15-C28	LB073461	µg/L	200	<200	90%
TRH C29-C36	LB073461	µg/L	200	<200	90%
TRH C37-C40	LB073461	µg/L	200	<200	NA
TRH C10-C36	LB073461	µg/L	450	<450	NA
TRH C10-C40	LB073461	µg/L	650	<650	NA

TRH F Bands

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
TRH >C10-C16 (F2)	LB073461	µg/L	60	<60	88%
TRH >C16-C34 (F3)	LB073461	µg/L	500	<500	92%
TRH >C34-C40 (F4)	LB073461	µg/L	500	<500	87%

Volatile Petroleum Hydrocarbons in Water Method: ME-(AU)-[ENV]AN433/AN434/AN410

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
TRH C6-C10	LB073650	µg/L	50	<50	100%
TRH C6-C9	LB073650	µg/L	40	<40	95%

Surrogates

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Dibromofluoromethane (Surrogate)	LB073650	%	-	109%	97%
d4-1,2-dichloroethane (Surrogate)	LB073650	%	-	107%	99%
d8-toluene (Surrogate)	LB073650	%	-	100%	94%
Bromofluorobenzene (Surrogate)	LB073650	%	-	89%	95%

VPH F Bands

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Benzene (F0)	LB073650	µg/L	0.5	<0.5	NA
TRH C6-C10 minus BTEX (F1)	LB073650	µg/L	50	<50	102%

METHOD	METHODOLOGY SUMMARY
AN083	Separatory funnels are used for aqueous samples and extracted by transferring an appropriate volume (mass) of liquid into a separatory funnel and adding 3 serial aliquots of dichloromethane. Samples receive a single extraction at pH 7 to recover base / neutral analytes and two extractions at pH < 2 to recover acidic analytes. QC samples are prepared by spiking organic free water with target analytes and extracting as per samples.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample . Reference APHA 2540 D. Internal Reference AN114
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is not corrected for Naphthalene.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Petroleum Hydrocarbons (TPH) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents .
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependant on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN433/AN434/AN410	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
^	Performed by outside laboratory.	NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

STATEMENT OF QA/QC PERFORMANCE

SE136991 R0

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	2

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	SE136991 R0
Report Number	0000105139
Date Reported	13 Mar 2015

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

Sample counts by matrix	2 Waters	Type of documentation received	COC
Date documentation received	6/3/2015	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	7.6°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice	Samples clearly labelled	Yes
Complete documentation received	Yes		

HOLDING TIME SUMMARY

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Upstream	SE136991.001	LB073703	04 Mar 2015	06 Mar 2015	11 Mar 2015	11 Mar 2015	18 Mar 2015	12 Mar 2015
Downstream	SE136991.002	LB073703	04 Mar 2015	06 Mar 2015	11 Mar 2015	11 Mar 2015	18 Mar 2015	12 Mar 2015

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Upstream	SE136991.001	LB073461	04 Mar 2015	06 Mar 2015	11 Mar 2015	09 Mar 2015	18 Apr 2015	12 Mar 2015
Downstream	SE136991.002	LB073461	04 Mar 2015	06 Mar 2015	11 Mar 2015	09 Mar 2015	18 Apr 2015	12 Mar 2015

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Upstream	SE136991.001	LB073650	04 Mar 2015	06 Mar 2015	11 Mar 2015	11 Mar 2015	20 Apr 2015	13 Mar 2015
Downstream	SE136991.002	LB073650	04 Mar 2015	06 Mar 2015	11 Mar 2015	11 Mar 2015	20 Apr 2015	13 Mar 2015

SURROGATES

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	Upstream	SE136991.001	%	40 - 130%	93
	Downstream	SE136991.002	%	40 - 130%	87
d4-1,2-dichloroethane (Surrogate)	Upstream	SE136991.001	%	60 - 130%	113
	Downstream	SE136991.002	%	60 - 130%	111
d8-toluene (Surrogate)	Upstream	SE136991.001	%	40 - 130%	93
	Downstream	SE136991.002	%	40 - 130%	93
Dibromofluoromethane (Surrogate)	Upstream	SE136991.001	%	40 - 130%	116
	Downstream	SE136991.002	%	40 - 130%	115

METHOD BLANKS

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Number	Parameter	Units	LOR	Result
LB073703.001	Total Suspended Solids Dried at 103-105°C	mg/L	5	<5

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB073461.001	TRH C10-C14	µg/L	50	<50
	TRH C15-C28	µg/L	200	<200
	TRH C29-C36	µg/L	200	<200
	TRH C37-C40	µg/L	200	<200

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Number		Parameter	Units	LOR	Result
LB073650.001		TRH C6-C9	µg/L	40	<40
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	109
		d4-1,2-dichloroethane (Surrogate)	%	-	107
		d8-toluene (Surrogate)	%	-	100
		Bromofluorobenzene (Surrogate)	%	-	89

DUPLICATES

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE136990.001	LB073703.011	Total Suspended Solids Dried at 103-105°C	mg/L	5	5	5	115	0
SE137121.001	LB073703.016	Total Suspended Solids Dried at 103-105°C	mg/L	5	10	9	69	5

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB073703.002		Total Suspended Solids Dried at 103-105°C	mg/L	5	120	100	80 - 120	120

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB073461.002		TRH C10-C14	µg/L	50	1000	1200	60 - 140	84
		TRH C15-C28	µg/L	200	1100	1200	60 - 140	90
		TRH C29-C36	µg/L	200	1100	1200	60 - 140	90
	TRH F Bands	TRH >C10-C16 (F2)	µg/L	60	1100	1200	60 - 140	88
		TRH >C16-C34 (F3)	µg/L	500	1100	1200	60 - 140	92
		TRH >C34-C40 (F4)	µg/L	500	520	600	60 - 140	87

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433/AN434/AN410

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB073650.002		TRH C6-C10	µg/L	50	950	946.63	60 - 140	100
		TRH C6-C9	µg/L	40	770	818.71	60 - 140	95
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	4.8	5	60 - 140	97
		d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.0	5	60 - 140	99
		d8-toluene (Surrogate)	µg/L	-	4.7	5	60 - 140	94
		Bromofluorobenzene (Surrogate)	µg/L	-	4.8	5	60 - 140	95
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	µg/L	50	650	639.67	60 - 140	102

MATRIX SPIKES

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

MATRIX SPIKE DUPLICATES

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

FOOTNOTES

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

*	Non-accredited analysis.
-	Sample not analysed for this analyte.
^	Analysis performed by external laboratory.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.
①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

ANALYTICAL REPORT

WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	5
Date Started	23 Mar 2015

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE137439 R0**
Report Number	0000106312
Date Reported	27 Mar 2015
Date Received	20 Mar 2015

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES

Dong Liang
Metals/Inorganics Team Leader

Huong Crawford
Production Manager

Kamrul Ahsan
Senior Chemist

		Sample Number	SE137439.001	SE137439.002	SE137439.003	SE137439.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	18 Mar 2015	18 Mar 2015	18 Mar 2015	18 Mar 2015
		Sample Name	MW1	MW2	MW3	MW4
Parameter	Units	LOR				

Anions by Ion Chromatography in Water Method: ME-AU-ENVAN245 Tested: 23/3/2015

Nitrate Nitrogen, NO3-N	mg/L	0.005	18	0.068	0.039	14
Chloride	mg/L	1	300	490	730	670
Sulphate, SO4	mg/L	1	100	150	130	93

Nitrite in Water Method: AN277/WC250.312 Tested: 23/3/2015

Nitrite Nitrogen, NO2 as N	mg/L	0.005	0.030	<0.005	<0.005	0.011

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281/AN292 Tested: 23/3/2015

Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	0.19	0.34	<0.05
Total Nitrogen (calc)	mg/L	0.05	18	0.26	0.38	14

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293 Tested: 23/3/2015

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	0.16	0.14	0.32	0.12

Alkalinity Method: ME-AU-ENVAN135 Tested: 25/3/2015

Bicarbonate Alkalinity as HCO3	mg/L	5	480	440	640	170
Carbonate Alkalinity as CO3	mg/L	1	<1	<1	<1	<1
Total Alkalinity as CaCO3	mg/L	5	390	360	520	140

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 23/3/2015

Ammonia Nitrogen, NH_3 as N	mg/L	0.005	0.013	0.023	0.27	0.024

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 25/3/2015

Total Dissolved Solids Dried at 175-185°C	mg/L	10	1100	1400	1900	1700

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 24/3/2015

Calcium, Ca	mg/L	0.1	52	95	160	110
Magnesium, Mg	mg/L	0.1	42	70	110	68
Potassium, K	mg/L	0.2	1.8	2.5	3.3	1.2
Sodium, Na	mg/L	0.1	320	340	390	330

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 25/3/2015

Aluminium, Al	μg/L	5	7	<5	5	9
Arsenic, As	μg/L	1	<1	<1	1	<1
Cadmium, Cd	μg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chromium, Cr	μg/L	1	<1	<1	<1	<1
Copper, Cu	μg/L	1	2	1	<1	4
Iron, Fe	μg/L	5	9	<5	<5	8
Lead, Pb	μg/L	1	<1	<1	<1	<1
Manganese, Mn	μg/L	1	320	660	400	21
Nickel, Ni	μg/L	1	6	59	5	9
Zinc, Zn	μg/L	5	12	13	11	18

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name: SE137439.001 Water 18 Mar 2015 MW1	SE137439.002 Water 18 Mar 2015 MW2	SE137439.003 Water 18 Mar 2015 MW3	SE137439.004 Water 18 Mar 2015 MW4
Mercury (dissolved) in Water Method: AN311/AN312 Tested: 27/3/2015						
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

		Sample Number	SE137439.005
		Sample Matrix	Water
		Sample Date	18 Mar 2015
		Sample Name	QC4
Parameter	**Units**	**LOR**	

Anions by Ion Chromatography in Water   Method: ME-AU-ENVAN245   Tested: 23/3/2015

Parameter	Units	LOR	QC4
Nitrate Nitrogen, NO3-N	mg/L	0.005	**0.10**
Chloride	mg/L	1	**500**
Sulphate, SO4	mg/L	1	**150**

Nitrite in Water   Method: AN277/WC250.312   Tested: 23/3/2015

Parameter	Units	LOR	QC4
Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser   Method: AN281/AN292   Tested: 23/3/2015

Parameter	Units	LOR	QC4
Total Kjeldahl Nitrogen	mg/L	0.05	**0.12**
Total Nitrogen (calc)	mg/L	0.05	**0.22**

Total Phosphorus by Kjeldahl Digestion DA in Water   Method: AN279/AN293   Tested: 23/3/2015

Parameter	Units	LOR	QC4
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	**0.15**

Alkalinity   Method: ME-AU-ENVAN135   Tested: 25/3/2015

Parameter	Units	LOR	QC4
Bicarbonate Alkalinity as HCO3	mg/L	5	**450**
Carbonate Alkalinity as CO3	mg/L	1	<1
Total Alkalinity as CaCO3	mg/L	5	**370**

Ammonia Nitrogen by Discrete Analyser (Aquakem)   Method: AN291   Tested: 23/3/2015

Parameter	Units	LOR	QC4
Ammonia Nitrogen, NH_3 as N	mg/L	0.005	**0.025**

Total Dissolved Solids (TDS) in water   Method: AN113   Tested: 25/3/2015

Parameter	Units	LOR	QC4
Total Dissolved Solids Dried at 175-185°C	mg/L	10	**1400**

Metals in Water (Dissolved) by ICPOES   Method: AN320/AN321   Tested: 24/3/2015

Parameter	Units	LOR	QC4
Calcium, Ca	mg/L	0.1	**91**
Magnesium, Mg	mg/L	0.1	**71**
Potassium, K	mg/L	0.2	**2.7**
Sodium, Na	mg/L	0.1	**350**

Parameter	Units	LOR	Sample Number SE137439.005 Sample Matrix Water Sample Date 18 Mar 2015 Sample Name QC4

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 25/3/2015

Aluminium, Al	µg/L	5	<5
Arsenic, As	µg/L	1	<1
Cadmium, Cd	µg/L	0.1	<0.1
Chromium, Cr	µg/L	1	<1
Copper, Cu	µg/L	1	<1
Iron, Fe	µg/L	5	<5
Lead, Pb	µg/L	1	<1
Manganese, Mn	µg/L	1	**670**
Nickel, Ni	µg/L	1	**15**
Zinc, Zn	µg/L	5	**9**

Mercury (dissolved) in Water Method: AN311/AN312 Tested: 27/3/2015

Mercury	mg/L	0.0001	<0.0001

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-AU-ENVAN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Bicarbonate Alkalinity as HCO3	LB074499	mg/L	5	<5		
Carbonate Alkalinity as CO3	LB074499	mg/L	1	<1		
Total Alkalinity as CaCO3	LB074499	mg/L	5	<5	1 - 5%	94%

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: ME-(AU)-[ENV]AN291

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH_3 as N	LB074363	mg/L	0.005	<0.005	19%	102%

Anions by Ion Chromatography in Water Method: ME-AU-ENVAN245

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Nitrate Nitrogen, NO3-N	LB074349	mg/L	0.005	<0.005	97%
Chloride	LB074349	mg/L	1	<1.0	92%
Sulphate, SO4	LB074349	mg/L	1	<1.0	95%

Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Mercury	LB074631	mg/L	0.0001	<0.0001	0%	97%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320/AN321

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Calcium, Ca	LB074375	mg/L	0.1	<0.1	0%	101%
Magnesium, Mg	LB074375	mg/L	0.1	<0.1	0%	100%
Potassium, K	LB074375	mg/L	0.2	<0.2	0%	97%
Sodium, Na	LB074375	mg/L	0.1	<0.1	0%	115%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Nitrite in Water Method: ME-(AU)-[ENV]AN277/WC250.312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB074362	mg/L	0.005	<0.005	1%	109%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB074525	mg/L	10	<10	9%	112%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB074302	mg/L	0.01	<0.01	3%	118%	104%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB074497	μg/L	5	<5	2%	107%	103%
Arsenic, As	LB074497	μg/L	1	<1	0%	100%	106%
Cadmium, Cd	LB074497	μg/L	0.1	<0.1	0%	102%	105%
Chromium, Cr	LB074497	μg/L	1	<1	0%	97%	95%
Copper, Cu	LB074497	μg/L	1	<1	0%	104%	97%
Iron, Fe	LB074497	μg/L	5	<5	11%	107%	95%
Lead, Pb	LB074497	μg/L	1	<1	0%	105%	100%
Manganese, Mn	LB074497	μg/L	1	<1		104%	84%
Nickel, Ni	LB074497	μg/L	1	<1	0%	102%	95%
Zinc, Zn	LB074497	μg/L	5	<5	15%	104%	101%

METHOD	METHODOLOGY SUMMARY
AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN135	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN279/AN293	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulphuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH, and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanuate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.
AN311/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320/AN321	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
^	Performed by outside laboratory.	NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

STATEMENT OF QA/QC PERFORMANCE

SE137439 R0

CLIENT DETAILS

Contact	James McMahon	Manager	Huong Crawford
Client	JM ENVIRONMENTS	Laboratory	SGS Alexandria Environmental
Address	37 TOOKE STREET COOKS HILL NSW 2300	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	(Not specified)	Telephone	+61 2 8594 0400
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499
Email	james@jmenvironments.com	Email	au.environmental.sydney@sgs.com
Project	**JME4061**	SGS Reference	SE137439 R0
Order Number	**JME4061**	Report Number	0000106313
Samples	5	Date Reported	27 Mar 2015

LABORATORY DETAILS

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Extraction Date	Alkalinity	5 items
Analysis Date	Alkalinity	7 items
	Total Dissolved Solids (TDS) in water	5 items

SAMPLE SUMMARY

Sample counts by matrix	5 Waters	Type of documentation received	COC
Date documentation received	20/3/2015	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	3.4°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes		

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Alkalinity

Method: ME-AU-ENVAN135

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074499	18 Mar 2015	20 Mar 2015	19 Mar 2015	25 Mar 2015†	19 Mar 2015	25 Mar 2015†
MW2	SE137439.002	LB074499	18 Mar 2015	20 Mar 2015	19 Mar 2015	25 Mar 2015†	19 Mar 2015	25 Mar 2015†
MW3	SE137439.003	LB074499	18 Mar 2015	20 Mar 2015	19 Mar 2015	25 Mar 2015†	19 Mar 2015	25 Mar 2015†
MW4	SE137439.004	LB074499	18 Mar 2015	20 Mar 2015	19 Mar 2015	25 Mar 2015†	19 Mar 2015	25 Mar 2015†
QC4	SE137439.005	LB074499	18 Mar 2015	20 Mar 2015	19 Mar 2015	25 Mar 2015†	19 Mar 2015	25 Mar 2015†

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074363	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW2	SE137439.002	LB074363	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW3	SE137439.003	LB074363	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW4	SE137439.004	LB074363	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
QC4	SE137439.005	LB074363	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015

Anions by Ion Chromatography in Water

Method: ME-AU-ENVAN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074349	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	26 Mar 2015
MW2	SE137439.002	LB074349	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	26 Mar 2015
MW3	SE137439.003	LB074349	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	26 Mar 2015
MW4	SE137439.004	LB074349	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	26 Mar 2015
QC4	SE137439.005	LB074349	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	26 Mar 2015

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074631	18 Mar 2015	20 Mar 2015	15 Apr 2015	27 Mar 2015	15 Apr 2015	27 Mar 2015
MW2	SE137439.002	LB074631	18 Mar 2015	20 Mar 2015	15 Apr 2015	27 Mar 2015	15 Apr 2015	27 Mar 2015
MW3	SE137439.003	LB074631	18 Mar 2015	20 Mar 2015	15 Apr 2015	27 Mar 2015	15 Apr 2015	27 Mar 2015
MW4	SE137439.004	LB074631	18 Mar 2015	20 Mar 2015	15 Apr 2015	27 Mar 2015	15 Apr 2015	27 Mar 2015
QC4	SE137439.005	LB074631	18 Mar 2015	20 Mar 2015	15 Apr 2015	27 Mar 2015	15 Apr 2015	27 Mar 2015

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074375	18 Mar 2015	20 Mar 2015	14 Sep 2015	24 Mar 2015	14 Sep 2015	24 Mar 2015
MW2	SE137439.002	LB074375	18 Mar 2015	20 Mar 2015	14 Sep 2015	24 Mar 2015	14 Sep 2015	24 Mar 2015
MW3	SE137439.003	LB074375	18 Mar 2015	20 Mar 2015	14 Sep 2015	24 Mar 2015	14 Sep 2015	24 Mar 2015
MW4	SE137439.004	LB074375	18 Mar 2015	20 Mar 2015	14 Sep 2015	24 Mar 2015	14 Sep 2015	24 Mar 2015
QC4	SE137439.005	LB074375	18 Mar 2015	20 Mar 2015	14 Sep 2015	24 Mar 2015	14 Sep 2015	24 Mar 2015

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074362	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW2	SE137439.002	LB074362	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW3	SE137439.003	LB074362	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW4	SE137439.004	LB074362	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
QC4	SE137439.005	LB074362	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015

TKN Kjeldahl Digestion by Discrete Analyser

Method: ME-(AU)-[ENV]AN281/AN292

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074301	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	27 Mar 2015
MW2	SE137439.002	LB074301	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	27 Mar 2015
MW3	SE137439.003	LB074301	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	27 Mar 2015
MW4	SE137439.004	LB074301	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	27 Mar 2015
QC4	SE137439.005	LB074301	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	27 Mar 2015

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074525	18 Mar 2015	20 Mar 2015	25 Mar 2015	25 Mar 2015	25 Mar 2015	26 Mar 2015†
MW2	SE137439.002	LB074525	18 Mar 2015	20 Mar 2015	25 Mar 2015	25 Mar 2015	25 Mar 2015	26 Mar 2015†
MW3	SE137439.003	LB074525	18 Mar 2015	20 Mar 2015	25 Mar 2015	25 Mar 2015	25 Mar 2015	26 Mar 2015†
MW4	SE137439.004	LB074525	18 Mar 2015	20 Mar 2015	25 Mar 2015	25 Mar 2015	25 Mar 2015	26 Mar 2015†
QC4	SE137439.005	LB074525	18 Mar 2015	20 Mar 2015	25 Mar 2015	25 Mar 2015	25 Mar 2015	26 Mar 2015†

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Sample Name	Sample No.	QC Ref

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Total Phosphorus by Kjeldahl Digestion DA in Water (continued)

Method: ME-(AU)-[ENV]AN279/AN293

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074302	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW2	SE137439.002	LB074302	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW3	SE137439.003	LB074302	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
MW4	SE137439.004	LB074302	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015
QC4	SE137439.005	LB074302	18 Mar 2015	20 Mar 2015	15 Apr 2015	23 Mar 2015	15 Apr 2015	24 Mar 2015

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE137439.001	LB074497	18 Mar 2015	20 Mar 2015	14 Sep 2015	25 Mar 2015	14 Sep 2015	26 Mar 2015
MW2	SE137439.002	LB074497	18 Mar 2015	20 Mar 2015	14 Sep 2015	25 Mar 2015	14 Sep 2015	26 Mar 2015
MW3	SE137439.003	LB074497	18 Mar 2015	20 Mar 2015	14 Sep 2015	25 Mar 2015	14 Sep 2015	26 Mar 2015
MW4	SE137439.004	LB074497	18 Mar 2015	20 Mar 2015	14 Sep 2015	25 Mar 2015	14 Sep 2015	26 Mar 2015
QC4	SE137439.005	LB074497	18 Mar 2015	20 Mar 2015	14 Sep 2015	25 Mar 2015	14 Sep 2015	26 Mar 2015

SURROGATES

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Alkalinity

Method: ME-AU-ENVAN135

Sample Number	Parameter	Units	LOR	Result
LB074499.001	Total Alkalinity as CaCO3	mg/L	5	<5

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Sample Number	Parameter	Units	LOR	Result
LB074363.001	Ammonia Nitrogen, NH_3 as N	mg/L	0.005	<0.005

Anions by Ion Chromatography in Water

Method: ME-AU-ENVAN245

Sample Number	Parameter	Units	LOR	Result
LB074349.001	Nitrate Nitrogen, NO3-N	mg/L	0.005	<0.005
	Chloride	mg/L	1	<1.0
	Sulphate, SO4	mg/L	1	<1.0

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Sample Number	Parameter	Units	LOR	Result
LB074631.001	Mercury	mg/L	0.0001	<0.0001

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result
LB074375.001	Calcium, Ca	mg/L	0.1	<0.1
	Magnesium, Mg	mg/L	0.1	<0.1
	Potassium, K	mg/L	0.2	<0.2
	Sodium, Na	mg/L	0.1	<0.1

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Sample Number	Parameter	Units	LOR	Result
LB074362.001	Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Number	Parameter	Units	LOR	Result
LB074525.001	Total Dissolved Solids Dried at 175-185°C	mg/L	10	<10

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Sample Number	Parameter	Units	LOR	Result
LB074302.001	Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	<0.01

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB074497.001	Aluminium, Al	µg/L	5	<5
	Arsenic, As	µg/L	1	<1
	Cadmium, Cd	µg/L	0.1	<0.1
	Chromium, Cr	µg/L	1	<1
	Copper, Cu	µg/L	1	<1
	Iron, Fe	µg/L	5	<5
	Lead, Pb	µg/L	1	<1
	Manganese, Mn	µg/L	1	<1
	Nickel, Ni	µg/L	1	<1
	Zinc, Zn	µg/L	5	<5

DUPLICATES

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Alkalinity

Method: ME-AU-ENVAN135

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137403.001	LB074499.004	Total Alkalinity as CaCO3	mg/L	5	340	325.050864	16	5
SE137439.005	LB074499.010	Total Alkalinity as CaCO3	mg/L	5	370	370	16	1

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137439.001	LB074363.004	Ammonia Nitrogen, NH_3 as N	mg/L	0.005	0.013	0.011	101	19

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137439.001	LB074631.006	Mercury	μg/L	0.0001	<0.0001	<0.0001	146	0

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137439.005	LB074375.012	Calcium, Ca	mg/L	0.1	91	92	15	0
		Magnesium, Mg	mg/L	0.1	71	71	15	0
		Potassium, K	mg/L	0.2	2.7	2.7	19	0
		Sodium, Na	mg/L	0.1	350	350	15	0

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137439.001	LB074362.004	Nitrite Nitrogen, NO2 as N	mg/L	0.005	0.030	0.030	32	1

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137439.005	LB074525.010	Total Dissolved Solids Dried at 175-185°C	mg/L	10	1400	1500	16	9

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137354.001	LB074302.007	Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	77	75	15	3

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE137517.004	LB074497.014	Aluminium, Al	μg/L	5	24	25	35	2
		Iron, Fe	μg/L	5	19	17	43	11
SE137526.023	LB074497.024	Arsenic, As	μg/L	1	<1	<1	200	0
		Cadmium, Cd	μg/L	0.1	<0.1	<0.1	200	0
		Chromium, Cr	μg/L	1	<1	<1	200	0
		Copper, Cu	μg/L	1	<1	<1	200	0
		Lead, Pb	μg/L	1	<1	<1	200	0
		Nickel, Ni	μg/L	1	<1	<1	200	0
		Zinc, Zn	μg/L	5	92	79	21	15

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Alkalinity

Method: ME-AU-ENVAN135

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074499.002	Total Alkalinity as CaCO3	mg/L	5	56	59.5	80 - 120	94

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074363.002	Ammonia Nitrogen, NH_3 as N	mg/L	0.005	2.5	2.5	80 - 120	102

Anions by Ion Chromatography in Water

Method: ME-AU-ENVAN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074349.002	Nitrate Nitrogen, NO3-N	mg/L	0.005	1.9	2	80 - 120	97
	Chloride	mg/L	1	18	20	80 - 120	92
	Sulphate, SO4	mg/L	1	19	20	80 - 120	95

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074375.002	Calcium, Ca	mg/L	0.1	2.0	2	80 - 120	101
	Magnesium, Mg	mg/L	0.1	2.0	2	80 - 120	100
	Potassium, K	mg/L	0.2	19	20	80 - 120	97
	Sodium, Na	mg/L	0.1	2.3	2	80 - 120	115

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074362.002	Nitrite Nitrogen, NO2 as N	mg/L	0.005	0.22	0.2	85 - 115	109

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074525.002	Total Dissolved Solids Dried at 175-185°C	mg/L	10	330	293	80 - 120	112

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074302.002	Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	1.2	1	80 - 120	118

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB074497.002	Aluminium, Al	µg/L	5	21	20	80 - 120	107
	Arsenic, As	µg/L	1	20	20	80 - 120	100
	Cadmium, Cd	µg/L	0.1	20	20	80 - 120	102
	Chromium, Cr	µg/L	1	19	20	80 - 120	97
	Copper, Cu	µg/L	1	21	20	80 - 120	104
	Iron, Fe	µg/L	5	21	20	80 - 120	107
	Lead, Pb	µg/L	1	21	20	80 - 120	105
	Manganese, Mn	µg/L	1	21	20	80 - 120	104
	Nickel, Ni	µg/L	1	20	20	80 - 120	102
	Zinc, Zn	µg/L	5	21	20	80 - 120	104

MATRIX SPIKES

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE137354.002	LB074302.009	Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	1.9	0.86	1	104

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE137439.001	LB074497.004	Aluminium, Al	µg/L	5	27	7	20	103
		Arsenic, As	µg/L	1	22	<1	20	106
		Cadmium, Cd	µg/L	0.1	21	<0.1	20	105
		Chromium, Cr	µg/L	1	19	<1	20	95
		Copper, Cu	µg/L	1	21	2	20	97
		Iron, Fe	µg/L	5	28	9	20	95
		Lead, Pb	µg/L	1	20	<1	20	100
		Manganese, Mn	µg/L	1	340	320	20	84
		Nickel, Ni	µg/L	1	25	6	20	95
		Zinc, Zn	µg/L	5	33	12	20	101

MATRIX SPIKE DUPLICATES

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

FOOTNOTES

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

*	Non-accredited analysis.
-	Sample not analysed for this analyte.
^	Analysis performed by external laboratory.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Sample Date: ~~11~~16/8/16

Page 1 of 1

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name: JM Environments
Address: 37 Tooke St
Cooks Hill NSW 2300
Contact Name: James McMahon

Project Name/No: JME4061
Purchase Order No: JME4061
Results Required By: std
Telephone: 0427 893 668
Email: james@jmenvironments.com

Client Sample ID	Lab Sample ID	WATER	SOIL	PRESERVATIVE	NO OF CONTAINERS	Total dissolved solids	Nutrients	Major Cations	Major Anions	Alkalinity	Dissolved metals
MW1	1	x				x	x	x	x	x	x
MW2	2	x				x	x	x	x	x	x
MW3	3	x				x	x	x	x	x	x
MW4	4	x				x	x	x	x	x	x
QC6	5	x				x	x	x	x	x	x

SGS Alexandria Environmental
SE156039 COC
Received: 17-Aug-2016

Relinquished By: J. McMahon	Date/Time:11/8/2015 4pm	Received By:TNT	Date/Time 11/8/2015 4pm
Relinquished By:	Date/Time:	Received By:	Date/Time 17/08/16 @ 10·50
Samples Intact: [✓ Yes]/ No	Temperature: Ambient / [✓ Chilled]	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No: ENVI126319

Sample Date: ~~18/3/2015~~
14/6/16

Comments:

Nutrients = Ammonia, nitrate, nitrite, total nitrogen, total phosphorous.

Dissolved Metals = Al, As, Cr, Cd, Cu, Fe, Hg, Mn, Ni, Pb, Zn
Please filter

Major Ions = Ca, Mg, Na, K, Cl, CO_3^{2-}, HCO_3^-, SO_4^{2-}

ICE 4.2°C 10:50am

SAMPLE RECEIPT ADVICE

SE156039

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	5

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Wed 17/8/2016
Report Due	Wed 24/8/2016
SGS Reference	**SE156039**

SUBMISSION DETAILS

This is to confirm that 5 samples were received on Wednesday 17/8/2016. Results are expected to be ready by Wednesday 24/8/2016. Please quote SGS reference SE156039 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	5 Water	Type of documentation received	COC
Date documentation received	17/8/2016	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	4.2°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice	Samples clearly labelled	Yes
Complete documentation received	Yes		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client JM ENVIRONMENTS
Project JME4061

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Anions by Ion Chromatography in Water	Mercury (dissolved) in Water	Metals in Water (Dissolved) by ICPOES	Nitrite in Water	TKN Kjeldahl Digestion by Discrete Analyser	Total Dissolved Solids (TDS) in water	Total Phosphorus by Kjeldahl Digestion DA in	Trace Metals (Dissolved) in Water by ICPMS
001	MW1	3	1	3	1	4	1	2	1	1	10
002	MW2	3	1	3	1	4	1	2	1	1	10
003	MW3	3	1	3	1	4	1	2	1	1	10
004	MW4	3	1	3	1	4	1	2	1	1	10
005	QC6	3	1	3	1	4	1	2	1	1	10

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	James McMahon	Manager	Huong Crawford
Client	JM ENVIRONMENTS	Laboratory	SGS Alexandria Environmental
Address	37 TOOKE STREET COOKS HILL NSW 2300	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	(Not specified)	Telephone	+61 2 8594 0400
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499
Email	james@jmenvironments.com	Email	au.environmental.sydney@sgs.com
Project	**JME4061**	SGS Reference	**SE156039 R0**
Order Number	**JME4061**	Date Received	17 Aug 2016
Samples	5	Date Reported	24 Aug 2016

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES

Bennet Lo
Senior Organic Chemist/Metals Chemis

Dong Liang
Metals/Inorganics Team Leader

Huong Crawford
Production Manager

Kamrul Ahsan
Senior Chemist

		Sample Number	SE156039.001	SE156039.002	SE156039.003	SE156039.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	16 Aug 2016	16 Aug 2016	16 Aug 2016	16 Aug 2016
		Sample Name	MW1	MW2	MW3	MW4
Parameter	Units	LOR				

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 23/8/2016

Parameter	Units	LOR	MW1	MW2	MW3	MW4
Total Dissolved Solids Dried at 175-185°C	mg/L	10	550	1400	1900	1400

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 18/8/2016

Parameter	Units	LOR	MW1	MW2	MW3	MW4
Ammonia Nitrogen, NH_3 as N	mg/L	0.01	0.01	0.01	0.11	<0.01

Anions by Ion Chromatography in Water Method: AN245 Tested: 19/8/2016

Parameter	Units	LOR	MW1	MW2	MW3	MW4
Chloride	mg/L	1	96	410	740	470
Nitrate Nitrogen, NO3-N	mg/L	0.005	6.8	0.17	<0.005	38
Sulphate, SO4	mg/L	1	40	190	140	80

Nitrite in Water Method: AN277/WC250.312 Tested: 18/8/2016

Parameter	Units	LOR	MW1	MW2	MW3	MW4
Nitrite Nitrogen, NO2 as N	mg/L	0.005	0.016	<0.005	<0.005	0.82

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281/AN292 Tested: 23/8/2016

Parameter	Units	LOR	MW1	MW2	MW3	MW4
Total Kjeldahl Nitrogen	mg/L	0.05	0.27	0.30	0.42	0.29
Total Nitrogen (calc)	mg/L	0.05	7.0	0.47	0.42	39

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293 Tested: 23/8/2016

Parameter	Units	LOR	MW1	MW2	MW3	MW4
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	0.05	0.01	0.07	0.26

		Sample Number	SE156039.001	SE156039.002	SE156039.003	SE156039.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	16 Aug 2016	16 Aug 2016	16 Aug 2016	16 Aug 2016
		Sample Name	MW1	MW2	MW3	MW4
Parameter	**Units**	**LOR**				

Alkalinity Method: AN135 Tested: 17/8/2016

Bicarbonate Alkalinity as HCO3	mg/L	5	300	460	670	230
Carbonate Alkalinity as CO3	mg/L	1	<1	<1	<1	<1
Total Alkalinity as CaCO3	mg/L	5	250	380	550	190

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 24/8/2016

Calcium, Ca	mg/L	0.2	14	76	180	130
Magnesium, Mg	mg/L	0.1	12	59	96	39
Potassium, K	mg/L	0.1	0.6	2.6	2.5	1.0
Sodium, Na	mg/L	0.5	180	340	400	290

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 22/8/2016

Aluminium, Al	μg/L	5	<5	<5	<5	<5
Arsenic, As	μg/L	1	1	<1	<1	1
Cadmium, Cd	μg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chromium, Cr	μg/L	1	<1	<1	<1	<1
Copper, Cu	μg/L	1	7	3	2	<1
Iron, Fe	μg/L	5	<5	<5	10	<5
Lead, Pb	μg/L	1	<1	<1	<1	<1
Manganese, Mn	μg/L	1	10	480	540	62
Nickel, Ni	μg/L	1	15	7	46	4
Zinc, Zn	μg/L	5	12	36	10	8

Mercury (dissolved) in Water Method: AN311(Perth)/AN312 Tested: 22/8/2016

Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

		Sample Number	SE156039.005
		Sample Matrix	Water
		Sample Date	16 Aug 2016
		Sample Name	QC6
Parameter	**Units**	**LOR**	

Total Dissolved Solids (TDS) in water   Method: AN113   Tested: 23/8/2016

Total Dissolved Solids Dried at 175-185°C	mg/L	10	1400

Ammonia Nitrogen by Discrete Analyser (Aquakem)   Method: AN291   Tested: 18/8/2016

Ammonia Nitrogen, NH_3 as N	mg/L	0.01	<0.01

Anions by Ion Chromatography in Water   Method: AN245   Tested: 19/8/2016

Chloride	mg/L	1	410
Nitrate Nitrogen, NO3-N	mg/L	0.005	0.17
Sulphate, SO4	mg/L	1	190

Nitrite in Water   Method: AN277/WC250.312   Tested: 18/8/2016

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser   Method: AN281/AN292   Tested: 23/8/2016

Total Kjeldahl Nitrogen	mg/L	0.05	0.30
Total Nitrogen (calc)	mg/L	0.05	0.47

Total Phosphorus by Kjeldahl Digestion DA in Water   Method: AN279/AN293   Tested: 23/8/2016

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	<0.01

Parameter	Units	LOR	Sample Number: SE156039.005 Sample Matrix: Water Sample Date: 16 Aug 2016 Sample Name: QC6

Alkalinity Method: AN135 Tested: 17/8/2016

Parameter	Units	LOR	SE156039.005
Bicarbonate Alkalinity as HCO3	mg/L	5	**470**
Carbonate Alkalinity as CO3	mg/L	1	<1
Total Alkalinity as CaCO3	mg/L	5	**390**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 24/8/2016

Parameter	Units	LOR	SE156039.005
Calcium, Ca	mg/L	0.2	**76**
Magnesium, Mg	mg/L	0.1	**59**
Potassium, K	mg/L	0.1	**2.5**
Sodium, Na	mg/L	0.5	**330**

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 22/8/2016

Parameter	Units	LOR	SE156039.005
Aluminium, Al	μg/L	5	<5
Arsenic, As	μg/L	1	<1
Cadmium, Cd	μg/L	0.1	<0.1
Chromium, Cr	μg/L	1	<1
Copper, Cu	μg/L	1	**3**
Iron, Fe	μg/L	5	<5
Lead, Pb	μg/L	1	<1
Manganese, Mn	μg/L	1	**630**
Nickel, Ni	μg/L	1	**7**
Zinc, Zn	μg/L	5	**33**

Mercury (dissolved) in Water Method: AN311(Perth)/AN312 Tested: 22/8/2016

Parameter	Units	LOR	SE156039.005
Mercury	mg/L	0.0001	<0.0001

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Bicarbonate Alkalinity as HCO3	LB108258	mg/L	5	<5		
Carbonate Alkalinity as CO3	LB108258	mg/L	1	<1		
Total Alkalinity as CaCO3	LB108258	mg/L	5	<5	0 - 1%	99%

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: ME-(AU)-[ENV]AN291

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH_3 as N	LB107931	mg/L	0.01	<0.01	21%	93%

Anions by Ion Chromatography in Water Method: ME-(AU)-[ENV]AN245

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride	LB107991	mg/L	1	<1.0	1%	92%
Nitrate Nitrogen, NO3-N	LB107991	mg/L	0.005	<0.005	0 - 9%	98%
Sulphate, SO4	LB107991	mg/L	1	<1.0	0%	96%

Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB108115	mg/L	0.0001	<0.0001	0%	98%	95%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320/AN321

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery	MS %Recovery
Calcium, Ca	LB108286	mg/L	0.2	<0.2	105%	135%
Magnesium, Mg	LB108286	mg/L	0.1	<0.1	99%	117%
Potassium, K	LB108286	mg/L	0.1	<0.1	97%	149%
Sodium, Na	LB108286	mg/L	0.5	<0.5	106%	117%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Nitrite in Water Method: ME-(AU)-[ENV]AN277/WC250.312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB107931	mg/L	0.005	<0.005	0%	97%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB108190	mg/L	10	<10	6%	92%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB108214	mg/L	0.01	<0.01	3%	108%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB108074	µg/L	5	<5		112%	109%
Arsenic, As	LB108074	µg/L	1	<1	0%	106%	118%
Cadmium, Cd	LB108074	µg/L	0.1	<0.1	0%	110%	113%
Chromium, Cr	LB108074	µg/L	1	<1	0%	115%	109%
Copper, Cu	LB108074	µg/L	1	<1	0%	117%	108%
Iron, Fe	LB108074	µg/L	5	<5		114%	110%
Lead, Pb	LB108074	µg/L	1	<1	0%	113%	110%
Manganese, Mn	LB108074	µg/L	1	<1		111%	106%
Nickel, Ni	LB108074	µg/L	1	<1	0 - 7%	115%	104%
Zinc, Zn	LB108074	µg/L	5	<5	0 - 1%	113%	112%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN279/AN293	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH, and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanuate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320/AN321	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full.

STATEMENT OF QA/QC PERFORMANCE

SE156039 R0

CLIENT DETAILS

Contact	James McMahon
Client	JM ENVIRONMENTS
Address	37 TOOKE STREET COOKS HILL NSW 2300
Telephone	(Not specified)
Facsimile	(Not specified)
Email	james@jmenvironments.com
Project	**JME4061**
Order Number	**JME4061**
Samples	5

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE156039 R0**
Date Received	17 Aug 2016
Date Reported	24 Aug 2016

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Matrix Spike	Metals in Water (Dissolved) by ICPOES	2 items

SAMPLE SUMMARY

Sample counts by matrix	5 Water	Type of documentation received	COC
Date documentation received	17/8/2016	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	4.2°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice	Samples clearly labelled	Yes
Complete documentation received	Yes		

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB108258	16 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016
MW2	SE156039.002	LB108258	16 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016
MW3	SE156039.003	LB108258	16 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016
MW4	SE156039.004	LB108258	16 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016
QC6	SE156039.005	LB108258	16 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016	17 Aug 2016

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB107931	16 Aug 2016	17 Aug 2016	13 Sep 2016	18 Aug 2016	13 Sep 2016	18 Aug 2016
MW2	SE156039.002	LB107931	16 Aug 2016	17 Aug 2016	13 Sep 2016	18 Aug 2016	13 Sep 2016	18 Aug 2016
MW3	SE156039.003	LB107931	16 Aug 2016	17 Aug 2016	13 Sep 2016	18 Aug 2016	13 Sep 2016	18 Aug 2016
MW4	SE156039.004	LB107931	16 Aug 2016	17 Aug 2016	13 Sep 2016	18 Aug 2016	13 Sep 2016	18 Aug 2016
QC6	SE156039.005	LB107931	16 Aug 2016	17 Aug 2016	13 Sep 2016	18 Aug 2016	13 Sep 2016	18 Aug 2016

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB107991	16 Aug 2016	17 Aug 2016	13 Sep 2016	19 Aug 2016	13 Sep 2016	24 Aug 2016
MW2	SE156039.002	LB107991	16 Aug 2016	17 Aug 2016	13 Sep 2016	19 Aug 2016	13 Sep 2016	24 Aug 2016
MW3	SE156039.003	LB107991	16 Aug 2016	17 Aug 2016	13 Sep 2016	19 Aug 2016	13 Sep 2016	24 Aug 2016
MW4	SE156039.004	LB107991	16 Aug 2016	17 Aug 2016	13 Sep 2016	19 Aug 2016	13 Sep 2016	24 Aug 2016
QC6	SE156039.005	LB107991	16 Aug 2016	17 Aug 2016	13 Sep 2016	19 Aug 2016	13 Sep 2016	24 Aug 2016

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB108115	16 Aug 2016	17 Aug 2016	13 Sep 2016	22 Aug 2016	13 Sep 2016	23 Aug 2016
MW2	SE156039.002	LB108115	16 Aug 2016	17 Aug 2016	13 Sep 2016	22 Aug 2016	13 Sep 2016	23 Aug 2016
MW3	SE156039.003	LB108115	16 Aug 2016	17 Aug 2016	13 Sep 2016	22 Aug 2016	13 Sep 2016	23 Aug 2016
MW4	SE156039.004	LB108115	16 Aug 2016	17 Aug 2016	13 Sep 2016	22 Aug 2016	13 Sep 2016	23 Aug 2016
QC6	SE156039.005	LB108115	16 Aug 2016	17 Aug 2016	13 Sep 2016	22 Aug 2016	13 Sep 2016	23 Aug 2016

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB108286	16 Aug 2016	17 Aug 2016	12 Feb 2017	24 Aug 2016	12 Feb 2017	24 Aug 2016
MW2	SE156039.002	LB108286	16 Aug 2016	17 Aug 2016	12 Feb 2017	24 Aug 2016	12 Feb 2017	24 Aug 2016
MW3	SE156039.003	LB108286	16 Aug 2016	17 Aug 2016	12 Feb 2017	24 Aug 2016	12 Feb 2017	24 Aug 2016
MW4	SE156039.004	LB108286	16 Aug 2016	17 Aug 2016	12 Feb 2017	24 Aug 2016	12 Feb 2017	24 Aug 2016
QC6	SE156039.005	LB108286	16 Aug 2016	17 Aug 2016	12 Feb 2017	24 Aug 2016	12 Feb 2017	24 Aug 2016

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB107931	16 Aug 2016	17 Aug 2016	20 Aug 2016	18 Aug 2016	20 Aug 2016	18 Aug 2016
MW2	SE156039.002	LB107931	16 Aug 2016	17 Aug 2016	20 Aug 2016	18 Aug 2016	20 Aug 2016	18 Aug 2016
MW3	SE156039.003	LB107931	16 Aug 2016	17 Aug 2016	20 Aug 2016	18 Aug 2016	20 Aug 2016	18 Aug 2016
MW4	SE156039.004	LB107931	16 Aug 2016	17 Aug 2016	20 Aug 2016	18 Aug 2016	20 Aug 2016	18 Aug 2016
QC6	SE156039.005	LB107931	16 Aug 2016	17 Aug 2016	20 Aug 2016	18 Aug 2016	20 Aug 2016	18 Aug 2016

TKN Kjeldahl Digestion by Discrete Analyser

Method: ME-(AU)-[ENV]AN281/AN292

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	24 Aug 2016
MW2	SE156039.002	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	24 Aug 2016
MW3	SE156039.003	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	24 Aug 2016
MW4	SE156039.004	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	24 Aug 2016
QC6	SE156039.005	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	24 Aug 2016

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB108190	16 Aug 2016	17 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016
MW2	SE156039.002	LB108190	16 Aug 2016	17 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016
MW3	SE156039.003	LB108190	16 Aug 2016	17 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016
MW4	SE156039.004	LB108190	16 Aug 2016	17 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016
QC6	SE156039.005	LB108190	16 Aug 2016	17 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016	23 Aug 2016

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Sample Name	Sample No.	QC Ref

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Total Phosphorus by Kjeldahl Digestion DA in Water (continued) Method: ME-(AU)-[ENV]AN279/AN293

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	23 Aug 2016
MW2	SE156039.002	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	23 Aug 2016
MW3	SE156039.003	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	23 Aug 2016
MW4	SE156039.004	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	23 Aug 2016
QC6	SE156039.005	LB108214	16 Aug 2016	17 Aug 2016	13 Sep 2016	23 Aug 2016	13 Sep 2016	23 Aug 2016

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
MW1	SE156039.001	LB108074	16 Aug 2016	17 Aug 2016	12 Feb 2017	22 Aug 2016	12 Feb 2017	22 Aug 2016
MW2	SE156039.002	LB108074	16 Aug 2016	17 Aug 2016	12 Feb 2017	22 Aug 2016	12 Feb 2017	22 Aug 2016
MW3	SE156039.003	LB108074	16 Aug 2016	17 Aug 2016	12 Feb 2017	22 Aug 2016	12 Feb 2017	22 Aug 2016
MW4	SE156039.004	LB108074	16 Aug 2016	17 Aug 2016	12 Feb 2017	22 Aug 2016	12 Feb 2017	22 Aug 2016
QC6	SE156039.005	LB108074	16 Aug 2016	17 Aug 2016	12 Feb 2017	22 Aug 2016	12 Feb 2017	22 Aug 2016

SURROGATES

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Sample Number	Parameter	Units	LOR	Result
LB108258.001	Total Alkalinity as CaCO3	mg/L	5	<5

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Sample Number	Parameter	Units	LOR	Result
LB107931.001	Ammonia Nitrogen, NH_3 as N	mg/L	0.01	<0.01

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result
LB107991.001	Chloride	mg/L	1	<1.0
	Nitrate Nitrogen, NO3-N	mg/L	0.005	<0.005
	Sulphate, SO4	mg/L	1	<1.0

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Number	Parameter	Units	LOR	Result
LB108115.001	Mercury	mg/L	0.0001	<0.0001

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result
LB108286.001	Calcium, Ca	mg/L	0.2	<0.2
	Magnesium, Mg	mg/L	0.1	<0.1
	Potassium, K	mg/L	0.1	<0.1
	Sodium, Na	mg/L	0.5	<0.5

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Sample Number	Parameter	Units	LOR	Result
LB107931.001	Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Number	Parameter	Units	LOR	Result
LB108190.001	Total Dissolved Solids Dried at 175-185°C	mg/L	10	<10

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Sample Number	Parameter	Units	LOR	Result
LB108214.001	Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	<0.01

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB108074.001	Aluminium, Al	µg/L	5	<5
	Arsenic, As	µg/L	1	<1
	Cadmium, Cd	µg/L	0.1	<0.1
	Chromium, Cr	µg/L	1	<1
	Copper, Cu	µg/L	1	<1
	Iron, Fe	µg/L	5	<5
	Lead, Pb	µg/L	1	<1
	Manganese, Mn	µg/L	1	<1
	Nickel, Ni	µg/L	1	<1
	Zinc, Zn	µg/L	5	<5

DUPLICATES

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE156092.007	LB108258.013	Total Alkalinity as CaCO3	mg/L	5	531.52128	533.61624	16	0
SE156092.010	LB108258.017	Total Alkalinity as CaCO3	mg/L	5	552.86992	547.98168	16	1

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE156016.006	LB107931.015	Ammonia Nitrogen, NH_3 as N	mg/L	0.01	0.02	0.03	55	21

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE156016.007	LB107991.013	Nitrate Nitrogen, NO3-N	mg/L	0.005	0.024	0.022	37	9
SE156039.005	LB107991.020	Chloride	mg/L	1	410	410	15	1
		Nitrate Nitrogen, NO3-N	mg/L	0.005	0.17	0.17	18	0
		Sulphate, SO4	mg/L	1	190	190	16	0

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE156098.004	LB108115.014	Mercury	μg/L	0.0001	-0.015	-0.0098	200	0
SE156123.048	LB108115.024	Mercury	μg/L	0.0001	-0.0134	-0.0124	200	0

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE155993.001	LB107931.004	Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	200	0
SE156016.006	LB107931.015	Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	200	0

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE156039.005	LB108190.009	Total Dissolved Solids Dried at 175-185°C	mg/L	10	1400	1400	16	6

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE156038.001	LB108214.014	Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	9.56008	9.86248	15	3

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE156098.002	LB108074.014	Arsenic, As	μg/L	1	4.944	4.946	35	0
		Cadmium, Cd	μg/L	0.1	0.009	0.008	200	0
		Chromium, Cr	μg/L	1	0.164	0.14	200	0
		Copper, Cu	μg/L	1	0.507	0.522	200	0
		Lead, Pb	μg/L	1	0.218	0.224	200	0
		Nickel, Ni	μg/L	1	1.354	1.265	91	7
		Zinc, Zn	μg/L	5	254.978	256.987	17	1
SE156116.021	LB108074.019	Arsenic, As	μg/L	1	<1	0.013	200	0
		Cadmium, Cd	μg/L	0.1	<0.1	0	200	0
		Chromium, Cr	μg/L	1	<1	-0.033	200	0
		Copper, Cu	μg/L	1	<1	0.02	200	0
		Lead, Pb	μg/L	1	<1	0.002	200	0
		Nickel, Ni	μg/L	1	<1	0.023	200	0
		Zinc, Zn	μg/L	5	<5	0.189	200	0

LABORATORY CONTROL SAMPLES

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB108258.002	Total Alkalinity as CaCO3	mg/L	5	59	59.5	76 - 124	99

Ammonia Nitrogen by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN291

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB107931.002	Ammonia Nitrogen, NH_3 as N	mg/L	0.01	2.3	2.5	80 - 120	93

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB107991.002	Chloride	mg/L	1	18	20	80 - 120	92
	Nitrate Nitrogen, NO3-N	mg/L	0.005	2.0	2	80 - 120	98
	Sulphate, SO4	mg/L	1	19	20	80 - 120	96

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB108286.002	Calcium, Ca	mg/L	0.2	2.1	2	80 - 120	105
	Magnesium, Mg	mg/L	0.1	2.0	2	80 - 120	99
	Potassium, K	mg/L	0.1	19	20	80 - 120	97
	Sodium, Na	mg/L	0.5	2.1	2	80 - 120	106

Nitrite in Water

Method: ME-(AU)-[ENV]AN277/WC250.312

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB107931.002	Nitrite Nitrogen, NO2 as N	mg/L	0.005	0.19	0.2	85 - 115	97

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB108190.002	Total Dissolved Solids Dried at 175-185°C	mg/L	10	270	293	81 - 119	92

Total Phosphorus by Kjeldahl Digestion DA in Water

Method: ME-(AU)-[ENV]AN279/AN293

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB108214.002	Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	1.1	1	80 - 120	108

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB108074.002	Aluminium, Al	µg/L	5	22	20	80 - 120	112
	Arsenic, As	µg/L	1	21	20	80 - 120	106
	Cadmium, Cd	µg/L	0.1	22	20	80 - 120	110
	Chromium, Cr	µg/L	1	23	20	80 - 120	115
	Copper, Cu	µg/L	1	23	20	80 - 120	117
	Iron, Fe	µg/L	5	23	20	80 - 120	114
	Lead, Pb	µg/L	1	23	20	80 - 120	113
	Manganese, Mn	µg/L	1	22	20	80 - 120	111
	Nickel, Ni	µg/L	1	23	20	80 - 120	115
	Zinc, Zn	µg/L	5	23	20	80 - 120	113

MATRIX SPIKES

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE156039.001	LB108115.004	Mercury	mg/L	0.0001	0.0076	<0.0001	0.008	95

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE156039.001	LB108286.004	Calcium, Ca	mg/L	0.2	84	14	52	135 ④
		Magnesium, Mg	mg/L	0.1	73	12	52	117
		Potassium, K	mg/L	0.1	78	0.6	52	149 ④
		Sodium, Na	mg/L	0.5	240	180	52	117

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE156039.001	LB108074.004	Aluminium, Al	µg/L	5	27	<5	20	109
		Arsenic, As	µg/L	1	25	1	20	118
		Cadmium, Cd	µg/L	0.1	23	<0.1	20	113
		Chromium, Cr	µg/L	1	22	<1	20	109
		Copper, Cu	µg/L	1	28	7	20	108
		Iron, Fe	µg/L	5	23	<5	20	110
		Lead, Pb	µg/L	1	22	<1	20	110
		Manganese, Mn	µg/L	1	31	10	20	106
		Nickel, Ni	µg/L	1	36	15	20	104
		Zinc, Zn	µg/L	5	34	12	20	112

MATRIX SPIKE DUPLICATES

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

FOOTNOTES

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover tthe performance of this service.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

Appendix B

Sediment and Erosion Blue Book Calculation Summary

1. Erosion Hazard and Sediment Basins

Site Name: **Martins Creek Quarry**

Site Location:

Precinct/Stage:

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	Year 5	Year 10	Current	west pit			
Total catchment area (ha)	38.4	90.7	13	69.3		38.4	
Disturbed catchment area (ha)	6.7	17	13	45.9		6.7	

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D	D		D	From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D	D		D	Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	2	5	5	5		5	See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	95	95	95	95		90	
x-day, y-percentile rainfall event (mm)	63	63	63	63		51.8	
Rainfall R-factor (if known)	2250	2250	2250	2250			Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)						10.3	

RUSLE Factors

Rainfall erosivity (*R* -factor)	2250	2250	2250	2250		2330	Auto-filled from above
Soil erodibility (*K* -factor)	0.03	0.03	0.05	0.05		0.04	RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	50	150	228	275		200	
Slope gradient (%)	13	13	8	35		35	
Length/gradient (*LS* -factor)	2.97	6.51	4.05	36.56		28.30	
Erosion control practice (*P* -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C* -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.79	0.79	0.79	0.79		0.63	See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	260	572	593	5347		3429	
Soil Loss Class	3	5	5	7		7	See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	200	440	456	4113		2638	Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	224	1246	988	31467		2946	See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	19112	45141	6470	34491		12531	See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	19336	46387	7458	65958		15477	

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

Appendix C

Groundwater Licence

NSW
GOVERNMENT

Department of
Primary Industries
Water

Contact: Hannah Grogan
Phone: 02 4904 2516
Fax: 02 4904 2503
Email: Hannah.grogan@dpi.nsw.gov.au

Hunter Industrial Rental Equipment Pty Limited
37 Tooke Street
Cooks Hill NSW 2300

29 January 2016

Dear Sir/Madam

Subject: Groundwater Licences under Part 5 of the Water Act 1912.

Please find enclosed groundwater licence 20BL173933. Your attention is drawn to the nature and description of the work, terms, limitations and conditions under which the licences are issued.

Please be advised that an annual water charge including a base charge and entitlement charge will apply to this licence. These charges are determined by the Independent Pricing & Regulatory Tribunal. This charge is administered by State Water and an account is issued for the period of 1 July to 30 June each year.

If you have any further questions in relation to this matter, please do not hesitate to the undersigned on 4904 2516.

Yours sincerely

Hannah Grogan
Water Regulation Officer
DPI Water

NSW Office of Water

Hunter Region
Po Box 2213
3/26 Honeysuckle Drive
Dangar NSW 2309
Phone: (02) 49042500

BORE LICENSE CERTIFICATE
UNDER SECTION 115 OF THE WATER ACT, 1912

20BL173933

Department of Primary Industries
Office of Water

Hunter Industrial Rental Equipment Pty Limited
37 Tooke Street
Cooks Hill NSW 2300

LICENSE NUMBER	
20BL173933	
DATE LICENSE VALID FROM	
29-Jan-2016	
DATE LICENSE VALID TO	
28-Jan-2021	
FEE	
$151.00	PAID

ABN 72189919072 GST NIL

LOCATION OF WORKS

Portion(s) or Lot/Section/DP	PARISH	COUNTY
6//242210	Barford	Durham

TYPE OF WORKS	PURPOSE(S) FOR WHICH WATER MAY BE USED
Excavation	Industrial Dewatering (groundwater)

CONDITIONS APPLYING TO THIS LICENSE ARE

As shown on the attached Condition Statement

20BL173933

NSW Office of Water

CONDITIONS STATEMENT REFERRED TO ON
20BL173933
ISSUED UNDER PART V OF THE WATER ACT, 1912
ON 29-Jan-2016

(1) THE LICENSEE SHALL NOT ALLOW ANY TAILWATER/DRAINAGE TO DISCHARGE FROM THE LICENSEE'S PROPERTY INTO OR ONTO:-

- ANY ADJOINING PUBLIC OR CROWN ROAD;
- ANY OTHER PERSONS LAND;
- ANY CROWN LAND;
- ANY RIVER, CREEK OR WATERCOURSE;
- ANY GROUNDWATER AQUIFER;
- ANY NATIVE VEGETATION AS DESCRIBED UNDER THE NATIVE VEGETATION CONSERVATION ACT 1997;
- ANY WETLANDS OF ENVIRONMENTAL SIGNIFICANCE.

(2) WORKS USED FOR THE PURPOSE OF CONVEYING, DISTRIBUTING OR STORING WATER TAKEN BY MEANS OF THE LICENSED WORK SHALL NOT BE CONSTRUCTED OR INSTALLED SO AS TO OBSTRUCT THE REASONABLE PASSAGE OF FLOOD WATERS FLOWING INTO OR FROM A RIVER.

(3) LOCATION OF LAND ON WHICH WATER MAY BE USED:-

LOT/DP: 6//242210
PARISH : BARDFORD
COUNTY : DURHAM

(4) THE VOLUME OF GROUNDWATER EXTRACTED FROM THE WORKS AUTHORISED BY THIS LICENCE SHALL NOT EXCEED 33 MEGALITRES IN ANY 12 MONTH PERIOD COMMENCING 1ST JULY.

(5) AN EXTRACTION MEASUREMENT DEVICE MUST BE INSTALLED AND MAINTAINED ON EACH EXTRACTION DEVICE (PUMP) USED FOR EXTRACTION OF WATER UNDER THIS LICENCE, AND SUCH DEVICES MUST BE OF A TYPE AND STANDARD, AND MUST BE MAINTAINED IN A MANNER, WHICH IS ACCEPTABLE TO DPI WATER.

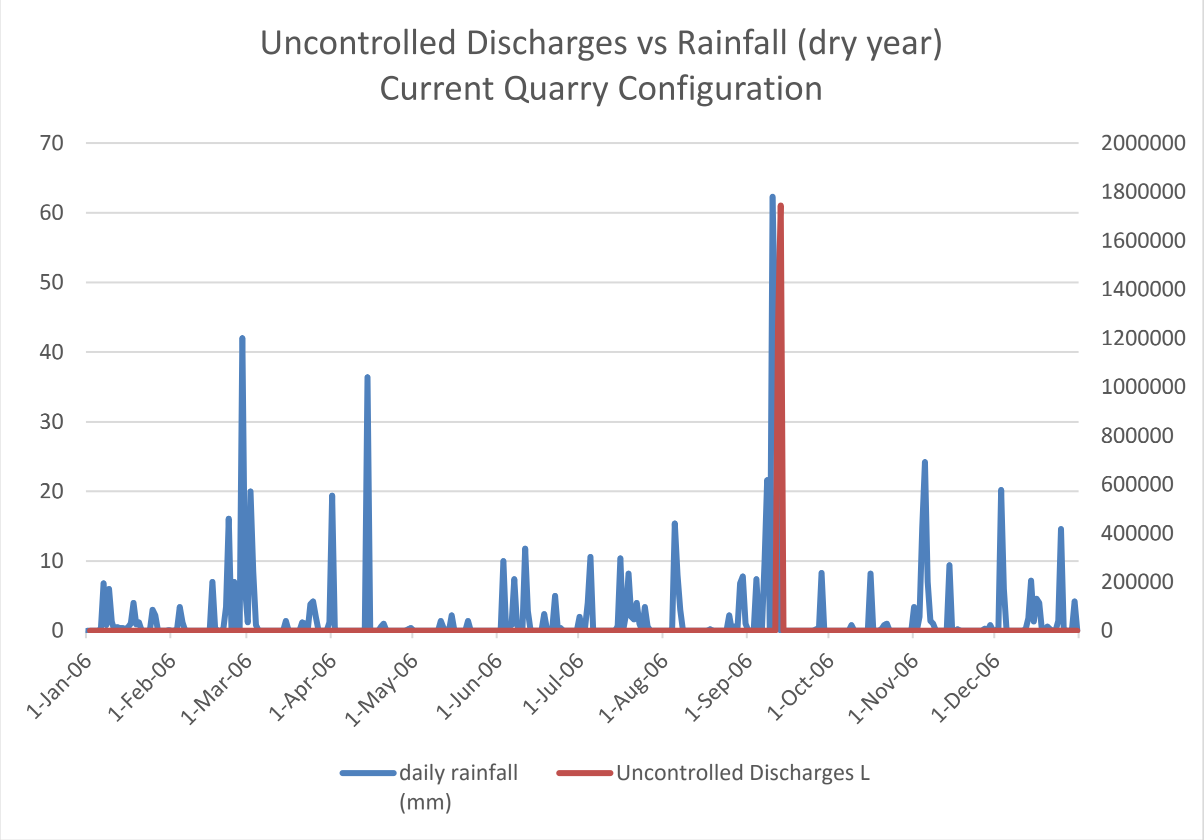
(6) DPI WATER SHALL HAVE THE RIGHT DURING THE CURRENCY OF THIS LICENSE TO VARY AT ANY TIME THE VOLUMETRIC ALLOCATION, OR THE RATE AT WHICH THIS ALLOCATION IS TAKEN.

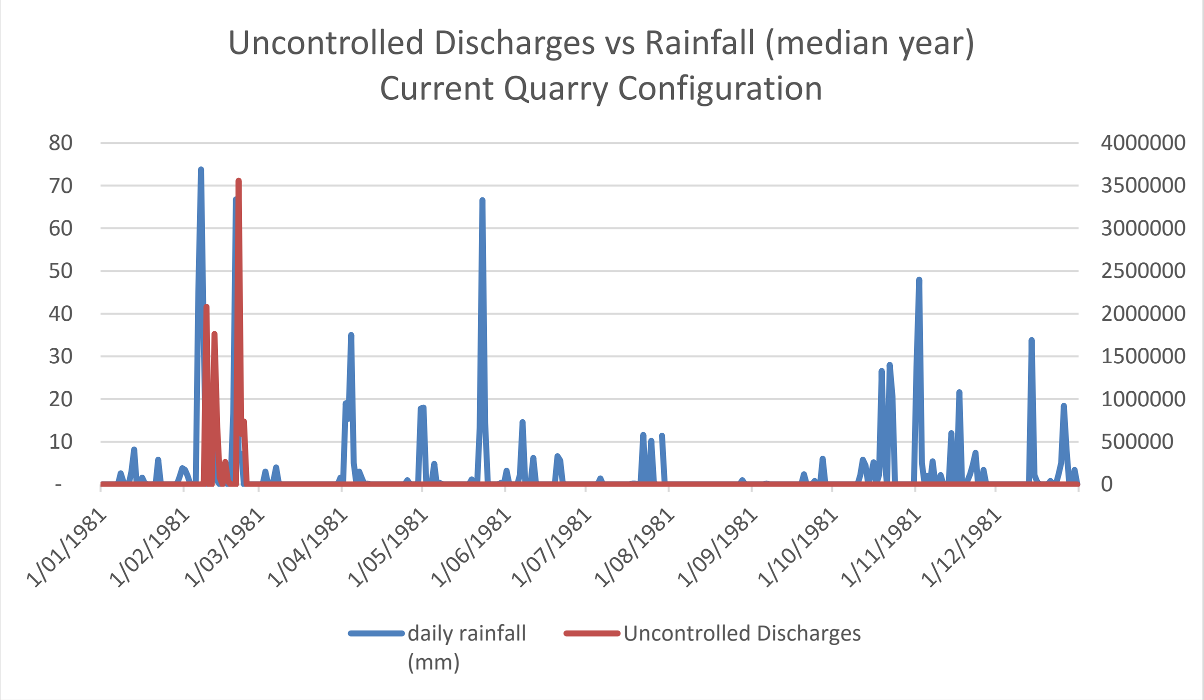
(7) THE LICENCE HOLDER MUST REPORT IN AN ANNUAL REPORT:
I) THE MONITORING RESULTS OF ANY GROUNDWATER MONITORING WITH RESPECT TO THIS LICENCE;
II) AN ASSESSMENT OF COMPLIANCE WITH THE CONDITIONS OF THIS LICENCE,
III) A SUMMARY OF NEW BORES OR PITS CONSTRUCTED DURING THE YEAR;
IV) THE TREND GRAPHS FOR MONITORING DATA COLLECTED FOR EACH BORE ASSOCIATED WITH THE LICENSED SITE;
V) A RECORD OF WATER EXTRACTION FOR THE REPORTING PERIOD AND THE METHOD FOR HOW WATER EXTRACTION WAS CALCULATED.
VI) PROVIDE ANY RECOMMENDATIONS FOR IMPROVEMENTS FOR THE NEXT REPORTING PERIOD.

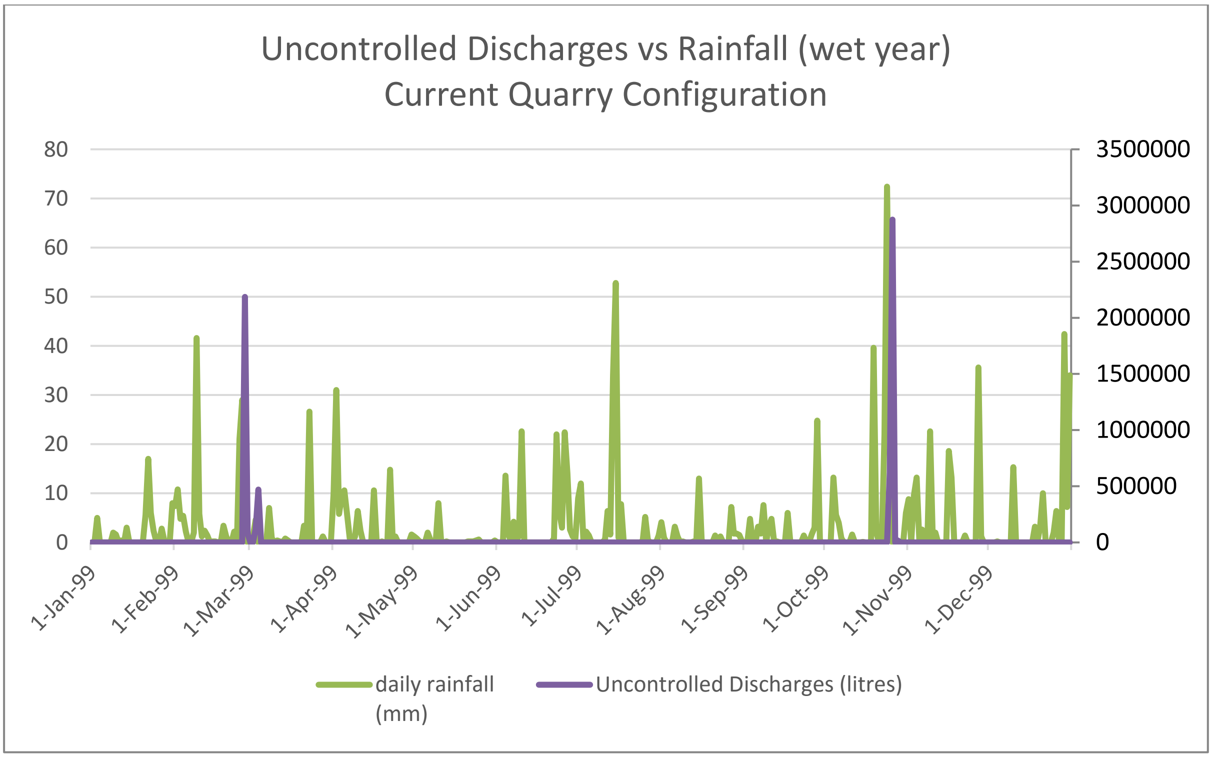
(8) THE LICENCE HOLDER MUST ALLOW DPI WATER OR ANY PERSON AUTHORISED BY IT, FULL AND FREE ACCESS TO THE WORKS, EITHER DURING OR AFTER CONSTRUCTION, FOR THE PURPOSE OF CARRYING OUT INSPECTION OR TEST OF THE WORKS AND ITS FITTINGS AND SHALL CARRY OUT ANY WORK OR ALTERATIONS DEEMED NECESSARY BY THE DEPARTMENT FOR THE PROTECTION AND PROPER MAINTENANCE OF THE WORKS, OR THE CONTROL OF THE WATER EXTRACTED AND FOR THE PROTECTION OF THE QUALITY AND THE PREVENTION FROM POLLUTION OR CONTAMINATION OF SUB-SURFACE WATER.

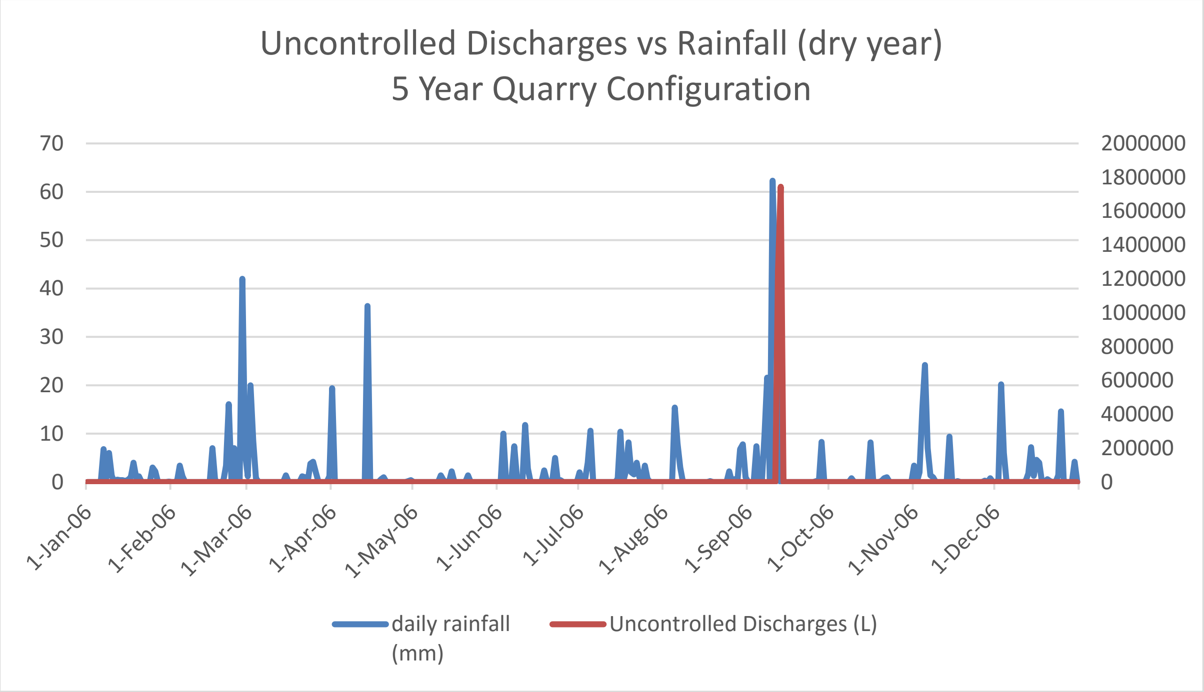
Appendix D

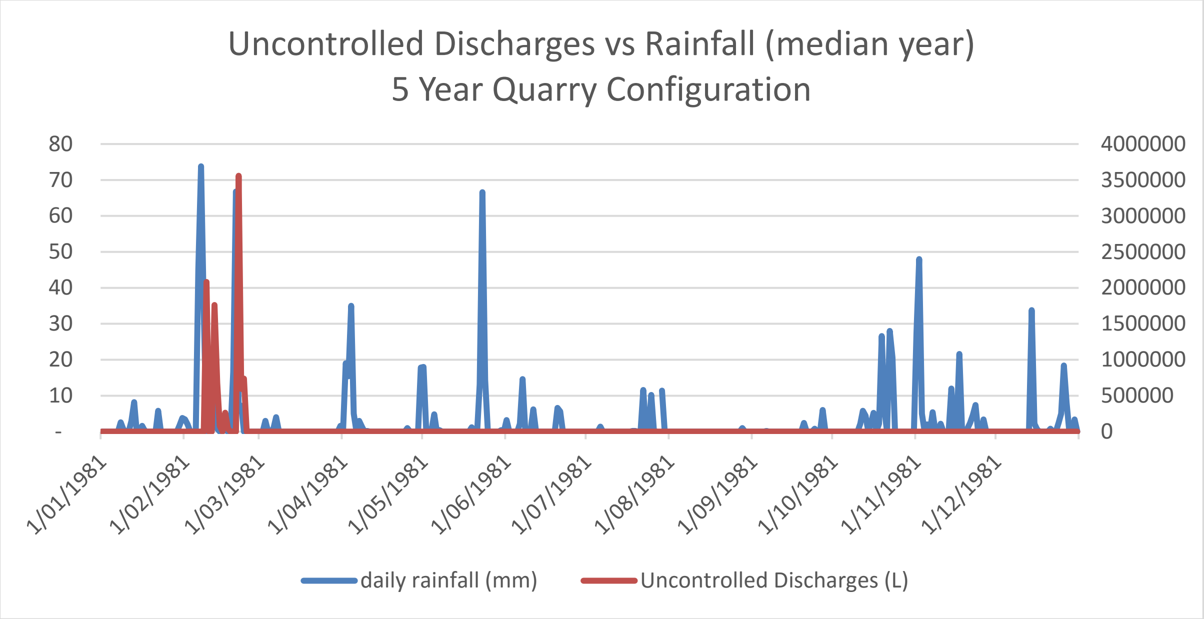
Uncontrolled Discharge Plots

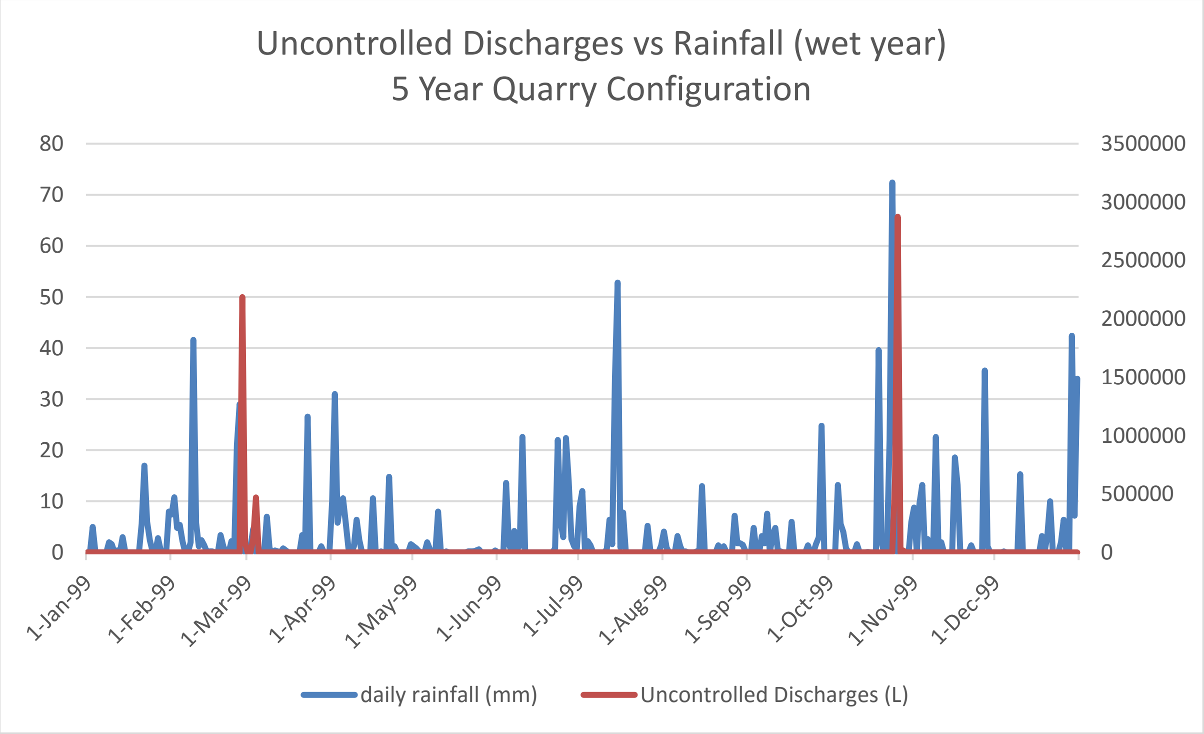

Uncontrolled Discharges vs Rainfall (dry year)
Current Quarry Configuration
70
60
50
40
30
20
10
0
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1-Jan-06
1-Feb-06
1-Mar-06
1-Apr-06
1-May-06
1-Jun-06
1-Jul-06
1-Aug-06
1-Sep-06
1-Oct-06
1-Nov-06
1-Dec-06
daily rainfall (mm)
Uncontrolled Discharges L

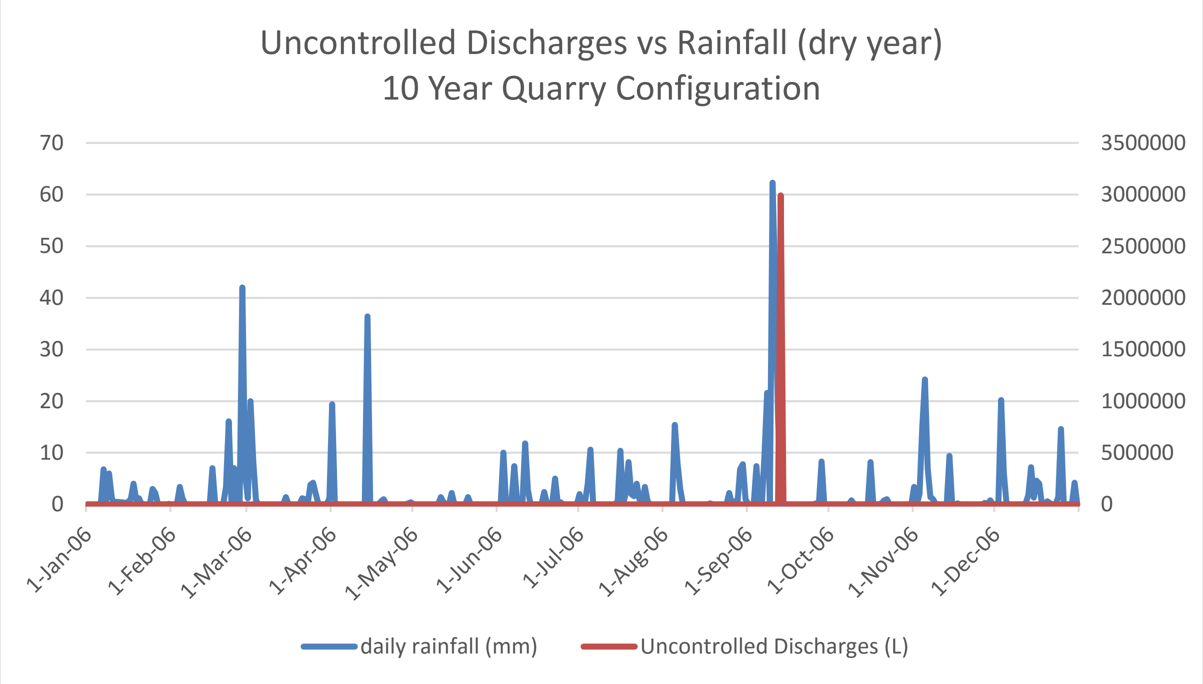

Uncontrolled Discharges vs Rainfall (median year)
Current Quarry Configuration
80
70
60
50
40
30
20
10
-
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1/01/1981
1/02/1981
1/03/1981
1/04/1981
1/05/1981
1/06/1981
1/07/1981
1/08/1981
1/09/1981
1/10/1981
1/11/1981
1/12/1981
daily rainfall (mm)
Uncontrolled Discharges

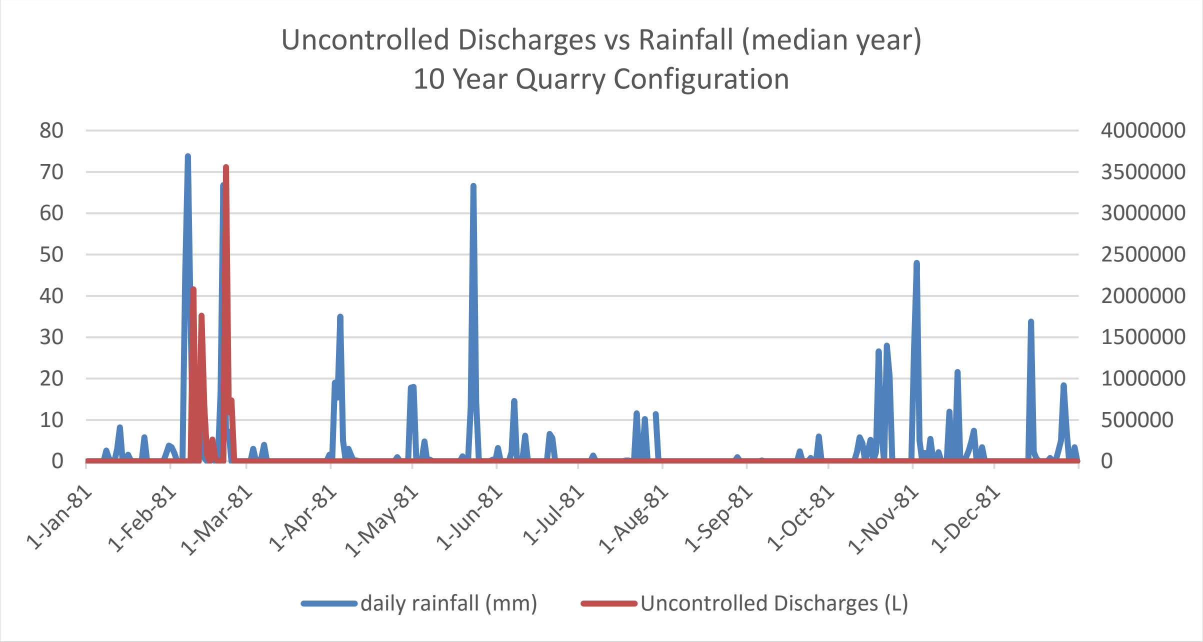

Uncontrolled Discharges vs Rainfall (wet year)
Current Quarry Configuration
80
70
60
50
40
30
20
10
0
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1-Jan-99
1-Feb-99
1-Mar-99
1-Apr-99
1-May-99
1-Jun-99
1-Jul-99
1-Aug-99
1-Sep-99
1-Oct-99
1-Nov-99
1-Dec-99
daily rainfall (mm)
Uncontrolled Discharges (litres)

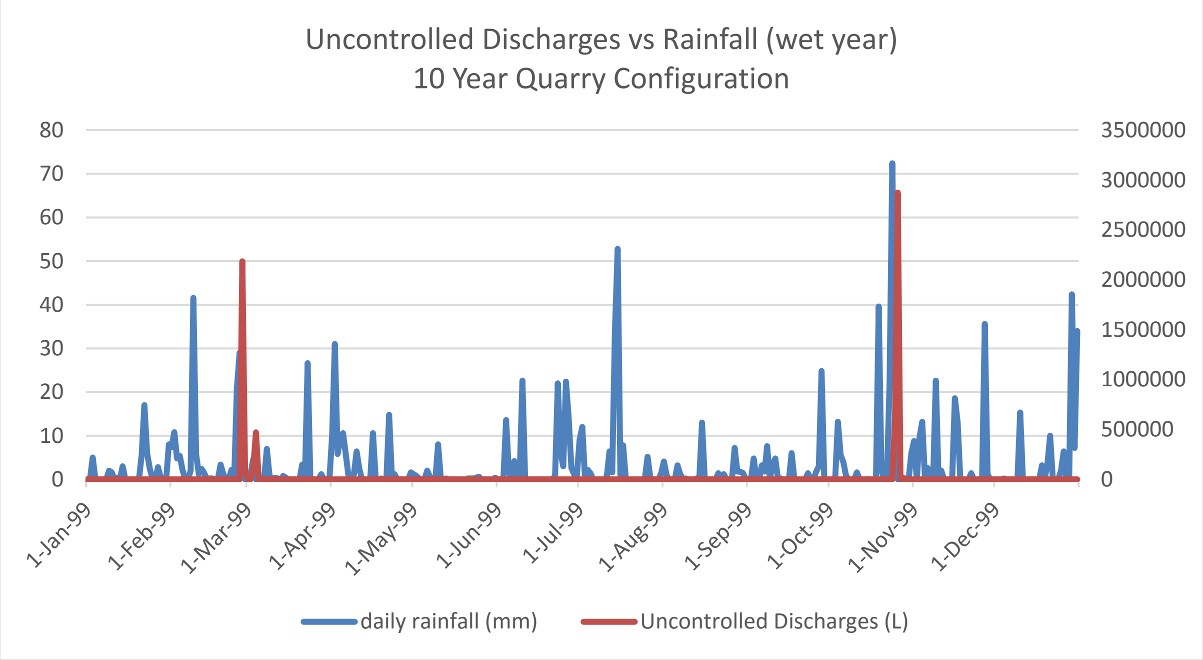

Uncontrolled Discharges vs Rainfall (dry year)
5 Year Quarry Configuration
70
60
50
40
30
20
10
0
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1-Jan-06
1-Feb-06
1-Mar-06
1-Apr-06
1-May-06
1-Jun-06
1-Jul-06
1-Aug-06
1-Sep-06
1-Oct-06
1-Nov-06
1-Dec-06
daily rainfall (mm)
Uncontrolled Discharges (L)

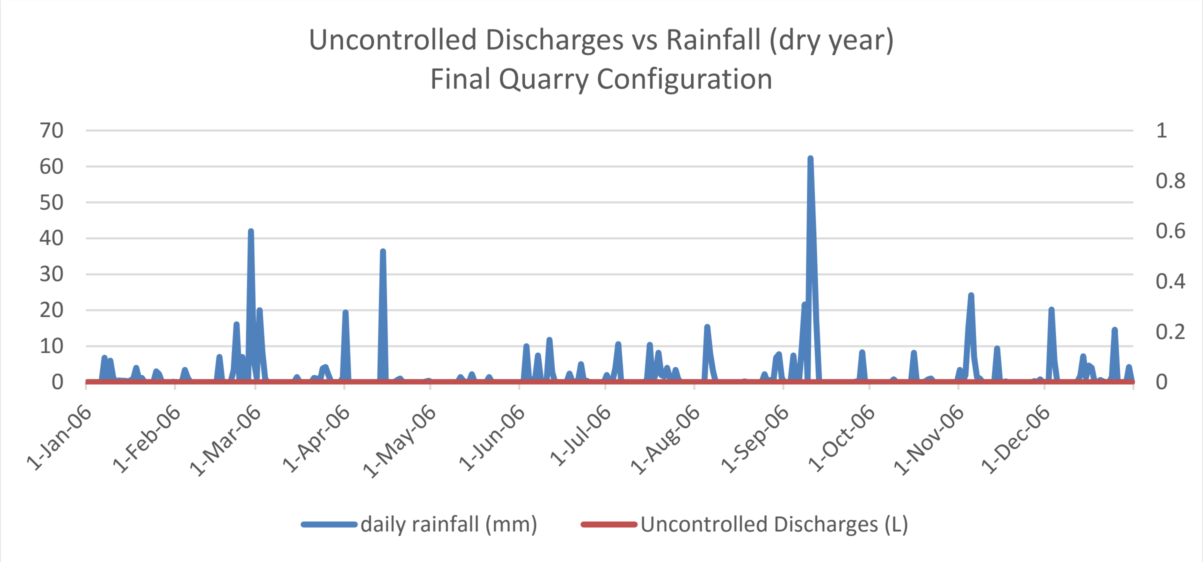

Uncontrolled Discharges vs Rainfall (median year)
5 Year Quarry Configuration
80
70
60
50
40
30
20
10
-
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1/01/1981
1/02/1981
1/03/1981
1/04/1981
1/05/1981
1/06/1981
1/07/1981
1/08/1981
1/09/1981
1/10/1981
1/11/1981
1/12/1981
daily rainfall (mm)
Uncontrolled Discharges (L)

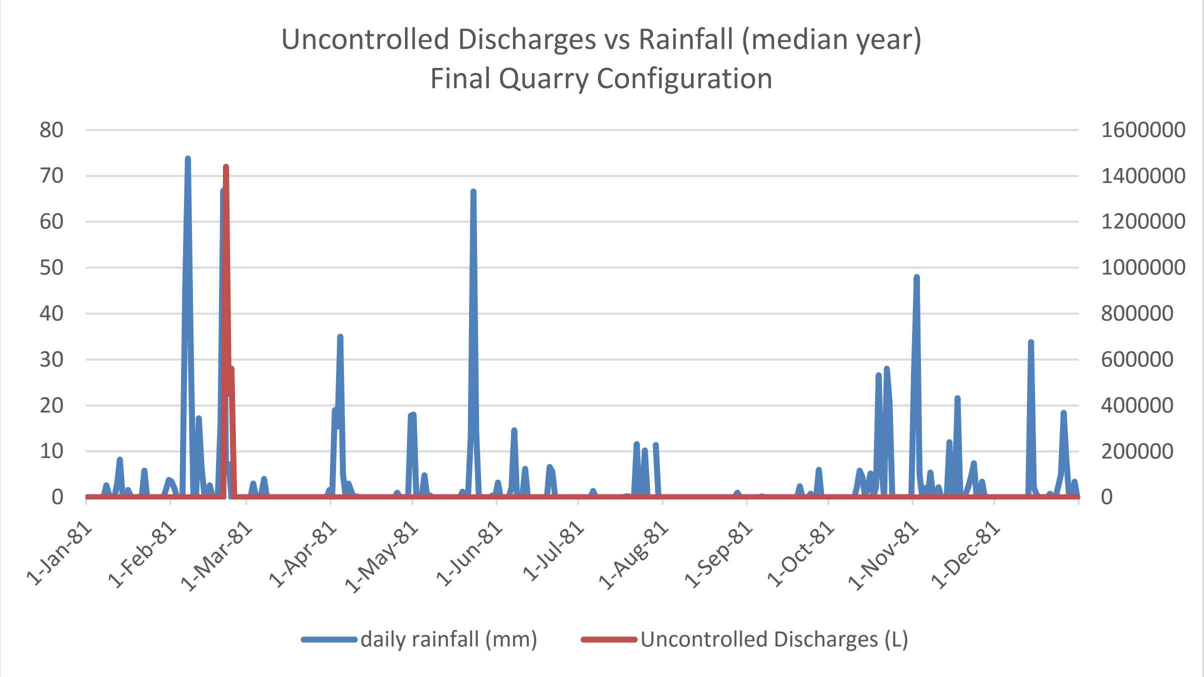

Uncontrolled Discharges vs Rainfall (wet year)
5 Year Quarry Configuration
80
70
60
50
40
30
20
10
0
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1-Jan-99
1-Feb-99
1-Mar-99
1-Apr-99
1-May-99
1-Jun-99
1-Jul-99
1-Aug-99
1-Sep-99
1-Oct-99
1-Nov-99
1-Dec-99
daily rainfall (mm)
Uncontrolled Discharges (L)

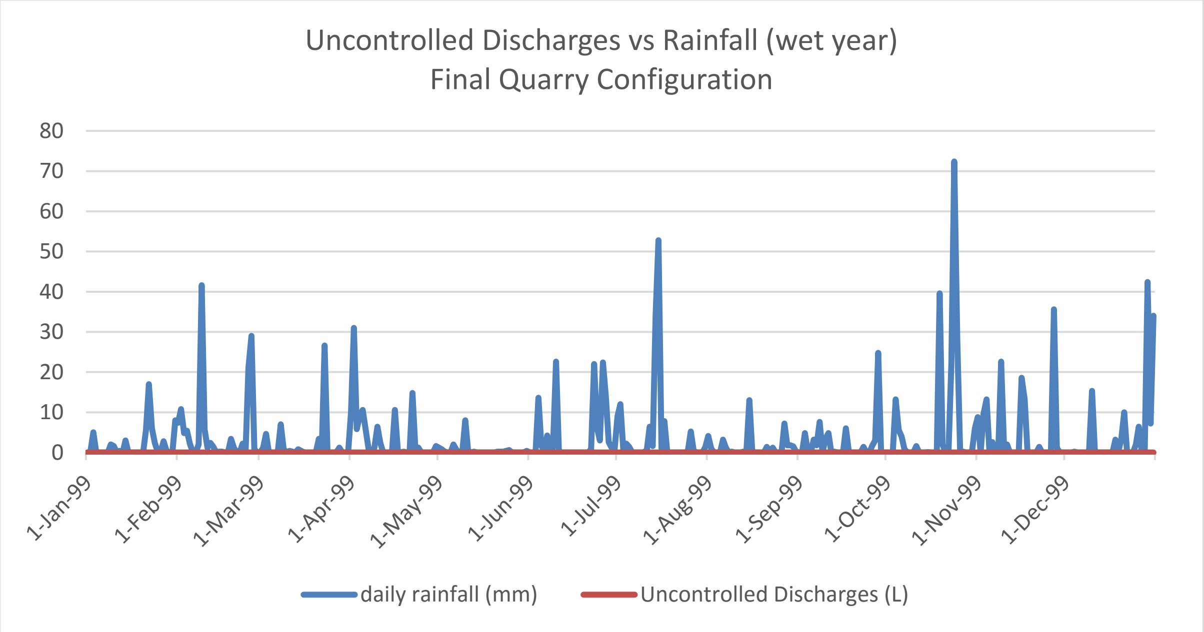

Uncontrolled Discharges vs Rainfall (dry year)
10 Year Quarry Configuration
70
60
50
40
30
20
10
0
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1-Jan-06
1-Feb-06
1-Mar-06
1-Apr-06
1-May-06
1-Jun-06
1-Jul-06
1-Aug-06
1-Sep-06
1-Oct-06
1-Nov-06
1-Dec-06
daily rainfall (mm)
Uncontrolled Discharges (L)


Uncontrolled Discharges vs Rainfall (median year)
10 Year Quarry Configuration
80
70
60
50
40
30
20
10
0
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1-Jan-81
1-Feb-81
1-Mar-81
1-Apr-81
1-May-81
1-Jun-81
1-Jul-81
1-Aug-81
1-Sep-81
1-Oct-81
1-Nov-81
1-Dec-81
daily rainfall (mm)
Uncontrolled Discharges (L)


Uncontrolled Discharges vs Rainfall (wet year)
10 Year Quarry Configuration
80
70
60
50
40
30
20
10
0
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1-Jan-99
1-Feb-99
1-Mar-99
1-Apr-99
1-May-99
1-Jun-99
1-Jul-99
1-Aug-99
1-Sep-99
1-Oct-99
1-Nov-99
1-Dec-99
daily rainfall (mm)
Uncontrolled Discharges (L)


Uncontrolled Discharges vs Rainfall (dry year)
Final Quarry Configuration
70
60
50
40
30
20
10
0
1
0.8
0.6
0.4
0.2
0
1-Jan-06
1-Feb-06
1-Mar-06
1-Apr-06
1-May-06
1-Jun-06
1-Jul-06
1-Aug-06
1-Sep-06
1-Oct-06
1-Nov-06
1-Dec-06
daily rainfall (mm)
Uncontrolled Discharges (L)


Uncontrolled Discharges vs Rainfall (median year)
Final Quarry Configuration
80
70
60
50
40
30
20
10
0
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1-Jan-81
1-Feb-81
1-Mar-81
1-Apr-81
1-May-81
1-Jun-81
1-Jul-81
1-Aug-81
1-Sep-81
1-Oct-81
1-Nov-81
1-Dec-81
daily rainfall (mm)
Uncontrolled Discharges (L)


Uncontrolled Discharges vs Rainfall (wet year)
Final Quarry Configuration
80
70
60
50
40
30
20
10
0
1-Jan-99
1-Feb-99
1-Mar-99
1-Apr-99
1-May-99
1-Jun-99
1-Jul-99
1-Aug-99
1-Sep-99
1-Oct-99
1-Nov-99
1-Dec-99
daily rainfall (mm)
Uncontrolled Discharges (L)