AGL Upstream Investments Pty Ltd

2013 Gloucester Groundwater and Surface Water Monitoring

Annual Status Report

11 October 2013

PARSONS BRINCKERHOFF

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Glossary

Alluvium	Unconsolidated sediments (clays, sands, gravels and other materials) deposited by flowing water. Deposits can be made by streams on river beds, floodplains, and alluvial fans.
Alluvial aquifer	Permeable zones that store and produce groundwater from unconsolidated alluvial sediments. Shallow alluvial aquifers are generally unconfined aquifers.
Anthropogenic	Occurring because of, or influenced by, human activity.
Aquifer	Rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water.
Aquifer properties	The characteristics of an aquifer that determine its hydraulic behaviour and its response to abstraction.
Aquifer, confined	An aquifer that is overlain by low permeability strata. The hydraulic conductivity of the confining bed is significantly lower than that of the aquifer.
Aquifer, semi-confined	An aquifer overlain by a low-permeability layer that permits water to slowly flow through it. During pumping, recharge to the aquifer can occur across the leaky confining layer – also known as a leaky artesian or leaky confined aquifer.
Aquifer, unconfined	Also known as a water table aquifer. An aquifer in which there are no confining beds between the zone of saturation and the surface. The water table is the upper boundary of an unconfined aquifer.
Aquitard	A low permeability unit that can store groundwater and also transmit it slowly from one formation to another. Aquitards retard but do not prevent the movement of water to or from adjacent aquifers.
Artesian water	Groundwater that is under pressure when tapped by a bore and is able to rise above the level at which it is first encountered. It may or may not flow at ground level. The pressure in such an aquifer commonly is called artesian pressure, and the formation containing artesian water is a confined aquifer.
Australian Height Datum (AHD)	The reference point (very close to mean sea level) for all elevation measurements, and used for correlating depths of aquifers and water levels in bores.
Baseflow	The part of stream discharge that originates from groundwater seeping into the stream.
Baseline sampling	A period of regular water quality and water level measurements that are carried out over a period long enough to determine the natural variability in groundwater conditions.
Bore	A structure drilled below the surface to obtain water from an aquifer or series of aquifers.

Coal	A sedimentary rock derived from the compaction and consolidation of vegetation or swamp deposits to form a fossilised carbonaceous rock.
Coal seam	A layer of coal within a sedimentary rock sequence.
Coal seam gas (CSG)	Coal seam gas is a form of natural gas (predominantly methane) that is extracted from coal seams.
Concentration	The amount or mass of a substance present in a given volume or mass of sample, usually expressed as microgram per litre (water sample) or micrograms per kilogram (sediment sample).
Conceptual model	A simplified and idealised representation (usually graphical) of the physical hydrogeologic setting and the hydrogeological understanding of the essential flow processes of the system. This includes the identification and description of the geologic and hydrologic framework, media type, hydraulic properties, sources and sinks, and important aquifer flow and surface-groundwater interaction processes.
Confining layer	Low permeability strata that may be saturated but will not allow water to move through it under natural hydraulic gradients.
Datalogger	A digital recording instrument that is inserted in monitoring and pumping bores to record pressure measurements and water level variations.
Discharge	The volume of water flowing in a stream or through an aquifer past a specific point in a given period of time.
Discharge area	An area in which there are upward or lateral components of flow in an aquifer.
Drawdown	A lowering of the water table in an unconfined aquifer or the pressure surface of a confined aquifer caused by pumping of groundwater from bores and wells.
Electrical Conductivity (EC)	A measure of a fluid's ability to conduct an electrical current and is an estimation of the total ions dissolved. It is often used as a measure of water salinity.
Fracture	Breakage in a rock or mineral along a direction or directions that are not cleavage or fissility directions.
Fractured rock aquifer	These occur in sedimentary, igneous and metamorphosed rocks which have been subjected to disturbance, deformation, or weathering, and which allow water to move through joints, bedding planes, fractures and faults. Although fractured rock aquifers are found over a wide area, they generally contain much less groundwater than alluvial and porous sedimentary rock aquifers.
Groundwater	The water contained in interconnected pores or fractures located below the water table in the saturated zone.
Groundwater flow	The movement of water through openings in sediment and rock within the zone of saturation.

Groundwater system A system that is hydrogeologically more similar than different in regard to geological province, hydraulic characteristics and water quality, and may consist of one or more geological formations.

Hydraulic conductivity The rate at which water of a specified density and kinematic viscosity can move through a permeable medium (notionally equivalent to the permeability of an aquifer to fresh water).

Hydraulic gradient The change in total hydraulic head with a change in distance in a given direction.

Hydraulic head Is a specific measurement of water pressure above a datum. It is usually measured as a water surface elevation, expressed in units of length. In an aquifer, it can be calculated from the depth to water in a monitoring bore. The hydraulic head can be used to determine a hydraulic gradient between two or more points.

Hydrogeology The study of the interrelationships of geologic materials and processes with water, especially groundwater.

Hydrology The study of the occurrence, distribution, and chemistry of all surface waters.

Infiltration The flow of water downward from the land surface into and through the upper soil layers.

Lithology The study of rocks and their depositional or formational environment on a large specimen or outcrop scale.

MicroSiemens per centimetre (µS/cm) A measure of water salinity commonly referred to as EC (see also Electrical Conductivity). Most commonly measured in the field with calibrated field meters.

Monitoring bore A non-pumping bore, is generally of small diameter that is used to measure the elevation of the water table and/or water quality. Bores generally have a short well screen against a single aquifer through which water can enter.

Permeability The property or capacity of a porous rock, sediment, clay or soil to transmit a fluid. It is a measure of the relative ease of fluid flow under unequal pressure. The hydraulic conductivity is the permeability of a material for water at the prevailing temperature.

Permeable material Material that permits water to move through it at perceptible rates under the hydraulic gradients normally present.

Permian The last period of the Palaeozoic era that finished approximately 230 million years before present.

Piezometer See monitoring bore.

Potentiometric surface The potential level to which water will rise above the water level in an aquifer in a bore that penetrates a confined aquifer; if the potential level is higher than the land surface, the bore will overflow and is referred to as artesian (same as

	piezometric surface).
Precipitation	(1) in meteorology and hydrology, rain, snow and other forms of water falling from the sky (2) the formation of a suspension of an insoluble compound by mixing two solutions. Positive values of saturation index (SI) indicate supersaturation and the tendency of the water to precipitate that mineral.
Quaternary	The most recent geological period extending from approximately 2.5 million years ago to the present day.
Recharge	The process which replenishes groundwater, usually by rainfall infiltrating from the ground surface to the water table and by river water reaching the water table or exposed aquifers. The addition of water to an aquifer.
Recharge area	A geographic area that directly receives infiltrated water from surface and in which there are downward components of hydraulic head in the aquifer. Recharge generally moves downward from the water table into the deeper parts of an aquifer then moves laterally and vertically to recharge other parts of the aquifer or deeper aquifer zones.
Recovery	The difference between the observed water level during the recovery period after cessation of pumping and the water level measured immediately before pumping stopped.
RL	Reduced level or height, usually in metres above or below an arbitrary or standard datum.
Salinity	The concentration of dissolved salts in water, usually expressed in EC units or milligrams of total dissolved solids per litre (mg/L TDS).
Salinity classification	***Fresh water quality –*** water with a salinity <800 µS/cm. ***Marginal water quality –*** water that is more saline than freshwater and generally waters between 800 and 1,600 µS/cm. ***Brackish quality –*** water that is more saline than freshwater and generally waters between 1,600 and 4,800 µS/cm. ***Slightly saline quality –*** water that is more saline than brackish water and generally waters with a salinity between 4,800 and 10,000 µS/cm. ***Moderately saline quality*** – water that is more saline than brackish water and generally waters between 10,000 and 20,000 µS/cm. ***Saline quality*** – water that is almost as saline as seawater and generally waters with a salinity greater than 20,000 µS/cm. ***Seawater quality*** – water that is generally around 55,000 µS/cm.
Saturated zone	The zone in which the voids in the rock or soil are filled with water at a pressure greater than atmospheric pressure. The water table is the top of the saturated zone in an unconfined aquifer.
Screen	A type of bore lining or casing of special construction, with apertures designed to permit the flow of water into a bore while preventing the entry of aquifer or filter pack material.

Sandstone	Sandstone is a sedimentary rock composed mainly of sand-sized minerals or rock grains (predominantly quartz).
Sedimentary rock aquifer	These occur in consolidated sediments such as porous sandstones and conglomerates, in which water is stored in the intergranular pores, and limestone, in which water is stored in solution cavities and joints. These aquifers are generally located in sedimentary basins that are continuous over large areas and may be tens or hundreds of metres thick. In terms of quantity, they contain the largest volumes of groundwater.
Shale	A laminated sedimentary rock in which the constituent particles are predominantly of clay size.
Siltstone	A fine-grained rock of sedimentary origin composed mainly of silt-sized particles (0.004 to 0.06 mm).
Specific storage	Relating to the volume of water that is released from an aquifer following a unit change in the hydraulic head. Specific storage normally relates to confined aquifers.
Specific yield	The ratio of the volume of water a rock or soil will yield by gravity drainage to the volume of the rock or soil. Specific yield generally relates to unconfined aquifers. Gravity drainage may take many months to occur.
Standing water level (SWL)	The height to which groundwater rises in a bore after it is drilled and completed, and after a period of pumping when levels return to natural atmospheric or confined pressure levels.
Stratigraphy	The depositional order of sedimentary rocks in layers.
Surface water-groundwater interaction	This occurs in two ways: (1) streams gain water from groundwater through the streambed when the elevation of the water table adjacent to the streambed is greater than the water level in the stream; and (2) streams lose water to groundwater through streambeds when the elevation of the water table is lower than the water level in the stream.
Tertiary	Geologic time at the beginning of the Cainozoic era, 65 to 2.5 million years ago, after the Cretaceous and before the Quaternary.
Total Dissolved Solids (TDS)	A measure of the salinity of water, usually expressed in milligrams per litre (mg/L). See also EC.
Tuff	Tuff is a type of volcanic rock consisting of consolidated explosive ash ejected from vents during a volcanic eruption.
Unsaturated zone	That part of an aquifer between the land surface and water table. It includes the root zone, intermediate zone and capillary fringe.
Water bearing zone	Geological strata that are saturated with groundwater but not of sufficient permeability to be called an aquifer.
Water quality	Term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water quality data	Chemical, biological, and physical measurements or observations of the characteristics of surface and ground waters, atmospheric deposition, potable water, treated effluents, and waste water and of the immediate environment in which the water exists.
Water table	The top of an unconfined aquifer. It is at atmospheric pressure and indicates the level below which soil and rock are saturated with water.
Well	Pertaining to a gas exploration well or gas production well.
Wellbore	A wellbore is the physical hole that makes up the well and can be cased, open or be a combination of both completions. In this report it generally refers to uncased gas exploration boreholes prior to a gas well being completed.
Siltstone	A fine-grained rock of sedimentary origin composed mainly of silt-sized particles (0.004 to 0.06 mm).
Specific storage	Relating to the volume of water that is released from an aquifer following a unit change in the hydraulic head. Specific storage normally relates to confined aquifers.
Specific yield	The ratio of the volume of water a rock or soil will yield by gravity drainage to the volume of the rock or soil. Specific yield generally relates to unconfined aquifers. Gravity drainage may take many months to occur.

Abbreviations

List of units

m	metres
m AHD	metres Australian Height Datum
m bgl	metres below ground level
mbtoc	metres below top of casing
m/day	metres per day
m^3/day	cubic metres per day
m/year	metres per year
µS/cm	microSiemens per centimetre
mg/L	milligrams per litre

List of abbreviations

AGL	AGL Upstream Investments Pty Ltd
BoM	Bureau of Meteorology
CSG	Coal seam gas
EC	Electrical Conductivity
GFDA	Gas Field Development Area
GGP	Gloucester Gas project
PEL	Petroleum Exploration Licence
PPL	Petroleum Production Lease

Executive Summary

AGL Upstream Infrastructure Investments Pty Ltd (AGL) is proposing to build the Gloucester Gas Project (GGP) which comprises several stages of development facilitating the extraction of coal seam gas (CSG) from the Gloucester Basin. Part 3A Approval and EPBC Approval has been granted for the Stage 1 Gas Field Development Area (GFDA).

A comprehensive surface water and groundwater monitoring network comprising nested monitoring bores and stream gauges was established during the Phase 2 Groundwater Investigations (Parsons Brinckerhoff, 2012a). Subsequent and ongoing site investigations have continued to expand this network since January 2011. This annual monitoring report provides a review of the groundwater and surface water monitoring data for the period January 2011 to June 2013, representing 30 months of baseline data, but focussing on the last annual monitoring period (July 2012 to June 2013).

During last monitoring year there were high rainfall periods in January and February 2013, with February 2013 receiving 219 mm, resulting in significantly higher than average rainfall in those months and local flooding of rivers and creeks.

All stream gauges on the Avon River and Dog Trap Creek show sharp increases in water level in response to rainfall events, and relatively steep recession curves. This is characteristic of rapid runoff responses from a relatively small upstream catchment and limited riverbank storage and groundwater contributions. Stream levels and flow decrease over several weeks following each rainfall event to a relatively consistent base level that represents a small baseflow component in the Avon River.

Groundwater level trends in monitoring bores vary depending on the lithology and depth of the screened interval:

- **Alluvium**: Groundwater levels in monitoring bores screened within the alluvial aquifers show characteristic quick responses to rainfall events. This indicates rapid shallow aquifer recharge via direct rainfall infiltrations and/or enhanced infiltration during creek high flow and flood events. Groundwater fluctuations over the monitoring period range from ~0.5 m to ~3 m. Rainfall recharge is impeded in areas where the alluvium is clay-rich or where thick clay layers overlie the coarser grained alluvial deposits.
- **Shallow rock**: There are no strong responses to individual rainfall events in the shallow rock monitoring bores, with the exception of the WKMB site at Forbesdale. For all sites there is a delayed response to periods of higher than average rainfall, indicating that groundwater levels are responding to slow rainfall recharge over a broad area, assumed to be up-gradient of the monitoring locations.
- **Interburden units**: Monitoring bores screened within the interburden units do not show an overall increase or decrease over the monitoring period. There are no strong responses to individual rainfall events.
- **Coal seams**: Groundwater levels in monitoring bores that are screened within the coal seams show varied but typically small (<0.2 m) overall changes in groundwater level over the monitoring period. There are no strong responses to individual rainfall events, indicating that groundwater levels are responding to slow rainfall recharge over a broad area, assumed to be up-gradient of the monitoring locations.

Surface water salinity is fresh and the pH is neutral. Generally the major ion chemistry of the surface water is dominated by sodium, chloride and bicarbonate. Dissolved metal analysis for surface water indicated that aluminium, copper, zinc concentrations were detected above the ANZECC (2000) guideline values. Dissolved methane concentrations were detected at two of the surface water monitoring locations.

Groundwater quality monitoring suggests that:

- Alluvial aquifer water quality is fresh to slightly saline, has slightly acidic to neutral pH and reducing conditions exist. The major ion chemistry is sodium-chloride dominant, reflecting the high clay content of the alluvium and rainfall recharge. The alluvial groundwater has minor dissolved metals, and dissolved methane was detected at the alluvial monitoring bores.
- Groundwater in the shallow rock unit is marginal to slightly saline, has neutral to alkaline pH conditions and reducing conditions exist. The major ion chemistry is sodium-chloride-bicarbonate dominant. Groundwater in the shallow rock unit has low concentrations of dissolved metals and minor detections of naturally occurring TPH, benzene and toluene occurred at a few monitoring sites. Dissolved methane concentrations were detected in all shallow rock aquifer monitoring bores.
- Groundwater quality of the interburden is brackish with alkaline pH and reducing conditions. The major ion chemistry is sodium-chloride dominant. Groundwater in the interburden has low concentrations of dissolved metals. Ammonia, total phosphorus and reactive phosphorous concentrations were elevated and at some monitoring locations. Minor detections of naturally occurring phenols, TPH and toluene occurred at all monitoring bores. Methane concentrations were detected at higher concentrations than the alluvial or shallow rock groundwater.
- Groundwater salinity in the coal seams is typically brackish to slightly saline, with neutral to alkaline pH and mostly reducing conditions. The major ion chemistry is generally sodium-chloride dominant. Groundwater in the coal seams has low concentrations of most analysed dissolved metals, these concentrations are considered natural and not unusual for Permian coal seams. Ammonia, total phosphorus and reactive phosphorus concentrations were elevated at some monitoring locations. Toluene and TPH were detected at some monitoring locations. Methane concentrations were detected at higher concentrations than the alluvial or shallow rock groundwater.

It is recommended that monitoring should continue at all dedicated surface water and groundwater monitoring sites in accordance with the existing program

1. Introduction

1.1 Gloucester Gas Project

AGL Upstream Infrastructure Investments Pty Ltd (AGL) is proposing to build the Gloucester Gas Project (GGP) which comprises several stages of development facilitating the extraction of coal seam gas (CSG) from the Gloucester Basin. Concept Plan and Project Approval (Part 3A Approval) for the Stage 1 Gas Field Development Area (GFDA) was granted on 22 February 2011 under Part 3A of the *Environmental Planning and Assessment Act (1979) (EP&A Act)*. In addition the project received approval under the *Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act)* (EPBC Approval) on 11 February 2013.

AGL also holds Petroleum Exploration Licence (PEL) 285, under the *Petroleum (Onshore) Act 1991*, covering the whole of the Gloucester Basin, approximately 100 km north of Newcastle, NSW. AGL has also applied for a Petroleum Production Lease (PPL) for the Stage 1 area subject of the planning approvals. The Stage 1 GFDA in relation to the PEL boundary is shown in Figure 1.1.

The GGP will involve the dewatering of deep groundwater and the extraction of gas from multiple coal seams within the Gloucester Coal Measures. Target coal seam depths will vary from site to site but are expected to range between 200 and 1,000 metres below ground level (mbgl). The current GGP includes the construction, operation and decommissioning of not more than 110 coal seam gas wells and associated infrastructure, including gas and water gathering lines, within the Stage 1 GFDA.

1.2 Importance of groundwater and surface water monitoring

Groundwater and surface water studies are required to confirm the baseline conditions (pre-development) and to determine the impact (if any) on water resources and local ecosystems as the GGP is constructed, commissioned and operated.

The monitoring network is focussed on the main water resources of the alluvium and shallow rock (<150 m) hydrogeological units, and surface water in the Avon River within the Stage 1 GFDA. The continuous monitoring of groundwater and surface water levels is part of the ongoing site investigations and compliance monitoring program.

The field based groundwater studies commenced with a comprehensive groundwater investigation, the Phase 2 Groundwater Investigations, which was completed in 2012 (Parsons Brinckerhoff, 2012a). The investigation established a dedicated water monitoring network, and enabled the collection of baseline water level, water quality and hydraulic conductivity data for each of the hydrogeological units represented across the different groundwater and surface water systems. The Hydrogeological Conceptual Model for the Gloucester Basin (Parsons Brinckerhoff, 2013a) provides further detail on the characterisation of the groundwater and surface water systems across the basin.

1.3 Objectives

The objectives of the continuing groundwater and surface water monitoring program are to:

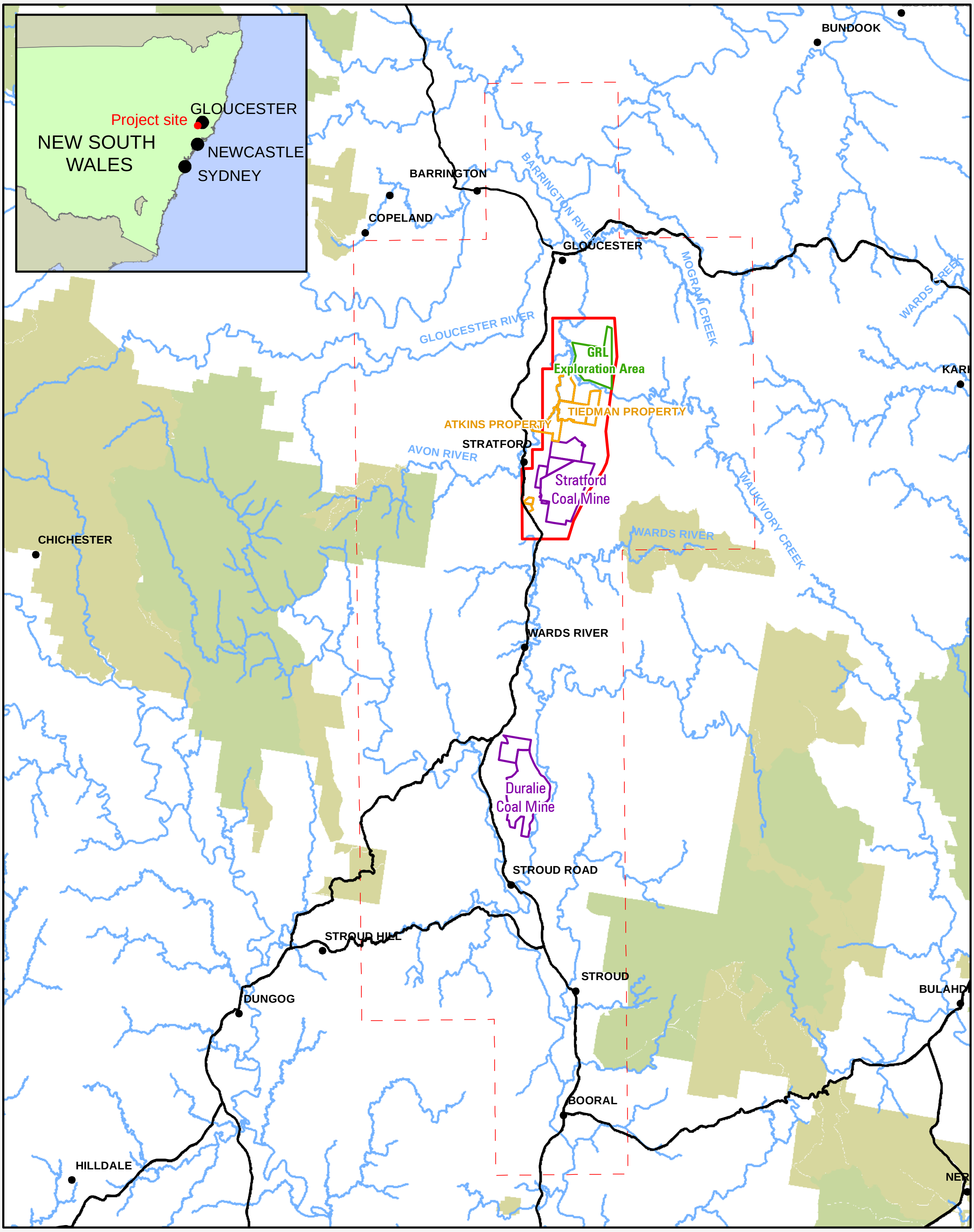
- provide information on lateral and vertical groundwater flow in the area by assessing regional and seasonal trends in groundwater levels and quality
- provide information on surface water systems in the area by assessing regional and seasonal trends in surface water levels and quality
- help the community understand what impacts, if any, there might be on local water supplies and groundwater as a result of gas exploration.

1.4 Report structure

This annual status report provides the second annual review of the monitoring network detailing groundwater and surface water level and quality trends for the period January 2011 to June 2013, and specifically for the last monitoring period from 1 July 2012 to 30 June 2013. The monitoring network is generally located within the Gloucester Basin and the northern catchment area which is predominantly the Avon River catchment.

The structure of the report is as follows:

- **Chapter 2:** provides an overview of the geological and hydrological setting of the Gloucester Basin.
- **Chapter 3:** provides an overview of the monitoring network.
- **Chapter 4:** discusses the surface water monitoring results for the monitoring period.
- **Chapter 5:** discusses the groundwater monitoring results for the monitoring period
- **Chapter 6:** presents the conclusions and recommendations for future monitoring.
- **Chapter 7:** outlines limitations relating to analysis and reporting of data.
- **Chapter 8:** comprises the references used in this report.



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- Stage 1 GFDA boundary
- PEL 285 boundary
- AGL owned properties
- Mining Lease Boundary
- GRL exploration area boundary
- Towns
- Rivers and streams
- Major roads
- NSW State Forest
- National Park, Nature Reserve or State Conservation Area

N

0 10

Kilometres

Figure 1.1
Regional Location

2. Physical setting

2.1 Topography and drainage

The Gloucester Basin is a narrow, north-south trending, elongated basin approximately 40 km long and 10 km wide, extending from Gloucester in the north to Stroud in the south. A major surface water divide, just north of Wards River, separates the Basin into two major catchment areas.

The Gloucester Basin is located high in the Manning River and Karuah River coastal catchments. The area occupied by the Permian Coal Measures (about 217 km^2) is small in comparison to the size of these catchments.

In the southern catchment area, surface water flow is generally to the south, and is part of the Karuah River catchment. In the northern catchment area, surface water flow is generally to the north, and is part of the Manning River catchment. Figure 2.1 illustrates the surface water catchments, and the surface water divide between the Wards River catchment (part of the Karuah River catchment) and the Avon River catchment (part of the Manning River catchment).

The Gloucester Basin is topographically enclosed to the west by the Gloucester and Barrington Tops, and to the east by the Mograni Range.

2.2 Rainfall and evapotranspiration

There are four Bureau of Meteorology (BoM) weather stations within the Gloucester Basin (Figure 2.1), and an additional AGL weather station on the Tiedman property (Figure 1.1). Average rainfall and the period of monitoring for the BoM stations are presented in Table 2.1.

Table 2.1 BoM stations in the Gloucester Basin (BoM 2013a)

BoM station number	Location name	Monitoring period	Long term average annual rainfall (mm)*
60015	Gloucester Post Office	1888 to present	982.4
60112	Gloucester Hiawatha	1976 to present	1023.2
60042	Craven (Longview)	1961 to present	1061.6
61071	Stroud Post Office	1889 to present	1145.8

* Long term average annual rainfall (mm) over the monitoring period.

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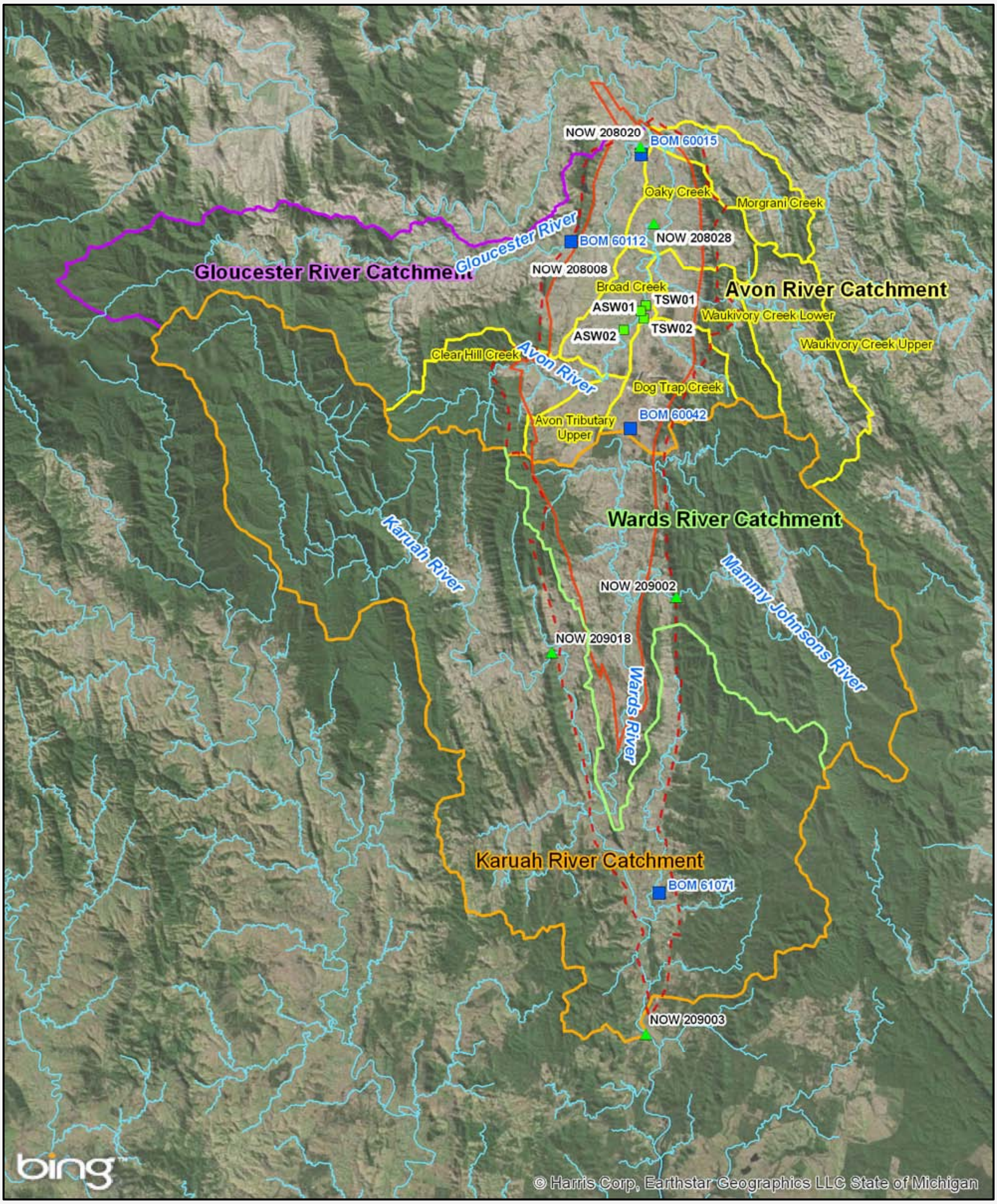

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Surface water catchments

- Avon River
- Gloucester River
- Karuah River (to NOW 209003)
- Wards River

- Alum Mountain Volcanics boundary
- Permian Coal Measures boundary
- Rivers and streams
- Project gauging station
- NOW gauging station
- BOM Weather Station

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0 10
Kilometres

Figure 2.1
Surface water catchments

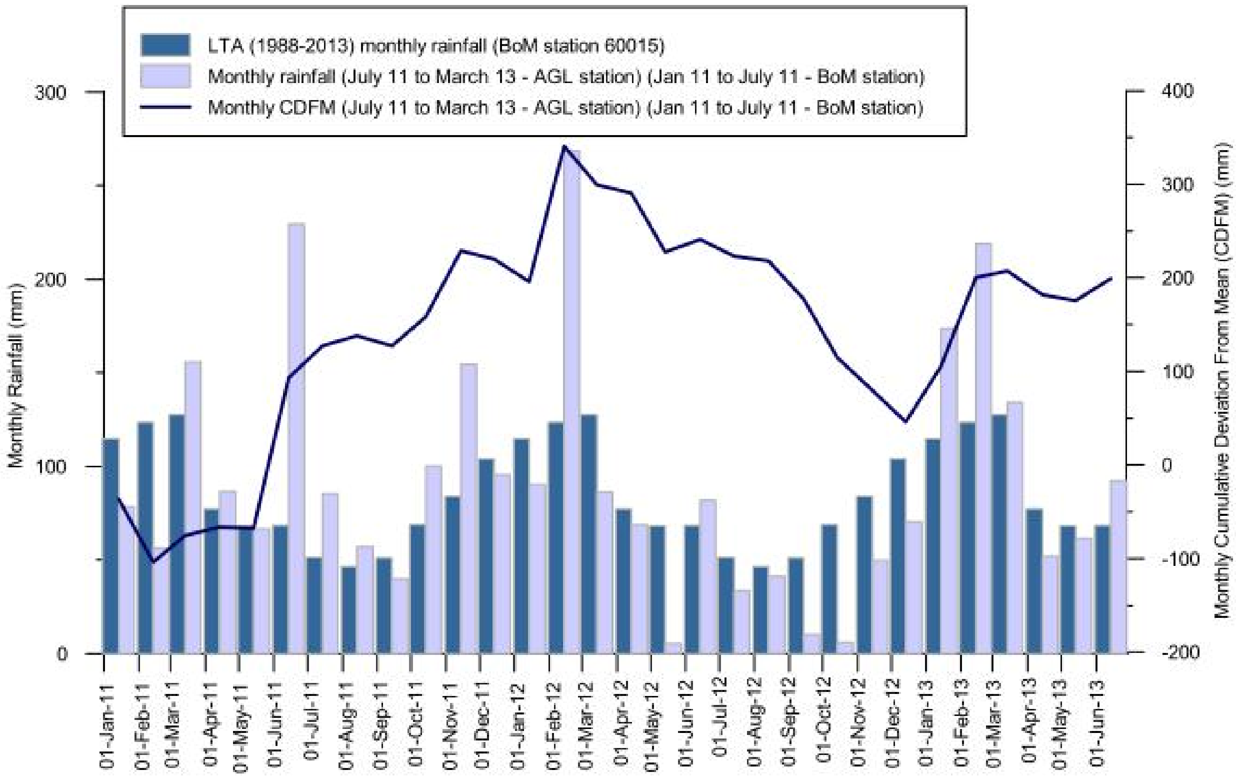


Figure 2.2 Monitoring period monthly rainfall, and cumulative deviation from the monthly mean rainfall (CDFM) at the AGL Gloucester station (AGL, 2013a)

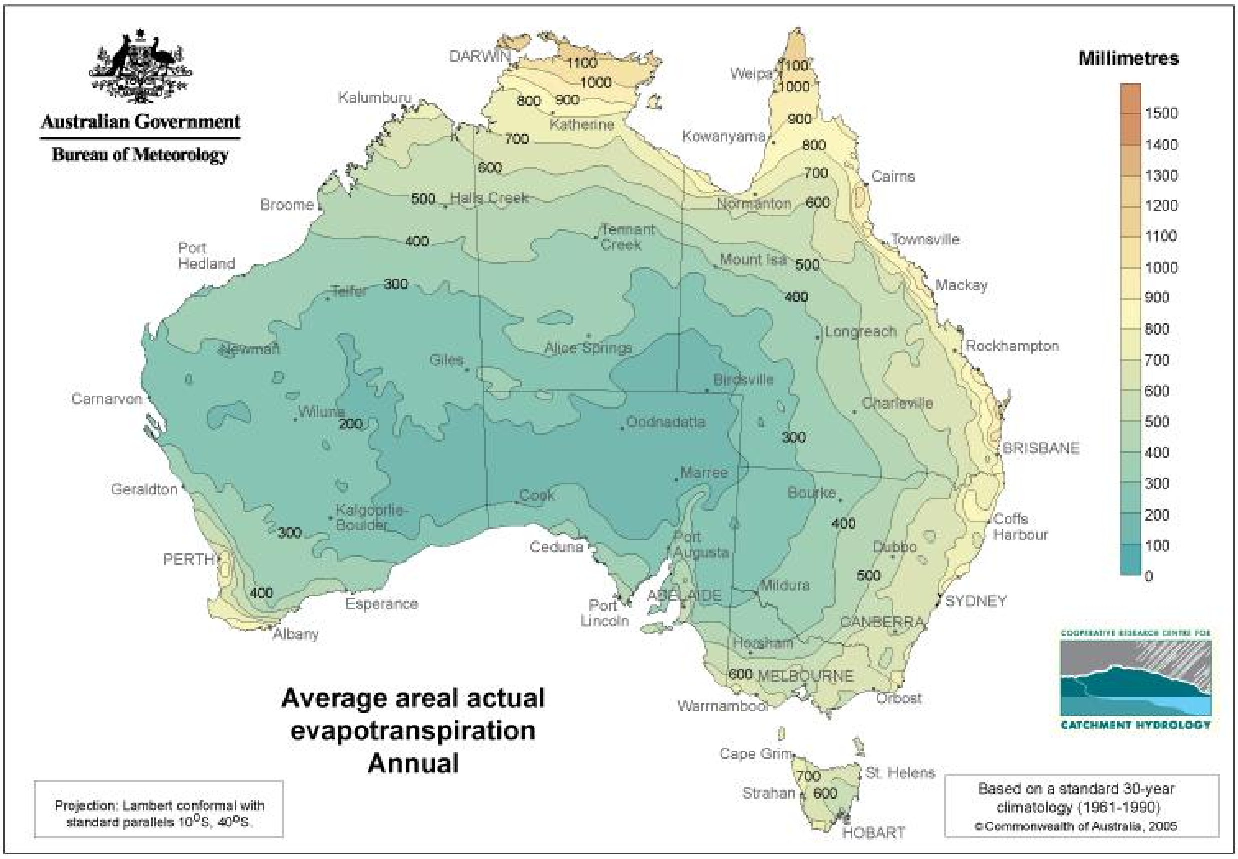


Figure 2.3 Average, areal, actual evapotranspiration (BoM, 2013b)

Monitoring data for the monitoring period January 2011 to June 2013 are presented in Figure 2.2. The AGL weather station commenced monitoring in June 2011, data prior to that was obtained from Gloucester Post Office (BoM Station 60015). From February 2011 to February 2012 actual rainfall was greater than average rainfall, as confirmed by the upward sloping cumulative deviation trend. In contrast, the period between February 2012 and December 2012 shows a downward sloping cumulative deviation curve, indicating that actual rainfall was lower than the average rainfall. From December 2012 to June 2013, actual rainfall was again higher than average rainfall.

Historically, the period between July and September records the lowest monthly rainfall, while the period between January and March typically has the highest monthly rainfall. During the entire monitoring period there were three notable high rainfall periods in June 2011 (229 mm), February 2012 (268 mm) and February 2013 (219 mm).

Evapotranspiration (ET) is the collective term encompassing the transfer of water, as water vapour, to the atmosphere from both vegetated and clear land surfaces (BoM 2013b). Evapotranspiration rates are affected by climate and the availability of water and vegetation.

The average, annual evapotranspiration for the whole Gloucester Basin is approximately 750 mm; this was obtained from the average, areal, actual evapotranspiration maps created by the BoM from data collected between 1961 and 1990 (Figure 2.3) (BoM 2013b).

2.3 Geological setting

The Gloucester Basin represents a complex geological system formed by the interplay of extensional tectonic faulting and high rates of sedimentation. The Basin stratigraphy comprises a thick succession of Permian sedimentary rocks representing deposition in both terrestrial and marine environments during a complex period of subsidence, uplift and relative sea level change (marine transgression and regression).

The Basin is a synclinal intermontane structure formed in part of the New England Fold Belt between a major Permian plate margin and the Sydney-Gunnedah Basin (Lennox, 2009). The north – south trending synclinal nature of the Gloucester Basin resulted from the collision between the East Australian and Pacific Plates.

Following a period of extension during the Early Permian the Gloucester Basin has undergone periods of normal and reverse faulting, with large scale tilting associated with late stage compressional movements towards the end of the Permian (Hughes 1984). Reverse faults dominate present day structure.
A comparison with the contemporary horizontal stress field map (Hillis *et al* 1998) indicates the Basin is likely to be under compression in an east-west orientation.

The stratigraphy dips steeply (up to 90°) on the flanks of the Basin, dipping towards the north-south trending synclinal basin axis and flattening toward the centre of the Basin. Early Permian and Carboniferous hard resistive volcanics form the ridgelines of the Basin: the Mograni Range to the east; and the Gloucester and Barrington Tops to the west.

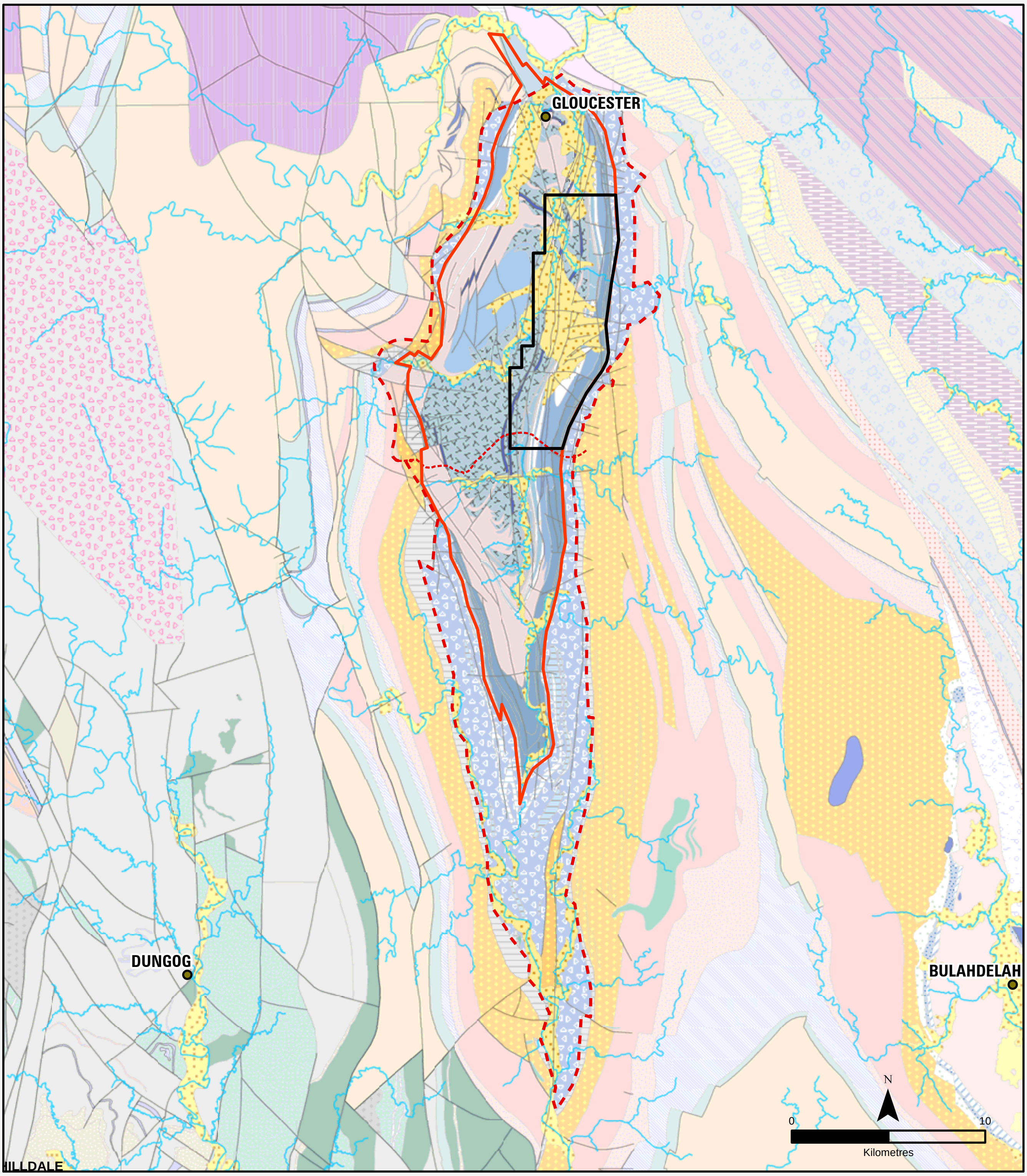
Overlying the Permian stratigraphy is a thin sequence of surficial Quaternary sediments. The Quaternary sediments are non-uniform in thickness, and comprise unconsolidated alluvial sediments (sand, gravel, silt and clay) along the drainage channels and colluvial deposits across the rest of the plain sourced from the surrounding outcropping Permian deposits.

The Gloucester Basin is divided into three major Permian stratigraphic units each representing a distinct depositional setting: the Gloucester Coal Measures, the Dewrang Group, and the Alum Mountain Volcanics. The generalised stratigraphy of the basin is summarised in Table 2.2. A geological map of the basin is shown in Figure 2.4. The CSG development in the Stage 1 GFDA is targeting the intermediate and deep coal seams in the Gloucester Coal Measures generally below depths of 200 m to around 1000 m.

Table 2.2 Stratigraphy of the Gloucester Basin

<table>
<tr><th>Period</th><th>Group</th><th>Sub-group</th><th>Formation</th><th>Approx. thickness (m)</th><th>Coal seam</th><th>Depositional Environment</th><th>Tectonic Events</th></tr>
<tr><td rowspan="22">Upper Permian</td><td rowspan="19">Gloucester Coal Measures</td><td rowspan="11">Craven</td><td>Crowthers Road Conglomerate</td><td>350</td><td></td><td rowspan="11">Marine regression, pro-gradation of alluvial fans</td><td rowspan="11">Uplift to west of Gloucester Basin</td></tr>
<tr><td rowspan="4">Leloma</td><td rowspan="4">585</td><td>Linden</td></tr>
<tr><td>JD</td></tr>
<tr><td>Bindaboo</td></tr>
<tr><td>Deards</td></tr>
<tr><td rowspan="3">Jilleon</td><td rowspan="3">175</td><td>Cloverdale</td></tr>
<tr><td>Roseville</td></tr>
<tr><td>Tereel/Fairbairns</td></tr>
<tr><td>Wards River Conglomerate</td><td>Variable</td><td></td></tr>
<tr><td rowspan="2">Wenham</td><td rowspan="2">23.9</td><td>Bowens Road</td></tr>
<tr><td>Bowens Road Lower</td></tr>
<tr><td colspan="2">Speldon Formation</td><td></td><td></td><td rowspan="8">Marine transgression but also some progradation of alluvial fans in the west related to uplift</td><td rowspan="8">Extension (normal fault development) and regional subsidence. Uplift to west of Basin</td></tr>
<tr><td rowspan="7">Avon</td><td>Dog Trap Creek</td><td>126</td><td>Glenview</td></tr>
<tr><td rowspan="6">Waukivory Creek</td><td rowspan="6">326</td><td>Avon</td></tr>
<tr><td>Triple</td></tr>
<tr><td>Rombo</td></tr>
<tr><td>Glen Road</td></tr>
<tr><td>Valley View</td></tr>
<tr><td>Parkers Road</td></tr>
<tr><td rowspan="3">Dewrang</td><td colspan="2">Mammy Johnsons</td><td>300</td><td>Mammy Johnsons</td><td rowspan="3">Marine transgression, regression and further marine transgression</td><td rowspan="3">Extension (normal fault development) and regional subsidence</td></tr>
<tr><td colspan="2">Weismantel</td><td>20</td><td>Weismantel</td></tr>
<tr><td colspan="2">Duralie Road</td><td>250</td><td></td></tr>
<tr><td rowspan="2">Lower Permian</td><td colspan="3" rowspan="2">Alum Mountain Volcanics</td><td rowspan="2"></td><td>Clareval</td><td rowspan="2">Arc-related rift</td><td rowspan="2">Rift?</td></tr>
<tr><td>Basal</td></tr>
</table>

(1) Modified from AECOM (2009) and SRK (2005).



Alum Mountain Volcanics boundary
Permian Coal Measures boundary
Stage 1 GFDA boundary
Rivers and streams

Gloucester Basin Geology

Qa Quaternary Alluvium

G Unnamed microgranite

Permian Geology

Plc Crowthers Rd Conglomerate
Pll Leloma Formation
Pllj Jo Doth Tuff Member
Plo Jilleon Formation
Plw Wards River Conglomerate
Pla Wards River Conglomerate
Plgx Gloucester Coal Measures
Plh Wenham Formation
Plp Speldon Formation
Plt Dog Trap Creek Formation
Pli Waukivory Creek Formation
Pldy Mammy Johnsons Formation
Plde Weismantels Formation
Pldd Duralie Road Formation
Pea Alum Mountain Volcanics
Pear Unnamed Rhyolite Member
Peat Unnamed Welded Tuff Member
Peac Unnamed Basal Sequence

Carboniferous geology

Clo1 Johnsons Creek Conglomerate
Clkm McInnes Formation
Clr Booral Formation
Fault

Figure 2.4
Regional geology

2.4 Hydrogeological units

Four broad hydrogeological units have been identified within the Gloucester Basin (Table 2.3).
The permeability and groundwater flow characteristics of rocks within the Gloucester Basin are controlled by several factors including lithology, depth and the degree of fracturing and faulting. In this sense hydrogeological units and flow systems do not always correspond with defined geological boundaries.

Table 2.3 Four hydrogeological units

Unit	Aquifer type	Formation name	General lithology	Hydraulic characteristics
Alluvium	Semi-confined, clay capped, porous, granular	Quaternary alluvium	Clay/mixed gravels	Heterogeneous, highly variable permeability associated with varying lithology
Shallow Rock (<150m)	Semi-confined, fractured rock	Upper Permian Coal Measures, Alum Mountain Volcanics	Interbedded sandstone/siltstone with bedding plane fractures	Heterogeneous, high and low permeability domains associated with fault zones and fracturing
Interburden	Confined, fractured rock	Upper Permian Coal Measures	Interbedded indurated sandstone/siltstone and claystone	Low permeability associated with sparse fractures, permeability decreases with depth
Coal Seams	Confined, fractured rock	Upper Permian Coal Measures	Coal/shale	Low permeability associated with cleating and fractures in coal seams, permeability decreases with depth

The four hydrogeological units are summarised as follows:

1. **Alluvial deposits** adjacent to major creeks and rivers comprising unconsolidated sand, gravel and clay. The deposits are typically 12–15 m thick. These systems are heterogeneous but generally permeable with rapid recharge, through-flow and discharge associated with interactions with streams, and to a lesser extent with the underlying less permeable shallow rock. Hydraulic conductivity measurements range from 0.3 to 300 metres per day (m/d), averaging around 10 m/d.
2. **Shallow rock** comprising variably weathered and fractured Permian rocks extending to approximately 150 m below the surface, across all sub-cropping Permian units. The shallow rock zone is highly heterogeneous with relatively impermeable domains separated by more permeable domains, but on the whole it is more permeable that the deeper coal measures. The domains of higher permeability domains are due to a higher density of fracturing associated with an irregular weathering profile and the near-surface expression of faulting. The known aquifer zones occur within 75 m of surface. Groundwater flow within this zone is more strongly controlled by weathering and fracturing than the attitude of geological strata. Hydraulic conductivity of the shallow rock ranges from 10 m/d to $1x10^{-6}$ m/d at a depth of 150 m, but is typically in the order of 10^{-3} to 10^{-4} m/d.
3. **Deep Coal Measures interburden**. Sandstone and siltstone units that form interburden to coal seams are indurated and typically of very low permeability, forming aquitards and confining layers. Permeability of interburden decreases with depth such that, at the maximum depth of CSG production is likely to be in the order of 10^{-5} to 10^{-7} m/d, or less.
4. **Coal seams**. Coal seams tend to be slightly more permeable than interburden and commonly form weak water bearing zones. Permeability and storage are provided by small fractures and cleats in the coal. As with interburden, drill-stem tests clearly show that the permeability of coal seams generally decreases with depth. At the maximum depth of CSG production, the permeability of coal seams is very low (10^{-4}–10^{-6} m/d), but may be an order of magnitude higher than the interburden.

The Alum Mountain Volcanics underlie the Permian Coal Measures, and form the impermeable base of the Gloucester Basin. The Alum Mountain Volcanics outcrop in the eastern and western boundaries of the basin, forming the elevated topography of the Gloucester and Barrington Tops to the west, and the Mograni Range to the east.

3. Monitoring network and methodology

A groundwater and surface water monitoring network for the Stage 1 GFDA was established as part of the Phase 2 Groundwater Investigations (Parsons Brinckerhoff, 2012a). Additional monitoring has been installed as part of the *Hydrogeological Investigation of a strike-slip fault in the Northern Gloucester Basin* (Parsons Brinckerhoff, 2013b). There are now more than 40 dedicated water monitoring locations and more than 24 months of baseline monitoring (water levels and water quality) across the project area. Several high rainfall periods and one extended dry period have occurred to provide a data set that is representative of seasonal variability.

A review of the monitoring network detailing groundwater and surface water level and water quality trends for the period January 2011 to June 2013, and specifically for the monitoring period from 1 July 2012 to 30 June 2013, is presented in Chapters 4 and 5.

3.1 Monitoring network

3.1.1 Surface water

There are four AGL stream gauges constructed in the Stage 1 GFDA; three on the Avon River and one on Dog Trap Creek (Figure 3.1 and Table 3.1).

Table 3.1 AGL stream gauges in the Stage 1 GFDA

Stream gauge	Easting (MGA, m)	Northing (MGA, m)	Property location	Stream location
TSW01	401994	6449417	Tiedman	Avon River
TSW02	401922	6448741	Tiedman	Dog Trap Creek
ASW01	401711	6449092	Atkins	Avon River
ASW02	400698	6447963	Atkins	Avon River

3.1.2 Groundwater

Three types of groundwater monitoring bores have been constructed in the Stage 1 GFDA (Figure 3.1 and Table 3.2):

1. Bores targeting the shallow alluvial sediments of the Avon River and its floodplain.
2. Bores targeting the shallow bedrock.
3. Bores targeting the Gloucester Coal Measures, including the interburden and coal seams.

Table 3.2 AGL groundwater monitoring bores in the Stage 1 GFDA

Monitoring bore	Property location	Total depth (mbgl)	Screened interval (mbgl)	Lithology	Formation	Hydrogeolog-ical unit
S4MB01	Tiedman	66	58–64	Sandstone	Leloma Formation	Shallow rock
S4MB02	Tiedman	97	89–95	Sandstone/ siltstone	Leloma Formation	Shallow rock
S4MB03	Tiedman	170	162–168	Coal	Jilleon Formation – Cloverdale Coal Seam	Coal
S5MB01	Tiedman	60	52–58	Sandstone/ siltstone	Jilleon Formation	Shallow rock
S5MB02	Tiedman	114	110–102	Siltstone	Jilleon Formation	Shallow rock
S5MB03	Tiedman	166	158–164	Coal/shale	Jilleon Formation – Roseville Coal Seam	Coal
TMB01	Tiedman	12	7–10	Clay	Avon River Alluvium	Alluvial
TMB02	Tiedman	15.5	9–12	Mixed gravels	Avon River Alluvium	Alluvial
TMB03	Tiedman	12.5	5–11	Mixed gravels and sand	Avon River Alluvium	Alluvial
TCMB01	Tiedman	90	87–93	Sandstone	Leloma Formation	Shallow rock
TCMB02	Tiedman	183	175–181	Sandstone	Leloma Formation	Interburden
TCMB03	Tiedman	268	260–266	Coal and sandstone	Jilleon Formation – Cloverdale Coal Seam	Coal
TCMB04 (core hole)	Tiedman	334.7	327.3–333.3	Coal	Jilleon Formation – Roseville Coal Seam	Coal
AMB01	Atkins – Avondale	12.6	8–10	Mixed gravels	Avon River Alluvium	Alluvial
AMB02	Atkins – Avondale	11.5	6.5–11	Mixed gravels	Avon River Alluvium	Alluvial
BMB01	Bignell	30	15–29	Sandstone/ siltstone	Leloma Formation	Shallow rock
BMB02	Bignell	138	124–136	Sandstone	Leloma Formation	Shallow rock
WMB01	GRL – Waukivory	8.5	5–8	Mixed gravel/ sand	Alluvium	Alluvial
WMB02	GRL – Waukivory	23	15–21	Sandstone	Wenhams Formation	Shallow rock
WMB03	GRL – Waukivory	36	32–34	Coal	Wenhams Formation – Bowens Road Coal Seam	Shallow rock
WMB04	GRL – Waukivory	80.5	67–79	Sandstone	Wenhams Formation	Shallow rock
RMB01	Rombo	51	42–48	Sandstone	Leloma Formation (upper)	Shallow rock

Monitoring bore	Property location	Total depth (mbgl)	Screened interval (mbgl)	Lithology	Formation	Hydrogeolog-ical unit
RMB02	Rombo	93	85–91	Sandstone	Leloma Formation (upper)	Shallow rock
WKMB01	GRL – Forbesdale	54	47–53	Sandstone	Leloma Formation	Shallow rock
WKMB02	GRL – Forbesdale	61	51–60	Sandstone/ siltstone	Leloma Formation	Shallow rock
WKMB03	GRL – Forbesdale	210	200–209	Sandstone	Leloma Formation	Interburden
WKMB04	GRL – Forbesdale	360	335–347	Coal and sandstone	Jilleon Formation – Roseville Coal Seam	Coal
Farley #	Pontilands	N/A	N/A	N/A	N/A	N/A
TTPB	Tiedman	90	76–88	Sandstone/ siltstone	Leloma Formation	Shallow rock
TTMB01	Tiedman	90	76–88	Sandstone/ siltstone	Leloma Formation	Shallow rock
TTMB02	Tiedman	90	76–88	Sandstone/ siltstone	Leloma Formation	Shallow rock
TTMB03	Tiedman	198	186–199	Sandstone/ siltstone	Leloma Formation	Interburden

Water levels only are monitored at this site. No trends are discussed in this report (although the hydrograph trace is provided in the Appendix) as there are few details known about the construction of this old water bore.

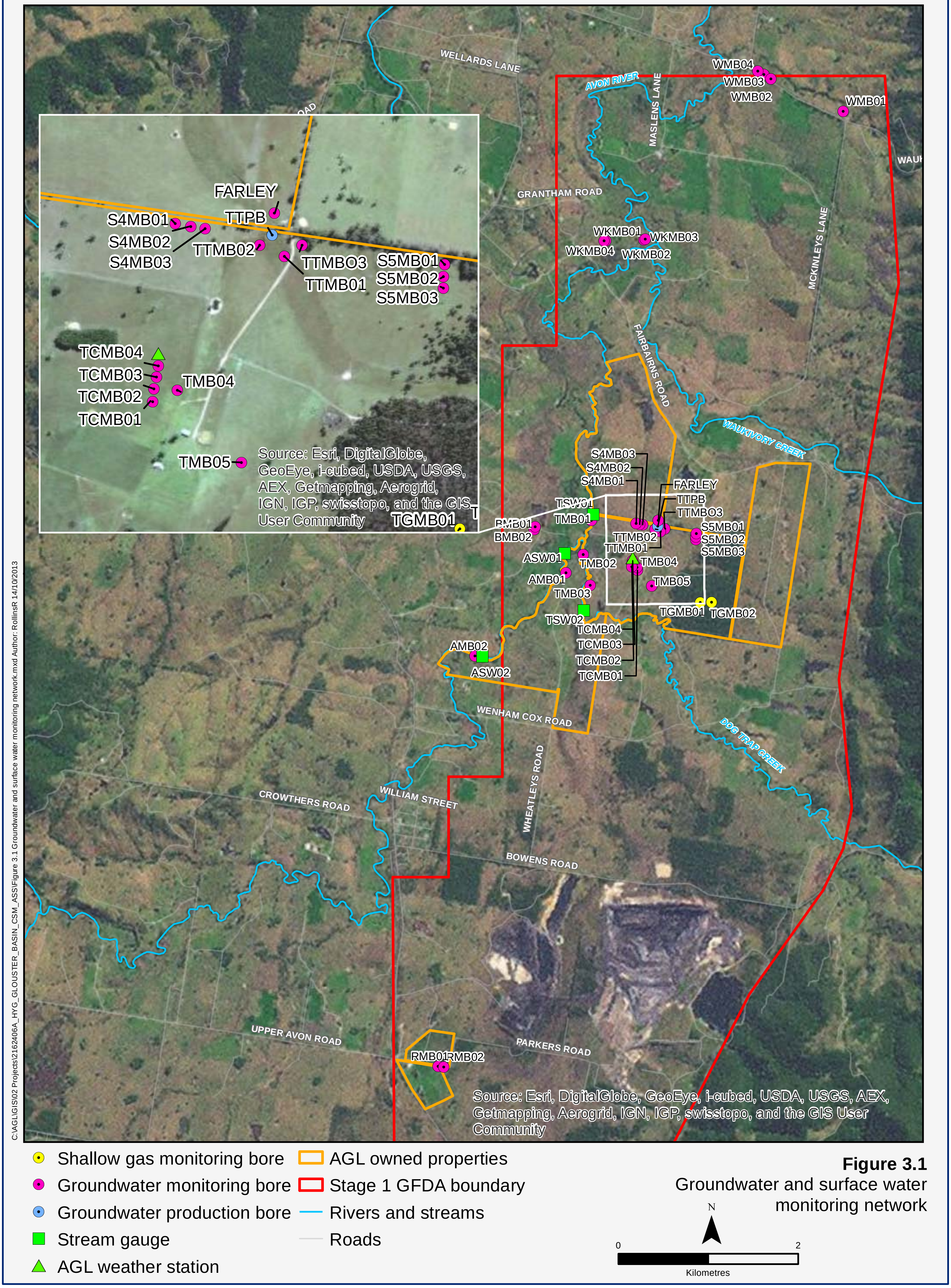


Figure 3.1
Groundwater and surface water monitoring network

3.2 Monitoring program

Groundwater level monitoring commenced in January 2011 and surface water level monitoring commenced in March 2011. The majority of the monitoring network has been in place since January 2011 as part of the Phase 2 Groundwater Investigations, as described in Parsons Brinckerhoff (2012a). The baseline water quality monitoring program includes two comprehensive sampling events, the first taking place between 4 April and 11 May 2011, and the second between 17 June and 3 July 2013.

All groundwater monitoring bores were sampled for water quality in June/July 2013, except TCMB03 and WKMB04. WKMB04 is currently capped and suspended awaiting a work-over program to reinstate it. TCMB03 is currently obstructed and can only be monitored for water levels. The datalogger at WKMB03 failed, but manual water level readings are available. The datalogger at TSW01 also failed between September 2012 and June 2013. Monitoring network details are provided in Figure 3.2.

Figure 3.2 Summary of current water level monitoring locations and data collection periods

3.3 Water level monitoring

3.3.1 Surface water levels

Dataloggers are installed at the stream gauges to monitor water levels and salinity every 15 minutes. Water level and salinity (electrical conductivity) measurements are verified by manual gauge board readings and electrical conductivity (EC) monitoring. The duration of monitoring for each of the stream gauges is shown in Figure 3.2.

3.3.2 Groundwater levels

Dataloggers are installed in each of the groundwater monitoring bores to monitor groundwater levels every 6 hours. To calibrate the level recorded by the dataloggers, manual groundwater level measurements are recorded every three (3) months using an electronic dip meter. The duration of monitoring for each of the groundwater bores is shown in Figure 3.2.

A barometric datalogger installed above the water table at S5MB01 records changes in atmospheric pressure. Data from this logger are used to correct for the effects of changing barometric pressure and barometric efficiency on groundwater levels.

Measured water levels in bores can be influenced by atmospheric pressure fluctuations in two main ways: Firstly, automated dataloggers measure absolute pressure including the atmospheric pressure that acts on the water column in the bore. Logger data are therefore corrected for this effect (manual water measurements do not need this correction). Secondly, in confined or semi-confined aquifers, changes in atmospheric pressure can cause water in the bore to be forced into (during a pressure increase), or drawn from (pressure decrease) elastic aquifer storage, thereby affecting the measured water level. Groundwater level data presented in this report have also been corrected to remove these responses so that any anthropogenic groundwater influences (such as pumping) can be more easily identified.

Atmospheric pressure fluctuates over daily to weekly periods as weather systems pass over the site. In general, the mean atmospheric pressure is slightly higher, and the amplitude of pressure fluctuation (between high and low pressure systems) larger in the winter than in the summer months. The amplitude of pressure fluctuation can be 20 mbar in the summer months and up to 30 mbar during the winter months. Given that 1 mbar is equivalent to 1.02 cm of water depth, atmospheric pressure fluctuations can result in observed bore level fluctuations of up to 20 to 30 cm, depending on the barometric efficiency of the bore. As noted above, this effect has been removed from the monitoring data presented here.

3.4 Water quality monitoring

3.4.1 Methodology

Surface water samples for water quality analysis were taken from the river bank using a telescopic sampler. Samples were collected from the deepest part of the channel in order to be representative of water quality conditions at the time of sampling.

Three methods were used to obtain groundwater quality samples from the monitoring bores. Methods were selected based on the permeability of the screened formation of each bore determined from the hydraulic testing. Higher yielding monitoring bores were purged and sampled using a submersible pump. Lower yielding bores were sampled using a low flow pump.

In summary:

- submersible pumps were used in monitoring bores: AMB01, AMB02, TMB01, TMB02, TMB03, BMB01, WMB01 and WMB02
- a micro-purge™ low flow sampling pump was used in monitoring bores: S4MB02, S5MB02, BMB02, TCMB01, TCMB03, WKMB01, WKMB02, WKMB03, TTPB and TTMB03
- discrete depth double-valve bailer was used in monitoring bores: S4MB01, S4MB03, S5MB01, S5MB03, TCMB02, TCMB04, WMB03, WMB04, RMB01, RMB02, WKMB01, WKMB02, WKMB03, TTMB01 and TTMB02.

Submersible pumps and disposable bailers were used to purge a minimum of three well volumes from the first group of monitoring bores prior to sampling to allow a representative groundwater sample to be collected. If purged until dry the bore was allowed to recharge before the remaining water was removed. Water quality parameters were measured during and following purging to monitor water quality changes and to indicate representative groundwater suitable for sampling and analysis.

For lower yielding bores and selected deeper bores with high purge volumes, a micro-purge™ low flow sampling system or double-valve bailer was deployed. The micro-purge™ system allows groundwater to be drawn into the pump intake directly from the screened portion of the aquifer, eliminating the need to purge relatively large volumes of groundwater from these bores. Water quality parameters were monitored during the micro-purge™ pumping to ensure that a representative groundwater sample was collected.

The following physical water quality parameters were measured in the field using a calibrated YSI water quality meter:

- Electrical conductivity (EC) – µS/cm.
- Temperature – °C.
- Dissolved oxygen (DO) – % saturation and mg/L.
- Oxidation reduction potential (ORP) – mV.
- pH – pH units.
- Total dissolved solids (TDS) – mg/L.

Surface water and groundwater samples collected in the field were analysed for a broad chemical suite designed specifically to assess the chemical characteristics of the different surface water and groundwater systems at each of the monitoring sites.

Water quality samples were collected in the sample bottles provided by the laboratory, with the appropriate preservation when required. Table 3.4 details the sample bottles used. Samples undergoing dissolved metal analysis were filtered through 0.45 µm filters in the field prior to collection. Samples were sent to the following laboratories under appropriate chain-of-custody protocols to the Australian Laboratory Service (ALS) Environmental Pty Ltd, Smithfield, Sydney, a. NATA certified laboratory.

Additional water samples are collected for the freshwater and produced water holding dams on the Tiedman property (and the nearby seepage monitoring bores). This water quality data is reported in the irrigation trial monitoring reports (Parsons Brinckerhoff, 2013c and 2013d) rather than this annual monitoring report.

3.4.2 Assessment criteria

All results have been compared against the ANZECC (2000) guidelines for freshwater ecosystems (south-east Australia – lowland rivers) because the rivers are the ultimate receiving waters for both surface water runoff and groundwater discharge. However, these water guidelines are often naturally exceeded in catchments with rocks deposited in marine environments, hence they are only guidelines and not strict criteria that should be used to evaluate individual water quality results. This is the case for the Avon River catchment which contains shallow marine and estuarine sedimentary rocks and is a known saline catchment.

Table 3.3 Analytical suite

Category	Parameters	
Field parameters	EC	Redox potential
	Temperature	pH
	Dissolved oxygen	
General parameters	EC	Total dissolved solids (TDS)
	Total suspended solids	
Major ions	Calcium Magnesium Sodium Potassium	Chloride Bicarbonate Sulphate Dissolved silica
Metals and minor/trace elements	Aluminium Arsenic Barium Boron Beryllium Bromine Cadmium Cobalt Copper Iron	Manganese Molybdenum Mercury Nickel Lead Selenium Strontium Uranium Vanadium Zinc
Nutrients	Total nitrogen Ammonia Phosphorus (reactive)	Nitrate Nitrite Total organic carbon (TOC)
Hydrocarbons	Phenol compounds Polycyclic aromatic hydrocarbons (PAH)	Total petroleum hydrocarbons (TPH)/total recoverable hydrocarbons (TRH) Benzene, toluene, ethyl benzene and xylenes (BTEX)
Dissolved gases	Methane	

Table 3.4 Sample bottles

Category	Sample bottle
Major cations/anions	1 x 1 L plastic, unpreserved
Dissolved metals	1 x 60 mL plastic, preserved
Nutrients	1 x 125 mL plastic, preserved
TOC	1 x 40 mL amber glass, preserved
Phenols/PAH/TPH (C_{10}–C_{36})	1 x 500 mL amber glass, unpreserved
TPH (C_6–C_9)/BTEX	2 x 40 ml amber glass, preserved
Methane	2 x 40 ml amber glass, preserved

4. Surface water monitoring

4.1 Surface water levels

All AGL stream gauges on the Avon River and Dog Trap Creek show sharp increases in water level in response to rainfall events, in particular the high rainfall events in June 2011, February 2012 and February 2013 (Figure 4.1). The hydrographs also show relatively steep recession curves. This is characteristic of rapid runoff responses from a relatively small upstream catchment and limited riverbank storage and groundwater contributions. Stream levels and flow decrease over several weeks following each rainfall event to a relatively consistent base level that represents a small baseflow component in the Avon River.

During monitoring, a period of anomalously low rainfall occurred in the months leading up to summer (September and October 2012). This resulted in a period of ‘no flow’ or very low flow, when the river was characterised by multiple disconnected pools from September 2012 to January 2013 (Figure 4.1). The high rainfall events in January and February 2013 resulted in a rapid return to flow in the Avon River and Dog Trap Creek and corresponding sharp increase in water levels. It is apparent that periodic and relatively frequent high rainfall events are required to recharge the alluvial groundwater system and sustain baseflow recessions over the following months. This suggests that the alluvial system is of limited storage and is rapidly depleted in the absence of rainfall recharge and replenished in response to rainfall events.

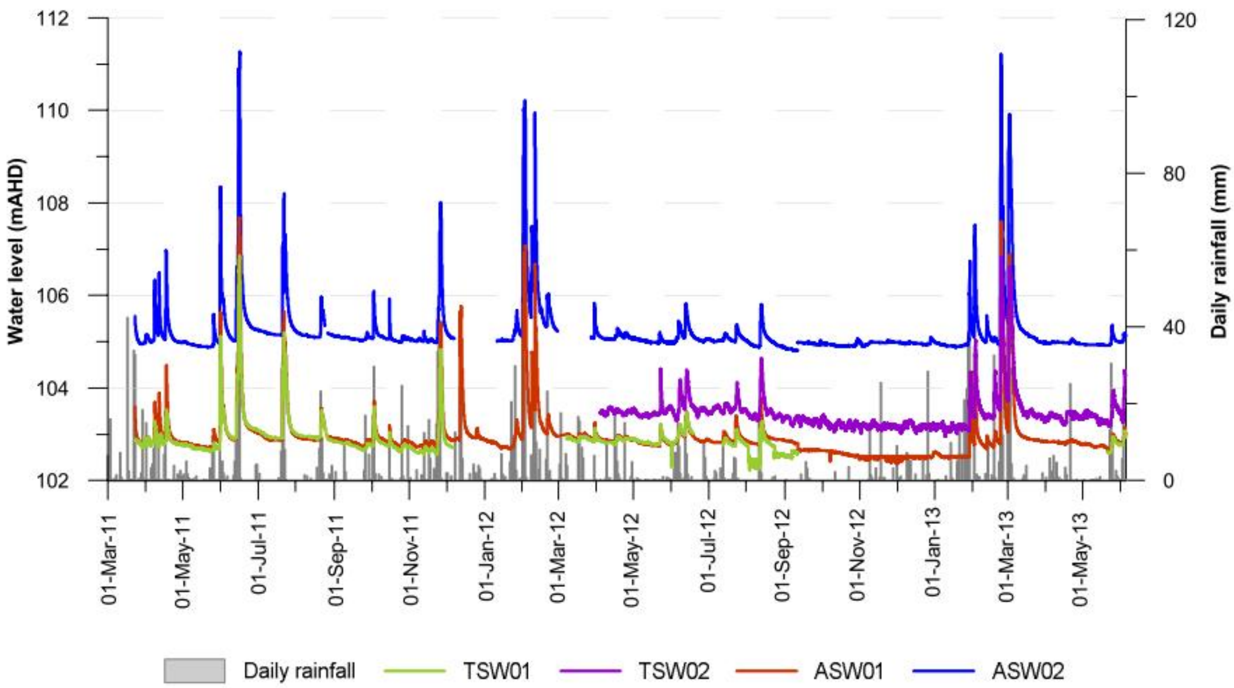


Figure 4.1 Avon River and Dog Trap Creek stream level data and rainfall

4.2 Surface water EC monitoring

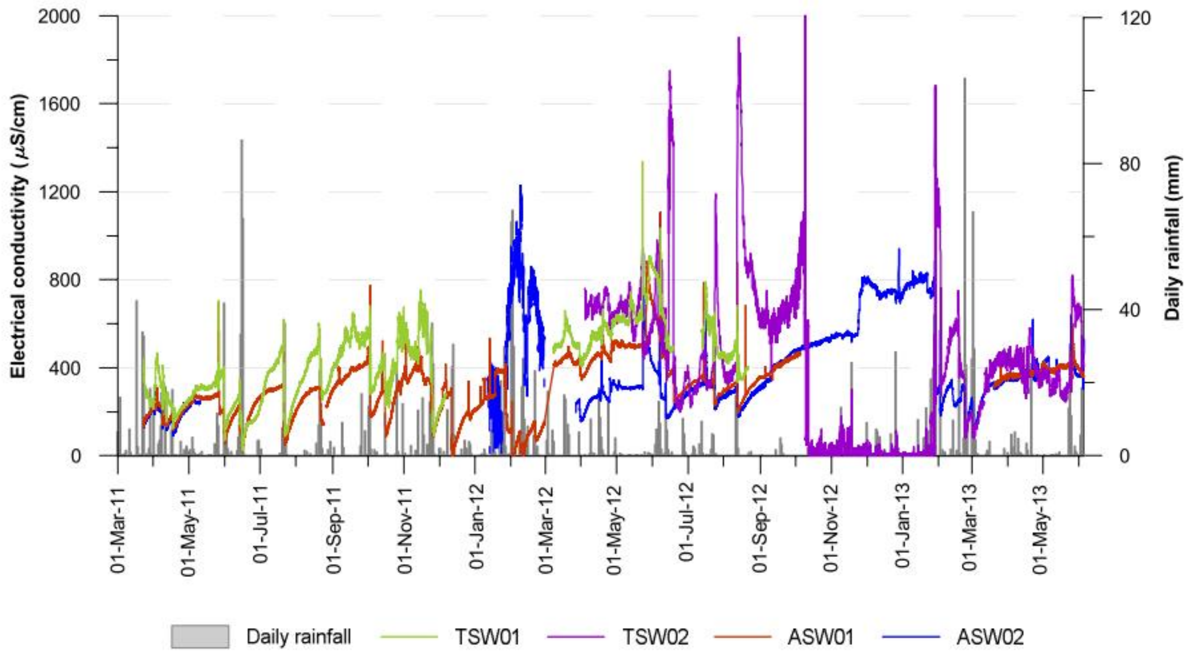


Figure 4.2 EC measurements and rainfall in the Avon River and Dog Trap Creek

Surface water salinity is inversely correlated with rainfall and flow (Figure 4.2). In general, surface water salinity measured as electrical conductivity (EC) sharply decreases after rainfall events as relatively fresh runoff is routed into streams. However an initial spike (sudden transient increase) in EC is often seen in the initial runoff phase as readily dissolvable salts are flushed from the ground surface and shallow soils of the catchment area. After the initial salinity spike and subsequent reduction in EC levels, the EC then gradually increases as flow decreases during periods of recession and groundwater discharge starts to become a more dominant component of flow. Evaporative concentration of salts may also be taking place in residual and connected pools.

During monitoring, a period of anomalously low rainfall occurred in the months leading up to summer in 2013, which resulted in a period of ‘no flow’ or very low flow, when the river was characterised by multiple disconnected pools from September 2012 to January 2013. EC measurements from this period are therefore not considered to be representative of the salinity of flowing water in the Avon River and Dog Trap Creek. The EC logger at TSW01 failed between September 2012 and June 2013, and the EC logger at ASW01 failed between September 2012 and March 2013.

Table 4.1 shows the range and average of the salinity data (from the EC loggers) at each of the surface water monitoring sites during the 2012/13 monitoring period. Surface water salinity increases downstream along the Avon River, with the lowest average salinities observed at ASW02 on the Avon River. The salinity of water from Dog Trap Creek is generally higher. The highest average salinities are observed at TSW01, the furthest downstream site on the Avon River (and downstream of the confluence with Dog Trap Creek).

Table 4.1 Maximum, minimum and average EC for surface water monitoring locations for the monitoring period (July 2012 to June 2013)

Location	River/creek	Minimum EC (µS/cm)	Maximum EC (µS/cm)	Average EC (µS/cm)
ASW01	Avon River	98	880	385
AWS02	Avon River	88	889	312
TWS01	Avon River	59	885	413
TWS02	Dog Trap Creek	80	1,900	408

4.3 Surface water quality

Water quality results for the surface water quality event are summarised and compared to the ANZECC (2000) guidelines for freshwater ecosystems (south-east Australia – lowland rivers) in Table 4 2. The ANZECC (2000) guidelines do not necessarily represent the expected water quality in naturally saline catchments such as the Avon River catchment. Section 7.4.4.1 of the ANZECC guidelines recommends that site specific guideline values are derived from local reference data, based on a minimum of two years of monitoring data at the reference site to establish a valid threshold taken at the 80th percentile.

All results for the June/July 2013 sampling event are presented in Appendix B. Laboratory reports are included in Appendix C. Sampling occurred during a relatively dry month, although rainfall was slightly above average in June 2013.

Table 4.2 Surface water quality summary for June/July 2013 monitoring event

Parameters	Units	ANZECC (2000) guidelines[a]	Surface water range	Surface water average[c]
Water quality parameters				
Field EC	µS/cm	125–2,200[b]	418–660	583
Field pH	pH units	6.5–8.0[b]	6.95–7.42	7.17
Redox	mV	–	-75.5 to –97.8	-89.5
Major ions				
Calcium	mg/L	–	14–16	15
Magnesium	mg/L	–	9–16	12.5
Sodium	mg/L	–	49–86	74.5
Potassium	mg/L	–	3–5	3.75
Chloride	mg/L	–	84–145	126
Sulphate	mg/L	–	10–55	30.75
Total alkalinity as $CaCO_3$	mg/L	–	22–64	46
Metals				
Aluminium	mg/L	0.055 (pH>6.5)	0.04–**1.57**	**0.51**
Arsenic	mg/L	0.013 (AsV), 0.024 (AsIII)	<0.001	<0.001

Parameters	Units	ANZECC (2000) guidelines[a]	Surface water range	Surface water average[c]
Barium	mg/L	–	0.087–0.261	0.147
Beryllium	mg/L	ID	<0.001	<0.001
Cadmium	mg/L	0.0002	<0.0001	<0.0001
Copper	mg/L	0.0014	<0.001–**0.006**	**0.002**
Lead	mg/L	0.0034	<0.002–0.001	0.0007
Manganese	mg/L	1.9	0.037–0.07	0.057
Molybdenum	mg/L	ID	<0.001	<0.001
Nickel	mg/L	0.011	<0.001–0.01	0.003
Selenium	mg/L	0.011 (total)	<0.01	<0.01
Strontium	mg/L	–	0.28–0.573	0.378
Uranium	mg/L	ID	<0.001	<0.001
Vanadium	mg/L	ID	<0.01	<0.01
Zinc	mg/L	0.008	**0.046–0.177**	**0.113**
Iron	mg/L	ID	<0.05	<0.05
Bromine	mg/L	ID	0.2–0.3	0.275
Nutrients				
Nitrite as N	mg/L	0.02[b]	<0.01	<0.01
Nitrate as N	mg/L	0.7	<0.01–0.1	0.04
Ammonia as N	mg/L	0.02[b]	<0.01	<0.01
Total Phosphorous as P	mg/L	0.05[b]	<0.01–0.03	0.015
Reactive Phosphorous as P	mg/L	0.02[b]	<0.01	<0.01
Total Organic Carbon	mg/L	–	4–6	5.25
Hydrocarbons				
Phenolic compounds	µg/l	–	<1.0	<1.0
Polycyclic aromatic hydrocarbons	µg/l	–	<1.0	<1.0
Monocyclic aromatic hydrocarbons				
Benzene	µg/l	950	<1	<1
Toluene	µg/l	ID	<2	<2
Ethyl Benzene	µg/l	ID	<2	<2
m&p-Xylenes	µg/l	ID	<2	<2
o-Xylenes	µg/l	350	<2	<2
Total petroleum hydrocarbons				
C_6–C_9	µg/l	–	<20	<20

Parameters	Units	ANZECC (2000) guidelines[a]	Surface water range	Surface water average[c]
C_{10}–C_{14}	µg/l	–	<50	<50
C_{15}–C_{29}	µg/l	–	<100	<100
C_{29}–C_{36}	µg/l	–	<50	<50
Dissolved gases				
Methane	µg/l	–	14–15	14.5

a ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: 95% protection levels (trigger values).

b ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: trigger values for lowland rivers in south-east Australia

c To calculate the average, values below detection limit are included in the calculation as half the LOR.

BOLD indicates a value outside of the ANZECC (2000) guideline range.

ID indicates insufficient data for trigger value to be established

4.3.1 Field parameters

Surface water salinity is fresh (<800 µS/cm). Electrical conductivity (EC) values are within the ANZECC (2000) guideline values for lowland rivers in south-east Australia (125–2,200 µS/cm).

The pH at each of the surface water locations is neutral and is within the ANZECC (2000) guideline value. The pH is consistent with the previous monitoring event in which the pH was slightly acidic at ASW01 and ASW01 and slightly alkaline at TSW01.

Redox values range from -75.5 to -97.8 mV, indicating reducing conditions.

Table 4.3 summarises the major ion chemistry of the surface water locations for the 2011 and 2013 monitoring events. Generally the major ion chemistry of the surface water is dominated by sodium, chloride and bicarbonate (ASW01 and ASW02 only). The major ion chemistry at TSW01 differs from the previous monitoring event.

A piper diagram is a graphical representation of the chemistry of a water sample and can be used to graphically show the relative concentrations of major ions (Ca^{2+}, Mg^{2+}, Na^{2+}, K^{+}, Cl^{-}, HCO_3^{-}, and SO_4^{2-}). Major ion chemistry for all surface water samples is shown on the piper diagram in Figure 4.3.

Table 4.3 Major ion chemistry of surface water locations

Location	Major ion chemistry – 2011	Major ion chemistry – 2013
ASW01	Na-Cl-HCO_3	Na-Cl-HCO_3
AWS02	Na-Cl-HCO_3	Na-Cl-HCO_3
TWS01	Na-Mg-Cl- HCO_3	Na-Cl
TWS02	N/A	Na-Mg-Cl-SO_4

Notes:

N/A – no data available

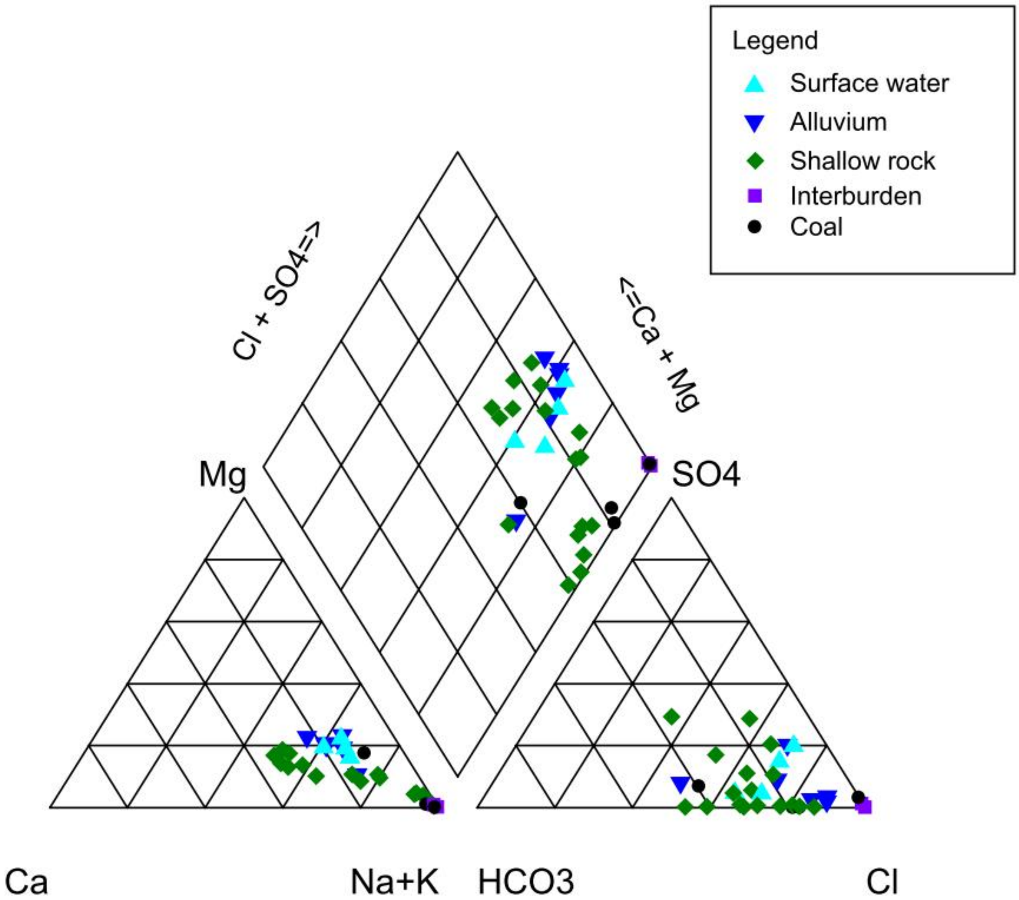


Figure 4.3 Piper diagram showing major ion composition of groundwater and surface water for June/July 2013 monitoring event

4.3.2 Dissolved metals

The major findings of dissolved metal analysis for surface water are as follows:

- Aluminium concentrations were detected above the ANZECC (2000) guideline value at three of the surface water monitoring locations. The highest concentration detected was 1.57 mg/L (AWS02). This is consistent with the previous monitoring event (2011).
- Copper concentrations were detected above the ANZECC (2000) guideline value at AWS02 (0.006 mg/L). This is consistent with the previous monitoring event.
- Zinc concentrations were detected above the ANZECC (2000) guideline value for all monitoring locations. The highest concentration recorded was 0.177 mg/L (AWS02). This is consistent with the previous monitoring event.
- Dissolved metal concentrations, including barium, manganese, nickel, strontium, iron, bromide, were detected at all monitoring locations, but below the ANZECC (2000) guideline values. This is consistent with the previous monitoring period.
- Arsenic, beryllium, cadmium, molybdenum, selenium, uranium and vanadium concentrations were all below the laboratory limit of reporting (LOR).

4.3.3 Nutrients

Nitrate concentrations were slightly elevated at the surface water monitoring locations, but are below the ANZECC (2000) guideline value. Total phosphorus was slightly elevated at AWS01 and TSW01, although below the ANZECC (2000) guideline value. Total organic carbon was detected at each of the surface water monitoring locations. Nitrite as N, ammonia as N and reactive phosphorus were all below the laboratory LOR. Overall nutrient concentrations decreased from the previous monitoring event (2011), in which the ANZECC (2000) guideline values for ammonia, total and reactive phosphorus were exceeded.

4.3.4 Hydrocarbons

Phenolic compounds, polycyclic aromatic hydrocarbons, petroleum hydrocarbons and BTEX were not detected (i.e. are less than the LOR) at any of the surface water monitoring locations.

4.3.5 Dissolved gases

Dissolved methane concentrations were detected at two of the surface water monitoring locations (AWS01 and AWS02), with an average concentration of 14.5 µg/l.

5. Groundwater monitoring

5.1 Groundwater levels

5.1.1 Overview

A summary of the groundwater monitoring bores in each hydrogeological unit is presented in Table 5.1.

Table 5.1 Summary of groundwater monitoring bores

Hydrogeological unit	No. of bores	Monitoring bores	Hydraulic characteristics
Alluvium	6	TMB01, TMB02, TMB03, AMB01, AMB02, WMB01	Heterogeneous, highly variable permeability associated with varying lithology
Shallow rock	17	S4MB01, S4MB02, S5MB01, S5MB02, TCMB01, BMB01, BMB02, WMB02, WMB03, WMB04, RMB01, RMB02, WKMB01, WKMB02, TTPB, TTMB01, TTMB02	Heterogeneous, high and low permeability domains associated with fault zones and fracturing
Interburden	2	TCMB02, TTMB03, WKMB03	Low permeability associated with sparse fractures, permeability decreases with depth
Coal	5	S4MB03, S5MB03, TCMB03[a], TCMB04, WKMB04[b]	Low permeability associated with cleating and fractures in coal seams, permeability decrease with depth

a TCMB03 is currently obstructed and unable to be sampled for water quality.

b WKMB04 is currently capped and suspended awaiting a work-over program to reinstate it.

5.1.2 Groundwater – surface water interaction

When comparing stream gauge data with adjacent groundwater level data, it is observed that the Avon River and Dog Trap Creek are gaining systems in the central Stage 1 GFDA under most climatic conditions (Figure 5.1). Groundwater levels are typically higher than adjacent stream levels (by between one and two metres), indicating that the streams are discharge features for shallow groundwater. It is only during relatively short periods of high stream water levels, associated with rainfall events and floods, that shallow alluvial groundwater is recharged from the streams.

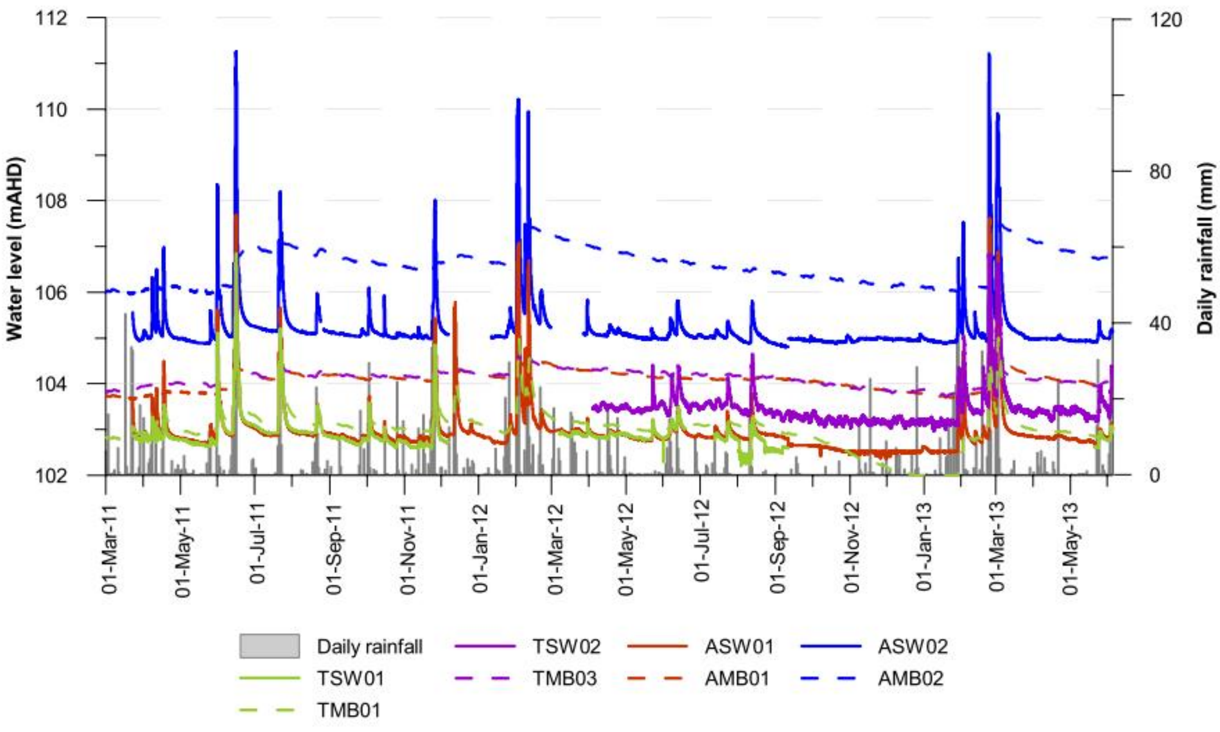


Figure 5.1 Surface water hydrographs for the Avon River and Dog Trap Creek (solid lines) and groundwater levels in the adjacent alluvium (dashed lines)

5.1.3 Temporal trends

Groundwater level trends in monitoring bores vary depending on the lithology and depth of the screened interval. No groundwater level responses to private bore abstraction or flow testing programs were observed during the monitoring period, with the exception of planned test pumping and slug testing of the AGL monitoring bores. Drawdown and recovery responses observed in the groundwater hydrographs in December 2011 correspond to sampling events carried out as part of the *Hydrogeological Investigation of a strike-slip fault in the northern Gloucester Basin* (Parsons Brinckerhoff 2013b).

5.1.3.1 Alluvium

Groundwater levels in monitoring bores screened within the alluvial aquifers show characteristic quick responses to rainfall events (Figure 5.2). This indicates rapid shallow aquifer recharge via direct rainfall infiltrations and/or enhanced infiltration during creek high flow and flood events. Groundwater fluctuations over the monitoring period range from ~0.5 m to ~3 m.

The groundwater level hydrographs can be divided into two main response types:

1. Rapid recharge response followed by a relatively steep groundwater recession curve (TMB01, TMB02, WMB01). These monitoring bores show rapid response to most rainfall events followed by a return to near-previous levels over a period of one to two months (i.e. a short term increase in storage). These responses imply a relatively direct recharge from rainfall and/or flooding and relatively high permeability of the alluvium.
2. A threshold response followed by a longer recession curve (TMB03, AMB01, AMB02). These monitoring bores show rapid recharge responses to the larger rainfall events, but slower responses to smaller rainfall events. In addition, the recession curves are flatter such that the groundwater level may take several months to recover to pre-existing levels and typically does not fully recover before the next major recharge event (i.e. longer term increase in storage). These responses imply rapid recharge during surface runoff and flooding events, but less significant recharge by rainfall alone. The shallow

recession curves imply lower permeability of the alluvium at these locations. This is supported by lithological records at these locations which indicate clay-rich alluvium, or thick clay layers overlying coarser grained alluvial deposits.

All alluvial monitoring bores show a decrease in groundwater levels from September 2012 to January 2013, corresponding to the lower than average rainfall over this period. This decrease is approximately 0.5 m in all bores except TMB01, which shows a greater decrease of 1.5 m. Groundwater levels in all alluvial monitoring bores show a sharp increase in groundwater levels in response to the high rainfall events in January and February 2013, ranging from ~1 m to ~3 m.

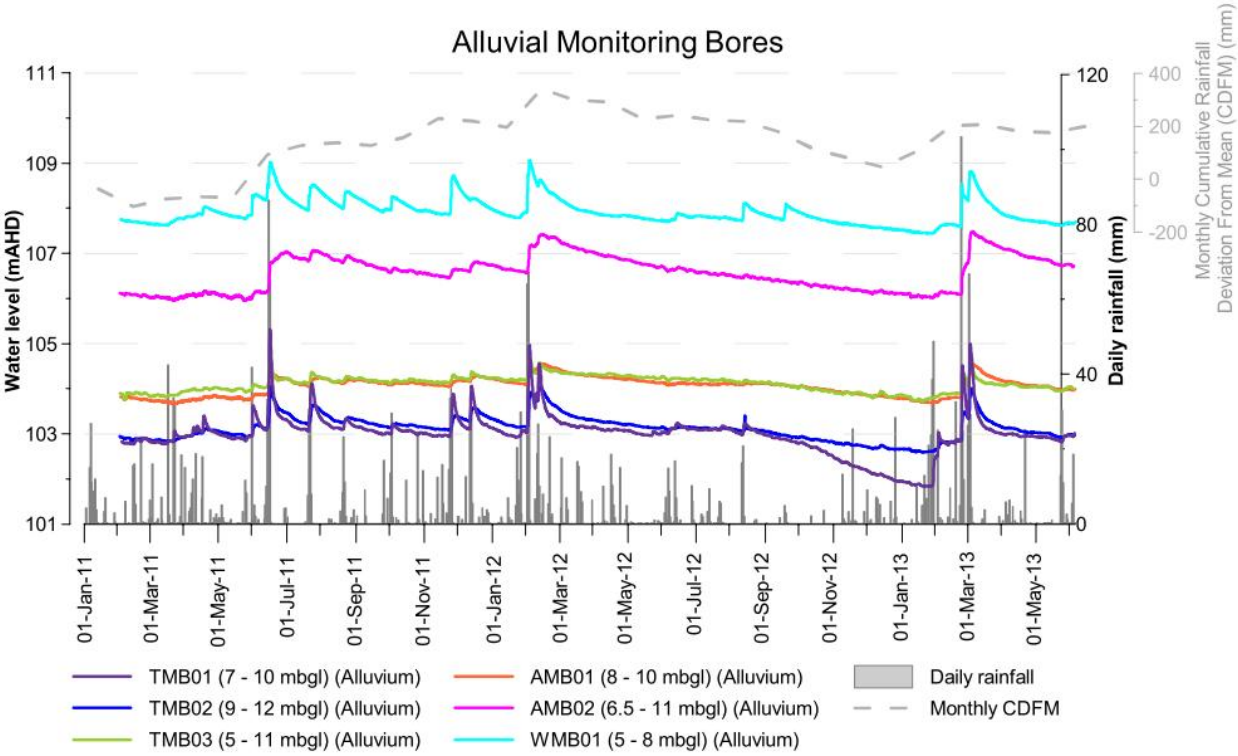


Figure 5.2 Groundwater levels and rainfall in the alluvial monitoring bores

5.1.3.2 Shallow rock

Monitoring bores screened within the shallow rock are present at all of the nested monitoring sites. There are no strong responses to individual rainfall events in the shallow rock monitoring bores, with the exception of the WKMB site. There is a delayed response to periods of higher than average rainfall, indicating that groundwater levels are responding to slow rainfall recharge over a broad area, assumed to be up-gradient of the monitoring locations.

The shallow rock hydrographs at the S4MB (Figure 5.3), TCMB (Figure 5.4), TTMB (Figure 5.5) and WMB (Figure 5.6) sites show a gradual increase in groundwater levels between ~0.2 m and ~0.5 m over the period February 2011 to September 2012, reflecting a delayed recharge response to the period of higher than average rainfall from the start of monitoring until February 2012. There is a gradual decrease in groundwater levels between ~0.2 m and ~0.5 m over the period September 2012 to January 2013, reflecting a delayed response to the period of lower than average rainfall from February 2012 to December 2012. At the S4MB, TCMB, TTMB and WMB sites, groundwater levels do not show a significant response to the high rainfall events in January and February 2013. From January 2013 to June 2013 groundwater levels remain fairly constant, with fluctuations of less than ~0.2 m.

At the BMB (Figure 5.7) and RMB (Figure 5.8) sites groundwater levels reflect the monthly cumulative deviation from mean rainfall plot, with groundwater levels changing in response to cumulative rainfall with a delay of approximately one month. Groundwater levels increase by ~0.4 m from February 2013 to March 2013 in response to the high rainfall events in January and February 2013. From April 2013 to June 2013 groundwater levels remain constant at the BMB site, and decrease at the RMB site.

S5MB01 (Figure 5.9) shows a very a slow recovery to the sampling events in March 2011 and June 2012, and therefore does not provide useful information on baseline groundwater trends. The slow recovery from purging suggests that the shallow rock in this area has very low permeability. Shallow rock monitoring bore S5MB02 shows a gradual increase of ~0.2 m from March 2011 to June 2013, with no overall response to the cumulative rainfall trends. This also suggests very low permeability in the shallow rock at this location.

Monitoring bores in the shallow rock at the WKMB site (Figure 5.10) show an increase in groundwater levels of ~0.5 m to ~2.5 m in response to the high rainfall events in January and February 2013. The reasons for the apparent larger recharge responses at this location are uncertain at this time.

5.1.3.3 Interburden units

The interburden monitoring bores TCMB02 (Figure 5.4) and TTMB03 (Figure 5.5) do not show an overall increase or decrease in groundwater levels over the monitoring period. There are no strong responses to individual rainfall events. TCMB02 and TTMB03 show a gradual increase of ~0.1 m in response to high rainfall events in January and February 2013, indicating that groundwater levels are responding to slow rainfall infiltration over a broad area, assumed to be up-gradient of the monitoring bores.

The datalogger in interburden monitoring bore WKMB03 failed, but manual readings are available (Figure 5.10). Groundwater levels increased by ~0.5 m from September 2012 to June 2013.

5.1.3.4 Coal seams

Monitoring bores in the coal seams at the TCMB (Figure 5.4) and S5MB (Figure 5.9) sites show a gradual increase in groundwater levels of ~0.2 m to ~0.7 m between January 2011 and June 2013. This increase may reflect a longer-term period of higher than average rainfall (from 2006 to 2012), indicating that groundwater levels are responding to slow recharge over a broad area, assumed to be up-gradient of the monitoring bores.

Groundwater levels in the coal seam monitoring bore S4MB03 show a similar response to the shallow rock monitoring bores at this nested S4MB site. Groundwater levels increase overall from February 2011 to September 2012 in a delayed response to higher than average rainfall, and the high rainfall event in February 2012. Groundwater levels then decrease ~0.5 m from September 2012 to January 2013 in response to the period of lower than average rainfall. This decrease is greater than at the shallow rock monitoring bores S4MB01 and S4MB02 at this site, and starts approximately one month after the end of flow testing of the nearby Stratford 4 well that was part of the *Hydrogeological Investigation of a strike-slip fault in the northern Gloucester Basin* (Parsons Brinckerhoff, 2013b). Groundwater levels at S4MB03 increase by ~0.2 m in response to the large rainfall events of January and February 2013, and then remain constant to June 2013.

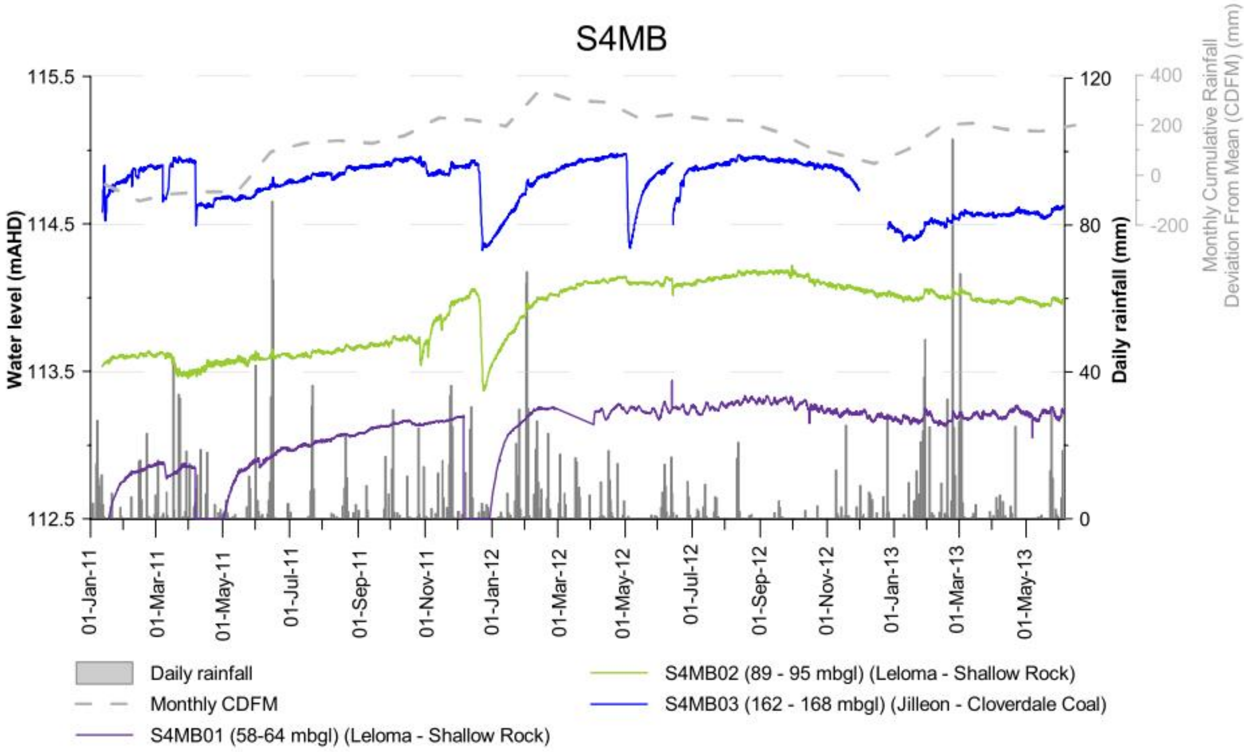


Figure 5.3 Groundwater levels and rainfall at the S4MB site

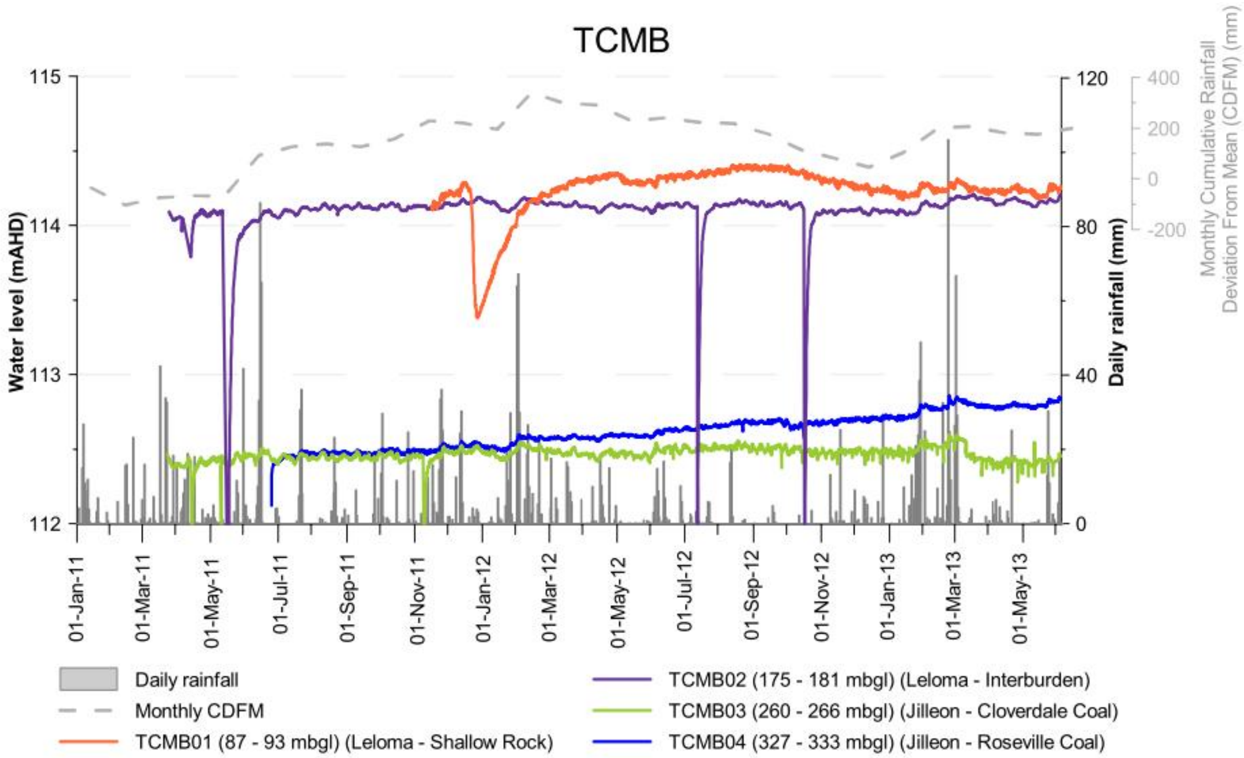


Figure 5.4 Groundwater levels and rainfall at the TCMB site

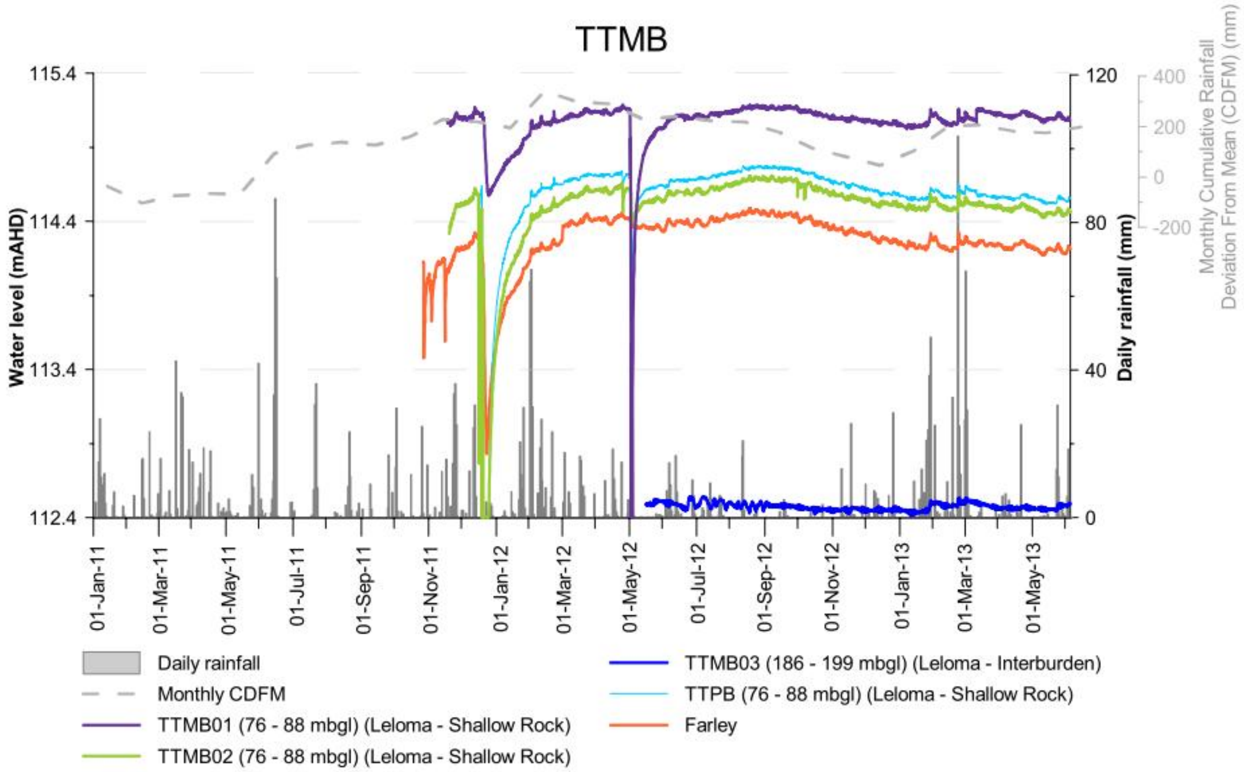


Figure 5.5 Groundwater levels and rainfall at the TTMB site

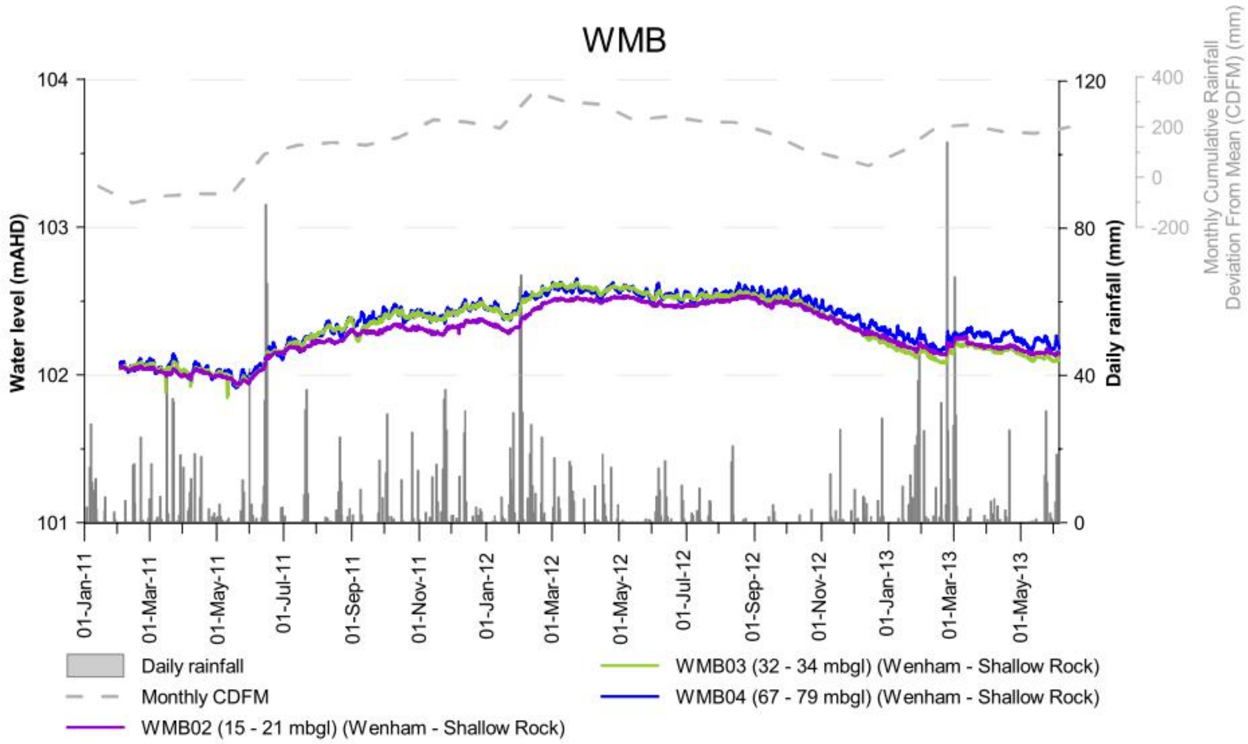


Figure 5.6 Groundwater levels and rainfall at the WMB site

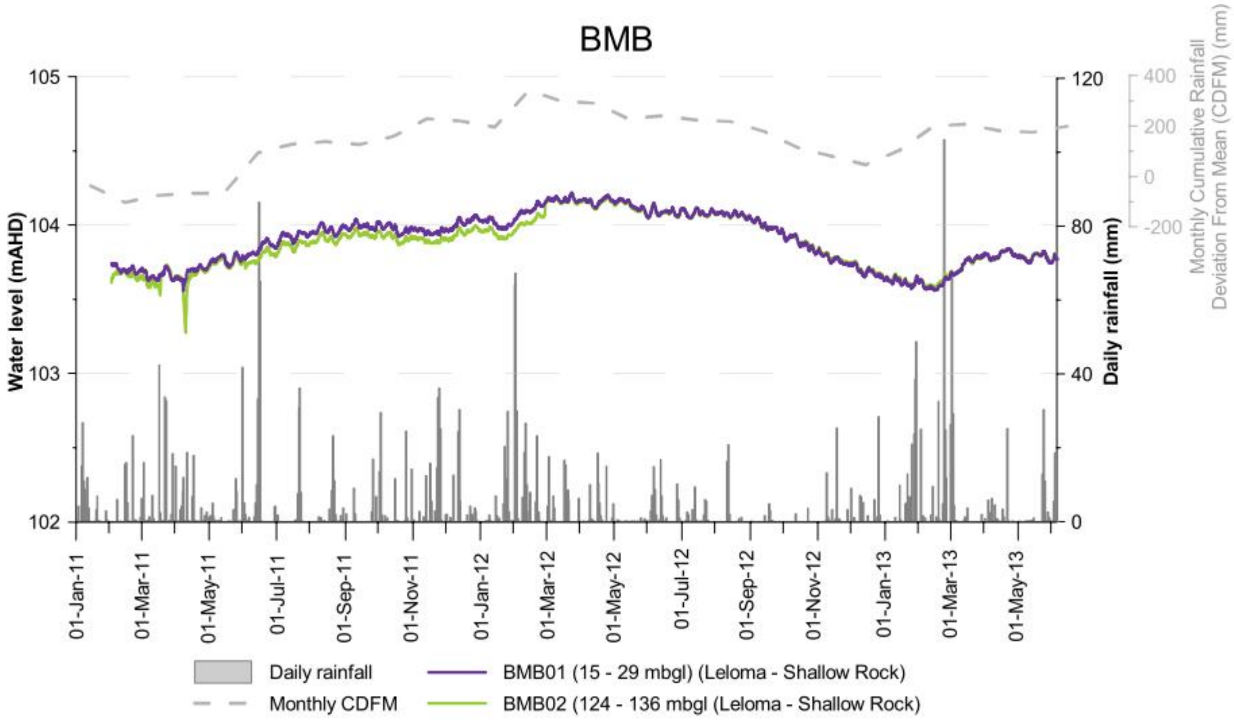


Figure 5.7 Groundwater levels and rainfall at the BMB site

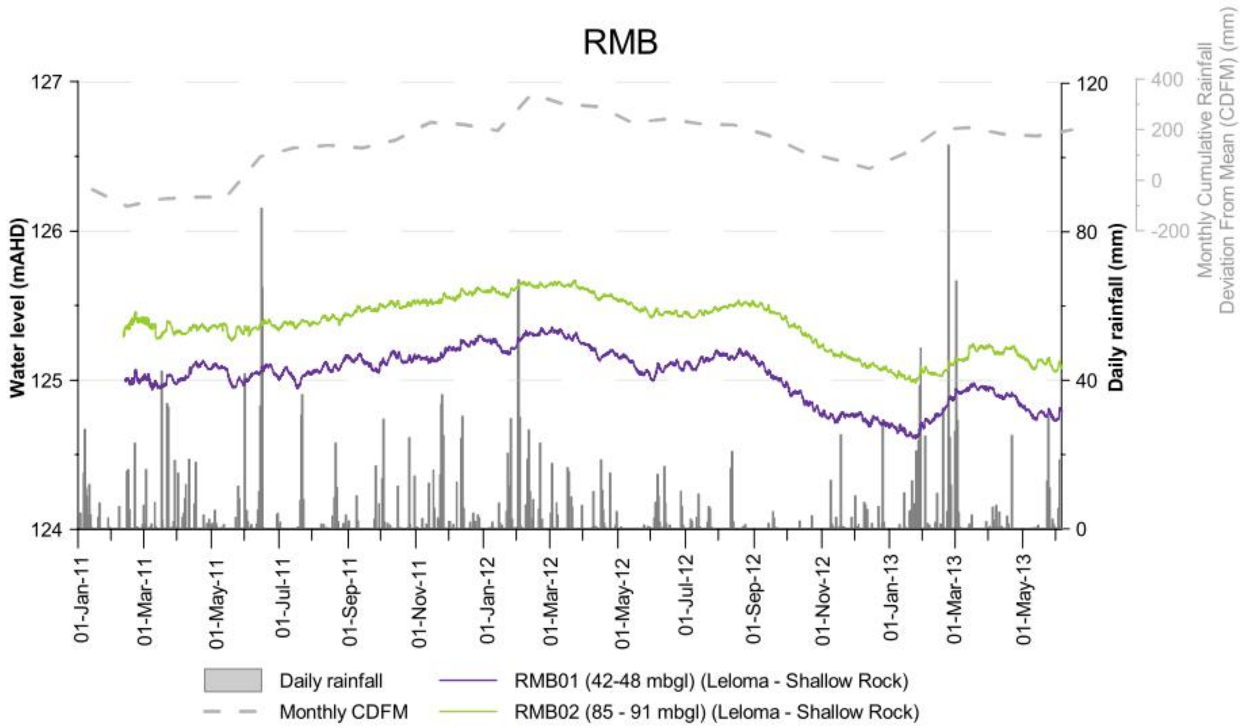


Figure 5.8 Groundwater levels and rainfall at the RMB site

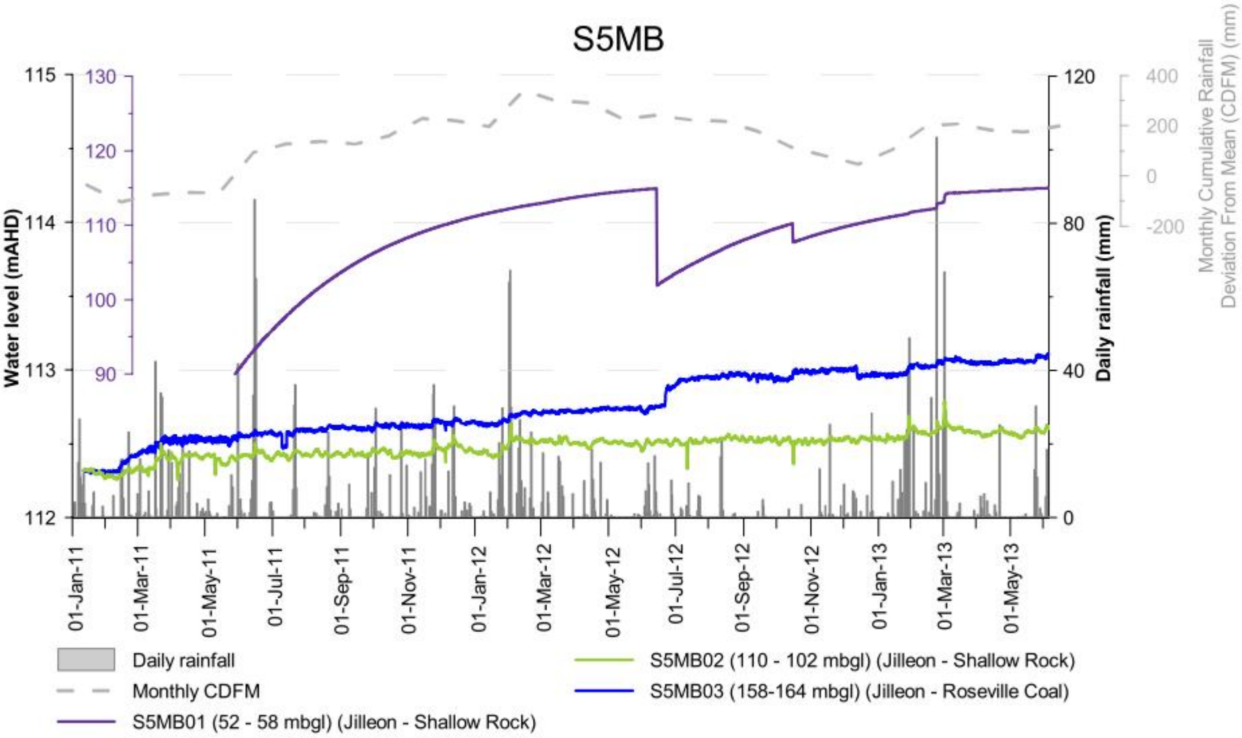


Figure 5.9 Groundwater levels and rainfall at the S5MB site

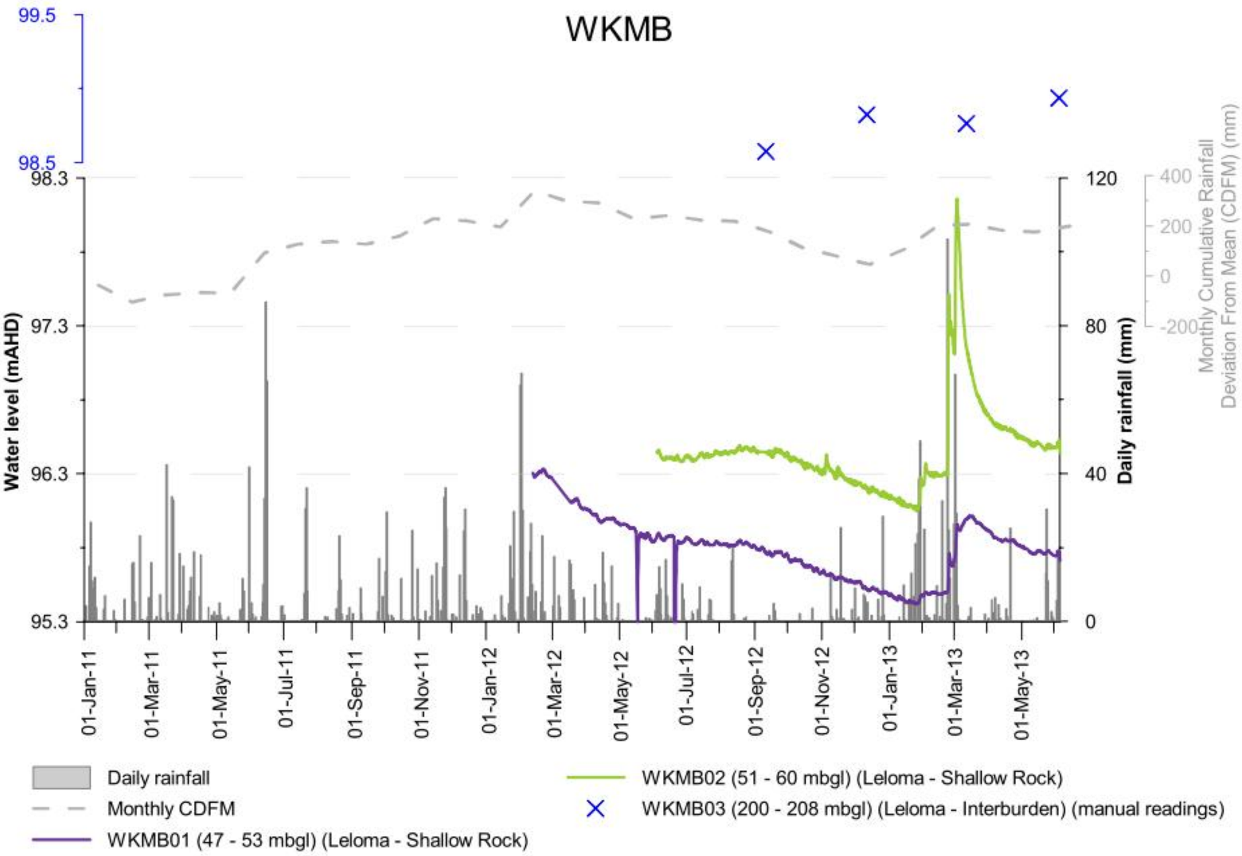


Figure 5.10 Groundwater levels and rainfall at the WKMB site

5.1.4 Vertical gradients

Significant vertical gradients were noted at six of the eight nested bore installations.

Downward hydraulic gradients were noted at the TCMB and TTMB nested bore sites. At the TCMB site there is a downward head gradient of ~ 1.5 m between the shallow rock and the deeper coal seams. At the TTMB site there is a downward head gradient of ~2 m to ~ 2.5 m between the shallow rock and the deeper coal seams. Downward gradients are characteristic of recharge zones and imply potential for slow downward seepage of groundwater between units.

Upward hydraulic gradients were noted at the S4MB, S5MB, RMB, and WKMB nested bore sites. At the S4MB site there is an upward head gradient of ~ 1 m to ~ 2 m from the deeper coal seam to the shallow rock. At the S5MB site there is an upward head gradient of ~ 0.5 m from the deeper coal seam at S5MB03 to the shallow rock at S5MB02. The shallow rock monitoring bore at S5MB01 shows a slow response to purging and recovery and therefore is not representative of baseline groundwater trends. At the RMB site there is an upward head gradient of ~ 0.5 m from the deeper to the shallower monitoring bore in the shallow rock. At the WKMB site there is an upward head gradient of ~ 2.5 m to ~ 3 m from the interburden to the shallow rock. Upward head gradients are characteristic of discharge zones and imply potential for slow upward seepage of groundwater between units.

No significant vertical head gradients were noted at the BMB and WMB nested bore sites.

In all cases it is noted that despite the vertical hydraulic gradients, due to the very low permeability of the interburden units, vertical seepage it likely to be limited and slow. Lateral flow within each of the geological units is concluded to be the primary groundwater flow mechanism when there are no stresses on the shallow or deep groundwater systems.

5.2 Groundwater quality

Water quality results for the sampling event are summarised and compared to the ANZECC (2000) guidelines for freshwater ecosystems (south-east Australia – lowland rivers) in Table 5.2. The ANZECC (2000) guidelines do not represent the expected water quality in the naturally saline groundwater systems that underlie the catchment. Section 7.4.4.1 of the ANZECC guidelines recommends that site specific guideline values are derived from local reference data, based on a minimum of two years of monitoring data at the reference site to establish a valid threshold taken at the 80th percentile.

All results for the June/July 2013 sampling event are presented in Appendix B. Laboratory reports are included in Appendix C. Sampling occurred during a relatively dry month, although rainfall was slightly above average in June 2013.

Table 5.2 Groundwater quality summary for June/July 2013 monitoring event

Parameters	Units	ANZECC (2000) guidelines[a]	Alluvial aquifer range (average)	Shallow rock range (average)	Interburden range (average)	Coal seams range (average)
Water quality parameters						
Field EC	µS/cm	125–2,200[b]	**396–8,130 (3,801)**	**1,060–9,780 (4,371)**	**3,060–3,200 (3,127)**	**3,360–5,340 (4,373)**
Field pH	pH units	6.5–8.0[b]	6.39–7.36 (6.93)	**7.13–9.3 (8.00)**	**10.3–10.6 (10.47)**	**7.55–11.5 (9.10)**
Field redox	mV	–	-190.3 to -78.6 (-127.4)	-313.0 to -16.8 (-176.5)	-87.5 to -52.1 (-63.93)	-37.5 to 62.2 (7.57)
Major ions						
Calcium	mg/L	–	12–206 (120)	2–312 (127)	<1–4 (2.17)	5–110 (43.7)
Magnesium	mg/L	–	5–223 (95)	6–108 (48)	0.5–3 (1.33)	<1–116 (30)
Sodium	mg/L	–	66–1,170 (540)	246–1,710 (739)	672–740 (697)	699–895 (770)
Potassium	mg/L	–	1–5 (3)	3–66 (11)	3–51 (20.7)	3–81 (31)
Chloride	mg/L	–	65–2,370 (1,018)	105–2,780 (956)	421–720 (557)	636–952 (815)
Sulphate	mg/L	–	14–226 (103)	4–688 (160)	<1–12 (4)	<1–164 (64)
Total alkalinity as $CaCO_3$	mg/L	–	78–492 (233)	124–1,020 (489)	341–931 (631)	247–987 (641)
Metals						
Aluminium	mg/L	0.055 (pH>6.5)	<0.01–0.03 (0.0092)	**<0.01–0.36 (0.06)**	**0.03–0.38 (0.16)**	**<0.01–2.9 (0.98)**
Arsenic	mg/L	0.013 (AsV), 0.024 (AsIII)	<0.02–0.003 (0.0015)	<0.001–0.003 (0.001)	<0.001–0.003 (0.0018)	<0.001–0.014 (0.005)
Barium	mg/L	–	0.055–0.725 (0.314)	0.039–9.84 (2.19)	0.33–0.998 (0.61)	0.143–1.76 (0.704)
Beryllium	mg/L	ID	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001–0.0002 (0.0001)
Copper	mg/L	0.0014	<0.001	**<0.001–0.021 (0.003)**	**<0.001–0.005 (0.0025)**	**<0.001–0.002 (0.0015)**
Lead	mg/L	0.0034	<0.001	<0.001–0.002 (0.001)	**<0.001–0.036 (0.0125)**	**<0.001–0.005 (0.002)**
Manganese	mg/L	1.9	**0.15–3.24 (1.21)**	0.008–0.401 (0.11)	0.002–0.014 (0.007)	0.003–0.143 (0.052)
Molybdenum	mg/L	ID	<0.001–0.001	<0.001–0.006	0.002–0.006	<0.001–0.005

Parameters	Units	ANZECC (2000) guidelines[a]	Alluvial aquifer range (average)	Shallow rock range (average)	Interburden range (average)	Coal seams range (average)
			(0.0006)	(0.001)	(0.004)	(0.002)
Nickel	mg/L	0.011	<0.001–0.01 (0.002)	**0.001–0.015 (0.005)**	**0.003–0.012 (0.001)**	0.001–0.011 (0.005)
Selenium	mg/L	0.011 (total)	<0.001	<0.01	<0.01	<0.01
Strontium	mg/L	–	0.246–6.19 (2.88)	0.35–31.08 (6.87)	0.445–2.44 (1.18)	0.672–5.61 (2.77)
Uranium	mg/L	ID	<0.001–0.013 (0.003)	<0.001–0.005 (0.003)	<0.001	<0.001
Vanadium	mg/L	ID	<0.001	<0.01	<0.01	<0.01
Zinc	mg/L	0.008	**0.009–0.038 (0.017)**	**0.007–0.277 (0.091)**	**0.023–23 (8.41)**	**0.061–3.07 (1.16)**
Iron	mg/L	ID	0.18–6.91 (3.15)	0.05–4.13 (1.21)	0.1–0.59 (0.28)	0.07–0.27 (0.16)
Bromine	mg/L	ID	0.2–4.6 (2.1)	0.3–7.7 (2.4)	0.9–1 (0.95)	0.9–2.2 (1.5)
Nutrients						
Nitrite as N	mg/L	0.02[b]	<0.01	<0.01	<0.01–0.01 (0.006)	<0.01
Nitrate as N	mg/L	0.7	<0.01	<0.01–0.38 (0.05)	<0.01–0.01 (0.006)	<0.01–0.02 (0.01)
Ammonia as N	mg/L	0.02[b]	**0.02–0.36 (0.18)**	**0.42–3.72 (1.39)**	**8.14–20.3 (12.73)**	**1.02–3.03 (1.70)**
Total Phosphorous as P	mg/L	0.05[b]	**<0.01–0.06 (0.027)**	**0.01–0.32 (0.13)**	**0.07–0.11 (0.087)**	**0.02–0.13 (0.067)**
Reactive Phosphorous as P	mg/L	0.02[b]	<0.01–0.02 (0.008)	**<0.01–0.25 (0.06)**	**<0.01–0.03 (0.018)**	**<0.01–0.05 (0.02)**
Total Organic Carbon	mg/L	–	1–4 (2)	2–110 (17)	14–124 (67)	2–39 (15)
Hydrocarbons						
Phenolic compounds	µg/l	–	<1.0–6.7 (1.5)	<1.0–3.8 (0.6)	3.5–13.2 (7.1)	<1.0
Polycyclic aromatic hydrocarbons	µg/l	–	<0.5	<0.5	<0.5	<0.5
Monocyclic aromatic hydrocarbons						
Benzene	µg/l	950	<1	<1–2 (0.6)	<1	<1
Toluene	µg/l	ID	<2–4 (1.5)	<2–56 (5.0)	1–10 (4.7)	1–4 (2.0)
Ethyl Benzene	µg/l	ID	<2	<2	<2	<2
m&p-Xylenes	µg/l	ID	<2	<2	<2	<2
o-Xylenes	µg/l	350	<2	<2	<2	<2

Parameters	Units	ANZECC (2000) guidelines[a]	Alluvial aquifer range (average)	Shallow rock range (average)	Interburden range (average)	Coal seams range (average)
Total petroleum hydrocarbons						
C_6–C_9	µg/l	–	<20	<20–80 (14)	<20–100 (40)	<20
C_{10}–C_{14}	µg/l	–	<50	<50–100 (29)	60–140 (97)	<50
C_{15}–C_{29}	µg/l	–	<100	<100–1,090 (105)	320–1,740 (837)	0.5–140 (47)
C_{29}–C_{36}	µg/l	–	<50	<50	<50–610 (298)	<50
Dissolved gases						
Methane	µg/l	–	13–92 (64)	<10–20,200 (5369)	9,030–31,100 (19,410)	274–30,500 (12,774)

a ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: 95% protection levels (trigger values).

b ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: trigger values for lowland rivers in south-east Australia.

c To calculate the average, values below detection limit are included in the calculation as half the LOR.

BOLD indicates a value outside of the ANZECC (2000) guideline range.

ID indicates insufficient data for trigger value to be established

5.2.1 Alluvium

5.2.1.1 Field parameters

Alluvial groundwater salinity ranges from fresh (<800 µS/cm) to slightly saline (<10,000 µS/cm). Electrical conductivity (EC) values are generally above the ANZECC (2000) guideline values. The average salinity has risen since the previous monitoring event. TMB01 has the highest recorded EC of the alluvial monitoring bores; and this is likely due to the screened lithology of clays at TMB01 (Parsons Brinckerhoff 2012a).

The pH conditions in alluvial monitoring bores range from slightly acidic to neutral, and are all within the ANZECC (2000) guideline values, which is consistent with the previous monitoring event.

Redox values range from -190.3 to -78.6 mV, indicating reducing conditions exist in the alluvium.

Table 5.3 summarises the major ion chemistry of the alluvium for the 2011 and 2013 monitoring events. Generally major ion chemistry in the alluvial aquifers is dominated by sodium, magnesium and chloride for this monitoring event (2013) and an increase in magnesium dominance is observed since the last monitoring event (2011). The continued dominance of sodium and chloride reflects the high clay content of the alluvium within the vicinity of the Tiedman and Atkins sites, and rainfall recharge.

A piper diagram is a graphical representation of the chemistry of a water sample and can be used to graphically show the relative concentrations of major ions (Ca^{2+}, Mg^{2+}, Na^{2+}, K^+, Cl^-, HCO_3^-, and SO_4^{2-}). Major ion chemistry for all groundwater samples is shown on the piper diagram in Figure 4.3.

Table 5.3 Major ion chemistry in alluvial groundwater

Location	Major ion chemistry – 2011	Major ion chemistry – 2013
AMB01	Na-Ca-Mg- Cl	Na-Mg-Cl
AMB02	Na-HCO_3-Cl	Na-Cl- HCO_3
TMB01	Na-Cl	Na-Mg-Cl
TMB02	Na-Cl	Na-Mg-Cl
TMB03	Na-Cl	Na-Cl
WMB01	Na-Ca-Cl	Na-Mg-Ca-Cl

5.2.1.2 Dissolved metals

The major findings of dissolved metal analysis for alluvial monitoring bores are as follows:

- Zinc concentrations are above the ANZECC (2000) guideline value except for TMB01 which is below the LOR (<0.005 mg/L). This is consistent with the previous monitoring event (2011).
- Manganese concentrations were detected in all bores but are only above the ANZECC (2000) guideline (1.9 mg/L) at AMB01 (3.24 mg/L), which is consistent with the previous monitoring event.
- Barium, iron and strontium concentrations were detected at all alluvial monitoring bores. This is consistent with the previous monitoring event.
- Uranium concentrations were detected in TMB01 and TMB03, which is consistent with the previous monitoring event.

Concentrations of these metals are not unexpected, given the brackish salinities and clayey nature of the Avon River alluvium, and the variety of sedimentary rocks across the catchment. The concentrations are natural and (when elevated) are only slightly above the ANZECC (2000) guideline values.

5.2.1.3 Nutrients

Ammonia, total phosphorus and reactive phosphorus concentrations are slightly elevated at the alluvial monitoring bores. Ammonia concentrations exceeded the ANZECC (2000) guideline at all the alluvial monitoring bores except at WMB01. Total phosphorus concentrations exceed the ANZECC (2000) guideline value at TMB01 and TMB02. Reactive phosphorus concentrations are below the ANZECC (2000) guideline value at all of the alluvial monitoring bores. Total organic carbon concentrations are low in all alluvial monitoring bores. These results are generally consistent with the previous monitoring event.

5.2.1.4 Hydrocarbons

Concentrations of total petroleum hydrocarbons (TPH) were below the laboratory LOR in all alluvial monitoring bores, while during the last monitoring event (2011), TPH concentrations were detected in TMB02, TMB03 and WMB01.

Polycyclic aromatic hydrocarbons are not detected in the alluvial monitoring bores. Phenolic compounds (3-&4-Methylphenol) were detected at TMB01 at a concentration of 6.7 µg/L. BTEX concentrations were below the laboratory LOR in all alluvial monitoring bores except for toluene at WMB01 (4 µg/L).

5.2.1.5 Dissolved gases

Dissolved methane concentrations were detected at TMB01, TMB02 and TMB03 (92 µg/L, 88 µg/l and 13 µg/L respectively). This differs from the results of the previous monitoring period in which dissolved methane was only detected at TMB02 (19 µg/L).

5.2.2 Shallow rock

5.2.2.1 Field parameters

Groundwater salinity in the shallow rock aquifers ranges from marginal (<1,600 µS/cm) to slightly saline (<10,000 µS/cm), with the field EC values ranging from 1,060-9,780 µS/cm. The EC values in the shallow rock aquifer monitoring bores are above the ANZECC (2000) guideline values except at WKMB02 (1,060 µS/cm) and TTMB01 (1,980 µS/cm).

The pH conditions in the shallow rock aquifers range from neutral to alkaline (pH 7.13-9.3). TMB01 (pH 5.91), BMB02 (pH 8.39), S5MB01 (pH 8.26), S5MB02 (pH 8.55), WKMB01 (pH 8.1) and WKMB02 (pH 9.3) fall outside the ANZECC (2000) guideline values.

Redox values range from -313.0 to -16.8 mV, indicating reducing conditions exist in the shallow rock unit.

Table 5.4 summarises the major ion chemistry in the shallow rock units for both monitoring events in 2011 and 2013. Generally the major ion chemistry in the shallow rock unit is dominated by sodium and chloride and to a lesser extent bicarbonate. Major ion chemistry for BMB01, S4MB01, S4MB02, and S5MB01 is slightly different at some sites between the two monitoring events.

Table 5.4 Major ion chemistry in shallow rock hydrogeological units

Location	Major ion chemistry – 2011	Major ion chemistry – 2013
BMB01	Na-Cl -HCO_3	Na-Cl
BMB02	Na-Cl -HCO_3	Na-Cl -HCO_3
RMB01	Na-Cl	Na-Cl
RMB02	Na-Cl -HCO_3	Na-Cl -HCO_3
S4MB01	Na-Ca-Cl-HCO_3	Na-Ca-Cl
S4MB02	Na-Ca-Cl	Na-Cl
S5MB01	Na-Cl-SO_4	Na-Cl -HCO_3
S5MB02	Na-Cl -HCO_3	Na-Cl -HCO_3
TTMB01	N/A	Na-Cl -HCO_3
TTMB02	N/A	Na-Ca-Cl-HCO_3
TTPB	N/A	Na-Ca-Cl-HCO_3
WKMB01	N/A	Na-Cl -HCO_3
WMB02	Na-Ca-Cl-SO_4	Na-Ca-Cl-SO_4
WMB03	Na-Ca-Cl	Na-Ca-Cl
WMB04	Na-Ca-Cl-HCO_3	Na-Ca-Cl-HCO_3

Notes:
N/A – no data available

5.2.2.2 Dissolved metals

The major findings of dissolved metal analysis for shallow rock aquifer monitoring bores are as follows:

- Aluminium concentrations exceed the ANZECC (2000) guideline value at BMB02, S5MB02, TTMB01 and WKMB02.
- Arsenic concentrations were detected in seven of the 17 shallow rock aquifer monitoring bores, all of which were below the ANZECC (2000) guideline value.
- Barium concentrations were detected in all bores with the highest values detected at RMB01 (9.84 mg/L).
- Strontium concentrations were detected in all bores with the highest value of strontium detected at S4MB01 (31.8 mg/L). This is consistent with the results of the previous monitoring event.
- Manganese concentrations were detected in all bores but did not exceed the ANZECC (2000) guideline values.
- Iron concentrations were detected in all bores. This is consistent with the previous monitoring period.
- Copper concentrations were detected in ten bores and generally exceed the ANZECC (2000) guideline value.
- Zinc concentrations were detected above the ANZECC (2000) guideline value at all locations except WMB02. The highest concentration of zinc was recorded at S4MB01 (0.277 mg/L).
- Bromine concentrations are highest at RMB01 and RMB02 and this is consistent with the previous monitoring event.
- Uranium concentrations are detected at RMB02, S4MB01, WKMB01 and WKMB02. All other shallow rock aquifer monitoring bores had uranium concentrations below the laboratory LOR.
- Molybdenum concentrations were detected at WKMB02 and WMB04. All other monitoring bores recorded values below the laboratory LOR.
- Nickel concentrations were elevated above the ANZECC (2000) guideline value at BMB01 and S5MB01.

The dissolved metal concentrations are considered natural and not unusual for these types of sedimentary rock.

5.2.2.3 Nutrients

Nitrite concentrations were not detected in any of the monitoring bores. Nitrate concentrations were detected in a number of monitoring bores, but all values are below the ANZECC (2000) guideline value. Ammonia concentration were detected above the ANZECC (2000) guideline value in all shallow rock monitoring bores and the highest concentration of ammonia was recorded at S5MB01. Total phosphorus concentrations were detected above the ANZECC (2000) guideline value in 14 of the 17 shallow rock aquifer monitoring bores. The highest concentration of total phosphorus was recorded at TTMB01. Reactive phosphorus was detected in 11 bores, of which eight have concentrations above the ANZECC (2000) guideline value. The highest concentration of reactive phosphorus was recorded at WKMB02. Total organic carbon was detected at all of the bores and the highest concentration was recorded at S5MB01 (110 mg/L).

5.2.2.4 Hydrocarbons

Phenolic compounds (phenol) were detected in S5MB01 (3.8 µg/L) which is below the ANZECC (2000) guideline (320 µg/L). Toluene concentrations were detected at eight of the shallow rock monitoring bores. The values range from 3 µg/L to 56 µg/L (S5MB01). Benzene was detected in S5MB02 (2 µg/L) but was well below the ANZECC (2000) guideline (950 µg/L). Concentrations of total petroleum hydrocarbons (TPH) (C10-C36 fraction) were detected in S5MB01 only (1,400 µg/L).

5.2.2.5 Dissolved gases

Dissolved methane concentrations were detected in all shallow rock aquifer monitoring and concentrations ranged from 10 µg/L at WMB02 to 20,200 µg/L at S5MB02.

5.2.3 Interburden units

5.2.3.1 Field parameters

Groundwater salinity in the interburden units is typically brackish (<4,800 µS/cm), with field values ranging from 3,060–3,200 µS/cm. These values are above the ANZECC guideline (2000) values.

The pH values are alkaline (pH ~10.5) and exceed the ANZECC (2000) guideline values.

Redox values range from -87.5 to -52.1 mV, indicating reducing conditions exist in the interburden unit.

Table 5.5 summarises the major ion chemistry of the interburden units for the monitoring events in 2011 and 2013 and shows that major ion chemistry has not changed. The major ion chemistry within the interburden units is dominated by sodium and chloride.

Table 5.5 Major ion chemistry in interburden hydrogeological units

Location	Major ion chemistry – 2011	Major ion chemistry – 2013
TCMB02	Na-Cl	Na-Cl
TTMB03	N/A	Na-Cl
WKMB03	N/A	Na-Cl

Notes:
N/A – no data available

5.2.3.2 Dissolved metals

The major findings of dissolved metal analysis for interburden monitoring bores are as follows:

- Concentrations of barium and strontium were detected in all of the interburden monitoring bores with the highest concentrations occurring at TCMB02.
- Manganese and arsenic concentrations were detected in all bores, but did not exceed the ANZECC (2000) guideline values.
- Aluminium concentrations were detected in all bores. The ANZECC (2000) guideline values for aluminium were exceeded at TTMB03 and WKMB03.
- Nickel concentrations were detected in all bores, but only exceeded the ANZECC (2000) guideline values TCMB02.
- Concentrations of copper were elevated and above the ANZECC (2000) guideline in TCMB02 and TTMB03.
- Cadmium concentrations were detected in WKMB03 but do not exceed the ANZECC (2000) guideline value.
- Concentrations of zinc were elevated and above the ANZECC (2000) guideline in all bores.
- Concentrations of lead were detected in TCMB02 and WKMB03. The concentrations in WKMB03 exceeded the ANZECC (2000) guideline value.
- Concentrations of iron, molybdenum and bromine were detected in all bores, but did not exceed the ANZECC (2000) guideline values.

The dissolved metal concentrations are considered natural and not unusual for these types of sedimentary rock.

5.2.3.3 Nutrients

Ammonia and total phosphorus concentrations were above the ANZECC (2000) guideline values in all monitoring bores. Reactive phosphorus was elevated and above ANZECC (2000) guideline value in TTMB03. Total organic carbon concentrations range from 14 mg/L to 124 mg/L.

5.2.3.4 Hydrocarbons

Phenolic compounds were detected in all of the interburden monitoring bores, with the highest concentration recorded at TTMB03. Toluene was detected in TCMB02 and WKMB03 with concentrations of 10 µg/L and 3 µg/L respectively. Polycyclic aromatic hydrocarbons (PAHs) were not detected in any of the monitoring bores. Total petroleum hydrocarbons (TPHs) were detected in all bores.

Hydrocarbons can be naturally occurring in these types of formations (Volk et al. 2011) and these concentrations of hydrocarbons are not considered unusual for sedimentary rocks based on early works in the Gloucester basin by Thornton (1982) and Hunt et al. (1983).

5.2.3.5 Dissolved gases

Methane concentrations were detected in all of the interburden monitoring bores ranging from 9,030 µg/L to 31,100 µg/L.

5.2.4 Coal seams

5.2.4.1 Field parameters

Groundwater salinity in the coal seams is typically brackish (<4,800 µS/cm) to slightly saline (<10,000 µS/cm), with field EC values ranging from 3,360-5,340 µS/cm. The EC values in all monitoring bores are above the ANZECC (2000) guideline values.

The pH values in the coal seam monitoring bores range from neutral to alkaline (pH 7.55-11.5). The pH values for all monitoring bores, except S5MB03 (pH 7.55) are above the ANZECC (2000) guideline values.

Redox values range from -37.5 to +62.2 mV, indicating conditions in the coal seams are mostly reducing. Oxidising conditions exist at TCMB04 (+62.2 mV).

Table 5.6 summarises the major ion chemistry of the coal seams for the 2011 and 2013 monitoring events. Generally the major ion chemistry within the coal seams is dominated by sodium and chloride. In comparison to the previous monitoring event (2011), major ion chemistry is similar and differs only slightly at TCMB04.

Table 5.6 Major ion chemistry in coal seams

Location	Major ion chemistry – 2011	Major ion chemistry – 2013
S4MB03	Na-Cl	Na-Cl
S5MB03	Na-Cl-HCO_3	Na-Cl-HCO_3
TCMB04	Na-Cl-HCO_3	Na-Cl

Notes:
N/A – no data available

5.2.4.2 Dissolved metals

The major findings of dissolved metal analysis for interburden monitoring bores are as follows:

- Aluminium concentrations were detected above ANZECC (2000) guideline value at TCMB04.
- Arsenic concentrations were detected above the ANZECC (2000) guideline value at S5MB03.
- Barium and bromine concentrations were detected in all of the coal seam monitoring bores.
- Cadmium concentrations were detected in S5MB03 and but were below the ANZECC (2000) guideline value.
- Copper concentrations were detected above ANZECC (2000) guideline values at S5MB03 and TCMB04.
- Lead concentrations were detected above the ANZECC (2000) guideline value at TCMB05.
- Manganese concentrations were detected at all of the coal seam monitoring bores, but were below the ANZECC (2000) guideline value.
- Molybdenum was detected at low concentrations at TCMB04.
- Nickel concentrations were detected at all monitoring bores but remained below the ANZECC (2000) guideline value.
- Strontium concentrations were detected at all monitoring bores, ranging from 0.652 mg/L (TCMB04) to 5.61 mg/L (S5MB03)
- Zinc concentrations were detected above the ANZECC (2000) guideline value at S4MB03 and S5MB03, with the highest concentration at S5MB03 (0.347 mg/L).
- Iron concentrations were detected in all of the monitoring bores, ranging from 0.07 mg/L (S4MB03) to 0.27 mg/L (S5MB03).

These dissolved metal concentrations are considered natural and not unusual for Permian coal seams.

5.2.4.3 Nutrients

Nitrate concentrations were detected in the Roseville Coal Seam (S5MB03), although the results are below the ANZECC (2000) guideline values. Ammonia concentrations were above the ANZECC (2000) guideline value in all coal seam monitoring bores. The highest concentration was detected at TCMB03 (Roseville Coal Seam). Total phosphorus concentrations are above the ANZECC (2000) guideline value in the Roseville Coal Seams (TCMB04). Reactive phosphorus concentrations were also above the ANZECC (2000) guideline value in the Roseville Coal Seam. Total organic carbon concentrations ranged from 2 mg/L in the Roseville Coal Seam.

5.2.4.4 Hydrocarbons

Toluene was the only monocyclic aromatic hydrocarbon detected in the coal seam monitoring bores (S5MB03).

Total petroleum hydrocarbons (TPH) were detected in the C15-C28 fraction in the Roseville Coal Seam (TCMB04).

5.2.4.5 Dissolved gases

Dissolved methane concentrations range from 274 µg/L to 7,550 µg/L in the Roseville Coal Seam. Concentrations were detected at 30,500 µg/L in the Cloverdale Coal Seam (S4MB03).

6. Conclusions and recommendations

6.1 Conclusions

A comprehensive surface water and groundwater monitoring network comprising nested monitoring bores and stream gauges was established during the Phase 2 Groundwater Investigations (Parsons Brinckerhoff, 2012a). Subsequent and ongoing site investigations have continued to expand this network since January 2011.

The following conclusions are drawn from a review of the groundwater and surface water monitoring data for the period January 2011 to June 2013, representing 30 months of baseline data, but focussing on the last annual monitoring period (July 2012 to June 2013).

6.1.1 Rainfall

Climatic data for the period between February 2012 and December 2012 indicates actual rainfall was lower than the average rainfall. From December 2012 to June 2013, actual rainfall was higher than average rainfall.

During the last monitoring year there were high rainfall periods in January and February 2013, with February 2013 receiving 219 mm, resulting in significantly higher than average rainfall in those months and local flooding of rivers and creeks.

6.1.2 Surface water

6.1.2.1 Water levels

All stream gauges on the Avon River and Dog Trap Creek show sharp increases in water level in response to rainfall events, and relatively steep recession curves. This is characteristic of rapid runoff responses from a relatively small upstream catchment and limited riverbank storage and groundwater contributions. Stream levels and flow decrease over several weeks following each rainfall event to a relatively consistent base level that represents a small baseflow component in the Avon River.

6.1.2.2 Water quality

Surface water salinity is fresh (<800 µS/cm) and the pH is neutral. Generally the major ion chemistry of the surface water is dominated by sodium, chloride and bicarbonate.

Salinity sharply decreases after rainfall events as relatively fresh runoff is routed into streams. However an initial spike (sudden transient increase) in salinity (EC) is often seen in the initial runoff phase as readily dissolvable salts are flushed from the ground surface and shallow soils of the catchment area. The EC concentrations then gradually increases as flow decreases during periods of recession and groundwater discharge starts to become a more dominant component of flow. Surface water salinity generally increases downstream.

Dissolved metal analysis for surface water indicated that aluminium, copper, zinc concentrations were detected above the ANZECC (2000) guideline values.

Nutrient concentrations were all below the ANZECC (2000) guideline values and decreased from the previous monitoring event (2011), in which the ANZECC (2000) guideline values for ammonia, total and reactive phosphorus were exceeded.

Phenolic compounds, polycyclic aromatic hydrocarbons, petroleum hydrocarbons and BTEX were not detected at any of the surface water monitoring locations. Dissolved methane concentrations were detected at two of the surface water monitoring locations (AWS01 and AWS02).

6.1.3 Groundwater

6.1.3.1 Groundwater levels

Groundwater level trends in monitoring bores vary depending on the lithology and depth of the screened interval:

- **Alluvium:** Groundwater levels in monitoring bores screened within the alluvial aquifers show characteristic quick responses to rainfall events. This indicates rapid shallow aquifer recharge via direct rainfall infiltrations and/or enhanced infiltration during creek high flow and flood events. Groundwater fluctuations over the monitoring period range from ~0.5 m to ~3 m. Rainfall recharge is impeded in areas where the alluvium is clay-rich or where thick clay layers overlie the coarser grained alluvial deposits.
- **Shallow rock**: There are no strong responses to individual rainfall events in the shallow rock monitoring bores, with the exception of the WKMB site at Forbesdale. For all sites there is a delayed response to periods of higher than average rainfall, indicating that groundwater levels are responding to slow rainfall recharge over a broad area, assumed to be up-gradient of the monitoring locations.
- **Interburden units**: Monitoring bores screened within the interburden units do not show an overall increase or decrease over the monitoring period. There are no strong responses to individual rainfall events.
- **Coal seams:** Groundwater levels in monitoring bores that are screened within the coal seams show varied but typically small (<0.2 m) overall changes in groundwater level over the monitoring period. There are no strong responses to individual rainfall events, indicating that groundwater levels are responding to slow rainfall recharge over a broad area, assumed to be up-gradient of the monitoring locations.

Significant vertical gradients were noted at six of the eight nested bore installations:

- Downward hydraulic gradients were noted at the TCMB and TTMB nested bore sites. Downward gradients are characteristic of recharge zones and imply potential for slow downward seepage of groundwater between units.
- Upward hydraulic gradients were noted at the S4MB, S5MB, RMB, and WKMB nested bore sites. Upward head gradients are characteristic of discharge zones and imply potential for slow upward seepage of groundwater between units.
- No significant vertical head gradients were noted at the BMB and WMB nested bore sites.

In all cases it was noted that despite the potential for vertical seepage, due to the very low permeability of the interburden units, vertical seepage is likely to be extremely slow. Lateral flow within each of the geological units is concluded to be the primary groundwater flow mechanism when there are no stresses on the shallow or deep groundwater systems.

6.1.3.2 Groundwater quality

Alluvial aquifer water quality is fresh to slightly saline, has slightly acidic to neutral pH and reducing conditions exist. The major ion chemistry is sodium-chloride dominant, reflecting the high clay content of the alluvium and rainfall recharge. An increase in magnesium is observed for this monitoring event (2013) compared to the last monitoring event (2011). The alluvial groundwater has minor dissolved metals and only zinc and manganese are detected above ANZECC (2000) guideline values in some monitoring bores, which is consistent with the last monitoring event. Ammonia and total phosphorus concentrations were elevated and exceeded the ANZECC (2000) guideline values at some monitoring locations. These results are generally consistent with the previous monitoring event. There was no detection of naturally occurring TPH, and only minor detection of BTEX compounds in the alluvial aquifer. Dissolved methane was detected at the alluvial monitoring bores (13 µg/L to 92 µg/L) and increased since the last monitoring event.

Groundwater in the shallow rock unit is marginal to slightly saline, has neutral to alkaline pH conditions and reducing conditions exist. The major ion chemistry is sodium-chloride-bicarbonate dominant, and was slightly different for four monitoring bores. Groundwater in the shallow rock unit has low concentrations of dissolved metals and only aluminium, copper, zinc and nickel were detected above ANZECC (2000) guideline values in some monitoring bores. Ammonia, total phosphorus and reactive phosphorus concentrations were elevated and exceeded the ANZECC (2000) guideline values at some monitoring locations. Minor detections of naturally occurring TPH, benzene and toluene occurred at a few monitoring sites. Dissolved methane concentrations were detected in all shallow rock aquifer monitoring bores and concentrations ranged from 10 µg/L to 20,200 µg/L.

Groundwater quality of the interburden confining units is brackish with alkaline pH and reducing conditions. The major ion chemistry is sodium-chloride dominant. Groundwater in the interburden unit has low concentrations of dissolved metals and only aluminium, copper, zinc, nickel and lead were detected above ANZECC (2000) guideline values in some monitoring bores. Ammonia, total phosphorus and reactive phosphorous concentrations were elevated and exceeded the ANZECC (2000) guideline values at some monitoring locations. Minor detections of naturally occurring phenols, TPH and toluene occurred at all monitoring bores. Methane concentrations were detected ranging from 9,030 µg/L to 31,100 µg/L.

Groundwater salinity in the coal seams is typically brackish to slightly saline, with neutral to alkaline pH and mostly reducing conditions. The major ion chemistry is generally sodium-chloride dominant. Groundwater in the coal seams has low concentrations of dissolved metals with aluminium, arsenic, copper, lead and zinc detected above ANZECC (2000) guideline values in some monitoring bores. These dissolved metal concentrations are considered natural and not unusual for Permian coal seams. Ammonia, total phosphorus and reactive phosphorus concentrations were elevated and exceeded the ANZECC (2000) guideline values at some monitoring locations. Toluene and TPH were detected in the Roseville coal seam. Dissolved methane concentrations range from 274 µg/L to 7,550 µg/L in the Roseville Coal Seam. Methane concentrations were detected at 30,500 µg/L in the Cloverdale Coal Seam.

6.2 Recommendations

The following recommendations are made regarding the ongoing groundwater and surface water monitoring of the GGP Stage 1 Gas Field Development Area:

- Monitoring should continue at all dedicated monitoring sites in accordance with the existing program. That is:
  - continuous water level and salinity (EC) monitoring at the four surface water locations
  - continuous water level monitoring at the six groundwater sites in the alluvium, 17 groundwater sites in the shallow rock, three groundwater sites in the interburden and five groundwater sites in the deep coal seams
  - comprehensive water quality sampling of all these dedicated sites on a two-yearly cycle is considered adequate (i.e. next sampling event to be mid 2015)
- Water level data for the newly installed monitoring bores constructed in mid-2013 in the area beyond the Stage 1 development area (and those proposed for construction during 2013/14) should be included in the annual status report for 2013/14.

7. Statement of limitations

7.1 Scope of services

This report has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and Parsons Brinckerhoff (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

7.2 Reliance on data

In preparing the report, Parsons Brinckerhoff has relied upon data, surveys, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, Parsons Brinckerhoff has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Parsons Brinckerhoff will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Parsons Brinckerhoff.

7.3 Environmental conclusions

In accordance with the scope of services, Parsons Brinckerhoff has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

7.4 Report for benefit of client

The report has been prepared for the benefit of the client (and no other party). Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Parties other than the client should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

7.5 Other limitations

Parsons Brinckerhoff will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

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Appendix A

Groundwater and surface water hydrographs

Figure A-1 Groundwater levels and rainfall TMB01

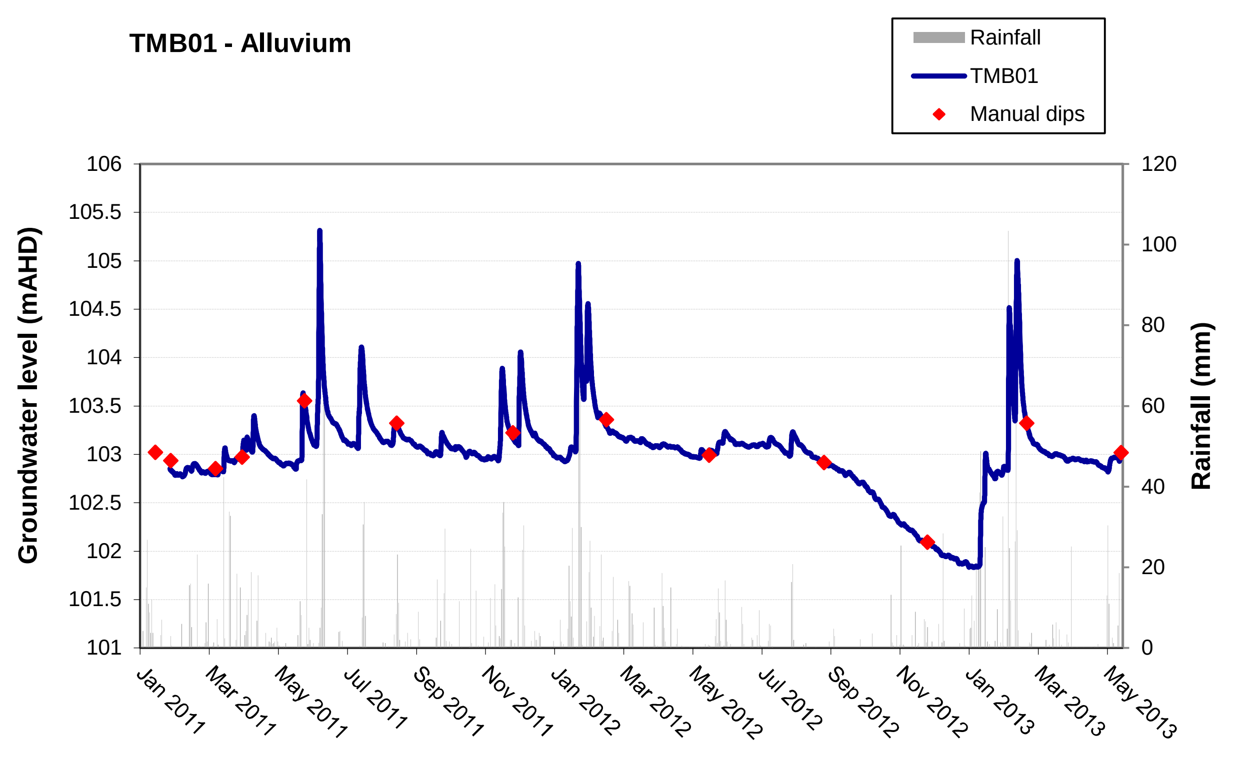


Figure A-2 Groundwater levels and rainfall at TMB02

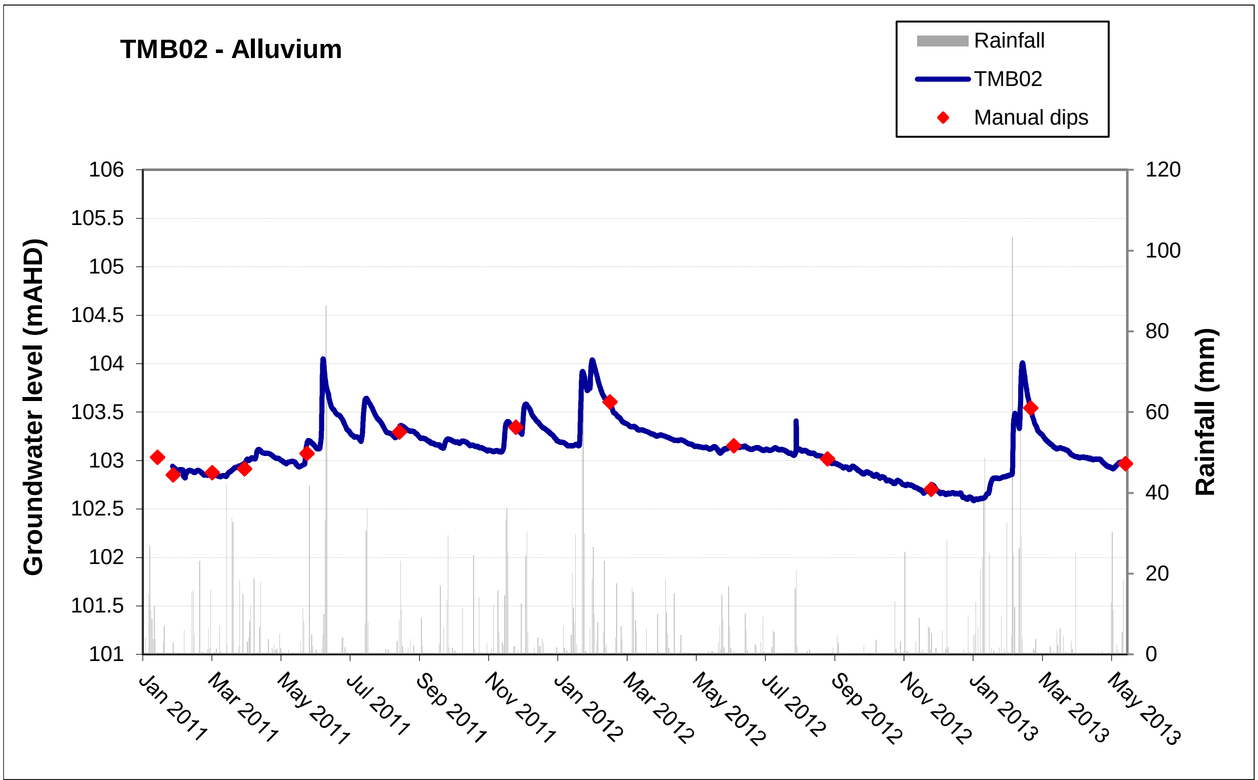


Figure A-3 Groundwater levels and rainfall at TMB03

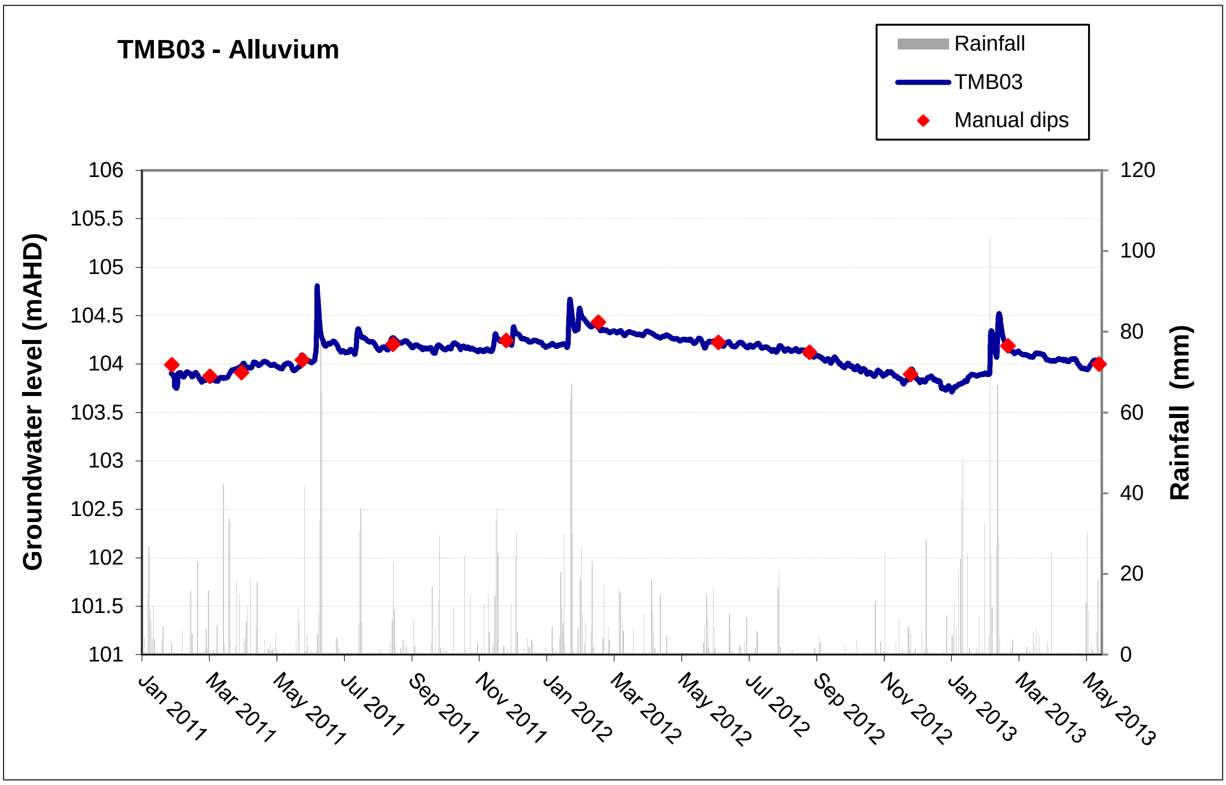


Figure A-4 Groundwater levels and rainfall at AMB01

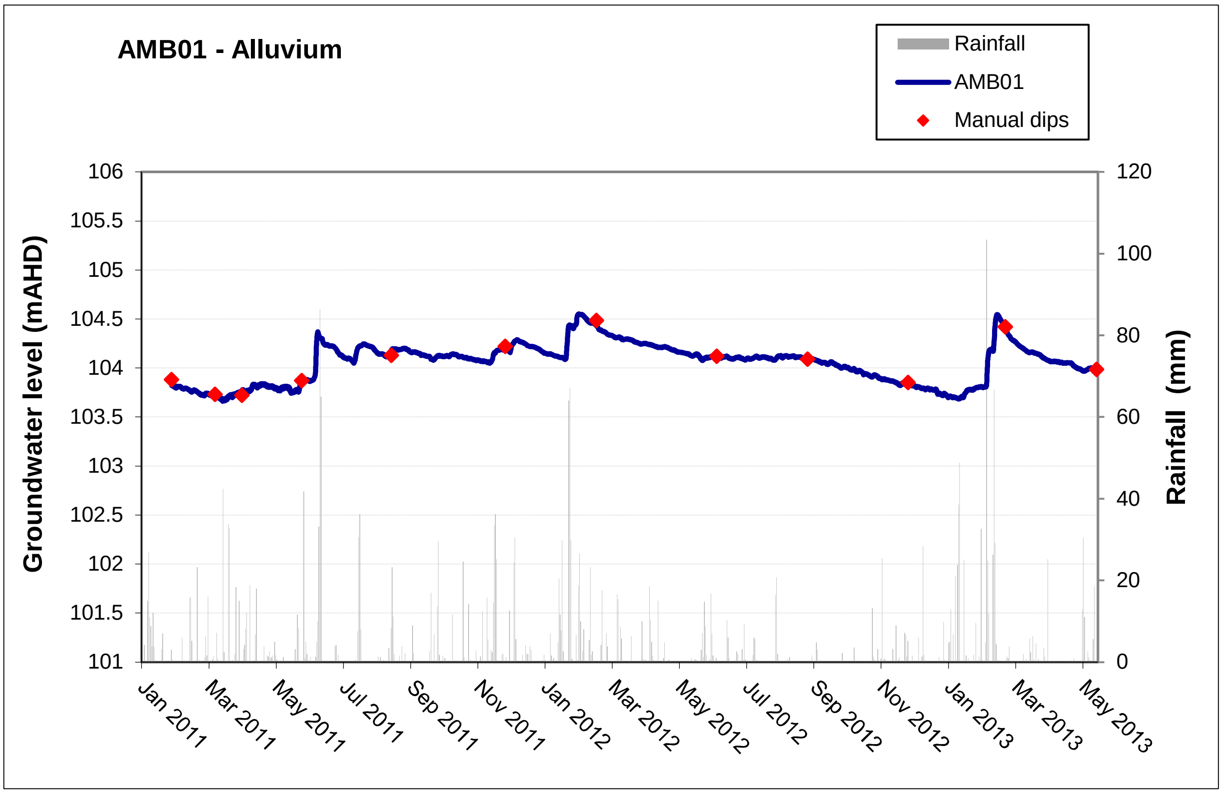


Figure A-5 Groundwater levels and rainfall at AMB02

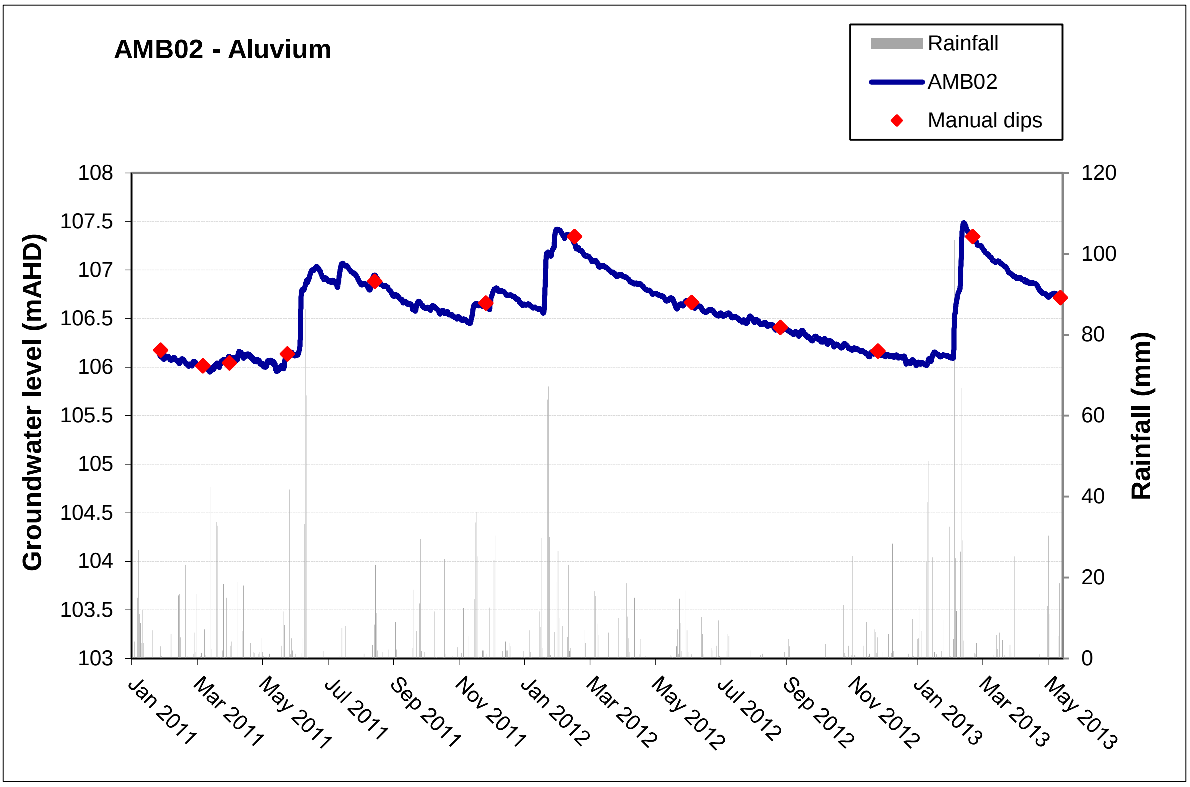
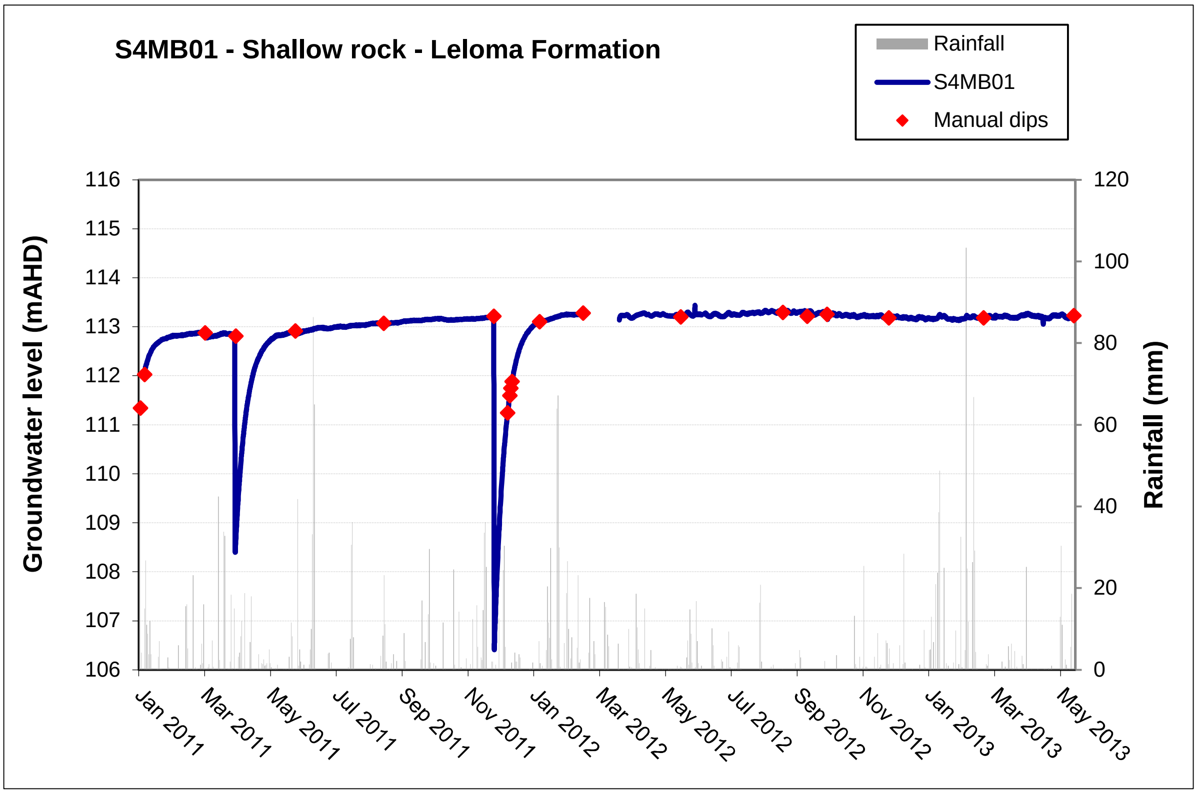


Figure A-6 Groundwater levels and rainfall at S4MB01



Client: AGL Upstream Gas Pty Ltd
Project: 2013 Gloucester Groundwater and Surface Water Monitoring
Location: Gloucester, NSW

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Figure A-7 Groundwater levels and rainfall at S4MB02

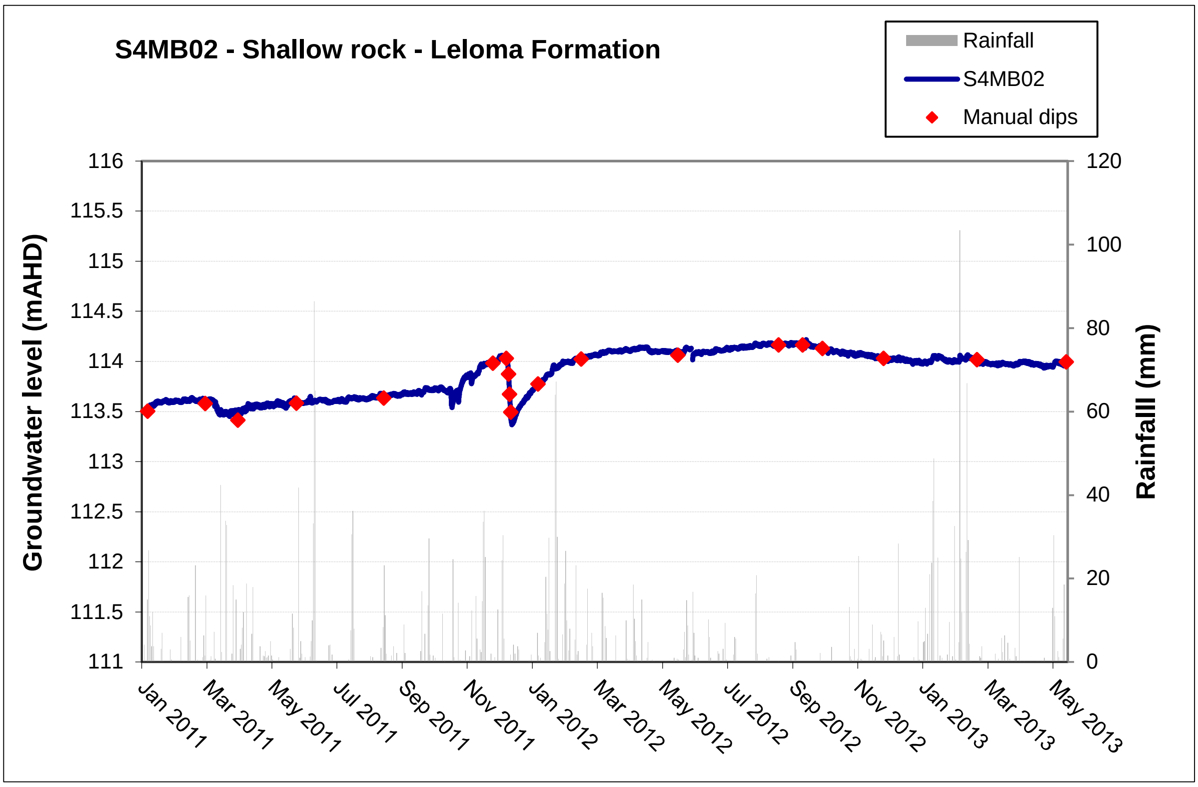

Figure A-8 Groundwater levels and rainfall at S4MB03

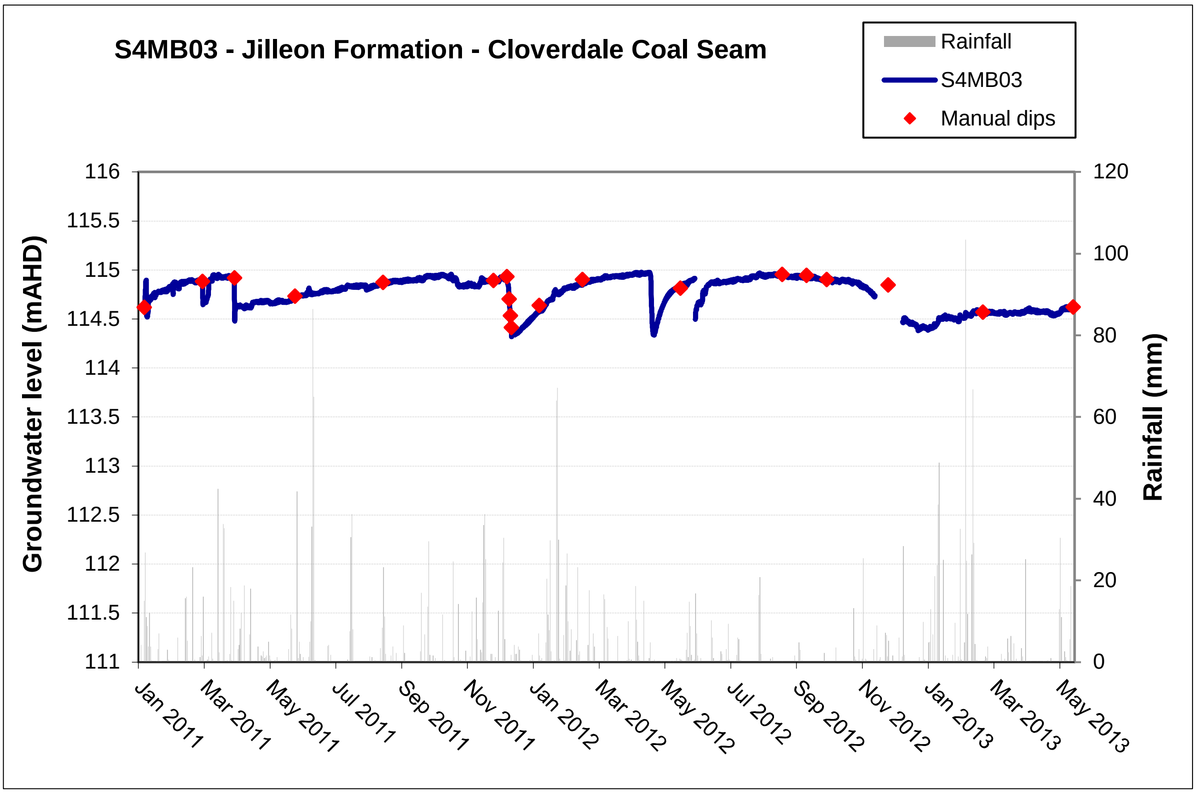

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Figure A-9 Groundwater levels and rainfall at S5MB01

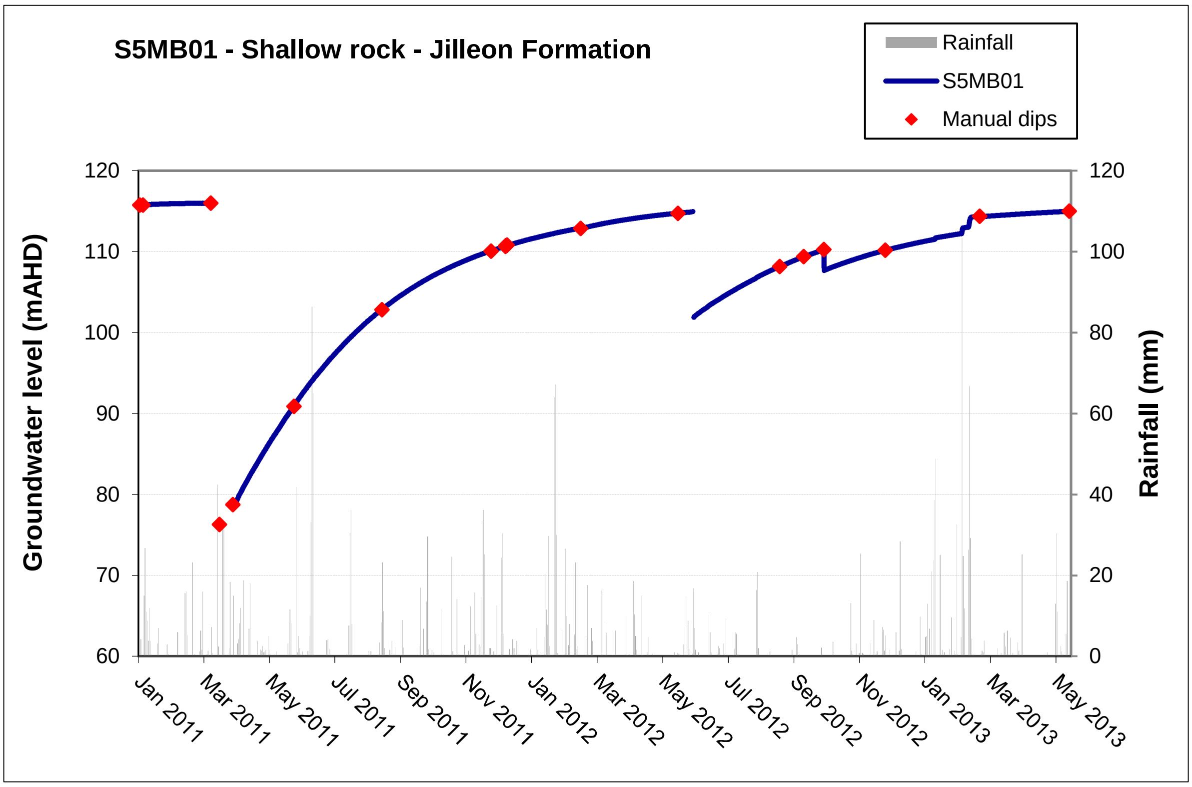
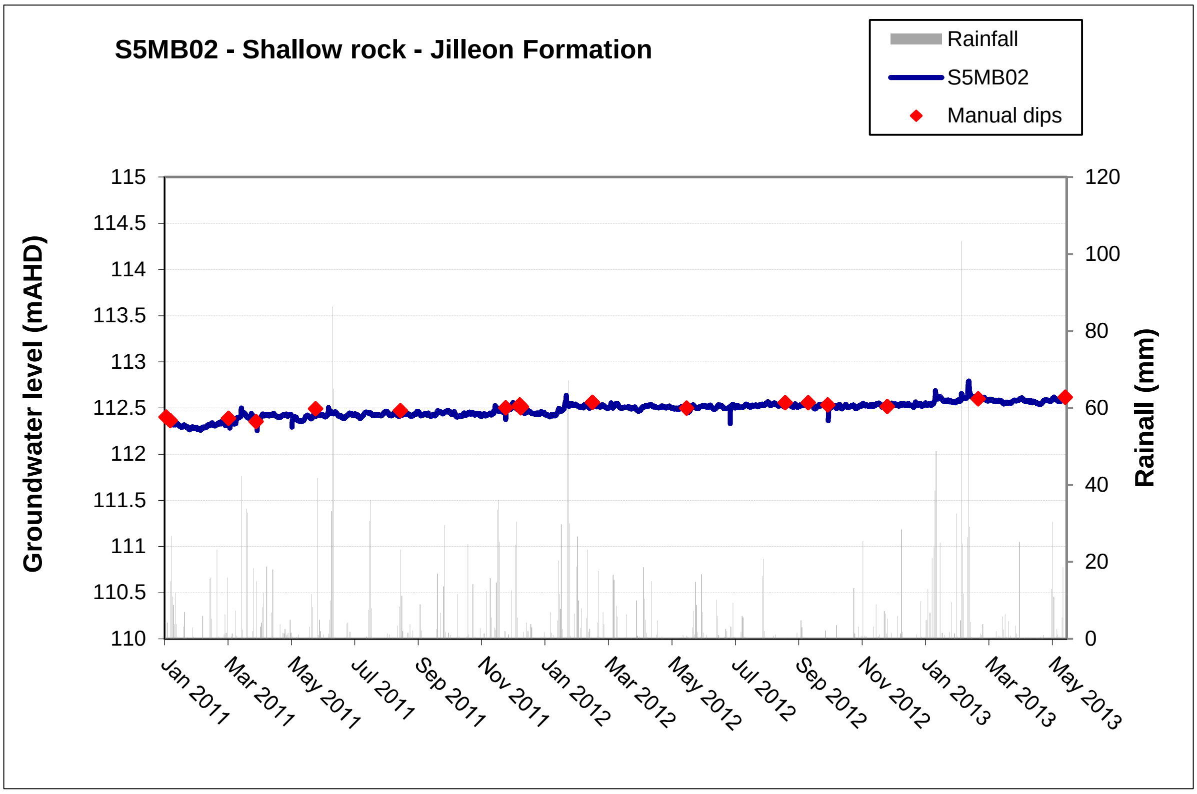


Figure A-10 Groundwater levels and rainfall at S5MB02



Client: AGL Upstream Gas Pty Ltd
Project: 2013 Gloucester Groundwater and Surface Water Monitoring
Location: Gloucester, NSW

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Figure A-11 Groundwater levels and rainfall at S5MB03

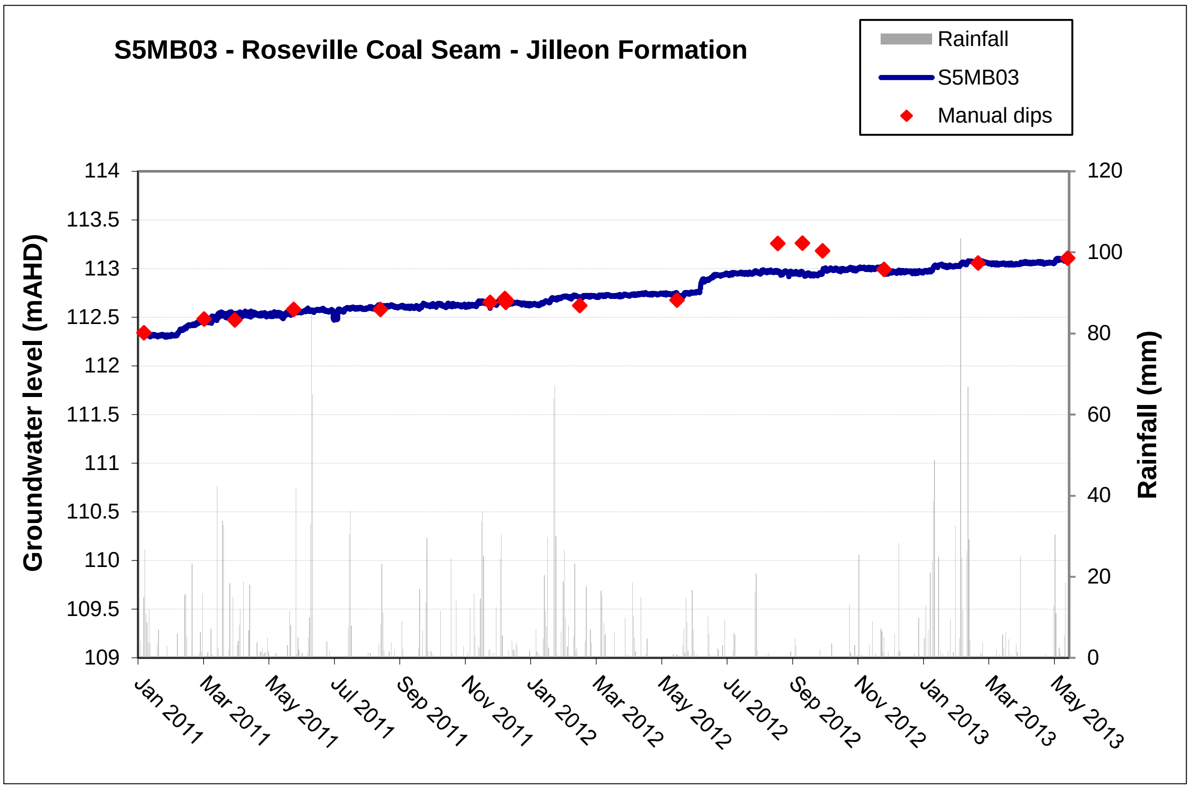
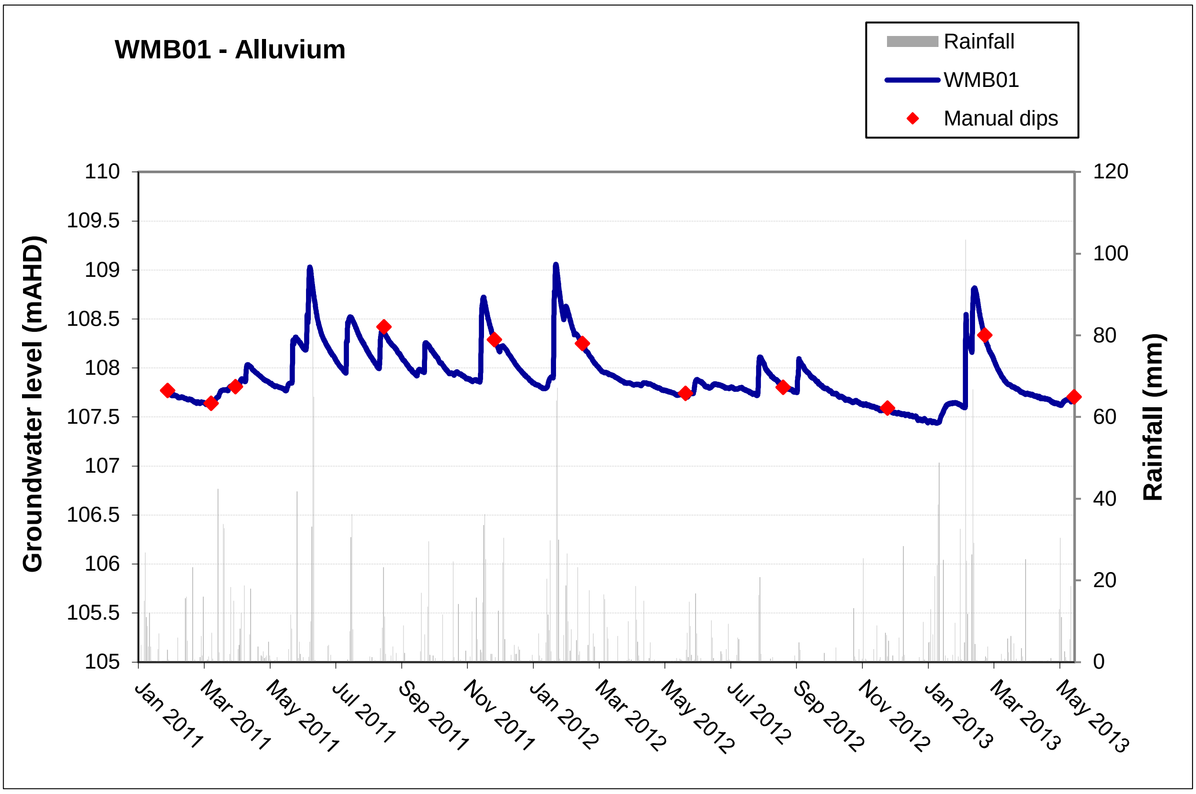


Figure A-12 Groundwater levels and rainfall at WMB01



Client: AGL Upstream Gas Pty Ltd
Project: 2013 Gloucester Groundwater and Surface Water Monitoring
Location: Gloucester, NSW

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Figure A-13 Groundwater levels and rainfall at WMB02

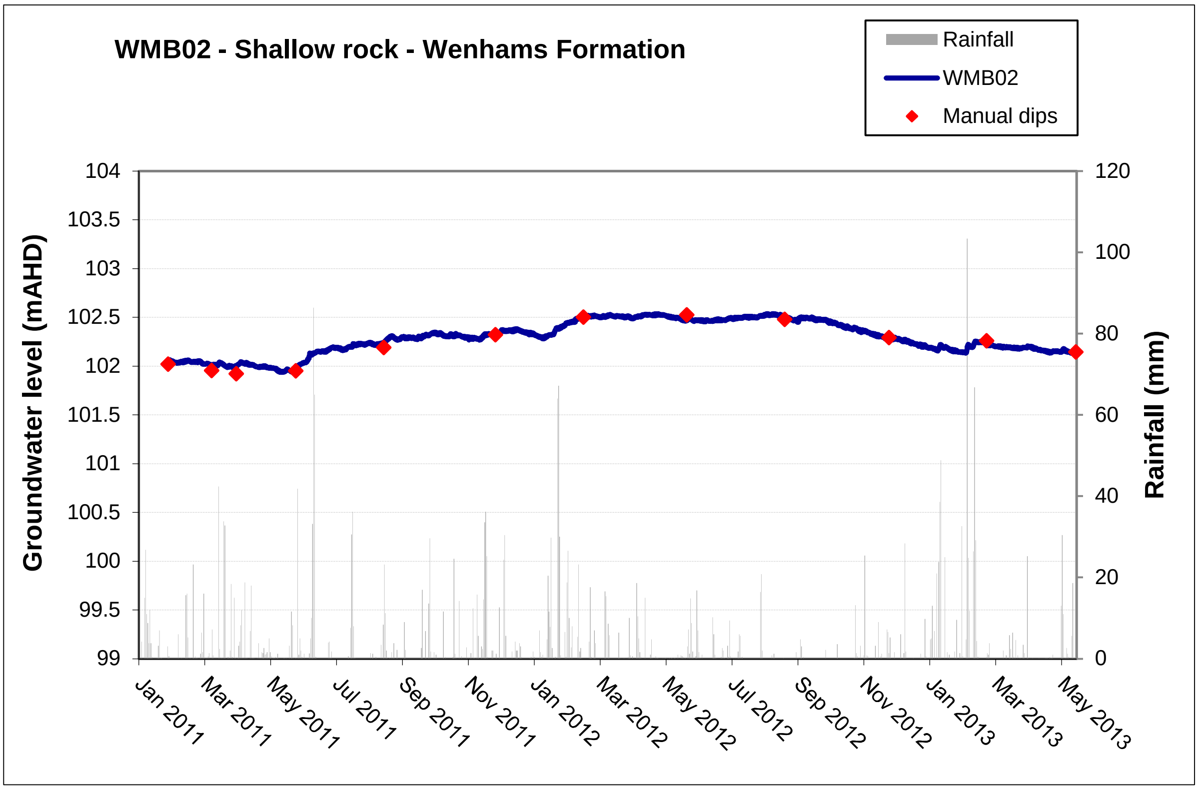


Figure A-14 Groundwater levels and rainfall at WMB03

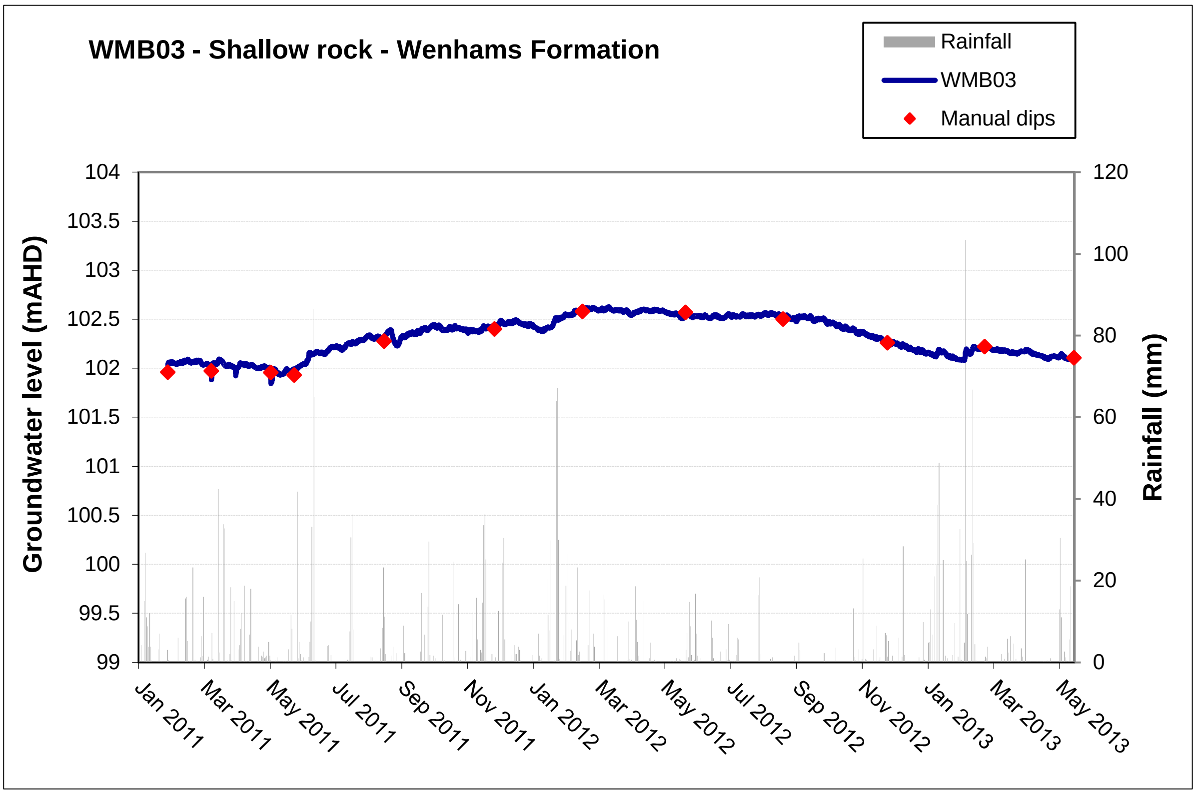


Figure A-15 Groundwater levels and rainfall at WMB04

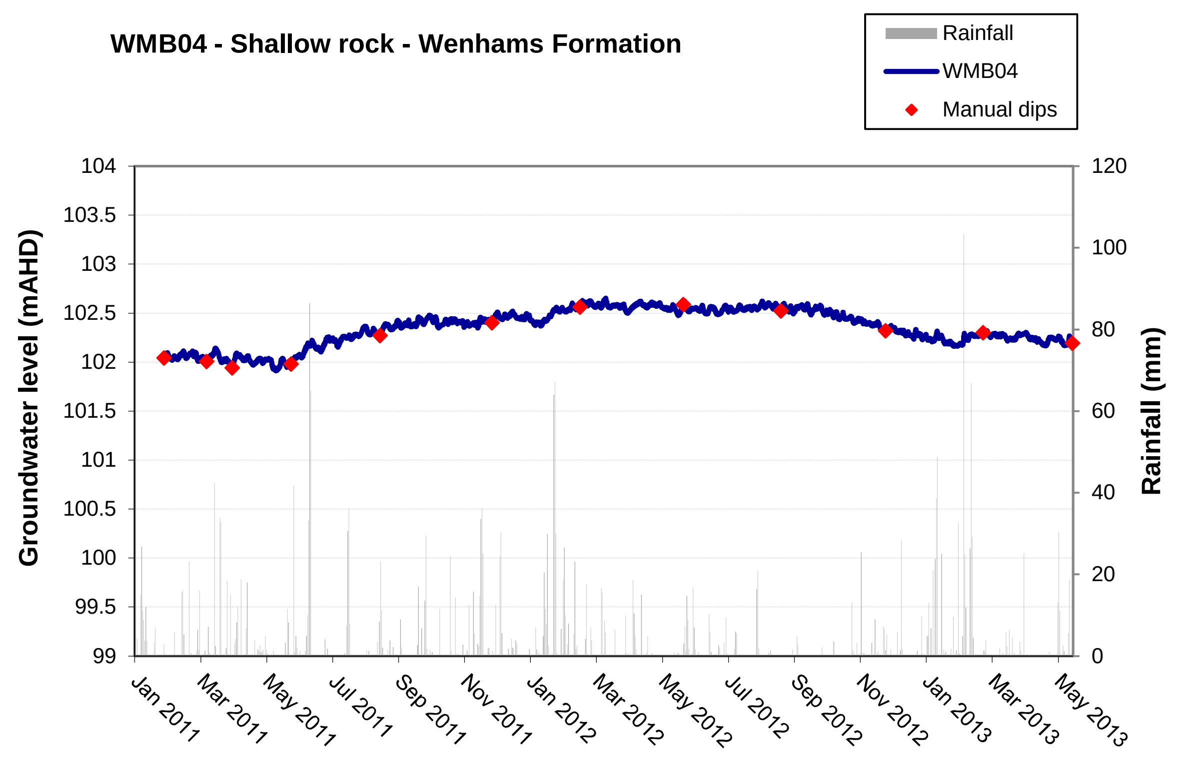
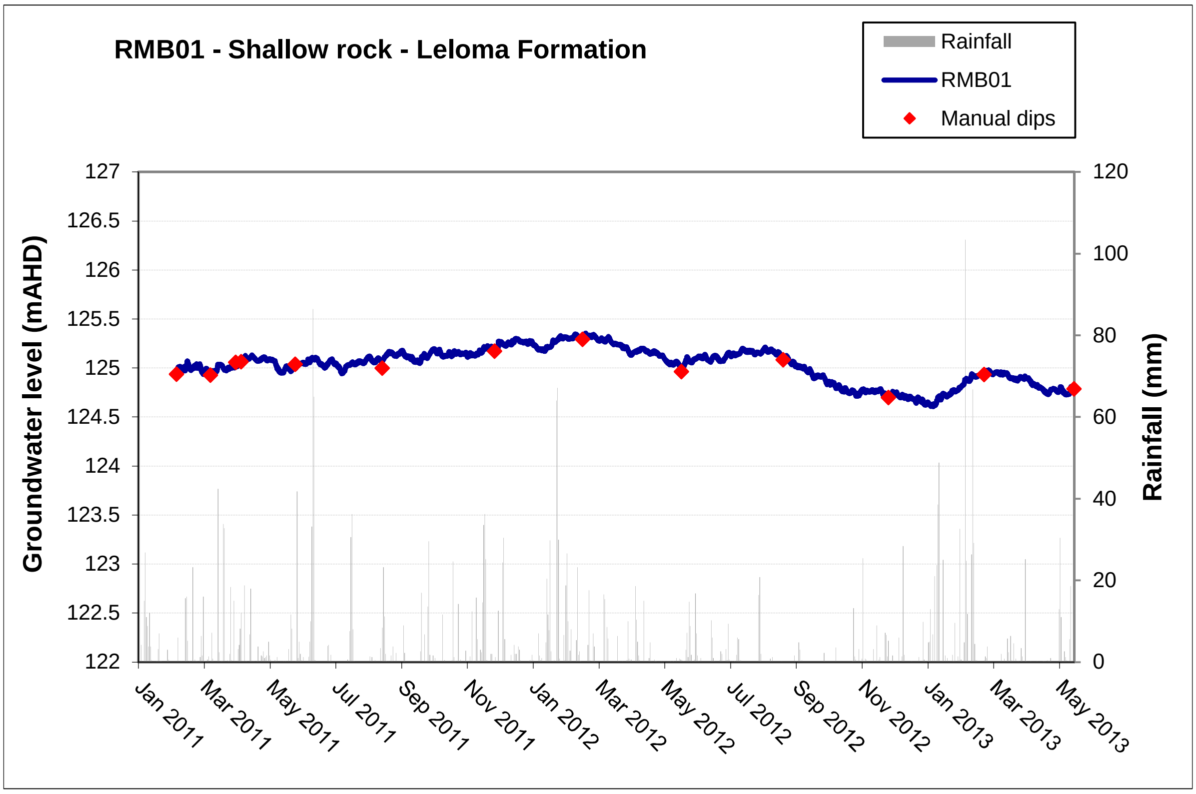


Figure A-16 Groundwater levels and rainfall at RMB01



Client: AGL Upstream Gas Pty Ltd
Project: 2013 Gloucester Groundwater and Surface Water Monitoring
Location: Gloucester, NSW

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Figure A-17 Groundwater levels and rainfall at RMB02

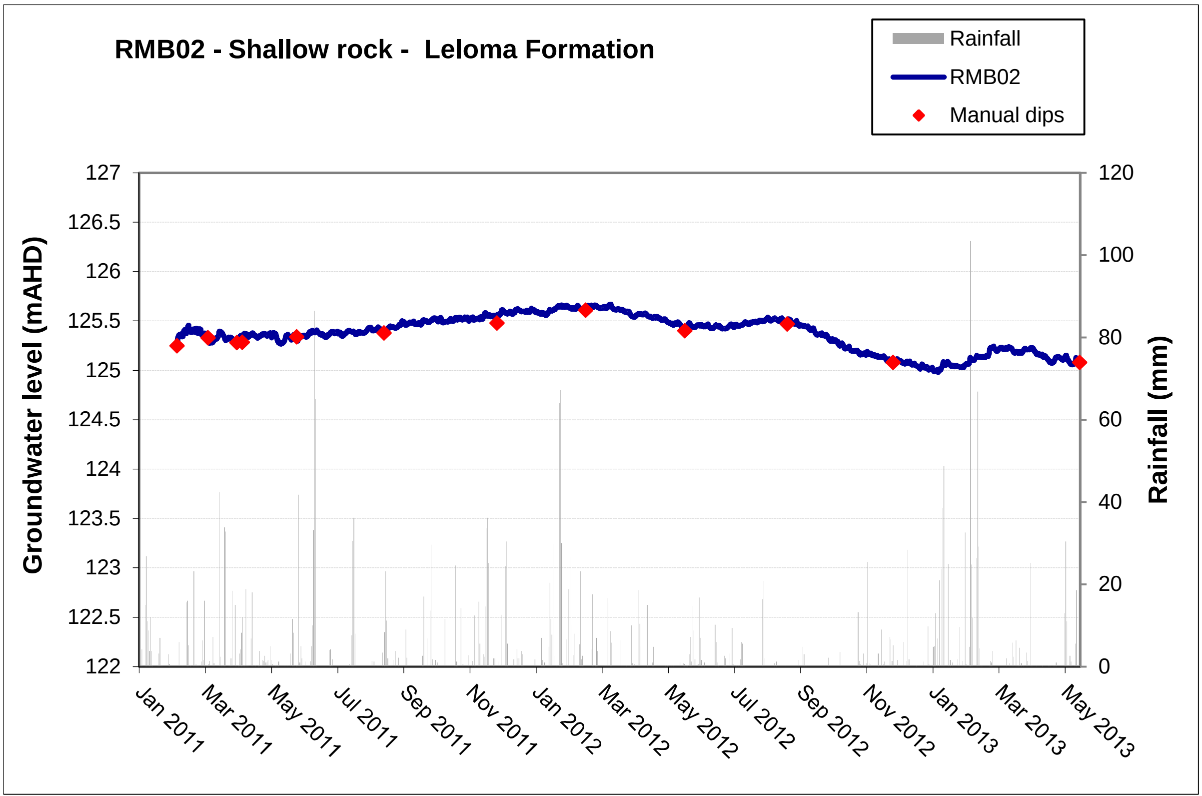


Figure A-18 Groundwater levels and rainfall at BMB01

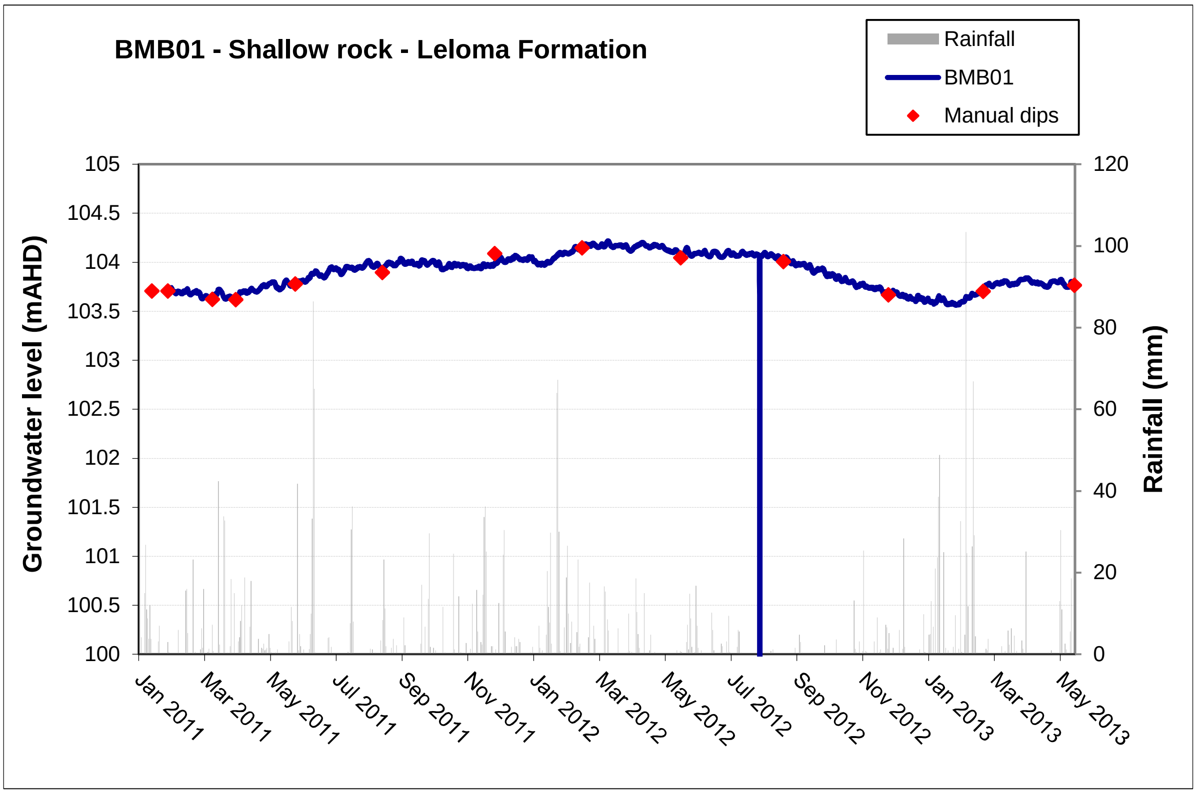


Figure A-19 Groundwater levels and rainfall at BMB02

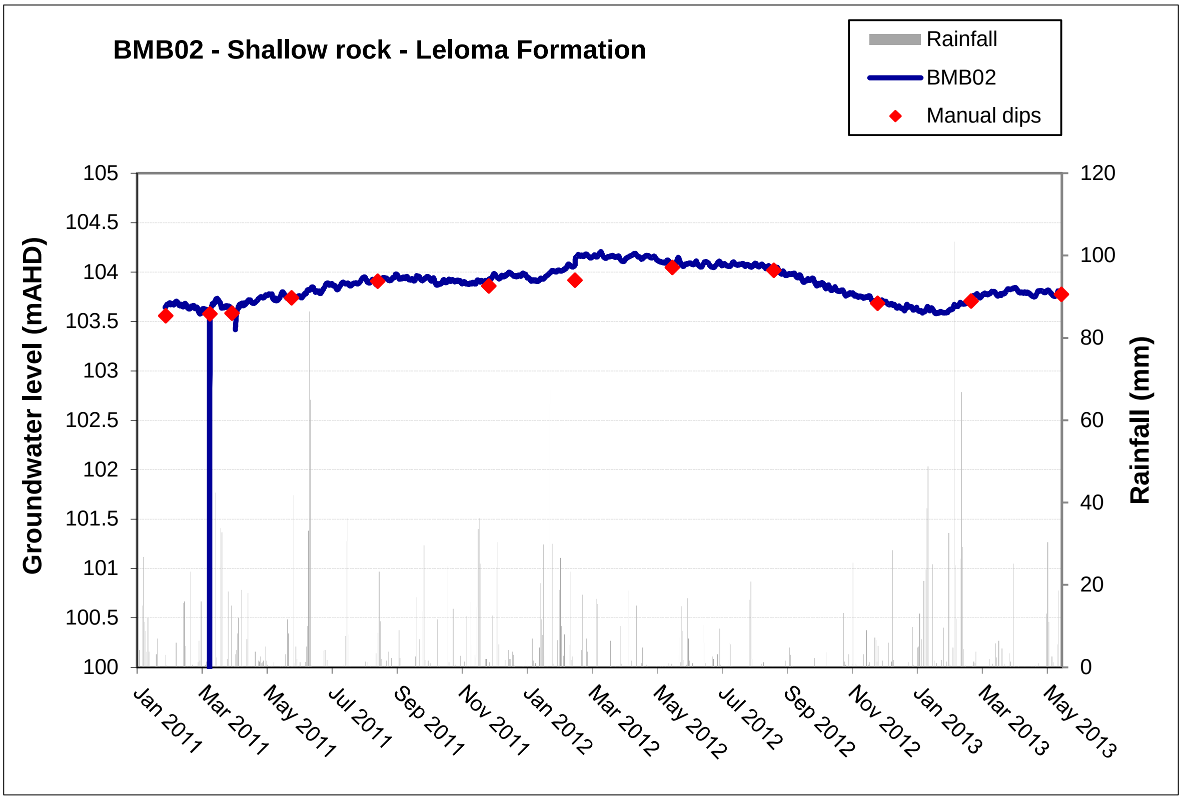
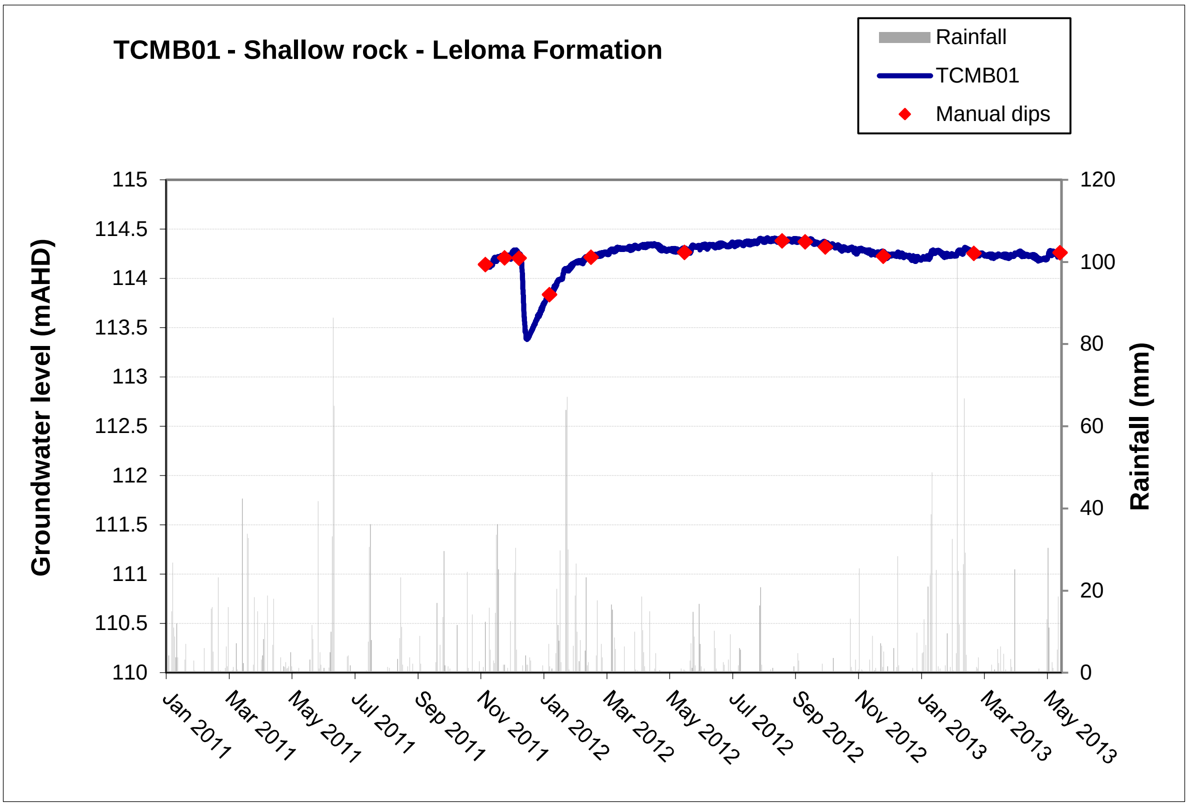


Figure A-20 Groundwater levels and rainfall at TCMB01



Client: AGL Upstream Gas Pty Ltd
Project: 2013 Gloucester Groundwater and Surface Water Monitoring
Location: Gloucester, NSW

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Figure A-21 Groundwater levels and rainfall at TCMB02

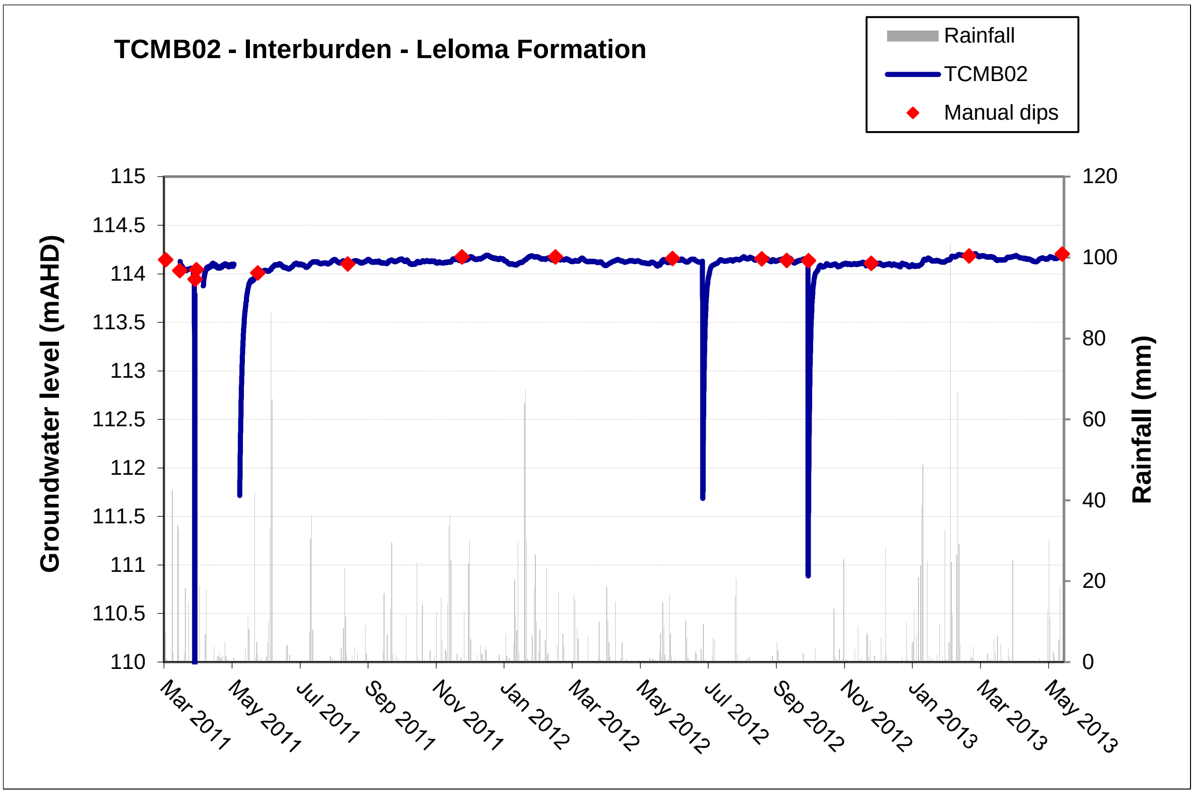
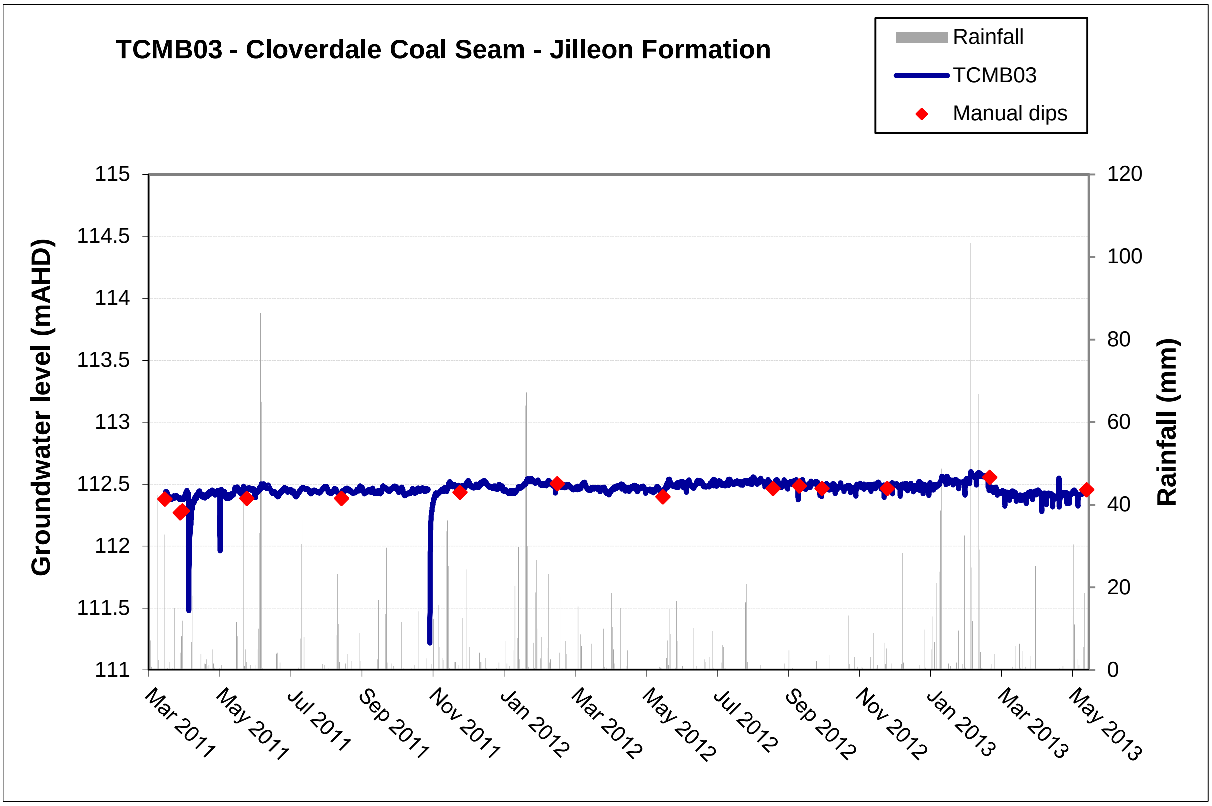


Figure A-22 Groundwater levels and rainfall at TCMB03



Client: AGL Upstream Gas Pty Ltd
Project: 2013 Gloucester Groundwater and Surface Water Monitoring
Location: Gloucester, NSW

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Figure A-23 Groundwater levels and rainfall at TCMB04

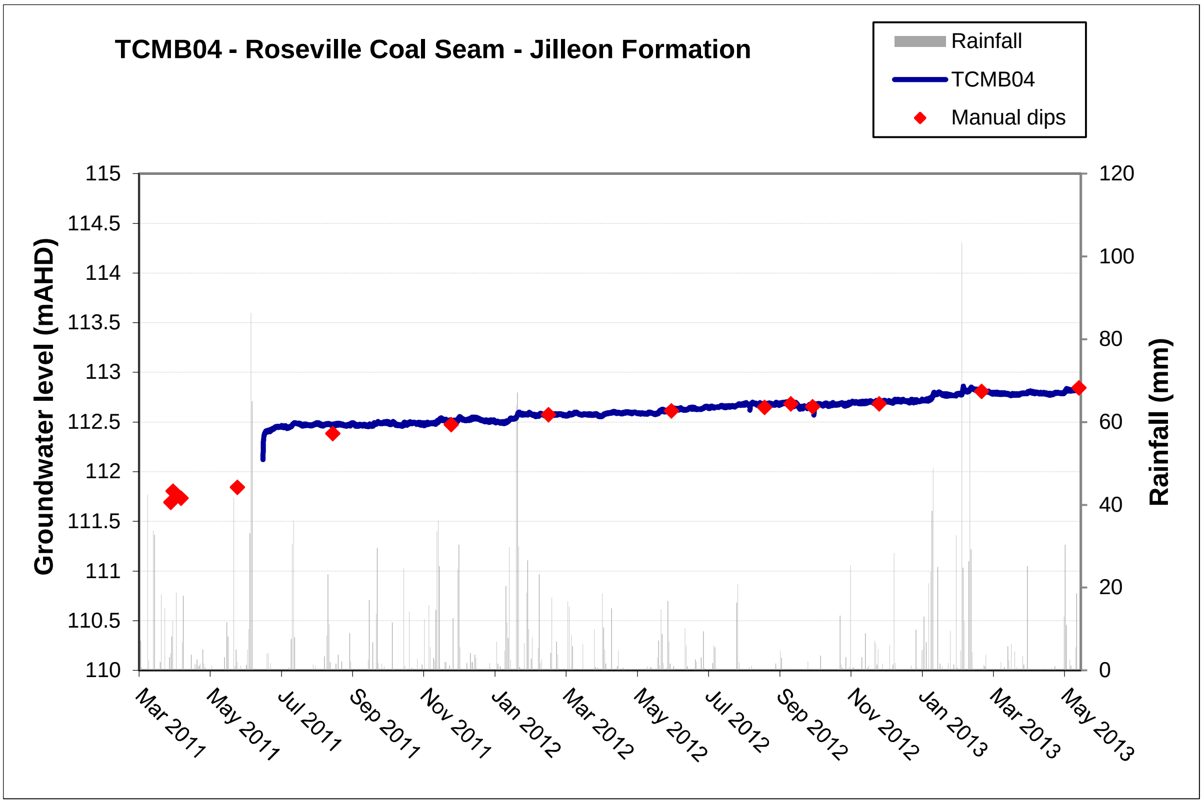


Figure A-24 Groundwater levels and rainfall at TTPB

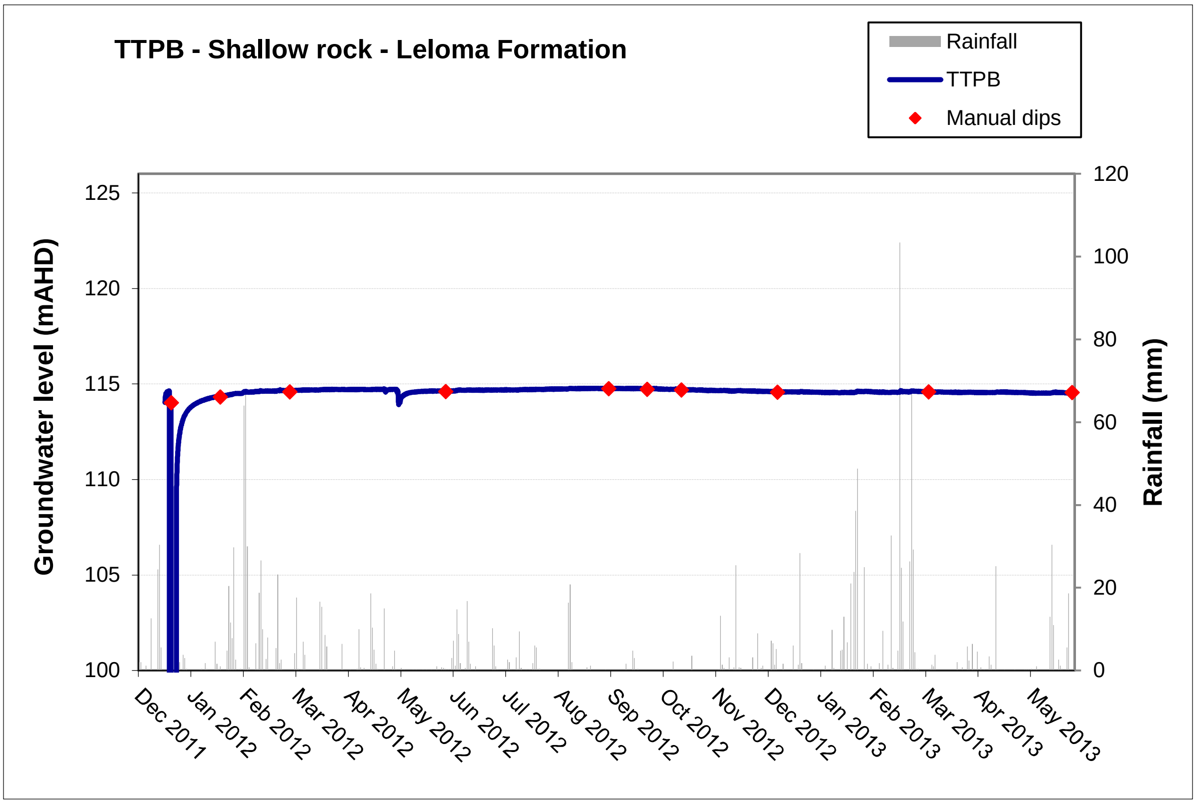


Figure A-25 Groundwater levels and rainfall at TTMB01

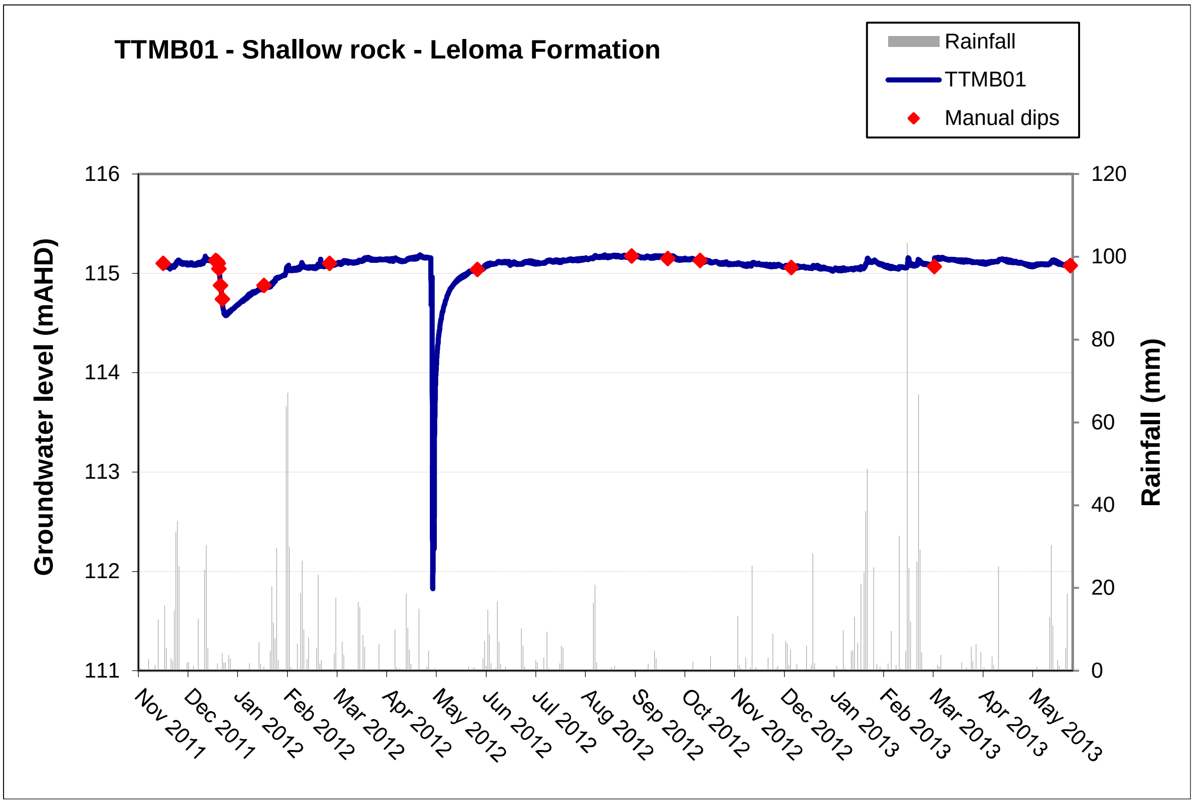
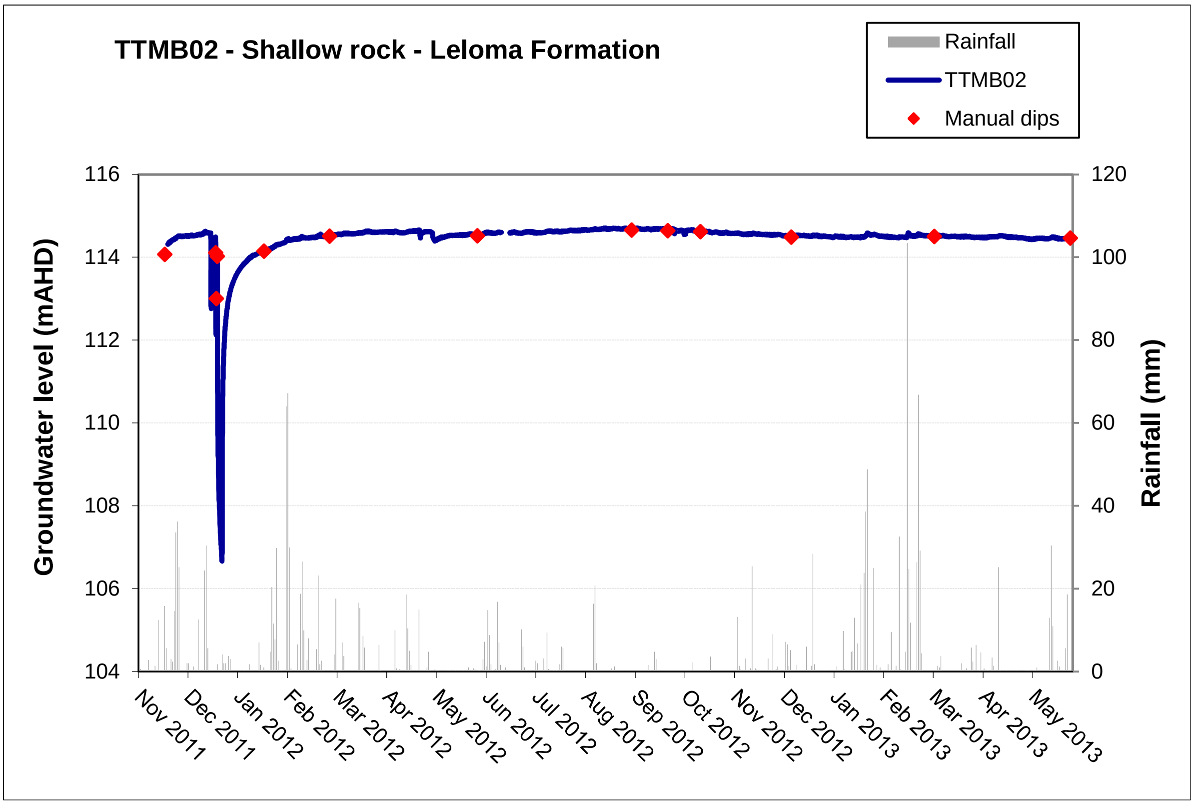


Figure A-26 Groundwater levels and rainfall at TTMB02



Client: AGL Upstream Gas Pty Ltd
Project: 2013 Gloucester Groundwater and Surface Water Monitoring
Location: Gloucester, NSW

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Figure A-27 Groundwater levels and rainfall at TTMB03

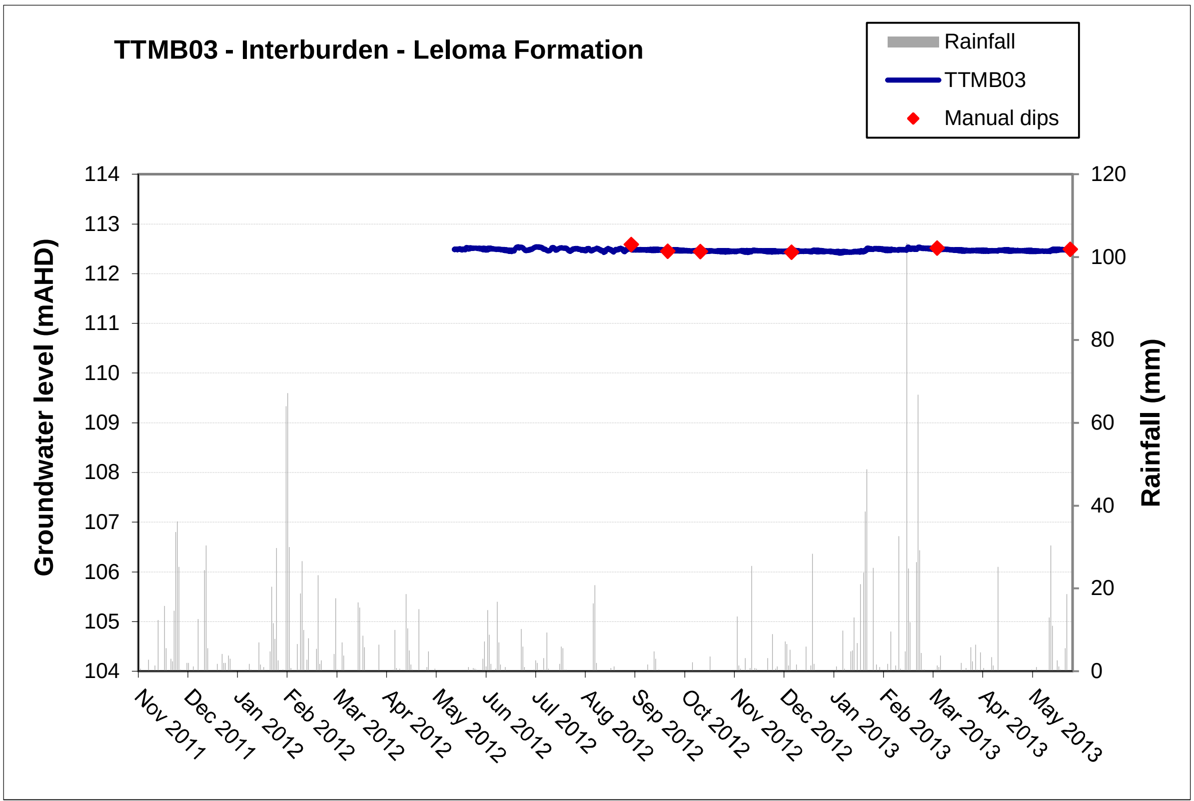


Figure A-28 Groundwater levels and rainfall at Farley

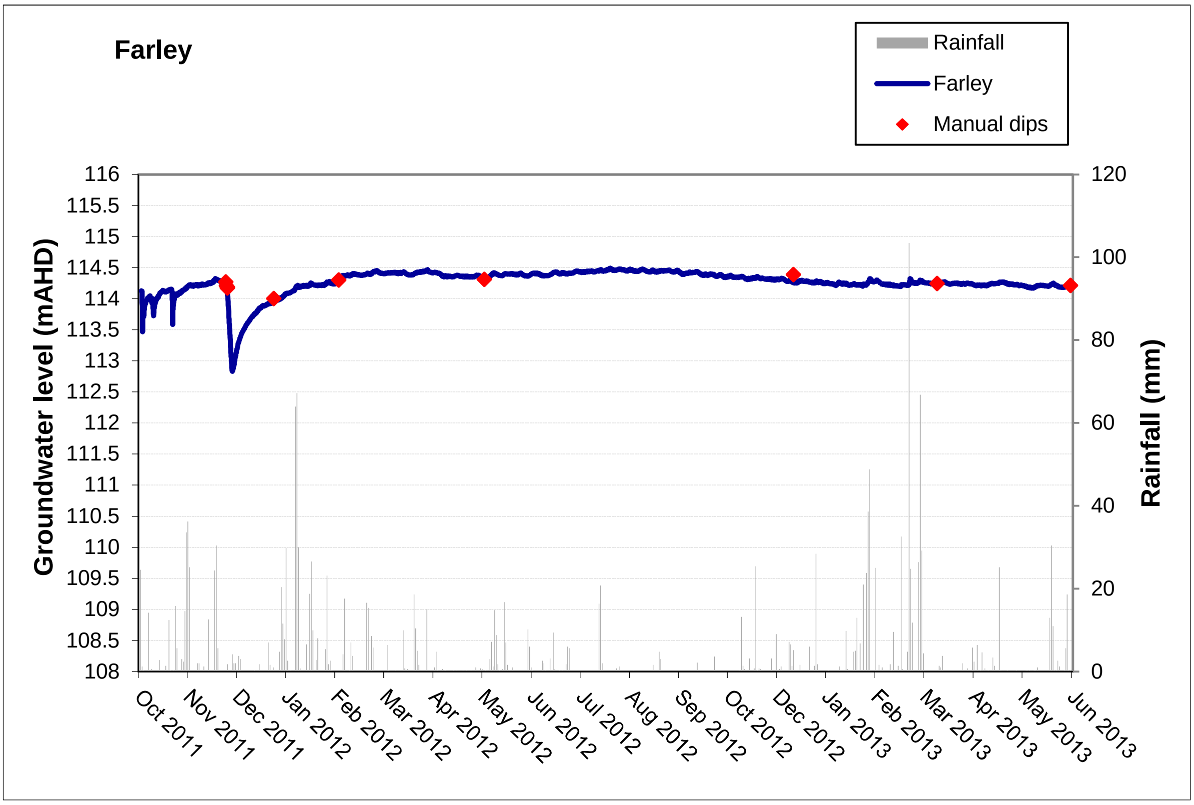


Figure A-29 Groundwater levels and rainfall at WKMB01

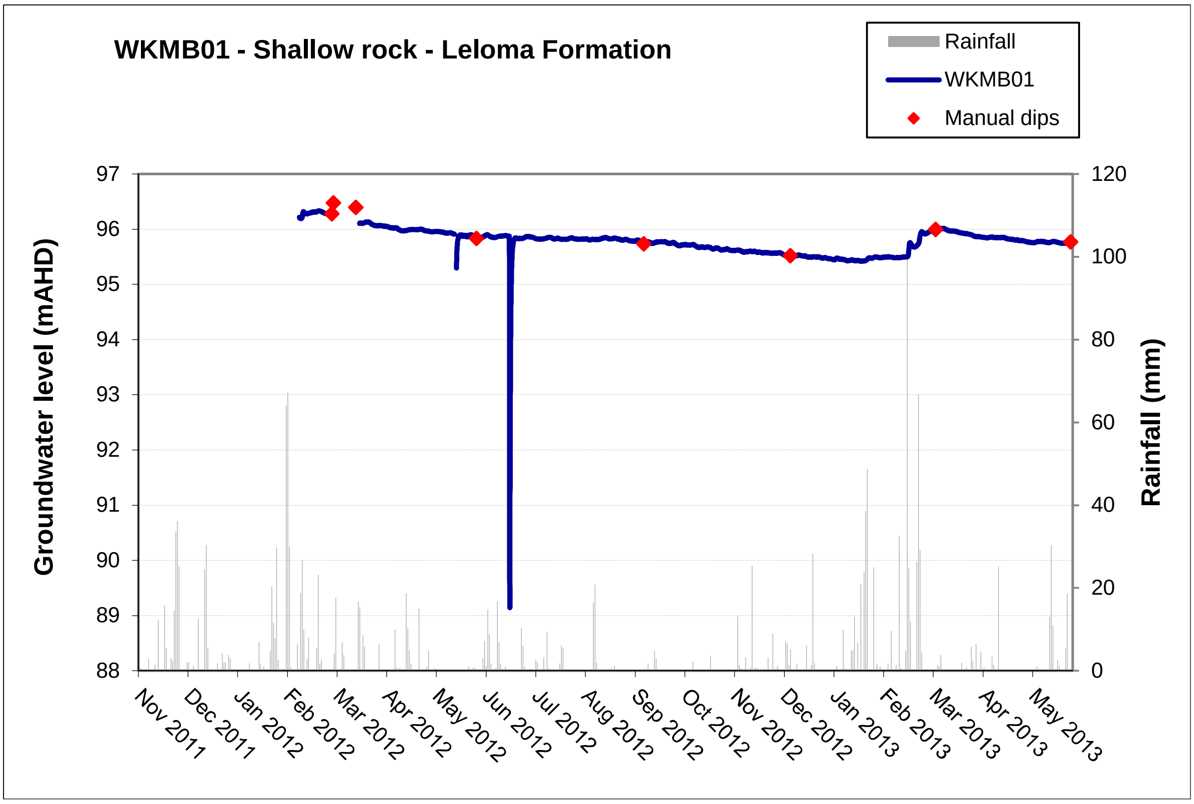


Figure A-30 Groundwater levels and rainfall at WKMB02

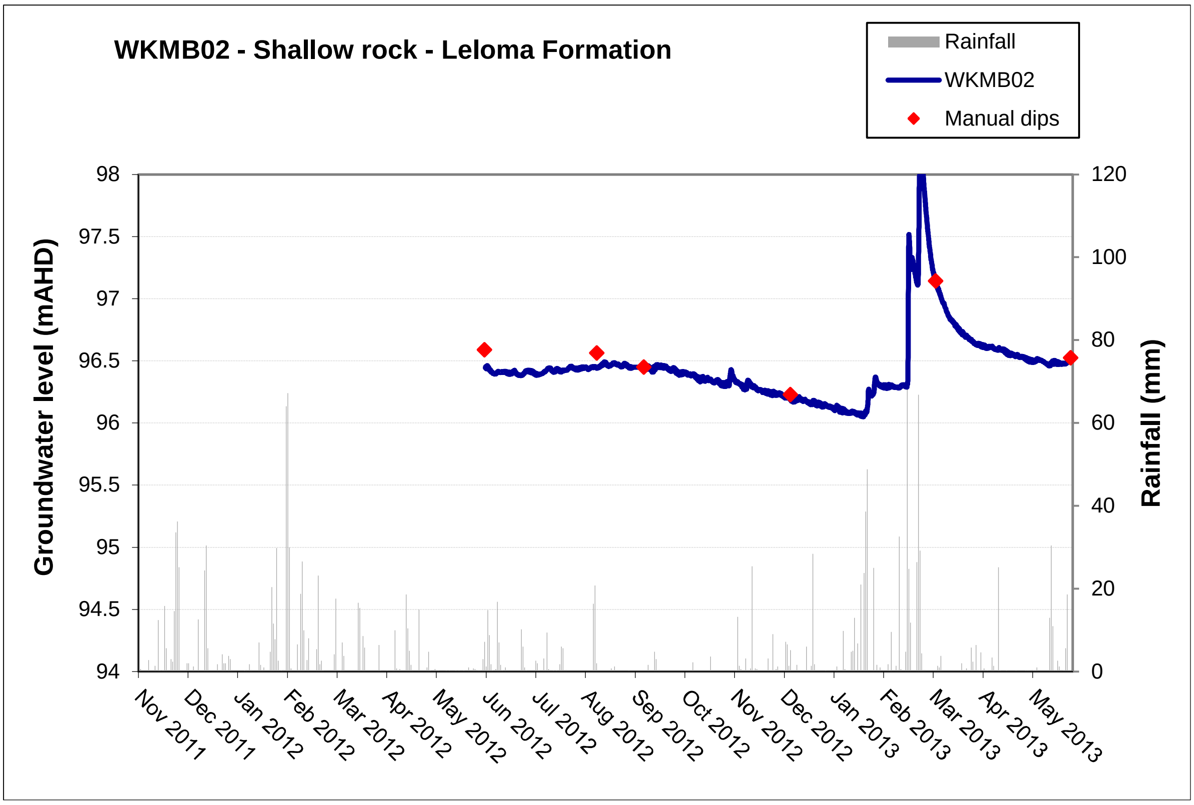


Figure A-31 Groundwater levels and rainfall at WKMB03

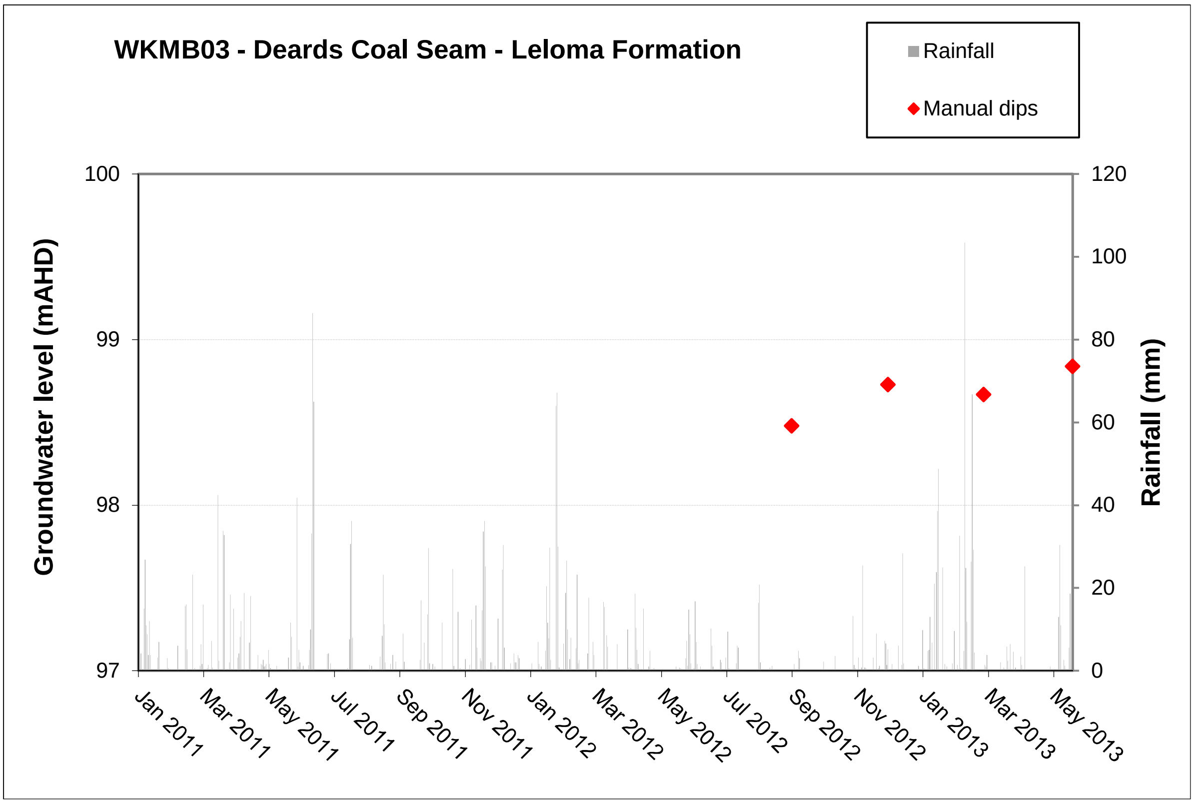


Figure A-32 Groundwater levels and rainfall at WKMB04

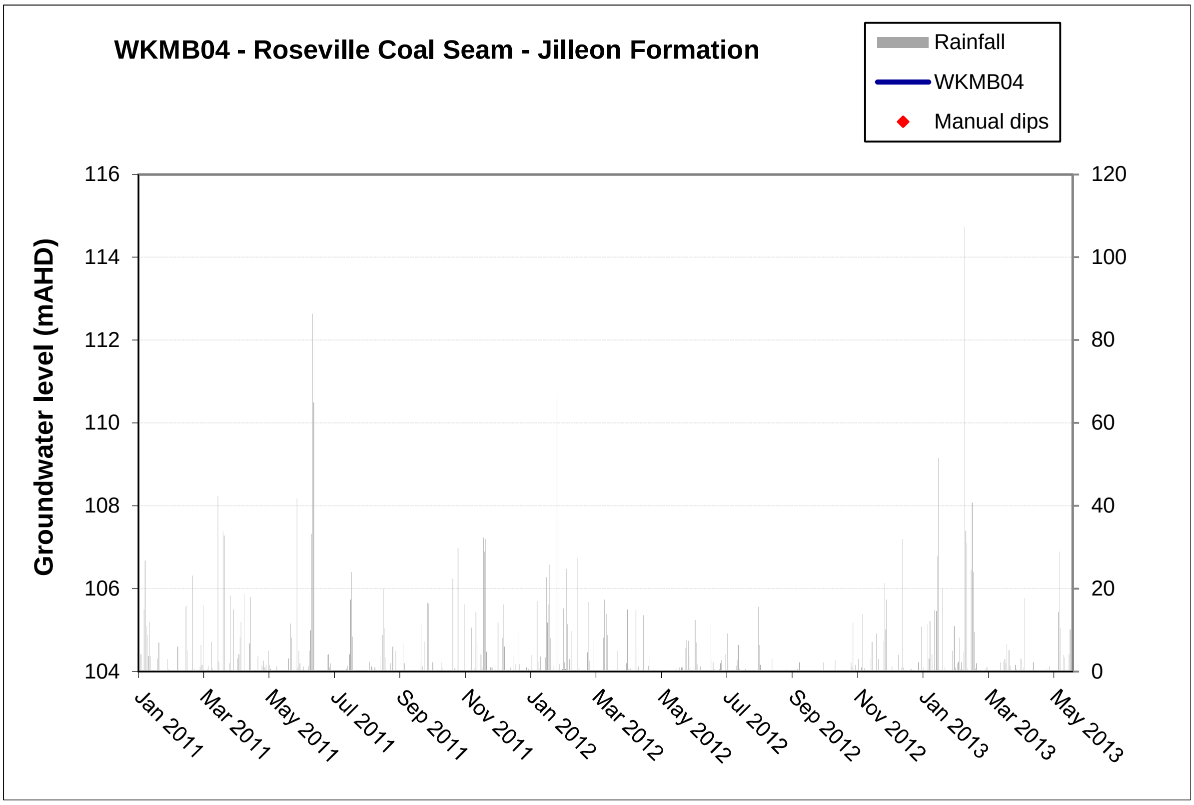


Figure A-33 Stream levels and rainfall at TSW01

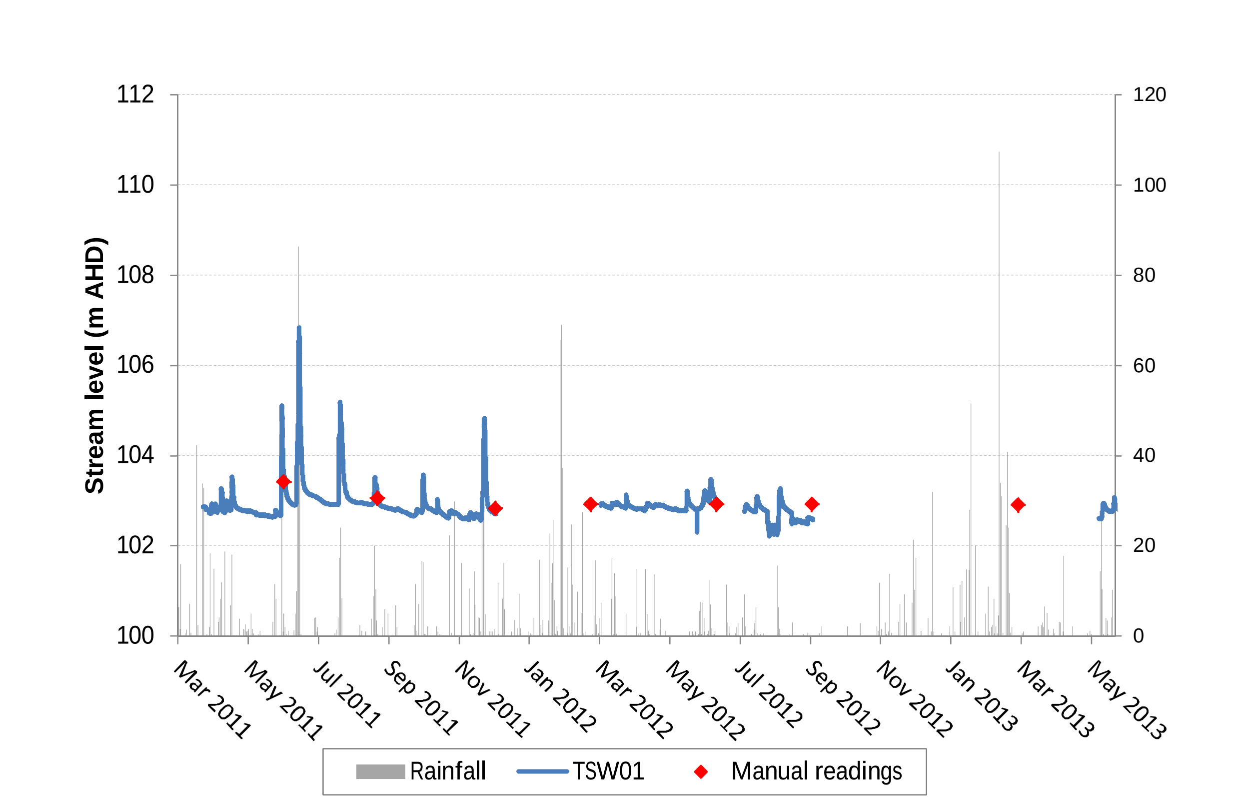


Figure A-34 Stream levels and rainfall at TSW02

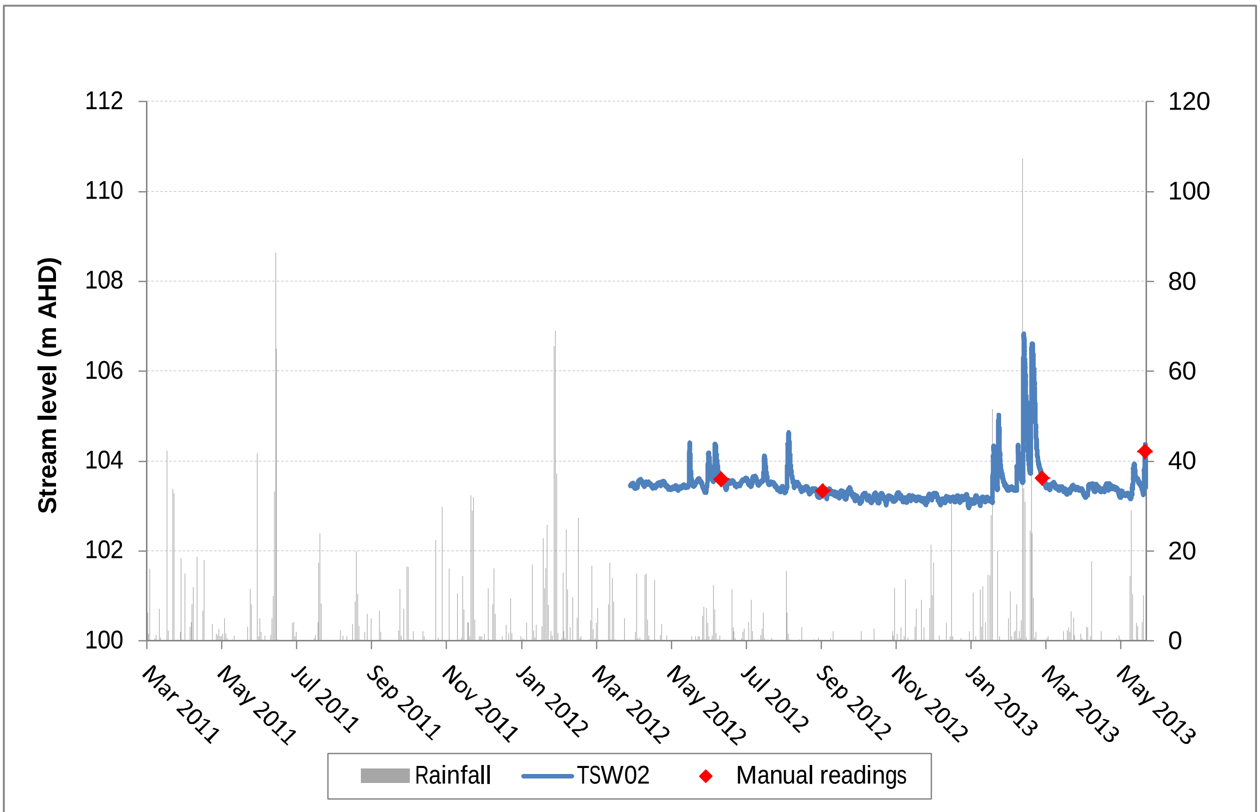


Figure A-35 Stream levels and rainfall at ASW01

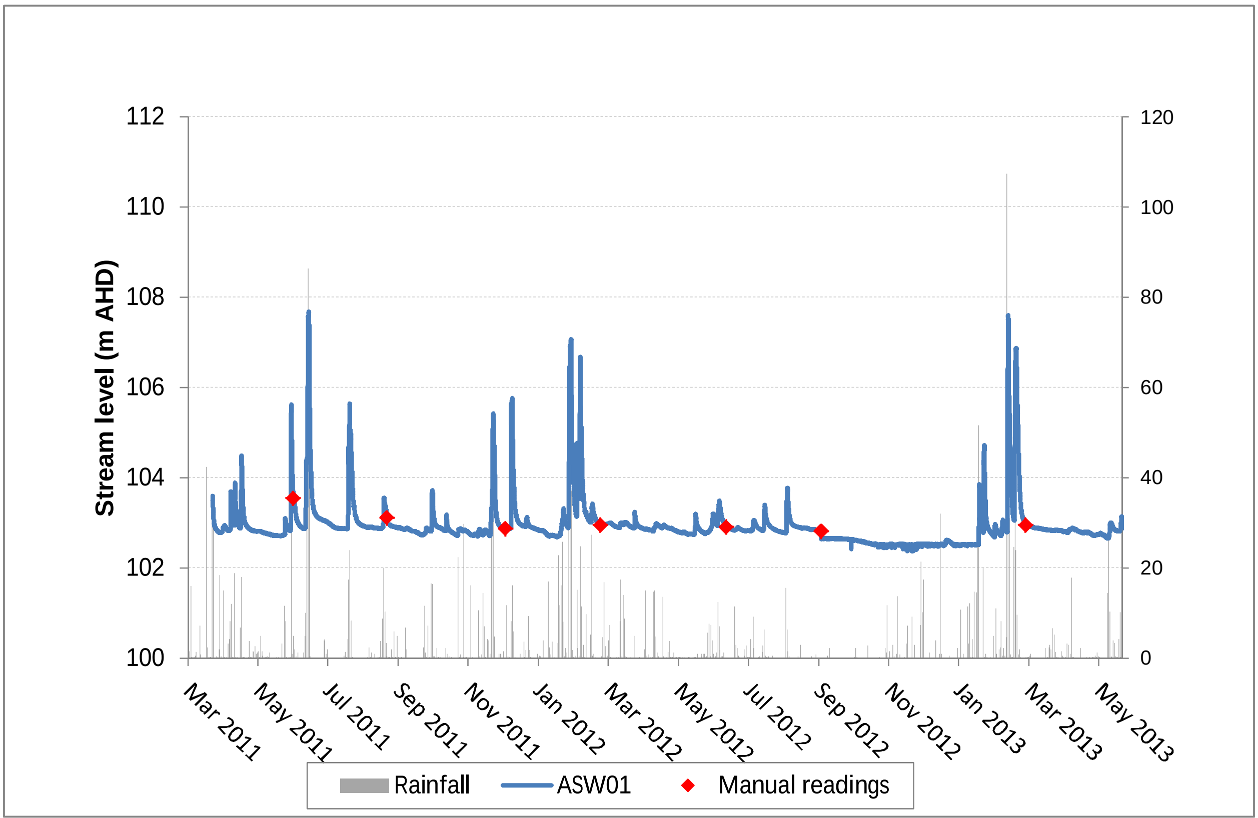
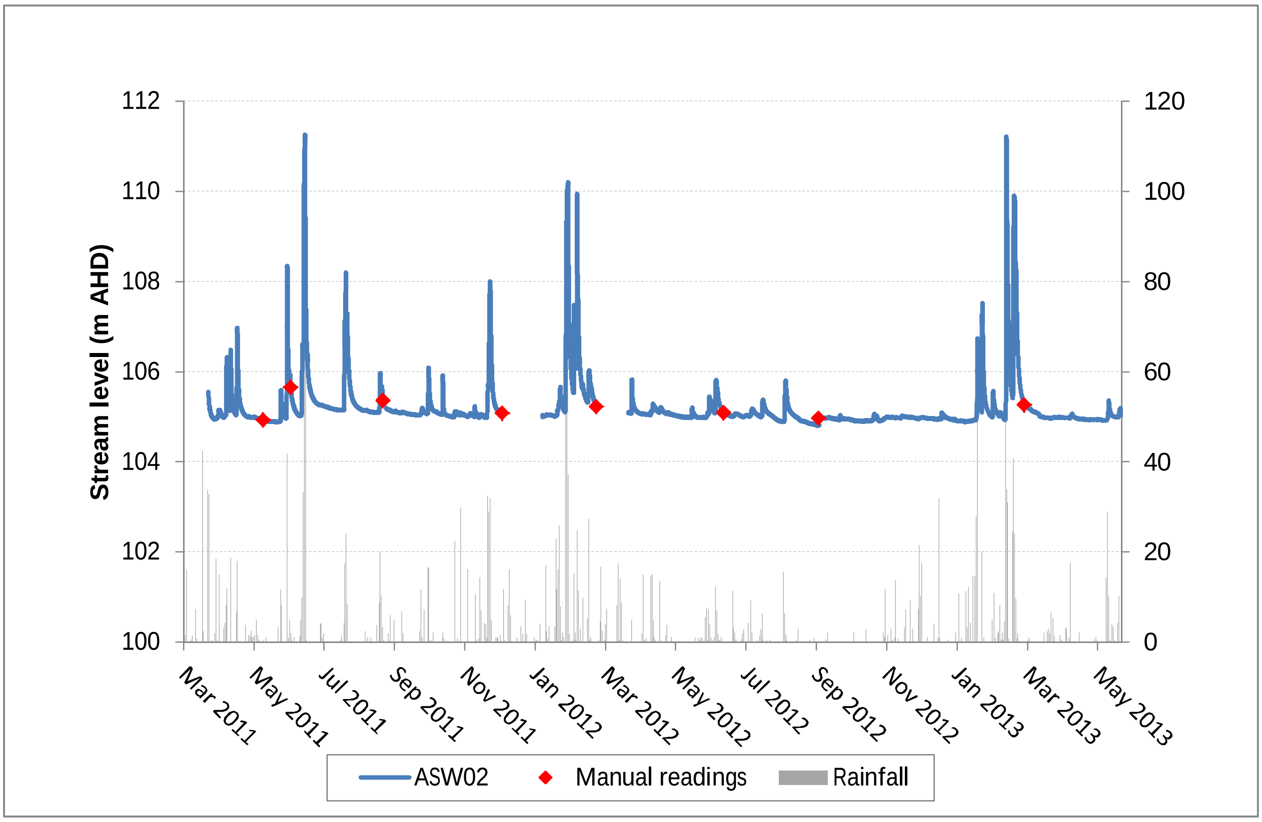


Figure A-36 Stream levels and rainfall at ASW02



Appendix B

Water quality summary tables

SUMMARY TABLE OF LABORATORY RESULTS JUNE 2013 GROUNDWATER MONITORING EVENT

Monitoring location				S4MB01	S4MB02	S4MB03	S5MB01	S5MB02	S5MB03	TMB01	TMB02	TMB03	TCMB01	TCMB02	TCMB03	TCMB04	AMB01	AMB02	BMB01	BMB02
Sample date				26/06/2013	21/06/2013	26/06/2013	26/06/2013	20/06/2013	25/06/2013	17/06/2013	18/06/2013	18/06/2013	20/06/2013	26/06/2013			19/06/2013	19/06/2013	24/06/2013	24/06/2013
Hydrogeological unit				Shallow rock	Shallow rock	Coal	Shallow rock	Shallow rock	Coal	Alluvium	Alluvium	Alluvium	Shallow rock	Interburden	Coal	Coal	Alluvium	Alluvium	Shallow rock	Shallow rock
Screen interval (mbgl)				58-64	89-95	162-168	52-58	100-112	158-164	7-10	9-12	5-11	87-93	175-181	260-266	327.3-333.3	8-10	6.5-11	15-29	124-136
General parameters																				
Analyte	Units	LOR	ANZECC 2000 Guidelines																	
pH	pH units	0.01	6.5 - 8.0*	7.82	7.7	8.25	8.26	8.55	7.55	7.3	6.98	7.36	7.25	10.5		11.5	6.39	6.73	7.76	8.39
Conductivity	µS/cm	1	125 - 2200*	5370	2300	3360	4320	4300	5340	8130	3710	5730	3100	3060	na	4420	2270	396	5240	4230
Total Dissolved Solids	mg/L	1	-	3240	1350	1680	2420	2310	2790	4820	2260	2830	2200	1630		1980	1650	273	2570	2180
Calculated Total Dissolved Solids#	mg/L	-	-												na					
Redox	mV	0.1	-	-85.8	-193.8	-37.5	-267.7	-313	-2	-167	-190.3	-120.3	-175.4	-52.1	na	62.2	-96.6	-111.8	-175.7	-236.3
Laboratory analytes																				
Hydroxide alkalinity as CaCO3	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		219	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	mg/L	1	-	<1	<1	<1	<1	39	<1	<1	<1	<1	<1	337	na	469	<1	<1	<1	18
Bicarbonate alkalinity as CaCO3	mg/L	1	-	432	124	247	600	765	987	492	154	478	286	4	na	<1	78	82	394	578
Total alkalinity as CaCO3	mg/L	1	-	432	124	247	600	804	987	492	154	478	286	341	na	688	78	82	394	596
Sulfate as SO4 2-	mg/L	1	-	233	<1	<1	323	4	164	95	29	222	5	12	na	29	32	14	15	15
Chloride	mg/L	1	-	1170	576	858	747	786	952	2370	1100	1370	724	720	na	636	618	65	1220	864
Calcium	mg/L	1	-	271	65	16	30	10	110	206	137	170	178	4	na	5	81	12	97	14
Magnesium	mg/L	1	-	62	21	4	24	6	116	223	87	133	65	3	na	<1	54	5	60	7
Sodium	mg/L	1	-	741	356	699	888	946	895	1170	513	871	332	672	na	744	301	66	852	860
Potassium	mg/L	1	-	7	3	3	66	5	9	4	4	2	5	8	na	81	2	1	5	4
Silica	mg/L	0.1	-	27.6	14.9	13.6	18.2	17.8	19.3	36.3	35.1	31.8	21.3	56.7	na	17.4	48.1	44	18.8	17.2
Ions															na					
Total anions	meq/L	0.01	-	46.5	18.7	29.1	39.8	38.3	50	78.7	34.7	52.8	26.2	27.4		32.3	19.7	3.76	42.6	36.6
Total cations	meq/L	0.01	-	51	20.5	31.6	43.8	42.3	54.2	79.6	36.4	57.4	28.8	29.9	na	34.7	21.6	3.91	47	38.8
Ionic balance	%	0.01	-	4.66	4.6	4.04	4.76	4.86	4.01	0.6	2.4	4.12	4.66	4.35	na	3.54	4.78	1.84	4.86	2.87
Dissolved metals															na					
Aluminium	mg/L	0.01	0.055	0.04	0.02	0.04	0.05	0.12	<0.01	<0.01	<0.01	<0.01	0.04	0.03		2.9	<0.01	0.03	0.05	0.06
Arsenic	mg/L	0	0.013 (As V)	0.002	<0.001	<0.001	0.003	0.001	0.014	0.001	0.002	0.003	<0.001	0.002	na	0.001	0.002	<0.001	<0.001	<0.001
Beryllium	mg/L	0	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0	-	0.8	3.98	1.76	0.18	1.91	0.143	0.214	0.725	0.199	4.5	0.998	na	0.208	0.555	0.055	0.751	0.749
Cadmium	mg/L	0	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	na	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	mg/L	0	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.003	<0.001	<0.001	na	<0.001	0.037	0.001	<0.001	<0.001
Copper	mg/L	0	0.0014	0.002	<0.001	<0.001	0.002	0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.002	na	0.002	<0.001	<0.001	0.021	0.003
Lead	mg/L	0	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	na	0.005	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0	1.9	0.292	0.023	0.01	0.039	0.012	0.143	0.878	1.12	1.42	0.098	0.002	na	0.003	3.24	0.15	0.23	0.034
Molybdenum	mg/L	0	ID	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.004	na	0.005	<0.001	<0.001	<0.001	0.003
Nickel	mg/L	0	0.011	0.005	0.001	0.001	0.013	0.002	0.006	<0.001	<0.001	<0.001	0.002	0.012	na	0.011	0.01	0.001	0.015	0.007
Selenium	mg/L	0.01	0.011 (total)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	0	-	31.8	7.45	2.04	3.68	1.27	5.61	6.19	3.17	4.66	12.3	2.44	na	0.672	1.84	0.246	5.21	2.06
Uranium	mg/L	0	ID	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	0.013	<0.001	<0.001	na	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	mg/L	0.01	ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.01	0.008	0.277	0.062	0.061	0.053	0.192	0.347	<0.005	0.009	0.01	0.151	2.21	na	3.07	0.038	0.014	0.028	0.032
Boron	mg/L	0.05	0.37	0.19	<0.05	<0.05	0.21	0.08	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	0.07	<0.05	<0.05	<0.05	0.05
Iron	mg/L	0.05	ID	1.11	0.3	0.07	0.11	0.05	0.27	2.83	6.8	1.28	1.84	0.1	na	0.13	6.91	0.89	0.8	0.2
Bromine	mg/L	0.1	ID	3	1.1	1.5	1.8	2.4	2.2	4.6	2.1	3.2	1	1	na	1.3	1	0.2	4	2.8
Nutrients															na					
Ammonia as N	mg/L	0.01	0.02*	1.92	1.31	1.02	3.72	1.86	1.05	0.35	0.36	0.12	1.33	9.76		3.03	0.19	0.04	0.42	0.92
Nitrite as N	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.7	<0.01	0.07	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite + nitrate as N	mg/L	0.01	0.04*	<0.01	0.07	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01
Total phosphorous	mg/L	0.01	0.05*	0.08	0.03	0.02	0.18	0.24	0.05	0.06	0.06	<0.01	0.01	0.07	na	0.13	<0.01	0.02	0.01	0.16
Reactive phosphorous	mg/L	0.01	0.02*	<0.01	<0.01	<0.01	0.11	0.18	0.01	<0.01	0.02	<0.01	<0.01	<0.01	na	0.05	<0.01	<0.01	<0.01	0.14
Total Organic Carbon	mg/L	1	-	54	2	3	110	12	2	2	1	2	4	64	na	39	2	2	2	18
Dissolved Gases															na					
Methane	µg/L	10	-	6550	5820	30500	36	20200	274	92	88	13	870	9030		7550	<10	<10	3470	17600
Phenolic compounds															na					
Phenol	µg/L	1	320	<1.0	<1.0	<1.0	3.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	4.7		<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	µg/L	1	490	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
3-&4-Methylphenol	µg/L	2	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	6.7	<2.0	<2.0	<2.0	<2.0	na	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	µg/L	1	160	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	µg/L	1	20	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	µg/L	2	ID	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	na	<2.0	<2.0	<2.0	<2.0	<2.0
Polycyclic aromatic hydrocarbons															na					
Naphthalene	µg/L	1	16	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	0.5	ID	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0
Sum of polycyclic aromatic hydrocarbons	µg/L	0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ (WHO)	µg/L	0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	<0.5	<0.5	<0.5
Total petroleum hydrocarbons															na					
C6-C9 Fraction	µg/L	20	ID	<20	<20	<20	80	<20	<20	<20	<20	<20	20	100		<20	<20	<20	<20	<20
C10-C14 Fraction	µg/L	50	ID	<50	<50	<50	100	<50	<50	<50	<50	<50	<50	60	na	<50	<50	<50	<50	<50
C15-C28 Fraction	µg/L	100	ID	<100	<100	<100	1090	<100	<100	<100	<100	<100	<100	1740	na	140	<100	<100	<100	<100
C29-C36 Fraction	µg/L	50	ID	<50	<50	<50	210	<50	<50	<50	<50	<50	<50	610	na	<50	<50	<50	<50	<50
C10-C36 Fraction (sum)	µg/L	50	-	<50	<50	<50	1400	<50	<50	<50	<50	<50	<50	2410	na	140	<50	<50	<50	<50
Total recoverable hydrocarbons															na					
C6 - C10 Fraction	µg/L	20	-	<20	<20	<20	80	<20	<20	<20	<20	<20	20	110		<20	<20	<20	<20	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	20	-	<20	<20	<20	20	<20	<20	<20	<20	<20	<20	100	na	<20	<20	<20	<20	<20
>C10 - C16 Fraction	µg/L	100	-	<100	<100	<100	180	<100	<100	<100	<100	<100	<100	<100	na	<100	<100	<100	<100	<100
>C16 - C34 Fraction	µg/L	100	-	<100	<100	<100	1190	<100	<100	<100	<100	<100	<100	2260	na	160	<100	<100	<100	<100
>C34 - C40 Fraction	µg/L	100	-	<100	<100	<100	110	<100	<100	<100	<100	<100	<100	100	na	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	µg/L	100	-	<100	<100	<100	1480	<100	<100	<100	<100	<100	<100	2360	na	160	<100	<100	<100	<100
Aromatic hydrocarbons															na					
Benzene	µg/L	1	950	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1
Toluene	µg/L	2	ID	<2	3	<2	56	3	4	<2	<2	<2	3	10	na	<2	<2	<2	<2	4
Ethyl Benzene	µg/L	2	ID	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2
m&p-Xylenes	µg/L	2	ID	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2
o-Xylenes	µg/L	2	350	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2
Total Xylenes	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2
Sum of BTEX	µg/L	1	-	<1	3	<1	56	5	4	<1	<1	<1	3	10	na	<1	<1	<1	<1	4

exceeds guideline limits

Guideline values

ANZECC 2000 - Water Quality Guidelines: 95% protection levels (trigger values) for the protection of freshwater aquatic ecosystems.

* ANZECC 2000 - Water Quality Guidelines: 95% protection levels (trigger values) for the protection of freshwater aquatic ecosystems, South-East Australia, low lying river ecosystems

^ This result is below the Minimum Detectable Activity (MDA) and Limit of Quantification (Quant Limit) and therefore has an unacceptable level of uncertainty. Hence the data should only be used as an indicator of true concentration.

ID - insufficient data

na - not analysed

SUMMARY TABLE OF LABORATORY RESULTS JUNE 2013 GROUNDWATER MONITORING EVENT

Monitoring location				WMB01	WMB02	WMB03	WMB04	RMB01	RMB02	WKMB01	WKMB02	WKMB03	WKMB04	TTPB	TTMB01	TTMB02	TTMB03	TSW01	TSW02	ASW01	ASW02
Sample date				18/06/2013	18/06/2013	3/07/2013	3/07/2013	3/07/2013	3/07/2013	3/07/2013	3/07/2013	3/07/2013		21/06/2013	26/06/2013	26/06/2013	25/06/2013	20/06/2013	20/06/2013	21/06/2013	21/06/2013
Hydrogeological unit				Alluvium	Shallow rock	Shallow rock	Shallow rock	Shallow rock	Shallow rock	Shallow rock	Shallow rock	Interburden	Coal	Shallow rock	Shallow rock	Shallow rock	Interburden	surface water	surface water	surface water	surface water
Screen interval (mbgl)				5-8	15-21	32-34	67-79	42-48	85-91	47-53	15-21	200-209	335-347	76-88	76-88	76-88	186-199				
General parameters																					
Analyte	**Units**	**LOR**	**ANZECC 2000 Guidelines**																		
pH	pH units	0.01	6.5 - 8.0*	6.8	7.18	7.13	7.34	7.5	7.81	8.1	9.3	10.3	na	7.3	7.66	7.7	10.6	7.06	6.95	7.42	7.26
Conductivity	µS/cm	1	125 - 2200*	2570	5140	4130	3760	9780	8250	6220	1060	3200	na	2750	1980	2370	3120	660	649	608	418
Total Dissolved Solids	mg/L	1	-	1570	2650	2720	2320	4620	4630	3440	561	2140	na	1640	1060	1420	1590	342	326	306	242
Calculated Total Dissolved Solids[#]	mg/L	-	-																		
Redox	mV	0.1	-	-78.6	-109	-16.8	-151	-271	-194.4	-291.2	-251.5	-87.5	na	-169.4	-47.4	-50.7	-52.2	-96.2	-75.5	-97.8	-88.6
Laboratory analytes																					
Hydroxide alkalinity as CaCO3	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	na	<1	<1	<1	56	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	85	795	na	<1	<1	<1	566	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	mg/L	1	-	116	392	268	471	801	1020	708	148	136	na	377	423	333	<1	41	22	64	57
Total alkalinity as CaCO3	mg/L	1	-	116	392	268	471	801	1020	708	234	931	na	377	423	333	622	41	22	64	57
Sulfate as SO4 2-	mg/L	1	-	226	688	367	93	12	18	297	117	<1	na	<1	<1	46	<1	44	55	14	10
Chloride	mg/L	1	-	584	995	872	853	2780	1880	1280	105	421	na	584	346	472	526	145	140	135	84
Calcium	mg/L	1	-	112	312	274	246	193	66	25	2	2	na	153	68	157	<1	16	15	15	14
Magnesium	mg/L	1	-	69	92	70	60	108	41	29	<1	<1	na	54	26	47	<1	14	16	11	9
Sodium	mg/L	1	-	316	736	486	475	1710	1700	1330	246	740	na	311	332	259	678	86	80	83	49
Potassium	mg/L	1	-	5	11	9	9	16	11	16	8	51	na	4	4	5	3	4	5	3	3
Silica	mg/L	0.1	-	32.1	33	39.3	36.3	19.1	26.2	21.5	31.4	7.78	na	24.4	30.3	32.4	42	10.1	7.34	12.7	13.1
Ions																					
Total anions	meq/L	0.01	-	23.5	50.2	37.6	35.4	94.7	73.8	56.4	10.1	30.5	na	24	18.2	20.9	27.3	5.83	5.53	5.38	3.72
Total cations	meq/L	0.01	-	25.1	55.4	40.8	38.1	93.3	80.9	61.9	11	33.6	na	25.7	20.1	23.1	29.6	5.79	5.67	5.34	3.65
Ionic balance	%	0.01	-	3.38	4.93	4.1	3.67	0.74	4.56	4.58	4.37	4.82	na	3.43	4.85	4.94	4.01	0.28	1.23	0.36	0.95
Dissolved metals																					
Aluminium	mg/L	0.01	0.055	<0.01	<0.01	<0.01	0.04	<0.01	0.02	0.02	0.36	0.38	na	0.02	0.07	0.02	0.07	0.13	0.04	0.29	1.57
Arsenic	mg/L	0	0.013 (As V)	<0.001	<0.001	<0.001	0.002	<0.001	0.002	0.001	0.003	<0.001	na	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001
Beryllium	mg/L	0	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0	-	0.136	0.039	0.096	0.105	9.84	3.76	0.436	0.084	0.334	na	5.22	4.11	0.743	0.49	0.097	0.261	0.087	0.144
Cadmium	mg/L	0	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	na	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	mg/L	0	ID	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0	0.0014	<0.001	<0.001	0.019	0.002	0.002	<0.001	<0.001	0.001	<0.001	na	<0.001	0.001	<0.001	0.005	0.001	<0.001	0.001	0.006
Lead	mg/L	0	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.036	na	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/L	0	1.9	0.466	0.401	0.164	0.138	0.053	0.084	0.112	0.008	0.014	na	0.07	0.046	0.13	0.004	0.06	0.061	0.037	0.07
Molybdenum	mg/L	0	ID	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	0.006	0.006	na	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0	0.011	0.001	<0.001	0.01	0.006	0.002	0.002	0.002	0.001	0.003	na	0.003	0.002	0.008	0.008	<0.001	<0.001	0.002	0.01
Selenium	mg/L	0.01	0.011 (total)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	0	-	1.15	4.24	8.82	5.77	13.3	5.71	3.23	0.348	0.651	na	4.92	3.11	3.64	0.445	0.28	0.573	0.295	0.364
Uranium	mg/L	0	ID	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	0.005	0.001	<0.001	na	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	mg/L	0.01	ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.01	0.008	0.016	0.007	0.115	0.213	0.091	0.068	0.015	0.053	23	na	0.048	0.086	0.05	0.023	0.079	0.153	0.046	0.177
Boron	mg/L	0.05	0.37	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	0.05	<0.05	0.08	na	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	<0.05
Iron	mg/L	0.05	ID	0.18	3.67	2.72	1.48	1.05	0.14	0.05	0.11	0.59	na	4.13	0.98	1.83	0.15	0.38	0.18	0.7	1.44
Bromine	mg/L	0.1	ID	1.5	2.4	2	1.6	7.7	5.6	3.1	0.3	0.9	na	0.9	0.6	0.7	0.9	0.3	0.3	0.3	0.2
Nutrients																					
Ammonia as N	mg/L	0.01	0.02*	0.02	0.78	1.58	1.28	2.75	2.38	0.71	0.6	20.3	na	0.9	0.73	0.44	8.14	<0.01	<0.01	<0.01	<0.01
Nitrite as N	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	na	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.7	<0.01	<0.01	0.38	0.3	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01	0.01	0.09	<0.01	0.05	0.1	<0.01	<0.01
Nitrite + nitrate as N	mg/L	0.01	0.04*	<0.01	<0.01	0.38	0.3	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01	0.01	0.09	<0.01	0.05	0.1	<0.01	<0.01
Total phosphorous	mg/L	0.01	0.05*	0.02	0.04	0.17	0.08	0.08	0.13	0.06	0.24	0.11	na	0.17	0.32	0.21	0.08	0.03	<0.01	0.02	<0.01
Reactive phosphorous	mg/L	0.01	0.02*	0.01	<0.01	0.01	0.01	0.02	0.12	0.04	0.25	0.02	na	<0.01	0.07	<0.01	0.03	<0.01	<0.01	<0.01	<0.01
Total Organic Carbon	mg/L	1	-	4	2	5	3	6	26	15	8	124	na	6	13	8	14	6	6	5	4
Dissolved Gases																					
Methane	µg/L	10	-	<10	10	14	103	16500	7060	10200	5330	18100	na	4200	3980	57	31100	<10	<10	14	15
Phenolic compounds																					
Phenol	µg/L	1	320	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.5	na	<1.0	<1.0	<1.0	13.2	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	µg/L	1	490	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
3-&4-Methylphenol	µg/L	2	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	na	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	µg/L	1	160	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	µg/L	1	20	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	µg/L	2	ID	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	na	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Polycyclic aromatic hydrocarbons																					
Naphthalene	µg/L	1	16	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	µg/L	1	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	0.5	ID	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	µg/L	1	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	na	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sum of polycyclic aromatic hydrocai	µg/L	0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ (WHO)	µg/L	0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total petroleum hydrocarbons																					
C6-C9 Fraction	µg/L	20	ID	<20	<20	<20	<20	<20	<20	<20	<20	<20	na	<20	<20	<20	<20	<20	<20	<20	<20
C10-C14 Fraction	µg/L	50	ID	<50	<50	<50	<50	<50	<50	<50	<50	140	na	<50	<50	<50	90	<50	<50	<50	<50
C15-C28 Fraction	µg/L	100	ID	<100	<100	<100	<100	<100	<100	<100	<100	450	na	<100	<100	<100	320	<100	<100	<100	<100
C29-C36 Fraction	µg/L	50	ID	<50	<50	<50	<50	<50	<50	<50	<50	260	na	<50	<50	<50	<50	<50	<50	<50	<50
C10-C36 Fraction (sum)	µg/L	50	-	<50	<50	<50	<50	<50	<50	<50	<50	850	na	<50	<50	<50	410	<50	<50	<50	<50
Total recoverable hydrocarbons																					
C6 - C10 Fraction	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	na	<20	<20	<20	<20	<20	<20	<20	<20
C6 - C10 Fraction minus BTEX (F1	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	na	<20	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 Fraction	µg/L	100	-	<100	<100	<100	<100	<100	<100	<100	<100	150	na	<100	<100	<100	<100	<100	<100	<100	<100
>C16 - C34 Fraction	µg/L	100	-	<100	<100	<100	<100	<100	<100	<100	<100	640	na	<100	<100	<100	300	<100	<100	<100	<100
>C34 - C40 Fraction	µg/L	100	-	<100	<100	<100	<100	<100	<100	<100	<100	110	na	<100	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	µg/L	100	-	<100	<100	<100	<100	<100	<100	<100	<100	900	na	<100	<100	<100	300	<100	<100	<100	<100
Aromatic hydrocarbons																					
Benzene	µg/L	1	950	<1	<1	<1	<1	<1	<1	<1	<1	<1	na	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2	ID	4	3	<2	<2	<2	<2	3	4	3	na	<2	<2	<2	<2	<2	<2	<2	<2
Ethyl Benzene	µg/L	2	ID	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2	<2	<2	<2
m&p-Xylenes	µg/L	2	ID	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2	<2	<2	<2
o-Xylenes	µg/L	2	350	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2	<2	<2	<2
Total Xylenes	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	na	<2	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	µg/L	1	-	4	3	<1	<1	<1	<1	3	4	3	na	<1	<1	<1	<1	<1	<1	<1	<1

exceeds guideline limits

Guideline values

ANZECC 2000 - Water Quality Guidelines: 95% protection levels (trigger values) for the protection of freshwater aquatic ecosystems.

* ANZECC 2000 - Water Quality Guidelines: 95% protection levels (trigger values) for the protection of freshwater aquatic ecosystems, South-East Australia, low lying river ecosystems

^ This result is below the Minimum Detectable Activity (MDA) and Limit of Quantification (Quant Limit) and therefore has an unacceptable level of uncertainty. Hence the data should only be used as an indicator of true concentration.

ID - insufficient data

na - not analysed

PARSONS BRINCKERHOFF

Appendix C

Laboratory results

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1313935**	Page	: 1 of 13
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Loren Schiavon
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: loren.schiavon@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61 2 8784 8503
Facsimile	: +61 02 9272 5101	Facsimile	: +61 2 8784 8500
Project	: 2162406E	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 21-JUN-2013
Sampler	: ----	Issue Date	: 26-JUN-2013
Site	: ----		
		No. of samples received	: 8
Quote number	: SY/394/09	No. of samples analysed	: 8

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
		Sydney Organics

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	S4MB02	S5MB02	TCMB01	ASW01	ASW02
			Client sampling date / time	21-JUN-2013 10:45	20-JUN-2013 12:00	20-JUN-2013 16:00	21-JUN-2013 13:15	21-JUN-2013 12:55
Compound	CAS Number	LOR	Unit	ES1313935-001	ES1313935-002	ES1313935-003	ES1313935-004	ES1313935-005
EA005: pH								
pH Value	----	0.01	pH Unit	7.70	8.55	7.25	7.42	7.26
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	2300	4300	3100	608	418
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	1350	2310	2200	306	242
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	39	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	124	765	286	64	57
Total Alkalinity as CaCO3	----	1	mg/L	124	804	286	64	57
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	4	5	14	10
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	576	786	724	135	84
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	65	10	178	15	14
Magnesium	7439-95-4	1	mg/L	21	6	65	11	9
Sodium	7440-23-5	1	mg/L	356	946	332	83	49
Potassium	7440-09-7	1	mg/L	3	5	5	3	3
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.02	0.12	0.04	0.29	1.57
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.001	<0.001	<0.001	<0.001
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	3.98	1.91	4.50	0.087	0.144
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	0.001	<0.001	0.001	0.006
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	7439-96-5	0.001	mg/L	0.023	0.012	0.098	0.037	0.070
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	0.001	0.002	0.002	0.002	0.010
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	7.45	1.27	12.3	0.295	0.364

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	S4MB02	S5MB02	TCMB01	ASW01	ASW02
Client sampling date / time				21-JUN-2013 10:45	20-JUN-2013 12:00	20-JUN-2013 16:00	21-JUN-2013 13:15	21-JUN-2013 12:55
				ES1313935-001	ES1313935-002	ES1313935-003	ES1313935-004	ES1313935-005
EG020F: Dissolved Metals by ICP-MS - Continued								
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	**0.062**	**0.192**	**0.151**	**0.046**	**0.177**
Boron	7440-42-8	0.05	mg/L	<0.05	**0.08**	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	**0.30**	**0.05**	**1.84**	**0.70**	**1.44**
Bromine	7726-95-6	0.1	mg/L	**1.1**	**2.4**	**1.0**	**0.3**	**0.2**
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**14.9**	**17.8**	**21.3**	**12.7**	**13.1**
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.1**	**0.9**	**0.1**	**0.1**	**0.1**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**1.31**	**1.86**	**1.33**	<0.01	<0.01
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.07**	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.07**	<0.01	<0.01	<0.01	<0.01
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.03**	**0.24**	**0.01**	**0.02**	<0.01
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.18**	<0.01	<0.01	<0.01
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**18.7**	**38.3**	**26.2**	**5.38**	**3.72**
Total Cations	----	0.01	meq/L	**20.5**	**42.3**	**28.8**	**5.34**	**3.65**
Ionic Balance	----	0.01	%	**4.60**	**4.86**	**4.66**	**0.36**	**0.95**
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**2**	**12**	**4**	**5**	**4**
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**5820**	**20200**	**870**	**14**	**15**
Ethene	74-85-1	10	µg/L	<10	<10	<10	<10	<10
Ethane	74-84-0	10	µg/L	<10	<10	<10	<10	<10
Propene	115-07-1	10	µg/L	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	S4MB02	S5MB02	TCMB01	ASW01	ASW02
			Client sampling date / time	21-JUN-2013 10:45	20-JUN-2013 12:00	20-JUN-2013 16:00	21-JUN-2013 13:15	21-JUN-2013 12:55
Compound	CAS Number	LOR	Unit	ES1313935-001	ES1313935-002	ES1313935-003	ES1313935-004	ES1313935-005
EP033: C1 - C4 Hydrocarbon Gases - Continued								
Propane	74-98-6	10	µg/L	<10	**16**	<10	<10	<10
Butene	25167-67-3	10	µg/L	<10	<10	<10	<10	<10
Butane	106-97-8	10	µg/L	<10	<10	<10	<10	<10
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	S4MB02	S5MB02	TCMB01	ASW01	ASW02
Client sampling date / time				21-JUN-2013 10:45	20-JUN-2013 12:00	20-JUN-2013 16:00	21-JUN-2013 13:15	21-JUN-2013 12:55
				ES1313935-001	ES1313935-002	ES1313935-003	ES1313935-004	ES1313935-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	**20**	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	**20**	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	**2**	<1	<1	<1
Toluene	108-88-3	2	µg/L	**3**	**3**	**3**	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	**3**	**5**	**3**	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**34.2**	**31.7**	**32.3**	**32.2**	**31.3**
2-Chlorophenol-D4	93951-73-6	0.1	%	**93.8**	**78.7**	**78.5**	**81.7**	**78.3**
2.4.6-Tribromophenol	118-79-6	0.1	%	**102**	**91.8**	**85.7**	**93.9**	**89.4**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**91.2**	**81.1**	**75.8**	**82.0**	**79.4**
Anthracene-d10	1719-06-8	0.1	%	**95.1**	**84.8**	**78.9**	**86.1**	**83.0**
4-Terphenyl-d14	1718-51-0	0.1	%	**88.7**	**79.5**	**74.2**	**80.3**	**77.8**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**80.9**	**80.0**	**73.5**	**86.3**	**72.4**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

			Client sample ID	S4MB02	S5MB02	TCMB01	ASW01	ASW02
			Client sampling date / time	21-JUN-2013 10:45	20-JUN-2013 12:00	20-JUN-2013 16:00	21-JUN-2013 13:15	21-JUN-2013 12:55
Compound	CAS Number	LOR	Unit	ES1313935-001	ES1313935-002	ES1313935-003	ES1313935-004	ES1313935-005
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	**104**	**106**	**101**	**103**	**85.0**
4-Bromofluorobenzene	460-00-4	0.1	%	**105**	**107**	**95.8**	**90.8**	**86.8**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TSW01	TSW02	TTPB	----	----
			Client sampling date / time	20-JUN-2013 17:05	20-JUN-2013 16:50	21-JUN-2013 08:30	----	----
Compound	CAS Number	LOR	Unit	ES1313935-006	ES1313935-007	ES1313935-008	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	**7.06**	**6.95**	**7.30**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**660**	**649**	**2750**	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	**342**	**326**	**1640**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**41**	**22**	**377**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**41**	**22**	**377**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**44**	**55**	<1	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**145**	**140**	**584**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**16**	**15**	**153**	----	----
Magnesium	7439-95-4	1	mg/L	**14**	**16**	**54**	----	----
Sodium	7440-23-5	1	mg/L	**86**	**80**	**311**	----	----
Potassium	7440-09-7	1	mg/L	**4**	**5**	**4**	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.13**	**0.04**	**0.02**	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.097**	**0.261**	**5.22**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.060**	**0.061**	**0.070**	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	**0.003**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Strontium	7440-24-6	0.001	mg/L	**0.280**	**0.573**	**4.92**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TSW01	TSW02	TTPB	----	----
			Client sampling date / time	20-JUN-2013 17:05	20-JUN-2013 16:50	21-JUN-2013 08:30	----	----
Compound	CAS Number	LOR	Unit	ES1313935-006	ES1313935-007	ES1313935-008	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	**0.079**	**0.153**	**0.048**	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	----	----
Iron	7439-89-6	0.05	mg/L	**0.38**	**0.18**	**4.13**	----	----
Bromine	7726-95-6	0.1	mg/L	**0.3**	**0.3**	**0.9**	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**10.1**	**7.34**	**24.4**	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	<0.1	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	**0.90**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.05**	**0.10**	<0.01	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.05**	**0.10**	<0.01	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.03**	<0.01	**0.17**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**5.83**	**5.53**	**24.0**	----	----
Total Cations	----	0.01	meq/L	**5.79**	**5.67**	**25.7**	----	----
Ionic Balance	----	0.01	%	**0.28**	**1.23**	**3.43**	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**6**	**6**	**6**	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	<10	<10	**4200**	----	----
Ethene	74-85-1	10	µg/L	<10	<10	<10	----	----
Ethane	74-84-0	10	µg/L	<10	<10	<10	----	----
Propene	115-07-1	10	µg/L	<10	<10	<10	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TSW01	TSW02	TTPB	----	----
			Client sampling date / time	20-JUN-2013 17:05	20-JUN-2013 16:50	21-JUN-2013 08:30	----	----
Compound	CAS Number	LOR	Unit	ES1313935-006	ES1313935-007	ES1313935-008	----	----
EP033: C1 - C4 Hydrocarbon Gases - Continued								
Propane	74-98-6	10	µg/L	<10	<10	<10	----	----
Butene	25167-67-3	10	µg/L	<10	<10	<10	----	----
Butane	106-97-8	10	µg/L	<10	<10	<10	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TSW01	TSW02	TTPB	----	----
			Client sampling date / time	20-JUN-2013 17:05	20-JUN-2013 16:50	21-JUN-2013 08:30	----	----
Compound	CAS Number	LOR	Unit	ES1313935-006	ES1313935-007	ES1313935-008	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**26.7**	**28.3**	**29.4**	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**77.8**	**81.3**	**80.3**	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	**86.8**	**91.1**	**91.0**	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**76.1**	**79.1**	**80.1**	----	----
Anthracene-d10	1719-06-8	0.1	%	**79.8**	**82.6**	**84.8**	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	**74.6**	**77.9**	**79.8**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**84.1**	**83.2**	**87.6**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TSW01	TSW02	TTPB	----	----
			Client sampling date / time	20-JUN-2013 17:05	20-JUN-2013 16:50	21-JUN-2013 08:30	----	----
Compound	CAS Number	LOR	Unit	ES1313935-006	ES1313935-007	ES1313935-008	----	----
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	102	104	96.9	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	93.9	101	102	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	15.9	102
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20.4	112
Anthracene-d10	1719-06-8	29.6	118
4-Terphenyl-d14	1718-51-0	21.5	126
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1314512**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Loren Schiavon
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: loren.schiavon@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61 2 8784 8503
Facsimile	: +61 02 9272 5101	Facsimile	: +61 2 8784 8500
Project	: 2162406E	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 26-JUN-2013
Sampler	: CR/SM	Issue Date	: 04-JUL-2013
Site	: ----		
		No. of samples received	: 5
Quote number	: SY/394/09	No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Edwandy Fadjar	Organic Coordinator	Sydney Organics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Phalak Inthaksone	Laboratory Manager - Organics	Sydney Organics
		Sydney Organics

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	S5MB01	S5MB03	BMB01	BMB02	TTMB03
			Client sampling date / time	26-JUN-2013 16:15	25-JUN-2013 15:00	24-JUN-2013 14:45	24-JUN-2013 14:30	25-JUN-2013 13:15
Compound	CAS Number	LOR	Unit	ES1314512-001	ES1314512-002	ES1314512-003	ES1314512-004	ES1314512-005
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.26	7.55	7.76	8.39	10.6
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	4320	5340	5240	4230	3120
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	2420	2790	2570	2180	1590
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	56
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	18	566
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	600	987	394	578	<1
Total Alkalinity as CaCO3	----	1	mg/L	600	987	394	596	622
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	323	164	15	15	<1
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	747	952	1220	864	526
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	30	110	97	14	<1
Magnesium	7439-95-4	1	mg/L	24	116	60	7	<1
Sodium	7440-23-5	1	mg/L	888	895	852	860	678
Potassium	7440-09-7	1	mg/L	66	9	5	4	3
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.05	<0.01	0.05	0.06	0.07
Arsenic	7440-38-2	0.001	mg/L	0.003	0.014	<0.001	<0.001	0.003
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.180	0.143	0.751	0.749	0.490
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0002	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.021	0.003	0.005
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.039	0.143	0.230	0.034	0.004
Molybdenum	7439-98-7	0.001	mg/L	0.001	<0.001	<0.001	0.003	0.002
Nickel	7440-02-0	0.001	mg/L	0.013	0.006	0.015	0.007	0.008
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	3.68	5.61	5.21	2.06	0.445

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	S5MB01	S5MB03	BMB01	BMB02	TTMB03
			Client sampling date / time	26-JUN-2013 16:15	25-JUN-2013 15:00	24-JUN-2013 14:45	24-JUN-2013 14:30	25-JUN-2013 13:15
Compound	CAS Number	LOR	Unit	ES1314512-001	ES1314512-002	ES1314512-003	ES1314512-004	ES1314512-005
EG020F: Dissolved Metals by ICP-MS - Continued								
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	**0.053**	**0.347**	**0.028**	**0.032**	**0.023**
Boron	7440-42-8	0.05	mg/L	**0.21**	**0.05**	<0.05	**0.05**	**0.08**
Iron	7439-89-6	0.05	mg/L	**0.11**	**0.27**	**0.80**	**0.20**	**0.15**
Bromine	7726-95-6	0.1	mg/L	**1.8**	**2.2**	**4.0**	**2.8**	**0.9**
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**18.2**	**19.3**	**18.8**	**17.2**	**42.0**
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**	**0.2**	**0.3**	**1.0**	**1.2**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**3.72**	**1.05**	**0.42**	**0.92**	**8.14**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.02**	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.02**	<0.01	<0.01	<0.01
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.18**	**0.05**	**0.01**	**0.16**	**0.08**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.11**	**0.01**	<0.01	**0.14**	**0.03**
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**39.8**	**50.0**	**42.6**	**36.6**	**27.3**
Total Cations	----	0.01	meq/L	**43.8**	**54.2**	**47.0**	**38.8**	**29.6**
Ionic Balance	----	0.01	%	**4.76**	**4.01**	**4.86**	**2.87**	**4.01**
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**110**	**2**	**2**	**18**	**14**
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**36**	**274**	**3470**	**17600**	**31100**
Ethene	74-85-1	10	µg/L	<10	<10	<10	<10	<10
Ethane	74-84-0	10	µg/L	<10	<10	<10	<10	<10
Propene	115-07-1	10	µg/L	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	S5MB01	S5MB03	BMB01	BMB02	TTMB03
			Client sampling date / time	26-JUN-2013 16:15	25-JUN-2013 15:00	24-JUN-2013 14:45	24-JUN-2013 14:30	25-JUN-2013 13:15
				ES1314512-001	ES1314512-002	ES1314512-003	ES1314512-004	ES1314512-005
EP033: C1 - C4 Hydrocarbon Gases - Continued								
Propane	74-98-6	10	µg/L	<10	<10	<10	<10	<10
Butene	25167-67-3	10	µg/L	<10	<10	<10	<10	<10
Butane	106-97-8	10	µg/L	<10	<10	<10	<10	<10
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	**3.8**	<1.0	<1.0	<1.0	**13.2**
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	S5MB01	S5MB03	BMB01	BMB02	TTMB03
			Client sampling date / time	26-JUN-2013 16:15	25-JUN-2013 15:00	24-JUN-2013 14:45	24-JUN-2013 14:30	25-JUN-2013 13:15
Compound	*CAS Number*	*LOR*	*Unit*	ES1314512-001	ES1314512-002	ES1314512-003	ES1314512-004	ES1314512-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**80**	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	**100**	<50	<50	<50	**90**
C15 - C28 Fraction	----	100	µg/L	**1090**	<100	<100	<100	**320**
C29 - C36 Fraction	----	50	µg/L	**210**	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	**1400**	<50	<50	<50	**410**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	**80**	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	**20**	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	**180**	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	**1190**	<100	<100	<100	**300**
>C34 - C40 Fraction	----	100	µg/L	**110**	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	**1480**	<100	<100	<100	**300**
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	**56**	**4**	<2	**4**	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	**56**	**4**	<1	**4**	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**31.5**	**33.9**	**34.1**	**34.0**	**28.6**
2-Chlorophenol-D4	93951-73-6	0.1	%	**83.3**	**85.4**	**90.0**	**92.9**	**81.2**
2.4.6-Tribromophenol	118-79-6	0.1	%	**98.3**	**107**	**103**	**104**	**108**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**95.7**	**102**	**106**	**100**	**103**
Anthracene-d10	1719-06-8	0.1	%	**100**	**106**	**105**	**103**	**108**
4-Terphenyl-d14	1718-51-0	0.1	%	**100**	**106**	**105**	**104**	**108**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**112**	**93.4**	**105**	**112**	**104**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

			Client sample ID	S5MB01	S5MB03	BMB01	BMB02	TTMB03
			Client sampling date / time	26-JUN-2013 16:15	25-JUN-2013 15:00	24-JUN-2013 14:45	24-JUN-2013 14:30	25-JUN-2013 13:15
Compound	CAS Number	LOR	Unit	ES1314512-001	ES1314512-002	ES1314512-003	ES1314512-004	ES1314512-005
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	**124**	**101**	**129**	**132**	**130**
4-Bromofluorobenzene	460-00-4	0.1	%	**110**	**88.5**	**116**	**118**	**119**

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	15.9	102
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20.4	112
Anthracene-d10	1719-06-8	29.6	118
4-Terphenyl-d14	1718-51-0	21.5	126
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1314668**	Page	: 1 of 13
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Loren Schiavon
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: loren.schiavon@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61 2 8784 8503
Facsimile	: +61 02 9272 5101	Facsimile	: +61 2 8784 8500
Project	: 2162406E	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 28-JUN-2013
Sampler	: JAMES DUGGLEBY	Issue Date	: 08-JUL-2013
Site	: ----		
		No. of samples received	: 6
Quote number	: SY/394/09	No. of samples analysed	: 6

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Phalak Inthaksone	Laboratory Manager - Organics	Sydney Organics
Phalak Inthaksone	Laboratory Manager - Organics	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	S4MB01	S4MB03	TCMB02	TCMB04 (CORE HOLE)	TTMB01
			Client sampling date / time	26-JUN-2013 14:30	26-JUN-2013 15:00	26-JUN-2013 10:00	26-JUN-2013 12:00	26-JUN-2013 17:00
Compound	CAS Number	LOR	Unit	ES1314668-001	ES1314668-002	ES1314668-003	ES1314668-004	ES1314668-005
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.82	8.25	10.5	11.5	7.66
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	5370	3360	3060	4420	1980
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	3240	1680	1630	1980	1060
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	219	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	337	469	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	432	247	4	<1	423
Total Alkalinity as CaCO3	----	1	mg/L	432	247	341	688	423
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	233	<1	12	29	<1
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	1170	858	720	636	346
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	271	16	4	5	68
Magnesium	7439-95-4	1	mg/L	62	4	3	<1	26
Sodium	7440-23-5	1	mg/L	741	699	672	744	332
Potassium	7440-09-7	1	mg/L	7	3	8	81	4
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.04	0.04	0.03	2.90	0.07
Arsenic	7440-38-2	0.001	mg/L	0.002	<0.001	0.002	0.001	<0.001
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.800	1.76	0.998	0.208	4.11
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.002	<0.001	0.002	0.002	0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.001	0.005	<0.001
Manganese	7439-96-5	0.001	mg/L	0.292	0.010	0.002	0.003	0.046
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.004	0.005	<0.001
Nickel	7440-02-0	0.001	mg/L	0.005	0.001	0.012	0.011	0.002
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	31.8	2.04	2.44	0.672	3.11

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	S4MB01	S4MB03	TCMB02	TCMB04 (CORE HOLE)	TTMB01
			Client sampling date / time	26-JUN-2013 14:30	26-JUN-2013 15:00	26-JUN-2013 10:00	26-JUN-2013 12:00	26-JUN-2013 17:00
				ES1314668-001	ES1314668-002	ES1314668-003	ES1314668-004	ES1314668-005
EG020F: Dissolved Metals by ICP-MS - Continued								
Uranium	7440-61-1	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	**0.277**	**0.061**	**2.21**	**3.07**	**0.086**
Boron	7440-42-8	0.05	mg/L	**0.19**	<0.05	<0.05	**0.07**	<0.05
Iron	7439-89-6	0.05	mg/L	**1.11**	**0.07**	**0.10**	**0.13**	**0.98**
Bromine	7726-95-6	0.1	mg/L	**3.0**	**1.5**	**1.0**	**1.3**	**0.6**
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**27.6**	**13.6**	**56.7**	**17.4**	**30.3**
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.4**	<0.1	**0.4**	**0.6**	**0.1**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**1.92**	**1.02**	**9.76**	**3.03**	**0.73**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	**0.01**	<0.01	**0.01**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	**0.01**	<0.01	**0.01**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.02**	**0.07**	**0.13**	**0.32**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	**0.05**	**0.07**
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**46.5**	**29.1**	**27.4**	**32.3**	**18.2**
Total Cations	----	0.01	meq/L	**51.0**	**31.6**	**29.9**	**34.7**	**20.1**
Ionic Balance	----	0.01	%	**4.66**	**4.04**	**4.35**	**3.54**	**4.85**
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**54**	**3**	**64**	**39**	**13**
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**6550**	**30500**	**9030**	**7550**	**3980**
Ethene	74-85-1	10	µg/L	<10	<10	<10	<10	<10
Ethane	74-84-0	10	µg/L	<10	<10	<10	<10	<10
Propene	115-07-1	10	µg/L	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	S4MB01	S4MB03	TCMB02	TCMB04 (CORE HOLE)	TTMB01
Client sampling date / time				26-JUN-2013 14:30	26-JUN-2013 15:00	26-JUN-2013 10:00	26-JUN-2013 12:00	26-JUN-2013 17:00
				ES1314668-001	ES1314668-002	ES1314668-003	ES1314668-004	ES1314668-005
EP033: C1 - C4 Hydrocarbon Gases - Continued								
Propane	74-98-6	10	µg/L	<10	<10	<10	<10	<10
Butene	25167-67-3	10	µg/L	<10	<10	<10	<10	<10
Butane	106-97-8	10	µg/L	<10	<10	<10	<10	<10
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	**4.7**	<1.0	<1.0
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	S4MB01	S4MB03	TCMB02	TCMB04 (CORE HOLE)	TTMB01
			Client sampling date / time	26-JUN-2013 14:30	26-JUN-2013 15:00	26-JUN-2013 10:00	26-JUN-2013 12:00	26-JUN-2013 17:00
Compound	CAS Number	LOR	Unit	ES1314668-001	ES1314668-002	ES1314668-003	ES1314668-004	ES1314668-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	**100**	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	**60**	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	**1740**	**140**	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	**610**	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	**2410**	**140**	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	**110**	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	**100**	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	**2260**	**160**	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	**100**	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	**2360**	**160**	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	**10**	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	**10**	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**24.8**	**27.5**	**21.1**	**20.2**	**25.6**
2-Chlorophenol-D4	93951-73-6	0.1	%	**56.0**	**77.8**	**57.9**	**60.3**	**75.3**
2.4.6-Tribromophenol	118-79-6	0.1	%	**76.1**	**98.4**	**85.0**	**86.8**	**101**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**69.4**	**57.2**	**85.1**	**71.3**	**79.3**
Anthracene-d10	1719-06-8	0.1	%	**93.8**	**90.6**	**87.8**	**90.5**	**92.3**
4-Terphenyl-d14	1718-51-0	0.1	%	**70.9**	**83.6**	**79.0**	**84.1**	**85.3**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**83.7**	**126**	**93.0**	**89.0**	**86.1**

Work Order : ES1314668
Client : PARSONS BRINCKERHOFF AUST P/L
Project : 2162406E

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

			Client sample ID	S4MB01	S4MB03	TCMB02	TCMB04 (CORE HOLE)	TTMB01
			Client sampling date / time	26-JUN-2013 14:30	26-JUN-2013 15:00	26-JUN-2013 10:00	26-JUN-2013 12:00	26-JUN-2013 17:00
Compound	CAS Number	LOR	Unit	ES1314668-001	ES1314668-002	ES1314668-003	ES1314668-004	ES1314668-005
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	94.7	114	89.6	104	100
4-Bromofluorobenzene	460-00-4	0.1	%	105	122	101	97.3	110

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

			Client sample ID	TTMB02	----	----	----	----
			Client sampling date / time	26-JUN-2013 16:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1314668-006	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.70	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	2370	----	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	1420	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	333	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	333	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	46	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	472	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	157	----	----	----	----
Magnesium	7439-95-4	1	mg/L	47	----	----	----	----
Sodium	7440-23-5	1	mg/L	259	----	----	----	----
Potassium	7440-09-7	1	mg/L	5	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.02	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	0.743	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	0.130	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.008	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	3.64	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TTMB02	----	----	----	----
			Client sampling date / time	26-JUN-2013 16:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1314668-006	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.050**	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**1.83**	----	----	----	----
Bromine	7726-95-6	0.1	mg/L	**0.7**	----	----	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**32.4**	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.44**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.09**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.09**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.21**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**20.9**	----	----	----	----
Total Cations	----	0.01	meq/L	**23.1**	----	----	----	----
Ionic Balance	----	0.01	%	**4.94**	----	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**8**	----	----	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**57**	----	----	----	----
Ethene	74-85-1	10	µg/L	<10	----	----	----	----
Ethane	74-84-0	10	µg/L	<10	----	----	----	----
Propene	115-07-1	10	µg/L	<10	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**TTMB02**	----	----	----	----
			Client sampling date / time	26-JUN-2013 16:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1314668-006**	**----**	**----**	**----**	**----**
EP033: C1 - C4 Hydrocarbon Gases - Continued								
Propane	74-98-6	10	µg/L	<10	----	----	----	----
Butene	25167-67-3	10	µg/L	<10	----	----	----	----
Butane	106-97-8	10	µg/L	<10	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	----	----	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TTMB02	----	----	----	----
			Client sampling date / time	26-JUN-2013 16:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1314668-006	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	----	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L	<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L	<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**28.4**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**73.2**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	**99.0**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**84.9**	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%	**89.8**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	**81.8**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**85.8**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TTMB02	----	----	----	----
			Client sampling date / time	26-JUN-2013 16:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1314668-006	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	98.2	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	108	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	15.9	102
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20.4	112
Anthracene-d10	1719-06-8	29.6	118
4-Terphenyl-d14	1718-51-0	21.5	126
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Group

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1315197**	Page	: 1 of 13
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Loren Schiavon
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: loren.schiavon@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61 2 8784 8503
Facsimile	: +61 02 9272 5101	Facsimile	: +61 2 8784 8500
Project	: 2162406E	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 04-JUL-2013
Sampler	: CR/KM	Issue Date	: 11-JUL-2013
Site	: ----		
		No. of samples received	: 7
Quote number	: SY/394/09	No. of samples analysed	: 7

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**
- **EK057G: It has been noted that Nitrite greater than NOx for sample ID (WKMB03), however this difference is within the limits of experimental variation.**
- **EK071G: It has been noted that Reactive P is greater thanTotal P (WKMB02), however this difference is within the limits of experimental variation.**

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
		Sydney Organics
Phalak Inthaksone	Laboratory Manager - Organics	Sydney Organics

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RMB01	RMB02	WMB03	WMB04	WKMB01
			Client sampling date / time	03-JUL-2013 14:00	03-JUL-2013 14:15	03-JUL-2013 12:15	03-JUL-2013 11:45	03-JUL-2013 08:45
Compound	CAS Number	LOR	Unit	ES1315197-001	ES1315197-002	ES1315197-003	ES1315197-004	ES1315197-005
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.50**	**7.81**	**7.13**	**7.34**	**8.10**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**9780**	**8250**	**4130**	**3760**	**6220**
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	**4620**	**4630**	**2720**	**2320**	**3440**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**801**	**1020**	**268**	**471**	**708**
Total Alkalinity as CaCO3	----	1	mg/L	**801**	**1020**	**268**	**471**	**708**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**12**	**18**	**367**	**93**	**297**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**2780**	**1880**	**872**	**853**	**1280**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**193**	**66**	**274**	**246**	**25**
Magnesium	7439-95-4	1	mg/L	**108**	**41**	**70**	**60**	**29**
Sodium	7440-23-5	1	mg/L	**1710**	**1700**	**486**	**475**	**1330**
Potassium	7440-09-7	1	mg/L	**16**	**11**	**9**	**9**	**16**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.02**	<0.01	**0.04**	**0.02**
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.002**	<0.001	**0.002**	**0.001**
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	**9.84**	**3.76**	**0.096**	**0.105**	**0.436**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.002**	<0.001	**0.019**	**0.002**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.053**	**0.084**	**0.164**	**0.138**	**0.112**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	**0.001**	**0.001**	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.002**	**0.002**	**0.010**	**0.006**	**0.002**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	**13.3**	**5.71**	**8.82**	**5.77**	**3.23**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	RMB01	RMB02	WMB03	WMB04	WKMB01
Client sampling date / time				03-JUL-2013 14:00	03-JUL-2013 14:15	03-JUL-2013 12:15	03-JUL-2013 11:45	03-JUL-2013 08:45
				ES1315197-001	ES1315197-002	ES1315197-003	ES1315197-004	ES1315197-005
EG020F: Dissolved Metals by ICP-MS - Continued								
Uranium	7440-61-1	0.001	mg/L	<0.001	**0.004**	<0.001	<0.001	**0.005**
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	**0.091**	**0.068**	**0.115**	**0.213**	**0.015**
Boron	7440-42-8	0.05	mg/L	<0.05	**0.08**	<0.05	<0.05	**0.05**
Iron	7439-89-6	0.05	mg/L	**1.05**	**0.14**	**2.72**	**1.48**	**0.05**
Bromine	7726-95-6	0.1	mg/L	**7.7**	**5.6**	**2.0**	**1.6**	**3.1**
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**19.1**	**26.2**	**39.3**	**36.3**	**21.5**
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	**0.4**	**0.2**	**0.1**	**0.5**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**2.75**	**2.38**	**1.58**	**1.28**	**0.71**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	**0.38**	**0.30**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	**0.38**	**0.30**	<0.01
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.13**	**0.17**	**0.08**	**0.06**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.02**	**0.12**	**0.01**	**0.01**	**0.04**
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**94.7**	**73.8**	**37.6**	**35.4**	**56.4**
Total Cations	----	0.01	meq/L	**93.3**	**80.9**	**40.8**	**38.1**	**61.9**
Ionic Balance	----	0.01	%	**0.74**	**4.56**	**4.10**	**3.67**	**4.58**
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**6**	**26**	**5**	**3**	**15**
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**16500**	**7060**	**14**	**103**	**10200**
Ethene	74-85-1	10	µg/L	<10	<10	<10	<10	<10
Ethane	74-84-0	10	µg/L	<10	<10	<10	<10	<10
Propene	115-07-1	10	µg/L	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	RMB01	RMB02	WMB03	WMB04	WKMB01
			Client sampling date / time	03-JUL-2013 14:00	03-JUL-2013 14:15	03-JUL-2013 12:15	03-JUL-2013 11:45	03-JUL-2013 08:45
				ES1315197-001	ES1315197-002	ES1315197-003	ES1315197-004	ES1315197-005
EP033: C1 - C4 Hydrocarbon Gases - Continued								
Propane	74-98-6	10	µg/L	<10	<10	<10	<10	<10
Butene	25167-67-3	10	µg/L	<10	<10	<10	<10	<10
Butane	106-97-8	10	µg/L	<10	<10	<10	<10	<10
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

			Client sample ID	RMB01	RMB02	WMB03	WMB04	WKMB01
			Client sampling date / time	03-JUL-2013 14:00	03-JUL-2013 14:15	03-JUL-2013 12:15	03-JUL-2013 11:45	03-JUL-2013 08:45
Compound	CAS Number	LOR	Unit	ES1315197-001	ES1315197-002	ES1315197-003	ES1315197-004	ES1315197-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	**3**
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	**3**
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**31.8**	**26.5**	**30.6**	**27.6**	**30.9**
2-Chlorophenol-D4	93951-73-6	0.1	%	**77.4**	**69.3**	**78.8**	**71.9**	**78.6**
2.4.6-Tribromophenol	118-79-6	0.1	%	**92.0**	**93.5**	**104**	**94.9**	**110**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**93.4**	**82.3**	**87.7**	**81.8**	**86.2**
Anthracene-d10	1719-06-8	0.1	%	**91.1**	**81.3**	**85.2**	**80.5**	**85.0**
4-Terphenyl-d14	1718-51-0	0.1	%	**86.2**	**75.4**	**80.4**	**75.1**	**78.9**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**115**	**119**	**112**	**108**	**114**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	RMB01	RMB02	WMB03	WMB04	WKMB01
			Client sampling date / time	03-JUL-2013 14:00	03-JUL-2013 14:15	03-JUL-2013 12:15	03-JUL-2013 11:45	03-JUL-2013 08:45
				ES1315197-001	**ES1315197-002**	**ES1315197-003**	**ES1315197-004**	**ES1315197-005**
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	**120**	**135**	**122**	**115**	**134**
4-Bromofluorobenzene	460-00-4	0.1	%	**105**	**121**	**102**	**89.8**	**121**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	WKMB02	WKMB03	----	----	----
Client sampling date / time				03-JUL-2013 09:35	03-JUL-2013 10:00	----	----	----
				ES1315197-006	ES1315197-007	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	9.30	10.3	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1060	3200	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	561	2140	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	85	795	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	148	136	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	234	931	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	117	<1	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	105	421	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	2	2	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	----	----	----
Sodium	7440-23-5	1	mg/L	246	740	----	----	----
Potassium	7440-09-7	1	mg/L	8	51	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.36	0.38	----	----	----
Arsenic	7440-38-2	0.001	mg/L	0.003	<0.001	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	0.084	0.334	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	0.002	0.036	----	----	----
Manganese	7439-96-5	0.001	mg/L	0.008	0.014	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	0.006	0.006	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.001	0.003	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Strontium	7440-24-6	0.001	mg/L	0.348	0.651	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**WKMB02**	**WKMB03**	----	----	----
			Client sampling date / time	03-JUL-2013 09:35	03-JUL-2013 10:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1315197-006**	**ES1315197-007**	**----**	**----**	**----**
EG020F: Dissolved Metals by ICP-MS - Continued								
Uranium	7440-61-1	0.001	mg/L	**0.001**	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.053**	**23.0**	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	**0.08**	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.11**	**0.59**	----	----	----
Bromine	7726-95-6	0.1	mg/L	**0.3**	**0.9**	----	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**31.4**	**7.78**	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.5**	**1.6**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.60**	**20.3**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	**0.01**	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.24**	**0.11**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.25**	**0.02**	----	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**10.1**	**30.5**	----	----	----
Total Cations	----	0.01	meq/L	**11.0**	**33.6**	----	----	----
Ionic Balance	----	0.01	%	**4.37**	**4.82**	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**8**	**124**	----	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**5330**	**18100**	----	----	----
Ethene	74-85-1	10	µg/L	<10	<10	----	----	----
Ethane	74-84-0	10	µg/L	<10	<10	----	----	----
Propene	115-07-1	10	µg/L	<10	<10	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	WKMB02	WKMB03	----	----	----
			Client sampling date / time	03-JUL-2013 09:35	03-JUL-2013 10:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1315197-006	ES1315197-007	----	----	----
EP033: C1 - C4 Hydrocarbon Gases - Continued								
Propane	74-98-6	10	µg/L	<10	<10	----	----	----
Butene	25167-67-3	10	µg/L	<10	<10	----	----	----
Butane	106-97-8	10	µg/L	<10	<10	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	**3.5**	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	----	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	WKMB02	WKMB03	----	----	----
			Client sampling date / time	03-JUL-2013 09:35	03-JUL-2013 10:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1315197-006	ES1315197-007	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	**140**	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	**450**	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	**260**	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	**850**	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	**150**	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	**640**	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	**110**	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	**900**	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	**4**	**3**	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L	**4**	**3**	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**29.6**	**22.8**	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**72.5**	**73.2**	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	**109**	**108**	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**87.1**	**88.7**	----	----	----
Anthracene-d10	1719-06-8	0.1	%	**86.1**	**86.9**	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	**80.6**	**80.4**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**119**	**107**	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	WKMB02	WKMB03	----	----	----
			Client sampling date / time	03-JUL-2013 09:35	03-JUL-2013 10:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1315197-006	ES1315197-007	----	----	----
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	**134**	**122**	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	**118**	**108**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	*CAS Number*	*Recovery Limits (%)* Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	15.9	102
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20.4	112
Anthracene-d10	1719-06-8	29.6	118
4-Terphenyl-d14	1718-51-0	21.5	126
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128