

Kiama Municipal Council

# **Minnamurra Waste Disposal Depot Annual Groundwater & Surface Water Monitoring Report – 2011 to 2012**

Report E2W-059 (R001a)

26 November 2012



**Prepared by: Dino Parisotto (Director)**

BAppSc-Geology (Hons); MAppSc-Groundwater  
Phone: (02) 4234 0829 Fax: (02) 4236 1824  
175 Fern St Gerringong NSW Australia 2534

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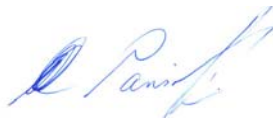
Project: Annual Surface and Groundwater Monitoring Report  
Minnamurra Waste Disposal Depot  
November 2011 to October 2012

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Quarterly Landfill Gas Monitoring: Kiama Municipal Council  
Groundwater and Surface Water Laboratory Analyses: Ecowise/ALS Environmental Pty Ltd

Prepared By: Earth2Water Pty Ltd



D. Parisotto (Principal Hydrogeologist)  
(BAppSc; Geology *Hons*, MAppSc; Groundwater, Lic Driller DL1977)

175 Fern Street, Gerringong NSW 2534  
Phone: (02) 4234 0829 Fax: (02) 4236 1824

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## **1. INTRODUCTION**

Earth2Water Pty Ltd (E2W) was engaged by Kiama Municipal Council (KMC) to provide the 2011 to 2012 annual surface and groundwater monitoring report for the Minnamurra Waste Disposal Depot (MWDD).

This report is based on information provided in field and laboratory reports provided by ALS Environmental Pty Ltd (formerly Ecowise) and previous monitoring reports by E2W (2004 - 2011), Eco-engineers Pty Ltd and Forbes Rigby Pty Ltd (pre 2004).

This monitoring report for the MWDD is based on quarterly monitoring results (2 November 2011, 2 February 2012, 30 May 2012, 9 August 2012) and NSW EPA Environmental Protection Licence (EPL) conditions (R1.10). Additional water sampling was conducted at selected locations (MD9B, MD9C, MD10B, Rocklow-Middle 5 August 2011) to verify the elevated ammonia concentrations reported in May 2011. E2W completed the landfill closure plan (LCP in October 2005) and construction quality assurance (April 2008) for the landfill rehabilitation works completed by KMC in January 2008.

### **1.1 Background**

KMC has owned and operated the MWDD from the 1960's until its closure in October 2006. The MWDD operated as a Solid Waste Class 1 Landfill under the EPL No. 5958. The MWDD formerly comprised a night soil depot for liquid pump out sullage, which ceased in 1998. The existing licence and amendments required the submission of a Landfill Closure Plan (LCP), which was completed by E2W in October 2005.

As of November 2012, Minnamurra Landfill will be accepting mixed food and garden organics (i.e. food waste trial), together with small loads of recyclable materials. All general waste materials are diverted to the waste facility at Shellharbour (Dunmore Waste Disposal Depot).

### **1.2 Objectives**

The objective of surface and groundwater monitoring in the 2011 to 2012 reporting period was to assess actual or potential impacts associated with the MWDD on the surrounding aquatic environment. Gas monitoring is undertaken by KMC to measure the performance of landfill rehabilitation works.

The objective of this annual report is to provide KMC and the DECCW with a summary of the monitoring results obtained in the 2011-2012 reporting period (i.e. EPL 5958 conditions).

## **2. SCOPE OF WORK**

E2W was commissioned by KMC to collate and assess surface and groundwater monitoring data provided by ALS (Ecowise) during 2011 and 2012. The annual reporting period covers four

quarterly monitoring events in November 2011, February 2012, May 2012 and August 2012 (Figures 1 & 2). E2W note that four locations (MD9B, MD9C, MD10B, Rocklow-Middle) were re-sampled on the 5 August 2011 to verify the elevated ammonia concentrations (& increasing trends) at the site.

Each monitoring event comprised the following:

- Sampling of onsite and offsite groundwater wells MD2B, MD2C, MD4B, MD4C, MD6B, MD6C, MD9B, MD9C, and MD10B<sup>1</sup>.
- Sampling of surface water at three locations along Rocklow Creek (Rocklow-Up, Rocklow-Middle and Rocklow-Down<sup>2</sup>).

Landfill gas monitoring was conducted by KMC (G.Hardy) at gas monitoring wells, biofilter pads and inside buildings. Monitoring was conducted using a calibrated landfill gas meter (GT402).

E2W undertook the following scope of work to satisfy KMC's surface and groundwater monitoring program at MWDD:

- Provide advice to KMC (in relation to monitoring results- as required).
- Prepare this annual report for monitoring period (November 2011 to August 2012) and comply with Section R1.10 of the EPL (No. 5958). The annual report is to include the following:
  1. Tabulation of the monitoring data obtained for the period.
  2. Graphical representation of the current and previous monitoring data (minimum - last three years). Statistically significant variations or anomalies will be highlighted.
  3. Analyses and interpretation of monitoring data.
  4. Analyses and response to any complaints received.
  5. Identification of any deficiencies in the environmental performance of the MWDD, as highlighted by the monitoring data, trends and/or accidents.
  6. Recommendations to address the above identified deficiencies.
  7. Recommendations on improving the overall environmental performance of the facility.

Rehabilitation of the landfill commenced in August 2006 and was completed by KMC in January 2008. The work included reshaping, cut/fill of waste materials and capping with clays and soil/compost mix (i.e. evapotranspiration layer). The rehabilitation works may have temporarily degraded the runoff and shallow groundwater (2007) due to exposure and leaching of buried putrescible waste which was redistributed during the reshaping.

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<sup>1</sup> MD1B no access, shallow wells MD4A dry during reporting period, MD2A, MD6A, MD9A, MD10A not enough water for sampling.

<sup>2</sup> No sample from Rocklow-down due to access restrictions



### 3. ENVIRONMENTAL SETTING

The Minnamurra Waste Disposal and Recycling Depot (MWDD) is located 1 km north of the Minnamurra township (Figures 1 and 2). The site is located within a swamp environment, bounded to the west by the rail line and Riverside Drive (formerly a part of the Princes Highway), and to the north and east by the confluence of Rocklow Creek and Minnamurra River. The site is approximately 1 km west of Mystics (Minnamurra) Beach (Figure 1).

The MWDD covers an area of approximately 50 acres (~20 ha), while the landfill mound occupies approximately 6 ha. At present, the MWDD comprises the following features:

- An elevated landfill mound (capped) ranging from 1 to 14 m AHD. The landfill mound was rehabilitated in 2006/2007 according to the LCP submitted by E2W in October 2005,
- A weighbridge and administration office/toilet block,
- KMC truck parking area,
- KMC storage sheds,
- Dog impounding facility,
- Green waste/composting,
- Waste/recycling recieval/transfer station.

#### 3.1 Climate

The long-term mean and median rainfall values available for the Kiama Bowling Club (Latitude 344033 N and Longitude 1055103E) between 1897 and 2001 indicate that average yearly rainfall at the MWDD is 1261 mm/year. On average, the MWDD would receive approximately 1220 mm, based on rainfall records obtained from Shellharbour and Albion Park (Forbes Rigby, 1996).

The annual rainfall from August 2011 to July 2012 was 1282.8 mm, which is slightly lower than the previous monitoring period (1308.0 mm, August 2010 to July 2011)<sup>3</sup>, and are both moderately higher than the 2009-2010 monitoring period (1054.4 mm). The higher rainfall in the past two years is interpreted to influence the ammonia levels at the site.

#### 3.2 Topography

A plan of the existing site topography and surrounds is presented in Figure 1. The site is located within mangrove tidal flats, an estuarine environment associated with Rocklow Creek and Minnamurra River (Figure 7 of Appendix B).

Local relief is less than 3 m AHD around the footprint of the landfill (except southern wall), with slopes generally less than 5%. The landfill forms a mound, which reaches a maximum of 14 m AHD above the surrounding low-lying ground surface (approximately 1 m AHD).

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<sup>3</sup> Note: data from Kiama (Bombo Headland) (Station ID 068242), ~4.5 km SSE of MWDD.

The RL of the landfill footprint area ranges from approximately 0.6 m AHD (north-east corner) to 5.2 m AHD (southern wall). On the western side of Riverside Drive the land rises rapidly to a small east and north-east facing ridge where Dunmore House is situated (Figures 1 and 2).

### 3.3 Geology

The site is located within Quaternary alluvial sediments comprising sands and silts. Based on drilling investigations undertaken by Forbes Rigby in 1996 and recent investigations at the site by KMC and E2W in 2005, the geology is dominated by fine to medium sandy sediments with minimal sandy silt and sandy clays. In most places, the sand is overlain by a 0.5 m thick organic silty loam.

Drill cores by the Geological Survey of NSW in the Rocklow Creek valley predominantly consist of poorly to well-sorted very fine to medium-grained quartz lithic sands. Sand deposits typically extend to a maximum depth of 14 m, with increasing clay content below about 7 m (Forbes Rigby, 1996).

### 3.4 Hydrogeology and Groundwater Flow Regime

The hydrogeology at the site is dominated by a semi-confined sandy aquifer. Groundwater is encountered at depths of approx 1 m below natural ground level (~0.5 m AHD) along the west, north and east sides of the landfill mound. The depth to water along the southern wall is not well known.

The groundwater quality at the site varies from fresh to saline, with electrical conductivity ranging from 0.85 to 44.6 mS/cm (E2W, October 2005). Groundwater generally becomes more saline in the vicinity of mangroves and tidal saline water bodies (i.e. Rocklow Creek and Minnamurra River).

Recharge to the aquifer system beneath and surrounding the waste disposal facility occurs from rainfall infiltration mainly outside of the capped landfill mound. Infiltration of rainfall is moderate (~30%) around the footprint area, due to the low elevation and leakage through the organic silt layer.

Groundwater gradients in the area of the waste mound are controlled by topography, permeable sands and the nearby tidal water bodies (Rocklow Creek and Minnamurra River). The predominant groundwater flow direction at the site is considered to be north-east and towards the confluence of Rocklow Creek and Minnamurra River. The hydraulic gradient is likely to be variable, depending on the tidal regime and proximity to the river. It is interpreted that the groundwater gradient is at a maximum during low tide (~0.02), and potentially reverses at high tide.

Groundwater discharge at Rocklow Creek and Minnamurra River is influenced by the presence of a fresh groundwater/salt water interface. The interface results from the density difference between groundwater and seawater. It is a dynamic and complex region with upward hydraulic



gradients, tidal fluctuations, microbiological processes, surface and groundwater interaction and salinity variations. The groundwater/salt water interface is generally associated with natural attenuation processes (biodegradation, dilution, sorption etc.), which tend to reduce levels of contaminants prior to discharge to marine ecosystems. The groundwater salt water interface is interpreted to exist at the boundary of the casuarinas and mangroves at the site.

The contamination of deep and shallow groundwater arises from nutrient enrichment at the MWDD and has been reported on in previous annual monitoring reports by Ecoengineers Pty Ltd (2004) and E2W (2005, 2006 and 2007).

The leachate plume originating from the MWDD is likely to persist for years after landfill remediation due to the age (1960s) of the waste mound. Improvements in groundwater quality is expected over the short to medium term (up to ~10 years) reflecting the rate of groundwater flushing effects from rainfall recharge.

### 3.5 Hydrology

The hydrology of the area is dominated by Rocklow Creek and Minnamurra River. Groundwater discharge, with possible leachate from both the Minnamurra and Shellharbour landfills, may be contributing to the nutrients detected in Rocklow Creek (Figure 1).

The Minnamurra River drains a catchment of approximately 142 km<sup>2</sup>. Seventy percent of the catchment is natural, mainly located on the steeper slopes of the Illawarra escarpment. The middle section of the catchment is characterised by a broad floodplain area called Terragong Swamp. This area, which comprises approximately 30% of the catchment, is used extensively for cattle grazing/dairying. The township of Jamberoo is located within this catchment. It can be expected that the Terragong Swamp farming area and Jamberoo itself are significant sources of nutrients and pollutants entering the river.

The entrance of Minnamurra River is permanently open, and the estuary is tidally influenced. The estuarine portion of the river extends approximately 7 km upstream from the mouth and has the suburb of Minnamurra on its western bank. The lower section of the river is an ecologically significant aquatic environment, comprising areas of seagrass, mangrove and salt marsh communities (Forbes Rigby, 1996).

Rocklow Creek catchment has an area of 23 km<sup>2</sup> and occupies the northern most portion of the Minnamurra River catchment. Rocklow Creek flows into the main arm of the Minnamurra River downstream of the MWDD, approximately 2 km upstream of the river entrance. Potential up-gradient sources of contamination may include the Shellharbour landfill, Princes Highway, Riverside Drive and nearby sand mining operations.

Water samples from Rocklow Creek and Minnamurra River have been collected by the DECCW in 1991 and 2005 (Denis Pascall, August 2005), as part of a water quality and landfill impact assessment for the area (Forbes Rigby, 1996).

The following opinions were offered as a result of DECCW's sampling work:

- Concentrations of most indicators (except dissolved oxygen) are considerably higher in Rocklow Creek than in Minnamurra River; and
- Concentration of nutrients (ammonia) measured at several locations along Rocklow Creek indicate that Shellharbour and Minnamurra landfills may be contributing leachate into the marine environment.

One upstream and one downstream Rocklow Creek location are sampled as part of the quarterly MWDD water quality monitoring program. Since 2009, a third location midstream of the creek has also been sampled. Access to the downstream location has been restricted due to mangrove growth along the track (no sample for past year). Sampling is undertaken by Ecowise (now ALS).

#### **4. LICENCE CRITERIA AND RELEVANT GUIDELINES**

Under the NSW EPA requirements for Licence No. 5958, the criteria for surface and groundwater quality are based on the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

The ANZECC guidelines include risk-based trigger levels and indicative interim working levels (IIWLs). The IIWLs are used when insufficient data is available to calculate a trigger level and are of low reliability. It should be noted that the ANZECC water quality guidelines are applicable to receiving water and not groundwater. However, they form an appropriate basis for undertaking a screening level assessment of groundwater quality. Selection of the applicable guideline values are based on an assessment of potential pathways by which human or environmental exposure might take place, as well as the beneficial end use of the groundwater.

The beneficial use classification for groundwater at the site depends on the quality of the water and its potential use in the long term. Although groundwater in the shallow aquifer surrounding (upgradient) the waste disposal facility is likely to be of relatively good quality (depending on the presence of saline intrusions), there are no known groundwater extraction bores (agricultural or domestic) within the immediate vicinity of the site. Therefore, the appropriate beneficial use category of the groundwater is considered to be for the protection of aquatic marine and fresh water ecosystems in discharge zones at Rocklow Creek and Minnamurra River, the closest aquatic environmental receptors for the site.

The adopted groundwater assessment guidelines are presented with the summary analytical results (i.e. Tables GW-1, SW-1). Exceedances of the ANZECC (2000) trigger values for marine water ecosystems have been highlighted on the tables.

##### **4.1 EPL Requirements**

The Environmental Protection Licence (EPL No. 5958) details 17 monitoring points for the MWDD (two for landfill gas and fifteen for groundwater monitoring). The landfill gas monitoring points are required to be analysed for methane every 6 months (i.e. twice in the



reporting period). Landfill gas monitoring was conducted on a quarterly basis by KMC (Appendix C) at gas wells and trenches, however annually for inside buildings.

The frequency of testing of the groundwater monitoring points (MD1B<sup>4</sup>, MD2A, MD2B, MD2C, MD4A, MD4B, MD4C, MD6A, MD6B, MD6C, MD9A, MD9B, MD9C, MD10A, MD10B) is also half yearly. However, groundwater monitoring is generally undertaken on quarterly basis (November 2011, February, May and August 2012 of each reporting period) to establish water quality trends post landfill rehabilitation works.

Some of the groundwater monitoring locations (i.e. MD2A, MD4A, MD6A, MD9A and MD10A) have not been sampled in the monitoring program (i.e. shallow wells have been dry or not enough water for sampling). Other available wells onsite including MD3B, MD3C, MD7, MD5A/B/C and MD8 however are not part of the EPL (previously tested prior to landfill closure for characterising the local groundwater).

Table 4.1 (below) lists the analytes that are included in the groundwater testing suite.

**Table 4.1: Half yearly groundwater analytical suite (as per the EPL)**

|                                    |                  |                      |                      |
|------------------------------------|------------------|----------------------|----------------------|
| Alkalinity (as CaCO <sub>3</sub> ) | Dissolved Oxygen | Nitrate              | Temperature          |
| Ammonia                            | Fluoride         | Potassium            | Total Phenolics      |
| Calcium                            | Iron             | Sodium               | Total Organic Carbon |
| Chloride                           | Magnesium        | Standing Water Level | pH                   |
| Conductivity                       | Manganese        | Sulphate             |                      |

Surface water monitoring is not a requirement of the EPL, however is undertaken quarterly by KMC in conjunction with groundwater monitoring. Surface water samples are collected and analysed from an up-gradient (Rocklow-Up), mid-gradient (Rocklow-Middle) and down-gradient location (Rocklow-Down, Figure 2). The mid sample location was included to assess the performance of the landfill rehabilitation works and requirement for a bund wall around the landfill (i.e. access to the upstream location is impeded due to the thick vegetation).

## 4.2 Previous Monitoring Results

The previous annual monitoring reports have been provided by E2W, Ecoengineers and Forbes Rigby. Groundwater ammonia results presented in these earlier reports are included in graphical form and attached in this report (Graph-1, Graph-2 and Graph-3).

Ammonia is a key landfill leachate indicator based on the results obtained from monitoring wells placed around the MWDD. Landfill leachate has impacted the local groundwater system, with potential or actual impact to Rocklow Creek and Minnamurra River (Appendix B, Figure 7).

<sup>4</sup> No access available to MD-1B

## 5. ENVIRONMENTAL MONITORING

Prior to May 2005, surface and groundwater monitoring was undertaken by KMC. Ecowise were (since August 2005) engaged to sample and analyse the surface and groundwater monitoring points as per the EPL and performed the November 2009 sampling round. Ecowise were acquired by ALS in November 2009, who carried out the subsequent surface and groundwater sampling in the reporting period (2009-2010, 2010-2011 and 2011-2012). Quarterly sampling in the 2011 to 2012 reporting period was undertaken on the following dates:

- 2 November 2011,
- 2 February 2012,
- 30 May 2012; and
- 9 August 2012.

The procedure for sample collection, storage and handling employed by KMC and Ecowise/ALS are generally in accordance with NEPM (1999) and ANZECC (2000).

The following subsections outline the nature of the site's monitoring and analytical program, as well as conditions at the time of sample collection (from information provided by KMC).

### 5.1 Landfill Gas Monitoring

The landfill gas testing locations (areas where intermediate or final cover has been placed and inside all buildings within 250 m of the deposited waste) were tested by KMC (February 2012, April 2012, July 2012 and October 2012) during the 2011/12 reporting period (Appendix C).

Six onsite landfill gas wells (Gas 1 to Gas 6) were installed by E2W on 2 August 2006 and gas monitoring has been performed since then as part of the landfill rehabilitation work. Landfill gas monitoring is a requirement of the EPL, but only relates to onsite buildings/sheds and the waste mound (over the capped area).

Two gas monitoring wells (i.e. Gas 5 and Gas 6) have not been monitored since November 2009 as they are located at the same location as Trench 1 (i.e. alternative gas test location, Refer to Figure 1 in Appendix C).

Monitoring data (2012) from the trenches (biofilter pads, Trench 1 to Trench 7) and gas monitoring wells (Gas 1 to Gas 3, Gas 4) showed similar concentrations to 2010/11. Methane gas readings were consistent at each sampling event through the monitoring period. The maximum methane gas reading was 890 ppm at Trench 4 (February 2012). The lowest was 100 ppm at Trench 3 (April 2012). The highest readings at each sampling event were recorded at either Trench 4 or Trench 7. Buildings were sampled for landfill gas in October 2012, with all location recording no methane gas readings (non-detectable).

E2W interpret that landfill gas is unlikely to be present in the buildings due to the previous results, no change to the landfill and nature of onsite buildings (well vented or air conditioned office).



## 5.2 Surface and Groundwater Monitoring Locations

Groundwater monitoring was undertaken from up to 9 existing groundwater wells (shallow, intermediate and deep) located on the landfill mound perimeter and surface water monitoring at two locations along Rocklow Creek (up, middle and down-gradient of the landfill mound, whilst no access possible to Rocklow-down during 2011-12). Monitoring locations are shown on Figure 2.

The wells and surface water locations sampled in the 2011 and 2012 reporting period are outlined below:

- 2 November 2011. Groundwater wells: MD2B, MD2C, MD4B, MD4C, MD6B, MD6C, MD9B, MD9C, MD10B, Surface water: Rocklow-Up, Rocklow-Middle,
- 2 February 2012. Groundwater wells: MD2B, MD2C, MD4B, MD4C, MD6B, MD6C, MD9B, MD9C, MD10B, Surface water: Rocklow-Up, Rocklow-Middle,
- 30 May 2012. Groundwater wells: MD2B, MD2C, MD4B, MD4C, MD6B, MD6C, MD9B, MD9C, MD10B, Surface water: Rocklow-Up, Rocklow-Middle,
- 9 August 2012. Groundwater wells: MD2B, MD2C, MD4B, MD4C, MD6B, MD6C, MD9B, MD9C, MD10B, Surface water: Rocklow-Up, Rocklow-Middle

Wells that were “not” tested in the 2011 and 2012 reporting period, but are part of the EPL include;

- MD1B. No access in all 4 rounds (November 2011, February 2012, May 2012, and August 2012)
- MD4A. Dry shallow well in 4 rounds.
- MD2A, MD6A, MD9A, MD10A. Not enough water for sampling.

It is noted that most shallow wells have been dry at time of sampling. One well has been damaged and requires (i.e. MD4A).

The nature of saline water stratification within the local groundwater system and well network is presented in Table 5.2.1 (below) and Appendix B (Figure 7).

**Table 5.2.1: Summary of Groundwater Quality Changes with Depth**

| Well ID | Salinity (EC, $\mu\text{S}/\text{cm}$ ) | Comment                          |
|---------|---|----------------------------------|
| MD1B    | 850                                     | Fresh- water 10 m away is saline |
| MD2A    | 25,200                                  | surface water from high tide     |
| MD2B    | 29,100                                  | saline groundwater               |
| MD2C    | 44,600                                  | saline groundwater               |
| MD4A    | NA                                      | Damaged well (shallow/dry)       |
| MD4B    | 15,300                                  | saline groundwater               |
| MD4C    | 33,100                                  | saline groundwater               |
| MD6A    | 11,100                                  | surface water from high tide     |
| MD6B    | 2,221                                   | fresh - brackish groundwater     |
| MD6C    | 27,400                                  | saline groundwater               |
| MD9A    | 3,375                                   | fresh - brackish groundwater     |
| MD9B    | 3,207                                   | fresh - brackish groundwater     |
| MD9C    | 3,600                                   | fresh - brackish groundwater     |
| MD10A   | 40,900                                  | saline groundwater               |
| MD10B   | 2,797                                   | fresh - brackish groundwater     |

*Note: Electrical Conductivity data is from sampling by E2W on 29 June 2005.*

*Well suffix 'A' and 'B' = shallow well screen (less than 3 m into water table).*

*Well suffix 'C' = well screen greater than 3 m below water table (refer to Figure 7 in Appendix B).*

Several of the groundwater wells (MD4A/B/C, MD6A/B/C etc.) comprise nested wells, which target various depths within the coastal sand aquifer. The sampling frequency and depth of the groundwater samples are presented in Table 5.2.2 (below).

**Table 5.2.2: Monitoring Summary for the 2011 to 2012 Reporting Period**

| Sample ID | Screen Interval (m AHD) - or Sample Location | Nov 2011  | Feb 2012  | May 2012  | Aug 2012  |
|-----------|--|-----------|-----------|-----------|-----------|
| (MD1A)    | 0.5 to -0.5                                  |           |           |           |           |
| MD1B      | -4.7 to -5.7                                 | No Access | No Access | No Access | No Access |
| MD2A      | 0.525 to -0.475                              | Dry       | Dry       | Dry       | #         |
| MD2B      | -2.93 to -3.93                               | X         | X         | X         | X         |
| MD2C      | -5.2 to -6.2                                 | X         | X         | X         | X         |
| (MD3B)    | -3.22 to -4.22*                              |           |           |           |           |
| (MD3C)    | -5.55 to -6.55*                              |           |           |           |           |
| MD4A      | 1.2 to 0.2                                   | Dry       | Dry       | Dry       | Dry       |
| MD4B      | -3.22 to -4.22                               | X         | X         | X         | X         |
| MD4C      | -5.55 to -6.55                               | X         | X         | X         | X         |
| MD6A      | 0.71 to -0.30                                | Dry       | Dry       | Dry       | #         |
| MD6B      | -1.05 to -2.05                               | X         | X         | X         | X         |
| MD6C      | -8.8 to -9.8                                 | X         | X         | X         | X         |
| (MD7)     | 0.5 to -0.5 *                                |           |           |           |           |
| (MD8)     | 0.5 to -0.5*                                 |           |           |           |           |
| MD9A      | 0.58 to -0.42                                | Dry       | Dry       | Dry       | #         |

|                |                                  |           |           |           |           |
|----------------|----------------------------------|-----------|-----------|-----------|-----------|
| MD9B           | -2.3 to -3.3                     | X         | X         | X         | X         |
| MD9C           | -4.75 to -5.75                   | X         | X         | X         | X         |
| MD10A          | 0.68 to -0.32                    | Dry       | Dry       | Dry       | #         |
| MD10B          | -2.85 to -3.85                   | X         | X         | X         | X         |
| Rocklow-Up     | Upstream of landfill             | X         | X         | X         | X         |
| Rocklow-Middle | Midstream of landfill            | X         | X         | X         | X         |
| Rocklow-Down   | Downstream and opposite landfill | No access | No access | No access | No access |

*Note: \*= to be confirmed (logs not available). X = Sample collected.*

*(MD7), well in brackets = well is not an EPL requirement. Blank space = not sampled.*

*# = Not enough water for sampling*

The groundwater monitoring wells and sampling depths for each event are summarised in Table 5.2 (above) and Table 5.3 (rear of report). The sampling labels for the nested wells ('A' to 'C') are attached to each of the depths associated with these wells (e.g. MD1A, MD1B, MD1C).

## 6. MONITORING RESULTS

All surface and groundwater analytical results for the 2011/12 reporting period are presented in Tables GW-1, and SW-1, SW-2, and SW-3. The ALS field records and laboratory reports are presented in Appendix A.

A summary of all groundwater monitoring data (1999 to 2012) for ammonia (mg/L) is presented in Graph-1, Graph-2 and Graph-3. The graphs highlight ammonia groundwater quality trends over the past ~ 13 years (January 1999 to August 2012). Ammonia is considered to be a key landfill leachate indicator for the site.

A summary of previous ammonia surface water results for Rocklow Creek is presented in Table SW-2. Ammonia is considered as the key landfill leachate indicator in surface waters in and around landfill sites, however other sources of ammonia exist in the same catchment (i.e. fertiliser use in paddocks and Dunmore landfill).

### 6.1 Groundwater Data

Groundwater for the 2011/12 reporting period was collected from a network of seventeen monitoring wells (mostly downgradient locations) at the MWDD (Figure 2). The results of the groundwater testing are summarised in Table GW-1, Graphs-1 to 3, Figure 2 and in the following subsections.

#### 6.1.2 Groundwater Depth

The depth to groundwater was measured prior to each sampling event using a water level probe. Depth to the groundwater below top of casing and relative to a common reference (i.e. Australian Height Datum, m AHD) is presented in Table GW-1. The inferred groundwater flow direction



for the site is presented in Figure 2. The groundwater flow direction and gradients would be influenced by tides.

The groundwater levels recorded from the 2011/12 reporting period are similar to previous years and reflect changes in rainfall and tide levels.

The reduced groundwater levels (m AHD) from the ten wells sampled in 2011/12<sup>5</sup> indicate a relatively low water table elevation (<1.5 m AHD), which is characteristic of the swamp/estuarine environment. The annual rainfall from August 2011 to July 2012 was 1282.8 mm (Bombo Headland), which was slightly lower than the previous monitoring period (1308.0 mm, August 2010 to July 2011)<sup>6</sup>.

Recharge to the aquifer system beneath and surrounding the waste disposal facility mainly occurs from rainfall infiltration and storm water runoff around the footprint. Some minor recharge may be occurring through the landfill mound (<5% of annual rainfall). It is likely infiltration of rainfall is moderate-high around the footprint area (uncapped areas) due to the low elevation and accumulated run-off from the batter slopes and spillways.

### **6.1.2 Field Parameters**

The field parameters measured during groundwater sampling are indicative only, due to the low purge volumes and dominant reduced/anaerobic condition of the groundwater (Table GW-1).

Insitu measurements (within borehole) are likely to provide a more accurate rendition of the field chemistry, especially with respect to dissolved oxygen.

#### **6.1.2.1 Field pH**

The pH from the 9 wells (MD2B, MD2C, MD4B, MD4C, MD6B, MD6C, MD9B, MD9C, MD10B) ranged from pH 6.8 to 7.6 in the 2011-12 reporting period, indicating relatively neutral water.

Fluctuation (minor) in pH is likely to relate to a combination of factors including leachate quality, acid sulphate soils, tidal influences (together with a rise in electrical conductivity) and surface water quality.

E2W considers that field pH measurements may be more reliable than laboratory, as the pH of waters can change once out of equilibrium with the natural environment and stored within containers (holding time for pH is less than 4 hrs).

#### **6.1.2.2 Electrical Conductivity (EC)**

The EC in groundwater collected from the site ranged from approximately 1.54 to 41 mS/cm (MD6B, MD9B, MD10B in August 2012 and MD2C in November 2011 respectively). The

<sup>5</sup> Note: MD2A, MD7 and MD10B have no RL measurement.

<sup>6</sup> Note: data from Kiama (Bombo Headland) (Station ID 068242), ~4.5 km SSE of MWDD.

salinity reflects the transgression/regression of fresh and marine groundwater and presence of saline groundwater at depth (Figure 2, & Appendix B).

The distribution of EC indicates fresh water is located under the landfill mound and close to the landfill footprint, with sharp salinity increases near Rocklow Creek and Minnamurra River (Figure 7, Appendix B). The saline water correlated with the fresh/salt water interface and presence of mangroves/sedges (tidal area).

### **6.1.2.3 Dissolved Oxygen (DO)**

The 9 wells recorded field dissolved oxygen (DO) concentrations ranging between 0.50 to 3.79 mg/L in the 2011/12 reporting period (MD2C in August 2012 and MD9C in May 2012, respectively). The concentrations of dissolved oxygen were similar to those reported in previous annual monitoring reports.

It is likely the concentrations of DO would be lower if measured insitu, as opposed to during the purging and sampling process. Wells with low purge volumes are unlikely to provide representative groundwater DO concentrations.

Landfill leachate and the organic rich sediments (estuary) are likely to deplete DO in the groundwater. This phenomenon is seen on many landfill sites, where organic carbon and nutrients provide surplus electron acceptors, which react with and consume the available DO in groundwater.

### **6.1.3 Nutrients (groundwater)**

#### **6.1.3.1 Nitrogen-based compounds**

Groundwater collected from the MWDD monitoring wells were analysed for ammonia and nitrate in the 2011/12 reporting period (note: Total nitrogen is not an EPL requirement).

Five wells (MD2B, MD2C, MD4B, MD4C and MD9C) reported one or more samples with nitrate concentrations above the ANZECC (2000) trigger value for fresh water ecosystems (0.7 mg/L, at 95% protection level). In 2011/12 concentrations ranged from <0.01 (non-detected/below LOR) to 8.17 mg/L. Nitrate concentrations are higher than previous levels of nitrate in 2010/11 and 2009/10. Average nitrate concentrations for 2011/12 were lowest at MD10B (0.09 mg/L) whilst highest at MD4B (3.23 mg/L). During 2010/11, wells MD4C (0.16 mg/L) and MD4B (1.66 mg/L) were reported as the lowest and highest average concentrations.

Nitrogen species in the groundwater is predominantly ammonia, and indicative of a reducing groundwater environment. Thus, potential impact to the aquatic environment is interpreted to arise from ammonia, and to a lesser extent, the oxidised nitrogen form (nitrate).

The guidelines (ammonia) for the protection of freshwater and marine ecosystems vary according to pH and temperature. Given the range of pH and temperature measured across the site and in Rocklow Creek, the guideline values have been calculated as 1.88 and 2.84 mg/L for fresh and marine waters, respectively (at pH of 7.3). With the exception of MD2C and MD4C,

all groundwater samples tested in all four monitoring rounds reported concentrations of ammonia in excess of the ANZECC (2000) trigger value for marine ecosystems (2.84 mg/L, based on a pH of 7.3).

Groundwater from the wells MD4B, MD6B, MD6C, MD9B, MD9C and MD10B, located on the north and eastern landfill perimeters (plume centreline path) reported the highest concentrations of ammonia (all  $\geq 30$  mg/L, Figure 2). Well (MD9C) reported the maximum ammonia of 101 mg/L (February 2012), which is lower than the maximum at MD9C in 2010/11 reporting period (118 mg/L). Ammonia trends over time are presented in Graph-1, Graph-2 and Graph-3. Highest ammonia correlates with the main downgradient area (plume centreline) of the waste mound and above average rainfall (2011).

It is noted that rehabilitation works were completed in early 2008, and the 2008/09 and 2009/10 ammonia concentrations have generally decreased since then at most well locations. Well locations MD2C, MD6B, MD6C, MD9C and MD10B have decreased in maximum ammonia concentrations in 2011/12 in comparison to the previous 2010/11 period.

#### 6.1.5. Ammonia Trends

The groundwater ammonia trends from 1999 to 2012 are presented in Graph-1, Graph-2 and Graph-3. The data indicates ammonia in most monitoring wells exceed the ANZECC (2000) marine water trigger value. A summary the ammonia trends are presented in Table 6.1.5.

**Table 6.1.5 Summary of Ammonia Trends in Groundwater**

| South-east of Landfill (Across-gradient) |                                  | North of Landfill (Down-gradient, plume centreline) |   |
|--|----------------------------------|---|---|
| Well ID                                  | Trend                            | Well ID   | Trend   |
| MD1B                                     | Overall Decreasing, but variable | MD4B  | Overall Decreasing, but variable                              |
| MD2B                                     | Overall Decreasing, but variable | MD4C  | Overall Decreasing  |
| MD2C                                     | Overall Decreasing, but variable | MD9B  | Overall Decreasing, but variable                              |
| MD6B                                     | Overall Decreasing, but variable | MD9C  | Rising trend & peak in late 2011, then irregularly Decreasing |
| MD6C                                     | Overall Decreasing, but variable | MD10B   | Irregularly Decreasing  |

*Note: "B" and "C" denote shallow and deep wells, respectively.*

The ammonia trends are generally variable over time, however most locations show a downward trend. The ammonia from the quarterly monitoring events may reflect a combination of seasonal rainfall, tidal fluctuations and the landfill rehabilitation works.

Monitoring reports (eg. E2W, 2008-09, 2009-10, 2010-11, 2011-12) have identified spikes in ammonia concentrations that are interpreted to result from high rainfall in preceding months. For example, in February 2008, high rainfall (169.2 mm, 5 February) was followed by a rise in ammonia in early to mid 2008. In October 2009, 187.8 mm of rainfall, which was the highest monthly rainfall recorded for the 2009 calendar year (next highest December 2009, 106.2 mm).



During the 2010-11 monitoring period, 22 March 2011 (163.8 mm rainfall) was followed by a rise in ammonia (May 2011, Graphs 1-3)<sup>7</sup>. Over the 2011/12 period, a combined 176.2mm rainfall from 20 to 23 July was followed by an increase in ammonia (November 2011, Graph 1-3)<sup>7</sup>. Rainfall of 289 mm in February and 213.2mm in March (502.2mm combined in 2 months) was followed by rises in ammonia (May 2012, Graph 1-3)<sup>7</sup>.

Rainfall events before or on the dates of sampling may contribute to rising ammonia concentrations in the groundwater due to some leachate migration, generation and/or rising water table.

During 2011/12 ammonia generally continues to decrease (variably) in wells compared with previous monitoring periods, but with continued variability (Graph-1 to Graph-3) due to above average rainfall. Over the 2010/11 and 2011/12 monitoring periods, MD9C shows an irregular decreasing ammonia trend in 2012 (although has an increasing trend over 1999-2011 which peaks in late 2011). During the 2011/12 reporting period, 6 wells (MD2B, MD2C, MD4C, MD6B, MD9C and MD10B) showed a temporary rise in ammonia concentrations in February 2012. The four wells (MD2C, MD6C, MD9C and MD10B) are preceded and followed by, a declining trend in the next sampling round (May 2012).

Review of aerial photographs taken of the landfill in late 2007 shows that the NE corner (where most of the wells are situated) was the last to be reshaped, capped and vegetated (& increase the potential for leachate generation and migration, as would have disturbance of soil and waste in that area). Continued monitoring of ammonia concentrations and climate is required to establish seasonal trends.

The amount of landfill leachate generated would decline following the closure of the landfill and completion of rehabilitation works. The groundwater quality is likely to take years (5+) to show improvements due to the flat hydraulic gradients (in estuary) and tidal movements (some reversal of gradient a high tide) around the landfill footprint.

Results from the 2011/12 monitoring period are similar to the 2010/11 monitoring period, and show variable, but generally decreasing ammonia trend and leachate impact (with the exception of MD9C which has elevated ammonia). Future monitoring is required to assess ammonia trends and characteristics (declines, variations etc).

#### **6.1.3.2 Total Phosphorus (TP, groundwater)**

The total phosphorus (TP) is not an EPL requirement, and was not sampled during the 2011/12 monitoring period (may cause algae in surface water environment). In the 2007/08 monitoring period the majority of TP results from twelve wells exceeded the ANZECC (2000) trigger values for the protection of marine ecosystems.

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<sup>7</sup> Rainfall data taken from the Kiama (Bombo Headland) Weather Station, (Station ID 068242)

#### **6.1.4 Hydrogeochemical Indicators**

Concentrations of major ions (chloride, sulphate, calcium, magnesium, sodium and potassium) in the groundwater at the site are presented in Table GW-1. The concentrations of major ions in all monitoring wells are within previously reported ranges and generally dominated by one cation (sodium) and anion (chloride). In wells with freshwater, (MD6B and MD10B) calcium concentrations are similar to, and sometimes greater than sodium concentrations.

The landfill leachate may be contributing concentrations of ions including calcium, potassium and magnesium. Contribution of sodium and chloride is difficult to ascertain as these ions are typically associated with marine environments (e.g. salt spray, tidal influence).

#### **6.1.5 Inorganic Contaminants (Iron, Manganese and Fluoride)**

Total iron (filtered at the laboratory) ranges from the LOR (<0.05 mg/L) at MD6C (November 2011) to 7.25 mg/L (MD6C, February 2012). With the exception of MD4B and MD10B, all the groundwater wells reported ANZECC (2000) exceedances (freshwater ecosystems, 0.3 mg/L) in a least one in of the four sampling rounds.

It is noted that the ANZECC (2000) guideline for iron is an indicative interim working level (IIWL) and is of low reliability. No guideline is available for iron in marine water, which has a higher relevance to Rocklow Creek and receiving water bodies.

Concentrations of manganese ranged from 0.045 mg/L to 0.727 mg/L (MD4B, August 2012 and MD9C, August 2012, respectively). The ANZECC (2000) guideline for manganese in fresh water is 1.9 mg/L. All results were reported below the ANZECC fresh water guidelines.

The levels of filterable iron and manganese are similar to those reported in previous reporting periods.

Concentrations of fluoride ranged from 0.3 mg/L (MD6B in November 2011 and MD9C in November 2011, May and August 2012) to 0.9 mg/L (MD10B, November 2011, February and August 2012). No recommended reliable ANZECC (2000) guidelines exist for fluoride in fresh or marine waters. The data ranges between the minimum and maximum values are similar to the levels reported in 2011/12. The results indicate that fluoride levels are generally associated with landfill leachate.

#### **6.1.6 Organic Contaminants (DOC, TOC and Phenols- Groundwater)**

Concentrations of dissolved organic carbon (DOC) ranged from 9 to 147 mg/L in the 2011/12 reporting period (MD6C, February 2012 and MD9C, November 2011, respectively). Concentrations of total organic carbon (TOC) ranged from 11 to 158 mg/L in the 2011/12 reporting period (MD6C, February 2012 and MD9C, November 2011, respectively). No recommended ANZECC (2000) guidelines exist for DOC or TOC. The DOC/TOC may relate to landfill leachate and/or naturally occurring organic matter associated with lowland/estuary and rivers.

Concentrations of phenols were below LOR (0.05 mg/L) and were below marine water trigger values (ANZECC 2000, 0.4 mg/L) at all wells in all monitoring rounds (November 2011, February 2012, May 2012 and August 2012). Future groundwater monitoring will determine if phenol concentrations warrant further assessment.

## **6.2 Surface Water**

Surface water sampling was undertaken quarterly during the 2011/12 reporting period (EPL requirement is only six-monthly sampling). Samples were collected from two locations along the estuarine reach of Rocklow Creek (Figure 2). Sample locations Rocklow-Up (upstream at the tidal limit and landfill), Rocklow-Middle (midstream<sup>8</sup>) and Rocklow-Down (downstream) are considered appropriate locations to assess water quality impacts from the MWDD. It is noted that impacts to Rocklow Creek water quality may be occurring from Shellharbour Waste Disposal Depot, which is situated on the northern side of Rocklow Creek and from runoff from agricultural and residential land in the catchment.

The three surface water locations are not sampled according to tidal levels (i.e. Rocklow Creek has marine water influences which is a mixture of groundwater discharge and tidal water), therefore nutrients concentrations are likely to vary due to tidal water influence.

The surface water monitoring data is variable and possibly reflecting a combination of tide sampling regimes and influence from the broader catchment area. Timing of the samples should be coordinated with the tide so that creek samples are collected during a run-out tide when the maximum amount of groundwater discharges into the creek.

### **6.2.1 Physical Parameters**

#### **6.2.1.1 pH**

The pH in Rocklow Creek at the middle and downstream location is generally neutral (6.8 to 7.7) in 2011/12, and has not changed significantly from the 2010/11 reporting period (i.e. downstream sample were not collected due to access constraints).

#### **6.2.1.2 TDS (and EC)**

The conductivity (EC, mS/cm) of waters at the upstream location are lower than those recorded downstream (Rocklow-Middle), reflecting the tidal range and groundwater discharge from the catchment area.

Water collected from Rocklow Creek is brackish to saline (Rocklow-Middle 7.38 to 22.70 mS/cm, and Rocklow-Up 0.92 to 12 mS/cm). EC values are lower than results from the 2010/11 monitoring period, however this may be due to the time sampling was taken (tidal range).

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<sup>8</sup> The Rocklow-Middle sample was recommended as part of the landfill closure and to assess if a perimeter bund wall was required to reduce discharges to Rocklow creek. Rocklow-Down was inaccessible and not sampled during the 2011-12 reporting period.



Sampling at low tide would result in decreased salinity due to an increased baseflow (fresh groundwater) contribution.

## **6.2.2 Nutrients (surface water)**

### **6.2.2.1 Nitrogen**

Rocklow Creek surface water samples collected in the 2011/12 reporting period reported ammonia below the ANZECC (2000) guidelines for marine and fresh water ecosystems (2.84 and 1.88 mg/L, respectively, Tables SW-1 and SW-2), with the exception of Rocklow-Middle (1.91 mg/L of ammonia) in August 2012 (above freshwater but not marine). Concentrations of nitrate were all at or below 0.26 mg/L (ANZECC (2000), lower than the trigger value for fresh water ecosystems (0.7 mg/L, at 95% protection level).

Water samples collected from Rocklow Creek during 2011/12 reporting period show an increase (of up to 1.87 mg/L) in ammonia in the midstream sample compared to the upstream sample. The ammonia increments between the upper and mid stream samples are presented in Table SW-2 and Graph-4 (note: mid-stream location is downgradient to MD-9C and MD-10B which have elevated and irregular ammonia trends).

Ammonia concentrations in Rocklow Creek (2011/12) are generally lower than in 2010/11 (Table SW-2).

Increases in ammonia from upstream to downstream of the landfill have been observed over previous monitoring periods (Graph-4). While these increases could be attributable to the discharge of groundwater impacted by ammonia from the MWDD, other sources of nitrogen input such as polluted runoff from the catchment (Shellharbour Landfill, agricultural areas) and nutrients bound in sediments cannot be discounted.

Graph-4 shows the ammonia increments in all monitoring periods since 1999 and illustrates a decreasing difference between upstream and downstream ammonia concentrations. Ammonia concentrations at Rocklow-Up have remained relatively stable over time while ammonia concentrations at Rocklow-Down show a declining trend (until 2010).

Rocklow-Middle (mid-stream sample) reported elevated ammonia concentration (1.91 mg/L, August 2012), which correlates to elevated ammonia during 2011/12 in the nearby groundwater reported at MD-9C/MD10B (i.e. surface water impacted by groundwater discharge as baseflow, refer to Graph 1 and Figure 2).

The ammonia contribution from the MWDD into Rocklow Creek is complicated by the sampling regime (i.e. sampling at various tides level with dilution from tidal water) and other potential sources of nitrogen in the area (Dunmore Landfill and nutrients from upstream agricultural areas).

### **6.2.2.2 Total Phosphorous (surface water)**

Total phosphorus (TP) is not an EPL requirement and were not analysed during the 2011/12 monitoring period.

Monitoring from previous years indicate that TP concentrations decrease from up to down-stream of the landfill (except in August 2008), implying there is nutrient contribution from other (agricultural) sources in the catchment area.

### **6.2.3 Organic Contaminants (DOC and Phenols)**

Concentrations of dissolved organic carbon (DOC) ranged from 8 to 11 mg/L in the 2010/11 reporting period (Rocklow-Middle in February & May 2012 and Rocklow-Middle in November 2011, respectively). No recommended ANZECC (2000) guidelines exist for DOC (concentrations could be related to natural waters or leachate).

Concentrations of phenols were below LOR (0.05 mg/L) in all other surface water samples in all monitoring rounds (November 2011, February 2012, May 2012 and August 2012).

The source and nature (possible sample bottles, gloves used for sampling, laboratory contamination) of phenols is not well known (concentrations are below guidelines).

## **7. CHEMICALS OF CONCERN AND CONTAMINANT PLUMES**

The results of 2011-2012 monitoring have been assessed to determine the surface and groundwater conditions with respect to the relevant guidelines which serve to protect aquatic ecosystems (both fresh and marine), as this is considered to be the dominant beneficial (environmental) use of local groundwater.

The primary landfill leachate indicator at the site is ammonia. Ammonia represents the analyte which exceeds ANZECC (2000) guidelines in the majority of monitoring wells. The landfill is also a source of dissolved salts, metals (i.e. iron, which was generally above interim guidelines) and potentially organics. The dissolved salts, metals and organics are associated with the dissolution of ions from various types of waste material.

Results of the sampling (1999 to 2012) confirm that ammonia concentrations are elevated above background levels. Improvement in groundwater quality (i.e. a decreasing ammonia trend) is evident in six wells (MD2B, MD2C, MD4B, MD4C, MD6B) since landfill rehabilitation works commenced (2006). High rainfall periods since landfill rehabilitation completion are interpreted to have resulted in periodic ammonia increases (eg. February 2008, March 2011, July 2011, February & March 2012).

It is likely the leachate plume arising from the landfill mound would migrate radially (local system) with (regional) flow mainly directed towards the north-east and east. It is likely that landfill leachate infiltrates the underlying sandy aquifer and consequently migrates under the predominant groundwater flow regime towards Rocklow Creek and Minnamurra River.

The extent of natural attenuation and degradation of the nutrient plume prior to discharge is not well known, however the groundwater/saltwater interface and mangrove environment are likely to enhance attenuation and de-nitrification of the ammonia plume (Appendix B, Figure 7).

## 7.1 Ecological Issues

Groundwater migrating from under the landfill mound to Rocklow Creek and Minnamurra River will be diluted by the dynamic and tidal nature of the environment. Contaminants contained within this discharge will be diluted and dispersed via biological, chemical and physical processes which occur at the groundwater/salt water interface. Uptake of the nutrients by plants (mangroves, sedges) dependent on groundwater will also occur at the creek and river.

The adverse effects arising from landfill leachate on the Rocklow Creek and Minnamurra River aquatic environments is unclear and difficult to ascertain, given the multiple sources of nutrients present and disturbance in the catchment area. No obvious evidence of degradation is evident in the water bodies or surrounding vegetation (Note; some trees were damaged/removed during landfill rehabilitation works in 2007/2008).

Discharges of landfill leachate to Rocklow Creek would be at a maximum when the tide is low and groundwater gradients are steeper. The net increment of ammonia in the midstream sample (Rocklow-Middle) averaged 0.91 mg/L in the 2011/12 reporting period (Table SW-2). This net increment average is affected by one elevated Rocklow-Middle sample (1.91 mg/L, located in direction of plume centreline) and is not directly comparable to downstream sample location (100 m downstream, greater tidal influx/dilution).

The net increment in the downstream in 2011/12 (0.91 mg/L) is lower than 2010/11 (1.57 mg/L averaged net increment). Previous net increment average are; 0.11mg/L in 2008/09 and average 0.44mg/L in 2009/10 (appears as an overall increasing trend, however this is dependant on tides during sampling).

The ammonia in groundwater (MD-9C and MD-10B) during 2011/12 may be contributing to the nutrient concentrations detected in the surface water (Rocklow-Middle), however this is not confirmed due to the other potential sources and no downstream sample. Downstream ammonia concentrations have declined since monitoring commenced in 1999 (Graph-4).

While it is likely that some nitrogen-impacted groundwater may discharge into Rocklow Creek and Minnamurra River, it is unclear as to the extent of attenuation of the nitrogen plume prior to discharge. Attenuation is likely to occur through a combination of dilution, through mixing of groundwater from north of the creek, by flows and tidal movements within the creek and estuary itself, oxidation of the ammonia to nitrate, and finally as nitrogen gas.

Ammonia and nitrate concentrations in all surface water samples collected in the 2011/12 reporting period were below ANZECC (2000) trigger values for fresh and marine water ecosystems, with the exception of Rocklow-Middle (1.91 mg/L, August 2012), which may relate

to the elevated ammonia at the up-gradient wells (MD-9C and MD-10B during 2011/12 monitoring year).

## 8. CONCLUSIONS

Surface and groundwater monitoring was undertaken at the Minnamurra Waste Disposal Facility by ALS on a quarterly basis<sup>9</sup> from November 2011 to August 2012 (EPL reporting period). Monitoring data collected during the 2011/2012 period was assessed by E2W to determine the impact of the landfill facility on local groundwater and aquatic ecosystems.

Based on the environmental data reviewed and assessed, E2W offer the following conclusions:

- Elevated concentrations of nutrients, in particular ammonia, continue to be detected in groundwater at the site. Ammonia levels reported by the laboratory exceed the ANZECC (2000) guidelines for the protection of fresh and marine water ecosystems at all monitoring wells sampled.
- The impacted wells are located on the footprint (downgradient) of the landfill mound, indicating contaminant migration towards Rocklow Creek and Minnamurra River (north-east and east).
- Elevated ammonia concentrations (above ANZECC 2000) were reported at several wells including; MD4B (36 mg/L), MD6B (30.3 mg/L), MD6C (43.2 mg/L), MD9B (45.7 mg/L), MD10B (72.8 mg/L), with the maximum at MD9C (101.0 mg/L). Elevated ammonia in the groundwater is located on the north and eastern landfill perimeters coinciding with the predominant groundwater flow direction.
- Nitrate concentrations during the 2011/12 reporting period ranged from not detected to 8.17 mg/L (MD9C) and exceeded the (ANZECC (2000) freshwater guidelines, 0.7 mg/L). Nitrate concentrations are higher than the previous concentrations reported in 2010/11 (MD-1B= 5.23 mg/L, but was not monitored in 2011/12).
- Ammonia concentrations in the 2011/12 monitoring period continue to be elevated and variable, however show an overall decreasing trend. Variations in ammonia are inferred to reflect seasonal trends (high rainfall resulting in increased concentrations) and decreased leachate generation due to the landfill rehabilitation works.
- During the 2011/12 monitoring period Rocklow-Down (downstream) was not sampled (due to access), however was substituted by Rocklow-Middle (midstream). Low concentrations of ammonia and nitrate (i.e. below ANZECC 2000 trigger values) were reported from the upstream and mid stream locations on Rocklow Creek during the 2011/12 reporting period, with the exception of Rocklow-Middle (1.91 mg/L, in August 2012). A minor increase occurs in the downstream sample locations (or Rocklow-Mid). The actual difference between upstream and downstream concentrations has reduced since 1999 (Graph 4, reflecting reduced leachate migration from the capped waste mound).
- The net increment of ammonia in the midstream sample (Rocklow-Middle) averaged 0.91 mg/L in the 2011/12 reporting period (Table SW-2). Although, this "net incremental average" is higher than previous years (except for 2010/11 which averaged 1.57mg/L), the average is skewed from one-off elevated results (Rocklow-Middle @ 1.91 mg/L) and not

<sup>9</sup> Council has conducted additional monitoring at the site as the EPL only requires 6 monthly sampling.



directly comparable to downstream sample location (100 m further downstream, given tidal dilution). The elevated ammonia in nearby groundwater (MD-9C and MD-10B) may be contributing to the nutrient concentrations in the surface water (Rocklow-Mid), however further monitoring is required to verify this interpretation.

- While downstream ammonia concentration increases could be attributable to the discharge of groundwater impacted by ammonia from the MWDD, contribution from other sources of nitrogen input such as polluted runoff from the catchment (Shellharbour Landfill, agricultural areas) is not discounted.
- All other water quality indicators were consistent with the results of previous monitoring periods.
- Bimonthly testing of the gas monitoring wells (Gas 1 to 3 and Gas 4) and trenches (Trench 1 to Trench 7 -the biofilter pads) indicated that gas levels have decreased during the 2011/12 monitoring period. All buildings sampled (within 250 m of the deposited waste) recorded no detectable landfill gas readings in October 2012 (annual monitoring).
- KMC (& E2W) are unaware of any complaints from the community arising from rehabilitation works at the MWDD during the 2011/12 reporting period.

The nutrients in the local surface and groundwater are likely to decrease over time due to the landfill closure and rehabilitation works. Given that the landfill capping commenced in August 2006 and completed in January 2008 the leachate generation has substantially decreased. Monitoring data in 2011/12 supports this interpretation and improvement in the local water quality.

The elevated ammonia concentrations reported at MD-9C and MD-10B is interpreted to relate to the remnant deeper centre/core plume migrating from under the landfill mound to the site boundary.

Monitoring over the next few years will continue to provide the relevant environmental data to assess the effectiveness and performance of the landfill rehabilitation (& remedial works- as necessary). The landfill closure and recent capping of the landfill mound would improve the local surface water and groundwater quality.

Close monitoring of the elevated ammonia at wells (MD-9C, MD-10B at centreline of plume) and Rocklow Creek (mid-creek) is recommended to address any remedial requirements (e.g. groundwater extraction and irrigation). E2W consider that additional time (1 year) is required to verify ammonia trends and remedial actions at MD-9C/MD-10B. The scale of the landfill mound (6 ha) and generally slow movement of the deeper groundwater is likely to be influencing results at MD-9C (i.e. the residual core leachate plume is still migrating slowly under the capped part of the mound).

E2W interpret that additional time (3 + years) is required to show a more consistent and widespread improvement in the water quality trends (eg. ammonia) due to landfill rehabilitation works. This interpretation takes in consideration the dilution effects of rainfall recharge, clean water runoff from the mound and subsequent attenuation of the landfill leachate around the landfill footprint. It is noted that the majority of the monitoring wells are situated immediately off the landfill perimeter and readily influenced from the leachate plume migrating under the waste mound.

## 8.1 Recommendations

E2W offer the following recommendations regarding the monitoring at the Minnamurra Waste Disposal Depot:

### *Groundwater:*

- Continued monitoring and assessment of the ammonia is required to assess trends in relation to the landfill rehabilitation works.

E2W have initiated concept design of potential groundwater remedial works to address the previous (2011) rising ammonia trend identified at well (MD-9C). Currently, two extraction wells and a holding dam are proposed to extract the ammonia enriched groundwater, facilitate biological treatment (via wetland plants) and irrigation to strip the ammonia from the groundwater. Groundwater remedial works are recommended if ammonia concentrations exceed 100 mg/L on two consecutive monitoring rounds in 2012 or 2013 (MD-9C or MD-10B).

Repairs works are recommended for the damaged shallow well (i.e. MD-4A, replacement of bent pipe-work at well head).

Details of the proposed groundwater remedial works will be provided in separate documentation to KMC or NSW EPA.

### *Sampling Procedures:*

- Recording of groundwater purge volumes and any observations (odour, sheen, turbidity) during sampling,
- Use of calibrated field instruments for measuring field chemistry (pH, EC, DO, Eh, T) prior to sampling,
- Sampling of surface water to be timed with a **low 'run out' tide**, and documenting tidal and climatic conditions (i.e. sampling at different tides dilutes the groundwater plume).
- Details regarding the well conditions (eg. damaged). Any damaged wells should be replaced or substituted with nearby wells.
- Sampling of MD-5B/5C (one event) is recommended to assess the extent of ammonia plume detected at MD-10B and MD-9C (i.e. improve plume delineation),
- Collection of an alternative (second) surface water sample in Rocklow Creek in proximity to MD-9B/9C (~50 m downstream of existing Rocklow-Middle) to better assess potential impacts associated with the groundwater ammonia plume.

The recommended groundwater monitoring program for the prescribed well locations (i.e. EPL conditions) is summarised in Table 8.1. E2W acknowledge that the EPL recommends a half yearly sampling frequency, whilst KMC have continued with quarterly groundwater monitoring and also include surface water sampling (two or three locations). The increased monitoring

frequency facilitates earlier detection of rising trends and decision making regarding potential; remedial works.

E2W recommend the current surface water monitoring program is continued on a quarterly basis for the 2012/13 reporting period (exceeds EPL requirements). Due to the impeded access to the Rocklow-Down sampling location, E2W propose that a second mid-stream sample approximately (50 to 80 m) downstream of existing location (Rocklow-Middle) is collected to assist with the assessment of rising ammonia trend at well (MD-9C), risk assessment and requirements associated groundwater extraction/remedial works.

Continued monitoring of landfill gas at the gas monitoring wells, trenches (biofilter pads) and buildings (6 monthly) is recommended to comply with the EPL.

**Table 8.1 - Recommended Groundwater Analytical Program for MWDD (2012/13)**

| Analytes                | Detection Limit | Sampling Frequency | Method Reference   |
|-------------------------|-----------------|--------------------|--|
| Alkalinity              | 0.5 mg/L        | 6 monthly          | APHA 2320B   |
| pH/Eh                   | 0.01 pH unit    | 3 monthly          | pH meter and probe/APHA4500-HB   |
| Electrical Conductivity | 0.01 mS/cm      | 3 monthly          | Conductivity meter and probe   |
| Dissolved Oxygen        | 0.01 %          | 6 monthly          | DO meter and probe   |
| Temperature             | 1 deg           | 6 monthly          | Temperature meter and probe  |
| Ammonia-nitrogen        | 0.01 mg/L       | 3 monthly          | FIA  |
| Nitrate-nitrogen        | 10 µg/L         | 3 monthly          | FIA  |
| Calcium                 | 1 mg/L          | 6 monthly          | USEPA 6010 A   |
| Chloride                | 0.5 mg/L        | 6 monthly          | Titrated with mercuric nitrate using diphenol-carbazone/xylene cyanol FF indicator |
| Fluoride                | 0.1 mg/L        | 6 monthly          | APHA4500-FC  |
| Magnesium               | 0.02 mg/L       | 6 monthly          | USEPA 6010 A   |
| Sulphate                | 1 mg/L          | 6 monthly          | ICID/MS  |
| Sodium                  | 0.05 mg/L       | 6 monthly          | USEPA 6010 A   |
| Total Alkalinity        | 0.5 mg/L        | 6 monthly          | APHA 2340C   |
| Potassium               | 0.05 mg/L       | 6 monthly          | USEPA 6010 A   |
| Total Organic Carbon    | 0.50 mg/L       | 6 monthly          | APHA 531 OC  |
| Iron                    | 1 µg/L          | 6 monthly          | USEPA 6010 A   |
| Manganese               | 1 µg/L          | 6 monthly          | USEPA 6010   |
| Phenols                 | 1 µg/L          | 6 monthly          | APHA 5530D   |
| Standing Water Level    | m AHD           | 6 monthly          | Probe  |

*Notes: The key landfill indicator (ammonia/nitrate) is proposed on a quarterly basis in groundwater/surface water locations*

*ICP - Inductively Coupled Plasma*

*FIA - Flow Injection Analyser*

*MS - Mass Spectrometry*

*FC - Client Filtered*

*µS/cm - micro Siemens per centimetre*

*µg/L - micrograms per litre*

*mg/L - milligrams per litre*

*APHA - American Public Health Association*

*USEPA - United States Environment Protection Agency*

## 9. LIMITATIONS

Earth2Water Pty Ltd has prepared this report for the use of Kiama Municipal Council in accordance with the standard terms and conditions of the consulting profession. This report is prepared in accordance with the agreed scope of work. The methodology adopted and sources of information used by E2W are outlined in this report.

This report was prepared during November 2012 and is based on the information reviewed at the time of preparation. This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented by Ecowise and our experience.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, E2W should be notified of any such findings and be provided with an opportunity to review our content and recommendations.

## 10. REFERENCES

Hazelton (1992). *Soil Landscapes of the Kiama 1:1,000,000 Sheet, Department of Conservation and Land Management.*

NSW EPA (1996). *Environmental Guidelines: Solid Waste Landfills.*

DUAP (1996). *EIS Practise Guideline: Landfilling*

NSW EPA (1999). *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes.* May 1999.

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

Earth2Water Pty Ltd (October, 2005). *Landfill Closure Plan for the Minnamurra Waste Disposal Facility.*



## Tables

**Table 5.3: Groundwater and Surface Water Monitoring (2011 to 2012)**

| Analytes                 | Groundwater |           |            |           | Surface Water (Rocklow Creek) |           |            |           | Detection Limits | Method Reference                                |
|--------------------------|-------------|-----------|------------|-----------|-------------------------------|-----------|------------|-----------|------------------|---|
|                          | 2/11/2011   | 2/02/2012 | 30/05/2012 | 9/08/2012 | 2/11/2011                     | 2/02/2012 | 30/05/2012 | 9/08/2012 |                  |   |
| Physical Properties      |             |           |            |           |                               |           |            |           |                  |   |
| pH                       | X           | X         | X          | X         | X                             | X         | X          | X         | 0.01 pH unit     | pH meter and probe/ APHA4500-HB                 |
| Electrical Conductivity  | X           | X         | X          | X         | X                             | X         | X          | X         | 0.01 mS/cm       | Conductivity meter and probe                    |
| Dissolved Oxygen         | X           | X         | X          | X         | X                             | X         | X          | X         | 0.0001           | DO meter and probe                              |
| Redox (Orp)              |             |           |            |           |                               |           |            |           | 1 mV             | Platinum electrode probe - NA                   |
| Temperature              | X           | X         | X          | X         | X                             | X         | X          | X         | 1 °C             | Temperature meter and probe                     |
| Turbidity                |             |           |            |           |                               |           |            |           | 1 NTU            | APHA2540D                                       |
| Nutrients                |             |           |            |           |                               |           |            |           |                  |   |
| Ammonia-nitrogen         | X           | X         | X          | X         | X                             | X         | X          | X         | 0.01 mg/L        | FIA   |
| Total Nitrogen           |             |           |            |           |                               |           |            |           |                  |   |
| Total Phosphorus         |             |           |            |           |                               |           |            |           | 2 µg/L           | FIA   |
| Hydrochemical            |             |           |            |           |                               |           |            |           |                  |   |
| Calcium                  | X           | X         | X          | X         | X                             | X         | X          | X         | 0.5 mg/L         | USEPA 6010 A                                    |
| Chloride                 | X           | X         | X          | X         | X                             | X         | X          | X         | 0.5 mg/L         | diphenol-carbazone/xylylene cyanol FF indicator |
| Fluoride                 | X           | X         | X          | X         | X                             | X         | X          | X         | 0.1 mg/L         | APHA4500-FC                                     |
| Magnesium                | X           | X         | X          | X         | X                             | X         | X          | X         | 0.02 mg/L        | USEPA 6010 A                                    |
| Sulphate                 | X           | X         | X          | X         | X                             | X         | X          | X         | 1 mg/L           | ICID/MS   |
| Sodium                   | X           | X         | X          | X         | X                             | X         | X          | X         | 0.05 mg/L        | USEPA 6010 A                                    |
| Bicarbonate/Alkalinity   | X           | X         | X          | X         | X                             | X         | X          | X         | 0.5 mg/L         | APHA2340C - "Hardness done by error"            |
| Potassium                | X           | X         | X          | X         | X                             | X         | X          | X         | 0.05 mg/L        | USEPA 6010 A                                    |
| Organic Contaminants     |             |           |            |           |                               |           |            |           |                  |   |
| Dissolved Organic Carbon | X           | X         | X          | X         | X                             | X         | X          | X         | 0.50 mg/L        | APHA 5310C                                      |
| Total Organic Carbon     | X           | X         | X          | X         | X                             | X         | X          | X         | 0.1 mg/L         | APHA 5310C                                      |
| Inorganic Contaminants   |             |           |            |           |                               |           |            |           |                  |   |
| Iron                     | X           | X         | X          | X         | X                             | X         | X          | X         | 1 µg/L           | USEPA 6010 A                                    |
| Manganese                | X           | X         | X          | X         | X                             | X         | X          | X         | 1 µg/L           | USEPA 6010                                      |
|                          |             |           |            |           |                               |           |            |           |                  |   |
| Total Phenolics          | X           | X         | X          | X         | X                             | X         | X          | X         | 1 µg/L           | APHA 5530D                                      |

Table GW-1: Summary 2011/12 Analytical Results - Minnamurra Waste Disposal Depot

## Minnamurra Waste Disposal Depot

| Sample ID                         | ANZECC, 2000  |              | MD 1B     | MD 1B     | MD 1B     | MD 1B     | No. Samples | Min | Mean | Max | MD2A    | No. Samples | MD 2B   | MD 2B   | MD 2B    | MD 2B   | No. Samples | Min   | Mean  | Max   |
|-----------------------------------|---------------|--------------|-----------|-----------|-----------|-----------|-------------|-----|------|-----|---------|-------------|---------|---------|----------|---------|-------------|-------|-------|-------|
| Field Measurements                | Freshwater    | Marine       | 2/11/2011 | 2/02/12   | 30/05/12  | 9/08/12   |             |     |      |     | 9/08/12 |             | 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       |
| RL (mAHD at TOC)                  |               |              | No Access | No Access | No Access | No Access | 0           | NA  | NA   | NA  | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| Standing water level (mTOC)       |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | 0.60    | 1           | 0.70    | 0.70    | 0.72     | 0.76    | 4           | 0.70  | 0.72  | 0.76  |
| Reduced SWL (mAHD)                |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| pH (field)                        | 6.5-8.0 (a)   | 8-8.4 (a)    | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 7.5     | 7.2     | 7.0      | 7.3     | 4           | 7.0   | 7.3   | 7.5   |
| Temperature                       |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 16.8    | 18.2    | 16.4     | 14.5    | 4           | 14.5  | 16.5  | 18.2  |
| Electrical Conductivity (mS/cm)   | 0.125-2.2 (a) |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 21.70   | 19.00   | 17.10    | 16.00   | 4           | 16.00 | 18.45 | 21.70 |
| Dissolved Oxygen (mg/L)           | 8.5-11.0 (a)  | 9.0-10.0 (a) | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 2.14    | 1.95    | 2.44     | 0.80    | 4           | 0.80  | 1.83  | 2.44  |
| Turbidity (NTU)                   | 6-50 (a)      | 0.5-10 (a)   | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| <b>Laboratory Analyses (mg/L)</b> |               |              |           |           |           |           |             |     |      |     |         |             |         |         |          |         |             |       |       |       |
| Sodium (ICP)                      |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 4600    | 4430    | 4210     | 3260    | 4           | 3260  | 4125  | 4600  |
| Potassium (ICP)                   |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 204     | 202     | 204      | 170     | 4           | 170   | 195   | 204   |
| Calcium (ICP)                     |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 316     | 379     | 395      | 376     | 4           | 316   | 367   | 395   |
| Magnesium (ICP)                   |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 556     | 521     | 501      | 499     | 4           | 499   | 519   | 556   |
| Chloride                          |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 7880    | 7320    | 6890     | 6640    | 4           | 6640  | 7183  | 7880  |
| Sulphate (SO4)                    |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 1040    | 942     | 777      | 964     | 4           | 777   | 931   | 1040  |
| <b>Water Parameters (mg/L)</b>    |               |              |           |           |           |           |             |     |      |     |         |             |         |         |          |         |             |       |       |       |
| Total Suspended Solids (TSS)      |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| Alkalinity (as CaCO3)             |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 678     | 744     | 812      | 801     | 4           | 678   | 759   | 812   |
| Fluoride                          |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 0.8     | 0.7     | 0.7      | 0.7     | 4           | 0.7   | 0.7   | 0.8   |
| Phenols                           |               | 0.40         | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  |
| <b>Metals (mg/L)</b>              |               |              |           |           |           |           |             |     |      |     |         |             |         |         |          |         |             |       |       |       |
| Iron (ICP)                        | 0.3 (1)       |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 0.17    | 0.40    | 0.35     | 0.28    | 4           | 0.17  | 0.30  | 0.40  |
| Manganese (ICP)                   | 1.90          |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 0.061   | 0.071   | 0.079    | 0.067   | 4           | 0.061 | 0.070 | 0.079 |
| <b>Nutrients (mg/L)</b>           |               |              |           |           |           |           |             |     |      |     |         |             |         |         |          |         |             |       |       |       |
| Nitrate (NO3 as N)                | 0.7 (7)       |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 2.93    | 1.27    | 2.35     | 3.68    | 4           | 1.27  | 2.56  | 3.68  |
| Ammonia (NH3 as N)                | 1.88 (2)      | 2.84 (2)     | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 15.40   | 18.00   | 19.50    | 16.00   | 4           | 15.40 | 17.23 | 19.50 |
| Total Nitrogen                    | 0.5 (3)       | 0.12 (4)     | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| Dissolved Organic Carbon (DOC)    |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 39      | 34      | 39       | 36      | 4           | 34    | 37    | 39    |
| Total Organic Carbon (TOC)        |               |              | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | 35      | 37      | 38       | 37      | 4           | 35    | 37    | 38    |
| Total Phosphorus (TP)             | 0.05 (5)      | 0.025 (6)    | -         | -         | -         | -         | 0           | NA  | NA   | NA  | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |

**Notes:**

1. Trigger value is an indicative interim working level only (IIWL).
  2. Ammonia trigger value at pH = 8.0, 95% PL, corrected to pH = 7.3.
  3. Trigger value for total nitrogen for lowland rivers in SE Australia.
  4. Trigger value for oxides of nitrogen (NOx) for marine ecosystems, NSW.
  5. Trigger value for total phosphorus in lowland rivers in NSW.
  6. Trigger value for total phosphorus in marine ecosystems in NSW.
  7. Trigger value for 95% protection level
- a. Reference only, not directly applicable to groundwater.

|  |
|--|
| Unsampled well on EPL                        |
| Exceeds ANZECC (2000) marine trigger value   |
| <LOR converted to LOR for statistic purposes |

Exceedance of IIWL values or fresh water not highlighted.

Table GW-1: Summary 2011/12 Analytical Results - Minnamurra Waste Disposal Depot

| MD 2C   | MD 2C   | MD 2C    | MD 2C   | No. Samples | Min   | Mean  | Max   | MD4A | MD 4B   | MD 4B   | MD 4B    | MD 4B   | No. Samples | Min   | Mean  | Max   | MD 4C   | MD 4C   | MD 4C    | MD 4C   | No. Samples | Min   | Mean  | Max   | MD6A    | No. Samples |
|---------|---------|----------|---------|-------------|-------|-------|-------|------|---------|---------|----------|---------|-------------|-------|-------|-------|---------|---------|----------|---------|-------------|-------|-------|-------|---------|-------------|
| 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       | DRY  | 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       | 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       | 9/08/12 |             |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |      | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           |
| 0.74    | 0.77    | 0.78     | 0.83    | 4           | 0.74  | 0.78  | 0.83  |      | 1.15    | 1.15    | 1.33     | 1.22    | 4           | 1.15  | 1.21  | 1.33  | 1.18    | 1.20    | 1.17     | 1.26    | 4           | 1.17  | 1.20  | 1.26  | 1.32    | 1           |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |      | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           |
| 7.1     | 7.0     | 6.9      | 7.2     | 4           | 6.9   | 7.1   | 7.2   |      | 7.5     | 7.4     | 7.0      | 7.3     | 4           | 7.0   | 7.3   | 7.5   | 7.0     | 6.9     | 6.8      | 7.1     | 4           | 6.8   | 7.0   | 7.1   | NM      | 0           |
| 16.8    | 17.8    | 16.1     | 14.8    | 4           | 14.8  | 16.4  | 17.8  |      | 16.6    | 17.7    | 16.1     | 14.3    | 4           | 14.3  | 16.2  | 17.7  | 16.3    | 17.2    | 16.2     | 14.3    | 4           | 14.3  | 16.0  | 17.2  | NM      | 0           |
| 41.00   | 40.60   | 34.90    | 32.00   | 4           | 32.00 | 37.13 | 41.00 |      | 9.86    | 8.93    | 4.86     | 4.0     | 4           | 4.0   | 6.91  | 9.86  | 38.40   | 37.90   | 28.30    | 24.00   | 4           | 24.00 | 32.15 | 38.40 | NM      | 0           |
| 2.60    | 1.48    | 2.48     | 0.50    | 4           | 0.50  | 1.77  | 2.60  |      | 2.35    | 1.86    | 3.19     | 0.90    | 4           | 0.90  | 2.08  | 3.19  | 1.93    | 1.46    | 3.07     | 0.90    | 4           | 0.90  | 1.84  | 3.07  | NM      | 0           |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |      | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           |
| 8970    | 9250    | 9440     | 9050    | 4           | 8970  | 9178  | 9440  |      | 1290    | 1460    | 729      | 680     | 4           | 680   | 1040  | 1460  | 8420    | 8050    | 7500     | 6730    | 4           | 6730  | 7675  | 8420  | NM      | 0           |
| 344     | 366     | 383      | 367     | 4           | 344   | 365   | 383   |      | 117     | 122     | 102      | 107     | 4           | 102   | 112   | 122   | 334     | 328     | 323      | 299     | 4           | 299   | 321   | 334   | NM      | 0           |
| 425     | 429     | 459      | 425     | 4           | 425   | 435   | 459   |      | 288     | 284     | 256      | 256     | 4           | 256   | 271   | 288   | 412     | 442     | 479      | 423     | 4           | 412   | 439   | 479   | NM      | 0           |
| 996     | 1010    | 1080     | 989     | 4           | 989   | 1019  | 1080  |      | 227     | 212     | 138      | 132     | 4           | 132   | 177   | 227   | 959     | 911     | 878      | 773     | 4           | 773   | 880   | 959   | NM      | 0           |
| 14800   | 14900   | 15400    | 15200   | 4           | 14800 | 15075 | 15400 |      | 2750    | 3050    | 1290     | 1260    | 4           | 1260  | 2088  | 3050  | 13800   | 13700   | 12400    | 10800   | 4           | 10800 | 12675 | 13800 | NM      | 0           |
| 2080    | 2020    | 1800     | 2060    | 4           | 1800  | 1990  | 2080  |      | 367     | 340     | 234      | 242     | 4           | 234   | 296   | 367   | 1860    | 1840    | 1480     | 1510    | 4           | 1480  | 1673  | 1860  | NM      | 0           |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |      | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           |
| 456     | 530     | 530      | 528     | 4           | 456   | 511   | 530   |      | 738     | 748     | 982      | 808     | 4           | 738   | 819   | 982   | 663     | 786     | 843      | 871     | 4           | 663   | 791   | 871   | NM      | 0           |
| 0.7     | 0.6     | 0.6      | 0.6     | 4           | 0.6   | 0.6   | 0.7   |      | 0.6     | 0.6     | 0.5      | 0.4     | 4           | 0.4   | 0.5   | 0.6   | 0.8     | 0.7     | 0.6      | 0.6     | 4           | 0.6   | 0.7   | 0.8   | NM      | 0           |
| 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  |      | 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  | 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  | NM      | 0           |
| 1.56    | 3.33    | 0.50     | 0.16    | 4           | 0.16  | 1.39  | 3.33  |      | 0.13    | 0.22    | 0.23     | 0.22    | 4           | 0.13  | 0.20  | 0.23  | 1.90    | 1.76    | 0.50     | 0.25    | 4           | 0.25  | 1.10  | 1.90  | NM      | 0           |
| 0.182   | 0.199   | 0.164    | 0.161   | 4           | 0.161 | 0.177 | 0.199 |      | 0.06    | 0.06    | 0.08     | 0.045   | 4           | 0.045 | 0.06  | 0.08  | 0.199   | 0.204   | 0.368    | 0.243   | 4           | 0.199 | 0.254 | 0.368 | NM      | 0           |
| 0.1     | 0.33    | 1.91     | 1.91    | 4           | 0.10  | 1.06  | 1.91  |      | 3.05    | 2.85    | 3.08     | 3.92    | 4           | 2.85  | 3.23  | 3.92  | 0.04    | 0.01    | 0.75     | 1.27    | 4           | 0.01  | 0.52  | 1.27  | NM      | 0           |
| 5.15    | 5.43    | 2.74     | 0.10    | 4           | 0.10  | 3.36  | 5.43  |      | 33.40   | 29.30   | 35.40    | 36.00   | 4           | 29.30 | 33.53 | 36.00 | 3.11    | 3.48    | 3.76     | 2.37    | 4           | 2.37  | 3.18  | 3.76  | NM      | 0           |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |      | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           |
| 21      | 17      | 20       | 19      | 4           | 17    | 19    | 21    |      | 38      | 32      | 48       | 48      | 4           | 32    | 42    | 48    | 29      | 24      | 30       | 31      | 4           | 24    | 29    | 31    | NM      | 0           |
| 22      | 19      | 20       | 19      | 4           | 19    | 20    | 22    |      | 38      | 39      | 48       | 49      | 4           | 38    | 44    | 49    | 28      | 28      | 30       | 32      | 4           | 28    | 30    | 32    | NM      | 0           |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |      | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           |

**Notes:**

1. Trigger value is an indicative interim working level only (IIWL).
2. Ammonia trigger value at pH = 8.0, 95% PL, corrected to pH = 7.3.
3. Trigger value for total nitrogen for lowland rivers in SE Australia.
4. Trigger value for oxides of nitrogen (NOx) for marine ecosystems, NSW.
5. Trigger value for total phosphorus in lowland rivers in NSW.
6. Trigger value for total phosphorus in marine ecosystems in NSW.
7. Trigger value for 95% protection level
  - a. Reference only, not directly applicable to groundwater.



Table GW-1: Summary 2011/12 Analytical Results - Minnamurra Waste Disposal Depot

| MD 6B   | MD 6B   | MD 6B    | MD 6B   | No. Samples | Min   | Mean  | Max   | MD 6C   | MD 6C   | MD 6C    | MD 6C   | No. Samples | Min   | Mean  | Max   | MD9A    | No. Samples | MD 9B   | MD 9B   | MD 9B    | MD 9B   | No. Samples | Min   | Mean  | Max   |
|---------|---------|----------|---------|-------------|-------|-------|-------|---------|---------|----------|---------|-------------|-------|-------|-------|---------|-------------|---------|---------|----------|---------|-------------|-------|-------|-------|
| 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       | 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       | 9/08/12 |             | 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 1.26    | 1.29    | 1.30     | 1.33    | 4           | 1.26  | 1.30  | 1.33  | 1.39    | 1.38    | 1.40     | 1.48    | 4           | 1.38  | 1.41  | 1.48  | 0.75    | 1           | 0.93    | 0.83    | 0.85     | 0.88    | 4           | 0.83  | 0.87  | 0.93  |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 7.0     | 6.9     | 6.8      | 6.9     | 4           | 6.8   | 6.9   | 7.0   | 7.3     | 7.0     | 6.8      | 7.1     | 4           | 6.8   | 7.1   | 7.3   | NM      | 0           | 7.3     | 6.9     | 6.9      | 7.0     | 4           | 6.9   | 7.0   | 7.3   |
| 17.4    | 18.5    | 17.1     | 15.6    | 4           | 15.6  | 17.2  | 18.5  | 17.6    | 18.3    | 18.2     | 16.8    | 4           | 16.8  | 17.7  | 18.3  | NM      | 0           | 17.5    | 19.1    | 16.8     | 14.4    | 4           | 14.4  | 17.0  | 19.1  |
| 2.31    | 1.96    | 1.54     | 2.0     | 4           | 1.54  | 1.95  | 2.31  | 29.50   | 28.60   | 22.70    | 21.00   | 4           | 21.00 | 25.45 | 29.50 | NM      | 0           | 2.88    | 2.66    | 2.19     | 2.0     | 4           | 2.0   | 2.43  | 2.88  |
| 2.47    | 2.03    | 2.12     | 0.80    | 4           | 0.80  | 1.86  | 2.47  | 2.52    | 1.84    | 2.25     | 0.70    | 4           | 0.70  | 1.83  | 2.52  | NM      | 0           | 1.94    | 1.74    | 2.98     | 0.90    | 4           | 0.90  | 1.89  | 2.98  |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 124     | 104     | 114      | 120     | 4           | 104   | 116   | 124   | 6380    | 5930    | 5960     | 4720    | 4           | 4720  | 5748  | 6380  | NM      | 0           | 226     | 265     | 217      | 232     | 4           | 217   | 235   | 265   |
| 48      | 49      | 50       | 47      | 4           | 47    | 49    | 50    | 220     | 207     | 211      | 172     | 4           | 172   | 203   | 220   | NM      | 0           | 73      | 77      | 73       | 80      | 4           | 73    | 76    | 80    |
| 216     | 175     | 170      | 203     | 4           | 170   | 191   | 216   | 399     | 402     | 443      | 363     | 4           | 363   | 402   | 443   | NM      | 0           | 146     | 135     | 138      | 156     | 4           | 135   | 144   | 156   |
| 97      | 69      | 64       | 72      | 4           | 64    | 76    | 97    | 728     | 695     | 682      | 550     | 4           | 550   | 664   | 728   | NM      | 0           | 96      | 78      | 72       | 83      | 4           | 72    | 82    | 96    |
| 277     | 203     | 171      | 238     | 4           | 171   | 222   | 277   | 10700   | 9660    | 9520     | 8800    | 4           | 8800  | 9670  | 10700 | NM      | 0           | 357     | 335     | 275      | 287     | 4           | 275   | 314   | 357   |
| 128     | 101     | 145      | 191     | 4           | 101   | 141   | 191   | 1450    | 1420    | 1000     | 1280    | 4           | 1000  | 1288  | 1450  | NM      | 0           | 36      | 42      | 66       | 82      | 4           | 36    | 57    | 82    |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 746     | 717     | 701      | 750     | 4           | 701   | 729   | 750   | 361     | 405     | 437      | 416     | 4           | 361   | 405   | 437   | NM      | 0           | 921     | 933     | 1010     | 893     | 4           | 893   | 939   | 1010  |
| 0.3     | 0.4     | 0.4      | 0.4     | 4           | 0.3   | 0.4   | 0.4   | 0.5     | 0.4     | 0.4      | 0.4     | 4           | 0.4   | 0.4   | 0.5   | NM      | 0           | 0.6     | 0.7     | 0.7      | 0.6     | 4           | 0.6   | 0.7   | 0.7   |
| 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  | 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  | NM      | 0           | 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  |
| 0.38    | 0.26    | 0.16     | 0.17    | 4           | 0.16  | 0.24  | 0.38  | 0.05    | 7.25    | 0.50     | 0.05    | 4           | 0.05  | 1.96  | 7.25  | NM      | 0           | 3.76    | 7.23    | 0.45     | 0.43    | 4           | 0.43  | 2.97  | 7.23  |
| 0.201   | 0.194   | 0.162    | 0.191   | 4           | 0.162 | 0.187 | 0.201 | 0.089   | 0.107   | 0.085    | 0.071   | 4           | 0.071 | 0.088 | 0.107 | NM      | 0           | 0.222   | 0.248   | 0.136    | 0.175   | 4           | 0.136 | 0.195 | 0.248 |
| 0.01    | 0.19    | 0.22     | 0.5     | 4           | 0.01  | 0.23  | 0.50  | 0.08    | 0.34    | 0.05     | 0.42    | 4           | 0.05  | 0.22  | 0.42  | NM      | 0           | 0.07    | 0.61    | 0.62     | 0.63    | 4           | 0.07  | 0.48  | 0.63  |
| 12.10   | 30.30   | 19.40    | 17.20   | 4           | 12.10 | 19.75 | 30.30 | 43.20   | 40.80   | 30.80    | 39.00   | 4           | 30.80 | 38.45 | 43.20 | NM      | 0           | 45.70   | 28.40   | 37.30    | 31.50   | 4           | 28.40 | 35.73 | 45.70 |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 36      | 28      | 35       | 34      | 4           | 28    | 33    | 36    | 14      | 9       | 13       | 13      | 4           | 9     | 12    | 14    | NM      | 0           | 54      | 40      | 41       | 36      | 4           | 36    | 43    | 54    |
| 32      | 32      | 34       | 33      | 4           | 32    | 33    | 34    | 13      | 11      | 13       | 14      | 4           | 11    | 13    | 14    | NM      | 0           | 48      | 40      | 39       | 37      | 4           | 37    | 41    | 48    |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |

**Notes:**

1. Trigger value is an indicative interim working level only (IIWL).
  2. Ammonia trigger value at pH = 8.0, 95% PL, corrected to pH = 7.3.
  3. Trigger value for total nitrogen for lowland rivers in SE Australia.
  4. Trigger value for oxides of nitrogen (NOx) for marine ecosystems, NSW.
  5. Trigger value for total phosphorus in lowland rivers in NSW.
  6. Trigger value for total phosphorus in marine ecosystems in NSW.
  7. Trigger value for 95% protection level
- a. Reference only, not directly applicable to groundwater.

Table GW-1: Summary 2011/12 Analytical Results - Minnamurra Waste Disposal Depot

| MD 9C   | MD 9C   | MD 9C    | MD 9C   | No. Samples | Min   | Mean  | Max    | MD10A   | No. Samples | MD 10B  | MD 10B  | MD 10B   | MD 10B  | No. Samples | Min   | Mean  | Max   |
|---------|---------|----------|---------|-------------|-------|-------|--------|---------|-------------|---------|---------|----------|---------|-------------|-------|-------|-------|
| 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |        | 9/08/12 |             | 2/11/11 | 2/02/12 | 30/05/12 | 9/08/12 |             |       |       |       |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA     | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 0.95    | 0.90    | 0.89     | 0.97    | 4           | 0.89  | 0.93  | 0.97   | 0.62    | 1           | 0.65    | 0.78    | 0.64     | 0.64    | 4           | 0.64  | 0.68  | 0.78  |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA     | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 7.0     | 7.1     | 6.8      | 6.9     | 4           | 6.8   | 7.0   | 7.1    | NM      | 0           | 7.6     | 7.5     | 7.4      | 7.3     | 4           | 7.3   | 7.5   | 7.6   |
| 18.1    | 19.8    | 17.7     | 14.8    | 4           | 14.8  | 17.6  | 19.8   | NM      | 0           | 18.6    | 21.2    | 17.4     | 15.3    | 4           | 15.3  | 18.1  | 21.2  |
| 5.90    | 4.53    | 3.46     | 3.0     | 4           | 3.0   | 4.22  | 5.90   | NM      | 0           | 2.53    | 2.44    | 2.05     | 2.0     | 4           | 2.0   | 2.26  | 2.53  |
| 1.20    | 1.69    | 3.79     | 1.00    | 4           | 1.00  | 1.92  | 3.79   | NM      | 0           | 1.45    | 1.19    | 3.21     | 0.90    | 4           | 0.90  | 1.69  | 3.21  |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA     | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 555     | 473     | 354      | 286     | 4           | 286   | 417   | 555    | NM      | 0           | 141     | 167     | 150      | 136     | 4           | 136   | 149   | 167   |
| 153     | 154     | 131      | 113     | 4           | 113   | 138   | 154    | NM      | 0           | 85      | 91      | 86       | 85      | 4           | 85    | 87    | 91    |
| 235     | 212     | 218      | 200     | 4           | 200   | 216   | 235    | NM      | 0           | 121     | 128     | 120      | 113     | 4           | 113   | 121   | 128   |
| 124     | 105     | 107      | 97      | 4           | 97    | 108   | 124    | NM      | 0           | 67      | 55      | 51       | 50      | 4           | 50    | 56    | 67    |
| 1040    | 863     | 655      | 683     | 4           | 655   | 810   | 1040   | NM      | 0           | 267     | 275     | 236      | 258     | 4           | 236   | 259   | 275   |
| 10      | 10      | 10       | 10      | 4           | 10    | 10    | 10     | NM      | 0           | 36      | 47      | 44       | 75      | 4           | 36    | 51    | 75    |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA     | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 1300    | 1370    | 1350     | 1170    | 4           | 1170  | 1298  | 1370   | NM      | 0           | 758     | 850     | 842      | 814     | 4           | 758   | 816   | 850   |
| 0.3     | 0.5     | 0.3      | 0.3     | 4           | 0.3   | 0.4   | 0.5    | NM      | 0           | 0.9     | 0.9     | 0.8      | 0.9     | 4           | 0.8   | 0.9   | 0.9   |
| 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05   | NM      | 0           | 0.05    | 0.05    | 0.05     | 0.05    | 4           | 0.05  | 0.05  | 0.05  |
| 4.08    | 5.48    | 0.85     | 1.77    | 4           | 0.85  | 3.05  | 5.48   | NM      | 0           | 0.26    | 0.06    | 0.08     | 0.13    | 4           | 0.06  | 0.13  | 0.26  |
| 0.518   | 0.512   | 0.644    | 0.727   | 4           | 0.512 | 0.600 | 0.727  | NM      | 0           | 0.186   | 0.196   | 0.189    | 0.214   | 4           | 0.186 | 0.196 | 0.214 |
| 0.20    | 8.17    | 0.10     | 0.17    | 4           | 0.10  | 2.16  | 8.17   | NM      | 0           | 0.01    | 0.26    | 0.01     | 0.07    | 4           | 0.01  | 0.09  | 0.26  |
| 67.70   | 101.00  | 78.50    | 82.80   | 4           | 67.70 | 82.50 | 101.00 | NM      | 0           | 54.20   | 71.60   | 51.80    | 72.80   | 4           | 51.80 | 62.60 | 72.80 |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA     | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |
| 147     | 99      | 94       | 97      | 4           | 94    | 109   | 147    | NM      | 0           | 56      | 45      | 51       | 51      | 4           | 45    | 51    | 56    |
| 158     | 100     | 94       | 93      | 4           | 93    | 111   | 158    | NM      | 0           | 57      | 42      | 50       | 51      | 4           | 42    | 50    | 57    |
| NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA     | NM      | 0           | NM      | NM      | NM       | NM      | 0           | NA    | NA    | NA    |

**Notes:**

1. Trigger value is an indicative interim working level only (IIWL).
2. Ammonia trigger value at pH = 8.0, 95% PL, corrected to pH = 7.3.
3. Trigger value for total nitrogen for lowland rivers in SE Australia.
4. Trigger value for oxides of nitrogen (NOx) for marine ecosystems, NSW.
5. Trigger value for total phosphorus in lowland rivers in NSW.
6. Trigger value for total phosphorus in marine ecosystems in NSW.
7. Trigger value for 95% protection level
  - a. Reference only, not directly applicable to groundwater.

Table SW-1: Summary Analytical Report - Surface Water (2011-12)

Table SW-1 Minnamurra Waste Disposal Depot (Rocklow Creek)

| Sample ID  | ANZECC, 2000 |           | Rocklow Up | Rocklow Mid | Rocklow Down | Rocklow Up | Rocklow Mid | Rocklow Down | Rocklow Up | Rocklow Mid | Rocklow Down | Rocklow Up | Rocklow Mid | Rocklow Down |
|--|--------------|-----------|------------|-------------|--------------|------------|-------------|--------------|------------|-------------|--------------|------------|-------------|--------------|
| Field Measurements                                     | Freshwater   | Marine    | 2/11/11    | 2/11/11     | 2/11/11      | 2/02/12    | 2/02/12     | 2/02/12      | 30/05/12   | 30/05/12    | 30/05/12     | 9/08/12    | 9/08/12     | 9/08/12      |
| pH (field)   | 6.5-8.0      | 8-8.4     | 7.5        | 7.4         | No Access    | 7.7        | 7.4         | No Access    | 6.9        | 6.8         | No Access    | 7.3        | 6.9         | No Access    |
| Temperature  |              |           | 18.3       | 18.4        | -            | 19.2       | 18.4        | -            | 10.9       | 12.5        | -            | 11.5       | 12.3        | -            |
| Electrical Conductivity (mS/cm)                        | 0.125-2.2    |           | 0.917      | 7.38        | -            | 12.00      | 22.70       | -            | 2.23       | 17.60       | -            | 0.005      | 0.018       | -            |
| Dissolved Oxygen (mg/L)                                | 8.5-11.0     | 9.0-10.0  | 7.10       | 6.52        | -            | 6.54       | 5.39        | -            | 13.60      | 7.77        | -            | 4.80       | 2.20        | -            |
| Turbidity (NTU)  | 6-50 (a)     | 0.5-10    | NM         | NM          | -            | NM         | NM          | -            | NM         | NM          | -            | NM         | NM          | -            |
| Laboratory Analyses (mg/L)                             |              |           |            |             |              |            |             |              |            |             |              |            |             |              |
| Sodium (ICP)   |              |           | 112        | 1310        | -            | 2340       | 4850        | -            | 500        | 4800        | -            | 1110       | 3080        | -            |
| Potassium (ICP)  |              |           | 5          | 51          | -            | 96         | 196         | -            | 20         | 180         | -            | 43         | 127         | -            |
| Calcium (ICP)  |              |           | 29         | 71          | -            | 126        | 214         | -            | 48         | 190         | -            | 78         | 154         | -            |
| Magnesium (ICP)  |              |           | 20         | 144         | -            | 270        | 550         | -            | 61         | 508         | -            | 141        | 407         | -            |
| Chloride   |              |           | 196        | 2140        | -            | 3870       | 7780        | -            | 812        | 6020        | -            | 2060       | 6710        | -            |
| Sulphate (SO4)   |              |           | 37         | 315         | -            | 451        | 1010        | -            | 153        | 681         | -            | 312        | 874         | -            |
| Water Parameters (mg/L)                                |              |           |            |             |              |            |             |              |            |             |              |            |             |              |
| Hardness (as CaCO3)                                    |              |           | 108        | 144         | -            | 171        | 196         | -            | 130        | 178         | -            | 144        | 194         | -            |
| Fluoride   |              |           | 0.1        | 0.4         | -            | 0.5        | 0.8         | -            | 0.2        | 0.7         | -            | 0.3        | 0.7         | -            |
| Phenols  |              | 0.40      | 0.05       | 0.05        | -            | 0.05       | 0.05        | -            | 0.05       | 0.05        | -            | 0.05       | 0.05        | -            |
| Metals (mg/L)  |              |           |            |             |              |            |             |              |            |             |              |            |             |              |
| Iron (ICP)   | 0.3 (1)      |           | 0.3        | 0.31        | -            | 0.33       | 0.90        | -            | 0.55       | 0.5         | -            | 1.12       | 0.36        | -            |
| Manganese (ICP)  | 1.90         |           | 0.113      | 0.135       | -            | 0.541      | 0.921       | -            | 0.163      | 0.116       | -            | 0.245      | 0.152       | -            |
| Nutrients (mg/L)                                       |              |           |            |             |              |            |             |              |            |             |              |            |             |              |
| Total Phosphorus (TP)                                  | 0.05 (5)     | 0.025 (6) | NM         | NM          | -            | NM         | NM          | -            | NM         | NM          | -            | NM         | NM          | -            |
| Total Nitrogen   | 0.5 (3)      | 0.12 (4)  | NM         | NM          | -            | NM         | NM          | -            | NM         | NM          | -            | NM         | NM          | -            |
| Nitrate (NO3 as N)                                     | 0.7 (7)      |           | 0.01       | 0.08        | -            | 0.02       | 0.01        | -            | 0.01       | 0.13        | -            | 0.14       | 0.26        | -            |
| Ammonia (NH3 as N)                                     | 1.88 (2)     | 2.84 (2)  | 0.03       | 0.31        | -            | 0.14       | 0.58        | -            | 0.01       | 1.06        | -            | 0.04       | 1.91        | -            |
| Ammonia Increment (from Upper to Lower Rocklow Creek)  |              |           | -          | -           | NA           | -          | -           | NA           | -          | -           | NA           | -          | -           | NA           |
| Ammonia Increment (from Upper to Middle Rocklow Creek) |              |           | -          | 0.28        | -            | -          | 0.44        | -            | -          | 1.06        | -            | -          | 1.87        | -            |
| Dissolved Organic Carbon (DOC)                         |              |           | 10         | 11          | -            | 10         | 8           | -            | 9          | 8           | -            | 9          | 9           | -            |
| Total Organic Carbon (TOC)                             |              |           | 10         | 12          |              | 9          | 9           | -            | 9          | 8           | -            | 9          | 9           | -            |

Notes:

1. Trigger value is an indicative interim working level only (IIWL).
2. Ammonia trigger value at pH = 8.0, 95% PL, corrected to pH = 7.3.
3. Trigger value for total nitrogen for lowland rivers in SE Australia.
4. Trigger value for oxides of nitrogen (NOx) for marine ecosystems, NSW.

5. Trigger value for total phosphorus in lowland rivers in NSW.
6. Trigger value for total phosphorus in marine ecosystems in NSW.
7. Trigger value for 95% protection level
- NM=NOT Measured, NA=Not Available

Exceeds ANZECC (2000) marine trigger value

<LOR converted to LOR for statistic purposes

Exceedance of IIWL values or fresh water not highlighted except for ammonia level.

Ammonia exceeds ANZECC (2000) freshwater trigger value

Table SW-2: Rocklow Creek - Historical Ammonia Concentrations (mg/L) (1999 - 2012)

Table SW-2: Rocklow Creek - Historical Ammonia Concentrations (mg/L) (1999 - 2012)

| Sample ID             | 6/05/1999 | 17/08/1999 | 2/12/2000 | 28/02/2000 | 11/05/2000 | 10/08/2000 | 21/11/2000 | 15/02/2001 | 17/05/2001 | 16/08/2001 | 13/11/2001 | 22/02/2002 | 8/04/2002 | 19/08/2002 | 14/11/2002 | 11/02/2003 | 12/06/2003 | 22/08/2003 | 20/11/2003 | 17/02/2004 | 12/05/2004 | 11/08/2004 | 7/12/2004 | 2/02/2005 | 4/05/2005 | 16/08/2005 |
|-----------------------|-----------|------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|-----------|------------|
| Upper Rocklow (mg/L)  | 0.16      | <0.02      | 0.10      | 0.16       | 0.03       | 0.06       | 0.04       | 0.10       | 0.22       | 0.35       | 0.18       | 0.10       | 0.07      | 0.13       | 0.06       | 0.01       | 0.11       | 0.14       | 0.03       | 0.17       | 0.28       | 0.03       | 0.22      | <0.02     | <0.02     | 0.06       |
| Middle Rocklow (mg/L) |           |            |           |            |            |            |            |            |            |            |            |            |           |            |            |            |            |            |            |            |            |            |           |           |           |            |
| Lower Rocklow (mg/L)  | 1.00      | 0.65       | 2.07      | 1.74       | 0.57       | 1.34       | 0.26       | 0.56       | 0.69       | 0.42       | 0.24       | 0.64       | 1.11      | 2.00       | 1.60       | 0.51       | 0.13       | 1.40       | 1.70       | 0.38       | 0.55       | 0.65       | 0.92      | <0.02     | 0.31      | 1.40       |
| Net Increment (mg/L)  | 0.84      | 0.64       | 1.97      | 1.58       | 0.54       | 1.28       | 0.22       | 0.46       | 0.47       | 0.07       | 0.06       | 0.54       | 1.04      | 1.87       | 1.54       | 0.50       | 0.02       | 1.26       | 1.67       | 0.21       | 0.27       | 0.62       | 0.70      | NA        | 0.30      | 1.34       |

| Sample ID             | 9/1/2005 | 28/02/2006 | 30/05/2006 | 30/08/2006 | 27/11/2006 | 26/02/2007 | 22/05/2007 | 21/08/2007 | 20/11/2007 | 21/02/2008 | 28/05/2008 | 26/08/2008 | 25/11/2008 | 16/02/2009 | 18/05/2009 | 28/08/2009 | 27/11/2009 | 26/02/2010 | 20/05/2010 | 17/08/2010 | 29/11/2010 | 25/02/2011 | 23/05/2011 | 23/08/2011 | 2/11/2011 | 2/02/2012 | 30/05/2012 | 9/08/2012 |
|-----------------------|----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|------------|-----------|
| Upper Rocklow (mg/L)  | <0.02    | <0.02      | 0.22       | 0.09       | 0.39       | 0.66       | 0.41       | 0.32       | 0.39       | <0.1       | 0.27       | 0.12       | <0.1       | 0.56       | 0.12       | 0.15       | 0.10       | 0.20       | <0.1       | 0.05       | 0.30       | <0.1       | 0.01       | 0.05       | 0.03      | 0.14      | <0.01      | 0.04      |
| Middle Rocklow (mg/L) |          |            |            |            |            |            |            |            |            |            |            |            |            | 0.56       | 0.61       | 0.38       | 0.80       | <0.1       | <0.1       | 0.27       | 0.33       | 5.65       | 0.56       | 0.20       | 0.31      | 0.58      | 1.06       | 1.91      |
| Lower Rocklow (mg/L)  | <0.02    | <0.02      | 0.64       | 0.90       | 1.20       | 0.32       | 0.62       | 0.48       | 1.60       | NM         | 1.60       | 1.20       | 0.16       | 0.66       | 0.30       | 0.21       | 0.60       | <0.1       | <0.1       | 0.42       | NM         | NM         | NM         | NM         | NM        | NM        | NM         | NM        |
| Net Increment (mg/L)  | NA       | NA         | 0.42       | 0.81       | 0.81       | (0.34)     | 0.21       | 0.16       | 1.21       | NA         | 1.33       | 1.08       | NA         | 0.10       | 0.18       | 0.06       | 0.50       | NA         | NA         | 0.37       | 0.03       | 5.55       | 0.55       | 0.15       | 0.28      | 0.44      | 1.06       | 1.87      |

**Legend**

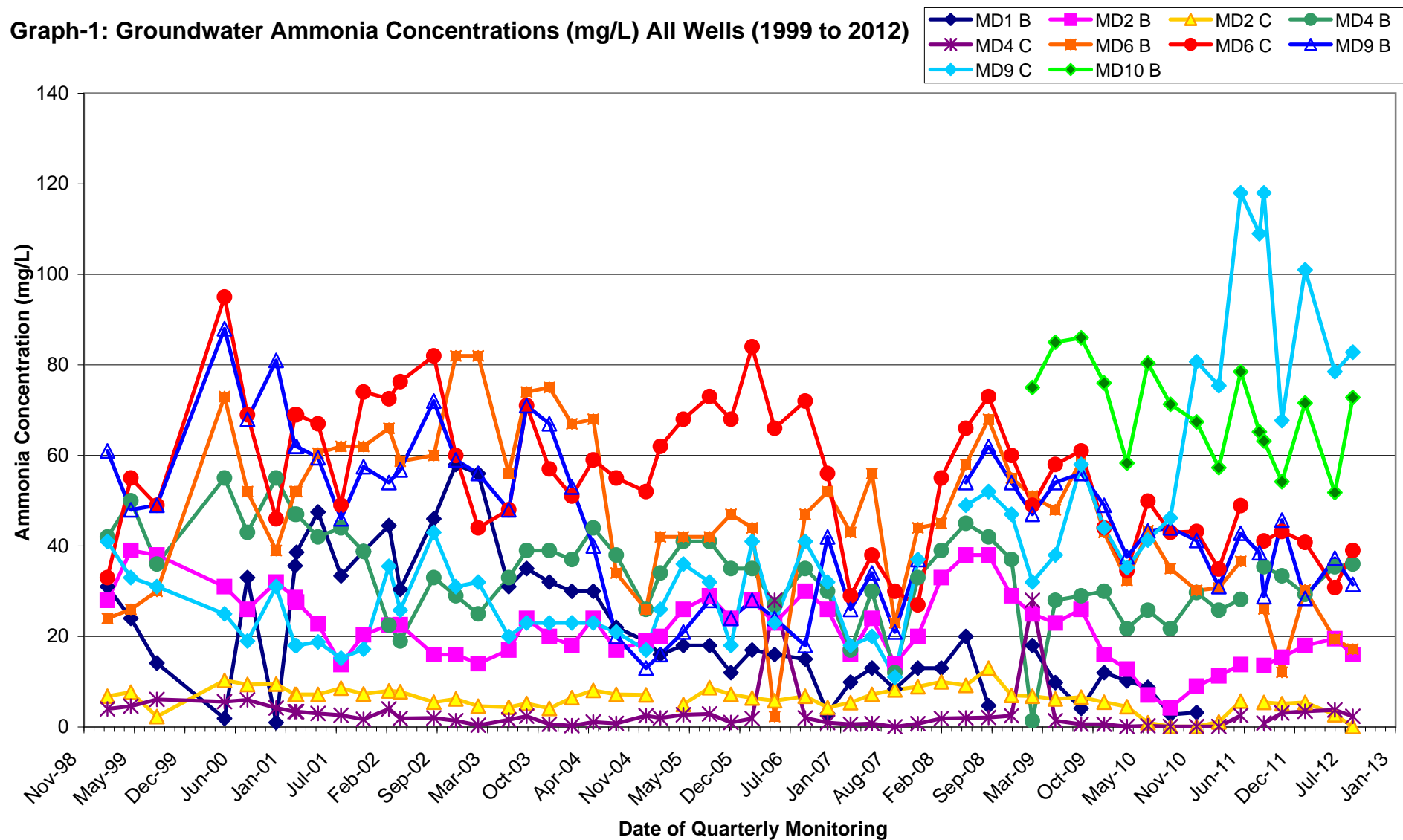
NA = Not Analysed

Note: Rocklow Down was inaccessible during the 2010-2012 monitoring periods

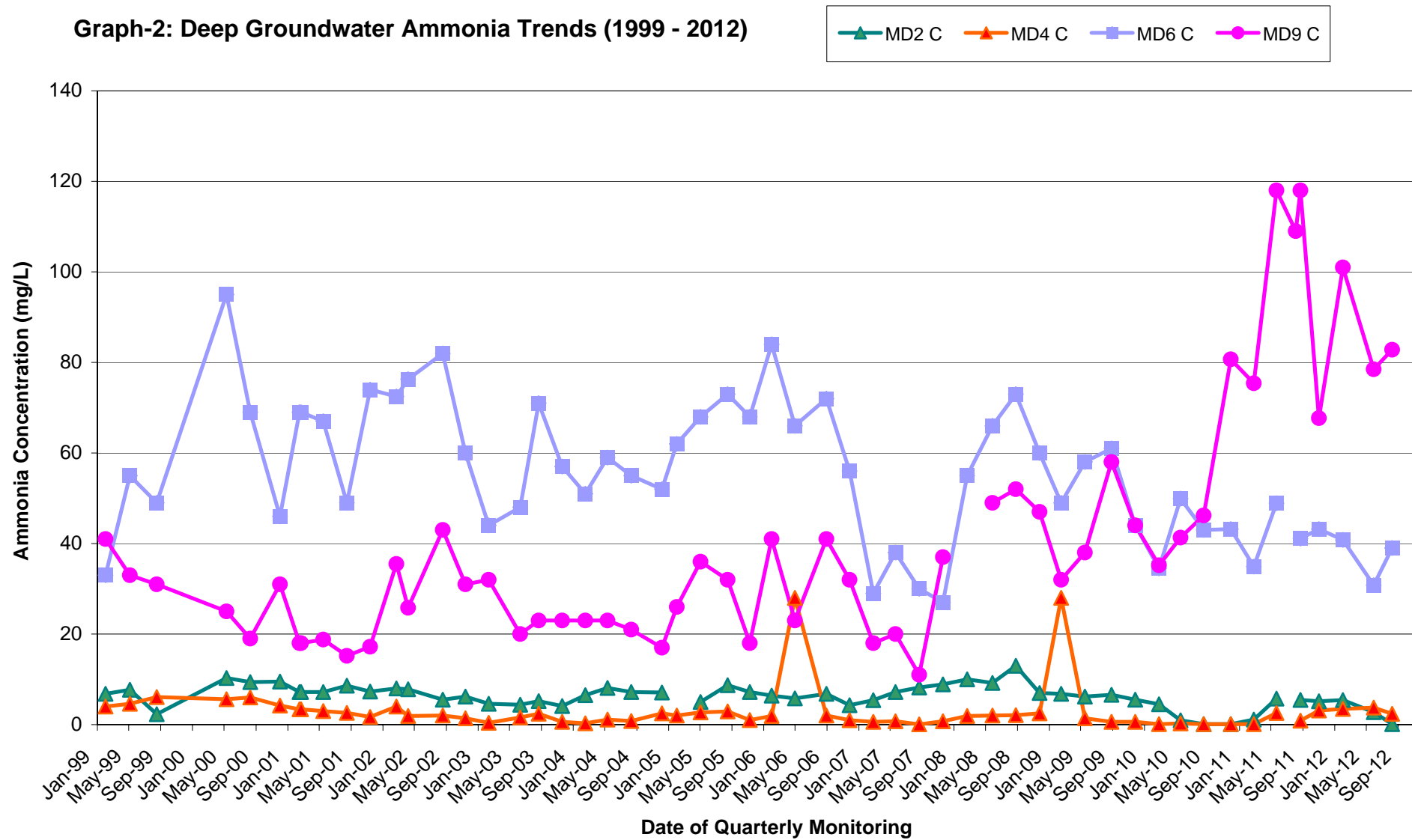


## Graphs

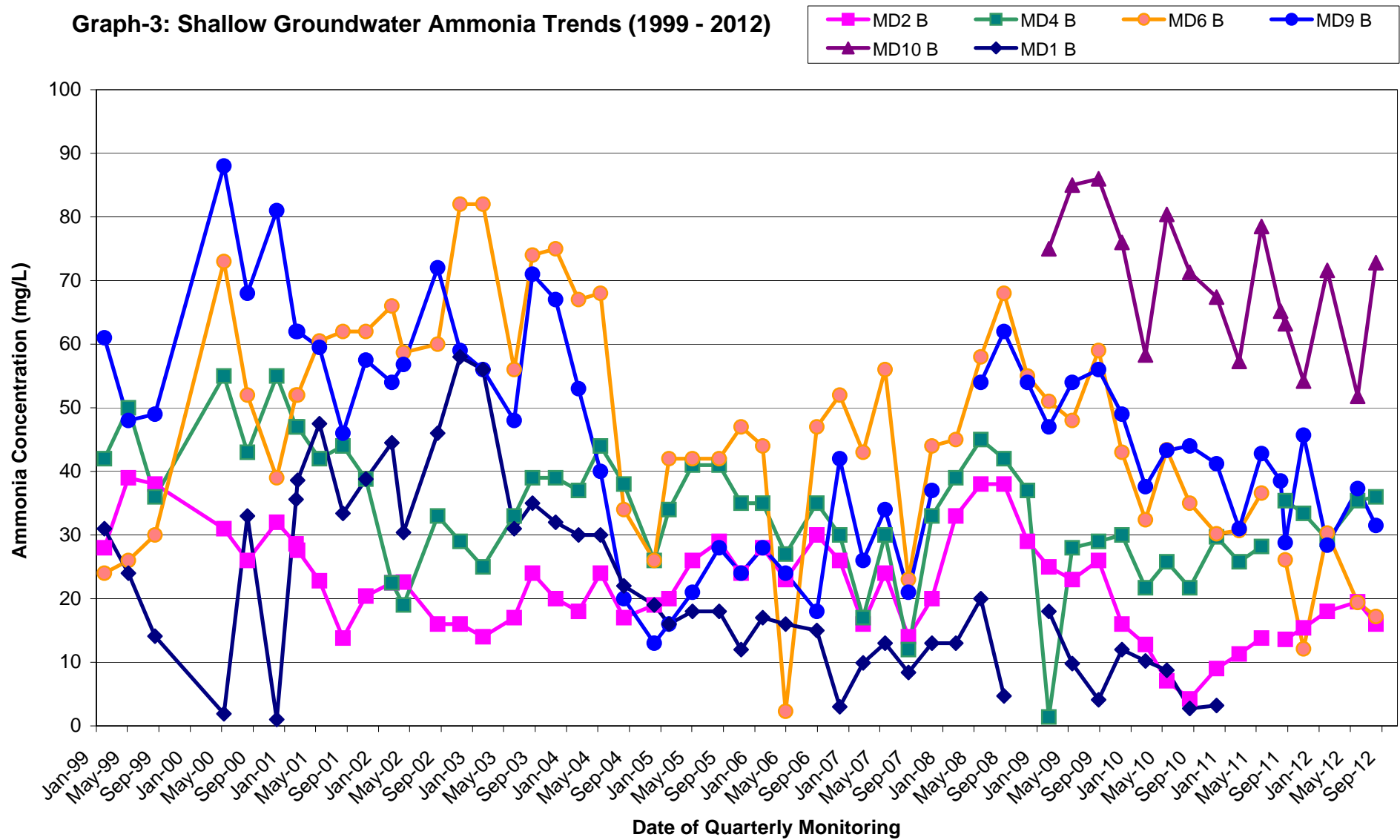
**Graph-1: Groundwater Ammonia Concentrations (mg/L) All Wells (1999 to 2012)**



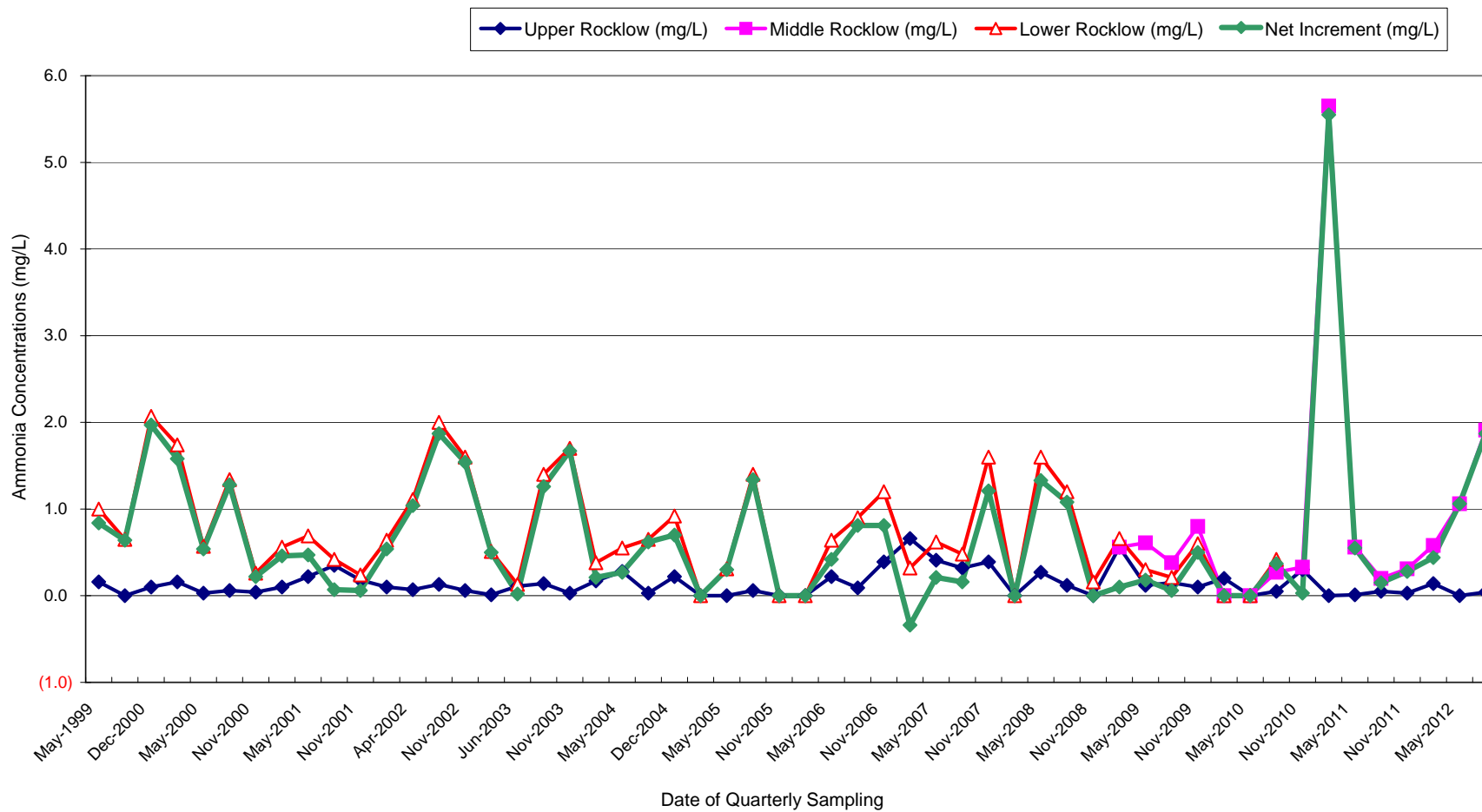
**Graph-2: Deep Groundwater Ammonia Trends (1999 - 2012)**



**Graph-3: Shallow Groundwater Ammonia Trends (1999 - 2012)**

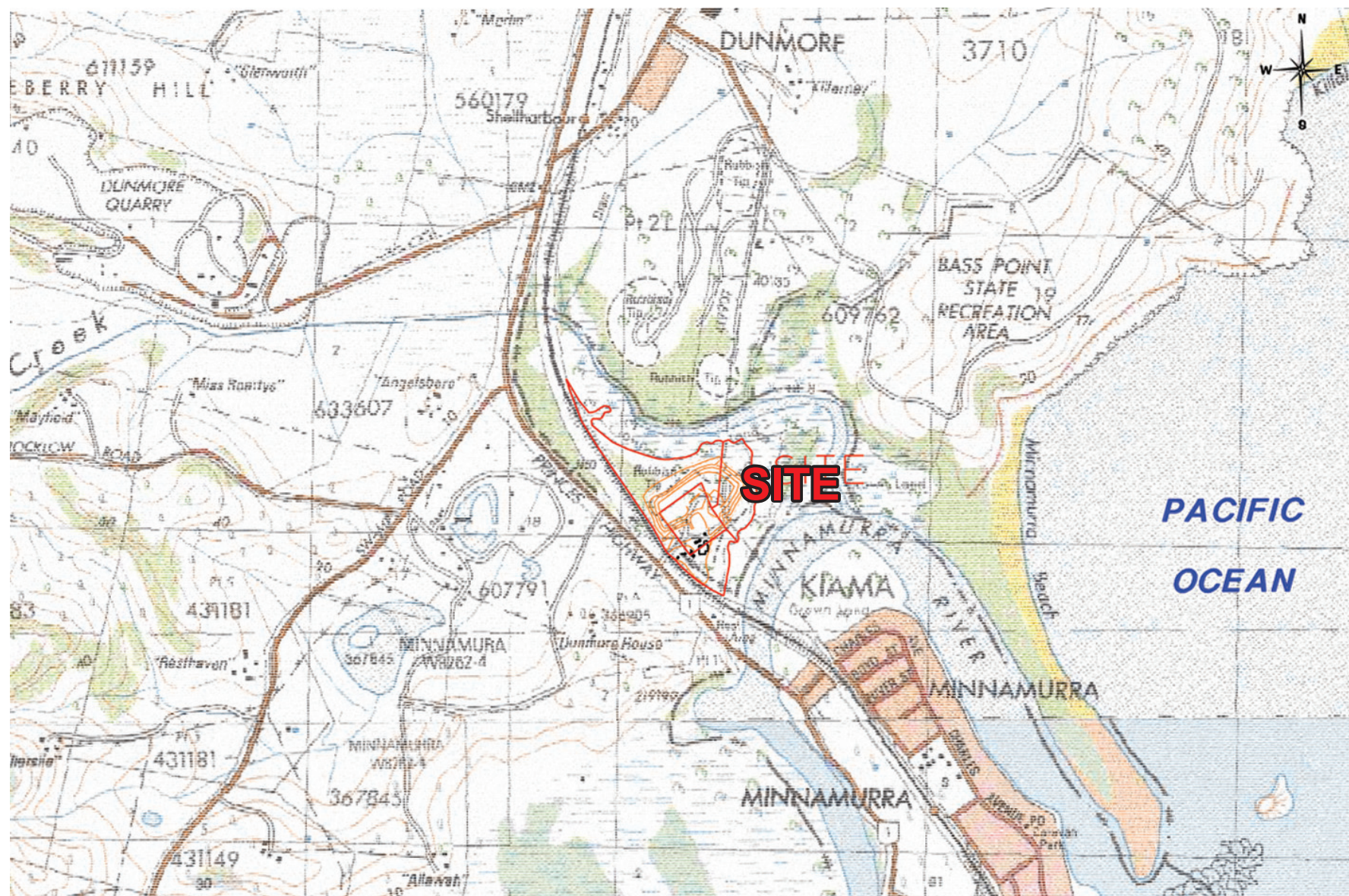


**Graph-04: Net Increments of Ammonia Between Up and Down Stream Samples (1999 to 2012)**











## Figures

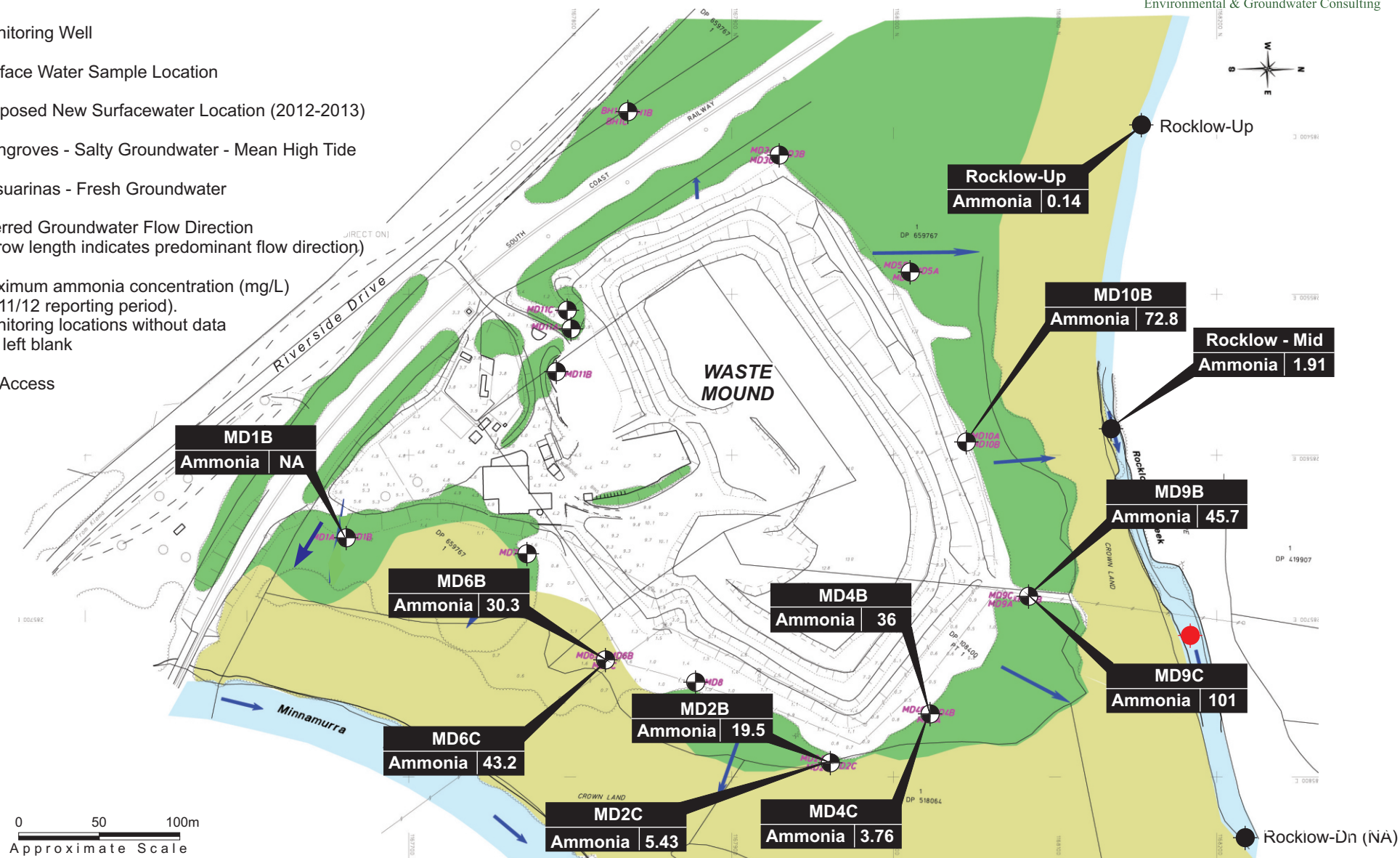


**SITE LOCATION**



# LEGEND

-  Monitoring Well
-  Surface Water Sample Location
-  Proposed New Surfacewater Location (2012-2013)
-  Mangroves - Salty Groundwater - Mean High Tide
-  Casuarinas - Fresh Groundwater
-  Inferred Groundwater Flow Direction  
(Arrow length indicates predominant flow direction)
- 3.2** Maximum ammonia concentration (mg/L)  
(2011/12 reporting period).  
Monitoring locations without data  
are left blank
- NA** No Access



Source: Neil Charters Pty Ltd

Date: 7 November 2012

Reference: E2W\_059\_04.cdr

## MONITORING WELL LOCATIONS AND MAXIMUM AMMONIA CONCENTRATIONS

KIAMA COUNCIL - MINNAMURRA ANNUAL MONITORING REPORT (2011-2012)

Figure 2

## Appendix A



## Environmental Division

### CERTIFICATE OF ANALYSIS

|                     |  |                                |  |
|---------------------|--|--------------------------------|--|
| <b>Work Order</b>   | <b>: EW1103264</b>                                       | <b>Page</b>                    | <b>: 1 of 10</b>   |
| <b>Client</b>       | <b>: KIAMA COUNCIL</b>                                   | <b>Laboratory</b>              | <b>: Environmental Division NSW South Coast</b>  |
| <b>Contact</b>      | <b>: MS JULIE MILEVSKI</b>                               | <b>Contact</b>                 | <b>: Glenn Davies</b>  |
| <b>Address</b>      | <b>: 11 MANNING STREET<br/>KIAMA NSW, AUSTRALIA 2533</b> | <b>Address</b>                 | <b>: 99 Kenny Street, Wollongong 2500<br/>Unit 4 / 13 Geary Place, PO Box 3105, North Nowra 2541<br/>AUSTRALIA</b> |
| <b>E-mail</b>       | <b>: juliem@kiama.nsw.gov.au</b>                         | <b>E-mail</b>                  | <b>: glenn.davies@alsglobal.com</b>  |
| <b>Telephone</b>    | <b>: +61 02 4232 0444</b>                                | <b>Telephone</b>               | <b>: 02 4225 3125</b>  |
| <b>Facsimile</b>    | <b>: +61 02 4232 0555</b>                                | <b>Facsimile</b>               | <b>: 02 4225 3128</b>  |
| <b>Project</b>      | <b>: Minnamurra Landfill</b>                             | <b>QC Level</b>                | <b>: NEPM 1999 Schedule B(3) and ALS QCS3 requirement</b>  |
| <b>Order number</b> | <b>: ----</b>  | <b>Date Samples Received</b>   | <b>: 02-NOV-2011</b>   |
| <b>C-O-C number</b> | <b>: ----</b>  | <b>Issue Date</b>              | <b>: 10-NOV-2011</b>   |
| <b>Sampler</b>      | <b>: Craig Wilson</b>                                    | <b>No. of samples received</b> | <b>: 19</b>  |
| <b>Site</b>         | <b>: ----</b>  | <b>No. of samples analysed</b> | <b>: 19</b>  |
| <b>Quote number</b> | <b>: Minnamurra Landfill SY/146/10</b>                   |                                |  |

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



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

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.

| <i>Signatories</i> | <i>Position</i>                       | <i>Accreditation Category</i> |
|--------------------|---------------------------------------|-------------------------------|
| Ankit Joshi        | Inorganic Chemist                     | Sydney Inorganics             |
| Celine Conceicao   | Senior Spectroscopist                 | Sydney Inorganics             |
| Evie.Sidarta       | Inorganic Chemist                     | Sydney Inorganics             |
| Glenn Davies       | Environmental Services Representative | Laboratory - Wollongong       |
| Sarah Millington   | Senior Inorganic Chemist              | Sydney Inorganics             |





## 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

- **ED041G: LOR raised for SO4 analysis on sample ID:MD 9C due to sample matrix.**
- **EG020: Particular sample(s) were diluted and reanalysed due to matrix interference(s) caused by high salinity. LORs have been raised accordingly.**
- **EP002: It has been noted that DOC is greater than TOC for various samples, however, these differences are within the limits of experimental variation.**
- **Sites MD2A, MD4A, MD6A, MD9A and MD10A - Dry at time of sampling.**



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |              | MD 1B             | MD 2A             | MD 2B             | MD 2C             | MD 4A             |
|--|-------------|-------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |              | 02-NOV-2011 07:45 | 02-NOV-2011 08:35 | 02-NOV-2011 08:30 | 02-NOV-2011 08:45 | 02-NOV-2011 09:00 |
| Compound   | CAS Number  | LOR   | Unit         | EW1103264-001     | EW1103264-002     | EW1103264-003     | EW1103264-004     | EW1103264-005     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |              |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L         | ----              | ----              | <1                | <1                | ----              |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L         | ----              | ----              | <1                | <1                | ----              |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L         | ----              | ----              | 678               | 456               | ----              |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L         | ----              | ----              | 678               | 456               | ----              |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |              |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L         | ----              | ----              | 1040              | 2080              | ----              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |              |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L         | ----              | ----              | 7880              | 14800             | ----              |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |              |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L         | ----              | ----              | 316               | 425               | ----              |
| Magnesium  | 7439-95-4   | 1     | mg/L         | ----              | ----              | 556               | 996               | ----              |
| Sodium   | 7440-23-5   | 1     | mg/L         | ----              | ----              | 4600              | 8970              | ----              |
| Potassium  | 7440-09-7   | 1     | mg/L         | ----              | ----              | 204               | 344               | ----              |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |              |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L         | ----              | ----              | 0.061             | 0.182             | ----              |
| Iron   | 7439-89-6   | 0.05  | mg/L         | ----              | ----              | 0.17              | 1.56              | ----              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |              |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L         | ----              | ----              | 0.8               | 0.7               | ----              |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |              |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L         | ----              | ----              | 15.4              | 5.15              | ----              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |              |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L         | ----              | ----              | <0.01             | <0.01             | ----              |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |              |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L         | ----              | ----              | 2.93              | 0.10              | ----              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |              |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L         | ----              | ----              | 2.93              | 0.10              | ----              |
| <b>EN055: Ionic Balance</b>  |             |       |              |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L        | ----              | ----              | 257               | 470               | ----              |
| Total Cations  | ----        | 0.01  | meq/L        | ----              | ----              | 267               | 502               | ----              |
| Ionic Balance  | ----        | 0.01  | %            | ----              | ----              | 1.77              | 3.30              | ----              |
| <b>EN67 PK: Field Tests</b>  |             |       |              |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit      | ----              | ----              | 7.5               | 7.1               | ----              |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm        | ----              | ----              | 21700             | 41000             | ----              |
| Dissolved Oxygen   | ----        | 0.01  | mg/L         | ----              | ----              | 2.14              | 2.60              | ----              |
| Dissolved Oxygen - % Saturation  | ----        | 0.1   | % saturation | ----              | ----              | 22.5              | 27.3              | ----              |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |      | MD 1B             | MD 2A               | MD 2B             | MD 2C             | MD 4A               |
|--|------------|------|------|-------------------|---------------------|-------------------|-------------------|---------------------|
|  |            |      |      | 02-NOV-2011 07:45 | 02-NOV-2011 08:35   | 02-NOV-2011 08:30 | 02-NOV-2011 08:45 | 02-NOV-2011 09:00   |
| Compound   | CAS Number | LOR  | Unit | EW1103264-001     | EW1103264-002       | EW1103264-003     | EW1103264-004     | EW1103264-005       |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |      |                   |                     |                   |                   |                     |
| Temperature                                      | ----       | 0.1  | °C   | ----              | ----                | 16.8              | 16.8              | ----                |
| Salinity   | ----       | 0.2  | g/L  | ----              | ----                | 15.8              | 31.8              | ----                |
| Depth  | ----       | 0.01 | m    | ----              | ----                | 0.70              | 0.74              | ----                |
| Field Observations                               | ----       | 0.01 | --   | NO ACCESS         | INSUFFICIENT SAMPLE | ----              | ----              | INSUFFICIENT SAMPLE |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |      |                   |                     |                   |                   |                     |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L | ----              | ----                | 39                | 21                | ----                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |      |                   |                     |                   |                   |                     |
| Total Organic Carbon                             | ----       | 1    | mg/L | ----              | ----                | 35                | 22                | ----                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |      |                   |                     |                   |                   |                     |
| Phenols (Total)                                  | ----       | 0.05 | mg/L | ----              | ----                | <0.05             | <0.05             | ----                |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |              | MD 4B             | MD 4C             | MD 6A             | MD 6B             | MD 6C             |
|--|-------------|-------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |              | 02-NOV-2011 08:55 | 02-NOV-2011 09:10 | 02-NOV-2011 08:05 | 02-NOV-2011 08:00 | 02-NOV-2011 08:15 |
| Compound   | CAS Number  | LOR   | Unit         | EW1103264-006     | EW1103264-007     | EW1103264-008     | EW1103264-009     | EW1103264-010     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |              |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L         | <1                | <1                | ----              | <1                | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L         | <1                | <1                | ----              | <1                | <1                |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L         | 738               | 663               | ----              | 746               | 361               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L         | 738               | 663               | ----              | 746               | 361               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |              |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L         | 367               | 1860              | ----              | 128               | 1450              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |              |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L         | 2750              | 13800             | ----              | 277               | 10700             |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |              |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L         | 288               | 412               | ----              | 216               | 399               |
| Magnesium  | 7439-95-4   | 1     | mg/L         | 227               | 959               | ----              | 97                | 728               |
| Sodium   | 7440-23-5   | 1     | mg/L         | 1290              | 8420              | ----              | 124               | 6380              |
| Potassium  | 7440-09-7   | 1     | mg/L         | 117               | 334               | ----              | 48                | 220               |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |              |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L         | 0.060             | 0.199             | ----              | 0.201             | 0.089             |
| Iron   | 7439-89-6   | 0.05  | mg/L         | 0.13              | 1.90              | ----              | 0.38              | <0.05             |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |              |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L         | 0.6               | 0.8               | ----              | 0.3               | 0.5               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |              |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L         | 33.4              | 3.11              | ----              | 12.1              | 43.2              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |              |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L         | <0.01             | <0.01             | ----              | <0.01             | <0.01             |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |              |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L         | 3.05              | 0.04              | ----              | <0.01             | 0.08              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |              |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L         | 3.05              | 0.04              | ----              | <0.01             | 0.08              |
| <b>EN055: Ionic Balance</b>  |             |       |              |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L        | 100               | 441               | ----              | 25.4              | 339               |
| Total Cations  | ----        | 0.01  | meq/L        | 92.2              | 474               | ----              | 25.4              | 363               |
| Ionic Balance  | ----        | 0.01  | %            | 4.06              | 3.59              | ----              | 0.01              | 3.37              |
| <b>EN67 PK: Field Tests</b>  |             |       |              |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit      | 7.5               | 7.0               | ----              | 7.0               | 7.3               |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm        | 9860              | 38400             | ----              | 2310              | 29500             |
| Dissolved Oxygen   | ----        | 0.01  | mg/L         | 2.35              | 1.93              | ----              | 2.47              | 2.52              |
| Dissolved Oxygen - % Saturation  | ----        | 0.1   | % saturation | 24.5              | 20.1              | ----              | 26.2              | 26.9              |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |      | MD 4B             | MD 4C             | MD 6A               | MD 6B             | MD 6C             |
|--|------------|------|------|-------------------|-------------------|---------------------|-------------------|-------------------|
|  |            |      |      | 02-NOV-2011 08:55 | 02-NOV-2011 09:10 | 02-NOV-2011 08:05   | 02-NOV-2011 08:00 | 02-NOV-2011 08:15 |
| Compound   | CAS Number | LOR  | Unit | EW1103264-006     | EW1103264-007     | EW1103264-008       | EW1103264-009     | EW1103264-010     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |      |                   |                   |                     |                   |                   |
| Temperature                                      | ----       | 0.1  | °C   | 16.6              | 16.3              | ----                | 17.4              | 17.6              |
| Salinity   | ----       | 0.2  | g/L  | 6.7               | 29.9              | ----                | <2.0              | 21.6              |
| Depth  | ----       | 0.01 | m    | 1.15              | 1.18              | ----                | 1.26              | 1.39              |
| Field Observations                               | ----       | 0.01 | --   | ----              | ----              | INSUFFICIENT SAMPLE | ----              | ----              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |      |                   |                   |                     |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L | 38                | 29                | ----                | 36                | 14                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |      |                   |                   |                     |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L | 38                | 28                | ----                | 32                | 13                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |      |                   |                   |                     |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L | <0.05             | <0.05             | ----                | <0.05             | <0.05             |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 9A             | MD 9B             | MD 9C             | MD 10A            | MD 10B            |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 02-NOV-2011 10:05 | 02-NOV-2011 10:00 | 02-NOV-2011 10:15 | 02-NOV-2011 09:40 | 02-NOV-2011 09:45 |
| Compound   | CAS Number  | LOR   | Unit    | EW1103264-011     | EW1103264-012     | EW1103264-013     | EW1103264-014     | EW1103264-015     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | <1                | <1                | ----              | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | <1                | <1                | ----              | <1                |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | 921               | 1300              | ----              | 758               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | 921               | 1300              | ----              | 758               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | 36                | <10               | ----              | 36                |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | 357               | 1040              | ----              | 267               |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | 146               | 235               | ----              | 121               |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | 96                | 124               | ----              | 67                |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | 226               | 555               | ----              | 141               |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | 73                | 153               | ----              | 85                |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | 0.222             | 0.518             | ----              | 0.186             |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | 3.76              | 4.08              | ----              | 0.26              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | 0.6               | 0.3               | ----              | 0.9               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | 45.7              | 67.7              | ----              | 54.2              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | <0.01             | 0.02              | ----              | <0.01             |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | 0.07              | 0.20              | ----              | 0.01              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | 0.07              | 0.22              | ----              | 0.01              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | 29.2              | 55.3              | ----              | 23.4              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | 26.9              | ----              | ----              | ----              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | ----              | 54.8              | ----              | 23.7              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | 4.17              | ----              | ----              | ----              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | ----              | 0.42              | ----              | 0.64              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | ----              | 7.3               | 7.0               | ----              | 7.6               |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | ----              | 2880              | 5900              | ----              | 2530              |





## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 9A               | MD 9B             | MD 9C             | MD 10A              | MD 10B            |
|--|------------|------|--------------|---------------------|-------------------|-------------------|---------------------|-------------------|
|  |            |      |              | 02-NOV-2011 10:05   | 02-NOV-2011 10:00 | 02-NOV-2011 10:15 | 02-NOV-2011 09:40   | 02-NOV-2011 09:45 |
| Compound   | CAS Number | LOR  | Unit         | EW1103264-011       | EW1103264-012     | EW1103264-013     | EW1103264-014       | EW1103264-015     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                     |                   |                   |                     |                   |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | ----                | 1.94              | 1.20              | ----                | 1.45              |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----                | 20.6              | 13.0              | ----                | 15.9              |
| Temperature                                      | ----       | 0.1  | °C           | ----                | 17.5              | 18.1              | ----                | 18.6              |
| Salinity   | ----       | 0.2  | g/L          | ----                | <2.0              | 3.7               | ----                | <2.0              |
| Depth  | ----       | 0.01 | m            | ----                | 0.93              | 0.95              | ----                | 0.65              |
| Field Observations                               | ----       | 0.01 | --           | INSUFFICIENT SAMPLE | ----              | ----              | INSUFFICIENT SAMPLE | ----              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                     |                   |                   |                     |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----                | 54                | 147               | ----                | 56                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                     |                   |                   |                     |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----                | 48                | 158               | ----                | 57                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                     |                   |                   |                     |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----                | <0.05             | <0.05             | ----                | <0.05             |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             |      |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|------|
|  |             |       |         | 02-NOV-2011 09:55 | 02-NOV-2011 09:30 | 02-NOV-2011 07:25 | 02-NOV-2011 07:00 | ---- |
| Compound   | CAS Number  | LOR   | Unit    | EW1103264-016     | EW1103264-017     | EW1103264-018     | EW1103264-019     | ---- |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |      |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | <1                | <1                | ----              | ---- |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | <1                | <1                | ----              | ---- |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | 144               | 108               | ----              | ---- |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | 144               | 108               | ----              | ---- |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |      |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | 315               | 37                | ----              | ---- |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |      |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | 2140              | 196               | ----              | ---- |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | ----              | ----              | <1                | ---- |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | ----              | ----              | <1                | ---- |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | ----              | ----              | <1                | ---- |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | ----              | ----              | <1                | ---- |
| <b>ED093T: Total Major Cations</b>   |             |       |         |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | 71                | 29                | ----              | ---- |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | 144               | 20                | ----              | ---- |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | 1310              | 112               | ----              | ---- |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | 51                | 5                 | ----              | ---- |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | ----              | ----              | <0.001            | ---- |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | ----              | ----              | <0.05             | ---- |
| <b>EG020T: Total Metals by ICP-MS</b>  |             |       |         |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | 0.135             | 0.113             | ----              | ---- |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | 0.31              | 0.30              | ----              | ---- |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |      |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | 0.4               | 0.1               | ----              | ---- |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |      |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | 0.31              | 0.03              | ----              | ---- |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |      |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | <0.01             | <0.01             | ----              | ---- |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |      |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | 0.08              | <0.01             | ----              | ---- |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |      |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | 0.08              | <0.01             | ----              | ---- |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |      |
| pH   | ----        | 0.1   | pH Unit | ----              | 7.4               | 7.5               | ----              | ---- |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             |      |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|------|
|  |            |      |              | 02-NOV-2011 09:55 | 02-NOV-2011 09:30 | 02-NOV-2011 07:25 | 02-NOV-2011 07:00 | ---- |
| Compound   | CAS Number | LOR  | Unit         | EW1103264-016     | EW1103264-017     | EW1103264-018     | EW1103264-019     | ---- |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |      |
| Electrical Conductivity (Non Compensated)        | ----       | 1    | µS/cm        | ----              | 7380              | 917               | ----              | ---- |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | ----              | 6.52              | 7.10              | ----              | ---- |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | 70.3              | 76.7              | ----              | ---- |
| Temperature                                      | ----       | 0.1  | °C           | ----              | 18.4              | 18.3              | ----              | ---- |
| Salinity   | ----       | 0.2  | g/L          | ----              | 4.7               | <2.0              | ----              | ---- |
| Field Observations                               | ----       | 0.01 | --           | NO ACCESS         | ----              | ----              | ----              | ---- |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |      |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | 11                | 10                | <1                | ---- |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |      |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | 12                | 10                | ----              | ---- |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |      |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | <0.05             | <0.05             | ----              | ---- |

## CERTIFICATE OF ANALYSIS

|              |  |                         |   |
|--------------|--|-------------------------|---|
| Work Order   | : <b>EW1200284</b>                               | Page                    | : 1 of 10   |
| Client       | : <b>KIAMA COUNCIL</b>                           | Laboratory              | : Environmental Division NSW South Coast  |
| Contact      | : MS JULIE MILEVSKI                              | Contact                 | : Glenn Davies  |
| Address      | : 11 MANNING STREET<br>KIAMA NSW, AUSTRALIA 2533 | Address                 | : 99 Kenny Street, Wollongong 2500<br>Unit 4 / 13 Geary Place, PO Box 3105, North Nowra 2541<br>AUSTRALIA |
| E-mail       | : juliem@kiama.nsw.gov.au                        | E-mail                  | : glenn.davies@alsglobal.com  |
| Telephone    | : +61 02 4232 0444                               | Telephone               | : 02 4225 3125  |
| Facsimile    | : +61 02 4232 0555                               | Facsimile               | : 02 4225 3128  |
| Project      | : Minnamurra Landfill                            | QC Level                | : NEPM 1999 Schedule B(3) and ALS QCS3 requirement  |
| Order number | : ----   | Date Samples Received   | : 02-FEB-2012   |
| C-O-C number | : ----   | Issue Date              | : 14-FEB-2012   |
| Sampler      | : Craig Wilson                                   | No. of samples received | : 19  |
| Site         | : ----   | No. of samples analysed | : 19  |
| Quote number | : Minnamurra Landfill WL/083/11                  |                         |   |

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



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       |
| Celine Conceicao | Senior Spectroscopist                 | Sydney Inorganics       |
| Glenn Davies     | Environmental Services Representative | Laboratory - Wollongong |
| Raymond Commodor | Instrument Chemist                    | Sydney Inorganics       |
| Sarah Millington | Senior Inorganic Chemist              | Sydney Inorganics       |

Address 99 Kenny Street, Wollongong 2500

Environmental Division NSW South Coast, Geary Place 3105, North Nowra 2541A Campbell Brothers Limited Company



## 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

- **ED041G: LOR raised for SO4 analysis on sample ID: MD 9C due to sample matrix**
- **EG020: LCS recoveries for particular element(s) fall outside ALS Dynamic control limit, however, they are within the acceptance criteria based on ALS DQO. No further action is required.**
- **EG020: Some samples were diluted and rerun due to matrix interference and LOR's have been raised accordingly. (High sample salinity)**
- **Sites MD 1B & Rocklow Down - No Access (overgrown)**  
Sites MD 2A, MD 4A, MD 6A, MD 9A & MD 10A - Dry at time of sampling.
- **Sites MD2A, MD4A, MD6A, MD9A and MD10A - Dry at time of sampling.**



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 1B             | MD 2A             | MD 2B             | MD 2C             | MD 4A             |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 02-FEB-2012 10:35 | 02-FEB-2012 08:45 | 02-FEB-2012 08:40 | 02-FEB-2012 08:50 | 02-FEB-2012 09:10 |
| Compound   | CAS Number  | LOR   | Unit    | EW1200284-001     | EW1200284-002     | EW1200284-003     | EW1200284-004     | EW1200284-005     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | ----              | <1                | <1                | ----              |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | ----              | 18                | <1                | ----              |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | ----              | 726               | 530               | ----              |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | ----              | 744               | 530               | ----              |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | ----              | 942               | 2020              | ----              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | ----              | 7320              | 14900             | ----              |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | ----              | 379               | 429               | ----              |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | ----              | 521               | 1010              | ----              |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | ----              | 4430              | 9250              | ----              |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | ----              | 202               | 366               | ----              |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | ----              | 0.071             | 0.199             | ----              |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | ----              | 0.40              | 3.33              | ----              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | ----              | 0.7               | 0.6               | ----              |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | ----              | 18.0              | 5.43              | ----              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | ----              | 0.06              | <0.01             | ----              |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | ----              | 1.27              | 0.33              | ----              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | ----              | 1.33              | 0.33              | ----              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | ----              | 241               | 473               | ----              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | ----              | 260               | 516               | ----              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | ----              | 3.72              | 4.36              | ----              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | ----              | ----              | 7.2               | 7.0               | ----              |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | ----              | ----              | 19000             | 40600             | ----              |
| Dissolved Oxygen   | ----        | 0.01  | mg/L    | ----              | ----              | 1.95              | 1.48              | ----              |





## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 1B             | MD 2A             | MD 2B             | MD 2C             | MD 4A             |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 02-FEB-2012 10:35 | 02-FEB-2012 08:45 | 02-FEB-2012 08:40 | 02-FEB-2012 08:50 | 02-FEB-2012 09:10 |
| Compound   | CAS Number | LOR  | Unit         | EW1200284-001     | EW1200284-002     | EW1200284-003     | EW1200284-004     | EW1200284-005     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | ----              | 21.2              | 16.1              | ----              |
| Temperature                                      | ----       | 0.1  | °C           | ----              | ----              | 18.2              | 17.8              | ----              |
| Salinity   | ----       | 0.2  | g/L          | ----              | ----              | 13.2              | 30.7              | ----              |
| Depth  | ----       | 0.01 | m            | ----              | ----              | 0.70              | 0.77              | ----              |
| Field Observations                               | ----       | 0.01 | --           | NO ACCESS         | DRY               | ----              | ----              | DRY               |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | ----              | 34                | 17                | ----              |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | ----              | 37                | 19                | ----              |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | ----              | <0.05             | <0.05             | ----              |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 4B             | MD 4C             | MD 6A             | MD 6B             | MD 6C             |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 02-FEB-2012 09:05 | 08-FEB-2012 09:15 | 02-FEB-2012 08:20 | 02-FEB-2012 08:15 | 02-FEB-2012 08:25 |
| Compound   | CAS Number  | LOR   | Unit    | EW1200284-006     | EW1200284-007     | EW1200284-008     | EW1200284-009     | EW1200284-010     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | <1                | <1                | ----              | <1                | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | <1                | <1                | ----              | <1                | <1                |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | 748               | 786               | ----              | 717               | 405               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | 748               | 786               | ----              | 717               | 405               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | 340               | 1840              | ----              | 101               | 1420              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | 3050              | 13700             | ----              | 203               | 9660              |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | 284               | 442               | ----              | 175               | 402               |
| Magnesium  | 7439-95-4   | 1     | mg/L    | 212               | 911               | ----              | 69                | 695               |
| Sodium   | 7440-23-5   | 1     | mg/L    | 1460              | 8050              | ----              | 104               | 5930              |
| Potassium  | 7440-09-7   | 1     | mg/L    | 122               | 328               | ----              | 49                | 207               |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | 0.060             | 0.204             | ----              | 0.194             | 0.107             |
| Iron   | 7439-89-6   | 0.05  | mg/L    | 0.22              | 1.76              | ----              | 0.26              | 7.25              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | 0.6               | 0.7               | ----              | 0.4               | 0.4               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | 29.3              | 3.48              | ----              | 30.3              | 40.8              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | 0.07              | <0.01             | ----              | 0.04              | 0.18              |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | 2.85              | <0.01             | ----              | 0.19              | 0.34              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | 2.92              | <0.01             | ----              | 0.23              | 0.52              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | 108               | 440               | ----              | 22.2              | 310               |
| Total Cations  | ----        | 0.01  | meq/L   | 98.2              | 456               | ----              | 20.2              | 340               |
| Ionic Balance  | ----        | 0.01  | %       | 4.76              | 1.67              | ----              | 4.63              | 4.65              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | 7.4               | 6.9               | ----              | 6.9               | 7.0               |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | 8930              | 37900             | ----              | 1960              | 28600             |
| Dissolved Oxygen   | ----        | 0.01  | mg/L    | 1.86              | 1.46              | ----              | 2.03              | 1.84              |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 4B             | MD 4C             | MD 6A             | MD 6B             | MD 6C             |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 02-FEB-2012 09:05 | 08-FEB-2012 09:15 | 02-FEB-2012 08:20 | 02-FEB-2012 08:15 | 02-FEB-2012 08:25 |
| Compound   | CAS Number | LOR  | Unit         | EW1200284-006     | EW1200284-007     | EW1200284-008     | EW1200284-009     | EW1200284-010     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | 19.9              | 15.5              | ----              | 22.0              | 19.9              |
| Temperature                                      | ----       | 0.1  | °C           | 17.7              | 17.2              | ----              | 18.5              | 18.3              |
| Salinity   | ----       | 0.2  | g/L          | 5.9               | 28.8              | ----              | <2.0              | 20.6              |
| Depth  | ----       | 0.01 | m            | 1.15              | 1.20              | ----              | 1.29              | 1.38              |
| Field Observations                               | ----       | 0.01 | --           | ----              | ----              | DRY               | ----              | ----              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | 32                | 24                | ----              | 28                | 9                 |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | 39                | 28                | ----              | 32                | 11                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | <0.05             | <0.05             | ----              | <0.05             | <0.05             |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 9A             | MD 9B             | MD 9C             | MD 10A            | MD 10B            |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 02-FEB-2012 10:15 | 02-FEB-2012 10:10 | 02-FEB-2012 10:20 | 02-FEB-2012 09:55 | 02-FEB-2012 09:50 |
| Compound   | CAS Number  | LOR   | Unit    | EW1200284-011     | EW1200284-012     | EW1200284-013     | EW1200284-014     | EW1200284-015     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | <1                | <1                | ----              | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | <1                | <1                | ----              | 7                 |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | 933               | 1370              | ----              | 844               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | 933               | 1370              | ----              | 850               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | 42                | <10               | ----              | 47                |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | 335               | 863               | ----              | 275               |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | 135               | 212               | ----              | 128               |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | 78                | 105               | ----              | 55                |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | 265               | 473               | ----              | 167               |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | 77                | 154               | ----              | 91                |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | 0.248             | 0.512             | ----              | 0.196             |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | 7.23              | 5.48              | ----              | 0.06              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | 0.7               | 0.5               | ----              | 0.9               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | 28.4              | 101               | ----              | 71.6              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | 0.06              | 0.04              | ----              | <0.01             |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | 0.61              | 8.17              | ----              | 0.26              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | 0.67              | 8.21              | ----              | 0.26              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | 29.0              | 51.7              | ----              | 25.7              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | 26.6              | 51.0              | ----              | 25.6              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | 4.17              | 0.78              | ----              | 0.23              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | ----              | 6.9               | 7.1               | ----              | 7.5               |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | ----              | 2660              | 4530              | ----              | 2440              |
| Dissolved Oxygen   | ----        | 0.01  | mg/L    | ----              | 1.74              | 1.69              | ----              | 1.19              |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 9A             | MD 9B             | MD 9C             | MD 10A            | MD 10B            |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 02-FEB-2012 10:15 | 02-FEB-2012 10:10 | 02-FEB-2012 10:20 | 02-FEB-2012 09:55 | 02-FEB-2012 09:50 |
| Compound   | CAS Number | LOR  | Unit         | EW1200284-011     | EW1200284-012     | EW1200284-013     | EW1200284-014     | EW1200284-015     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | 19.1              | 18.8              | ----              | 13.5              |
| Temperature                                      | ----       | 0.1  | °C           | ----              | 19.1              | 19.8              | ----              | 21.2              |
| Salinity   | ----       | 0.2  | g/L          | ----              | <2.0              | 2.7               | ----              | <2.0              |
| Depth  | ----       | 0.01 | m            | ----              | 0.83              | 0.90              | ----              | 0.78              |
| Field Observations                               | ----       | 0.01 | --           | DRY               | ----              | ----              | DRY               | ----              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | 40                | 99                | ----              | 45                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | 40                | 100               | ----              | 42                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | <0.05             | <0.05             | ----              | <0.05             |

|  |             |       |      |                             |                   |                   |                   |                   |      |
|--|-------------|-------|------|-----------------------------|-------------------|-------------------|-------------------|-------------------|------|
| Sub-Matrix: WATER  |             |       |      | Client sample ID            | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             | ---- |
|  |             |       |      | Client sampling date / time | 02-FEB-2012 10:05 | 02-FEB-2012 09:40 | 02-FEB-2012 07:55 | 02-FEB-2012 08:05 | ---- |
| Compound   | CAS Number  | LOR   | Unit | EW1200284-016               | EW1200284-017     | EW1200284-018     | EW1200284-019     | ----              |      |
| 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 | ----                        | <1                | <1                | ----              | ----              |      |
| Bicarbonate Alkalinity as CaCO3                              | 71-52-3     | 1     | mg/L | ----                        | 196               | 171               | ----              | ----              |      |
| Total Alkalinity as CaCO3                                    | ----        | 1     | mg/L | ----                        | 196               | 171               | ----              | ----              |      |
| ED041G: Sulfate (Turbidimetric) as SO4 2- by DA              |             |       |      |                             |                   |                   |                   |                   |      |
| Sulfate as SO4 - Turbidimetric                               | 14808-79-8  | 1     | mg/L | ----                        | 1010              | 451               | ----              | ----              |      |
| ED045G: Chloride Discrete analyser                           |             |       |      |                             |                   |                   |                   |                   |      |
| Chloride   | 16887-00-6  | 1     | mg/L | ----                        | 7780              | 3870              | ----              | ----              |      |
| ED093F: Dissolved Major Cations                              |             |       |      |                             |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Magnesium  | 7439-95-4   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Sodium   | 7440-23-5   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Potassium  | 7440-09-7   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| ED093T: Total Major Cations                                  |             |       |      |                             |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L | ----                        | 214               | 126               | ----              | ----              |      |
| Magnesium  | 7439-95-4   | 1     | mg/L | ----                        | 550               | 270               | ----              | ----              |      |
| Sodium   | 7440-23-5   | 1     | mg/L | ----                        | 4850              | 2340              | ----              | ----              |      |
| Potassium  | 7440-09-7   | 1     | mg/L | ----                        | 196               | 96                | ----              | ----              |      |
| EG020F: Dissolved Metals by ICP-MS                           |             |       |      |                             |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L | ----                        | ----              | ----              | <0.001            | ----              |      |
| Iron   | 7439-89-6   | 0.05  | mg/L | ----                        | ----              | ----              | <0.05             | ----              |      |
| EG020T: Total Metals by ICP-MS                               |             |       |      |                             |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L | ----                        | 0.921             | 0.541             | ----              | ----              |      |
| Iron   | 7439-89-6   | 0.05  | mg/L | ----                        | 0.90              | 0.33              | ----              | ----              |      |
| EK040P: Fluoride by PC Titrator                              |             |       |      |                             |                   |                   |                   |                   |      |
| Fluoride   | 16984-48-8  | 0.1   | mg/L | ----                        | 0.8               | 0.5               | ----              | ----              |      |
| EK055G: Ammonia as N by Discrete Analyser                    |             |       |      |                             |                   |                   |                   |                   |      |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L | ----                        | 0.58              | 0.14              | ----              | ----              |      |
| 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              | 0.02              | ----              | ----              |      |
| EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser |             |       |      |                             |                   |                   |                   |                   |      |
| Nitrite + Nitrate as N                                       | ----        | 0.01  | mg/L | ----                        | 0.01              | 0.02              | ----              | ----              |      |
| EN67 PK: Field Tests   |             |       |      |                             |                   |                   |                   |                   |      |





## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             |      |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|------|
|  |            |      |              | 02-FEB-2012 10:05 | 02-FEB-2012 09:40 | 02-FEB-2012 07:55 | 02-FEB-2012 08:05 | ---- |
| Compound   | CAS Number | LOR  | Unit         | EW1200284-016     | EW1200284-017     | EW1200284-018     | EW1200284-019     | ---- |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |      |
| pH   | ----       | 0.1  | pH Unit      | ----              | 7.4               | 7.7               | ----              | ---- |
| Electrical Conductivity (Non Compensated)        | ----       | 1    | µS/cm        | ----              | 22700             | 12000             | ----              | ---- |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | ----              | 5.39              | 6.54              | ----              | ---- |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | 58.3              | 71.6              | ----              | ---- |
| Temperature                                      | ----       | 0.1  | °C           | ----              | 18.4              | 19.2              | ----              | ---- |
| Salinity   | ----       | 0.2  | g/L          | ----              | 15.9              | 7.8               | ----              | ---- |
| Field Observations                               | ----       | 0.01 | --           | NO ACCESS         | ----              | ----              | ----              | ---- |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |      |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | 8                 | 10                | <1                | ---- |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |      |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | 9                 | 9                 | ----              | ---- |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |      |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | <0.05             | <0.05             | ----              | ---- |

## Environmental Division

# CERTIFICATE OF ANALYSIS

|              |  |                         |   |
|--------------|--|-------------------------|---|
| Work Order   | : <b>EW1201520</b>                               | Page                    | : 1 of 10   |
| Client       | : <b>KIAMA COUNCIL</b>                           | Laboratory              | : Environmental Division NSW South Coast  |
| Contact      | : MS JULIE MILEVSKI                              | Contact                 | : Glenn Davies  |
| Address      | : 11 MANNING STREET<br>KIAMA NSW, AUSTRALIA 2533 | Address                 | : 99 Kenny Street, Wollongong 2500<br>Unit 4 / 13 Geary Place, PO Box 3105, North Nowra 2541<br>AUSTRALIA |
| E-mail       | : juliem@kiama.nsw.gov.au                        | E-mail                  | : glenn.davies@alsglobal.com  |
| Telephone    | : +61 02 4232 0444                               | Telephone               | : 02 4225 3125  |
| Facsimile    | : +61 02 4232 0555                               | Facsimile               | : 02 4225 3128  |
| Project      | : Minnamurra Landfill                            | QC Level                | : NEPM 1999 Schedule B(3) and ALS QCS3 requirement  |
| Order number | : ----   | Date Samples Received   | : 30-MAY-2012   |
| C-O-C number | : ----   | Issue Date              | : 08-JUN-2012   |
| Sampler      | : Craig Wilson                                   | No. of samples received | : 19  |
| Site         | : ----   | No. of samples analysed | : 19  |
| Quote number | : Minnamurra Landfill WL/083/11                  |                         |   |

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



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       |
| Celine Conceicao | Senior Spectroscopist                 | Sydney Inorganics       |
| Glenn Davies     | Environmental Services Representative | Laboratory - Wollongong |
| Sarah Millington | Senior Inorganic Chemist              | Sydney Inorganics       |

Address 99 Kenny Street, Wollongong 2500

Environmental Division NSW South Coast, PO Box 3105, North Nowra 2541A Campbell Brothers Limited Company



## 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

- **ED041G: LOR raised for Sulfate on sample ID (MD 9C) due to sample matrix.**
- **EG020: Some samples were diluted and rerun due to matrix interference and LOR's have been raised accordingly (Sample Salinity)**
- **LOR raised for Nitrite & NoX due to sample matrix for sample MD 9C**
- **Site MD 1B & Rocklow Down - No Access too overgrown.**
- **Sites MD2A, MD4A, MD6A, MD9A and MD10A - Dry at time of sampling.**



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 1B             | MD 2A             | MD 2B             | MD 2C             | MD 4A             |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 30-MAY-2012 09:56 | 30-MAY-2012 08:31 | 30-MAY-2012 08:33 | 30-MAY-2012 08:39 | 30-MAY-2012 08:48 |
| Compound   | CAS Number  | LOR   | Unit    | EW1201520-001     | EW1201520-002     | EW1201520-003     | EW1201520-004     | EW1201520-005     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | ----              | <1                | <1                | ----              |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | ----              | <1                | <1                | ----              |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | ----              | 812               | 530               | ----              |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | ----              | 812               | 530               | ----              |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | ----              | 777               | 1800              | ----              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | ----              | 6890              | 15400             | ----              |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | ----              | 395               | 459               | ----              |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | ----              | 501               | 1080              | ----              |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | ----              | 4210              | 9440              | ----              |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | ----              | 204               | 383               | ----              |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | ----              | 0.079             | 0.164             | ----              |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | ----              | 0.35              | <0.50             | ----              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | ----              | 0.7               | 0.6               | ----              |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | ----              | 19.5              | 2.74              | ----              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | ----              | 0.01              | 0.05              | ----              |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | ----              | 2.35              | 1.91              | ----              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | ----              | 2.36              | 1.96              | ----              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | ----              | 227               | 483               | ----              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | ----              | 251               | 532               | ----              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | ----              | 4.97              | 4.90              | ----              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | ----              | ----              | 7.0               | 6.9               | ----              |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | ----              | ----              | 17100             | 34900             | ----              |
| Dissolved Oxygen   | ----        | 0.01  | mg/L    | ----              | ----              | 2.44              | 2.48              | ----              |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 1B             | MD 2A             | MD 2B             | MD 2C             | MD 4A             |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 30-MAY-2012 09:56 | 30-MAY-2012 08:31 | 30-MAY-2012 08:33 | 30-MAY-2012 08:39 | 30-MAY-2012 08:48 |
| Compound   | CAS Number | LOR  | Unit         | EW1201520-001     | EW1201520-002     | EW1201520-003     | EW1201520-004     | EW1201520-005     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | ----              | 26.9              | 29.6              | ----              |
| Temperature                                      | ----       | 0.1  | °C           | ----              | ----              | 16.4              | 16.1              | ----              |
| Salinity   | ----       | 0.2  | g/L          | ----              | ----              | 12.3              | 27.0              | ----              |
| Depth  | ----       | 0.01 | m            | ----              | ----              | 0.72              | 0.78              | ----              |
| Field Observations                               | ----       | 0.01 | --           | NO ACCESS         | DRY               | ----              | ----              | DRY               |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | ----              | 39                | 20                | ----              |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | ----              | 38                | 20                | ----              |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | ----              | <0.05             | <0.05             | ----              |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 4B             | MD 4C             | MD 6A             | MD 6B             | MD 6C             |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 30-MAY-2012 08:50 | 30-MAY-2012 08:58 | 30-MAY-2012 08:14 | 30-MAY-2012 08:16 | 30-MAY-2012 08:24 |
| Compound   | CAS Number  | LOR   | Unit    | EW1201520-006     | EW1201520-007     | EW1201520-008     | EW1201520-009     | EW1201520-010     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | <1                | <1                | ----              | <1                | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | <1                | <1                | ----              | <1                | <1                |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | 982               | 843               | ----              | 701               | 437               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | 982               | 843               | ----              | 701               | 437               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | 234               | 1480              | ----              | 145               | 1000              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | 1290              | 12400             | ----              | 171               | 9520              |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | 256               | 479               | ----              | 170               | 443               |
| Magnesium  | 7439-95-4   | 1     | mg/L    | 138               | 878               | ----              | 64                | 682               |
| Sodium   | 7440-23-5   | 1     | mg/L    | 729               | 7500              | ----              | 114               | 5960              |
| Potassium  | 7440-09-7   | 1     | mg/L    | 102               | 323               | ----              | 50                | 211               |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | 0.080             | 0.368             | ----              | 0.162             | 0.085             |
| Iron   | 7439-89-6   | 0.05  | mg/L    | 0.23              | <0.50             | ----              | 0.16              | <0.50             |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | 0.5               | 0.6               | ----              | 0.4               | 0.4               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | 35.4              | 3.76              | ----              | 19.4              | 30.8              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | 0.02              | 0.07              | ----              | 0.24              | 0.03              |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | 3.08              | 0.75              | ----              | 0.22              | 0.05              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | 3.10              | 0.82              | ----              | 0.46              | 0.08              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | 397               | ----              | 21.8              | 298               |
| Total Anions   | ----        | 0.01  | meq/L   | 61.1              | ----              | ----              | ----              | ----              |
| Total Cations  | ----        | 0.01  | meq/L   | 61.0              | 431               | ----              | 21.4              | 329               |
| Ionic Balance  | ----        | 0.01  | %       | 0.12              | 4.04              | ----              | 1.13              | 4.87              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | 7.0               | 6.8               | ----              | 6.8               | 6.8               |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | 4860              | 28300             | ----              | 1540              | 22700             |





## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 4B             | MD 4C             | MD 6A             | MD 6B             | MD 6C             |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 30-MAY-2012 08:50 | 30-MAY-2012 08:58 | 30-MAY-2012 08:14 | 30-MAY-2012 08:16 | 30-MAY-2012 08:24 |
| Compound   | CAS Number | LOR  | Unit         | EW1201520-006     | EW1201520-007     | EW1201520-008     | EW1201520-009     | EW1201520-010     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | 3.19              | 3.07              | ----              | 2.12              | 2.25              |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | 33.0              | 35.5              | ----              | 22.1              | 26.2              |
| Temperature                                      | ----       | 0.1  | °C           | 16.1              | 16.2              | ----              | 17.1              | 18.2              |
| Salinity   | ----       | 0.2  | g/L          | 3.2               | 21.4              | ----              | 0.9               | 16.0              |
| Depth  | ----       | 0.01 | m            | 1.33              | 1.17              | ----              | 1.30              | 1.40              |
| Field Observations                               | ----       | 0.01 | --           | ----              | ----              | 0                 | ----              | ----              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | 48                | 30                | ----              | 35                | 13                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | 48                | 30                | ----              | 34                | 13                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | <0.05             | <0.05             | ----              | <0.05             | <0.05             |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 9A             | MD 9B             | MD 9C             | MD 10A            | MD 10B            |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 30-MAY-2012 09:30 | 30-MAY-2012 09:32 | 30-MAY-2012 09:38 | 30-MAY-2012 09:07 | 30-MAY-2012 09:09 |
| Compound   | CAS Number  | LOR   | Unit    | EW1201520-011     | EW1201520-012     | EW1201520-013     | EW1201520-014     | EW1201520-015     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | <1                | <1                | ----              | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | <1                | <1                | ----              | <1                |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | 1010              | 1350              | ----              | 842               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | 1010              | 1350              | ----              | 842               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | 66                | <10               | ----              | 44                |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | 275               | 655               | ----              | 236               |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | 138               | 218               | ----              | 120               |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | 72                | 107               | ----              | 51                |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | 217               | 354               | ----              | 150               |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | 73                | 131               | ----              | 86                |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | 0.136             | 0.644             | ----              | 0.189             |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | 0.45              | 0.85              | ----              | 0.08              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | 0.7               | 0.3               | ----              | 0.8               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | 37.3              | 78.5              | ----              | 51.8              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | 0.02              | <0.10             | ----              | <0.01             |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | 0.62              | <0.10             | ----              | <0.01             |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | 0.64              | <0.10             | ----              | <0.01             |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | 29.3              | 45.4              | ----              | 24.4              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | 26.8              | 44.0              | ----              | 22.6              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | 4.54              | 1.61              | ----              | 3.84              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | ----              | 6.9               | 6.8               | ----              | 7.4               |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | ----              | 2190              | 3460              | ----              | 2050              |
| Dissolved Oxygen   | ----        | 0.01  | mg/L    | ----              | 2.98              | 3.79              | ----              | 3.21              |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 9A             | MD 9B             | MD 9C             | MD 10A            | MD 10B            |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 30-MAY-2012 09:30 | 30-MAY-2012 09:32 | 30-MAY-2012 09:38 | 30-MAY-2012 09:07 | 30-MAY-2012 09:09 |
| Compound   | CAS Number | LOR  | Unit         | EW1201520-011     | EW1201520-012     | EW1201520-013     | EW1201520-014     | EW1201520-015     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | 30.9              | 40.2              | ----              | 33.6              |
| Temperature                                      | ----       | 0.1  | °C           | ----              | 16.8              | 17.7              | ----              | 17.4              |
| Salinity   | ----       | 0.2  | g/L          | ----              | 1.4               | 2.2               | ----              | 1.2               |
| Depth  | ----       | 0.01 | m            | ----              | 0.85              | 0.89              | ----              | 0.64              |
| Field Observations                               | ----       | 0.01 | --           | DRY               | ----              | ----              | DRY               | ----              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | 41                | 94                | ----              | 51                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | 39                | 94                | ----              | 50                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | <0.05             | <0.05             | ----              | <0.05             |

|  |             |       |      |                             |                   |                   |                   |                   |      |
|--|-------------|-------|------|-----------------------------|-------------------|-------------------|-------------------|-------------------|------|
| Sub-Matrix: WATER  |             |       |      | Client sample ID            | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             |      |
|  |             |       |      | Client sampling date / time | 30-MAY-2012 09:43 | 30-MAY-2012 09:21 | 30-MAY-2012 08:05 | 30-MAY-2012 08:13 | ---- |
| Compound   | CAS Number  | LOR   | Unit | EW1201520-016               | EW1201520-017     | EW1201520-018     | EW1201520-019     | ----              |      |
| 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 | ----                        | <1                | <1                | ----              | ----              |      |
| Bicarbonate Alkalinity as CaCO3                              | 71-52-3     | 1     | mg/L | ----                        | 178               | 130               | ----              | ----              |      |
| Total Alkalinity as CaCO3                                    | ----        | 1     | mg/L | ----                        | 178               | 130               | ----              | ----              |      |
| ED041G: Sulfate (Turbidimetric) as SO4 2- by DA              |             |       |      |                             |                   |                   |                   |                   |      |
| Sulfate as SO4 - Turbidimetric                               | 14808-79-8  | 1     | mg/L | ----                        | 681               | 153               | ----              | ----              |      |
| ED045G: Chloride Discrete analyser                           |             |       |      |                             |                   |                   |                   |                   |      |
| Chloride   | 16887-00-6  | 1     | mg/L | ----                        | 6020              | 812               | ----              | ----              |      |
| ED093F: Dissolved Major Cations                              |             |       |      |                             |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Magnesium  | 7439-95-4   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Sodium   | 7440-23-5   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Potassium  | 7440-09-7   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| ED093T: Total Major Cations                                  |             |       |      |                             |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L | ----                        | 190               | 48                | ----              | ----              |      |
| Magnesium  | 7439-95-4   | 1     | mg/L | ----                        | 508               | 61                | ----              | ----              |      |
| Sodium   | 7440-23-5   | 1     | mg/L | ----                        | 4800              | 500               | ----              | ----              |      |
| Potassium  | 7440-09-7   | 1     | mg/L | ----                        | 180               | 20                | ----              | ----              |      |
| EG020F: Dissolved Metals by ICP-MS                           |             |       |      |                             |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L | ----                        | ----              | ----              | <0.001            | ----              |      |
| Iron   | 7439-89-6   | 0.05  | mg/L | ----                        | ----              | ----              | <0.05             | ----              |      |
| EG020T: Total Metals by ICP-MS                               |             |       |      |                             |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L | ----                        | 0.116             | 0.163             | ----              | ----              |      |
| Iron   | 7439-89-6   | 0.05  | mg/L | ----                        | 0.50              | 0.55              | ----              | ----              |      |
| EK040P: Fluoride by PC Titrator                              |             |       |      |                             |                   |                   |                   |                   |      |
| Fluoride   | 16984-48-8  | 0.1   | mg/L | ----                        | 0.7               | 0.2               | ----              | ----              |      |
| EK055G: Ammonia as N by Discrete Analyser                    |             |       |      |                             |                   |                   |                   |                   |      |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L | ----                        | 1.06              | <0.01             | ----              | ----              |      |
| 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 | ----                        | 0.13              | <0.01             | ----              | ----              |      |
| EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser |             |       |      |                             |                   |                   |                   |                   |      |
| Nitrite + Nitrate as N                                       | ----        | 0.01  | mg/L | ----                        | 0.14              | <0.01             | ----              | ----              |      |
| EN67 PK: Field Tests   |             |       |      |                             |                   |                   |                   |                   |      |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             | ---- |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|------|
|  |            |      |              | 30-MAY-2012 09:43 | 30-MAY-2012 09:21 | 30-MAY-2012 08:05 | 30-MAY-2012 08:13 | ---- |
| Compound   | CAS Number | LOR  | Unit         | EW1201520-016     | EW1201520-017     | EW1201520-018     | EW1201520-019     | ---- |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |      |
| pH   | ----       | 0.1  | pH Unit      | ----              | 6.8               | 6.9               | ----              | ---- |
| Electrical Conductivity (Non Compensated)        | ----       | 1    | µS/cm        | ----              | 17600             | 2230              | ----              | ---- |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | ----              | 7.77              | 13.6              | ----              | ---- |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | 79.4              | 124               | ----              | ---- |
| Temperature                                      | ----       | 0.1  | °C           | ----              | 12.5              | 10.9              | ----              | ---- |
| Salinity   | ----       | 0.2  | g/L          | ----              | 14.0              | 1.6               | ----              | ---- |
| Field Observations                               | ----       | 0.01 | --           | NO ACCESS         | ----              | ----              | ----              | ---- |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |      |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | 8                 | 9                 | <1                | ---- |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |      |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | 8                 | 9                 | ----              | ---- |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |      |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | <0.05             | <0.05             | ----              | ---- |

## Environmental Division

# CERTIFICATE OF ANALYSIS

|              |  |                         |   |
|--------------|--|-------------------------|---|
| Work Order   | : EW1202214                                      | Page                    | : 1 of 10   |
| Amendment    | : 1  |                         |   |
| Client       | : KIAMA COUNCIL                                  | Laboratory              | : Environmental Division NSW South Coast  |
| Contact      | : MR PAUL CZULOWSKI                              | Contact                 | : Glenn Davies  |
| Address      | : 11 MANNING STREET<br>KIAMA NSW, AUSTRALIA 2533 | Address                 | : 99 Kenny Street, Wollongong 2500<br>Unit 4 / 13 Geary Place, PO Box 3105, North Nowra 2541<br>AUSTRALIA |
| E-mail       | : paulc@kiama.nsw.gov.au                         | E-mail                  | : glenn.davies@alsglobal.com  |
| Telephone    | : +61 02 4232 0444                               | Telephone               | : 02 4225 3125  |
| Facsimile    | : +61 02 4232 0555                               | Facsimile               | : 02 4225 3128  |
| Project      | : Minnamurra Landfill                            | QC Level                | : NEPM 1999 Schedule B(3) and ALS QCS3 requirement  |
| Order number | : ----   |                         |   |
| C-O-C number | : ----   | Date Samples Received   | : 09-AUG-2012   |
| Sampler      | : Craig Wilson                                   | Issue Date              | : 29-AUG-2012   |
| Site         | : ----   |                         |   |
| Quote number | : Minnamurra Landfill WL/083/11                  | No. of samples received | : 19  |
|              |  | No. of samples analysed | : 19  |

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



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  |
|------------------|---------------------------------------|-------------------------|
| Ashesh Patel     | Inorganic Chemist                     | Sydney Inorganics       |
| Celine Conceicao | Senior Spectroscopist                 | Sydney Inorganics       |
| Glenn Davies     | Environmental Services Representative | Laboratory - Wollongong |
| Sarah Millington | Senior Inorganic Chemist              | Sydney Inorganics       |

Address 99 Kenny Street, Wollongong 2500

Environmental Division NSW South Coast, Geary Place 3105, North Nowra 2541A Campbell Brothers Limited Company





## 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

- **ED041G:LOR raised for SO4 analysis on various samples due to sample matrix.**
- **EG020-T: Unpreserved aliquots from natural bottles were used in the analysis of samples 17 and 18.**
- **EK055G: LOR raised for Ammonia on sample ID (MD 2C) due to sample matrix.**
- **EP002: It has been noted that DOC is greater than TOC for sample ID's 'MD 6B' and 'MD 9C', however, these differences are within the limits of experimental variation.**
- **Sites MD1B & Rocklow Down - No Access at time of sampling**  
Sites MD2A, MD6A, MD9A and MD10A - Only depth reading taken due to insufficient water in bore at time of sampling.  
Site MD4A - Dry at time of sampling
- **This report has been amended following the change of Conductivity and Dissolved Oxygen results. All other analysis results are as per the previous report.**



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 1B             | MD 2A             | MD 2B             | MD 2C             | MD 4A             |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 09-AUG-2012 09:48 | 09-AUG-2012 08:03 | 09-AUG-2012 08:13 | 09-AUG-2012 08:23 | 09-AUG-2012 08:23 |
| Compound   | CAS Number  | LOR   | Unit    | EW1202214-001     | EW1202214-002     | EW1202214-003     | EW1202214-004     | EW1202214-005     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | ----              | <1                | <1                | ----              |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | ----              | 48                | 3                 | ----              |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | ----              | 752               | 525               | ----              |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | ----              | 801               | 528               | ----              |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | ----              | 964               | 2060              | ----              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | ----              | 6640              | 15200             | ----              |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | ----              | 376               | 425               | ----              |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | ----              | 499               | 989               | ----              |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | ----              | 3260              | 9050              | ----              |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | ----              | 170               | 367               | ----              |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | ----              | 0.067             | 0.161             | ----              |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | ----              | 0.28              | 0.16              | ----              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | ----              | 0.7               | 0.6               | ----              |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | ----              | 16.0              | <0.10             | ----              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | ----              | <0.01             | <0.01             | ----              |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | ----              | 3.68              | 1.91              | ----              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | ----              | 3.68              | 1.91              | ----              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | ----              | 223               | 482               | ----              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | ----              | 206               | 506               | ----              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | ----              | 4.06              | 2.36              | ----              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | ----              | ----              | 7.3               | 7.2               | ----              |
| Electrical Conductivity (Non Compensated)                                      | ----        | 1     | µS/cm   | ----              | ----              | 16200             | 32500             | ----              |
| Dissolved Oxygen   | ----        | 0.01  | mg/L    | ----              | ----              | 2.48              | 4.50              | ----              |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 1B             | MD 2A             | MD 2B             | MD 2C             | MD 4A             |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 09-AUG-2012 09:48 | 09-AUG-2012 08:03 | 09-AUG-2012 08:13 | 09-AUG-2012 08:23 | 09-AUG-2012 08:23 |
| Compound   | CAS Number | LOR  | Unit         | EW1202214-001     | EW1202214-002     | EW1202214-003     | EW1202214-004     | EW1202214-005     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | ----              | 23.8              | 44.8              | ----              |
| Temperature                                      | ----       | 0.1  | °C           | ----              | ----              | 14.5              | 14.8              | ----              |
| Salinity   | ----       | 0.2  | g/L          | ----              | ----              | 12.1              | 25.8              | ----              |
| Depth  | ----       | 0.01 | m            | ----              | 0.60              | 0.76              | 0.83              | ----              |
| Field Observations                               | ----       | 0.01 | --           | No Access         | ----              | ----              | ----              | DRY               |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | ----              | 36                | 19                | ----              |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | ----              | 37                | 19                | ----              |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | ----              | <0.05             | <0.05             | ----              |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 4B             | MD 4C             | MD 6A             | MD 6B             | MD 6C             |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 09-AUG-2012 08:33 | 09-AUG-2012 08:43 | 09-AUG-2012 07:44 | 09-AUG-2012 07:54 | 09-AUG-2012 07:59 |
| Compound   | CAS Number  | LOR   | Unit    | EW1202214-006     | EW1202214-007     | EW1202214-008     | EW1202214-009     | EW1202214-010     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | <1                | <1                | ----              | <1                | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | <1                | 29                | ----              | <1                | <1                |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | 808               | 842               | ----              | 750               | 416               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | 808               | 871               | ----              | 750               | 416               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | 242               | 1510              | ----              | 191               | 1280              |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | 1260              | 10800             | ----              | 238               | 8800              |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | 256               | 423               | ----              | 203               | 363               |
| Magnesium  | 7439-95-4   | 1     | mg/L    | 132               | 773               | ----              | 72                | 550               |
| Sodium   | 7440-23-5   | 1     | mg/L    | 680               | 6730              | ----              | 120               | 4720              |
| Potassium  | 7440-09-7   | 1     | mg/L    | 107               | 299               | ----              | 47                | 172               |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | 0.045             | 0.243             | ----              | 0.191             | 0.071             |
| Iron   | 7439-89-6   | 0.05  | mg/L    | 0.22              | 0.25              | ----              | 0.17              | 0.05              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | 0.4               | 0.6               | ----              | 0.4               | 0.4               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | 36.0              | 2.37              | ----              | 17.2              | 39.0              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | <0.01             | 0.01              | ----              | 0.02              | <0.01             |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | 3.92              | 1.27              | ----              | 0.50              | 0.42              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | 3.92              | 1.28              | ----              | 0.52              | 0.42              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | 56.7              | 354               | ----              | 25.7              | 283               |
| Total Cations  | ----        | 0.01  | meq/L   | 56.0              | 385               | ----              | ----              | 273               |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | ----              | ----              | 23.7              | ----              |
| Ionic Balance  | ----        | 0.01  | %       | 0.68              | 4.27              | ----              | ----              | 1.83              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | ----              | ----              | 4.05              | ----              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | 7.3               | 7.1               | ----              | 6.9               | 7.1               |



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 4B             | MD 4C             | MD 6A             | MD 6B             | MD 6C             |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 09-AUG-2012 08:33 | 09-AUG-2012 08:43 | 09-AUG-2012 07:44 | 09-AUG-2012 07:54 | 09-AUG-2012 07:59 |
| Compound   | CAS Number | LOR  | Unit         | EW1202214-006     | EW1202214-007     | EW1202214-008     | EW1202214-009     | EW1202214-010     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Electrical Conductivity (Non Compensated)        | ----       | 1    | µS/cm        | 4360              | 24300             | ----              | 1860              | 20700             |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | 2.53              | 3.51              | ----              | 3.64              | 3.50              |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | 25.0              | 34.8              | ----              | 36.0              | 34.8              |
| Temperature                                      | ----       | 0.1  | °C           | 14.3              | 14.3              | ----              | 15.6              | 16.8              |
| Salinity   | ----       | 0.2  | g/L          | 3.0               | 19.0              | ----              | 1.2               | 15.0              |
| Depth  | ----       | 0.01 | m            | 1.22              | 1.26              | 1.32              | 1.33              | 1.48              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | 48                | 31                | ----              | 34                | 13                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | 49                | 32                | ----              | 33                | 14                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | <0.05             | <0.05             | ----              | <0.05             | <0.05             |



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

|  |             |       |         | MD 9A             | MD 9B             | MD 9C             | MD 10A            | MD 10B            |
|--|-------------|-------|---------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |             |       |         | 09-AUG-2012 09:00 | 09-AUG-2012 09:09 | 09-AUG-2012 09:15 | 09-AUG-2012 09:20 | 09-AUG-2012 09:28 |
| Compound   | CAS Number  | LOR   | Unit    | EW1202214-011     | EW1202214-012     | EW1202214-013     | EW1202214-014     | EW1202214-015     |
| <b>ED037P: Alkalinity by PC Titrator</b>                                       |             |       |         |                   |                   |                   |                   |                   |
| Hydroxide Alkalinity as CaCO <sub>3</sub>                                      | DMO-210-001 | 1     | mg/L    | ----              | <1                | <1                | ----              | <1                |
| Carbonate Alkalinity as CaCO <sub>3</sub>                                      | 3812-32-6   | 1     | mg/L    | ----              | 17                | <1                | ----              | 63                |
| Bicarbonate Alkalinity as CaCO <sub>3</sub>                                    | 71-52-3     | 1     | mg/L    | ----              | 876               | 1170              | ----              | 751               |
| Total Alkalinity as CaCO <sub>3</sub>  | ----        | 1     | mg/L    | ----              | 893               | 1170              | ----              | 814               |
| <b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>              |             |       |         |                   |                   |                   |                   |                   |
| Sulfate as SO <sub>4</sub> - Turbidimetric                                     | 14808-79-8  | 1     | mg/L    | ----              | 82                | <10               | ----              | 75                |
| <b>ED045G: Chloride Discrete analyser</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Chloride   | 16887-00-6  | 1     | mg/L    | ----              | 287               | 683               | ----              | 258               |
| <b>ED093F: Dissolved Major Cations</b>   |             |       |         |                   |                   |                   |                   |                   |
| Calcium  | 7440-70-2   | 1     | mg/L    | ----              | 156               | 200               | ----              | 113               |
| Magnesium  | 7439-95-4   | 1     | mg/L    | ----              | 83                | 97                | ----              | 50                |
| Sodium   | 7440-23-5   | 1     | mg/L    | ----              | 232               | 286               | ----              | 136               |
| Potassium  | 7440-09-7   | 1     | mg/L    | ----              | 80                | 113               | ----              | 85                |
| <b>EG020F: Dissolved Metals by ICP-MS</b>                                      |             |       |         |                   |                   |                   |                   |                   |
| Manganese  | 7439-96-5   | 0.001 | mg/L    | ----              | 0.175             | 0.727             | ----              | 0.214             |
| Iron   | 7439-89-6   | 0.05  | mg/L    | ----              | 0.43              | 1.77              | ----              | 0.13              |
| <b>EK040P: Fluoride by PC Titrator</b>   |             |       |         |                   |                   |                   |                   |                   |
| Fluoride   | 16984-48-8  | 0.1   | mg/L    | ----              | 0.6               | 0.3               | ----              | 0.9               |
| <b>EK055G: Ammonia as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L    | ----              | 31.5              | 82.8              | ----              | 72.8              |
| <b>EK057G: Nitrite as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrite as N   | ----        | 0.01  | mg/L    | ----              | <0.01             | <0.01             | ----              | <0.01             |
| <b>EK058G: Nitrate as N by Discrete Analyser</b>                               |             |       |         |                   |                   |                   |                   |                   |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L    | ----              | 0.63              | 0.17              | ----              | 0.07              |
| <b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b> |             |       |         |                   |                   |                   |                   |                   |
| Nitrite + Nitrate as N   | ----        | 0.01  | mg/L    | ----              | 0.63              | 0.17              | ----              | 0.07              |
| <b>EN055: Ionic Balance</b>  |             |       |         |                   |                   |                   |                   |                   |
| Total Anions   | ----        | 0.01  | meq/L   | ----              | 27.6              | 42.6              | ----              | 25.1              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | 26.8              | ----              | ----              | ----              |
| Total Cations  | ----        | 0.01  | meq/L   | ----              | ----              | 39.2              | ----              | 23.0              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | 1.64              | ----              | ----              | ----              |
| Ionic Balance  | ----        | 0.01  | %       | ----              | ----              | 4.16              | ----              | 4.37              |
| <b>EN67 PK: Field Tests</b>  |             |       |         |                   |                   |                   |                   |                   |
| pH   | ----        | 0.1   | pH Unit | ----              | 7.0               | 6.9               | ----              | 7.3               |





## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | MD 9A             | MD 9B             | MD 9C             | MD 10A            | MD 10B            |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |            |      |              | 09-AUG-2012 09:00 | 09-AUG-2012 09:09 | 09-AUG-2012 09:15 | 09-AUG-2012 09:20 | 09-AUG-2012 09:28 |
| Compound   | CAS Number | LOR  | Unit         | EW1202214-011     | EW1202214-012     | EW1202214-013     | EW1202214-014     | EW1202214-015     |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |                   |
| Electrical Conductivity (Non Compensated)        | ----       | 1    | µS/cm        | ----              | 1960              | 3180              | ----              | 1880              |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | ----              | 3.11              | 2.98              | ----              | 2.42              |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | 32.0              | 28.7              | ----              | 24.0              |
| Temperature                                      | ----       | 0.1  | °C           | ----              | 14.4              | 14.8              | ----              | 15.3              |
| Salinity   | ----       | 0.2  | g/L          | ----              | 1.3               | 2.1               | ----              | 1.2               |
| Depth  | ----       | 0.01 | m            | 0.75              | 0.88              | 0.97              | 0.62              | 0.64              |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |                   |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | 36                | 97                | ----              | 51                |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |                   |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | 37                | 93                | ----              | 51                |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |                   |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | <0.05             | <0.05             | ----              | <0.05             |

Sub-Matrix: **WATER**

*Client sample ID*

Client sampling date / time

| Sub-Matrix: WATER  |             |       |      | Client sample ID            | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             | ---- |
|--|-------------|-------|------|-----------------------------|-------------------|-------------------|-------------------|-------------------|------|
|  |             |       |      | Client sampling date / time | 09-AUG-2012 08:51 | 09-AUG-2012 08:59 | 09-AUG-2012 15:00 | 09-AUG-2012 15:00 | ---- |
| Compound   | CAS Number  | LOR   | Unit | EW1202214-016               | EW1202214-017     | EW1202214-018     | EW1202214-019     | ----              |      |
| 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 | ----                        | <1                | <1                | ----              | ----              |      |
| Bicarbonate Alkalinity as CaCO3                              | 71-52-3     | 1     | mg/L | ----                        | 194               | 144               | ----              | ----              |      |
| Total Alkalinity as CaCO3                                    | ----        | 1     | mg/L | ----                        | 194               | 144               | ----              | ----              |      |
| ED041G: Sulfate (Turbidimetric) as SO4 2- by DA              |             |       |      |                             |                   |                   |                   |                   |      |
| Sulfate as SO4 - Turbidimetric                               | 14808-79-8  | 1     | mg/L | ----                        | 874               | 312               | ----              | ----              |      |
| ED045G: Chloride Discrete analyser                           |             |       |      |                             |                   |                   |                   |                   |      |
| Chloride   | 16887-00-6  | 1     | mg/L | ----                        | 6710              | 2060              | ----              | ----              |      |
| ED093F: Dissolved Major Cations                              |             |       |      |                             |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Magnesium  | 7439-95-4   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Sodium   | 7440-23-5   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| Potassium  | 7440-09-7   | 1     | mg/L | ----                        | ----              | ----              | <1                | ----              |      |
| ED093T: Total Major Cations                                  |             |       |      |                             |                   |                   |                   |                   |      |
| Calcium  | 7440-70-2   | 1     | mg/L | ----                        | 154               | 78                | ----              | ----              |      |
| Magnesium  | 7439-95-4   | 1     | mg/L | ----                        | 407               | 141               | ----              | ----              |      |
| Sodium   | 7440-23-5   | 1     | mg/L | ----                        | 3080              | 1110              | ----              | ----              |      |
| Potassium  | 7440-09-7   | 1     | mg/L | ----                        | 127               | 43                | ----              | ----              |      |
| EG020F: Dissolved Metals by ICP-MS                           |             |       |      |                             |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L | ----                        | ----              | ----              | <0.001            | ----              |      |
| Iron   | 7439-89-6   | 0.05  | mg/L | ----                        | ----              | ----              | <0.05             | ----              |      |
| EG020T: Total Metals by ICP-MS                               |             |       |      |                             |                   |                   |                   |                   |      |
| Manganese  | 7439-96-5   | 0.001 | mg/L | ----                        | 0.152             | 0.245             | ----              | ----              |      |
| Iron   | 7439-89-6   | 0.05  | mg/L | ----                        | 0.36              | 1.12              | ----              | ----              |      |
| EK040P: Fluoride by PC Titrator                              |             |       |      |                             |                   |                   |                   |                   |      |
| Fluoride   | 16984-48-8  | 0.1   | mg/L | ----                        | 0.7               | 0.3               | ----              | ----              |      |
| EK055G: Ammonia as N by Discrete Analyser                    |             |       |      |                             |                   |                   |                   |                   |      |
| Ammonia as N   | 7664-41-7   | 0.01  | mg/L | ----                        | 1.91              | 0.04              | ----              | ----              |      |
| EK057G: Nitrite as N by Discrete Analyser                    |             |       |      |                             |                   |                   |                   |                   |      |
| Nitrite as N   | ----        | 0.01  | mg/L | ----                        | 0.02              | <0.01             | ----              | ----              |      |
| EK058G: Nitrate as N by Discrete Analyser                    |             |       |      |                             |                   |                   |                   |                   |      |
| Nitrate as N   | 14797-55-8  | 0.01  | mg/L | ----                        | 0.26              | 0.14              | ----              | ----              |      |
| EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser |             |       |      |                             |                   |                   |                   |                   |      |
| Nitrite + Nitrate as N                                       | ----        | 0.01  | mg/L | ----                        | 0.28              | 0.14              | ----              | ----              |      |
| EN67 PK: Field Tests   |             |       |      |                             |                   |                   |                   |                   |      |



## Analytical Results

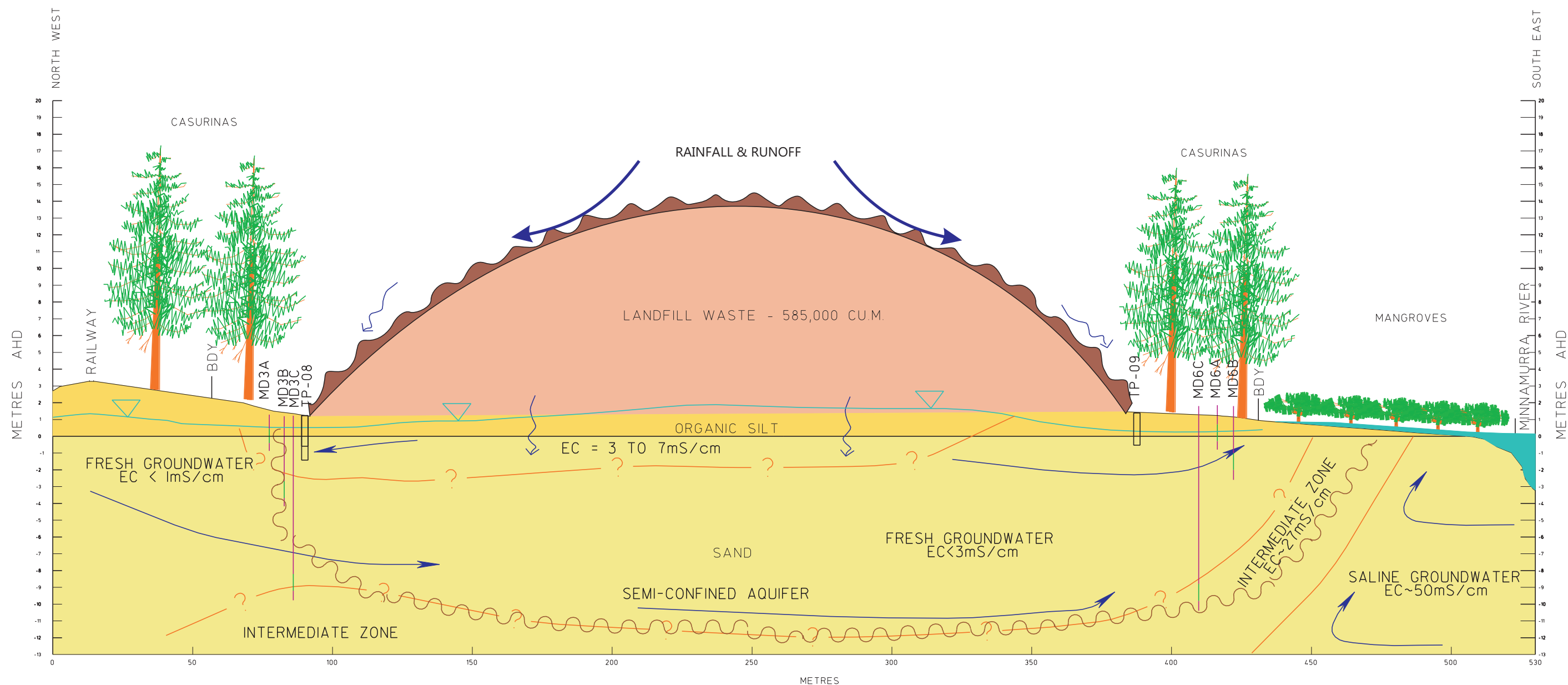
Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

|  |            |      |              | Rocklow Down      | Rocklow Middle    | Rocklow Up        | Blank             |      |
|--|------------|------|--------------|-------------------|-------------------|-------------------|-------------------|------|
|  |            |      |              | 09-AUG-2012 08:51 | 09-AUG-2012 08:59 | 09-AUG-2012 15:00 | 09-AUG-2012 15:00 | ---- |
| Compound   | CAS Number | LOR  | Unit         | EW1202214-016     | EW1202214-017     | EW1202214-018     | EW1202214-019     | ---- |
| <b>EN67 PK: Field Tests - Continued</b>          |            |      |              |                   |                   |                   |                   |      |
| pH   | ----       | 0.1  | pH Unit      | ----              | 6.9               | 7.3               | ----              | ---- |
| Electrical Conductivity (Non Compensated)        | ----       | 1    | µS/cm        | ----              | 18100             | 4980              | ----              | ---- |
| Dissolved Oxygen                                 | ----       | 0.01 | mg/L         | ----              | 10.8              | 10.9              | ----              | ---- |
| Dissolved Oxygen - % Saturation                  | ----       | 0.1  | % saturation | ----              | 105               | 106               | ----              | ---- |
| Temperature                                      | ----       | 0.1  | °C           | ----              | 12.3              | 11.5              | ----              | ---- |
| Salinity   | ----       | 0.2  | g/L          | ----              | 14.5              | 3.7               | ----              | ---- |
| Field Observations                               | ----       | 0.01 | --           | No Access         | ----              | ----              | ----              | ---- |
| <b>EP002: Dissolved Organic Carbon (DOC)</b>     |            |      |              |                   |                   |                   |                   |      |
| Dissolved Organic Carbon                         | ----       | 1    | mg/L         | ----              | 9                 | 9                 | <1                | ---- |
| <b>EP005: Total Organic Carbon (TOC)</b>         |            |      |              |                   |                   |                   |                   |      |
| Total Organic Carbon                             | ----       | 1    | mg/L         | ----              | 9                 | 9                 | ----              | ---- |
| <b>EP035G: Total Phenol by Discrete Analyser</b> |            |      |              |                   |                   |                   |                   |      |
| Phenols (Total)                                  | ----       | 0.05 | mg/L         | ----              | <0.05             | <0.05             | ----              | ---- |

## Appendix B



SECTION B - B1

- LEGEND**
- INFERRED EXTENT OF LEACHATE PLUME
  - INFERRED LEACHATE MOVEMENT
  - INFERRED GROUNDWATER LEVEL
  - INFERRED LOCAL REGIONAL GROUNDWATER FLOW
  - EXTENT OF HIGH TIDE LEVEL (& SALINE LEVEL)
  - MONITORING WELL
  - WELL SCREEN INTERVAL
  - LANDFILL CAPPING SYSTEM (2007)

## Appendix C



## LANDFILL GAS MONITORING

|          |                               |
|----------|-------------------------------|
| GAS 1    | Site Entrance                 |
| GAS 2    | 40m South of Landfill         |
| GAS 3    | Carpark South of Landfill     |
| GAS 4    | Next to Secondhand Shop       |
| GAS 5    | Landfill West Bank, Bench     |
| GAS 6    | Landfill West Bank, Bund Wall |
| TRENCH 1 | West Bank                     |
| TRENCH 2 | North Bank West Side          |
| TRENCH 3 | North Bank Middle             |
| TRENCH 4 | South Bank Side               |
| TRENCH 5 | East Bank Side                |
| TRENCH 6 | North Bank East Side          |
| TRENCH 7 | Lower Level South Side        |

| WELL ID  | DATE      | TIME  | LEL PPM |       |        |     | COMMENTS         |
|----------|-----------|-------|---------|-------|--------|-----|------------------|
|          |           |       | MAX     |       | STABLE |     |                  |
|          |           |       | LEL%    | PPM   | LEL%   | PPM |                  |
| Trench 4 | 25-Jan-11 | 13:10 |         | 4,700 |        | 900 | Good readings    |
| Trench 1 | 25-Jan-11 | 13:15 |         | 700   |        | 220 | " " " " " " " "  |
| Trench 2 | 25-Jan-11 | 13:20 |         | 370   |        | 100 | " " " " " " " "  |
| Trench 3 | 25-Jan-11 | 13:25 |         | 480   |        | 120 | " " " " " " " "  |
| Trench 6 | 25-Jan-11 | 13:30 |         | 400   |        | 110 | " " " " " " " "  |
| Trench 5 | 25-Jan-11 | 13:35 |         | 270   |        | 180 | " " " " " " " "  |
| Trench 7 | 25-Jan-11 | 13:40 |         | 1,000 |        | 380 | " " " " " " " "  |
| Gas 1    | 25-Jan-11 | 13:45 |         | 240   |        | 180 | " " " " " " " "  |
| Gas 2    | 25-Jan-11 | 13:50 |         | 300   |        | 190 | " " " " " " " "  |
| Gas 3    | 25-Jan-11 | 13:55 |         | 590   |        | 390 | " " " " " " " "  |
| Gas 5    | 25-Jan-11 |       |         |       |        |     |                  |
| Gas 4    | 25-Jan-11 | 14:00 |         | 500   |        | 470 | " " " " " " " "  |
| Gas 6    | 25-Jan-11 |       |         |       |        |     |                  |
|          |           |       |         |       |        |     |                  |
| Trench 4 | 31-Mar-11 | 8:05  |         | 2,100 |        | 780 | Windy Conditions |
| Trench 1 | 31-Mar-11 | 8:10  |         | 560   |        | 200 | " " " " " " " "  |
| Trench 2 | 31-Mar-11 | 8:15  |         | 210   |        | 120 | " " " " " " " "  |
| Trench 3 | 31-Mar-11 | 8:20  |         | 440   |        | 100 | " " " " " " " "  |
| Trench 6 | 31-Mar-11 | 8:25  |         | 400   |        | 110 | " " " " " " " "  |
| Trench 5 | 31-Mar-11 | 8:30  |         | 430   |        | 200 | " " " " " " " "  |
| Trench 7 | 31-Mar-11 | 8:35  |         | 690   |        | 370 | " " " " " " " "  |

|               |           |       |     |       |  |     |                                       |
|---------------|-----------|-------|-----|-------|--|-----|---------------------------------------|
| Gas 1         | 31-Mar-11 | 8:45  |     | 370   |  | 210 | " " " " " " "                         |
| Gas 2         | 31-Mar-11 | 8:50  |     | 300   |  | 200 | " " " " " " "                         |
| Gas 3         | 31-Mar-11 | 8:55  |     | 580   |  | 320 | " " " " " " "                         |
| Gas 5         | 31-Mar-11 |       |     |       |  |     |                                       |
| Gas 4         | 31-Mar-11 | 9:05  |     | 240   |  | 150 | " " " " " " "                         |
| Gas 6         | 31-Mar-11 |       |     |       |  |     |                                       |
|               |           |       |     |       |  |     |                                       |
| Trench 4      | 30-Jun-11 | 8:00  |     | 4,900 |  | 800 | Good readings                         |
| Trench 1      | 30-Jun-11 | 8:05  |     | 1,000 |  | 190 | " " " " " " "                         |
| Trench 2      | 30-Jun-11 | 8:10  |     | 800   |  | 210 | " " " " " " "                         |
| Trench 3      | 30-Jun-11 | 8:15  |     | 1,100 |  | 280 | " " " " " " "                         |
| Trench 6      | 30-Jun-11 | 8:25  |     | 500   |  | 260 | " " " " " " "                         |
| Trench 5      | 30-Jun-11 | 8:30  |     | 810   |  | 340 | " " " " " " "                         |
| Trench 7      | 30-Jun-11 | 8:35  |     | 1,410 |  | 800 | Slight increase                       |
| Gas 1         | 30-Jun-11 | 8:45  |     | 400   |  | 280 | Good readings                         |
| Gas 2         | 30-Jun-11 | 8:50  |     | 210   |  | 190 | " " " " " " "                         |
| Gas 3         | 30-Jun-11 | 8:55  |     | 240   |  | 300 | " " " " " " "                         |
| Gas 5         | 30-Jun-11 |       |     |       |  |     |                                       |
| Gas 4         | 30-Jun-11 | 9:00  |     | 500   |  | 200 | " " " " " " "                         |
| Gas 6         | 30-Jun-11 |       |     |       |  |     |                                       |
|               |           |       |     |       |  |     |                                       |
|               |           |       |     |       |  |     | Started LEL % from inside trench pipe |
| Trench 4      | 11-Oct-11 | 9:30  | 100 | 5,300 |  | 980 | Good Readings                         |
| Trench 1      | 11-Oct-11 | 9:35  | 62  | 1,180 |  | 580 | " " " " " " "                         |
| Trench 2      | 11-Oct-11 | 9:40  | 100 | 900   |  | 210 | " " " " " " "                         |
| Trench 3      | 11-Oct-11 | 9:45  | 100 | 5,100 |  | 510 | Small pocket found                    |
| Trench 6      | 11-Oct-11 | 9:50  | 100 | 510   |  | 120 | Good Readings                         |
| Trench 5      | 11-Oct-11 | 9:55  | 100 | 1,200 |  | 250 | Slight increase                       |
| Trench 7      | 11-Oct-11 | 10:00 | 100 | 1,600 |  | 600 | Good Readings                         |
| Gas 1         | 11-Oct-11 | 10:10 |     | 380   |  | 200 | " " " " " " "                         |
| Gas 2         | 11-Oct-11 | 10:15 |     | 200   |  | 170 | " " " " " " "                         |
| Gas 3         | 11-Oct-11 | 10:20 |     | 220   |  | 170 | " " " " " " "                         |
| Gas 5         | 11-Oct-11 |       |     |       |  |     |                                       |
| Gas 4         | 11-Oct-11 | 10:30 |     | 470   |  | 200 | " " " " " " "                         |
| Gas 6         | 11-Oct-11 |       |     |       |  |     |                                       |
|               |           |       |     |       |  |     |                                       |
| Weighbridge   | 11-Oct-11 | 10:40 |     | 0     |  | 0   | All Buildings no reading at all       |
| Cleaning Shed | 11-Oct-11 | 10:45 |     | 0     |  | 0   | " " " " " " "                         |
| MRF           | 11-Oct-11 | 10:50 |     | 0     |  | 0   | " " " " " " "                         |
| Lunchroom     | 11-Oct-11 | 10:55 |     | 0     |  | 0   | " " " " " " "                         |

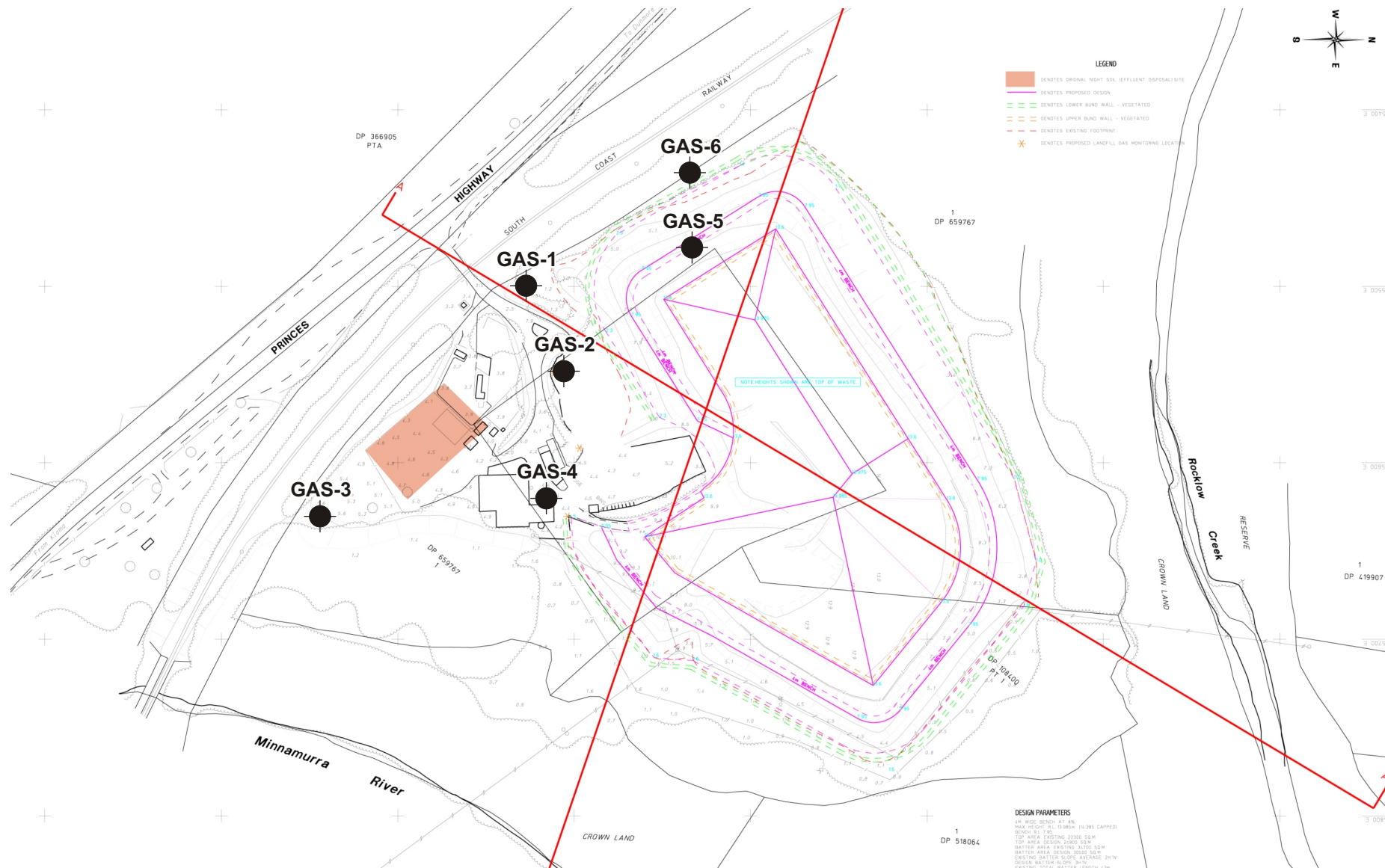
[illegible]

## LANDFILL GAS MONITORING

|          |                               |
|----------|-------------------------------|
| GAS 1    | Site Entrance                 |
| GAS 2    | 40m South of Landfill         |
| GAS 3    | Carpark South of Landfill     |
| GAS 4    | Next to Secondhand Shop       |
| GAS 5    | Landfill West Bank, Bench     |
| GAS 6    | Landfill West Bank, Bund Wall |
| TRENCH 1 | West Bank                     |
| TRENCH 2 | North Bank West Side          |
| TRENCH 3 | North Bank Middle             |
| TRENCH 4 | South Bank Side               |
| TRENCH 5 | East Bank Side                |
| TRENCH 6 | North Bank East Side          |
| TRENCH 7 | Lower Level South Side        |

| WELL ID       | DATE      | TIME  | LEL PPM |       |        |     | COMMENTS                        |
|---------------|-----------|-------|---------|-------|--------|-----|---------------------------------|
|               |           |       | MAX     |       | STABLE |     |                                 |
|               |           |       | LEL%    | PPM   | LEL%   | PPM |                                 |
| Trench 4      | 2-Feb-12  | 10:00 | 100     | 4,700 |        | 890 | Good readings                   |
| Trench 1      | 2-Feb-12  | 10:05 | 100     | 1,100 |        | 600 | " " " " " " " "                 |
| Trench 2      | 2-Feb-12  | 10:10 |         | 1,200 |        | 250 | " " " " " " " "                 |
| Trench 3      | 2-Feb-12  | 10:15 | 100     | 3,500 |        | 620 | " " " " " " " "                 |
| Trench 6      | 2-Feb-12  | 10:20 |         | 700   |        | 200 | " " " " " " " "                 |
| Trench 5      | 2-Feb-12  | 10:25 | 100     | 1,100 |        | 250 | " " " " " " " "                 |
| Trench 7      | 2-Feb-12  | 10:30 | 100     | 1,550 |        | 470 | " " " " " " " "                 |
| Gas 1         | 2-Feb-12  | 10:35 |         | 370   |        | 200 | " " " " " " " "                 |
| Gas 2         | 2-Feb-12  | 10:40 |         | 210   |        | 160 | " " " " " " " "                 |
| Gas 3         | 2-Feb-12  | 10:45 |         | 200   |        | 180 | " " " " " " " "                 |
| Gas 5         | 2-Feb-12  |       |         |       |        |     |                                 |
| Gas 4         | 2-Feb-12  | 10:55 |         | 450   |        | 210 | " " " " " " " "                 |
| Gas 6         | 2-Feb-12  |       |         |       |        |     |                                 |
|               |           |       |         |       |        |     |                                 |
| Trench 4      | 23-Apr-12 | 9:15  | 100     | 4,000 |        | 520 | Damp Conditions                 |
| Trench 1      | 23-Apr-12 | 9:20  | 100     | 760   |        | 190 | " " " " " " " "                 |
| Trench 2      | 23-Apr-12 | 9:30  |         | 590   |        | 110 | " " " " " " " "                 |
| Trench 3      | 23-Apr-12 | 9:40  | 100     | 1,900 |        | 100 | " " " " " " " "                 |
| Trench 6      | 23-Apr-12 | 9:45  |         | 400   |        | 120 | " " " " " " " "                 |
| Trench 5      | 23-Apr-12 | 9:50  | 95      | 700   |        | 240 | " " " " " " " "                 |
| Trench 7      | 23-Apr-12 | 9:55  | 95      | 690   |        | 290 | " " " " " " " "                 |
| Gas 1         | 23-Apr-12 | 10:00 |         | 290   |        | 180 | " " " " " " " "                 |
| Gas 2         | 23-Apr-12 | 10:05 |         | 300   |        | 200 | " " " " " " " "                 |
| Gas 3         | 23-Apr-12 | 10:10 |         | 300   |        | 290 | " " " " " " " "                 |
| Gas 5         | 23-Apr-12 |       |         |       |        |     |                                 |
| Gas 4         | 23-Apr-12 | 10:20 |         | 210   |        | 150 | " " " " " " " "                 |
| Gas 6         | 23-Apr-12 |       |         |       |        |     |                                 |
|               |           |       |         |       |        |     |                                 |
| Trench 4      | 17-Jul-12 |       | 100     | 4,800 |        | 770 | Good readings                   |
| Trench 1      | 17-Jul-12 |       | 100     | 1,000 |        | 190 | " " " " " " " "                 |
| Trench 2      | 17-Jul-12 |       |         | 800   |        | 210 | " " " " " " " "                 |
| Trench 3      | 17-Jul-12 |       | 100     | 4,800 |        | 280 | Small Pocket                    |
| Trench 6      | 17-Jul-12 |       | 87      | 660   |        | 260 | " " " " " " " "                 |
| Trench 5      | 17-Jul-12 |       | 100     | 990   |        | 340 | " " " " " " " "                 |
| Trench 7      | 17-Jul-12 |       | 100     | 1,380 |        | 800 | " " " " " " " "                 |
| Gas 1         | 17-Jul-12 |       |         | 310   |        | 250 | " " " " " " " "                 |
| Gas 2         | 17-Jul-12 |       |         | 280   |        | 200 | " " " " " " " "                 |
| Gas 3         | 17-Jul-12 |       |         | 270   |        | 240 | " " " " " " " "                 |
| Gas 5         | 17-Jul-12 |       |         |       |        |     |                                 |
| Gas 4         | 17-Jul-12 |       |         | 490   |        | 190 | " " " " " " " "                 |
| Gas 6         | 17-Jul-12 |       |         |       |        |     |                                 |
|               |           |       |         |       |        |     |                                 |
|               |           |       |         |       |        |     |                                 |
| Trench 4      | 25-Oct-12 | 13:20 | 100     | 5,000 |        | 810 | Good Readings                   |
| Trench 1      | 25-Oct-12 | 13:25 | 100     | 1,080 |        | 470 | " " " " " " " "                 |
| Trench 2      | 25-Oct-12 | 13:40 | 69      | 810   |        | 230 | " " " " " " " "                 |
| Trench 3      | 25-Oct-12 | 13:50 | 100     | 2,000 |        | 600 | " " " " " " " "                 |
| Trench 6      | 25-Oct-12 | 13:55 | 89      | 790   |        | 220 | " " " " " " " "                 |
| Trench 5      | 25-Oct-12 | 14:00 | 100     | 1,000 |        | 380 | " " " " " " " "                 |
| Trench 7      | 25-Oct-12 | 14:05 | 100     | 1,350 |        | 470 | " " " " " " " "                 |
| Gas 1         | 25-Oct-12 | 14:15 |         | 320   |        | 210 | " " " " " " " "                 |
| Gas 2         | 25-Oct-12 | 14:20 |         | 200   |        | 190 | " " " " " " " "                 |
| Gas 3         | 25-Oct-12 | 14:25 |         | 240   |        | 170 | " " " " " " " "                 |
| Gas 5         | 25-Oct-12 |       |         |       |        |     |                                 |
| Gas 4         | 25-Oct-12 | 14:30 |         | 480   |        | 200 | " " " " " " " "                 |
| Gas 6         | 25-Oct-12 |       |         |       |        |     |                                 |
|               |           |       |         |       |        |     |                                 |
| Weighbridge   | 25-Oct-12 | 12:30 |         | 0     |        | 0   | All Buildings no reading at all |
| Cleaning Shed | 25-Oct-12 | 12:40 |         | 0     |        | 0   | " " " " " " " "                 |
| MRF           | 25-Oct-12 | 12:45 |         | 0     |        | 0   | " " " " " " " "                 |
| Lunchroom     | 25-Oct-12 | 12:50 |         | 0     |        | 0   | " " " " " " " "                 |
| Ute Shed      | 25-Oct-12 | 13:00 |         | 0     |        | 0   | " " " " " " " "                 |

**CALIBRATED WITH SPAN GAS:**



Source: Neil Charters Pty Ltd

## GAS WELL MONITORING LOCATIONS

KIAMA MUNICIPAL COUNCIL - MINNAMURRA LANDFILL

Date: 7 August 2006

Reference: E2W\_047\_10.cdr

Figure 1