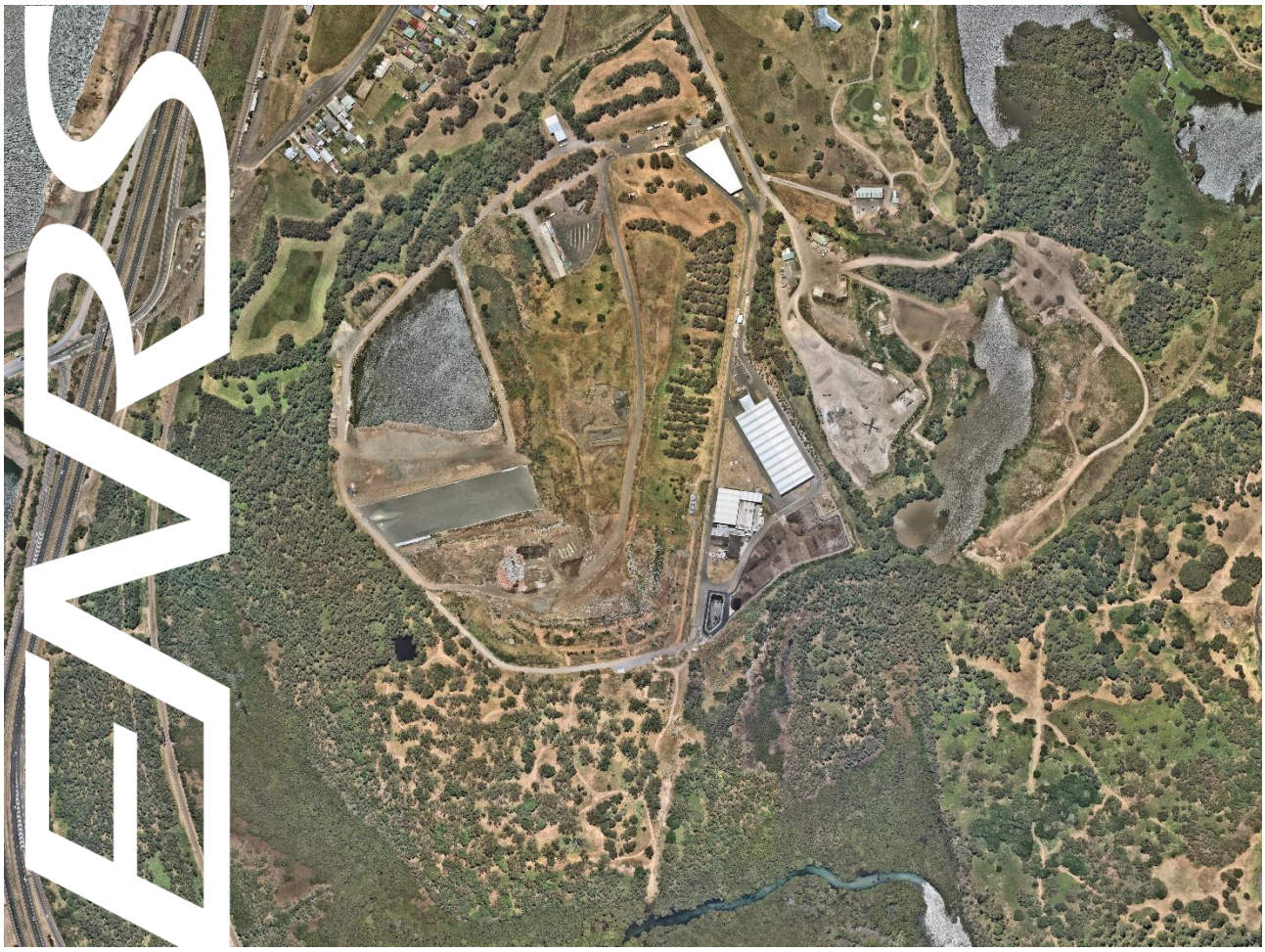

QUARTERLY ENVIRONMENTAL MONITORING REPORT (QEMR) DECEMBER 2019

DUNMORE RECYCLING & WASTE DEPOT
44 BUCKLEYS ROAD,
DUNMORE, NSW, 2529

ENVIRONMENT PROTECTION LICENCE (EPL) 5984

Prepared For: **Shellharbour City Council**

Project Number: **ENRS0033**

Date: **January 2020**

ENVIRONMENT & NATURAL RESOURCE SOLUTIONS
108 Jerry Bailey Road, Shoalhaven Heads, NSW
T 02 4448 5490 E: projects@enrs.com.au
ABN 68 600 154 596 WWW.ENRS.COM.AU

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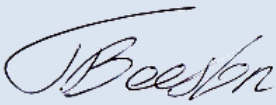
ACKNOWLEDGEMENTS

The project was conducted through close liaison with Shellharbour City Council (SCC) and ALS Environmental.

Author and Document Control

Written/Submitted by:	Reviewed / Approved by:
 **Paddy Lenane (BEng.)** *Environmental Engineer and Consultant*	 **Rohan Last (BSc. MSc)** *Hydrogeologist & Environmental Scientist*
 **Taite Beeston (BSc.)** *Geologist & Environmental Consultant*	

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EXECUTIVE SUMMARY

Environment & Natural Resource Solutions (ENRS Pty Ltd) were commissioned as independent environmental consultants by *ALS Environmental* (Wollongong) on behalf of *Shellharbour City Council* (SCC) to prepare the Quarterly Environmental Monitoring Report (QEMR) for the Dunmore Recycling and Waste Depot (herein referred to as the Site).

This report summarises the results of field testing and laboratory analysis conducted by ALS for the December 2019 quarterly monitoring period. This Quarterly Report provides the necessary data assessment and analysis to meet requirements of the Site's Environment Protection Licence/s (EPL's); No.5984 and No.12903.

The objectives of this Quarterly Environmental Monitoring Report are to:

- Meet the environmental monitoring requirements of Sites EPLs; No. 5984 and 12903;
- Assess and analyse the environmental monitoring data for the Site against NSW EPA endorsed criteria;
- Identify any on-site or off-site impacts associated with operation of the Site;
- Advise SCC if the current environmental monitoring program is providing adequate information to identify potential environmental impacts from existing operations (if any) and provide recommendations on improvement to the monitoring program if required; and
- Document monitoring results in a Quarterly Environmental Monitoring Report.

The scope of work for this Quarterly Environmental Monitoring Report comprised the collation, assessment and reporting of Site data made available to ENRS from the quarterly December 2019 monitoring period in regard to the following tasks:

- Review previous reports and document the hydrogeological setting;
- Tabulate results of all monitoring data for both water and dust samples, collected and provided by ALS as required by the EPLs for the respective reporting period.
- Analysis and interpretation of all monitoring data (water, dust and landfill surface gas);
- Identification of any deficiencies in environmental performance identified by the monitoring data, trends or environmental incidents, and identification of remedial actions taken or proposed to be taken to address these deficiencies; and
- Recommendations on improving the environmental performance of the facility including improvement to the monitoring program.

Based on the findings obtained during the December 2019 quarterly monitoring program the following conclusions and recommendations are provided:

- Shallow groundwater flow is expected to mimic topography with low hydraulic gradients flowing towards the south and southeast towards Rocklow creek. The nearest sensitive receptors are likely to include; recreational users of the Minnamurra River estuary environs; down gradient stakeholders; and downgradient alluvial aquifers, swamps, Rocklow Creek, Minnamurra River and Groundwater Dependent Ecosystems near discharge zones;

- Groundwater at the Site was considered to be likely impacted by site activities. Key indicators of landfill activities and leachate (ammonia, heavy metals and nitrate) were identified in exceedance of the assessment criteria within multiple groundwater bores; BH-1c, BH-2, BH-4, BH-9, BH-10, BH-12r, BH-, BH-14, BH-15, BH-19r, BH-20 and BH-20s). This is consistent with previous monitoring events;
- Onsite surface water samples (SWP-1, SW-2, SWP-4 and SWP-5) reported concentrations of leachate indicators below onsite groundwater samples. However, ENRS note that ammonium was not analysed within these samples;
- Downgradient Rocklow Creek surface water samples (SWC-Up, SWC-2, SWC-down and SWC-down 2) were generally reported within the adopted Site Assessment Criteria. Concentrations of ammonium and nitrate were below the ANZECC (2000) trigger values for marine waters. This is consistent with previous monitoring events (*Environmental earth Sciences*, 2018);
- The existing monitoring locations and sampling regime (specified in EPL 5984) is generally considered to provide a suitable assessment of surface water, leachate and groundwater conditions;
- Surface gas methane monitoring reported satisfactory results all within the adopted assessment criteria;
- Dust deposition gauges recorded elevated results above the adopted guidelines. The December 2019 period was the first round of sampling to include the four (4) sample locations. Monitoring should continue to establish baseline conditions and/or causes of the dust;
- No non-compliances with the EPL were reported during the December 2019 quarterly monitoring period;
- Based on this review of the quarterly December 2019 monitoring period, contaminants associated with the landfill cell, leachate dam/s and general site uses are considered to be relatively consistent with the range of historical results; and
- Should any change in Site conditions or incident occur which causes a potential environmental impact, a suitable environmental professional should be engaged to further assess the Site and consider requirements for any additional monitoring.

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1.0 INTRODUCTION

Environment & Natural Resource Solutions (ENRS Pty Ltd) were commissioned as independent environmental consultants by *ALS Environmental* (Wollongong) on behalf of *Shellharbour City Council* (SCC) to prepare the Quarterly Monitoring Report for the Dunmore Recycling and Waste Depot (herein referred to as the Site).

This report summarises the results of field testing and laboratory analysis conducted by ALS for the December 2019 quarterly monitoring period. This Quarterly Report provides the necessary data assessment and analysis to meet requirements of the Site's Environment Protection Licence/s (EPL's); No.5984 and No.12903.

1.1 PROJECT BACKGROUND

1.1.1 Site History

The Site was established in 1945 and has been managed by Shellharbour Council (SC) since 1983. The Site accepts putrescible and non-putrescible waste within its managed landfill cell. Recycling activities conducted at the site include Resource Recovery Centre, Revolve Centre and Food Organics and garden Organics (FOGO) processing.

1.1.2 EPL Requirements

Waste regulation in NSW is administered by the EPA under the Protection of the Environment Operations (POEO) Act (1997); the *Waste Avoidance and Resource Recovery Act* (2001).

The Site operates under the conditions of two (2) EPLs:

- **EPL No. 5984**. Landfill activities. Consisting of; extractive activities, waste disposal and composting.
- **EPL No. 12903**. Resource recovery activities. Consisting of; composting and waste storage within the FOGO Facilities and Resource Recovery Centre.

A copy of the relevant EPL sections outlining the sampling requirements are provided in **Appendix A** (EPL No. 5984). ENRS note that EPL No. 12903 does not specify sample points.

1.2 OBJECTIVES

The objectives of this Quarterly Environmental Monitoring Report are to:

- Meet the environmental monitoring requirements of Sites EPLs; No. 5984 and 12903;
- Assess and analyse the environmental monitoring data for the Site against NSW EPA endorsed criteria;
- Identify any on-site or off-site impacts associated with operation of the Site;

- Advise SCC if the current environmental monitoring program is providing adequate information to identify potential environmental impacts from existing operations (if any) and provide recommendations on improvement to the monitoring program if required; and
- Document monitoring results in a Quarterly Environmental Monitoring Report.

1.3 SCOPE OF WORK

The scope of work for this Quarterly Environmental Monitoring Report comprised the collation, assessment and reporting of Site data made available to ENRS from the quarterly December 2019 monitoring period in regard to the following tasks:

- Review previous reports and document the hydrogeological setting;
- Tabulate results of all monitoring data for both water and dust samples, collected and provided by ALS as required by the EPLs for the respective reporting period.
- Analysis and interpretation of all monitoring data (water, dust and landfill surface gas);
- Identification of any deficiencies in environmental performance identified by the monitoring data, trends or environmental incidents, and identification of remedial actions taken or proposed to be taken to address these deficiencies; and
- Recommendations on improving the environmental performance of the facility including improvement to the monitoring program.

2.0 SITE DESCRIPTION

2.1 LOCATION

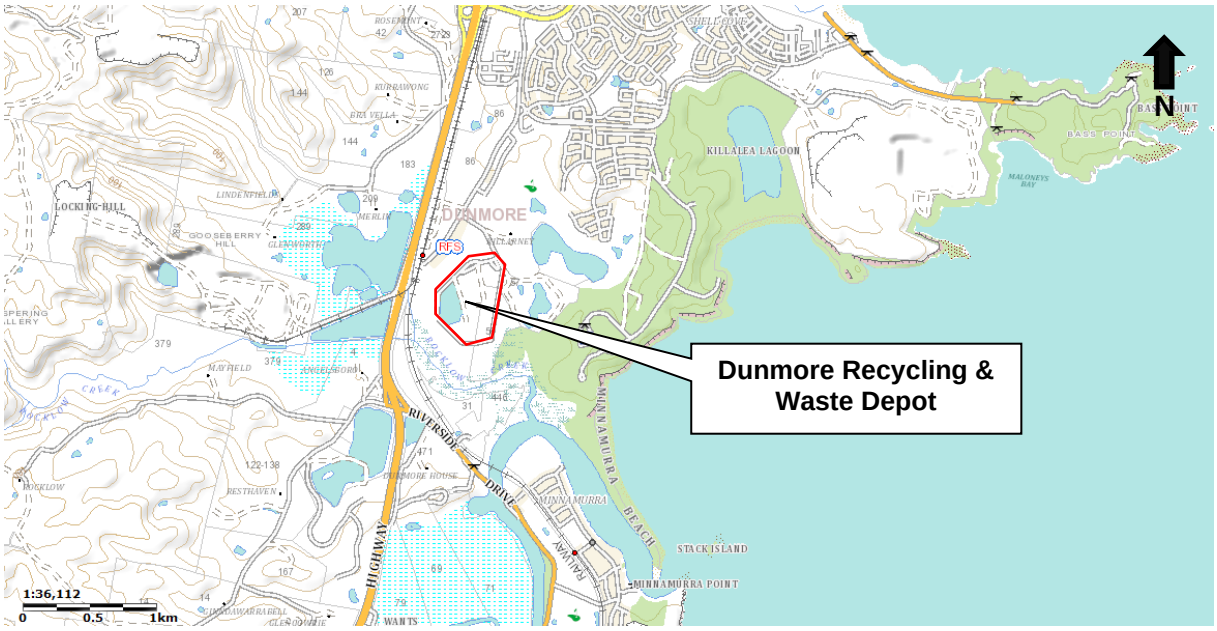
The Site is located at 44 Buckleys Road, Dunmore, NSW, 2529, legally defined as Lot 21 in Deposited Plan 653009 and Lot 1 Deposited Plan 419907. The Site is situated approximately three and a half (3.5) kilometres southwest of the Shellharbour town centre. The area's regional location is defined in **Figure 1** below. Details of the Site boundary and sampling points are provided in the Site Plan (see **Figure 2**). The key features required to identify the Site are summarised in **Table 1**.

Table 1: Site Identification

Aspect	Description
Site	Dunmore Recycling and Waste Depot
Street Address	44 Buckleys Road, Dunmore, NSW 2529
Site Area	72.36 hectares
Title Identifier	Lot 21 DP 653009, Lot 1 DP 419907

Aspect	Description
Zoning	RU1 Primary Production
Local Government Area	Shellharbour City Council

Figure 1: Site Location Map



Source: SIX Maps (https://maps.six.nsw.gov.au/) (cited 16/01/2020)

2.2 SURROUNDING LANDUSE

The current activities and operations on adjacent properties and the surrounding area include:

Table 2: Surrounding Land use

Direction	Land Use
North:	Buckleys Road, commercial infrastructure and open grassland. Residential dwellings along the northwest border of the Site. Golf course further to the northeast.
East:	Dunmore Resources and Recycling facility immediately to the east, bushland to the southeast.
South:	Bushland, Rocklow Creek (300m from landfill activities). Further to Kiama Community Recycling Centre and Riverside Drive.
West:	Bushland to the southwest, scattered trees immediately to the west and further to the Princes Highway. Boral Quarries complex beyond the Highway. Residential dwellings to the Northwest.

2.2.1 Sensitive Receptors

The nearest sensitive receptors are likely to include:

- Recreational users of the Minnamurra River estuary environs;
- Down gradient stakeholders; and
- Down gradient alluvial aquifers, swamps, Rocklow Creek, Minnamurra River and Groundwater Dependent Ecosystems (GDE) near discharge zones.

2.3 TOPOGRAPHY & DRAINAGE

A review of the current series Albion Park (90281N) 1:25,000 topographic map sheet was conducted to assess the regional topography and to identify potential runoff and groundwater controls in the region. Topography provides a useful indicator for groundwater controls including gradient and flow path.

The Site presents low topographic relief, remaining between approximately 3-5 mAHD across the entirety of the Site. The regional topographic gradient trends south-southeast towards Rocklow Creek and Minnamurra River.

2.4 SOIL LANDSCAPE

The previous annual monitoring report (Environmental Earth Sciences 2018) reported the soil profile at the Site as organic, black, massive sandy loam topsoil overlying loose bleached light grey sand with iron staining in the subsoil.

Review of the online *Shellharbour City Council* Acid Sulphate Soil Risk Map indicates that the Site lies within a **Class 3** area, suggesting that works beyond 1 metre below the ground level (mbGL) have the potential to encounter Acid Sulphate Soils (ASS).

2.5 GEOLOGY

A review of the Site geology was undertaken with reference to the Wollongong 1:250,000 geological series sheet (Si56.9) and the Shellharbour-Kiama area coastal quaternary 1:50,000 geology sheet. The Site is predominately underlain by the Quaternary alluvial deposits (Qal) characterised as Holocene backbarrier flat; marine sand, silt, clay, gravel and shell (Qhbf). The northern most corner of the site is intersected by the Gerringong Volcanics (Pbb) characterised by Latite. Based on the mapped geology, previous investigations and borehole logs, the Site infrastructure including the landfill cell is located within the alluvial deposits.

2.6 HYDROGEOLOGY

Groundwater resources in the area are expected to be associated with *Shallow unconfined* alluvial and unconsolidated systems, generally less than 20 m in depth with moderate to high transmissivity, variable water quality, and strongly controlled by rainfall recharge.

2.6.1 Existing Bores

A network of groundwater monitoring bores is installed at the Site to provide specific data on the quality and nature of groundwater.

A review of the *NSW Office of Water* (*NOW*) existing bore records was conducted to develop the conceptual understanding of regional groundwater conditions, including aquifer depths, yields, water quality, and distribution. A search of the Bureau of Meteorology Australian Groundwater Explorer groundwater database identified a total of eighty-eight (88) registered bores within one and a half (1.5) kilometres of the Site (see **Figure 5**). Registered bores in the area are predominantly associated with the Landfill Site and with the quarry complex (*Boral Site*) to the west of the EPL Site. The majority of bores are registered for monitoring purposes, excluding a single well (GW044447), which is registered for stock and domestic purposes. The stock bore is located approximately one (1) kilometre to the north of the Site, on the western side of the Princes Highway, which is considered to be up gradient of the Site and not in direct hydraulic connectivity. Registered bore depths are between 1.25 m and 22 m. Bore records indicate shallow unconsolidated aquifer systems.

2.6.2 Flow Regime

Previous reports (Environmental Earth Sciences 2018) have identified that groundwater flows vary across the Site, but the general trend is south, towards Rocklow Creek.

Based on the unconfined nature of the aquifer, the shallow groundwater flow is inferred to mimic topography with low to moderate hydraulic gradients flowing towards the south.

The Site and adjoining land, is largely unsealed with potential for local recharge from rainfall infiltration. Likely discharge areas are predominantly to the south and east of the Site including swamps and Rocklow Creek. The waterbodies surrounding the Site are recognised as State Environmental Planning Policy No.14 (SEPP14) registered wetlands and Proximity Areas for Coastal Wetlands border the eastern, southern and western boundaries of the Site.

2.7 SURFACE WATER

The Site topography indicates that surface water flow will generally trend to the east towards off Site wetlands and southeast towards Rocklow Creek. These present the primary regional drainage structures for natural surface water and runoff. A series of stormwater infrastructure is present at the Site which is expected to capture run off. Infrastructure includes but not limited to; stormwater drains; sedimentation ponds; levee banks; collection and diversion drains; and leachate dams.

3.0 ASSESSMENT CRITERIA

3.1 CONTAMINANTS OF POTENTIAL CONCERN

This section of the report provides a summary of the Contaminants of Potential Concern (CoPC) associated with the Site. CoPC's are identified in the Sites EPL/s which document the

CoPC and water quality indicators required to be monitored. Analytical requirements for all water, dust and surface gas sampling are provided in Appendix A, Appendix B, and Appendix C, respectively.

3.2 WATER QUALITY GUIDELINES

Nationally developed guidelines are provided in the National Water Quality Management Strategy (NWQMS): Guidelines for Groundwater Protection in Australia (ARMCANZ & ANZECC 1995). For the purpose of this assessment, the relevant criteria selected to protect environmental values are summarised in **Table 3** below:

Table 3: Groundwater Assessment Criteria

Environmental Value	Relevant Guideline
Ecosystems / Health Screening Levels	ANZG (2018) (Australian and New Zealand Guidelines for Fresh and Marine Water Quality).
	National Environment Protection Measure (NEPM) (2013).
Drinking Water	Australian Drinking Water Guidelines (ADWG) (2018)

3.2.1 ANZECC Guidelines

The relevant criteria for this water quality assessment are the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG;2018). The ANZG (2018) provide Default Guideline Values (DGVs) for four (4) levels of protection categorised by the percentage of species possibly affected, being 80%, 90%, 95% or 99% of species. Values for a level of protection for 95% of species in a marine environment have been adopted and are displayed in **Table 4**. Reference has also been made to previous reports (Environmental Earth Sciences;2018). Where DVGs are not available reference is made against the ANZECC (2000) Trigger Values (TVs). The *NSW Office of Water* (DECCW;2007) endorsed groundwater management guidelines recommend assessment for aquatic ecosystems based on the ***95 per cent of species level of protection***.

Table 4: Adopted Guideline Criteria

Parameter	Groundwater Guideline	Surface water Guideline
Ammonia	2.09 mg/L	1.88 mg/L
Nitrate	10.6 mg/L	10.6 mg/L
pH	6.5-8.5 pH units	6.5-8.5 pH units
Soluble Iron	0.3 mg/L	0.3 mg/L
Manganese	1.9 mg/L	1.9 mg/L
Electrical Conductivity	125-2200 µS/cm	-

3.2.2 National Environmental Protection Measure (NEPM)

The NSW EPA has endorsed the use of the Groundwater Investigation Levels (GILs) given in the 2013 ASC NEPM 'Schedule B(1) Guideline on the Investigation Levels for Soil and Groundwater'. The latest NEPM provide a framework for risk-based assessment of groundwater contamination.

Groundwater Health Screening Levels (HSLs) are provided for four (4) land use categories for vapour intrusion (Table 1A[4]) associated with Total Recoverable Hydrocarbons TRH (F1 & F2) and BTEX compounds.

NEPM	Description of Land use Categories
HIL A	Residential A with garden/accessible soil also includes children's day care centres, preschools and primary schools.
HIL B	Residential B with minimal opportunities for soil access; includes buildings with fully and permanently paved yard space such as high-rise buildings and apartments.
HIL C	Recreational C includes public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and unpaved footpaths.
HIL D	Commercial/industrial D includes premises such as shops, offices, factories and industrial sites.
GILs	Groundwater Investigation Levels (GILs) should be applied based on the receiving environment and groundwater resources. GILs are provided in NEPM Table 1C for; Fresh Waters; Marine Waters; and Drinking Water;
EILs	Ecological Investigation Levels (EILs) for common contaminants in the top two (2) metres of soil based on three (3) generic land use settings: • Areas of ecological significance; • Urban residential areas and public open space; and Commercial and industrial land uses.

3.3 DUST DEPOSITION ASSESSMENT CRITERIA

Criteria for collection and assessment of dust deposition concentrations are provided within the Australian standard AS3580.10.1 - Methods for sampling and analysis of ambient air; method 10.1- Determination of particulate matter - Deposited matter - Gravimetric method. AS3580.10.1 provides an acceptable level of 4 g/m^2/month.

3.4 SURFACE METHANE GAS ASSESSMENT CRITERIA

The NSW EPA Solid Waste Landfill Guidelines 2nd Edition (2016) provides sampling methodologies and threshold for surface methane gas concentrations at landfill sites. The acceptable threshold for capped landfills is 500 parts per million (ppm) at 5 cm above the capping surface.

4.0 SAMPLING METHODOLOGY

Field sampling was conducted by *ALS Environmental* (Wollongong) as commissioned by *SCC* during December 2019 and January 2020. ENRS understands that sampling was conducted in accordance with ALS sampling protocols with reference to current industry standards and Code of Practices. The following sub-sections provide a summary of the sampling methodologies.

Monitoring frequency is defined by the EPL/s and is designed to capture necessary site data to support assessment of Site conditions (quarterly and annual), any long-term trends or overflow events. Monitoring is conducted quarterly and annually for selected analytes with additional overflow and event-based sampling triggered by Site conditions.

4.1 WATER SAMPLING

4.1.1 Location of Water Monitoring Points

Groundwater and surface water monitoring requirements are defined by the EPL No. 5984, as provided in Appendix A. In summary the sampling regime collected samples from; eight (8) surface waters; seventeen (17) groundwater monitoring wells; and two (2) leachate points. Sampling locations are illustrated in **Figure 2** attached.

4.1.2 Depth to Water

Prior to sampling, the depth to the groundwater table was measured from the top of casing (TOC) using a water dipper and clear disposable bailer. The bores were inspected for the presence of hydrocarbon and the thickness of any LNAPL was measured visually in clear disposable bailers. ***No LNAPL was identified in monitoring Wells***.

4.1.3 Sample Collection

Sampling is conducted independently by *ALS Environmental* under contract with *SCC*. Chain of Custody records and field sheets are provided in Appendix E. ENRS understand sampling is conducted in accordance with *ALS* sampling protocols.

4.1.4 Groundwater Sampling

Groundwater Wells were sampled in order of distance from any areas of known contamination to ensure that lower contaminated Wells are sampled before likely higher contaminated Wells. Groundwater bores were purged prior to sampling by removing at least three (3) well volumes or low flow parameter stabilisation methods applied with field sheets provided to document pumping volumes and field parameters. Samples were collected using clear disposal bailers. and were sealed in laboratory-prepared sampling containers appropriate for the analysis. All samples were stored on ice immediately after their collection and transported to the laboratory under Chain of Custody (CoC) documentation.

Surface water and leachate samples were collected using as ‘grab samples’ from the midpoint of the structure and at mid-depth.

Any loss of volatile compounds was kept to a minimum by employing the following sampling techniques:

- Minimal practical disturbance during sampling;
- Samples placed in sample containers as soon as possible;
- Sample containers contain zero headspace;
- Samples placed directly on ice and transported to the laboratory as soon as possible; and
- Employing the most appropriate analytical method to minimise volatile losses at the laboratory.

4.1.5 Field Testing

Field testing was conducted during bore purging and sampling to record physical water parameters. A multi-probe water quality meter was used to measure the following parameters:

- Oxygen Reduction Potential (ORP, representing redox).
- Electrical Conductivity (Salinity - EC);
- Temperature; and
- pH (Acidity).

4.2 DUST DEPOSITION SAMPLING

Measurement of Dust deposition was carried out in accordance with the Australian Standard AS3580.10.1 (2016). This Australian Standard provides a mean of determining the mean surface concentration of deposited matter from the atmosphere.

Dust collection gauges were set up for a one (1) month period between the ***11th December 2019*** and ***16th January 2020***. A total of four (4) dust monitoring locations were considered adequate to assess site conditions. ENRS note that the December 2019 quarterly sampling was the first event to four (4) dust gauges.

4.3 SURFACE METHANE GAS MONITORING

The concentration of methane gas (in units of ppm) at the Site was carried out in accordance with EPA Guidelines Solid Waste Landfill 2nd Edition 2016. On the day of sampling the wind speed was below 10 km/hr. Testing was conducted using a calibrated *LaserOne* portable gas monitor specifically designed for landfill gas monitoring. A calibration Certificate is provided in Appendix F.

One field technician commenced data collection along transect lines in a grid pattern across the landfill surface at 25-metre spacings. A site plan depicting the sampled transect line is provide in **Figure 3**. Transects were recorded using a Magellan *SporTrak* GPS. The concentration of methane gas was measured at a height of 5 cm above the ground in areas with intermediate or final cover over the emplaced waste. The concentration of methane gas

was also recorded in any buildings located within a distance of 250 m of the deposited waste, and any depressions or surface fissures away from the sampling grid were also investigated.

4.4 LABORATORY ANALYSIS

ALS, a NATA accredited laboratory, was contracted by *SC* to undertake the sample analysis in accordance with current standards. Laboratory QA/QC results are detailed in the Laboratory reports contained in the appendices section of this report.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

5.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQO) are required to define the quality and quantity of data needed to support management decisions. The process for establishing DQO's is documented by Australian Standard: AS 4482.1-2005 and referenced by the National Environment Protection (Assessment of Site Contamination) Measure (NEPC;2013). The DQO's for the investigation were to obtain representative data to allow assessment of:

- groundwater quality;
- The risks posed to human health and the environment, including potential future users of the Site; and
- The requirements for any further investigative works.

The assessment was conducted to a standard consistent with generally accepted and current professional consulting practice for such an investigation. The evaluation criteria adopted for the investigation are summarised in **Table 5**.

Table 5: Data Quality Objectives

DQO	Evaluation Criteria
Documentation completeness	Completion of field records, chain of custody documentation, laboratory test certificates from NATA-accredited laboratories.
Data comparability	Use of appropriate techniques for the sampling, storage and transportation of samples. Use of NATA accredited laboratory using NEPM endorsed procedures.
Data representativeness	Adequate sampling coverage of all areas of environmental concern at the Site, and selection of representative samples.
Precision and accuracy for sampling and analysis	Use properly trained and qualified field personnel and achieve field and laboratory QA/ QC criteria.

5.2 QA/QC PROCEDURES

Data provided for the purpose of this report by SC was prepared by *ALS.* *ALS* is NATA accredited for the laboratory testing. The QA/QC indicators as provided to ENRS either all complied with the required standards, or showed variations that would have no significant effect on the quality of the data or the conclusions of this environmental assessment. Therefore, the data is considered acceptable for use in this assessment.

It should be noted that whilst the EPL does not require field duplicates, ENRS recommend sampling include rinsate samples and field duplicates at the standard rate of 1 in 10, or field QA/QC is conducted in accordance with *ALS* procedures.

5.3 EPL NON-COMPLIANCE

Monitoring requirements are defined by the EPL. ENRS understand the December 2019 quarterly monitoring results identified no non-compliance with the terms of the EPL. It is noted that BH5 was destroyed and a variation to amend the EPL to remove BH5 from the sampling regime was lodged by Council with the EPA prior to this sampling event, which is satisfactory.

6.0 WATER QUALITY RESULTS

Laboratory results for groundwater and surface water were provided to ENRS for tabulation and comparison with relevant EPL assessment criteria. A summary of results is provided in **Table 8** with comparison against the relevant Site Assessment Criteria (SAC). Exceedances of relevant guidelines are also summarised in **Table 6**. The laboratory certificates of analysis are provided in Appendix C.

6.1 OVERFLOW RESULTS

ENRS understand no overflow events were recorded during the December 2019 quarterly monitoring period. Hence, no water samples were collected by *ALS* and no results are presented for this reporting period.

6.2 FIELD TESTING

Field testing is conducted by ALS during sampling to record physical water parameters. Records of field measurements are provided in Appendix C. A water quality meter is used to measure the following parameters in the field:

- Electrical Conductivity (Salinity);
- pH (Acidity); and
- Dissolved Oxygen

6.3 PHYSICAL INDICATORS

6.3.1 Salinity (EC & TDS)

Salinity is reported by the laboratory as either Electrical Conductivity (EC) or Total Dissolved Solids (TDS). The ANZECC guidelines document a conversion ratio for of 0.68 mg/L = 0.68 EC (µS/cm). Table 3.3.3 of the ANZECC (2000) guidelines document default TV for EC in lowland rivers between 125 µS/cm - 2,200 µS/cm (~1,500 mg/L).

Groundwater

Salinity in groundwater is typically higher than surface water due to mineral dissolution. Groundwater salinity at the Site was reported between **1,100 mg/L** (BH-a) and **10,400 mg/L** (BH-15) which is above the TV.

Leachate

Leachate salinity for the quarterly December 2019 monitoring period was reported to be **16,200 µS/cm** (LP1) and **16,600 µS/cm** (Sump) which is above the TV.

6.3.2 Dissolved Oxygen

Levels of Dissolved Oxygen (DO) were measured in the field during sampling. DO reflects the equilibrium between oxygen-consuming processes and oxygen-releasing processes. DO can initiate redox reactions resulting in the uptake or release of nutrients. Low DO concentrations can result in adverse effects on many aquatic organisms which depend on oxygen for their efficient metabolism. At reduced DO concentrations many compounds become increasingly toxic, for example Zinc, Lead, Copper, phenols, cyanide, hydrogen sulfide and Ammonia.

The ANZECC (2000) guidelines Table 3.3.2 outlines a range between 85% to 110% saturation for low land rivers. Assuming a water temperature of 18°C this is equivalent to approximately 7-11 mg/L or ppm.

Dissolved Oxygen was recorded for Leachate only, at **1.65 mg/L** (Sump) and **4.33 mg/L** (LP1).

6.3.3 pH

pH is a measure of hydrogen activity. pH determines the balance between positive hydrogen ions (H+) and negative hydroxyl ions (OH-) and provides a test of water acidity (low pH) or alkalinity (high pH). Most natural freshwaters have a pH in the range 6.5 to 8.0. Changes in pH may affect the physiological functioning of biota and affect the toxicity of contaminants. Both increases and decreases in pH can result in adverse effects, although decreases are likely to cause more significant problems. Low pH indicates acidic conditions which may increase the mobility of heavy metals, whilst high pH indicates alkaline conditions which may also generate Ammonia. Previous investigations of other regional Landfill Sites in the Illawarra-Shoalhaven (Forbes Rigby;1996) report regionally acidic groundwater with low readings in the range of 4.3 pH associated with silica saturation and oxidation of accessory marcasites grains (iron sulphide).

Surface Water

Surface water reported pH values of between **pH 7.1** (SWP-1, SWC-2) and **pH 8.7** (SWP-4).

Groundwater

Groundwater pH was reported between **pH 6.3** (BH-a) and **pH 7.4** (BH-20 and BH-20s). With the exception of BH-a, all groundwater pH results fell within the ANZECC recommended range of pH 6.5-8.0. The results are largely within the recommended range and may be considered satisfactory.

6.3.4 Total Suspended Solids (TSS)

TSS provides a measure of turbidity reported as the mass of fine inorganic particles suspended in the water. Measurement of TSS provides a valuable indication of the sediment and potential nutrient load. Elevated TSS decreases light penetration whilst phosphorus is absorbed onto sediment surfaces.

TSS was reported for surface water. Concentrations were reported between **<5 mg/L** (SWC-up, SWC-2) and **56 mg/L** (SWC-down 2).

6.4 INORGANIC ANALYTES

6.4.1 Nutrients

Water samples were analysed for select nutrients including Ammonia, Ammonium, Nitrate and Nitrite. The most bio-available forms of Nitrogen are Ammonium (NH4+) and Nitrate (NO3-). Ammonia is an oxygen-consuming compound and is toxic to aquatic biota at elevated concentrations. Ammonia toxicity increases under low oxygen levels and higher pH.

Ammonia

Ammonia was measured within groundwater monitoring bores between **0.15 mg/L** (BH-12r) and **380 mg/L** (BH-1c). Numerous exceedances of the adopted trigger value of **0.91 mg/L** were recorded.

Ammonia in leachate was reported at **1400** and **1450 mg/L** (Sump and LP1 respectively). The result is considered characteristic of untreated leachate.

Ammonium

Ammonium was measured at selected surface water monitoring locations within down-gradient Rocklow Creek between 0.03 mg/L (SWC-down 2) and 0.48 mg/L (SWC-2). Results are below the adopted trigger value of 1.88 mg/L and are considered satisfactory. ENRS note that ammonium was not analysed in onsite surface water dams; SWP-1, SWP-2, SWP-3 and SWP-5.

Nitrate

Results for Nitrate in groundwater were reported between <0.01 mg/L (BH-17r, BH-1c) and 68.4 mg/L (BH-12r). BH-12r represents the only exceedance for the quarterly December 2019 monitoring period, the next highest value being 10.6 mg/L (BH-3) which is equivalent to the trigger value.

Nitrate in leachate was reported below the LOR (LP1) and **0.01 mg/L** (Sump).

6.4.2 Metals & Metalloids

Magnesium (Total Mg)

Concentrations of magnesium in surface water were reported between 12 mg/L (SWP-1) and 1420 mg/L (SWC-down 2).

Manganese (Total Mn)

Concentrations of Manganese in groundwater were reported between 0.07 mg/L (BH-20) and 0.844 mg/L (BH-2). Leachate concentrations were reported as 0.412 mg/L (Sump) and 0.425 mg/L (LP1). These values are below the adopted TV (1.9 mg/L) and are considered acceptable. Concentrations of Manganese should continue to be reviewed during subsequent monitoring events.

6.5 ORGANIC ANALYTES

6.5.1 Total Organic Carbon

Total Organic Carbon (TOC) provides a measure of the total concentration of organic material in a water sample. TOC is typically higher in surface water than groundwater, however high TOC is also characteristic of leachate from landfill. TOC provides a marker for biological activity associated with contaminant degradation and can be used to delineate contaminant plumes. TOC influences geochemical processes by:

- acting as proton donors/acceptors;
- providing pH buffering;
- participating in mineral dissolution/precipitation reactions; and
- providing carbon substrate for microbe-based biodegradation.

TOC was reported during monitoring period at the following concentrations:

- Groundwater; between **11 mg/L** (BH-10) and **218 mg/L** (BH-1c).
- Leachate; **870 mg/L** (LP1) and **900 mg/L** (Sump).

6.6 SUMMARY OF WATER QUALITY EXCEEDANCES

The following table provides a summary of exceedances above the adopted assessment criteria for the collected water samples.

Table 6: Summary of Quarterly Water Monitoring Exceedances

Sample ID	Exceedances		Comments
	Results	Guideline	
BH-1c	Dissolved Iron 10.9 mg/L Ammonia 380 mg/L EC 7360 µS/cm	0.3 mg/L 2.09 mg/L 125-2200 µS/cm	Elevated levels of nutrients in groundwater can be indicative of interaction with leachate. High levels of ammonia in bores BH-1c, BH-2, BH-3, BH-9, BH-15 and BH-17r. High nitrate BH-10 Previous investigations (*Environmental Earth Sciences,* 2018) have also noted high levels of ammonia, total dissolved solids, potassium and nitrate in groundwater. Concentrations are considered to be consistent with historical data sets.
BH-2	Dissolved Iron 8.62 mg/L Ammonia 17.3 mg/L EC 2360 µS/cm	0.3 mg/L 2.09 mg/L 125-2200 µS/cm	
BH-3	Dissolved Iron 2.04 mg/L Ammonia 34.3 mg/L	0.3 mg/L 2.09 mg/L	
BH-4	Dissolved Iron 4.08 mg/L Ammonia 6.13 mg/L	0.3 mg/L 2.09 mg/L	
BH-9	Dissolved Iron 0.35 mg/L Ammonia 143 mg/L EC 4780 µS/cm	0.3 mg/L 2.09 mg/L 125-2200 µS/cm	
BH-10	EC 2330 µS/cm Nitrate 68.4 mg/L	125-2200 µS/cm 10.6 mg/L	
BH-12r	Nitrate 68.4 mg/L EC 2550 µS/cm	10.6 mg/L 125-2200 µS/cm	
BH-13	No exceedances		
BH-14	Dissolved Iron 0.5 mg/L Ammonia 2.86 mg/L TOC 32 mg/L	0.3 mg/L 2.09 mg/L 1.9 mg/L	
BH-15	Dissolved Iron 12.8 mg/L Ammonia 111 mg/L EC 10400 µS/cm	0.3 mg/L 2.09 mg/L 125-2200 µS/cm	
BH-16	Dry		
BH-17r	Dissolved Iron 14.9 mg/L Ammonia 12.9 mg/L	0.3 mg/L 2.09 mg/L	
BH-18r	Dry		
BH-19	Ammonia 5.43 mg/L	2.09 mg/L	
BH-20	Dissolved Iron 1.36 mg/L Ammonia 37.2 mg/L	0.3 mg/L 2.09 mg/L	
BH-20s	Ammonia 3.33 mg/L	2.09 mg/L	
SWP-1	Dissolved Iron 0.72 mg/L	0.3mg/L	Minor exceedances at sampled surface water monitoring locations
SWP-2	No exceedances		
SWP-4	pH 8.7	6.5-8.5 pH units	
SWP-5	Dry		
SWC-up	No exceedances		
SWC-down	No exceedances		
SWC-down 2	Dissolved Iron 1.48 mg/L	0.3 mg/L	
Leachate Sump	Dissolved Iron 3.22 mg/L Ammonia 1400	0.3 mg/L 2.09 mg/L	Considered to be characteristic of untreated leachate material.
Leachate Tank LP1	Dissolved Iron 3.52 mg/L Ammonia 1450	0.3 mg/L 2.09 mg/L	

7.0 DUST GAUGE RESULTS

The below table provides the results of the dust depositions results. A total of four (4) dust collectors were onsite for one (1) month between 11th December 2019 and 16th January 2020, in general accordance with AS3580.10.1.

Table 7: Summary of Dust Gauge Results

Sample ID	Guideline Criteria (g/m^2/month)	Total Insolvable Matter (g/m^2/month)	Lab Comments
DDG1	4	7.4	High levels of soil and ash
DDG2		4.7	High levels of soil and ash
DDG3		7.7	High levels of soil and ash
DDG4		4.4	High levels of soil and ash

Results for depositional dust during the December 2019 quarterly monitoring period reported levels of dust between **4.4 g/m^2/month** (DDG4) and **7.7 g/m^2/month** (DDG3). All results were reported above the adopted assessment criteria of 4 g/m^2/month. ENRS note that this was first round of sampling at each of the locations, and the monitoring period was characterized by elevated levels of regional dust from bushfires and dust storms. It is recommended that monitoring is continued as part of the quarterly regime in order to establish baseline conditions and/or establish trends at the Site.

8.0 SURFACE METHANE GAS RESULTS

The surface gas monitoring from the December 2019 quarterly monitoring period reported levels of methane between 0.9 ppm and 8.6 ppm which is below the EPA license limits of 500 ppm. The results are considered satisfactory. A summary of results is provided in Appendix E.

9.0 ENVIRONMENTAL ASSESSMENT

9.1 MONITORING POINT SUMMARY

Field measurements and laboratory water quality results from the quarterly December 2019 quarterly monitoring period reported concentrations analytes generally within the range historical values. Groundwater and surface water within the Site boundary reported high levels of analytes considered to be characteristic of landfill and leachate. Offsite sample locations within Rocklow Creek reported satisfactory results. Results are considered to be consistent with historical monitoring events.

All dust gauges were reported above the site assessment criteria. This sampling event was the first to include all four (4) locations. Monitoring should continue to establish baseline conditions and/or causes of the dust.

Results of surface methane gas monitoring recorded satisfactory results. The landfill surface cap is therefore considered intact and effective.

10.0 CONCLUSION AND RECOMMENDATIONS

Based on the findings obtained during the December 2019 quarterly monitoring program the following conclusions and recommendations are provided:

- Shallow groundwater flow is expected to mimic topography with low hydraulic gradients flowing towards the south and southeast towards Rocklow creek. The nearest sensitive receptors are likely to include; recreational users of the Minnamurra River estuary environs; down gradient stakeholders; and downgradient alluvial aquifers, swamps, Rocklow Creek, Minnamurra River and Groundwater Dependent Ecosystems near discharge zones;
- Groundwater at the Site was considered to be likely impacted by site activities. Key indicators of landfill activities and leachate (ammonia, heavy metals and nitrate) were identified in exceedance of the assessment criteria within multiple groundwater bores; BH-1c, BH-2, BH-4, BH-9, BH-10, BH-12r, BH-, BH-14, BH-15, BH-19r, BH-20 and BH-20s). This is consistent with previous monitoring events;
- Onsite surface water samples (SWP-1, SW-2, SWP-4 and SWP-5) reported concentrations of leachate indicators below onsite groundwater samples. However, ENRS note that ammonium was not analysed within these samples;
- Downgradient Rocklow Creek surface water samples (SWC-Up, SWC-2, SWC-down and SWC-down 2) were generally reported within the adopted Site Assessment Criteria. Concentrations of ammonium and nitrate were below the ANZECC (2000) trigger values for marine waters. This is consistent with previous monitoring events (*Environmental earth Sciences*, 2018);
- The existing monitoring locations and sampling regime (specified in EPL 5984) is generally considered to provide a suitable assessment of surface water, leachate and groundwater conditions;
- Surface gas methane monitoring reported satisfactory results all within the adopted assessment criteria;
- Dust deposition gauges recorded elevated results above the adopted guidelines. The December 2019 period was the first round of sampling to include the four (4) sample locations. Monitoring should continue to establish baseline conditions and/or causes of the dust;

- No non-compliances with the EPL were reported during the December 2019 quarterly monitoring period;
- Based on this review of the quarterly December 2019 monitoring period, contaminants associated with the landfill cell, leachate dam/s and general site uses are considered to be relatively consistent with the range of historical results; and
- Should any change in Site conditions or incident occur which causes a potential environmental impact, a suitable environmental professional should be engaged to further assess the Site and consider requirements for any additional monitoring.

11.0 LIMITATIONS

This report and the associated services performed by ENRS are in accordance with the scope of services set out in the contract between ENRS and the Client. The scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

ENRS derived the data in this report primarily from visual inspections, examination of available records, interviews with individuals with information about the site, and if requested, limited sample collection and analysis made on the dates indicated. In preparing this report, ENRS has relied upon, and presumed accurate, certain information provided by government authorities, the Client and others identified herein. The report has been prepared on the basis that while ENRS believes all the information in it is deemed reliable and accurate at the time of preparing the report, it does not warrant its accuracy or completeness and to the full extent allowed by law excludes liability in contract, tort or otherwise, for any loss or damage sustained by the Client arising from or in connection with the supply or use of the whole or any part of the information in the report through any cause whatsoever.

Limitations also apply to analytical methods used in the identification of substances (or parameters). These limitations may be due to non-homogenous material being sampled (i.e. the sample to be analysed may not be representative), low concentrations, the presence of 'masking' agents and the restrictions of the approved analytical technique. As such, non-statistically significant sampling results can only be interpreted as 'indicative' and not used for quantitative assessments.

The data, findings, observations, conclusions and recommendations in the report are based solely upon the state of the site at the time of the investigation. The passage of time, manifestation of latent conditions or impacts of future events (e.g. changes in legislation, scientific knowledge, land uses, etc) may render the report inaccurate. In those circumstances, ENRS shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of the report.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between ENRS and the Client. ENRS accepts no liability or responsibility whatsoever and expressly disclaims any responsibility for or in respect of any use of or reliance upon this report by any third party or parties.

It is the responsibility of the Client to accept if the Client so chooses any recommendations contained within and implement them in an appropriate, suitable and timely manner.

12.0 REFERENCES

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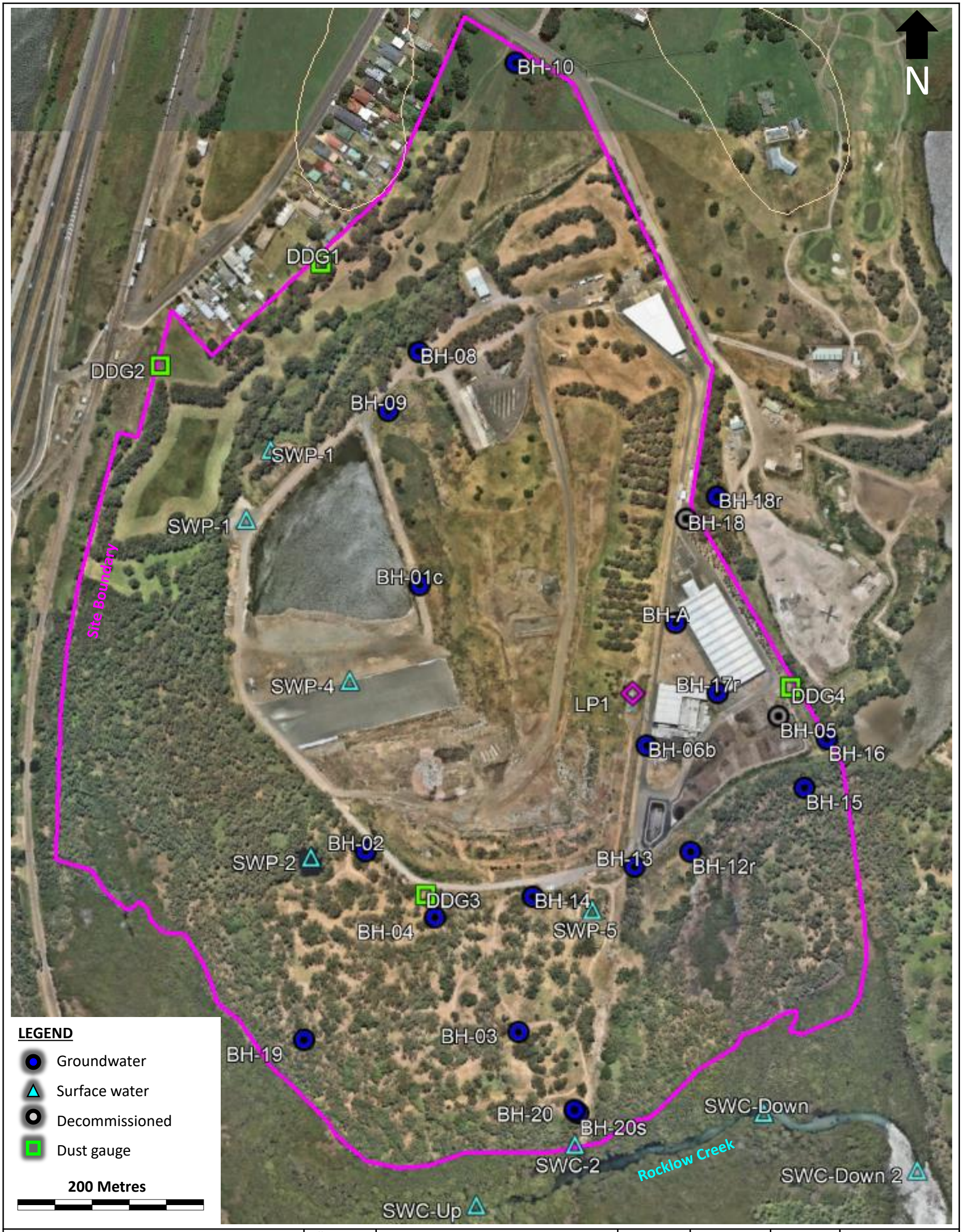
FIGURES



ENRS
Environment & Natural Resource Solutions
108 Jerry Bailey Road, Shoalhaven Heads, NSW, 2535
Tel: 02 4448 5490 Fax: 02 90374708
projects@enrs.com.au www.enrs.com.au

Client:	**Shellharbour City Council**	Drawn:	**PL**	Figure:	**2**
Project:	**ENRS0033**	Source:	**NearMaps**	Date:	**4/02/2020**
Location:	Dunmore Recycling & Waste Depot 44 Buckleys Rd, Dunmore, NSW	Scale:	**NA**	Title:	**Site Plan**
		Status:	**Rev 1**		

ENRS
Environment & Natural Resource Solutions
108 Jerry Bailey Road, Shoalhaven Heads, NSW, 2535
Tel: 02 4448 5490 Fax: 02 90374708
projects@enrs.com.au www.enrs.com.au

Client:	**Shellharbour City Council**	Drawn:	**PL**	Figure:	**3**
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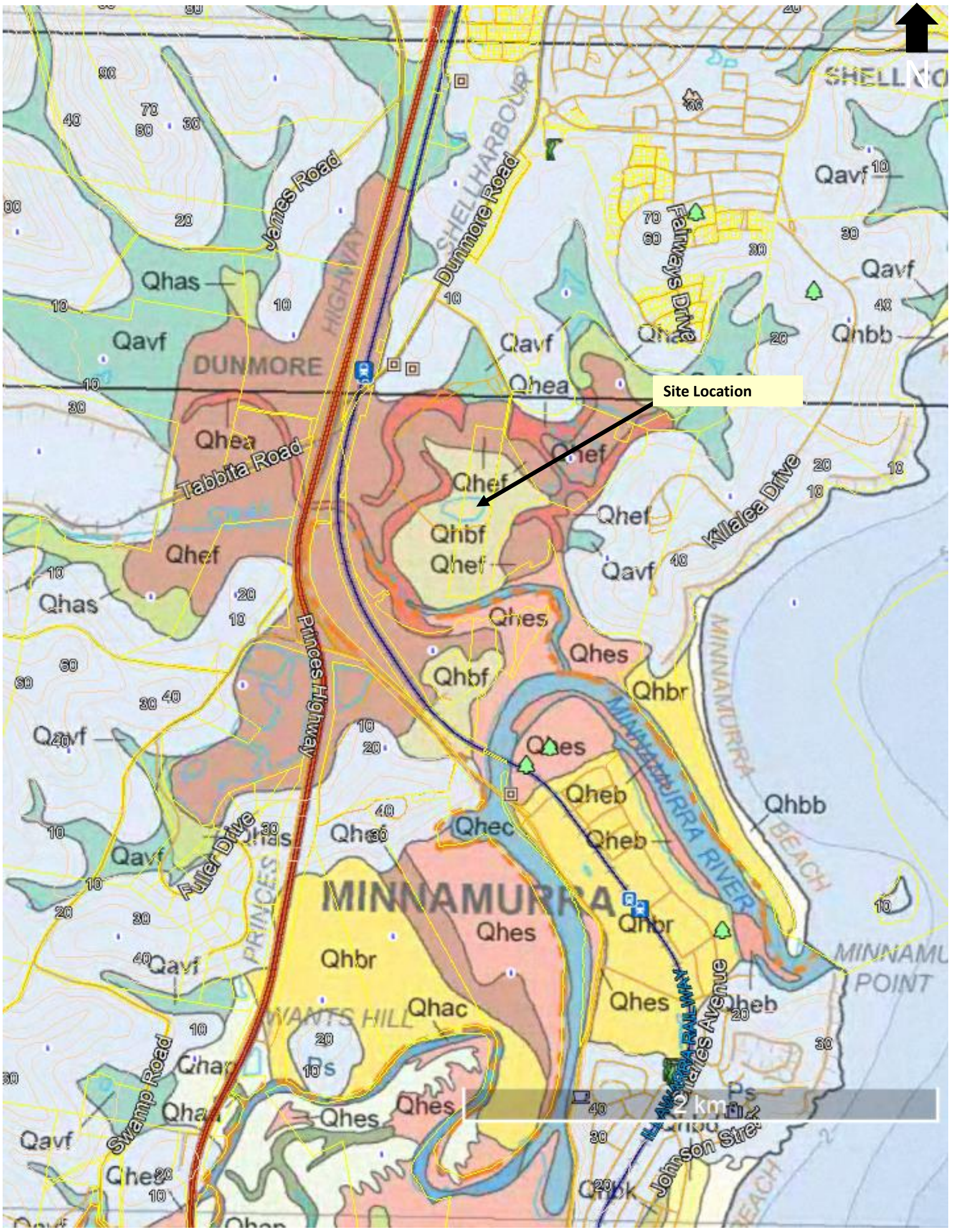
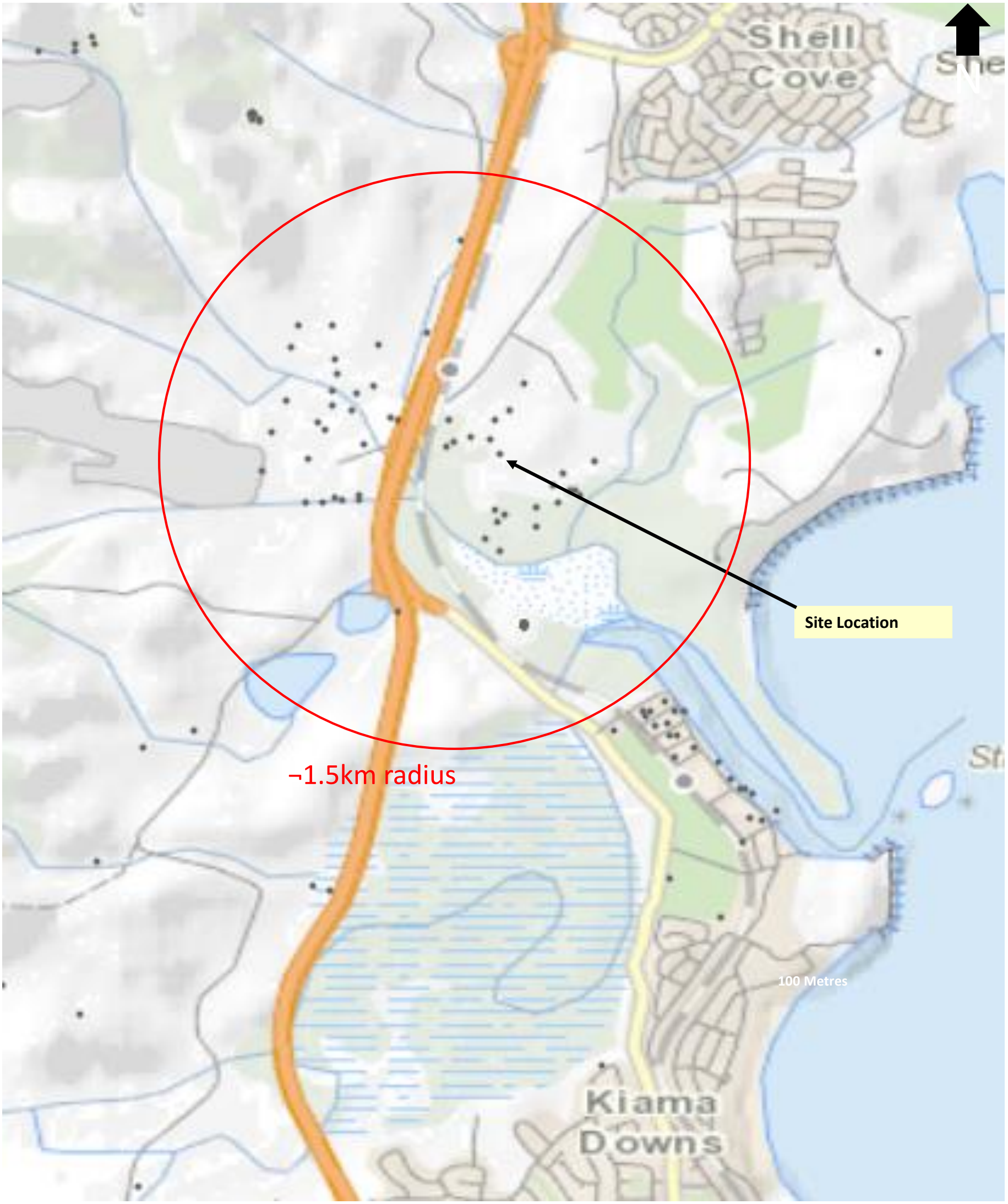
		Status:	**Rev 1**		



ENRS *Environment & Natural Resource Solutions* 108 Jerry Bailey Road, Shoalhaven Heads, NSW, 2535 Tel: 02 4448 5490 Fax: 02 90374708 projects@enrs.com.au www.enrs.com.au	Client:	**Shellharbour City Council**	Drawn:	**PL**	Figure:	**4**
	Project:	**ENRS0033**	Source:	**DPI**	Date:	**16/01/2020**
	Location:	Dunmore Recycling & Waste Depot 44 Buckleys Rd, Dunmore, NSW	Scale:	**NA**	Title:	**Geology**
			Status:	**Rev 1**		



ENRS *Environment & Natural Resource Solutions* 108 Jerry Bailey Road, Shoalhaven Heads, NSW, 2535 Tel: 02 4448 5490 Fax: 02 90374708 projects@enrs.com.au www.enrs.com.au	Client:	**Shellharbour City Council**	Drawn:	**PL**	Figure:	**5**
	Project:	**ENRS0033**	Source:	**SixMaps**	Date:	**16/01/2020**
	Location:	Dunmore Recycling & Waste Depot 44 Buckleys Rd, Dunmore, NSW	Scale:	**NA**	Title:	**Registered Bores**
			Status:	**Rev 1**		

TABLES

TABLE 8: Total Concentration Results

Quarterly Water Monitoring Results - December 2019: Dunmore Recycling and Waste Depot

GILs -Trigger Values for Freshwater (Protection of 95% of Species) [A]		-	-	-	-	-	1.9	-	-	-	0.9 (pH 8)	0.9 (pH 8)	-	0.7	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5 - 8.0	2200	-		
GILs -Trigger Values for Marine Water (Protection of 95% of Species) [A]		-	-	-	-	-	-	-	-	-	0.91 (pH 8)	0.91 (pH 8)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Australian Drinking Water Guidelines (2018)[C]	Health	-	-	-	-	-	0.5	-	-	1.5	-	-	3	50	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5 - 8.0	-	-		
	Aesthetic	250	-	-	180	-	0.1	0.3	0.3	-	0.5	0.5	-	-	-	-	-	-	-	-	-	250	-	-	-	5	-	-	-	6.5 - 8.0	-	-		
Sample No.	Date Sampled	Chloride	Calcium	Magnesium	Sodium	Potassium	Manganese	Total Iron	Dissolved Iron	Fluoride	Ammonia as N	Ammonium as N	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Organic Carbon	Biochemical Oxygen Demand	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4 - Turbidimetric	Dissolved Oxygen	Dissolved Oxygen - % Saturation	Suspended Solids (SS)	Turbidity	Total Anions	Total Cations	Ionic Balance	pH	Electrivcal Conductivity	Temperature	Depth to Water (mbgl TOC)	Comments	
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L	NTU	meq/L	meq/L	meq/L	pH	µS/cm	°C	mbgl		
Laboratory PQL		1	1	1	1	1	0.001	0.05	0.05	0.1	0.01	0.01	0.01	0.01	0.01	1	2	1	1	1	1	1	0.01	0.1	5	0.1	0.01	0.01	0.01	0.01	1	0.1	-	-	
Groundwater Bores	BH-a	17/12/2019	50	135	-	-	12	0.089	-	3.10	<0.1	0.2	-	0.04	0.56	0.60	26	-	<1	<1	260	260	291	-	-	-	-	-	-	-	6.3	1100	20.1	3.52	-	
	BH-1c	17/12/2019	951	147	-	-	231	0.098	-	10.90	0.4	380.0	-	<0.01	<0.01	<0.01	218	-	<1	<1	2880	2880	<5	-	-	-	-	-	-	-	7	7360	22.9	3.72	-	
	BH-2	17/12/2019	322	136	-	-	30	0.844	-	8.62	0.7	17.3	-	<0.01	<0.01	<0.01	44	-	<1	<1	783	783	90	-	-	-	-	-	-	-	7.1	2360	22.2	4.27	-	
	BH-3	17/12/2019	254	152	-	-	33	0.171	-	2.04	0.2	34.3	-	0.11	10.60	10.70	16	-	<1	<1	408	408	126	-	-	-	-	-	-	-	7.2	1800	19	3.3	-	
	BH-4	17/12/2019	200	183	-	-	18	0.252	-	4.08	0.1	6.1	-	<0.01	0.01	0.01	20	-	<1	<1	540	540	141	-	-	-	-	-	-	-	7.1	1730	18.8	4.56	-	
	BH-5	17/12/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		Destroyed. Variation submitted to remove point from the EPL.			
	BH-9	17/12/2019	620	215	-	-	88	0.679	-	0.35	0.3	143.0	-	<0.01	0.22	0.22	121	-	<1	<1	1950	1950	<10	-	-	-	-	-	-	-	6.7	4780	22.1	3.8	-	
	BH-10	17/12/2019	449	27	-	-	10	0.160	-	0.15	0.7	1.9	-	0.03	0.13	0.16	11	-	<1	<1	433	433	70	-	-	-	-	-	-	-	6.7	2330	22.2	1.67	-	
	BH-12r	17/12/2019	260	292	-	-	48	0.525	-	0.06	0.3	0.2	-	0.42	68.40	68.80	17	-	<1	<1	617	617	256	-	-	-	-	-	-	-	6.6	2550	22.4	4.59	-	
	BH-13	17/12/2019	104	197	-	-	61	0.208	-	0.13	0.4	1.2	-	0.08	7.28	7.36	27	-	<1	<1	612	612	311	-	-	-	-	-	-	-	6.9	1840	25.8	4.57	-	
	BH-14	17/12/2019	243	186	-	-	21	0.247	-	0.50	0.8	2.9	-	0.02	1.60	1.62	32	-	<1	<1	704	704	108	-	-	-	-	-	-	-	6.8	1970	21.5	5.07	-	
	BH-15	17/12/2019	2740	214	-	-	694	0.444	-	12.80	0.4	111.0	-	0.03	0.29	0.32	170	-	<1	<1	938	938	440	-	-	-	-	-	-	-	6.7	10400	20.9	0.95	-	
	BH-16	17/12/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		Non EPL sample point, could not be located.		
	BH-17r	17/12/2019	389	161	-	-	55	0.225	-	14.90	0.2	12.9	-	0.02	<0.01	0.02	32	-	<1	<1	444	444	158	-	-	-	-	-	-	-	6.7	2160	19.9	3.8	-	
	BH-18r	17/12/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry	
	BH-19r	17/12/2019	270	159	-	-	21	0.118	-	0.17	0.2	5.4	-	0.09	0.05	0.14	32	-	<1	<1	501	501	201	-	-	-	-	-	-	-	7.1	1940	19	4.69	-	
	BH-20	17/12/2019	210	154	-	-	52	0.070	-	1.36	0.2	37.2	-	0.01	0.08	0.09	20	-	<1	<1	393	393	170	-	-	-	-	-	-	-	7.4	1630	18.5	2.41	-	
	BH-20s	17/12/2019	60	134	-	-	85	0.088	-	<0.05	0.2	3.3	-	<0.01	3.78	3.78	18	-	<1	<1	387	387	240	-	-	-	-	-	-	-	7.4	1340	19	2.44	-	
Surface Water	SWP-1	17/12/2019	53	31	12	48	7	-	3.03	0.72	-	-	-	-	-	-	-	-	<1	<1	148	148	<5	-	-	44	26	4	5	4	7.1	-	-	-	-	
	SWP-2	17/12/2019	399	95	56	341	30	-	0.07	<0.05	-	-	-	-	-	-	-	-	<1	<1	536	536	207	-	-	9	4	26	25	3	7.8	-	-	-	-	
	SWP-4	17/12/2019	447	53	68	380	20	-	0.20	<0.05	-	-	-	-	-	-	46	3	<1	34	350	383	316	-	-	30	9	27	25	3	8.7	-	-	-	-	
	SWP-5	17/12/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rocklow Creek	SWC-up	17/12/2019	18300	463	1340	11000	401	-	<0.50	0.10	-	-	0.50	<0.01	<0.01	<0.01	-	-	<1	<1	207	207	2880	-	-	<5	1	580	622	3	7.2	-	-	-	-	
	SWC-2	17/12/2019	-	-	-	-	-	-	<0.50	<0.10	-	-	0.48	<0.01	<0.01	<0.01	-	-	<1	<1	202	202	-	-	-	<5	-	-	-	-	7.1	-	-	-	-	
	SWC-down	17/12/2019	18100	452	1330	11000	396	-	<0.50	<0.10	-	-	0.28	<0.01	<0.01	<0.01	-	-	<1	<1	202	202	2850	-	-	5	1	574	621	4	7.4	-	-	-	-	
	SWC-down 2	17/12/2019	18400	461	1420	11800	415	-	1.48	<0.10	-	-	0.03	<0.01	0.05	0.05	-	-	<1	<1	186	186	2940	-	-	56	18	584	664	6	7.6	-	-	-	-	
Leachate	Leachate Sump	17/12/2019	2050	105	-	-	502	0.412	3.22	-	0.8	1400	-	0.68	0.01	0.69	900	-	<1	<1	6000	6000	<5	2	24	-	-	-	-	-	7.8	16600	32.1	-	-	
	Leachate Tank LP1	17/12/2019	1990	122	-	-	560	0.425	3.52	-	0.9	1450	-	<0.10	<0.10	<0.10	870	-	<1	<1	5950	5950	<5	4	57	-	-	-	-	-	7.8	16200	28.3	-	-	

[A] Investigation levels apply to typical slightly-moderately disturbed systems. Trigger Levels for 95% of species. See ANZECC & ARMCANZ (2000) for guidance on applying these levels to different ecosystem conditions. Also the sames as the NEPM (2013) EILs.
[B] ANZG 2018 - pH Upper and Lower Limit for NSW Lowland Rivers (Table 3.3.2).
[C] Investigation levels are taken from the health values of the Australian Drinking Water Guidelines (NHMRC 2018).

APPENDICES

Appendix A

EPL Sampling Locations

Table 9: EPL Sampling Locations

EPA ID No.	Type of Monitoring Point	Type of Discharge Point	Location Description	Sampled December 2019
1	-	Overflow drain	Catch drain collecting overflows from Sediment Dams 1 & 2. See drawing 96650132-01 in LMEP	Yes Compliant with EPL
2	Leachate monitoring	-	Leachate Sump- L1	Yes Compliant with EPL
3	Groundwater monitoring	-	Southwest of solid waste disposal area and to the north of sand mining area- BH-1b	Yes Compliant with EPL
5	Groundwater monitoring	-	Outside of the premises, about 125 metres south of the site- BH-3	Yes Compliant with EPL
6	Groundwater monitoring	-	Outside of the premises, about 125 metres south of the site about 150 metres west of BH-3- BH-4	Yes Compliant with EPL
7	Groundwater monitoring	-	On the eastern corner of the site- BH-5	No – bore destroyed. Request for variation to EPL being considered by EPA at time of sampling.
10	Groundwater monitoring	-	South east of landfill next to perimeter road- BH-13	Yes Compliant with EPL
11	Groundwater monitoring	-	South of landfill next to perimeter road- BH-14	Yes Compliant with EPL
15	Leachate volume and quality monitoring	-	Leachate storage tanks	Yes Compliant with EPL

Appendix B

EPL Sampling Locations

Table 10: Monitoring Location Summary

Bore	Date Installed	Location Description	Former Bores	Access to Location
BH-1a	May 2004- May 2010	Immediately south & down-gradient of the previous disposal area, and to the west of the currently operating fill area	BH-1 - moved in; destroyed in February 2004	Decommissioned in 2010
BH-1b	Aug 2010	As above	BH-1a – required replacement due to damage.	Accessible
BH-1c	Aug 2013	As above	BH-1a and BH-1b	Accessible
BH-2	Aug 1991	South of the access road, down-gradient of land filling	-	Accessible
BH-3	Aug 1991	Down-gradient of landfill, between the landfill and Rocklow Ck	-	Accessible
BH-4	Aug 1991	As above	-	Accessible
BH-5	Aug 1991	In a low-lying area on the verge of swamplands adjacent to Restoration Fill Services	-	Decommissioned in 2017
BH-6b	Feb 2007	Down-hydraulic gradient of the HDPE lined leachate ponds	BH-6 (August 1991); BH-6a (August 2000)	Decommissioned in 2016 during construction of new waste mgt facility.
BH-7	Aug 1991	-	-	Destroyed by dredging activities
BH-8	Aug 1991	Up-gradient of old landfill cell and land filling activities	-	Could not be located
BH-9	Aug 1991	On edge of old landfill cell and up-gradient of current activities	-	Accessible
BH-10	Dec 1992	North of site and up-gradient of the landfill, in a paddock adjacent to and down gradient of residential dwellings	-	Accessible
BH-11	Jun 2002	Immediately east of the active landfill and southeast of the old capped landfill	Replaced by BH-18	Decommissioned
BH-12	Nov 2008	Down-hydraulic gradient of the HDPE lined leachate ponds and land filling operations	Previous BH-12 moved south ~4 m to allow expansion of adjacent landfill cell	Decommissioned in 2017
BH-13	Jun 2002	Down-hydraulic gradient of land filling operations on the southern side of the site - should detect impacts on groundwater from the controlled waste disposal areas	-	Accessible
BH-14	Jun 2002	Down-hydraulic gradient of land filling operations on the southern side of the site - should detect impacts on groundwater from the controlled waste disposal areas	-	Accessible
BH-15	Jun 2010	South of former borehole BH-5 located within Killalea State park	-	Accessible
BH-16	Jun 2010	East of former borehole BH-5 located on adjacent property	-	Accessible
BH-17	Nov 2012	North east corner of leachate pond	-	Decommissioned in 2016 during construction works undertaken for new waste management facility.
BH-18	Jun 2010	North of former borehole BH-11	-	As above
BH-19	Jul 2013	On the south west boundary of the site in close proximity to Rocklow creek	-	Accessible
BH-20	Jul 2013	On the south boundary of the site in close proximity to Rocklow creek	-	Accessible
BH-20s	Sep 2017	Nested well near BH-20 (screened at 1.5-4.5 mBGL)	-	Accessible
SWC-2	-	Rocklow creek south of the landfill	-	Accessible
SWC-up	Aug 2013	Upper Rocklow creek south of the landfill	-	Accessible
SWC-down	Aug 2013	South Rocklow creek south of the landfill	-	Accessible
SWC-down 2	Nov 2017	South east of SWC_Down within Rocklow Creek	-	Accessible
LP1	-	Leachate tanks to the east of current active cell	-	Accessible
SWP-1	-	West of the current active landfill and adjacent to the access road running around the site	-	Accessible

Appendix C

Laboratory Chain of Custody (COC) & Certificates of Analysis (COA) – Water Samples

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ Sydney: 277 Woodpark Rd, Smithfield NSW 2176 Ph: 02 8784 8555 E:samples.sydney@alsenviro.com
☐ Newcastle: 5 Rosegum Rd, Warabrook NSW 2304 Ph:02 4968 9433 E:samples.newcastle@alsenviro.com
☐ Brisbane: 32 Shand St, Stafford QLD 4053 Ph:07 3243 7222 E:samples.brisbane@alsenviro.com
☐ Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph:07 4796 0600 E: townsville.environmental@alsenviro.com
☐ Melbourne: 2-4 Westall Rd, Springvale VIC 3171 Ph:03 8549 9600 E: samples.melbourne@alsenviro.com
☐ Adelaide: 2-1 Burma Rd, Pooraka SA 5095 Ph: 08 8359 0890 E:adelaide@alsenviro.com
☐ Perth: 19 Hod Way, Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsenviro.com
☐ Launceston: 27 We... Ph: 03 6331 2158 E:...

Environmental Division
Wollongong
Work Order Reference
EW1905497

Telephone : 02 42253125

CLIENT:	Shellharbour City Council	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)	☐ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):
OFFICE:	41 Burelli St WOLLONGONG NSW 2500		
PROJECT:	Dunmore Quarterly Surface Waters	ALS QUOTE NO.: WO/030/19 TENDER	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7
ORDER NUMBER:			
PROJECT MANAGER:	Joel Culton		
SAMPLER:		SAMPLER MOBILE:	
COC emailed to ALS? (YES / NO)		EDD FORMAT (or default):	
Email Reports to :			
Email Invoice to :			

FOR LABO: Custody Seal / Free Ice / froz... receipt? / Random San... / Other comm...

N/A
N/A

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED
Glenn	Anete	
DATE/TIME: 17.12.19	DATE/TIME: 17.12.19	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: CC reports to:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	TSS	NT-1, NT-2 (Ionic Balance)	TOC & BOD	Dissolved and Total Fe	Turbidity	NH4 & NO3	Alkalinity		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	SWP1	17.12.19 11:30	W	500ml P, [illegible], N x2	5	✓	✓		✓	✓				Field Tests - pH
	SWP2	9:15	W			✓	✓		✓	✓				Field Tests - pH
	SWP4 - Sand Mine Dam	11:16	W	VS		✓	✓	✓	✓	✓				Field Tests - pH
	SWP5	11:00	W	VS		✓	✓	✓	✓	✓		(P) Dry		Field Tests - pH
	SWC_UP	10:16	W	SP		✓	✓		✓	✓	✓			Field Tests - pH & Temp
	SWC_2	10:06	W	SP		✓			✓		✓	✓		Field Tests - pH & Temp
	SWC_DOWN	10:25	W	SP		✓	✓		✓	✓	✓			Field Tests - pH & Temp
	SWC_DOWN_2	10:20	W	SP		✓	✓		✓	✓	✓			Field Tests - pH & Temp
				TOTAL	10									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EW1905497**	Page	: 1 of 6
Client	: **SHELLHARBOUR CITY COUNCIL**	Laboratory	: Environmental Division NSW South Coast
Contact	: Joel Coulton	Contact	: Aneta Prosaroski
Address	: LAMERTON HOUSE, LAMERTON CRESCENT SHELL HARBOUR CITY CENTRE NSW, AUSTRALIA 2529	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW Australia
Telephone	: ----	Telephone	: +61 2 4225 3125
Project	: Dunmore Quarterly Surface Water	Date Samples Received	: 17-Dec-2019 16:30
Order number	: TBA	Date Analysis Commenced	: 17-Dec-2019
C-O-C number	: ----	Issue Date	: 06-Jan-2020 11:18
Sampler	: Aneta Prosaroski, Glenn Davies		
Site	: DUNMORE LANDFILL TENDER		
Quote number	: WO/030/19 TENDER SURFACE WATER		
No. of samples received	: 8		
No. of samples analysed	: 8		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Robert DaLio	Sampler	Laboratory - Wollongong, NSW

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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG020: Some samples were diluted and rerun due to matrix interference and LOR's have been raised accordingly. (High Total Dissolved Solids)
- ED041G:LOR raised for Sulfate analysis on various samples due to sample matrix.
- Sampling and sample data supplied by ALS Wollongong.
- Sampling Completed as per EN/67.4 Lakes and Reservoirs
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SWP1	SWP2	SWP4 - Sand Mine Dam	SWP5	SWC_UP
			Client sampling date / time	17-Dec-2019 11:30	17-Dec-2019 09:15	17-Dec-2019 11:16	17-Dec-2019 11:00	17-Dec-2019 10:16
Compound	CAS Number	LOR	Unit	EW1905497-001	EW1905497-002	EW1905497-003	EW1905497-004	EW1905497-005
				Result	Result	Result	Result	Result
EA005FD: Field pH								
pH	----	0.1	pH Unit	7.1	7.8	8.7	----	7.2
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	44	9	30	----	<5
EA045: Turbidity								
Turbidity	----	0.1	NTU	25.5	3.5	9.0	----	1.2
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	34	----	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	148	536	350	----	207
Total Alkalinity as CaCO3	----	1	mg/L	148	536	383	----	207
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<5	207	316	----	2880
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	53	399	447	----	18300
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	31	95	53	----	463
Magnesium	7439-95-4	1	mg/L	12	56	68	----	1340
Sodium	7440-23-5	1	mg/L	48	341	380	----	11000
Potassium	7440-09-7	1	mg/L	7	30	20	----	401
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	0.72	<0.05	<0.05	----	0.10
EG020T: Total Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	3.03	0.07	0.20	----	<0.50
EK055G-NH4: Ammonium as N by DA								
Ammonium as N	14798-03-9_N	0.01	mg/L	----	----	----	----	0.50
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	----	----	----	----	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	----	----	----	----	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	----	----	----	----	<0.01
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	4.45	26.3	26.8	----	580

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SWP1	SWP2	SWP4 - Sand Mine Dam	SWP5	SWC_UP
				Client sampling date / time	17-Dec-2019 11:30	17-Dec-2019 09:15	17-Dec-2019 11:16	17-Dec-2019 11:00	17-Dec-2019 10:16
Compound	CAS Number	LOR	Unit		EW1905497-001	EW1905497-002	EW1905497-003	EW1905497-004	EW1905497-005
					Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued									
ø Total Cations	----	0.01	meq/L		4.80	24.9	25.3	----	622
ø Ionic Balance	----	0.01	%		3.78	2.59	2.99	----	3.48
EN67 PK: Field Tests									
Field Observations	----	0.01	--		----	----	----	dry	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		----	----	46	----	----
EP030: Biochemical Oxygen Demand (BOD)									
Biochemical Oxygen Demand	----	2	mg/L		----	----	3	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SWC_2	SWC_DOWN	SWC_DOWN 2	----	----
			Client sampling date / time	17-Dec-2019 10:06	17-Dec-2019 10:25	17-Dec-2019 10:20	----	----
Compound	CAS Number	LOR	Unit	EW1905497-006	EW1905497-007	EW1905497-008	--------	--------
				Result	Result	Result	----	----
EA005FD: Field pH								
pH	----	0.1	pH Unit	7.1	7.4	7.6	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	5	56	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	----	1.4	17.9	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	202	202	186	----	----
Total Alkalinity as CaCO3	----	1	mg/L	202	202	186	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	----	2850	2940	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	----	18100	18400	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	----	452	461	----	----
Magnesium	7439-95-4	1	mg/L	----	1330	1420	----	----
Sodium	7440-23-5	1	mg/L	----	11000	11800	----	----
Potassium	7440-09-7	1	mg/L	----	396	415	----	----
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	<0.10	<0.10	<0.10	----	----
EG020T: Total Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	<0.50	<0.50	1.48	----	----
EK055G-NH4: Ammonium as N by DA								
Ammonium as N	14798-03-9_N	0.01	mg/L	0.48	0.28	0.03	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	0.05	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.05	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	----	574	584	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**SWC_2**	**SWC_DOWN**	**SWC_DOWN 2**	**----**	**----**
				Client sampling date / time	17-Dec-2019 10:06	17-Dec-2019 10:25	17-Dec-2019 10:20	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EW1905497-006**	**EW1905497-007**	**EW1905497-008**	**--------**	**--------**
					Result	Result	Result	----	----
EN055: Ionic Balance - Continued									
ø **Total Cations**	----	0.01	meq/L		**----**	**621**	**664**	**----**	**----**
ø **Ionic Balance**	----	0.01	%		**----**	**3.91**	**6.39**	**----**	**----**

ALS Laboratory: please tick →
Ph: 02 9784 8555 E:samples.sydney@alsenviro.com
☐ Newcastle: 5 Rosegum Rd, Warabrook NSW 2304 Ph:02 4968 9433 E:samples.newcastle@alsenviro.com
Ph:07 3243 7222 E:samples.brisbane@alsenviro.com
☐ Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph:07 4796 0600 E: townsville.environmental@alsenviro.com
Ph:08 8359 0890 E:samples.melbourne@alsenviro.com
☐ Adelaide: 2-1 Burma Rd, Pooraka SA 5095 Ph: 08 8359 0890 E:adelaide@alsenviro.com
Ph: 08 9209 7655 E: samples.perth@alsenviro.com
☐ Launceston: 27 Wellington St, Launceston TAS 7250 Ph: 03 8331 2158 E: launceston@alsenviro.com

CLIENT:	Shellharbour City Council	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):
OFFICE:	41 Burelli St WOLLONGONG NSW 2500	ALS QUOTE NO.:	WO/030/19 TENDER
PROJECT:	Dunmore Quarterly Ground Waters	COC SEQUENCE NUMBER (Circle)	COC: 1 2 3 4 5 6 7 / OF: 1 2 3 4 5 6 7
ORDER NUMBER:			
PROJECT MANAGER:	Joel Culton		
SAMPLER:		SAMPLER MOBILE:	
COC emailed to ALS? (YES / NO)		EDD FORMAT (or default):	
Email Reports to :			
Email Invoice to :			

RELINQUISHED BY:	RECEIVED BY:	RELINQUIS
Glenn	Aneta	
DATE/TIME: 17/12/19	DATE/TIME: 17/12/19	DATE/TIME

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: CC reports to:

Environmental Division Wollongong
Work Order Reference
EW1905499

Telephone : 02 42253125

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be lis) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Ammonia	NT-2A (Alka, So4, Cl, Fl) Filtered Ca, K	TOC	Dissolved Fe & Mn	NT-4 (NO2, NO3)				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	BHA	17/12/19 12:23	W	500ml P, SP, VS, N,	4	✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH1C	8:39	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH2	8:59	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH3	11:03	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH4	9:22	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH9	11:44	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH10	15:28	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH15	15:00	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH12R	13:20	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH13	13:03	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH14	10:47	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH16	~	W			✓	✓	✓	✓	✓	Can't	Find		Field Tests - pH, EC, Temp & SWL
	BH17R	12:45	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH18R	15:20	W			✓	✓	✓	✓	✓	DRY.			Field Tests - pH, EC, Temp & SWL
	BH19R	9:32	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH20	9:~~55~~	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
	BH20s	9:54	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & SWL
				TOTAL	10									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EW1905499**	Page	: 1 of 10
Client	: **SHELLHARBOUR CITY COUNCIL**	Laboratory	: Environmental Division NSW South Coast
Contact	: Joel Coulton	Contact	: Aneta Prosaroski
Address	: LAMERTON HOUSE, LAMERTON CRESCENT SHELL HARBOUR CITY CENTRE NSW, AUSTRALIA 2529	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW Australia
Telephone	: ----	Telephone	: +61 2 4225 3125
Project	: Dunmore Quarterly Groundwaters	Date Samples Received	: 17-Dec-2019 16:30
Order number	: TBA	Date Analysis Commenced	: 17-Dec-2019
C-O-C number	: ----	Issue Date	: 28-Dec-2019 06:54
Sampler	: Aneta Prosaroski, Glenn Davies		
Site	: DUNMORE LANDFILL TENDER		
Quote number	: WO/030/19 TENDER GROUNDWATERS		
No. of samples received	: 17		
No. of samples analysed	: 17		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Robert DaLio	Sampler	Laboratory - Wollongong, NSW

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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED041G:LOR raised for Sulfate analysis on various samples due to sample matrix.
- Sampling and sample data supplied by ALS Wollongong.
- Sampling completed as per EN/67.11 Groundwater Sampling.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BHA	BH1C	BH2	BH3	BH4
			Client sampling date / time	17-Dec-2019 12:23	17-Dec-2019 08:39	17-Dec-2019 08:59	17-Dec-2019 11:03	17-Dec-2019 09:22
Compound	CAS Number	LOR	Unit	EW1905499-001	EW1905499-002	EW1905499-003	EW1905499-004	EW1905499-005
				Result	Result	Result	Result	Result
EA005FD: Field pH								
pH	----	0.1	pH Unit	6.3	7.0	7.1	7.2	7.1
EA010FD: Field Conductivity								
Electrical Conductivity (Non Compensated)	----	1	µS/cm	1100	7360	2360	1800	1730
EA116: Temperature								
Temperature	----	0.1	°C	20.1	22.9	22.2	19.0	18.8
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	260	2880	783	408	540
Total Alkalinity as CaCO3	----	1	mg/L	260	2880	783	408	540
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	291	<5	90	126	141
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	50	951	322	254	200
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	135	147	136	152	183
Potassium	7440-09-7	1	mg/L	12	231	30	33	18
EG020F: Dissolved Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.089	0.098	0.844	0.171	0.252
Iron	7439-89-6	0.05	mg/L	3.10	10.9	8.62	2.04	4.08
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	0.4	0.7	0.2	0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.21	380	17.3	34.3	6.13
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	0.04	<0.01	<0.01	0.11	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.56	<0.01	<0.01	10.6	0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.60	<0.01	<0.01	10.7	0.01
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	26	218	44	16	20

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	BHA	BH1C	BH2	BH3	BH4
				Client sampling date / time	17-Dec-2019 12:23	17-Dec-2019 08:39	17-Dec-2019 08:59	17-Dec-2019 11:03	17-Dec-2019 09:22
Compound	CAS Number	LOR	Unit		EW1905499-001	EW1905499-002	EW1905499-003	EW1905499-004	EW1905499-005
					Result	Result	Result	Result	Result
FWI-EN/001: Groundwater Sampling - Depth									
Standing Water Level	----	0.01	m AHD		**3.52**	**3.72**	**4.27**	**3.30**	**4.56**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BH9	BH10	BH15	BH12R	BH13
			Client sampling date / time	17-Dec-2019 11:44	17-Dec-2019 15:28	17-Dec-2019 15:00	17-Dec-2019 13:20	17-Dec-2019 13:03
Compound	CAS Number	LOR	Unit	EW1905499-006	EW1905499-007	EW1905499-008	EW1905499-009	EW1905499-010
				Result	Result	Result	Result	Result
EA005FD: Field pH								
pH	----	0.1	pH Unit	6.7	6.7	6.7	6.6	6.9
EA010FD: Field Conductivity								
Electrical Conductivity (Non Compensated)	----	1	µS/cm	4780	2330	10400	2550	1840
EA116: Temperature								
Temperature	----	0.1	°C	22.1	22.2	20.9	22.4	25.8
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1950	433	938	617	612
Total Alkalinity as CaCO3	----	1	mg/L	1950	433	938	617	612
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	70	440	256	311
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	620	449	2740	260	104
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	215	27	214	292	197
Potassium	7440-09-7	1	mg/L	88	10	694	48	61
EG020F: Dissolved Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.679	0.160	0.444	0.525	0.208
Iron	7439-89-6	0.05	mg/L	0.35	0.15	12.8	0.06	0.13
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.3	0.7	0.4	0.3	0.4
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	143	1.91	111	0.15	1.24
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.03	0.03	0.42	0.08
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.22	0.13	0.29	68.4	7.28
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.22	0.16	0.32	68.8	7.36
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	121	11	170	17	27

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	BH9	BH10	BH15	BH12R	BH13
				Client sampling date / time	17-Dec-2019 11:44	17-Dec-2019 15:28	17-Dec-2019 15:00	17-Dec-2019 13:20	17-Dec-2019 13:03
Compound	CAS Number	LOR	Unit		EW1905499-006	EW1905499-007	EW1905499-008	EW1905499-009	EW1905499-010
					Result	Result	Result	Result	Result
FWI-EN/001: Groundwater Sampling - Depth									
Standing Water Level	----	0.01	m AHD		**3.80**	**1.67**	**0.95**	**4.59**	**4.57**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BH14	BH16	BH17R	BH18R	BH19R
			Client sampling date / time	17-Dec-2019 10:47	17-Dec-2019 00:00	17-Dec-2019 12:45	17-Dec-2019 15:20	17-Dec-2019 09:32
Compound	CAS Number	LOR	Unit	EW1905499-011	EW1905499-012	EW1905499-013	EW1905499-014	EW1905499-015
				Result	Result	Result	Result	Result
EA005FD: Field pH								
pH	----	0.1	pH Unit	6.8	----	6.7	----	7.1
EA010FD: Field Conductivity								
Electrical Conductivity (Non Compensated)	----	1	µS/cm	1970	----	2160	----	1940
EA116: Temperature								
Temperature	----	0.1	°C	21.5	----	19.9	----	19.0
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	<1	----	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	<1	----	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	704	----	444	----	501
Total Alkalinity as CaCO3	----	1	mg/L	704	----	444	----	501
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	108	----	158	----	201
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	243	----	389	----	270
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	186	----	161	----	159
Potassium	7440-09-7	1	mg/L	21	----	55	----	21
EG020F: Dissolved Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.247	----	0.225	----	0.118
Iron	7439-89-6	0.05	mg/L	0.50	----	14.9	----	0.17
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.8	----	0.2	----	0.2
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	2.86	----	12.9	----	5.43
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	0.02	----	0.02	----	0.09
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	1.60	----	<0.01	----	0.05
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	1.62	----	0.02	----	0.14
EN67 PK: Field Tests								
Field Observations	----	0.01	--	----	not found	----	dry	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	BH14	BH16	BH17R	BH18R	BH19R
				Client sampling date / time	17-Dec-2019 10:47	17-Dec-2019 00:00	17-Dec-2019 12:45	17-Dec-2019 15:20	17-Dec-2019 09:32
Compound	*CAS Number*	*LOR*	*Unit*		**EW1905499-011**	**EW1905499-012**	**EW1905499-013**	**EW1905499-014**	**EW1905499-015**
					Result	Result	Result	Result	Result
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		**32**	**----**	**32**	**----**	**32**
FWI-EN/001: Groundwater Sampling - Depth									
Standing Water Level	----	0.01	m AHD		**5.07**	**----**	**3.80**	**----**	**4.69**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BH20	BH20s	----	----	----
			Client sampling date / time	17-Dec-2019 09:45	17-Dec-2019 09:54	----	----	----
Compound	CAS Number	LOR	Unit	EW1905499-016	EW1905499-017	--------	--------	--------
				Result	Result	----	----	----
EA005FD: Field pH								
pH	----	0.1	pH Unit	7.4	7.4	----	----	----
EA010FD: Field Conductivity								
Electrical Conductivity (Non Compensated)	----	1	µS/cm	1630	1340	----	----	----
EA116: Temperature								
Temperature	----	0.1	°C	18.5	19.0	----	----	----
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	393	387	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	393	387	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	170	240	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	210	60	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	154	134	----	----	----
Potassium	7440-09-7	1	mg/L	52	85	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.070	0.088	----	----	----
Iron	7439-89-6	0.05	mg/L	1.36	<0.05	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	37.2	3.33	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	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	0.08	3.78	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.09	3.78	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	20	18	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**BH20**	**BH20s**	**----**	**----**	**----**
				Client sampling date / time	17-Dec-2019 09:45	17-Dec-2019 09:54	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EW1905499-016**	**EW1905499-017**	**--------**	**--------**	**--------**
					Result	Result	----	----	----
FWI-EN/001: Groundwater Sampling - Depth									
Standing Water Level	----	0.01	m AHD		**2.41**	**2.44**	**----**	**----**	**----**

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ Sydney: 277 Woodpark Rd, Smithfield NSW 2176 Ph: 02 8784 8555 E: samples.sydney@alsenviro.com
☐ Newcastle: 5 Rosegum Rd, Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsenviro.com
☐ Brisbane: 32 Shand St, Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsenviro.com
☐ Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsenviro.com
☐ Melbourne: 2-4 Westall Rd, Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsenviro.com
☐ Adelaide: 2-1 Burma Rd, Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsenviro.com
☐ Perth: 10 Hod Way, Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsenviro.com
☐ Launceston: 27 Wellington St, Launceston TAS 7250 Ph: 03 6331 2158 E: launceston@alsenviro.com

CLIENT:	Shellharbour City Council	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE:	41 Burelli St WOLLONGONG NSW 2500		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes / No / N/A
PROJECT:	Dunmore Quarterly Leachate	**ALS QUOTE NO.:**	WO/030/19 TENDER	Free ice / frozen ice bricks present upon receipt? Yes / No / N/A
ORDER NUMBER:				Random Sample Temperature on Receipt: °C
PROJECT MANAGER:	Joel Culton			Cooler comment:

COC SEQUENCE NUMBER (Circle)

COC:	1	2	3	4	5	6	7
OF:	1	2	3	4	5	6	7

SAMPLER:	**SAMPLER MOBILE:**	**RELINQUISHED BY:** Glenn	**RECEIVED BY:** Anete
COC emailed to ALS? (YES / NO)	**EDD FORMAT (or default):**	DATE/TIME: 17-12-19	DATE/TIME: 17.12.19
Email Reports to :		**RELINQUISHED BY:**	**RECEIVED BY:**
Email Invoice to :		DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: **CC reports to:**

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Ammonia	NT-2A (Alka, So4, Cl, Fl) Filtered Ca, K	TOC	~~Dissolved~~ Total Fe & Mn	NT-4 (NO2, NO3)				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	Leachate Sump	17/12/19 13:30	W	500ml, SP, VS, N		✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & DO
	Leachate Tank LP1	13:45	W			✓	✓	✓	✓	✓				Field Tests - pH, EC, Temp & DO
				TOTAL	10									

Environmental Division
Wollongong
Work Order Reference
EW1905498

Telephone : 02 4225 3125

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EW1905498**	Page	: 1 of 4
Client	: **SHELLHARBOUR CITY COUNCIL**	Laboratory	: Environmental Division NSW South Coast
Contact	: Joel Coulton	Contact	: Aneta Prosaroski
Address	: LAMERTON HOUSE, LAMERTON CRESCENT SHELL HARBOUR CITY CENTRE NSW, AUSTRALIA 2529	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW Australia
Telephone	: ----	Telephone	: +61 2 4225 3125
Project	: Dunmore Quarterly Leachate	Date Samples Received	: 17-Dec-2019 15:50
Order number	: TBA.	Date Analysis Commenced	: 17-Dec-2019
C-O-C number	: ----	Issue Date	: 31-Dec-2019 09:29
Sampler	: Aneta Prosaroski, Glenn Davies		
Site	: DUNMORE LANDFILL TENDER		
Quote number	: WO/030/19 TENDER LEACHATE		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Robert DaLio	Sampler	Laboratory - Wollongong, NSW

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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED041G: LOR raised for Sulfate on various samples due to sample matrix.
- EK057G: LOR raised for Nitrite on sample No.2 due to sample matrix.
- EK059G-EK058G: LOR raised for NOx-Nitrate on sample 2 due to sample matrix.
- Sampling and sample data supplied by ALS Wollongong.
- Sampling Completed as per EN/67.4 Lakes and Reservoirs
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Leachate Sump	Leachate Tank LP1	----	----	----
			Client sampling date / time	17-Dec-2019 13:30	17-Dec-2019 13:45	----	----	----
Compound	CAS Number	LOR	Unit	EW1905498-001	EW1905498-002	--------	--------	--------
				Result	Result	----	----	----
EA005FD: Field pH								
pH	----	0.1	pH Unit	**7.8**	**7.8**	----	----	----
EA010FD: Field Conductivity								
Electrical Conductivity (Non Compensated)	----	1	µS/cm	**16600**	**16200**	----	----	----
EA116: Temperature								
Temperature	----	0.1	°C	**32.1**	**28.3**	----	----	----
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	**6000**	**5950**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**6000**	**5950**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<5	<5	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**2050**	**1990**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**105**	**122**	----	----	----
Potassium	7440-09-7	1	mg/L	**502**	**560**	----	----	----
EG020T: Total Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	**0.412**	**0.425**	----	----	----
Iron	7439-89-6	0.05	mg/L	**3.22**	**3.52**	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.8**	**0.9**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**1400**	**1450**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.68**	<0.10	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.01**	<0.10	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.69**	<0.10	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**900**	**870**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**Leachate Sump**	**Leachate Tank LP1**	**----**	**----**	**----**
				Client sampling date / time	17-Dec-2019 13:30	17-Dec-2019 13:45	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EW1905498-001**	**EW1905498-002**	**--------**	**--------**	**--------**
					Result	Result	----	----	----
EP025FD: Field Dissolved Oxygen									
Dissolved Oxygen	----	0.01	mg/L		**1.65**	**4.33**	**----**	**----**	**----**
Dissolved Oxygen - % Saturation	----	0.1	% saturation		**23.7**	**56.9**	**----**	**----**	**----**

Appendix D

Laboratory Chain of Custody (COC) & Certificates of Analysis (COA) – Dust Samples

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ **Sydney**: 277 Woodpark Rd, Smithfield NSW 2176 Ph: 02 8784 8555 E: samples.sydney@alsenviro.com
☐ **Newcastle**: 5 Rosegum Rd, Warabrook NSW 2304 Ph:02 4968 9433 E: samples.newcastle@alsenviro.com
☐ **Brisbane**: 32 Shand St, Stafford QLD 4053 Ph:07 3243 7222 E: samples.brisbane@alsenviro.com
☐ **Townsville**: 14-15 Desma Ct, Bohle QLD 4818 Ph:07 4796 0600 E: townsville.environmental@alsenviro.com
☐ **Melbourne**: 2-4 Westall Rd, Springvale VIC 3171 Ph:03 8549 9600 E: samples.melbourne@alsenviro.com
☐ **Adelaide**: 2-1 Burma Rd, Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsenviro.com
☐ **Perth**: 10 Hod Way, Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsenviro.com
☐ **Launceston**: 27 Wellington St, Launceston TAS 7250 Ph: 03 6331 2158 E: launceston@alsenviro.com

CLIENT:	Shellharbour City Council	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT **(List due date):**
OFFICE:	Dunmore		☐ Non Standard or urgent TAT **(List due date):**
PROJECT:	Dunmore Dust	**ALS QUOTE NO.:**	WO/030/19 TENDER
ORDER NUMBER:			
PROJECT MANAGER:	Joel Culton		

COC SEQUENCE NUMBER (Circle)

COC:	1	2	3	4	5	6	7
OF:	1	2	3	4	5	6	7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt:		°C	
Other comment:			

SAMPLER:	**SAMPLER MOBILE:**	**RELINQUISHED BY:** Anela	**RECEIVED BY:** Arrican
COC emailed to ALS? (YES / NO)	**EDD FORMAT (or default):**	DATE/TIME: 16/1/20	DATE/TIME: 16/1/20
Email Reports to :		**RELINQUISHED BY:**	**RECEIVED BY:**
Email Invoice to :		DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: **CC reports to:**

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	A04 (Ash, CM, TIS)								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	DDG1	11/12/19 - 16/1/20	AIR			✓								
2	DDG2	↓	AIR			✓								
3	DDG3		AIR			✓								
4	DDG4		AIR			✓								
				TOTAL	10									

Environmental Division
Wollongong
Work Order Reference
EW2000231

Telephone : 02 42253125

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EW2000231**	Page	: 1 of 2
Client	: **SHELLHARBOUR CITY COUNCIL**	Laboratory	: Environmental Division NSW South Coast
Contact	: Joel Coulton	Contact	: Aneta Prosaroski
Address	: LAMERTON HOUSE, LAMERTON CRESCENT SHELL HARBOUR CITY CENTRE NSW, AUSTRALIA 2529	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW Australia
Telephone	: ----	Telephone	: +61 2 4225 3125
Project	: Dunmore Landfill Dust	Date Samples Received	: 16-Jan-2020 15:57
Order number	: 126450	Date Analysis Commenced	: 20-Jan-2020
C-O-C number	: ----	Issue Date	: 04-Feb-2020 09:31
Sampler	: Glenn Davies		
Site	: DUNMORE LANDFILL TENDER		
Quote number	: WO/030/19 TENDER DUST		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Alison Graham	Supervisor - Inorganic	Newcastle - Inorganics, Mayfield West, NSW

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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sample exposure period is 36 days which is outside the typical exposure period of 30 +/- 2 days as per AS3580.10.1.
- Analysis as per AS3580.10.1-2016. Samples passed through a 1mm sieve prior to analysis. NATA accreditation is not held for results reported in g/m².mth.

Analytical Results

Sub-Matrix: **DEPOSITIONAL DUST** (Matrix: **AIR**)				Client sample ID	**DDG1 11/12/19 - 16/01/20**	**DDG2 11/12/19 - 16/01/20**	**DDG3 11/12/19 - 16/01/20**	**DDG4 11/12/19 - 16/01/20**	**----**
				Client sampling date / time	16-Jan-2020 14:15	16-Jan-2020 14:00	16-Jan-2020 14:10	16-Jan-2020 14:22	----
Compound	*CAS Number*	*LOR*	*Unit*		**EW2000231-001**	**EW2000231-002**	**EW2000231-003**	**EW2000231-004**	**--------**
					Result	Result	Result	Result	----
EA120: Ash Content									
Ash Content	----	0.1	g/m².month		**5.6**	**3.9**	**6.2**	**3.6**	**----**
Ash Content (mg)	----	1	mg		**119**	**82**	**132**	**77**	**----**
EA125: Combustible Matter									
Combustible Matter	----	0.1	g/m².month		**1.8**	**0.8**	**1.5**	**0.8**	**----**
Combustible Matter (mg)	----	1	mg		**37**	**18**	**32**	**17**	**----**
EA141: Total Insoluble Matter									
Total Insoluble Matter	----	0.1	g/m².month		**7.4**	**4.7**	**7.7**	**4.4**	**----**
Total Insoluble Matter (mg)	----	1	mg		**156**	**100**	**164**	**94**	**----**

Appendix E

Surface Gas (Methane) Field Sheets

ALS Landfill Emissions Report

Client: Shellharbour City Council
Site: Dunmore
Date: 11/12/2019
Sampler(s) Glenn Davies, Aneta Prosaroski

Transact / Location	Point	GPS North	GPS East	CH4 Conc (ppm)	Comments
A	1	6168 375	302 461	1.8	
A	2	6168 344	302 464	1.6	
A	3	6168 331	302 463	8.6	
A	4	6168 310	302 458	2.1	
A	5	6168 289	302 455	1.7	
A	6	6168 266	302 453	2.2	
A	7	6168 242	302 450	1.9	
A	8	6168 221	302 440	1.8	
B	1	6168 059	302 419	1.6	
B	2	6168 084	302 420	2.1	
B	3	6168 117	302 423	2.1	
B	4	6168 138	302 423	2.1	
B	5	6168 164	302 430	1.7	
B	6	6168 188	302 431	1.5	
B	7	6168 210	302 437	1.4	
B	8	6168 230	302 431	1.2	
B	9	6168 271	302 434	2.1	
B	10	6168 323	302 443	1.8	
B	11	6168 346	302 443	1.5	
C	1	6168 338	302 393	1.5	
C	2	6168 314	302 401	1.6	
C	3	6168 277	302 408	1.5	
C	4	6168 256	302 413	1.5	
C	5	6168 235	302 414	1.7	
C	6	6168 213	302 414	1.4	
C	7	6168 190	302 414	1.2	
C	8	6168 169	302 410	1.1	
C	9	6168 146	302 406	1.1	
C	10	6168 127	302 404	0.9	
C	11	6168 103	302 401	1.4	
C	12	6168 081	302 398	1.2	
C	13	6168 059	302 396	1.4	
D	1	6168 058	302 376	1.6	
D	2	6168 081	302 373	1.7	
D	3	6168 101	302 369	1.8	
D	4	6168 127	302 367	2.0	
D	5	6168 165	302 374	1.7	
D	6	6168 180	302 365	1.5	
D	7	6168 199	302 364	1.7	
D	8	6168 226	302 370	1.3	
D	9	6168 246	302 373	1.5	
E	1	6168 249	302 347	1.4	
E	2	6168 229	302 344	1.4	
E	3	6168 207	302 342	1.6	
E	4	6168 185	302 344	1.4	
E	5	6168 167	302 343	1.5	
E	6	6168 144	302 346	1.5	
E	7	6168 122	302 355	1.6	
E	8	6168 103	302 361	1.6	
E	9	6168 073	302 365	1.8	
E	10	6168 057	302 366	1.8	
F	1	6168 154	302 315	1.7	
F	2	6168 180	302 214	1.4	
F	3	6168 203	302 213	1.5	
F	4	6168 225	302 304	1.4	
F	5	6168 239	302 300	1.5	
F	6	6168 253	302 297	1.2	
Site Offices				3.2	
Landfill Weighbridge (General public)				3.1	
Revolve Centre				3.8	
Resalable area				1.2	
Landfill Weighbridge (Tip Face)				1.2	
Methane Blank (Pre testing)				1.3	Taken at entrance to Dunmore site before main gate
Methane Blank (Post testing)				1.2	Taken at entrance to Dunmore site before main gate

Comments:

Sampling performed in accordance to EPA Environmental Guidelines Solid Waste Landfills, Second Edition, 2016
Gas concentrations are reported as raw values without correction for background concentration.

Appendix F

Calibration Certificates

EQUIPMENT SHEET / CALIBRATION CERTIFICATE

Instrument: Inspectra Laser (ATEX)

Serial No: 5700418

Equipment Information	Enclosed	Comment
Inspectra Laser ATEX Instrument Manual	✓	
AC Charger Cable (Australian)	✓	
ATEX Charger	✓	
12VDC Vehicle Charger	✓	
Sample Handle	✓	
Sampling Probe	✓	
Telescoping Wand	✓	
C10 Regulator + Tubing		
3mm Hex Driver (Red)		
Inspectra Spanner Wrench Hydrophobic		
Filters x 5		
Cotton Filters x 20		
Dust Filters (Yellow) x 5		
Harness Straps	✓	
Yellow Gazomat Carry Case	✓	

Calibration Results		
Parameter	Standard	Result
CH4	10ppm	10ppm

This is to certify that where possible, this instrument has been calibrated in accordance with the manufacturer's calibration procedure. ECO Standard Rental Terms and Conditions apply to all equipment calibrations.

Regards,

Geremy Kil

Equipment Specialist
Eco Environmental Holdings

03-Dec-2019

Head Office Perth
Tel: +61 8 9328 2900
eco@ecoenvironmental.com.au

Adelaide Office
Tel: +61 8 8293 3355
adelaide@ecoenvironmental.com.au

Brisbane Office
Tel: +61 7 3135 9600
brisbane@ecoenvironmental.com.au