STAGE 4 LAND BASELINE WATER QUALITY REPORT

WEST NOWRA RECYCLING & WASTE FACILITY
120 Flatrock Road
Mundamia, NSW, 2540

Environment Protection Licence (EPL) 5877

Prepared For:	**Shoalhaven City Council**
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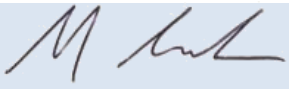	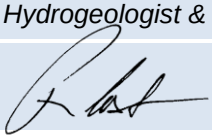

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EXECUTIVE SUMMARY

Environment & Natural Resource Solutions (ENRS) were commissioned as an independent environmental consultant by Shoalhaven City Council (SCC) to prepare a Baseline Water Quality Report for the Stage 4 Land at the West Nowra Recycling and Waste Facility (*herein referred to as the Site*). This Report summarises the results of field testing and laboratory analysis conducted by ENRS in June 2017. This Baseline Report provides a preliminary data assessment and analysis to document the site conditions and identify any potential environmental impacts on Stage 4 land from the adjacent landfilling operations.

The West Nowra Recycling and Waste Facility is licensed as a general solid waste (putrescible and non-putrescible) facility. Operations commenced in 1975. The disposal of hazardous and toxic waste, with the exception of asbestos, has been prohibited since 1986. Landfilling of waste is staged:

- Stage 1 - closed and rehabilitated, after commencing in 1975;
- Stage 2 – operational with partial rehabilitation. Subdivided into 2a, 2b, 2c, and 2d;
- Stage 3 – operational and landfilling, HDPE lined; and

Stage 4 – future proposed landfilling, subject to regulatory approval.

The objectives of this Baseline Water Quality Report are to:

- Document baseline water quality and chemistry in the Stage 4 area;
- Assess and analyse the environmental monitoring data for the Site against EPA endorsed water quality criteria;
- Compare baseline water quality and chemistry against existing data from Stages 1, 2 and 3;
- Identify any potential impacts associated with current landfilling operations on Stage 4 land;
- Document results in a Baseline Water Quality Report.

The scope of work for this Baseline Water Quality Report comprised the collection, collation, assessment and reporting of Site in regard to the following tasks:

- Review 2015/2016 West Nowra Annual Report and document the hydrogeological setting;
- Conduct one (1) round of groundwater sampling in June 2017;
- Tabulate baseline results of June 2017 monitoring data collected for the purposes of this report;
- Analysis and interpretation of all monitoring data, including graphical presentation of data in order to show future variability/and or trends;
- Identification of any deficiencies in environmental performance identified by the monitoring data, trends or environmental incidents; and
- Discussion and conclusions on the baseline groundwater quality and the potential of any environmental impacts from existing landfilling operations on Stage 4 land.

Based on the reviewed Stage 4 June 2017 data and results of the 2015/2016 West Nowra Stages 1, 2 and 3monitoring program the following conclusions are provided:

- A total of seven (7) groundwater monitoring points were inspected on 14th June 2017. Samples were collected by ENRS personnel and analysed by Council's preferred contractor, ALS Environmental, a NATA accredited laboratory;
- The nearest existing groundwater monitoring well for West Nowra Stages 1, 2 and 3 is BH19 which has been dry for the last five (5) monitoring periods;
- Wells installed on the Stage 4 Site generally target deeper groundwater than those targeted by existing Stage 1, 2 and 3 monitoring wells;
- Groundwater salinity is elevated across the Site with levels of TDS generally reported above the adopted trigger values is likely associated with the site geology which comprises marine sedimentary rocks and residual clays;
- Results for pH in groundwater at the Site generally reported neutral pH levels which are within the range of those anticipated to occur naturally;
- Concentrations of nutrients in Stage 4 groundwater are present in concentrations below the adopted TVs and what has been historically observed for Stage 1, 2 and 3 ground waters;
- Dissolved concentrations in groundwater of Aluminium, Arsenic, Barium, Cadmium, Cobalt, Chromium, Hexavalent Chromium (CrVI), Copper, Magnesium, Manganese and Mercury were reported below the laboratory detection limit and/or the adopted Trigger Value. The only TV exceedance from metals was reported in GW4 for Zinc;
- Reported concentrations of Total Organic Carbon (TOC) reported below the laboratory detection limit and/or the adopted Trigger Value;
- Concentrations of TRH and BTEX were reported below the laboratory detection limit;
- Concentrations of PAHs were reported below the laboratory detection limit;
- The monitoring locations and sampling techniques is considered to provide suitable assessment of groundwater conditions on the Stage 4 Land; and
- Based on this review of June 2017 Stage 4 Land baseline water quality data, ENRS conclude that there is unlikely to be any significant impacts from existing Stage 1, 2 and 3 landfilling operations.

Based on the findings obtained during this Baseline Water Quality Assessment the following recommendations are provided:

- Additional periodic sampling of Stage 4 Land groundwater be conducted by a suitably qualified person to further characterise baseline conditions;
- Stage 1, 2 and 3 results for metals and metalloids to be reported as total concentrations for surface water and dissolved concentrations for groundwater. Consider testing for both total and dissolved concentrations in groundwater for the next round of testing to provide for comparison.
- Should any change in Site conditions or incident occur which causes a potential environmental impact, ENRS should be notified to further assess the Site and consider requirements for any additional monitoring.

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1.0 INTRODUCTION

Environment & Natural Resource Solutions (ENRS) were commissioned as an independent environmental consultant by Shoalhaven City Council (SCC) to prepare a Baseline Water Quality Report for the Stage 4 Land at the West Nowra Recycling and Waste Facility (*herein referred to as the Site*). This Report summarises the results of field testing and laboratory analysis conducted by ENRS in June 2017. This Baseline Report provides a preliminary data assessment and analysis to document the site conditions and identify any potential environmental impacts on Stage 4 land from the adjacent landfilling operations.

1.1 PROJECT BACKGROUND

1.1.1 Site History

The West Nowra Recycling and Waste Facility is licensed as a general solid waste (putrescible and non-putrescible) facility. Operations commenced in 1975. The disposal of hazardous and toxic waste, with the exception of asbestos, has been prohibited since 1986. Landfilling of waste is staged:

- Stage 1 - closed and rehabilitated, after commencing in 1975;
- Stage 2 – operational with partial rehabilitation. Subdivided into 2a, 2b, 2c, and 2d;
- Stage 3 – operational and landfilling, HDPE lined; and
- Stage 4 – future proposed landfilling, subject to regulatory approval.

1.1.2 Legislation and Planning Requirements

Waste regulation in NSW is administered by the EPA under the Protection of the Environment Operations (POEO) Act (1997) and the Waste Avoidance and Resource Recovery Act (2001). The Site is required to operate under the terms and conditions of EPA Environment Protection Licence (EPL) Number 5877. Separate to the requirements of this licence, general obligations of licensees are set out in the POEO Act. The current EPL (varied 28th Sept. 2016) stipulates the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1 (refer to EPL 5877) at twenty five (25) monitoring/discharge points or utilisation areas as specified by the point numbers 1-3, 5-9, 11, 13-14, 17-18, 20-21, 26-27, and 29-36 (see **Appendix A**).

1.2 OBJECTIVES

The objectives of this Baseline Water Quality Report are to:

- Document baseline water quality and chemistry in the Stage 4 area;
- Assess and analyse the environmental monitoring data for the Site against EPA endorsed water quality criteria;
- Compare baseline water quality and chemistry against existing data from Stages 1, 2 and 3;
- Identify any potential impacts associated with current landfilling operations on Stage 4 land;

- Document results in a Baseline Water Quality Report.

1.3 SCOPE OF WORK

The scope of work for this Baseline Water Quality Report comprised the collection, collation, assessment and reporting of Site in regard to the following tasks:

- Review 2015/2016 West Nowra Annual Report and document the hydrogeological setting;
- Conduct one (1) round of groundwater sampling in June 2017;
- Tabulate baseline results of June 2017 monitoring data collected for the purposes of this report;
- Analysis and interpretation of all monitoring data, including graphical presentation of data in order to show future variability/and or trends;
- Identification of any deficiencies in environmental performance identified by the monitoring data, trends or environmental incidents; and
- Discussion and conclusions on the baseline groundwater quality and the potential of any environmental impacts from existing landfilling operations on Stage 4 land.

2.0 SITE DESCRIPTION

2.1 LOCATION

The Site is located on Flatrock Road, Mundamia, NSW, 2540. The Site is situated approximately five (5) kilometres west-southwest of the Nowra town centre. The area's regional location is defined in **Figure 1**. 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	West Nowra Recycling and Waste Facility
Street Address	120 Flatrock Road, Mundamia, NSW 2540
Site Area	~50 hectares (Stages 1-3) ~10 Hectares (Stage 4)
Title Identifier	Lot 437, DP 808415 – E3 (Environmental Management) Lot 436, DP 808415 – SP2 (Infrastructure) Lot 1, DP 1018193 - SP2 (Infrastructure) Lot 1, DP 847203 – SP2 (Infrastructure) Lot 1, DP 870268 – SP2 (Infrastructure) Lot 1, DP 1104402 – SP2 (Infrastructure)
Zoning	Infrastructure and Environmental Management
Local Gov. Area	Shoalhaven City Council

Figure 1 Site Location Map

2.2 SURROUNDING LANDUSE

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

Table 2: Surrounding Landuse

Direction	Land use
North:	Shoalhaven River ~1.5 Km
East:	commercial properties (~100 m) and Cabbage Tree Creek (~150 m)
South:	Rural / farmland ~200 m
West:	Sandy Creek (150 m) and forested Crown Land

2.3 TOPOGRAPHY AND SURFACE WATER

Coffey Geotechnics (2016) conducted a detailed review of the topography and surface water of the Stage 4 Project area. Topography in the Stage 4 Project area generally slopes east from a north-south ridgeline of around 50 m AHD towards Cabbage Tree Creek at an elevation of around 30 m AHD, approximately 500 m east of the Project area. Surface water in Cabbage Tree Creek flows north-east discharging into the Shoalhaven River approximately 1.5 km from the Project area. West of the ridgeline topography generally slopes west discharging towards Sandy Creek at an elevation of around 30 m AHD. The topographic relief of the Site is provided in **Figure 3**.

2.4 SOIL LANDSCAPE

Previous investigations (E2W 2008) report the soil profile at the Site consists of silty-clay and sandy-clay sediments. Soil depths range from 1.5 m to 3.5 m at Stage 1 and 2, and up to 7 m at Stage 3.

2.5 GEOLOGY

A review of the Site geology was undertaken with reference to the Wollongong 1:250,000 geological series sheet (Si5609). The Site is located near the south eastern boundary of the Sydney Basin in an area underlain by Permian sediments of the Shoalhaven Group and Megalong Conglomerate subgroup, comprising Nowra Sandstone (Psn).

2.6 HYDROGEOLOGY

Groundwater resources in the area are expected to be associated with two (2) primary forms of aquifer systems;

1. *Shallow unconfined* and unconsolidated systems, generally less than 20m in depth with moderate yields, variable water quality, and strongly controlled by rainfall recharge; and
2. *Deep fractured rock* and dual porosity aquifers hosted by the Shoalhaven Group sedimentary rock sequence. Typically deeper than 20m with low yields, high iron and variable salinity.

Fifteen (15) groundwater monitoring wells are installed within Stage 1, 2 and 3 land and seven (7) groundwater monitoring wells are installed at the Stage 4 Site to provide specific data on the quality and nature of groundwater.

It should be noted that the five (5) deep monitoring wells installed on the Stage 4 Site have screens targeting geological units at 12m below ground level (mbGL) or greater whereas only BH14 (screened between 8.67-11.67mbGL) and BH17 (9-12mbGL) have screens placed at depth greater than 10mbGL within the existing landfill site.

The nearest existing monitoring well to the Stage 4 Site is BH19. It should be noted that the top of casing (TOC) of BH19 has been surveyed at 49.705mAHD and the well is constructed with a screened interval between 5.2 and 8.2 mbGL.

A review of the *NSW Office of Water* (*NOW*) existing bore records was previously conducted to develop the conceptual understanding of regional groundwater conditions, including aquifer depths, yields, water quality, and distribution. The database search did not identify any registered production bores within one (1) kilometre of the Site area. All bores in proximity to the area are registered for monitoring purposes.

Groundwater beneath the Site is expected to be associated with both shallow unconfined systems and deep fractured rock aquifers. Shallow groundwater flow is inferred to mimic topography with low hydraulic gradients flowing west-northwest towards Sandy Creek (see **Figure 3**). The Site, and adjoining land, is largely unsealed with potential for local recharge from rainfall infiltration. Likely discharge areas are identified in **Figure 3** along Sandy Creek and Cabbage Tree Creek approaching the Shoalhaven River. The nearest sensitive receptors are likely to include:

- Recreational users of the Sandy Creek and Shoalhaven River environs;
- Down gradient stakeholders (primarily rural); and
- Down gradient alluvial aquifers, Sandy Creek, and Groundwater Dependent Ecosystems (GDE) near discharge zones.

2.6.1 Site Investigation (Coffey 2016)

Water level loggers were installed in the seven (7) Stage 4 monitoring wells to record at six (6) hour intervals. Data collected from the dates of 7th June 2016 and 30th June 2016 was used to produce a contour map of hydraulic head surface. These are provided in **Figure 4**.

2.7 SURFACE WATER

The Site topography generally slopes west from a north-south ridgeline (~51 mAHD) towards Sandy Creek (~30 mAHD) on the western boundary (refer to **Figure 2**). Stormwater is intercepted by a system of cut-off drains which direct water around the Site and into collection dams.

2.8 WATER MANAGEMENT STRUCTURES

No structures have been constructed on Stage 4 land. A number of existing structures have been constructed on Stages 1, 2 and 3 to manage surface water, leachate and groundwater. These include but are not limited to:

- Sediment dam - stormwater collection;
- First flush dam;
- Stage 1, 2 & 3 - groundwater collection curtain/drain;
- Leachate is piped to the leachate dam; and
- Sub-surface leachate collection drains.

3.0 WATER QUALITY ASSESSMENT CRITERIA

3.1 CONTAMINANTS OF CONCERN

The contaminants and water quality indicators required to be monitored are defined by the EPL. Based on the Site history of landfilling and ongoing use as a waste and recycling facility the contaminants of concern include but are not limited to those defined in **Table 3**.

Table 3: Potential Contaminants of Concern

Potential Contaminants	Historical Activities	Dispersion Mechanism & Areas of Environmental Concern (AEC)
Heavy Metals	**General landfill activities**	Landfill, spills, leaks, leachate, detention pond, drains
Total Petroleum Hydrocarbons (TPH)		
Benzene Toluene Ethylbenzene, Xylenes (BTEX)		
Polycyclic Hydrocarbons (PAH)		
Phenols		
Organochlorine Pesticides (OCP)		
Organophosphate Pesticides (OPP)		
Nutrients, pH, Electrical Conductivity (EC), Total Suspended Solids (TSS)		

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). The relevant criteria to protect environmental values are:

Table 4: Groundwater Assessment Criteria

Environmental Value	Relevant Guideline
Ecosystems / Health Screening Levels	AWQG (fresh & marine ecosystem guidelines ANZECC 2000); NEPM (2013); and Health Screening Levels for Petroleum Hydrocarbons in Soil & Groundwater (CRC CARE, Sept. 2011)
Drinking Water	ADWG (2006)
Recreational Use	GMRRW (NHMRC 2008)
Agriculture (irrig. & stock)	AWQG (Irrigation & Stock water guidelines)
Effluent Irrigation	Environmental Guidelines (NSW EPA 2004)

3.2.1 ANZECC Guidelines

The relevant criteria for this water quality assessment are the Australian and New Zealand Guidelines for Fresh and Marine Waters (ANZECC Guidelines) Trigger Values (TV) for fresh water. Where the EPL does not dictate limits ENRS has adopted the assessment criteria considered most appropriate for the contaminants of concern, based on the receiving freshwater and estuarine environments and the historical level of disturbance at the Site. The adopted assessment criteria Trigger Values are provided in **Table 7** and **Table 8**. The Trigger Values are categorised by the per cent of species possibly affected. The OEH (DECC;2007) endorsed groundwater management guidelines recommend assessment for aquatic ecosystems based on the 95 per cent of species level of protection.

For selected heavy metals, the standard TV may be recalculated based on the impact of water hardness, pH, and alkalinity. These modifications require consideration in fresh waters (up to 2,500 mg/L^{-1} or 4,000µS/cm salinity) where they may affect the bioavailability of potentially toxic metals. In those cases, a hardness-modified trigger value (HMTV) may be derived to support a site specific assessment. The metal hardness-dependent algorithms (ANZECC 2000) are listed below:

- Cadmium HMTV = TV $(H/30)^{0.89}$
- Chromium(III) HMTV = TV $(H/30)^{0.82}$
- Copper HMTV = TV $(H/30)^{0.85}$
- Lead HMTV = TV $(H/30)^{1.27}$
- Nickel HMTV = TV $(H/30)^{0.85}$
- Zinc HMTV = TV $(H/30)^{0.85}$

Where:

- HMTV, hardness-modified trigger value (µg/L);
- TV, trigger value (µg/L) at a hardness of 30 mg/L as $CaCO_3$; and
- H, measured hardness (mg/L as $CaCO_3$) of fresh surface water (<2.5%).

pH modified TV are also available for further assessment of total Ammonia for waters within pH range 6 to 9 (i.e. TV at pH=7 is 2.18 mg/L). pH TV are provided in ANZECC Table 8.3.7 (ANZECC 2000). Where pH is less than 6 a conservative approach should be adopted, TV for pH 6 may be applied.

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 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) landuse categories for vapour intrusion (Table 1A[4]) associated with Total Recoverable Hydrocarbons TRH (F1 & F2) and BTEX compounds.

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.**

The appropriate HSL's should be selected based on the; landuse; aquifer medium (sand, silt, clay); and depth of watertable.

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. In addition to the HILs the amended NEPM (2013) provides the following site assessment criteria (SAC):

- ***Management Limits*** for petroleum hydrocarbon compounds (Table 1 B(7));
- ***Health Screening Levels*** (HSLs) potential vapour intrusion (Table 1A[4]) which should be selected based on the; landuse; medium (sand, silt, clay); and depth.
- ***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; and
- ***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
  - Commercial and industrial land uses.

4.0 SAMPLING METHODOLOGY

4.1 GROUNDWATER SAMPLING LOCATIONS

Groundwater samples were collected from five (5) of the seven (7) monitoring wells installed within the Stage 4 land on 14th June 2017. Two (2) of the wells (GW1-S and GW2-S) were not sampled due to either being dry or insufficient water being available to collect a representative sample. Monitoring well locations are illustrated in **Figure 2**.

Monitoring wells are assigned identification numbers GW1 to GW5, with GW1-S and GW2-S representing shallow wells installed at the sites of both GW1 and GW2.

A summary of well construction details is provided in **Appendix B**.

4.2 SAMPLE COLLECTION

Wells were dry purged then sampled using EPA endorsed low flow sampling techniques in order to obtain representative samples adjacent the slotted well screen. Designated equipment and pump tubing is used for each Well and is not re-used between sites as to avoid cross contamination. Samples were collected once field parameters stabilised within 10 per cent of the previous reading whilst maintaining a constant water level with no significant drawdown.

Groundwater samples for dissolved metal analysis were field filtered, using a disposable 0.45 µm membrane filter, prior to collection in acid preserved containers. Samples were sealed in laboratory-prepared sampling containers appropriate for the analysis and clearly labelled with the sample identification. All samples were stored on ice immediately after their collection and transported to the laboratory under Chain of Custody (COC) documentation. Any loss of volatile compounds was kept to a minimum by employing the following sampling techniques:

- Minimal practical disturbance during sampling;
- Samples placed immediately in sample containers with 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.

4.3 FIELD TESTING

Field testing was conducted during well purging and sampling to record physical water parameters. A TPS multi-probe water quality meter (90 FLMV) was used to measure the following parameters:

- Temperature;
- Dissolved Oxygen (DO);
- Electrical Conductivity (Salinity - EC);
- pH (Acidity); and
- Oxygen Reduction Potential (Redox/ORP/Eh).

Calibration certificates are provided in **Appendix C** with a summary of field testing results presented in **Table 10**.

4.4 LABORATORY ANALYSIS

ALS Environmental, NATA registered laboratory was contracted to undertake the laboratory analysis in accordance with the NATA Approved methods.

5.0 QUALITY ASSURANCE & QUALITY CONTROL PROCEDURES

5.1 DATA QUALITY OBJECTIVES

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

- The location, nature, and degree of ground contamination at selected sampling locations (if any);
- 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 (Decision Rules) 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 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 laboratory QC criteria.

5.2 FIELD QUALITY ASSURANCE & QUALITY CONTROL

The Quality Assurance and Quality Control (QA/QC) protocols used during the fieldwork are shown in **Table 6**. Refer to **Appendix D** for sample Chain of Custody (COC) documentation and **Appendix C** for equipment calibration certificates.

Table 6: Field QA/QC

Protocol	Description
Sampling Team	Site personnel comprised only experienced and qualified environmental professionals trained in conducting site contamination investigations.
Sample Equipment	All sample equipment disposed or decontaminated between sample sites.

Protocol	Description
Field Screening	Visual and manual inspection of sample materials for potential contamination
Chain of Custody Forms	All samples were logged and transferred under appropriately completed Chain of Custody (COC) forms.

5.3 LABORATORY ANALYTICAL METHODS

Analysis of samples was conducted by ALS Environmental (ALS). ALS is NATA accredited for the selected analysis. Laboratory QA/QC results are detailed in the Laboratory report contained in the appendices section of this report.

5.4 QUALITY ASSURANCE & QUALITY CONTROL DISCUSSION

A summary of the Data Quality performance is provided in **Table 7**.

Table 7: Data Quality Objectives and Criteria

DQO	Evaluation Criteria	Status
Documentation completeness	Completion of field records, chain of custody documentation, equipment calibration, laboratory test certificates from NATA-registered laboratories.	✓
Data comparability	Use of appropriate techniques for the sampling, storage and transportation of samples. Use of NATA certified laboratory using NEPM procedures. Comparison with previous site information, if any.	✓
Data representativeness	Sampling coverage of all areas of environmental concern at the site, and selection of representative samples from each sampling location. Targeting Areas of Environmental Concern (AEC) for contaminants of concern.	✓
Precision and accuracy for sampling and analysis	Use properly trained and qualified field personnel. Appropriate sampling and field techniques. Achieve laboratory QC criteria.	✓

The laboratory was NATA accredited and the Limit Of Resolution (LOR) were within the acceptable levels for the investigation criteria. Laboratory certificates of analysis provided in **Appendix D** indicate that for the samples collected during the scope of works, sampling techniques, transport procedures and laboratory analysis were satisfactory.

The QA/QC indicators 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 Water Quality Assessment. It is therefore concluded that the QA/QC results are adequate and the quality of the ***data is acceptable for use in this assessment***.

6.0 WATER QUALITY RESULTS

Laboratory results for groundwater were provided to ENRS for tabulation and comparison with relevant EPL assessment criteria and are reported in **Table 10.** During the June 2017 monitoring event, the following water monitoring locations were inspected for sampling;

- GW1, GW1-S, GW2, GW2-S, GW3, GW4, and GW5

These results have been compared against results reported in the 2015-2016 Stages1, 2 and 3 annual report.

6.1 PHYSICAL INDICATORS

6.1.1 Salinity (EC & TDS)

Salinity is reported by ALS as either Electrical Conductivity (EC) or Total Dissolved Solids (TDS). The ANZECC guidelines apply a ratio for filterable residue (1 mg/L) = 0.68 EC (µS/cm). In general fresh water is less than 1,000mg/L or 1,470 µS/cm.

Salinity levels in Stage 4 groundwaters ranged from **1210 mg/L TDS** in GW3 to **7830 mg/L TDS** in GW4. It should be noted that the adopted TV for TDS is 1500 mg/L. TDS values for groundwater are commonly in excess of the adopted TV and further monitoring is required to draw any conclusions regarding the significance of these levels.

For the 2015/2016 West Nowra Stages 1, 2 and 3 annual reporting period groundwater salinity was reported between **153 mg/L** (BH4, May 2016) and **2,070 mg/L** (BH7, February 2016) for landfill Stages 1,2 & 3.

6.1.2 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.

Generally low dissolved oxygen concentrations are encountered in groundwater and sampling has the potential to introduce dissolved oxygen into the water.

Dissolved oxygen levels measured in Stage 4 groundwater ranged from **0.41 mg/L** in GW3 to **1.99 mg/L** in GW1.

6.1.3 Oxidation Reduction Potential (Redox)

Oxidation Reduction Potential (ORP) is a measure of the capacity to either release electrons (positive=oxidation) or gain electrons (negative=reduction). Redox reactions govern the biological degradation of hydrocarbon contaminants and the mobility of many compounds such as nitrogen and sulphur. Microorganisms, such as bacteria, obtain energy for growth by transferring electrons from an electron donor to

an electron acceptor. Biodegradation of potential organic contaminants will rapidly deplete DO levels. Once DO levels are depleted, anaerobic microorganisms will typically use available electron acceptors in the following order: nitrate, Mn(IV), Fe(III) hydroxide, sulfate, and carbon dioxide. Interpretation of ORP is also affected by ionic concentrations, as indicated by salinity.

Measurements of ORP were recorded in the field using a TPS Ag/AgCl saturated KCL probe. To convert field readings to a Standard Hydrogen Electrode (SHE) the TPS manufacturer recommends adding 199 mV to the field readings (APHA;1999).

Field measurements of ORP during Stage 4 groundwater sampling reported positive (oxidising) values between **180.7 mV** (GW2) and **310.9 mV** (GW1). These are within the range of naturally occurring values and are unlikely to result in the formation of chemical species associated with biodegradation.

6.1.4 Hardness

Water hardness is a dimensionless unit which reflects the concentration of metallic cations in water. Analytical testing measures the dissolved calcium and Magnesium salts in mg/L of calcium carbonate (CaCO3) equivalent. Hardness affects the behaviour of water including corrosion potential and the solubility of heavy metals such as Copper, Zinc, Lead and Cadmium. Hardness was not reported by the laboratory. ENRS calculated hardness (Sum milliequivalents of Ca + Mg x 50) for selected monitoring points to support assessment of heavy metals concentrations against HMTV.

Table 8: Hardness Modified Trigger Values

Hardness Modified Trigger Values (mg/L)							
Site	Hardness $CaCO_3$	Cd HMTV	Cr VI HMTV	Cu HMTV	Pb HMTV	Ni HMTV	Zn HMTV
GW1	478.9	0.002	0.010	0.015	0.115	0.116	0.084
GW2	949.0	0.004	0.017	0.026	0.273	0.207	0.151
GW3	658.1	0.003	0.013	0.019	0.172	0.152	0.110
GW4	2493.5	0.010	0.038	0.060	0.932	0.471	0.343
GW5	228.6	0.0012	0.005	0.008	0.045	0.062	0.04

Hardness values in Stage 4 groundwater are reported between **228.6 mg/L** (GW5) and **2493.5 mg/L** (GW4). Hardness values in groundwater for the 2015 – 2016 Stages 1,2 & 3 monitoring period reported between **50.4 mg/L** (BH10) and **370.2 mg/L** (BH7).

6.1.5 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 at the Site by Forbes Rigby (1996) report acidic groundwater with a low pH of 4.3 associated with silica saturation and oxidation of accessory marcasites grains (iron sulphide) within weathered sandstone at the site which belongs to the Shoalhaven Group and Nowra Sandstone formation (marine sediments).

Stage 4 field measured pH values for June 2017 reported between **6.49** (GW4) and **6.75** (GW2) and are within the range of naturally occurring pH values.

During the 2015/2016 West Nowra Stages 1, 2 and 3 annual monitoring event pH in groundwater at the site remains low. Groundwater pH is reported between **3.4** (BH7, May 2016) and **5.9** (BH18, Feb 2015). Whilst the readings are generally below the ANZECC recommended range of pH 6.5-8.0 the results are within the range of historical values for the site and present an upward trending and less acidic pH.

6.2 INORGANIC ANALYTES

6.2.1 Nutrients

Groundwater samples were analysed for select nutrients including Ammonia, Nitrate, Phosphorus (P) and Phosphate. 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.

Phosphorus (Total P)

Stage 4 total phosphorous was reported at levels between **0.08 mg/L** (GW5) and the laboratory detection limit **<0.1 mg/L** (GW1).

Phosphate

Stage 4 phosphate (as reactive P) *for June 2017* was reported at a level of **0.02 mg/L** in GW3. All other wells reported phosphate levels below the laboratory detection limit.

Concentrations of Phosphate in groundwater for the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period are reported below the laboratory detection limit **(<0.01 mg/L**). The results are satisfactory.

Ammonia

Stage 4 concentrations of ammonia for June 2017 was reported at levels between **0.02 mg/L** (GW3) and **0.08 mg/L** (GW4). It should be noted that the ANZECC 95% TV is **2.57 mg/L** for waters with a pH of 6 and **0.08 mg/**L for waters with a pH of 8. All Stage 4 wells fall below this value.

Concentrations in groundwater for the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period were reported between the laboratory detection limit (**<0.01 mg/L**) and **1.25 mg/L** (BH10 Aug. 2016).

Nitrate

Stage 4 concentrations of nitrate for June 2017 was reported at a level of **0.01 mg/L** in GW4 and GW5. All other wells returned results below the laboratory detection limit.

Results for Nitrate in groundwater for the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period are reported between the laboratory detection limit (<0.01 mg/L) and **0.08 mg/L** (BH7) which is below the adopted **0.7 mg/L** TV. Hence, the results are satisfactory.

6.2.2 Total Phenolics

Phenols do not tend to bio-accumulate and have a relatively short half-life of between 2 and 20 days. Phenols are present in a range of industrial and household products including disinfectants, fertilisers, explosives, paints and paint removers, drugs, pharmaceuticals, textiles and charcoal (coke). The largest single use of phenol is as an intermediate in the production of phenolic resins, which are low-cost, versatile, thermoset resins used in the plywood adhesive, construction, automotive, and appliance industries. It is also used as an intermediate in the production of bisphenol A, which is used to make epoxy and other resins. Phenol is also naturally occurring in animal waste and decomposing organic matter.

Stage 4 laboratory results of Total Phenols for June 2017 reported at levels below the laboratory detection limit.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results for Total Phenols in Site waters generally returned levels below the laboratory detection limit (**<0.05 mg/L**) with two minor detections of **0.06 mg/L** (BH18) and **0.08 mg/L** (BH10) which below the adopted TV (**0.32 mg/L**). Concentrations of phenols have previously been detected in BH10 between 2010 and 2011 up to **0.24 mg/L**.

6.2.3 Metals & Metalloids

Water samples were analysed for a suite of selected heavy metals and metalloids. Where heavy metal concentrations exceeded the standard ANZECC 95% threshold Trigger Value, site specific Hardness-Modified Trigger Values (HMTV) were calculated. Details of metal and metalloid concentrations with HMTV are provided in **Table 8**.

Aluminium (Dissolved Al)

Stage 4 concentrations of dissolved aluminium for June 2017 were reported at **0.02 mg/L** in GW1. All other wells returned results below the laboratory detection limit.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report elevated concentrations of total aluminium were reported above the ANZECC 95%TV (**0.055 mg/L**) in most sampled groundwater and leachate locations (BH6, BH7, BH13, BH14, BH16, BH17, BH18, BH22, and LD1). Previous Site investigations report naturally occurring levels up to **4.6 mg/L** (Forbes Rigby;1996). Review of the historical data indicates the sites are within the range of historical values. It was noted that results are reported for Total metal concentrations which indicates there is potential for elevated levels due to sampling conditions and turbidity.

Arsenic (Filtered As)

Stage 4 concentrations of dissolved arsenic for June 2017 were reported at levels between **0.006 mg/L** (GW2) and below the laboratory detection limit (GW1).

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period concentrations of total arsenic in Site waters were generally reported below the laboratory detection limit (**<0.01mg/L**) and the adopted TV (**0.024 mg/L**). Similar to the previous reporting period a minor exceedance is noted in BH13 (**0.076 mg/L**). Elevated levels of arsenic in BH13 have been reported since 2010.

Barium (Dissolved Ba)

Stage 4 concentrations of dissolved barium for June 2017 were reported at levels between **0.068 mg/L** (GW1) and **0.14 mg/L** (GW2)

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results reported concentrations of total barium in Site waters were reported between **0.018 mg/L** (BH22) and **0.266 mg/L** (Leach PH).

Cadmium (Dissolved Cd)

Stage 4 concentrations of dissolved cadmium for June 2017 were reported at a level of **0.0087 mg/L** in GW4. All other wells returned results below the laboratory limit of detection. This is below the HMTV of **0.01 mg/L.**

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total cadmium in Site waters at levels between the laboratory detection limit (**<0.0001 mg/L**) and **0.0002 mg/L** (BH6). Comparison with HMTV reports no exceedances of the ANZECC guidelines.

Cobalt (Dissolved Co)

Stage 4 concentrations of dissolved cobalt for June 2017 were reported at levels between **0.005 mg/L** (GW2) and **0.052 mg/L** (GW4).

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total cobalt in Site waters between the laboratory detection limit **0.001 mg/L** (BH13) and **0.054 mg/L** (BH6).

Copper (Dissolved Cu)

Stage 4 concentrations of dissolved copper for June 2017 were reported at a level of **0.001 mg/L** in GW4. All other wells reported levels below the laboratory limit of detection.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total copper in Site waters between the laboratory detection limit (**<0.001 mg/L**) and **0.032 mg/L** (BH10). Review of historical data and statistical analysis indicates concentrations for Copper have declined since the previous monitoring event and are within the range of historical values. Similar to Aluminum, results for Copper are likely influenced by low pH and sample turbidity.

Hexavalent Chromium (Dissolved CrVI)

Stage 4 concentrations of dissolved hexavalent chromium for June 2017 were reported at levels below the laboratory levels of detection

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total hexavalent chromium in Site waters below the laboratory detection limit (**<0.01mg/L**). Hexavalent chromium has not been detected in site waters since 2008.

Chromium (Dissolved Cr)

Stage 4 concentrations of dissolved chromium for June 2017 were reported at levels below the laboratory levels of detection.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total chromium in groundwater between the laboratory LOR **<0.001 mg/L** and **0.026 mg/L** (BH10). HMTV are available for CrVI and may be used for screening Total Cr. Minor exceedances of the HMTV were reported in BH10, BH17 and BH18. Similar to results for other metals these concentrations are influenced by the low pH of site waters which increases metal mobility.

Lead (Dissolved Pb)

Stage 4 concentrations of dissolved lead for June 2017 were reported at levels below the laboratory levels of detection.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total lead in Site waters between the laboratory detection limit (<0.001 mg/L) and **0.043 mg/L** (BH10). Comparison of results against HMTV reports a single exceedance in BH10 with **0.043 mg/L** which is above the HMTV of **0.007 mg/L**.

Magnesium (Dissolved Mg)

Stage 4 concentrations of dissolved magnesium for June 2017 were reported at levels between **47 mg/L** (GW3) and **298 mg/L** (GW4).

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total magnesium in groundwater at levels between **6 mg/L** (BH22) and **62 mg/L** (BH7). No TV are available for screening purposes. However, it was noted that results are generally within the range of historical values.

Manganese (Dissolved Mn)

Stage 4 concentrations of dissolved manganese for June 2017 were reported at levels between **0.62 mg/L** (GW1) and **3.39 mg/L** (GW4). It should be noted that only GW4 reported manganese levels higher than the **1.9 mg/L** TV.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total manganese in groundwater between **0.06 mg/L** (BH17) and **0.797 mg/L** (BH18).

Mercury (Dissolved Hg)

Stage 4 concentrations of dissolved mercury for June 2017 were reported at levels below the laboratory detection limit.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total mercury in Site waters below the laboratory detection limit (**<0.0001mg/L**).

Zinc (Dissolved Zn)

Stage 4 concentrations of dissolved zinc for June 2017 were reported at levels between **0.009 mg/L** (GW3) and **0.394 mg/L** (BH4). Only GW4 reports results in exceedance of its HMTV of **0.343 mg/L**.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period laboratory results report concentrations of total zinc in groundwater between **0.03 mg/L** (BH17) and **0.162 mg/L** (BH10). Exceedances of the calculated HMTV were reported in BH6, BH7, BH10, BH13, BH14, BH16, BH17, BH18 and BH22.

Review of heavy metals results for Stage 4 June 2017 reports elevated concentrations of Cobalt, Magnesium, Manganese and Zinc. Some metals can occur naturally at the reported levels. Mobility of metals in groundwater can be increased in low pH conditions such as those encountered in groundwater at Stages 1, 2 and 3 existing landfill site. It is recommended that concentrations of metals in site waters continue to be monitored closely. The sampling contractor shall ensure samples are field filtered to minimise the influence of turbidity.

6.3 ORGANIC ANALYTES

6.3.1 Total Organic Carbon (TOC)

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.

Stage 4 TOC concentrations for June 2017 were observed at a level of **2 mg/L** in GW4. All other wells reported results below the laboratory detection limit.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period the reported TOC concentrations were between **2 mg/L** (BH4, BH10) and **66 mg/L** (BH10).

Review of historical data (since 2007) indicates readings for TOC in groundwater during the 2015-2016 monitoring period are within the range of historical values with no significant changes compared with the 2014-2015 monitoring period.

6.3.2 Total Recoverable Hydrocarbons (TRH)

Laboratory testing was conducted for light fraction (C6-9) and heavy fraction (C10-34) Total Recoverable Hydrocarbons (TRH), previously referred to as Total Petroleum Hydrocarbons (TPH). The updated TRH suite provides for improved screening of a wider range of hydrocarbons.

Levels of TRH were reported below the laboratory detection limit in all Stage 4 wells.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period minor detections for light fraction TRH C6-C9 were detected in **BH10 (0.02 mg/L)** below the NEPM (2013) trigger value of **7 mg/L**. Results for heavy fraction C10-C36 report minor detections in **BH10 (0.41 mg/L)** which is below the adopted (NEPM 2013) guidelines.

6.3.3 Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)

BTEX compounds are volatile compounds commonly found in petroleum products and are a common indicator of ground contamination.

Levels of BTEX were reported below the laboratory detection limit in all Stage 4 wells.

BTEX results in Site waters for the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period generally reported concentrations below the laboratory LOR and the adopted TV. Minor concentrations of Toluene were detected in BH10 at a level of **0.01mg/L**, less than the **0.3mg/L** guidelines.

6.3.4 Polycyclic Aromatic Hydrocarbons (PAH)

PAH's are formed by the incomplete combustion of coal, oil, petrol, wood, or other organic materials. Major sources of PAHs include asphalt roads, road tar, coal, and fires of all types.

Concentrations of PAHs were reported below the laboratory detection limit in all Stage 4 wells.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period concentrations of PAHs in groundwater were all reported as less than the laboratory LOR (**<0.0005 mg/L**).

6.3.5 Organochlorine Pesticides (OCP)

OCPs are characteristically very stable. They degrade slowly and accumulate in the food chain. Since they were first introduced into Australia in the mid-1940s, OCPs have been used in many commercial products. Commonly used OCP insecticides were DDT, lindane, chlordane, dieldrin, aldrin and heptachlor.

Concentrations of OCPs were reported below the laboratory detection limit in all Stage 4 wells.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period results for OCPs were reported as less than the laboratory detection limit (**<0.001 mg/L**).

6.3.6 Organophosphorus Pesticides (OPP)

OPPs are synthetic, more water soluble and have higher degradation rates than OCPs. OPPs may interfere with the nervous system and cause development or reproductive harm, and endocrine disruption.

Concentrations of OPPs were reported below the laboratory detection limit in all Stage 4 wells.

For the 2015/2016 West Nowra Stages 1, 2 and 3 monitoring period results for OPPs were reported as less than the laboratory detection limit (**<0.001 mg/L**).

7.0 ENVIRONMENTAL ASSESSMENT

7.1 MONITORING POINT SUMMARY

Field measurements and laboratory water quality results from the Stage 4 June 2017 environmental monitoring event report concentrations of analytes generally within the adopted guideline trigger values. A summary of the key water quality results, trends and recommendations for monitoring points is provided in **Table 9**.

Table 9: Summary of June 2017 Monitoring Results

Sample ID	Exceedance		Comment
	Result	Guideline	
GW2	2570 mg/L TDS	1500 mg/L (ANZECC 2000 95%)	TDS values exceeding 1500 mg/L are of common occurrence in natural groundwater and is likely associated with the site geology which comprises marine sedimentary rocks and residual clays
GW3	1870 mg/L TDS		
GW5	2380 mg/L TDS		
GW4	7830 mg/L TDS 3.39 mg/L Mn 0.394 mg/L Zn	1500 mg/L (ANZECC 2000 95%) 1.9 mg/L Mn 0.343 mg/L Zn (HMTV)	TDS values exceeding 1500 mg/L are of common occurrence in natural groundwater and is likely associated with the site geology which comprises marine sedimentary rocks and residual clays. With water of this hardness (calculated to be 2493.5 mg/L $CaCO_3$) high concentrations of dissolved metals can be a common occurrence. It is the recommendation of ENRS that additional sampling be undertaken periodically to better characterise the nature of water in GW4. It should also be noted that GW4 is the furthest away from active landfill and is screened at a depth closer to ground level than the other wells sampled. This may influence the nature of the water chemistry.

7.2 HISTORICAL DATA ASSESSMENT

This sampling event is the first to have been undertaken on the Stage 4 wells and was conducted for the purpose of gathering baseline data.

Water quality monitoring has been conducted at the Stage 1, 2 and 3 site since December 2001, although the sampling regime has been altered since that time. This assessment of environmental monitoring has considered the available data from at least the previous four (4) years to support the identification of background levels, trends and changes in water quality. In general, concentrations of key landfill leachate indicators, including Ammonia, pH and Organic Carbon were within the historical range reported for the Site.

8.0 CONCLUSION AND RECOMMENDATIONS

8.1 CONCLUSIONS

Based on the reviewed Stage 4 June 2017 data and results of the 2015/2016 West Nowra Stages 1, 2 and 3monitoring program the following conclusions are provided:

- A total of seven (7) groundwater monitoring points were inspected on 14th June 2017. Samples were collected by ENRS personnel and analysed by Council's preferred contractor, ALS Environmental, a NATA accredited laboratory;
- The nearest existing groundwater monitoring well for West Nowra Stages 1, 2 and 3 is BH19 which has been dry for the last five (5) monitoring periods;
- Wells installed on the Stage 4 Site generally target deeper groundwater than those targeted by existing Stage 1, 2 and 3 monitoring wells;
- Groundwater salinity is elevated across the Site with levels of TDS generally reported above the adopted trigger values is likely associated with the site geology which comprises marine sedimentary rocks and residual clays;
- Results for pH in groundwater at the Site generally reported neutral pH levels which are within the range of those anticipated to occur naturally;
- Concentrations of nutrients in Stage 4 groundwater are present in concentrations below the adopted TVs and what has been historically observed for Stage 1, 2 and 3 ground waters;
- Dissolved concentrations in groundwater of Aluminium, Arsenic, Barium, Cadmium, Cobalt, Chromium, Hexavalent Chromium (CrVI), Copper, Magnesium, Manganese and Mercury were reported below the laboratory detection limit and/or the adopted Trigger Value. The only TV exceedance from metals was reported in GW4 for Zinc;
- Reported concentrations of Total Organic Carbon (TOC) reported below the laboratory detection limit and/or the adopted Trigger Value;
- Concentrations of TRH and BTEX were reported below the laboratory detection limit;
- Concentrations of PAHs were reported below the laboratory detection limit;
- The monitoring locations and sampling techniques is considered to provide suitable assessment of groundwater conditions on the Stage 4 Land; and
- Based on this review of June 2017 Stage 4 Land baseline water quality data, ENRS conclude that there is unlikely to be any significant impacts from existing Stage 1, 2 and 3 landfilling operations.

8.2 RECOMMENDATIONS

Based on the findings obtained during this Baseline Water Quality Assessment the following recommendations are provided:

- Additional periodic sampling of Stage 4 Land groundwater be conducted by a suitably qualified person to further characterise baseline conditions;
- Stage 1, 2 and 3 results for metals and metalloids to be reported as total concentrations for surface water and dissolved concentrations for groundwater. Consider testing for both total and dissolved concentrations in groundwater for the next round of testing to provide for comparison.
- Should any change in Site conditions or incident occur which causes a potential environmental impact, ENRS should be notified to further assess the Site and consider requirements for any additional monitoring.

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.

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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.

9.0 REFERENCES

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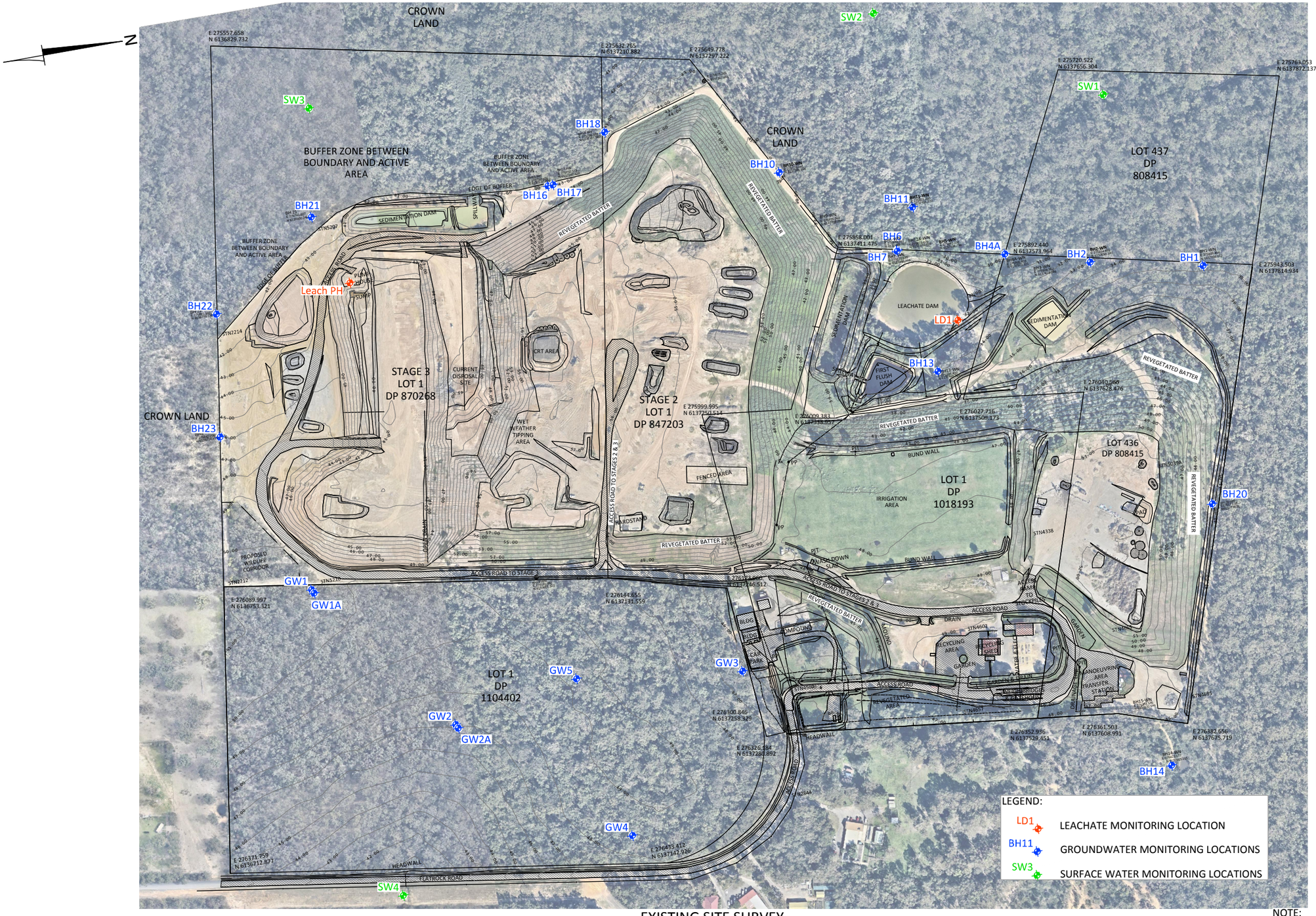
FIGURES

Figure 2 Site Plan & Well Location Map
Figure 3 Topographic Map
Figure 4 Regional Geology
Figure 5 Hydraulic Head Surfaces



EXISTING SITE SURVEY
SCALE 1:4000

LEGEND:

- LD1 — LEACHATE MONITORING LOCATION
- BH11 — GROUNDWATER MONITORING LOCATIONS
- SW3 — SURFACE WATER MONITORING LOCATIONS

STAGE 4
MONITORING LOCATION COORDINATES

SETTING OUT POINT	EASTING	NORTHING	GROUND LEVEL
GW1	276,107.00	6,136,839.00	50.37
GW1A	276,111.00	6,136,841.00	50.39
GW2	276,263.00	6,136,958.00	47.08
GW2A	276,267.00	6,136,960.00	46.97
GW3	276,258.00	6,137,248.00	46.25
GW4	276,401.00	6,137,113.00	48.49
GW5	276,238.00	6,137,084.00	49.13

Shoalhaven City Council

NOTE:
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

ISSUED FOR INFORMATION ONLY

REFERENCE

DWG. NUMBER	TITLE
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-

REVISIONS

No.	DATE	DESCRIPTION	BY	CHKD
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
B	29.11.16	REVISED AFTER COMMENTS FROM SCC	AB	AD
A	30.03.16	ISSUED FOR INFORMATION	AB	AD

SLR Consulting Australia Pty Ltd
Consulting Engineers & Scientists
589 Hay Street
Jolimont 6014
Western Australia
Tel : +61 8 9422 5900
Fax : +61 8 9422 5901

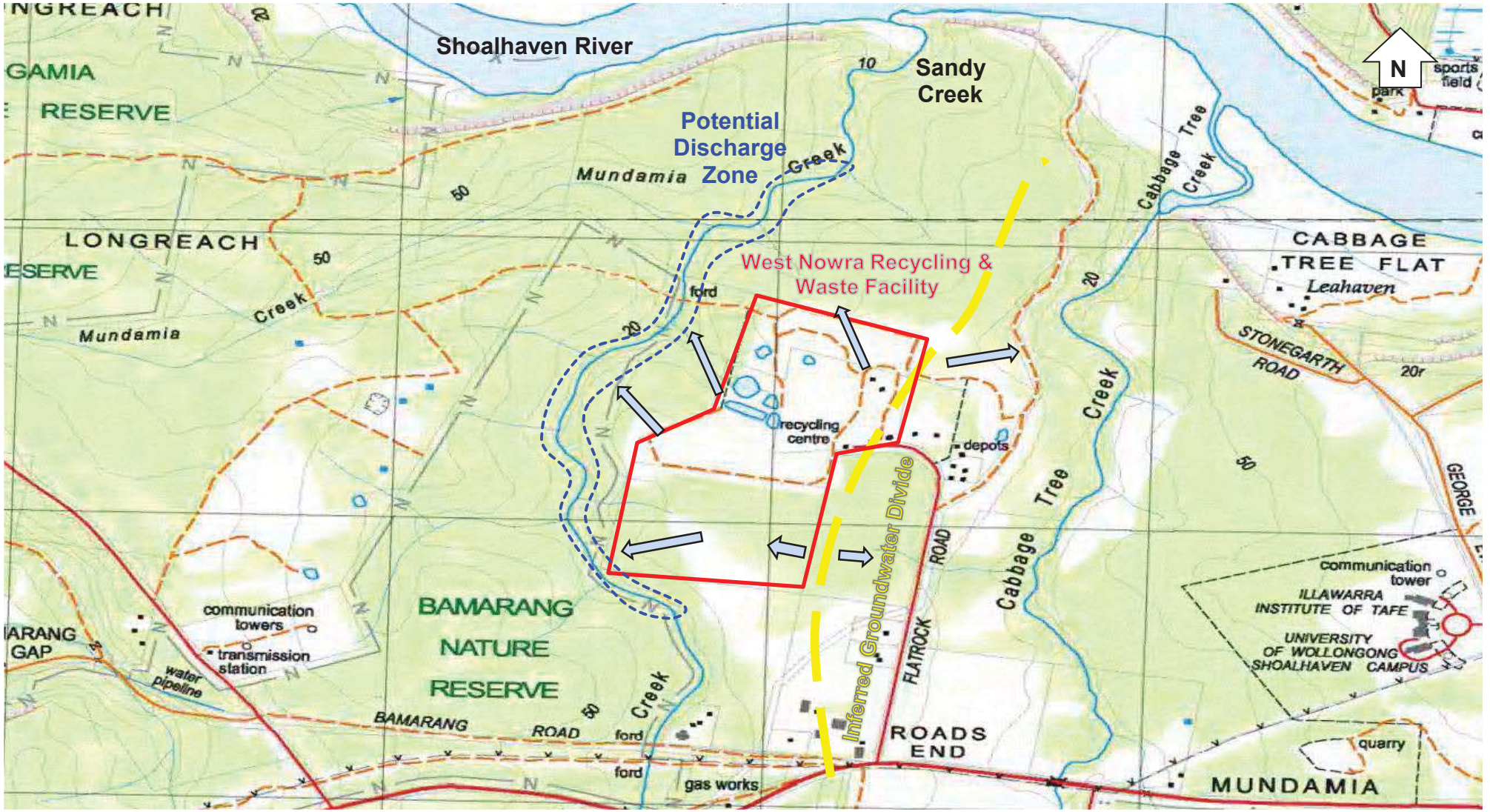
APPROVED		
DEPT.	DATE	SIGN
Civil	-	-
Engineering	-	-
Production	-	-
PROJ. ENG.	-	-
PROJ. MNG.	-	-

	DATE	NAME
DRAWN BY:	NOV 2016	AB
CHECKED:	NOV 2016	AD
APPROVED:	-	-

SHOALHAVEN CITY COUNCIL
.
WEST NOWRA RECYLING AND WASTE FACILITY
.
MONITORING LOCATIONS LAYOUT

SCALE: 1:4000
SHEET: 1 of 1

SLR PROJECT NUMBER: 610.15781 | DRAWING NUMBER: FIGURE 18 | REV: B



LEGEND

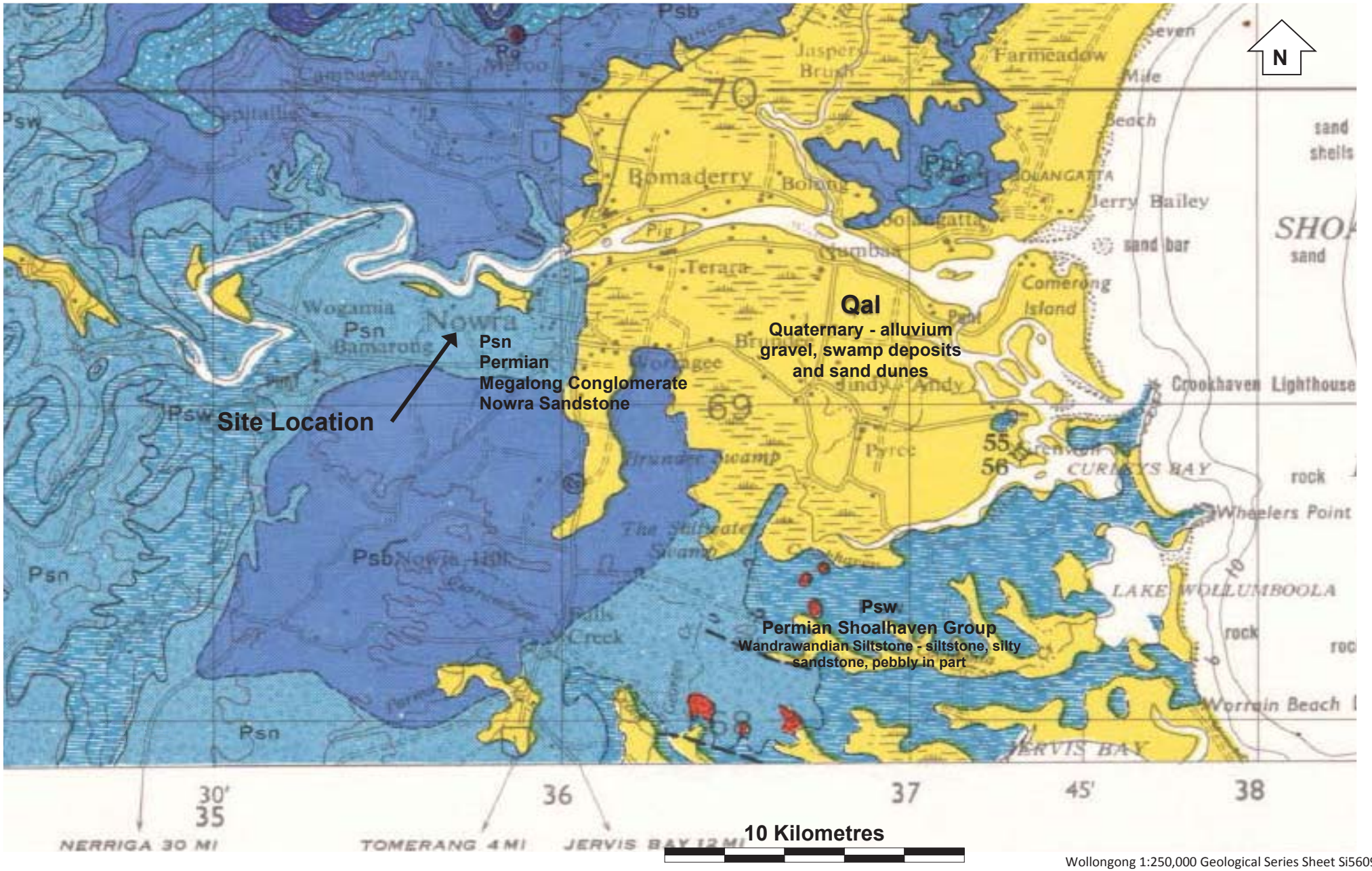
- Site Boundary
- Surface Water Sampling Location
- Groundwater Monitoring Bore
- Interpreted Groundwater Gradient
- Inferred Groundwater Flow Boundary
- Likely Groundwater Discharge Zone

1 Kilometre

Nowra 1:25,000 Topographic Sheet 90283S

ENRS
Environment & Natural Resource Solutions
25 River Road, Shoalhaven Heads, NSW, 2535
T/F 02 90374708 M. 0401518443 projects@enrs.com.au

Scale:	scale bar	Status:	Rev 1	Client:	Shoalhaven City Council	Title:	Topographic Map
Revision:	A	Drawn:	RL	Project:	ENRS0047.4	Date:	15/12/2014
Checked:	RL	Approved:	RL	Location:	West Nowra Recycling & Waste Facility	Figure:	3



Wollongong 1:250,000 Geological Series Sheet Si5609

ENRS
Environment & Natural Resource Solutions
25 River Road, Shoalhaven Heads, NSW, 2535
T/F 02 90374708 M. 0401518443 projects@enrs.com.au

Scale:	scale bar	Status:	Rev 1	Client:	Shoalhaven City Council	Title:	Regional Geology
Revision:	A	Drawn:	RL	Project:	ENRS0047.4	Date:	15/12/2014
Checked:	RL	Approved:	RL	Location:	West Nowra Recycling & Waste Facility	Figure:	4

STAGE 2
LOT 1
DP 847203

ACCESS ROAD TO STAGES 2 & 3

CRT AREA

WET WEATHER TIPPING AREA

CURRENT DISPOSAL SITE

STAGE 3
LOT 1
DP 870268

ACCESS ROAD TO STAGE 3

PROPOSED WILDLIFE CORRIDOR

BLDG

BLDG

CAR PARK

ACCESS ROAD

LOT 1
DP 1104402

PROPOSED LANDFILL EXTENSION AREA

ENVIRONMENTAL ZONE

FLATROCK ROAD

GW3 40.7

BH5

TP10

TP9

BH6

TP7

BH4

TP8

GW4*

TP6

GW5 40.5

BH3

TP5

TP3

TP4

TP2

GW2A DRY
GW2 40.1

BH2

TP1

BH1

GW1A DRY
GW1 41.8

N

LEGEND

Piezometer screened in sandstone ■ GW1

Water table elevation (m AHD) 40.5

Interpreted water table contours (m AHD)

Interpreted groundwater flow direction

Interpreted groundwater divide

*GW4 -
Intermittent saturation around base of screen 36.5 m AHD

Code	Easting	Northing	Elevation
GW1 TOP OF COVER	276107.374	6136839.030	51.109
GW1 GROUND SURF	276107.374	6136839.030	50.439
GW1A TOP OF COVER	276110.640	6136841.108	51.254
GW1A GROUND SURF	276110.640	6136841.108	50.434
GW2 TOP OF COVER	276262.662	6136958.080	47.841
GW2 GROUND SURF	276262.662	6136958.080	47.031
GW2A TOP OF COVER	276265.537	6136960.076	47.709
GW2A GROUND SURF	276265.537	6136960.076	46.899
GW3 TOP OF COVER	276257.533	6137248.077	47.057
GW3 GROUND SURF	276257.533	6137248.077	46.312
GW4 TOP OF COVER	276400.884	6137112.751	49.259
GW4 GROUND SURF	276400.884	6137112.751	48.509
GW5 TOP OF COVER	276238.189	6137084.391	48.771
GW5 GROUND SURF	276238.189	6137084.391	48.171
TP1 GROUND SURF	276134.712	6136886.794	49.834
TP2 GROUND SURF	276189.083	6136966.198	48.978
TP3 GROUND SURF	276145.041	6137007.424	48.973
TP4 GROUND SURF	276257.553	6136889.717	47.552
TP5 GROUND SURF	276351.271	6137023.158	47.008
TP6 GROUND SURF	276150.232	6137094.303	48.531
TP7 GROUND SURF	276192.148	6137130.366	48.691
TP8 GROUND SURF	276373.876	6137102.583	48.609
TP9 GROUND SURF	276311.454	6137206.309	48.259
TP10 GROUND SURF	276238.740	6137202.454	47.444
BH1 GROUND SURF	276229.734	6136876.567	48.250
BH2 GROUND SURF	276128.943	6136949.571	49.310
BH3 GROUND SURF	276162.930	6137037.180	48.913
BH4 GROUND SURF	276281.165	6137109.243	49.110
BH5 GROUND SURF	276178.244	6137214.947	48.350
BH6 GROUND SURF	276372.990	6137188.075	48.920

DESIGNED: G. BIANCO 21/7/16	SURVEYED: E. VENHUIZEN	AMENDMENTS	
DRAWN: G. BIANCO 21/7/16	FIELD BOOK:		
CHECKED:	ORIGIN OF LEVELS:		
APPROVED:	DATUM: AHD		
DRAWING FILE:	CIVILCAD FILE:		

Shoalhaven City Council
Environment - Growth - Community

CITY OF SHOALHAVEN

West Nowra Recycling and Waste Facility
Geotechnical and Hydrogeological Investigation
Drawing 3 - Hydraulic Head Surface (m AHD) 7 June 2016

SCALE:
1:1,000 for A1 size plot, 1:2,000 for A3 size plot
Do not scale off drawings.
Confirm all dimensions on site prior to start of construction.

DIRECTOR ASSETS & WORKS: DATE:

- PLAN REFERENCE -
2824_281B

TERMS & CONDITIONS FOR SUPPLY OF ELECTRONIC DATA

THE DATA PROVIDED MAY HAVE BEEN PREPARED BY US, OR WHOLLY, OR IN PART BY THIRD PARTIES ON BEHALF OF PROJECT DELIVERY SCC, AND ALTHOUGH WE USE OUR BEST ENDEAVORS TO ENSURE NO INACCURACIES OR DEFECTS EXIST IN THE PHYSICAL MEDIA, DATA OR SOFTWARE, WE MAKE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND TO ITS MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THESE DRAWINGS DO NOT REPRESENT 'AS-BUILT' DRAWINGS, AND THEREFORE PROJECT DELIVERY SCC DO NOT WARRANT THE INTEGRITY OF THE DATA OR ACCURACY OR QUALITY OF ANY INFORMATION CONTAINED WITHIN THE DATA. THEREFORE, ALL RESPONSIBILITY RELATING TO THE USE OF SUCH INFORMATION IS ENTIRELY THAT OF THE USER.
IF YOU HAVE ALTERED THE DATA IN ANY WAY, YOU WILL ENSURE THAT THE PROJECT DELIVERY SCC TITLE BLOCK AND SCC LOGO IS REMOVED FROM THE DATA BEFORE RE-ISSUE.

ACCESS ROAD
BLDG
BLDG
CAR PARK
GW3
40.6
STAGE 2
LOT 1
DP 847203
BH5
TP10
TP9
BH6
ACCESS ROAD TO STAGES 2 & 3
TP7
LOT 1
DP 1104402
BH4
TP8
GW4
39.3
CRT AREA
WET WEATHER TIPPING AREA
TP 6
GW5
40.5
PROPOSED LANDFILL EXTENSION AREA
ACCESS ROAD TO STAGE 3
BH3
TP5
TP3
TP4
CURRENT DISPOSAL SITE
STAGE 3
LOT 1
DP 870268
TP2
GW2A DRY
GW2
40.0
BH2
ENVIRONMENTAL ZONE
FLATROCK ROAD
TP 1
BH1
GW1A DRY
GW1
42.0
PROPOSED WILDLIFE CORRIDOR

N

LEGEND

Piezometer screened in sandstone ■ GW1

Water table elevation (m AHD) 40.5

Interpreted water table contours (m AHD)

Interpreted groundwater flow direction

Interpreted groundwater divide

Code	Easting	Northing	Elevation
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BH6 GROUND SURF	276372.990	6137188.075	48.920

DESIGNED: G. BIANCO 21/7/16	SURVEYED: E. VENHUIZEN	AMENDMENTS	
DRAWN: G. BIANCO 21/7/16	FIELD BOOK:		
CHECKED:	ORIGIN OF LEVELS:		
APPROVED:	DATUM: AHD		
DRAWING FILE:	CIVILCAD FILE:		

Shoalhaven City Council
Environment - Growth - Community

CITY OF SHOALHAVEN

West Nowra Recycling and Waste Facility
Geotechnical and Hydrogeological Investigation
Drawing 4 - Hydraulic Head Surface (m AHD) 30 June 2016

SCALE:
1:1,000 for A1 size plot, 1:2,000 for A3 size plot
Do not scale off drawings.
Confirm all dimensions on site prior to start of construction.
NOTE:

DIRECTOR ASSETS & WORKS: DATE:

- PLAN REFERENCE -
2824_281B

TABLES

Table 10: Summary of Results: June 2017

		ANZECC 2000 Freshwater (95% Species)	GW1	GW1-S	GW2	GW2-S	GW3	GW4	GW5
Alkalinity (CaCO3)	mg/L		228		444		402	234	399
Aluminium	mg/L	0.055	0.02		<0.01		<0.01	<0.01	<0.01
Ammonia as N	mg/L	0.9 0.9 (pH 8) - 2.57 (pH 6)	0.04		0.03		0.02	0.08	0.03
Arsenic	mg/L	0.024	<0.001		0.006		0.001	0.004	0.001
Barium	mg/L	-	0.068		0.14		0.129	1.12	0.101
Benzene	mg/L	0.95	<1		<1		<1	<1	<1
Bicarbonate	mg/L	-	228		444		402	234	399
Cadmium	mg/L	0.0002	<0.0001		<0.0001		<0.0001	0.0087	<0.0001
Calcium	mg/L	-	106		286		186	507	224
Carbonate	mg/L	-	<1		<1		<1	<1	<1
Chloride	mg/L	-	392		971		760	4130	925
Hexavalent Chromium	mg/L	0.001	<0.01		<0.01		<0.01	<0.01	<0.01
Total Chromium	mg/L	0.001	<0.001	Dry	<0.001		<0.001	<0.001	<0.001
Cobalt	mg/L	-	0.03		0.005		0.011	0.052	0.006
Conductivity Field	µS/cm	2200 max - 125 min	2411		4647		3719	14520	4390
Conductivity Lab	µS/cm	2200 max - 125 min	2100		4180		3330	12500	3960
Copper	mg/L	0.0014	<0.001		<0.001		<0.001	0.001	<0.001
Ethyl- Benzene	mg/L	0.14 **	<2		<2		<2	<2	<2
Fluoride	mg/L	1.5 ***	0.2		0.3		0.5	0.2	0.5
Lead	mg/L	0.0034	<0.001		<0.001		<0.001	<0.001	<0.001
Magnesium	mg/L	-	52		57		47	298	60
Manganese	mg/L	1.9	0.62		0.793		1.16	3.39	0.684
Mercury	mg/L	0.0006	<0.0001		<0.0001		<0.0001	<0.0001	<0.0001
Nitrate	mg/L	0.7	<0.01		<0.01		<0.01	0.01	0.01
Nitrite	mg/L	-	<0.01		<0.01		<0.01	<0.01	<0.01
OCP's	mg/L								
Aldrin	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
alpha-BHC	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
alpha-Endosulphan	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
beta-BHC	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
beta-Endosulphan	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Chlordane	mg/L	0.00008	<0.5		<0.5		<0.5	<0.5	<0.5
cis-Chlordane	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
trans-Chlordane	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
DDD	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
DDE	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
DDT	mg/L	0.00001	<2.0		<2.0		<2.0	<2.0	<2.0
delta-BHC	mg/L	-	<0.5	DRY	<0.5		<0.5	<0.5	<0.5
Dieldrin	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Endosulphan Sulphate	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Endrin	mg/L	0.00002	<0.5		<0.5		<0.5	<0.5	<0.5
Endrin ketone	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Endrin Aldehyde	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
gamma-BHC	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Heptachlor	mg/L	0.00009	<0.5		<0.5		<0.5	<0.5	<0.5
Heptachlor Epoxide	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Hexachlorobenzene	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Lindane	mg/L	-							
Methoxychlor	mg/L	-	<2.0		<2.0		<2.0	<2.0	<2.0
OPP's	mg/L								
Azinphos Methyl	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Bromophos-ethyl	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Carbophenothion	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Chlorfenvinphos	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Chlorpyrifos	mg/L	0.00001	<0.5		<0.5		<0.5	<0.5	<0.5
Chlorpyrifos-methyl	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Demeton-S-methyl	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Diazinon	mg/L	0.00001	<0.5		<0.5		<0.5	<0.5	<0.5
Dichlorvos	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Dimethoate	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Ethion	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Fenamiphos	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Fenthion	mg/L	-	<0.5	DRY	<0.5		<0.5	<0.5	<0.5
Malathion	mg/L	0.00005	<0.5		<0.5		<0.5	<0.5	<0.5
Mevinphos (Phosdrin)	mg/L	-							
Monocrotophos	mg/L	-	<2.0		<2.0		<2.0	<2.0	<2.0
Parathion	mg/L	0.000004	<2.0		<2.0		<2.0	<2.0	<2.0
Parathion-methyl	mg/L	-	<2.0		<2.0		<2.0	<2.0	<2.0
Pirimphos-ethyl	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Prothiofos	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Ronnel	mg/L	-							
Stirofos	mg/L	-							
Phosphate	mg/L	0.02 FRP*	<0.01		<0.01		0.02	<0.01	<0.01
Phosphorous	mg/L	-	<0.01		0.01		0.03	0.1	0.08

Insufficent volume to sample

PAHs	mg/L								
Acenaphthene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Acenaphthylene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Anthraccene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Benzo(a)anthracene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Benzo(a)pyrene	mg/L	-	<0.5		<0.5		<0.5	<0.5	<0.5
Benzo(b)&(k)fluoranthene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Benzo(b)fluranthene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Benzo(k)fluranthene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Chrysene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Dibenzo(a,h)anthracene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Fluoranthene	mg/L	-	<1.0		<1.0	Insufficent volume to sample	<1.0	<1.0	<1.0
Fluorene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Indeno(1,2,3-c,d)pyrene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Naphthalene	mg/L	0.016	<1.0		<1.0		<1.0	<1.0	<1.0
Dissolved Oxygen Field	mg/L	11 (110%) - ~7ppm(85%)*	1.99	DRY	0.54		0.41	1.39	0.57
PAH (total)	mg/L	0.016	<1.0		<1.0		<1.0	<1.0	<1.0
Phenanthrene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
Pyrene	mg/L	-	<1.0		<1.0		<1.0	<1.0	<1.0
pH Field	pH units	8 - 6.5	6.55		6.75		6.73	6.49	6.65
pH Lab	pH units	8 - 6.5	7.02		7.22		7.4	7.08	7.26
Potassium	mg/L	-	4		2		1	7	2
ORP	mV	-	310.9		210.3		180.7	256	216
Sodium	mg/L	-	253		452		411	1650	472
Standing water level	mbTOC	-	10.115		7.972		6.379	10.26	9.302
Sulphate	mg/L	-	231		56		46	37	60
Temperature	^{0}C	-	17.2		17.6		19.2	17.9	17.4
Toluene	mg/L	0.3 **	<2		<2		<2	<2	<2
Total Phenolics	mg/L	0.32	<0.05		<0.05		<0.05	<0.05	<0.05
Total Dissolved Solids	mg/L	1500 max - 85 min	1210		2570		1870	7830	2380
Total Organic Carbon	mg/L	-	<1		<1		<1	2	<1
TPHs	mg/L								
C10-C14	mg/L	-	<50		<50		<50	<50	<50
C15-C28	mg/L	-	<100		<100	Insufficent volume to sample	<100	<100	<100
C29-C36	mg/L	10 **	<50	DRY	<50		<50	<50	<50
C6-C9	mg/L	7 (NEPM F1)	<20		<20		<20	<20	<20
Xylene	mg/L	0.35	<2		<2		<2	<2	<2
Zinc	mg/L	0.008	0.05		0.016		0.009	0.394	0.017

Australian and New Zealand Environment and Conservation Council, Guidelines for Fresh and Marine Water Quality (ANZECC 2000)

*ANZECC 2000 Trigger Levels for Fresh Water & Lowland Rivers (Table 3.3.2) in South East Australia

**NSW DEC (1994) Guidelines for Assessing Service Station Sites - Threshold Concentrations for Aquatic Enviornments - Fresh Waters

***NEPM 2013 Schedule B1 Guideline on Investigation Levels for Soil and Groundwater

****ANZECC 2000 Trigger Levels for Lowland Rivers (Table 8.2.12) in New South Wales

FRP = Filterable Reactive Phosphate

APPENDICES

Appendix A: EPA SAMPLING LOCATIONS

Location of Monitoring / Discharge Points

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Leachate Quality Monitoring		Leachate dam LD1 as shown on drawing 2824_16 referenced as EPA WOF9346
2		Overflow drain	Overflow from first flush dam DP2 as shown on drawing 2824_16 referenced as EPA WOF9346
3	Overflow drain	Overflow drain	Overflow from sedimentation dam 1 DP3 as shown on drawing 2824_16 referenced as EPA WOF9346
5	Surface water monitoring		Immediately downstream from the leachate dam at the boundary of the site as shown on drawing 2824_16 referenced as EPA WOF9346
6	Surface water monitoring		Upstream of site in Sandy Creek as shown on drawing 2824_16 referenced as EPA WOF9346.
7	Surface water monitoring		Downstream of site in Sandy Creek as shown on drawing 2824_16 referenced as EPA WOF9346.
8	Groundwater monitoring		Groundwater monitoring well labelled BH1 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275936 N6137766
9	Groundwater monitoring		Groundwater monitoring well labelled BH2 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01). E275914 N6137656
11	Groundwater monitoring		Groundwater monitoring well labelled BH4A on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275896 N6137573
13	Groundwater monitoring		Groundwater monitoring well labelled BH6 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275871 N6137469
14	Groundwater monitoring		Groundwater monitoring well labelled BH7 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275872 N6137469
17	Groundwater monitoring		Groundwater monitoring well labelled BH10 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275775 N6137366
18	Groundwater monitoring		Groundwater monitoring well labelled BH11 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275830 N6137492

20	Groundwater monitoring		Groundwater monitoring well labelled BH13 on diagram titled "Bore Location Plan" May 17/01/14 (DOC14/6276-07) E275996 N6137489
21	Groundwater monitoring		Groundwater monitoring well labelled BH14 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E276421 N6137653
25	Leachate Volume Monitoring		Pipeline from Leachate Dam (LD1) to irrigation area as shown on drawing 2824_16 referenced as EPA WOF 9346
26		Utilisation Area	Irrigation area as shown on drawing 2824_16 referenced as EPA WOF9346
27	Leachate Volume and Quality		leachate pumphouse for Stage 3
29	Groundwater monitoring		Groundwater monitoring well labelled BH16 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275750 E6137137
30	Groundwater monitoring		Groundwater monitoring well labelled BH17 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275750 N6137142
31	Groundwater monitoring		Groundwater monitoring well labelled BH18 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275707 N6137202
32	Groundwater monitoring		Groundwater monitoring well labelled BH19 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E276132 N6137061
33	Groundwater monitoring		Groundwater monitoring well labelled BH20 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E276171 N6137736
34	Groundwater Monitoring		Groundwater monitoring well labelled BH21 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275742 N6136900
35	Groundwater monitoring		Groundwater monitoring well labelled BH22 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275821 N6136791
36	Groundwater monitoring		Groundwater monitoring well labelled BH23 on diagram titled "Bore Location Plan" dated 17/01/14 (DOC14/6276-01) E275942 N6136774

Appendix B: MONITORING WELL CONSTRUCTION

Summary of Monitoring Well Construction Details – West Nowra

EPA Point	WELL ID	Easting	Northing	Depth mbgl	RL SCC Plan mAHD	TOC RL SCC mAHD	Screen Coffey mbgl	PVC Stick Up magl
N/A	GW1	276107.4	6136839	18.0	32.5	51.109	14.0-17.0	0.67
N/A	GW1-S	276111.8	613841.1	9.0	41.45	51.264	5.0-8.0	0.83
N/A	GW2	276263.7	6136958.1	17.15	29.9	47.841	13.15-16.15	0.81
N/A	GW2-S	276266.5	6136960.1	9.0	37.9	47.709	5.0-8.0	0.81
N/A	GW3	276257.5	6137248.1	18.0	28.4	47.057	14.0-17.0	0.745
N/A	GW4	276400.7	6137112.8	13.0	35.5	49.259	9.0-12.0	0.75
N/A	GW5	276238.2	6137084.4	18.0	31.2	49.771	14.0-17.0	0.6

EPA Point	WELL ID	Easting	Northing	Depth mbgl	RL SCC Plan mAHD	TOC RL E2W mAHD	Screen E2W mbgl	PVC Stick Up magl
8	BH1	275936.45	6137766.21	7	35.00	47.86	1.5-2.4	N/A
9	BH2	275914.46	6137656.15	9	33.09	45.78	1.6-3.0	N/A
~~10~~	~~BH3~~	~~275908.36~~	~~6137619.07~~	~~7.4~~	~~31.64~~	~~44.9~~	~~1.9-2.7~~	~~N/A~~
11	BH4A	275895.50	6137573.12	7.25	31.83	44.7	0.5-1.7	N/A
~~12~~	~~BH5~~	~~275883.05~~	~~6137508.80~~	~~8.85~~	~~30.56~~	~~48.3~~	~~1.8-2.3~~	~~N/A~~
13	BH6	275870.78	6137469.07	9.6	32.34	49.11	1.1-2.3	N/A
14	BH7	275871.84	6137468.76	7.4	32.44	49.91	1.6-2.6	N/A
~~15~~	~~BH8~~	~~275907.62~~	~~6137372.04~~	~~3.15~~	~~32.62~~	~~46.62~~	~~Destroyed 1999~~	~~N/A~~
~~16~~	~~BH9~~	~~275836.04~~	~~6137399.29~~	~~7.95~~	~~36.37~~	~~47.7~~	~~Destroyed 1999~~	~~N/A~~
17	BH10	275775.24	6137366.10	8.75	39.62	47.1	3.8-6.7	N/A
18	BH11	275831.25	6137491.27	9.1	31.78	47.16	0.7-1.2	N/A
~~19~~	~~BH12A~~	~~275871.07~~	~~6137478.69~~	~~8.75~~	~~31.82~~	~~44.36~~	~~7-8~~	~~N/A~~
20	BH13	275996.40	6137488.92	8.2	34.67	45.49	0.2-1.0	N/A
21	BH14	276421.18	6137653.16	7	45.08	44.99	8.67-11.67	N/A
~~28~~	~~BH15~~	~~276365.69~~	~~6137582.41~~	-	~~45.99~~	~~N/A~~	~~N/A~~	~~N/A~~
29	BH16	275750.11	6137137.29	8.2	-	43.156	5.2-8.2	N/A
30	BH17	275750.12	6137142.42	12	-	43.458	9-12	N/A
31	BH18	275706.99	6137201.69	8	-	44.41	5-8	N/A
32	BH19	276131.95	6137061.32	8.2	-	49.705	5.2-8.2	N/A
33	BH20	276171.38	6137736.01	8.2	-	41.925	5.2-8.2	N/A
34	BH21	275741.83	6136900.25	-	-	N/A	N/A	N/A
35	BH22	275821.38	6136791.13	-	-	N/A	N/A	N/A
36	BH23	275942.26	6136774.41	5.63	46.62	N/A	N/A	0.55

~~BHXX~~ = removed from current EPL. Monitoring no longer required.

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Engineering Log - Monitoring Well

Hole ID.	**GW1**
sheet:	1 of 1
project no.	**GEOTWOLL03957AA**
client:	**Shoalhaven City Council**
date started:	**26 May 2016**
principal:	**-**
date completed:	**26 May 2016**
project:	**Geotechnical and Hydrogeological Investigation**
logged by:	**MB**
location:	**West Nowra Recycling and Waste Facility, Mundamia NSW**
checked by:	**CDC**

position: E: 276107; N: 6136839 (MGA94 Zone 56) | surface elevation: 50.44 m (AHD) | angle from horizontal: 90°

equipment type: Hanjin DB8, Track mounted | drilling fluid: none | hole diameter : 110 mm

drilling information				well details	material substance								
method & support	penetration 1 2 3	water	samples & field tests	GW1	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
AD/T		07/06/16			50				**Sandy CLAY**: medium plasticity, brown, fine grained sand, trace of sub-angular gravel, trace of organics.	D	F	**TOPSOIL**
					49						F - St	**RESIDUAL**
					48	2.0			**Sandy CLAY**: medium to high plasticity, brown, red mottled, orange mottled, trace of sub-angular gravel, trace of organics. some sub-angular to angular gravel, including ironstone at 1m		St - VSt	**EXTREMELY WEATHERED MATERIAL**
					47							
					46	4.0			**Sandy CLAY**: low to medium plasticity, brown, grey.		VSt	
					45							
					44	6.0			**CLAYEY SAND**: fine to medium grained, brown, grey, low plasticity clay, trace of sub-angular gravel.	M	VSt - H	
DHH					43				**SANDSTONE**: fine grained, brown, trace of sub-angular gravel, including ironstone.	D	H	Refusal, borehole continued as down hole hammer at 6.48m
					42	8.0						**HIGHLY TO MODERATELY WEATHERED SANDSTONE**
					41				colour change to grey			
					40	10.0			colour change to brown, grey			
					39				colour change to grey			
					38	12.0						
					37					M		moist at 13.3m
					36	14.0						
					35							
					34	16.0						
					33							
					32	18.0			Monitoring Well GW1 terminated at 18.00 m Target depth			**backfill details:** 0.0-10.3m: Grout 10.3-12.4m: Bentonite 12.4-18.0m: Sand **standpipe piezo. GW1 details:** stickup: -0.67m 14.0-17.0m: screen
					31							
					30	20.0						

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- DHH downhole hammer

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
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Engineering Log - Monitoring Well

Hole ID.	**GW1A**
sheet:	1 of 1
project no.	**GEOTWOLL03957AA**
client:	***Shoalhaven City Council***
date started:	***26 May 2016***
principal:	**-**
date completed:	***26 May 2016***
project:	***Geotechnical and Hydrogeological Investigation***
logged by:	***MB***
location:	***West Nowra Recycling and Waste Facility, Mundamia NSW***
checked by:	***CDC***

position: E: 276111; N: 6136841 (MGA94 Zone 56) | surface elevation: 50.43 m (AHD) | angle from horizontal: 90°

equipment type: Hanjin DB8, Track mounted | drilling fluid: none | hole diameter : 110 mm

drilling information | **well details** | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	GW1A	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
CB					50	0.0			**Gravelly CLAYEY SAND**: fine to medium grained, brown, sub-angular gravel, trace of organics.	D	F	**TOPSOIL**
									Sandy CLAY: medium to high plasticity, brown, red mottled, orange mottled, fine grained sand, trace of sub-angular gravel.		St	**RESIDUAL**
					49	1.0						
					48	2.0					VSt	**EXTREMELY WEATHERED MATERIAL**
					47	3.0						
					46	4.0						
					45	5.0			**CLAYEY SAND**: brown, grey, low plasticity clay, trace of sub-angular gravel.			
DHH					44	6.0			**SANDSTONE**: fine grained, brown, trace of sub-angular gravel.		H	**HIGHLY TO MODERATELY WEATHERED SANDSTONE**
					43	7.0						
					42	8.0						GW1A was dry on 7 June 2016
					41	9.0			Monitoring Well GW1A terminated at 9.00 m Target depth			**backfill details:** 0.0-2.7m: Grout 2.7-3.85m: Bentonite 3.85-9.0m: Sand **standpipe piezo. GW1A details:** stickup: -0.83m 5.0-8.0m: screen
					40	10.0						

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- DHH downhole hammer

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
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Engineering Log - Monitoring Well

Hole ID.	**GW2**
sheet:	1 of 1
project no.	**GEOTWOLL03957AA**
client:	**Shoalhaven City Council**
date started:	**31 May 2016**
principal:	**-**
date completed:	**31 May 2016**
project:	**Geotechnical and Hydrogeological Investigation**
logged by:	**MB**
location:	**West Nowra Recycling and Waste Facility, Mundamia NSW**
checked by:	**CDC**

position: E: 276263; N: 6136958 (MGA94 Zone 56) | surface elevation: 47.03 m (AHD) | angle from horizontal: 90°

equipment type: Hanjin DB8, Track mounted | drilling fluid: none | hole diameter : 110 mm

drilling information				well details	material substance							
method & support	penetration 1 2 3	water	samples & field tests	GW2	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
DHH		07/06/16			47				**Sandy Gravelly CLAY**: medium plasticity, brown, sub-angular gravel, fine to medium grained sand, trace of organics.	D	F	**TOPSOIL**
					46						St	**RESIDUAL**
					45	2.0			**Sandy CLAY**: medium to high plasticity, brown, red mottled, orange mottled, trace of sub-rounded gravel, trace of organics.			
					44				**Sandy CLAY**: medium to high plasticity, brown, grey, red mottled, orange mottled, sub-angular gravel.		VSt	**EXTREMELY WEATHERED MATERIAL**
					43	4.0						
					42				**Sandy CLAY**: low to medium plasticity, grey, orange mottled, fine to medium grained sand, trace of sub-angular gravel.			
					41	6.0			**SANDSTONE**: fine to medium grained, grey, brown, trace of sub-angular gravel, including ironstone. colour change to dark brown		H	**HIGHLY TO MODERATELY WEATHERED SANDSTONE**
					40							
					39	8.0			colour change to dark grey			
					38							
					37	10.0						
					36							
					35	12.0			colour change to brown, grey	M		moist at 11.9m
					34				colour change to grey			
					33	14.0			colour change to grey, brown mottled			
					32				colour change to dark grey			
					31	16.0						
					30							
					29	18.0			Monitoring Well GW2 terminated at 17.15 m Target depth			**backfill details:** 0.0-10.8m: Grout 10.8-12.0m: Bentonite 12.0-17.15m: Sand **standpipe piezo. GW2 details:** stickup: -0.81m 13.15-16.15m: screen
					28							
					27	20.0						

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- DHH downhole hammer

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Monitoring Well

Hole ID.	**GW2A**
sheet:	1 of 1
project no.	**GEOTWOLL03957AA**
client:	***Shoalhaven City Council***
date started:	***26 May 2016***
principal:	**-**
date completed:	***26 May 2016***
project:	***Geotechnical and Hydrogeological Investigation***
logged by:	***MB***
location:	***West Nowra Recycling and Waste Facility, Mundamia NSW***
checked by:	***CDC***

position: E: 276267; N: 6136960 (MGA94 Zone 56) | surface elevation: 46.90 m (AHD) | angle from horizontal: 90°

equipment type: Hanjin DB8, Track mounted | drilling fluid: none | hole diameter : 110 mm

drilling information				well details	material substance							
method & support	penetration 1 2 3	water	samples & field tests	GW2A	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
CB					46	1.0			**Sandy CLAY**: medium plasticity, brown, fine grained sand, trace of sub-angular gravel.	D	F	**TOPSOIL**
									Sandy CLAY: medium to high plasticity, brown, orange mottled, red mottled, trace of sub-angular gravel.		F - St	**RESIDUAL**
					45	2.0						
					44	3.0			colour change to pale brown with white mottling		VSt	**EXTREMELY WEATHERED MATERIAL**
					43	4.0			**CLAYEY SAND**: fine grained, brown, grey, medium plasticity clay, trace of sub-angular gravel.			
					42	5.0						
					41	6.0						
					40	7.0						
DHH									**SANDSTONE**: fine to coarse grained, grey, trace of sub-angular gravel.		H	**HIGHLY TO MODERATELY WEATHERED SANDSTONE**
					39	8.0						GW2A was dry on 7 June 2016
					38	9.0			Monitoring Well GW2A terminated at 9.00 m Target depth			**backfill details:** 0.0-2.75m: Grout 2.75-4.02m: Bentonite 4.02-9.0m: Sand **standpipe piezo. GW2A details:** stickup: -0.81m 5.0-8.0m: screen
					37	10.0						
					36							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- DHH downhole hammer

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Monitoring Well

Hole ID.	**GW3**
sheet:	1 of 1
project no.	**GEOTWOLL03957AA**
client:	***Shoalhaven City Council***
date started:	***31 May 2016***
principal:	**-**
date completed:	***31 May 2016***
project:	***Geotechnical and Hydrogeological Investigation***
logged by:	***MB***
location:	***West Nowra Recycling and Waste Facility, Mundamia NSW***
checked by:	***CDC***

position: E: 276258; N: 6137248 (MGA94 Zone 56) | surface elevation: 46.31 m (AHD) | angle from horizontal: 90°

equipment type: Hanjin DB8, Track mounted | drilling fluid: none | hole diameter : 110 mm

drilling information | **well details** | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	GW3	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	structure and additional observations
DHH		07/06/16			46				**Gravelly Sandy CLAY**: medium plasticity, brown, fine grained sand, sub-angular gravel, trace of organics.	D	F	**TOPSOIL**
					45						St	**RESIDUAL**
					44	2.0			**Sandy CLAY**: medium to high plasticity, brown, red mottled, orange mottled, fine to medium grained sand, trace of sub-angular to sub-rounded gravel.		VSt	**EXTREMELY WEATHERED MATERIAL**
					43							
					42	4.0			colour change to grey			
					41							
					40	6.0			**CLAYEY SAND**: fine to medium grained, brown, grey, trace of sub-angular gravel.			
					39				**SANDSTONE**: fine to medium grained, brown, with some ironstone.		H	**HIGHLY TO MODERATELY WEATHERED SANDSTONE**
					38	8.0			colour change to brown, grey mottled			
					37				colour change to grey			
					36	10.0			colour change to grey, brown mottled			
					35							
					34	12.0			colour change to grey			
					33							
					32	14.0			colour change to dark grey	M		
					31					W		Water at 15.3m approximate air lift yield of 0.2 l/s
					30	16.0						
					29							
					28	18.0			Monitoring Well GW3 terminated at 18.00 m Target depth			**backfill details:** 0.0-12.0m: Grout 12.0-13.1m: Bentonite 13.1-18.0m: Sand **standpipe piezo. GW3 details:** stickup: -0.745m 14.0-17.0m: screen
					27							
					26	20.0						

CDF_0_9_06_LIBRARY.GLB rev:AM Log COF PIEZOMETER GW03957AA_DATABASE.GPJ <<DrawingFile>> 15/06/2016 15:01

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- DHH downhole hammer

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Monitoring Well

Hole ID.	***GW4***
sheet:	1 of 1
project no.	***GEOTWOLL03957AA***
client:	***Shoalhaven City Council***
date started:	***01 Jun 2016***
principal:	***-***
date completed:	***01 Jun 2016***
project:	***Geotechnical and Hydrogeological Investigation***
logged by:	***MB***
location:	***West Nowra Recycling and Waste Facility, Mundamia NSW***
checked by:	***CDC***

position: E: 276401; N: 6137113 (MGA94 Zone 56) | surface elevation: 48.51 m (AHD) | angle from horizontal: 90°

equipment type: Hanjin DB8, Track mounted | drilling fluid: none | hole diameter : 110 mm

drilling information | **well details** | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	well details: GW4	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	structure and additional observations
DHH		07/06/16 ▽			48				**Sandy Gravelly CLAY**: medium plasticity, brown, fine to medium grained sand, sub-rounded gravel, trace of organics.	W	F	**TOPSOIL**
					47					D	F - St	**RESIDUAL**
					46	2.0			**Sandy CLAY**: medium to high plasticity, brown, orange mottled, red mottled, fine grained sand, trace of organics, trace of sub-angular gravel.			
					45				**Sandy CLAY**: medium to high plasticity, brown, red, orange mottled, grey mottled, trace of sub-angular gravel.		VSt	**EXTREMELY WEATHERED MATERIAL**
					44	4.0						
					43							
					42	6.0			colour change to brown, grey mottled			
					41				**SANDSTONE**: fine to coarse grained, brown.		H	**HIGHLY TO MODERATELY WEATHERED SANDSTONE**
					40	8.0				M		
					39							
					38	10.0			colour change to grey			
					37							
					36	12.0						
					35				Monitoring Well GW4 terminated at 13.00 m Target depth			**backfill details:** 0.0-7.4m: Grout 7.4-8.0m: Bentonite 8.0-13.0m: Sand **standpipe piezo. GW4 details:** stickup: -0.75m 9.0-12.0m: screen
					34	14.0						
					33							
					32	16.0						
					31							
					30	18.0						
					29							
					28	20.0						

CDF_0_9_06_LIBRARY.GLB rev:AM Log COF PIEZOMETER GW03957AA_DATABASE.GPJ <<DrawingFile>> 15/06/2016 15:01

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- DHH downhole hammer

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Monitoring Well

Hole ID.	**GW5**
sheet:	1 of 1
project no.	**GEOTWOLL03957AA**
client:	***Shoalhaven City Council***
date started:	***30 May 2016***
principal:	**-**
date completed:	***31 May 2016***
project:	***Geotechnical and Hydrogeological Investigation***
logged by:	***MB***
location:	***West Nowra Recycling and Waste Facility, Mundamia NSW***
checked by:	***CDC***

position: E: 276238; N: 6137084 (MGA94 Zone 56) | surface elevation: 49.17 m (AHD) | angle from horizontal: 90°

equipment type: Hanjin DB8, Track mounted | drilling fluid: none | hole diameter : 110 mm

drilling information | **well details** | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	GW5	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	structure and additional observations
DHH		07/06/16 ▽			49				**Gravelly Sandy CLAY**: medium plasticity, brown, fine grained sand, sub-angular gravel, trace of organics.	D	F	**TOPSOIL**
					48						St	**RESIDUAL**
					47	2.0			**Sandy CLAY**: medium to high plasticity, brown, red mottled, fine grained sand, trace of sub-angular gravel, trace of organics.			
					46				**Sandy CLAY**: medium to high plasticity, brown, red, orange mottled, grey mottled, trace of sub-angular gravel. colour change to grey colour change to pale brown, grey		VSt	**EXTREMELY WEATHERED MATERIAL**
					45	4.0						
					44				colour change to brown, grey			
					43	6.0						
					42				**SANDSTONE**: fine grained, dark brown, trace of sub-angular gravel, including ironstone.		H	**HIGHLY TO MODERATELY WEATHERED SANDSTONE**
					41	8.0						
					40							
					39	10.0			colour change to grey			
					38				colour change to dark brown			
					37	12.0			colour change to dark grey			
					36							
					35	14.0				M		moist at 13.7m
					34							
					33	16.0						
					32							
					31	18.0			Monitoring Well GW5 terminated at 18.00 m Target depth			**backfill details:** 0.0-6.0m: Grout 6.0-7.5m: Bentonite 7.5-18.0m: Sand **standpipe piezo. GW5 details:** stickup: -0.6m 14.0-17.0m: screen
					30							
					29	20.0						

CDF_0_9_06_LIBRARY.GLB rev:AM Log COF PIEZOMETER GW03957AA_DATABASE.GPJ <<DrawingFile>> 15/06/2016 15:01

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- DHH downhole hammer

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
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- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
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F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Appendix C: CALIBRATION CERTIFICATES

ENVIRONMENT & NATURAL RESOURCE SOLUTIONS
ABN 68 600 154 596
25 River Road, Shoalhaven Heads, NSW, 2535
T/F 02 9037 4708 M: 0401 518 443
E: projects@enrs.com.au www.enrs.com.au

EQUIPMENT CALIBRATION CERTIFICATE – TPS 90FLMV WATER QUALITY METER

This Water Quality Meter has been performance checked / calibrated* as follows:

pH	☐pH 6.88	■pH 7.00	■pH 4.00
Conductivity	☐0.0mS/cm	■2.76mS/cm	☐12.88mS/cm
TDS	☐0.0ppk	☐36ppk	☐ ppk
Dissolved Oxygen	☐0.00ppm in Sodium Sulphite	■100% Saturation in Air	
Redox (ORP)* **	☐Electrode operability test 238mV$^{+}_{-}$10%		Actual: _____ mV
Logging Unit	■Electrodes cleaned/checked	■Charged ___v(min7.2V)	☐Temperature

*Calibration solution traceability information is available upon request.
** This meter uses an Ag/AgCl ORP electrode. To convert readins to SHE (Standard Hydrogen Electrode), add 199mV to the mV reading. For further information refer to supplier.

Equipment Checklist:

1. ■90FLMV Unit. Ops Check / Battery Voltage @_____.
2. ■pH sensor 1m
3. ■Conductivity / TDS / Temperature k = 10 sensor 1m
4. ■Dissolved Oxygen sensor 1m
5. ■Redox (ORP) sensor 1m
6. ■Battery Charger: 240v AC to 12V DC 200mA
7. ■Instruction Manual
8. ■Syringe with storage solution for pH, EC and ORP sensors
9. ■Carry Case

Equipment MODEL	TPS 90FLMV WATER QUALITY METER / LOGGER
Equipment Serial No.	0311-22

Date: 14/06/2017 **Checked by:** M Lemcke

Signed: _____ _____

Appendix D: LABORATORY CERTIFICATES OF ANALYSIS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EW1702653**	Page	: 1 of 8
Client	: **ENVIRONMENT & NATURAL RESOURCE SOLUTIONS**	Laboratory	: Environmental Division NSW South Coast
Contact	: RESULTS ADDRESS	Contact	: Aneta Prosaroski
Address	: 25 River Rd Shoalhaven Heads 2535	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW
Telephone	: 02 9037 4708	Telephone	: 02 4225 3125
Project	: SCC West Nowra Stage 4	Date Samples Received	: 14-Jun-2017 16:28
Order number	: ENRS0047	Date Analysis Commenced	: 15-Jun-2017
C-O-C number	: ----	Issue Date	: 22-Jun-2017 08:51
Sampler	: Matt L		
Site	: ----		
Quote number	: WO/001/17 Blanket Quote		
No. of samples received	: 5		
No. of samples analysed	: 5		

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
- Surrogate Control Limits

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
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, Smithfield, 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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

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.

- Poor spike recovery for Flouride analysis due to matrix interferences(confirmed by re-analysis).
- Poor spike recovery for Hexavalent Chromium analysis due to matrix interferences(confirmed by re-analysis).
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GW01	GW02	GW03	GW04	GW05
			Client sampling date / time	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00
Compound	CAS Number	LOR	Unit	EW1702653-001	EW1702653-002	EW1702653-003	EW1702653-004	EW1702653-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.02	7.22	7.40	7.08	7.26
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	2100	4180	3330	12500	3960
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	1210	2570	1870	7830	2380
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	61	49	30	212	198
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	228	444	402	234	399
Total Alkalinity as CaCO3	----	1	mg/L	228	444	402	234	399
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	231	56	46	37	60
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	392	971	760	4130	925
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	106	286	186	507	224
Magnesium	7439-95-4	1	mg/L	52	57	47	298	60
Sodium	7440-23-5	1	mg/L	253	452	411	1650	472
Potassium	7440-09-7	1	mg/L	4	2	1	7	2
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.02	<0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.006	0.001	0.004	0.001
Barium	7440-39-3	0.001	mg/L	0.068	0.140	0.129	1.12	0.101
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	0.0087	<0.0001
Cobalt	7440-48-4	0.001	mg/L	0.030	0.005	0.011	0.052	0.006
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.620	0.793	1.16	3.39	0.684
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	0.050	0.016	0.009	0.394	0.017
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW01	GW02	GW03	GW04	GW05
				Client sampling date / time	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00
Compound	CAS Number	LOR	Unit		EW1702653-001	EW1702653-002	EW1702653-003	EW1702653-004	EW1702653-005
					Result	Result	Result	Result	Result
EG050F: Dissolved Hexavalent Chromium									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.3**	**0.5**	**0.2**	**0.5**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.04**	**0.03**	**0.02**	**0.08**	**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	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	**0.01**	**0.01**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	**0.01**	**0.01**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.01	**0.01**	**0.03**	**0.10**	**0.08**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	**0.02**	<0.01	<0.01
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**20.4**	**37.4**	**30.4**	**122**	**35.3**
Total Cations	----	0.01	meq/L		**20.7**	**38.7**	**31.0**	**122**	**36.7**
Ionic Balance	----	0.01	%		**0.62**	**1.64**	**1.02**	**0.07**	**1.92**
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		<1	<1	<1	**2**	<1
EP035G: Total Phenol by Discrete Analyser									
Phenols (Total)	----	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	319-85-7	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	58-89-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	319-86-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	76-44-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	309-00-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW01	GW02	GW03	GW04	GW05
				Client sampling date / time	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00
Compound	CAS Number	LOR	Unit		EW1702653-001	EW1702653-002	EW1702653-003	EW1702653-004	EW1702653-005
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	60-57-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	72-20-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDT	50-29-3	2	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Methoxychlor	72-43-5	2	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	6923-22-4	2	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Dimethoate	60-51-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	333-41-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Parathion-methyl	298-00-0	2	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Malathion	121-75-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	55-38-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	56-38-2	2	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Prothiofos	34643-46-4	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Ethion	563-12-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Carbophenothion	786-19-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW01	GW02	GW03	GW04	GW05
				Client sampling date / time	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00
Compound	CAS Number	LOR	Unit		EW1702653-001	EW1702653-002	EW1702653-003	EW1702653-004	EW1702653-005
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	<100	<100	<100

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW01	GW02	GW03	GW04	GW05
				Client sampling date / time	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00	14-Jun-2017 00:00
Compound	CAS Number	LOR	Unit		EW1702653-001	EW1702653-002	EW1702653-003	EW1702653-004	EW1702653-005
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.5	%		73.9	89.8	97.8	85.5	77.9
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.5	%		73.8	91.6	98.9	88.0	78.3
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%		22.8	27.6	29.1	26.1	28.0
2-Chlorophenol-D4	93951-73-6	1	%		56.2	69.4	70.1	70.2	65.0
2.4.6-Tribromophenol	118-79-6	1	%		44.7	64.8	54.9	59.6	49.2
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%		79.1	85.1	83.9	82.5	84.7
Anthracene-d10	1719-06-8	1	%		92.9	92.4	87.5	87.3	98.9
4-Terphenyl-d14	1718-51-0	1	%		70.2	79.8	93.0	81.2	75.3
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		94.9	94.5	100	95.6	92.8
Toluene-D8	2037-26-5	2	%		99.8	101	101	98.7	107
4-Bromofluorobenzene	460-00-4	2	%		91.0	95.8	108	96.5	97.6

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	30	120
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	27	129
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Appendix E: CHAIN OF CUSTODY SHEET

ENRS

Environment & Natural Resource Solutions

Chain of Custody

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
NOWRA 4/13 Geary Place, North Nowra NSW 2541
Ph: 02 4421 2003 E: nowra@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500
Ph: 12 4225 3125 E: wollongong@alsglobal.com

CLIENT: ENRS Pty Ltd	**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: 25 River Rd Shoalhaven Heads		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: SCC West Nowra Stage 4 **PROJECT NO.:** ENRS0047	**ALS QUOTE NO.:** WO/001/17	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: **PURCHASE ORDER NO.:** Use Proj No.	**COUNTRY OF ORIGIN:**	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Rohan Last	**CONTACT PH:** 0401 518 443	OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: ML	**SAMPLER MOBILE:** 0403526292	**RELINQUISHED BY:**	**RECEIVED BY:**
COC Emailed to ALS? (YES / NO)	**EDD FORMAT (or default):**	M. Lemcke	Aneta
Email Reports to (will default to PM if no other addresses are listed): lab@enrs.com.au		DATE/TIME:..... 31/05/2017	DATE/TIME: 14/6/17
Email Invoice to (will default to PM if no other addresses are listed):		**RELINQUISHED BY:** DATE/TIME:	**RECEIVED BY:** DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

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)		Ammonia, TOC, TDS, Potassium, ph, EC	TSS, Total Phosphorus	Alkalinity, Cl, SO4, Ca, Mg, Na, K, HCO3, CO3	Al, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Zn, Hg, Cr+6	Nitrate, Nitrite, Phosphate, TotalPhenolics, Fluoride	TPH, BTEX, PAH, OCP, OPP			Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	GW01	14/06/2017	Water	500mlP, SP, N, VOC, TOC, AG, H		1	1	1	1	1	1			ALS to select appropriate batch codes
2	GW02	14/06/2017	Water	500mlP, SP, N, VOC, TOC, AG, H		1	1	1	1	1	1			
3	GW03	14/06/2017	Water	500mlP, SP, N, VOC, TOC, AG, H		1	1	1	1	1	1			
4	GW04	14/06/2017	Water	500mlP, SP, N, VOC, TOC, AG, H		1	1	1	1	1	1			
5	GW05	14/06/2017	Water	500mlP, SP, N, VOC, TOC, AG, H		1	1	1	1	1	1			
				TOTAL	0	5	5	5	5	5				

Environmental Division
Wollongong
Work Order Reference
EW1702653

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; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.