Phase 2 Environmental Site Assessment, Parcel 16

Prepared for:
Hydro Aluminium Kurri Kurri Pty Ltd

Prepared by:
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This document is issued in confidence to Hydro Aluminium Kurri Kurri Australia Pty Ltd for the purposes of a Phase 2 Environmental Site Assessment. It should not be used for any other purpose. The scope of the Phase 2 Environmental Site Assessment was based on ENVIRON's proposal dated 18 November 2013.

Specific assumptions and limitations identified by ENVIRON as being relevant are set out in the report. The methodology adopted and sources of information used by ENVIRON are outlined in our scope of work. ENVIRON has made no independent verification of this information beyond the agreed scope of works.

This report should be read in full.

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Acronyms and Abbreviations

ACM	Asbestos Containing Materials
AHD	Australian Height Datum
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
B(a)P	Benzo(a)pyrene
BGL	Below Ground Level
BTEX	Benzene, Toluene, Ethylbenzene & Xylenes (Monocyclic aromatic Hydrocarbons)
CT	Certificate of Title
DEC	NSW Department of Environment and Conservation, now EPA
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EIL	Ecological Investigation Level
EPA	NSW Environment Protection Authority
ESA	Environmental Site Assessment
F	Fluoride
GMU	Groundwater Management Unit
GPS	Global Positioning System
Ha	Hectare
HIL	Health Investigation Level
HSL	Health Screening Level
HRA	Health Risk Assessment
km	Kilometres
LOR	Limit of Reporting
m	Metres
Mercury	Inorganic mercury unless noted otherwise
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Fe: Iron, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury, Se: Selenium
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
m AHD	Metres relative to the Australian Height Datum
m BGL	Metres below ground level
mg/L	Micrograms per Litre
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
NEHF	National Environmental Health Forum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW	New South Wales
n	Number of Samples
OH&S	Occupational Health & Safety
PAH	Polycyclic Aromatic Hydrocarbons
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
US EPA	United States Environment Protection Authority
µg/L	Micrograms per Litre
VENM	virgin excavated natural material
-	On tables is "not calculated", "no criteria" or "not applicable"

Executive Summary

ENVIRON completed a Phase 2 Environmental Site Assessment at Parcel 16, located in the east of the buffer zone of the Hydro Aluminium Kurri Kurri Smelter. Parcel 16 is owned by Hydro Aluminium and currently comprises open bushland. Previously, the three lots on Parcel 16 were used for residential landuse, with one dwelling on each lot near the Dickson Road frontage between the 1960s and the 1990s. During the 1980s, smelter wastes were landfilled on the central portion of Lots 424 and 425.

The objectives of the assessment were to assess the potential for contamination at Parcel 16 based on historical and current land use and to assess the suitability of Parcel 16 for the purposes of environmental conservation (E2) and general industrial (IN1) landuse.

The site walkover identified open bushland with mature trees in the northern portion of the parcel and denser bushy shrubs in the southern portion of the parcel, where the parcel slopes south toward Swamp Creek. The locations of the former dwellings on Lot 423, 424 and 425 were identified and a 10m by 10m screening survey for asbestos was conducted. No ACM fragments were identified in surface soils. Following the walkover screening survey, a back hoe was used to excavate into soil at the footprints of the two former houses and no buried demolition wastes were observed.

Surface soil samples from across Parcel 16 were analysed for soluble fluoride. Fluoride results were below the preliminary screening level for the proposed rural and commercial/ industrial landuse.

A Phase 2 Environmental Site Assessment completed at the Dickson Road landfill in 2012 identified an estimated 14,000m^3 or 21,500 tonnes of wastes within the landfill, including smelter specific wastes, general waste and soil.

On the basis of the investigations undertaken, the risks to human health or the environment from contaminants is limited to the Dickson Road landfill. The remainder of Parcel 16 is considered suitable for the proposed environmental conservation and general industrial use.

The Dickson Road Landfill will be suitable for the proposed environmental conservation (E2) and general industrial (IN1) landuse subject to the completion of the following remedial actions:

- Remediation of the landfill area is required to reduce risk to future site users and to manage aesthetic affects. Materials within the infilled areas include smelter waste, general waste and soils. Material volumes were estimated to comprise smelter related materials of 4,000 tonnes, contaminated soils of 8,500 tonnes and general wastes of 9,000 tonnes (ENVIRON 2012).

- It is anticipated that the Dickson Road landfill will be remediated as part of the remediation of the Hydro Aluminium Kurri Kurri Smelter. The wastes within the landfill will be excavated and relocated to the smelter for remediation with other smelter wastes. Following this remediation and successful validation, Parcel 16 will be suitable for industrial and rural landuse.

- For aesthetic reasons, the discarded tyres should be collected and disposed of appropriately.

ENVIRON consider that Parcel 16 can be made suitable for the proposed environmental conservation (E2) and general industrial (IN2) landuse following remediation. A Remedial Action Plan will be completed to assess the remedial options and outline the requirements for remediation and validation.

Hydro has separated engaged a NSW EPA-accredited Site Auditor to review the investigations completed and the Remedial Action Plan and to complete an interim opinion letter, indicating that the site can be made suitable for the proposed landuse.

1 Introduction

1.1 Background

This report presents the findings of a Phase 2 Environmental Site Assessment undertaken on part of the Hydro Aluminium Kurri Kurri Pty Limited (Hydro) owned land known as Parcel 16. Parcel 16 is located off Dickson Road, Loxford, New South Wales (2326). Parcel 16 location is shown in **Figure 1**.

The work has been performed at the request of Hydro Aluminium Kurri Kurri Pty Limited (the "Client").

Hydro is currently evaluating options for the divestment of land parcels for a range of land uses following the closure of the site in May 2014. A Rezoning Masterplan has been developed that identifies Parcel 16 to comprise land suitable for environmental conservation (E2) and general industrial (IN1).

A Phase 1 Environmental Site Assessment has previously been prepared for all Hydro owned lands and evaluated the potential for contamination. On Parcel 16, these investigations identified the presence of a waste disposal area used to dispose of smelter wastes and the presence of former dwellings potentially constructed from building materials containing asbestos. The parcel is also located within close proximity of the smelter and could be impacted from dust deposition. The remote location of the site may also lead to illegal dumping of wastes.

It is noted that at the time of the fieldwork, this land parcel was named Employment Land Subarea 3 and as such the soil samples reference this name. The parcel was renamed Parcel 16 during the rezoning process.

The location of Parcel 16 in the context of the Rezoning Masterplan and proposed future land use is shown in **Figure 2**.

1.2 Objectives and Scope of Work

The objectives of the assessment were to assess the potential for contamination at Parcel 16 based on historical and current land use and to assess the suitability of Parcel 16 for the purposes of environmental conservation (E2) and general industrial (IN1) landuse.

The scope of work performed to meet the objectives comprised:

- A review of available information relating to land use to assess the potential for soil, groundwater or surface water contamination arising from historic and current activities;
- A review of published geological, hydrogeological and hydrological data to establish the environmental setting and sensitivity;
- Field work comprising:
  - Collection of surface soil samples to provide a coarse grid assessment to assess the potential for dust deposition from the smelter operations;
  - A site walkover to evaluate other potential locations of buried waste or illegal dumping;
  - Intrusive investigations by backhoe to investigate disturbed ground;

- Data interpretation including comparison against relevant guidelines and a discussion of the findings in terms of human health and environment risk under the current and future land use scenarios.
- Review of options available for remediation or management to render Parcel 16 suitable for the proposed land use.

2 Site Description

2.1 Site Location

Parcel 16 is owned by Hydro Aluminium Kurri Kurri Pty Limited and is located approximately 35km north west of the city of Newcastle and 150km north of Sydney, in New South Wales, Australia. The address of Parcel 16 is Dickson Road, Loxford, New South Wales, Australia. The location of Parcel 16 is shown in **Figure 1**.

Parcel 16 is located within the Buffer Zone of the Hydro Aluminium Kurri Kurri Smelter, immediately south east of the smelter. The Buffer Zone is an area of land surrounding the smelter that provides a buffer between the smelter and surrounding communities. Parcel 16 is not developed and is predominantly covered in grasses and other scattered small trees and shrubs.

Parcel 16 is located within the Cessnock Local Government Area and is zoned RU2 – Rural Landscape under the Cessnock Local Environment Plan.

Parcel 16 is approximately 14 hectares (ha) and comprises the lot numbers and deposited plans listed in **Table 1**:

Table 1: Lot and Deposited Plans for Parcel 16.

Subarea	Lot/ DP	Area (ha)	Total Area (ha)
Parcel 16	Lot 423 DP755231 Lot 424 DP755231 Lot 425 DP755231 Lot 426 DP755231	3.0 3.4 3.7 4.1	14.2

Land uses surrounding Parcel 16 are as follows:

North: Dickson Road then speedway racing track and bushland;

South: Swamp Creek then rural residential properties;

East: Swamp Creek then rural residential properties;

West: Bushland and the smelter.

Parcel 16 is located approximately 0.4km to the south east of the smelter site boundary.

2.2 Site Setting

2.2.1 Topography

Parcel 16 is located in a low lying swampy area of the Buffer Zone at an elevation of approximately 12 mAHD. The site generally slopes from Dickson Road on the northern boundary to the south towards Swamp Creek, which represents the southern and eastern boundaries. The topography in the central area has been altered by filling with smelter wastes, creating a platform in the centre of the parcel, which drops steeply to the south and east. The approximate extent of the infilled area is shown on **Figure 3**.

2.2.2 Regional Geology

According to the review of the regional geology described on the Sydney Basin Geological Sheet, Parcel 16 is underlain by siltstone, marl and minor sandstone from the Permian aged Rutherford Formation (Dalwood Group) in the Sydney Basin.

Undifferentiated Quaternary alluvium occurs on the surface of Parcel 16 associated with surface water bodies. Quaternary sediments which are associated with Swamp Creek (located on the southern boundary of Parcel 16) and the Hunter River consist of gravel, sand, silt and clay.

2.2.3 Site Hydrology

Surface water from Parcel 16 discharges primarily via infiltration and overland flow to Swamp Creek, located on the southern boundary. Swamp Creek discharges into Wentworth Swamp, which in turn discharges to the Hunter River approximately 11km northeast of Parcel 16 near Maitland.

The Wentworth Swamp system is within the Fishery Creek Catchment, where declining stream water quality and a reduction in diversity of native plants and animals has occurred due to population growth and development pressures in the last ten years (Hunter-Central Rivers Catchment Management Authority).

2.2.4 Regional Hydrogeology

Regional groundwater is expected to follow topography and flow northeast towards the surface water bodies that discharge to the Hunter River. Locally, groundwater beneath Parcel 16 is expected to flow south as Swamp Creek is located on the southern boundary and the site slopes to the south.

According to the NSW Office of Environment and Heritage (Natural Resource Atlas), there are 11 licensed groundwater abstractions (bores) located within 1km of Parcel 16. The majority of the groundwater bores are located within the aluminium smelter and buffer zone.

Information for 11 bores located in a 1km radius from Parcel 16 has been included in **Appendix A**. The bores are used for monitoring purposes. No further information, such as depth to water or logging information was provided.

The Hunter River Alluvium Groundwater Management Unit (GMU) is an important groundwater resource to the region. Groundwater extraction for irrigation, urban supply, drought supply, stock, domestic and commercial/ industrial use occurs, with volumes in excess of 10,000ML per annum extracted from the Hunter River Alluvium GMU. Aquifer storage and recovery is also an important use of this GMU. It is noted that the Hunter River GMU is not the primary drinking water supply in the region, although the protection of drinking water is a water quality objective for the Hunter River (NSW Water Quality and River Flow Objectives)(www.environment.nsw.gov.au/ieo/Hunter/index.htm).

2.3 Site Sensitivity

The sensitivity of Parcel 16 with respect to surface water and groundwater is considered to be moderate based on the following:

- Surface water and groundwater discharge into Swamp Creek, located on the southern boundary of Parcel 16, which discharges to the Hunter River via Wentworth Swamp within the Fishery Creek Catchment, approximately 11km northeast of Parcel 16 near Maitland.

- Declining stream water quality and a reduction in diversity of native plants and animals has occurred within the Fishery Creek Catchment and water quality down gradient of Parcel 16 has been impacted by historical coal mining;

- The Hunter River GMU is used for irrigation, urban supply, drought supply, stock, domestic and commercial/ industrial use but it is not the main drinking water supply in the region.

3 Site History

Site history investigations included in the Phase 1 ESA for the Hydro Aluminium Kurri Kurri Smelter, dated 26 August 2013 provided the following historical information about Parcel 16:

- The earliest records (aerial photograph in 1951) showed the land to be cleared but no dwellings were evident at this time;
- Lots 423, 424 and 425 in DP 755231 were developed for residential landuse with a dwelling in the early 1960s. Historical aerial photographs indicate the dwellings were demolished some time prior to 1994. This was confirmed by Mr Kerry McNaughton, local resident and Hydro employee;
- Smelter wastes were used to fill land on Lots 424 and 425 in the 1980s. ENVIRON completed investigations to assess this former use of Parcel 16 in November 2012. This is discussed further in **Section 4**.
- Additionally, Parcel 16 is located approximately 0.4km from the smelter boundary and may be impacted from smelter dust deposition.

The location of the waste disposal area and former dwellings are included in **Figure 3**.

4 Previous Investigations

ENVIRON completed a Phase 2 Environmental Site Assessment (ENVIRON (2012) Phase 2 Environmental Site Assessment, Dickson Road, Loxford) at Parcel 16 in November 2012. This investigation was completed to assess the former use of a portion of Parcel 16 for landfilling of smelter wastes. The investigation included the excavation of fifteen test pits, the installation of three groundwater wells and the collection and analysis of soil, groundwater and surface water samples.

Smelter-specific wastes were identified in the test pits, including aluminium casts, carbon fluxing tubes, 'Kaowool', baghouse socks, spent anode, bulker bags, steel casting tools and a drum of old ramming compound. Other wastes included concrete blocks and smaller concrete pieces, plastic, plastic strapping and steel strapping, plywood packing cases, electrical conduit, hydraulic hoses and air hoses, PVC and steel pipes, bricks including some bake furnace refractory bricks, timber, crushed 22 and 44 gallon drums, tyres, solenoid and steel. ENVIRON notes that no Spent Pot Linings (SPL) was identified during the investigations.

The approximate extent of the buried waste was delineated during the field investigations and is represented on **Figure 3**. The investigations indicated an embankment was likely progressively backfilled with wastes from the smelter over a period of time. Sampling of the soil matrix within the waste materials identified fluoride, benzo(a)pyrene, polycyclic aromatic hydrocarbons and heavy fraction total petroleum hydrocarbons at concentrations exceeding the selected criteria. Sampling of the underlying sands did not identify impacts to the underlying natural sands.

The estimated volume of waste within the waste disposal area was approximately 14,000m^3 or 21,500 tonnes. It was estimated that there is an average 60% by volume of waste within the soil matrix. Approximately 8,500 tonnes of soil comprising clayey sand, 4,000 tonnes of smelter specific waste and 9,000 tonnes of general waste was estimated.

Sampling of groundwater up gradient and down gradient of the waste indicated that fluoride concentrations were elevated in groundwater between the waste and Swamp Creek, the nearest surface water receptor. Sampling of Swamp Creek found that the fluoride concentration immediately down gradient of the waste was elevated above the upstream concentrations and the upstream, mid stream and downstream fluoride concentrations exceeded the stock watering and irrigation criteria. The report recommended the undertaking of a risk assessment for elevated fluoride in Swamp Creek given the potential use of water from Swamp Creek for stock watering and irrigation.

The presence of the waste was not considered to represent a risk of harm under the current landuse i.e. fenced, inaccessible to the public and undeveloped. The 2012 assessment report recommended that a Remedial Action Plan be developed to assess the remedial options for the site given in potential for the site use to change in the future.

5 Sampling and Analytical Quality Plan

5.1 Potential Areas and Contaminants of Concern

Based on Parcel 16 historical information as discussed in **Section 3**, the following areas of concern were identified:

- Former dwellings on Lots 423, 424 and 425 that have been demolished.
- The filling of land using smelter wastes on Lots 424 and 425.
- Smelter dust deposition.
- Illegal dumping.

Potential contaminants of concern associated with land filling, including heavy metals, petroleum hydrocarbon and polycyclic aromatic hydrocarbons, were assessed as part of previous investigations (ENVIRON 2012) and included an assessment of soil, groundwater and surface water impacts. Potential contaminants of concern associated with the other former uses of Parcel 16 are:

- Asbestos;
- Fluoride.

Impacts to surface water and groundwater could occur from soluble contaminants where these are present above background concentrations. Evaluation of groundwater and surface water was undertaken in conjunction with the investigation of landfilling activities and this is discussed in Section 8.1. Historical information of other site activities excluding the landfill does not suggest that impacts to surface water and groundwater have occurred and evaluation of these media has not been included at this time. Further evaluation can be undertaken where contaminants in soil are present at levels that are likely to result in impacts to surface water or groundwater.

5.2 Data Quality Objectives and Data Quality Indicators

Data quality objectives (DQOs) and Data Quality Indicators (DQIs) were developed by ENVIRON using the US EPA seven-step DQO process. Completing the seven-step process helps to define the purpose of the assessment and the type, quality and quantity of data needed to inform decisions relating to the assessment of site contamination.

The seven-step DQO process and DQIs are included in **Appendix F**.

5.3 Sampling Design

The sampling design was optimised following the development of DQOs and DQIs. The sampling design is outlined below. ENVIRON notes that the historical site activities indicate potential contamination to surface soils only. No potential contamination sources to subsurface soils, surface water or groundwater have been identified.

5.3.1 Fluoride

To assess the potential for fluoride in soil from dust deposition from the Hydro Aluminium Kurri Kurri Smelter, surface soil samples were collected at a rate of one sample per 3.5ha.

The sample density is lower than that suggested in Table A of NSW EPA (1995) Contaminated Sites: Sampling Design Guidelines. The density is considered adequate for the purposes of this investigation for the following reasons:

- Aerial dust deposition is likely to be relatively consistent over the surface of the parcel;
- Sampling on a low density will allow for identification of whether or not dust deposition is an issue;
- In the event that elevated or variable fluoride concentrations are identified, additional sampling will be completed.

Samples were collected by trowel from surface soils on an approximate grid across open areas of Parcel 16. Sample locations were logged by GPS.

Soil samples were placed into laboratory-supplied paper bags and stored in an ice-filled cooler for transportation to the laboratory. Soil samples were transported to the laboratory under chain of custody conditions. Intra-laboratory duplicate soil samples were collected at a rate of 10%.

Soil samples were analysed for soluble fluoride, as this is the portion of total fluoride that is available for uptake in receptors including biota, flora, fauna and humans. The laboratory was NATA accredited for the analysis.

5.3.2 Asbestos

To assess the potential for asbestos and other illegally dumped wastes to be present at Parcel 16, a site walkover of accessible areas was completed.

The location of former dwellings and sheds were identified to assess for potential ACM associated with the demolition of the structures. A 10m by 10m grid was set up over the footprint and a walkover screening survey conducted comprising two passes with a 90º directional change between them, as per NEPM (2013).

Following the walkover screening survey, a back hoe was used to excavate into the footprint of the former houses to confirm no waste materials were present.

6 Basis for Assessment Criteria

6.1 Soil

The criteria proposed for the assessment of soil contamination were sourced from the following references:

- National Environment Protection Council (2013) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM).

The objective of the Phase 2 ESA is to assess soil contamination at Parcel 16 in relation to risks posed to human health and the environment under the proposed future land use of commercial/ industrial. As the contaminants of concern are fluoride and asbestos, guidelines for these contaminants under commercial/ industrial and rural landuse scenarios are provided below.

The Health Screening Levels (HSLs) for asbestos are applicable for assessing human health risk via the exposure pathway of inhalation of airborne asbestos and are presented in **Table 2**. The HSLs are generic to all soil types. As there is no HSL for rural landuse, the HSL for Residential A will be used and is considered conservative.

Table 2: Health screening levels for asbestos contamination in soil (w/w)				
Form of asbestos	**Residential A[1]**	**Residential B[2]**	**Recreational C[3]**	**Commercial/ Industrial D[4]**
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF[1] (friable asbestos)	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

1. The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

NEPM (2013) do not provide criteria for fluoride in soils in Australia. Therefore, ENVIRON (2013) conducted a preliminary level Human Health Risk Assessment (HRA) specific to fluoride in order to derive a specific preliminary screening level for fluoride for the Hydro Aluminium Kurri Kurri Smelter . The screening levels are protective of the range of human receptors and are provided in **Table 3**:

Table 3: Site Specific Soil Assessment Criteria (mg/kg) for Fluoride	
Preliminary screening levels	
Land Use	**Preliminary screening level**
Residential landuse	F 440mg/kg
Recreational landuse	F 1200mg/kg
Commercial/ industrial landuse	F 17000mg/kg

Soil investigation results for the samples taken from a grid formation across Parcel 16 have been compared against the residential land use screening level. The fluoride 'residential land use' screening level is considered to be suitably protective of both 'residential' and 'rural' land use because the exposure pathways (including vegetable ingestion) and behavioural assumptions (e.g. soil ingestion rate) for a child are considered to be identical under residential and rural land use scenarios.

There is a possibility that the rural plots may contain a low density of domestic livestock such as poultry and goats, however there is limited evidence of fluoride accumulation in milk and edible tissues of animals fed high levels of fluorides (ATSDR, 2003; NAS, 1971). Rather, fluoride accumulates primarily (up to approximately 99%) in the skeletal tissues of terrestrial animals that consume fluoride-containing foliage (WHO, 1997; ATSDR, 2003). This assumption is supported by site-specific data collected during the 29th annual cattle survey conducted in March 2012 on cattle located within the site's buffer zone, and surrounding areas (AECOM, 2013). The results of this survey concluded that cattle has had little or no exposure to excess environmental fluoride; skeletal fluoride levels decreased compared to 2011 levels, with all fluoride measurements below the toxic threshold; and all cattle examined were in good health and body condition. Consequently, the residential screening level is considered to be suitably protective of rural land use that may contain a low density of domestic livestock.

Consistent with the guidance provided in the NEPM, the data was assessed against the above adopted site guidelines by:

- Comparing individual concentrations against the relevant guidelines and if discrete samples are in excess of the relevant guideline then;
- Comparing the 95% upper confidence limit (UCL) of mean against the relevant guideline also ensuring that:
    - the standard deviation of the results is less than 50% of the relevant investigation or screening level, and
    - no single value exceed 250% of the relevant investigation or screening level.

7 Results

7.1 Site Walkover

A site walkover was completed to identify areas of environmental concern, such as demolition wastes associated with the former dwellings at Parcel 16. The entrance to Parcel 16 is from Dickson Road, which borders the northern boundary of the parcel. There are no roadways or tracks within Parcel 16.

Parcel 16 comprises bushland, with a flat, open grassed area in the northern portion of the parcel close to Dickson Road. There are stands of mature trees in this area. The central portion of the parcel slopes south towards Swamp Creek, located on the southern boundary. The vegetation becomes denser in the southern portion, with tall grasses, reeds and shrubs providing ground cover.

Hummocky ground, disturbed ground and a small soil stockpile was identified in the northern portion of Lots 423, 424 and 425 at the location of former dwellings. No evidence of construction debris was identified on the surface of Lots 423, 425 or 426. Some small fragments of iron waste identified the former house footprint on Lot 424. (**Figure 3**). Hummocky ground was also identified in the northern portion of Lot 426, although historical photos show no development on this part of the Lot. Several discarded tyres were observed in the northern portion of Lot 423.

The area of Lots 424 and 425 that has been filled with smelter wastes as assessed in the ENVIRON (2012) Phase 2 Environmental Site Assessment, were identified during the site walkover. As this area has previously been assessed, no additional investigations were completed in this area.

Photographs are included in **Appendix B**. Field Information Sheets are included in **Appendix C**.

7.2 Soil Investigations

Four surface soil samples were collected from across Parcel 16 at a rate of one sample per 3.5ha to assess the potential for fluoride in soil from dust deposition from the Hydro Aluminium Kurri Kurri Smelter as shown in **Figure 3**.

To assess the potential for asbestos fragments at the footprints of the former houses on Lots 423, 424 and 425, a 10m by 10m grid was set up over the former house footprints and a walkover screening survey conducted comprising two passes with a 90º directional change between them, as per NEPM (2013). No asbestos containing material (ACM) fragments were identified during the walkover.

Following the walkover, a back hoe was used to excavate into the three house footprints and to assess the hummocky ground, to confirm that no asbestos or other wastes were present due to the burial of demolition wastes. Observations made during the excavation works indicated there were no demolition wastes buried at the location of the former houses.

A generalised lithology of the surface soils encountered at Parcel 16 is as follows:

- Topsoil: Sandy silt/ silty sand, fine grained, grey/ brown, moist

7.3 Soil Results

A summary of the soil results is presented in **Table 4**. Laboratory tables are included in **Appendix D** and laboratory reports are included in **Appendix E**.

Table 4: Summary of Soil Results

Analyte	No. of Samples	Maximum Concentration (mg/kg)	No. exceeding Site Criteria	Criteria Exceeded (mg/kg)
Fluoride	4	14	0	-

The results of the surface soil sampling for fluoride demonstrate that surface soils at Parcel 16 have not been impacted by stack particulate fallout from the Hydro Aluminium Kurri Kurri Smelter.

7.4 Quality Assurance/ Quality Control

A quality assurance assessment for this report is presented in **Appendix F**. An assessment was made of data completeness, comparability, representativeness, precision and accuracy based on field and laboratory considerations, as outlined in NSW DEC (2006) and NSW EPA (2007) guidelines. Overall it is considered that the completed investigation works and the data are of suitable quality to meet the project objectives.

8 Discussion

8.1 Conceptual Site Model

Parcel 16 consists of open bushland and is bound by Dickson Road on the northern boundary, Swamp Creek on the southern boundary and open bushland on the eastern and western boundaries. Parcel 16 is located in the eastern portion of the Buffer Zone of the Hydro Aluminium Kurri Kurri Smelter.

Parcel 16 previously contained three houses near the Dickson Road frontage. The houses were constructed in the early 1960s and were demolished in the early 1990s. Little evidence of the construction debris associated with the houses was identified during the site walkover apart from some small scraps of iron waste. Excavations into the three house footprints did not identify buried demolition wastes. Some discarded car tyres were noted on the eastern boundary of Lot 423.

Surface soil sampling across Parcel 16 indicates that the site has not been affected by dust deposition of fluoride from the Hydro Aluminium Kurri Kurri Smelter, with fluoride concentrations in surface soil below the preliminary screening level. It is noted that there is currently no source of aerial fluoride emissions, as the smelter has ceased operations.

A landfill of smelter wastes was deposited on Lots 424 and 425 in the 1980s. The Phase 2 Assessment of Parcel 16, completed by ENVIRON in November 2012, identified smelter-specific wastes, such as aluminium casts, carbon fluxing tubes, 'Kaowool', baghouse socks, spent anode, bulker bags, steel casting tools and a drum of old ramming compound. Other wastes included concrete blocks and smaller concrete pieces, plastic, plastic strapping and steel strapping, plywood packing cases, electrical conduit, hydraulic hoses and air hoses, PVC and steel pipes, bricks including some bake furnace bricks, timber, crushed 22 and 44 gallon drums, tyres, solenoid and lumps of steel.

The estimated approximate volume of waste within the waste disposal area was 14,000m^3 or 21,500 tonnes. It was estimated that there is an average 60% by volume of waste within the soil matrix. Approximately 8,500 tonnes of soil comprising clayey sand, 4,000 tonnes of smelter specific waste and 9,000 tonnes of general waste was estimated.

The extent of the buried waste was identified during the field investigations. The investigations indicated an embankment was progressively backfilled with wastes from the smelter over a period of time. Sampling of the soil matrix identified fluoride, benzo(a)pyrene, polycyclic aromatic hydrocarbons and heavy fraction total petroleum hydrocarbons at concentrations exceeding the selected criteria. Sampling of natural soils beneath the landfill indicated that contaminants have not impacted the underlying natural sands.

Sampling of groundwater up gradient and down gradient of the waste indicated elevated fluoride concentrations in groundwater between the waste and Swamp Creek, the nearest surface water receptor. Sampling of Swamp Creek found that the fluoride concentration immediately down gradient of the waste was elevated above the upstream concentrations and the upstream, mid stream and downstream fluoride concentrations exceeded the stock watering and irrigation criteria.

ENVIRON completed an ecological risk assessment (ENVIRON (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Smelter), which involved an assessment of surface water quality at sites upstream and downstream of Parcel 16 in relation to fluoride. The ecological risk assessment identified that the concentrations present have not impacted on the aquatic species at the receptor point. The fluoride concentrations measured in surface water at Parcel 16 are broadly similar to fluoride concentrations used during the ecological risk assessment and as such are similarly not expected to pose an unacceptable risk to aquatic species.

The presence of the waste was not considered to represent a risk of harm under the current landuse i.e. fenced, inaccessible to the public and undeveloped. Site remediation to remove landfilled materials was recommended to remediate the site to a level suitable for the proposed land use.

9 Conclusions and Recommendations

This report presents the findings of a Phase 2 Environmental Site Assessment undertaken on part of the Hydro Aluminium Kurri Kurri (Hydro) owned land known as Parcel 16. Parcel 16 is a rural property and is accessed from Dickson Road, Kurri Kurri and located immediately east of the Hydro aluminium smelter within the buffer zone for the smelter.

In 2012, Hydro suspended operations at the Kurri Kurri Smelter and implemented care and maintenance until permanent site closure was announced in May 2014. Environmental investigations commenced at the time of suspension to assess site remediation requirements and the potential for land divestment. This work was undertaken in conjunction with the development of a Preliminary Masterplan (dated December 2013) which identified possible end land use scenarios.

The objectives of this Phase 2 ESA assessment were to assess the potential for contamination at Parcel 16 based on historical and current landuse and to assess the suitability of the site for the proposed environmental conservation (E2) and general industrial (IN1) landuse.

A Phase 1 Environmental Site Assessment has previously been completed for the Hydro owned lands including Parcel 16 (ENVIRON (22 October 2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter). The Phase 1 assessment identified that contamination of Parcel 16 may have occurred from dust deposition due to the proximity of the Hydro smelter, construction and demolition of dwellings and use of the parcel for landfilling of smelter wastes.

The landfilling of smelter wastes was the subject of a Phase 2 ESA (ENVIRON 2012) to assess the extent and impacts from the presence of these materials. The Phase 2 Environmental Site Assessment completed at the Dickson Road landfill in 2012 identified an estimated 14,000m^3 or 21,500 tonnes of wastes within the landfill, including smelter specific wastes, general waste and soil. The 2012 assessment report recommended that a Remedial Action Plan be developed to assess the remedial options for the site, based on the waste classification and the potential for the site use to change in the future.

Sampling of groundwater up gradient and down gradient of the waste indicated elevated fluoride concentrations in groundwater between the waste and Swamp Creek, the nearest surface water receptor. ENVIRON completed an ecological risk assessment (ENVIRON (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Smelter), which involved an assessment of surface water quality at sites upstream and downstream of Parcel 16 in relation to fluoride. The ecological risk assessment identified that the concentrations present have not impacted on the aquatic species at the receptor point. The fluoride concentrations measured in surface water at Parcel 16 are broadly similar to fluoride concentrations used during the ecological risk assessment and as such are similarly not expected to pose an unacceptable risk to aquatic species.

To assess the potential for soil contamination associated with fluoride dust deposition and demolition of dwellings at Parcel 16, a site walkover was completed and surface soil samples were collected on an approximate grid across the parcel.

The site walkover identified open bushland with mature trees in the northern portion of the parcel and denser bushy shrubs in the southern portion of the parcel, where the parcel slopes south toward Swamp Creek. The locations of the former dwellings on Lot 423, 424 and 425 were identified from historical aerial photos and information from a local resident. A 10m by 10m screening survey for asbestos was conducted on each footprint of the former residence. No asbestos containing materials (ACM) fragments were identified in surface soils, however soil disturbance was noted and subsequently intrusive investigations by back hoe were completed. The back hoe excavated into soil at the footprints of the three former houses and no buried wastes were observed. Some scattered wastes (comprising discarded car tyres), were noted near the eastern boundary of Lot 423.

Surface soil samples from across Parcel 16 were analysed for soluble fluoride. Fluoride results were below the preliminary screening level for commercial/ industrial landuse.

On the basis of the investigations undertaken, the risks to human health or the environment from contaminants is limited to the Dickson Road landfill. The remainder of Parcel 16 is considered suitable for the proposed environmental conservation and general industrial use.

The Dickson Road Landfill can be made suitable for the proposed landuse subject to the completion of the following remedial actions:

- Remediation of the landfill area is required to reduce risk to future site users and to manage aesthetic affects. Materials within the infilled areas include smelter waste, general waste and soils. Material volumes were estimated to comprise smelter related materials of 4,000 tonnes, contaminated soils of 8,500 tonnes and general wastes of 9,000 tonnes (ENVIRON 2012).

- It is anticipated that the Dickson Road landfill will be remediated as part of the remediation of the Hydro Aluminium Kurri Kurri Smelter. The wastes within the landfill will be excavated and relocated to the smelter for remediation with other smelter wastes. Following this remediation and successful validation, Parcel 16 will be suitable for industrial and rural landuse.

- For aesthetic reasons, the discarded tyres should be collected and disposed of appropriately.

ENVIRON consider that Parcel 16 can be made suitable for the proposed environmental conservation (E2) and general industrial (IN2) landuse following remediation. A Remedial Action Plan will be completed to assess the remedial options and outline the requirements for remediation and validation.

Hydro has separated engaged a NSW EPA-accredited Site Auditor to review the investigations completed and the Remedial Action Plan and to complete an interim opinion letter, indicating that the site can be made suitable for the proposed landuse.

10 References

ANZECC & NHMRC (1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites;

ENVIRON (2012) Phase 2 Environmental Site Assessment, Dickson Road, Loxford;

ENVIRON (2013) Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford;

ENVIRON (2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter;

ENVIRON (2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford;

Hunter Catchment Management Trust (2000) Wallis and Fishery Creeks Total Catchment Management Strategy;

NEPC (2013) National Environmental Protection (Assessment of Site Contamination) Amendment Measure (NEPM);

NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme (Second Edition);

NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination;

NSW DECC (2008) Waste Classification Guidelines.

11 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to Hydro Aluminium Kurri Kurri Pty Ltd dated 25 June 2012 and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses was undertaken as part of this investigation, based on past and present known uses of Parcel 16. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous.

Site conditions may change over time. This report is based on conditions encountered at Parcel 16 at the time of the report and ENVIRON disclaims responsibility for any changes that may have occurred after this time.

The conclusions presented in this report represent ENVIRON's professional judgment based on information made available during the course of this assignment and are true and correct to the best of ENVIRON's knowledge as at the date of the assessment.

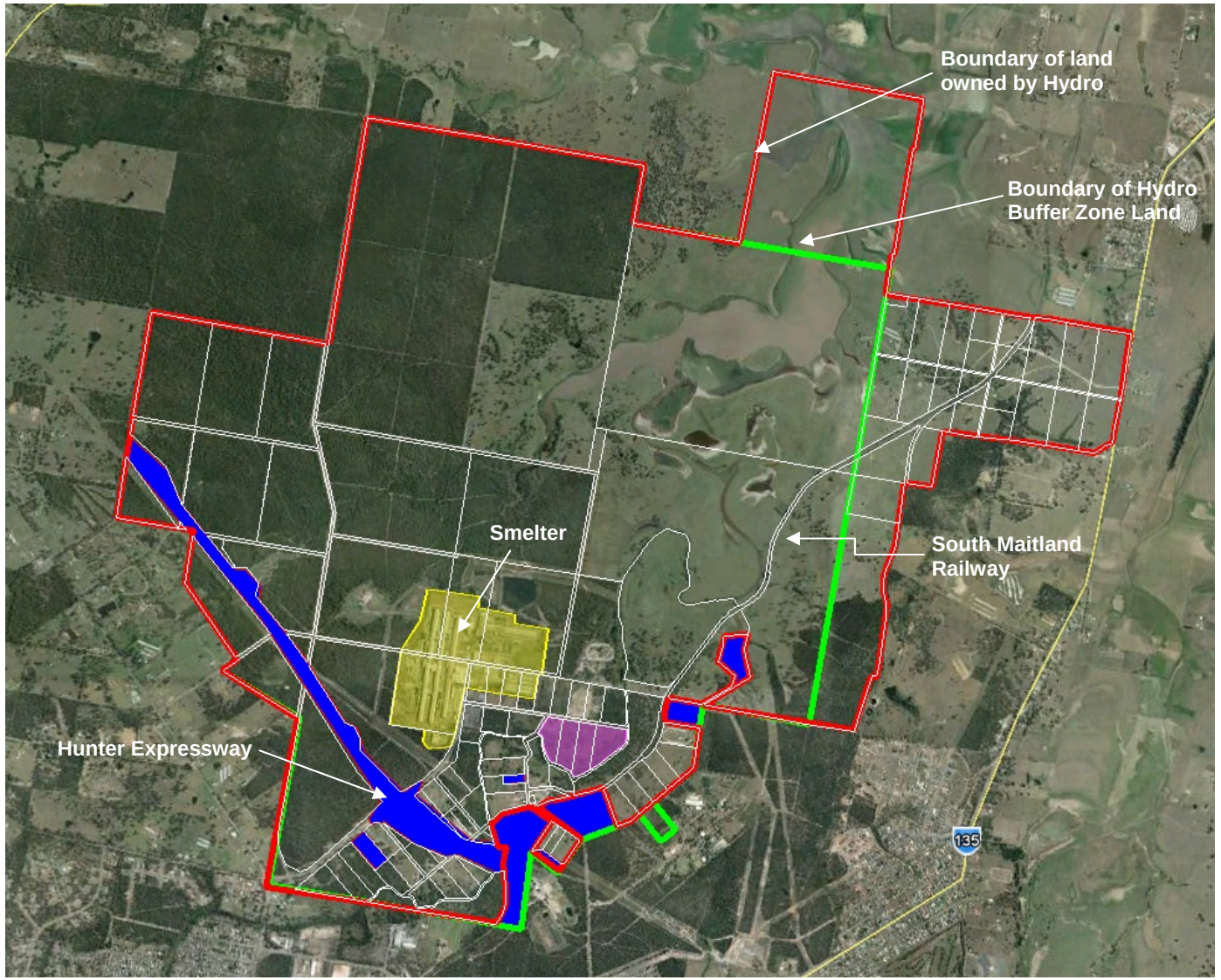
ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to ENVIRON was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

11.1 User Reliance

This report has been prepared exclusively for Hydro Aluminium Kurri Kurri Pty Ltd and may not be relied upon by any other person or entity without ENVIRON's express written permission.

Figures



Google Earth Pro: Licence valid til 5/2/15.

Approximate Location of land owned by Hydro

Approximate Location of Buffer Zone

Land not owned by Hydro

Parcel 16

N

Hydro Aluminium Kurri Kurri – Phase 2 Environmental Site Assessment

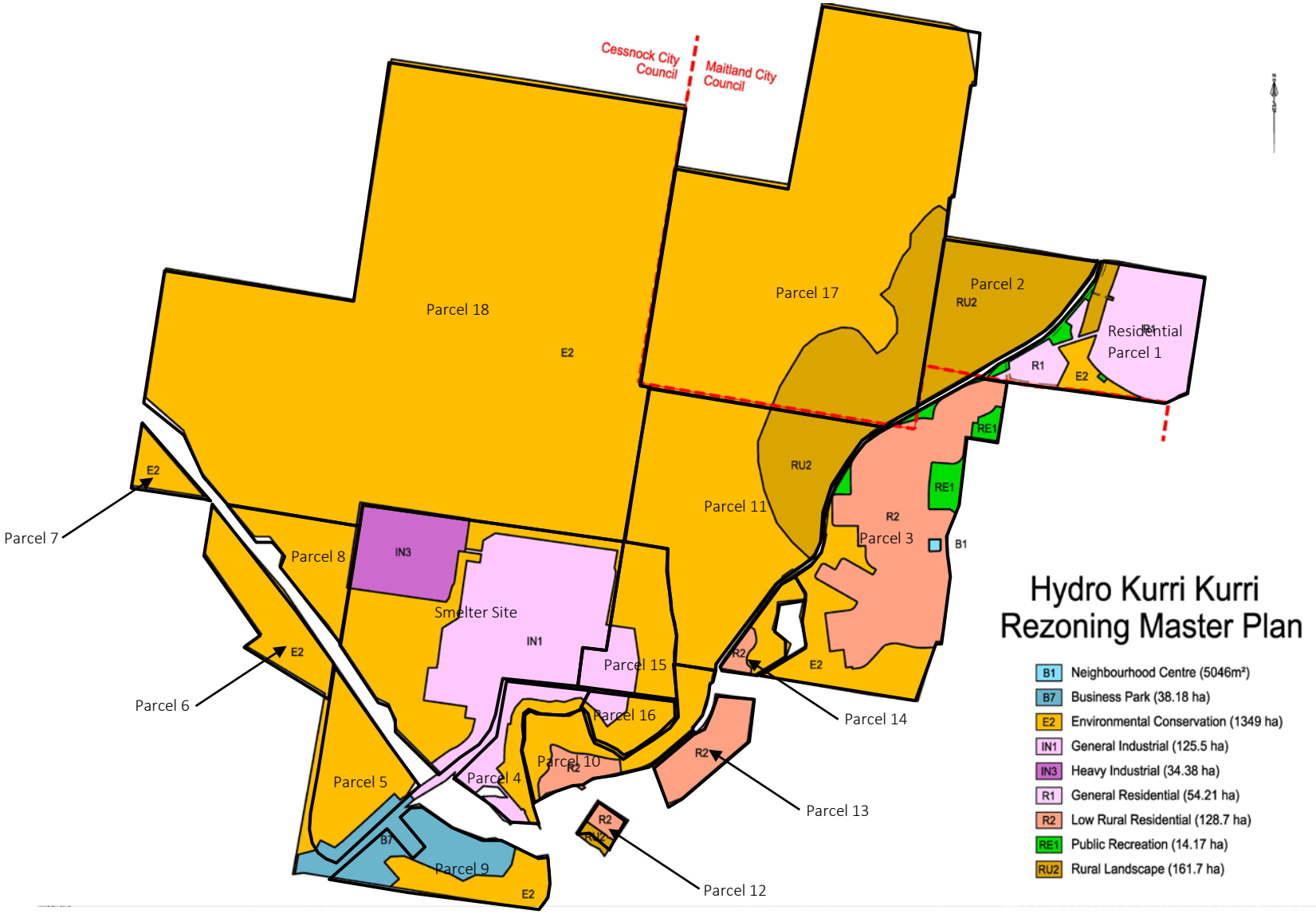
Parcel 16 - Site Location

ENVIRON

JOB NO: AS130348

DATE: May 2014

FIGURE 1



Proposed Land Zonings taken from
Hydro Kurri Kurri Preliminary Masterplan dated 26/3/15

Hydro Aluminium Kurri Kurri – Phase 2 Buffer Zone investigations

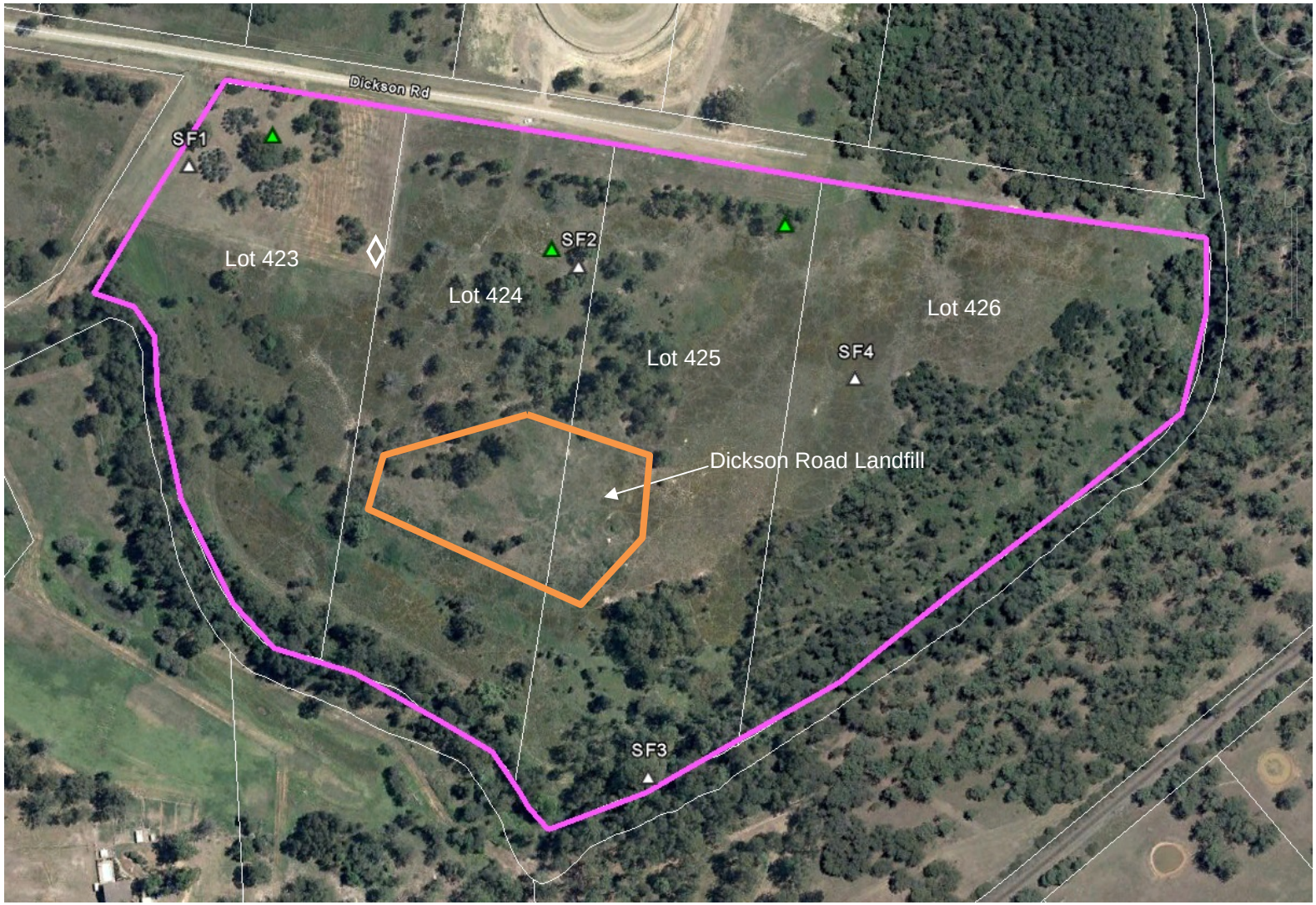
Land Parcels and Proposed Land Zoning

ENVIRON

JOB NO: AS 130348

DATE: March 2015

FIGURE 2



KEY:

- Site Boundary
- △ SF — Soil Sample for Fluoride Analysis
- Building Footprint/Walkover/ Test Pit Location
- Approximate Area of Dickson Road Landfill
- Dumped Waste (Tyres)

N

Google Earth Pro: Licenced til 5/2/15

Hydro Aluminium Kurri Kurri – Phase 2 Environmental Site Assessment

Parcel 16 – Soil Sampling Locations

ENVIRON

JOB NO: AS130348

DATE: May 2014

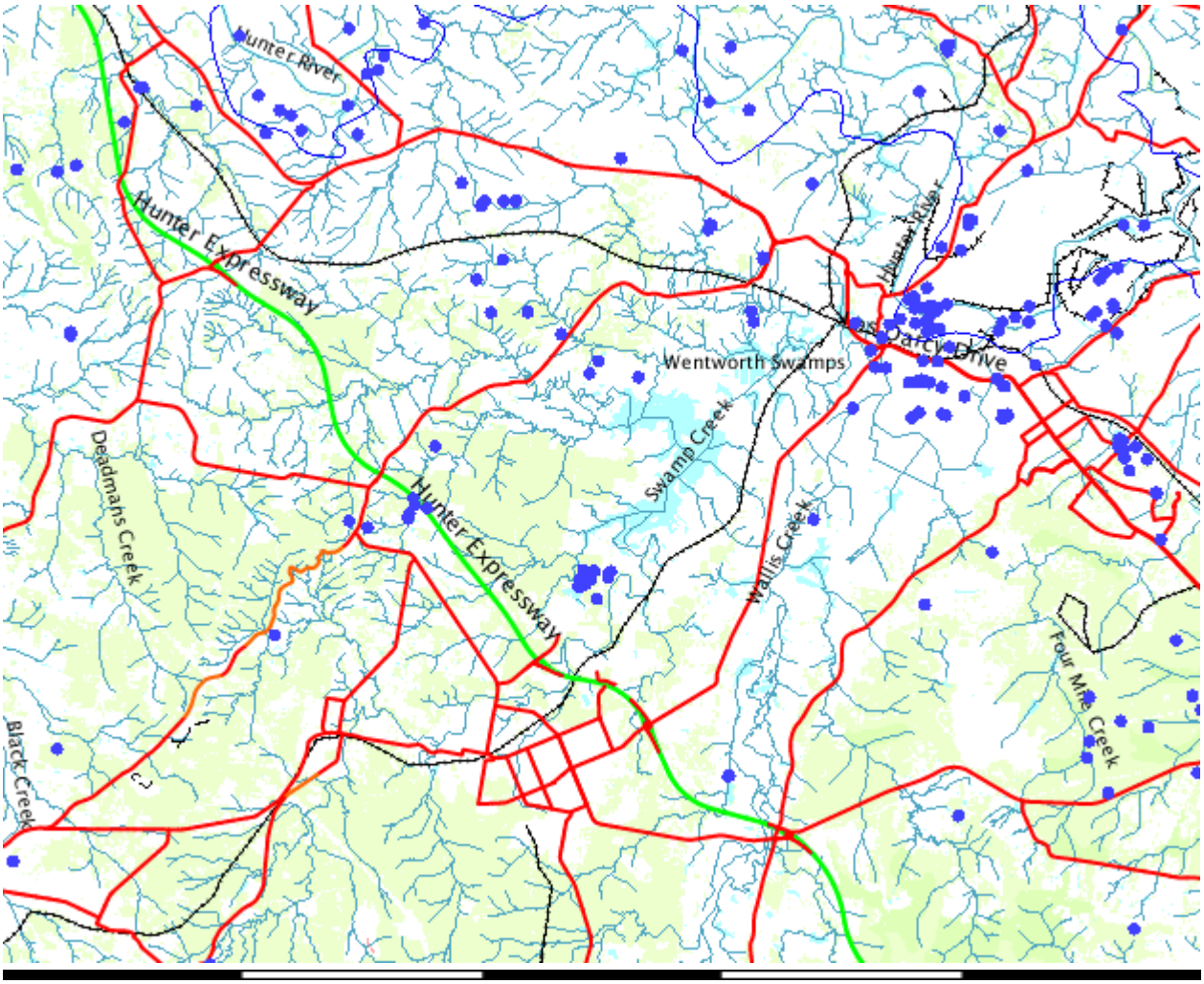
FIGURE 3

Appendix A

Surrounding Groundwater Bores

Registered groundwater bores in the vicinity of the site

Map created with NSW Natural Resource Atlas - http://www.nratlas.nsw.gov.au
Tuesday, April 29, 2014



0 24 Km

Legend

Symbol	Layer	Custodian
	Cities and large towns	
Cowra	Populated places	
	Towns	
	Groundwater Bores	
	Catchment Management Authority boundaries	
	Major rivers	
Primary/arterial road Motorway/freeway Railway Runway Contour Background	Topographic base map	

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079088

Works Details (top)

GROUNDWATER NUMBER	GW079088
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371306.00
EASTING	358054.00
LATITUDE	32 47' 13"
LONGITUDE	151 29' 3"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079090

Works Details (top)

GROUNDWATER NUMBER	GW079090
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371368.00
EASTING	358105.00
LATITUDE	32 47' 11"
LONGITUDE	151 29' 5"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079092

Works Details (top)

GROUNDWATER NUMBER	GW079092
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371429.00
EASTING	358078.00
LATITUDE	32 47' 9"
LONGITUDE	151 29' 4"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
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Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079093

Works Details (top)

GROUNDWATER NUMBER	GW079093
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371460.00
EASTING	358078.00
LATITUDE	32 47' 8"
LONGITUDE	151 29' 4"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079094

Works Details (top)

GROUNDWATER NUMBER	GW079094
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371462.00
EASTING	358234.00
LATITUDE	32 47' 8"
LONGITUDE	151 29' 10"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079096

Works Details (top)

GROUNDWATER NUMBER	GW079096
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371707.00
EASTING	358152.00
LATITUDE	32 47' 0"
LONGITUDE	151 29' 7"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079097

Works Details (top)

GROUNDWATER NUMBER	GW079097
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371679.00
EASTING	358335.00
LATITUDE	32 47' 1"
LONGITUDE	151 29' 14"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
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Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079099

Works Details (top)

GROUNDWATER NUMBER	GW079099
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371003.00
EASTING	358448.00
LATITUDE	32 47' 23"
LONGITUDE	151 29' 18"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079101

Works Details (top)

GROUNDWATER NUMBER	GW079101
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371680.00
EASTING	358387.00
LATITUDE	32 47' 1"
LONGITUDE	151 29' 16"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
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Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079102

Works Details (top)

GROUNDWATER NUMBER	GW079102
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371685.00
EASTING	358725.00
LATITUDE	32 47' 1"
LONGITUDE	151 29' 29"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079103

Works Details (top)

GROUNDWATER NUMBER	GW079103
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371530.00
EASTING	358675.00
LATITUDE	32 47' 6"
LONGITUDE	151 29' 27"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Appendix B

Site Photographs

Photo 1: Photograph showing flat northern portion of Lot 423, facing north. Note the discarded tyres.

Photo 2: Photograph showing the southern portion of Lot 423, with Swamp Creek in the background.

Photo 3: Photograph of the northern boundary of Parcel 16, showing Dickson Road.

Photo 4: Photograph of the northern portion of Lot 424 at the location of the former dwelling.

Photo 5: Photograph of minor construction debris associated with the former dwelling on Lot 424.

Photo 6: Photograph of the southern portion of Lot 424, facing south towards Swamp Creek.

Photo 7: Photograph of the northern portion of Lot 425, facing north.

Photo 8: Photograph of the southern portion of Lot 425, facing south.

Title:	Phase 2 ESA	Approved: KG	Project-Nr.: AS130348	Date: 24/1/2014
Site:	Parcel 16			
Client:	Hydro Aluminium Kurri Kurri		ENVIRON	

Photo 9: Photograph of the southern portion of Lot 426, facing south.

Photo 10: Photograph of the general site at Lot 426, facing east.

Appendix C

Field Investigation Sheets

Site Walkover Checklist

Project No.:	AS130348	**Date and Time:**	30/10/13
Land Parcel:	EMB	**Weather:**	Fine
Lot and DP:	Lot 423	**Environ Personnel:**	SC.

Site Description	
Topography	Flat at front (N) slope to ck in south to lower chi[illegible]
Surface Geology	no outcrop.
Fill evident?	
Hummocky ground?	
Structures on site?	NO.
Location of structures	
Building materials used in structures	
Asbestos debris on site?	
Location of asbestos debris?	
Volume of asbestos debris?	

GPS Locations of Interest		
Point of Interest	Easting	Northing
Q110 x10	151.48639.	32.79268

Description of Photographs Taken
903-907 NW Station mid-E boundary
908-909 - Pond at rear (S) area
910-915 - Pan SE-N on mid W. boundary
916-918 - Pan S→E Dn NW cor (Dickson Rd)

Miscellaneous Field Comments
Flat, open Lot - few trees/grasses - Bushy at rear (S) close to ck. - to lower terrace.
Q1 on approx house s.c. - no ACM (no sign of any debris).
Tyres ~ 6-8 - dumped on M.B. east boundary

Site Walkover Checklist

Project No.:	AS130348	**Date and Time:**	30/10/13
Land Parcel:	EMP3	**Weather:**	Fine, mild.
Lot and DP:	Lot 424	**Environ Personnel:**	SC

Site Description	
Topography	Flat on N. half - slopes at rear to S. creek
Surface Geology	Sand / Alluvials.
Fill evident?	Yes - See Dixon Rd Landfill report
Hummocky ground?	at rear(s) of house block - see map.
Structures on site?	No
Location of structures	
Building materials used in structures	-
Asbestos debris on site?	-
Location of asbestos debris?	-
Volume of asbestos debris?	-

GPS Locations of Interest		
Point of Interest	Easting	Northing
Q2 10x10m	151.48796	32.79302

Description of Photographs Taken

919-923 - Pan ESW at front gate.
925-926 - old house block at front (Dickson Rd). Q2.
926- - concr & plastic on east. boundary.
927-930 Pan on E. boundary NWS
931-932 - looking N at Filled creek.

Miscellaneous Field Comments

Flat in north (Dixon Rd), then slope at rear to lower lvl of creek.

Q2 10x10 at Dickson Rd end - (no ACM) - small bags - iron waste
Sl. hummocky area in bracken to S. of Q2 & towards E. boundary - concrete, plastic

Site Walkover Checklist

Project No.:	AS130348	**Date and Time:**	30/10/12
Land Parcel:	EMP3	**Weather:**	Fine / mild.
Lot and DP:	Lot 425	**Environ Personnel:**	SC

Site Description	
Topography	Northern 2/3 Flat - Terrace down to creek at S. end. gentle slope east towards Swamp Creek (≈Lot 426)
Surface Geology	Sands - alluvial
Fill evident?	Dickson Rd L/fill on mid-west of Lot.
Hummocky ground?	
Structures on site?	NO
Location of structures	–
Building materials used in structures	–
Asbestos debris on site?	–
Location of asbestos debris?	–
Volume of asbestos debris?	–

GPS Locations of Interest		
Point of Interest	Easting	Northing
Small soil mound.	151 · 48868 ·	32 · 79299
Q3 (10x10)	151 - 48927.	32 · 7929D

Description of Photographs Taken

933 - Small soil mound.
934 - 938 Pan from N. and W - S - ~~W~~.

Miscellaneous Field Comments

Open area, grass cover - trees on mid-west section (Dickson Rd L/fill area).
Small soil mound at N. end (< 1m³).
Q3 10x10 on house block (from hist. aerials). - No ACM (or other constr. debris)

Site Walkover Checklist

Project No.:	AS130426	**Date and Time:**	30/10/13
Land Parcel:	EMP3	**Weather:**	Fine, mild.
Lot and DP:	Lot 426	**Environ Personnel:**	SC.

Site Description	
Topography	
Surface Geology	
Fill evident?	
Hummocky ground?	
Structures on site?	
Location of structures	
Building materials used in structures	
Asbestos debris on site?	
Location of asbestos debris?	
Volume of asbestos debris?	

GPS Locations of Interest		
Point of Interest	Easting	Northing

Description of Photographs Taken

939 – 942 Pan from NW cnr. W-S-E.

943 – 946 " " Mid W border NE-N-W

Miscellaneous Field Comments

Appendix D

Results Tables

TABLE A: Soil Analytical Results - Grid Sampling

Sample Depth: 0m-0.01m

Sampling Date: 30/10/13

Laboratory PQL: 5 mg/kg

Site Specific HIL - Fluoride: 440mg/kg

Sample Identification	Soluble Fluoride mg/kg (1:5 soil:water)
EMP3-SF1	13
EMP3-SF2	7
EMP3-SF3	4
EMP3-SF4	14

TABLE B: Soil Quality Assurance/ Quality Control Results			
Sample Identification	EMP3-SF1	EMP3-QA1	RPD %
Sample Depth (m)	0-0.01		
Duplicate Type	Intralaboratory		
Sample Profile	TOPSOIL		
Sample collected by	SC		
Non Metallic Inorganics			
Fluoride	13	15	14

Note all units in mg/kg

BOLD identifies where RPD results

intralaboratory	interlaboratory	
>50	>60	where both sample results exceed ten x PQL
>75	>85	where both sample results are within 5 to 10 x PQL
>100	>100	where both sample results are within 2 to 5 x PQL
AD>2.5 * PQL		where one or both sample results are <2 x PQL

BOLD identified where blanks >0

Where results are within two of the above ranges the most conservative criteria have been used to assess duplicate performance

Appendix E

Laboratory Reports

CERTIFICATE OF ANALYSIS

Work Order	: **ES1323940**	Page	: 1 of 3
Amendment	: **1**		
Client	: **ENVIRON AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 564 MAITLAND NSW, AUSTRALIA 2320	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 49344359	Facsimile	: +61-2-8784 8500
Project	: HYDRO BUFFER ZONE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: P5130348		
C-O-C number	: ----	Date Samples Received	: 05-NOV-2013
Sampler	: SC	Issue Date	: 18-FEB-2014
Site	: ----		
		No. of samples received	: 5
Quote number	: SY/446/12	No. of samples analysed	: 5

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics

General Comments

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

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

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

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

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

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

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

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	EMP3-SF1	EMP3-SF2	EMP3-SF3	EMP3-SF4	EMP3-QA1
			Client sampling date / time	30-OCT-2013 15:00	30-OCT-2013 15:00	30-OCT-2013 15:00	30-OCT-2013 15:00	30-OCT-2013 15:00
Compound	CAS Number	LOR	Unit	ES1323940-001	ES1323940-002	ES1323940-003	ES1323940-004	ES1323940-005
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**3.8**	**4.9**	**10.0**	**10.8**	**10.8**
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**13**	**7**	**4**	**14**	**15**

QUALITY CONTROL REPORT

Work Order	: **ES1323940**	Page	: 1 of 4
Amendment	: **1**		
Client	: **ENVIRON AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 564 MAITLAND NSW, AUSTRALIA 2320	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 49344359	Facsimile	: +61-2-8784 8500
Project	: HYDRO BUFFER ZONE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 05-NOV-2013
Sampler	: SC	Issue Date	: 18-FEB-2014
Order number	: P5130348		
		No. of samples received	: 5
Quote number	: SY/446/12	No. of samples analysed	: 5

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics

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.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
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
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 3147358)									
ES1323903-011	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	22.4	22.1	1.5	0% - 20%
ES1323940-002	EMP3-SF2	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	4.9	4.7	4.0	No Limit
EK040S: Fluoride Soluble (QC Lot: 3147239)									
ES1323940-002	EMP3-SF2	EK040S: Fluoride	16984-48-8	1	mg/kg	7	6	0.0	No Limit
ES1323941-005	Anonymous	EK040S: Fluoride	16984-48-8	1	mg/kg	6	6	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EK040S: Fluoride Soluble (QCLot: 3147239)								
EK040S: Fluoride	16984-48-8	1.0	mg/kg	<1	25.0 mg/kg	111	69	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK040S: Fluoride Soluble (QCLot: 3147239)							
ES1323940-002	EMP3-SF2	EK040S: Fluoride	16984-48-8	25.0 mg/kg	101	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EK040S: Fluoride Soluble (QCLot: 3147239)										
ES1323940-002	EMP3-SF2	EK040S: Fluoride	16984-48-8	25.0 mg/kg	101	----	70	130	----	----

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1323940**	Page	: 1 of 5
Amendment	: **1**		
Client	: ENVIRON AUSTRALIA PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 564 MAITLAND NSW, AUSTRALIA 2320	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 49344359	Facsimile	: +61-2-8784 8500
Project	: HYDRO BUFFER ZONE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 05-NOV-2013
Sampler	: SC	Issue Date	: 18-FEB-2014
Order number	: P5130348		
		No. of samples received	: 5
Quote number	: SY/446/12	No. of samples analysed	: 5

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

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Pulp Bag (EA055-103)							
EMP3-SF1, EMP3-SF2, EMP3-SF3, EMP3-SF4, EMP3-QA1	**30-OCT-2013**	**----**	----	----	**08-NOV-2013**	13-NOV-2013	✓
EK040S: Fluoride Soluble							
Pulp Bag (EK040S)							
EMP3-SF1, EMP3-SF2, EMP3-SF3, EMP3-SF4, EMP3-QA1	**30-OCT-2013**	**07-NOV-2013**	06-NOV-2013	×	**11-NOV-2013**	05-DEC-2013	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Fluoride - Soluble	EK040S	2	15	**13.3**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	2	20	**10.0**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Fluoride - Soluble	EK040S	1	15	**6.7**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Fluoride - Soluble	EK040S	1	15	**6.7**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Fluoride - Soluble	EK040S	1	15	**6.7**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Fluoride - Soluble	EK040S	SOIL	APHA 21st ed., 4500 F--C Soluble Fluoride is determined after a 1:5 soil/water extract using an ion selective electrode.

Preparation Methods	Method	Matrix	Method Descriptions
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW 846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK040S: Fluoride Soluble						
Pulp Bag						
EMP3-SF1, EMP3-SF2, EMP3-SF3, EMP3-SF4, EMP3-QA1	07-NOV-2013	06-NOV-2013	**1**	----	----	----

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 40 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townesville.environmental@alsglobal.com

WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: ENVIRON AUSTRALIA P/L	TURNAROUND REQUIREMENTS: ☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)	
OFFICE: 19B, 50 Glebe Rd, The Junction NSW 2291	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact?	Yes No N/A
PROJECT: HYDRO BUFFER ZONE PROJECT NO.:	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle)	Free Ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: AB30348 PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Steve Cadman CONTACT PH: 49625444		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: " "	SAMPLER MOBILE: 0423583538	RELINQUISHED BY:	RECEIVED BY:
COC Emailed to ALS? (YES / NO)	EDD FORMAT (or default):	DATE/TIME: 5/11/13	DATE/TIME: 5/11/13 5:40pm
Email Reports to (will default to PM if no other addresses are listed):	scadman@environcorp.com	RELINQUISHED BY: Sp	RECEIVED BY: Steven
Email Invoice to (will default to PM if no other addresses are listed):	" "	DATE/TIME: 6/11/13 17:00	DATE/TIME: 6/11/13 19:00

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)	TOTAL BOTTLES	Soluble Fluoride								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	EMP3 – SF1	30/10/13	S	Pulp Bag	1	✓								
2	" SF2	↓	↓		1	✓								
3	" SF3				1	✓								
4	" SF4				1	✓								
5	" QA1	↓	↓		1	✓								
				TOTAL										

Environmental Division
Sydney
Work Order
ES1323940

Telephone : +61-2-8784 8555

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.

Appendix F

QA/QC Assessment

APPENDIX F

DATA QUALITY OBJECTIVES

To ensure that reliable data of adequate type was collected and assessed for the investigation, the seven-step Data Quality Objective (DQO) approach, endorsed in the NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme 2nd Edition, will be adopted. The DQOs set quality assurance and quality control parameters for the field and laboratory programs to ensure data of appropriate reliability will be used to assess the environmental conditions at Parcel 16.

ENVIRON has developed DQOs in accordance with the seven-step process, which is presented below.

Step 1 – State the Problem

Based on the information available from the Phase 1 ESA, uses of Parcel 16 include residential use, with three dwellings on the northern portion of the parcel between the early 1960s and early 1990s, and as a landfill for the deposition of smelter wastes. This use of Parcel 16 requires confirmation via a site walkover. In addition, the potential for fluoride in surface soils from dust deposition from the Hydro smelter requires assessment.

Step 2 – Identification of the Goals (Decisions) of the Study

The following decisions are to be made from this study:

- Are the current and former uses of Parcel 16 consistent with site observations?
- Has Parcel 16 been impacted by fluoride from dust deposition from the Hydro smelter?
- Has Parcel 16 been impacted by other contaminants?
- Is Parcel 16 suitable for environmental conservation and general industrial landuse?

Step 3 – Identify Information Inputs to the Decision or Goal of the Study

The inputs required to make the above decisions as listed below:

- A site walkover, including collection of field notes and photographs;
- Results of surface soil samples collected for fluoride analysis;
- Results of other soil samples from fill/ hummocky ground collected for suitable analysis during the site walkover;
- Proposed land use;
- Appropriate NSW contamination guidelines.

Step 4 – Define the Study Boundaries

Spatial boundaries - the study boundaries have been defined as the spatial boundary of Parcel 16, as shown on Figure 1.

Vertical boundaries – as areas of concern at Parcel 16 are restricted to surface soils, the vertical boundary of the study is the top 200mm unless subsurface contamination issues are identified during the site walkover.

Temporal boundaries – the temporal boundary is limited to the data collected during the investigation works.

Constraints within the study boundaries – This investigation does not require investigation of subsurface soils or groundwater.

Step 5 – Develop a Decision Rule

The decision rules for this investigation are as follows:

- If it is determined that the data generated through this investigation is reliable for use in producing a site conceptual model and assessing the suitability of Parcel 16 for environmental conservation and general industrial landuse, then an assessment of the suitability of Parcel 16 for environmental conservation and general industrial landuse will be made;

- If it is determined that the data generated through this investigation is not suitable, comprehensive or reliable for use in producing a site conceptual model, then further investigations may be recommended prior to the development of a site conceptual model and assessment of the suitability of Parcel 16 for environmental conservation and general industrial landuse.

Step 6 – Specify Performance or Acceptance Criteria that the Data need to Achieve

Acceptable limits on decision errors have been developed based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness. The DQIs for this investigation are outlined below.

The potential for significant decision errors were minimized by:

- Completion of a QA/QC assessment of the investigation data to assess if the data satisfies the DQIs;

- Assessment of whether appropriate sampling and analytical densities were completed for the purpose of the investigation; and

- Ensuring that the criteria set for the investigation were appropriate for the proposed use of Parcel 16.

Minimization of the potential for significant decision errors limits the potential that a conclusive statement may be incorrect.

Step 7 – Optimisation of the Design of Collection of Data

The collection of data was optimized by the completion of a Phase 1 ESA, data gap review and development of a sampling design, which is included in Section 5.3. Attainment of the DQOs has been assessed by reference to the DQIs, presented below.

DATA QUALITY INDICATORS

The project Data Quality Indicators (DQIs) have been established to set acceptance limits on field and laboratory data collected as part of this investigation. Field and laboratory procedures acceptance limits are set at different levels for different projects and by different laboratories. Non-compliances with acceptance limits are to be documented and discussed in the report. The DQIs are presented in Table A.

Table A: Data Quality Indicators

DQI	Field	Laboratory	Acceptability Limits
Completeness	All critical locations sampled All samples collected Experienced sampler Documentation correct	All critical samples analysed and all analytes analysed according to Standard Operating Procedures (SOPs) Appropriate Practical Quantitation Limits (PQLs) Sample documentation complete Sample holding times complied with	As per NEPM (2013)
Comparability	Experienced sampler In the event of multiple sampling events: Same types of samples collected Same sampling methodologies used Climatic conditions	Same analytical methods used Same PQLs Same units Same primary and secondary laboratories	As per NEPM (2013)
Representativeness	Appropriate media sampled Relevant media sampled	All samples analysed according to SOPs	
Precision	Collection of duplicate samples Sampling methodologies appropriate and complied with	Analysis of: Blind duplicate samples at rate of 1 in 10 samples Split duplicate samples at rate of 1 in 20 samples Laboratory duplicate samples	 RPD of 30 to 50% RPD of 30 to 50% RPD of 30 to 50%

Accuracy	Sampling methodologies appropriate and complied with.	Analysis of: Method blanks Matrix spikes Surrogate spikes Laboratory control samples Reagent blanks Reference material	 Non-detect 70 to 130% 70-130% 70 to 130%

QUALITY ASSURANCE AND QUALITY CONTROL

A quality assurance assessment for this report is presented in Table A and B below. An assessment was made of data completeness, comparability, representativeness, precision and accuracy based on field and laboratory considerations, as outlined in NSW DEC (2006) and NSW EPA (2007) guidelines.

Table A: QA/QC – Sampling and Analysis Methodology Assessment

Sampling Methodology	ENVIRON Assessment
Sampling Pattern and Locations	Surface soil sampling was undertaken on a grid pattern across Parcel 16 to assess the impact of particulate fallout from Hydro Aluminium Smelter.
Sampling Density	Four soil samples were collected from a grid across the entire of Parcel 16 which is approximately 14 ha. The purpose of the sampling was to assess for impacts from smelter particulate fallout and therefore is considered suitable in density and spatial layout.
Sample depths	Surface soil samples were collected from a grid across the entire of Parcel 16 from the soil surface.
Sample Collection Method	Surface soil samples across Parcel 16 were collected directly from the ground surface using using dedicated disposable gloves and a hand trowel. The hand trowel was brushed clean prior to sample collection. Soil samples were collected into laboratory supplied, acid rinsed glass jars.
Decontamination Procedures	Surface soil samples across Parcel 16 were collected directly from the ground surface using using dedicated disposable gloves and a hand trowel. The hand trowel was brushed clean prior to sample collection.
Sample handling and containers	All soil samples were placed into laboratory-supplied paper bags. Soil and water samples were placed on ice following collection and during transportation to the laboratory.
Chain of Custody	Samples were transported to the laboratory under chain of custody conditions. The chain of custody forms were signed by the laboratory on receipt of the samples.
Detailed description of field screening protocols	Field screening for volatiles was not completed during soil sampling as volatile contaminants were not the main chemical of concern.
Calibration of field equipment	No equipment requiring calibration was used.

Table A: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling Methodology	**ENVIRON Assessment**
Sampling Logs	The lithology of surface soil samples was documented on the field information sheets, which are included in Appendix C.

Table B: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**ENVIRON Comments**
Field quality control samples	Intra-laboratory duplicate soil samples were analysed at a ratio of 1:4 for fluoride analysed for the grid samples across the entire of Parcel 16. No rinsate blank samples were collected.
Field quality control results	Intra-laboratory duplicate results are presented in Table B. There were no RPD exceedences for the intra-laboratory duplicates collected for this assessment.
NATA registered laboratory and NATA endorsed methods	ALS was used as the primary laboratory. ALS laboratory certificates are NATA stamped and the lab is accredited for the analyses performed for this assessment.
Analytical methods	A summary of analytical methods were included in the laboratory test certificates.
Holding times	Review of the COCs and laboratory certificates indicate that holding times were met.
Practical Quantitation Limits (PQLs)	PQLs for all soil analytes were below Parcel 16 assessment criteria.
Laboratory quality control samples	Laboratory quality control samples including duplicates, laboratory control samples, matrix spikes, surrogate spikes and blanks were undertaken by the laboratories at appropriate frequencies.
Laboratory quality control results	All results for laboratory soil duplicates, laboratory control samples, matrix spikes and surrogates were acceptable and no detections were made in blank samples.

Overall it is considered that the completed investigation works and the data obtained adequately complied with the requirements of NSW DEC (2006) and NSW EPA (2007) guidelines and that the data is of suitable quality to meet the project objectives.