



## Phase 2 Environmental Site Assessment, Parcel 7

Prepared for:  
**Hydro Aluminium Kurri Kurri Pty Ltd**

Prepared by:  
**ENVIRON Australia Pty Ltd**

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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.

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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
BGL	Below Ground Level
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
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
µg/L	Micrograms per Litre
NATA	National Association of Testing Authorities
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
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
UCL	Upper Confidence Limit
µg/L	Micrograms per Litre
VENM	virgin excavated natural material
-	On tables is "not calculated", "no criteria" or "not applicable"

## Executive Summary

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 7. Parcel 7 is a rural property comprising approximately 19ha and is accessed from Lumby Lane, Sawyers Gully and located within the buffer zone and to the west of the Hydro Aluminium Kurri Kurri Smelter. Parcel 7 comprises bushland.

The objectives of the assessment were to assess the presence of contamination at Parcel 7 and to assess the suitability of that site for both current land uses and future uses for the purposes of environmental conservation (E2) land use.

To assess the potential for waste and the potential for soil contamination associated with fluoride dust deposition at Parcel 7, a site walkover was completed and surface soil samples were collected from across the parcel. Surface soil samples from across Parcel 7 were analysed for soluble fluoride. Fluoride results were below the preliminary screening level for residential landuse.

The site walkover identified two areas of illegally dumped waste, one within the parcel at the western end of the power line easement in bushland; and one outside the fenced parcel near Lumby Lane. The illegally dumped waste near the power line easement included a stockpile of at least four Super Six roof sheets, which are likely to contain asbestos; a fridge and other rusted metal items. The illegally dumped wastes on Lumby Lane included tyres, fencing and scrap metal. No soil contamination issues were identified at Parcel 7.

Parcel 7 is suitable for the current landuse and the proposed environmental conservation (E2) landuse.

Hydro has separately engaged a NSW EPA-accredited Site Auditor to issue a Site Audit Statement certifying that the site is suitable for the proposed use.

ENVIRON considers that interim management is required to remove illegally dumped wastes, as follows:

1. An appropriately licenced asbestos removal contractor be engaged to remove and dispose of the Super Six roof sheets. Validation of the asbestos removal should be undertaken by an appropriately qualified consultant and documented.
2. Other illegally dumped wastes should also be removed and disposed of appropriately.

# 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 7. Parcel 7 is located off Lumby Lane, Sawyers Gully, New South Wales (2326). Parcel 7 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 smelter in May 2014. A Rezoning Masterplan has been developed that identifies Parcel 7 to comprise land suitable for the purposes of environmental conservation (E2) land use.

A Phase 1 Environmental Site Assessment has previously been prepared for all Hydro owned lands and evaluated the potential for contamination. On Parcel 7, these investigations identified aerial fallout of fluoride from the smelter and illegal dumping of waste to have potentially impacted the site.

It is noted that at the time of the fieldwork, this land parcel was named Employment Land Subarea 7 and as such the soil samples reference this name. Prior to the completion of this report, a Masterplan was completed for Hydro-owned land and the use of this land parcel under the Masterplan changed from employment land to rural land. The name of the land parcel as referenced in this report subsequently changed to Parcel 7.

The location of Parcel 7 in the context of the Rezoning Masterplan 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 7 based on historical and current land use and to assess the suitability of Parcel 7 for environmental conservation (E2) land use.

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.
- 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 7 suitable for the current and future land use.

## 2 Site Description

### 2.1 Site Location

Parcel 7 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 the suburb of Sawyers Gully, Kurri Kurri, New South Wales, Australia. Parcel 7 is accessed from Lumby Lane. The location of Parcel 7 is shown in **Figure 1**.

Parcel 7 is located within the Buffer Zone of the Hydro Aluminium Kurri Kurri Smelter, to the west 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 7 comprises dense undeveloped bushland.

Parcel 7 is located within the Cessnock Local Government Area and is zoned RU2 – Rural Landscape under the Cessnock Local Environment Plan.

Parcel 7 is approximately 19 hectares (ha) and comprises the lot numbers and development plans listed in Table 1:

<b>Table 1: Lot and Development Plans for Parcel 7.</b>			
<b>Subarea</b>	<b>Lot/ DP</b>	<b>Area (ha)</b>	<b>Total Area (ha)</b>
Parcel 7	Lot 10 DP1082775 Pt 2	19.3	19.3

Land uses surrounding Parcel 7 are as follows:

- North: Bushland;
- South: Farm land and rural residential land;
- East: Hunter Expressway, then bushland then the smelter;
- West: Farm land and rural residential land.

The Smelter is located approximately 2.2km to the east of Parcel 7.

### 2.2 Site Setting

#### 2.2.1 Topography

Parcel 7 is located in an area of the Buffer Zone that is of higher elevation at approximately 17 mAHD. The topography of the site is relatively flat, with a gentle slope to the south east. The natural topography slopes towards the south east of the site, towards a tributary of Black Waterholes Creek located approximately 50m south east the site.



### **2.2.2 Regional Geology**

According to the review of the regional geology described on the Sydney Basin Geological Sheet, Parcel 7 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 7 associated with surface water bodies. Quaternary sediments which are associated with Black Waterholes Creek, an unnamed tributary of which flows through the site; Swamp Creek (approximately 1km south east of Parcel 7) and the Hunter River consist of gravel, sand, silt and clay.

### **2.2.3 Site Hydrology**

Surface water from Parcel 7 discharges primarily via infiltration and overland flow to an unnamed tributary of Black Waterholes Creek located approximately 50m south east of the site. Black Waterholes Creek discharges into Wentworth Swamp, which in turn discharges to the Hunter River approximately 12km northeast of Parcel 7 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 7 is expected to flow south east to a tributary of Black Waterholes Creek located approximately 50m south east of the site.

According to the NSW Office of Environment and Heritage (Natural Resource Atlas), there are 23 licensed groundwater abstractions (bores) located within 1km of Parcel 7. The majority of the groundwater bores are located close to tributaries of Black Waterholes Creek. No further information was available for any of these bores. It is likely the bores are used for stock watering, irrigation or domestic supply.

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](http://www.environment.nsw.gov.au/ieo/Hunter/index.htm)).

### 2.3 Site Sensitivity

The sensitivity of Parcel 7 with respect to surface water and groundwater is considered to be moderate based on the following:

- Surface water and groundwater discharge into an unnamed tributary of Black Waterholes Creek, located approximately 50m south east of Parcel 7, which discharges to the Hunter River via Wentworth Swamp within the Fishery Creek Catchment, approximately 12km northeast of Parcel 7 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 7 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 relevant to Parcel 7:

- Earliest records (aerial photograph in 1951) indicate Parcel 7 was bushland. Subsequent aerial photographs to the present day indicate that the bushland has never been developed;
- Parcel 7 is located approximately 1.2km west of the smelter boundary and may be impacted from smelter dust deposition;
- The remoteness of Parcel 7 and surrounding bushland may also give rise to illegal dumping though it is noted that the Buffer Zone area is fenced and regularly monitored by Hydro personnel.

### 4 Sampling and Analytical Quality Plan

#### 4.1 Potential Areas and Contaminants of Concern

Based on Parcel 7 historical information as discussed in **Section 3**, the following areas of concern were identified:

- Smelter dust deposition.
- Illegal dumping.

Potential contaminants of concern associated with the range of previous site activities are:

- Asbestos;
- Fluoride.

#### 4.2 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**.

#### 4.3 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.

##### 4.3.1 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 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 in accessible areas of Parcel 7. As Parcel 7 comprises inaccessible dense bushland, samples were collected around the perimeter of the bushland and in open areas, where accessible. 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.

#### **4.3.2 Asbestos**

To assess the potential for asbestos and other illegally dumped wastes to be present at Parcel 6, a site walkover of accessible areas was completed. ENVIRON consider that dense bushland that is not readily accessible by foot is unlikely to have been accessed for waste dumping.

The location and type of dumped wastes were detailed on Field Information Sheets and logged by GPS. Where asbestos was confidently identified by the field personnel, no sampling was completed. If not, a sample of potential asbestos containing material (ACM) was collected for laboratory analysis. ACM fragments were collected into a zip-lock bag using dedicated disposable gloves.

ACM fragments were analysed for asbestos identification by a laboratory NATA accredited for the analysis.

## 5 Basis for Assessment Criteria

### 5.1 Soil

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

- NEPC (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 7 in relation to risks posed to human health and the environment under the proposed future land use of rural land. As the contaminants of concern are fluoride and asbestos, guidelines for these contaminants under a rural land use scenario 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.

<b>Table 2: Health screening levels for asbestos contamination in soil (w/w)</b>				
<b>Form of asbestos</b>	<b>Residential A<sup>1</sup></b>	<b>Residential B<sup>2</sup></b>	<b>Recreational C<sup>3</sup></b>	<b>Commercial/ Industrial D<sup>4</sup></b>
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF <sup>1</sup> (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) does not provide criteria for fluoride in soils in Australia. 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 are provided in Table 3.

<b>Table 3: Site Specific Soil Assessment Criteria (mg/kg) for Fluoride</b>	
<b>Preliminary screening levels</b>	
<b>Land Use</b>	<b>Preliminary screening level</b>
Residential landuse	F 440mg/kg
Recreational landuse	F 1,200mg/kg
Commercial/ Industrial landuse	F 17,000mg/kg

Soil investigation results for the samples taken from a grid formation across Parcel 6 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 the 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 have 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.

## 6 Results

### 6.1 Site Walkover

A site walkover was completed to identify areas of environmental concern, such as illegally dumped wastes and fill at Parcel 7. The entrance to Parcel 7 is from Lumby Lane, which borders the western boundary of the parcel. The parcel is fully fenced.

The majority of Parcel 7 comprised dense bushland. There is a power line easement along the north western boundary, which is approximately 30m wide and comprises low cut grass and power lines.

Illegally dumped waste was identified at two locations, one within the parcel at the western end of the power line easement in bushland; and one outside the fenced parcel near Lumby Lane. The illegally dumped waste near the power line easement included a stockpile of at least four Super Six<sup>1</sup> roof sheets, which are likely to contain asbestos; a fridge and other rusted metal items. The illegally dumped wastes on Lumby Land included tyres, fencing and scrap metal. Given the rusted state of metal items and the volume of leaf litter covering the roof sheeting, the dumped wastes are considered to have been dumped some time ago.

One track into the dense bushland was identified in the north western corner of the parcel. This track extended approximately 140m and no signs of dumped waste were identified along it.

No other signs of disturbed land or of land filling were observed during the walkover.

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

### 6.2 Soil Investigations

Four surface soil samples were collected from across Parcel 7 at a rate of one sample per 5ha to assess the potential for fluoride in soil from dust deposition from the Hydro Aluminium Kurri Kurri Smelter as shown in **Figure 3**.

A generalised lithology of the surface soils encountered at Parcel 7 is as follows:

- Topsoil: Silty clay, brown/ red, dry.

### 6.3 Soil Results

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

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<sup>1</sup> Super Six is the commercial name for a corrugated asbestos containing cement sheet. The sheets were used for roofing and fencing and were manufactured by James Hardie & Co between the 1950's and 1985.

**Table 4: Summary of Soil Results**

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

The results of surface soil sampling for fluoride demonstrate that surface soils at Parcel 7 have not been impacted by stack particulate fallout from the Hydro Aluminium Smelter.

#### **6.4 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.



## 7 Discussion

### 7.1 Conceptual Site Model

Parcel 7 consists of predominantly undisturbed bushland with a cleared, grassed power line easement along the northern boundary. Parcel 7 is bounded by the Hunter Expressway on the north eastern boundary and rural land on the western and southern boundaries. Lumby Lane extends along the parcel's western boundary and provides access to the parcel.

Aerial photographs indicate that Parcel 7 has never been developed. The site walkover indicated the parcel comprises dense bushland that is inaccessible aside from a narrow track extending 140m from the power line easement. Two areas of illegally dumped wastes, including a fridge, stockpile of super 6 roof sheeting, tyres, fencing and scrap metal, were identified in accessible areas of the parcel. The Super Six roof sheeting is likely to contain asbestos. The approximate locations of the two waste stockpiles are shown in **Figure 3**. The presence of the waste stockpiles indicates that accessible areas of Parcel 7 are susceptible to illegal dumping, although the rusted state of the metal and the volume of leaf litter over the Super Six sheeting indicates that the dumping is not recent.

Parcel 7 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 for residential landuse. It is noted that there is currently no source of aerial fluoride emissions, as the smelter is in a care and maintenance mode.

No other soil contamination issues were identified on the remainder of Parcel 7, which is considered suitable for rural landuse.

### 7.2 Waste Characterisation and Disposal

The Super Six roof sheeting observed in the western portion of the power line easement classifies as Asbestos Waste. The sheeting and broken fragments should be collected and disposed of by an appropriately licenced contractor and appropriately managed or disposed. Alternatively, planning permission could be sought for emplacement of the waste building materials within a containment cell within the Hydro site.

## 8 Conclusions and Recommendations

ENVIRON completed a Phase 2 Environmental Site Assessment at Parcel 7, located to the west of the buffer zone of the Hydro Aluminium Kurri Kurri Smelter. Parcel 7 is owned by Hydro Aluminium and is currently comprises unused bushland with a power line easement along the north eastern boundary.

The objectives of the assessment were to assess the presence of contamination at Parcel 7 and to assess the suitability of that site for both current land uses and future uses for the purposes of environmental conservation (E2) land use.

To assess the potential for waste and the potential for soil contamination associated with fluoride dust deposition at Parcel 7, a site walkover was completed and surface soil samples were collected from across the parcel. Surface soil samples from across Parcel 7 were analysed for soluble fluoride. Fluoride results were below the preliminary screening level for residential landuse.

The site walkover identified two areas of illegally dumped waste, one within the parcel at the western end of the power line easement in bushland; and one outside the fenced parcel near Lumby Lane. The illegally dumped waste near the power line easement included a stockpile of at least four Super Six roof sheets, which are likely to contain asbestos; a fridge and other rusted metal items. The illegally dumped wastes on Lumby Lane included tyres, fencing and scrap metal. No soil contamination issues were identified at Parcel 7.

Parcel 7 is suitable for the current landuse and the proposed environmental conservation (E2) landuse.

Hydro has separately engaged a NSW EPA-accredited Site Auditor to issue a Site Audit Statement certifying that the site is suitable for the proposed use.

ENVIRON considers that interim management is required to remove illegally dumped wastes, as follows:

- An appropriately licenced asbestos removal contractor be engaged to remove and dispose of the Super Six roof sheets. Validation of the asbestos removal should be undertaken by an appropriately qualified consultant and documented.
- Other illegally dumped wastes should also be removed and disposed of appropriately.

## 9 References

AECOM. 2013. Hydro Aluminum – 2012 Annual Environmental Management Review. 2 June 2013;

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

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;

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

National Academy of Sciences. 1971a. Biologic effects of atmospheric pollutants: Fluorides. Washington, DC: National Academy of Sciences, National Research Council, Committee on Biologic Effects of Atmospheric Pollutants, 239.

National Environment Protection Council (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;

World Health Organisation (1997) Environmental Health Criteria for Fluorides and Fluorosis. 2nd ed. Internal Technical Report, International Program on Safety, WHO, Geneva.

## 10 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 18 November 2013 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 7. 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 7 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.

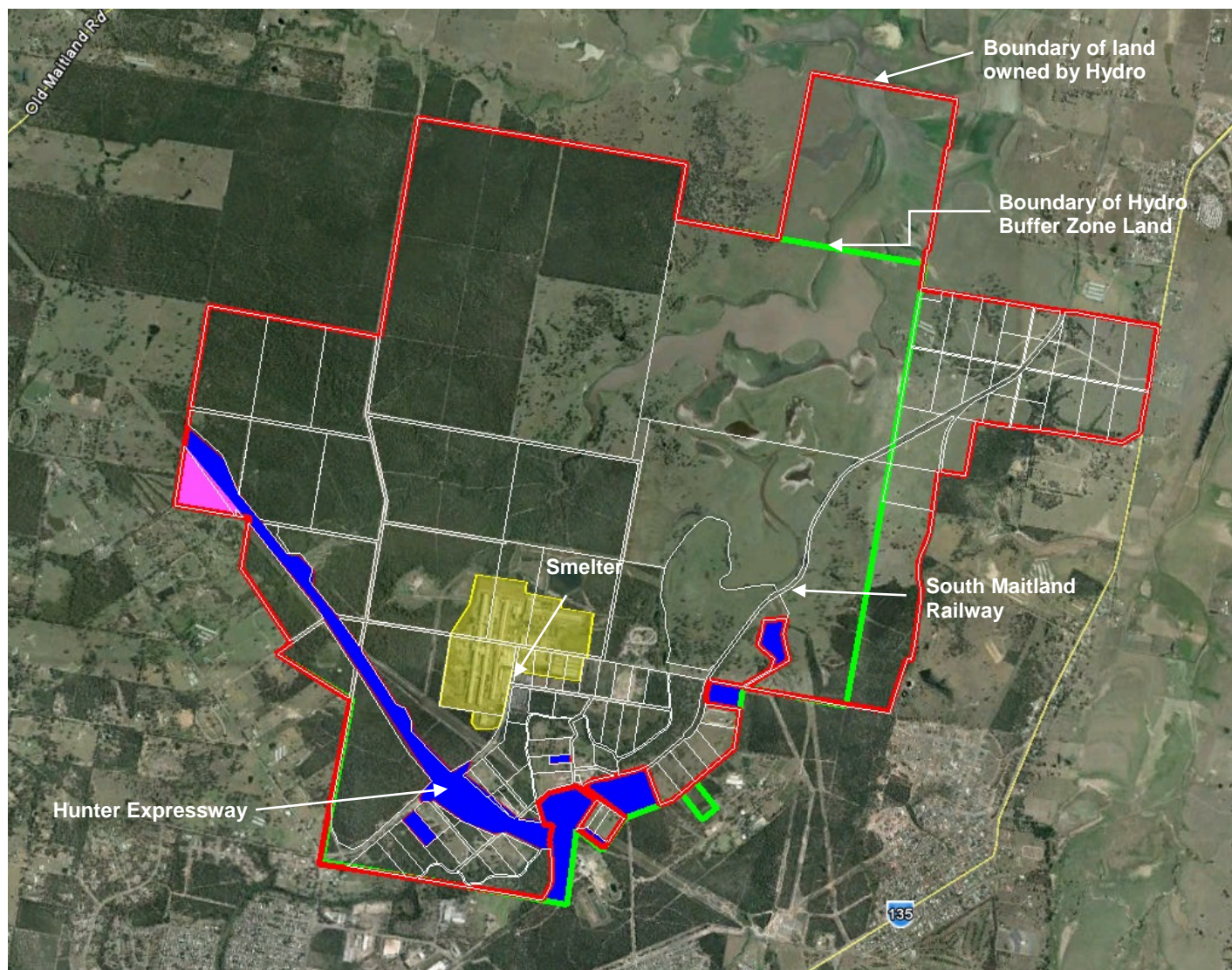
ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided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

### 10.1 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.

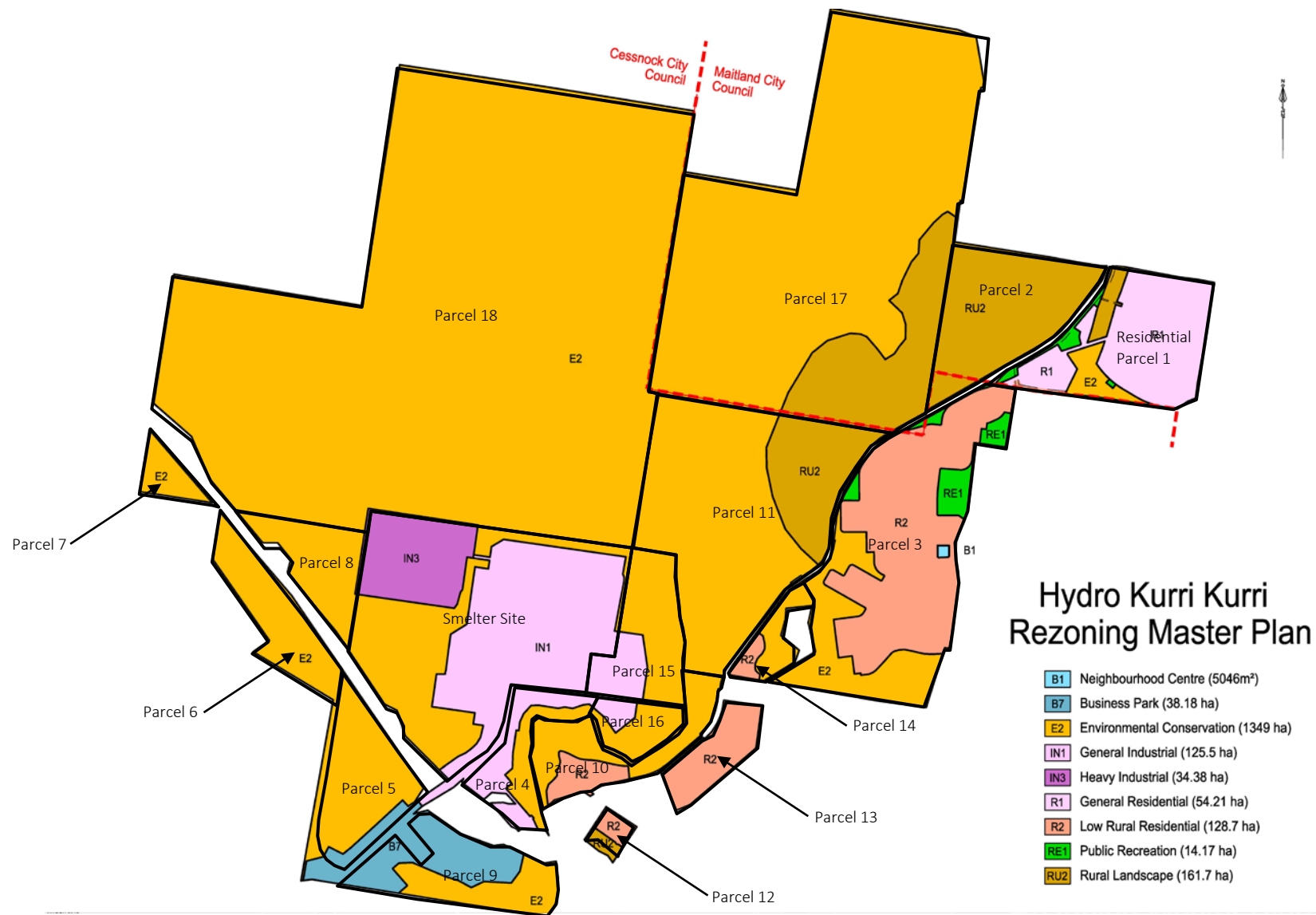
## Figures



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

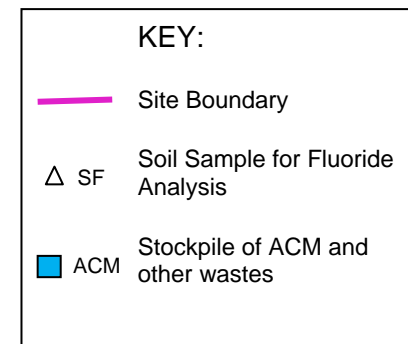
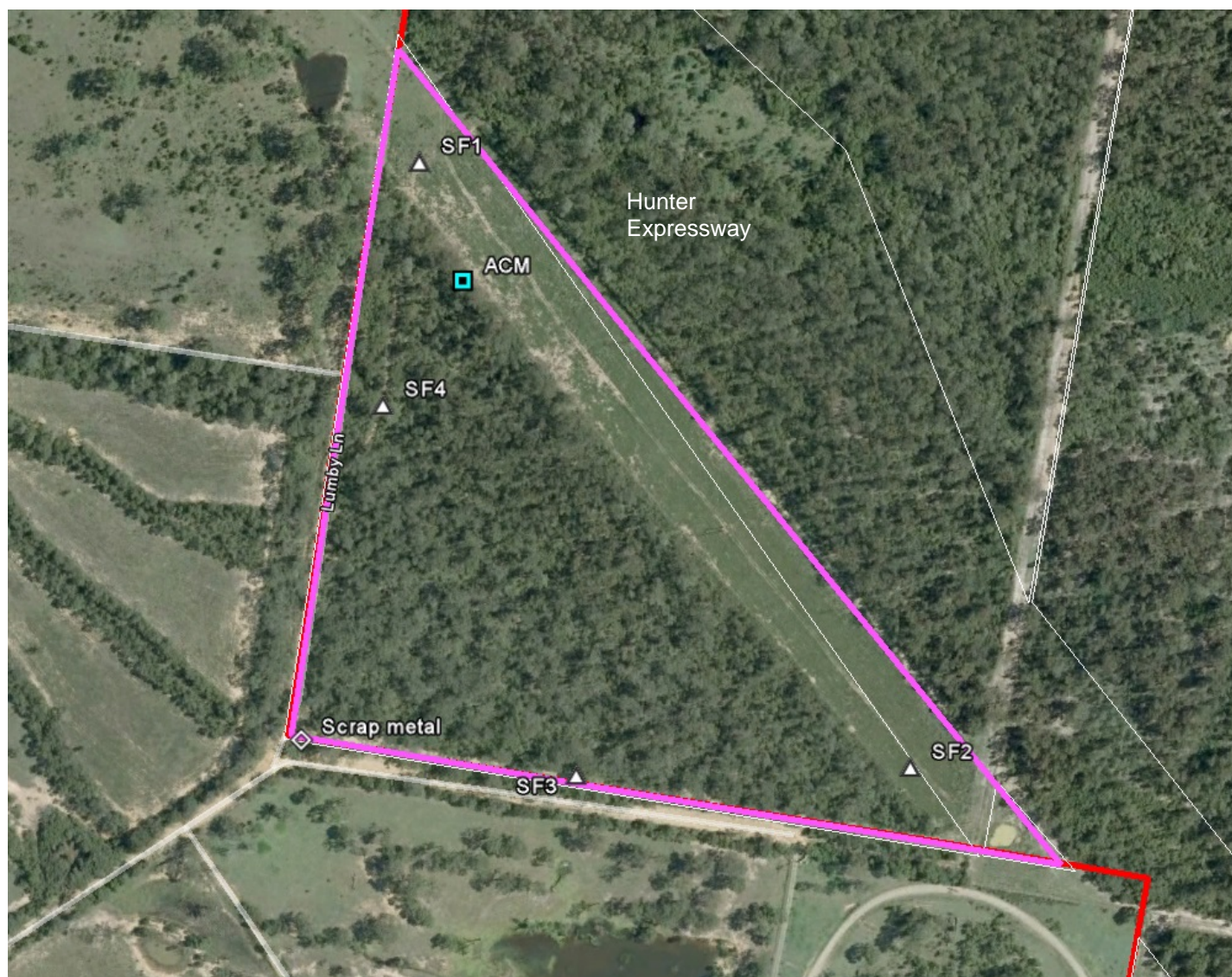
- Approximate Location of land owned by Hydro
- Approximate Location of Buffer Zone
- Land not owned by Hydro
- Parcel 7





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







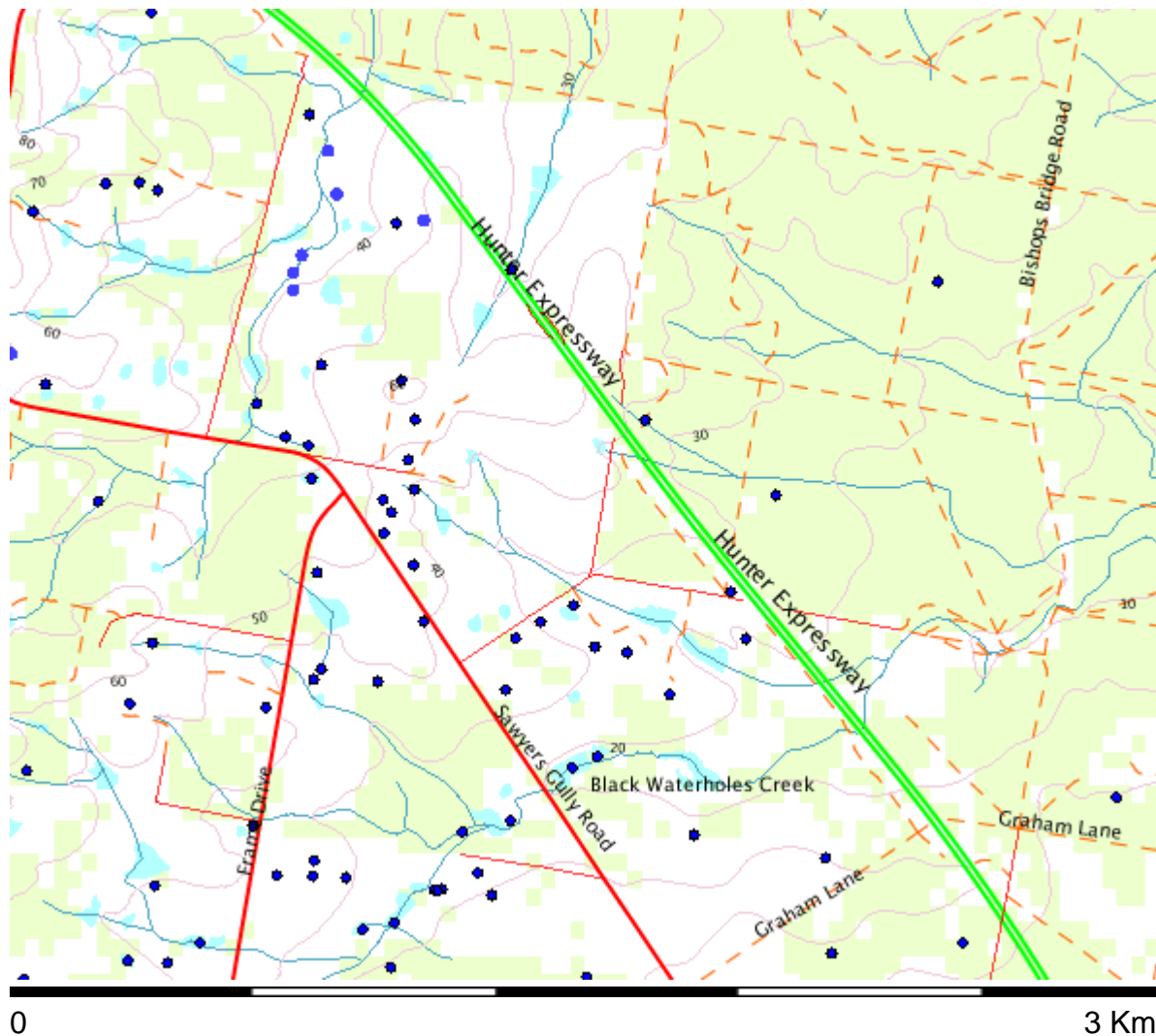
## **Appendix A**

### **Surrounding Groundwater Bores**

# Groundwater Bores near Employment Land Subarea 7

Map created with NSW Natural Resource Atlas - <http://www.nratlas.nsw.gov.au>

Tuesday, January 07, 2014



## Legend

Symbol	Layer	Custodian
	Cities and large towns	renderImage: Cannot build image from features
	Populated places	renderImage: Cannot build image from features
	Towns	
	Groundwater Bores	
	Catchment Management Authority boundaries	
	Major rivers	
	Primary/arterial road	
	Motorway/freeway	
	Railway	
	Runway	
	Contour	
	Background	
	Topographic base map	

Copyright © 2014 New South Wales Government. Map has been compiled from various sources and may contain errors or omissions. No representation is made as to its accuracy or suitability.

# 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

---

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## 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

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## 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

---

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## 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

---

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[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

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## 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

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## 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

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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

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# Groundwater Works Summary

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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

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## 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

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[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

---

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## **Appendix B**


### **Site Photographs**



**Photo 1:** Scrubland in vicinity of surface soil sampling location (SF4)



**Photo 2:** Photograph of dumped Super Six sheeting (asbestos containing material) in the northern portion of Employment Land Parcel 7.

Title:	Phase 2 ESA	Approved: MM	Project-Nr.: AS130348	Date: 23/01/2014
Site:	Employment Land Subarea 12			
Client:	Hydro Aluminium Kurri Kurri			






**Photo 3:** Photograph of dumped municipal waste at the northern portion of Employment Land Parcel 7.



**Photo 4:** Photograph of dumped concrete and scrap metal adjacent to the Lumby Lane entry gate of Employment Land Parcel 7.

Title:	Phase 2 ESA	Approved: MM	Project-Nr.: AS130348	Date: 23/01/2014
Site:	Employment Land Subarea 12			
Client:	Hydro Aluminium Kurri Kurri			

## **Appendix C**

### **Field Information Sheets**

# Site Walkover Checklist

Project No.: AS 13034 8	Date and Time: 31/10/13 10.30 - 12.00
Land Parcel: EMP 7	Weather: Fine 25° Rain 2 days prior
Lot and DP: Lot 10 DP1082775 Pt2	Environ Personnel: M. Manditch

Site Description	
Topography	Slope to SE. Mainly woodland / scrub coverage
Surface Geology	Brown, loose soil
Fill evident?	No
Hummocky ground?	No
Structures on site?	Power lines. No other structures
Location of structures	Eastern boundary.
Building materials used in structures	Timber poles
Asbestos debris on site?	Yes. ACM sheeting
Location of asbestos debris?	- 32.778508 151.457380
Volume of asbestos debris?	0.75 m <sup>3</sup> estimate

CP Locations of Interest Co-ords taken from Google Earth		
Point of Interest	Easting	Northing
Dumped ACM and municipal waste	-32.778508	151.457380
Dumped concrete & metal waste.	-32.780759	151.456459

Description of Photographs Taken	
• Each soil sampling site photographed 1630 → 1639, 41, 42.	
• Typical woodland and scrub scene. 1640	
• Dumped ACM sheeting - 3 as labelled 'EMP7-dumped ACM image'	
• Dumped municipal waste - 'EMP7-dumped materials image'	
• Dumped concrete and metal waste.	
- 4 photos 'EMP7-dumped metal image'	

Miscellaneous Info / Comments	
Some cleared area where power lines run on eastern boundary. New freeway adjacent to eastern boundary.	
Soil samples collected from 4 locations for fluoride sampling analysis	
10 x 10m m <sup>2</sup> walkover off track accessible into bush -32.779003 151.456863	

M. Manditch



ENVIRON

1

## PROJECT SAMPLE REGISTER

Project No	Project Name	Date commenced
AS130348	Hydro buffer zone	31/10/13
Location	Refer to Daily log for weather details	Date completed
Kurri Kurri EMP5 EMP7		31/10/13

Rain 2 days prior. All samples had some moisture, still low 20.

#	Sample Name	Sampled by	Easting from Coogle Earth	Northing from Coogle Earth	Depth m	Description (soil type, moisture, colour, foreign content, signs of contamination) or 'refer to log'	Quality Assurance	Comments (eg lab analyse)
1	EMP7-SF1	MM	-32.777678	151.457091	10	Cleared away grass. Downstream small alluvial soil, drainage line, loose soil. No trees.		Under power line
2	EMP7-SF2		-32.780774	151.460087	5	No trees. Unders power line. Lichen, spiky bushes. No leaf litter		
3	EMP7-SF3		-32.780808	151.458031	10	Mod coverage trees & scrub. Loose soil. Soil brown		Leaf litter
4	EMP7-SF4		-32.778908	151.456866	10	Off track. Heavy coverage trees & scrub. Leaf litter. Soil red colouring		
5	EMP7-asbestos	adjacent			10	Soil adjacent to dumped roofing panels		
6	EMP5-SF1	MM	-32.791569	151.469440	10	Mod scrub & tree coverage. Lichen, brown soil. Moderately compacted		
7	EMP5-SF2		-32.795591	151.468403	10	Large eucalypts, scrub, leaf litter reedy grass. Loose brown soil. Low point.		
8	EMP5-SF3		-32.800563	151.468400	15	Large eucalypt sand scrub trees. Heavy coverage trees & scrub. Leaf litter. Sandy soil. Yellow colouring in patches.		
9	EMP5-SF4		-32.799751	151.470854	5	No trees. Low coverage scrub. Sandstone rocks. Sandy sand, compacted. Small rocks		
10	EMP5-SF5	✓	-32.799256	151.470053	10	Mod leaf litter & tree coverage. Banksia bushes. Burnt tree trunks. Brown, loose soil.		



#	Sample Name	Sampled by	Easting	Northing	Depth m	Description (soil type, moisture, colour, foreign content, signs of contamination) or 'refer to log'	Quality Assurance	Comments (eg lab analyse)
	EMPS - SF6	MM	-32. 796403	151. 473376	10	Mod coverage trees & scrub leaf litter moderate. Brown soil	duplicate 1	
	EMPS - SF7	MM	-32. 795670	151. 472557	5	Compressed soil, sandy, small obelisks. Mod coverage trees scrub leaf litter. Dumped car.		Hydrosta
	EMPS - SF8	MM	-32. 795155	151. 469676	5	Compacted sand and small rocks. Moderate scrub, leafy tree.	Dup 2	Adjacent to creek
						Dumped car body at SF8.		

## **Appendix D**

### **Results Tables**



**TABLE A: Soil Analytical Results - Grid Sampling, Parcel 7**

Sample Depth: 0.005m - 0.01m

Sampling Date: 31/10/13

Laboratory PQL: 1 mg/kg

Site Specific HIL - Fluoride: 440 mg/kg

Sample Identification	Soluble Fluoride mg/kg (1:5 soil:water)
S1	2
S2	2
S3	4
S4	<1

## **Appendix E**

### **Laboratory Reports**



# CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ Sydney: 277 Woodpark Rd, Smithfield NSW 2164  
Ph: 02 8794 8555 E: samples.sydney@alsenviro.com  
☐ Newcastle: 5 Rosegum Rd, Warabrook NSW 2304  
Ph: 02 4969 9433 E: samples.newcastle@alsenviro.com

☐ Brisbane: 32 Shand St, Stafford QLD 4053  
Ph: 07 3243 7222 E: samples.brisbane@alsenviro.com  
☐ Townsville: 14-15 Desma Ct, Bohle QLD 4818  
Ph: 07 4796 0600 E: townsville.environmental@alsenviro.com

☐ Melbourne: 2-4 Westall Rd, Springvale VIC 3171  
Ph: 03 8549 9500 E: samples.melbourne@alsenviro.com  
☐ Adelaide: 2/1 Burma Rd, Pooraka SA 5095  
Ph: 08 8350 0890 E: adelaide@alsenviro.com

☐ Perth: 10 Hoo Way, Malaga WA 6090  
Ph: 08 9209 7655 E: samples.perth@alsenviro.com  
☐ Launceston: 27 Wellington St, Launceston, TAS 7250  
Ph: 03 6331 2156 E: launceston@alsenviro.com

CLIENT: **ENVIRON Australia P/L** TURNAROUND REQUIREMENTS: ☒ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):

OFFICE: **148 50 Adelaide The Junction** (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)

PROJECT: **Hydro Buffer Zone 2201** ALS QUOTE NO.:

PURCHASE ORDER NUMBER: **AS130348**

PROJECT MANAGER: **Steve Cadman** CONTACT PH: **49625444**

SAMPLER: **Michelle Mandibler** MOBILE: **0447677711**

COC emailed to ALS? (YES / NO) ☐ EDD FORMAT (or default):

Email Reports to (will default to PM if no other addresses are listed): **S. Cadman**

Email Invoice to (will default to PM if no other addresses are listed): **S. Cadman**

COMMENTS/ SPECIAL HANDLING/STORAGE OR DISPOSAL: **Scadman@environcorp.com**

COC SEQUENCE NUMBER (Circle)  
COC: **2** OF: **1**  
2 3 4 5 6 7


FOR LABORATORY USE ONLY (Circle)  
Custody Seal Intact? ☐ Yes ☐ No  
Free Ice / frozen ice bricks present upon receipt? ☐ Yes ☐ No  
Random Sample Temperature on Receipt: ☐ °C  
Other comment:

RECEIVED BY: **ce** DATE/TIME: **4/11/13 0950**

RELINQUISHED BY: **ce** DATE/TIME: **4/11/13 1702**

RECEIVED BY: **Fraser** DATE/TIME: **5/11/13 1030**

ALS USE	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 CONTAINERS						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.	
1	EMP7-SF1	31/10/13	S	unpreserved glass jar	1	soluble fluoride						
2	EMP7-SF2											
3	EMP7-SF3											
4	EMP7-SF4											
5	EMP5-SF1											
6	EMP5-SF2											
7	EMP5-SF3											
8	EMP5-SF4											
9	EMP5-SF5											
10	EMP5-SF6											
11	EMP5-SF7											
12	EMP5-SF8											
TOTAL					12	12						



Environmental Division  
Sydney  
Work Order  
**ES1323624**

Telephone : + 61-2-8784 8555

Environmental Division  
Sydney  
Work Order

ES1323624



Telephone : +61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airtight Unpreserved Plastic; V = VOA Via HCl Preserved; VB = VOA Via Sodium Bisphosphate Preserved; VS = VOA Via Sulfuric Preserved; NV = Airtight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl Preserved Plastic; HS = HCl Preserved Speculation 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 Suphate Soils; U = Unpreserved Bag.

155068

## CERTIFICATE OF ANALYSIS

Work Order	: <b>ES1323624</b>	Page	: 1 of 5
Amendment	: <b>1</b>		
Client	: <b>ENVIRON AUSTRALIA PTY LTD</b>	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 99548114	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: HYDRO BUFFER ZONE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: AS130348		
C-O-C number	: ----	Date Samples Received	: 04-NOV-2013
Sampler	: ----	Issue Date	: 17-FEB-2014
Site	: ----		
Quote number	: SY/285/10	No. of samples received	: 14
		No. of samples analysed	: 14

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

				EMP7 - SF1	EMP7 - SF2	EMP7 - SF3	EMP7 - SF4	EMP5- SF1
Client sampling date / time				31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00
Compound	CAS Number	LOR	Unit	ES1323624-001	ES1323624-002	ES1323624-003	ES1323624-004	ES1323624-005
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	10.7	16.1	19.6	18.9	10.4
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	2	2	4	<1	2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

				EMP5- SF2	EMP5- SF3	EMP5- SF4	EMP5- SF5	EMP5- SF6
Client sampling date / time				31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00
Compound	CAS Number	LOR	Unit	ES1323624-006	ES1323624-007	ES1323624-008	ES1323624-009	ES1323624-010
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	18.8	16.1	3.3	12.2	11.2
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	2	3	<1	2	2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	EMP5- SF7	EMP5- SF8	EMP5- DUP1	EMP5- DUP2	----
				Client sampling date / time	31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00	31-OCT-2013 15:00	----
Compound	CAS Number	LOR	Unit		ES1323624-011	ES1323624-012	ES1323624-013	ES1323624-014	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		4.7	1.6	10.6	1.5	----
EK040S: Fluoride Soluble									
Fluoride	16984-48-8	1	mg/kg		<1	<1	2	<1	----



## QUALITY CONTROL REPORT

Work Order	: ES1323624	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 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 99548114	Telephone	: +61-2-8784 8555
Facsimile	: ----	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	: 04-NOV-2013
Sampler	: ----	Issue Date	: 17-FEB-2014
Order number	: AS130348		
Quote number	: SY/285/10	No. of samples received	: 14
		No. of samples analysed	: 14

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 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.

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 (%)
<b>EA055: Moisture Content (QC Lot: 3142480)</b>									
ES1323571-012	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	16.9	16.6	2.2	0% - 50%
ES1323624-006	EMP5- SF2	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	18.8	18.8	0.0	0% - 50%
<b>EA055: Moisture Content (QC Lot: 3142481)</b>									
ES1323718-001	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	11.1	10.7	2.9	0% - 50%
ES1323791-002	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	5.9	5.7	3.3	No Limit
<b>EK040S: Fluoride Soluble (QC Lot: 3142827)</b>									
ES1323624-001	EMP7 - SF1	EK040S: Fluoride	16984-48-8	1	mg/kg	2	2	0.0	No Limit
ES1323624-010	EMP5- SF6	EK040S: Fluoride	16984-48-8	1	mg/kg	2	2	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**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) LowHigh	
Method: Compound	CAS Number	LOR	Unit	Result				
EK040S: Fluoride Soluble (QCLot: 3142827)								
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 Concentration	SpikeRecovery(%) MS	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number			Low	High
<b>EK040S: Fluoride Soluble (QCLot: 3142827)</b>							
ES1323624-001	EMP7 - SF1	EK040S: Fluoride	16984-48-8	25.0 mg/kg	115	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 Concentration	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number		MS	MSD	Low	High	Value	Control Limit
<b>EK040S: Fluoride Soluble (QCLot: 3142827)</b>										
ES1323624-001	EMP7 - SF1	EK040S: Fluoride	16984-48-8	25.0 mg/kg	115	----	70	130	----	----

## INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: <b>ES1323624</b>	Page	: 1 of 5
Amendment	: <b>1</b>		
Client	: ENVIRON AUSTRALIA PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 99548114	Telephone	: +61-2-8784 8555
Facsimile	: ----	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	: 04-NOV-2013
Sampler	: ----	Issue Date	: 17-FEB-2014
Order number	: AS130348		
Quote number	: SY/285/10	No. of samples received	: 14
		No. of samples analysed	: 14

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

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 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: **x** = Holding time breach ; **✓** = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content								
Soil Glass Jar - Unpreserved (EA055-103)		31-OCT-2013	----	----	----	05-NOV-2013	14-NOV-2013	✓
EMP7 - SF1,	EMP7 - SF2,							
EMP7 - SF3,	EMP7 - SF4,							
EMP5- SF1,	EMP5- SF2,							
EMP5- SF3,	EMP5- SF4,							
EMP5- SF5,	EMP5- SF6,							
EMP5- SF7,	EMP5- SF8,							
EMP5- DUP1,	EMP5- DUP2							
EK040S: Fluoride Soluble								
Soil Glass Jar - Unpreserved (EK040S)		31-OCT-2013	06-NOV-2013	07-NOV-2013	✓	06-NOV-2013	04-DEC-2013	✓
EMP7 - SF1,	EMP7 - SF2,							
EMP7 - SF3,	EMP7 - SF4,							
EMP5- SF1,	EMP5- SF2,							
EMP5- SF3,	EMP5- SF4,							
EMP5- SF5,	EMP5- SF6,							
EMP5- SF7,	EMP5- SF8,							
EMP5- DUP1,	EMP5- DUP2							



## 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	20	10.0	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	4	40	10.0	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Fluoride - Soluble	EK040S	1	20	5.0	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Fluoride - Soluble	EK040S	1	20	5.0	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Fluoride - Soluble	EK040S	1	20	5.0	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 SW846 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.

- No Analysis Holding Time Outliers exist.

### 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.

## **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 2<sup>nd</sup> 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 7.

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 7 appear to be limited to undeveloped bushland. The use of Parcel 7 requires confirmation via a site walkover and judgmental sampling. 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 7 consistent with site observations?
- Has Parcel 7 been impacted by fluoride from dust deposition from the Hydro smelter?
- Has Parcel 7 been impacted by other contaminants from historical site uses?
- Is Parcel 7 suitable for the purposes of environmental conservation (E2) landuse?

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

The inputs required to make the above decisions are 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 7, as shown on Figure 1.

Vertical boundaries – as areas of concern at Parcel 7 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 unless impacts to subsurface soils or groundwater are considered likely to have occurred from the historical site activities.

#### **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 7 for environmental conservation landuse, then an assessment of the suitability of Parcel 7 for environmental conservation 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 7 for environmental conservation 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 7.

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 4.3. 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, including targeted sampling of areas of environmental concern identified during the site walkover. Fluoride soil sampling completed on a reduced density to identify if fluoride in surface soils is an issue. 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%
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#### 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.

<b>Table A: QA/QC – Sampling and Analysis Methodology Assessment</b>	
<b>Sampling Methodology</b>	<b>ENVIRON Assessment</b>
Sampling Pattern and Locations	Surface soil sampling was undertaken on a grid pattern across Parcel 7 to assess the impact of particulate fallout from Hydro Aluminium Smelter.
Sampling Density	Six soil samples were collected from a grid across the entire of Parcel 7 which is approximately 31.5 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 7 from the ground surface.
Sample Collection Method	Surface soil samples across Parcel 7 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 7 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 field equipment requiring calibration was used during this

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

<b>Table B: QA/QC – Field and Lab Quality Assurance and Quality Control</b>	
<b>Field and Lab QA/QC</b>	<b>ENVIRON Comments</b>
Field quality control samples	No intra-laboratory or inter-laboratory duplicate soil samples were collected at Parcel 7. Duplicate samples were collected as part of the overall field program for the buffer zone investigations at a rate of 1:20 at a minimum. No rinsate blank samples were collected.
Field quality control results	Not applicable.
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 7 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.