DLA Environmental Services
A Pacific Environment company

Validation Report

Clay Borrow Pit Area
Hart Road, Loxford
New South Wales, Australia, 2326

Hydro Aluminium Kurri Kurri Pty Limited

DLH1155_H000638

October 2015

PROJECT NAME	Clay Borrow Pit Area
PROJECT ID	DLH1155
DOCUMENT CONTROL NUMBER	H000638
PREPARED FOR	Hydro Aluminium Kurri Kurri Pty Limited
APPROVED FOR RELEASE BY	Stephen Challinor
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DOCUMENT CONTROL

VERSION	DATE	COMMENT	PREPARED BY	REVIEWED BY
Version 1.0	21.10.15	Draft Copy	Jon Mansfield	Tot Le
H00638	29.10.15	Final Copy	Jon Mansfield	Stephen Challinor

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ABBREVIATIONS

ACM	Asbestos Containing Material
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AST	Above-ground Storage Tank
ASS	Acid Sulfate Soil
B(a)P	Benzo(a)Pyrene
BGL	Below Ground Level
BH	Borehole
BTEX	Benzene, Toluene, Ethyl Benzene, Xylene
COC	Chain of Custody documentation
CLM	Contaminated Land Management
DA	Development Application
DEC	Department of Environment and Conservation (NSW)
DECC	Department of Environment and Climate Change (NSW)
DECCW	Department of Environment, Climate Change and Water (NSW)
DLA	DLA Environmental Services
DP	Deposited Plan
DQO	Data Quality Objective
EC	Electrical Conductivity
EIL	Ecological Investigation Level
EMP	Environmental Management Plan
EPA	Environment Protection Authority (NSW)
ESL	Ecological Screening Level
HIL	Health-Based Investigation Level
LOR	Limit of Reporting
MW	Monitoring Well
NATA	National Association of Testing Authorities, Australia
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
NSW	New South Wales
OCP	Organochlorine Pesticides
OEH	Office of Environmental and Heritage
OPP	Organophosphorus Pesticides
OH&S	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photo-Ionisation Detector
PQL	Practical Quantification Limit
QA/QC	Quality Assurance and Quality Control
RAP	Remedial Action Plan
RPD	Relative Percentage Difference
SAC	Site Acceptance Criteria
SAQP	Sampling Analysis and Quality Plan
SEPP	State Environmental Planning Policy
SWL	Standing Water Level
TCLP	Toxicity Characteristic Leaching Procedure
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WHS	Work Health Safety

EXECUTIVE SUMMARY

DLA Environmental Services (DLA) was engaged by Hydro Aluminium Kurri Kurri Pty Ltd (the Principle) to conduct a Validation Assessment on part of the land at the Clay Borrow Pit Area (CBP), located to the west of the existing Hydro Aluminium Kurri Kurri Smelter on Hart Road, Loxford. The area of works are identified as Lot 319 DP755231 and Lot 3 DP456769 the hard stand stockpile area within the smelter grounds. The report has also been prepared utilising background information obtained as part of the remediation process, from previous assessment reports and from experience, knowledge, and current industry practice in remediation of similar sites.

The project objectives of this Validation are to satisfy the general requirements of State Environmental Planning Policy No.55 (SEPP 55). Specifically, this investigation will consider the potential for historical activities to have caused contamination at the Site and to demonstrate the suitability of the land for future land use consistent with *Commercial/Industrial D* in the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1) (NEPM 2013). Primarily the report needs to determine if the objectives of the remedial strategy presented in the Remediation Action Works Plan (RAWP) prepared by ENVIRON Australia Pty Ltd (ENVIRON) (ref: AS130386) on 23rd December 2014, have been achieved.

The Site is located in Loxford between Maitland and Kurri Kurri within the buffer zone of the Hydro Kurri Kurri Aluminium Smelter. The purpose of this report is to verify by visual validation that all contaminated soils, foreign materials and their residual soils have been removed from the Clay Borrow Pit Area on the Site, and that the Site is suitable for its proposed future land use (Commercial/Industrial).

Contamination Status

In 1995 clay material to a maximum depth of 1.5m was transported from this area to the cathode pile. The vegetation and topsoil was stripped prior to excavation. The clay borrow pit was then progressively backfilled with refractory bricks, bitumen, concrete, building materials and automotive waste material and capped with clay material.

Potential Contaminants of Concern (PCoC's) identified in previous investigations and the RAWP were identified as fluoride and cyanide, Polycyclic Aromatic Hydrocarbons (PAHs), Heavy Metals and Asbestos, from disposal of building materials.

Two additional areas were identified in the RAWP as containing exceedances of the maximum NEPM 2013 commercial/industrial concentrations of cadmium and fluoride due to the type of bulk refractory brick inclusions in these areas. The identified hotspots were specifically targeted for test pitting as identified in the EPA Draft *Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption*. Following this application NSW EPA requested a detailed characterisation of the refractory bricks as per the *Sampling, Analysis and Quality Plan, Refractory Brick Characterisation* (ENVIRON, 2012). The characterisation sampling was conducted in August 2014, which identified RB18, in the north-east area of the Main CBP excavation and RB14 in the south-west area of the Main CBP excavation. These areas have been identified as Hotspot 1 (HS1) and Hotspot 2 (HS2) respectively.

Remediation Process

The remediation option identified as most appropriate in the RAWP was option five which was to excavate and remove smelter derived materials from the Clay Borrow Pit to another location within Hydro owned land for recycling. This would achieve all contaminant management requirements and be finalised by reshaping the resultant land surface. Excavated materials were proposed to be coarsely sorted and stockpiled in a designated area of the Smelter site. The materials relocated within the Smelter site will be stockpiled separately for later beneficial reuse where permissible, incorporated within a whole-of-site remediation strategy.

Remediation was undertaken based on the recommendations of the RAWP produced by the Principle amended during the remediation works. The remediation works were carried out with material excavated and sorted within two stockpile staging areas. Material that contained inclusions was transported to the Stockpile Staging Area directly west of the Smelter Site to be sorted. The fines of the sorted material were then transported to a stockpiling area south of the primary excavation awaiting for the future 'whole-of-site' remediation strategy.

The foreign fill materials were identified and removed from eight primary areas of the Site. Four of these were outlined in the RAWP, known as concrete/asphalt on surface (South of CBP), bricks on surface with some light cover (West of CBP), bricks in pit covered with fill (main CBP excavation) and brick/concrete/fill (North of CBP). There were a further 4 areas uncovered throughout excavation of the Site, known as Unexpected Finds Area (UFA), Unexpected Finds Area 2 (UFA2), the Bench Area and East of CBP.

During works, a further seven areas were identified as unexpected finds containing contaminants of concern. These were identified by visual inspection during works indicating the presence of one, or several, contaminants of concern. These areas were identified as Well 1, Well 2, CBP asbestos find, South of CBP mineral fibres, Automotive Find, UFA Packing Coke Find and the Bench Packing Coke Pits. Of these areas, validation sampling was required in Well 1, Well 2, South of CBP mineral fibres, Automotive Find and UFA Packing Coke Find.

All eight areas excavated throughout works contained a range of underlying fills within soils. Fill materials were observed from 1.0m to 4.0m across the Site. These included imported clay, sand and gravel fills, refractory brick, concrete, bitumen, automotive material, steel, packing coke, general rubbish and house building materials including; timber, ACM and house bricks. The fill materials were removed until a natural clay base was reached throughout the Site.

All materials with inclusions were removed from the Site to the Stockpile Staging Area in accordance with the *RAWP* Remediation Methodology. The excavated material was then screened to 75mm minus. Fines from areas identified to contain no Contaminants of Concern were then transported to the southwest area of site to facilitate room for materials in the Stockpile Staging Area.

As a result of the remedial works, any aesthetic impact has been negated and no further management should be required.

Photographic Documentation
Validation of the Site was based on visual assessment and documentation (photographic) of remaining soils for absence of fill materials. A survey of the Site based on a 30m x 30 m was utilised to facilitate compilation of evidence for 'whole of site' remediation. The survey map was produced by Rennie Golledge Pty Ltd in January 2015 with the UTM coordinates of each grid line highlighted.

Following the removal of foreign materials photographic documentation was compiled of each of the eight primary areas excavated throughout works. Each grid square on the Site Survey Map geotagged in the approximate centre with the coordinates highlighted in the Validation Photo gallery. A total of eight photos were used of each grid square to highlight the removal of all foreign fill materials. The precession of the photographic documentation within the gallery commenced from the north-west corner of the grid square continuing in a clockwise direction and was completed on the western side of the square.

Sample Analysis
Eight areas containing Potential Contaminants of Concern (PCoC's) required soil sampling during works. The sampling was undertaken to either validate excavations that required backfilling or delineate contaminated material into individual stockpiles. These materials were removed from the Site and remain in the stockpile staging area at Hydro Aluminium Kurri Kurri for use in the 'whole of site' remediation strategy.

Ecological Assessment

Following a walkover of the areas surrounding the Site a small series of stockpiles was found southwest of the surveyed area surrounded by vegetation. Following visual investigation inclusions in these stockpiles were concrete and bitumen within gravel fill and approximately 500m^3 volume.

This area was identified within the *Hydro Remediation and Demolition Project – Ecological Assessment* conducted by Eco-Logical Australia in April 2015 as containing several threatened species and an Endangered Ecological Community (EEC). These included *Eucalyptus parramattensis subsp. decadens* and *Grevillea parviflora subsp. Parviflora* and the Lower Hunter Spotted Gum – Ironbark Forest EEC. DLA investigated the possibility of removing the material without disturbing any potential threatened species by conducting floral identification of the species of concern within the area. Two *Eucalyptus parramattensis subsp. decadens,* two Ironbark and one spotted gum were positively identified. Approximately 15 juvenile *Grevillea parviflora* were positively identified, however due to their size it was not possible to identify if they were *Grevillea parviflora subsp. Parviflora* without extensive investigation.

The identified species were flagged in order to determine if access to the area with an excavator or smaller plant machine was possible. Although all options were explored it was deemed impossible to excavate the material with inclusions without disturbing the threatened species or EEC. As the material is a small volume relative to the entire amount excavated throughout works (<1%) and offers minimal visual impact due to its secluded nature the decision was made to allow it to remain in situ.

Groundwater / Water Quality Assessment

No groundwater was encountered during works. Perched water was encountered in the Main CBP excavation, the UFA and the North of CBP area. The perched water was generally found below the clay capping layer encountered throughout the Site from approximately 0.5m-1.0m below ground level (bgl). A dewatering system was set up to remove water from the CBP to the Western Surge Pond, utilised to satisfy 'whole of site' water management.

Conclusion

The sampling regime and subsequent assessment and reporting of the Site are considered to be adequate for validation purposes to determine the future land use suitability of the Subject Site in accordance with Cessnock City Council, relevant Development Consent Conditions and the general requirements of State Environmental Planning Policy No.55 (SEPP 55). All reporting has been undertaken in accordance with the *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 2011) and the *Guidelines for the NSW Site Auditor Scheme* (NSW EPA, 2nd ed., 2006). No significant issues were encountered during the remediation works.

Following remediation works, no visual evidence could be found to infer chemical contamination by Fluoride and Cyanide, PAH, Heavy Metals or asbestos at the Site, which were previously identified as the contaminants of concern in the RAWP (ENVIRON, 2014). Other aesthetic concerns at the Site including inclusions of brick, concrete and bitumen were also successfully managed as part of the remediation programme. Other materials encountered throughout works that were potentially contaminated have been delineated from all inert material and remain on the Hydro Aluminium Kurri Kurri property.

The completion of this report concludes that the remediation objectives of the RAWP (Environ, 2014) have been achieved through the implementation of the selected remediation strategy. On the basis of this information and with the implementation of an EMP, the Site is considered suitable for an end land use consistent with NEPM (NEPC, 2013) Table 1(A)1 *Commercial/Industrial D –sites.*

Site assessment objectives have therefore been achieved in accordance with NSW EPA recommended guidelines. All chemical and asbestos validation samples collected from the Site are compliant with the NEPM 2013 *Commercial/Industrial D* and indicate that the Site is suitable for the intended land use of Commercial/Industrial.

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APPENDICES

1.0 INTRODUCTION

1.1 General

DLA Environmental Services (DLA) was commissioned by Hydro Aluminium Kurri Kurri Pty Ltd (Principal) to conduct a Validation assessment for the property identified as:

Clay Borrow Pit Area (CBP), Hydro Kurri Kurri Aluminium Smelter, Hart Road, Loxford, NSW, 2326 (The Site)

The area of works are identified as part of Lot 319 DP755231 (CBP) and Lot 3 DP456769 the hard stand stockpile area within the smelter grounds.

The CBP area is located adjacent to the western boundary of the Hydro Kurri Kurri Aluminium Smelter Site and is located on the crest and eastern flank of a broad north east to west trending ridge, with slopes generally one to three degrees. The current Site layout consists of an undulating surface profile with a number of small stockpiles present. The area is covered with grass and vegetation with mature eucalypt and scrub vegetation occurring to the East and North.

Refer to **Figure 1** *Site Location*.

The purpose of this report us to verify that all contaminated soils, foreign materials and their residual soils have been removed from the CBP area of the site, by means of visual validation, and the Site is suitable for its proposed future land use Commercial/Industrial.

1.2 Objectives

The primary objective of the Validation Program was to ensure the Site remediation was completed in accordance with the ENVIRON *Remediation Action Work Plan* (*RAWP*, 2014) and therefore the site, was remediated to the extent that it will be suitable for the proposed Commercial/Industrial land use and shall pose no future unacceptable risk to human health or to the environment generally.

The project objectives of this Validation are to satisfy the stated OEH requirements in accordance with the NSW EPA *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 2011.* Specifically, this investigation will consider the potential for historical activities to have caused contamination at the Site and to demonstrate the suitability of the land for future land use consistent with *Commercial/Industrial D* in the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1) (NEPM 2013).

1.3 Scope of Works

To achieve this objective, DLA carried out the following works:

- Inspection of the site and surrounding land;
- Desktop study including a review of available current and historical information and previous investigation work;
- Visual assessment and documentation (photographic) of the walls and bases of excavation areas to confirm that the area is free of impacted materials;
- Conduct validation sampling of the base and surrounding area of visually impacted or odorous material encountered within excavation areas;
- Document in detail all procedures and plans implemented to reduce risks to acceptable levels for the proposed site use;
- Ensure all environmental safeguards were in place to complete the remediation in an environmentally acceptable manner;
- Identify and obtain all necessary approvals and licenses required by regulatory authorities;
- Provide where necessary any recommendations to manage identified risks posed by soil, water or vapour conditions to allow the Site to be suitable for the intended use; and,
- Ensure the accurate and detailed reporting of the Remediation Validation in accordance with the *Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 2011) and the *Guidelines for the NSW Site Auditor Scheme* (NSW EPA, 2nd ed., 2006).

The foreign fill materials were identified and removed from eight primary areas of The Site. The RAWP completed by Environ Australia Pty Ltd (Environ, 2014) outlined four of these, known as concrete/asphalt on surface (South of CBP), Bricks on surface with some light cover (West of CBP), brick in Pit covered with fill (main CBP Excavation) and brick/concrete/fill (North of CBP). There were a further four areas uncovered throughout excavation of the Site, known as Unexpected Finds Area (UFA), Unexpected Finds Area two (UFA2), the Bench Area and East of CBP.

Refer to **Figure 2**, *CBP Areas Map.*

Two additional areas were identified in the *RAWP* (ENVIRON, 2014) as containing exceedances of the absolute maximum concentrations from the 2012 EPA Draft *Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption* for cadmium and fluoride due to the bulk refractory brick inclusions in these areas. The identified hotspots were specifically targeted for test pitting due to concentrations of cadmium and fluoride in the bulk refractory brick in these areas. These two areas were initially identified in the 2012 EPA Draft *Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption*. Following this application NSW EPA requested a detailed characterisation of the refractory bricks as per the *Sampling, Analysis and Quality Plan, Refractory Brick Characterisation* (ENVIRON, 2012). The characterisation sampling was conducted in August 2014, which identified RB18, in the north-east area of the Main CBP excavation and RB14 in the south-west area of the Main CBP excavation. These areas have been identified as Hotspot 1 (HS1) and Hotspot 2 (HS2) respectively.

Excavation of these areas occurred within the first stage of the Main CBP works with all material stockpiled separately following excavation. Brick oversized material from these locations are currently in SP18 and fines material is currently in SP37. Test pits were conducted to ascertain bulk brick areas, in one test pit a hydrocarbon odour was noted and sampled. Both samples returned no detections above the limit of reporting.

Refer to **Figure 3**, *Hotspot Areas* and **Figure 4**, *ENVIRON Brick Sampling Locations* (2014).

During works, a further seven areas were identified as unexpected finds containing contaminants of concern. These were identified by visual inspection during works indicating the presence of one, or several, contaminants of concern. These areas were identified as Well 1, Well 2, CBP asbestos find, South of CBP mineral fibres, Automotive Find, UFA Packing Coke Find and the Bench Packing Coke Pits. Validation sampling was required in Well 1, Well 2, South of CBP mineral fibres, Automotive Find and UFA Packing Coke Find.

Refer to **Figure 3**, *Hotspot Areas.*

One additional area known as Unexpected Finds Area 3 (UFA3) located within The Site was identified to contain inclusions of foreign fill materials which remain in situ. This is due to the sensitive nature of the ecological communities surrounding the foreign material. *Eucalyptus parramatensis subsp. decadens and Grevillea parviflora subsp. parviflora* are threatened species identified in the area. In addition, the area is located within a Lower Hunter Spotted Gum – Ironbark Forest Endangered Ecological Communities (EEC's). Two mature *Eucalyptus parramatensis subsp. decadens* and several Juvenile *Grevillea parviflora* were identified and flagged by DLA, along with two ironbark species, with photographic evidence provided for validation purposes.

Following species identification, it was determined that the removal of the foreign fill material was not possible without disturbing both the threatened species and the EEC's. As the inclusions in the fill material were determined to be predominantly concrete and bitumen surrounded by vegetation, posing minimal environmental or visual amenity disturbance, all foreign material was allowed to remain in situ.

Refer to **Appendix A** *Hydro Remediation and Demolition Project- Ecological Assessment* and **Appendix B** *Hydro Aluminium CBP Validation Photo Gallery*.

2.0 SITE DESCRIPTION

2.1 Site Identification

The Site identification details are summarised in **Table 2a** below:

Table 2a – Site Identification Summary

ITEMS	DETAILS
Site Name	Clay Borrow Pit Area
Address	Hart Road, Loxford, New South Wales, Australia, 2326
Local Government Authority	Cessnock City Council
Lot and Deposited Plan	Part of Lot 319 DP 755231
Development Controls	CCC LEP 2011
Site Zoning	RU2 – Rural Landscape
Current Use (NEPM 2013 Table 1A(1)	Commercial/Industrial
Proposed Use (NEPM 2013 Table 1A(1)	Commercial/Industrial
Site Area (approx.)	Approximately 6 ha. Lot 319 comprises 52.1 ha.
Locality Map	Refer to **Figure 1** – *Site Location*
Site Survey	Refer to **Figure 6** – *Site Survey Map*

2.2 Boundaries and Surrounding Land Use

The boundary and surrounding landscape features of the Site are summarised in **Table 2b** below:

Table 2b – Boundaries and Surrounding Land Use

DIRECTION	DETAILS
North	Vegetated land owned by Hydro
East	Western side of Smelter site
South	Bushland area with an Ausgrid easement and the Hunter Expressway further south
West	Vegetated land owned by Hydro and the former Bishops Bridge road

Neighbouring premises are considered unlikely to pose a significant pollution risk to the Site.

2.3 Site Geology and Soils

The natural existing subsurface conditions present adjacent to the Clay Borrow Pit are relatively uniform and consist of:

Topsoil - Silty sand, fine to medium grained to depth ranging 0.1m to 0.15, overlying;
Colluvium - Clay, high plasticity, consistency ranges soft to stiff, discontinuous, undulant fissures to depth ranging 0.55m to 1.1m, overlying;
Residual Soil - Clay, sandy clay and sandy gravelly clay, high plasticity, fine to medium sand, medium to coarse gravel and cobble sized sandstone rock fragments, hard consistency to depth ranging 1.25m to 3.70m, overlying;
Sandstone - Highly to extremely weathered sandstone.

2.4 Site Topography

The CBP is located adjacent to the western boundary of the Hydro Kurri Kurri Aluminium Smelter Site and is located on the crest and eastern flank of a broad north east to west trending ridge, with slopes generally one to three degrees, at approximately 25m AHD. The current Site layout consists of an undulating surface profile with a number of stockpiles present. The area is covered with grass and vegetation with mature eucalypt and scrub vegetation occurring to the East and North. The land largely slopes towards the south-east towards Black Waterholes Creek, which conveys surface water towards Wentworth Swamp located to the north.

2.5 Acid Sulphate Soils

Review of the Australian Soil Research Information System, National Acid Sulfate Soils Occurrence Risk Map (CSIRO Land and Water, 2009), indicated that there are no known occurrences of acid sulfate soils in the area. No visual indications of acid sulfate soils were observed.

2.6 Hydrology and Hydrogeology

The hydrology and hydrogeology of the Site are provided in **Table 2c** below:

Table 2c – Site Hydrology and Hydrogeology

FEATURE	DETAILS
Hydrology	Discharge of surface water from the CBP is via the southeast corner of the main CBP excavation prior to entering an unnamed creek northwest of the smelter via natural drainage lines. The north western portion of the site drains toward the northern tributary of Black Waterholes Creek which flows into the Wentworth Swamp wetlands system, approximately 2.5km to the north-east (ENVIRON, 2014). 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) (ENVIRON, 2014).

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 the CBP Area is expected to generally flow south-east and east to the adjacent Black Waterholes Creek and more distant Wentworth Swamp (ENVIRON, 2014). According to the NSW Office of Environment and Heritage (Natural Resource Atlas), there are 31 licensed groundwater abstractions (bores) located approximately 9km north east of the CBP. The groundwater bores are located within the coal measures or Quaternary Alluvium associated with Wentworth Swamp and other associated surface water bodies. Information for seven bores located in a 5km radius from the CBP indicated the bores are used for domestic, recreation, monitoring, irrigation and stock watering purposes (ENVIRON, 2014). 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.gov.au/ieo./Hunter/index.htm).

2.7 Site Meteorology

The Bureau of Meteorology NSW gives the average annual rainfall for the Cessnock Airport area at 720.5mm, with an annual daytime temperature range of 10.4° to 24.1°C, and an annual average temperature of 17.2°C.

2.8 Site History Summary

Key aspects of the Site history summary include:

- The land was used as a hobby farm until approximately 1967;
- Unused from then until the early 1990's when a proposal to cap a waste stockpile located on the smelter site was approved;
- This clay capping was won from the area now known as the Clay Borrow Pit;
- In 1995 borrowed clay material to a maximum depth of 1.5m was excavated and transported from this area to the Smelter's site Cathode waste stockpile for remediation works.
- Anecdotal evidence indicates the North of CBP area was shaped into a series of ponds following the removal of clay material.
- The vegetation and topsoil was stripped prior to excavation and remains in the Clay Borrow Pit Area.
- The clay borrow pit was then progressively backfilled with refractory bricks including, other fill material, other smelter material and capped with clay material.
- This process was done repetitively, with materials placed followed by clay capping layers.
- Prior to the Smelter closure materials were relocated to this area and placed in stockpiles of refractory bricks, concrete and bitumen. .

3.0 SUMMARY OF PREVIOUS INVESTIGATIONS

3.1 Phase 2 ESA, Clay Borrow Pit Area Kurri Kurri NSW (ENVIRON Australia Pty Ltd)

A site assessment was conducted by Environ Australia Pty Ltd in April 2012 in order to determine the potential for soil and groundwater contamination in the CBP area. A site inspection, excavation of five test pits, drilling of six boreholes and the installation of four groundwater monitoring wells were completed. This indicated that several materials were placed in the remaining void, and stockpiled on the surface, following the winning of clay material for use in the cathode stockpile during the 1995 works. These included bake furnace refractory brick, concrete and bitumen (assumed to be from internal roads at the smelter) and metal. The buried materials encountered were mixed with soils. During the Phase two investigation no asbestos containing materials were identified.

The excavation of five test pits and sampling of four groundwater monitoring wells aided in determining the nature and extent of fill materials in the CBP area and any impacts to surrounding soils or groundwater. The depth of fill material encountered extended to 4.2m at its greatest depth in the eastern extent of the CBP. Two of the five test pits excavated (TP1 and TP2) positively identified inclusions of refractory brick and concrete. TP3, TP4 and TP5 did not identify inclusions of any refractory brick, concrete or bitumen. TP1, TP2 and TP3 were terminated at depths of 1.8m, 1.2m and 2.0m due to water ingress. Two of the monitoring wells installed (MW03a and MW05) identified inclusions of brick in the fill material. All excavations that identified brick inclusions indicated the fill was covered with approximately 1m of clay or sand fill. All fill material was underlain by grey/red clay to depths of up to 10.0m, which was then underlain by weathered siltstone.

Soil samples were analysed for hydrocarbons, a range of semi-volatile hydrocarbon including polycyclic aromatic hydrocarbons, 8 heavy metals, total fluoride, pesticide and chlorinated hydrocarbons. All soil matrix samples were either below detectable limits or below guideline concentrations.

Groundwater samples were also analysed for all analytes listed above with cyanide as an addition. Elevated concentrations of fluoride (15,000µg/L) were returned in MW05, which is located in part of the in-filled area of the CBP. This concentration is considered elevated when compared to the background concentration found in MW06 (1,000µg/L).

Groundwater wells surrounding the Clay Borrow Pit (MW03 and MW04) identified concentrations of aluminium (maximum 2530µg/L), fluoride (maximum 5500µg/L), cadmium (maximum 3.1µg/L), nickel (maximum 938µg/L) and zinc (1840µg/L) exceeding the criteria and above concentrations found in MW05. Wells MW03 and MW04 are situated in residual soils and up gradient of the CBP. A second round of sampling was completed in August 2012, which confirmed the results of the initial sampling. The concentrations of the analytes detected are above levels considered to be natural occurring however, given the up gradient location of the wells the elevated metals concentrations are not considered to be associated with activities at the site or from the placement of fill in the CBP. It is noted that the surrounding land consists of virgin bushland of the buffer zone and there are no identified industrial facilities up gradient of the CBP that could provide a source for the elevated metals concentrations.

Remediation of the CBP is required to removal aesthetic impact from the presence of these materials and to mitigate possible impacts to groundwater.

Refer to **Appendix C** *Remediation Action Works Plan (RAWP)*.

3.2 Application for Exemption – Refractory Brick, Hydro Aluminium Pty Ltd (ENVIRON Pty Ltd, August 2012)

Hydro Aluminium Kurri Kurri Pty Limited sought a resource recovery exemption for the re-use of refractory brick as a road construction material. The application process was completed by the ENVIRON Pty Ltd in August 2012.

As part of the application process, 20 samples of brick were collected for chemical analysis of PAH, heavy metals and other chemical of concern including Fluoride and Cyanide. Results indicated low concentrations of all contaminants analysed. No soil samples were collected as part of the application process.

A draft version of 'The Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012' was issued by the NSW EPA in October 2012. This publication details the chemical concentration and sampling density requirements of the exemption related to the reuse of bricks. Final approval of the exemption is currently being sought and will be available prior to remedial works commencing.

Refer to **Appendix C** *RAWP.*

3.3 The Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption, (ENVIRON Pty Ltd, 2012).

The Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012 was granted by NSW EPA in October 2012. In a letter dated 21st December 2012, NSW EPA requested a detailed characterisation of the refractory bricks be completed as per ENVIRON (December 2012) Sampling, Analysis and Quality Plan (SAQP). This detailed characterisation sampling was undertaken in August 2014.

The detailed characterisation sampling was completed as per the sampling locations outlined in Figure 1 of the SAQP on an approximate 20m grid (see **Figure 4** in *RAWP* (ENVIRON, 2014). Brick samples were collected from both stockpiled and buried material. Twelve brick samples were collected from 25 test pits and 24 brick samples were collected from above-ground stockpiles. Each sample comprised five brick chips that were crushed and composited to form one sample. As per the SAQP, each sample was analysed for Heavy Metals, fluoride (total), cyanide (total) and 20% of the samples were analysed for PAHs.

The analytical results were compared against Table 2 of the Draft 'The Hydro Aluminium Kurri Kurri base ovens refractory brick exemption 2012', with average concentrations compared against Column 2 and maximum concentrations compared against Column 4, as outlined in **Table 3a**.

Table 3a: Summary Chemical Characteristics of Refractory Brick (2014)

	ANALYTE	No. of Samples	Average	Maximum Average[1]	Maximum	Absolute Maximum[2]
		Summary statistics (mg/kg)				
Metals	Arsenic	36	2	15	2	30
Metals	Cadmium	36	0.2	0.5	**2**	1
Metals	Chromium	36	2.7	40	20	80
Metals	Copper	36	2.1	40	9	80
Metals	Nickel	36	2	25	8	50
Metals	Lead	36	1.1	50	10	100
Metals	Zinc	36	2	150	25	300
Metals	Mercury	36	0.05	0.5	0.05	1
Non Metallic Inorganics	Total Fluoride	36	86.8	300	**730**	600
Non Metallic Inorganics	Total Cyanide	36	0	-	0	1
PAH	Benzo(a)pyrene	7	<0.05	-	0.39	1
PAH	Sum of reported PAH	7	<0.0.5	-	4	40

1 Maximum Average Concentration for Characterisation, from Column 2 of Table 2 from the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012

2 Absolute Maximum Concentration, from Column 4 of Table 2 from the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012

As shown in **Table 3a**, the absolute maximum concentration of cadmium and fluoride were exceeded. The cadmium concentration in one sample, RB18, was 2mg/kg exceeding the absolute maximum concentration of 1mg/kg. The total fluoride concentration in one sample, RB14, was 730mg/kg exceeding the absolute maximum concentration of 600mg/kg. Both RB14 and RB18 are samples of buried bricks.

No bricks were found within 13 of the 25 test pits excavated into the eastern portion of the Clay Borrow Pit. Where no bricks were found, the test pits generally comprised brown/red gravel sand/clay fill material.

It is noted that the laboratory results from the characterisation sampling are below the HILs for commercial/ industrial land use and below the EILs and no asbestos containing materials were identified during this investigation.

3.4 *Remediation Action Work Plan (RAWP)* (ENVIRON Australia Pty Ltd, 23 December 2014, AS130386)

Environ Australia Ltd (ENVIRON) was commissioned by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to prepare a Remediation Action Work Plan (RAWP) for the implementation of remedial works at the site known as the Clay Borrow Pit (CBP), Hart Road, Loxford, New South Wales, 2320.

The CBP is owned by Hydro and is situated within the Hydro Aluminium Smelter Buffer Zone, which is a large land area owned and managed by Hydro as part of the smelter operations. Smelter closure was announced in May 2014 and Hydro is now preparing land for future divestment and redevelopment. The CBP is proposed for commercial/industrial land use and remediation of the land for this purpose is required. The objective of this *RAWP* is to describe the works necessary to render the site suitable for the future land use. The CBP is zoned Rural Landscape (RU2) under the Cessnock Local Environment Plan 2011 and has been used for rural land use and materials storage during and prior to the smelter operations.

Historical records indicate the site was the source of clay materials for capping of the Capped Waste Stockpile located on the eastern side of the Smelter site and undertaken in the 1990's. Since that time, reinstatement of the excavated area using inert materials from the Smelter site, including concrete, refractory brick and bitumen has been undertaken. An evaluation of soil and surface water identified that impacts to surface water from the filled areas has not occurred. No impacts to soil within the fill were identified. The presence of fill was recognised to represent an impact on visual amenity and safety risk to the proposed future use of the property.

A review of remediation options was undertaken and also included a review of remedial options applicable to all Hydro owned lands (a whole-of-site strategy). Remediation options were considered in terms of cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability. The preferred strategy was excavation of the filled materials to remove all contaminant management requirements from The CBP and reshaping of the resultant land surface. Excavated materials are proposed to be coarsely sorted and stockpiled in a designated area of the Smelter site. Materials relocated to the Smelter site will be stockpiled separately for later beneficial reuse where permissible, or incorporated within a whole-of-site remediation strategy.

The *RAWP* outlined the remedial plan to be implemented at the site to achieve the remediation objective. The *RAWP* included a detailed works methodology including validation requirements and environmental controls to be implemented during the works. At the completion of works a validation report will be compiled including a clear statement of the suitability of the site for the proposed future commercial/industrial use.

Refer to **Appendix C**, *RAWP*.

3.5 *Hydro Remediation and Demolition Project – Ecological Assessment* (Eco Logical Australia, April 2015)

In April 2015 Eco Logical Australia conducted an Ecological Assessment of all areas surrounding the Hydro Aluminium Kurri Kurri smelter site to identify any Threatened flora and Endangered Ecological Communities (EEC's) present surrounding the Site. Several Eucalyptus *Parramattensis subsp. Decadens, Grevillea parviflora subsp. parviflora and callistemon linearifolius* along with the Lower Hunter Spotted Gum – Ironbark Forest EEC were identified to be close to, but outside the CBP Site boundary.

3.6 Archaeological Find Email Correspondence.

In April 2015 AECOM conducted an Aboriginal Archaeological Site Survey within the CBP Site. The survey highlighted that almost all areas were found to be grossly disturbed. However, some limited areas of minimally-to-moderately disturbed terrain were also noted (mostly demarcated by extant vegetation). One Aboriginal archaeological site was identified during survey. This was an isolated stone artefact located on the eastern edge of the light vehicle track which approaches the CBP area from the NNW. The artefact was exposed during the installation of sediment fencing in the area. AECOM advised that the area was to be fenced off in order to avoid any inadvertent impacts. Based on this assessment, an Aboriginal Cultural Heritage Management Plan (ACHMP) was not deemed to be required for the project.

Refer to **Appendix D** *Archaeological Find Correspondence*.

3.7 Contamination Status

3.7.1 Soils and Perched Groundwater

The *Phase Two Environmental Site Assessment* (ENVIRON, 2012) of the Clay Borrow Pit addressed the potential for soil and groundwater contamination within the Site. Materials placed to reinstate the void following the winning of clay included concrete, bitumen/asphalt slabs (assumed to be from internal roads at the smelter) and bake furnace refractory brick. These materials were found to be both buried and stockpiled at the surface. Buried materials were mixed with soils. No asbestos containing materials were identified during the investigations.

Excavation of five test pits, the drilling of six boreholes and the installation of four groundwater monitoring wells to assess the extent and nature of the fill materials and any impacts to surrounding soils or groundwater was undertaken. Investigations found the depth of fill material to extend up to 4.2m with the greatest depth occurring at the eastern extent of the filled area. Fill materials comprised refractory bricks, broken concrete slabs, metal and rubble within a sandy clay matrix. Three of the five test pits were terminated at depths between 1.2m and 2.0m due to instability from water ingress. Refractory bricks were not identified within test pits TP3, TP4 and TP5. In some areas of the Clay Borrow Pit, refractory bricks were identified beneath approximately 1m of overlying sand and clay fill (e.g. test pit TP1 and borehole MW05). Fill materials were underlain by red/grey residual clay to depths of approximately 8m to 10m, underlain by extremely weathered siltstone.

Soil samples were analysed for hydrocarbons, heavy metals, total fluoride, and a range of semi-volatile hydrocarbon including PAHs, pesticide, and chlorinated hydrocarbons. Soil matrix samples detected potential contaminants of concern either below detectable limits or below guideline concentrations.

Groundwater samples were also analysed for hydrocarbons, heavy metals, fluoride, cyanide, and a range of semi-volatile hydrocarbon including PAHs, pesticide, and chlorinated hydrocarbons. Evaluation of groundwater quality from within the in-filled borrow pit (MW05) found elevated concentrations of fluoride (15,000µg/L). The fluoride concentration, compared to a background concentration of 1000µg/L in MW06, is considered to be elevated. Groundwater wells surrounding the Clay Borrow Pit (MW03 and MW04) identified concentrations of aluminium (maximum 2530µg/L), fluoride (maximum 5500µg/L), cadmium (maximum 3.1µg/L), nickel (maximum 938µg/L) and zinc (1840µg/L) exceeding the criteria and above concentrations found in MW05. Wells MW03 and MW04 are situated in residual soils and up gradient of the Borrow Pit.

A second round of sampling was completed in August 2012, which confirmed the results of the initial sampling. The concentrations of the analytes detected are above levels considered to be natural occurring however, given the up gradient location of the wells the elevated metals concentrations are not considered to be associated with activities at the site or from the placement of fill in the CBP.

It is noted that the surrounding land consists of virgin bushland of the buffer zone and there are no identified industrial facilities up gradient of the CBP that could provide a source for the elevated metals concentrations. Remediation of the clay borrow pit is required to removal aesthetic impact from the presence of these materials and to mitigate possible impacts to groundwater. One exceedance of the site guidelines for groundwater was encountered during the Phase Two Investigation in MW5, which may be attributed to the fill materials as the groundwater samples was from a perched water table surrounded by refractory brick.

Refer to **Appendix C,** *RAWP*.

3.7.2 Asbestos

No Asbestos Containing Material (ACM) was identified during any of the previous investigations within the Site. As there has been an indication of the disposal of building waste on the Site, encountering ACM during excavation cannot be ruled out.

3.7.3 Fluoride and Cadmium

The EPA draft *Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption* was granted by NSW EPA in October 2012. In a letter dated 21 December 2012, NSW EPA requested a detailed characterisation of the refractory bricks be completed as per the *Sampling, Analysis and Quality Plan* (SAQP) (ENVIRON, 2012).

Brick samples were collected from both stockpiled and buried material. Twelve brick samples were collected from 25 test pits and 24 brick samples were collected from above-ground stockpiles. Each sample comprised five brick chips that were crushed and composited to form one sample. As per the SAQP, each sample was analysed for Heavy Metals, fluoride (total), cyanide (total) and 20% of the samples were analysed for PAHs. The cadmium concentration in one sample, RB18, was 2mg/kg exceeding the absolute maximum concentration of 1mg/kg. The total fluoride concentration in one sample, RB14, was 730mg/kg exceeding the absolute maximum concentration of 600mg/kg. Both RB14 and RB18 are samples of buried bricks. No bricks were found within 13 of the 25 test pits excavated into the eastern portion of the CBP. Where no bricks were found, the test pits generally comprised brown/ red gravelly sandy clay fill material.

Refer to **Appendix C,** *RAWP*.

4.0 CONCEPTUAL SITE MODEL

4.1 Potential Contaminants

On the basis of the information summarised above, the principal potential contamination sources are associated with fill materials. Potential Contaminants of Concern (PCOC) therefore include Fluoride and Cyanide, Polycyclic Aromatic Hydrocarbons (PAH), Heavy Metals and Asbestos (from disposal of building material) within fill materials. It must also be noted that a broad suite of PCOC are possible due to historical filling practices used to form landscape mounds and establish Site levels.

Although a possibility exists for the historical application of pesticides across the premises due to weed eradication programs, previous environmental assessments have not revealed any evidence of impact from these compounds.

4.2 Release and Transport Mechanisms

Contaminants generally migrate from a site via a combination of windblown dusts, rainwater infiltration, groundwater migration and surface water runoff. The potential for contaminants to migrate is a combination of:

- The nature of the contaminants (solid/liquid and mobility characteristics);
- The extent of the contaminants (isolated or widespread);
- The location of the contaminants (surface soils or at depth); and,
- The site topography, geology, hydrology and hydrogeology.

As a significant proportion of the Site is exposed clay, the potential for windblown dust migration of contamination from the Site was considered to be high. The potential for migration of contamination via surface water movement and infiltration of water and subsequent migration through the soil profile was considered generally to be low given the reported permeability of the expected soils in the Neath landscape group. Due to the low permeability of the underlying soils, migration of contamination via groundwater movement was also considered to be moderate.

4.3 Exposure Pathways

Based on the identified COPCs, the exposure pathways for the Site's use include:

- Inhalation of COPC vapours migrating upwards from fill material of unknown origins or impacted surface soils resulting from potential historical activities; and/or,
- Potential dermal and oral contact to impacted soils in unpaved areas; and,
- Potential contaminant uptake by vegetation within landscaped areas.

4.4 Sensitive Receptors

The potential sensitive receptors of environmental impacts present at the Site include:

- Present and future workers and users of the Site who may potentially be exposed to COPCs through direct contact with impacted soils and/or inhalation of dusts/vapours associated with impacted soils;
- People who use the surrounding areas for recreational purposes;
- Maintenance workers conducting activities at the Site, who may potentially be exposed to COPCs through direct contact with impacted soils present in excavations/boreholes and/or inhalation of dusts associated with impacted soils;
- Flora and fauna species established at the Site; and,
- The freshwater ecosystem of Unnamed Creek and Black Waterholes Creek, located hydro-geologically down gradient of the Site.

5.0 REMEDIATION SCOPE OF WORKS

5.1 Sequence of Activities

The following sequence of activities involves a summary of works to facilitate the removal of inclusions in areas identified within the Environ *RAWP* (2014) and the remediation of additional areas containing inclusions identified during works.

Refer to **Figure 2,** *CBP Areas Map*.

The Site was remediated with the implementation of works in the following nine (9) areas:

5.1.1 Main CBP Excavation

The Main CBP excavation was undertaken in four stages. Works commenced 24th February 2015 to excavate the material from the two hotspots identified in the Environ RAWP. Hotspot one (HS1), identified as RB18 and Hotspot two (HS2), identified as RB14 in the Environ *Refractory Brick Characterisation Sampling* (August, 2014), contained bulk refractory brick material. Both hotspots encountered a high volume of perched water during excavation, which was removed from the area via pump-out truck. A trench was excavated in HS1 on 25th February 2015 to drain water to a sump. The bulk of brick material was removed to stockpile on 18th March 2015 and the area was completed on 19th March 2015. A sump was excavated on 9th March 2015 to dewater HS2. As the sump was unable to facilitate drainage of all water from the area the sump was opened up on 16th March 2015 to facilitate the completion of the removal of refractory brick. The bulk of material was removed by 26th March 2015 and the area was completed on 30th March 2015.

Three test pits were excavated on 5th March 2015, surrounding HS1 to determine the extent and depth of refractory brick inclusions. Test Pit 3 (TP3) was observed to contain a hydrocarbon odour and mottled green material. Two soil samples were analysed for TRH and BTEX fractions and returned no detections above LOR for all analytes.

Refer to **Figure 3,** *Hotspot areas*, **Appendix E,** *Nata Certified Analytical Results* and **Appendix C,** *RAWP.*

Stage two involved the removal of material from the remainder of the main pit area. This area extended from the hotspots and commenced on 23rd March 2015 whilst the remainder of perched water was removed from HS2.

Stage three involved the removal of material in the south and east of the main CBP excavation, which commenced on 13th April 2015. This continued from the trench excavated to dewater HS1, extending west. At this time material was being removed north of HS2.

One additional area was identified to contain a Potential Contaminant of Concern (PCoC). During works to excavate material several sheets of broken asbestos were encountered. As these materials were isolated it was deemed appropriate to visually validate their removal from the excavation. All monitoring and analysis was conducted in accordance with the Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC:3003(2005)]. Asbestos air monitoring was conducted on 15th April 2015 at both the excavation face and in the unload area within the stockpile staging area. No detections of asbestos in air were found during this monitoring event.

Following the completion of North of CBP the remaining area containing inclusions recommenced on 15th July 2015. Stage four involved the removal of a wedge of material within the excavation and a 1.0m seam of material with brick and concrete inclusions extending to the haul road. This area was completed on 22nd July 2015.

5.1.2 South of CBP

South of CBP was excavated in two stages. Works commenced on 24th of February to remove the concrete and asphalt on the surface identified in the Environ *RAWP* (2014) with works continuing for approximately 3 weeks to remove all oversized material. As part of the sediment and erosion control protocol of the Site drainage, was installed in the western extent on 3rd March 2015 to facilitate free flowing storm water into the South of CBP pond. During the excavation of this drain synthetic mineral insulation fibres were uncovered in a shallow pit. Asbestos sampling was undertaken on the fibres, which returned no detections of asbestos. The material containing the fibres was stockpiled separately in the Residential Parcel Asbestos Stockpile south of the Stockpiling Staging Area on Hydro Aluminium Kurri Kurri owned land.

As the oversized concrete was removed a brick circle structure was uncovered. This was determined to be a small 1.0m diameter well from the homestead on the Site. Investigation as to the extent of inclusions below uncovered one backfilled well. This well was identified as Well 2 for validation purposes. The well was excavated to natural clays on edges and base. The well contained building material, which included Asbestos Containing Material (ACM). Excavation of the ACM was monitored by conducting asbestos air monitoring during works and asbestos in soils validation by sampling the walls and base. All two samples returned no detections for asbestos.
Refer to **Figure 3** *Hotspot areas* and **Appendix E** *Nata Certified Analytical Results*.

Following the removal of oversized material, the area was utilised to stockpile material with minor brick inclusions from North of CBP area. Stockpile 20 (SP20) remained in this area until screening commenced on 1st September 2015. On 27th and 28th August a 0.5m depth band of gravel material with brick inclusions was removed from south of SP20 to allow the fines to be stockpiled in that position post screening. Oversized material from this stockpile was removed from the Site and stockpiled in the stockpile Staging area in SP43.

Following the screening of SP20 the remaining surface material was scraped back to a natural clay base to facilitate validation. One remaining layer of material in the eastern area of south of CBP was excavated over a two day period on 23rd and 24th September 2015. The west portion of the haul road was excavated on the 23rd September 2015 with the remaining haul road test pitted in order to determine the presence of any inclusions. A total of 16 test pits were excavated along the haul road with no returning any visual identification of inclusions or PCoC's. The material present was approximately 200mm of gravel material with underlying natural clay. The haul road remains in situ.

Refer to **Appendix B** *Hydro Aluminium CBP Validation Photo Gallery*.

5.1.3 West of CBP

Excavation of the West of CBP area was undertaken in two stages. Works commenced in this area on 24th February 2015 to remove a 1.5m height stockpile containing brick material as identified in the *RAWP*. As the stockpile was removed the surface layer was scraped back which uncovered one brick circle structure, a former well from the homestead on the Site. Investigation as to the extent of inclusions below uncovered one backfilled well. This well was identified as Well 1 for validation purposes. The well was excavated to natural clays on edges and base. The well contained building material, which included Asbestos Containing Material (ACM). Excavation of the ACM was monitored by conducting asbestos air monitoring during works and asbestos in soils validation by sampling the walls and base. All eight samples returned no detections for asbestos except for one fragment sample which was positively identified as asbestos. Following the removal of material with inclusions from the southern sector of West of CBP and validation on 30th March 2015 the area was utilised to stockpile fines material for the duration of works, which will later be utilised in the 'whole of site' remediation strategy.

Refer to **Figure 3** *Hotspot areas* and **Appendix E** Nata Certified Analytical Results.

Stage two of works consisted of the removal of a seam of material with brick and bitumen inclusions approximately 1.0m depth between SP15 and the UFA. This process commenced on the 18th May 2015 and continued for approximately one week. On Wednesday morning 20th May 2015 works to clean up the area south of the west dam occurred. A section of imported fill was found surrounded by natural clay material, following investigation it was found that there was automotive material buried at depth. All material was removed and transported to the Stockpile Staging area, retained as a separate stockpile (SP24) and remains in situ.

The water (slurry) in the excavation had a visible sheen and hydrocarbon odour. The intended removal of the slurry via the water cart to facilitate transport to the onsite oil separator was unable to be completed. This was due to the heavy consistency of the slurry. An alternative measure was put in place to mix the slurry with gravel fill and brick material to facilitate excavation of the pit. It was then transported and stockpiled next to the automotive material to facilitate the 'whole of site' remediation strategy.

Once all of the foreign material was removed, the area was scraped back and visual validation occurred. Validation samples of all four walls and the base of the pit were then taken in order to validate the removal of the removal of automotive waste and associated contaminants.

The excavation was then backfilled using clean red clay and light brown sandy material previously removed from Area 5, which contained no inclusions. Backfilling was undertaken immediately due to the impending rain event to prevent ponding of water in the excavation.

Refer to **Figure 3** *Hotspot areas,* ***Figure 6*** *Final Stockpile Locations,* **Appendix E** *Nata Certified Analytical Results* and **Appendix G** *Unexpected Finds and Hotspot Photo Gallery.*

5.1.4 Unexpected Finds Area (UFA)

This area was initially identified in the Environ RAWP as Mounds of dirt and gravel no refractory. Following the removal of a series of small surface stockpiles on 18th March 2015, the area was further investigated to determine if there was any inclusions present in the fill material below. Following the identification of brick and concrete material in the excavation face it was decided that test pitting of the area was required. A total of 25 test pits were excavated on 27th and 30th March 2015, which positively identified 5 areas containing fill with inclusions of refractory brick, bitumen and concrete.

Refer to **Figure 7** *Unexpected Finds Area Volumes Map.*

The following summary highlights the size of each area and their estimated inclusions:

- ***Area 1** (surrounding TP223)*
  This area contains a volume of refractory brick at an estimated area of 900m^2 with inclusions between 1 and 1.5m depth.
- ***Area 2** (surrounding TP206)*
  This area contains a volume of concrete and bitumen pieces at an estimated area of 720m^2. The concrete and bitumen pieces are found to 1.8m in depth and for the purposes of estimation averaged at 1.4m depth.
- ***Area 3** (Within approximately half of TP207, TP208 and TP209)*
  This area contains a volume of bulk refractory brick at an estimated area between TP207 and TP209 with a total area of 600m^2. The refractory brick is found between 1.0 and 3.0m in depth and for the purposes of estimation averaged at 1.4m in TP207 and TP209 and 3.0m in TP208.
- ***Area 4** (Surrounding TP217)*
  This area contains a volume of large concrete and bitumen pieces at an estimated area of 300m^2. The concrete is found in pieces to 700mm thick under 400mm of cover to a total average depth of 1.1m.
- ***Area 5** (Throughout approximately half of TP206-210 and TP220-TP221, a small portion of TP202, TP203 and TP205 and all of TP211-TP214)*
  This area contains a volume of red and brown fill material at an estimated area of 2450m^3. The fill is found between 0.5m and 2.0m depth and for the purposes of estimation averaged at 1.5m depth.

Refer to **Figure 7** *Unexpected Finds Area's Volumes Map.*

Stage one of excavation of material commenced in this area on 15th May 2015 and continued until 5th June 2015. As the depth of inclusions encountered was greater than initially anticipated and the presence of a high volume of perched water all material from this area, including surface fill with no inclusions, required removal. The perched water and loose fill caused walls to slump, which was both a safety issue and hindered the screening process. The second stage of works was undertaken following the completion of North of CBP and UFA2 from 8th July 2015 with the area completed on 15th July 2015.

During works to excavate the bulk refractory brick inclusions within Area 3 of the UFA, black granular material was identified surrounding the brick inclusions. Following consultation with staff from Environ and Hydro it was determined the likely source of this material was packing coke transported to this area following the dismantling of B furnace in 1995.

Sampling was conducted on the material to determine if PAHs were present. One sample was collected of the material as it was of uniform colour and consistency and could be easily delineated from the surrounding natural clay. This sample was taken to determine if there was any PAH presence rather than taking multiple samples to obtain a representative understanding of the entire body of material present. The sample was then sent to Envirolab services for testing.

Although the presence of PAH were detected (BaP TEQ 18mg/kg, Total PAH 120mg/kg) the results from the monitoring indicate that the foreign material would comply with NEPM 2013 Commercial/Industrial criteria (BaP TEQ 40mg/kg, Total PAH 4000mg/kg). DLA can confirm that the area excavation surrounding the material of concern is considered to be able to form part of overall validation of the site. Validation of this area will occur as soon as the surrounding areas in the UFA have all foreign material removed.

All of this material was removed to the Stockpile Staging area (SP30) and placed at the end of the stockpile delineate the material as part of the 'whole of site' remediation strategy. The removal of the extent of foreign material, the area was scraped back to natural clay and visual validation occurred. As the material was dry enough to facilitate its entire removal the area surrounding the find was deemed to be clean.

Refer to **Figure 3** *Hotspot areas,* **Figure 6** *Final Stockpile Locations,* **Appendix E** *NATA Certified Analytical Results* and **Appendix F** *CBP Historical Photos Gallery*.

5.1.5 Unexpected Finds Area Two (UFA2)

Excavation of material in UFA2 commenced on 16th June 2015 and were completed on 2nd July 2015. As the fill material with brick, concrete and bitumen inclusions was encountered to 1.0m depth no perched water was encountered during excavation. Rain events on several days during this two week period halted works for approximately one week. No materials containing PCOCs were identified during excavation of UFA2.

5.1.6 North of CBP

Excavation of this area was undertaken in three stages. Works commenced in the northern extent from mid-May and continued for approximately one week. As this area contained a high proportion of clay fill, directly screening material was hindered. Works ceased for one week until more stockpiling space was created in the main stockpiling area. From early June excavation continued south and east for approximately two weeks before perched water prevented works.

Following two weeks of excavation in UFA2 works continued for approximately one week to complete the removal of foreign materials from the area. As works continued in North of CBP it was visually identified that a mound of material within the fill was clean red clay, approximately 150m^3 in volume, which had been previously imported onto the Site. In order to ensure all material with inclusions was removed DLA observed these works of fill containing brick and bitumen at depth. This was removed to a natural clay base and the walls of the mound were scraped back. Two test pits were excavated within the clay mound to ensure no inclusions were buried at depth. This material remained in situ until it was utilised to facilitate the shaping of the main CBP excavation to ensure free flowing drainage occurred.

Refer to **Appendix B** *Hydro Aluminium CBP Validation Photo Gallery.*

5.1.7 Bench Area

Works to complete the removal of foreign material from the bench area commenced on 27th July 2015 and was completed on 4th August 2015. The removal of the fill material with inclusions required delineation in three areas.

The first area commenced on 29th July 2015 and involved the investigation into a rectangular pit of material with light brown sand fill at the surface, surrounded on the sides and base by natural clays. Excavation of the pit revealed bulk large concrete pieces surrounded by perched water and light brown gravel fill. Following consultation with Hydro Aluminium it was determined that the material was likely to have been placed in the excavation following the dismantling of potroom two. As the only inclusions present were inert concrete slabs and pillars only visual validation occurred prior to backfilling the void.

The second area involved the identification of bulk refractory brick with two craters to a maximum of 1.0m depth. Surrounding the brick material was black granular material identical to the previously identified packing coke find. As the black material was clearly delineated from the natural clay below, all inclusions were removed and stockpiled in the same location as the packing coke material excavated from the UFA (SP30) and visual validation occurred. The shallow depth of foreign materials throughout the area and clear weather expedited the remediation process.

Refer to **Figure 3** *Hotspot areas*, **Figure 6** *Final Stockpile Locations* and **Appendix G** *Unexpected finds and hotspot photo gallery.*

5.1.8 East of CBP

Works to complete the removal of foreign material from the east of CBP was undertaken in two stages. Excavation commenced on 27th July 2015 to remove material from the northern extent of the area and continued for two days. Following completion of the bench area works in East of CBP recommenced on 4th August 2015 and was completed 11th August 2015. As the material encountered was approximately to 1.0m depth there was no perched water encountered during excavation which expedited the completion of removal of foreign materials. No materials containing PCOCs were identified during excavation of East of CBP.

In April 2015 AECOM conducted an Aboriginal Archaeological Site Survey within the CBP Site. The survey highlighted that almost all areas were found to be grossly disturbed. However, some limited areas of minimally-to-moderately disturbed terrain were also noted (mostly demarcated by extant vegetation). One Aboriginal archaeological site was identified during survey. This was an isolated stone artefact located on the eastern edge of the light vehicle track which approaches the CBP area from the NNW. The artefact was exposed during the installation of sediment fencing in the area. AECOM Pty Ltd advised that the area was to be fenced off in order to avoid any inadvertent impacts. Based on this assessment, an Aboriginal Cultural Heritage Management Plan (ACHMP) was not deemed to be required for the project.

The Aboriginal archaeological site was located east of the sediment fencing that was utilised to represent the site boundary in the East of CBP area. Works to excavate material with inclusions from this area were undertaken to ensure that no material east of the sediment fencing occurred due to the sensitive nature of the site.

Refer to **Appendix D** *Archaeological Find Correspondence*.

5.1.9 Unexpected Finds Area Three (UFA3)

Following a walkover of the areas surrounding the Site a small series of stockpiles was found southwest of the surveyed area surrounded by vegetation. Following visual investigation inclusions in these stockpiles were concrete and bitumen within gravel fill and approximately 500m^3 volume.

This area was identified within the *Hydro Remediation and Demolition Project – Ecological Assessment* conducted by Eco-Logical Australia in April 2015 as containing several threatened species or Endangered Ecological Communities (EEC). These included *Eucalyptus parramattensis subsp. Decadens* and *Grevillea parviflora subsp. Parviflora* and the Lower Hunter Spotted Gum – Ironbark Forest EEC. DLA investigated the possibility of removing the material without disturbing any potential threatened species by conducting floral identification of the species of concern within the area. Two *Eucalyptus parramattensis subsp. decadens,* two Ironbark and one spotted gum were positively identified. Approximately 15 juvenile *Grevillea parviflora* were positively identified, however due to their size it was not possible to identify if they were *Grevillea parviflora subsp. Parviflora* without extensive investigation.

The identified species were flagged in order to determine if access to the area with an excavator was possible. Although all options were explored it was deemed impossible to excavate the material with inclusions without disturbing the threatened species or EEC highlighted. As the material is a small volume relative to the entire amount excavated throughout works (<1%) and offers minimal visual impact due to its secluded nature the decision was made to allow it to remain in situ.

Refer to **Appendix A** *Hydro Remediation and Demolition Project- Ecological Assessment* and **Appendix B** *Hydro Aluminium CBP Validation Photo Gallery.*

5.2 General Fill

Throughout works the eight previously identified areas contained a heterogeneous mixture of inclusions within the encountered fill. The materials encountered are outlined below:

5.2.1 Main CBP Excavation

The two previously identified hotspot areas primarily contained bulk refractory brick material. Throughout the remainder of the Main CBP excavation there was pockets of concrete, bitumen, refractory brick, and a small area of asbestos sheeting. The north and western section of the pit contained bitumen, concrete, rubbish steel and brick. Inclusions were generally in layers of clay and loam fill material with clay capping between layers. Total depth of material was up to 3.5m depth throughout the CBP.

5.2.2 South of CBP

South of CBP initially contained concrete and asphalt on the surface which was removed and transferred to the stockpiling area off-site. One small 1.0m diameter well from the homestead previously on the Site was removed during works. The well contained bricks and building material, including ACM. During the second stage of excavation foreign materials removed include light brown fill with gravel and brick inclusions. One area of synthetic fibre insulation was encountered during excavation of a drainage channel. Total depth of material did not exceed 1.0m bgl.

5.2.3 West of CBP

West of CBP contained refractory brick on the surface up to 1.5m high with 0.5m clay capping. One 2.0m diameter well from the homestead previously on the Site was removed during works. The well contained bricks and building material, including ACM.

5.2.4 Unexpected Finds Area (UFA)

Throughout works to excavate foreign materials from the UFA materials encountered included bitumen, concrete, refractory brick, automotive waste (including steel, rubber and odorous hydrocarbon materials) and packing coke. Due to the high permeability of fill materials and the clay capping a high volume of perched water was encountered during excavation.

5.2.5 Unexpected Finds Area two (UFA2)

Materials encountered throughout the excavation of UFA2 were light brown fill with inclusions of refractory brick, small quantities of concrete and bitumen. Excavation of this area was to a maximum of 1.0m depth and the inclusions were scattered throughout the filled area. There were no sections within this area that contained pockets of bulk inclusions.

5.2.6 North of CBP

The material encountered during excavation of this area contained concrete and asphalt within light brown gravel fill in the western portion of this area to a maximum depth of 1.0m. As the excavation continued south towards the main CBP excavation brick was encountered at the surface within light brown fill with bulk areas of bitumen, concrete and steel to a maximum depth of 2.5m. A thin band of material up to 0.5m with refractory brick inclusions was encountered to the vegetation line in the north and north-east. Excavation of the east area encountered refractory brick at a depth of approximately 1.5m-2.5m depth with a 1.0 capping layer of imported red clay. The surface layer of this area contained refractory brick and concrete to a depth of 0.5m. Part of this area contained predominantly clean red imported clay with minimal inclusions. Following the removal of the inclusions this material was transferred west of the UFA to be used to facilitate shaping of the site to prevent ponding following the completion of works. As some of this material was not required to shape the UFA the remaining proportion red clay with no inclusions remained in-situ for the same process to the north of CBP.

5.2.7 Bench Area

Material from this area primarily contained refractory brick within light brown sand/loam fill. Some gravel was present, which was generally found with small slabs of bitumen. One area of this section contained large slabs and columns of concrete, believed to be from the dismantling of potroom two. In three areas containing bulk refractory brick, the oversized material was surrounded by packing coke. This material was delineated and stockpiled separately from the remainder of material excavated in this section.

5.2.8 East of CBP

Material excavated east of CBP was generally refractory brick located within light brown sandy fill to approximately 1.0m depth. The inclusions of brick were encountered at the surface to the northern and eastern extent of the grassed area and discontinued as vegetation increased in density. There were two sections of fill material that remained in situ due to the sensitive nature of the vegetation located on top of the fill. The first area of fill was approximately $10m^3$ and had two *Eucalyptus Parramatensis* subsp. *decadens* positively identified as located situated within and above the fill. This species was identified within the Flora survey of the CBP area conducted in April 2015 as threatened. The two trees and surrounding material remains in situ. The second area of fill was approximately $15m^3$ and had four *Acacia Floribunda* located on top of fill. This material was determined to be acceptable to remain in situ as the potential inclusion of refractory brick inclusion was unlikely and there is no impact to visual amenity of the Site. As removal of fill materials surrounding the vegetation would cause gross disturbance to the vegetation it was decided the foreign fill could remain in situ.

5.3 Stockpile Management

The areas encountered during the remediation of The Site containing Contaminants of Concern had the excavated material tracked and stockpiled separately in the stockpiling staging area west of potline three. The location of these materials is noted in order for them to be tracked and later disposed of as part of the 'whole of site' remediation strategy. The areas encountered and the locations of their stockpiles are outlined below:

- **Hotspot 1 and Hotspot 2 material**- Oversized Brick material is in Stockpile 18 and fines material in Stockpile 37 in the main Stockpile Staging Area.
- **Asbestos Containing Material (ACM) from Well 1 and Well 2**- Stockpiled with ACM from the Residential Parcel 1 (Wangara) excavation, south of the main Stockpile Staging area.

- **Synthetic fibre material from South of CBP area** - Stockpiled with ACM from the Residential Parcel 1 (Wangara) excavation, south of the main Stockpile Staging area.
- **ACM from the CBP asbestos find** - Stockpiled with ACM from the Residential Parcel 1 (Wangara) excavation, south of the main Stockpile Staging area.
- **Packing coke material encountered in the UFA and Bench area** – Stockpile 30 in the main Stockpile Staging area.
- **Automotive waste material encountered in the UFA** – Bulk steel material is stockpiled next to the haul road adjacent to potline 3. Fines and oversized are stockpiled in the main Stockpile Staging area in stockpile 24.
- **Hydraulic fluid material from the MOXY incident** – Stockpile 21 in the main Stockpile Staging area. This stockpile remains covered to minimise any runoff.
- **Sediment scrapings from Hotspot 2 and the CBP sediment pond** – Stockpile 33 in the main Stockpile Staging area.

As stockpiles are expected to remain in situ for an extended period of time several measures were put in place to ensure sediment and erosion control protocol as per the *RAWP.* Stockpiles within the CBP Site and stockpiles containing Contaminants of Concern within the Stockpile Staging area had sediment fencing installed in all areas down gradient to ensure minimal sediment and erosion issues are caused.

Refer to **Figure 6** *Final Stockpile Locations*

5.4 Environmental Management

5.4.1 Waste Disposal

No material was removed from the Hydro Aluminium site throughout the CBP works. Several pockets of material uncovered throughout excavation were deemed to require isolated stockpiling in the main stockpile staging area west of potline 3 due to either confirmed or potential contamination. The current location of these materials is outlined below:

- **Asbestos from main CBP excavation and Well 1 and Well 2** - Res Parcel Stockpile
- **Synthetic mineral fibres from South of CBP area** - Res Parcel Stockpile
- **Packing coke material from UFA and Bench area** - SP30
- **Hotspot 1 and Hotspot 2 material** - SP18 and SP37
- **Automotive waste material** - SP24

- **Hydraulic oil spill material from MOXY incident.** - SP21

These materials will temporarily remain in situ and will later be utilised as part of the 'whole of site' remediation strategy.

Refer to **Figure 6** *Final Stockpile Locations*

5.4.2 Imported Material

In order to facilitate the sediment and erosion control measures put in place by the Environ RAWP the trapezoidal drain utilised as the exit point for storm water from the CBP gabion rock was imported to line the drain. 3.5 tonne of this material was imported from Quarry products Newcastle by Enviro Pacific Services and visually inspected by DLA following its installation. It is considered that this material will be of no hindrance to the visual amenity or chemical validation of The Site.

5.4.3 Discharge Water Treatment

Throughout the excavation of the CBP dewatering was required in both the CBP and UFA excavations. Initially, the two hotspot areas required dewatering via pumpout to tankers. The water was then transported and discharged into the Hydro stormwater retention system west of potline 3.

Following further excavation in the main CBP area the southeast corner of the excavation was utilised as a sediment pond. Dewatering perched and stormwater from the UFA required pumping into the CBP and allowing natural drainage lines to transport the water into the CBP sediment pond. All stormwater entering the CBP also was free flowing into the sediment pond. Water was then pumped out of the CBP and onward to the Hydro stormwater retention system west of potline 3.

Following the completion of all excavation in the CBP and UFA and dewatering all excavation the sediment pond was scraped back to natural clay and the sediment transferred to stockpile 33 off site. Sampling of the clay base was undertaken in both the CBP sediment pond and the base of the hotspot area for the contaminants of concern. CBP-Pond-Base and CBP-Hotspot-Base returned no exceedances of Site accepted criteria.

See **Appendix E** *NATA Certified Analytical Data* and **Appendix H** *Data Summary Table*

5.4.4 Environmental Pollution Control

During the remediation process and prior to work commencing, environmental controls were put in place in accordance with the Site Management Plan as provided in the RAWP (ENVIRON, 2014). Throughout all excavation a water tanker was utilised to minimise dust pollution on-site. All areas down gradient of main excavations had sediment fencing installed in order to comply with the sediment and erosion control measures put in place by the *RAWP*.

No work was conducted during periods of excessive rain or winds. All works were conducted between the standard WorkCover work hours, including on weekends and public holidays. Appropriate dust control measures were implemented during the loading out of the contaminated material.

These methods were considered acceptable to satisfy environmental pollution requirements as the Site encapsulated by either industrial or dense vegetation. The closest sensitive receptor is a residence located approximately 1.0 km distance from all works undertaken and buffered by heavily vegetated areas.

5.5 WHS Measures

Secure fencing was installed to limit access to the Site by the public. The standard WorkCover requirements for a Site induction prior to undertaking any works were implemented. Personal Protective Equipment (PPE) in the form of hard hats, safety boots and high visibility vests were mandatory at all times. Strict personal hygiene practices were also implemented. Throughout all works positive communication was required by all personnel present on site.

Safety equipment including gloves and P2 respirators were provided on-site and issued by the Site Manager when required. The Remedial Contractor provided evidence of equipment licences and maintenance schedules to the Project Manager prior to the commencement of the Works Contract. Extending from this, Site access was limited to inducted personnel only via a secured manned gatehouse. Additional site boundaries were fenced and the main gate to the site was locked outside of working hours.

5.6 Regulatory Approvals and Licenses

The Project was subject to Consent Conditions imposed by Cessnock City Council under the provisions of SEPP 55. Prior to the commencement of remediation, more than one month's notification was given to Cessnock City Council notifying them and detailing the intended remediation works.

Seven days notification was given to WorkCover for the removal of asbestos contaminated soils, which was approved by Workcover. DLA Environmental has four licenced asbestos assessors, Stephen Challinor (LAA001119), Simon Sprydz (LAA000116), Anthony Richard (LAA00181) and Shane Williams (LAA000128). Any personnel on site from DLA Environmental were working under the direct guidance of one of the four licenced individuals.

6.0 VALIDATION SCOPE OF WORKS

6.1 Validation Strategy

Validation of the Site was based on visual assessment and documentation (photographic) of remaining soils for absence of fill materials. A survey of the Site based on a 30m x 30 m was utilised to facilitate compilation of evidence for 'whole of site' remediation. The survey map was produced by Rennie Golledge Pty Ltd in January 2015 with the UTM coordinates of each grid line highlighted. Each of these squares was photographed from eight locations to demonstrate the removal of all foreign fill materials. The photographs of each grid square were collated into a photo gallery for validation purposes.

Refer to **Figure 5** Site *Survey Map* and **Appendix B** *Hydro Aluminium CBP Validation Photo Gallery*.

Nine areas containing Potential Contaminants of Concern (PCoC's) required sampling or asbestos air monitoring during works. The sampling or monitoring was undertaken to either validate excavations that required backfilling, to delineate contaminated material into individual stockpiles or to ensure a safe work zone. These materials were removed from the Site and remain in the stockpile staging area at Hydro Aluminium Kurri Kurri for use in the 'whole of site' remediation strategy. Areas sampled, identified Contaminant/s of Concern and method of sampling and include:

- **Hotspot 1 material** – Hydrocarbon odour identified during test pitting. Two soil samples collected for analysis of TRH/BTEX.
- **Asbestos Containing Material (ACM) from Well 1** - Visual identification of ACM. Six soil samples and one fragment sample collected for asbestos analysis. Asbestos air monitoring undertaken during movement of material from one part of the Stockpile staging area to another.
- **Asbestos Containing Material (ACM) from Well 2 -** Visual identification of ACM. Two bulk soil samples collected for asbestos analysis. Asbestos air monitoring undertaken during excavation and movement of material within Stockpile staging area.
- **Synthetic fibre material from South of CBP area** – Visual identification of potential ACM. One sample collected of fibrous material for asbestos analysis.
- **ACM from the CBP asbestos find** – Asbestos air monitoring undertaken during excavation and movement of material within Stockpile staging area.
- **Packing Coke Material encountered in the UFA and Bench area** – Visual identification of material containing PAH. One soil sample collected for PAH analysis.

- **Automotive Waste Material encountered in the UFA** – Hydrocarbon odour and sheen identified during excavation. 12 validation soil samples collected for TRH/BTEX/Metals analysis.
- **Sediment scrapings from Hotspot 2 and the CBP sediment pond** – Previous identification of PCoC's within RAWP. Two soil samples collected for Fluoride and Cadmium analysis.
- **Stockpile containing ACM movement in Stockpile staging area** – Validation of footprint following transfer of known ACM stockpile. Two bulk soil samples collected for asbestos analysis.

Refer to **Figure 3** *Hotspot Areas* and **Appendix E** *NATA Certified Analytical Results*.

The sampling regime for the validation area of the Site was in accordance with the requirements of the *Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 2011) and *the Sampling Design Guidelines* (NSW EPA, 1995) taking into consideration the requirements of the *Guidelines for the NSW Site Auditor Scheme* (NSW EPA, 2nd ed., 2006) and the NEPM (NEPC, 2013).

Validation at the Site included a review of the contamination status, in conjunction with validation sampling of all remediation areas. The likelihood of residual contamination was assessed by comparison of validation results with NSW EPA produced or endorsed criteria available at the time this report was published. The justification of the sampling point regime for the assessment was based on the investigator's knowledge, operational requirements, experience and history of the Site. All historical investigations and anecdotal evidence supported the sampling approach adopted and provided for samples to be collected in an unbiased manner.

6.1.1 Soil Collection

Soil samples for chemical analyses were generally collected in accordance with the *Sampling Design Guidelines* (NSW EPA, 1995), NEPM (NEPC, 2013) and AS4482.1-2005. Collected soil samples were immediately transferred to sample containers of appropriate composition (glass jars for chemical analysis, plastic bags for asbestos). Job number; sample identification number; sampler's initials and date of sampling were recorded on sample labels affixed to the sample containers.

Samples were then placed immediately into a chilled esky to prevent the loss of potential volatile components. The samples were transported under standard DLA chain-of-custody protocols to the NATA accredited laboratories – Envirolab Services Pty Ltd. All samples were stored and transported at temperatures below 4°C.

All samples were collected by DLA staff who are specifically trained in hazardous waste field investigation techniques and health and safety procedures. All techniques used are specified in DLA Field Manual for Contaminated Sites, which are based on methods specified by the United States Environment Protection Agency (US EPA) and NEPM (NEPC, 2013).

6.1.2 Waste Classification Sample Collection

As all materials remained on the Hydro Aluminium Kurri Kurri Site no waste classification was required throughout works.

6.2 Analytical Strategy

Samples were sufficiently analysed to ensure the effective remediation of all identified contaminants of concern and allow statistical confidence with respect to the Site acceptance criteria. In summary, the following samples were collected:

Table 6a – Sample Collection and Analysis

Hotspot 1	
vTRH / BTEX	2 samples
TRH	2 samples
Well 1	
Asbestos - Fines	5 samples
Asbestos - Fragment	1 sample
Asbestos Air Monitoring	3 cowls
Well 2	
Asbestos - Fines	2 samples
Asbestos Air Monitoring	4 cowls
Synthetic fibre material	
Asbestos - material	1 sample
CBP Asbestos Find	
Asbestos Air Monitoring	4 samples
UFA Packing Coke Material	
PAH	5 samples
Automotive Waste Find	
vTRH / BTEX	12 samples + 1 Intra Laboratory sample
TRH	12 samples + 1 Intra Laboratory sample
Heavy Metals*	12 samples + 1 Intra Laboratory sample
Hotspot 2 and CBP Sediment Pond Scrapings	
Fluoride	1 sample
Cadmium	1 sample
Stockpile Movement Footprint	
Asbestos - fines	2 samples

* Analysis conducted for As, Cd, Cr, Cu, Pb, Hg, Ni, Zn

Refer to **Appendix H** *Data Summary Table*.

6.3 Data Quality Objectives

The NEPM (NEPC, 2013) and Australian Standard (AS) 4482.1-2005 recommend that data quality objectives (DQOs) be implemented during the validation of remediated sites. The DQO process described in AS 4482.1-2005 Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part 1: Non-Volatile and Semi-Volatile Compounds outlines seven distinct steps to outline the project goals, decisions, constraints and an assessment of the project uncertainties and how to address these when they arise. The DQOs have been summarised the table below:

Table 6b – Summary of DQOs

1	State the Problem	In its current state, the site is not considered suitable for the proposed land use due to impacts to visual amenity from stockpiled and buried fill and remediation is required. Remediation of the stockpiled and buried fill is required to remove the impacts to visual amenity. The materials that are stockpiled and buried at the site include bake furnace refractory brick, concrete and bitumen. No potential contaminants of concern were identified at concentrations above the site guidelines, including heavy metals, fluoride, PAHs or SVOCs.
2	Identify the Decisions	To validate the effectiveness of the remediation strategy, visual validation of the removal of stockpiled and buried material is required. Validation sampling of soil is not required as there is no risk of impact to the natural soils from the stockpiled and buried material or from the soil matrix. The site will be considered remediated when the remediation program has been carried out successfully. Remediation is deemed to be successful when: – All fill materials have been removed from the Clay Borrow Pit Area, sorted and appropriately relocated; – Excavations have been reshaped to an accepted landform.
3	Identify Inputs to Decisions	For the remediation of the Clay Borrow Pit site the following input into the decision making process is required: – A visual evaluation of the removal of all stockpiled and buried materials is required to validate the remedial works. – Documented materials tracking that demonstrates all materials have been appropriately relocated as described in **Section 9.7** of the Environ RAWP (2014). – Final survey that demonstrates the landform has been reshaped to achieve the objectives of the final landform as described in **Section 9.10** of the Environ RAWP (2014).

4	**Define Study Boundaries**	The site boundary has been outlined and defined in Figure two of the *Environ RAWP* (2014). Remediation is required of both buried fills and materials above ground. The site survey map was utilised for identification of the Site boundary during works. See **Figure 6** Site *Survey Map* and **Appendix C** *RAWP*.
5	**Develop Decision Rule**	Decision rules for the validation of the remedial works are based around visual validation of the removal of stockpiled and buried materials, including refractory brick, concrete and bitumen. The decision rules are as follows: - Can it be visually confirmed that stockpiled and buried fill materials have been removed from the Clay Borrow Pit; - Visual validation should show that the walls and base of the excavation are within red /grey, medium to high plasticity clay. - If visual validation cannot be confirmed, additional excavation should be completed until the excavation can be validated as being in red / grey, medium to high plasticity clay.
6	**Specify Limits on Decision Errors**	Acceptable limits and the manner of addressing possible decision errors are outlined below: - The decision to be made is that all stockpiled and buried fill material has been excavated from the Clay Borrow Pit and that the resultant excavation is within natural red / grey clay. - Possible decision errors include deciding that all stockpiled and buried fill material has been removed when it has not or deciding that the resultant excavation is within natural red / grey clay when it is not. - As the validation of the removal of stockpiled and buried fill material is visual, there is no acceptable limit on decision errors.

7	Optimise Design for Obtaining Data	The excavation is to be photographed on a daily basis to show the removal of stockpiled and buried fill material. The photolog shall be used to demonstrate compliance with the remedial strategy. Contingency for validation sampling: - In the event that visually impacted (including ACM) or odorous soils are excavated as part of the remedial works, validation sampling of the base of the excavation in the vicinity of the visually impacted or odorous soils will be completed; - The analytical suite for the validation samples will vary and will depend on the visual impact or odour. Soils impacted with an oily sheen or hydrocarbon odour will result in validation sampling for hydrocarbons. Discoloured soils will result in validation sampling for a suite of analytes, including heavy metals, fluoride and cyanide. Material with ACM fragments will result in validation sampling for asbestos (as well as the implementation of the Asbestos Management Protocol in the RAWP). - In the event that ACM fragments are identified during the excavation works, an asbestos clearance certificate will be required by a suitably qualified and experienced person at the completion of the remedial works. - Discrete sampling will be undertaken by collecting surface soil using a steel trowel or collection directly from the soil surface by hand. Discrete samples will be spaced in a 30m grid formation across the area to ensure that an even coverage of the site is achieved. - Decontamination of sampling equipment will be undertaken before sampling and between samples by cleaning with "Decon 90/Xtran" and potable water. - Disposable gloves will be worn for all sample collection. - Where walls of excavations are present and are not proposed to be excavated and are deeper than 0.2m, discrete sampling will be undertaken from each soil type present every 10 lineal metres. - Where walls of excavations are present and are not proposed to be excavated and are deeper than 0.2m, discrete sampling will be undertaken from each soil type present every 10 lineal metres. - All samples will be given a unique identifier and marked on a plan.

Table 6c – Summary of DQIs

DATA PRECISION AND ACCURACY	
Acceptable Relative Percentage Difference (RPD)	>10 x LOR: 30% inorganics; 50% organics (Field) <10 x LOR: Assessed on individual basis (Field) >5 x LOR: 50% (laboratory) <5 x LOR: No Limit (laboratory)
Adequate Laboratory Performance	Based on acceptance criteria of laboratory as specified on certificate of analysis, includes: blank samples, matrix spikes, control samples, and surrogate spike samples. Use of analytical laboratories with adequately trained and experienced testing staff experienced in the analyses undertaken, with appropriate NATA certification.
DATA REPRESENTATIVENESS	
Sample and Analysis Selection	Representativeness of all contaminants of concern.
Trip Blanks	No detection above LOR.
Trip Spikes	Recoverable concentrations of volatiles between 60 – 140%.
Laboratory Selection	Adequate laboratory internal quality control and quality assurance methods, complying with the NEPM (NEPC, 2013).
DOCUMENTATION COMPLETENESS	
Chain of Custody Records	Laboratory sample receipt information received confirming receipt of samples intact and appropriate chain of custody.
	NATA registered laboratory results certificates provided.
DATA COMPLETENESS	
	Analysis for all contaminants of concern.
	Field duplicate sample numbers complying with NEPM (NEPC, 2013)
	Trip spike samples prepared and sent with field samples regularly.
COMPARABILITY	
	Use of NATA registered laboratories.
	Detailed logs of all sample locations recorded.
	Test methods comparable between primary and secondary laboratory
	Acceptable RPD's between original samples and field duplicates and inter-laboratory triplicate samples.

6.4 Validation Criteria

The Validation criteria have been chosen in accordance with current Australian and NSW EPA guidelines. The criteria provided are the most current and widely accepted for Tier 1 assessment of land use suitability at present in Australia, and have generally been developed using a risk-based approach.

Validation of the Site was based on visual assessment and documentation (photographic) of remaining soils for absence of fill materials. In order to achieve this a survey map was produced on a 30m x 30m grid basis with the coordinates of each square highlighted. Each of these squares was photographed from eight locations to demonstrate the removal of all foreign fill materials. The photographs of each grid square were collated into a photo gallery for validation purposes.

A contingency for validation sampling was adhered to as per the *RAWP*. If visually impacted (including ACM) or odorous soils were excavated as part of remedial works, validation sampling of the base of the excavation in the vicinity of the visually impacted or odorous soils was completed. The analytical suite for the validation samples was dependent on the visual impact or odour. Soils impacted with an oily sheen or hydrocarbon odour resulted in validation sampling for hydrocarbons. Discoloured soils resulted in validation sampling for a suite of analytes, including heavy metals, fluoride and cyanide. Material with ACM fragments resulted in validation sampling for asbestos.

As ACM fragments were identified during the excavation works, an asbestos clearance certificate have been provided as appendices in this validation report. Discrete sampling was undertaken by collecting surface soil using a steel trowel or collected directly from the soil surface by hand. Decontamination of sampling equipment was undertaken before sampling and between samples by cleaning with “Decon 90/Xtran” and potable water. Disposable gloves were worn for all sample collection.

Refer to **Figure 5** *Site Survey Map*, **Appendix B** Hydro Aluminium CBP Validation Photo Gallery and **Appendix I** *Asbestos Clearance Certificates.*

6.4.1 Soil Criteria

The guidelines proposed for the assessment of soil contamination at the Clay Borrow Pit were sourced from the following references:

- NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM); and
- Site specific derivation of a guideline for fluoride.

The variation to the NEPM was approved on 19 June 2013 by the NSWEPA under the *Contaminated Land Management Act 1997*. The NEPM amendment 2013 provide revised health-based soil investigation levels (HILs), health based screening levels (HSLs), ecological-based investigation levels (EILs) and ecological based screening levels (ESLs) for various land uses. A summary of the applicability of these guidelines follows.

- The HILs are applicable for assessing human health risk via all relevant pathways of exposure and have been developed for four main land use categories. The HILs are generic to all soil types and apply generally to a depth of 3m below the surface for residential use.
- HSLs for soil vapour intrusion from petroleum hydrocarbons are guidelines that prevent accumulation of vapours at concentrations that may represent a health risk. The HSLs are derived for various depths and are for the same generic land uses as for the HILs. The guidelines are relevant were soils are beneath building or structures such as confined spaces.
- EILs have been developed for commercial/ industrial land use and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and generally apply to the top 2m of soil. Site-specific EILs were developed using pH and Cation Exchange Capacity data from topsoil samples collected from across the entire Buffer Zone. The EIL site-specific calculations were provided by Environ in the RAWP (2014). These were calculated using the NEPM Toolbox.
- ESLs have been developed for commercial/ industrial land use and are developed for selected petroleum hydrocarbon compounds and fractions and are applicable for assessing risk to terrestrial ecosystems. These are also generally applicable to the top 2m of soil.
- Management Limits where concentrations above these limits may indicate poor aesthetics, high odour and potentially explosive vapour. Management limits are to be applied after consideration of relevant ESLs and HSLs.

Refer to **Appendix J** *ENVIRON EIL Site-Specific Calculations*.

The applicable assessment criteria for site soils are presented in **Table 6d.**

Table 6d: Soil Guidelines (mg/kg) – Health and Ecological Investigation Levels

	ANALYTES	HIL-D	EIL
HEAVY METALS	**Arsenic**	3000	160[1]
	Cadmium	900	-
	Chromium (VI)	3600	-
	Chromium (III)		320[2] (1% clay)
	Copper	240 000	300[2]
	Lead	1500	1800[1]
	Nickel	6000	310[2]
	Zinc	400 000	700[2]
	Mercury (inorganic)	730	-
	Cyanide (free)	1500	-
PAH	**Naphthalene**	NL	370[1]
	Carcinogenic PAHs (as BaP TEQ)	40	-
	Total PAHs	4000	-

1. EILs represent the most conservative value possible as the lowest value for added contaminant limit (ACL) was used and the ambient background concentration (ABC) was not added.
2. Chromium III, nickel, zinc and copper EILs were calculated by adding the ACL with the estimated ABC using the NEPM (2013) EIL Calculation Spreadsheet for aged contamination under commercial/ industrial land use.

The applicable assessment criteria for volatile PAHs in soil are presented in **Table 6e and Table 6f**.

Table 6e: Soil Assessment Guidelines for Vapour Intrusion - HSL D (mg/kg) – Sand

ANALYTES	0 to <1m	1m to <2m	2m to <4m	4m+
Naphthalene	NL	NL	NL	NL

1. The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.
2. (For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit>50% respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.
3. To obtain F2 subtract naphthalene from the >C10-C16 fraction.

Table 6f: ESLs and Management Limits for Petroleum Hydrocarbons in Soil

TPH fraction	Soil texture	ESLs (mg/kg dry soil)	Management Limits[1] (mg/kg dry
		Commercial and Industrial	Commercial and Industrial
Benzo(a)pyrene	Fine	1.4	-

1. Management limits are applied after consideration of relevant ESLs and HSLs.
2. Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2.
3. ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability.
4. To obtain F1 for ESLs, subtract the sum of BTEX from C6-C10 fraction. For F2, naphthalene should not be subtracted as there is no separate ESL for naphthalene.

The HSLs for asbestos are applicable for assessing human health risk via the exposure pathway of inhalation of airborne asbestos and are presented in **Table 6g.** The HSLs are generic to all soil types.

Table 6g Health screening levels for asbestos contamination in soil

Health Screening Level (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]	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 soluble fluoride for the Hydro Aluminium Kurri Kurri Smelter. The screening levels are protective of the range of human receptors and are provided in **Table 6h.**

Table 6h Site Specific Soil Assessment Guidelines (mg/kg) for Soluble Fluoride

Land Use	Preliminary screening level
Commercial/ industrial - soil	F 17000mg/kg

6.4.2 Surface water Criteria

The assessment criteria for the assessment of surface water were sourced from the following references:

- NEPC (2013) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM).
- NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination;
- ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- ENVIRON (2013) Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford.

6.4.3 Potential Beneficial Uses

Potential beneficial uses of surface water on site and down gradient of the Clay Borrow Pit include:

- Flow to Black Waterholes Creek and ultimately discharge to Wentworth Swamp, which supports aquatic ecosystems, and potentially flows into the Hunter River;
- Extraction of water from Wentworth Swamp may also be used for stock watering and/or irrigation.
- Discharge into groundwater, which is used by local communities for domestic, recreation, monitoring, irrigation and stock watering purposes.

It is noted that drinking water has not been included as a potential beneficial use of water from Wentworth Swamp, for the following reasons:

- Drinking water supply to the local communities is reticulated and originates from Chichester Dam located on the Chichester River;
- The Kurri Kurri Waste Water Treatment Works is located up gradient of the Clay Borrow Pit. The Works has a licensed discharge point into Swamp Creek, which flows into Wentworth Swamp. Extraction of surface water for drinking water down gradient of this discharge point is therefore not undertaken.

6.4.4 Appropriate Criteria for Surface Water

Based on the review of potential beneficial uses of groundwater and surface water, the criteria for protection of aquatic ecosystems, irrigation and stock watering will be used. Additionally, site specific preliminary screening levels for fluoride and aluminium in surface water have been developed for the Hydro Aluminium Kurri Kurri Smelter (ENVIRON 2013). These are protective of human health and are as follows:

- Surface water (recreational use): Fluoride – 1.5mg/L, Aluminium – 9mg/L.

The investigation levels presented in ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality are considered applicable for the protection of aquatic ecosystems of receiving waters. ANZECC (2000) advocates a site- specific approach to developing guideline trigger values based on such factors as local biological affects data and the current levels of disturbance of the ecosystem. The guidelines present 'low risk trigger values' which are defined as concentrations of key performance parameters below which there is a low risk of adverse biological effects. If these trigger values are exceeded, then further action is required which may include further site-specific investigations to assess potential contamination or management/ remedial action.

Low risk trigger values are presented in Table 3.4.1 of ANZECC (2000) for the protection of 80-99% of species in fresh and marine waters, with trigger values depending on the health of the receiving waters.

Surface water results will be compared against trigger values for the protection of 95% of freshwater species. A 95% protection of fresh water species was selected due to the indication from the Hunter-Central Rivers Catchment Management Authority that declining stream water quality and a reduction in diversity of native plants and animals has occurred in the last ten years.

ANZECC (2000) indicates there is currently insufficient data to derive a high reliability trigger value for TRH but propose a low reliability trigger value of 7µg/L. This guideline is considered by industry to be overly conservative and is below the TRH detection limit that most laboratories can achieve. Therefore the limit of reporting (LOR) will be adopted as a screening trigger for TRH.

Trigger values for cadmium, copper, nickel, lead and zinc can be modified for hardness, as the bioavailability of these heavy metals decreases with increasing hardness. Total hardness was calculated for the receiving waters of Wentworth Swamp using calcium and magnesium concentrations, with results indicating hard water (236mg/L $CaCO_3$). Trigger values modified for hard waters have been used, as per Table 3.4.3 of ANZECC (2000).

Surface water results will also be compared against trigger values for irrigation and stock watering. Section 4.3.4 of ANZECC (2000) indicates that stock watering trigger values for heavy metals and metalloids are for total concentrations, irrespective of whether the constituent is dissolved, complexed with an organic compound or bound to suspended solids. Fluoride is included in this section.

Investigation levels for livestock drinking water are not available for organic contaminants, such as TRH and PAHs. In the absence of available investigation levels, the limit of reporting (LOR) will be adopted as a screening trigger for TRH and PAHs.

Refer to **Appendix J** *ENVIRON EIL Site-Specific Calculations*.

The long term trigger value has been used for irrigation guidelines. Section 9.2.5.11 of ANZECC (2000) indicates that the long term trigger value for fluoride is based on the assumption that the irrigation water could potentially be phytotoxic to sensitive plant species or could contaminate stock drinking water. As stock watering guidelines are for total metal and metalloid concentrations, total fluoride concentrations will be used.

6.4.5 Ecological Risk Assessment Criteria

According to NEPM (NEPC, 2013), Schedule B (5a) – *Guideline on Ecological Risk Assessment*, factors that may influence a Risk Management Decision (and therefore determine Ecological Risk Assessment outcomes) are generally based on economic, ecological or societal considerations.

Examples include:

- The size of the site, land value, cost of remediation (economic);
- The type of contaminants present, current and potential site land use, surrounding land use (societal); and,
- The ecological significance (e.g. a rare and endangered species or a species that supports a valued ecological process or a sensitive introduced species of low ecological significance) of the values identified in the Receptor Identification component of Ecological Risk Assessment (ERA) to be protected.

In April 2015 Eco Logical Australia conducted an Ecological Assessment of all areas surrounding the Hydro Aluminium Kurri Kurri smelter site to identify any Threatened flora and Endangered Ecological Communities (EEC's) present surrounding the Site. Several Eucalyptus *Parramattensis subsp. Decadens, Grevillea parviflora subsp parviflora and callistemon linearifolius* along with the Lower

Hunter Spotted Gum – Ironbark Forest EEC were identified to be close to, but outside to the CBP Site boundary.

The threatened species and EEC's identified in this report were utilised for the criteria of ecological assessment within the Site and were only encountered in the UFA3 area found outside the Site boundary. As material with inclusions of concrete and bitumen were found within this area field assessment of flora was conducted surrounding the areas including the fill materials.

In order to conduct this assessment *Field Guide to the Native Plants of Sydney* (Robinson, 1991) was examined, along with Office of Environment and Heritage (OEH) species profiles for Small Flowered Grevillea, *Eucalyptus Parramattensis subsp. Decadens* and Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion (OEH, 2015). Field assessment involved the use of this information and photographic documentation to demonstrate the presence of these species.

Refer to **Appendix A** Hydro Remediation and Demolition Project- Ecological Assessment *and* **Appendix B** *Hydro Aluminium Kurri Kurri CBP Validation Photo Gallery*.

7.0 VALIDATION RESULTS

7.1 Field Observations

7.1.1 Visual assessment and documentation (photographic)

Validation of the Site was based on visual assessment and documentation (photographic) of remaining soils for absence of fill materials. A survey of the Site based on a 30m x 30 m was utilised to facilitate compilation of evidence for 'whole of site' remediation. The survey map was produced by Rennie Golledge Pty Ltd in January 2015 with the UTM coordinates of each grid line highlighted. Each of these squares was photographed from eight locations to demonstrate the removal of all foreign fill materials. The photographs of each grid square were collated into a photo gallery for validation purposes.

Following the removal of foreign materials photographic documentation was compiled of each of the eight primary areas excavated throughout works. Each grid square on the Site Survey Map geotagged in the approximate centre with the coordinates highlighted in the Validation Photo gallery. A total of eight photos were used of each grid square to highlight the removal of all foreign fill materials. The precession of the photographic documentation within the gallery commenced from the north-west corner of the grid square continuing in a clockwise direction and was completed on the western side of the square.

Refer to **Figure 5** *Site Survey Map* and **Appendix B** Hydro Aluminium CBP *Validation Photo Gallery.*

7.1.2 Soils

All eight primary areas excavated throughout works contained a range of underlying fills within soils. Fill materials were observed from 1.0m to 4.0m across the Site. These included imported clay, sand and gravel fills, refractory brick, concrete, bitumen, automotive material, steel, packing coke, general rubbish and house building materials including; timber, ACM and house bricks. The fill materials were removed until a natural clay base was reached throughout the Site.

Following the removal of refractory brick stockpiles in West of CBP area it appeared that a large volume of fill material was located below the surface. Following further investigation it was determined that the area contained fill including refractory brick, bitumen and concrete. A total of 25 test pits were excavated throughout the area. The area was separated into five sections delineated by the type of fill encountered. The total volume of material to be excavated from this area was estimated to be between 9800m^3 and 11,700m^3. During works to excavate the foreign fills from this area refractory brick, bitumen, concrete, packing coke, steel and general rubbish were encountered.

All materials with inclusions were removed from the Site to the Stockpile Staging Area in accordance with the *RAWP* Remediation Methodology. The excavated material was then screened in order to separate oversized material from fines. Fines from areas identified to contain no Potential Contaminants of Concern (PCOC's) were then transported to the southwest area of site to facilitate room for materials in the Stockpile Staging Area.

As a result of the remedial works, any aesthetic impact has been negated and no further management should be required.

7.1.3 Groundwater

No groundwater was encountered during works. Perched water was encountered in the Main CBP excavation, the UFA and the North of CBP area. The perched water was generally found below the clay capping layer encountered throughout the Site from approximately 0.5m-1.0m below ground level (bgl).

7.2 Soil Sampling

Eight (8) areas containing PCoC's required soil sampling during works. Soil samples for chemical analysis were sent to Envirolab group in Chatswood, Sydney and soil samples for Asbestos analysis were sent to ASET in Hornsby, Sydney. The sampling was undertaken to either validate excavations that required backfilling or delineate contaminated material into individual stockpiles. These materials were removed from the Site and remain in the stockpile staging area at Hydro Aluminium Kurri Kurri for use in the 'whole of site' remediation strategy. Areas sampled, identified Contaminant/s of Concern, method of sampling and final stockpile locations include;

7.2.1 Adjoining Hotspot 1 Material

Hydrocarbon odour identified during test pitting. Two soil samples taken for analysis of TRH/BTEX. Both samples TP ESP3 – 2.2 and TP ESP3 – 2.5 returned no detections for all analytes. Final stockpile location – SP 18 (Oversized) and SP 37 (fines) in the Stockpile Staging area.

7.2.2 Asbestos Containing Material (ACM) from Well 1

Visual identification of ACM. Five soil samples and one identified asbestos fragment sample taken for asbestos analysis. Soil samples Well 1 – NW, Well 1 – EW, Well 1 – SW, Well 1 – WW and Well 1 – Base returned no asbestos detections. The identified asbestos fragment sample Well 1 returned a detection of Chrysotile asbestos and Amosite asbestos. Final stockpile location – Residential Parcel Stockpile in the Stockpile Staging Area.

7.2.3 Asbestos Containing Material (ACM) from Well 2

Visual identification of ACM. Two bulk soil samples taken for asbestos analysis. Soil sample Well 2 and Well 2 – Area returned no asbestos detections. Final stockpile location – Residential Parcel Stockpile in the Stockpile Staging Area.

7.2.4 Synthetic fibre material from South of CBP area

Visual identification of potential ACM. One sample taken of fibrous material for asbestos analysis. Fibre sample South Pit – Insulation returned no asbestos detections. Final stockpile location – Residential Parcel Stockpile in the Stockpile Staging Area.

7.2.5 Packing Coke Material encountered in the UFA and Bench area

Visual identification of material containing PAH. One soil sample taken for PAH analysis. Soil Sample UFA-Fines returned no detections exceeding the validation criteria for Total Positive PAH (4000 mg/kg) or BaP TeQ (40 mg/kg). Soil sample UFA-Fines returned a detection BaP (11 mg/kg). This an exceedance of ESL criteria (0.7 mg/kg) and it is recommended that the material is buried at >2m depth as part of the 'whole of site' remediation strategy. Results are summarised in Table 7a below. Final stockpile location – SP30 in the Stockpile Staging Area.

Table 7a UFA Packing Coke Find Results (mg/kg)

Sample ID	Total Positive PAH	BaP	BaP TEQ
UFA - Fines	120	**11**	18

Bold denotes exceedance of validation criteria

Refer to **Appendix K** *Packing Coke Material Letter Report*. **Appendix L** *Automotive Waste Find Validation Report.*

7.2.6 Automotive Waste Material encountered in the UFA

Hydrocarbon odour and sheen identified during excavation. Twelve (12) soil samples taken for TRH/BTEX/Metals analysis. No soil samples returned detections of TRH or BTEX above laboratory LOR. No soil samples returned detections exceeding the validation criteria for any of the eight heavy metals. Results are summarised in **Table 7b** and **Table 7c** below. Final stockpile location - SP24 (oversized and fines) and east of the haul road (scrap steel) in the Stockpile Staging Area.

Table 7b Automotive Waste Find Results (mg/kg)

Sample ID	F1	F2	F3	F4	Benzene	Toulene	Ethylbenzene	Xylene
PIT 1-NW1	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-NW2	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-SW1	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-SW2	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-WW1	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-WW2	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-EW1	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-EW2	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-EW3	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-BASE-SW	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-BASE-NW	nd	nd	nd	nd	nd	nd	nd	nd
PIT1-BASE-NWA	nd	nd	nd	nd	nd	nd	nd	nd

Bold denotes exceedance of validation criteria

nd = not detected above laboratory LOR

Table 7c Automotive Waste Find Results (mg/kg)

Sample ID	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
PIT 1-NW1	nd	nd	8	4	7	nd	2	13
PIT1-NW2	nd	nd	8	5	8	nd	2	12
PIT1-SW1	nd	nd	8	5	24	nd	2	19
PIT1-SW2	nd	nd	11	7	7	nd	2	19
PIT1-WW1	nd	nd	9	3	43	nd	3	13
PIT1-WW2	18	nd	11	6	6	nd	3	18
PIT1-EW1	5	nd	13	5	32	nd	2	11
PIT1-EW2	nd	nd	7	4	14	nd	1	8
PIT1-EW3	nd	nd	6	6	5	nd	2	12
PIT1-BASE-SW	nd	nd	8	7	10	0.5	2	19
PIT1-BASE-NW	5	nd	12	8	15	nd	4	63
PIT1-BASE-NWA	8	nd	19	18	14	nd	7	110

Bold denotes exceedance of validation criteria

nd = not detected above laboratory LOR

Refer to **Appendix L** *Automotive Waste Find Validation Report.*

7.2.7 Sediment scrapings from Hotspot 2 and the CBP sediment pond

Previous identification of PCoC's within RAWP. Two (2) soil samples taken for Fluoride and Cadmium analysis. Soil sample CBP-Pond-Base returned no detections for cadmium or fluoride. Soil sample CBP-Hotspot-Base returned no detection for cadmium and a detection of 21mg/kg of fluoride. The detection of fluoride was well within site accepted criteria (17,000mg/kg). Final stockpile location - SP43 in the Stockpile Staging Area.

7.2.8 Stockpile containing ACM movement in Stockpile staging area

Validation of footprint following transfer of known ACM stockpile. Two (2) bulk soil samples taken for asbestos analysis. Soil sample Footprint – 1 and soil sample Footprint – 2 returned no asbestos detections. Final stockpile location – Residential Parcel Stockpile in the Stockpile Staging Area.

Refer to **Figure 3** *Hotspot Areas Map* and **Appendix E** *NATA Certified Analytical Results.*

7.3 Groundwater Sampling

No sampling of groundwater was undertaken throughout works. Groundwater monitoring was undertaken in the Phase Two ESA (ENVIRON, 2012) which identified fluoride and cadmium as the Potential Contaminants of Concern (PCoC).

Refer to **Appendix C** *RAWP* (Summary of Phase Two ESA) (Environ, 2014)

7.4 Soil Vapour Sampling

No soil vapour sampling occurred throughout excavation. There was only one (1) section that required testing for volatiles (The Automotive Pit). Samples in this area were tested for volatile and semi-volatile hydrocarbons following the removal of fill material. For this reason, soil vapour sampling was not required.

7.5 QA/QC Comments

Due to the minimal chemical analysis required to achieve validation (12 samples), only one sample was utilised for QA/QC. When validation sampling was conducted of the Automotive Pit which included a Laboratory Duplicate. Laboratory QA/QC on all samples analysed included calculation of %RPD, matrix spike recovery and blank determinations. All matrix spike recovery and blank determinations were within acceptable limits. Therefore, it is considered that sampling techniques and transportation of samples were appropriate. An intra-laboratory duplicate rate of 8.3% was achieved. Laboratory Duplicates were tested to ensure the results meet the requirements of QA/QC. The %RPD for the majority of intra-laboratory duplicates had concentrations that complied with the criteria set for acceptable RPDs and where exceedances were noted, the heterogeneity observed in the duplicate samples was not deemed significant enough to diminish confidence in the sampling technique or laboratory results.

Refer to **Appendix M** – *Quality Assurance and Quality Control* and **Appendix N** – *Automotive Find RPD Data*.

8.0 DISCUSSION

8.1 Remediation Outcome

In 1995 clay material to a maximum depth of 1.5m was transported from this area to the cathode pile. The vegetation and topsoil was stripped prior to excavation. The clay borrow pit was then progressively backfilled with refractory bricks, bitumen, concrete, building materials and automotive waste material and capped with clay material. This process was done repetitively, with inclusions placed on top of clay capping layers. Additional material was then relocated in this area in small stockpiles. Potential Contaminants of Concern (PCoC's) identified in previous investigations and the RAWP were identified as fluoride and cyanide, Polycyclic Aromatic Hydrocarbons (PAHs), Heavy Metals and Asbestos, from disposal of building materials.

The soil containing inclusions on-site was distributed throughout the entire site area (approximately 50,000m^2). For the purposes of identification and validation, the Site was compartmentalised into eight areas. Materials encountered throughout works requiring removal included refractory brick, concrete, bitumen, scrap steel, rubbish, asbestos, building materials, packing coke, automotive waste material and synthetic mineral fibres. The total volume of material removed from the Site was approximately 77,177m^3. Primary Areas of excavation with the highest proportion of inclusions were the Main CBP area and the UFA as they both contained large areas where bulk filling practices were conducted. The additional six areas required remediation to remove fill materials with inclusions, however the proportion of inclusions was less.

Two areas were identified prior to the commencement of works as containing PCoC's. These were named Hotspot 1 (HS1) and Hotspot 2 (HS2). The identified PCoC's were fluoride and Cadmium due to the presence of bulk lots refractory brick. During works, HS1 was identified to contain a hydrocarbon odour. A further six areas were identified to contain PCoC's throughout works. Four were identified to potentially contain asbestos. These were identified as Well 1, Well 2, South of CBP Synthetic Fibre Material and CBP asbestos find. The Automotive Waste Find was an isolated pit containing automotive waste with a hydrocarbon odour. The UFA packing coke find and the Bench packing coke pits contained carbon material utilised to fill walls in the blast furnace. This material was identified to contain PAHs. All materials containing PCoC's were from the Site and remain in the Stockpile Staging area at Hydro Aluminium Kurri Kurri for use in the 'whole of site' remediation strategy.

Operational samples were collected in the Packing Coke Find and HS1 to identify PCoC's and advise the client of future requirements as part of 'whole of site' remediation. Following excavation, surfaces scraped back to natural clays in the Automotive Waste Find and sediment from HS1 and HS2 areas underwent chemical analysis to confirm if the excavations complied with the NEPM (2013) criteria for a land use consistent with *Commercial/Industrial.* Asbestos sample analysis was undertaken in Well 1, Well 2, South of CBP Synthetic Fibre Material and CBP asbestos find. The results of this evaluation are discussed in **Section 8.2** and **Section 8.3** below.

Refer to **Appendix K** *Packing Coke Material Letter Report* and **Appendix L** *Automotive Waste Find Validation Report.*

Materials identified to contain PCoC's were stockpiled in the Stockpile Staging Area for future use within the 'whole of site' remediation strategy. Their final locations are outlined below;

- **HS1 material** – SP 18 (Oversized) and SP 37 (fines) in the Stockpile Staging area.
- **Asbestos Containing Material (ACM) from Well 1** - Residential Parcel Stockpile in the Stockpile Staging Area.
- **Asbestos Containing Material (ACM) from Well 2 -** Residential Parcel Stockpile in the Stockpile Staging Area.
- **Synthetic fibre material from South of CBP area** – Residential Parcel Stockpile in the Stockpile Staging Area.
- **Packing Coke Material encountered in the UFA and Bench area** – SP30 in the Stockpile Staging Area.
- **Automotive Waste Material encountered in the UFA** – SP24 (oversized and fines) and east of the haul road (scrap steel) in the Stockpile Staging Area.
- **Sediment scrapings from HS2 and the CBP sediment pond** – SP43 in the Stockpile Staging Area.
- **Stockpile containing ACM movement in Stockpile staging area** – Residential Parcel Stockpile in the Stockpile Staging Area.

8.2 Chemical Assessment

The concentration of the PCoC's in the operational samples collected from the material in the UFA packing coke material and HS1 and the samples collected from base and walls of the Automotive Waste Material pit and the base of the Sediment scrapings of HS2 were found to be compliant with the NEPM (2013) criteria for a land use consistent with *Commercial/Industrial.*

8.3 Ecological Assessment

An exceedance of ESL criteria (0.7mg/kg) for BaP was noted in soil sample UFA-Fines, which returned a detection of 11mg/kg. Schedule B1 of the NEPM (NEPC, 2013) states that ESLs and EILs apply from the surface to 2m bgl, which corresponds to the root zone and habitation zone of many species. It is recommended that the material is buried at >2m depth as part of the 'whole of site' remediation strategy.

Following a walkover of the areas surrounding the Site a small series of stockpiles was found southwest of the surveyed area surrounded by vegetation. Following visual investigation inclusions in these stockpiles were concrete and bitumen within gravel fill and approximately 500m^3 volume.

This area was identified within the *Hydro Remediation and Demolition Project – Ecological Assessment* conducted by Eco-Logical Australia in April 2015 as containing several threatened species or Endangered Ecological Communities (EEC). These included *Eucalyptus parramattensis subsp. Decadens* and *Grevillea parviflora subsp. Parviflora* and the Lower Hunter Spotted Gum – Ironbark Forest EEC. DLA investigated the possibility of removing the material without disturbing any potential threatened species by conducting floral identification of the species of concern within the area. Two *Eucalyptus parramattensis subsp. Decadens,* two Ironbark and one spotted gum were positively identified. Approximately 15 juvenile *Grevillea parviflora* were positively identified, however due to their size it was not possible to identify if they were *Grevillea parviflora subsp. Parviflora* without extensive investigation.

The identified species were flagged in order to determine if access to the area with an excavator was possible. Although all options were explored it was deemed impossible to excavate the material with inclusions without disturbing the threatened species or EEC highlighted. As the material is of small volume relative to the entire amount excavated throughout works (<1%) and offers minimal visual impact due to its secluded nature the decision was made to allow it to remain in situ. As the total volume of material excavated across the Site was 77,177m^3, the total estimated volume of 500m^3 in this area represents approximately 0.65%.

8.4 Visual Validation

Validation of the Site was based on visual assessment and documentation (photographic) of remaining soils for absence of fill materials. A survey of the Site based on a 30m x 30 m was utilised to facilitate compilation of evidence for 'whole of site' remediation. The survey map was produced by Rennie Golledge Pty Ltd in January 2015 with the UTM coordinates of each grid line highlighted. Each of these squares was photographed from eight locations to demonstrate the removal of all foreign fill materials. The photographs of each grid square were collated into a photo gallery for validation purposes.

Following the removal of foreign materials photographic documentation was compiled of each of the eight primary areas excavated throughout works. Each grid square on the Site Survey Map geotagged in the approximate centre with the coordinates highlighted in the Validation Photo gallery. A total of eight photos were used of each grid square to highlight the removal of all foreign fill materials. The precession of the photographic documentation within the gallery commenced from the north-west corner of the grid square continuing in a clockwise direction and was completed on the western side of the square.

The removal of the fill material to natural or a clay lining and the shaping of all excavations to prevent ponding and satisfy the erosion and sediment control measures identified in the *RAWP* have been completed across the site.

9.0 CONCLUSIONS

The sampling regime and subsequent assessment and reporting of the Site are considered to be adequate for validation purposes to determine the future land use suitability of the Subject Site in accordance with Cessnock City Council, relevant Development Consent Conditions and the general requirements of State Environmental Planning Policy No.55 (SEPP 55). All reporting has been undertaken in accordance with the *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 2011) and the *Guidelines for the NSW Site Auditor Scheme* (NSW EPA, 2nd ed., 2006). No significant issues were encountered during the remediation works.

Following remediation works, no evidence could be found to infer chemical contamination by Fluoride and Cyanide, PAH, Heavy Metals or asbestos at the Site, which were previously identified as the Contaminants of Concern in the RAWP (Environ, 2014). Other aesthetic concerns at the Site including inclusions of brick, concrete and bitumen were also successfully managed as part of the remediation programme. Other materials encountered throughout works that were potentially contaminated have been delineated from all inert material and remain on the Hydro Aluminium Kurri Kurri property.

The completion of this report concludes that the remediation objectives of the RAWP (Environ, 2014) have been achieved through the implementation of the selected remediation strategy. On the basis of this information and with the implementation of an EMP, the Site is considered suitable for an end land use consistent with NEPM (NEPC, 2013) Table 1(A)1 *Commercial/Industrial D – Shops, offices, factories and industrial sites.*

10.0 REFERENCES

- *Application for Exemption – Refractory Brick, Hydro Aluminium Pty Ltd,* ENVIRON Australia Pty Ltd (ENVIRON 2012a);
- *Australian and New Zealand Guidelines for the Management of Contaminated Sites* (ANZECC/NHMRC 1992);
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- *Australian Drinking Water Guidelines, National Water Quality Management Strategy* 2011;
- Chapman, G A, Murphy, C L, Tille, P J, Atkinson, G and Morse, R J, *Sydney Soil Landscapes Map*, Series 9130 (1989);
- *Code of Practice for the Safe Removal of Asbestos* (NOHSC, 2nd eds, 2005);
- *Contaminated Land Management Act 1997* (NSW);
- *Contaminated Sites: Assessing Service Station Sites, 1994* (NSW EPA, 1994);
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA 2011);
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- *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme* (NSW EPA, 2nd ed., 2006);
- *Contaminated Sites: Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report* (NSW EPA 1999);
- *Contaminated Sites: Sampling Design Guidelines* (NSW EPA 1995);
- *Environmental Guidelines: Solid Waste Landfills* (NSW EPA, 1996);
- *Eucalyptus Paramattensis subsp. Decadens – Profile* (Office of Environment and Heritage NSW, 2014) http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10305, Viewed 20/08/2015
- *Field Guide to the Native Plants of Sydney* (2nd Edn.) (Robinson, 1991);
- *Guidelines for the Assessment of On-Site Containment of Contaminated Soil* (ANZECC, 1999).
- *Health - Based Soil Investigation Levels, Imray, P & Langley, A, National Environmental Health Forum Monographs, Soil Series No. 2 (2nd Ed), South Australian Health Commission* (NEHF 1998b);
- *How to Safely Remove Asbestos: Code of Practice* (WorkCover, 2011);
- *Lower Hunter Spotted Gum- Iron Bark Forest in the Sydney Basin Bioregion* (Department of Environment and Climate Change, 2007);
- *Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion – profile* (Office of Environment and Heritage NSW, 2014) http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10942, Viewed 20/08/2015
- *National Environment Protection (Assessment of Site Contamination) Measure (No.1)* (NEPC, 2013);

- *Managing Land Contamination: Planning Guidelines, SEPP 55 - Remediation of Land* (DUAP, 1998);
- *Remedial Action Work Plan – Clay Borrow Pit Area*, Kurri Kurri ENVIRON Australia Pty Ltd (ENVIRON, 2014);
- Sampling, Analysis and Quality Plan, Refractory Brick Characterisation, ENVIRON Australia Pty Ltd (ENVIRON 2012a);
- *Small Flower Grevillea – Profile* (Office of Environment and Heritage, NSW, 2015)
- *Storage and Handling of Dangerous Goods Code of Practice 2005*;
- Pacific Southwest, Region 9 Regional Screening Levels (US EPA, 2014);
- *Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter,* ENVIRON Australia Pty Ltd (ENVIRON 2013b;
- *Phase 2 ESA*, Kurri Kurri Aluminium Smelter, Norsk Hydro ASA, ENVIRON Australia Pty Ltd (ENVIRON 2012);
- *Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford,* ENVIRON Australia Pty Ltd (ENVIRON 2013a);
- *Tier 2 Ecological Risk Assessment Kurri Kurri Aluminium Smelter, Hart Road, Loxford,* ENVIRON Australia Pty Ltd (ENVIRON 2013);
- *Wallis and Fishery Creeks Total Catchment Management Strategy*, Hunter Catchment Management Trust, (HCTM 2000);
- *Waste Avoidance and Resource Recovery Act 2001* (NSW);
- *Waste Classification Guidelines* (NSW EPA, 2014); and,
- *Work Health and Safety Act 2011* (NSW) and associated regulations.

FIGURE 1 – SITE LOCATION

DLA Environmental Services
A Pacific Environment company

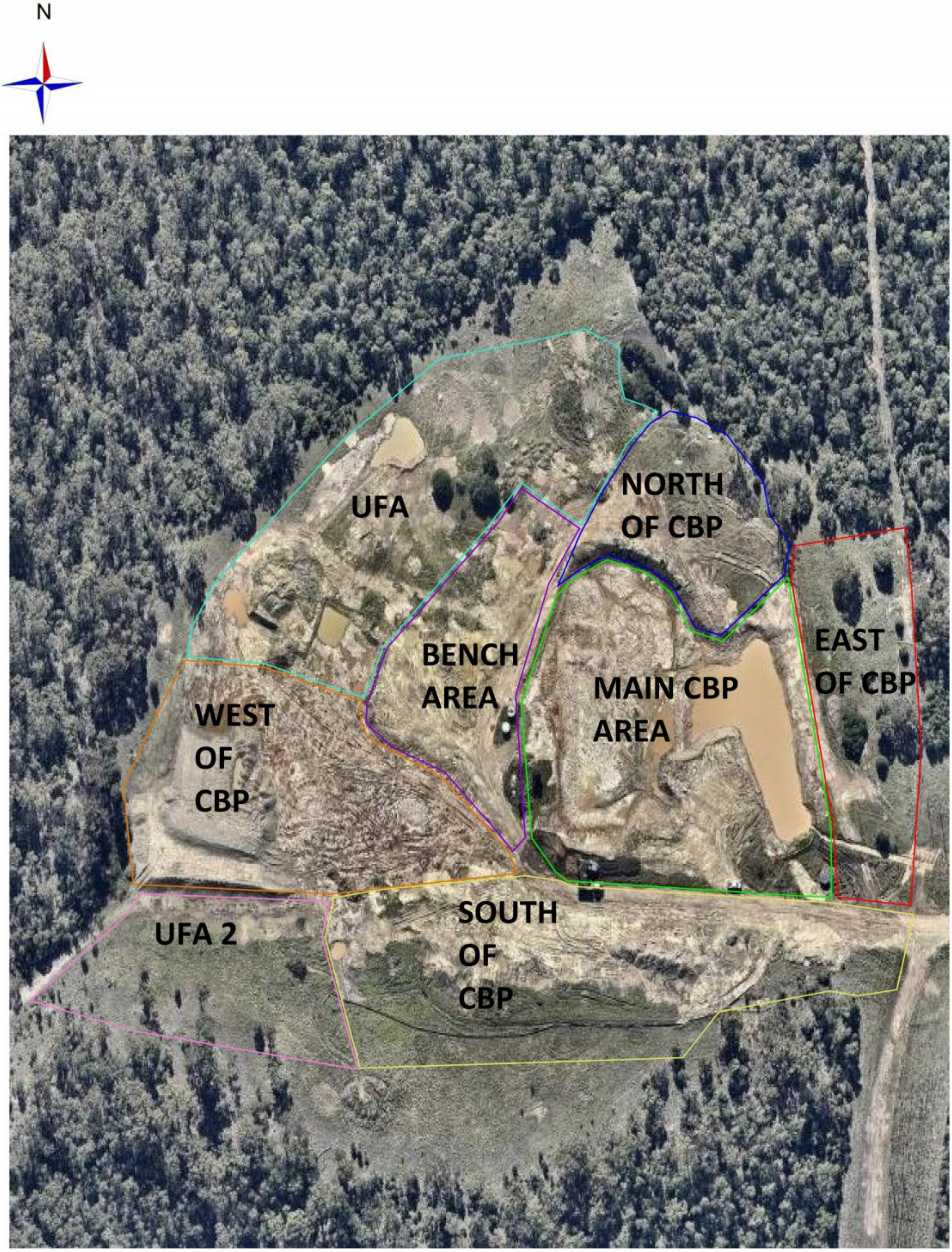
Sydney
Unit 2B/30 Leighton Place
Hornsby NSW 2077
2335
Tel: 02-94761765
Fax: 02-94761557

Maitland
42B Church Street
Maitland NSW

Tel: 02-49330001

Title:	Clay Borrow Pit Site - Hydro Aluminium Lot 1 Hart Rd Loxford NSW 2326
Figure: 1	Project no:: DLH1155
Date: 30/09/2015	Revision: 1

FIGURE 2 – CBP AREAS MAP



Legend

Area Boundary

Approximate Scale

0m 20m 40m

DLA Environmental Services
A Pacific Environment company

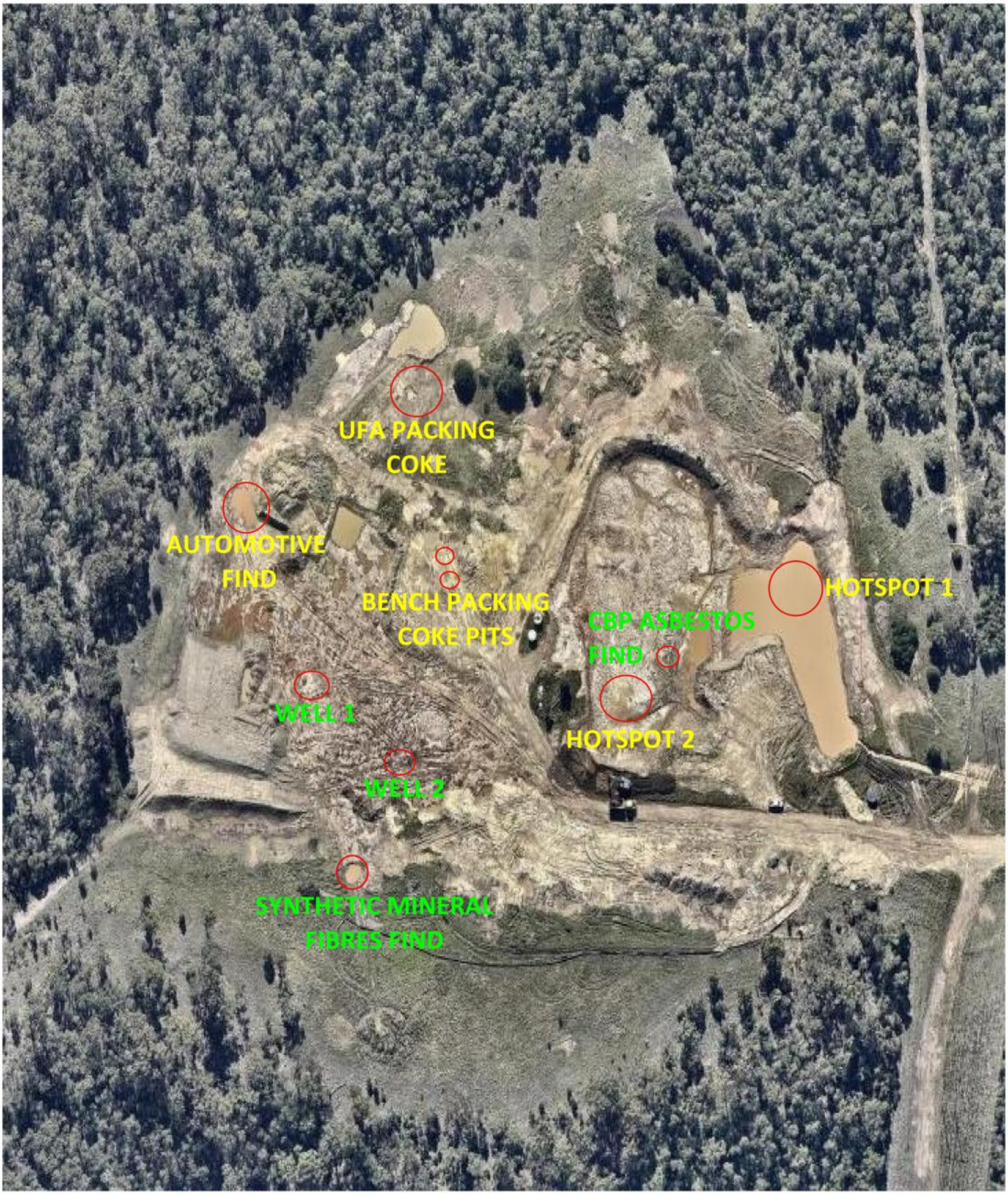
Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Maitland Office
Phone (02) 4933 0001

Title			
Clay Borrow Pit Areas Map			
Client: Hydro Aluminium	Figure No: 2		Date: 30/09/2015
Project No.: DLH1155	Scale: As Shown	Compiled: JM	Revision: R00

FIGURE 3 – HOTSPOT AREAS

N



Legend

- Asbestos Hotspot
- Area Boundary
- Chemical Hotspot

Approximate Scale

0m 20m 40m

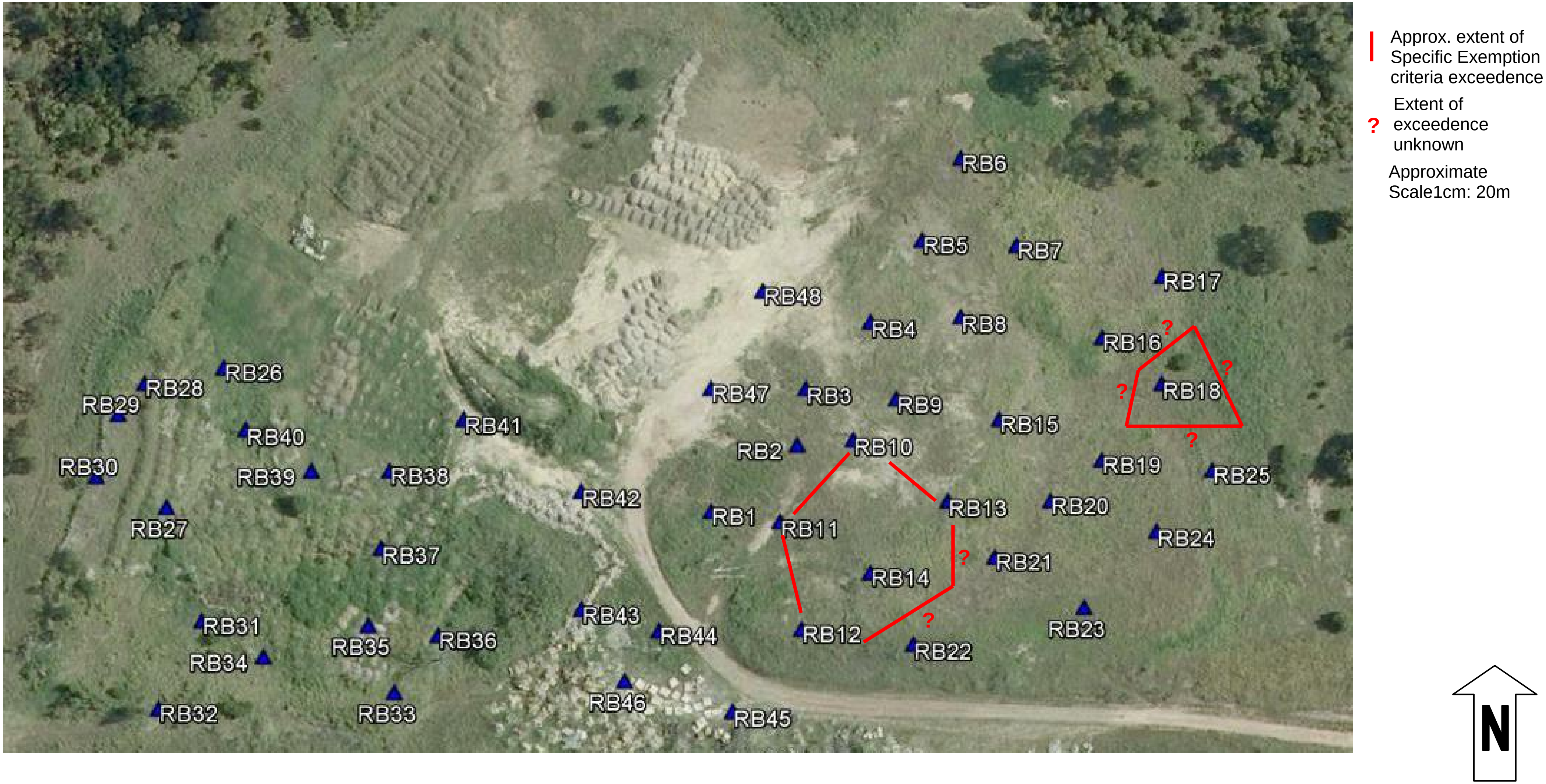
DLA Environmental Services
A Pacific Environment company

Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Maitland Office
Phone (02) 4933 0001

Title			
Hotspot Areas			
Client	Figure No		Date
Hydro Aluminium	3		30/09/2015
Project No.	Scale	Compiled	Revision
DLH1155	As Shown	JM	R00

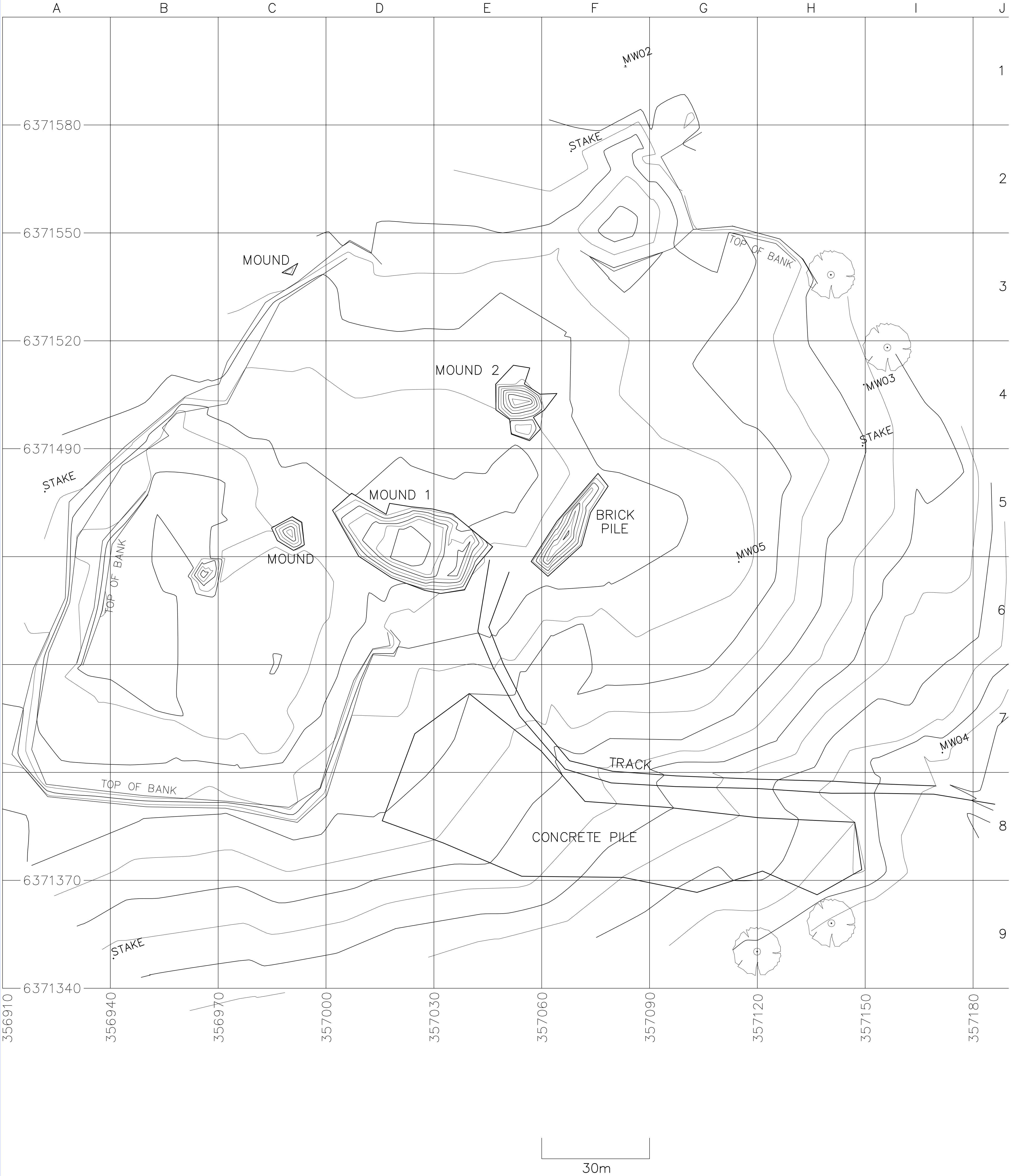
FIGURE 4 – ENVIRON BRICK SAMPLING LOCATIONS (2014)



NB Aerial image is dated 2009 and may not reflect actual current (August 2014) stockpile locations

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit		Brick Sampling Locations – August 2014	
ENVIRON	JOB NO:AS130386	DATE: December 2014	FIGURE 4

FIGURE 5 – SITE SURVEY MAP – RENNIE GOLLEDGE HYDRO ALUMINIUM EXCAVATION SITE 3



RENNIE GOLLEDGE PTY. LTD.
SURVEYORS & PLANNERS
P.O. BOX 132
36 St ANDREWS ST
MAITLAND NSW 2320
ABN: 55 002 622 317
PH (02) 49334977
FAX (02) 49338579
mail@renniegolledge.com.au

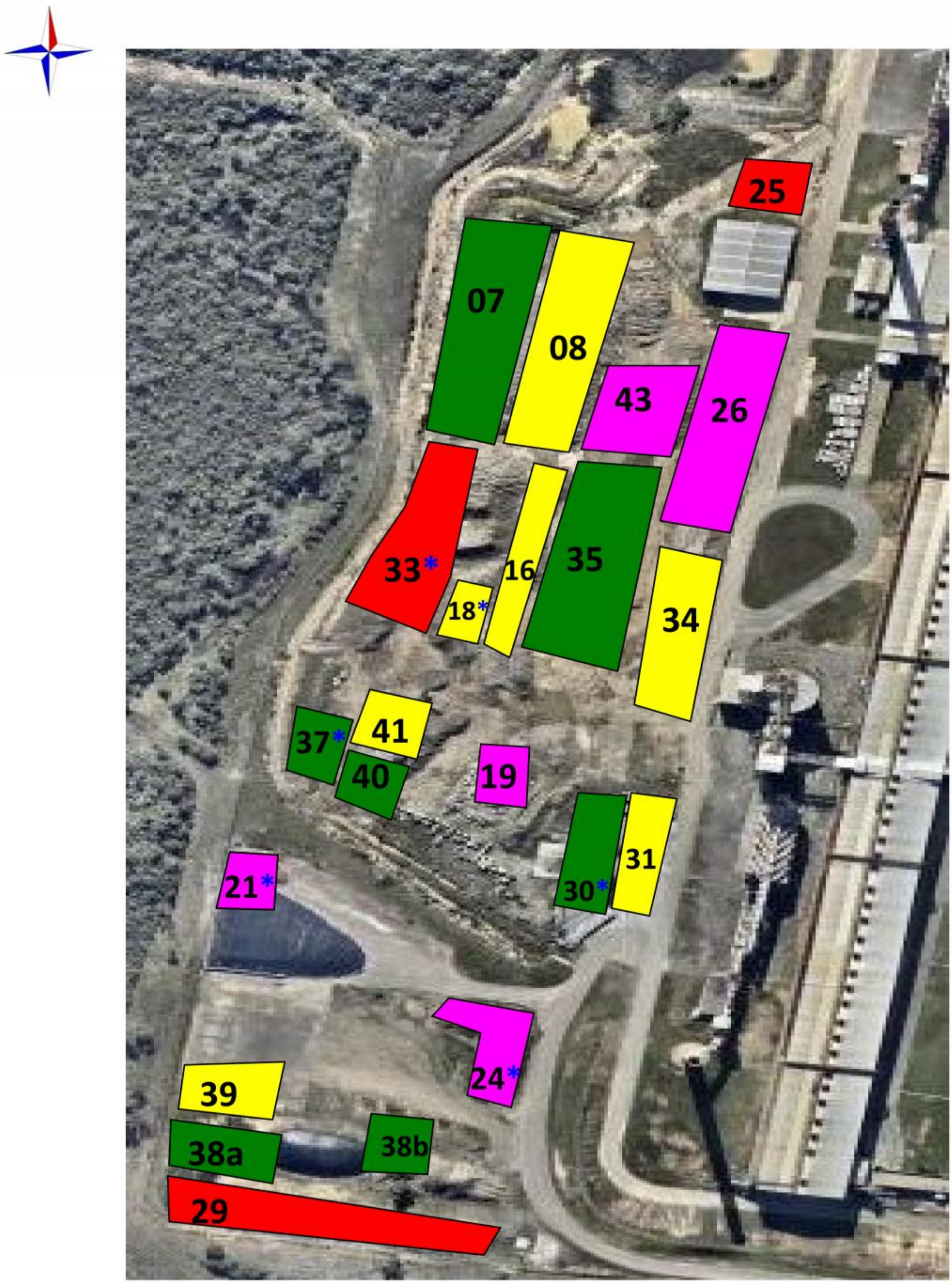
DATE: 12/1/15 REF: 309.14

HYDRO ALUMINIUM
EXCAVATION SITE 3
KURRI KURRI

ENVIROPACIFIC

DRAWING NOT TO SCALE

FIGURE 6 – FINAL STOCKPILE LOCATIONS



Legend

FINES

CONCRETE/ASPHALT/RUBBISH

BRICKS

UNSEGREGATED

*= HOTSPOT

Approximate Scale

0m 15m 30m

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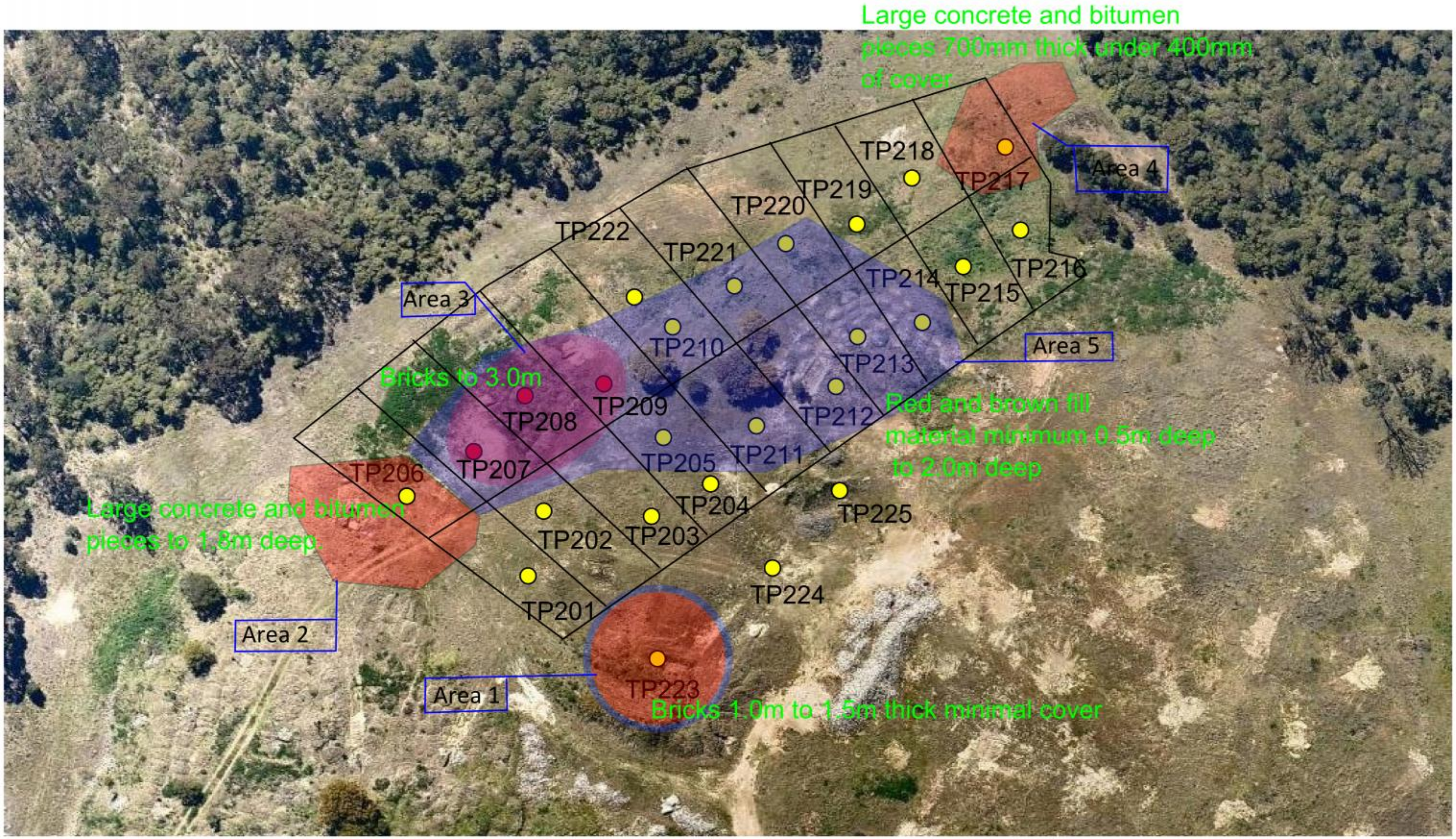
A Pacific Environment company

Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Maitland Office
Phone (02) 4933 0001

Title			
Final Stockpile Locations			
Client: Hydro Aluminium	Figure No: 6		Date: 02/10/2015
Project No.: DLH1155	Scale: As Shown	Compiled: JM	Revision: R00

FIGURE 7 – UNEXPECTED FINDS AREA VOLUMES MAP



Legend

Test Pit Location

N

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A Pacific Environment company

Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Maitland Office
Phone (02) 4933 0001

Title			
CBP- Unexpected finding Investigation Plan			
Client: Hydro Aluminium	Project No.: DLH 1155	Figure No: 7	Date: 30/09/2015
	Scale: As Shown	Compiled: JM	Revision: R00

APPENDIX A – HYDRO REMEDIATION AND DEMOLITION PROJECT - ECOLOGICAL ASSESSMENT

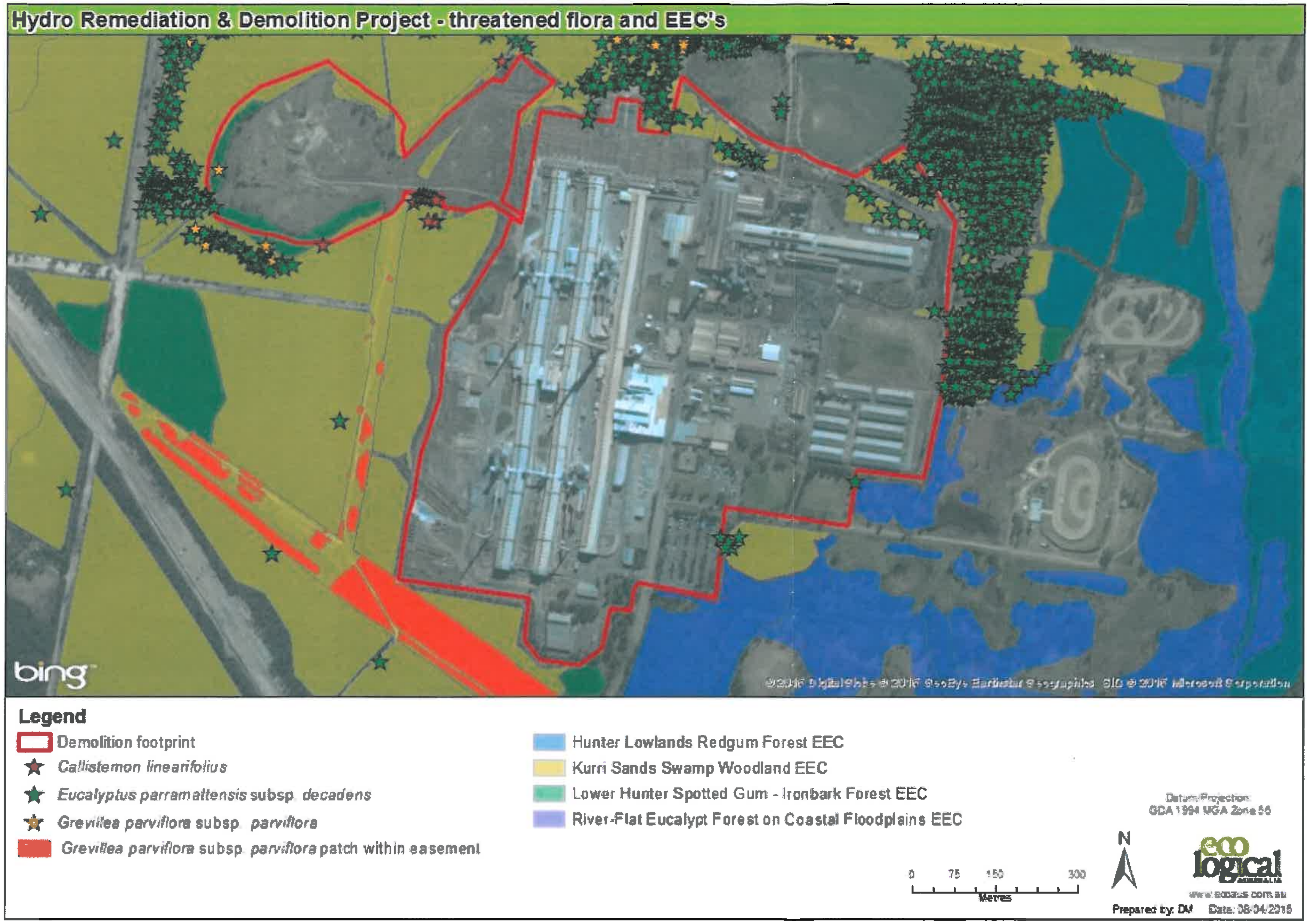


Figure 7: Threatened flora and EEC's within and surrounding the project area*.

*Note: Flora surveys have focussed on specific areas and records do not represent all the individuals in the study area. An indicative distribution of *E .parramattensis* and *G. parviflora* in the study area can be seen in the Kurri Sands Swamp Woodland EEC where these threatened species were observed to occur regularly at variable densities.

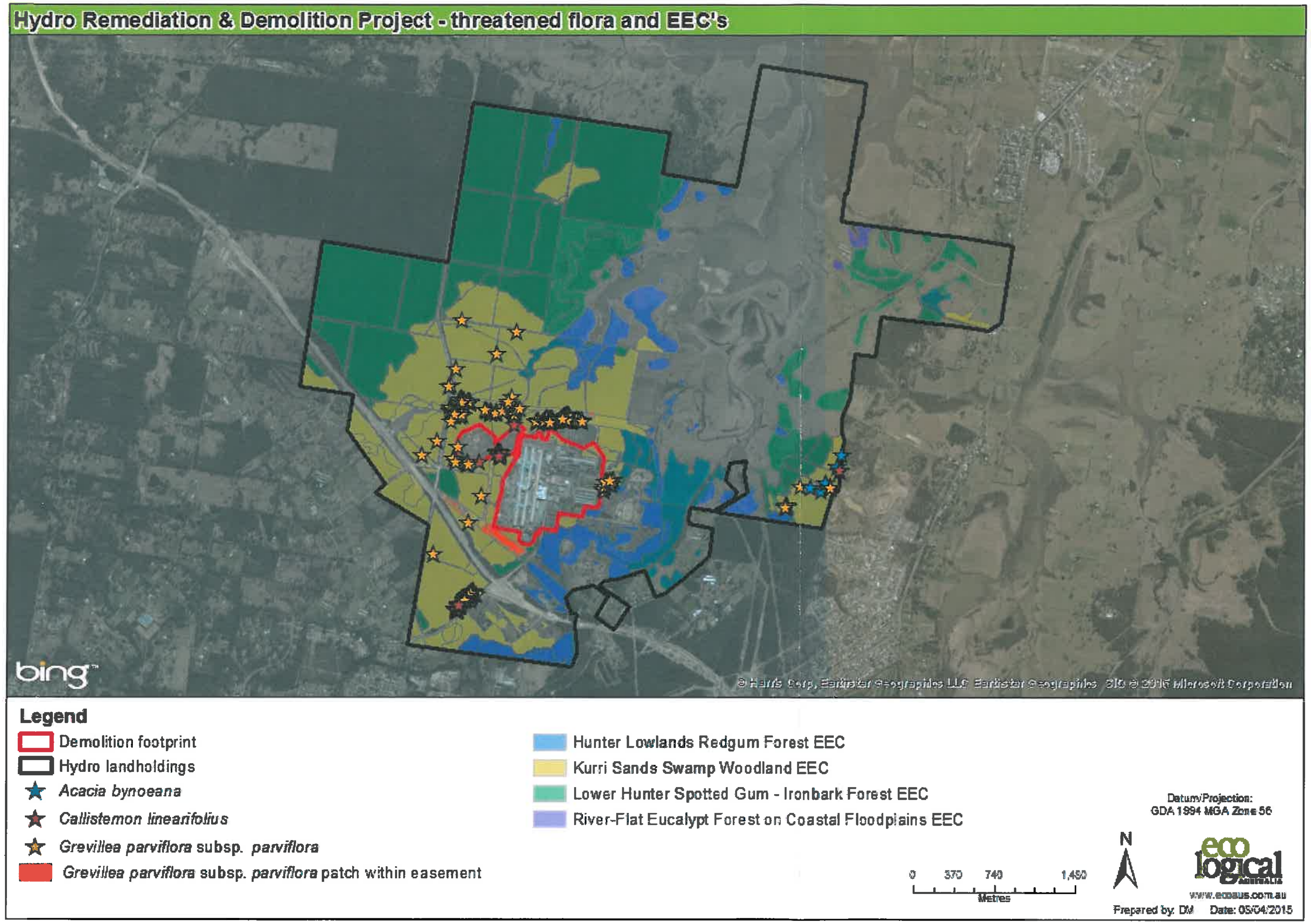


Figure 6: Recorded threatened flora locations and EEC's within the study area*.

*Note: Flora surveys have focussed on specific areas and records do not represent all the individuals in the study area. For clarity, the specific locations of *E. parramattensis* subsp. *decadens* have not been displayed. However an indicative distribution of the species can be seen in the Kurri Sands Swamp Woodland EEC where this species is often the dominant or co-dominant canopy species.

APPENDIX B – HYDRO ALUMINIUM CBP VALIDATION PHOTO GALLERY

HYDRO ALUMINIUM KURRI KURRI CLAY BORROW PIT - DLH1155

Validation Photo Gallery

January-September 2015

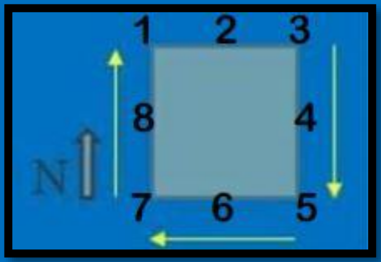
DLA Environmental Services

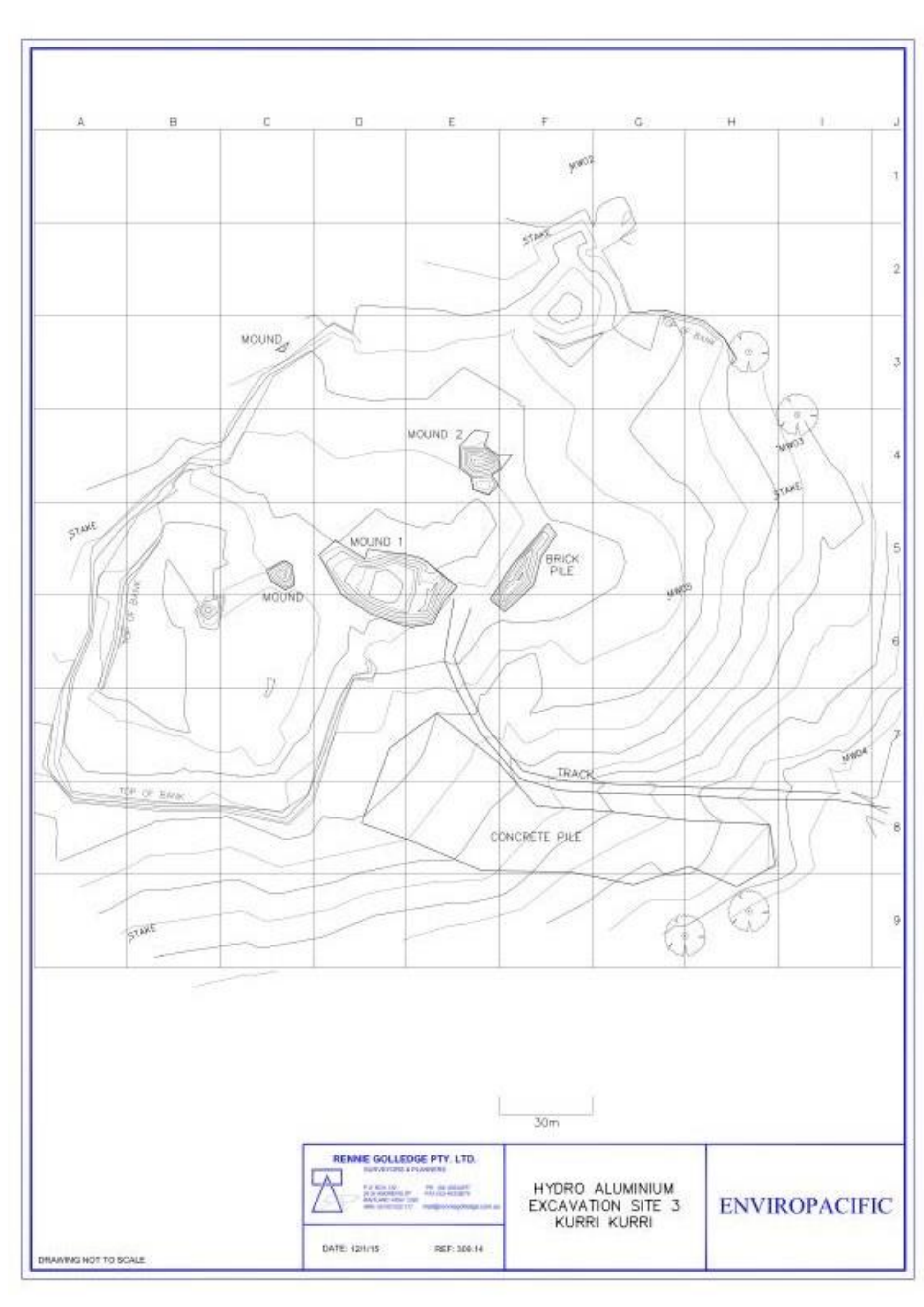
GALLERY FORMAT

- The following gallery has been designed based on validation of the Clay Borrow Pit Excavation area by utilising the survey map produced by Rennie Golledge Pty Ltd on 12/01/2015.
- Each grid square represents a 30m x 30m area within the targeted site.
- All GPS coordinates displayed within the gallery have been abstracted from the location of the centre of each grid square marked out throughout the validation process.
- Grid square dimensions have been approximately marked out for validation purposes prior to documenting photographic evidence in compliance with the Environ RWAP (2014).
- As this method was chosen to expedite validation of the works process coordinates presented in this gallery are considered the most accurate method of determining the final position of each grid square.

GALLERY INSTRUCTIONS

- When viewing each gallery page click on the GPS coordinates for the respective grid square
- This will return you to the survey map slide to view the corresponding grid square
- Click on the survey map to return to the previously viewed slide
- The procession of eight photos demonstrating visual validation of each grid square begins from the north-west corner and continues around the square in a clockwise direction finishing with a view from the western side.
- Grid Squares F7, G7, H7 and I7 were utilised to specifically validate the haul road. These progression of photos on in these sections includes six photos of the road area and two photos of test pits demonstrating the absence of foreign fill materials.
- Grid square G1 has four photos as it is mostly vegetated.





Survey Map

Produced by

Rennie Golledge PTY LTD

12/01/2015

- All grid squares found on this map have photographic evidence provided in the following gallery except for those completely vegetated and considered to be outside of the required scope of works.

Grid Square A4

GPS Coordinates: Latitude: -32 ° 47 ' 6.30782 " Longitude: 151 ° 28 ' 19.83491 "

06/06/2015

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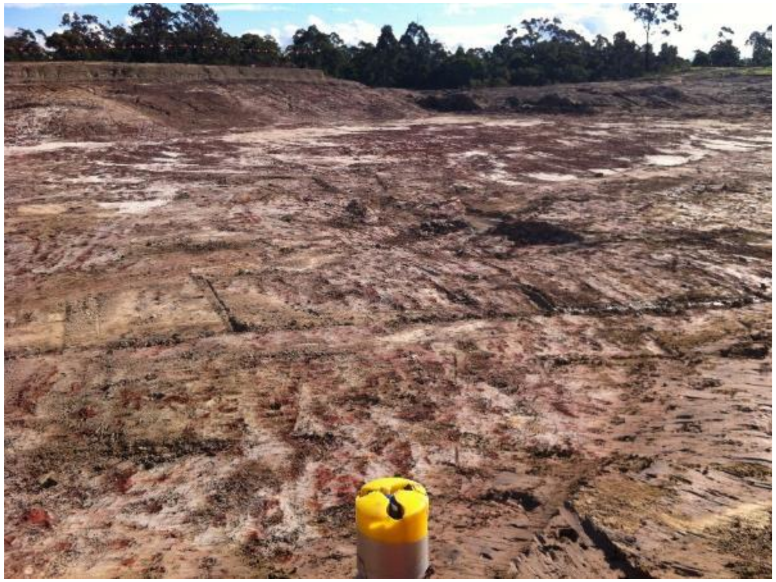
A Pacific Environment company

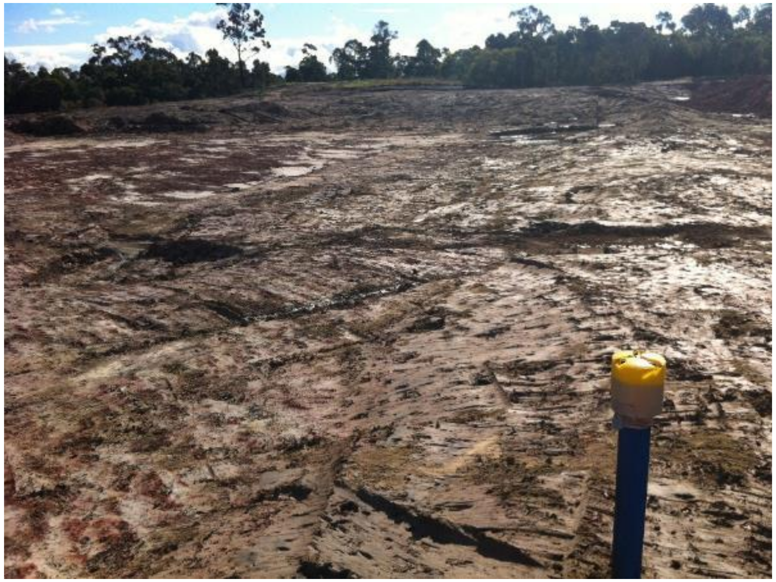
Grid Square A4 GPS Coordinates: Latitude: -32 ° 47 ' 6.30782 " Longitude: 151 ° 28 ' 19.83491 "

06/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square A5 GPS Coordinates: Latitude: -32 ° 47 ' 7.28170 " Longitude: 151 ° 28 ' 19.81826 "

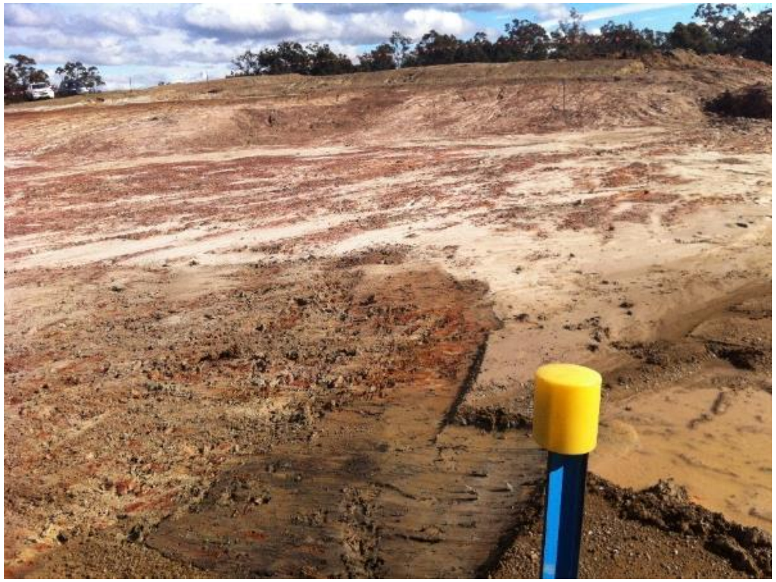




16/07/2015

DLA Environmental Services
A Pacific Environment company

Grid Square A5 GPS Coordinates: Latitude: -32 ° 47 ' 7.28170 " Longitude: 151 ° 28 ' 19.81826 "



16/07/2015

DLA Environmental Services
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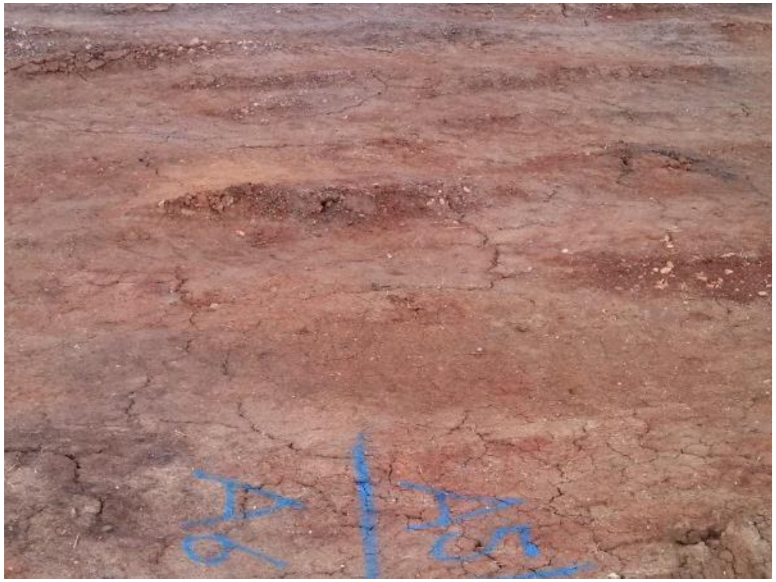
Grid Square A6 GPS Coordinates: Latitude: -32 ° 47 ' 8.25559 " Longitude: 151 ° 28 ' 19.80161 "






30/06/2015

Grid Square A6

GPS Coordinates: Latitude: -32 ° 47 ' 8.25559 " Longitude: 151 ° 28 ' 19.80161 "

30/03/2015

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Grid Square A7

GPS Coordinates: Latitude: -32 ° 47 ' 9.22948 " Longitude: 151 ° 28 ' 19.78496 "




30/03/2015

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Grid Square A7

GPS Coordinates: Latitude: -32 ° 47 ' 9.22948 " Longitude: 151 ° 28 ' 19.78496 "




30/03/2015

Grid Square A8

GPS Coordinates: Latitude: -32 ° 47 ' 10.20336 " Longitude: 151 ° 28 ' 19.76831 "

02/07/2015

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Grid Square A8 GPS Coordinates: Latitude: -32 ° 47 ' 10.20336 " Longitude: 151 ° 28 ' 19.76831 "

02/07/2015

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Grid Square B3 GPS Coordinates: Latitude: -32 ° 47 ' 5.34799 " Longitude: 151 ° 28 ' 21.00448 "

04/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square B3 GPS Coordinates: Latitude: -32 ° 47 ' 5.34799 " Longitude: 151 ° 28 ' 21.00448 "

04/06/2015

DLA Environmental Services
A Pacific Environment company

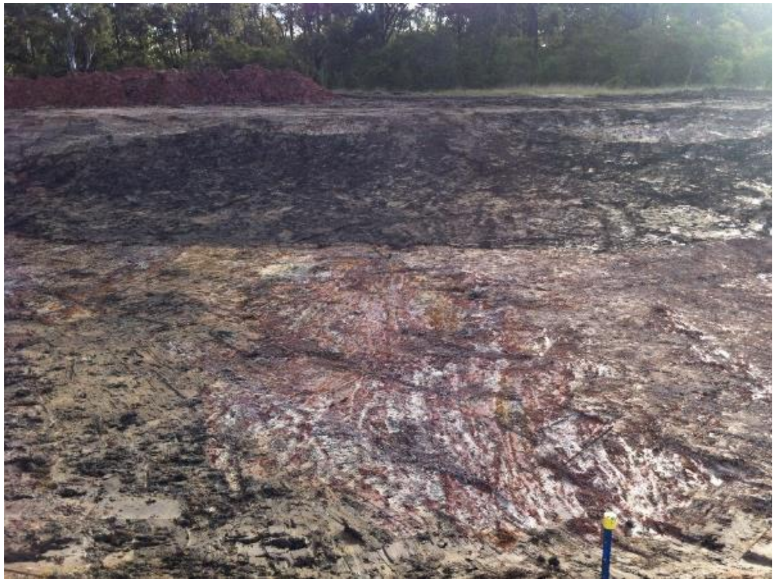
Grid Square B4

GPS Coordinates: Latitude: -32 ° 47 ' 6.32188 " Longitude: 151 ° 28 ' 20.98784 "

05/06/15

DLA Environmental Services
A Pacific Environment company

Grid Square B4 GPS Coordinates: Latitude: -32 ° 47 ' 6.32188 " Longitude: 151 ° 28 ' 20.98784 "



05/06/15

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10/06/2015 and 11/06/2015

Grid Square B5 GPS Coordinates: Latitude: -32 ° 47 ' 7.29577 " Longitude: 151 ° 28 ' 20.97119 "

10/06/2015 and 11/06/2015

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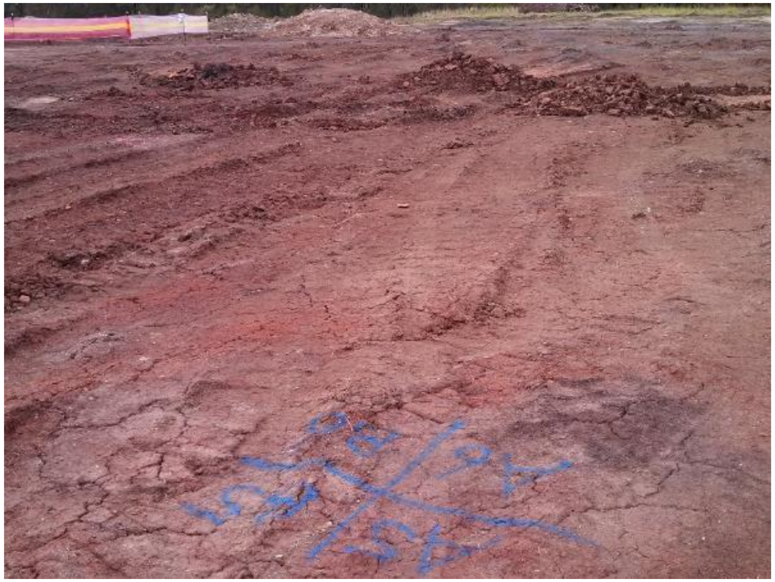

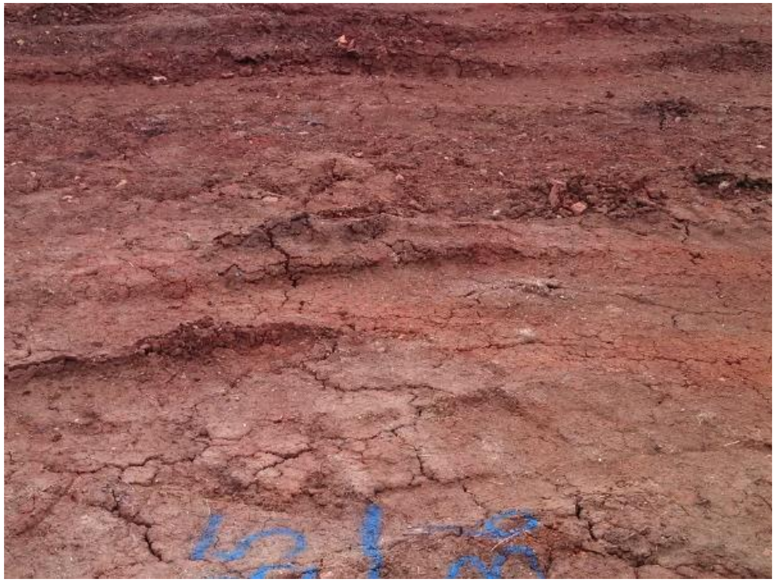

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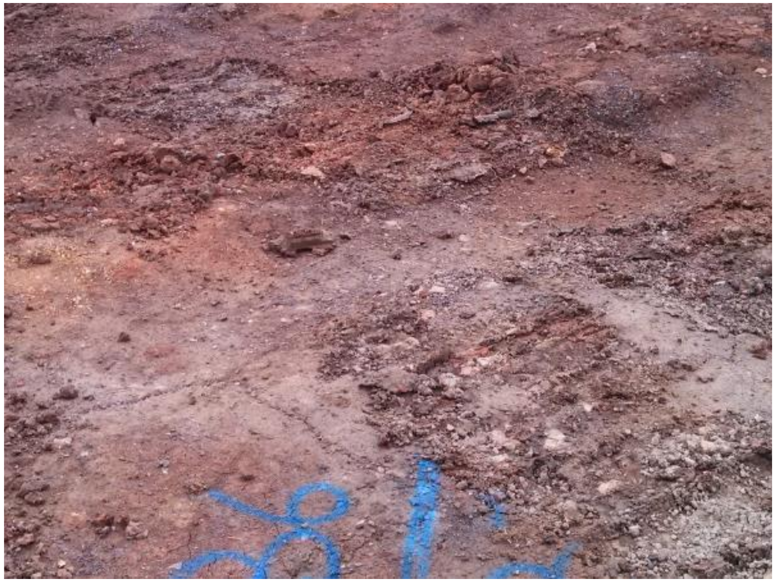
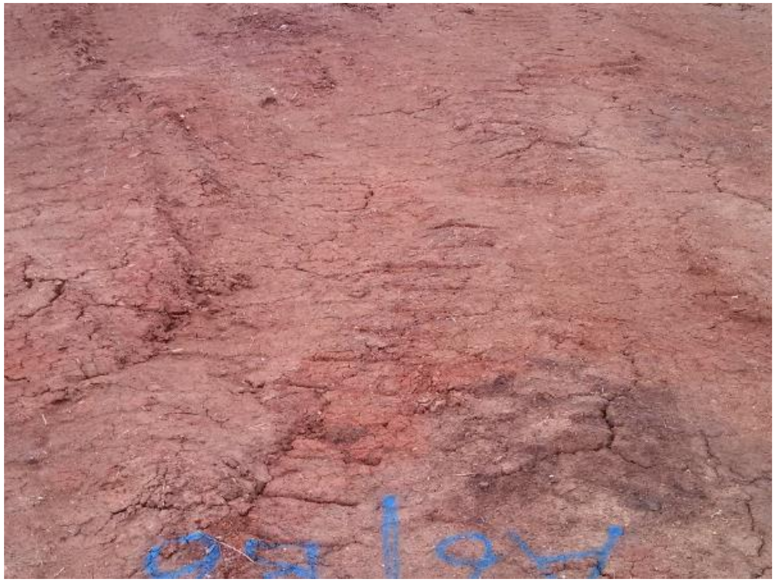
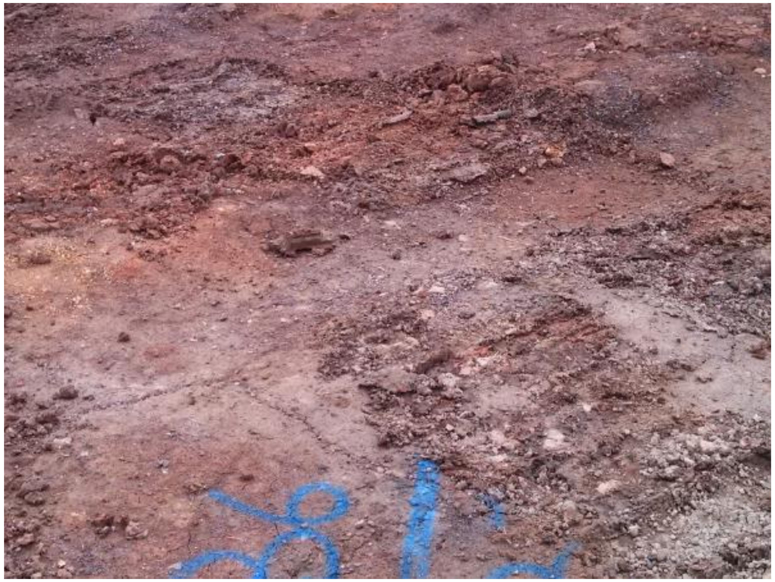




30/03/2015

DLA Environmental Services
A Pacific Environment company

Grid Square B7 GPS Coordinates: Latitude: -32 ° 47 ' 9.24354 " Longitude: 151 ° 28 ' 20.93789 "



30/03/2015

DLA Environmental Services
A Pacific Environment company

Grid Square B7 GPS Coordinates: Latitude: -32 ° 47 ' 9.24354 " Longitude: 151 ° 28 ' 20.93789 "

30/03/2015

DLA Environmental Services
A Pacific Environment company

Grid Square B8 GPS Coordinates: Latitude: -32 ° 47 ' 10.21743 " Longitude: 151 ° 28 ' 20.92124 "

02/07/2015 and 03/07/2015

DLA Environmental Services
A Pacific Environment company

Grid Square B8

GPS Coordinates: Latitude: -32 ° 47 ' 10.21743 " Longitude: 151 ° 28 ' 20.92124 "

02/07/2015 and 03/07/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C2 GPS Coordinates: Latitude: -32 ° 47 ' 4.38817 " Longitude: 151 ° 28 ' 22.17405 "

09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C2 GPS Coordinates: Latitude: -32 ° 47 ' 4.38817 " Longitude: 151 ° 28 ' 22.17405 "

09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C3

GPS Coordinates: Latitude: -32 ° 47 ' 5.36206 " Longitude: 151 ° 28 ' 22.15740 "

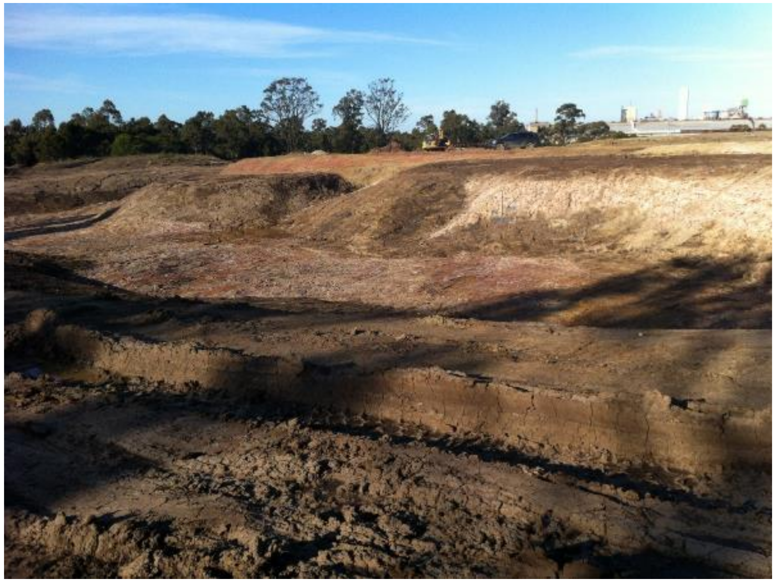



09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C3

GPS Coordinates: Latitude: -32 ° 47 ' 5.36206 " Longitude: 151 ° 28 ' 22.15740 "



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DLA Environmental Services
A Pacific Environment company

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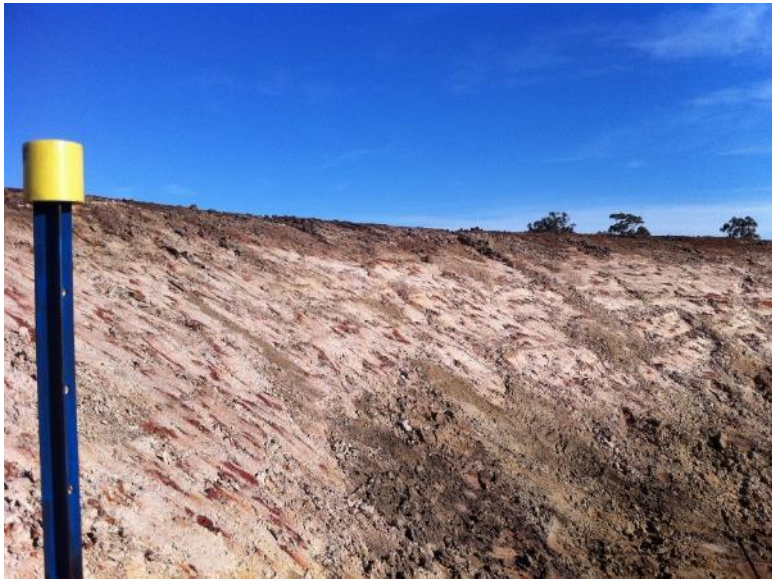

09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C4 GPS Coordinates: Latitude: -32 ° 47 ' 6.33594 " Longitude: 151 ° 28 ' 22.14076 "

09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C5 GPS Coordinates: Latitude: -32 ° 47 ' 7.30983 " Longitude: 151 ° 28 ' 22.12411 "

07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C5 GPS Coordinates: Latitude: -32 ° 47 ' 7.30983 " Longitude: 151 ° 28 ' 22.12411 "

07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C6

GPS Coordinates: Latitude: -32 ° 47 ' 8.28372 " Longitude: 151 ° 28 ' 22.10747 "

11/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C6

GPS Coordinates: Latitude: -32 ° 47 ' 8.28372 " Longitude: 151 ° 28 ' 22.10747 "

11/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C7

GPS Coordinates: Latitude: -32 ° 47 ' 9.25760 " Longitude: 151 ° 28 ' 22.09082 "

15/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C7 GPS Coordinates: Latitude: -32 ° 47 ' 9.25760 " Longitude: 151 ° 28 ' 22.09082 "

15/06/2015

DLA Environmental Services
A Pacific Environment company

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02/07/2015

DLA Environmental Services
A Pacific Environment company

Grid Square C8 GPS Coordinates: Latitude: -32 ° 47 ' 10.23149 " Longitude: 151 ° 28 ' 22.07418 "

02/07/2015

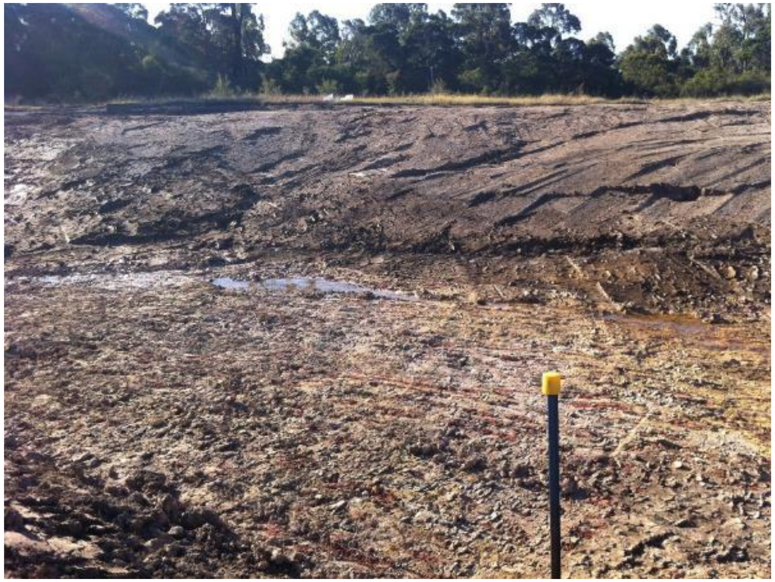
Grid Square D2 GPS Coordinates: Latitude: -32 ° 47 ' 4.40223 " Longitude: 151 ° 28 ' 23.32696 "

09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D2

GPS Coordinates: Latitude: -32 ° 47 ' 4.40223 " Longitude: 151 ° 28 ' 23.32696 "



09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D3 GPS Coordinates: Latitude: -32 ° 47 ' 5.37611 " Longitude: 151 ° 28 ' 23.31032 "

07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D3 GPS Coordinates: Latitude: -32 ° 47 ' 5.37611 " Longitude: 151 ° 28 ' 23.31032 "

07/08/2015

Grid Square D4 GPS Coordinates: Latitude: -32 ° 47 ' 6.35000 " Longitude: 151 ° 28 ' 23.29368 "

07/08/2015

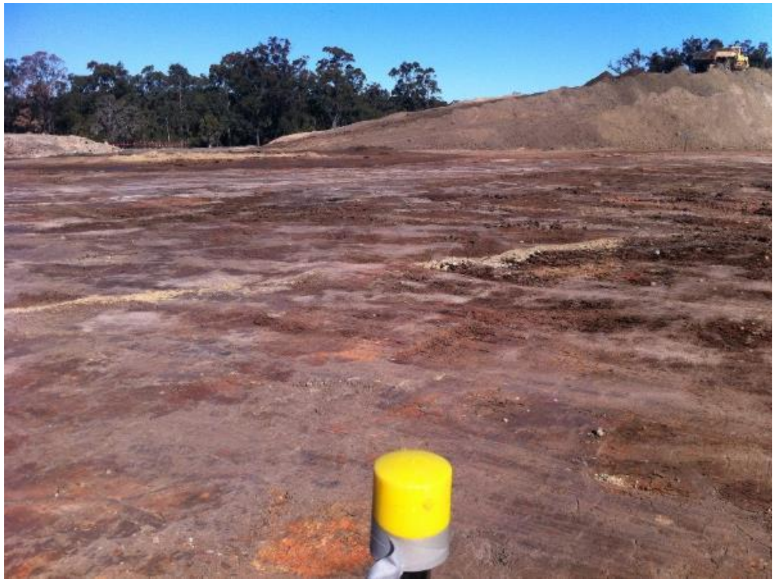
DLA Environmental Services
A Pacific Environment company

Grid Square D4 GPS Coordinates: Latitude: -32 ° 47 ' 6.35000 " Longitude: 151 ° 28 ' 23.29368 "

07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D5 GPS Coordinates: Latitude: -32 ° 47 ' 7.32389 " Longitude: 151 ° 28 ' 23.27704 "



07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D5 GPS Coordinates: Latitude: -32 ° 47 ' 7.32389 " Longitude: 151 ° 28 ' 23.27704 "

07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D6 GPS Coordinates: Latitude: -32 ° 47 ' 8.29777 " Longitude: 151 ° 28 ' 23.26040 "

07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D6

GPS Coordinates: Latitude: -32 ° 47 ' 8.29777 " Longitude: 151 ° 28 ' 23.26040 "

07/08/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D7 GPS Coordinates: Latitude: -32 ° 47 ' 9.27166 " Longitude: 151 ° 28 ' 23.24376 "




24/09/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D7

GPS Coordinates: Latitude: -32 ° 47 ' 9.27166 " Longitude: 151 ° 28 ' 23.24376 "

24/09/2015

DLA Environmental Services

A Pacific Environment company

Grid Square D8 GPS Coordinates: Latitude: -32 ° 47 ' 10.24555 " Longitude: 151 ° 28 ' 23.22711 "

24/09/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D8 GPS Coordinates: Latitude: -32 ° 47 ' 10.24555 " Longitude: 151 ° 28 ' 23.22711 "

24/09/2015

DLA Environmental Services
A Pacific Environment company

Grid Square D9 GPS Coordinates: **Latitude:** -32 ° 47 ' 11.21944 "**Longitude:**151 ° 28 ' 23.21047 "

01/09/2015

Grid Square D9 GPS Coordinates: **Latitude:** -32 ° 47 ' 11.21944 "**Longitude:**151 ° 28 ' 23.21047 "

01/09/2015

DLA Environmental Services
A Pacific Environment company

Grid Square E1 GPS Coordinates: Latitude: -32 ° 47 ' 3.44239 " Longitude: 151 ° 28 ' 24.49651 "

09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square E1 GPS Coordinates: Latitude: -32 ° 47 ' 3.44239 " Longitude: 151 ° 28 ' 24.49651 "

09/06/2015

DLA Environmental Services
A Pacific Environment company

Grid Square E2 GPS Coordinates: Latitude: -32 ° 47 ' 4.41628 " Longitude: 151 ° 28 ' 24.47988 "

16/07/2015

DLA Environmental Services
A Pacific Environment company

Grid Square E2 GPS Coordinates: Latitude: -32 ° 47 ' 4.41628 " Longitude: 151 ° 28 ' 24.47988 "




16/07/2015

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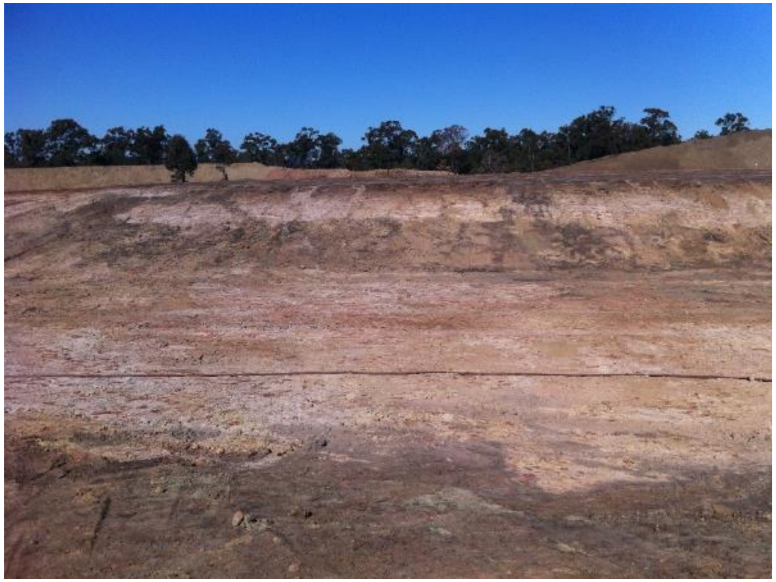

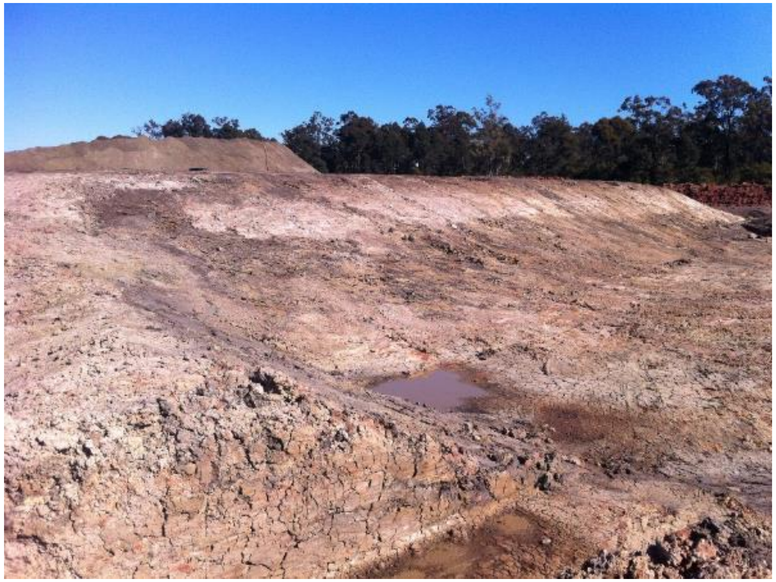

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07/08/2015

DLA Environmental Services
A Pacific Environment company

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07/08/2015

DLA Environmental Services
A Pacific Environment company

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A Pacific Environment company

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A Pacific Environment company

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A Pacific Environment company

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24/09/2015

DLA Environmental Services
A Pacific Environment company

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24/09/2015

DLA Environmental Services

A Pacific Environment company

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24/09/2015

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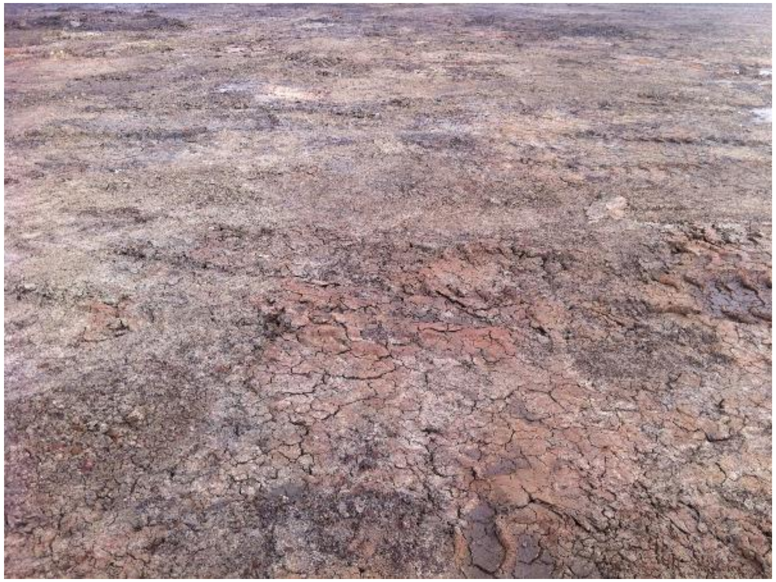

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01/09/2015

DLA Environmental Services
A Pacific Environment company

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01/09/2015

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16/07/2015

DLA Environmental Services
A Pacific Environment company

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16/07/2015

DLA Environmental Services
A Pacific Environment company

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16/07/2015

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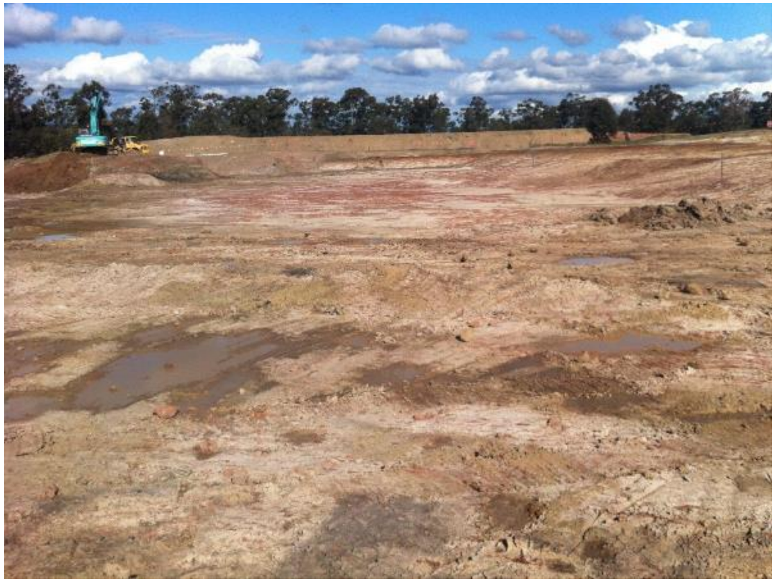

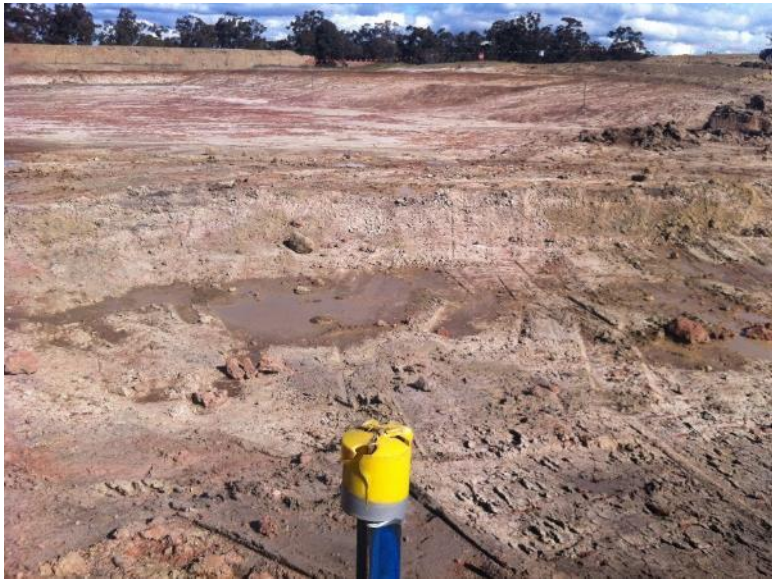

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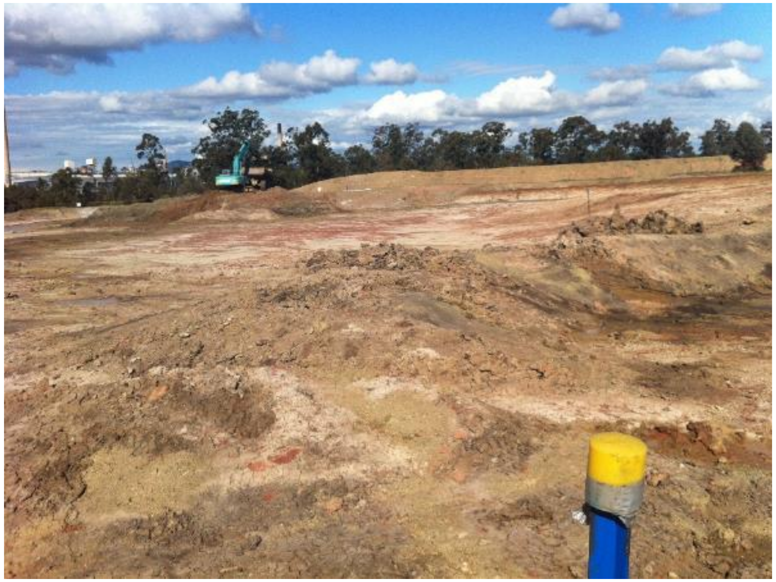

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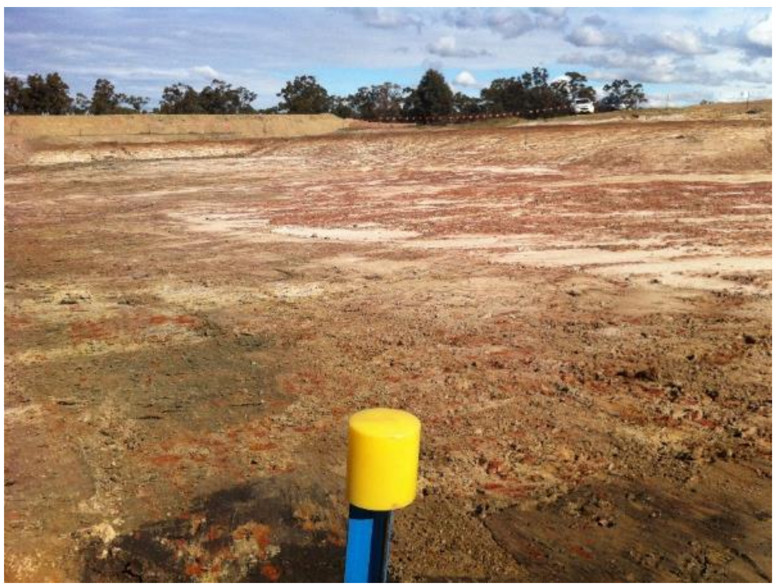

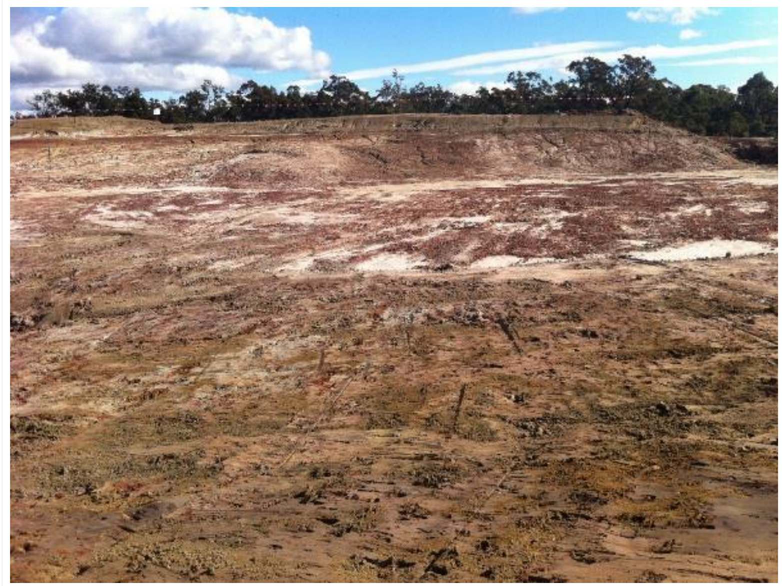

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DLA Environmental Services
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22/07/2015

DLA Environmental Services
A Pacific Environment company

Grid Square F5

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22/07/2015

DLA Environmental Services
A Pacific Environment company

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DLA Environmental Services
A Pacific Environment company

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DLA Environmental Services
A Pacific Environment company

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A Pacific Environment company

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A Pacific Environment company

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A Pacific Environment company

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01/09/2015

DLA Environmental Services
A Pacific Environment company

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DLA Environmental Services
A Pacific Environment company

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16/07/2015

DLA Environmental Services
A Pacific Environment company

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05/06/2015 and 15/07/2015

DLA Environmental Services
A Pacific Environment company

Grid Square G2

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05/06/2015 and 15/07/2015

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Test Pits highlighting clean clay
15/07/2015

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A Pacific Environment company

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16/07/2015

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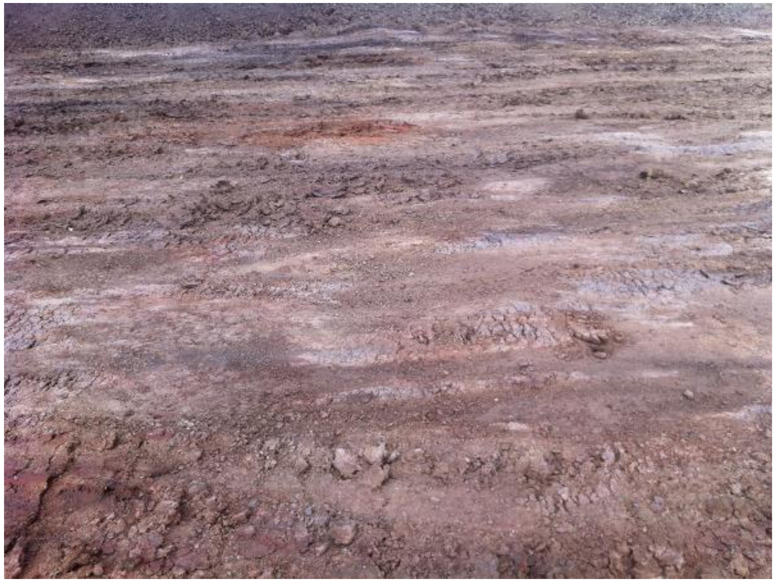

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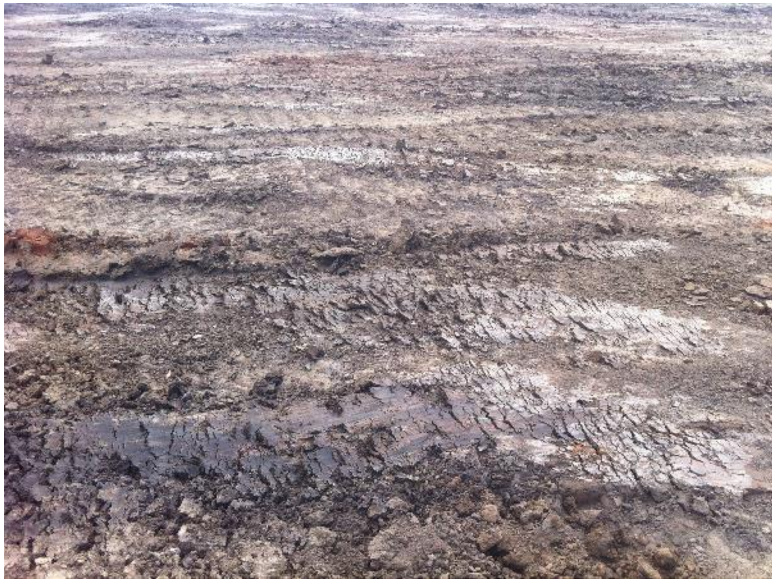

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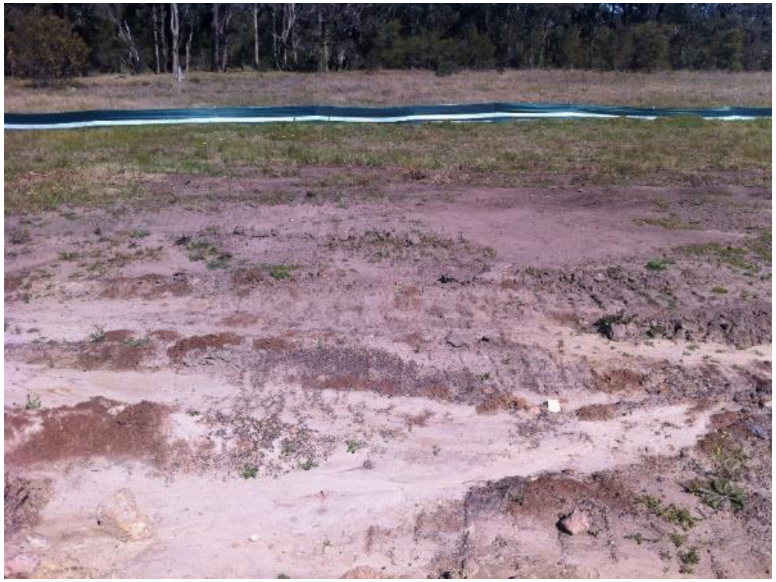

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Grid Square H3

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17/08/2015

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A Pacific Environment company

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17/08/2015

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A Pacific Environment company

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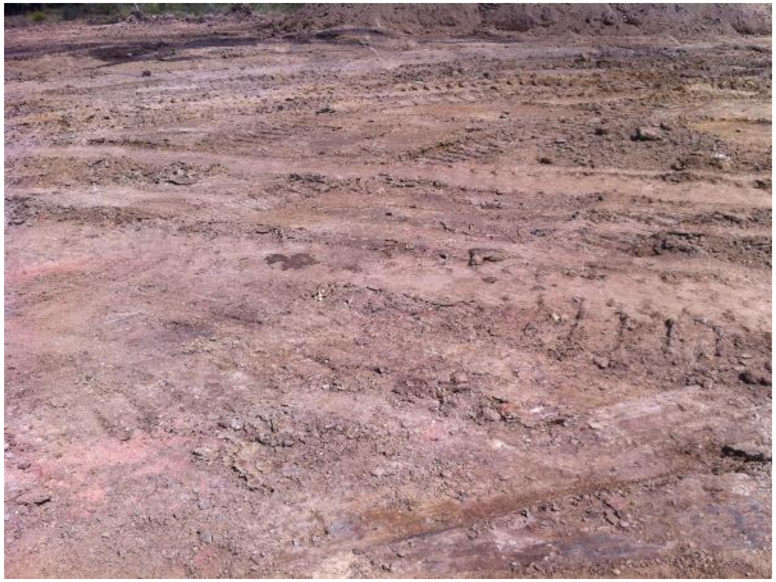

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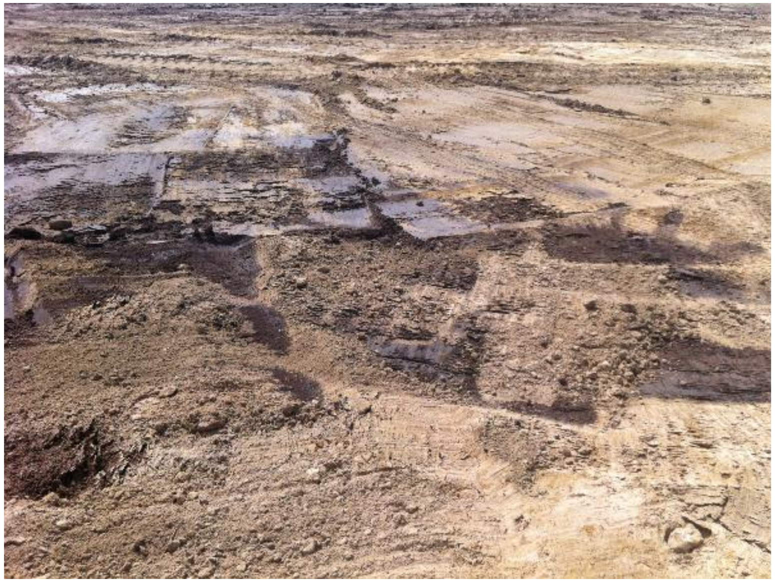

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DLA Environmental Services
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07/08/2015

DLA Environmental Services
A Pacific Environment company

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A Pacific Environment company

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A Pacific Environment company

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17/08/2015

DLA Environmental Services
A Pacific Environment company

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APPENDIX C – REMEDIATION ACTION WORKS PLAN (RAWP)

Privileged and Confidential



Remedial Action Work Plan, Clay Borrow Pit Area

Kurri Kurri NSW

Prepared for:
Hydro Aluminium Kurri Kurri Pty Ltd

Prepared by:
ENVIRON Australia Pty Ltd

Date:
23 December 2014

Project Number:
AS130386

ENVIRON

Prepared by:		**Authorised by:**	
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Signature:	KGreenfield Date:23/12/14	Signature:	Fiona Robinson Date:23/12/14

VERSION CONTROL RECORD

Document File Name	Date Issued	Version	Author	Reviewer
_386 Clay Borrow Pit RAWP_D1	27 June 2014	Draft 1	S Cadman	F Robinson
_386 Clay Borrow Pit RAWP_FINAL V2	24 July 2014	Final	S Cadman	F Robinson
_386 Clay Borrow Pit RAWP_FINAL V2	17 December 2014	Revised Final	K Greenfield	F Robinson
_386 Clay Borrow Pit RAWP_FINAL V2	23 December 2014	Revised Final	K Greenfield	F Robinson

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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
m TOC	Metres below top of casing
ML	Megalitre, one million litres
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
RAWP	Remediation Action and Work Plan
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 Australia Ltd (ENVIRON) has been commissioned by Hydro Aluminium Kurri Kurri Pty Limited (Hydro) to prepare this Remedial Action Work Plan (RAWP) for the implementation of remedial works at the site known as the Clay Borrow Pit, Hart Road Loxford, New South Wales, 2320.

The Clay Borrow Pit is owned by Hydro and is situated within the Hydro Aluminium Smelter Buffer Zone, which is a large land area owned and managed by Hydro as part of the smelter operations. Smelter closure was announced in May 2014 and Hydro is now preparing land for future divestment and redevelopment. The Clay Borrow Pit is proposed for commercial/industrial land use and remediation of the land for this purpose is required. The objective of this RAWP is to describe the works necessary to render the site suitable for the future land use.

The Clay Borrow Pit is zoned Rural Landscape (RU2) under the Cessnock Local Environment Plan 2011 and has been used for rural land use and materials storage during and prior to the smelter operations.

Historical records indicate the site was the source of clay materials for capping of the Capped Waste Stockpile located on the eastern side of the Smelter site and undertaken in the 1990's. Since that time, reinstatement of the excavated area using inert materials from the Smelter site, including concrete, refractory brick and bitumen has been undertaken.

An evaluation of soil and surface water identified that impacts to surface water from the filled areas has not occurred. No impacts to soil within the fill were identified. The presence of fill was recognised to represent an impact on visual amenity and safety risk to the proposed future use of the property.

A review of remediation options was undertaken and also included a review of remedial options applicable to all Hydro owned lands (a whole-of-site strategy). Remediation options were considered in terms of cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability. The preferred strategy was excavation of the filled materials to remove all contaminant management requirements from The Clay Borrow Pit and reshaping of the resultant land surface. Excavated materials are proposed to be coarsely sorted and stockpiled in a designated area of the Smelter site. Materials relocated to the Smelter site will be stockpiled separately for later beneficial reuse where permissible, or incorporated within a whole-of-site remediation strategy.

This RAWP outlines the remedial plan to be implemented at the site to achieve the remediation objective. The RAWP includes a detailed works methodology including validation requirements and environmental controls to be implemented during the works. At the completion of works a validation report will be compiled including a clear statement of the suitability of the site for the proposed future commercial/industrial use.

1 Introduction

The following Remediation Action and Work Plan (RAWP) details site conditions and requirements for remediation of the area of land known as the “Clay Borrow Pit Area”, located immediately west of the Hydro Aluminium Kurri Kurri Pty Ltd (Hydro), Aluminium Smelter (**Figure 1**).

1.1 Background

Hydro is currently evaluating options for the redevelopment and possible divestment of land parcels following closure of the smelter in May 2014. A Preliminary Masterplan was developed that identified land proposed for industrial/commercial rezoning which includes the Clay Borrow Pit, located to the west of the Smelter site.

Low permeability clay was won from the Clay Borrow Pit for the purpose of capping a waste stockpile, now known as the Capped Waste Stockpile, located on the Smelter site. These works were undertaken in the 1990’s. Since that time the resultant void has been progressively filled with inert smelter derived materials originating from plant maintenance and expansion works. These materials typically comprise bake furnace refractory brick and building materials including concrete and asphalt.

As part of the pre-closure due diligence assessment, a site wide Phase 2 Environmental Assessment was undertaken (ENVIRON 2012). This investigation identified the presence of smelter derived materials and included a visual assessment of the materials by excavation, and assessment of impacts to soil and groundwater from the presence of these materials. Materials stockpiled at the Clay Borrow Pit include above and below ground stockpiles.

A preliminary characterisation of bake furnace refractory brick was completed in 2012 as part of an application for a resource recovery exemption. Detailed characterisation sampling was completed in 2014 following the provision of the draft ‘The Hydro Aluminium Kurri Kurri bake ovens refractory brick exemption 2012’. Characterisation sampling indicated the majority of the refractory bricks are suitable for re-use under the draft exemption.

Environmental investigations of these materials found a low risk to human health and the environment. The materials were identified to represent a visual impact under future commercial/industrial land use.

1.2 Objective

The objective of the works is to remediate the Clay Borrow Pit to a level suitable for the proposed commercial/industrial land use. This RAWP forms part of those works and provides a description of the impacted areas requiring remediation and the methodology to remediate and validate those areas in order to meet the project objective.

1.3 Regulatory Framework and Guidelines

This document has been prepared in, light of the following guidelines:

- Contaminated Land Management Act, 1997.
- Protection of the Environment Operations Act, 1997.
- Environmental Planning and Assessment Act, 1979.

2 Scope of Work

To meet the objective ENVIRON have completed the following scope of work.

- Review of all previous reports prepared for the Clay Borrow Pit including:
  - ENVIRON Australia Pty Ltd (ENVIRON 2012a) Application for Exemption – Refractory Brick, Hydro Aluminium Pty Ltd, August 2012.
  - ENVIRON Australia Pty Ltd (ENVIRON 2012b) Sampling, Analysis and Quality Plan, Refractory Brick Characterisation, December 2012.
  - ENVIRON, Phase 1 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, October 2013.
  - ENVIRON, Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter, prepared for Norsk Hydro ASA, November 2012.
- Sampling of the refractory brick for characterization in accordance with ENVIRON (2012) Sampling, Analysis and Quality Plan, Refractory Brick Characterisation.
- Identification and evaluation of possible remedial options including consultation with Hydro personnel in order to determine the most appropriate remedial option.
- Consultation with regulatory guidelines.
- Presenting the selected remedial option, and the basis for that option, in this RAWP.

3 Site Identification

3.1 Site Details

Table 3.1 presents site identification and location details.

Table 3.1: Site Identification

Site Owner	Hydro Aluminum Kurri Kurri Pty Limited (subject to Deed of Company Arrangement)
Street Address	Hart Road, Loxford, New South Wales, Australia , 2326
Local Government Area	Cessnock City Council
Parish	Heddon
County	Northumberland
Distance from Nearest CBD	Approximately 3.5km north-west of Kurri Kurri, and 30km north-west of Newcastle.
Geographical Coordinates	Latitude 32 78 53 S, Longitude 151 4735 E
Lot and DP Numbers	Part of Lot 319 DP 755231
Site Area	Approximately 6 ha. Lot 319 comprises 52.1 ha.
Zoning (current)	RU2 – Rural Landscape
Site Elevation	RL 20 to 30 m in the centre and north of the lot to RL 10-15m in the south and south east.
Site Map	Figure 1

3.2 Site Boundaries

The site is located within the following boundaries:

- in the east by the western side of the Smelter site;
- in the north by vegetated land owned by Hydro;
- to the west by the former Bishops Bridge Road (now defunct due to the construction of the new Hunter Expressway) and vegetated land owned by Hydro; and
- to the south by bushland, with an Ausgrid easement and the Hunter Expressway further south.

The location of the Clay Borrow Pit is shown on **Figure 1**.

4 Site History

The Clay Borrow Pit is located approximately 400m to the west of the Smelter. Site history investigations included in the Phase 1 ESA for the Hydro Aluminium Kurri Kurri Smelter, dated 26 August 2013 indicate that the Clay Borrow Pit was the location of a hobby farm until approximately 1967. The land was unused from then until the early 1990's when a proposal to cap a waste stockpile located on the Smelter main site was approved. The clay capping comprised low permeability clay which was won from the area now known as the Clay Borrow Pit. The resultant void was later filled with inert materials from the Smelter site primarily comprising bake furnace refractory, concrete and asphalt. Filling has reinstated the excavation to ground level. Subsequent filling has resulted in above ground stockpiling of these smelter materials in this area.

Historical photographs of the Clay Borrow Pit are included in **Appendix A**.

4.1 Potential Areas of Concern

Based on the site history review potential areas of concern were identified to be:

- Presence of smelter derived materials for use in filling and later as stockpiles;
- Potential for dust deposition of the site due to the proximity of the Smelter.

5 Site Conditions

5.1 Topography

The Clay Borrow Pit is located on slightly elevated land to the west of the main Smelter plant site on a north-south trending ridge, at approximately 25 mAHD. The land generally slopes towards the south-east and the small southern tributary of Black Waterholes Creek. The creek conveys surface water to the north towards Wentworth Swamp.

The main entrance to the site is an unsurfaced four wheel drive access road from the western side of the Smelter plant site.

5.2 Geology

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

Undifferentiated Quaternary alluvium occurs to the south-east of the site associated with surface water bodies. Quaternary sediments which are associated with Black Waterholes Creek and Wentworth Swamp consist of gravel, sand, silt and clay.

5.3 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 the Clay Borrow Pit Area is expected to generally flow south-east and east to the adjacent Black Waterholes Creek and more distant Wentworth Swamp.

According to the NSW Office of Environment and Heritage (Natural Resource Atlas), there are 31 licensed groundwater abstractions (bores) located approximately 9km north east of the Clay Borrow Pit.

The groundwater bores are located within the coal measures or Quaternary Alluvium associated with Wentworth Swamp and other associated surface water bodies.

Information for seven bores located in a 5km radius from the Clay Borrow Pit indicated the bores are used for domestic, recreation, monitoring, irrigation and stock watering purposes.

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.gov.au/ieo./Hunter/index.htm).

5.4 Hydrology

Surface water from the Clay Borrow Pit discharges via natural drainage lines to the south-east site boundaries. The north western portion of the site drains toward the northern tributary of Black Waterholes Creek which flows into the Wentworth Swamp wetlands system, approximately 2.5km to the north-east.

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).

5.5 Site Sensitivity

The sensitivity of the Clay Borrow Pit with respect to surface water and groundwater is considered to be moderate based on the following:

- Surface water and groundwater discharge into Wentworth Swamp located approximately 2.5km north-east of the Clay Borrow Pit and discharges to the Hunter River within the Fishery Creek Catchment, approximately 12km north-east of the Clay Borrow Pit 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 the Clay Borrow Pit 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.

6 Soil and Surface Water Assessment Criteria

6.1 Potential Contaminants of Concern

Potential Contaminants of concern associated with the burial and stockpiling of smelter materials and smelter stack particulate fallout were considered to include the following:

- fluoride and cyanide;;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Heavy Metals;
- Asbestos, from disposal of building materials.

6.2 Soil

The guidelines proposed for the assessment of soil contamination at the Clay Borrow Pit were sourced from the following references:

- NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM); and
- Site specific derivation of a guideline for fluoride.

The variation to the NEPM was approved on 19 June 2013 by the NSWEPA under the *Contaminated Land Management Act 1997*. The NEPM amendment 2013 provide revised health-based soil investigation levels (HILs), health based screening levels (HSLs), ecological-based investigation levels (EILs) and ecological based screening levels (ESLs) for various land uses. A summary of the applicability of these guidelines follows.

- The HILs are applicable for assessing human health risk via all relevant pathways of exposure and have been developed for four main land use categories. The HILs are generic to all soil types and apply generally to a depth of 3m below the surface for residential use.
- HSLs for soil vapour intrusion from petroleum hydrocarbons are guidelines that prevent accumulation of vapours at concentrations that may represent a health risk. The HSLs are derived for various depths and are for the same generic land uses as for the HILs. The guidelines are relevant were soils are beneath building or structures such as confined spaces.
- EILs have been developed for commercial/ industrial landuse and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and generally apply to the top 2m of soil. Site-specific EILs were developed using pH and Cation Exchange Capacity data from topsoil samples collected from across the entire Buffer Zone. The EIL site-specific calculations using the NEPM Toolbox are included in **Appendix B**.
- ESLs have been developed for commercial/ industrial landuse and are developed for selected petroleum hydrocarbon compounds and fractions and are applicable for assessing risk to terrestrial ecosystems. These are also generally applicable to the top 2m of soil.

- Management Limits where concentrations above these limits may indicate poor aesthetics, high odour and potentially explosive vapour. Management limits are to be applied after consideration of relevant ESLs and HSLs.

The applicable assessment criteria for site soils are presented in **Table 6.1.**

Table 6.1: Soil Guidelines (mg/kg) – Health and Ecological Investigation Levels

	HIL D	EIL
Arsenic	3000	160[1]
Cadmium	900	-
Chromium (VI)	3600	-
Chromium (III)		320[2] (1% clay)
Copper	240 000	300[2]
Lead	1500	1800[1]
Nickel	6000	310[2]
Zinc	400 000	700[2]
Mercury (inorganic)	730	-
Cyanide (free)	1500	-
Naphthalene	NL	370[1]
Carcinogenic PAHs (as BaP TEQ)	40	-
Total PAHs	4000	-

1 EILs represent the most conservative value possible as the lowest value for added contaminant limit (ACL) was used and the ambient background concentration (ABC) was not added,

2. Chromium III, nickel, zinc and copper EILs were calculated by adding the ACL with the estimated ABC using the NEPM (2013) EIL Calculation Spreadsheet for aged contamination under commercial/ industrial landuse.

The applicable assessment criteria for volatile PAHs in soil are presented in **Table 6.2 and Table 6.3.**

Table 6.2: Soil Assessment Guidelines for Vapour Intrusion - HSL D (mg/kg) - Sand

	0 to <1m	1m to <2m	2m to <4m	4m+
Naphthalene	NL	NL	NL	NL

1 The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as ‘not limiting’ or ‘NL’.

2 (For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit>50% respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.

3 To obtain F2 subtract naphthalene from the >C10-C16 fraction.

Table 6.3: ESLs and Management Limits for Petroleum Hydrocarbons in Soil

TPH fraction	Soil texture	ESLs (mg/kg dry soil)	Management Limits[1] (mg/kg dry soil)
		Commercial and Industrial	Commercial and Industrial
Benzo(a)pyrene	Fine	1.4	-

1. Management limits are applied after consideration of relevant ESLs and HSLs.
2. Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2.
3. ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability.
4. To obtain F1 for ESLs, subtract the sum of BTEX from C6-C10 fraction. For F2, naphthalene should not be subtracted as there is no separate ESL for naphthalene.

The HSLs for asbestos are applicable for assessing human health risk via the exposure pathway of inhalation of airborne asbestos and are presented in **Table 6.4**. The HSLs are generic to all soil types.

Table 6.4: Health screening levels for asbestos contamination in soil
Health Screening Level (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 soluble fluoride for the Hydro Aluminium Kurri Kurri Smelter. The screening levels are protective of the range of human receptors and are provided in **Table 6.5**.

Table 6.5: Site Specific Soil Assessment Guidelines (mg/kg) for Soluble Fluoride

Land Use	Preliminary screening level
Commercial/ industrial - soil	F 17000mg/kg

6.3 Water

The assessment criteria for the assessment of surface water were sourced from the following references:

- NEPC (2013) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM).
- NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination;
- ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

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

6.3.1 Potential Beneficial Uses

Potential beneficial uses of surface water on site and down gradient of the Clay Borrow Pit include:

- Flow to Black Waterholes Creek and ultimately discharge to Wentworth Swamp, which supports aquatic ecosystems, and potentially flows into the Hunter River;
- Extraction of water from Wentworth Swamp may also be used for stock watering and/ or irrigation.
- Discharge into groundwater, which is used by local communities for domestic, recreation, monitoring, irrigation and stock watering purposes, as described in **Section 5.3**.

It is noted that drinking water has not been included as a potential beneficial use of water from Wentworth Swamp, for the following reasons:

- Drinking water supply to the local communities is reticulated and originates from Chichester Dam located on the Chichester River;
- The Kurri Kurri Waste Water Treatment Works is located up gradient of the Clay Borrow Pit. The Works has a licensed discharge point into Swamp Creek, which flows into Wentworth Swamp. Extraction of surface water for drinking water downgradient of this discharge point is therefore not undertaken.

6.3.2 Appropriate Criteria for Surface Water

Based on the review of potential beneficial uses of groundwater and surface water, the criteria for protection of aquatic ecosystems, irrigation and stock watering will be used. Additionally, site specific preliminary screening levels for fluoride and aluminium in surface water have been developed for the Hydro Aluminium Kurri Kurri Smelter (ENVIRON 2013). These are protective of human health and are as follows:

- Surface water (recreational use): Fluoride – 1.5mg/L, Aluminium – 9mg/L.

The investigation levels presented in ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality are considered applicable for the protection of aquatic ecosystems of receiving waters. ANZECC (2000) advocates a site-specific approach to developing guideline trigger values based on such factors as local biological affects data and the current levels of disturbance of the ecosystem. The guidelines present ‘low risk trigger values’ which are defined as concentrations of key performance parameters below which there is a low risk of adverse biological effects. If these trigger values are exceeded, then further action is required which may include further site-specific investigations to assess potential contamination or management/ remedial action.

Low risk trigger values are presented in Table 3.4.1 of ANZECC (2000) for the protection of 80-99% of species in fresh and marine waters, with trigger values depending on the health of the receiving waters.

Surface water results will be compared against trigger values for the protection of 95% of freshwater species. A 95% protection of fresh water species was selected due to the indication from the Hunter-Central Rivers Catchment Management Authority that declining stream water quality and a reduction in diversity of native plants and animals has occurred in the last ten years.

ANZECC (2000) indicates there is currently insufficient data to derive a high reliability trigger value for TRH but propose a low reliability trigger value of 7µg/L. This guideline is considered by industry to be overly conservative and is below the TRH detection limit that most laboratories can achieve. Therefore the limit of reporting (LOR) will be adopted as a screening trigger for TRH.

Trigger values for cadmium, copper, nickel, lead and zinc can be modified for hardness, as the bioavailability of these heavy metals decreases with increasing hardness. Total hardness was calculated for the receiving waters of Wentworth Swamp using calcium and magnesium concentrations, with results indicating hard water (236mg/L $CaCO_3$). Trigger values modified for hard waters have been used, as per Table 3.4.3 of ANZECC (2000).

Surface water results will also be compared against trigger values for irrigation and stock watering. Section 4.3.4 of ANZECC (2000) indicates that stock watering trigger values for heavy metals and metalloids are for total concentrations, irrespective of whether the constituent is dissolved, complexed with an organic compound or bound to suspended solids. Fluoride is included in this section.

Investigation levels for livestock drinking water are not available for organic contaminants, such as TRH and PAHs. In the absence of available investigation levels, the limit of reporting (LOR) will be adopted as a screening trigger for TRH and PAHs.

The long term trigger value has been used for irrigation guidelines. Section 9.2.5.11 of ANZECC (2000) indicates that the long term trigger value for fluoride is based on the assumption that the irrigation water could potentially be phytotoxic to sensitive plant species or could contaminate stock drinking water. As stock watering guidelines are for total metal and metalloid concentrations, total fluoride concentrations will be used.

7 Site Characterisation

7.1 Assessment of Contamination

ENVIRON conducted a site assessment of the Clay Borrow Pit in 2012 as part of a Hydro-wide preliminary investigation to addressing the potential for soil and groundwater contamination (ENVIRON 2012).

Materials placed to reinstate the void following the winning of clay included concrete, bitumen/asphalt slabs (assumed to be from internal roads at the smelter), bake furnace refractory brick. These materials were found to be both buried and stockpiled at the surface. Buried materials were mixed with soils. No asbestos containing materials were identified during the investigations.

The Phase 2 investigation undertaken in 2012 included the excavation of five test pits, the drilling of six boreholes and the installation of four groundwater monitoring wells to assess the extent and nature of the fill materials and any impacts to surrounding soils or groundwater. The sampling locations are shown in **Figure 3**. Copies of the borehole and test pit logs are included in **Appendix B**.

Investigations found the depth of fill material to extend up to 4.2m with the greatest depth occurring at the eastern extent of the filled area. Fill materials comprised refractory bricks, broken concrete slabs, metal and rubble within a sandy clay matrix. Three of the five test pits were terminated at depths between 1.2m and 2.0m due to instability from water ingress. Refractory bricks were not identified within test pits TP3, TP4 and TP5. In some areas of the Clay Borrow Pit, refractory bricks were identified beneath approximately 1m of overlying sand and clay fill (e.g. test pit TP1 and borehole MW05). Fill materials were underlain by red / grey residual clay to depths of approximately 8m to 10m, underlain by extremely weathered siltstone.

Soil samples were analysed for hydrocarbons, heavy metals, total fluoride, and a range of semi-volatile hydrocarbon including PAHs, pesticide, and chlorinated hydrocarbons. Soil matrix samples detected potential contaminants of concern either below detectable limits or below guideline concentrations.

Groundwater samples were also analysed for hydrocarbons, heavy metals, fluoride, cyanide, and a range of semi-volatile hydrocarbon including PAHs, pesticide, and chlorinated hydrocarbons. Evaluation of groundwater quality from within the in-filled borrow pit (MW05) found elevated concentrations of fluoride (15,000µg/L). The fluoride concentration, compared to a background concentration of 1000µg/L in MW06, is considered to be elevated.

Groundwater wells surrounding the Clay Borrow Pit (MW03 and MW04) identified concentrations of aluminium (maximum 2530µg/L), fluoride (maximum 5500µg/L), cadmium (maximum 3.1µg/L), nickel (maximum 938µg/L) and zinc (1840µg/L) exceeding the criteria and above concentrations found in MW05. Wells MW03 and MW04 are situated in residual soils and upgradient of the Borrow Pit. A second round of sampling was completed in August 2012, which confirmed the results of the initial sampling. The concentrations of the analytes detected are above levels considered to be natural occurring however, given the upgradient location of the wells the elevated metals concentrations are not considered to be associated with activities at the site or from the placement of fill in the Clay Borrow Pit. It is noted that the surrounding land consists of virgin bushland of the buffer zone and there are no identified industrial facilities up gradient of the Clay Borrow Pit that could provide a source for the elevated metals concentrations.

Summary tables presenting analytical results compared to adopted site guidelines and the location of soil and water sampling points are presented in **Appendix C.**

Remediation of the clay borrow pit is required to removal aesthetic impact from the presence of these materials and to mitigate possible impacts to groundwater.

7.2 Refractory Brick Exemption Sampling 2012

It was recognised that concrete, asphalt and bake furnace refractory materials within the Clay Borrow Pit may be suitable for reuse under existing and specific exemptions in accordance with the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption under Part 6, Clause 51 and 51A.

Chemical analysis of bake furnace refractory was undertaken as part of a submission for beneficial reuse of these materials. The chemical composition determined as part of that exemption is tabulated in **Table 7.1**.

Table 7.1: Summary Chemical Characteristics of Refractory Brick (2012)

Analyte	PQL	Summary statistics			
		Minimum	Average	Maximum	Standard Deviation
Moisture Content		<0.5	0.5	7.5	2.3
Metals					
Arsenic	4	<4	-	<4	0
Beryllium	1	<1	-	<1	0
Boron	3	<3	26	98	25
Cadmium	0.5	<0.5	0.5	4	1
Chromium	1	2	12	38	8
Lead	1	<1	5	45	10
Molybdenum	1	<1	1	2	0
Nickel	1	2	5	7	2
Selenium	2	<2	-	<2	0
Tin	1	<1	1	2	0
Mercury	0.1	<0.1	-	<0.1	0
Silver	1	<1	-	<1	0
Copper	1	8	12	23	7
Zinc	1	3	7	12	4
Vanadium	0.5	8	20	46	10
Non Metallic Inorganics					
Total Fluoride	50	<50	191	920	276
Total Cyanide	0.5	<0.5	-	<0.5	0
Sulphur	1	110	1871	9100	2624
Total Organic Carbon	1	1100	1910	5600	1125

Chloride	1	<100	-	<100	0
Electrical Conductivity	1	42	902	2500	825
pH	1	7	9	11	2
Polycyclic Aromatic Hydrocarbons					
Sum of reported PAH	0.1	<0.1	-	-	-

All units are mg/kg on a dry weight basis.

Concentrations presented in **Table 7.1** are below the site guidelines for soils. This supports the conclusion that the risk associated with the presence of these materials is associated with visual amenity. Also, the data further supports that metals identified in groundwater are not likely to be resulting from the presence of these materials. The exception is the concentration of fluoride identified at MW5 which may be attributed to the presence of these materials, noting that groundwater sampled at MW5 is a perched water table present within the filled materials.

This preliminary characterisation data was used in the application for the resource recovery exemption.

7.3 Refractory Brick Exemption Sampling 2014

The Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012 was granted by NSW EPA in October 2012. In a letter dated 21 December 2012, NSW EPA requested a detailed characterisation of the refractory bricks be completed as per ENVIRON (December 2012) Sampling, Analysis and Quality Plan (SAQP). This detailed characterization sampling was undertaken in August 2014.

The detailed characterisation sampling was completed as per the sampling locations outlined in Figure 1 of the SAQP on an approximate 20m grid (see **Figure 4**). Brick samples were collected from both stockpiled and buried material .Twelve brick samples were collected from 25 test pits and 24 brick samples were collected from above-ground stockpiles. Each sample comprised five brick chips that were crushed and composited to form one sample. As per the SAQP, each sample was analysed for Heavy Metals, fluoride (total), cyanide (total) and 20% of the samples were analysed for PAHs.

The analytical results were compared against Table 2 of the Draft 'The Hydro Aluminium Kurri Kurri base ovens refractory brick exemption 2012', with average concentrations compared against Column 2 and maximum concentrations compared against Column 4, as outlined in **Table 7.2**. A full laboratory summary is presented in **Appendix D**.

Table 7.2: Summary Chemical Characteristics of Refractory Brick (2014)

Analyte	No. of Samples	Summary statistics (mg/kg)			
		Average	Maximum Average[1]	Maximum	Absolute Maximum[2]
Metals					
Arsenic	36	2	15	2	30
Cadmium	36	0.2	0.5	**2**	1
Chromium	36	2.7	40	20	80
Copper	36	2.1	40	9	80
Nickel	36	2	25	8	50
Lead	36	1.1	50	10	100

Zinc	36	2	150	25	300
Mercury	36	0.05	0.5	0.05	1
Non Metallic Inorganics					
Total Fluoride	36	86.8	300	**730**	600
Total Cyanide	36	0	-	0	1
Polycyclic Aromatic Hydrocarbons					
Benzo(a)pyrene	7	<0.05	-	0.39	1
Sum of reported PAH	7	<0.0.5	-	4	40

1 Maximum Average Concentration for Characterisation, from Column 2 of Table 2 from the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012

2 Absolute Maximum Concentration, from Column 4 of Table 2 from the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012

As shown in **Table 7.2**, the absolute maximum concentration of cadmium and fluoride were exceeded. The cadmium concentration in one sample, RB18, was 2mg/kg exceeding the absolute maximum concentration of 1mg/kg. The total fluoride concentration in one sample, RB14, was 730mg/kg exceeding the absolute maximum concentration of 600mg/kg. Both RB14 and RB18 are samples of buried bricks. The segregation of these two exceedences is discussed further in **Section 9.5**.

No bricks were found within 13 of the 25 test pits excavated into the eastern portion of the Clay Borrow Pit. Where no bricks were found, the test pits generally comprised brown/ red gravelly sandy clay fill material. The anticipated extent of the buried bricks is outlined in **Figure 3**.

It is noted that the laboratory results from the characterisation sampling are below the HILs for commercial/ industrial landuse and below the EILs and no asbestos containing materials were identified during this investigation.

7.4 Assessment of Exposure Routes and Potential Receptors

The Clay Borrow Pit forms part of the Hydro smelter buffer zone and is a temporary stockpiling area for site demolition wastes. As such the site is rarely frequented and presents no impact on visual amenity, as the appearance is directly related to the Hydro purpose of use.

Impacts to surrounding surface water and groundwater are inconclusive. However, if impacts occur the primary receptors would include the ecological community of Black Waterholes Creek and Wentworth Swamp under both the current and future land use scenarios.

For the proposed future commercial/industrial land use the site in its current state is considered to represent an impact on visual amenity.

7.5 Statement of Suitability for Existing and Proposed Site Use

The site is suitable for the current land use although further assessment of impacts to groundwater should be undertaken if management or remediation is not proposed. The site is not considered suitable for the proposed commercial/industrial land use due to the impacts on visual amenity and the potential for impacts to groundwater and surface water.

8 Remedial Action Plan

8.1 Remediation Goal

The goal of this remediation project is to remediate and validate those areas of the Clay Borrow Pit identified as being unsuitable for commercial/industrial development due to impacts to visual amenity from stockpiled and buried fill material.

8.2 Extent of the Remediation Required

Aesthetic impacts from stockpiled and buried smelter demolition materials including refractory brick, concrete and bitumen within a soil matrix requires remediation across the area on Lot 319 DP755231, shown in **Figure 2** and known as the Clay Borrow Pit.

The impacts to visual amenity identified comprise a former excavation being reinstated with smelter derived construction materials and subsequently stockpiling of these materials across an area adjacent to the filled excavation.

Estimated volumes of materials are shown on **Figure 5**.

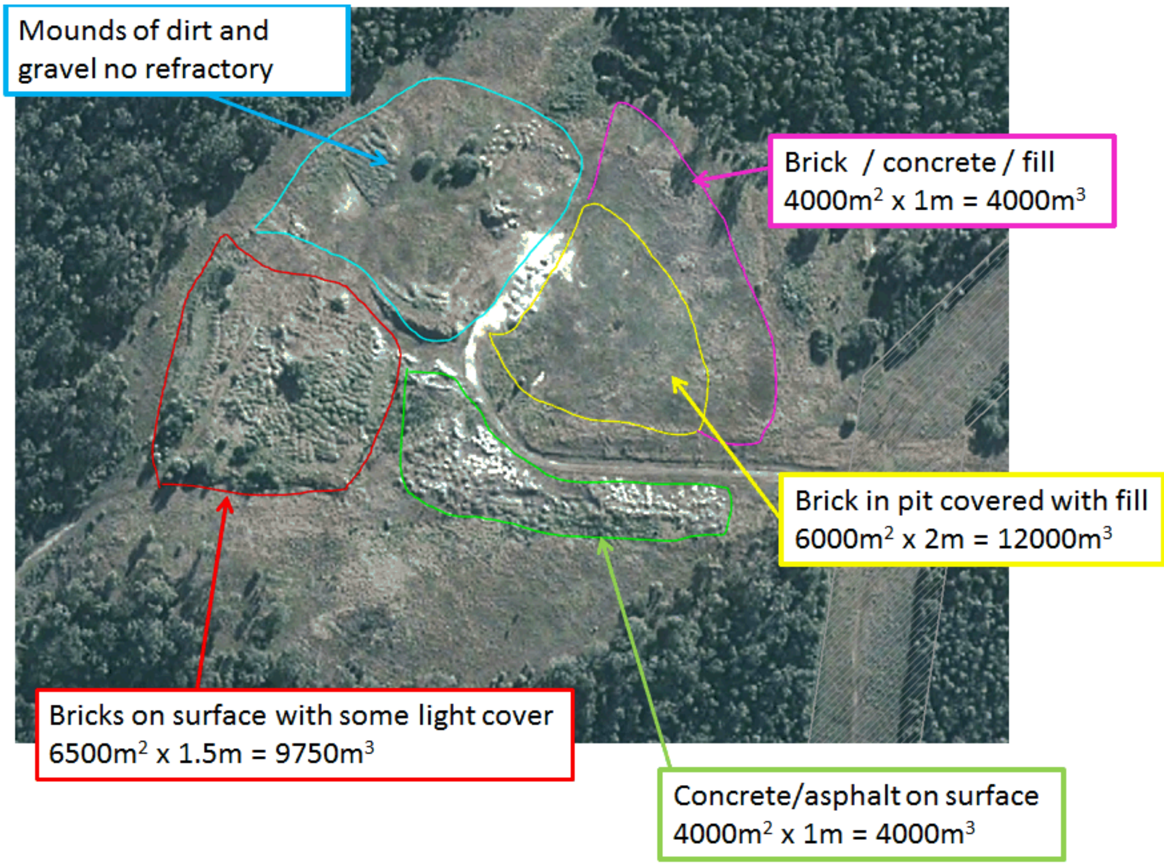


Figure 5: Estimated Material Volumes

Potential contaminants of concern, including heavy metals and fluoride, were detected within the soil matrix at concentrations below the site criteria. PAHs and SVOCs were not detected above the laboratory limits of reporting. As the stockpiled and buried materials are inert (concrete, refractory brick and bitumen) and the soil matrix shows no impact, it considered there is no risk of impact to the underlying clay, therefore the extent of remediation is to extend to the top of the underlying clay. In general, **Figure 5** will serve as a preliminary guide to the extent of remediation required however remediation will be undertaken to the final satisfaction of the Principal or Principal's representative.

8.3 Remediation Options

Based on the site characterisation presented in **Section 7**, a review of potential remediation options for the Clay Borrow Pit was undertaken.

Table 8.1 presents a summary of the available remedial options considered for the site and the contaminants present.

Table 8.1: Assessment of Remediation Options

Option	Description	Advantages	Disadvantages
1	Do nothing	Cost effective solution. An EMP may not be required.	Does not address the aesthetic issues or potential risks to groundwater from the presence of filled materials. Planning approval may be an issue. May require an Environment Protection Licence. Reduction of land values.
2	Excavate and dispose to landfill.	Removes long term management requirement from site, leaving no legacy issues. Improves land value. Planning approval requirements straightforward.	Consumes off site landfill space. Disposal costs are very high. Remaining void may need rehabilitation with clean fill.
3	Re-use smelter derived materials in-situ and establish capping layers	Long term management risk low. Costs mitigated by a combination approach and relatively easy to achieve	May reduce property value. Development may be restricted due to potential presence of unsuitable materials due to geotechnical/foundation properties of placed materials. May require management into future (including monitoring)
4	Excavation and combined encapsulation of all materials at another location within Hydro owned land	Relocates long term management requirements. Improves land value for Clay Borrow Pit.	Planning approval may be an issue. Timeline is reliant on whole of site solution.
5	Excavate and removal of smelter derived materials to another location within Hydro owned land for recycling (potential a minor component will not be able to be	Relocates long term management requirements. Improves land value for Clay Borrow Pit. Offers most sustainable solution. Allows for an immediate improvement in aesthetics.	Requires additional costs for testing (to obtain resource recovery exemption).

Table 8.1: Assessment of Remediation Options			
Option	**Description**	**Advantages**	**Disadvantages**
	recycled).		

8.4 Rational for the Selection of the Recommended Remedial Option

Remediation options were considered in terms of cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability. In terms of these evaluators, Option 5 was preferred. Option 5 provides a sustainable reuse option for concrete, bitumen and refractory brick. These materials will be segregated pending later evaluation for reuse under the NSW EPA resource recovery general and specific exemptions. Any materials that are unable to be reused will be incorporated in a whole-of-site solution allowing consolidation of materials in one location thereby reducing environmental footprint, potential land sterilization, and long term management requirements. Hydro has conducted a whole-of-site remediation options study in 2014 to identify the most appropriate remediation strategy applicable to the issues across all Hydro owned lands. Materials not able to be recycled from the Clay Borrow Pit temporarily stockpiled for incorporation in a whole-of-site strategy.

8.5 Contingency if the remedial strategy fails

Table 8.2 outlines the potential failure scenarios that could occur and the contingency mechanisms that will be implemented to achieve the overall remediation objective.

Table 8.2: Remediation Contingency Planning	
Failure Scenario	**Contingency Response**
All foreign materials cannot be excavated due to safety or other risks	While all efforts will be undertaken to remove identified wastes/contamination, if a situation arises where it becomes impractical to completely remove fill/soil to meet the remediation objectives, (eg physical constraints, safety etc), alternative strategies may be employed to justify leaving contamination in place (eg specific risk assessment). Such alternatives will not proceed without consultation and full written approval of the Principal.
Unexpected materials are encountered including significant volumes of highly contaminated soils and/or asbestos-containing materials, not currently allowed for using the proposed methodology	The Principal will be advised and consideration will be given to alternate methods of disposal (eg, off-site to landfill or to temporary storage).
Concrete, bitumen, refractory brick do not meet general or specific exemptions for reuse.	Consider the hierarchy of other preferred options including off site disposal or onsite treatment and disposal.
Material segregation proves not feasible using the proposed methodology	The Principal will consider transport of unsegregated material to the stockpile location for evaluation at a later date.
A whole-of-site strategy is not approved that incorporates the Clay Borrow Pit unusable materials.	Consider the hierarchy of other preferred options including off site disposal or onsite treatment and disposal.

8.6 Interim Site Management Plan

The Clay Borrow Pit is located within the Hydro site boundaries and is not accessed by the public. Soils at the site are stabilised by vegetation and do not represent an erosion potential. On this basis, there is not considered to be a requirement for interim site management.

9 Remedial Action Works Plan

9.1 HOLD POINT

Prior to commencing works the Contractor is to provide to the Principal for written approval a proposed remediation work methodology. The methodology is to describe:

- Mobilisation and site facilities required and proposed locations
- Methods of excavation, sorting, materials tracking, backfilling;
- Compaction specification for reinstatement of the void;
- Final landform design;
- Quality control procedures that demonstrate how the requirements of the RAWP (including validation) will be met and documented.

The general objectives are outlined in the following.

9.2 Mobilisation

Mobilisation and setup on-site of required plant and personnel.

Setup of work controls including environmental and safety systems and controls, both at the Clay Borrow Pit and at the proposed area identified on the main Hydro site and referred to as the Smelter site stockpile area (location to be advised).

Establishment of all controls listed herein and within the CEMP, **Section 11.**

9.3 Survey

Survey, conducted by a registered surveyor, will be undertaken. The survey will involve:

- Pre-remediation survey of the surface, excluding surface stockpiles;
- Following excavation and removal of fill material, but prior to backfilling and completion of the remediation; and
- Post-remediation following backfilling, topsoiling/landscaping.

Survey should be conducted such that a 3D model can be located laterally and vertically on a registered survey plan, suitable for potential attachment to a land title.

The survey plan forms part of the remediation validation requirements described in **Section 9.9.**

9.4 Remediation Methodology

Excavation and sorting of materials in the Clay Borrow Pit Area (including materials currently stockpiled on the surface and materials buried across the site), identified in **Figure 2** is required. Materials are to be sorted and transported to the stockpile locations, excavations are to be validated and the area is to be reshaped.

9.5 Excavation

The Contractor may schedule excavation works in stages to allow partial excavation and validation before proceeding on to the next stage. If remediation is undertaken in this fashion, the Contractor will still need to comply with the validation and survey requirements as set out in **Section 10** and in **Section 9.3** respectively.

It is noted that bricks were not identified at all sampling locations during the previous investigations. The locations where bricks were not identified are included on **Figure 4**. It is also noted that bricks were identified at some locations below approximately 1m of cover. Excavation works shall extend to a minimum of 1.5m bgs in the area of buried bricks, and extending laterally outwards from the main fill area until natural ground is reached.

Two samples of bricks with exceedences of the absolule maximum concentrations for cadmium and fluoride were identified during characterisation sampling under the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012. As per ENVIRON (2012b) SAQP, non-conforming materials need to be separately excavated and stockpiled as per the following methodology:

- Where individual sample locations fail on the basis of a non-conforming maximum concentration, the sample will be removed from the data set and the area represented by the sample considered a hotspot.
- The area defined as a hotspot will be that area represented by the closest conforming samples and extending vertically in the profile.
- The volume of material defined as a hotspot can be calculated. This volume of material will be deemed unsuitable and is to be stockpiled separately.
- Where further sampling is required to reduce the volume of material deemed as unsuitable, samples will be collected at the mid-point between the elevated sample(s) and the closet conforming samples. Samples will be collected and analysed in accordance with this SAQP with the exception that samples will be analysed only for the non-conforming analytes(s).

The two sampling locations with exceedences, RB14 and RB18, are shown on **Figure 4**. No refractory bricks were identified within the test pits surrounding the location of RB18. As the bricks within test pit RB18 are isolated, refractory bricks from around the location of RB18 are to be excavated and stockpiled separately. The co-ordinates for RB18 are -32.78545 latitude and 151.47466 longitude.

Bricks were identified in four of the six test pits surrounding the location of RB14, with no bricks identified in test pits to the east or south east. The closest conforming samples are from test pits RB10, RB11, RB12 and RB13. The latitude and longitudes for these test pits are as follows:

- RB10: -32.78556, 151.47394;
- RB11: -32.78572, 151.47377 ;
- RB12: -32.78593, 151.47382;

- RB13: - 32.78568, 151.47416
- RB14: -32.78582, 151.47398.

9.6 Sorting

Coarse high level sorting is to be conducted on the Clay Borrow Pit and is described below.

It is envisaged that fill materials will be sorted on both a size and composition basis.

Coarser materials will be split into:

- concrete fragments;
- asphalt fragments,
- broken/whole refractory fragments;
- “other”, including metal and other inert materials; and
- Fine material including soil and below a “sortable” size, materials will necessarily be mixed and include soil-sized materials.

All materials will be transported to the area identified for storage on the smelter plant site. Classification in accordance with the NSW EPA resource recovery general and specific exemptions will be undertaken at a later date.

Although the site assessment did not identify contaminated soils or materials such as asbestos containing materials (ACM), a protocol detailing actions where unexpected materials (including ACM) are encountered during the excavation works is addressed in **Section 14.1.**

9.7 Spoil Management

The following general principles should be incorporated into management of stockpiles:

- No stockpiles or other materials shall be placed on steep slopes and will be away from the natural watercourse of Black Waterholes Creek.
- Control of dust from all atockpiles.
- All stockpiles will be placed on a level area as a low elongated mound.

Further erosion and sediment controls in accordance with the CEMP (refer to **Section 11.8**) are to be implemented.

9.8 Materials Tracking

A procedure shall be provided including:

- Truck logging at the site entrances and exits or materials being exported and imported.
- Logging of material destinations from/to the Clay Borrow Pit and the smelter stockpile site.
- If any material is taken offsite to landfill, all waste facility tipping dockets will be retained on file by the Contractor’s Environmental Representative and be correlated to the truck logging sheets in a weekly materials tracking report.

It is not proposed that any contaminated soils will be transported from the site or on public roads. The Hydro Smelter site is considered to be part of the site.

However, in the event that contaminated soils are transported off site, these will need to be controlled as per the NSWEPA requirements of waste tracking and acceptance, where classified as a waste that must be tracked. Waste disposal dockets are to form part of the validation report.

These are as follows based on regulations current at the time of this RAWP:

- Obtain a written consignment authorisation number from a licensed waste disposal or treatment facility before moving waste to the facility.
- Complete a waste data form signed by the consignor before the waste is dispatched.
- The waste consignor, the waste transporters and the waste facility must each keep a copy of the waste data form for up to four years for auditing purposes.
- The waste consignor must give a completed copy of the waste data form to the transporters, who must check that it is completed and then sign it. The driver must carry the waste data form in the vehicle.
- The transporters must give a completed copy of the waste data form to the waste facility on arrival at the destination. The waste facility operator must check the load details on the form. The waste data form must be signed by a representative of the waste facility on receipt of the waste at the destination
- The waste consignor must receive from the waste facility written confirmation of receipt of the waste within 21 days of dispatch. This must be kept for up to four years for auditing purposes.

Imported Fill

All fill imported on to the site shall be tracked including landscaping materials. All soil and landscaping materials shall be validated **PRIOR** to being received at the site to confirm it is ENM or VENM and meets the geotechnical requirements for backfill described in **Section 9.10**.

9.9 Validation of Remediation.

Detailed validation requirements are presented in **Section 10.**

Generally validation will comprise visual inspection identifying that the excavation is free of all impacted materials. The analysis of soil samples from the walls and base of the excavation is not required as there is no risk of impact to the natural soils from the stockpiled and buried material or from the soil matrix.

Visual validation of the exposed excavation shall be undertaken prior to reinstatement of the excavation. Excavation backfilling is not permitted until the Contractors environmental representative is satisfied that visual validation shows the remediation goal has been achieved **or, where the goal has not been achieved then** following written approval from the Principal or Principal’s Representative.

9.10 Backfilling and Final Landform

It is not envisaged that the site will be backfilled but that the land will be reshaped to the minimum effort level necessary to achieve;

- A final landform that is consistent with the surrounding topography without steep slopes or abrupt changes in slope;
- The levels and grades of the finished landform shall be such that it encourages the shedding of incident stormwater but are at grades that would not result in erosion;
- The finished landform shall comprise a surface layer not less than 100mm of topsoil and shall be vegetated with native grasses.

In the event that backfill soils are required, all backfilling works shall comply with the following requirements:

- All backfill shall be appropriate soil material complying with either the VENM or EMN exemptions. All materials imported as backfill to the site shall have appropriate documentation to confirm their status (as ENM/VENM). It is the responsibility of the Contractor that material used to reinstate the excavation meets these requirements;
- Acid sulfate soil shall be specifically excluded from use in backfilling;
- Fill material shall be placed and undergo sufficient compaction such that it will not be subject to subsidence or erosion either in the short or long term.

9.11 Demobilisation

At the completion of the works the Contractor is to demobilise. The Contractor is to remove all project infrastructure and wastes unless agreed to remain in writing by the Principal.

9.12 Smelter Site Stockpile Area.

The Contractor will be responsible for the preparation of the Smelter site stockpile area on the smelter plant site.

The Principal shall identify the area to be used on the smelter.

Materials transported from the Clay Borrow Pit will be stored at this location.

The Contractor shall undertake site preparation works, (in the area identified by Hydro) to ensure:

- The layout of the smelter site stockpile area will be suitable for placement of the anticipated material volumes (or as indicated by the Principal), in terms of allowance for space and access;
- During active construction of the stockpiles, appropriate erosion and sediment controls have been installed (refer to **Section 11.8**);
- Upon completion of the stockpiling works, (following the Clay Borrow Pit remediation works), the Contractor shall undertake works to ensure long-term stabilization of the **soil** stockpile. No stabilisation is required for concrete, refractorty brick or bitumen. These are envisaged to include:
  - Placement, shaping and compaction of stockpile landform to encourage runoff but not erosion;

- Placement of a topsoil layer (min 100mm) and vegetation (eg, hydromulch) over the finer materials stockpile; and
- Surface water diversion and erosion control measures as appropriate to divert stormwater away from and around stockpiles, and capture any sediment in runoff from the stockpiles.

10 Validation of Remediation

The following is the validation sampling, analytical and quality plan (SAQP) to be implemented to validate the remediation objective has been achieved for the Clay Borrow Pit.

10.1 Validation Sampling and Analysis

Validation sampling will be required to demonstrate that, following excavation of all fill materials, remaining soils are within the adopted guidelines for the site.

Validation will involve:

- Visual assessment and documentation (photograqphic) of remaining soils for absence of fill materials.

Soil sampling across the excavation is not required as there is no risk of impact to the natural soils from the stockpiled and buried material or from the soil matrix.

10.2 Validation Data Quality Objectives

In order to achieve the objectives and purpose of the validation program, both the field and laboratory programs must be representative of the actual extent of contamination in soil. As such, specific Data Quality Objectives (DQOs) have been developed for the validation of field and analytical data obtained during the investigation. The DQO process is a systematic, seven step process that defines the criteria that the sampling should satisfy in accordance with the requirements of DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition).

Step 1 – State the Problem

In its current state, the site is not considered suitable for the proposed land use due to impacts to visual amenity from stockpiled and buried fill and remediation is required. Remediation of the stockpiled and buried fill is required to remove the impacts to visual amenity. The materials that are stockpiled and buried at the site include bake furnace refractory brick, concrete and bitumen. No potential contaminants of concern were identified at concentrations above the site guidelines, including heavy metals, fluoride, PAHs or SVOCs. .

Further details of site contaminants are presented in **Section 7.**

The remediation methodology is detailed above in **Section 9.4**. The remediation process involves the removal of stockpiled and buried materials and sorting prior to temporary storage as potentially recyclable material or later inclusion in a whole-of-site strategy. The Clay Borrow Pit is to be reshaped following visual validation of the removal of materials.

Step 2 – Identify the Decisions

The validation SAQP is to ensure that all relevant contamination has been identified on the site, that all contamination identified has been adequately assessed, that remediation has been carried out successfully and that strategies are in place to ensure that the site is not re-contaminated in the future.

Sections 7 and 8 of this RAWP outline the previous investigations completed to assess potential contaminants of concern, the validity of the data, the remediation strategy proposed and the appropriateness of this remediation strategy for the impact to visual amenity.

To validate the effectiveness of the remediation strategy, visual validation of the removal of stockpiled and buried material is required. Validation sampling of soil is not required as there is no risk of impact to the natural soils from the stockpiled and buried material or from the soil matrix. The site will be considered remediated when the remediation program has been carried out successfully. Remediation is deemed to be successful when:

- All fill materials have been removed from the Clay Borrow Pit Area, sorted and appropriately relocated;
- Excavations have been reshaped to an accepted landform.

Step 3 – Identify Inputs to the Decision

For the remediation of the Clay Borrow Pit site the following input into the decision making process is required:

- A visual evaluation of the removal of all stockpiled and buried materials is required to validate the remedial works.
- Documented materials tracking that demonstrates all materials have been appropriately relocated as described in **Section 9.7**.
- Final survey that demonstrates the landform has been reshaped to achieve the objectives of the final landform as described in **Section 9.10**.

Step 4 – Definition of the Boundaries of the Investigation

The site boundaries have been outlined and defined within this RAWP and are presented in **Figure 2**. Remediation applies to fill materials both buried and above ground.

Step 5 – Development of Decision Rules

Decision rules for the validation of the remedial works are based around visual validation of the removal of stockpiled and buried materials, including refractory brick, concrete and bitumen. The decision rules are as follows:

- Can it be visually confirmed that stockpiled and buried fill materials have been removed from the Clay Borrow Pit;
- Visual validation should show that the walls and base of the excavation are within red / grey, medium to high plasticity clay.
- If visual validation cannot be confirmed, additional excavation should be completed until the excavation can be validated as being in red / grey, medium to high plasticity clay.

Step 6 – Specification of the Acceptable Limits on Decision Errors

Acceptable limits and the manner of addressing possible decision errors are outlined below:

- The decision to be made is that all stockpiled and buried fill material has been excavated from the Clay Borrow Pit and that the resultant excavation is within natural red / grey clay.

- Possible decision errors include deciding that all stockpiled and buried fill material has been removed when it has not or deciding that the resultant excavation is within natural red / grey clay when it is not.

- As the validation of the removal of stockpiled and buried fill material is visual, there is no acceptable limit on decision errors.

Step 7 – Optimisation of the design of the collection of data

The excavation is to be photographed on a daily basis to show the removal of stockpiled and buried fill material. The photolog shall be used to demonstrate compliance with the remedial strategy.

Justification for the validation program is presented in **Table 10.1**.

Table 10.1: Validation Sampling Program

Validation Sample Type	Sample Frequency and Justification	Analytes
Visual documentation of the removal of fill materials	Excavations are to be photographed and a photographic log maintained and included in the validation report.	N/A

Contingency for validation sampling:

- In the event that visually impacted (including ACM) or odorous soils are excavated as part of the remedial works, validation sampling of the base of the excavation in the vicinity of the visually impacted or odorous soils will be completed;

- The analytical suite for the validation samples will vary and will depend on the visual impact or odour. Soils impacted with an oily sheen or hydrocarbon odour will result in validation sampling for hydrocarbons. Discoloured soils will result in validation sampling for a suite of analytes, including heavy metals, fluoride and cyanide. Material with ACM fragments will result in validation sampling for asbestos (as well as the implementation of the Asbestos Management Protocol in Section 14.1).

- In the event that ACM fragments are identified during the excavation works, an asbestos clearance certificate will be required by a suitably qualified and experienced person at the completion of the remedial works.

- Discrete sampling will be undertaken by collecting surface soil using a steel trowel or collection directly from the soil surface by hand. Discrete samples will be spaced in a 30m grid formation across the area to ensure that an even coverage of the site is achieved.

- Decontamination of sampling equipment will be undertaken before sampling and between samples by cleaning with “Decon 90/Xtran” and potable water.

- Disposable gloves will be worn for all sample collection.

- Where walls of excavations are present and are not proposed to be excavated and are deeper than 0.2m, discrete sampling will be undertaken from each soil type present every 10 lineal metres.
- Where walls of excavations are present and are not proposed to be excavated and are deeper than 0.2m, discrete sampling will be undertaken from each soil type present every 10 lineal metres.
- All samples will be given a unique identifier and marked on a plan.

Imported Fill Sampling

Any imported fill that is proposed to be brought to the site during the remediation project is to be VENM or ENM. The history of the source site must show that the site has not been previously contaminated and a visual inspection of the source material is to be conducted. VENM material must be accompanied by a VENM certificate as outlined by the EPA. Refer to http://www.epa.nsw.gov.au/wr/venm.htm.

Imported ENM is to meet the criteria outlined in the ENM exemption issued under the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption under Part 6, Clause 51 and 51A, The Excavated Natural Material Exemption 2012.

10.3 Remediation Acceptance Guidelines

Remediation acceptance is a visual validation of the removal of stockpiled and buried materials, with the resultant excavation to be within red / grey, medium to high plasticity clay.

10.4 Validation Report

A Validation Report will be compiled by the environmental consultant on completion of the works. This report will contain an overview of the remediation activities conducted and document the following:

- Site description.
- Details of the fieldwork undertaken.
- Supporting factual evidence of the remediation work including photographic and field records, and materials tracking data including waste disposal dockets.
- Volumes of excavated material and location of excavations/stockpiles.
- Surveyed plan of sampling locations for each analyte.
- Visual validation of the removal of all stockpiled and buried wastes.
- Visual validation of the resultant excavation being in natural red / grey clay.
- A statement indicating the suitability of the Site for the proposed land use

The Validation report will be prepared in accordance with the NSWEPA Guidelines for Consultants Reporting on Contaminated Sites (NSWEPA 1997) and the Department of Environment and Conservation Guidelines for the NSW Site Auditor Scheme 2nd Edition (DEC 2006).

10.5 HOLD POINT

At the completion of remedial works the Contractor is to provide to the Principal for review and approval a validation report that demonstrates that the RAWP has been successfully implemented. The requirements of the validation report are presented in **Section 10.4**

11 Construction Environmental Management Plan

11.1 HOLD POINT

Prior to the commencement of remediation works a Construction Environmental Management Plan (CEMP) shall be developed for written approval by the Principal. The CEMP is to incorporate the following detailed management plans.

11.2 Construction Environmental Management Plan

The contractor is to prepare a CEMP consistent with the “Guideline for the Preparation of Environmental Management Plans” (NSW Department of Infrastructure, Planning and Natural Resources, 2004). The CEMP is to address the issues discussed in **Sections 11.3** to **11.14.**

11.3 Site Access

During remediation works access to the site is to be strictly controlled by the Contractor. The contractor should include signage at the entry to the work area identifying the nature of the works, the contractor details and the Remediation Project Manager’s details.

Only authorized persons who have been inducted into the safety and environmental controls on the site will be permitted to work on the site. Visitors to the site will be accompanied by such inducted personnel.

Vehicle access to the site will be along established access roads where possible.

If the construction of additional access tracks is required, these shall be detailed for approval from the Principal’s Representative prior to commencement of any construction works.

11.4 Hours of Operation

The Contractor shall only undertake works associated with the Project that may generate an audible noise at the closest residential receptor during the following hours unless under direction from a relevant authority for safety reasons or in the event of an emergency:

- 7.00 am to 6.00 pm, Monday to Friday;
- 7.00 am to 1:00 pm on Saturdays; and
- At no time on Sundays or public holidays.

11.5 Community Consultation

The Principal will be responsible for community liaison activities including notification and complaints handling.

11.6 Air Controls

Dust Control

Dust emissions shall be managed to avoid dust generation that could impact on a sensitive receiver. The CEMP is to identify the dust control measures the contractor will implement to meet this objective.

The following dust control procedures should be considered:

- Securely covering all loads entering or exiting the site.

- Use of water carts on unsealed roads, parking and other trafficable areas.
- Control of dust from all stockpiles
- All vehicles to travel on designated access roads.
- Temporarily ceasing an activity that generates dust that could affect a sensitive receiver.

Odour

Given the nature and extent of the stockpiled and buried fill identified at the site, there is a low potential for odours to be emitted.

Should a complaint be received by the Remediation Project Manager regarding odour, the source of the odour is to be identified and appropriate control measures identified and implemented.

Control measures could include:

- Use of appropriate covering techniques such as the use of plastic sheeting to cover specific excavation faces or stockpiles.
- Use of fine mist sprays.
- Any equipment and machinery used on site need to have been maintained in accordance with manufacturers' requirements to minimise exhaust emissions.

Records of odours and control measures (if required) shall be kept by the Remediation Project Manager.

11.7 Noise Control

The remediation works shall comply with the "Interim Construction Noise Guideline" (DECCW, 2009). This would include remediation works being restricted to the hours described in **Section 11.4**.

The CEMP is to identify the noise control measures the contractor will implement to comply with the guideline. The following noise control measures should be considered:

- Construction vehicles and machinery would be selected with consideration of noise emissions. Equipment should be fitted with appropriate silencers (where applicable) and be maintained in accordance with manufacturer's requirements. Machines found to produce excessive noise compared to typical noise levels should be removed and replaced, or repaired or modified prior to recommencing works.
- Where possible construction vehicles and machinery would be turned off or throttled down when not in use.
- All site staff would be informed of their obligations to minimise potential noise impacts on residents during the site induction and the need to take reasonable and practical measures to minimise noise.

11.8 Erosion and Sediment Control

The CEMP is to include erosion and sediment control measures consistent with Managing Urban Stormwater: Soils and Construction (4th Ed) (Landcom, 2004).

The erosion and sediment control plan is to be prepared and implemented for the Clay Borrow Pit works area and the Smelter site stockpile location.

The following erosion and sediment control measures should be considered:

- Installation of silt fences in drainage channels downgradient of the remediation work areas and any stockpile areas.
- Any material which is collected at the silt fences (or other sediment control measures) should be managed with the soil component of the excavated fill material.

Once a week and following rain events the sediment control measures would be inspected and maintained as required.

11.9 Surface Water and Groundwater Control

Surface water

Previous analysis has identified that potential contaminants of concern were generally identified at concentrations below the laboratory detection limits and therefore the generation of dissolved contaminants in surface water runoff is not expected. Surface water controls are required to manage erosion and sediment control (refer to **Section 11.8**, and surface water collected within excavations.

The CEMP is to identify the measures the contractor will implement to manage surface water quality. The following control measures should be considered:

- Erosion and sediment controls outlined in **Section 11.8** are implemented;
- Diversion of surface water upgradient of the excavation and stockpile areas from the areas of disturbance.
- Stockpile areas are to be on flat land where possible and out of any drainage lines.
- Water collected within excavations would drain from the excavation area through sediment controls (as outlined in **Section 11.8**). Where the water is required to be pumped from the excavation it is to be subjected to the sediment controls outlined in **Section 11.8** prior to discharge from the site.
- The contractor is to keep themselves informed of weather conditions and the potential for rain events and proactively manage the site.

Groundwater

Perched groundwater is expected to be encountered within the buried fill materials in the eastern portion of the Clay Borrow Pit. The Contractor is to develop a methodology for management of this water during excavation. The following control measures should be considered:

- The Western Surge Pond on the Smelter site can be utilised for the discharge of water.

- Perched groundwater being discharged to the Western Surge Pond does not require analysis for suitability as analysis completed by ENVIRON in 2012 indicates that concentrations of heavy metals, fluoride, PAHs and SVOCs are within the ranges of other waters which are managed through the Smelter stormwater management system.

The interception of this water is not considered to be an interception of groundwater under the *Water Act 1912*. This groundwater is perched or trapped sub-surface water within a former excavation.

11.10 Traffic Control

It is envisaged that all haulage routes will be within Hydro property. All haulage routes for trucks transporting soil, materials, equipment or machinery to and from the site shall be selected to meet the following objectives:

- Comply with road traffic rules
- Minimise noise, vibration and odour to adjacent premises; and
- Maximise travel on state and arterial roads and avoid use of local roads.

The CEMP is to include a traffic control plan for the Hart Road site access point as per Cessnock City Council guidelines. The plan should also designate internal material haulage routes.

If the traffic control plan includes the placement of signage or other traffic controls within the Hart Road road reserve, the Contractor is to consult with the Cessnock Council and attain any required approvals or permits prior to placing the signage or controls.

The CEMP should also include the following measures:

- Deliveries of soil, materials, equipment or machinery are to occur during standard construction hours (refer to **Section 11.4**).
- Securely cover all loads to prevent any dust or odour emissions during transportation.
- Vehicles are not to track soil, mud or sediment onto the road.

11.11 Spill Response

The Contractor is to develop a spill response protocol to be implemented in the event that site activities result in a spill.

Examples where spills could occur are:

- Transport of contaminated material from the site, involving loss of load anywhere including private and public property;
- Fuel spill during machinery use or refuelling that occurs anywhere including private or public property.

11.12 Hazardous Materials

11.12.1 Contractor Materials

The CEMP shall include measures for the storage, transport and use of any hazardous materials and dangerous goods during site activities. This will reference the guidance and requirements in the following:

- *Protection of the Environment Operations Act 1997* and associated regulations;
- *Work Health and Safety Act 2011* and the *Work Health and Safety Regulation 2011*;
- Australian Standard (AS1216) *Class Labels for Dangerous Goods*;
- Australian Standard (AS1940-2004) *The storage and handling of flammable and combustible liquids*; and
- Australian Standard (AS3833): *The Storage and Handling of mixed classes of dangerous goods in packages and intermediate bulk containers*.

Relevant Safe Data Sheets (SDS) for each material, chemical or hazardous substance used at the workplace is to be obtained from the manufacturer or suppliers of those goods prior to its arrival on site. All substances brought on to site must be registered on the SDS Register. This register must be developed and controlled by the site environmental manager who will be responsible for the receipt of such substances / materials in accordance with the Hazardous Substances Regulation, the Dangerous Goods Act and the Dangerous Goods Regulations.

11.12.2 Waste Materials

Although no ACM (fragments of asbestos sheeting) was identified on the site it should be considered that there is a low potential for ACM to be present.

The Contractor is to develop and implement an Asbestos Removal Control Plan consistent with the Asbestos Management Protocol included in **Section 14.1**.

11.13 Flora and Fauna

The CEMP is to include procedures for the clearance of vegetation (if required). This should include:

- Strategies for minimising vegetation clearance within the worksite and protection of vegetated areas adjoining the work area.
- Weed control measures.
- Measures for the management and disposal of cleared vegetation matter.
- Stockpiles and other materials are not to be stored below the drip line of any tree.

12 Health and Safety

12.1 HOLD POINT

Prior to the commencement of any works, a project specific Health and Safety plan is to be developed for written approval by the Principal.

A site specific health and safety plan detailing procedures and requirements that are to be implemented will need to be developed for the remediation works including as a minimum but not limited to, the requirements described below.

The objectives of the health and safety plan are:

- To apply standard procedures that reduce risks resulting from the works;
- To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- To have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- Assignment of responsibilities;
- An evaluation of hazards;
- Establishment of personal protection standards and mandatory safety practices and procedures; and
- Provision for contingencies that may arise while operations are being conducted at the site.

Specifically the Health and Safety plan is to address the following identified hazards:

- The stability of excavations;
- The presence of services;
- The presence of livestock, wildlife including snakes;
- The presence of contaminants as described within this document;
- The presence of other site personnel, work and traffic.

The Contractors Health and Safety plan is to be compliant with:

- Hydro Aluminum’s Contractor Occupational Health Safety and Environment Requirements Version 3 2014. **This requires the Contractor and all employees and subcontractors to be inducted to the Hydro site and for Hydro work permits to be obtained prior to starting any work.**
- Work Health and Safety Act 2011.
- Work Health and Safety Regulation.
- Applicable state and federal regulations, legislation and codes of practice.

13 Remediation Schedule

The final remediation schedule will be discussed with the Contractor. A proposed schedule up to the completion of a draft validation report is outlined below.

Table 13.1: Remediation Schedule

Task	Estimated Duration	Estimated Completion Date
Cessnock City Council Category 2 notification	30 days	Completed
Contractor Procurement	4 wks	Completed
Preliminaries (documentation)	3 wks	19/1/2015
Site establishment and mobilisation	1 wk	28/1/15
Site works	6 – 8 wks	1/5/15
Demobilisation	1 wk	15/5/15
Validation reporting	3 wk	30/6/15

14 Environmental Controls Contingency Plan

This section of the RAWP describes the contingency plans to respond to site incidents that may occur during remedial works and could impact on the surrounding environment and the community.

The environmental controls described in **Section 11** are designed to be sufficiently protective under the normal range of site conditions. The contingencies presented in **Table 14.1** are to be implemented where unexpected site conditions or circumstances arise.

Table 14.1: Environmental Controls Contingency Plan

Contingency Event	Contingency	Responsibility
Discovery of unexpected materials excluding ACM	Contact the Principal's representative, then sort materials to a segregated stockpile and discuss possible disposal options with the Principal or the Principal's representative.	Principal following notification from the Remediation Contractor.
Discovery of ACM	Stop work and implement the Asbestos Removal Control Plan. Refer to **Section 14.1.**	Remediation Contractor
Receival of a noise complaint	Identify noise source and implement noise control measures	Remediation Contractor
Receival of a dust or odour complaint	Identify odour or dust source and implement control measures	Remediation Contractor
Flooding event/sediment laden discharge	Assess and improve sediment and erosion control measures and stockpile management.	Remediation Contractor

14.1 Asbestos Management Protocol

14.2 HOLD POINT

The Contractor is to submit an Asbestos Removal Control Plan in accordance with this Protocol to the Principal for written approval 10 working days prior to the commencement of the asbestos removal.

The purpose of this protocol is to describe:

- The permits and approvals required to be attained prior to the works for the removal and management of potential asbestos containing materials (ACM) if encountered.
- The procedures to be implemented in the event that ACM is encountered.

14.2.1 Asbestos Related Permits and Approvals

The Contractor is required to possess a Class A friable asbestos removal license issued by WorkCover NSW or an equivalent asbestos removal license issued in another Australian jurisdiction.

The Contractor is responsible for notifying WorkCover NSW of the asbestos removal work **five days prior** to the commencement of the works. The Notification of Asbestos Removal Work is to address the removal of ACM that may be encountered below the surface.

The Contractor is required to prepare an Asbestos Removal Control Plan consistent with this Protocol, which is to be amended (as required); in the event that ACM is encountered.

The Contractor must notify a licensed waste management facility of the requirement to dispose of ACM prior to transporting the material to the facility. The Contractor would be required to provide the Contractor's Environmental Consultant with a docket from the facility confirming that the material was appropriately disposed as ACM at the facility and for that docket to be included in the Validation Report, refer to **Section 10**.

14.2.2 Management of ACM

The Contractor is to develop and implement an Asbestos Removal Control Plan consistent with *How to Safely Remove Asbestos: Code of Practice* (WorkCover NSW, 2011) ("the Code"), addressing the following:

– Delineation of and installation of warning signage around the asbestos removal area as appropriate as described in Section 4.2 of the Code.

– Provision of the appropriate personal protective equipment to all asbestos removal personnel as described in Section 4.5 of the Code.

– Removal and containment of asbestos fragments as described in Section 4.8 of the Code.

– Disposal of disposable personal protective equipment in accordance with Section 3.9 of the Code.

– Notification of the waste management facility of the requirement to dispose of ACM waste (refer to previous section).

– Transportation of the contained ACM waste to the licensed waste management facility (including defining the route to be travelled by the disposal vehicle), disposal in accordance with facility requirements, and a disposal docket attained and presented to the Contractors Environmental Consultant.

– The requirement for a clearance inspection to be undertaken by an appropriate person as described in Section 3.10 of the Code upon completion of the ACM removal.

– The procedures to be implemented in the event that unexpected ACM is uncovered (refer to **Section 14.1**).

15 Regulatory Approvals and Licensing

Table 15.1 outlines the regulatory requirements applicable at the time of preparation of the RAWP.

Table 15.1: Key Relevant Legislation and Regulations

Legislation or Regulation	Relevance
State Environmental Planning Policy 55 – Remediation of Land (SEPP 55)	Under SEPP 55 remediation work are permissible in any zone, regardless of any provision in another environmental planning instrument (such as a local environmental plan). SEPP 55 also establishes: Category 1 remediation works: remediation that required development consent. This includes remediation that is: designated development; likely to have a significant impact on ecological values; deemed as requiring development consent by another SEPP; within a sensitive land zone under a local environmental plan; or not consistent with a contaminated land planning guideline made by the relevant council. Category 2 remediation works: remediation which does not require development consent. This is any remediation that is not deemed category 1 remediation works. The Clay Borrow Pit remediation works are considered to fall under Category 2 and Hydro will notify Cessnock City Council 30 days prior to commencement of remediation works.
Protection of the Environment Operations Act 1997 (POEO Act)	The POEO Act is the primary legislation for the management and control of pollution of the environment. This includes the licensing of premises that are listed as scheduled premises under Schedule 1 of the POEO Act. The Clay Borrow Pit and the Smelter site storage area are regulated under Environment Protection Licence (EPL) 1548. Activities proposed for the remediation works are consistent with the scheduled activities permitted by the EPL.
Cessnock Local Environmental Plan 2011 (Cessnock LEP)	The Cessnock LEP is the key local land use planning document for the Cessnock local government area. Category 2 remediation works are permissible without consent however SEPP55 requires notification to Council, as outlined above.
Protection of the Environment Operations (Waste) Regulation 2005	The regulations make requirements relating to non-licensed waste activities and waste transporting. Section 42 of the Regulation stipulates special transportation, re-use or recycling requirements relating to asbestos waste and must be complied with regardless whether the activity is licensed. The requirements for the transportation of asbestos waste include: • bonded asbestos material must be securely packaged at all times, • friable asbestos material must be kept in a sealed container, • asbestos-contaminated soils must be wetted down,

Table 15.1: Key Relevant Legislation and Regulations

Legislation or Regulation	Relevance
	• all asbestos waste must be transported in a covered, leak-proof vehicle. The requirements relating to the off site disposal of asbestos waste are as follows: • asbestos waste in any form must be disposed of only at a waste facility that may lawfully receive the waste, • when asbestos waste is delivered to a waste facility site, the occupier of the waste facility site must be informed by the person delivering the waste that the waste contains asbestos, • when unloading and disposing of asbestos waste at a waste facility site, the waste must be unloaded and disposed of in such a manner as to prevent the generation of dust or the stirring up of dust, • asbestos waste disposed of at a waste facility site must be covered with virgin excavated natural material or other material as approved in the facility's environment protection licence. • Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded. The Regulation exempts certain waste streams from the full waste tracking and record keeping requirements. Waste tracking is required only for hazardous wastes. However these are not anticipated to be present on the site.
Native Vegetation Act 1993 (NV Act)	The NV Act controls the clearance of native vegetation in NSW, including identifying clearance activities requiring development consent and where exclusions from the need for consent apply. Section 22 of the act states that clearing for the purpose of "routine agriculture management activities" does not require development consent. The definition of "routine agriculture management activities" includes "any activity reasonably considered necessary to remove or reduce an imminent risk of serious personal injury or damage to property." The purpose of the works is to remediate the area suitable for its existing use, currently rural land as part of the smelter buffer zone. In the event that the contractor determines that a tree poses a risk of injury or property damage, this section applies and development consent is not required.
National Parks and Wildlife Act 1974 (NPW Act)	Under the NOW Act it is an offence to harm protected fauna. Protected fauna are native fauna species. In the event that a tree is required to be removed the contractor is to avoid harm to native fauna.
Threatened Species Conservation Act 1995 (TSC Act)	The TSC Act lists threatened flora and fauna specispecieds and endangered ecological communities. In the event that a tree is required to be removed the

Table 15.1: Key Relevant Legislation and Regulations	
Legislation or Regulation	**Relevance**
	contractor is to avoid harm to native fauna. The contractor should also avoid any further clearance of native vegetation in the event that it is an endangered ecological community.
Water Management Act 2000	A controlled activity approval is required for works in or within 40 metres of a natural watercourse. Works in the Clay Borrow Pit itself are located in excess of 40m from Black Waterholes Creek. However, transport to the Smelter stockpile area requires traversing this creek on an existing roadway. If upgrades to the roadway are required to complete the works, then a controlled activity approval under the Water Management Act 2000 may be required. The Contractor will be responsible for advising the Principal if an upgrade is required and is to seek the neccessary approvals. Evidence of the approvals is to be provided to Hydro prior to commencing any works.
Water Act 1912	A groundwater interception licence is required for works that intercept groundwater. However minor temporary dewatering activities that is estimated to be less than three megalitres per year (including both construction dewatering and subsequent managed inflows) will generally not require a licence or approval from the Office of Water. Groundwater is not expected to be intercepted during the works. In the unlikely event it is intercepted, it is likely to require dewatering of less than three megalitres per year.

16 Project Quality Management Plan

16.1 HOLD POINT

The Contractor will prepare a Project Quality Management Plan that will outline the quality management measures to be implemented for all relevant elements of the Project including Inspection and Test Plans that will be applied to demonstrate that the requirements of the RAWP have been implemented.

17 Long Term Management

The RAWP has been designed to remove any requirement for long term site management from the Clay Borrow Pit in relation to contamination. Once remediation is complete and the site has been validated as suitable for the proposed industrial/commercial use, no further remediation management is proposed. Reshaping of the landform and interim soil and erosion management of the site prior to redevelopment will be undertaken in accordance with the site CEMP.

Management of stockpiled materials at the Smelter site stockpile area is required until such time the disposal method is determined and available. For this period the stockpile management will be in accordance with the site wide Hydro stormwater management procedures and would be implemented by the Principal.

18 Roles and Responsibilities

Table 18.1 summarises the expected roles and responsibilities of all stakeholders in the remediation works:

Table 18.1: Roles and Responsibilities

Stakeholder	Name and Contact Details	Role/Responsibility
Principal	Hydro Aluminium Kurri Kurri Pty Ltd	Owner of the ClAy Borrow Pit and ultimately responsible for all works on the site. Will engage/contract all other parties.
Principal’s Environmental Representative	ENVIRON Australia Pty Ltd	Person employed by or sub-contracted to Hydro to oversee/provide technical advice on remediation works
Remediation Contractor	Enviropacific Services Pty Ltd	Company contracted to undertake remediation works. Will supply all plant and personnel to conduct works as outlined in this RAWP and as required under local, state and federal legislation
Remediation Supervisor or Project Manager	Enviropacific Services Pty Ltd	Responsible Person appointed by Contractor to supervise/coordinate all aspects of remedial works on behalf of the Contractor. Is the primary point of contact for the project.
Contractor’s Environmental Consultant	DLA Environmetal	Appropriately qualified environmental consulting company/person appointed to validate the implementation of the RAWP. The Contractor’s Environmental Consultant will supervise the works, conduct validation sampling and undertake all activities necessary to prepare validation report that documents the implementation of the RAWP for submission and review by the Principal
Contaminated Land Auditor	Ross McFarland, AECOM	Hydro has engaged a Contaminated Land Auditor to prepare a Contaminated Land Audit for the site in accordance with the Contaminated Land Management Act 1997. The Contaminated Land Auditor will be appointed by Hydro.

19 Conclusions and Recommendations

Environmental site assessment has confirmed that site remediation is required to address the impact to visual amenity present in a filled area located at the Clay Borrow Pit as a result of historical smelter management activities.

The evaluation of suitable remedial options identified the preferred option to comprise excavation and coarse sorting of all fill materials and transportation to an interim storage area identified on the Smelter plant site. The majority of materials are expected to be suitable for beneficial reuse following evaluation in accordance with the NSW EPA resource recovery general and specific exemptions. Other materials that are not suitable for reuse will be temporarily stockpiled for incorporation in a whole-of-site remediation strategy.

This RAWP outlines the remediation methodology to be followed and the validation required to demonstrate that the remediation has been successfully implemented.

Following remediation and successful validation the site will be suitable for the proposed commercial/industrial land use.

20 References

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

ENVIRON Australia Pty Ltd (ENVIRON 2012) Phase 2 ESA, Kurri Kurri Aluminium Smelter, Norsk Hydro ASA, 1 November 2012;

ENVIRON Australia Pty Ltd (ENVIRON 2012a) Application for Exemption – Refractory Brick, Hydro Aluminium Pty Ltd, August 2012.

ENVIRON Australia Pty Ltd (ENVIRON 2012a) Sampling, Analysis and Quality Plan, Refractory Brick Characterisation, December 2012.

ENVIRON Australia Pty Ltd (ENVIRON 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford, 20 March 2013;

ENVIRON Australia Pty Ltd (ENVIRON 2013a) Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford, 2 April 2013;

ENVIRON Australia Pty Ltd (ENVIRON 2013b) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter, 22 October 2013;

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

NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013;

New South Wales Department of Environment and Conservation (NSW DEC 2006) Guidelines for the NSW Site Auditor Scheme (Second Edition);

New South Wales Department of Environment and Conservation (NSW DEC 2007) Guidelines for the Assessment and Management of Groundwater Contamination;

NSW DECC (2008) Waste Classification Guidelines.

21 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 5th June 2014 and in accordance with our understanding and interpretation of current regulatory standards.

Site conditions may change over time. This report is based on conditions encountered at the site 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.

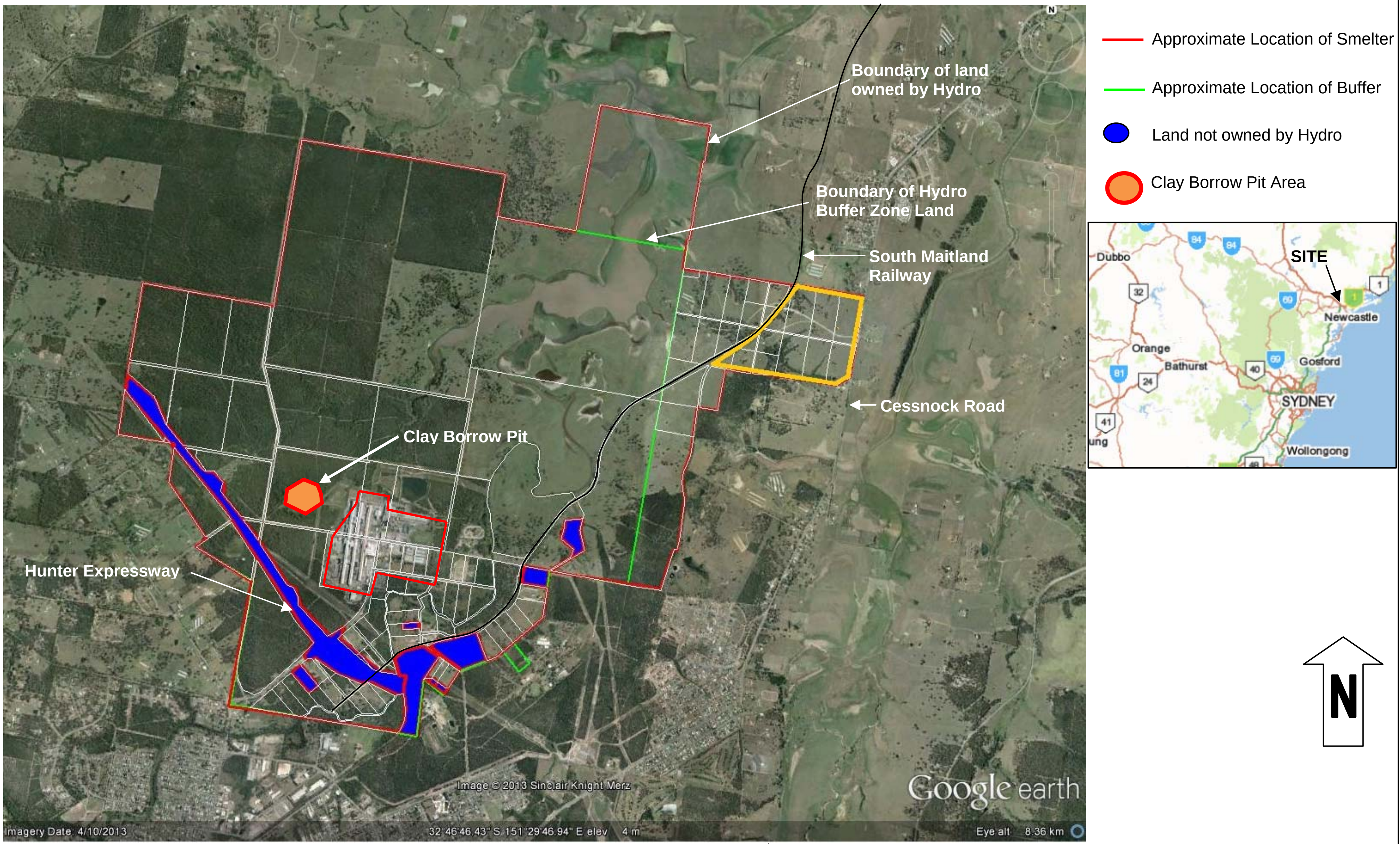
ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided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

21.1 User Reliance

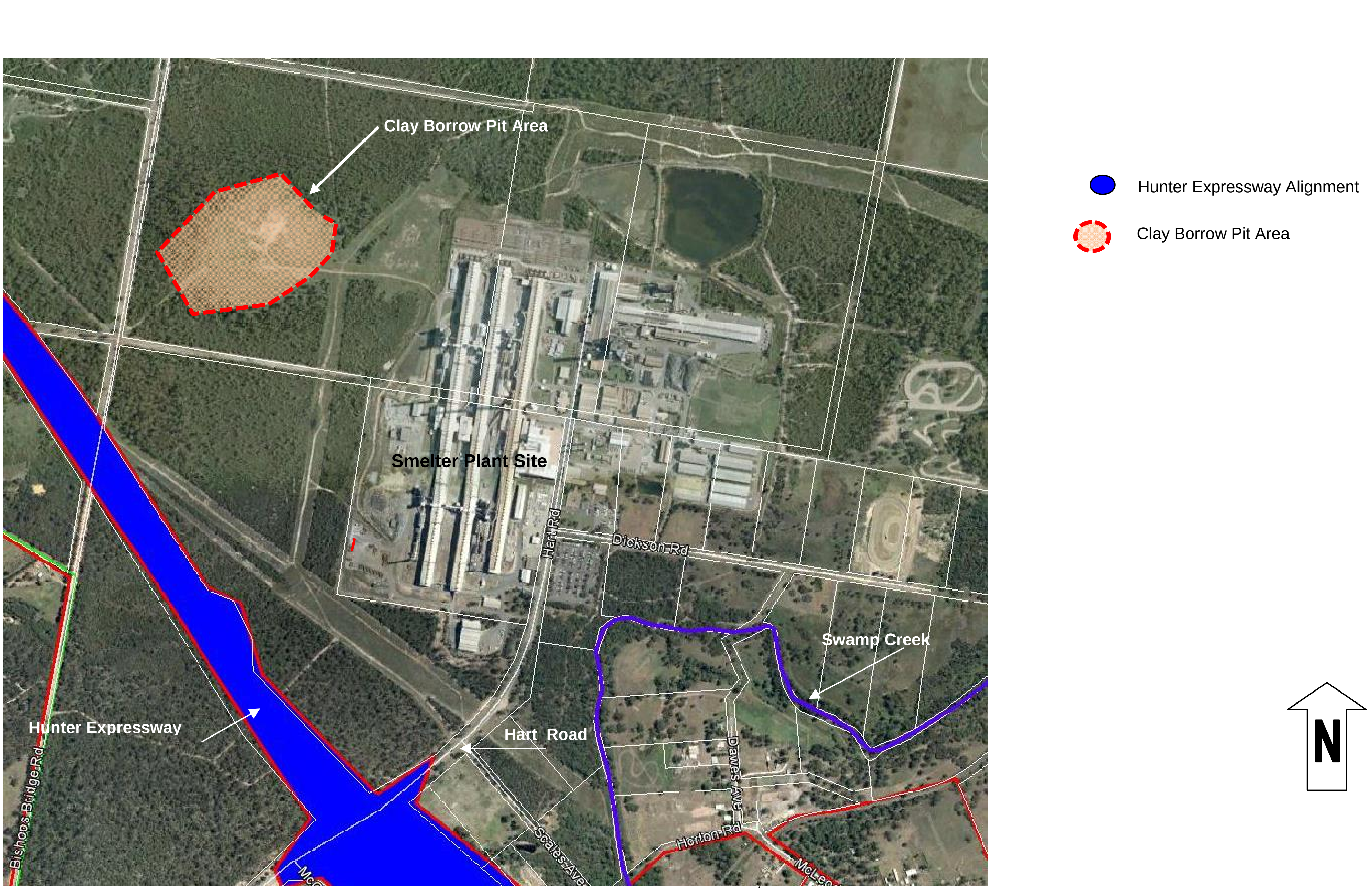
This report has been prepared exclusively for Hydro Aluminium Kurri Kurri Pty Ltd and may not be relied upon by any other person or entity without ENVIRON's express written permission.

Figures



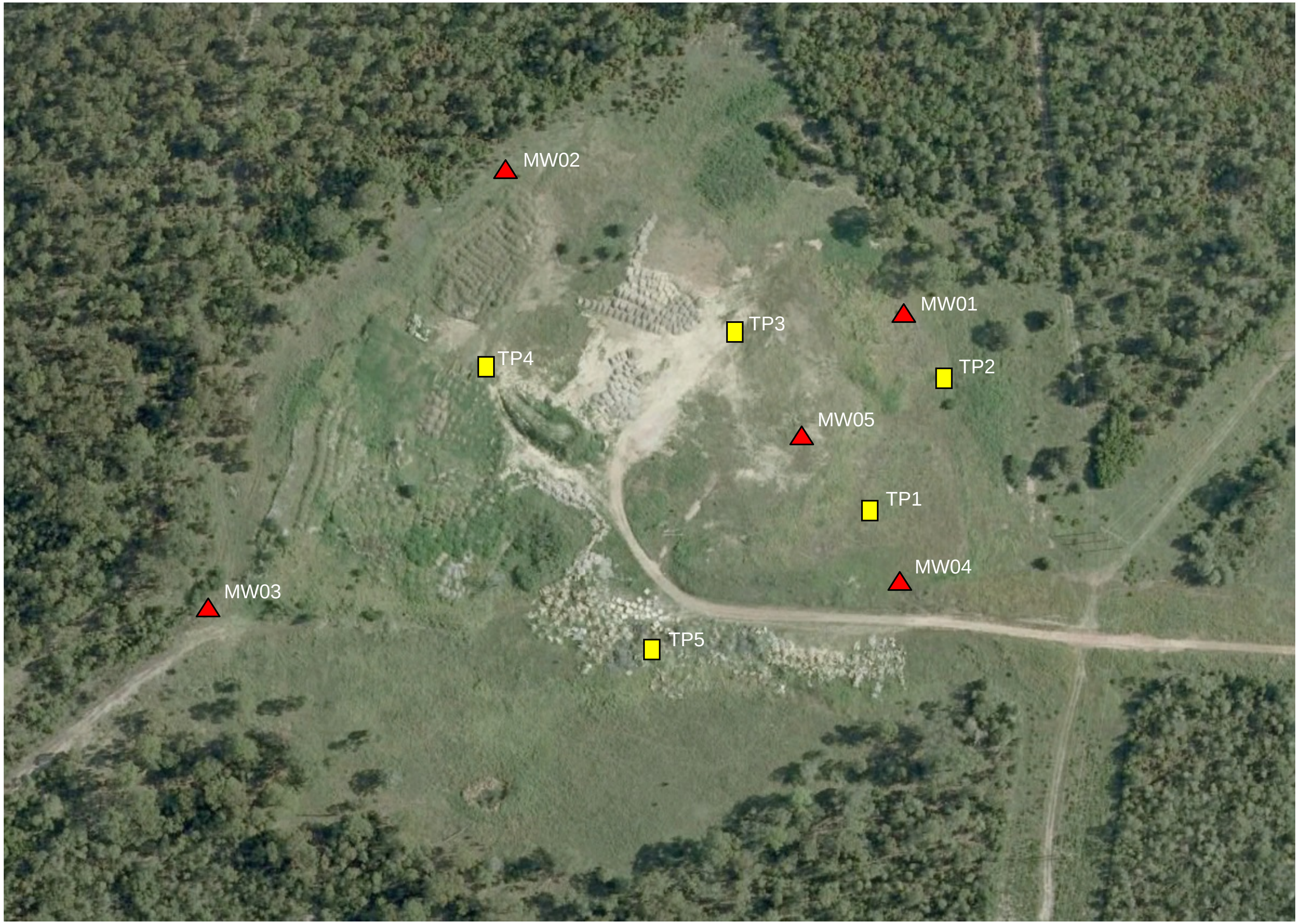
Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit	Site Location

ENVIRON JOB NO: AS130386 DATE: June 2014 FIGURE 1



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit	Site Layout

ENVIRON JOB NO: AS130386 DATE: June 2014 FIGURE 2



Test Pit Locations

Borehole Locations

Approximate Scale1cm: 28m

N

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

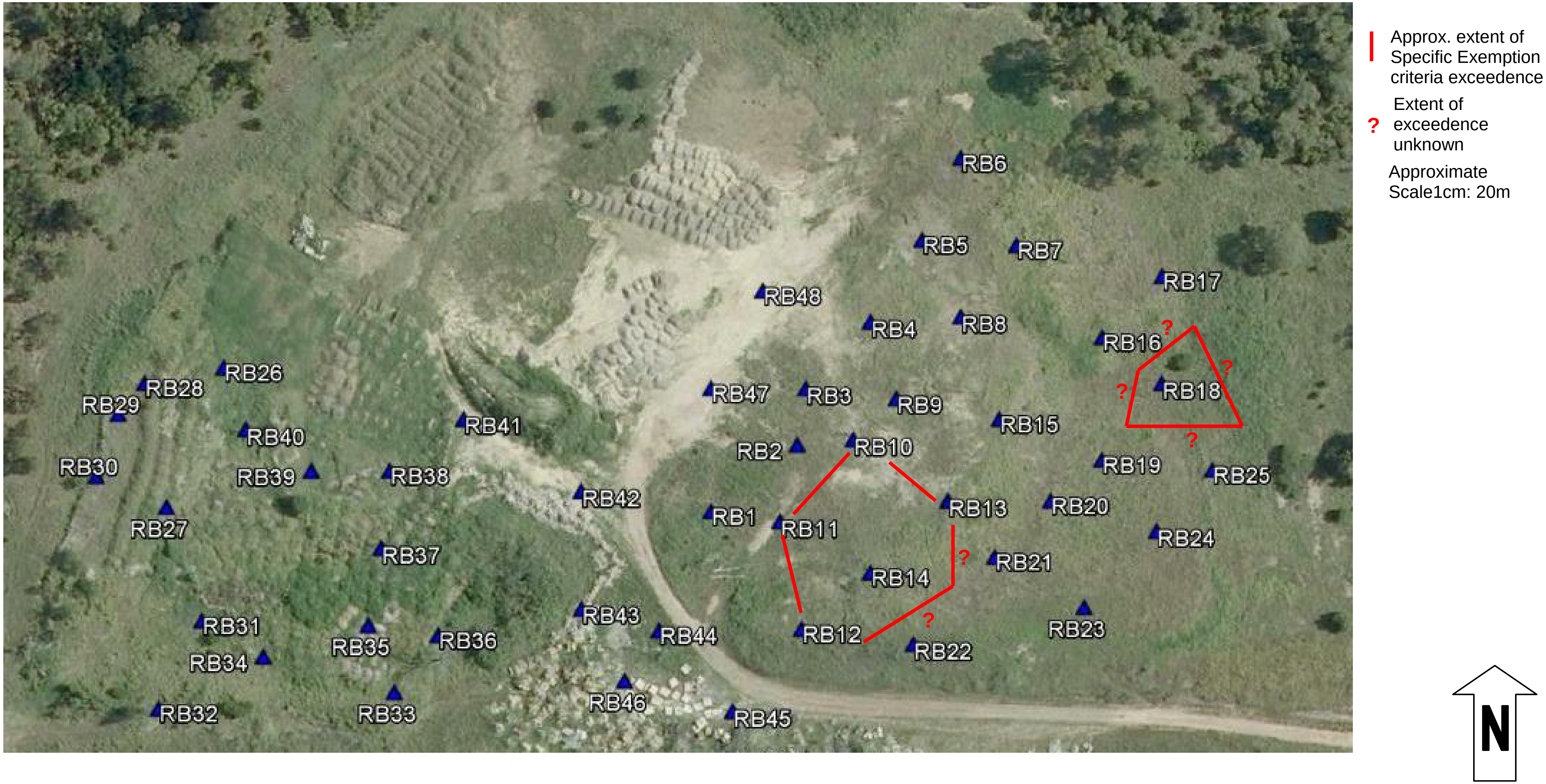
Sampling Locations, 2012 Phase 2 ESA

ENVIRON

JOB NO: AS130386

DATE: December 2014

FIGURE 3

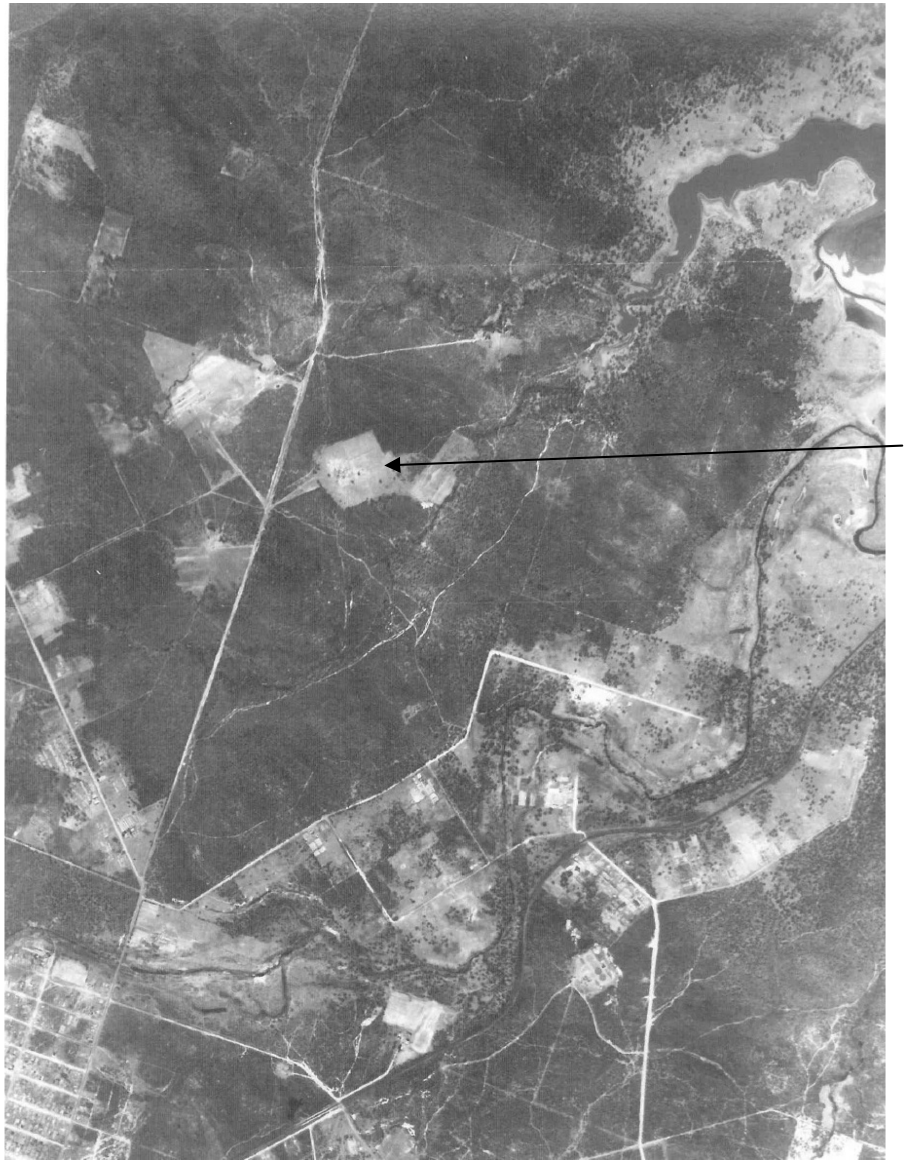


NB Aerial image is dated 2009 and may not reflect actual current (August 2014) stockpile locations

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit			Brick Sampling Locations – August 2014
ENVIRON	JOB NO:AS130386	DATE: December 2014	FIGURE 4

Appendix A

Historical Photographs



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 1951

ENVIRON

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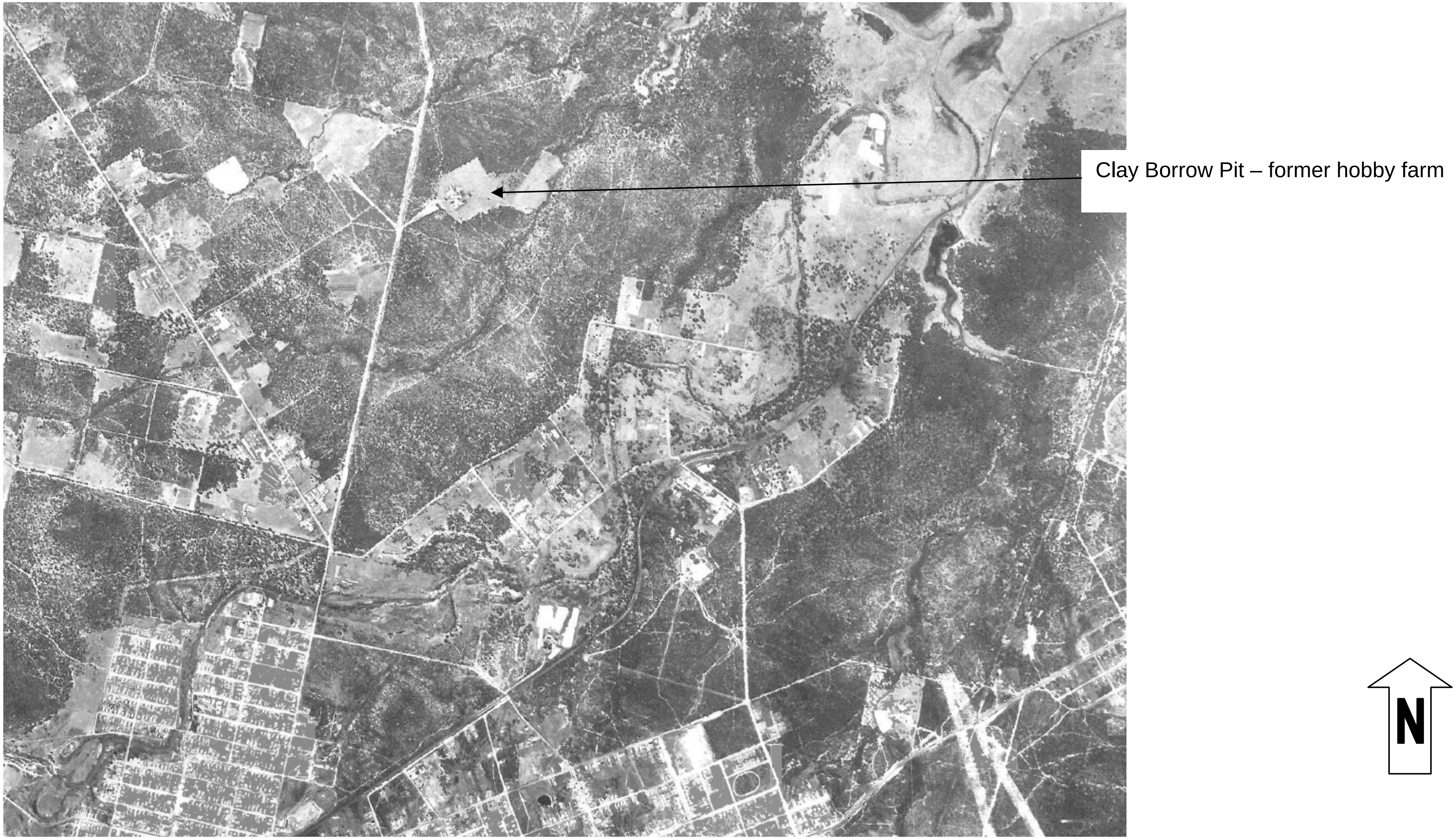
DATE: December 2014

APPENDIX A



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 1961

ENVIRON

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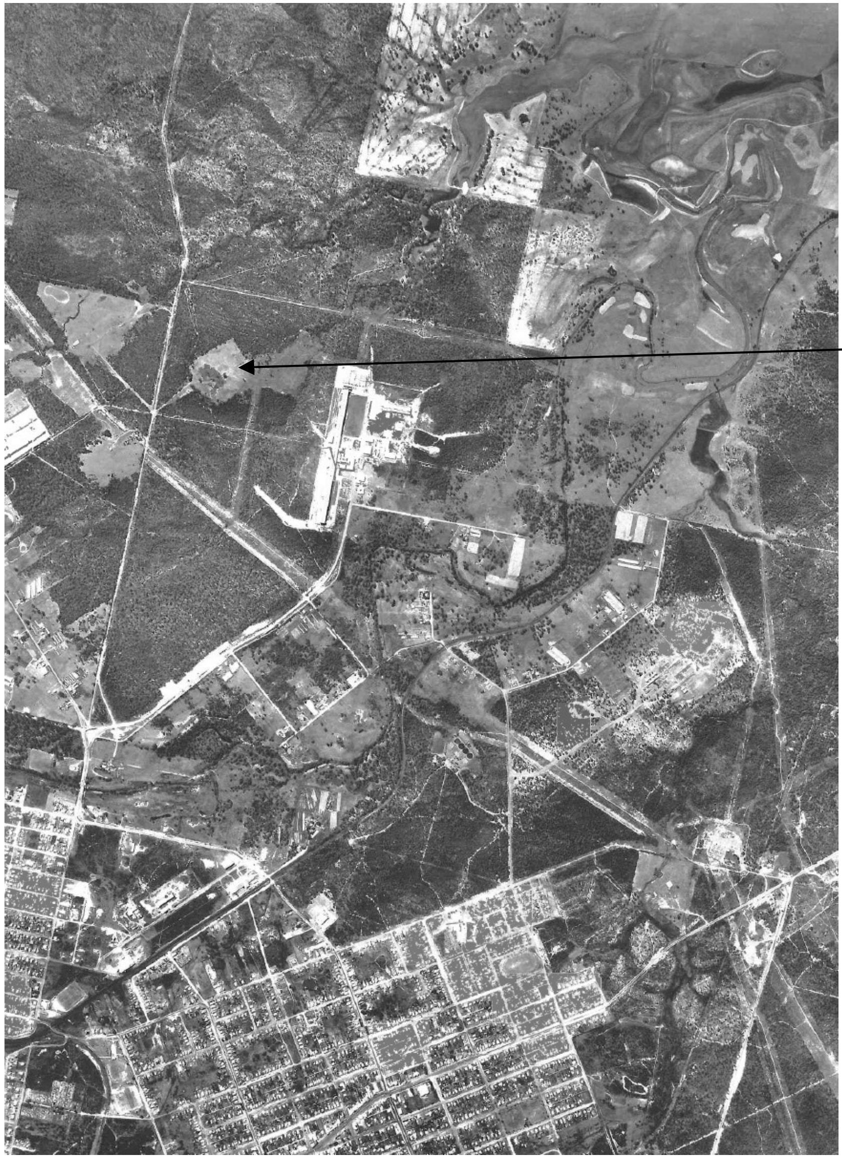
DATE: December 2014

APPENDIX A



Clay Borrow Pit – former hobby farm

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 1975

ENVIRON

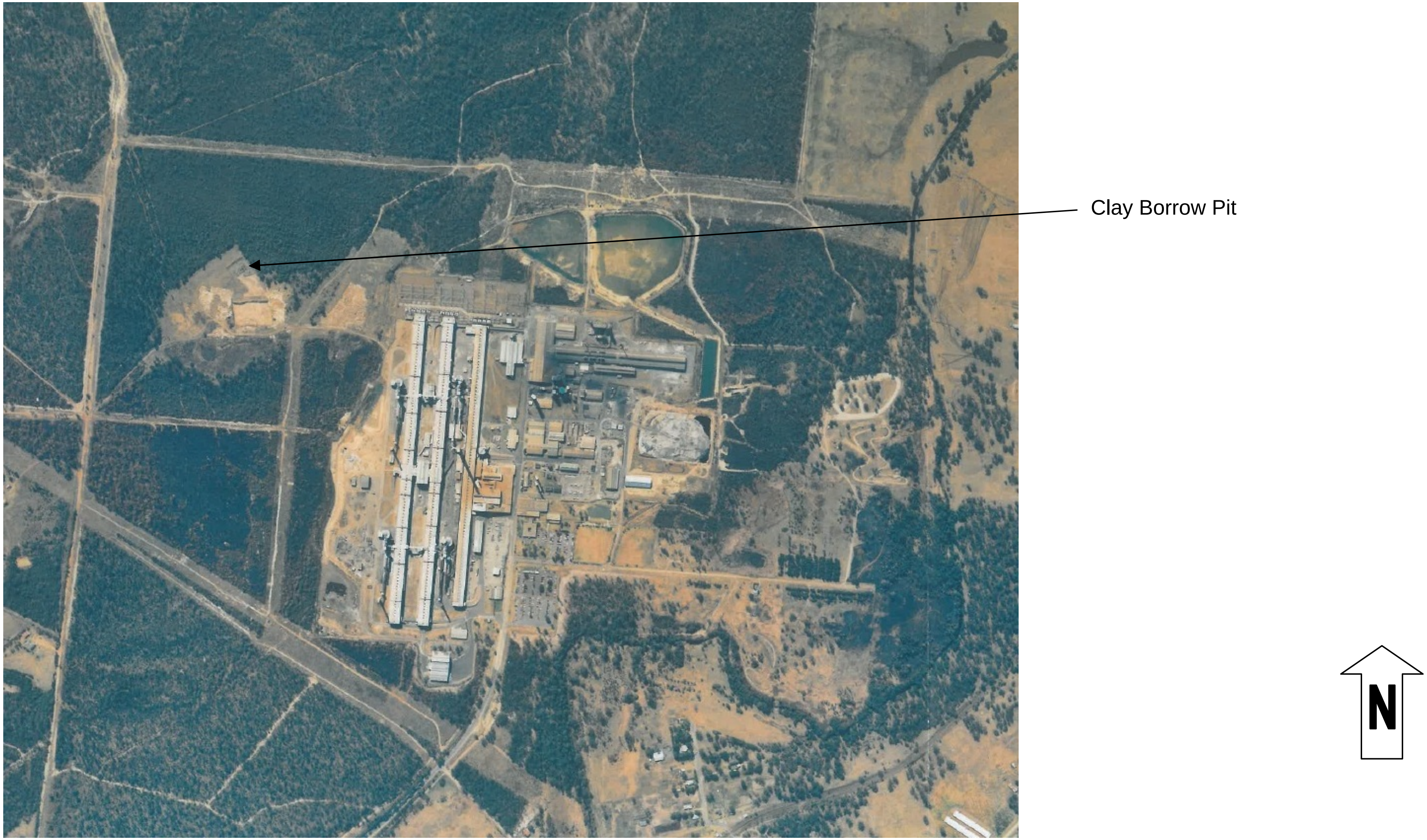
JOB NO:AS130386

DATE: December 2014

APPENDIX A

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit	Historical Aerial Photo - 1987

ENVIRON JOB NO:AS130386 DATE: December 2014 APPENDIX A



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 1994

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JOB NO:AS130386

DATE: December 2014

APPENDIX A