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Preliminary Containment Cell Study

Hydro Aluminium Kurri Kurri NSW

Prepared for:
Hydro Aluminium Kurri Kurri Pty Ltd

Prepared by:
ENVIRON Australia Pty Ltd

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Contents

Acronyms and Abbreviations

CBP	Clay Borrow Pit
ESA	Environmental site assessment
ha	hectare
km	kilometre, 1000m
m	metre
m^3	cubic metres
mAHD	meters in Australian Height Datum
SPL	Spent Pot Lining

1 Introduction

The following report presents a preliminary desktop study undertaken to identify potential sites for a proposed containment cell (the "Supercell") on the Hydro-owned properties at the Kurri Kurri smelter site.

Environmental site assessment (ESA) works have been undertaken at the Hydro Aluminium Kurri Kurri Smelter following a decision by Hydro to curtail smelting operations at the site. These investigations included review of documentation relating to storage of Spent Pot Liner (SPL) and other smelter waste in an area known as the 'Alcan Mound' on the north-east boundary of the smelter property. The Alcan Mound is a stockpile of mixed smelter waste used during early smelter operations between 1969 and 1992. An estimated 100,000 m^3 of mixed wastes, including SPL, were stored in this area and were subsequently capped with clay in 1995.

The investigations also identified other areas of impacted soils that would require remediation should a decision to close the facility be made. These areas included part of the operational sites and parts of the surrounding buffer zone including the Dickson Road site and the Glen Ayr Drift.

To facilitate an understanding of remedial options for impacted soils on the site ENVIRON undertook a remedial options study (ENVIRON 2012a) that evaluated a range of remedial options including construction of an engineered onsite containment cell, 'Supercell'. As part of this review, it was recognised that other unusable and unrecyclable materials at the site or that may arise from site demolition could also be managed within an onsite containment cell. The final nature and volume of materials that may require placement has not yet been quantified. For the purpose of this assessment a volume requiring placement of 300,000m^3 to 400,000m^3 has been assumed.

During preliminary evaluations, the clay borrow pit area, a former excavation to the west of the plant site, had been identified as the most suitable location for the proposed Supercell. This site was identified as suitable based on its elevation above groundwater, the presence of low permeability soils below the proposed cell, the close proximity to the existing Alcan Mound landfill and the presence of preliminary haulage roads. The clay borrow pit is however currently the repository for a significant volume of refractory brick waste.

To allow flexibility for future site redevelopment, assessment of other potential locations for the Supercell (on Hydro-owned lands) is now required including an assessment of these locations in terms of suitability.

ENVIRON was engaged to conduct a review of existing information to identify potential alternative Supercell development sites by reviewing the positive physical attributes necessary for development and also characteristics which may constrain containment cell development.

The following scope of work was undertaken:

- desktop review of all existing, available information relating to the geology, hydrogeology and soil profiles of the Hydro – owned lands;

- identify the location on site of physical criteria critical to the successful development of the containment cell, while excluding those areas which would constrain development across the Hydro properties;
- conduct a site inspection confirming the results of the review and identifying other constraints which may potentially inhibit development, not identified in the desk top study; and
- present these findings in a report.

2 Landfill Development

The following criteria were considered in assessing the suitability of a particular location for a containment cell:

- site topography and available area;
- presence of suitable soils/geology;
- depth to groundwater;
- distance from surface water bodies;
- location with respect to the surround area in terms of residential occupation/commercial use other sensitive receptors; (ie, set-off distances from housing for example);
- presence of significant infrastructure; and
- presence of vegetation.

For the purposes of this assessment, we have assumed that a suitable site for the Supercell will ideally:

- be underlain by appropriate soil/geological profile comprising low permeability soils, able to also be a source of embankment/capping material (ie, clays);
- be an appropriate height above a standing water table (at least 3 to 4m, which is considered sufficient to allow for seasonal fluctuation), the presence of a high water table may otherwise contribute to generation and migration of leachate (as is the case with the current Alcan Mound landfill);
- have relatively flat topography over a minimum area equivalent to 300 by 300 m (ie, 9 ha.). This area is adopted from the anticipate volume requiring containment of 300 000m^3 to 400 000m^3 and assuming that a containment cell height/depth of 3 to 4m is acceptable. These assumptions require validation based on final landform requirements. It should be noted that the shape of the final cell (nominally presented as a square on the attached plan – **Appendix A**), may vary according to the requirements of depth of excavation and topography;
- minimal vegetation cover or an existing altered vegetation cover (which does not include sensitive ecosystems);
- not be constrained by significant infrastructure (or example, the Energy Australia high voltage transmission lines which cross the Hydro site); and
- be located as close as possible to the Alcan Mound landfill/plant site to minimise haul distances and reduce the requirement for road building/upgrading needed for the heavy vehicle traffic during containment cell construction and filling.

3 Physical Setting

3.1 Site Location/Description

The site area reviewed for this study generally included the topographic highs to the west and north of the plant site, excluding lower lying areas associated with Swamp Creek and the Wentworth Swamp (due to presence of unsuitable, permeable sediments and significant water features). Areas to the east of Wentworth Swamp were excluded due to access difficulties and distance from the source site.

The extent of Hydro-owned lands is shown on the attached plan (**Appendix A**).

3.2 Topography/Drainage

Topography on the Hydro land comprises a series of low undulating ridges, generally rising to the north-west and west of the plant site to over 50 mAHD (Australian Height Datum), with low-lying areas on the eastern and north-eastern margins, down to less than 10 mAHD before rising again in the north-east.

Two drainage lines flow across the site and are annotated on the attached plan (**Appendix A**). Swamp Creek runs approximately south-north on the eastern margin of the site. Black Waterholes Creek flows from the western margins of the site across to the east and north-east. Both creeks lead into the Wentworth Swamp wetlands on the north-east corner of the site.

Small isolated dams and water features are located across the property and retain surface water following rainfall.

3.3 Geology/Soils and Hydrogeology

The 1:100,000 Newcastle Coalfields map indicates the geology of the Hydro site comprises the Lower Permian-aged Dalwood Group - a sequence of mudstones, sandstones, shales siltstones, conglomerate and tuff, which form the local bedrock. In the eastern part of the site these strata are overlain with Quaternary-aged alluvial sediments including sands, silts, gravels and clays in a complex, braided sequence which can change rapidly both laterally and vertically. (Site Plan, **Appendix A).**

The boundary between the alluvial sediments and the residual clay soils and underlying bedrock is not sufficiently defined on the 1:100000 geology map. Detailed investigations on the Hydro site (involving borehole drilling programmes) have been limited to the smelter area and the area around the Alcan mound and, the buffer zone to the east and west. The investigations to date are limited but do provide some information on detailed geology.

Drilling programs have shown that the current Alcan Mound SPL storage is located on the alluvial sediments and it is considered that this is not a suitable geological environment for the containment cell due to the of a shallow water table situated in high permeability sediments – (sands/gravels) which have the potential to rapidly change over short horizontal distance. .

The Quaternary sediments are found on the eastern side of the site associated with the Swamp Creek and the Wentworth wetlands area, with a weathered sequence of residual soils (silty clays and clays) grading to weathered rock, generally found on the topographically higher western and northern areas of the site.

Regional groundwater is expected to follow topography and flow northeast towards surface water bodies that feed into the Hunter River. Locally, groundwater beneath the site was found to flow northeast to Swamp Creek. ENVIRON (2012).

Groundwater in the low lying areas across the eastern parts of the site is found in the shallow (approximately 1m below ground surface), complex, braided alluvial sediments (silty sands and clays). ENVIRON (2012).

Whilst not shown on the 1:100000 Geological map, it is expected that an alluvial aquifer is associated with Swamp Creek and likely lenses out in close proximity to the creek. Also that, because of steepness of topography, any alluvium associated with Black Waterholes Creek is also likely to be limited in extent.

Boreholes were drilled in the clay borrow pit as part of the ENVIRON Phase 2 Study (ENVIRON 2012). Well MW03 was drilled in the vicinity of the clay borrow pit and showed residual clays from the surface and groundwater encountered at a depth of approximately 9m below ground surface.

3.4 Vegetation

Vegetation is quite diverse across the Hydro properties, ranging from completely altered/cleared agricultural land and cleared access track/roadways to areas of scrub and woodland/forest. The area around the plant has been cleared for the Hydro smelter works with thicker vegetation located on the ridge area in the west on each side of Bishops Bridge Road.

3.5 Infrastructure

Infrastructure in the area is centred around the main Hydro plant site and the main access roads, which include Hart Road and Dickson Road which intersect at the smelter site, and Bishops Bridge Road which starts in the south as a minor gravelled road continuing north over the ridge becoming an access track for the Energy Australia transmission line network.

The new Hunter Expressway, currently under construction, runs south-east-north-west through the south-west corner of the Hydro properties.

The Energy Australia transmission line network runs from the east just to the north of the plant area, turning to the north up Bishops Bridge Road.

3.6 Surrounding Use

The Hydro properties are approximately 2 km north of township of Kurri Kurri and 3 km north-west of the township of Heddon Greta.

The surrounding land uses include industrial properties to the south on Mitchell Avenue and the closest rural and rural residential properties to the south-west and west of the site, now westwards of the Hunter Expressway alignment.

4 Site Inspection

A site inspection was conducted on 21 March 2013 (Steve Cadman, ENVIRON and Kerry McNaughton, Hydro), which generally covered the area to the west of the plant site along, and off, Bishops Bridge Road. The area inspected was identified from the preliminary

desktop review of potential suitable sites with the focus being to identify additional observable constraints.

The inspection concentrated on areas to the west of Bishops Bridge Road on the southern ridge line, including an area to the west of Bishops Bridge Road, south of Lumby Lane where an informal motorcycle track had been located. This area was partially cleared and sloped towards Black Waterholes Creek. The alignment of the under-construction Hunter Expressway was immediately to the south west of this area. Inspection of the exposed, excavated soil profiles in a drain and sedimentation dam associated with the road construction indicated the presence of clayey soils.

Much of the remaining potential sites along Bishops Bridge Road were forested with ti-tree scrub and mature trees. On Bishops Bridge Road, it was observed that washouts (from rainfall runoff) also had exposed underlying clayey soils.

Photographs from the site inspection are presented below.

Photo 1 Potential Site South of “Lumby Lane” looking North-east (photo compilation)

Photo 2 Sedimentation pond from Hunter Expressway works showing clayey soils in exposed banks in south-west of the Lumby Lane site

Photo 3 Clayey soils in exposed banks of sedimentation pond

Photo 4 Showing clayey soils in rain washout at base of Energy Australia pole on Bishops Bridge Road

5 Constraint Assessment

5.1 Site Constraints

In order to assess site suitability for containment cell location the Hydro site was initially subject to a constraints assessment where areas were ruled out of consideration.

Constraining the site on a geological basis has been hampered by the local low resolution (on the geology map) of the geological boundary between Quaternary-aged alluvial sediments and the more suitable weathered clay profiles overlying the Permian-aged bedrock and the lack of investigative data on the western side of the site.

Therefore, for the purposes of this study, topography has been adopted as a first tier identifier of the more suitable geological setting for a proposed containment cell.

It is considered that:

- land below 10 mAHD has a significant potential for the presence of alluvial sediments and shallow groundwater and has been excluded from consideration;
- between 10 and 20 mAHD has a low potential for the presence of alluvial sediments and would need to be subject to a site investigation to confirm it geological suitability;
- over 20 mAHD is likely to be underlain by suitable soils comprising low permeability residual clays. The presence of shallow bedrock, which may increase excavation costs, would need to be considered.

The attached constraints plan of the Hydro site (**Appendix A**) shows the following areas

1. Hydro site with boundary of Hydro-owned land
2. Area acquired for RMS Hunter Expressway Construction.
3. Approximate topographic contours (10m contour interval) with 10m contour (**yellow**), 20 m contour (**blue**) and 30 m contour (**green**), where they cross the site.
4. Mapped Quaternary alluvium from the 1:100,000 Newcastle Coalfields map (dashed outline, yellow fill).
5. The Clay Borrow Pit. (CBP)

Areas of the site which were excluded as suitable locations for the containment cell are shown in red and yellow hatching, **Appendix A**.

These constrained areas are:

- All areas below 10m AHD – mostly the eastern site areas;
- The mapped alluvium;
- The areas to the south-west of the Hunter Expressway corridor (too close to rural/residential properties on the eastern side of Sawyers Gully Road, and too physically constrained, ie too narrow);

- The areas to the east of Wentworth Swamp being too far from the source area; and
- The area occupied by the Energy Australia transmission line network.

5.2 Identification of Suitable Sites

Exclusion of the above areas leaves the western and northern areas of the Hydro property, (along either side of Bishops Bridge Road), as potential sites for the containment cell.

These areas, based on preliminary review, have the ability to contain the proposed footprint area and the potential for suitable subsurface soils that can be used in construction.

During a site inspection it was noted that near-surface soils along Bishops Bridge Road had clay exposed in rainfall washout features adjacent to the installed Energy Australia transmission poles.

Anecdotal evidence (pers. comm. Kerry McNaughton – Hydro 21 March 2013) indicated that the Bishops Bridge Road area and areas to the west (along access tracks/fire trails) got very “clayey/slippery “and retained water in wet weather.

The presence of clayey soils, (as above), observed during the site inspection, indicated potentially favourable geological conditions for siting the containment cell at these locations.

The closest site (provisionally marked on the plan), in terms of haul distance and the fact it is already partially cleared, is an area (informal use as a motorcycle racetrack) immediately to the west of the CBP on the western side of Bishops Bridge Road, south of Lumby Lane.

This area slopes gently down towards the western reaches of Black Waterholes Creek however if moved back towards Bishops Bridge Road may accommodate the containment cell development with additional vegetation clearance.

Sites to the north, along the southern slopes of the ridgeline also appear suitable.

6 Discussion and Conclusions

Based on this preliminary study for siting the proposed Supercell (site containment cell), the following conclusions were drawn:

- Critical criteria for selection of a suitable site were assessed as, the presence of low permeability soils across the whole footprint of the containment cell, groundwater at a depth greater than 6m, a minimum area of 300 x 300m, away from sensitive uses (eg residential), or major infrastructure, minimal or low value vegetation cover and a minimum distance from the proposed waste source (ie, the Alcan Mound);
- Assessment of the site, based on available information, excluded much of the eastern parts of the Hydro-owned properties on the basis of geology and the likely presence of shallow groundwater, and the haulage distance;
- On the basis of minimising vegetation clearance and future haul distances, the most suitable alternative to the CBP is located immediately to the west of the CBP on the western side of Bishops Bridge Road, south of Lumby Lane.
- Further potential sites are located the north, along the southern slopes of the ridgeline although there is an increased distance and vegetation clearance would be required.
- If not constrained by a higher priority land use, the clay borrow pit area remains the most suitable site for the Supercell on the Hydro-owned lands, although existing fill in this area (refractory brick waste) would need to be managed as part of site development.
- Any and all site options for containment cell development (including the clay borrow pit), will require further detailed investigation in terms of geological, geotechnical, environmental and hydrogeological assessment.

7 References

ENVIRON Australia Pty Limited, “Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter”, November 2012.

ENVIRON Australia Pty Limited, “Draft Remedial Options Study, Kurri Kurri Aluminium Smelter”, November 2012a.

Department of Mineral Resources, “1:100,000 Newcastle Coalfield Regional Geology”, Edition 1 1994

Kerry McNaughton, Hydro Aluminium Kurri Kurri Pty Ltd.. Personal interview. 21 March 2013.

8 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to Hydro dated 7 February2013 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.

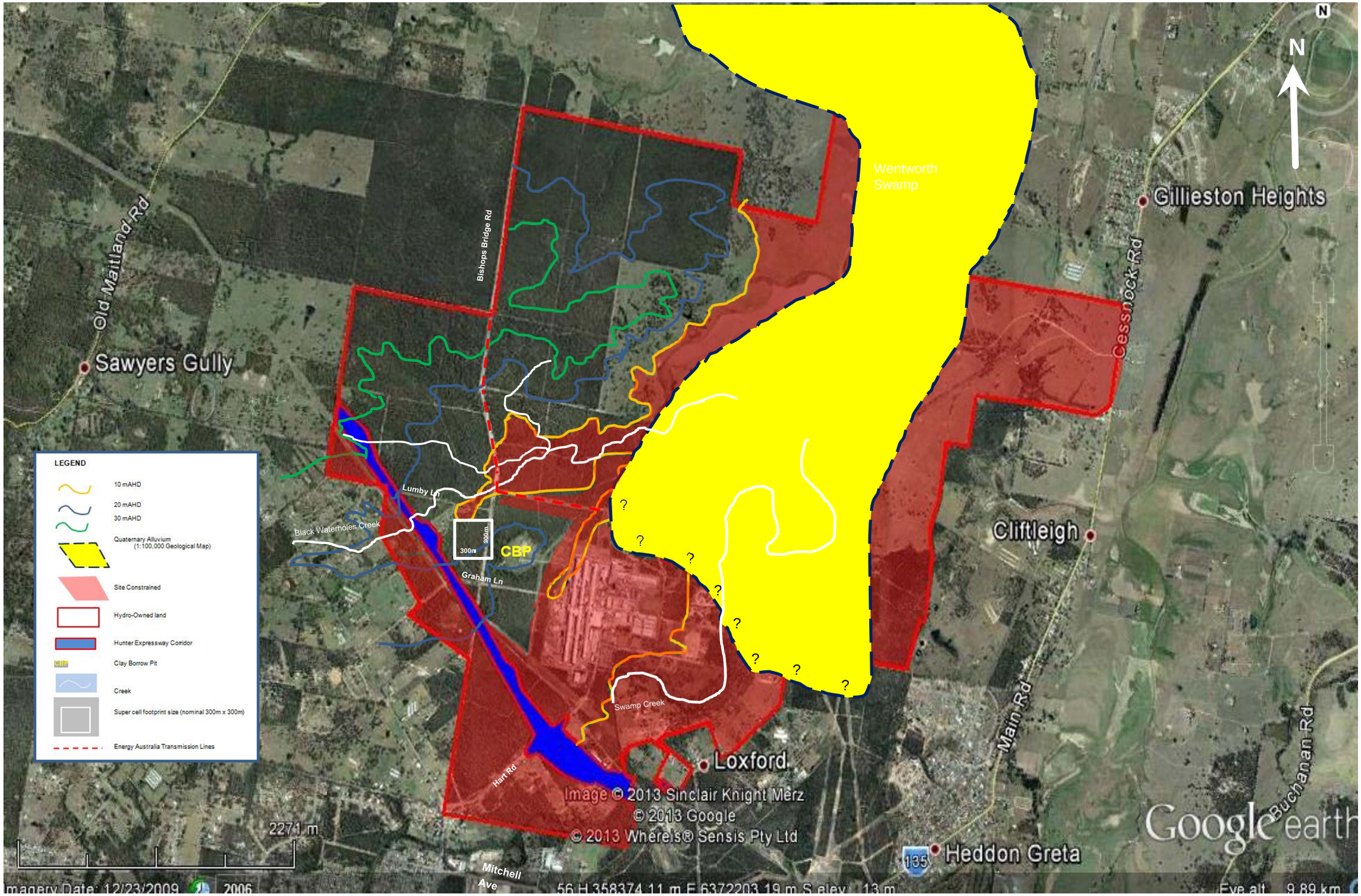
This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

8.1 User Reliance

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

Appendix A

Site Constraints Plan


N
Wentworth
Swamp
Gillieston Heights
Old Maitland Rd
Bishops Bridge Rd
Cessnock Rd
Sawyers Gully
LEGEND
10 mAHD
20 mAHD
30 mAHD
Quaternary Alluvium
(1:100,000 Geological Map)
Site Constrained
Hydro-Owned land
Hunter Expressway Corridor
Clay Borrow Pit
Creek
Super cell footprint size (nominal 300m x 300m)
Energy Australia Transmission Lines
Lumby Ln
Black Waterholes Creek
300m
300m
CBP
Graham Ln
Swamp Creek
Cliftleigh
Main Rd
Buchanan Rd
Loxford
Hart Rd
Image © 2013 Sinclair Knight Merz
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© 2013 Whereis® Sensis Pty Ltd
2271 m
Mitchell Ave
Heddon Greta
135
Google earth
Imagery Date: 12/23/2009
2006
56 H 358374.11 m E 6372203.19 m S elev 13 m
Eye alt 9.89 km