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Riverview Group

Report for West Belconnen Residential Development

Risks posed by Adjacent Landfill Discussion Paper

February 2012

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Executive Summary

The Riverview Group Pty Ltd (Riverview) proposes to develop land adjacent to the West Belconnen Landfill Site (WBLS) for residential use as part of a joint venture with the ACT Government.

As part of the preliminary works relating to this potential development, Riverview engaged GHD to undertake a preliminary evaluation of the likely issues that the WBLS site and its operations may pose to the proposed development.

The preliminary evaluation identified several key issues which have the potential to impact upon the proposed residential development. These are as follows:

- The mandated 500 metre buffer distance from the WBLS currently contained within the ACT Government's *Territory Plan 2008* document;
- The current status of the WBLS as the ACT's Emergency Landfill site;
- The existing (and any future) waste landfilled at the WBLS; and
- The existing (and any future) resource recovery operations.

The preliminary evaluation suggests that the mandated 500 metre buffer distance currently impacts upon significant areas of land within the ACT. However, the preliminary evaluation also suggests that if appropriate actions were taken, then it may be possible to reduce the mandated 500 metre buffer distance with no additional impacts upon adjacent receptors (i.e. new residential properties).

Appropriate actions are likely to include:

- Agreement with the ACT Government that the mandated 500 metre buffer distance can be varied if supported by an appropriate site specific assessment / modelling;
- A more detailed assessment of the suitability of other sites to act as the ACT's emergency landfill site. Following completion of this assessment (and assuming it is acceptable to ACT Government stakeholders), Riverview should seek a formal agreement from the ACT Government that the WBLS will not be required as a future landfill site (emergency or otherwise);
- Undertaking additional leachate / landfill gas management measures as identified within this report;
- Other hazards (e.g. asbestos, dust, odour, noise, litter, visual and traffic) associated with the landfilled waste at the WBLS should be investigated and assessed to determine the likely current and future level of impacts under a variety of scenarios. These impacts should also be assessed under a scenario where the WBLS needs to re-open for waste disposal under an emergency scenario. Following these assessments, recommended improvements to existing environmental monitoring and environmental management systems should be identified and implemented;

- Following completion of the additional investigative / assessment works in relation to landfill gas, leachate and “other” landfill hazards, the required buffer distance for the landfill in relation to all identified hazards (landfill gas, leachate and “other”) should be determined and formally agreed with ACT government;
- A more detailed assessment of the potential to upgrade or relocate the existing recycling / resource recovery operations should be completed. Following completion of this assessment (and assuming it is acceptable to ACT Government stakeholders), Riverview should seek a formal agreement from the ACT Government that operations at the WBLS will be upgraded / restricted to those which are compatible with the proposed development only;
- Assessment of the hazards potentially associated with the individual recycling / resource recovery operations should be assessed to determine the current / future level of impacts. Following these assessments, recommended improvements to existing environmental monitoring and environmental management systems should be identified; and
- Following completion of the two tasks identified above, the required buffer distances for the recycling / resource recovery operations in relation to all identified hazards (noise, dust, odour etc.) should be determined and formally agreed with the ACT Government.

1. Introduction

The Riverview Group Pty Ltd (Riverview) proposes to develop land adjacent to the West Belconnen Landfill Site (WBLS) for residential use as part of a joint venture with the ACT Government. Riverview engaged GHD to review existing available (and relevant) information on the WBLS and undertake a preliminary evaluation of the likely issues that the WBLS site and its operations may pose to the proposed development. Riverview propose to use the outcomes of this review when meeting with the ACT Government, local regulatory authorities and other relevant stakeholders to discuss their proposal for residential subdivision and development. Riverview are aware of the issues relating to the Stevenson's Road landfill site in Cranbourne (Victoria), and are particularly interested in further understanding the potential for landfill gas migration from the WBLS to impact upon their proposal.

2. Methodology

In order to gain an understanding of the WBLS and the risks it presents to the proposed Riverview development, GHD undertook the following:

1. Collection and review of relevant data for the WBLS, including existing ACT NoWaste data / reports (including the Landfill Cell Remediation Plan and the site Master Plan), which provided the following information:
    - A brief site history;
    - Waste composition and input tonnages since the site commenced operation;
    - Details on local geology & hydrogeology;
    - Existing borehole installation logs;
    - Information on existing landfill containment systems;
    - Recent site volumetric / topographic surveys and cross sections;
    - Locations of on-site monitoring infrastructure, buildings and underground services;
    - Locations of known buildings and underground services within 500 metres of the site's boundary;
    - Details on existing leachate and landfill gas management systems;
    - Existing landfill gas monitoring data and reports;
    - Future developments proposed at / adjacent to the site;
    - Current and future land zoning of the site and land within 500 metres;
    - Existing Landfill Environmental Management Plans & Master Plans;
    - Existing groundwater, surface water and leachate monitoring data and reports; and
    - Details on existing Environmental Approvals / site licences / notice of development / discharge consents etc.

The data / information identified was obtained from ACT NoWaste by GHD on Riverview's behalf, with a subsequent review being completed by GHD.

2. Preliminary evaluation of risks to the proposed development, posed by the WBLS, including risks from landfill gas and leachate;
3. Confirmation of the current buffer distance requirements with local regulatory authorities (within the ACT and NSW), and preliminary assessment of how these may impact upon the extent of the proposed Riverview Development;
4. Preliminary evaluation / investigation of alternative emergency landfill site locations;

5. Preliminary evaluation of necessary / possible upgrading of landfill monitoring and management measures, including:
    - Landfill gas monitoring;
    - Leachate monitoring;
    - Landfill gas management measures e.g. gas barrier / interception walls;
    - Leachate management measures; and
    - Other relevant aspects as identified.

This evaluation included identification of “of order” costs of the required upgrading works.

6. Preparation and issue of a Report (this report) to Riverview.

3. Description of the Proposed Residential Development

Discussions with Riverview personnel have provided the following details / approach relating to the proposed residential development.

Riverview currently anticipate that if the development project is given approval, it will proceed as a Joint Venture between Riverview and the ACT government. Riverview has advised that the potential for this development was put to the ACT Government in August 2011. A decision on the Joint Venture was deferred pending the outcome of the Draft ACT Planning Strategy due to be endorsed at the end of the last quarter of 2012.

With the exception of the identified constraints from existing roads and electricity powerlines, Riverview's current intent is to develop land adjacent to the WBLS for residential use right up to the WBLS' land boundary. It is currently anticipated that the residential development will contain the usual sub-surface services such as potable water, sewerage, telecoms and electricity.

Riverview currently estimate that approximately 4,500 lots may be developed within the ACT portion of the development land between approximately 2013 and 2024 (11 years). Riverview currently estimate that approximately 3,500 lots may be developed within the NSW portion of the development land between approximately 2024 and 2035 (9 years). GHD understand that the land located within the ACT to the east of the WBLS is wholly owned by the ACT Government. As such, Riverview would be unlikely to have any involvement in relation to any proposed residential development upon this land.

Development of the land is proposed to commence in late 2013 along Stockdill Road to the southeast of the WBLS. Development is then anticipated to move slowly northwards in the direction of the WBLS. Upon reaching the southern boundary of the WBLS, development will proceed around the western boundary of the WBLS until reaching the ACT / NSW border. Development will then proceed into NSW moving along the northern boundary of the WBLS in an easterly direction. At present, Riverview estimate that it may take approximately 7 years from commencement of development works in 2013 for the residential development to reach the southern boundary of the WBLS. From approximately 2020 until 2035, the residential development will occur immediately adjacent to the western and northern boundaries of the WBLS.

4. Description of the West Belconnen Landfill Site

4.1 General

ACT NOWaste is the leaseholder of the WBLS site (Block 1586, Belconnen) and is responsible for all operations, activities and maintenance aspects for the site. The site includes the Parkwood Road Recycling Estate, however, management responsibility for the Estate lies with ACT Department of Land and Property Services. A number of other commercial resource recycling / recovery operations currently operate at the site, including Canberra Sand and Gravel (green waste facility), Building Waste Recycling Pty Ltd (construction and demolition waste facility) and Energy Developments Limited (landfill gas power generation facility), under direct leases with ACT NOWaste.

The *Territory Plan 2008* (Territory Plan) is the key statutory planning document in the ACT, providing the policy framework for the administration of planning in the ACT. The Territory Plan identifies land use zoning in all areas of the ACT. It also identifies the objectives of each zone and lists development types that are permissible and prohibited in each of the zones.

The WBLS site is situated on land that is zoned NUZ3 - Hills, Ridges and Buffer. Under the Territory Plan, ancillary land uses such as a landfill site, recycling facility and recycling materials collection are permissible on this site (on a site specific basis) subject to assessment under the ACT “Merit Track”. The landfill site, recycling facility and recycling materials collection developments are required to meet the requirements of the Non-Urban Zones Development Code.

GHD notes that much of the information contained in this Section of the report has been derived from *Report for West Belconnen Master Plan - Landfill Cell Remediation Plan* (GHD, November 2010). The *Master Plan* document was prepared at a time when GHD were unaware that adjacent land may be developed for residential use. Knowledge of this possibility may have altered the rehabilitation and remediation measures proposed within the *Master Plan* document.

4.2 Site Location and Layout

The WBLS is situated approximately 15 km north west from the centre of Canberra, ACT. The landfill is located 2 km west of the residential suburbs of Macgregor, Holt and Higgins and is abutted by the NSW/ACT border to the immediate north, Parkwood Road to the east, and open fields to the south and west. The existing access road to the site is located in the south eastern corner.

The WBLS covers an area of approximately 84 hectares, although not all of the land has had waste deposited across / within it. An internal buffer zone of variable width appears to currently be in existence between the waste footprint and the boundary of the WBLS. In some western locations this buffer may be as much as 300 metres wide,

in other locations (notably the north and east of the WBLS) it may be as little as 25 to 50 metres wide. A plan of the existing WBLS is included in Appendix A.

In the north eastern corner of the site, lies Parkwood Road Recycling Estate, a facility which recycles many resources including paper and cardboard, glass and plastic containers, aluminium and car batteries. This area also contains a Pesticide Storeroom and a Chemical Depot. Within the site boundary, along the eastern side is a tyre trench and the area leased by Canberra Sand and Gravel. The site also includes twelve dams and three irrigation areas. To the north of the site is an "Asbestos Pit", which is slowly being restored by filling with imported asbestos contaminated materials. Likewise, to the south of the landfill cells lies a "Borrow Pit" which is also slowly being restored by filling with imported asbestos contaminated materials. During periods of heavy rainfall, Dams 1 and 2 are the primary water catchment dams. These discharge to a watercourse located on the western side of the site, which then further discharges through the proposed development land to the Murrumbidgee River (located approximately 750 m to the southwest of the WBLS).

4.3 Site History

Waste disposal operations began at the WBLS in approximately 1970. Initial operations consisted of the excavation and landfilling of a series of trenches across the landfill footprint. Following completion of these trenches, the landfilling approach is understood to have altered to an "area fill" method occurring directly across the historically landfilled trenches. The WBLS was used to landfill predominantly municipal solid waste (MSW), although it is understood that smaller quantities of commercial & industrial, construction & demolition and other wastes have also been disposed of at the site. Use of the site for general waste disposal purposes is understood to have occurred up to 2002. Between 2002 and 2006, only relatively small quantities of special wastes and tyres are understood to have been accepted for disposal at the landfill. Landfilling of all wastes at the WBLS is understood to have ceased in 2006. However, GHD understands that currently two areas of the WBLS (the Borrow Pit and the Asbestos Pit areas) are being landfilled with asbestos contaminated materials, which are sourced on an ad-hoc basis from various development sites within the ACT. It is unknown to GHD when the landfilling of these areas commenced. Complete remediation of these areas is understood to be likely to take approximately 5 years, but is dependent on the availability of suitable imported material which can vary from time to time depending on the major construction works undertaken in the ACT.

Other waste management operations including a green waste processing facility, a construction & demolition recycling operation, a landfill gas fuelled power station, a public drop off facility and the Parkwood Road Recycling Estate are currently in operation at the WBLS. Precise dates for the commencement of these operations are unknown. However, it is likely that they commenced operation sometime in the late 1990's / early 2000's and are likely to continue into the future.

The WBLS is currently identified within the *West Belconnen Resources Management Centre – Master Plan* (GHD, November 2010) as the emergency landfill site for the ACT. As such, the WBLS would be used as Canberra's main landfill site should a

situation arise where waste cannot be accepted at the Mugga Lane Resource Management Centre and transporting of waste to another landfill site is considered prohibitively expensive. The location of the part of the WBLS that would be used as the emergency landfill is identified on the plan within Appendix B.

4.4 Waste Composition and Quantity

No detailed information is available on the composition and quantity of the waste landfilled at the WBLS. Anecdotal evidence suggests that the site accepted predominantly MSW between 1970 and 2002. From 2002 to 2006, the WBLS appears to have only accepted relatively small quantities of special wastes (including asbestos) and tyres. The Asbestos Pit and Borrow Pit areas are currently accepting asbestos contaminated materials for landfilling in unknown quantities.

A preliminary assessment of the landform at the WBLS completed by GHD as part of this project suggests a total possible volume of in-place material of circa 5,000,000 m^3. This estimate includes all deposited waste materials, all engineering materials (including the final landfill cover layer and daily cover materials) and assumes that the original trenches extend across the entire landfilled footprint to a depth of 3 metres below pre-existing ground levels.

Assuming the final landfill cover layer and trench lining materials are nominally a total of 1 metre thick across the landfill footprint (See comments in Sections 4.10 and 4.11), the landfill footprint is 46 Hectares, daily cover accounts for 15% of the in-situ material and a landfill airspace utilisation rate of 700 kg of waste / m^3 of airspace was acheived, a **total waste tonnage** of circa **2,700,000 tonnes** is estimated to be in-situ at the WBLS. The majority of this material is understood to be located above the pre-existing ground levels.

Assuming a nominal 10,000 tonnes per annum of waste between 2002 and 2006, this suggests an average waste input quantity of circa 80,000 – 85,000 tonnes per annum between 1970 and 2002.

The estimate above excludes any of the asbestos materials recently deposited within the Asbestos Pit or Borrow Pit areas.

4.5 Geology

According to a geological evaluation of the site by the Department of National Development Bureau of Mineral Resources, Geology and Geophysics (Vanden Broek, 1971), the site is a mildly eroded, perched basin. It is underlain by Silurian Soils from the Mount Painter Porphyry group. The site's geology specifically consists of highly weathered to fresh volcanic and sedimentary rocks, which were mostly covered by a thick layer of soil (Vanden Broek, 1971).

The site is shown as being located in an area of Moderate to Moderately High groundwater vulnerability on the NSW Natural Resources Atlas (http://www.nratlas.nsw.gov.au).

The pre-filling soil profile consisted of a thin top soil layer (0.3 m to 0.6 m), underlain by a thick layer of clay (CL to CH in the Unified Soil Classification) (1.5 m to 3 m) and then completely weathered volcanic rock or moderately weathered sedimentary rock (Vanden Broek, 1971).

4.6 Hydrogeology

Hydrogeological information collected at the WBLS prior to its development and operation as a landfill revealed groundwater is present within both confined and unconfined aquifers in the lower portions of the site (Vanden Broek, 1971). Seepage after heavy rainfall within the unconfined aquifer, and springs from the confined aquifer through the overlying impermeable layer was observed during geological investigations undertaken prior to the site's development (Vanden Broek, 1971).

The permeability of the completely weathered volcanic rock (the confined aquifer) was investigated and estimated at 8.7×10^{-7} cm/sec (Van den Broek, 1971). These geological investigations determined that the site was not hydrologically safe and that lining of trenches with clay was required.

Maximum groundwater levels are generally observed in October-November and minimum levels in February-April (Jacobson, 1978). According to groundwater monitoring data collected by Scientists Engineers Managers & Facilitators (SEMF) in 2008, the watertable at the site ranges from 4.4 below ground level (bgl) (Bore 13) at the south western perimeter to 25.6 m bgl (WBBH5) at the eastern perimeter of the site. Groundwater flow within the confined fractured rock aquifer is generally to the southwest (Jacobson, 1978).

4.7 Topography and Landform

The WBLS is a small dome-shaped hillock that rises above the natural ground levels. Prior to filling the site was described as rolling to undulating terrain that was used for grazing (Vanden Broek, 1971).

The topography surrounding the WBLS consists of relatively flat plains with small undulating hills to the east of the site. The highest peak reaches circa 600 metres Australian Height Datum (AHD).

4.8 Hydrology

The WBLS has a number of stormwater drains constructed on / across the site and Gooroman Creek runs to the east of the site. These drains and creek all ultimately drain to the west of the site through the proposed development land and finally into the Murrumbidgee River.

4.9 Climate

Rainfall data from the Bureau of Meteorology's weather station at Canberra Airport, taken over a period of seventy years (1939 – 2009), indicate that the annual average rainfall is 615.9 mm. Monthly averages range from the highest in November (64.6 mm)

to the lowest in June (40.8 mm), as shown in **Figure 1**. Average monthly evaporation data is presented in **Table 1**.

The mean maximum daily temperatures recorded at Canberra ranged from 28.0°C in January to 11.3°C in July.

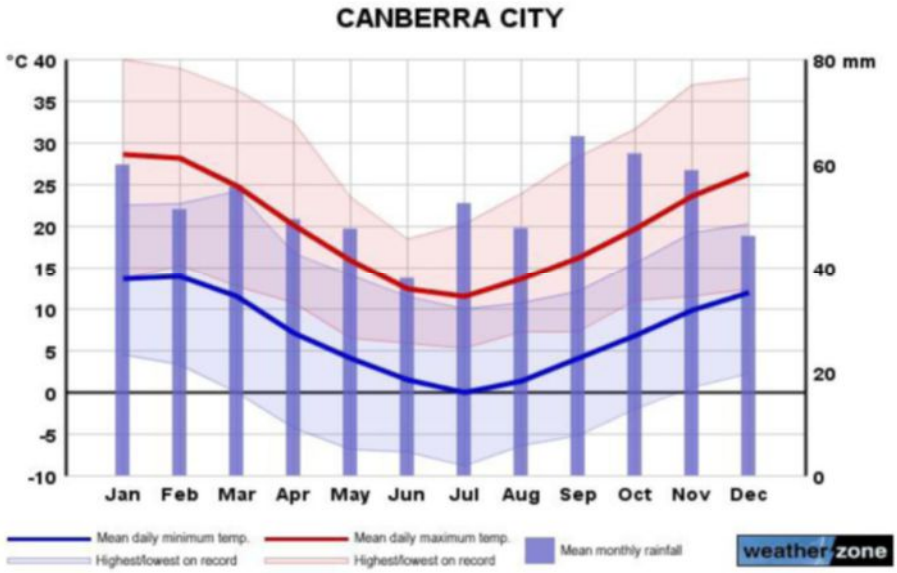

Figure 1 Average Monthly Rainfall and Temperature

Table 1 Average Monthly Evaporation (mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
198.4	155.3	133.3	87	49.6	33	34.1	49.6	78	117.8	159	201.5	1314.9

Source: BOM Station Number 070282 (2010)

4.10 Landfilling Operation

Landfilling was initially undertaken on a balanced cut and fill trench approach, with soil excavated as part of trenching and utilised as cover material in the landfilling operation. Based on the information provided in the "Planning Report" by L.T. Frazer & Associates Pty. Ltd, 1973, it is understood that the landfill trenches were lined with approximately 300 mm of on-site sourced clay material. The degree of compaction (if any) on the clay is unknown. The trench excavation batter walls are understood to have been approximately 2(H): 1(V), while a pseudo-leachate collection system was provided by a "layer of permeable" (Frazer & Associates, 1973) material placed on top of the clay liner.

Based on the local geological profile and the likely operational equipment available for trenching, it is inferred that the depth of the trenches was probably limited to the upper

clay layer, approximately 1.5 m to 3 m bgl. It is therefore considered unlikely that trenches extend into the underlying weathered volcanic and sedimentary rock.

It is understood that landfilling moved towards an area filling practice once landfilling moved above the landfilled trenches.

It is understood that the following waste filling and segregation procedures were adopted during the landfilling operations (Frazer & Associates, 1973):

- Fluffy, elastic, or light weight materials spread at the bottom of the fill;
- Large bulky objects confined to a separate area of the site;
- Waste placed and compacted in layers no greater than 600 mm;
- Compaction to a target density of 700 kg/m3;
- Cell height (above natural ground level) from 2 m to 9 m, with the first lift limited to 2 m; and
- Cover material of a minimum 150 mm thick was placed over each cell at the end of each day.

4.11 Final Landfill Cover Layer

The existing final landfill cover layer consists of clayey sand / sandy clay with occasional gravel / cobble inclusions. It is of a variable thickness ranging between approximately 0.3 m and 1.3 m across the landfill footprint of the WBLS.

The available information suggests that the final landfill cover layer was not engineered to any specifically required standard. Furthermore, no specific construction quality assurance monitoring of this layer are known to have taken place.

Based on a geotechnical investigation completed by *GHD (Report for West Belconnen Landfill - Preliminary Capping Layer Investigation, July 2009*), the existing final landfill cover layer does not meet the requirements outlined in the Victorian EPA guidelines (selected by ACT NOWaste for assessment purposes). However, anecdotal evidence (*Report for West Belconnen Master Plan - Landfill Closure Plan,* GHD, January 2010) suggests that the current final landfill cover configuration appears to be providing an effective barrier against surface water infiltration (and therefore preventing significant leachate generation). No data is currently available to confirm that the final landfill cover layer is adequate for landfill gas emission control at present.

4.12 Leachate Generation and Management

No information is available regarding the rate of leachate generation for the WBLS or details for the leachate collection system within the landfill trenches. However, it is understood that leachate generation has dropped in recent years since the majority of waste disposal ceased (2006). This is likely due to the:

- The high net evaporation at the site (pan evaporation is approximately 650 mm higher than rainfall); and

- The placement of the final landfill cover layer over the landfilled waste.

Based on the recent leachate monitoring results the following key points are noted:

- The leachate pH is typically neutral to moderately alkaline;
- The maximum ammonia concentration recorded in mid 2005 is 0.8 mg/L; and
- The leachate quality data in general represents low level concentration of contaminants and therefore suggests some level of dilution with surface waters.

Leachate within the landfilled waste is collected via basic-leachate collection system that comprises a “layer of permeable” (Frazer & Associates, 1973) material placed on top of the clay liners within the excavated trenches. It is understood that the trenches were lined with approximately 300 mm of clay to provide a rudimentary leachate containment system.

Leachate generated by the landfill is collected by the leachate collection system and gravity feeds to Dam 2 which acts as both a retention and evaporation pond. As per condition 19 of the site’s Environmental Authorisation (No. 0374), leachate cannot be discharged offsite through the site’s surface water management system. Therefore all leachate is retained within Dam 2 and can only be disposed of via evaporation or through irrigation over a defined leachate irrigation area.

Perimeter drains constructed along the boundaries of the leachate irrigation area collect any potential leachate run-off and direct the waters back towards the leachate storage dam (Dam 2), thereby preventing any leachate from being discharged offsite.

The environmental effects of leachate irrigation over the designated irrigation area(s) are unknown, with little information available in regards to soil and surface water contamination.

4.13 Landfill Gas Generation and Management

No landfill gas generation / emission model has been provided for this WBLS. However, a GHD preliminary estimate based on the data within Section 4.4 suggests that the WBLS is still likely to be generating landfill gas in significant quantities (possibly between 750 and 1250 m^3/hr during 2010). It is considered likely that the WBLS will continue to generate landfill gas for a considerable period from 2010 (>30 years).

There are understood to be two landfill gas collections systems operating at the WBLS. The first is a passive landfill gas collection system consisting of a gravel filled trench located along the toe of the waste batters constructed during the initial landfilling (trenching) operations. The Development Report (L.T. Frazer & Associates Pty. Ltd, 1975) describes the gas collection trenches as approximately 600 mm deep and installed to the east of the landfill trenches primarily fronting Parkwood Road.

In addition to the passive system, an active landfill gas collection and treatment system has been installed within the site by Energy Development Pty Ltd (EDL). The system is operated and maintained by EDL and consists of a series of vertical gas extraction wells installed throughout the landfill waste mass. The wells are linked by an

underground pipe network to a series of central gas collection points (manifolds). Landfill gas collected at these manifolds is directed via gas header lines to the landfill gas treatment facility (a landfill gas fuelled engine). The collected landfill gas is combusted in a gas engine which drives a generator, with the green electricity created exported to the electricity grid.

The entire active gas collection system is maintained under a vacuum (or negative pressure) to assist the extraction of landfill gas to the treatment facility. Prior to combustion in the gas engine, the collected landfill gas is processed to remove excess moisture levels and large particles. The active landfill gas collection and treatment system appears to have a reasonable coverage over the landfilled area, although it is noted that the gas wells do not extend to the boundary of the landfilled waste.

The available data suggests that the total quantity of landfill gas extracted from the WBLS has reduced from 2003 to 2009. The most recent complete data for the system (FYE 2009) suggests that an average of circa 200 – 300 m^3/hr of landfill gas was extracted from the site during that year. This is significantly lower than the preliminary estimate made by GHD of landfill gas generation during 2009 (possibly between 750 and 1250 m^3/hr). The precise reasons for the reduction in total quantity of landfill gas extracted from the WBLS and the discrepancy between EDL's figures and GHD's estimates are not currently known but should be investigated further and confirmed. Possible reasons could include local climatic conditions (quite dry) and / or the condition / operation of the current landfill gas management system.

Limited landfill gas monitoring was recently undertaken during March 2011 to provide information as to the presence or extent of any landfill gas sub-surface migration and / or accumulation off-site. No significant impacts were observed during any of the three monitoring rounds.

No information on the emissions from the landfill gas engine has been provided.

4.14 Environmental Monitoring

As part of the WBLS' existing environmental monitoring program, the following environmental aspects are analysed:

- Groundwater;
- Stormwater;
- Leachate;
- Landfill gas (surface emissions only); and
- Soil (leachate irrigation area only).

4.14.1 Monitoring locations

There are 11 groundwater monitoring bores located on site however only 10 are currently monitored. Six bores are located near the western boundary in the area where groundwater discharges from the site. Two bores are located near the centre of

the site, hydrogeologically downstream of the old landfill area. Background monitoring bores are located near the site entrance and the Borrow Pit area.

Stormwater monitoring is undertaken at Dam 1 and downstream of the WBLS at Tip Creek.

Leachate monitoring is undertaken at Dam 2 only.

Landfill gas monitoring is undertaken across the surface of the WBLS only.

Soil sampling is undertaken across the leachate irrigation area only.

4.14.2 Monitoring Parameters and Frequencies

The following paragraphs provide an outline of the monitoring program. Further details are provided in the WBLS's Environmental Authorisation (No. 0374) and the *Report for West Belconnen Master Plan - Landfill Cell Remediation Plan* (GHD, November 2010).

The groundwater monitoring bores are monitored quarterly for a range of typical groundwater parameters.

The stormwater monitoring locations are monitored quarterly for a range of typical stormwater parameters.

Leachate quality is monitored (at Dam 2) every 6 months, for a range of typical leachate parameters.

Landfill gas monitoring currently encompasses monitoring emissions across the surface of the landfill on a quarterly basis using a handheld gas analyser.

Soil sampling is undertaken across the leachate irrigation area, on a random basis, annually. The soil is tested for a range of parameters.

4.15 Post Closure Management, Monitoring and Maintenance

The *Report for West Belconnen Master Plan - Landfill Cell Remediation Plan* (GHD, November 2010) outlines the post closure management, monitoring and maintenance requirements of the WBLS. Summarised, these consist of the following:

- Upgrading the existing final landfill cover layer (as of November 2010);
- Ongoing operation and maintenance of landfill environmental management systems including the leachate extraction and treatment system, landfill gas extraction and treatment system, surface water management system and the final landfill cover layer;
- Upgrading and ongoing maintenance of the existing environmental monitoring infrastructure including surface water, leachate, groundwater and landfill gas; and
- Ongoing environmental monitoring and reporting.

4.16 Proposed Future Uses of the WBLS

The *West Belconnen Resource Management Centre – Master Plan* (GHD, 2010) outlines the proposed future uses for the WBLS. ACT NoWaste has advised that portions of the site will be required for resource recovery and recycling operations post closure. However, the previously landfilled areas are generally not suitable for this use and will be converted to low maintenance areas (i.e grassed areas).

At present, ACT NoWaste intends to develop the WBLS into 9 discrete areas as outlined in the plan contained in Appendix C. Areas 1 & 1A consist of the majority of the existing landfill footprint and a large portion of the land to the immediate west of these areas. Areas 2 to 8 consist of the existing borrow pit area, the majority of the land immediately adjacent to Parkwood Road, the Parkwood Road Recycling Estate and the majority of land immediately adjacent to NSW border to the WBLS' north. The likely future land uses within these areas are identified within Table 2 below (refer to plan contained in Appendix C for location of the various areas).

Table 2 Proposed Future Land Uses of the WBLS

Area	Proposed Future Land Uses
1	Primary use: Closed low maintenance area. Alternative uses: Solar energy generation in areas with a northerly aspect.
1A	Primary use: Closed low maintenance area. Alternative uses: Additional filling with contaminated soil; Solar panel energy generation; Expansion of Area 4 for activities such as material storage and stockpiling.
2	Primary use: Contaminated Land remediation area. Alternative uses: Solar panel energy generation; Expansion into northern part of Area 4 to create a separate leasable area with a frontage on Parkwood Road. Best suited to material storage and stockpiling; Contaminated soil remediation area.
3	Primary use: Parkwood Road Recycling Estate. Retain existing use (as an area for resource recovery operations).
4	Primary use: Contaminated Land remediation area (northern section only); Resource recovery facility. Best suited to material storage and stockpiling. Alternative uses: Solar energy generation.
5	Primary use: Retain existing use (Public Drop-off Facility).
6	Primary use: Green Waste Processing Facility. Alternative uses: C&D Processing Facility; Solar energy generation Facility.
7	Primary use: Resource recovery facility Alternative uses: Solar panel energy generation or closed low maintenance area.
8	Primary use: Contaminated Land remediation area;

Area	Proposed Future Land Uses
	Alternative uses: Separate resource recovery facility; Incorporation into Parkwood Road Recycling Estate; Solar energy generation facility.

It can be seen from Table 2 and the plan in Appendix C that Areas 1 & 1A (essentially low maintenance areas) will constitute approximately 50% of the land at the WBLS, with the remaining 50% of the land area being constituted by Areas 2 to 8 (active operational areas for resource recovery / recycling).

GHD notes that in order to facilitate the proposed land uses identified within Table 2, certain upgrade / construction works will be required in certain areas of the WBLS. At present, these works are likely to include;

- Thickening, regrading and revegetation of the final landfill cover layer (Area 1);
- Upgrading / construction of appropriate stormwater collection infrastructure (Areas 1A, 2, 3, 4, 6, 7 & 8);
- Construction of a vegetated visual screen around the perimeter (Areas 2 & 7);
- Monitoring of landfill gas emissions (Areas 2 & 4);
- Filling and rehabilitation of the Asbestos Pit and Borrow Pit areas (Areas 8 and 7 respectively); and
- A range of upgrade works (Area 5).

As outlined in Section 4.2, the WBLS covers an area of approximately 84 hectares, although not all of the land has had waste deposited across / within it. An internal buffer zone of variable width appears to currently exist between the waste footprint and the boundary of the WBLS (some areas of which have resource recovery / recycling facilities currently operating on them). In some western locations this internal buffer may be as much as 300 metres wide, but in other locations (notable the north, east and south of the WBLS) it may be as little as 25 to 50 metres wide.

At present, once the Asbestos Pit and Borrow Pit areas have been landfilled with asbestos containing materials, it is proposed that no further landfilling operations will occur at the WBLS (unless an emergency scenario eventuates as detailed in Section 4.3). As such, the existing internal buffer zone between the landfilled waste mass and the WBLS boundary is unlikely to be significantly reduced from its current status.

However, GHD notes that future recycling / resource recovery operations at the Site are likely to encroach into this existing internal buffer zone in certain areas (refer to plan in Appendix C). GHD further notes that in some areas only a 20 – 30 metre wide vegetated visual screen will be present between recycling / resource recovery operations and the WBLS boundary. GHD considers that this proposal is of significance for several reasons as follows:

- Expansion of the recycling / resource recovery operations in close proximity to the WBLS boundary increases the likelihood of off-site impacts upon existing and future local receptors from these operations;

- If future remedial works are required in relation to the landfilled waste mass, and there is insufficient internal landfill buffer land in which these works can be completed due to expansion of the recycling / resource recovery operations, then the remedial works may need to be completed either off-site or in the land proposed to be occupied by a vegetated visual screen. These possibilities have the potential to be technically complex, cause community concern and create legal issues for both ACT NoWaste and Riverview; and
- Recycling / resource recovery operations built in close proximity to the landfilled waste mass (within the existing internal buffer zone) will need to be appropriately designed and monitored to confirm that they are not subject to any significant impacts from the landfilled waste mass.

5. Potential Issues and Hazards (Landfill Only)

5.1 General

A review of the proposed residential development and the WBLS has identified the following main potential issues / hazards for the proposed development from the WBLS (landfill only):

- Landfill gas – As waste materials degrade at the WBLS, landfill gas is generated. Landfill gas contains a number of gases, which are potentially harmful to a range of receptors due to their toxicity, flammability or other properties. Landfill gas may be emitted from the WBLS via a number of pathways including surface emissions, sub-surface emissions, leachate / groundwater dissolution and via the management system / treatment technology;
- Leachate – Leachate (contaminated water) is generated as waste materials degrade and water ingress into the waste materials occurs. Leachate contains a number of chemical components which are potentially harmful to a range of receptors due to their toxicity or other properties. Leachate may be emitted from the WBLS via a number of pathways including surface seepages, leachate irrigation, uncontrolled release into surface water bodies / drains and basal / side wall liner seepage; and
- Other (Asbestos, Dust, Odour, Litter, Noise, Visual and Traffic) – As the WBLS is currently only accepting relatively small quantities of asbestos containing materials for disposal and local sensitive receptors are currently limited, it is considered unlikely that significant off-site asbestos, dust, odour1, litter, noise2, visual or traffic issues / hazards are occurring in relation to the landfill operations. However, this should be confirmed by completing appropriate environmental monitoring and / or modelling. GHD recommends that this should be completed as soon as possible to confirm existing impacts from these operations. If the landfill were to re-commence significant waste disposal operations under an emergency scenario (as mentioned in Section 4.3), the risk of impact from the issues / hazards identified above are likely to become of greater significance than they are at present. The risk of impact should therefore be appropriately assessed at this time (ideally before waste disposal operations re-commenced).

In light of the above, the following sections focus only on the more significant risks identified above which specifically relate to the existing landfilled waste at the WBLS (i.e. landfill gas and leachate).

[1] GHD notes that the existing landfill gas and leachate management activities may generate some minor noise and / or odour.

[2] GHD notes that the existing landfill gas and leachate management activities may generate some minor noise and / or odour.

5.2 Landfill gas

- **Source (the landfill)**
  - A significant quantity (approximately 2,700,000 tonnes) of mixed waste (MSW, C&I and C&D) has been deposited at the WBLS between the 1970's and the present date (asbestos contaminated materials only);
  - The available climatic data suggests that the local climate is quite dry and therefore the rate of waste degradation and landfill gas generation at the WBLS is likely to be relatively slow (and therefore likely to continue for many years);
  - The WBLS appears to be generating a significant quantity of landfill gas (GHD estimate circa 750 to 1,250 m3/hr of landfill gas during 2009) and is likely to do so for a considerable period (>30 years);
  - Landfill gas is being actively extracted and used for the generation of electricity (data available suggests that an average of circa 200 – 300 m3/hr of landfill gas was extracted from the site during 2009);
  - There is a notable discrepancy between the quantity of landfill gas estimated via modelling and the average quantity collected by the extraction system during the most recent complete data period (2009); and
  - The available data suggests that the total quantity of landfill gas being extracted from the site has reduced from 2003 to 2009. The precise reasons for this are unknown and should be further investigated.

- **Pathways (how landfill gas could be emitted from the site)**
  - At least a portion of the landfilled waste materials at the WBLS have been placed in trenches below the adjacent ground levels. As such, landfill gas may be emitted from the WBLS through the adjacent sub-surface geology. The extent and characteristics of the lining of the landfill are not well known and thus the risk of subsurface landfill gas movement could be relatively high. However, the local geology comprises low permeability clay soils and volcanic and sedimentary rock, which may reduce the risk of significant lateral sub-surface movement of landfill gas. Limited perimeter / off-site landfill gas monitoring was undertaken during March 2011 to identify the significance of this pathway. No significant emissions were detected during either of the three monitoring rounds;
  - Landfill gas may be emitted through sub-surface services (utilities) entering or in close proximity to the WBLS. Limited monitoring of on and off-site sub-surface services (utility pits) was undertaken during March 2011 to identify the significance of this pathway. No significant emissions were detected during either of the three monitoring rounds;

- Landfill gas may be emitted to the atmosphere through the existing landfill final cover layer (and penetrations through it such as leachate sumps). The existing final cover layer is of variable thickness and characteristics (see Section 4.11) and thus emissions through the final cover layer could be elevated. No surface emission monitoring data was available to GHD to confirm the significance of this pathway;
- Landfill gas may travel off-site within leachate and subsequently be emitted via dissolution / generation from contaminated local groundwater and / or leachate. Limited monitoring of this pathway was undertaken during March 2011 to confirm the significance of this pathway. No significant emissions were detected during either of the three monitoring rounds.
- Combustion products of concern (and unburnt landfill gas components) may be emitted via the landfill gas treatment technology in operation at the WBLS (a reciprocating gas engine). No emissions monitoring data is currently available to confirm the significance of this pathway; and
- The operation of the existing landfill gas collection and treatment system acts to reduce the likelihood of significant landfill gas emissions from the WBLS. However, an appropriate landfill gas monitoring program is required to ensure the ongoing effectiveness of the existing landfill gas management measures (including the landfill gas collection and treatment system). To date, only limited landfill gas monitoring has been completed to confirm the effectiveness of the existing landfill gas management measures.

- **Receptors (who or what could be impacted by landfill gas emitted from the site)**
  - Currently there are a number of buildings / structures on or in relatively close proximity to the WBLS, which may be at risk from landfill gas emissions. These include WBLS on-site offices, isolated rural buildings to the site's west, the Parkwood Road Recycling Estate to the site's north, industrial facilities to the site's east and an electricity sub-station to the site's south-east;
  - The available data suggests that there are a number of underground services in close proximity to the WBLS (and crossing it in several locations). These services include electricity, water, gas and telecoms. These services are located along part or all of the WBLS's eastern, northern and western boundaries. These services may be at risk of landfill gas impacts or may act as conduits for gas movement off-site;
  - Limited landfill gas monitoring completed during March 2011 did not identify any significant concentrations of landfill gas accumulating within the monitored off-site buildings or underground services;

- Both on and off-site workers may be at risk of landfill gas impacts;
- Off-site residents may be at risk of landfill gas impacts;
- Both on and off-site flora and fauna may be at risk of landfill gas impacts;
- The global climate and local air quality may be at risk of landfill gas impacts;
- Riverview's development proposal suggests that residential properties will be constructed around the entire perimeter of the WBLS right up to the site boundary. Any newly developed properties in close proximity (<500 metres) of the WBLS' boundary may be at risk from landfill gas impacts; and
- The underground services required to be installed as part of Riverview's development proposal (if approved) may be at risk of landfill gas impact or may act as conduits for gas movement.

5.3 Leachate

- **Source (the landfill)**
  - A significant quantity (approximately 2,700,000 tonnes) of mixed waste (MSW, C&I and C&D) has been deposited at the WBLS between the 1970's and the present date (asbestos contaminated materials only);
  - The available climatic data suggests that the local climate is quite dry and therefore the rate of waste degradation and landfill gas generation at the WBLS is likely to be relatively slow (and therefore likely to continue for many years);
  - No substantial data was available to GHD to confirm the composition and quantity of leachate generated at the site;
  - No leachate generation model is available for the WBLS, so likely quantities of leachate generated are currently unclear. The available data suggests that the landfill is generating a relatively minor quantity of leachate, which may be being diluted by stormwater ingress through the landfill final cover layer;
  - The quantity of leachate extracted from the WBLS and subsequently managed on site is unknown; and
  - Leachate was historically disposed of by on-site irrigation. At present, how leachate will be disposed of / managed at this site into the future is unknown.
- **Pathways (how leachate could be emitted from the site)**
  - At least a portion of the landfilled waste materials at the WBLS have been placed in trenches below the adjacent ground levels. As such, leachate may be emitted from the WBLS through the adjacent sub-surface geology. The extent and characteristics of the lining of the landfill are not well

known and thus the risk of subsurface leachate movement could relatively high. However, the local geology comprises low permeability clay soils and volcanic and sedimentary rock, which may reduce the risk of significant lateral sub-surface movement of leachate. Regular groundwater monitoring is completed at the WBLS. No significant leachate emissions have yet been detected by this monitoring;

- Leachate may escape the WBLS via surface seepage and subsequent flow into local surface water bodies (which may flow through the adjoining land where the residential development is proposed). The risk of leachate being emitted via this pathway may be relatively high due to the basic landfill final cover layer currently in place at the WBLS;
- An overflow from the existing leachate dam could occur, which may impact upon local surface water bodies (which may flow through the adjoining land where the residential development is proposed); and
- Disposal of leachate via spray irrigation could impact upon both on and off-site receptors via spray drift.

- **Receptors (who or what could be impacted by leachate emitted from the site)**
  - Local groundwater quality may be at risk of impacts from leachate;
  - Local surface water quality may be at risk of leachate impacts;
  - Land adjacent to the WBLS which receives upgradient surface water run-off may be at risk of leachate impacts;
  - Current and future residents located hydraulically downstream of the WBLS may be at risk of leachate impacts (e.g. potential local groundwater contamination by leachate preventing use of local groundwater);
  - Both on and off-site workers may be at risk of leachate impacts;
  - Both on and off-site flora and fauna may be at risk of leachate impacts;
  - On-site soils may be at risk of leachate impacts (from historic and / or future leachate spray irrigation);
  - Current and future residents may be affected by leachate spray drift (if spray irrigation continues to be the preferred method of leachate disposal at the site);
  - Local air quality may be at risk from leachate impacts (if spray irrigation continues or leachate is particularly odorous); and
  - Riverview's development proposal suggests that residential properties will be constructed around the entire perimeter of the WBLS right up to the site boundary. Any newly developed properties in close proximity (500 metres) of the WBLS' boundary may be at risk from leachate impacts.

6. Potential Issues and Hazards (Recycling / Resource Recovery Only)

6.1 General

A review of the proposed residential development and the WBLS has identified the following main potential issues / hazards for the proposed development from the WBLS (recycling / resource recovery only):

- Contaminated Stormwater – Stormwater runoff from areas containing waste materials (raw or recycled) can be contaminated (by contact with the waste / recycled materials) and enter local stormwater or groundwater. Contaminated stormwater can contain a number of chemical components which are potentially harmful to a range of receptors due to their toxicity or other properties. Contaminated stormwater may be emitted from the recycling / resource recovery operations via a number of pathways including uncontrolled release into surface water bodies / drains or basal / side bund liner seepage. Currently it is unclear from the available information whether the recycling / resource recovery operations occurring at the WBLS are having any significant off-site contaminated stormwater issues / hazards. GHD recommend that suitable assessment(s) should be completed as soon as possible to confirm existing impacts from these operations; and
- Other (Dust, Odour, Litter, Noise, Visual and Traffic) – Currently it is unclear from the available information whether the recycling / resource recovery operations occurring at the WBLS are having any significant off-site dust, odour[3], litter, noise[4], visual or traffic issues / hazards. GHD recommend that suitable assessment(s) should be completed as soon as possible to confirm existing impacts from these operations.

Furthermore, GHD understand that various resource recovery and recycling operations are currently in operation at the WBLS and that these may expand in scale into the future (*West Belconnen Resource Management Centre – Master Plan* (GHD, 2010). Assessing the likely future level of impacts from these operations (and their associated upgrade / construction works as identified in Section 4.16) is outside the scope of this report but it is recommended that the proposed plans be confirmed as soon as possible (with due consideration to the proposed residential development). This will allow the likely future impacts of these operations upon local receptors to be assessed, understood and managed / mitigated accordingly.

[3] GHD notes that the existing landfill gas and leachate management activities may generate some minor noise and / or odour.

[4] GHD notes that the existing landfill gas and leachate management activities may generate some minor noise and / or odour.

7. Buffer Distances & Likely Impacts upon Proposed Residential Development

7.1 Current ACT Government Required Buffer Distance (Landfill and Recycling / Resource Recovery Operations)

The current buffer distance nominated for the WBLS (Belconnen Landfill) for landfill and recycling / resource recovery operations is detailed within the Territory Plan. Part 12.6 of this document states the following:

Parkwood Egg Farm, Belconnen Landfill, Mugga Lane Landfill Canberra Abattoir

Development around these areas needs to be restricted to prevent the environmental impacts of these existing land uses, such as spread of odours and wind blown particulates, conflicting with more sensitive land uses. No new residential use of community use will be permitted within 500m of the boundaries of these areas.

This requirement is currently absolute and does not take into account site specific conditions such as the operational status of the landfill, the installed environmental control technology and / or the existing internal buffer distance currently present at the WBLS in relation to determining the required buffer distance. The current absolute nature of the required buffer distance results in a significant quantity of potentially developable land being impacted now and into the future. Figure 2 contained within Appendix D shows the impact that the existing 500 metre buffer distance requirement has on the proposed residential development within the ACT[5]. Table 3 below shows the approximate quantity of land which the existing landfill buffer distance impacts upon within the ACT.

Table 3 Land Impacted By 500 metre Territory Plan Buffer Distance (Approximate)

Land Holder	Impacted Land (Hectares)	Number of Lots Impacted*
Riverview	139.2	1,879
ACT LAPS	55.6	750
Total	194.8	2,629

* Assumes 13.5 Lots per Hectare normally possible. Figures do not consider land also impacted by Parkwood Egg Farm on ACT LAPS land.

The current absolute nature of the 500 metre buffer distance results in a significant quantity of potentially developable land being impacted upon within the ACT (circa 195

[5] Readers should note that the absolute 500 metre buffer distance required by the *Territory Plan* does not apply to land located within NSW. NSW legislation currently recommends that a site specific assessment must be completed in order to determine what a reasonable buffer distance from the landfill and / or recycling / resource recovery operations is.

Hectares). It is considered that the absolute nature of this 500 metre buffer distance may be potentially over-conservative for the following reasons:

- The buffer distance is applied from the site boundary not the limit of waste or activities as per other jurisdictions (e.g. NSW and Victoria). As a variable amount of internal buffer distance is currently present at the WBLS (Section 4.16), this means that in most locations at the WBLS a 500 metre buffer distance from the boundary actually results in a 525 to 800 metre (approximate) buffer distance from the limits of waste and / or recycling / resource recovery operations;
- This absolute buffer does not take into account site specific conditions which may reasonably allow a reduced buffer distance to be applied around the WBLS (e.g. site no longer landfills putrescible wastes, use of environmental control technology etc.); and
- No site specific assessments have been completed to confirm what the required buffer distances around the WBLS (based on site specific conditions) should be. GHD notes that the absolute nature of the required buffer distance does not currently allow site specific assessments to be made and subsequently used as justification to reduce the required buffer distances. The use of site specific assessments is an approach commonly used within other jurisdictions (e.g. NSW and Victoria).

For these reasons, it is considered that the Territory Plan should be amended to allow site specific assessments to occur to allow the determination of site specific buffer distances, in keeping with other jurisdictions (e.g. NSW and Victoria). This in turn would prevent the large scale, long term and (potentially unnecessary) impact upon significant quantities of land within the ACT caused by an absolute buffer distance.

7.2 ACT DECCEW Nominated Buffer Distance and Guidance (Landfill Only)

GHD understand that the ACT DECCEW currently nominates EPA Victoria's *Best Practice Environmental Management Siting, Location, Design, Operation and Rehabilitation of Landfills (September 2010)* for determining landfill buffer distances.

This document suggests that as the WBLS is a municipal (type 2) landfill site, then a buffer distance of 500 metres from buildings and structures should be maintained. This buffer distance should be measured from the edge of the closest waste disposal cell (where it is known) or the site boundary where the edge of the closest waste disposal cell is not known. Where this buffer distance is proposed to be reduced or encroached upon, a site specific landfill gas risk assessment and environmental audits are required to confirm that this encroachment is acceptable.

This approach allows consideration of site specific conditions such as the operational status of the landfill, the installed environmental control technology and / or the existing internal buffer distance currently present at the WBLS in relation to determining the required buffer distance.

Figure 3 contained in Appendix D shows the impact that EPA Victoria's recommended 500 metre buffer distance has on the proposed development within the ACT[6]. Table 4 below shows the approximate quantity of land which application of this buffer distance would impact upon within the ACT.

Table 4 Land Impacted By Recommended 500 Metre EPA Victoria Buffer Distance (Approximate)

Land Holder	Impacted Land (Hectares)	Number of Lots Impacted *
Riverview	117.1	1,580
ACT LAPS	51.1	689
Total	168.2	2,269

**Assumes 13.5 Lots per Hectare normally possible. Figures do not consider land also impacted by Parkwood Egg Farm on ACT LAPS land.*

If the entire 500 metre buffer distance were applied based on EPA Victoria's approach, this would still result in a significant quantity of potentially developable land being impacted within the ACT (circa 170 Hectares). However, this approach would result in the release of approximately 25 Hectares in comparison with the existing ACT required buffer distance due to the start point of the buffer distance being the edge of the closest waste cell rather than the site boundary. This approach would therefore take into account the currently existing internal buffer distance available within the WBLS's site boundary (approximately 25 – 300 metres wide as detailed within Section 4.16).

If a site specific landfill gas risk assessment and environmental audits were completed and reasonably showed that the buffer distance could be reduced to 50 metres (as an example of the minimum likely possible buffer distance), then Figure 4 contained within Appendix D shows the impact that this buffer would have on the proposed development within the ACT[7]. Table 5 below shows the approximate quantity of land that application of this buffer distance would impact upon within the ACT.

Table 5 Land Impacted By Potential 50 Metre Buffer Distance (Approximate)

Land Holder	Impacted Land (Hectares)	Number of Lots Impacted*
Riverview	3.6	48
ACT LAPS	0.9	12

[6] Readers should note that the absolute 500 metre buffer distance required by the *Territory Plan* does not apply to land located within NSW. NSW legislation currently recommends that a site specific assessment must be completed in order to determine what a reasonable buffer distance from the landfill and / or recycling / resource recovery operations is.

[7] Readers should note that the absolute 500 metre buffer distance required by the *Territory Plan* does not apply to land located within NSW. NSW legislation currently recommends that a site specific assessment must be completed in order to determine what a reasonable buffer distance from the landfill and / or recycling / resource recovery operations is.

Land Holder	Impacted Land (Hectares)	Number of Lots Impacted*
Total	4.5	60

**Assumes 13.5 Lots per Hectare normally possible. Figures do not consider land also impacted by Parkwood Egg Farm on ACT LAPS land.*

If it could be proven to be reasonable, the application of this 50 metre buffer distance would result in a much smaller quantity of potentially developable land being impacted upon within the ACT (circa 5 Hectares). This approach would result in the release of approximately 190 Hectares in comparison with the existing ACT required buffer and approximately 165 Hectares in comparison with the EPA Victoria 500 metre buffer distance. This approach would take into account both the currently existing internal buffer distance available within the WBLS's site boundary as detailed within Section 4.16) and site specific landfill gas risk assessments & environmental audits.

It is considered that the application of EPA Victoria's approach to landfill buffer distance determination is likely to be more suitable for the WBLS for the following reasons:

- The buffer distance is applied from the limit of waste as per other jurisdictions (e.g. NSW and Victoria). As a variable amount of internal buffer distance is currently present at the WBLS (Section 4.16), this means that this land is considered to form part of the recommended landfill buffer and therefore a potentially over-conservative buffer distance is not recommended;
- This approach takes into account site specific conditions (e.g. site operational status and use of environmental control technology); and
- This approach allows consideration of a site specific landfill gas risk assessment and environmental audits to confirm what the required buffer distances around the WBLS should be. GHD notes that this is an approach commonly used within other jurisdictions (e.g. NSW and Victoria).

For these reasons, it is considered that the application of EPA Victoria's approach to determining the required landfill buffer distances should be adopted within the ACT to allow site specific assessments to occur to allow the determination of site specific buffer distances. This is consistent with other jurisdictions (e.g. NSW and Victoria). The application of this approach would prevent the large scale, long term and (potentially unnecessary) impact upon significant quantities of land within the ACT caused by an absolute buffer distance.

ACT NoWaste may wish to retain the WBLS as the ACT's emergency landfill site following the completion of a site specific landfill gas risk assessment and environmental audits, which may reasonably show that the buffer distance could be reduced to 50 metres from the existing landfilled waste mass (as an example of the minimum likely possible buffer distance), but not the emergency landfill area. In this scenario, a 500 metre buffer distance may be required around the emergency landfill area ONLY, with a 50 metre buffer distance being acceptable around the existing landfilled waste mass. Under these circumstances, Figure 5 contained within Appendix

D shows the impact that these buffers would have on the proposed development within the ACT[8]. Table 6 below shows the approximate quantity of land which application of these buffer distances would impact upon within the ACT.

Table 6 Land Impacted by Potential 50 Metre Buffer Distance from Existing Waste Mass and 500 metre Buffer Distance from Emergency Landfill Area (Approximate)

Land Holder	Impacted Land (Hectares)	Number of Lots Impacted*
Riverview - 50 m buffer + 500 m buffer from Emergency Landfill Area only	26.1	352
ACT LAPS – 50 m buffer + 500 m buffer from Emergency Landfill Area only	2.1	28
Total	28.2	380

**Assumes 13.5 Lots per Hectare normally possible. Figures do not consider land also impacted by Parkwood Egg Farm on ACT LAPS land.*

The application of a 50 metre buffer from the existing landfilled waste mass (if it could be proven to be reasonable) and a 500 metre buffer from the emergency landfill area would result in a greater quantity of potentially developable land being impacted upon within the ACT than if the WBLS was not designated at the ACT's emergency landfill site and only had the 50 metre buffer distance applied to the existing landfill. An additional 24 Hectares of land (approximate) is impacted by the requirement for the 500 metre buffer for the emergency landfill than would be impacted upon if only the 50 metre buffer from existing waste needed to be applied (and was proven to be reasonable). This approach would take into account both the currently existing internal buffer distance available within the WBLS's site boundary as detailed within Section 4.16), site specific landfill gas risk assessments & environmental audits and the current requirement to retain the WBLS as the ACT's emergency landfill site.

7.3 ACT DECCEW Nominated Buffer Distances and Guidance (Current Recycling / Resource Recovery Operations Only)

GHD understands that the ACT DECCEW currently nominates the following EPA Victoria documents for determining recycling / resource recovery operation buffer distances:

[8] Readers should note that the absolute 500 metre buffer distance required by the *Territory Plan* does not apply to land located within NSW. NSW legislation currently recommends that a site specific assessment must be completed in order to determine what a reasonable buffer distance from the landfill and / or recycling / resource recovery operations is.

- *Document 1 - Recommended Buffer Distances or Industrial Residual Air Emissions (1990); and;*
- *Document 2 - Environmental Guidelines for Composting and Other Organic Recycling Facilities (1996).*

Table 7 below shows the recommended buffer distances for the recycling / resource recovery operations known to be in operation at the WBLS at present. The relevant EPA Victoria guidance documents outline that these buffer distances are to be measured from *all plant, buildings or other structures and features – such as stockpiles – from which residual air emissions may be anticipated are the starting point* (Document 1) or *whichever activity capable of emitting odour or other nuisance is nearest a sensitive land use* (Document 2). Furthermore, GHD notes that both Document 1 and Document 2 allow for consideration of reduced buffer distances based on site specific criteria / assessments such as technology in use, complaint numbers, plant size and completion of site specific environmental audits.

Table 7 Recommended EPA Victoria Buffer Distances for Recycling / Resource Recovery Operations (Approximate)

Recycling / Resource Recovery Operation	Process	Recommended Minimum Buffer Distance (Metres)	Source
Building Waste Recycling	Building Waste Recycling	200 (if classified as a Recycling and composting centre)	Document 1
Public Drop Off-Facility	Waste bulking / transfer	300 (if classified as a Transfer Station)	Document 1
Contaminated Land Remediation Area	Contaminated Land Remediation	200 (if classified as a Recycling and composting centre)	Document 1
Parkwood Road Recycling Estate - Scrapyards	Car dismantling / stockpiling	200 (if classified as a Recycling and composting centre)	Document 1
Parkwood Road Recycling Estate – Skip Company	Waste recycling / stockpiling	300 (if classified as a Transfer Station)	Document 1
Green Waste Facility	Composting	1,275* * Based on a Process Rating of 2 (Hard Green Waste), a Feedstock Rating of 12 (Windrow, turned) and a plant capacity of approximately 55 tonnes per day output (estimated – Canberra Sand & Gravel were not prepared to	Document 2

Recycling / Resource Recovery Operation	Process	Recommended Minimum Buffer Distance (Metres)	Source
		supply this commercially sensitive information to GHD)	
NoWaste Woodbusters	Wood Shredding	Currently 0 metres as is non-operational. Likely to be significantly more if it re-commences operation.	Document 2

Figure 6 contained in Appendix D shows the impact that EPA Victoria's recommended buffer distances would have on the proposed development within the ACT[9]. Table 8 below shows the approximate quantity of land that application of these buffer distances would impact upon within the ACT.

Table 8 Land Impacted By Recommended EPA Victoria Buffer Distances Recycling and Resource Recovery Operations Only (Approximate)

Land Holder	Impacted Land (Hectares)$	Number of Lots Impacted*$
Riverview	231.0	3,118
ACT LAPS	99.2	1,339
Total	330.2	4,457

**Assumes 13.5 Lots per Hectare normally possible. Figures do not consider land also impacted by Parkwood Egg Farm on ACT LAPS land.*

$Figures do not consider land impacted by two or more operations (e.g. impacted land is counted once only).

It can be seem from comparing Table 4 and Table 8 that the application of the EPA Victoria buffer distances from Documents 1 & 2 significantly increase the quantity of impacted land in comparison to the mandated Territory Plan buffer distance of 500 metres (by circa 162 Hectares in total).

If recycling / resource recovery operations were relocated from the WBLS or the technologies in use were upgraded, then the buffer distances identified in Table 8 above may be able to be reduced following completion of a site specific assessment.

If site specific risk assessments for the recycling / resource recovery operations were completed and reasonably showed that the buffer distances could be reduced to 50 metres from the limit of activity for all operations except the green waste facility (but this assessment showed that a 200 metre buffer was now required instead of 1,275 metres), and then the green waste facility was relocated away from the site boundary,

[9] Readers should note that EPA Victoria's recommended buffer distances for recycling / resource recovery operations within Documents 1 & 2 do not apply to land within NSW. Rather a site specific assessments would be required to determine what a reasonable buffer distances from the individual recycling / resource recovery operations.

then Figure 5 contained within Appendix D shows the impact which these buffer distances would have on the proposed development within the ACT[10] (assuming that the emergency landfill area was retained at the site for possible future use). Table 9 below details the approximate quantity of land which application of these buffer distances would impact upon within the ACT.

Table 9 Land Impacted by Potential 50 Metre Buffer Distance from Existing Recycling / Resource Recovery Operations, 200 Metre buffer Distance from Green Waste facility and 500 metre Buffer Distance from Emergency Landfill Area (Approximate)

Land Holder	Impacted Land (Hectares)$	Number of Lots Impacted*$
Riverview	28.0	378
ACT LAPS	20.6	278
Total	48.6	656

**Assumes 13.5 Lots per Hectare normally possible. Figures do not consider land also impacted by Parkwood Egg Farm on ACT LAPS land.*

$Figures do not consider land impacted by two or more operations (e.g. impacted land is counted once only).

If it could be proven to be reasonable, the application of these buffer distances would result in a much smaller quantity of potentially developable land being impacted upon within the ACT than the mandated Territory Plan buffer distance of 500 metres (circa 148 Hectares less land impacted in total).

It is considered that the application of EPA Victoria's approach to recycling / resource recovery buffer distance determination is likely to be suitable for the facilities at the WBLS for the following reasons:

- The buffer distance is applied from the limit of activities as per other jurisdictions (e.g. NSW). As a variable amount of internal buffer distance is currently present at the WBLS (Section 4.16), this means that this land is considered to form part of the recommended recycling / resource recovery buffer and therefore a potentially over-conservative buffer distance is not recommended;
- This approach takes into account site specific conditions (e.g. use of environmental control technology) to confirm what the required buffer distances around the facilities at the WBLS should be. GHD notes that this is an approach commonly used within other jurisdictions (e.g. NSW).

For these reasons, it is considered that application of EPA Victoria's approach to determining the required recycling / resource recovery facility buffer distances should

[10] Readers should note that EPA Victoria's recommended buffer distances for recycling / resource recovery operations within Documents 1 & 2 do not apply to land within NSW. Rather a site specific assessments would be required to determine what a reasonable buffer distances from the individual recycling / resource recovery.

be adopted within the ACT to allow site specific assessments to occur to allow the determination of site specific buffer distances. This is consistent with other jurisdictions (e.g. NSW). The application of this approach would prevent the large scale, long term and (potentially unnecessary) impact upon significant quantities of land within the ACT caused by an absolute buffer distance.

7.4 Other Buffer Distance Considerations

GHD notes that other buffer distance considerations are likely to be relevant for this project including those associated with agricultural land within NSW and the Parkwood Egg Farm. Consideration of these buffer distances is currently outside the scope of this project and is merely noted for completeness.

8. Current & Alternative Locations for Emergency Landfill Area

8.1 Current Emergency Landfill Area

As previously outlined, the WBLS is currently identified within the *West Belconnen Resources Management Centre – Master Plan* (GHD, November 2010) as the emergency landfill site for the ACT. As such, the WBLS could be used as the ACT's main landfill site should a situation arise where:

- Scenario 1 - Waste cannot be accepted at the Mugga Lane Resource Management Centre and transporting of waste to another landfill site is considered prohibitively expensive; or
- Scenario 2 - A major emergency (e.g. bushfire or flood) impacts upon the ACT.

The likely location of the part of the WBLS which would be used as the emergency landfill is identified on the plan within Appendix B. However, GHD notes that the final size and location of the emergency landfill area may alter depending on the ACT Government's requirements.

GHD notes that the identified emergency landfill area at WBLS has a capacity of circa 80,000 – 90,000 m^3. GHD further notes that the current landfilled waste input into the Mugga Lane site is circa 200,000 tonnes per year. Assuming a 1:1 compaction ratio could be achieved, the indicated emergency landfill area at WBLS could provide emergency landfill disposal capacity for the Mugga Lane site for a period of approximately 5 to 6 months only. GHD further notes that if a more expansive emergency landfill area was selected at the WBLS, the maximum available disposal capacity could be of the order of 1,000,000 m^3. This would provide approximately 5 years of landfill disposal capacity for the ACT.

Recent discussions with DECCEW personnel suggest that under Scenario 1, DECCEW would expect the WBLS emergency landfill area to be engineered to a modern standard prior to landfilling operations commencing. This would involve considerable time, cost and technical issues, which may prevent the WBLS acting as an emergency landfill and may require an alternative site to be identified and utilised.

8.2 Alternative Emergency Landfill Sites

There are a number of possible alternative emergency landfill sites within the ACT and NSW, which have been previously identified within CBRE's report *Emergency Landfill Options Paper* (2011). This report is included in Appendix E of this document. To summarise CBRE's report's main findings:

- Under Scenario 1, waste could be transported to several licensed landfill sites within NSW (e.g. Woodlawn, Isabel Drive or Cooma). GHD recommends that further assessment of the feasibility of waste being transported to and accepted for disposal at these sites should be completed;

- Under Scenario 2, waste could either be transported to the licensed landfill sites identified under Scenario 1 or disposed of within the ACT under reduced environmental controls as agreed with the DECCEW (as would be typical under a true emergency scenario). GHD recommends that further assessment of the DECCEW's position in relation to a true emergency scenario and associated waste disposal needs be confirmed.

A plan showing the locations of these potential emergency landfill sites is provided within CBRE's report.

9. Current & Alternative Options for Recycling Resource Recovery Operations

9.1 Current & Future Recycling / Resource Recovery Operations

As previously outlined, there are a number of recycling / resource recovery operations in operation at the WBLS. These operations in their current condition have the potential to significantly impact upon any proposed residential development around the WBLS.

At present, ACT NoWaste intends to continue these operations in their current condition and likely expand them into the future, retaining the WBLS as a recycling / resource recovery centre.

9.2 Alternative (Upgraded) Recycling / Resource Recovery Operations

Currently it is unclear what the actual environmental impacts from the recycling / resource recovery operations at the WBLS are. However, if operations are expanded then the risk of impacts could increase, depending on the level of environmental controls implemented. It can be seen from Section 7 that the required buffer distances of these operations are significant and impact upon significant areas of potentially developable land.

Upgrading the current & future recycling / resource recovery operations may allow the likely impacts from these operations to be reduced and allow a reduction in the required buffer distances as detailed within Section 7. GHD recommends that a more detailed evaluation of options that allow a reduction of the required buffer distance be completed.

9.3 Alternative Location(s) for the Recycling / Resource Recovery Operations

Currently it is unclear what the actual environmental impacts from the recycling / resource recovery operations at the WBLS are. However, if operations are expanded then the risk of impacts could increase, depending on the level of environmental controls implemented. It can be seen from Section 7 that the required buffer distances of these operations are significant and impact upon significant areas of potentially developable land.

Relocating the current & future recycling / resource recovery operations would remove the likely impacts from these operations and allow a reduction in the required buffer distances. There are other possible sites within the ACT / NSW that could provide alternative locations for the recycling / resource recovery operations. At present, the most likely of these is considered to be the Mugga Lane Resource Recovery Park. GHD recommends that a more detailed assessment of the potential sites be completed.

10. Preliminary Evaluation of Risks (Landfill Only)

10.1 General

- There is a significant quantity of waste landfilled at the site (approximately 2,700,000 tonnes across approximately 46 Hectares);
- This waste mass continues to degrade, generating landfill gas and leachate;
- Whilst the site ceased accepting putrescible waste in 2002; the degradation will continue for many years i.e. > 30 to 50 years;
- The landfilling occurred over a long period (from the 1970s to present), with the majority occurring prior to the implementation of modern environmental management standards; and
- The site continues to accept asbestos containing wastes for landfilling.

10.2 Landfill Gas

- It is estimated that there is a significant quantity of landfill gas being generated at the site i.e. (750 – 1,250 m3/hr of landfill gas during 2009);
- This will continue for many years i.e. > 30 to 50 years;
- There is an active landfill gas extraction system at the site that covers most of the landfilled waste;
- There is substantial uncertainty about the effectiveness of landfill gas containment measures at the site i.e. lining of landfill cell side walls and the landfill final cover layer, with limited monitoring of such currently occurring;
- In addition, modelling indicates a significant difference between landfill gas generation and the actual quantity of gas being captured, suggesting significant quantities of landfill gas could be escaping from the WBLS (alternatively the model could be inaccurate);
- The local geology is a variable mixture of clay, weathered volcanics and weathered sedimentary rock. The clay may restrict potential subsurface landfill gas movement, however, there is insufficient data to assess the potential for gas movement through the weathered volcanics and sedimentary rock. Fractures may be the main pathways for landfill gas sub-surface migration;
- There appears to be a fairly limited unsaturated zone to the west of the WBLS (circa 3 to 5 metres in thickness) that landfill gas may readily move through but a much larger unsaturated zone to the east of the WBLS (circa 15 to 20 metres in thickness);
- Recent landfill gas monitoring did not identify any significant off-site impacts at the monitored locations; and

- Further site specific monitoring / assessment will be required to more fully determine the likely level of risk posed by landfill gas emissions from the WBLS.

10.3 Leachate

- There is a large quantity of waste landfilled at the WBLS and thus there is potential for the generation of significant quantities of leachate;
- This will continue for many years i.e. > 50 years;
- However, as Canberra typically has a dry climate, where evaporation exceeds rainfall, this suggests that leachate generation should be low;
- The majority of the landfilled area has no leachate collection system. There is a rudimentary system in the most recently completed area which consists of two (2) drainage pipes that flow to the leachate dam;
- According to the available information, the landfill trenches / cells were lined on the base with clay. However the effectiveness of the constructed layers are unknown as no as-built or QA/QC records are available;
- There is substantial uncertainty about the present effectiveness of the existing landfill capping layer (which is currently being upgraded);
- There is no data on the quantity of leachate generated by the WBLS. Anecdotal information suggests leachate generation at the site is low, which would be consistent with the climate;
- The local geology is likely to limit subsurface migration of leachate due to the presence of clay. However, leachate movement through the weathered volcanics and weathered sedimentary rock may be more likely;
- There is little risk of leachate moving to the east of the WBLS as this is upgradient, rather the greatest risk of significant leachate impacts is to the west (i.e down gradient towards the majority of the proposed residential development);
- The groundwater monitoring bores installed at the WBLS provide only a limited coverage of the potential migration pathways and are mainly located on the downstream (western) side of the WBLS (only one upstream monitoring bore is present). These monitored locations do not show any significant impacts from leachate;
- Leachate disposal via irrigation (untreated) increases the risk of contamination of local surface water(depending upon the capacity of the leachate dam and prevailing management practices);
- Irrigation of untreated leachate presents a risk to off-site receptors from spray drift ; and
- Further site specific monitoring / assessment will be required to more fully determine the likely level of risk posed by leachate emissions from the WBLS.

10.4 Other Hazards

- Asbestos is still being landfilled at the WBLS, presenting a risk to on site and off-site receptors;
- Insufficient data is available to currently confirm the significance of any off-site impacts from dust, odour, litter, noise, visual and traffic. GHD recommend that assessments of such should be completed as soon as possible to confirm existing impacts from these operations; and
- If the landfill were to re-commence waste disposal operations under an emergency scenario (as mentioned in Section 4.3), the risk of impact from the issues / hazards identified above are likely to become of greater significance than they are at present. The risk of impact should therefore be appropriately assessed at this time (ideally before waste disposal operations re-commenced).

11. Preliminary Evaluation of Risks (Recycling / Resource Recovery Operations Only)

11.1 General

There are a number of potential risks posed by the existing recycling / resource recovery operations, including contaminated stormwater, dust, odour, litter, noise, visual and traffic. Currently it is unclear from the available information whether the recycling / resource recovery operations occurring at the WBLS are having any significant impacts off-site from these hazards. GHD recommend that suitable assessment(s) should be completed as soon as possible to confirm existing impacts from these operations.

Furthermore, GHD understand that these operations may expand in scale into the future (*West Belconnen Resource Management Centre – Master Plan* (GHD, 2010). Assessing the likely future level of impacts from these operations (and their associated upgrade / construction works as identified in Section 4.16) is outside the scope of this report but it is recommended that this be confirmed as soon as possible (with due consideration to the proposed residential development). This will allow the likely future impacts of these operations upon local receptors to be assessed, understood and managed / mitigated accordingly.

12. Recommended Upgrading / Additional Environmental Monitoring and Management Measures (Landfill Only)

12.1 General

Based on the findings of the preliminary assessments in earlier sections, GHD considers that there are a number of possible risks to current and future receptors both on and off-site associated with the WBLS. This would include any additional buildings and structures proposed to be constructed in close proximity to the WBLS as part of the residential development. As previously mentioned, available data on a number of potential risks associated with the current and future landfill operations is currently not available (e.g. asbestos, dust, odour, noise, visual etc.). As such, GHD recommends that these risks be reviewed and assessed once sufficient information on the current / future activities is available (with due consideration to the proposed residential development). This will allow the likely impacts of these operations upon local receptors to be assessed, understood and managed / mitigated accordingly.

As such, this section primarily focuses on the requirement for upgrading / additional environmental monitoring and management required in relation to the significant risks identified / associated with landfill gas and leachate from the landfilled waste. GHD considers the measures outlined in the following sections to be required.

GHD notes that a number of recommendations contained in the following text were previously recommended within the *Report for West Belconnen Master Plan - Landfill Cell Remediation Plan* (GHD, November 2010).

12.2 Upgrading / Additional Environmental Monitoring (Landfill Only)

12.2.1 Landfill gas

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* recommends a number of actions in relation to landfill gas management including the following:

- Landfill gas surface emissions monitoring should be completed across the landfill site's surface on a regular basis to confirm the effectiveness of the existing landfill gas capture system and the integrity of the final landfill cover layer and penetrations through it. This monitoring should incorporate monitoring of the existing gas interception trench adjacent to Parkwood Road;
- Landfill gas accumulation monitoring across the site, including all above and below ground building and structures within 250 m of the landfilled waste; and

- Evaluation of the risk of offsite subsurface landfill gas migration and implementation of an appropriate monitoring program, including installation of subsurface landfill gas monitoring wells if found to be necessary.

In addition to the above, recommendations, GHD makes the following recommendations in light of the proposed residential development upon land adjacent to the WBLS:

- Perimeter sub-surface landfill gas monitoring bores should be installed around the entire perimeter of the WBLS on a risk assessment basis. These bores should be monitored on a regular basis to confirm that significant sub-surface landfill gas migration is not occurring. A two layer system of landfill gas monitoring bores could be constructed (near waste and at WBLS boundary) so that impacts can be tracked and appropriate remedial actions taken prior to off-site impacts occurring;
- Landfill gas accumulation monitoring should be completed in off-site sub-surface services on a regular basis to confirm that landfill gas is not accumulating within these structures;
- Perimeter groundwater monitoring bores should be monitored for the presence of landfill gas in the headspace above the groundwater table. These locations should be monitored on a regular basis to confirm that landfill gas is not accumulating within these structures or migrating off-site via leachate / contaminated groundwater;
- If perimeter groundwater monitoring bores suggest significant concentrations of landfill gas are present, consideration to sampling of leachate and / or groundwater for dissolved gases should be given;
- If the collected monitoring data suggests that there is a significant likelihood of off-site landfill gas impact, all buildings / structures within 250 metres of the site's boundary should be monitored for landfill gas until such time as the issue has been appropriately resolved;
- Landfill gas extraction data from the individual gas wells should be obtained regularly and reviewed; and
- Regular monitoring of operational hours, noise, odour and exhaust emissions associated with the treatment of landfill gas at the engine should be completed. If significant issues are identified then appropriate remedial actions will be required.

12.2.2 Leachate

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* recommends a number of actions in relation to leachate management including the following:

- Regular monitoring of local climatic conditions;
- Regular monitoring of depth of leachate stored within the leachate dam;
- Regular monitoring of volume of leachate irrigated;

- Regular monitoring of soil quality in the leachate irrigation area;
- Regular monitoring & maintenance of leachate extraction system (pumps, dam, riser pipes, sprinkler etc.).

In addition to the above, recommendations, GHD makes the following recommendations in light of the proposed residential development upon land adjacent to the WBLS:

- Regular monitoring of leachate static head within the waste mass should be implemented at the WBLS. This will assist in further understanding the quantity of leachate present within the landfilled waste mass and its potential impacts upon the operation of the landfill gas management system;
- Regular monitoring of the composition and quantity of leachate extracted from the WBLS should be completed;
- Automatic monitoring systems / alarm / control should be installed at the leachate dam (if they are not already) so that forewarning of any potential spill is received;
- Regular monitoring of noise and odour associated with the extraction and treatment of leachate should be completed. If significant issues are identified, then appropriate remedial actions will be required.

12.2.3 Groundwater

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* recommends a number of actions in relation to groundwater management including the following:

- The groundwater monitoring system needs to be upgraded / revised to provide adequate coverage around the WBLS as per the SEMF report.
- In addition to the above, recommendation, GHD makes the following recommendation in light of the proposed residential development upon land adjacent to the WBLS:
- A two layer system of groundwater monitoring bores could be constructed (near waste and at WBLS boundary) so that impacts can be tracked and appropriate remedial actions taken prior to off-site impacts occurring.

12.2.4 Surface water

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* recommends a number of actions in relation to surface water management including the following:

- Regular monitoring of surface water quality should continue, with the existing infrastructure and monitoring to be rationalised as per the SEMF report; and
- Regular monitoring & maintenance of surface water management system (channels, pipes, dams etc.).

- In addition to the above, recommendations, GHD makes the following recommendation in light of the proposed residential development upon land adjacent to the WBLS:
- A review of the suitability / expansion of current surface water monitoring locations and parameters should be completed in light of the potential residential development.

12.3 "Of Order" Costs – Environmental Monitoring

Error! Reference source not found. below details the estimated "of-order" costs for the potential upgrading / additional environmental monitoring measures.

Table 10 Of Order Costs – Environmental Monitoring[11]

Task	Of Order Cost
Landfill Gas Monitoring	
Surface Emissions Monitoring	$3,000 - $5,000 per round including a brief report
Landfill Gas Accumulation Monitoring (on-site) including sub-surface services	$3,000 - $5,000 per round including a brief report
Installation of Sub-surface Perimeter Landfill Gas Monitoring Bores	$3,000 - $5,000 per bore (drillers cost only, no construction quality assurance or design)
Sub-surface Perimeter Landfill Gas Monitoring (including off-site services)	$3,000 - $5,000 per round including a brief report
Landfill Gas Accumulation Monitoring (off-site) including sub-surface services	$5,000 - $20,000 per round including a brief report (the cost of this will increase in direct proportion with the number of local receptors)
Landfill gas monitoring of perimeter groundwater monitoring bores	$3,000 - $5,000 per round including a brief report
Analysis of leachate / groundwater for dissolved gases	$3,000 - $5,00 per round including a brief report
Review of landfill gas extraction data	$1,000 - $2,000 per round including brief report
Monitoring of operational hours, noise, odour and exhaust emissions from engine	$5,000 - $10,000 per round including a brief report
Leachate Monitoring	

[11] It is likely that there would be synergies between much of the landfill gas monitoring required and that substantial reductions in the estimated costs could be achieved by completing the monitoring on one or a succession of days.

Task	Of Order Cost
Monitoring of climatic conditions	$100 per round
Monitoring of the depth of leachate in the leachate dam	$500 - $1,000 per round
Monitoring of the quantity of leachate irrigated	$500 - $1,000 per round
Monitoring of soil quality in leachate irrigation area	$2,000 - $5,000 per round (assumes a maximum of 5 samples)
Installation of in-waste leachate monitoring bores	$10,000 - $20,000 (assumes installation of 2 – 3 bores). Could be cheaper if strategically located gas extraction wells can be converted.
Leachate Static Head	$1,000 - $2,000 per round
Monitoring of the composition and quantity of leachate extracted	$1,500 - $2,000 per round (assumes a maximum of 1 sample per round)
Monitoring of operational hours, noise and odour associated with leachate management system	$5,000 - $10,000 per round including a brief report
Groundwater Monitoring	
Revision / update of groundwater bore network	$20,000 - $30,000 (assumes installation of 3 – 5 additional bores)
Surface Water Monitoring	
Rationalisation of existing infrastructure / monitoring	$2,500 - $5,000
Review of the suitability / expansion of current surface water monitoring locations and parameters	$5,000 - $10,000 including a brief report

12.4 Upgrading / Additional Environmental Management Measures (Landfill Only)

12.4.1 Landfill gas

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* does not specifically recommend any additional landfill gas management measures. In light of the proposed residential development upon land adjacent to the WBLS, GHD now makes the following recommendations:

- The requirement for upgrading / additional environmental management measures will ultimately be determined by the results from the environmental monitoring completed;

- Ideally a landfill gas generation and emission model for the WBLS should be produced for subsequent calibration with the quantity of landfill gas extracted from the WBLS by EDL and newly obtained landfill gas monitoring data;
- The landfill gas extraction system should be operated in such a manner as to ensure continuous gas extraction and treatment with the management goal of minimising the quantity of landfill gas emitted from the WBLS. If excess landfill gas is available to that required to allow the engine to operate, then a stand-by flare should be installed and operated to control this excess landfill gas. Automatic monitoring / alarms / controls on the landfill gas treatment infrastructure should be installed if they are not already; and
- If landfill gas surface emission, sub-surface or accumulation monitoring identify significant emissions, repairs to landfill gas extraction wells (or additional wells), a subsurface landfill gas barrier / interception wall, an upgrade of the final landfill cover layer or other remedial measures may be required.

12.4.2 Leachate

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* does not specifically recommend any additional leachate management measures. In light of the proposed residential development upon land adjacent to the WBLS, GHD makes the following recommendations:

- The requirement for upgrading / additional environmental management measures will ultimately be determined by the results from the environmental monitoring completed. The available data suggests that no significant off-site impacts from leachate have been observed;
- A leachate generation and emission model (water balance) for the WBLS should be produced for comparison with the quantity of leachate extracted from the WBLS and subsequently disposed of (via evaporation and irrigation). This model should subsequently be calibrated with the quantity of leachate extracted from the WBLS and newly obtained leachate static head data;
- Following calibration of the leachate generation / emission model, an assessment as to the ongoing suitability of the existing method of leachate disposal should be completed. If this method is considered to be unsuitable then alternatives should be identified and assessed (it may be possible to connect the WBLS to the sewer constructed for any residential development);
- Contingency measures for periods when excessive quantities of leachate are present on-site should be determined (e.g. off-site tankering, connection to sewer discharge etc.); and
- If significant off-site leachate impacts are identified in the future, then repairs to leachate extraction wells (or additional wells), groundwater pump and treat and / or subsurface leachate barrier / treatment walls may be required.

12.4.3 Groundwater

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* does not specifically recommend any additional groundwater management measures. In light of the proposed residential development upon land adjacent to the WBLS, GHD now makes the following recommendation:

- If significant off-site leachate impacts are identified in the future, then additional groundwater monitoring bores, more frequent sampling, restrictions on use of local groundwater and / or groundwater pump and treat may be required.

12.4.4 Surface water

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* recommends the following in relation to surface water management:

- Regular monitoring of the existing surface water management infrastructure should be completed, with regular maintenance completed as required.

GHD makes no further recommendations at this time (other than those already identified within this document) in light of the proposed residential development upon land adjacent to the WBLS.

12.4.5 Final Landfill Cover Layer

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* recommends the following in relation to the final cover layer:

- Assess the existing landfill final cover layer's efficiency in controlling emissions of landfill gas and shedding of surface water (no ponding);
- Where stormwater is ponding or unacceptable levels of landfill gas are escaping, either undertake contouring works, install additional gas extraction wells, or apply a 300 mm layer of mulch / compost to promote microbial methane oxidation as appropriate; and
- Where the landfill gas extraction system is not functioning properly (broken), consider undertaking contouring worker before repairing / replacing the dysfunctional part of the system.

In light of the proposed residential development upon land adjacent to the WBLS, GHD now makes the following recommendations:

- Regular visual monitoring of the toe's of the landfill batters should be completed to confirm that no leachate seepages are occurring at this juncture.

12.4.6 Possible Off-Site Mitigation / Remedial Measures for Proposed Residential Development

The *West Belconnen Resource Management Centre Landfill Cell Rehabilitation Plan (November 2010)* does not specifically recommend any off-site mitigation / remedial measures. In light of the proposed residential development upon land adjacent to the WBLS, GHD now makes the following recommendations:

- Re-assess / re-consider the actual appropriateness of having an operational landfill site in a newly established urban area;
- Retention of a limited internal buffer land within the WBLS as a future attenuation / remediation zone so that access to install any required remedial measures would be available. Such a zone would need to be free of significant semi-permanent / permanent structures and a minimum of 20 – 30 metres wide around the entire boundary of the WBLS to allow access for trucks, excavators, barrier walls, gas extraction wells etc12. This buffer land could be additional to the proposed vegetated visual screen or could replace it;
- Retention of limited buffer land immediately adjacent to the WBLS boundary (on the development land) as a future attenuation / remediation zone so that access to install any required remedial measures would be available. Such land would need to be free of significant semi-permanent / permanent structures and a minimum of 20 – 30 metres wide around the entire boundary of the WBLS to allow access for trucks, excavators, barrier walls, gas extraction wells etc.;
- The proposed residential properties could be designed with the possibility of landfill gas or leachate impacting upon them in the future (e.g. no basements, sub-slab ventilation, gas proof membranes, services provided above ground etc.); and
- A community consultative / monitoring committee could be established to discuss the WBLS' operations and its impacts upon local residents on an ongoing basis. Any issues identified could subsequently be addressed as they are identified.

12.5 "Of Order" Costs – Environmental Management

Error! Reference source not found. below details the estimated "of-order" costs for the potential upgrading / additional environmental management measures.

Table 11 Of Order Costs – Environmental Management

Task	Of Order Cost
Landfill Gas Management[13]	
Landfill gas generation and emission model	$5,000 - $10,000 including: calibration with EDL data, other landfill gas monitoring data and a brief report
Installation of landfill gas flare and automatic monitoring / alarms	$150,000 - $250,000 (excludes any civil and design works required)
Replacement / additional landfill gas extraction wells	$3,000 - $5,000 per well

[12] GHD notes that the retention of an appropriate internal buffer zone may not be possible in some locations due to historical activities.

[13] It is likely that there would be synergies between much of the landfill gas monitoring required and that substantial reductions in the estimated costs could be achieved by completing the monitoring on one or a succession of days.

Task	Of Order Cost
Sub-surface landfill gas barrier / Interception wall	$1,000,000 - $20,000,000 (cost heavily dependent upon depth, width and length of barrier required)
Upgrade of final landfill cover layer	$500,000 - $2,000,000 (cost heavily dependent upon thickness and extent of upgrade required)
Leachate Management[14]	
Leachate generation and emission model	$5,000 - $10,000 including: calibration with leachate extraction data, leachate static head data and a brief report
Assessment of suitability of current leachate disposal method	$5,000 - $10,000 including a brief report
Installation of automatic level monitoring systems / alarms on the leachate dam	$5,000 - $10,000
Determination of contingency measures	$5,000 - $10,000 including a brief report
Replacement / additional leachate extraction wells	$3,000 - $5,000 per well
Sub-surface leachate barrier / treatment wall	$1,000,000 - $20,000,000 (cost heavily dependent upon depth, width and length of barrier required)
Groundwater pump and treat	$500,000 - $20,000,000 (cost heavily dependent upon extent and type of contamination observed)
Groundwater Management	
Additional groundwater bores	$5,000 - $10,000 per bore
Establishment of a restricted groundwater use zone	$5,000 - $10,000
Surface Water Management	
Visual monitoring of existing surface water infrastructure and associated maintenance	$2,000 - $5,000 per round
Recommendations contained within *Landfill Cell Remediation Plan* (GHD, 2010)	$10,000 - $20,000 per annum
Final Landfill Cover Layer	
Confirmation of final landfill cover	$5,000 - $10,000 including a brief report

[14] It is likely that there would be synergies between the leachate monitoring required and that substantial reductions in the estimated costs could be achieved by completing the monitoring on one or a succession of days.

Task	Of Order Cost
layer's integrity re. landfill gas and surface water run-off	
Application of 300 mm of mulch / compost if required to reduce methane emissions	$500 - $1,000 per location (if extensive failures are noted, consideration to thickening the landfill final cover layer or increasing the number of landfill gas extraction wells will be required)
Contouring works	$5,000 - $20,000 + (depends on several factors including area, availability of plant and material etc.)
Visual monitoring of landfill batter toe's	$2,000 - $5,000 per round
Off-Site Mitigation / Remedial Measures	
Re-assess whether having an operational landfill site in a newly established urban area is appropriate	$10,000 - $20,000 (the cost to the ACT Government could be significant from lost revenue and need to relocate existing operations to another site)
Retention of limited internal buffer land at WBLS (on-site)	No actual capital cost, but cost to ACT Government could be $10,000's per annum from lost revenue
Retention of limited external buffer land around WBLS (off-site)	No actual capital cost, but cost to joint venture could be $100,000's from lost revenue
Design of residential development with consideration of possible future landfill gas and leachate impacts	$20,000 - $30,000
Increase in construction costs to individual residential properties due to mitigation measures to prevent potential future impact from landfill gas and / or leachate	$2,000 - $5,000 per property
Establishment and operation of community consultative / monitoring committee	$5,000 - $10,000 per annum

13. Recommended Upgrading / Additional Environmental Monitoring and Management Measures (Recycling / Resource Recovery Operations Only)

13.1 General

As previously mentioned, available data on the risks associated with the current and future resource recovery / recycling operations / future land use is currently not available. As such, GHD recommends that the identified risks presented by these operations are reviewed and assessed in detail once sufficient information on the current / future activities is available (with due consideration to the proposed residential development). This will allow the likely impacts of these operations upon local receptors to be further assessed, the current baseline impacts determined and then recommendations can be made for upgrading / additional works to manage / mitigate these risks accordingly.

As such, no recommendations for upgrading / additional measures or indicative costings have been made at this stage.

14. Conclusions & Recommendations

14.1 Landfill Conclusions

The preliminary assessment of issues relating to the proposed residential development completed herein suggests that the landfilled waste mass at WBLS is potentially a significant source of contaminants and has the potential to impact upon both on and off-site receptors via a number of pathways for a considerable length of time. The most significant hazards / issues relating to the landfilled waste are currently considered to be landfill gas and leachate.

In order to more fully assess and subsequently reduce the likely level of risk posed from landfill gas and leachate emitted from the WBLS, a series of recommended improvements to existing environmental monitoring and environmental management systems could be implemented. These have been previously outlined in Section 12.

Other hazards (e.g. asbestos, dust, odour, noise, litter, visual and traffic) are also associated with the landfilled waste but little information / data is currently available on them. As such, it is not possible to determine the existing or future impacts from these hazards at this point in time.

This preliminary investigation identifies that there are a number of ways in which the required buffer distances could be measured and determined, each with a different spatial impact upon the proposed development land. Likewise the required buffer distances are heavily dependent upon the future land use requirements at the landfill (e.g. the emergency landfill requirement is likely to require more buffer land than if this requirement was removed / relocated). A common approach will need to be agreed with the relevant ACT Government stakeholders which may require an amendment to the Territory Plan to be made. To maximise the land able to be developed for residential development would involve measurement of the buffer distance from the limit of the waste footprint / activity and site specific assessments being undertaken to determine the required buffer distances.

A preliminary evaluation of the issues identifies that there are a number of possible alternative emergency landfill sites within the ACT and NSW to which waste could be transported under either of the identified emergency scenarios.

14.2 Landfill Recommendations

Based on the conclusions above, GHD makes the following recommendations:

- Riverview should seek to formalise the Joint Venture as soon as possible;
- Riverview should seek a formal agreement and timescales from the ACT government to alter how buffer distances are determined within the Territory Plan in relation to the proposed residential development;
- A more detailed assessment of the suitability of other sites to act as ACT's emergency landfill site should be completed. Following completion of this assessment (and assuming it is acceptable to ACT government stakeholders),

Riverview should seek a formal agreement from the ACT government that the WBLS will not be required as a future landfill site (emergency or otherwise);

- The landfill gas and leachate recommendations outlined in Section 12 should be completed as soon as practicable (ideally prior to any further development/ earthworks on-site and definitely prior to any construction works relating to the proposed residential development);
- Other hazards (e.g. asbestos, dust, odour, noise, litter, visual and traffic) associated with the WBLS should be investigated and assessed to determine the likely current and future level of impacts under a variety of scenarios. These impacts should also be assessed under a scenario where the WBLS needs to re-open for waste disposal under an emergency scenario. Following these assessments, recommended improvements to existing environmental monitoring and environmental management systems should be identified and implemented; and
- Following completion of the additional investigative / assessment works in relation to landfill gas, leachate and "other" hazards, the required buffer distance for the landfill in relation to all identified hazards (landfill gas, leachate and "other") should be determined and formally agreed with ACT government.

14.3 Recycling / Resource Recovery Operations Conclusions

The preliminary assessment of issues relating to the proposed residential development completed herein suggests that the recycling / resource recovery operations at the WBLS currently pose an unknown level of impact / hazard to both on and off-site receptors.

In order to more fully assess and subsequently reduce the likely level of risk posed by these operations, further investigative / assessment works are required.

A preliminary evaluation identifies that there are a number of ways in which the required buffer distances could be measured and determined, each with a different spatial impact upon the proposed development land. Likewise the required buffer distances are heavily dependent upon the future land use requirements for recycling / resource recovery operations at the WBLS (e.g. ongoing / expanded resource recovery operations are likely to require more buffer land than if these facilities were removed / relocated or upgraded). A common approach will need to be agreed with the relevant ACT Government stakeholders which may require an amendment to the Territory Plan. To maximise the land able to be developed for residential development To potentially minimise the extent of the impacted land, this would involve some or all of the following:

- Measurement of the buffer distance from the limit of the individual activities;
- Upgrade of existing recycling / resource recovery facilities;
- Relocation of existing facilities; and / or

- Site specific assessments being undertaken to determine the required buffer distances.

The preliminary investigation of issues identifies that there are a number of possible sites to relocate the recycling / resource recovery operations to within the ACT and NSW.

14.4 Recycling / Resource Recovery Operations Recommendations

Based on the conclusions above, GHD makes the following recommendations in addition to those detailed in Section 14.2:

- A more detailed assessment of the potential to upgrade or relocate the existing recycling / resource recovery operations should be completed. Following completion of this assessment (and assuming it is acceptable to ACT government stakeholders), Riverview should seek a formal agreement from the ACT government that operations at the WBLS will be upgraded / restricted to those which are compatible with the proposed development only;
- Assessment of the hazards potentially associated with the individual recycling / resource recovery operations should be assessed to determine the current / future level of impacts. Following these assessments, recommended improvements to existing environmental monitoring and environmental management systems should be identified; and
- Following completion of the two tasks identified above, site specific assessments should be completed to determine the required buffer distances for the recycling / resource recovery operations to be retained on-site.

Appendix A

Plan of Existing WBLS Layout

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Checked	Approved	Date
D	SITE BOUNDARY AMENDED		AM	AR*	SD*	25.11.10
C	EXTENTS REVISED		AH	AR		10.09.10
B	FINAL DRAFT		AH	AR		25.05.10
A	PRELIMINARY		AM	AR		27.11.09

0 25 50 75 100 125m
SCALE 1:2500 AT ORIGINAL SIZE

GHD CLIENTS | PEOPLE | PERFORMANCE
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Canberra ACT 2601 Australia
GPO Box 1877 Canberra ACT 2601
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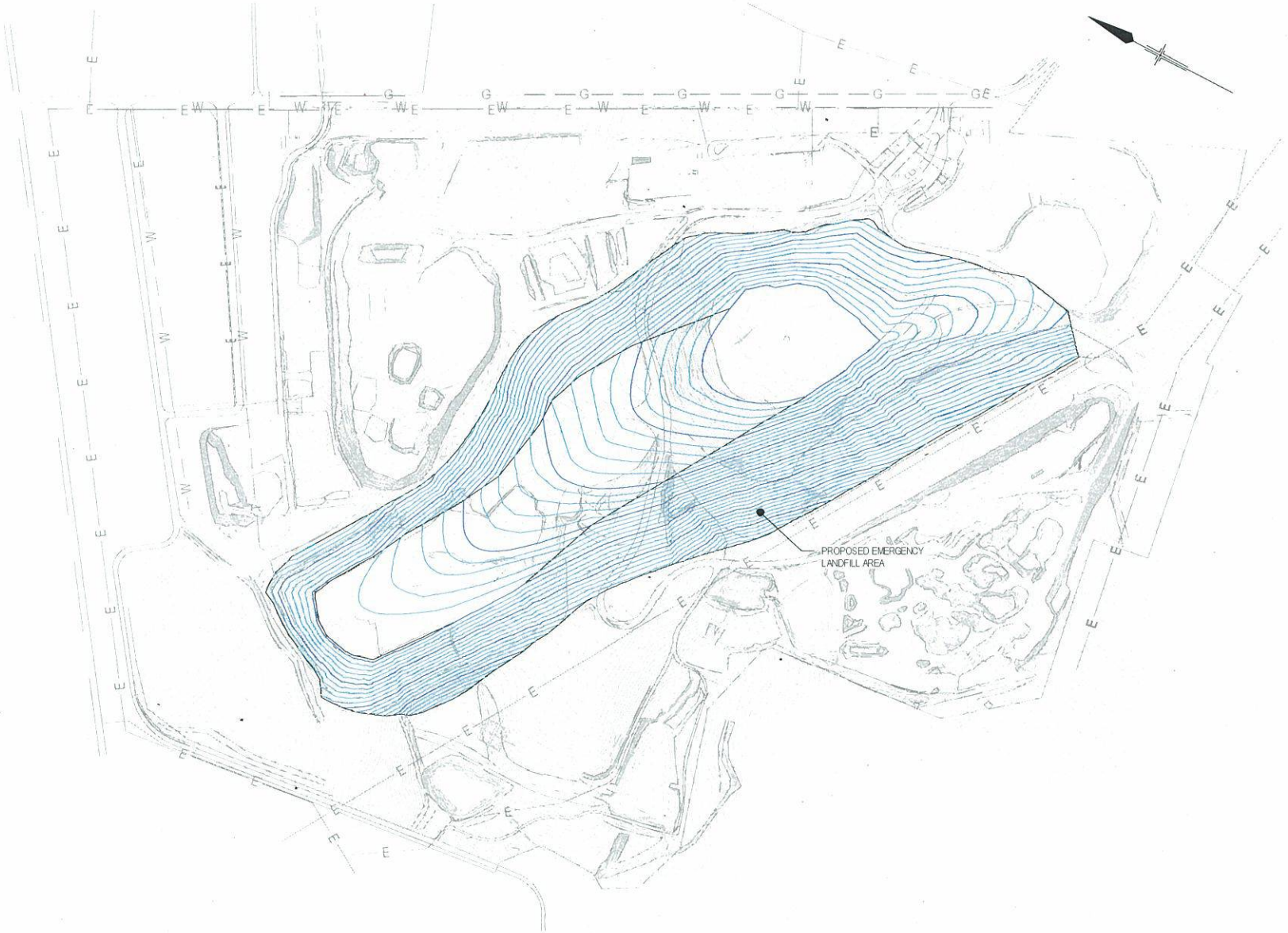
E cbrmail@ghd.com.au W www.ghd.com.au

Drawn A. MILLER	Designed A. ROBERTS	Client	ACT NOWaste
Drafting Check	Design Check	Project	WEST BELCONNEN LANDFILL MASTER PLAN
Approved		Title	LANDFILL CELL REMEDIATION PLAN EXISTING SITE PLAN
Date			
Scale 1:2500	This Drawing must not be used for Construction unless signed as Approved	Original Size A1	Drawing No: 21-18515-C002 Rev: D

Plot Date: 25 November 2010 - 1:43 PM Plotted by: Adrian P Miller/Sydney/GHD/AU Cad File No: G:\21\18515\CADD\Drawings\21-18515-C002.dwg

Appendix B

Plan of Possible Emergency Landfill Area



LEGEND

PROPOSED LANDFORM

NOTE
APPROXIMATE FILL VOLUME OF EMERGENCY
LANDFILL AREA = 850,000 - 90,000 m3
(DEPENDENT ON EXTENT OF EXCAVATION)

0 0.05 0.10 0.15m
SCALE 1:5 AT ORIGINAL SIZE

CLIENTS | PEOPLE | PERFORMANCE

ACT NOWaste
WEST BELCONNEN LANDFILL
MASTER PLAN
LANDFILL CLOSURE PLAN
EMERGENCY LANDFILL AREA

Job Number | 21-18515
Revision | A
Date | MAY 2010

Figure 10

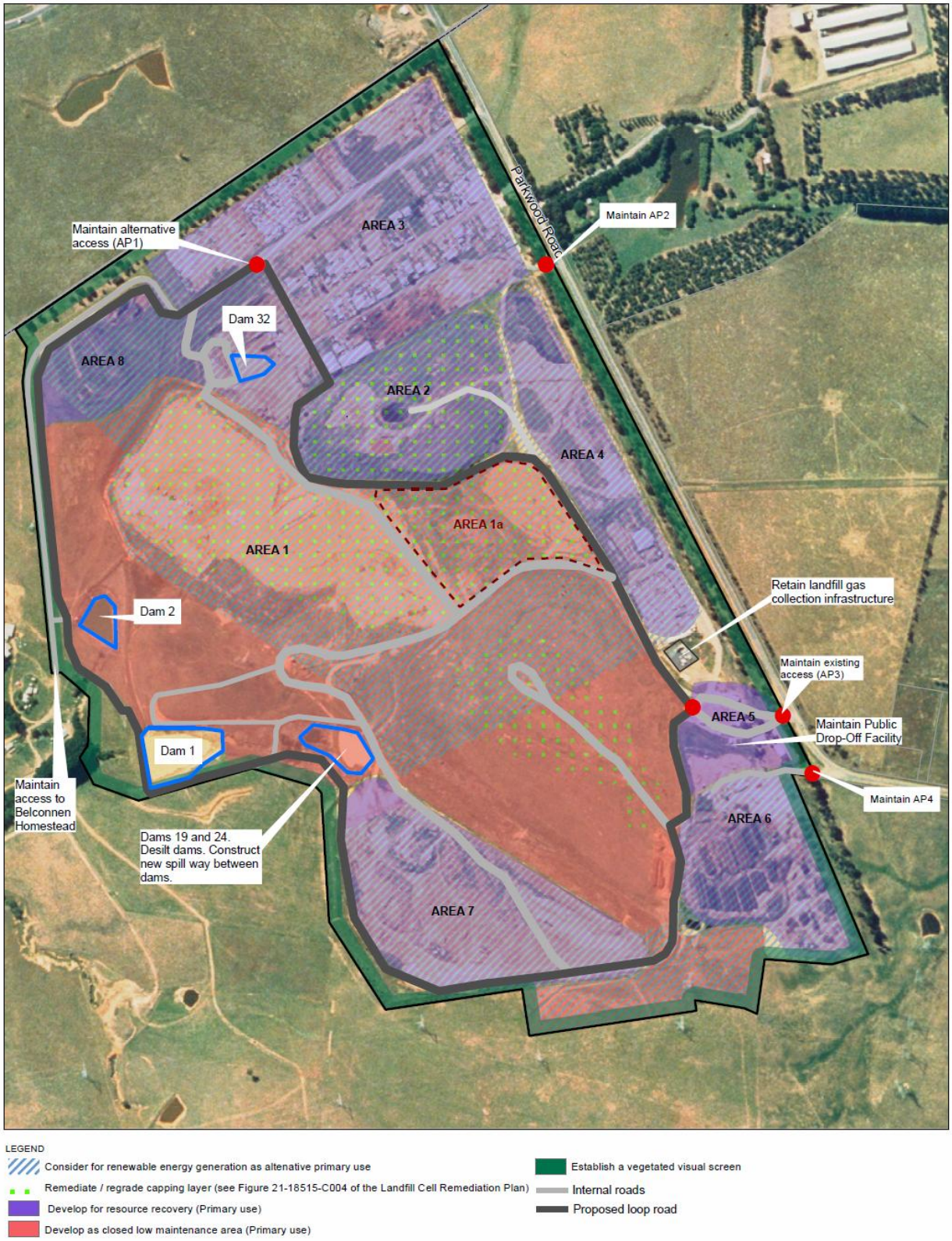
Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Plot Date: 26 May 2010 - 11:18 AM Plotted by: Adrian P Miller/Sydney/GHD/AU Cad File No: G:\21\18515\CADD\Drawings\21-18515-FIG10.dwg

Appendix C

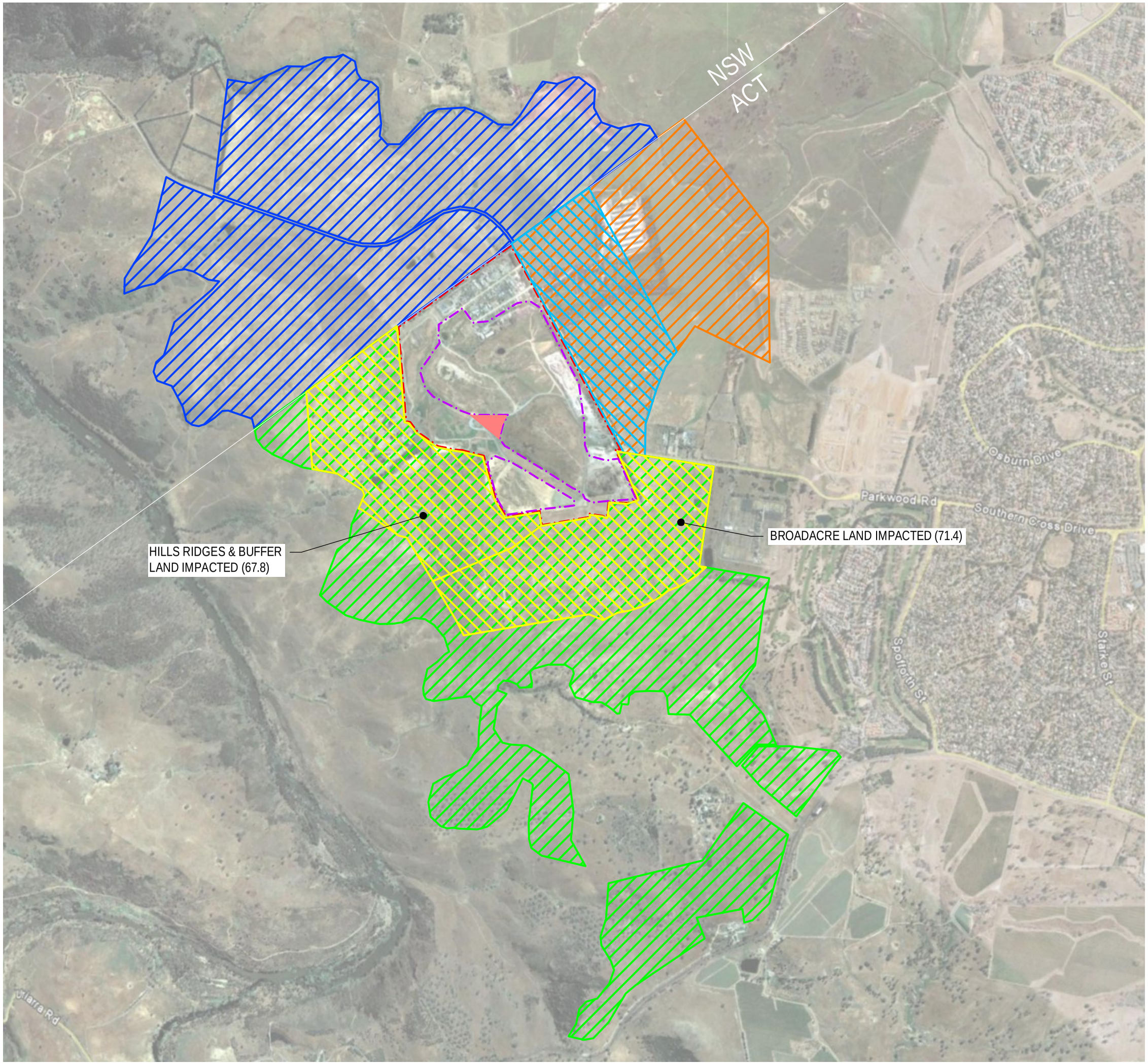
Plan of Proposed Future Land Uses at WBLS

Figure ES. 1 Master Plan



Appendix D

Figures of Required and Potential Future Buffer Distances



LEGEND

	RIVERVIEW CONTROLLED LAND (ACT)	345.0ha
	RIVERVIEW CONTROLLED LAND (NSW)	264.3ha
	ACT GOVT. CONTROLLED LAND (ACT)	126.2ha
	RIVERVIEW CONTROLLED LAND IMPACTED	139.2ha
	ACT GOVT. CONTROLLED LAND IMPACTED	55.6ha
	EMERGENCY LANDFILL AREA	1.1ha
	SITE BOUNDARY	
	APPROX. EXTENT OF EXISTING WASTE	

Nb: ALL LAND AREAS/BOUNDARIES
ARE APPROXIMATE.

0 200 400 600m
SCALE 1:20,000 AT ORIGINAL SIZE

N

THE RIVERVIEW GROUP
WEST BELCONNEN LANDFILL SITE
PRELIMINARY WORKS

EXISTING 500m TERRITORY PLAN BUFFER DISTANCE

GHD CLIENTS | PEOPLE | PERFORMANCE

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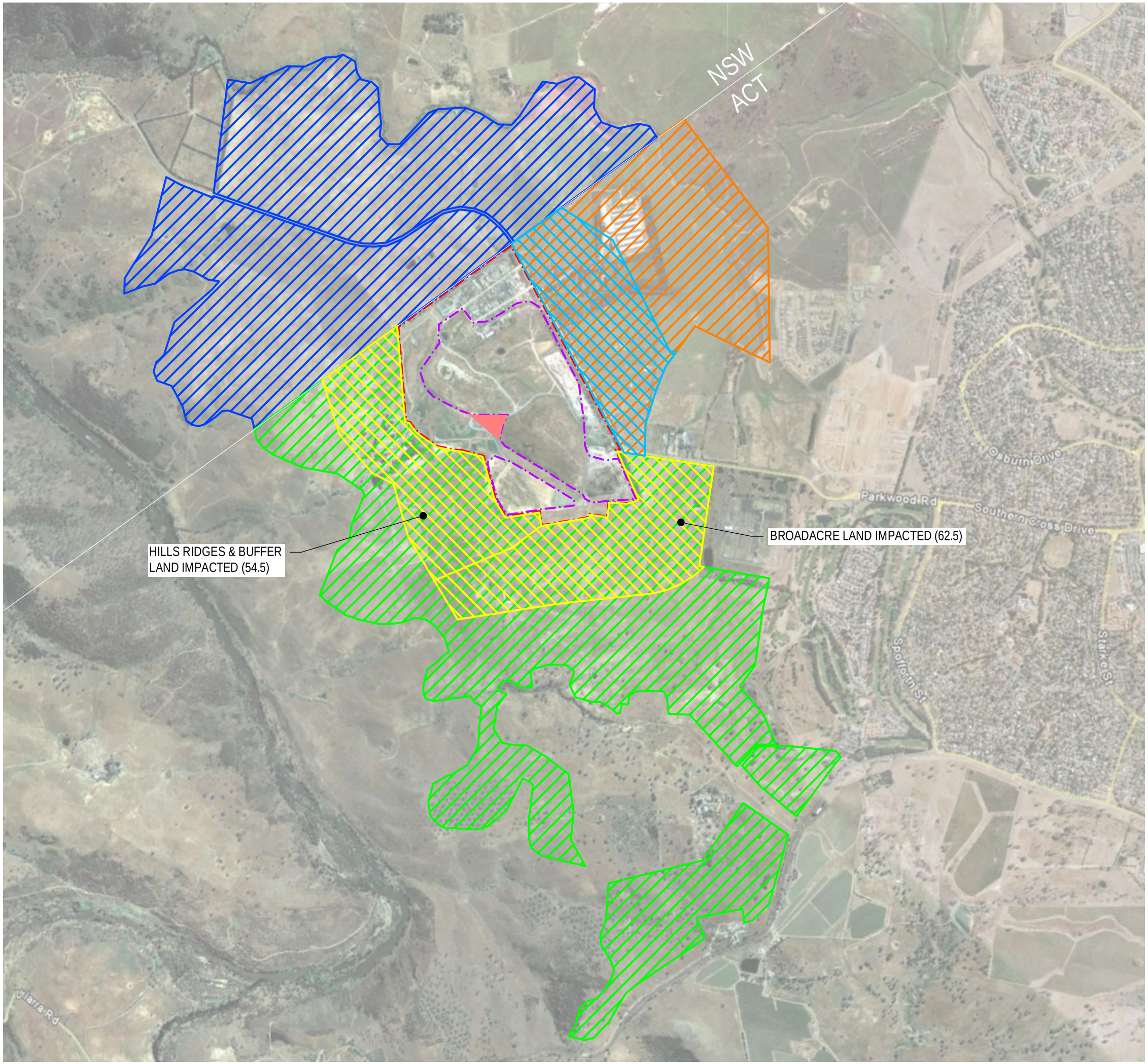
Revision | C
Date | FEB 2012

Figure 01

Plot Date: 7 February 2012 - 11:17 AM Plotted by: Adrian P Miller/Sydney/GHD/AU Cad File No: G:\21\20325\CADD\Drawings\21-20325-FIG01.dwg



LEGEND

	RIVERVIEW CONTROLLED LAND (ACT)	345.0ha
	RIVERVIEW CONTROLLED LAND (NSW)	264.3ha
	ACT GOVT. CONTROLLED LAND (ACT)	126.2ha
	RIVERVIEW CONTROLLED LAND IMPACTED	117.1ha
	ACT GOVT. CONTROLLED LAND IMPACTED	51.1ha
	EMERGENCY LANDFILL AREA	1.1ha
	SITE BOUNDARY	
	APPROX. EXTENT OF EXISTING WASTE	

Nb: ALL LAND AREAS/BOUNDARIES
ARE APPROXIMATE.

0 200 400 600m
SCALE 1:20,000 AT ORIGINAL SIZE

N

THE RIVERVIEW GROUP
WEST BELCONNEN LANDFILL SITE
PRELIMINARY WORKS

EPA VIC 500m BUFFER FROM EXISTING WASTE LIMIT

GHD CLIENTS | PEOPLE | PERFORMANCE

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Job Number	21-20325
Revision	C
Date	FEB 2012

Figure 02

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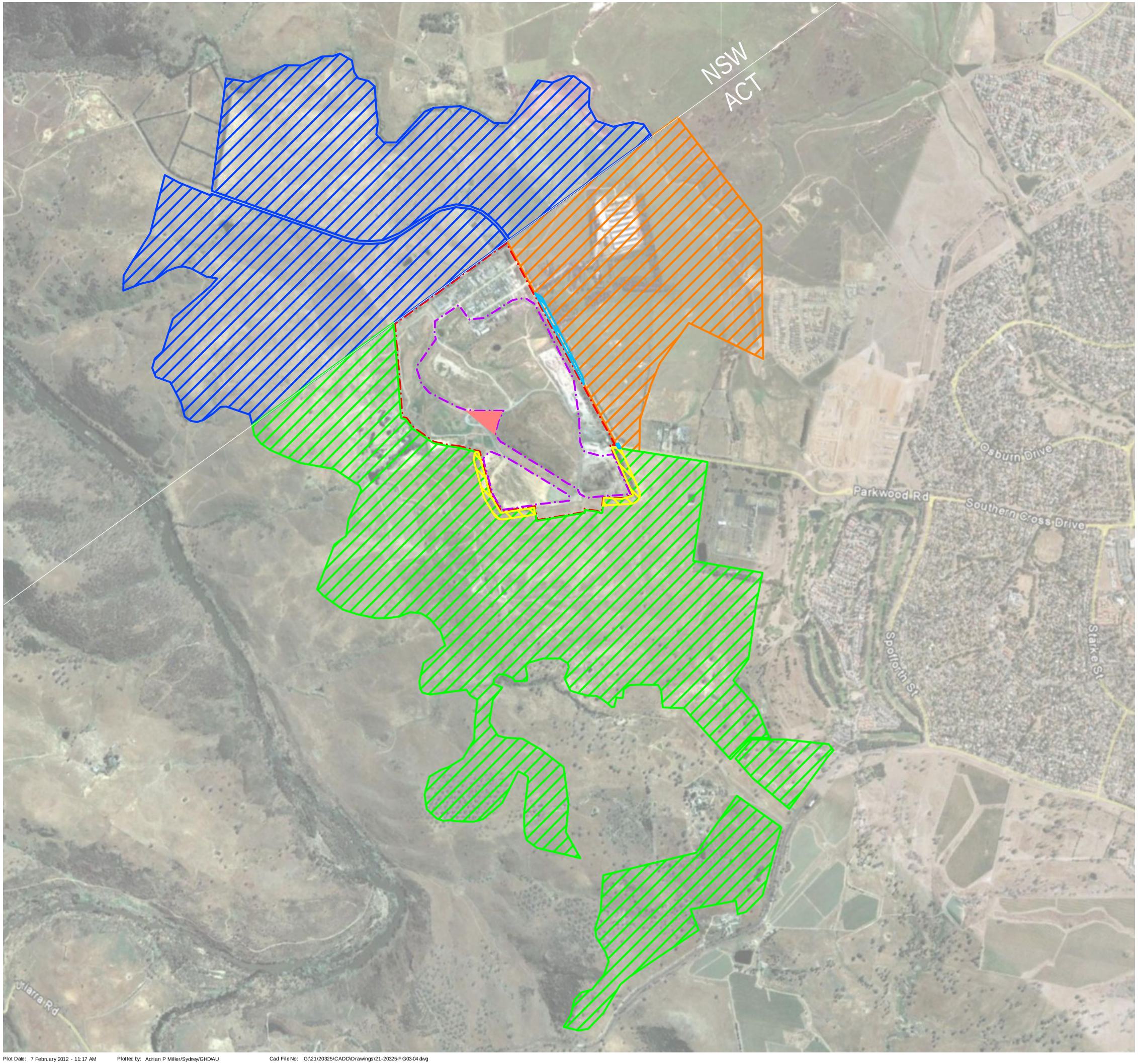

LEGEND

	RIVERVIEW CONTROLLED LAND (ACT)	345.0ha
	RIVERVIEW CONTROLLED LAND (NSW)	264.3ha
	ACT GOVT. CONTROLLED LAND (ACT)	126.2ha
	RIVERVIEW CONTROLLED LAND IMPACTED	3.6ha
	ACT GOVT. CONTROLLED LAND IMPACTED	0.9ha
	EMERGENCY LANDFILL AREA	1.1ha
	SITE BOUNDARY	
	APPROX. EXTENT OF EXISTING WASTE	

Nb: ALL LAND AREAS/BOUNDARIES
ARE APPROXIMATE.

0 200 400 600m
SCALE 1:20,000 AT ORIGINAL SIZE

N

THE RIVERVIEW GROUP
WEST BELCONNEN LANDFILL SITE
PRELIMINARY WORKS

EPA VIC 50m BUFFER FROM WASTE LIMIT

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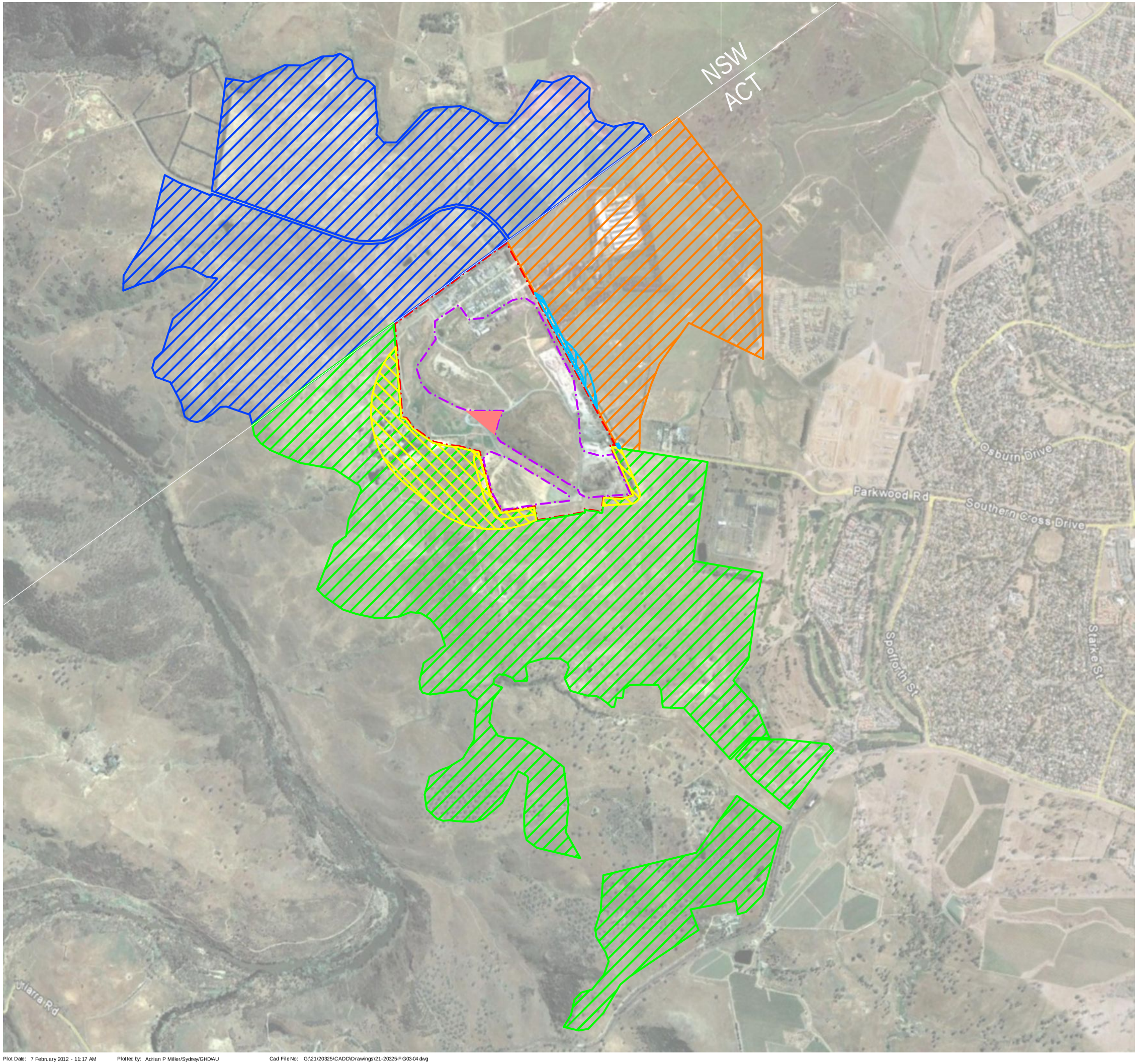
Job Number	21-20325
Revision	C
Date	FEB 2012

Figure 03

Plot Date: 7 February 2012 - 11:17 AM Plotted by: Adrian P Miller/Sydney/GHD/AU Cad File No: G:\21\20325\CADD\Drawings\21-20325-FIG03-04.dwg



LEGEND

	RIVERVIEW CONTROLLED LAND (ACT)	345.0ha
	RIVERVIEW CONTROLLED LAND (NSW)	264.3ha
	ACT GOVT. CONTROLLED LAND (ACT)	126.2ha
	RIVERVIEW CONTROLLED LAND IMPACTED BY EMERGENCY LANDFILL AREA	26.1ha
	ACT GOVT. CONTROLLED LAND IMPACTED BY EMERGENCY LANDFILL AREA	2.1ha
	EMERGENCY LANDFILL AREA	1.1ha
	SITE BOUNDARY	
	APPROX. EXTENT OF EXISTING WASTE	

Nb: ALL LAND AREAS/BOUNDARIES ARE APPROXIMATE.

NOTE: GREEN WASTE FACILITY WOULD HAVE 200m BUFFER DISTANCE. (THIS MAY BE INSIDE SITE BOUNDARY)

0 200 400 600m
SCALE 1:20,000 AT ORIGINAL SIZE

N

THE RIVERVIEW GROUP
WEST BELCONNEN LANDFILL SITE
PRELIMINARY WORKS

EPA VIC 50m BUFFER FROM WASTE LIMIT & EPA VIC 500m BUFFER FROM EMERGENCY LANDFILL WASTE LIMIT

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T 61 2 9239 7100 **F** 61 2 9239 7199
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Job Number	21-20325
Revision	C
Date	FEB 2012

Figure 04

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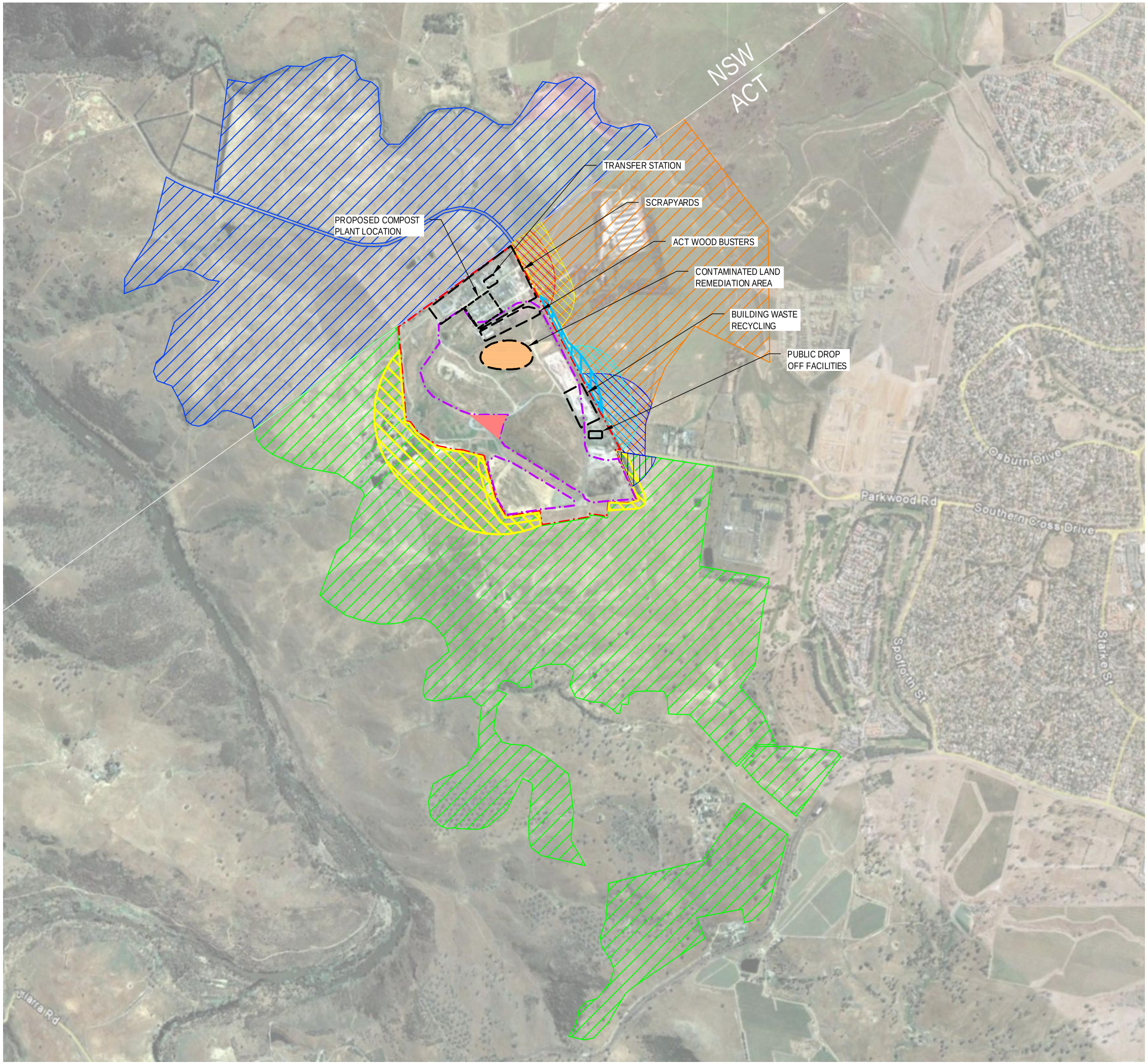

LEGEND

RIVERVIEW CONTROLLED LAND (ACT)	345.0ha
RIVERVIEW CONTROLLED LAND (NSW)	264.3ha
ACT GOVT. CONTROLLED LAND (ACT)	126.2ha
RIVERVIEW CONTROLLED LAND IMPACTED BY EMERGENCY LANDFILL AREA	26.1ha
ACT GOVT. CONTROLLED LAND IMPACTED BY EMERGENCY LANDFILL AREA	2.1ha
RIVERVIEW CONTROLLED LAND IMPACTED BY PUBLIC DROP-OFF AREA BUFFER (300m)	1.9ha
RIVERVIEW CONTROLLED LAND IMPACTED BY GREEN WASTE BUFFER (1275m)	231.0ha
ACT GOVT. CONTROLLED LAND IMPACTED BY PUBLIC DROP-OFF AREA BUFFER (300m)	8.8ha
ACT GOVT. CONTROLLED LAND IMPACTED BY GREEN WASTE BUFFER (1275m)	99.2ha
ACT GOVT. CONTROLLED LAND IMPACTED BY TRANSFER STATION BUFFER (300m)	4.6ha
ACT GOVT. CONTROLLED LAND IMPACTED BY SCRAPYARDS BUFFER (200m)	8.8ha
ACT GOVT. CONTROLLED LAND IMPACTED BY BUILDING WASTE RECYCLING BUFFER (200m)	8.8ha
RIVERVIEW CONTROLLED LAND IMPACTED BY CONTAMINATED LAND BUFFER (200m)	0.4ha
EMERGENCY LANDFILL AREA	1.1ha
SITE BOUNDARY	
APPROX. EXTENT OF EXISTING WASTE	
SITE FACILITY BOUNDARIES	
PROPOSED COMPOST PLANT LOCATION	

NOTES:

ALL LAND AREAS/BOUNDARIES ARE APPROXIMATE.
200m BUFFER DISTANCE FROM GREENWASTE PLANT IS ENTIRELY WITHIN SITE BOUNDARY IN ACT.
NO BUFFER REQUIRED FOR ACT WOODBUSTERS AS NON-OPERATIONAL.

TOTAL RIVERVIEW LAND IMPACTED:	29.8ha
TOTAL ACT GOVT. LAND IMPACTED:	20.6ha

0 200 400 600m
SCALE 1:20,000 AT ORIGINAL SIZE

N

THE RIVERVIEW GROUP
WEST BELCONNEN LANDFILL SITE
PRELIMINARY WORKS

EPA VICTORIA 50m BUFFER FROM EXISTING WASTE LIMIT & 500m BUFFER FROM EMERGENCY LANDFILL WASTE LIMIT

GHD CLIENTS | PEOPLE | PERFORMANCE

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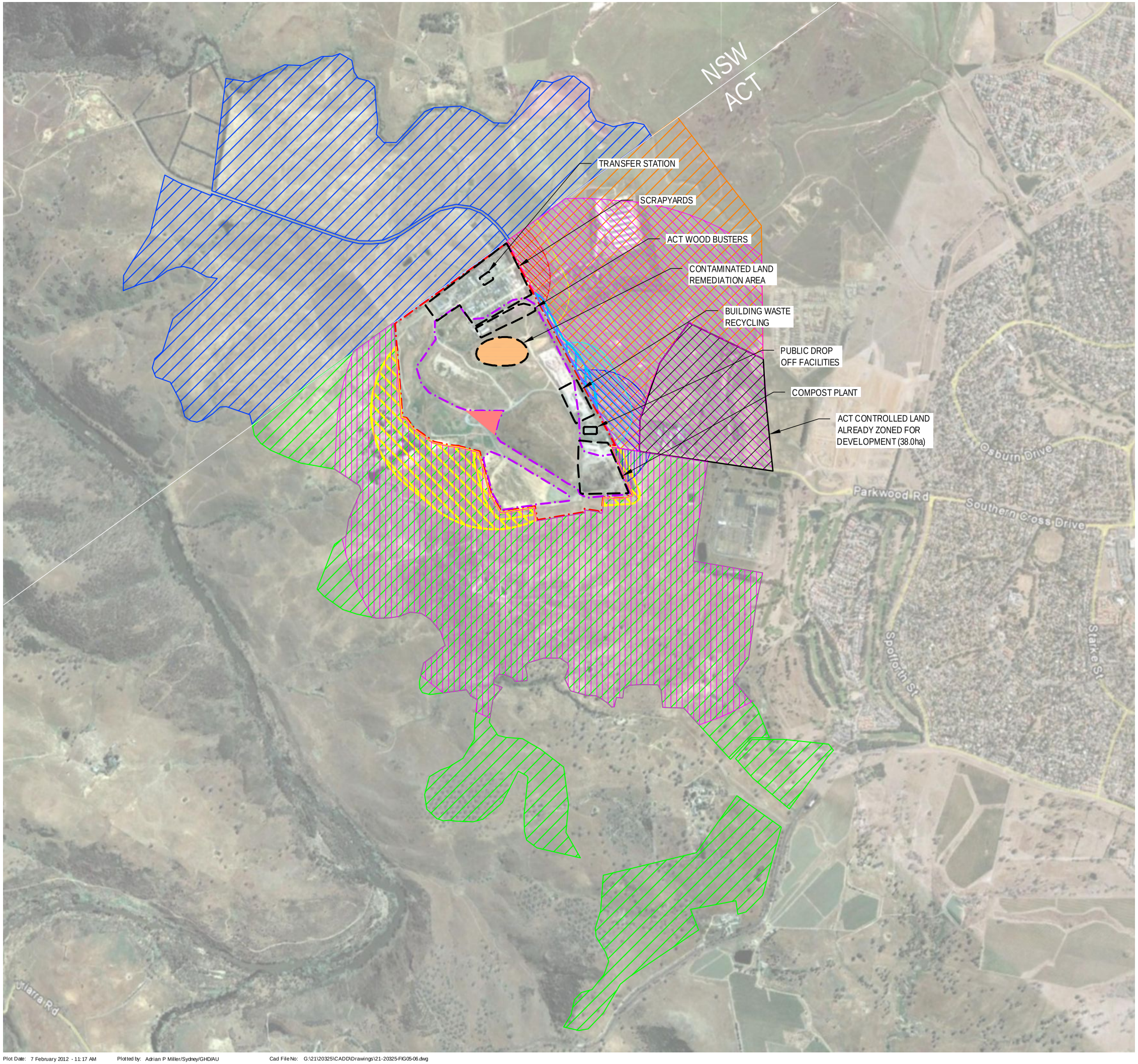
Date	FEB 2012

Figure 05

Plot Date: 7 February 2012 - 11:17 AM Plotted by: Adrian P Miller/Sydney/GHD/AU Cad File No: G:\21\20325\CADD\Drawings\21-20325-FIG05-06.dwg



LEGEND

RIVERVIEW CONTROLLED LAND (ACT)	345.0ha
RIVERVIEW CONTROLLED LAND (NSW)	264.3ha
ACT GOVT. CONTROLLED LAND (ACT)	126.2ha
RIVERVIEW CONTROLLED LAND IMPACTED BY EMERGENCY LANDFILL AREA	26.1ha
ACT GOVT. CONTROLLED LAND IMPACTED BY EMERGENCY LANDFILL AREA	2.1ha
RIVERVIEW CONTROLLED LAND IMPACTED BY PUBLIC DROP-OFF AREA BUFFER (300m)	1.9ha
RIVERVIEW CONTROLLED LAND IMPACTED BY GREEN WASTE BUFFER (1275m)	231.0ha
ACT GOVT. CONTROLLED LAND IMPACTED BY PUBLIC DROP-OFF AREA BUFFER (300m)	8.8ha
ACT GOVT. CONTROLLED LAND IMPACTED BY GREEN WASTE BUFFER (1275m)	99.2ha
ACT GOVT. CONTROLLED LAND IMPACTED BY TRANSFER STATION BUFFER (300m)	4.6ha
ACT GOVT. CONTROLLED LAND IMPACTED BY SCRAPYARDS BUFFER (200m)	8.8ha
ACT GOVT. CONTROLLED LAND IMPACTED BY BUILDING WASTE RECYCLING BUFFER (200m)	8.8ha
RIVERVIEW CONTROLLED LAND IMPACTED BY CONTAMINATED LAND BUFFER (200m)	0.4ha
EMERGENCY LANDFILL AREA	1.1ha
SITE BOUNDARY	
APPROX. EXTENT OF EXISTING WASTE	
SITE FACILITY BOUNDARIES	

NOTES:

ALL LAND AREAS/BOUNDARIES ARE APPROXIMATE.
NO BUFFER REQUIRED FOR ACT WOODBUSTERS AS NON-OPERATIONAL.
TOTAL RIVERVIEW LAND IMPACTED: 231.0ha
TOTAL ACT GOVT. LAND IMPACTED: 99.2ha
TOTAL ACT GOVT. LAND FOR DEVELOPMENT IMPACTED: 39.2ha

0 200 400 600m
SCALE 1:20,000 AT ORIGINAL SIZE

N

THE RIVERVIEW GROUP
WEST BELCONNEN LANDFILL SITE PRELIMINARY WORKS

EPA VIC RECYCLING/RESOURCE RECOVERY FACILITIES BUFFER DISTANCES

GHD CLIENTS | PEOPLE | PERFORMANCE

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Job Number | 21-20325
Revision | D
Date | FEB 2012

Figure 06

Plot Date: 7 February 2012 - 11:17 AM Plotted by: Adrian P Miller/Sydney/GHD/AU Cad File No: G:\21\20325\CADD\Drawings\21-20325-FIG05-06.dwg

Appendix E

CBRE Emergency Landfill Report

EMERGENCY LANDFILL OPTIONS PAPER

A REPORT PREPARED FOR

RIVERVIEW

CBRE
CB RICHARD ELLIS

Revision History

MID	Version	Date	Author	Reviewer
160888	Preliminary	25/02/11	KT	-
	Draft	07/03/11	KT	-

Contact Details
CB Richard Ellis Pty Ltd
Kip Tanner
PO Box 1987
CANBERRA ACT 2601

Contact No: 02 6232 2733

CONTENTS

1 Introduction

The former landfill site at Belconnen has been identified as a possible emergency landfill site. This report has been prepared to discuss the requirements of emergency landfill sites and to identify other potential sites that may be more suitable depending upon the location and nature of the emergency.

This paper focuses on sites that may be appropriate for use in the event of a declared state of emergency.

It is possible that some of the sites identified could also be suitable as short term optional landfill sites in the event that the ACT's primary landfill at Mugga is unavailable for unforeseen (but not declared emergency) reasons.

2 Emergency Management

Emergencies in the ACT are primarily managed under the Emergencies Act 2004. The objectives of this Act include:

- to protect and preserve life, property and the environment; and
- to provide for effective emergency management that has regard to the need to prepare for, prevent, respond to and recover from emergencies;

For the purposes of the Act, an emergency is defined as an actual or imminent event that requires a significant and coordinated response. Examples given include fire, flood, storm, earthquake, accident or explosion, epidemic or animal disease, or a shortage of electricity, gas, fuel or water.

The Act allows for the Chief Minister to declare a state of emergency for all or part of the ACT if he is satisfied that an emergency has happened, is happening or is likely to happen.

Upon declaring a state of emergency the Chief Minister must appoint a person to be the emergency controller.

The emergency controller has a range of functions that include:

- to manage the response to, and recovery from, the emergency by ensuring that entities dealing with the emergency are appropriately deployed; and
- to coordinate the disposition of other resources to manage the emergency.

For the purpose of managing a state of emergency, the emergency controller may:

- direct or prohibit the movement of people, animals or vehicles
- take control of property
- take possession of premises
- excavate land, form tunnels or construct earthworks, barriers or temporary structures,
- control, use, close off or block a drainage facility
- maintain, restore or prevent disruption of essential services.

The emergency controller may delegate these functions.

Importantly, the management role of the emergency controller operates despite any other Territory law. This gives the emergency controller the power to operate outside the requirements of the Territory Plan and other normal planning constraints.

3 Emergency Landfill

Emergencies tend to result in large quantities of waste that needs to be cleaned up quickly as part of the emergency response. Accordingly, depending upon the nature of the emergency, an emergency landfill site may be established by the emergency controller.

For example, in the cleanup of the 2003 bushfires a dedicated landfill was established in Stromlo Forest to facilitate the efficient and rapid clean-up of affected residential areas.

As the emergency controller is not constrained by Territory Laws, constraints such as the Territory Plan are not strictly relevant. It is reasonable however to identify a number of possible sites in anticipation of emergencies occurring to help the emergency controller in the event of an emergency, and to prevent poor decisions about landfill sites that could be made in haste in the event of an emergency.

An ideal emergency landfill site would be characterised by:

- being close enough to the site of the emergency to allow for efficient clean-up (a target distance of 5 kilometres might be appropriate)
- not being subject to ecological or heritage constraints
- not being on a significant drainage line

There are some areas that would not be appropriate to consider such as:

- potable water supply catchments
- current and future residential areas

Depending upon the nature of the material to be disposed of, other constraints or management considerations may also be appropriate. For example, putrescible waste may require a greater control of odour during transport and disposal.

Due to the need to identify potential sites that are close to the emergency, it is reasonable to identify sites that could potentially service each of Canberra's Districts.

4 Potential Sites

Based upon the discussion above, we have identified an area for consideration for emergency landfill sites that is generally:

- within 5 kilometres of the urban area
- not within a water supply catchment
- excludes current and future residential areas (based upon the Territory Plan) and areas zoned for high order uses (such as commercial or industrial)
- not within a nature reserve, proposed nature reserve or an area identified as woodland (other than severely modified) or natural temperate grassland

Within this area we have identified a number of sites that could be identified as possible emergency landfill sites pending the particular circumstance of the emergency. The sites are typically old quarries, pine forest areas or other previously disturbed sites that are not likely to be identified for higher value uses in the medium to longer term.

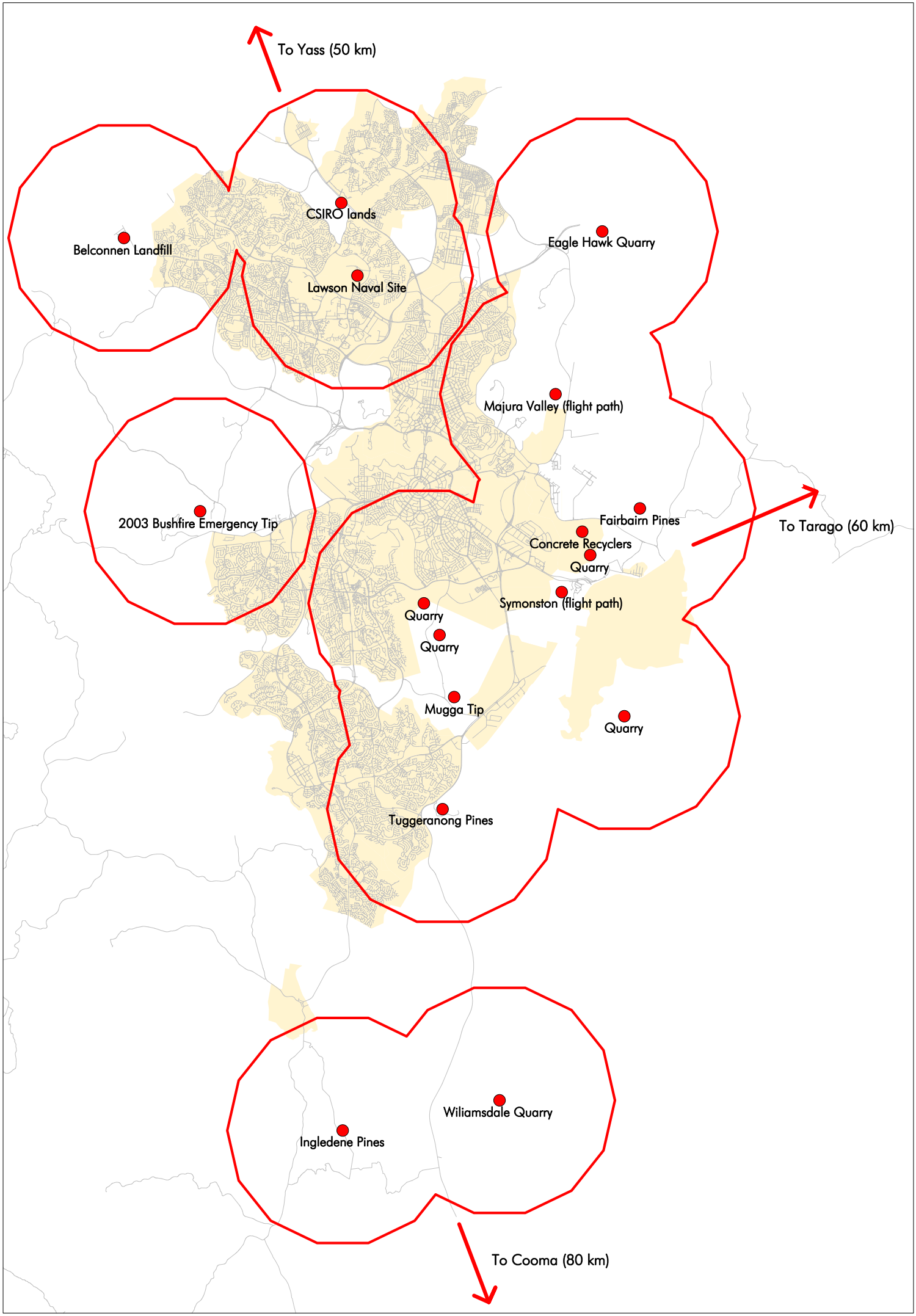
The sites are (from North to South):

- the CSIRO estate near the Barton Highway
- the former Belconnen Landfill site
- the quarry at Eagle Hawk
- the Lawson Naval Base
- Majura Valley on land sterilised by the flight path
- Fairbairn pines
- Stromlo Forest Park (former emergency landfill)
- the quarry and concrete recycling facility at Pialligo
- the old quarries on mugga hill
- the quarry at Googong
- Tuggeranong Pines
- the quarry at Williamsdale
- Ingledene Pines

In addition, the following existing landfill sites could be considered as they are currently capable of accepting municipal waste:

- the existing landfill at Mugga
- Yass (approximately 50 km north of Canberra)
- Cooma (approximately 80 km south of Canberra), or
- Woodlawn, Tarago (approximately 60 km east of Canberra by road or rail).

The following map demonstrates that there are a number of potential sites that provide good coverage of the urban area. Each site is presented with a 5 kilometre radius.


To Yass (50 km)
CSIRO lands
Belconnen Landfill
Lawson Naval Site
Eagle Hawk Quarry
Majura Valley (flight path)
2003 Bushfire Emergency Tip
Fairbairn Pines
Concrete Recyclers
Quarry
Symonston (flight path)
Quarry
Quarry
Mugga Tip
Quarry
Tuggeranong Pines
To Tarago (60 km)
Wiliamsdale Quarry
Ingledene Pines
To Cooma (80 km)

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