Part C
Environmental assessment

7. Identification and prioritisation of issues

7.1 Overview

The SEARs for the proposal specify that the EIS needs to identify the potential environmental impacts of the proposal and prioritise the key issues for further assessment.

This chapter provides the results of the identification and prioritisation of issues. The analysis was undertaken in the form of a preliminary, desktop level risk assessment, to broadly assess the potential environmental risks that may arise as a result of the proposal. The preliminary environmental risk assessment identifies and ranks potential proposal environmental risks with the aim of identifying potential impacts for detailed technical studies.

The outcome of the assessment was used to inform the scope of further work and investigations, as described in Chapters 8 to 22.

The detailed impact assessment chapters that follow this chapter consider a wider range of environmental issues than those identified in the SEARs, and address the issues identified by this preliminary risk assessment. SITA is committed to improving environmental outcomes by the application of best practice prevention, mitigation and rectification measures. A compilation of the proposed mitigation measures is provided in Section 24.2.

7.2 Risk assessment method

7.2.1 Impacts, risks and risk analysis

The proposal would result in impacts to the surrounding environment. An impact can be considered as any change to the environment either wholly or partially resulting from activities associated with the proposal. Impacts may either be beneficial to the environment and the community, or may give rise to changes that are considered less desirable. The events or activities that would lead to impacts that do not provide a benefit would require some level of monitoring, mitigation and/or management. The extent of management or monitoring required would depend on the level of risk that may be associated with the impact.

Risk is generally measured as the result of a combined consideration of:

- How likely is it that an impact would occur (‘likelihood’)
- What would be the outcomes if it did occur (‘consequence’)

The environmental risk assessment was undertaken with general consideration of (Australian Standards 2009b) ‘AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines’. This involves:

- Evaluating likelihood of occurrence
- Evaluating consequence
- Assigning a risk rating

7.2.2 Evaluating likelihood

The likelihood of an impact occurring can be described in terms of probability. Overlaying this is the need to recognise the uncertainty that may be associated with the potential impacts,

particularly during the initial risk assessment process. Where there is scientific uncertainty a cautious approach will identify a higher level of risk.

Each identifiable impact can be assigned a likelihood between remote and almost certain. In simplifying the possible impacts for the purpose of a risk assessment an element of subjectivity is introduced. The purpose of the risk assessment is not necessarily to agree on the probability of any particular impact, but to facilitate an understanding of the relative probability of different impacts.

To undertake the risk analysis for this proposal, potential risks were given a ranking between one and three with regard to the likelihood of it occurring (assuming that the proposal is designed and implemented with standard environmental controls) in accordance with the following definitions:

- Likelihood of occurrence:
  - 1 Lower: unlikely to occur.
  - 2 Medium: potential to occur.
  - 3 Higher: likely to occur.

7.2.3 Evaluating consequence

Assessing the consequences of a potential risk requires a degree of subjective assessment, as the likely consequences of an impact may consist of several elements. To undertake the risk analysis for the proposal, potential risks were given a number between one and three with regard to the perceived consequence if left unmanaged, in accordance with the following definitions:

- Consequence of unmanaged impacts:
  - 1 Lower: potential for insignificant to minor environmental change; localised implications; imperceptible or short term cumulative impacts; offsets readily available.
  - 2 Medium: potential for moderate adverse environmental change; regional implications; modest or medium term cumulative impacts; offsets available.
  - 3 Higher: potential for adverse environmental change; inter-regional implications; serious or long term cumulative impacts; offsets not readily available.

7.2.4 Risk rating

Based on the assessment of likelihood and consequence a foreseeable impact/risk can be assigned a risk rating. This enables higher rating risks to be identified early in the process for the purpose of focusing the environmental assessment process. The matrix shown in Table 7.1 was used to prioritise potential proposal environmental risks as either category A, B or C.

Table 7.1 Impact priority matrix

	Consequence		
Likelihood	3 Higher	2 Medium	1 Lower
3 Higher	*Category A*	*Category A*	*Category B*
2 Medium	*Category A*	*Category B*	*Category C*
1 Lower	*Category B*	*Category C*	*Category C*

Category A issues were considered the highest priority and were the main focus of the environmental impact assessment.

In general, the following was applied when scoping requirements for the environmental impact assessment:

- Category A issues – require detailed specialist investigations and field work, and were the highest priority to enable identification of appropriate management and mitigation options;
- Category B issues – desirable to undertake further investigations as part of the environmental assessment to address some uncertainties; and
- Category C issues – may not require detailed specialist investigations, particularly where identifiable management/mitigation guidelines exist, only broad or desktop investigations were undertaken.

7.3 Assessment results

The preliminary risk assessment for the proposal involved:

- Identifying potential environmental issues (listed below)
- Identifying potential key risks (or impacts) associated with each of these potential issues
- Evaluating the likelihood of occurrence and consequence in accordance with the definitions provided in Section 7.2
- Assigning a risk ranking/priority using Table 7.1
- Deciding on a response – it was decided that a specialist study would be undertaken for any overall issues which included a risk ranking of category A or B.
- The potential environmental issues associated with the proposal that require further assessment were considered to include (in no particular order):
  - Air quality
  - Surface water and soils
  - Ground water
  - Leachate
  - Biodiversity
  - Traffic and transport
  - Noise
  - Hazards and risk
  - Visual
  - Land use
  - Waste management
  - Post closure

Table 7.2 provides the results of the preliminary environmental risk assessment for the proposal. It includes:

- A summary of the potential issues and potential key risks (columns 1 and 2);
- Likelihood of occurrence and consequence (columns 3 and 4);
- The risk ranking/prioritisation categories that were assigned (column 5); and
- A comment regarding the findings of the assessment (column 6).

Post closure risks are identified within the Parkland, Future Use and Post Closure Management report (Appendix R) and the LHRRP post closure EMP (Appendix V).

Table 7.2 Results of risk assessment and prioritisation of environmental issues

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
Air quality	Dust emissions from construction activities and ongoing operations causing nuisance to sensitive receptors.	Medium	Medium	B	Some dust emissions would be generated during earthworks and general construction activities. The proposal has potential to generate odour from a number of activities including receival of waste, composting/processing of waste, ongoing landfill operations (including reprofiling). The proposal incorporates features in the design and operation to reduce potential odour impacts including process controls, odour controls (biofilters), enclosure or partial enclosure of odourous activities and additional odour management techniques. Therefore, despite an increased overall throughput of waste to the LHRRP, odour impacts are expected to reduce. The SEARs have also identified this as a key issue requiring assessment. Potential air quality impacts including both dust and odour are considered in Chapter 12.
	Odour emissions from waste, raw material, leachate, compost or finished product at levels that exceed odour limits and affect sensitive receptors.	Higher	Medium	A	
Surface water and soils	Erosion and sediment and surface water quality impacts during construction leading to contamination of surface water	Medium	Medium	B	There is potential for erosion and sedimentation during construction. However appropriate mitigation measures would be implemented to reduce the potential for off-site impacts. The proposal has potential for erosion and sedimentation during operation from run-off from disturbed areas. Appropriate stormwater management controls are proposed to manage surface water run-off. The SEARs have identified soil, water and leachate as a key issue requiring assessment. Potential surface water and soils impacts are considered in Chapter 13. Contamination is considered in Chapter 16.
	Erosion and sediment and or other surface water quality impacts during operation	Medium	Medium	B	
	Flooding impacts	Medium	Medium	B	
Groundwater	Impacts on groundwater quality, availability and groundwater elevations from operation of the proposal	Medium	Medium	B	As a result of landfill reprofiling there is potential for changes to rainfall infiltration and groundwater recharge. There is also potential for similar or reduced leachate generation. The construction of the ARRT and GO facilities also

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
					have potential to create 'dirty' water which may migrate to underlying groundwater systems (or surface water systems). However a number of mitigation measures would be implemented to effectively minimise any potential groundwater impacts. The SEARs have identified soil, water and leachate this as a key issue requiring assessment. Potential groundwater impacts are considered in Chapter 14.
Leachate	Changes to leachate generation leading to migration of leachate to groundwater or surface water.	Medium	High	A	Leachate generation is expected to reduce as the landfill is progressively reprofiled and improved capping is installed. However an assessment of leachate would be required to assess the capacity of the proposed leachate management system. The SEARs have identified soil, water and leachate as a key issue requiring assessment. Leachate is considered in Chapter 15
Heritage	Encounter and disturb items of European or Aboriginal cultural heritage during construction and operation	Lower	Lower	C	The proposal would occur on previously landfilled and or disturbed areas with limited potential for heritage impacts. Heritage searches identified that four Aboriginal heritage items on the proposal site, but as part of past approved development they were given consent for destruction and destroyed in accordance with the specific approval conditions. Some existing vegetation (*Eucalyptus squamosal* and *Eucalyptus paniculata*) is identified on Sutherland Local Environmental Plan 2006 as having heritage values. Only a very small part of this item is located within the north-eastern tip of the LHRRP site. This vegetation would not be impacted by the proposal. No other non-Aboriginal listed heritage items exist on the LHRRP or in the surrounding area. The SEARs have identified this as a key issue requiring assessment. This issue has been considered in Section 22.1.
Biodiversity	Effects on threatened or vulnerable species through	Medium	Medium	B	Most of the proposal site is located on land which has been impacted as a result of the development of the

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
	removal of vegetation and destruction of habitat.				existing landfill and therefore there is limited vegetation across the majority of the proposal site. However there would be some vegetation clearance as a result of construction of the proposed ARRT and GO facilities on the western side of the proposal site.
	Impacts on aquatic ecology in Mill Creek due to surface water or contamination from proposal operations.	Medium	Medium	B	The potential for contamination of surface water and or groundwater due to proposal operations is addressed in the surface water assessment (Chapter 13). The SEARs have identified this as a key issue requiring assessment. This issue has been considered in Chapter 19
Traffic and transport	Increase in traffic during construction and or operation affecting the operation of local roads.	Medium	Medium	B	Traffic would increase as a result of operation of the proposal. However the overall traffic increase on New Illawarra Road and Heathcote Road is expected to be minimal, and the road network is expected to have the capacity to deal with the increase. The SEARs have also identified this as a key issue requiring assessment. Potential traffic impacts are considered in Chapter 9.
Greenhouse gas	Emissions from fuel use in construction equipment and electricity use, mobile equipment and transport significantly contributing to global warming.	Lower	Lower	C	The proposal would have a power demand and fuel demand for operation of the GO facility and ARRT facility. The landfill operations would also require a small increase in fuel consumption during some years. However, the proposal would increase the processing capacity of the GO facility and provide 200,000 tonnes per year processing capacity at the ARRT facility. Diversion of organics out of landfill reduces potential greenhouse gas emissions. The SEARs have also identified this as a key issue requiring assessment. Potential greenhouse gas impacts are considered in Chapter 21.
Noise	Noise emissions from site activities during construction affect sensitive receptors	Medium	Medium	B	The proposal has potential to have noise impacts during the construction of the GO facility and ARRT facility. However construction activities would be short-term given the proximity of the proposal site to sensitive receivers, the impacts are not expected to be significant.

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
	Noise emissions during operation exceed noise limits and affect sensitive receptors.	Lower	Medium	C	There would be an increase in traffic to the LHRRP and additional plant and equipment operating at the proposal site. The ARRT facility activities would be undertaken within buildings, however activities at the GO facility would be undertaken outdoors. Hence there is potential for some increased noise emissions. However given the proximity of the proposal site to sensitive receivers, the proposal is not expected to have any significant operational noise impacts. The SEARs have also identified this as a key issue requiring assessment. Potential noise impacts are considered in Chapter 10.
Pests, vermin and noxious weeds	Operation of the proposal leading to a spread of noxious weeds or pathogens in the local area or in products.	Lower	Medium	C	At both the ARRT facility and GO facility, the regular monitoring of temperature within the compost is expected to result in composting conditions that would ensure that the resulting compost is free of pathogenic organisms.
	Operation of the proposal attracting pests and vermin, resulting in a nuisance to nearby sensitive receptors.	Lower	Medium	C	The ARRT facility operations would take place within buildings, and the GO facility would not receive food organics. Hence the likelihood of large numbers of pests and vermin being attracted to the operations would be minimal. The SEARs have not identified this as a key issue requiring assessment. This issue has not been assessed further.
Hazards and risk	Dangerous or hazardous materials or scenarios causing harm to the environment or people. Including: • Spills • Receipt of hazardous substances such as gas bottles and chemicals • Lead shot from SICTA land and proximity to SICTA boundary • Compost or landfill fire	Medium	Medium	B	No significant hazards with the potential for offsite impacts are expected. The proposal would not change the potential for hazards and risk significantly at the landfill beyond current operations. Existing controls and procedures would be updated to reflect this and applied to ensure hazards and risks continue to be managed. The stockpiling of larger quantities of compost at the GO facility and within the ARRT facility would slightly increases the potential for fire. New controls and procedures would be put in place for

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
	• Exposure to dust, bio-aerosols or bio-hazardous material • Vehicle interactions, falls, trips, entanglement and other WHS risks				the ARRT facility to address potential hazards and risks. The ARRT facility would be located within the existing SICTA boundary and within proximity of operations at the shooting range. Fire risks are addressed in Chapter 18. The SEARs have also identified this as a key issue requiring assessment. Potential hazard and risks are considered in Chapter 17.
Visual	Visibility of the proposed facilities reducing the amenity of nearby sensitive receptors.	High	Medium	A	Part of the ARRT facility and GO facility are expected to be visible from Heathcote Road. The final maximum height of the landform would be higher than the currently approved landform at the highest point. This increase in height would be visible from some surrounding areas. The proposal includes an interim landscape plan with vegetation screening to mitigate against potential visual impacts. The SEARs have identified this as a key issue requiring assessment. Potential visual impacts are considered in Chapter 11.
Utilities and infrastructure provisions	Utilities demand exceeds supply available and places a burden on existing infrastructure.	Lower	Lower	C	The capacity of the existing supply wires and transformers, and of the district supply infrastructure is currently being verified. If necessary, required upgrades would be implemented. On site sewage package treatment plant or a storage tank with pump out capacity would be provided. This is not considered a key issue. It has not been identified as a key issue in the SEARs.
Socio-economic	Amenity impacts during construction and operation. Employment during	Medium Medium	Lower Lower	C C	There is potential for some amenity impacts during construction and operation of the proposal. These are addressed in various specialist studies and chapters of the EIS. The proposal includes design features and mitigation measures to reduce the potential for amenity impacts. The proposal would generate around 112 new jobs

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
	construction and operation.				during operation and 50 during construction.
Land use	Construction impacts to adjacent and nearby land uses Operational impacts to adjacent and nearby land uses	Medium	Medium	B	The ARRT facility would extend into the southern portion of existing SICTA gun club area. The SEARs have identified this as a key issue requiring assessment. Potential land use impacts are considered in Chapter 20.
Final land use	Landfill gas and or leachate impacting on the community or vegetation	Lower	Medium	C	There is potential for landfill gas and or leachate during parkland operations to impact on the community Hazards associated with final land use are assessed in Appendix L.
Fire	Large scale bushfire impacting the proposal facilities over the course of the proposal life. Landfill, compost or ARRT facility fire causing damage to property.	Medium Medium	Medium Medium	B B	There is potential for bushfire to impact the facility given the proximity of large areas of vegetation and forest, with risk of damage to property and life. There is also risk of fire internal to the proposal facilities or landfill with potential to cause damage to property. Fire management and prevention are considered in Chapter 18.
Waste management	Potential impacts associated with treating, storing, using and disposing of waste and waste products.	Medium	Medium	B	The proposal would including the handling storage and disposal of a number of waste streams. The proposal design incorporates a number of measures to mitigate against potential impacts associated with the storage, handling and disposal of waste. Waste management is considered in detail in Chapter 8.
Litter and illegal dumping	Litter from proposal operations and from transport of waste to the proposal site impacting on the environment and amenity of the surrounding area.	Medium	Lower	C	There would be potential for windblown litter. However SITA would continue to implement and improve management/mitigation of litter with existing and proposed measures. Litter and illegal dumping are addressed in Section 22.3.

8. Waste management

This chapter provides information of the likely waste streams that would be handled, stored and disposed of at the proposal site, details of the location and size of stockpiles of waste and products, details of the landfill cell design and integrity and an overview of the waste processing and quality control measures. Impacts associated with the treatment, storage, use and disposal of waste are considered in the other impact assessment chapters. The proposal consistency with the NSW Waste Avoidance and Resource Recovery Strategy is assessed in Section 5.2.

8.1 Impact assessment

8.1.1 Construction

The following wastes may be generated during construction:

- Construction material including spoil/fill
- General waste from site personnel (such as food scraps, aluminium cans, glass bottles, plastic and paper containers, paper, cardboard and other office wastes)
- Paints and solvents
- Wastewater and sewage from site compounds.

The management of wastes generated during construction would be in accordance with relevant NSW legislation and the principles of the waste management hierarchy set out in the NSW Waste Avoidance and Resource Recovery Strategy 2014-21 (EPA 2014a). Any excess cut from construction of the GO facility or ARRT facility would be stockpiled on the proposal site for future engineering applications at the landfill.

8.1.2 Likely waste streams, classifications and quantities

Table 8.1 provides a summary of the proposed waste streams and quantities expected to be received at the proposal site and proposal components.

Table 8.1 Proposed incoming waste streams and quantities

Activity	Proposed (t/yr)
Reprofiling (landfill disposal)	850,000
GO facility	80,000*
Resource recovery centre and waste collection point	10,000**
ARRT facility	200,000
Maximum waste received at each facility	1,135,000
Less internal transfer:	
ARRT residue to landfill	60,000
GO facility and RRC waste to landfill	8,000
Resource recovery centre waste to GO facility	2,000
Maximum waste received at LHRRP	1,070,000

* This does not include approximately 37,000 tonnes of imported blending materials
**All waste received is removed from the RRC and either
- Recycled and removed from site (e.g. paints, batteries etc.)
- Delivered to the GO for processing, or
- Disposed to landfill

Note: The quantities of each of the above will be determined by the waste types delivered to the RRC.

The maximum waste input rate would change over time and the stated maximum input rate of 1,070,000 tonnes per year is subject to the operation of the ARRT facility and GO facility at full capacity. When the ARRT facility becomes operational approximately 60,000 tonnes per year of unrecoverable waste from this facility would be landfilled (i.e. used for reprofiling the proposal site). The GO facility and RRC would generate very small quantities of waste not suitable for composting or recycling and this residual waste[5] would also be landfilled (in the order of 5,000 tonnes per year).

Table 8.2 lists the likely waste classifications of incoming waste streams according to the EPA (2014b) 'Waste Classification Guidelines – Part 1: Classifying Waste'.

Table 8.2 Likely waste classification of incoming waste streams

Activity	Waste stream	Classification
GO facility	Garden organics	General solid waste (non-putrescible)
ARRT facility	Source separated food and garden organics	General solid waste (putrescible)
	Mixed waste	General solid waste (putrescible)
	Biosolids	General solid waste (non-putrescible)
Reprofiling (landfill disposal)	Municipal solid waste	General solid waste (putrescible)
	Dry waste (e.g. commercial, small vehicle drop off, council clean up)	General solid waste (non-putrescible)
	Asbestos	Special waste
Resource recovery centre and waste collection point	Dry waste (e.g. batteries, crushed sandstone, metals, oils, paint, paper, plastics, containers, shredded timber)	General solid waste (non-putrescible) Special waste Hazardous waste
	Garden organics	General solid waste (non-putrescible)

In addition to the above incoming waste streams, the GO facility would receive up to 2,000 tonnes per year of turkey manure compost and 35,000 tonnes per year of sand for blending purposes.

As discussed in sections 6.3.6 and 6.4.2, an onsite sewage package treatment tank or a storage tank with pump out capability would be provided to manage wastewater from amenities facilities at the GO facility and ARRT facility. The wastewater (partly treated or untreated) would be tankered to an external waste water treatment plant for disposal.

8.1.3 Storage and handling

Chapter 6 describes the proposed layout for the GO facility and ARRT facility in detail. A brief overview of how waste would be handled at each facility and stored on site is provided below.

GO facility

Following weighing, trucks would unload incoming garden organics in the waste reception/sorting/preparation area. This area has been sized to store the equivalent of three

[5] The residue from decontaminating the incoming garden organics waste generally contains glass, plastic, textiles, etc and would be disposed of on site if it meets the classification of general solid waste or as otherwise stipulated in the EPL or it would be removed off site to a facility which can lawfully receive the waste.

days of incoming green waste during peak periods, and one week during normal periods. The layout of the GO facility and location of the reception/sorting/preparation area is shown on Figure 6.11. More detail would be provided at the detail design stage, following approval.

Following sorting, shredding and screening, the material would separated into a fine fraction which would undergo composting and a coarse fraction which would be used to produce mulch (or biomass for energy production).

Mulch would be stored in stockpiles in the mulch storage area.

Material that has been composted in the concrete bunkers (for four weeks) would then undergo maturation for a further eight weeks. This would occur in the maturation area and regularly turned. Material would be transferred between bunkers to the maturation area by front end loader.

Once material has completed maturation it would be screened and blended as required and stored in a dedicated area. The storage pad has been designed for a five month storage capacity. During this phase the compost is stable and as a consequence, no turning is planned.

Dispatch from the GO facility would be by truck and occur as quickly as possible after blending is complete.

ARRT facility

Waste would be delivered to the ARRT facility predominantly by trucks with enclosed ‘walking floor’ trailers. Up to 10,000 tonnes per annum of biosolids would be transported in enclosed tanker trucks and processed entirely enclosed ARRT facility. Material would be directed to the receivals/processing building once it has been accepted at the weighbridge. This building would be enclosed and operate under a negative pressure environment maintained by ventilation fans and high-speed roller doors.

Material handling within the ARRT facility process would occur via a combination of skid steers, loaders and a variety of conveyors.

Finished product ready for market would be stored within the composting halls/storage building before being transported off-site in trucks.

Residuals from the ARRT facility would be stored temporarily in skip bins within buildings at the ARRT facility and then periodically transferred to the landfill.

Landfill

Waste would be delivered in a variety of vehicle types.

Once passing over the weighbridge, transfer trailers, council vehicles and larger private vehicles would be directed to the landfill working face. Mechanically unloaded vehicles and hand unloaded vehicles would be separated at the working face. Special wastes would be received at a designated area of the working face.

Small vehicles would be directed to the resource recovery centre and waste collection point.

Waste would be deposited in the landfill would be spread and compacted in layers. At the end of each working day all exposed waste surfaces would be covered with a layer of compacted soil or other suitable materials (daily cover).

Where filled areas have not reached the final landform level but will remain inactive for an extended time (longer than 90 days), an intermediate covering layer would be applied.

The final cover, including capping layer would be progressively constructed as soon as practicable after reaching final landform levels.

Resource recovery centre and waste collection point

The resource recovery centre and waste collection point currently accepts pre-sorted recyclable materials. This practice would continue.

The centre contains separate bins for the acceptance of glass containers, aluminium and steel cans, plastic containers, paper and cardboard and batteries.

Sump oil and scrap metal would be collected in outdoor containers. Gas bottles and fire extinguishers would also continue to be collected at separate undercover enclosures and taken away by contractors for venting and reuse or reprocessing.

Outdoor facilities would continue to be provided for tipping separated wastes such as building materials, garden waste and untreated wood.

Materials collected at the resource recovery centre and waste collection point would be dispatched by truck to appropriate organisations offsite for recycling or may be processed and used on site for construction purposes.

8.1.4 Details of stockpiles

The ARRT facility would be enclosed and no stockpiles of incoming waste or product would occur outdoors. The GO facility would include a number of outdoor stockpile areas. These would include the waste reception/sorting/preparation area, maturation area, mulch storage area and blending and finished product storage areas. The locations and sizes of these areas are shown on Figure 6.11.

The waste reception/sorting/preparation area would be approximately 2,620 m^2 and would provide around three days incoming waste storage capacity and space for shredding and preparation of material prior to composting. Stockpiles in this area would be approximately 5 m in height.

The mulch stockpile area would be approximately 1,950 m^2 with space for two months storage of mulch to a height of around 5 m.

The maturation area would include space for five maturation windrows of dimensions 50 m x 20 m with an approximate height of 3 m. This would provide two months storage space for maturing compost.

The compost storage area would be used for finished compost (following maturation) and provide space for seven windrows of dimensions 50 m x 20 m with an approximate height of 5 m.

A small area (approximately 400 m^2) for blending materials would be provided adjacent to the finished product storage area.

8.1.5 Landfill cell design and integrity

The design of the leachate collection and extraction systems have evolved as the landfill has developed. A series of five stages have been identified, as illustrated in Figure 8.1.

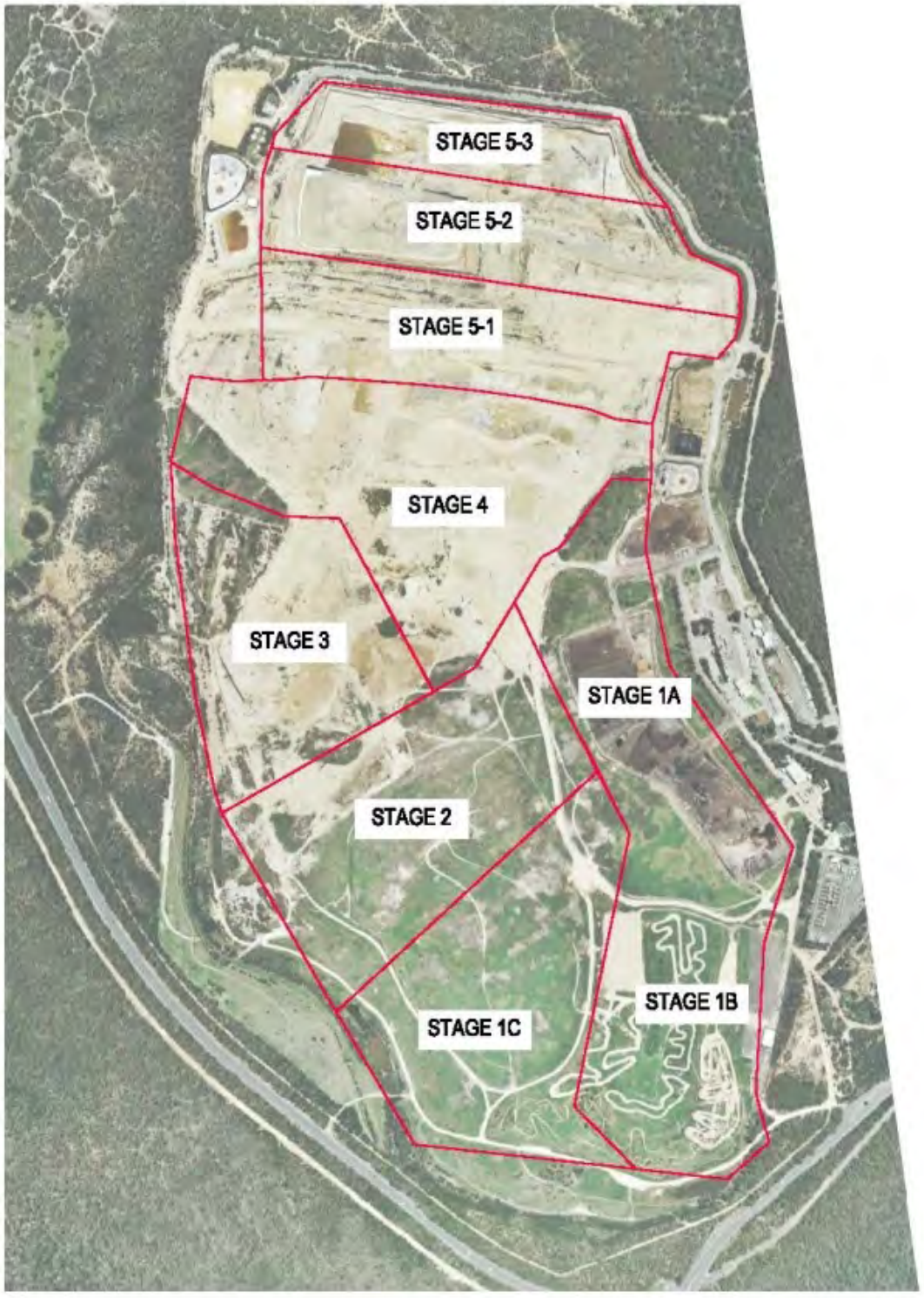


Figure 8.1 Layout of landfill stages

The system provides extraction within each stage and has been constructed in such a way that excess leachate can flow from one stage into the next, with the base level of Stages 1 – 4 known to be located at a higher level than Stage 5-1. The result is a system where all leachate can travel to the double-lined sump located in Cell 5.3A (see Figure 8.2).

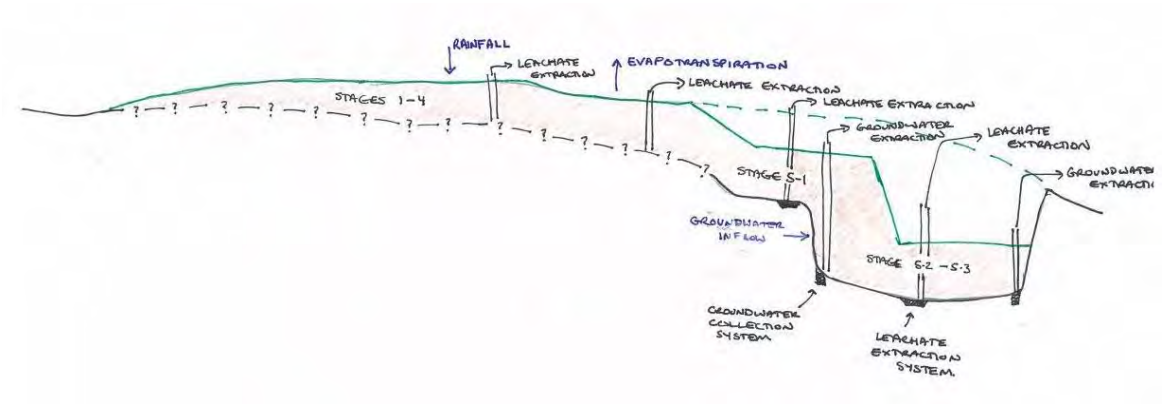


Figure 8.2 Conceptual cell arrangement

The leachate containment and collection system varies throughout the LHRRP as described below:

Stages 1-3

Stages 1 to 3 were constructed and filled throughout the late 1980s and 1990s. Leachate is substantially contained above the natural low permeability sandstone that underlies the site.

Leachate is collected through 300 mm concrete slotted leachate drainage pipes on the floor of the landfill under the waste that run from the south end of the site to the leachate dam situated in the north western corner of the site.

Leachate collection is facilitated by the construction of leachate collection trenches that have a maximum spacing of 100 m and are arranged in a grid layout. This minimises the potential for leachate to perch within waste lifts. The trenches are graded at 1% and drain to the boundary bund where a second leachate trench directs the leachate through a 300 mm slotted HDPE leachate collection pipe and to the leachate dam.

Leachate collection trenches also help eliminate ponding of leachate on the covered waste and evenly distribute the leachate through the waste layers enhancing leachate absorption and waste decomposition.

Following the 1999 expansion approval and prior to overtopping of Stages 1-3 with waste, a series of two metre diameter holes were excavated through the existing cover material into the waste. Vertical, slotted leachate re-injection pipes were inserted into the holes and backfilled with rubble.

In areas of where waste overtopping occurred additional leachate drains were constructed around the perimeter to collect leachate and gravity feed it to the leachate dam.

Stage 4

Stage 4 was constructed and filled from the mid-1990s. Containment in Stage 4 is via the natural low permeability sandstone.

Leachate is managed via a set of leachate pipes laid within every lift of waste (inter-lift leachate extraction). The leachate collection pipes connect to a main HDPE leachate pipe servicing the eastern side of Stage 4 via a vertical riser, which then flows to the leachate dam.

Stage 5 – Cell 5.1 and Cell 5.2A

Cell 5.1 and Cell 5.2A were generally developed in accordance with the benchmark techniques outlined in EPA (1996) ‘Guidelines for Solid Waste Landfills’ in approximately 2010, prior to SITA operating the site.

The leachate barrier for these cells consist of a 900 mm thick engineered clay layer with 10-9 m/s permeability sitting on an engineered subgrade layer underlain by the naturally low permeability sandstone base.

The leachate extraction system includes HDPE leachate pipes surrounded by 500 mm of protective aggregate ranging between 20-40 mm constructed within each waste lift. The leachate pipes connect to leachate main risers from which the leachate is pumped to the leachate dam.

In addition to inter-lift leachate collection, leachate is conveyed through parallel basal leachate collection trenches, typically spaced at 50 m and draining west at a grade of 1%.

In Cell 5.2A, the base of the landfill liner was graded with a longitudinal grade of 1% and a transverse grade of 0.5%.

Stage 5 – Cell 5.2B and Cell 5.3

Cell 5.2B and Cell 5.3A have been constructed by SITA since taking over the operations at the LHRRP. These cells have been constructed with groundwater, leachate barrier and leachate collection systems and exceed the recommended environmental measures in the EPA's 'Environmental Guidelines: Solid Waste Landfills' (1996) benchmark techniques. The remainder of Cell 5.3 will be constructed as the landfill airspace is required and in accordance with the proposed staging of the reprofiling works (reference). Cell 5.3B will be constructed to the same standard as Cell 5.3A, with Cell 5.3B being constructed by SITA in 2015.

The leachate barrier for these cells consists of 900 mm low permeability compacted clay overlain by 2.5 mm HDPE geomembrane (double liner). The leachate barrier system is continuous along the base and the sidewalls of these cells, to 10 m above the base of the cells and above this height the leachate barrier will consist of the 900 mm low permeability compacted clay liner in accordance with the EPA's requirements.

The additional geomembrane barrier was voluntarily installed by SITA. For the recent cell 5.3A, SITA also voluntarily undertook arc testing of the geomembrane prior to the placement of the leachate drainage aggregate and a further geomembrane liner leak detection (dipole) survey was undertaken following installation of the aggregate to confirm the integrity of the installation of the geomembrane.

The double lined design adopted by SITA exceeds the NSW EPA guideline for landfill liner systems and provides significantly more environmental protection.

The entire base contains a 300 mm blanket of leachate drainage aggregate and perforated HDPE leachate collection pipes placed within aggregate filled trenches. To promote leachate drainage over the lined sidewalls, a tri-planar drainage geocomposite was installed over the sidewall liner.

A groundwater collection system was installed as part of the construction of Cell 5.2B and Cell 5.3A. To err on the side of conservatism, the water being collected and extracted from this system is pumped to the landfill leachate dam for storage, treatment and disposal.

The groundwater system is constructed below the liner system and protects the liner from possible uplift damage from the groundwater below. It comprises of trenches cut into the natural rock subgrade which drain to sumps located along the western boundary of the cells. These trenches contain perforated pipe and are backfilled with aggregate to promote flow to the sump, from which any collected water can be extracted for treatment and disposal. Three separate systems have been installed - one below the interface between Cell 5.2 and Cell 5.2B, one around the perimeter of the base of Cell 5.2B and one around the perimeter of the base of Cell 5.3A. These systems were designed and constructed as hydraulically independent systems to minimise mixing of different water sources.

GHD was engaged to undertake the Construction Quality Assurance works for the construction of Cell 5.2 and Cell 5.3A and verify that the constructed works were undertaken in accordance with design documentation and EPL conditions (GHD 2013 and 2014a).

Landfill gas extraction

The landfill gas management system comprises an extensive collection system utilising ring mains, sub mains, gas wells and dual gas/leachate wells with some horizontal wells remaining from the early stages of the landfill. Landfill gas is transferred to the power station located at the south eastern portion of the LHRRP and transformed into energy for power generation or flared.

Landfill gas extraction wells have been progressively installed in completed areas to control gas migration. Overlap of the radius of influence is allowed for extraction wells located at the border perimeter of the landfill, to assist effective control of offsite gas migration. Gas extraction wells would continue to be installed progressively in operational areas as gas develops and the landfill develops.

8.1.6 Outputs and expected use

This section outlines the expected product and residuals outputs from the GO facility and ARRT facility. Other emissions such as GO leachate, landfill leachate and greenhouse gases are addressed in Chapters 13, 15 and 21 respectively.

GO facility

The GO facility is expected to generate a mulch product and a compost which would be blended with other materials to produce an enriched compost product for market. The products would meet the requirements of the following NSW EPA resource recovery orders:

- 'The raw mulch order 2014'
- 'The compost order 2014'

It is estimated that only a small amount of residuals (around 250 tonnes per year) would require disposal at the landfill.

The expected outputs from the GO facility when operating at full capacity are shown in Table 8.3. These figures take into account expected loss of organic matter and moisture from the composting process.

It should be noted that the material produced from the GO facility composting process would be blended with sand and turkey manure compost to produce an enriched compost product suitable for market. The expected blending materials for preparation of final products are shown in Table 8.4.

Table 8.3 Expected GO facility output streams

Output	Estimated output quantity (t/yr)
Residuals (landfill)	250
Mulch	12,000
Enriched GO compost*	70,661
Total	82,911

* includes 37,000 tonnes per year of blending material as shown in Table 8.4

Table 8.4 Expected GO facility blending material inputs

Blending material	Estimated quantity (t/yr)
Turkey manure compost	2,000

Sand	35,000
Total	37,000

ARRT facility

The compost derived from kerbside collected food waste, bulk green waste and source separated food waste (excluding grease trap waste) would meet the requirements of (EPA 2014c) 'The solid food waste order 2014'.

The compost derived from mixed waste would meet the requirements of (EPA 2014d) 'The organic outputs derived from mixed waste order 2014'. Compost derived from the source separated food and garden organics streams would meet the requirements of (EPA 2014e) 'The compost order 2014'.

It is anticipated that approximately 60,000 tonnes of residuals from the ARRT facility would require disposal at the landfill per year.

Table 8.5 summarises the expected outputs from the ARRT facility when operating at full capacity.

Table 8.5 Expected ARRT facility output streams

Output	Estimated output quantity (t/yr)
Residuals (landfill)	60,000
PEF	40,000
Compost	50,000

8.1.7 Quality control

Accurate recording of all waste movements into and out of the proposal site would be conducted for recording customer data and associated taxes and levies.

Before leaving the proposal site as compost, samples of the material from both the GO facility and ARRT facilities would be taken and subjected to NATA laboratory testing. For some markets, testing will demonstrate that the product complies with the Australian Standard (Australian Standards 2012) for composting (AS 4454-2012: Composts, Soil Conditioners and Mulches) and inform the purchaser of the nutrient value of the product. Where required, testing would also be undertaken in accordance with the requirements of the respective resource recovery orders.

SITA is committed to implementing best practice prevention, mitigation and rectification measures to ensure a quality product. Therefore, in addition to the above, at each facility, a number of other process steps and measures are proposed.

GO facility

At the GO facility this would include:

- Decontamination upon receival – manual inspection and removal of contaminants
- Mixing, blending and shredding to ensure a consistent feedstock
- Aerated concrete bunkers:
  - Forced aeration to maintain oxygen in the composting process
  - Water spray as necessary to maintain moisture content during composting
- Screening and refinement to remove larger woody pieces and other coarse physical impurities

ARRT facility

At the ARRT facility this would include:

- Regular formal audits of incoming materials would be conducted and visual inspection of loads would occur continuously
- Additional contaminants would be removed in a pre-treatment phase (such as batteries, metals and other incompatible material). These materials would be separated and directed to either the landfill or appropriate recycling businesses.
- Composting hall/compost storage:
  - The SCT system would automatically record applied water, airflow rates and duct temperatures which can be correlated to compost temperatures
  - Compost movement across reactors would be tracked via the turning system operation.
- Screens would remove oversize contaminants, and density sorting (densimetric tables) would be undertaken to remove glass and stones etc. These materials would be sorted and recorded for subsequent disposal to landfill.

Landfill screening of waste

The existing quality control measures at the landfill would continue. This includes:

- Signs at the entrance clearly indicating the type of wastes that are accepted and those that are not accepted
- Screening of incoming waste at the weighbridge by asking incoming vehicles to describe the content of loads. If the content cannot be clearly described or identified, closer examination or inspection of the load before it leaves the weighbridge
- Monitoring of mechanically unloaded and hand unloaded vehicles at the tipping face by site operational staff.
- Training to weighbridge operators, landfill supervisors and site operational personnel to ensure their ability to recognise and manage unacceptable wastes.

8.2 Mitigation and management measures

The following mitigation measures would be implemented to minimise potential waste management impacts during construction and operation of the proposal.

8.2.1 Construction

A waste management sub-plan would be prepared as part of the construction environmental management plans for each of the proposal components – landfill, ARRT facility and GO facility. The plans would include procedures for the management of wastes in accordance with relevant NSW legislation and the principles of the waste management hierarchy set out in the NSW Waste Avoidance and Resource Recovery Strategy 2014-21 (EPA 2014a).

8.2.2 Operation

The ARRT facility and GO facility would be operated in accordance with the OEMPs for these facilities (Appendix T and Appendix U). The OEMPs would include:

- Waste handling procedures:
  - weighbridge operations and record keeping.
  - requirements for inspection and removal of contaminants.

  - waste storage and handling requirements.
- Waste processing procedures
- Quality control procedures and protocols including sampling and testing
- Finished product storage and handling requirements.

Sampling and testing would also be carried out in accordance with the requirements of the relevant resource recovery orders to allow compost from the proposal to be applied to land. If necessary, SITA would apply for a specific resource recovery order for any other products from the proposal not covered under a general exemption.

The landfill would be operated in accordance with the LHRRP OEMP (Appendix S), which would include details for screening of incoming wastes.

9. Traffic, transport and access

The information presented in this chapter is based on the findings of the traffic impact assessment undertaken by GHD. The traffic impact assessment is included in Appendix D of this EIS.

9.1 Approach and methodology

The traffic impact assessment was undertaken with reference to 'Guide to Traffic Generating Development' (RTA 2002). While not mandatory, the guideline suggests a process and methodology to undertake the traffic impact assessment. The traffic operation assessment process outlined in the guidelines stipulates that the operating characteristics need to be compared with agreed performance criteria.

The assessment included the following steps:

- Identify existing conditions – a review of existing road features, adjacent developments, traffic volumes, sight distances and crash data.
- Identify impacts of the proposal – provides details of the proposal and a review of additional traffic generated as a result of the LHRRP modification.
- Traffic impact assessment – provides an assessment of the traffic impact on the surrounding road network and assesses the access and parking associated with construction.
- Identify the transport and parking infrastructure works required to mitigate the impacts of the development and ensure that the transportation network continues to operate at an acceptable level of amenity.

The assessment focuses on the ultimate peak scenario (2027) during this period and the overall effect on the surrounding road network.

9.1.1 Objectives

In addition to addressing the SEARs, the traffic impact assessment provides an assessment of how well the proposal meets SITA's objectives. The following objectives have been identified:

- No significant impacts on the community or environment
- Minimises disruption to local traffic
- No queuing on public roads
- Ensures road safety.

9.1.2 Intersection assessment criteria

The 'Level of Service' (or LoS) is the standard measure used to understand the operational performance of the network and intersections. This is defined as the qualitative assessment of the quantitative effect of factors such as speed, traffic volume, geometric features, delays and freedom of movement. The level of service concept is applied to intersections through measures of effectiveness, as summarised in Table 9.1.

Table 9.1 Measures of effectiveness for Level of Service definition for intersections

Intersection control	Measure of effectiveness
Priority controlled	Degree of Saturation Delay to critical movements (sec/vehicle) Queue length for critical movements
Traffic Signals	Average Delay (sec/vehicle) Delay to critical movements Degree of Saturation Cycle Length Queue length for critical movements
Roundabout	Average Delay (sec/vehicle) Delay to critical movements Degree of Saturation Queue length for critical movements

The assessment of intersection operation is based on criteria outlined in Table 9.2**,** as defined by the RTA (2002).

Table 9.2 Intersection Level of Service assessment criteria

LoS	Average delay/ vehicle (secs)	Traffic signals & roundabouts	Give-way & stop signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	28 to 42	Satisfactory	Satisfactory, but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays; roundabout requires other control mode	At capacity; requires other control mode
F	exceeding 70	Unsatisfactory; requires additional capacity	Unsatisfactory, requires other control mode.

Source: Guide to Traffic Generating Developments (RTA 2002)
Note:

- The average delay assessed for signalised intersections is over all movements.
- For roundabouts and priority control intersections (with Stop and Give Way signs or operating under the T-junction rule), the critical criterion for assessment is the movement with the highest delay per vehicle.
- Average delay is expressed in seconds per vehicle.

The operational performance of intersections has been assessed using SIDRA Intersection analysis software tool. The Level of Service criteria set by the RMS is outlined in Table 9.2 and it is noted that LoS ‘D’ is generally an accepted operating condition along urban roads.

9.2 Existing environment

9.2.1 Existing road network characteristics

Little Forest Road

Little Forest Road functions as a local road which provides access to LHRRP only. The road operates as a two-way road with a raised centre median from New Illawarra Road to the waste and recycling centre gates which are located approximately 100 m from the intersection with New Illawarra Road.

Photo 9.1 Little Forest Road access to LHRRP, facing northwest

New Illawarra Road

New Illawarra Road functions as an arterial road and forms part of the NSW State Road corridor (Metroad No. 6), providing connection between Carlingford to Heathcote.

New Illawarra Road has a sign posted speed limit of 80 km/h in the vicinity of the LHRRP. The road is approximately 10 m wide, providing a two way undivided, marked carriageway in the vicinity of the intersection with Little Forest Road.

New Illawarra Road has recently had the speed limit increased from 70 km/h to 80 km/h between Heathcote Road and Recreation Drive.

Photo 9.2 New Illawarra Road southwest of Little Forest Road, facing west

Heathcote Road

Between New Illawarra Road and the Princes Highway, Heathcote Road functions as an arterial road and forms part of the NSW State road corridor (Metroad No. 6) providing connection between Carlingford to Heathcote.

To the north of New Illawarra Road, Heathcote Road provides a connection between Holsworthy and Heathcote.

Heathcote Road has a sign posted speed limit of 70 km/h south of New Illawarra Road, and 100 km/h north of New Illawarra Road, which reduces to 70 km/h on approach to the New Illawarra road signalised intersection. Heathcote Road is approximately 10 m wide, providing a two way undivided, marked carriageway.

Photo 9.3 Heathcote Road north of New Illawarra Road, facing south

9.2.2 Public transport

No public transport services currently facilitate LHRRP. Engadine train station is located approximately 8 kilometres from the LHRRP site.

9.2.3 Existing daily and peak hour traffic volumes

Midblock traffic counts

Traffic 'tube' count surveys were undertaken on Heathcote Road in the vicinity of the proposed access intersection. The traffic counts were undertaken between Monday 4th and Sunday 10th February 2013 and recorded classified (by vehicle type) directional traffic flows on Heathcote Road.

A profile of the two-way (northbound and southbound traffic flows combined) traffic flows is shown at Figure 9.1, with the traffic surveys provided in full in Appendix D.

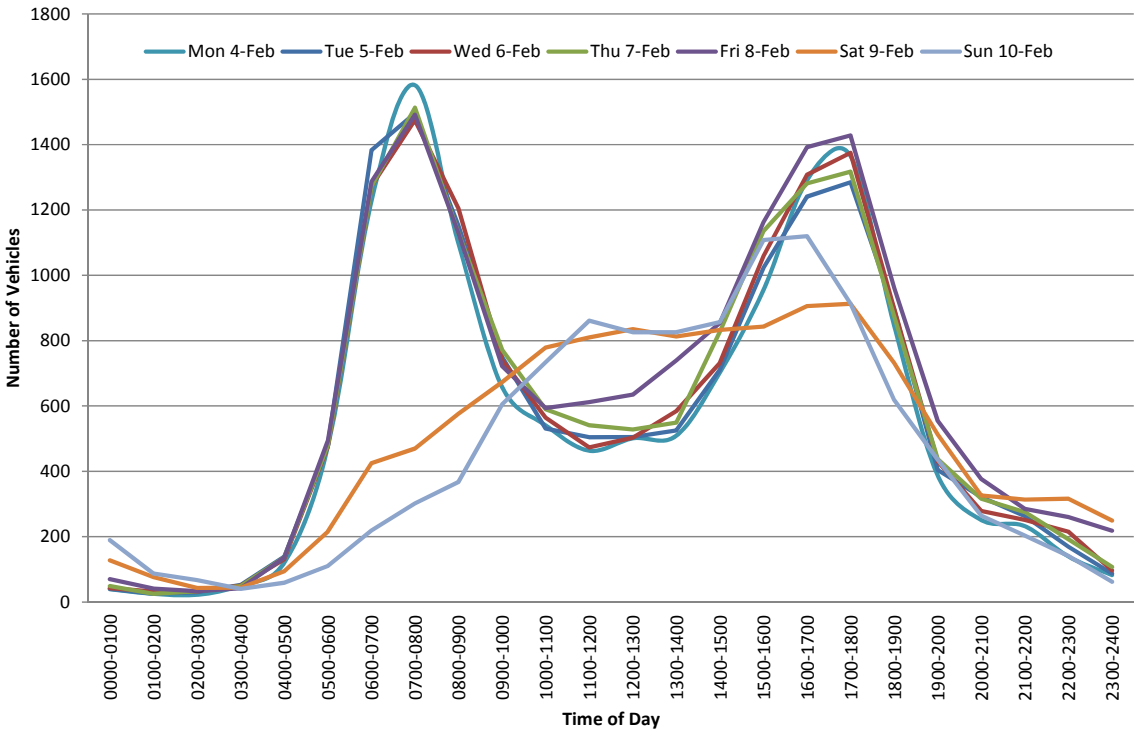


Figure 9.1 2013 Surveyed traffic volumes on Heathcote Road (two-way)

With reference to Figure 9.1, the weekday AM and PM peak hours on Heathcote Road was found to occur between 07:00-08:00 and 17:00-18:00 respectively. Traffic volumes along Heathcote Road are generally lower on a Saturday and Sunday. The worst case AM and PM peak and daily traffic volumes are shown in Table 9.3.

Table 9.3 Heavy vehicles – February 2013

	Vehicles per hour	HCV* (vph)	HCV* %
Weekday AM Peak (07:00-08:00)	1,582	-	-
Weekday PM Peak (17:00-18:00)	1,428	-	-
Daily (24 hour)	15,518	1,498	9.7%

Note: * HCV – heavy commercial vehicles

As shown in Table 9.3**,** heavy vehicle traffic on Heathcote Road accounts for approximately 10% of the daily traffic volumes. In addition, weekday peak hour traffic was observed to be approximately 10% of the total daily traffic volumes.

Table 9.4 provides a summary of the average and 85th percentile speeds observed on Heathcote Road during the traffic "tube" counts. This shows that the observed 85th percentile speed was found to be similar to the 100 km/h speed limit.

Table 9.4 Average and 85th percentile speeds on Heathcote Road – February 2013

	Average speed (km/h)	85th percentile speed (km/h)
Heathcote Road Northbound	93.8	101.5
Heathcote Road Southbound	94.9	102.6

Intersection traffic counts

Classified intersection traffic surveys were undertaken at the following intersections on Tuesday 29 July 2014 between 6.30 and 9.30 AM and on Monday 9 February 2015 between 3.30 and 6.30 PM:

- Heathcote Road/New Illawarra Road signal controlled T-intersection; and
- Little Forest Road/New Illawarra Road priority controlled T-intersection.

The traffic surveys are provided in full in Appendix D.

A summary of the observed peak hours and two-way traffic volumes on New Illawarra Road in the vicinity of these intersections is shown in Table 9.5. Although the PM peak hour at the Little Forest Road/New Illawarra Road intersection was observed to occur between 5.30 and 6.30 PM, the LHRRP is not currently in operation during these hours. To properly assess the traffic impact of the proposal, the PM peak hour analysed was correlated with the final hour of operation (i.e. between 4.00 and 5.00 PM). This is considered to be robust as the proportional impact of the traffic generated by the proposal in the afternoon is maximised in this way.

The highest weekday peak hour traffic volumes were observed during the morning peak hours on both New Illawarra Road and Heathcote Road.

Table 9.5 2014 Surveyed weekday peak hourly traffic volumes on New Illawarra Road

Location	7.30 to 8.30 AM		4.00 to 5.00 PM	
	Two-way Traffic Volumes (veh/h)*	% Heavy Vehicles	Two-way Traffic Volumes (veh/h)*	% Heavy Vehicles
New Illawarra Road, north of Little Forest Road	1,951	4%	1,636	3%
New Illawarra Road, south of Little Forest Road	1,902	2%	1,631	2%
Little Forest Road	73	52%	51	27%
Heathcote Road, north of New Illawarra Road	1,603	2%	1,365	2%
Heathcote Road, south of New Illawarra Road	1,892	2%	1,603	2%

Note: * veh/h – vehicles per hour

** PM 2014 volumes based on 2008 volumes adjusted using growth factors provided by RMS

9.2.4 Intersection capacity assessments

The capacity and LoS analysis has been carried out for the intersections during AM and PM weekday peak period conditions using the SIDRA intersection model. SIDRA model calculates capacities, queue lengths and delays for traffic signals, roundabouts and priority controlled intersections. The following intersections have been analysed using SIDRA for the weekday AM and PM peak hours based on the 2014 traffic counts discussed in Section 9.2.3:

- Heathcote Road/New Illawarra Road signal controlled T-intersection
- Little Forest Road/New Illawarra Road priority controlled T-intersection.

A summary of the results of the SIDRA intersection modelling is shown in Table 9.6. Detailed SIDRA outputs provided in Appendix D. Based on this SIDRA analysis, both of the key intersections currently operate with an acceptable level of service.

During the AM Peak, the Little Forest Road and New Illawarra Road intersection experiences a LoS D on the north approach where vehicles are turning right out of Little Forest Road. It has a queue length of 10 m and an average delay of 46 seconds.

Table 9.6 SIDRA results - 2014 surveyed traffic flows

Intersection	AM peak		PM peak	
	Ave delay (s)	LoS	Ave delay (s)	LoS
Heathcote Road/New Illawarra Road	35	C	32	C
Little Forest Road/New Illawarra Road	27	B	17	B

9.2.5 Crash statistics

RMS supplied crash statistics for roads within the study area over a 6-year period between 2008 and 2013. This crash data was used to determine the main factors contributing to crashes within the study area.

The study area has been limited to the extent of 2 km north and south along Heathcote Road, from the New Illawarra Road/Heathcote Road intersection. The boundary of New Illawarra Road to the intersection Recreation Drive is also included in the study area. An extract of the crash incidents around the LHRRP can be seen in Figure 9.2, with a detailed crash report found in Appendix D.

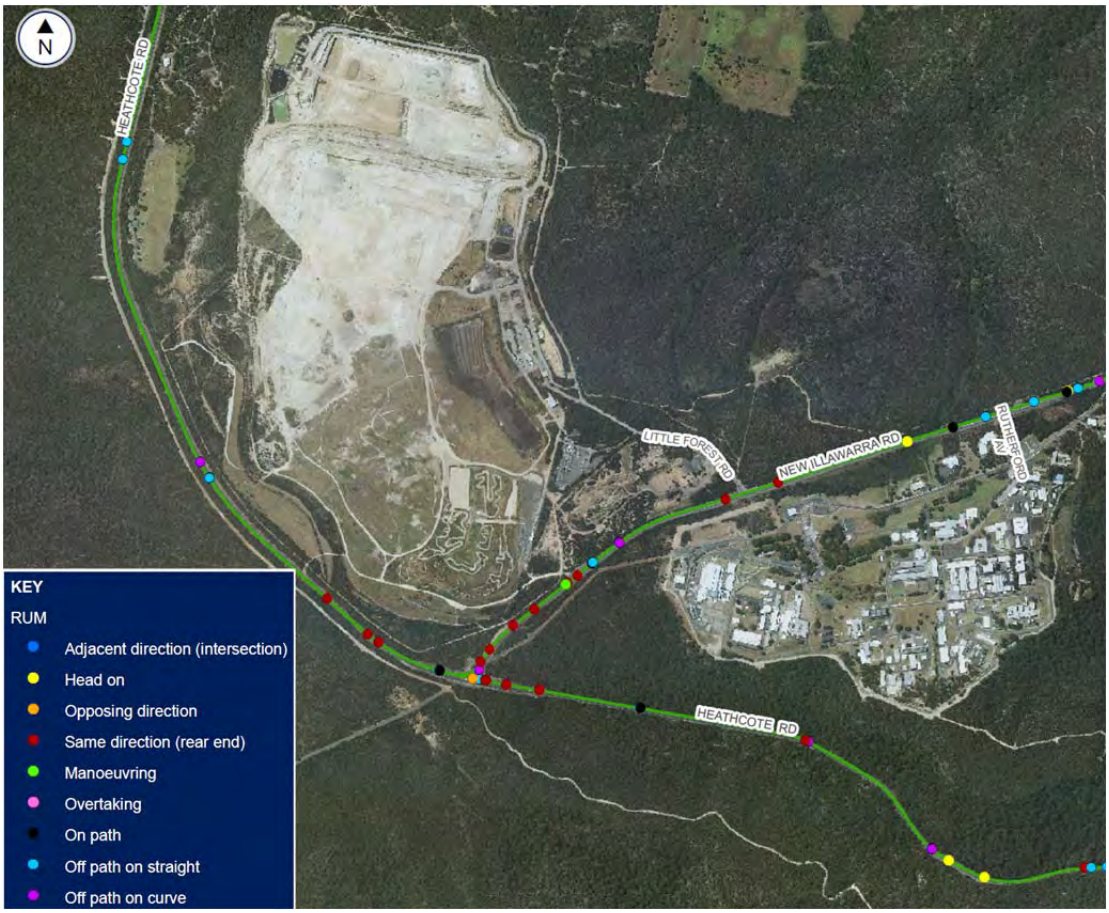


Figure 9.2 Crash incidents around the LHRRP site

Analysis of the RMS crash data for road sections within the study area indicate that there are a number of crashes around the intersection of Heathcote Road/New Illawarra Road, with the majority of crashes being rear end collisions.

New Illawarra Road

In total, there were 33 crashes recorded along New Illawarra Road within the study area. Of these:

- 17 (52%) incidents resulted in injuries

- Three (9%) incidents occurred at an intersection
- Seven (21%) incidents involved right turning vehicles colliding with through traffic
- Six (18%) incidents involved right turning traffic colliding with traffic travelling in the opposite direction.
- Two incidents were recorded near the intersection with Little Forrest road, which both involved rear end shunts.

Heathcote Road, west of New Illawarra Road

In total, there were 12 crashes recorded along Heathcote Road, west of New Illawarra Road, within the study area. Of these:

- Six (50%) incidents resulted in injuries
- Six (50%) incidents involved vehicles driving off the carriageways
- Two (17%) incidents involved rear end collisions with other vehicles.

Heathcote Road, east of New Illawarra Road

In total, there were 46 crashes recorded along Heathcote Road east of New Illawarra Road, within the study area. Of these:

- 11 (24%) incidents resulted in injuries
- One (2%) incident resulted in a fatality, which involved a car and a bus travelling in the opposite direction
- 14 (30%) incidents involved rear end collisions with other vehicles
- Eight (17%) incidents involved vehicles driving off the carriageways.

Crash data summary

Below is a summary of the crash data in the study area:

- A total of 91 crashes occurred in the study area
- 79 (87%) involved car crashes
- 12 (13%) of the incidents involved speeding, which was the main contributing factor of the accidents
- 73 (80%) of the incidents occurred at mid-block sections
- 16 (35%) incidents occurred at the intersection of New Illawarra Road and Heathcote Road. It should be noted that this intersection was upgraded to a signalised intersection in March 2010. However, there have been a much lower number of crashes (four crashes) recorded following the upgrade of this intersection, from a seagull type intersection to traffic signal controlled. This suggests that RMS may have upgraded the intersection as a result of its poor crash history.

9.3 Assessment of potential impacts

9.3.1 Comparison to planning consent for capacity expansion (1999)

The Traffic Impact Assessment report for the 1999 EIS provides estimated traffic generation for the current approved waste operations, including during the AM peak:

- 88 truck movements (44 arriving and 44 departing) during the AM peak hour between 7.30-8.30 AM, assuming the peak hour is 50 percent of the 7-9 AM two hour period.

- 30 light vehicle movements (15 arriving and 15 departing) during the AM peak hour, resulting in,
- 118 vehicle movements in total during the AM peak hour

The above traffic generation estimates of 118 vehicle movements includes only waste transferred to the site by bulk waste transfer vehicles and by council waste vehicles.

Based on the assessment undertaken as part of this proposal, the technical analysis indicates that 105 vehicle movements (trucks and light vehicles) in total would occur during the AM peak hour (for the year where maximum level of traffic movements is expected – 2027). This assessment has taken into consideration waste delivery vehicles as well as vehicles associated with operations and capping activities.

Therefore this proposal is expected to generate less traffic movements than that approved in the 1999 consent (105 compared to 118 vehicle movements during the AM peak hour).

9.3.2 Traffic generation and peak hour vehicle trips

The following process has been used to determine the amount of traffic forecast to be generated by the proposal:

- Generate yearly vehicle trips based on scale of development
- Derive AM and PM peak hour vehicle trips
- Assign generated trips through the local road network

Annual trip generation

SITA provided traffic generation estimates associated with the construction and operation of the proposal during the construction/operational period until 2037.

The traffic impact assessment is based on the 2017 and 2027, ten year horizon. The 2027 ten year horizon is also represents the peak period in terms of traffic generation for the proposal. As such, this provides a worst case assessment of the proposal. A summary of the annual trip generation for the analysis years 2017 and 2027 is presented in Table 9.7. The forecast additional traffic generation for each year until 2037 is provided in Appendix D.

Table 9.7 Annual vehicle trip generation from the proposal

Additional vehicles from:	2017			2027		
	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
Non-waste inputs	0	0	0	0	25,642	25,642
Waste inputs and staff	59,462	27,413	86,876	59,462	27,413	86,876
Total	**59,462**	**27,413**	**86,876**	**59,462**	**53,055**	**112,518**

AM and PM peak hour vehicle trips

For the purposes of this assessment, the following peak hours have been assumed based on previously commissioned traffic counts at both intersections:

- Weekday AM peak hour = 7:30 – 8:30 AM
- Weekday PM peak hour = 4:00 – 5:00 PM

For each of the assessment years, the total light and heavy vehicle annual trip generation was converted into a weekday AM and PM peak hour volume based on weighbridge traffic movement data supplied by SITA, which contains hourly breakdowns of trucks entering the site every day for the period 1 July 2013 to 30 June 2014.

Table 9.8 shows the AM and PM peak hour volumes derived for light and heavy vehicles in 2017 and 2027. The traffic volumes shown are one-way traffic movements. For this assessment it has been assumed that all vehicles would enter and depart in the same hour period.

Table 9.8 Derivation of AM & PM peak hour traffic volumes (one-way)

Additional vehicles in:	2017			2027		
	Light Vehicles	Heavy vehicles	Total	Light Vehicles	Heavy vehicles	Total
Yearly volume (Mon-Sun)	59,462	27,413	86,875	59,462	53,055	112,517
Yearly volume (Mon-Fri)	47,663	21,973	69,636	47,663	42,527	90,190
Weekly volume (Mon-Fri)	917	423	1,340	917	818	1,735
Daily volume (weekday)	183	85	268	183	164	347
AM peak hour volume	**17**	**8**	**25**	**17**	**15**	**32**
PM peak hour volume	**17**	**8**	**25**	**17**	**15**	**32**

Construction workforce

Construction of the ARRT and GO facilities between 2016 and 2018 is expected to involve around 25-30 workers entering and leaving the proposal site per day on average. Workers would arrive in the morning between 6-7 am and depart between 3-4 pm.

Based on a worst case, with all workers accessing the proposal site by car, this would result in up to 30 small vehicles entering and leaving the proposal site each day. However, these construction workers are expected to access the proposal site before the morning peak (7.30-8.30 am) and depart the proposal site before the evening peak (4-5 pm), which would not affect the peak hour traffic assessment.

9.3.3 Baseline traffic volumes

Following discussion and agreement regarding the scope of this assessment, RMS has supplied future growth factors to be applied to the 2014 classified traffic counts (see Section 9.2.3), allowing the derivation of light and heavy traffic volumes for 2017 and 2027.

The AM and PM peak hour generated trips were distributed and assigned to the local road network using the following assumptions:

- 50% of generated traffic travels to/from north-east via New Illawarra Road (north)
- 50% of generated traffic travels to/from north-west via New Illawarra Road and Heathcote Road (north)

It is also assumed that 100% of the generated traffic will enter and exit the facility during each peak hour. This is a robust assumption as it is highly likely that waste trucks using the facility will dispose of their payload as quickly as possible and will not remain on the proposal site for extended periods of time. The previous Cardno (2009) traffic impact assessment estimates that trucks will typically turnaround from weighbridge to exit in an average time of 15 minutes (25 minutes maximum).

9.3.4 SIDRA intersection analysis results

The impact assessment evaluated the performance of the following intersections:

- Heathcote Road/New Illawarra Road
- Little Forest Road/New Illawarra Road

The performance of both intersections was modelled in SIDRA 6 during the AM and PM peak periods under the following scenarios:

- 2017 baseline traffic
- 2017 baseline + proposal traffic
- 2027 baseline traffic
- 2027 baseline + proposal traffic

Traffic signal cycle times were optimised in SIDRA to a maximum of 150 seconds in one second increments, minimising the degree of saturation.

A summary of the results of the SIDRA intersection analysis of intersections within the study area is as follows. Detailed results are provided in Appendix D.

Heathcote Road/New Illawarra Road

The SIDRA results for the Heathcote Road/New Illawarra Road intersection is summarised in Table 9.9.

Table 9.9 Heathcote Road/New Illawarra Road SIDRA results summary

Scenario/peak period	LoS	Ave. delay (s)	Max delay (s)	Deg. satn	Max queue (m)
2017 baseline AM	C	35	67	0.685	191.1
2017 baseline + proposal AM	C	34	65	0.702	191.0
2017 baseline PM	C	32	66	0.490	136.2
2017 baseline + proposal PM	C	32	67	0.495	140.5
2027 baseline AM	C	36	54	0.793	208.2
2027 baseline + proposal AM	C	33	59	0.778	196.3
2027 baseline PM	C	32	66	0.530	148.3
2027 baseline + proposal PM	C	32	67	0.533	155.4

The SIDRA assessment results indicate that the Heathcote Road/New Illawarra Road intersection is forecast to operate satisfactorily with the additional traffic generation from the proposal during both the AM and PM peak hour in 2017 and 2027.

The proposal would have negligible impacts to the operation of the Heathcote Road/New Illawarra Road intersection.

Little Forest Road/New Illawarra Road intersection

Serving as the main access point to the LHRRP, the Little Forest Road/New Illawarra Road intersection is currently a priority controlled T-intersection. Turn bays are provided on New Illawarra Road for traffic to turn left or right into Little Forest Road. Acceleration lanes are also provided in both directions on New Illawarra Road for traffic turning out of Little Forest Road.

With the location of an acceleration lane on New Illawarra Road southbound, a two-stage right turn from Little Forest Road is possible. The first stage models the crossing of the carriageway closest to Little Forest Road, whilst the second stage is represented in SIDRA by a dummy median leg, modelling the entry into the New Illawarra Road southbound carriageway. The results were combined for this right-turn movement only by taking the greater degree of saturation and adding the delay of the two stages together. It is noted that SIDRA is not able to natively model two-stage right turns. Modelling the right turn as a single stage can produce unrealistically large delays in the results.

For this intersection, a ‘weighted delay’ methodology has been adopted in order to account for vehicle bunching from the traffic signals at the Heathcote Road/New Illawarra Road intersection. Details of this methodology and the results of the intermediate weighted delay calculations are provided in Appendix D.

The weighted average delays and LoS derived for both critical movements at this intersection are summarised in Table 9.10 and Table 9.11.

Table 9.10 Right turn from New Illawarra Road to Little Forest Road results

Scenario/peak period	Delay	LoS
2017 baseline AM	30	C
2017 baseline + proposal AM	29	C
2017 baseline PM	15	A
2017 baseline + proposal PM	14	A
2027 baseline AM	44	D
2027 baseline + proposal AM	50	D
2027 baseline PM	15	A
2027 baseline + proposal PM	15	A

Table 9.11 Right turn from Little Forest Road to New Illawarra Road results

Scenario/Peak Period	Delay	LoS
2017 baseline AM	22	B
2017 baseline + proposal AM	28	B
2017 baseline PM	17	B
2017 baseline + proposal PM	18	B
2027 baseline AM	25	B
2027 baseline + proposal AM	44	D
2027 baseline PM	18	B
2027 baseline + proposal PM	19	B

The SIDRA results summarised in Table 9.10 and Table 9.11 indicate that the Little Forest Road/New Illawarra Road intersection is forecast to operate at:

- LoS C during the AM peak hour in 2017 for both with and without proposal scenarios.
- LoS B during the AM peak hour in 2017 for both with and without proposal scenarios.
- LoS D during the AM peak hour in 2027 for both with and without proposal scenarios.
- LoS B during the PM peak hour in 2027 for both with and without proposal scenarios.

Summary of intersection analysis

For the Heathcote Road/New Illawarra Road intersection, a LoS of C is maintained for the AM and PM peak periods through 2027, both with and without the proposal. This would suggest that the intersection is able to accommodate both the forecast growth in baseline traffic plus the additional traffic associated with the proposal.

The Little Forest Road/New Illawarra Road intersection is forecast to operate at a LoS C during the 2017 AM peak, and at a LoS D during the 2027 AM peak, both with and without the increased development. The critical movements are the right turn from Little Forest Road to New Illawarra Road southbound, and from New Illawarra Road southbound to Little Forest Road. By the criteria listed in Table 9.2, the SIDRA results indicate that the intersection is likely to be able to accommodate the forecast traffic volumes through 2027 with the proposal traffic.

Based on the above, both intersections are likely to operate within capacity through 2027.

However, as the current two-stage right turn movement from Little Forrest Road is not a formal seagull intersection arrangement, it is recommended that a safety review is conducted for the

Little Forest Road/New Illawarra Road intersection to determine if any modifications are necessary in order to improve the existing layout.

9.3.5 Review of SIDRA analysis using traffic microsimulation

At the request of SSC, a review of the SIDRA intersection modelling was undertaken using the Paramics traffic microsimulation program. This additional analysis was undertaken in order to provide further analysis on the gaps in traffic along New Illawarra Road from the traffic signals at the Heathcote Road/New Illawarra Road intersection.

A 2027 AM worst case (70/30 split) model was developed using the forecast SIDRA traffic volumes and signal timing information from the Heathcote Road/New Illawarra Road intersection SIDRA model. In developing this model, cars and heavy vehicles were modelled as two separate origin/destination matrices to ensure that the delays at the intersection of New Illawarra Road and Little Forest Road were based on vehicle performance. Additionally, the model was built in a 3D environment to ensure that truck performance on gradients was accurately represented.

The results of the 2027 AM peak hour Paramics modelling assessment are shown in Table 9.12 and Table 9.13 for the Little Forest Road/New Illawarra Road intersection and the Heathcote Road/New Illawarra Road intersection respectively.

Table 9.12 Little Forest Road/New Illawarra Road Intersection Paramics Model Results – 2027 AM peak

Intersection	Approach	Turn	Average Delay (s)	LoS
New Illawarra Rd / Little Forest	Little Forest (N)	Left	5	A
		Right	20	B
	New Illawarra (E)	Through	0	A
		Right	32	C
	New Illawarra (W)	Left	0	A
		Through	0	A

Table 9.13 Heathcote Road/New Illawarra Road Intersection Paramics Model Results – 2027 AM peak

Intersection	Approach	Turn	Delay (s)	LoS
New Illawarra Rd / Heathcote Rd	New Illawarra Rd (E)	Left	6	A
		Right	21	B
	Heathcote Rd (S)	Through	21	B
		Right	21	B
	Heathcote Rd (N)	Left	15	B
		Through	55	E

The Paramics modelling indicates that both intersections would operate satisfactorily under the worst case 2027 AM peak traffic conditions. Sufficient gaps in traffic are provided along New Illawarra Road from the Heathcote Road/New Illawarra Road traffic signals which allow both heavy vehicles and light vehicles to turn into and out of Little Forrest Road with minimal delays.

9.3.6 Mid-block traffic volumes

The forecast increase in two-way traffic volumes associated with the proposal along road sections within the study area is shown in Table 9.14 and Table 9.15 for the 2027 AM and PM peak hours respectively. As shown, there would be marginal increases to two-way traffic volumes along New Illawarra Road and Heathcote Road associated with the proposal.

Table 9.14 AM Peak hour forecast increase in traffic (2027)

2027 Traffic Volumes	2027 Base (2-way traffic)	2027 Base + proposal (2-way traffic)	Increase	% Increase
New Illawarra Road, north of Little Forest Road	2,221	2,253	32	1.4%
New Illawarra Road, south of Little Forest Road	2,172	2,204	32	1.4%
Little Forest Road	73	136	63	46.4%
Heathcote Road, north of New Illawarra Road	1,875	1,906	32	1.7%
Heathcote Road, south of New Illawarra Road	2,143	2,143	0	0.0%

Table 9.15 PM Peak hour forecast increase in traffic (2027)

2027 Traffic Volumes	2027 Base (2-way traffic)	2027 Base + proposal (2-way traffic)	Increase	% Increase
New Illawarra Road, north of Little Forest Road	1,725	1,756	32	1.8%
New Illawarra Road, south of Little Forest Road	1,720	1,751	32	1.8%
Little Forest Road	51	114	63	55.3%
Heathcote Road, north of New Illawarra Road	1,474	1,506	32	2.1%
Heathcote Road, south of New Illawarra Road	1,747	1,747	0	0.0%

9.3.7 Impacts to ANSTO access intersection

ANSTO is accessed via a priority controlled seagull intersection at New Illawarra Road, located approximately 800 m to the northeast of the Little Forest Road/ New Illawarra Road intersection. As summarised in Table 9.14 and Table 9.15, the proposal is forecast to result in the following increase in two-way traffic at New Illawarra Road to the north of Little Forest Road:

- 1.4% (32 vehicles) during the AM peak hour in 2027
- 1.8% (32 vehicle movements) during the PM peak hour in 2027

Based on the above, the proposal is expected to have negligible impacts to the operation of the ANSTO access/New Illawarra Road intersection.

9.3.8 Future residential traffic generation at Barden Ridge

Parts of areas north of the LHRRP have been rezoned to allow for six new discrete communities surrounding Barden Ridge. Additional SIDRA and Paramics traffic modelling was undertaken to assess the traffic impacts associated with the proposal, including the additional traffic associated with this future residential development.

SIDRA 6.1 modelling software was used to develop the signal phasing times for input into the Paramics modelling of the Heathcote Road/New Illawarra Road intersection. The traffic demand for this analysis included background traffic growth rates provided by Roads and Maritime Services, traffic associated with the proposed residential development at Barden Bridge and traffic associated with the proposal. The 'with development' assessment scenario was modelled based on an assumed a 70/30 split of traffic generated from the facility.

The Paramics modelling indicates that both intersections would operate satisfactorily under the

worst case 2027 AM peak traffic conditions. Sufficient gaps in traffic are provided along New Illawarra Road from the Heathcote Road/New Illawarra Road traffic signals which allow both heavy vehicles and light vehicles to turn into and out of Little Forrest Road with minimal delays.

9.3.9 Impacts of construction workforce

Construction of the ARRT and GO facilities between 2016 and 2018 is expected to involve around 25-30 workers. Based on a worst case, with all workers accessing the proposal site by single occupancy car, this would generate up to 30 trips to the proposal site per day, or 60 two-way movements (arrivals and departures).

Workers are expected to arrive at the proposal site between 6-7 AM and depart between 3-4 PM. As such, construction workers would access the proposal site before the morning peak (7.30-8.30 AM) and depart before the evening peak (4-5 PM). Based on this, traffic impacts associated with workers accessing the proposal site would be reduced, compared to the AM and PM peak operations, discussed in Section 9.3.1. The impacts associated with the construction workers accessing the proposal site would be minimal, with both the Little Forest Road/New Illawarra Road intersection and the Heathcote Road/New Illawarra Road intersection expected to operate within capacity during the construction period between 2016 and 2018.

9.3.10 Parking and access

On-street parking

There is no car parking provision along New Illawarra Road or Forest Road near the proposal site access. All parking would be provided internally in the proposal site.

On-site parking

In total, there would be a total of approximately 96 car bays provided on-site to service the expanded facilities under the proposal, divided between three car parks. These are:

- ARRT facility car park (north) – 32 bays servicing the composting hall and biofilter
- ARRT facility car park (south) – 57 bays servicing the waste receival and processing building
- GO facility car park – 7 bays servicing the receival area, GO facility and amenities office

Table 9.16 breaks down the number of bays provided in each car park by type, whilst Figure 6.11 and Figure 6.12 illustrate the conceptual layout of the proposed car parks.

Table 9.16 ARRT and GO facility on-site car parking provision

Number of bays	Staff	Visitors	Accessible	Motorcycle	Total
ARRT car park (north)	50	20	1	2	32
ARRT car park (south)			1	3	57
GO facility carpark			1	1	7

The SSC (2006) ‘Development Control Plan (DCP) 2006, Chapter 7: Vehicular Access, Traffic, Parking and Bicycles’ contains parking requirements and ratios by land use within the Shire, however no specific guidance or conditions are provided for landfill or waste management facilities. Similarly, the RTA’s ‘Guide to Traffic Generating Developments’ (2002) does not provide any parking ratios for landfill or waste management sites in particular.

Therefore, in the absence of further guidance the parking provision in Table 9.16 has been calculated based on projected staff numbers for the ARRT and GO facilities. An additional 20 bays have also been set aside for visitor parking.

Provision for accessible parking is governed by the Building Code of Australia (BCA). Assuming that the proposed facilities can be best classified under the BCA as Class 8 buildings under the code (defined as 'a laboratory, or a building in which a handicraft or process for the production, assembling, altering, repairing, packing, finishing, or cleaning of goods or produce is carried on for trade, sale, or gain'), then 1 accessible space for every 100 car parking spaces (or part thereof) needs to be provided under clause D3.5. Based on this, one accessible bay is to be provided in each of the three car parks, designed in accordance with (Australian Standards 2009a) AS2890.6-2009, 'Parking facilities Part 6: Off-street parking for people with disabilities'.

Chapter 7, clause 1.b.2 of the SSC DCP 2006 states that motorcycle parking is to be provided at the rate of one motorcycle parking space per 25 car spaces (or part thereof).

All car and motorcycle bays were designed and dimensioned in accordance with (Australian Standards 2004) AS2890.1-2004, 'Parking facilities Part 1: Off-street parking' assuming a User Class 1 (being suited to employee and all-day parking).

Access arrangements

The traffic management plan would address the timing of trucks accessing the proposal site to ensure there is sufficient room within the proposal site to accommodate these vehicles.

9.3.11 Impacts to pedestrians

There are no footpaths along New Illawarra Road or Little forest Road. Little Forest Road is currently used by some ANSTO staff for cycling and pedestrian to access walking tracks on their land. As such, the proposal would have no impacts to pedestrians.

9.3.12 Impacts to cycling

There are no dedicated cycleways along New Illawarra Road, Little forest Road or Heathcote Road, although cyclists can use the shoulder along New Illawarra Road and Heathcote Road. Little Forest Road is also currently used by some ANSTO staff for cycling and pedestrian to access walking tracks on their land.

The proposal is expected to have negligible impacts to cyclists.

9.3.13 Impacts to public transport

There are no bus stops along New Illawarra Road or Heathcote Road in the vicinity of the LHRRP. The nearest train station is at Engadine train station, which is located approximately 8 km from the proposal site.

As such, the proposal would have no impacts to public transport operations.

9.4 Mitigation and management measures

A number of mitigation measures have been identified to ensure that transport and traffic impacts associated with the construction and operation of proposal are minimised. These measures are summarised below and would be incorporated into a Traffic Management Plan.

9.4.1 Construction

An important mitigation measure relating to construction traffic impacts is the implementation of a community information and awareness program. This program would be initiated prior to construction commencing and continue throughout the entire construction period to ensure that local residents are fully aware of the construction activities, with particular regard to construction traffic issues. The awareness program would identify communication protocols for community

feedback on issues relating to construction vehicle driver behaviour and construction-related matters.

Examples of key measures for the construction stage that would be undertaken as part of the Traffic Management Plan include:

- Consultation with RMS and SSC to ensure that general signposting of construction access roads are appropriate and provide adequate warning of heavy vehicle and construction activity
- Distribute construction activity warning notices to advise local road users of scheduled construction activities
- Provide advance notice of road/lane closures and advice on alternative routes (if required)
- Whenever practical, promote the use internal and haulage access roads rather than public roads by construction vehicles
- Manage the transportation of construction materials to maximise vehicle loads and minimise vehicle movements in consultation with RMS and SSC and the NSW Police Services

9.4.2 Safety review

SITA would engage an independent traffic expert to perform a safety review in both 2020 and 2025 on the safety of the intersection of New Illawarra Road and Little Forest Road. The expert would be jointly selected by SITA and SSC.

The report would include analysis of the relevant peak periods and include the following:

- Vehicle turn counts using video surveillance
- Measured average delay per vehicle for vehicles turning into and out of Little Forest Road based on the video surveillance
- Crash data
- Benefit Cost Ratio Analysis for the provision of a controlled intersection using the RMS Road Safety Project Nomination Benefit Cost Ratio (BCR) model

Should the report indicate either of the following:

- That the measured average delay per vehicle is equal to or greater than 56 seconds for any of the turning movements to and from Little Forest Road from New Illawarra Road, or
- That the Benefit Cost Ratio for the provision of a controlled intersection is equal to or greater than 1, then

SITA would modify the Little Forest Road / New Illawarra Road intersection to address any issues identified, subject to the approval of RMS and SSC. All costs associated with upgrading of the intersection (if required) would be borne by SITA.

9.4.3 Operation

A comprehensive list of prevention, mitigation and rectification measures has been identified and they are detailed in the LHRRP OEMP (Appendix S). The identified mitigation and rectification measures would be implemented as required and their exact details would be based on a case by case situation depending on the issue and technical solutions available at the time. Traffic control for inbound and outbound vehicles for the GO facility and the ARRT facility would be considered with traffic associated with the rest of the LHRRP (i.e. LHRRP OEMP).

Examples of key measures that are included in the OEMPs and initiatives that would be undertaken as part of the Traffic Management Plan include:

- Review signposted and non-signposted speed restrictions along the road network and where necessary, provide additional signposting of speed limitations
- Consult with schools and school bus services to determine and mitigate if any school bus service use roads within the study area
- Install appropriate traffic control and warning signs for areas identified to have existing potential safety risks
- Consult with the NSW Police Service to mitigate impacts of heavy (multi-dimensional) vehicles on the roads
- Project induction training for truck and vehicle operators
- Manage queuing and prevent long queues at site entrance
- Actively monitor area and have in place traffic control
- Delay trucks when required
- Manage dispatch timing for vehicles from SITA controlled facilities
- SITA owned waste transfer vehicles are to travel on arterial or sub-arterial roads rather than local roads (with the exception of Little Forest Road)
- SITA would discourage customer's transfer trailers and B doubles from travelling on local roads

9.5 Conclusions

The overall traffic increase on the New Illawarra Road and Heathcote Road would be minimal and the road network has the capacity to deal with the increase. The proposal would not adversely impact upon the operation of the existing or future road network.

It is expected that the proposal would generate a similar amount of traffic as was predicted in the 1999 EIS.

As a result of the proposal, approximately 4% of the vehicles using New Illawarra Road would be accessing the LHRRP in 2027, which is the expected peak year for traffic movements.

SIDRA modelling indicates that the proposal would have negligible impacts to the operation of the Heathcote Road/New Illawarra Road intersection. Paramics traffic microsimulation and sensitivity testing with worse case conditions confirmed these conclusions.

The proposal is also expected to have negligible impacts to the operation of the ANSTO access/New Illawarra Road intersection and no impacts to pedestrians, cyclists or to public transport operations.

This assessment addresses the SEARs and concludes that the proposal would meet the following objectives:

- No significant impacts on the community or environment
- Minimises disruption to local traffic
- No queuing on public roads
- Ensures road safety

10. Noise

The information presented in this chapter is based on the findings of the noise assessment undertaken by GHD. The noise assessment report is included in Appendix E of this EIS.

10.1 Approach and methodology

The noise assessment involved the following tasks:

- Identification of noise sensitive receivers
- Review of background noise levels from previous studies plus additional background noise monitoring at two locations
- Attended noise monitoring at the LHRRP and surrounds to quantify existing noise sources on site
- Establishment of operational and construction noise criteria based on EPA guidelines and the results of noise monitoring
- Assessment of potential construction, operation and traffic noise impacts, by:
  - noise modelling to predict the potential for impacts at sensitive receivers
  - assessing predicted impacts against noise criteria
  - considering relevant EPA guidelines including the 'Interim Construction Noise Guideline' (DECC 2009), 'Industrial Noise Policy' (DECCW 2000), and 'Environmental Criteria for Road Traffic Noise' (OEH 1999).

10.1.1 Objectives

In addition to addressing the SEARs, the noise assessment provides an assessment of how well the proposal meets SITA's objectives.

The following objectives have been identified:

- No significant impacts on the community or environment
- Prevent the degradation of local amenity
- Prevent noise pollution

10.2 Existing environment

10.2.1 Noise sensitive receivers

Noise and vibration sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Sensitive noise and vibration receivers could include both existing and proposed:

- Residences
- Educational institutes
- Hospitals and medical facilities
- Places of worship

- Passive and active recreational areas such as parks, sporting fields and golf courses. Note that these recreational areas are only considered sensitive when they are in use or occupied
- Commercial or industrial premises

The noise sensitive receivers and land uses near the proposal site are identified in Table 10.1 and shown on Figure 10.1.

LEGEND

- Noise sensitive receiver
- Background noise monitoring location
- LHRRP boundary

Paper Size A4

0 125 250 500 750 1,000

Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

SITA Australia
Lucas Heights Resource Recovery Park

Job Number 21-23482
Revision Draft
Date 27 Feb 2015

Noise sensitive receivers and background noise monitoring locations

Figure 10.1

\\ghdnet\ghd\AU\Sydney\Projects\21\23482\GIS\Maps\MXD\21-23482-Z047_SensitiveReceptorsLevel 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

Aerial Imagery: ESRI, 2014. Works: GHD/SITA, 2014. Roads: NSW LPMA, 2012. Created by:ppandey

Table 10.1 Nearby noise sensitive receivers

Sensitive receiver	Approximate distance to the LHRRP (km)
R1 Engadine	2
R2 Barden Ridge	3
R3 Menai	3.3
R4 ANSTO	0.3
R5 ANTSO Motel	0.5
R6 Gandangara	1.5
R7 Gandangara North	1.6
R8 The Ridge Sports Complex	2

10.2.2 Background noise

Background noise levels have been provided by SITA (SITA 2008). The noise measurements were undertaken in 2008 and are considered representative of current conditions. The noise levels are typical of a suburban residential area. Additional background measurements were undertaken at two locations within ANSTO by GHD (refer to Figure 10.1). Both sets of data are summarised in Table 10.2. Background monitoring charts for the monitoring undertaken in 2014 are provided in Appendix E.

Table 10.2 Summary of measured noise levels, dB(A)

Noise monitoring locations	Rating background level			Ambient level, $L_{Aeq(period)}$		
	Day	Evening	Night	Day	Evening	Night
	7 am to 6 pm	6 pm to 10 pm	7 am to 6 pm	7 am to 6 pm	6 pm to 10 pm	7 am to 6 pm
67 Thomas Mitchell Drive, Barden Ridge	42	38	33	54	51	46
22 Mountain Street, North Engadine	40	36	32	54	47	49
ANSTO Motel (Location 1)	41	38	36	57	45	48
ANSTO (Location 2)	48	47	41	58	54	53

10.2.3 Noise criteria

The 'Interim Construction Noise Guideline' (DECC 2009) is used to assess noise impacts associated with construction works. This guideline involves the following:

Recommended hours of construction

The recommended standard construction hours are:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm
- Sundays and public holidays: no work permitted

Construction outside the recommended standard hours

The five categories of works that might be undertaken outside the recommended standard construction hours are:

- Delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- Public infrastructure works that shorten the length of the proposal and are supported by the affected community
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Noise management goals

People's reaction to noise from construction will depend on the time of day that works are undertaken. Residents are usually most annoyed by work at night-time as it has the potential to disturb sleep.

The management levels for noise at residences are listed below and described in Table 10.3. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level. The rating background level (RBL) is used when determining the management level. The RBL is the overall background noise level measured in each relevant assessment period. The term RBL is described in detail in the 'NSW Industrial Noise Policy' (INP) (DECCW 2000).

Table 10.3 Noise at residences using quantitative assessment, Interim Construction Noise Guideline

Time of day	Management level LAeq(15min)	Explanation and approach
Recommended standard construction hours	Noise affected - RBL plus 10 dB(A)	The noise affected level represents the level above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected - 75 dB(A)	The highly noise affected level represents the level above which there may be strong community reaction to noise. Where noise is above this level, the relevant consent, determining or regulatory authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:

		1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended hours	Noise affected - RBL plus 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

A summary of the noise management levels for the proposed construction works are provided in Table 10.4 for each sensitive receiver area.

Proposal-specific construction noise goals

Table 10.4 provides proposal-specific noise goals at the surrounding residential receivers during recommended standard hours and outside of the recommended standard hours.

Table 10.4 Proposal construction noise management levels, dB(A)

Receiver	Noise management levels, $L_{Aeq(15min)}$	
	Recommended standard hours	Outside recommended standard hours
R1 Engadine	50	37
R2 Barden Ridge	52	38
R3 Menai[2]	50	37
R4 ANSTO	70	-
R5 ANTSO Motel[1]	70	41
R6 Gandangara[2]	50	37
R7 Gandangara North[2]	50	37
R8 The Ridge Sports Complex	65	-

Note 1: Assumed to be a residential receiver out of hours and a commercial receiver during standard construction hours.

Note 2: The noise criteria are based on the North Engadine noise monitoring location.

Operational noise criteria

The proposal-specific operational noise criteria are summarised in Table 10.5.

The proposal noise criteria reflect the most stringent noise criteria derived from the intrusive and amenity criteria. Note that the intrusive criteria is assessed over a 15-minute period whereas the amenity criteria is assessed over the entire day, evening or night-time period.

Table 10.5 Proposal operational noise criteria

Receiver	Time period	Amenity criteria (acceptable noise level)[1] $L_{Aeq(period)}$	RBL, $L_{Aeq(15min)}$	Intrusive criteria, $L_{Aeq(15min)}$	Proposal specific noise criteria (external)	Sleep disturbance criteria L_{Amax} (external)
Residential (R1, R3, R6, R7)	Day	55	40	45	45 $L_{Aeq(15min)}$	-
	Evening	45	36	41	41 $L_{Aeq(15min)}$	-
	Night	40	32	37	37 $L_{Aeq(15min)}$	47 L_{Amax}
Residential (R2)	Day	55	42	47	47 $L_{Aeq(15min)}$	-
	Evening	45	38	43	43 $L_{Aeq(15min)}$	-
	Night	40	33	38	38 $L_{Aeq(15min)}$	48 L_{Amax}
R4 ANSTO	When in use	65	-	-	65 $L_{Aeq(when\ in\ use)}$	-
R5 ANSTO Motel[2]	Day	65	-	-	65 $L_{Aeq(when\ in\ use)}$	-
	Night	40	36	41	40 $L_{Aeq(15min)}$	51 L_{Amax}
R8 The Ridge Sports Complex	55	-	-	-	55 $L_{Aeq(when\ in\ use)}$	-

Note 1: With consideration to the INP 'noise amenity area' classification, the residential receivers surrounding the proposal site have been classified as 'suburban'.

Note 2: Assumed to be a residential receiver during the night-time period and a commercial receiver during the day-time period.

Traffic noise criteria

The NSW Road Noise Policy (RNP) (OEH 2011) provides traffic noise target levels for residential receivers in the vicinity of existing roads (Table 10.6).

The application notes[6] for the RNP state that '*for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development*. *This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.*'

If road traffic noise increases from the development and is within 2 dB(A) of current levels, then the objectives of the RNP are met.

Table 10.6 Traffic noise target levels, $L_{Aeq(period)}$, dB(A)

Type of development	Day 7 am – 10 pm	Night 10 pm – 7 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 Leq(15hr)	55 Leq(9hr)
Existing residence affected by additional traffic on local roads generated by land use developments	55 Leq(1hr)	50 Leq(1hr)

[6] http://www.environment.nsw.gov.au/noise/roadnoiseappnotes.htm 12 December 2012

10.3 Assessment of potential impacts

10.3.1 Construction

Noise modelling results

The following activities were included as part of the construction noise impact assessment:

- Relocation of the GO facility including the following:
  - Earthworks and civil infrastructure: Site preparation, vegetation clearing, construction of temporary drainage works, bulk earthworks, pavement construction, installation of utility services and other miscellaneous civil construction activities
  - Construction of building infrastructure and concrete bunkers: Onsite buildings would be constructed and pre-fabricated concrete bunkers would be installed
  - Installation of equipment and services including covers and the aeration system
  - Commissioning
- Construction works for the ARRT facility including the following:
  - Earthworks and civil infrastructure works including site preparation, vegetation clearing, construction of temporary drainage works, bulk earthworks, pavement construction, installation of utility services and other miscellaneous civil construction activities
  - Building infrastructure construction: concrete would be delivered to site pre-mixed and items formed and constructed on site
  - Installation of mechanical equipment and large plant and services
  - Internal fit-out of the ARRT facility
  - Commissioning

Construction would be undertaken during recommended standard construction hours of Monday to Friday: 7 am to 6 pm, Saturday: 8 am to 1 pm and no work on Sundays or public holidays.

Owing to the longer term nature of the reprofiling works and the similarity of equipment relative to the operation of the landfill, the reprofiling works are considered in the operational impact assessment.

A summary of the predicted construction noise levels are shown in Table 10.7.

Table 10.7 Predicted construction noise levels at surrounding receivers, dB(A)

Receiver	Criteria, $L_{Aeq(15min)}$		Predicted noise level, $L_{Aeq(15min)}$
	Recommended standard hours	Outside recommended standard hours	GO/ARRT facility construction
R1 Engadine	50	37	27
R2 Barden Ridge	52	38	25
R3 Menai	50	37	22

R4 ANSTO	70	-	37
R5 ANTSO Motel	70	41	32
R6 Gandangara	50	37	31
R7 Gandangara North	50	37	30
R8 The Ridge Sports Complex	65	-	28

Construction activities are predicted to comply with the 'Interim Construction Noise Guideline' (DECC 2009) construction noise management levels at all residential and sensitive receivers during standard and outside of standard recommended hours. Specific construction mitigation measures are therefore not necessary to be recommended.

Vibration

The nearest sensitive receivers are over 300 m from the proposal site. Due to the distance from the proposal site, construction vibration impacts are not anticipated at any sensitive receivers. Hence, specific vibration mitigation measures are not considered necessary.

10.3.2 Operation

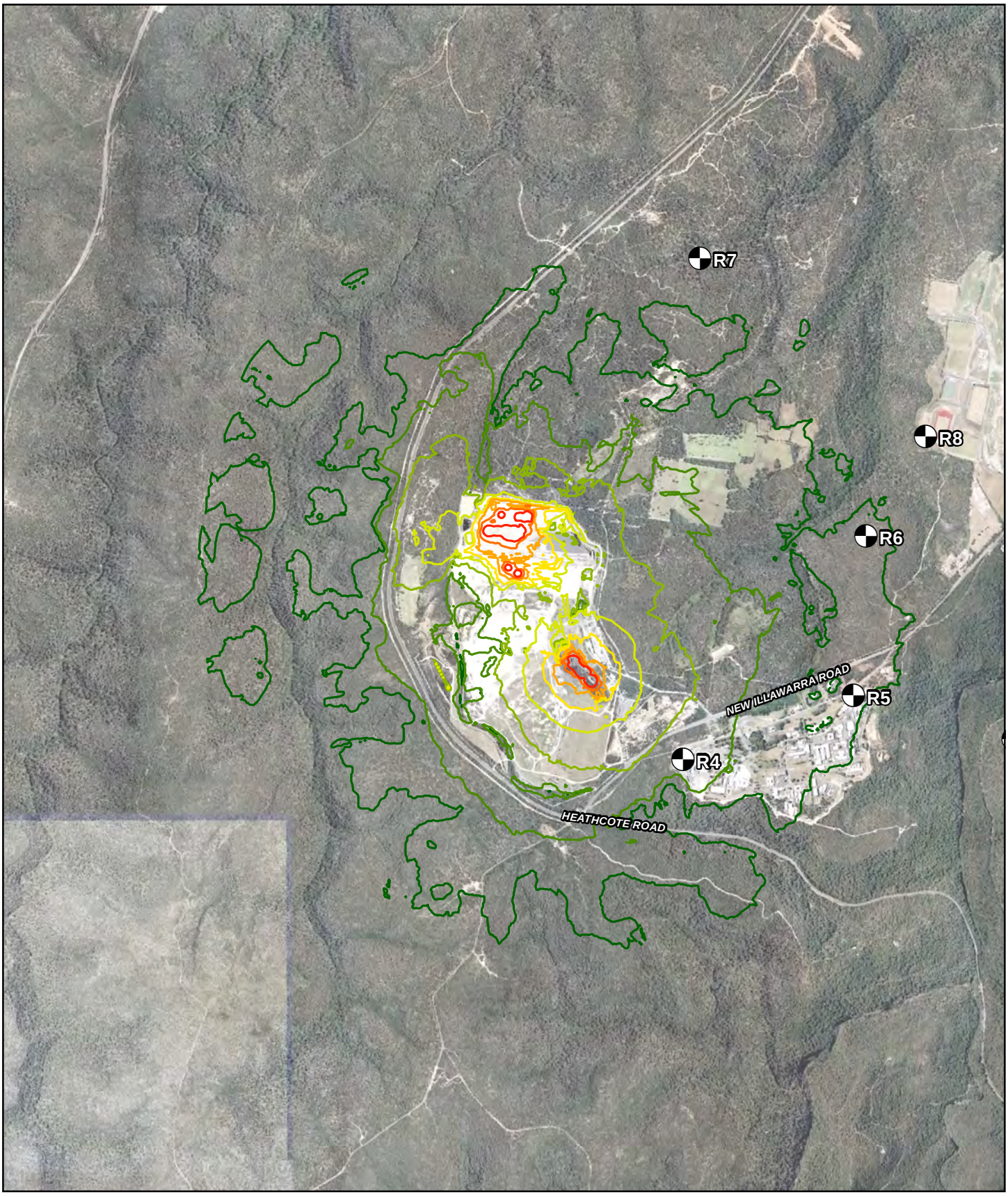
Noise modelling was undertaken assuming all equipment to be operational in the landfill, GO and ARRT areas. Predicted noise levels are provided below in Table 10.8.

As site operations are proposed to commence at 6 am, the most stringent night time operational noise criteria would apply for the operational noise assessment. The results show that the predicted noise levels during operation would comply with the most stringent night-time criteria, assuming all equipment to be operational in the landfill, GO and ARRT facility areas.

Table 10.8 Predicted operational noise levels

Receiver	Noise criteria dB(A)		Predicted noise level, LAeq(15min) dB(A)
	Day	Night	
R1 Engadine	45	37	31-32
R2 Barden Ridge	47	38	29
R3 Menai	45	37	26-27
R4 ANSTO	65	-	40-48
R5 ANSTO Motel	65	40	36-40
R6 Gandangara	45	37	37
R7 Gandangara North	45	37	31-34
R8 The Ridge Sports Complex	55	-	35

Noise contour maps for the existing and future scenarios are shown in Figure 10.2, Figure 10.3 and Figure 10.4.



LEGEND

Noise sensitive receiver

Sound pressure level, dB(A)

35
40
45
50
55
60
65
70

Paper Size A4

0 125 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

SITA Australia
Lucas Heights Resource Recovery Park
Predicted LHRRP night-time operational noise levels - current landform

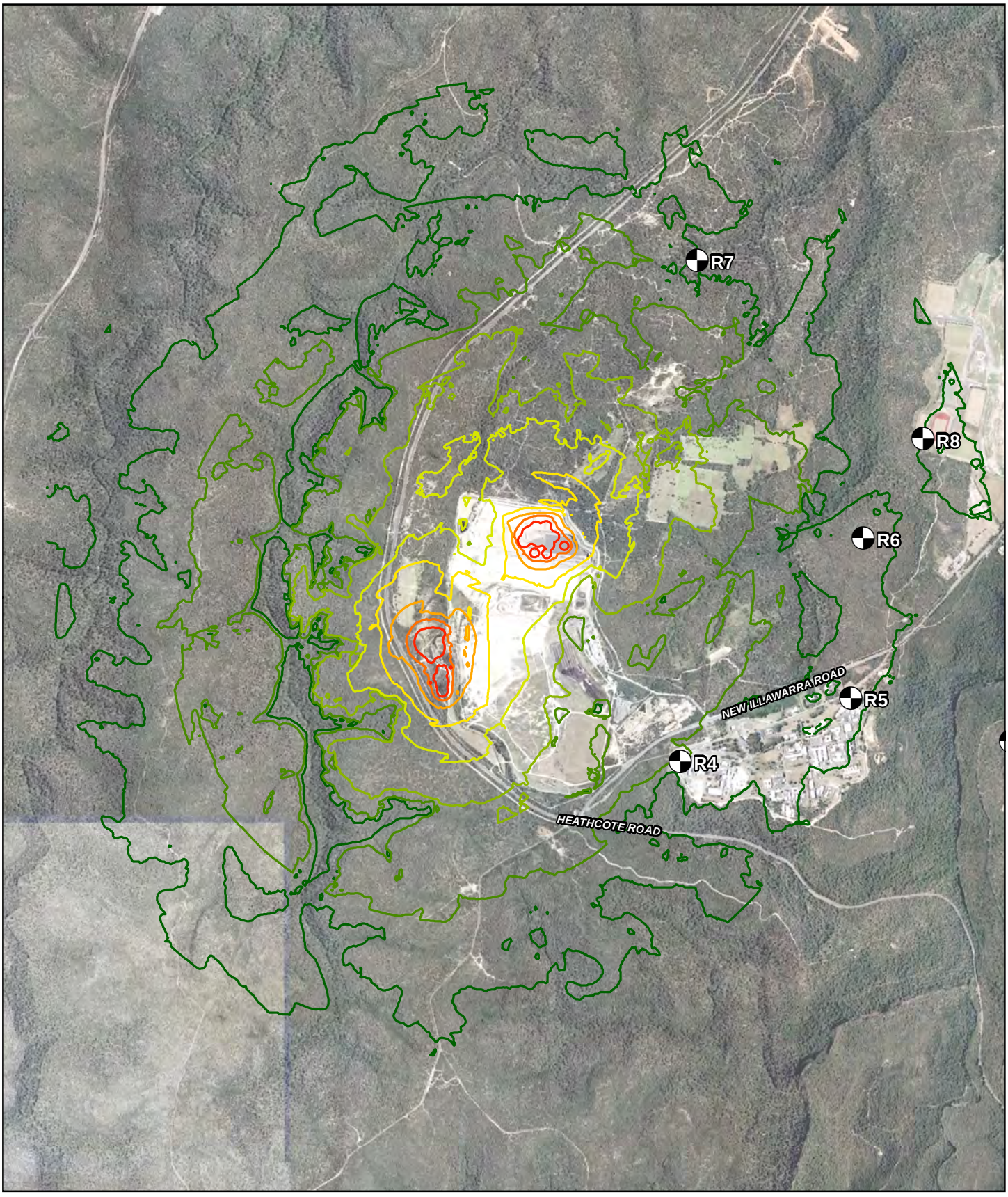
Job Number 21-23482
Revision Draft
Date 31 Mar 2015

Figure 10.2

\\ghdnet\ghd\AU\Sydney\Projects\21\23482\GIS\Maps\MXD\21-23482-Z049_CurrentNoiseLevels.mxd

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

Aerial Imagery: ESRI, 2014. Works: GHD/SITA, 2014. Roads: NSW LPMA, 2012. Created by:ppandey



LEGEND

Noise sensitive receiver

Noise contours (dB(A))

- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70

Paper Size A4

0 125 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

SITA Australia
Lucas Heights Resource Recovery Park
Predicted LHRRP operational noise levels - future landform (northern area profiling works)

Job Number 21-23482
Revision Draft
Date 31 Mar 2015

Figure 10.3

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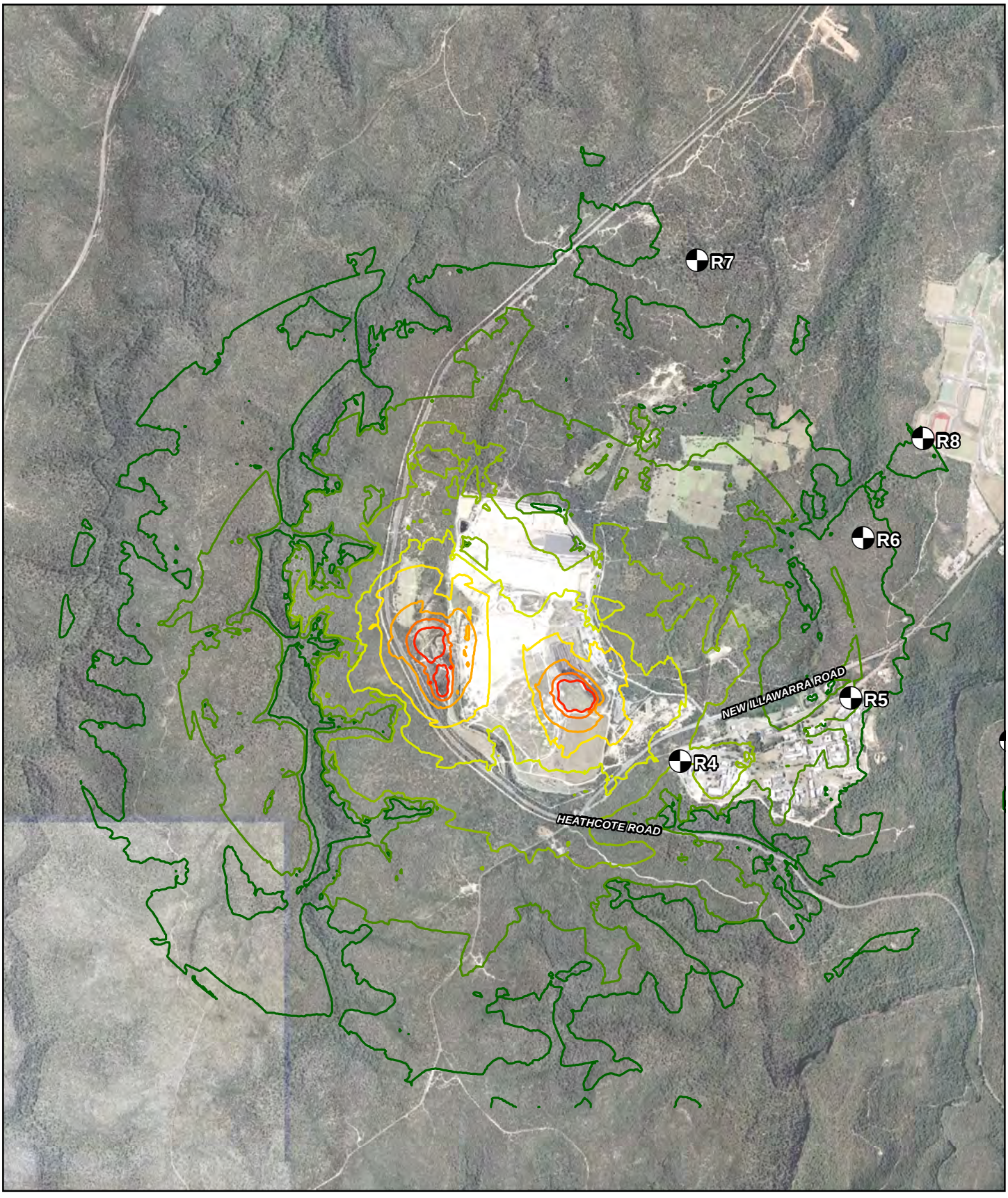
Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Aerial Imagery: ESRI, 2014. Works: GHD/SITA, 2014. Roads: NSW LPMA, 2012. Created by:ppandey



LEGEND

Noise sensitive receiver

Noise contours (dB(A))

- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70

Paper Size A4

0 125 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

SITA Australia
Lucas Heights Resource Recovery Park
Predicted LHRRP operational noise levels - future landform (southern area profiling works)

Job Number 21-23482
Revision Draft
Date 31 Mar 2015

Figure 10.4

\\ghdnet\ghd\AU\Sydney\Projects\21\23482\GIS\Maps\MXD\21-23482-Z050_FutureNoiseLevels_Level15.mxd

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

Aerial Imagery: ESRI, 2014. Works: GHD/SITA, 2014. Roads: NSW LPMA, 2012. Created by:ppandey

Traffic noise

The additional traffic generation from the proposed LHRRP modification in 2027 has been estimated in Table 10.9 **as approximately 432 vehicles per day**. Consistent with the assumptions of the traffic impact assessment, the split has been assumed at 50/50 between the two main road routes; New Illawarra Road and Heathcote Road.

Table 10.9 Estimated traffic from LHRRP in 2027

Road	Additional vehicle trips per day
New Illawarra Road	216
Heathcote Road	216

Note: the estimated traffic daily volumes in the above table includes contributions from the reprofiling works, GO and ARRT.

As can be seen, the relative proportion of additional traffic from the proposal relative to existing traffic volumes, and by extrapolation, in 2027, is very low. Based on the United Kingdom Department of Transport Calculation of Road Traffic Noise algorithm, the increase in traffic noise emissions from the proposal is not predicted to be noticeable (<0.1 dB(A)). Since the additional traffic generation from the proposal is predicted to increase road traffic noise emission levels by less than 2 dB(A), the road traffic noise levels from the proposal are predicted to comply with the RNP noise criteria at sensitive receivers along the traffic routes.

10.4 Mitigation and management measures

A comprehensive list of prevention, mitigation and rectification measures have been identified and are detailed in the LHRRP OEMP (Appendix S), ARRT facility (Appendix U) and GO facility OEMP (Appendix T). The identified mitigation and rectification measures would be implemented as required and their exact details would be based on a case by case situation depending on the issue and technical solutions available at the time.

Examples of key measures that are included in the OEMPs are provided in the sections below.

LHRRP

- Limit waste receival hours
- Select plant and equipment to minimise noise emissions where possible whist maintaining efficiency of function. Fit residential grade silencers and maintain all noise control equipment in good order
- Maintain all machinery and equipment in proper working order in accordance with manufacturer's requirements
- No activities of heavy machinery outside site operating hours
- Site inductions will include a noise component

GO facility

- Select plant and equipment to minimise noise emissions where possible whist maintaining efficiency of function. Fit residential grade silencers and maintain all noise control equipment in good order
- Restrict operations to designated areas
- Restrict noisy activities to daylight hours

- Use reverse quackers with a low decibel output rather than beepers for excavators and wheel loaders
- Utilise favourable routes for accessing and exiting the facility to ensure avoidance of residential areas where possible

ARRT facility

- Conduct all operations within buildings
- Use reverse quackers rather than alarms with a low decibel output for excavators and wheel loaders
- Utilise favourable routes for accessing and exiting the facility to ensure avoidance of residential areas where possible
- Noise reduction measures fitted within the buildings

10.5 Conclusions

Construction activities are predicted to comply with the 'Interim Construction Noise Guideline' (DECC 2009) construction noise management levels at all sensitive receivers both during standard and outside of standard recommended hours. The nearest sensitive receivers are over 300 m from the proposal site. Due to the distance from the proposal site, construction vibration impacts are not anticipated at any sensitive receivers.

The noise levels, assuming all equipment to be operational at the landfill, GO facility and ARRT facility (a conservative assumption), are predicted to comply with all noise criteria. The road traffic noise levels from the proposal are also predicted to comply with the noise criteria at sensitive receivers along the traffic routes.

This assessment addresses the SEARs and concludes that the proposal would meet the following objectives:

- No significant impacts on the community or environment
- Prevent the degradation of local amenity
- Prevent noise pollution.

11. Visual

The information presented in this chapter is based on the findings of the visual impact assessment undertaken by GHD. The visual impact assessment report is included in Appendix F of this EIS.

11.1 Approach and methodology

The visual impact assessment was prepared with reference to The Landscape Institute and the Institute for Environmental Management and Assessment in the UK (2013) 'Guidelines for Landscape and Visual Impact Assessment, Third Edition'. The assessment included:

- Review of the various aspects of the proposal, primarily in terms of scale, bulk earthwork requirements, technical specifications, and landscaping.
- Analysis of the subject site, particularly with regard to visual qualities, visual exposure, landscape values and characteristics.
- Identification of a theoretical visual catchment and potential visual receptors, and the subsequent identification of key sensitive receptor groups.
- Rating of sensitivity of representative receptors groups.
- Identification of potential impacts on identified key receptor groups and rating of magnitude of impacts for each receptor group.
- Rating of impact significance on each receptor group. The significance of impacts has been evaluated as a product of:
  - the sensitivity or value of the receptor being affected; and
  - the magnitude of impacts on the identified receptor.
- Identification of potential mitigation measures for any impacts seen to exceed community expectations or planning intents for the proposal site and for this type of development.

The assessment included extensive desktop analysis as well as a number of site investigations during September and October 2014. The desktop analysis included a review of:

- GIS data sets
- aerial photography
- models of the local topography
- the proposal.

During the site investigations, the weather was fair, with some haze but was regarded as typical weather for the locality.

A number of photomontages (three in total) were also prepared by GHD to inform the assessment.

11.1.1 Objectives

In addition to addressing the SEARs, the visual impact assessment provides an assessment of how well the proposal meets SITA's objectives of having no significant impacts on the community or environment. The main identified objective for the proposal is to have no significant visual impacts on the community.

11.1.2 Assessment magnitude and significance

Impact magnitude

Impact magnitude was evaluated based on variables such as: the extent of the proposal that would be visible, the proportion of the visible parts of the proposal to the entire view, the nature and intensity of the impacts, whether key features were obscured or affected, the geographic extent of the impacts, the duration and reversibility of particular impacts, and the likelihood of occurrence of impacts.

As for receptor sensitivity, the nature and the magnitude of impacts were rated. Table 11.1 below describes impacts that constitute each rating.

Table 11.1 Visual impact magnitude description

Rating	Descriptor
High	Severe consequences, significant at a regional level, likely to be unacceptable at a regional level. Large number of people measurably affected. Substantial / obvious changes due to total loss of, or change to, elements, features or characteristics of the landscape which are regionally significant.
Moderate	Moderate consequences, significant at a local level and likely to be unsatisfactory at a local level. Discernible changes due to partial loss of, or change to the several elements, features or characteristics of the landscape which are locally significant.
Low	Low consequences, significant at a local level, likely to a satisfactory at a local level providing appropriate mitigation measures are implemented. Minor change in the landscape due to loss or change to one or two elements, features, or characteristics of the landscape which are locally significant.
Negligible	No consequences or significance. Almost imperceptible or no change to the landscape as there is little or no loss of / or change to the elements, features or characteristics of the landscape.

Impact significance

The significance of impacts was evaluated as a product of:

- the sensitivity or value of the environment or receptor being affected; and
- the magnitude of impact on that environment or receptor.

Again a rating is assigned, based on the matrix presented at Table 11.2. The ratings themselves are not a determination of the acceptability of the proposal, they are simply a means of comparing impacts on different receptors, and with consideration of different impacts.

The process of assessment and the use of ratings tables reflects typical outcomes for visual impacts, particularly:

- Impacts on receptors that are particularly sensitive to changes in views and visual amenity are more likely to be significant.
- Impacts on receptors at scenic routes or lookouts are more likely to be significant.

- Impacts that constitute a substantial change to the visual environment a likely to be more significant than impacts that do not cause substantial change.

Table 11.2 Visual impact significance rating

Receptor Sensitivity	Impact magnitude			
	High	Moderate	Low	Negligible
High	High	Moderate-High	Moderate	Low
Moderate	Moderate-High	Moderate	Moderate-Low	Negligible
Low	Moderate	Moderate-Low	Low	Negligible
Negligible	Low	Negligible	Negligible	Negligible

Typically, impacts with a significance rating of moderate or higher pose some concern and flag the need for mitigation measures. However, no rating is intended to indicate the acceptability or unacceptability of the proposal.

11.2 Existing environment

11.2.1 Surrounding landscape

The landscape surrounding the LHRRP facility is a predominantly a natural landscape defined by reasonably dense vegetation and dramatic topography. These natural landscapes are interrupted by the LHRRP and the ANSTO facility, and the reasonably busy New Illawarra Road and Heathcote Road.

The undulating landscape provides reasonably expansive views from a number of vantage points, but access to such vantage points are limited.

11.2.2 Sensitive receptors

Sensitive visual receptors are defined as a person and/or viewer group that would experience a potential impact. They are considered in terms of viewing locations where the proposal may be visible to residents, or areas where visitors spend extended amounts of time. Sensitive receptors include houses as well as areas from which fixed or transient views would be possible, but where the time of stay is shorter, such as roads, lookouts, or recreational areas.

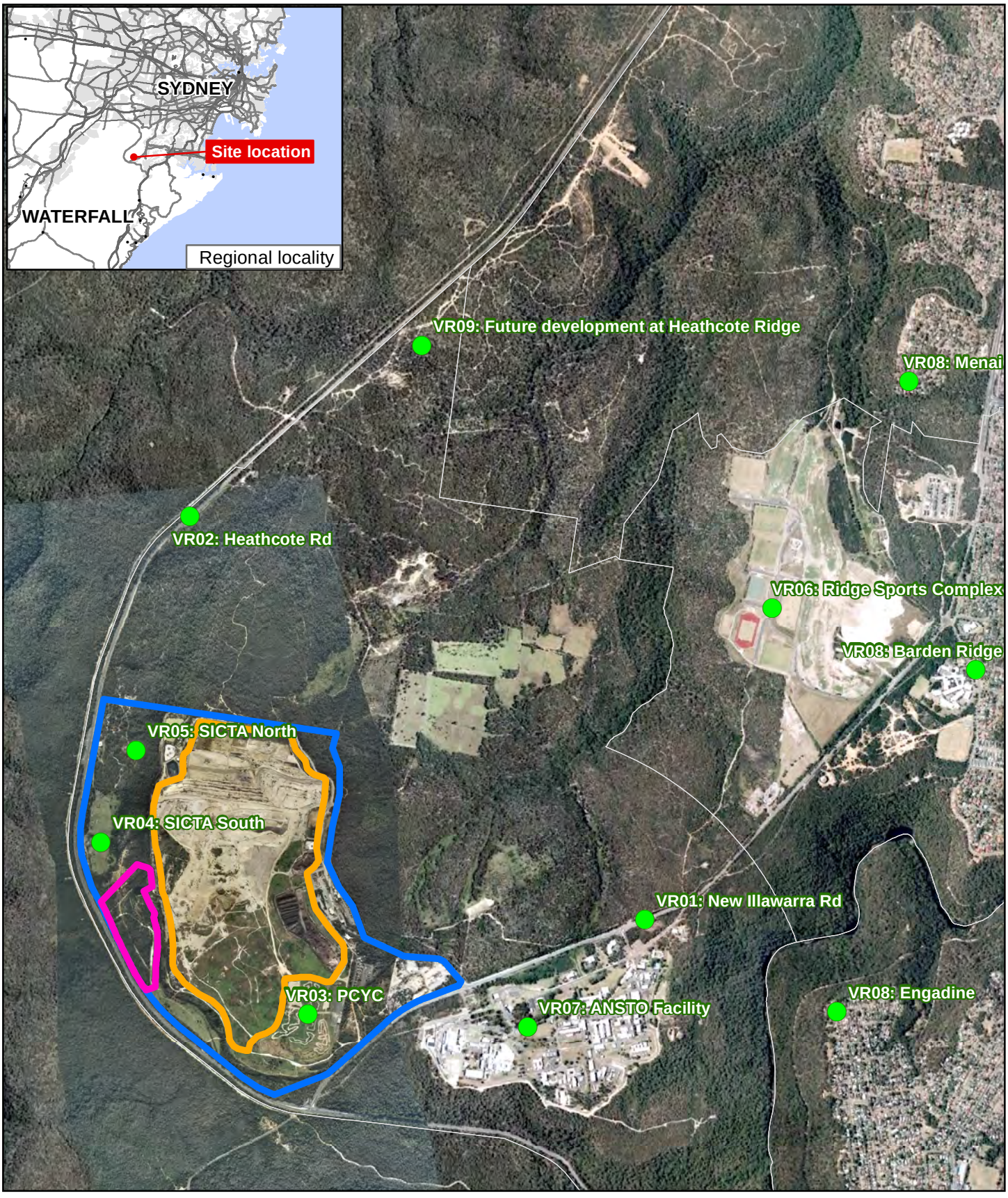
Visual receptors were initially identified through desktop assessment, including review of aerial photography and GIS datasets, as well as preparation of a visual catchment map for the proposal.

Nine representative viewpoints were identified. The viewpoints were selected to provide a representative range of views for the study area (i.e. views from the road, views from recreation areas, views from elevated residential areas to the north-west, north-east, and east). The selected viewpoints are described below and shown on Figure 11.1.

- VR01 – Travellers along New Illawarra Road
- VR02 – Travellers along Heathcote Road
- VR03 – Receptors at the PCYC
- VR04 – Receptors at the southern part of the SICTA Gun Club
- VR05 – Receptors at the northern part of the SICTA Gun Club
- VR06 – Receptors at the Ridge Sporting Complex

- VR07 – Receptors at the ANSTO Facility
- VR08 – Existing residents to the north and east of the proposal site (Engadine, Barden Ridge, and Menai)
- VR09 – Future residents to the north-west of the proposal site (Heathcote Ridge)

For VR01 and VR02, the visual assessments were undertaken with consideration of the entire road section that may be subject to visual impacts. Figure 11.1 shows where the photographs in the sections below were taken from. As both Illawarra Road and Heathcote Road are high speed roads, it was not considered safe to stop and take a photo at where the 'worst impact' could be experienced. The assessments however discuss the impact that may be experienced for travellers driving along the roads.



LEGEND

- Lucas Heights Resource Recovery Park boundary
- Proposed ARRT/GO facilities
- Landform re-profiling extents
- Visual receptors

Paper Size A4

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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SITA Australia
Lucas Heights Resource Recovery Park

Job Number	21-23482
Revision	A
Date	05 May 2015

Locations of receptor groups

Figure 11.1

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

N:\AU\Sydney\Projects\21\23482\GIS\Maps\MXD\21_23482_Z059_LocationsOfReceptorGroups.mxd

Aerial Imagery: Google 2015 and ESRI 2015. LHRRP Boundary: GHD, 2014. Roads/Suburbs: NSW LPMA 2012. Location Data: GEOSCIENCE AU 2014. Created by:jrichardson

11.3 Assessment of potential impacts

11.3.1 Potential impact generators

The following components are considered to be potential impact generators:

- Changes to landform profiles and materials stockpiles
- Visibility of the proposed ARRT facility building and relocation of the GO facility

Based on desktop and site investigations – landform profile increases are likely to be greatest impact generator for the majority of identified receptors. The waste would be placed to a level which would result in a landform with maximum height of RL 179.9 m AHD after settlement (includes waste and final cap). This is approximately 8 m above the level which is currently approved.

Table 11.3 shows a summary of the different proposed heights.

The maximum height of the constructed surface at the highest point of the reprofiled landfill would not exceed RL 184.9 m AHD (includes waste and final cap). This means that the highest point of the reprofiled landform, located near the centre of the site, would be approximately 2 m above the height of the existing stockpile (2015) which is located towards the northern end of the site.

Table 11.3 Proposed heights for final landform

	Height (m AHD)			Height (m AHD)
Approved landform	172	Proposed landform	Pre-settled	184.9
			Post-settled	179.9

It is noted that these changes would be incremental over the life of the proposal and would be subsequently revegetated to attractive landscapes.

The construction and operation of the ARRT and GO facilities are likely to only affect identified receptors to the western extent of the LHRRP site (gun club, road users) as the existing topography surrounding the LHRRP and associated increased landform of the proposal would screen the presence of the proposed facilities for all receptors to the east of the proposal site.

11.3.2 Assessment of viewpoints

VR01 – Travellers along New Illawarra Road

Photo 11.1 Representative view from receptor group VR01

New Illawarra Road, bordering the eastern extent of the LHRRP, traverses a distinctive transition in landscape character from the peri-urban landscape of the south-west extent of Sydney into the more remote and natural landscape character associated with the heavily vegetated extents of Lucas Heights Conservation Area, Holsworthy Military Reserve and the northern extents of Heathcote National Park.

As the road users travel southbound through the Old Illawarra Road intersection and past the ridge sporting complex, this landscape character transition is most apparent, with little to no sign of residential or commercial/industrial development, other than the ANSTO facility which becomes visible as users approach the LHRRP.

The undulating topography of the road presents a series of crests and depressions. For the most part, views from the road are restricted by roadside vegetation. However, some ridges offer fleeting views to the distance. Where views beyond the immediate road corridor are achieved, the extended view is of vegetation canopy only – reinforcing the natural and remote character of the surroundings.

Consequently, as the road users approach the LHRRP from the north, even when in close physical proximity to the proposal site, there is little visual sign of the existing landfill activities. If the user was travelling the route for the first time, they would only become aware of the LHRRP once passing the entrance or viewing the road signage adjacent to the entrance.

Table 11.4 VR01 Impact assessment

Consideration	Rating and comment
Sensitivity	**Low** The sensitivity of the road users to change on the subject site would be low. Although the overall landscape character south of Menai and Barden Ridge could be described as attractive natural

	landscape, road users are not subject to any existing significant views of regional or even local significance due to the constraints of existing roadside vegetation and the existing topography of the area.
Magnitude	**Negligible** The only elements of the proposal which are likely to be visible are the landform re-profiling. The proposal is unlikely to be visible from the majority of the road corridor due to the existing topography and roadside vegetation. Where it might be visible, views would be fleeting. Once the proposed plantings are completed, the operations including the landfill, GO facility and ARRT facility are not likely to be visible from the adjacent New Illawarra Road and Heathcote Road. Where the reprofiled landform is visible, it would only be the upper limits of the landform profile that would be visible, and the change to the view would be incremental and difficult to discern. Figure 11.5 includes a photomontage of the proposal from a vantage point on New Illawarra Road.
Impact Significance	**Negligible**

VR02 – Travellers along Heathcote Road

Photo 11.2 Representative view from receptor group VR02

Heathcote Road continues past the southern and western boundaries of the LHRRP, and, like New Illawarra Road, accommodates significant volumes of traffic.

Also like New Illawarra Road, the visual experience of Heathcote Road is largely defined by the existing roadside vegetation. There are however, fleeting glimpses to elevated topography within the Holsworthy Military Reserve to the west of the road.

Specifically, as users travel north on Heathcote Road, along the western edge of the LHRRP from the south-western corner, elevated topography affords expansive views out of the immediate road corridor – over the considerable extents of Holsworthy Military Reserve and further north. The prevailing experience is defined by views of the natural landscape.

As users continue north along the western extent of the LHRRP, views are largely constrained by the roadside vegetation. In selected locations, gaps in roadside vegetation allow views to the east over the landfill extents and stockpile of the LHRRP. The very brief duration and extents of these views substantially limits the perceived presence of the LHRRP and would limit the potential for noticeable impacts arising from changes on the proposal site.

Similarly to New Illawarra Road, if a road user was to travel along Heathcote Road for the first time, there would be almost no visible indication of the LHRRP – it is likely the road user would only become aware of the LHRRP once passing the entrance or viewing the road signage adjacent to the entrance.

Table 11.5 VR02 Impact assessment

Consideration	Rating and comment
Sensitivity	**Moderate** The sensitivity of the road users to change would be moderate. The overall landscape and visual context of the road can be described as predominantly natural, with little sign of development. The majority of the road corridor views are constrained by the adjacent roadside vegetation, however the road users are subject to some existing views of regional significance, over the surrounding natural context including the Holsworthy Military Reserve.
Magnitude	**Low** The elements of the proposal which are likely to be visible from the road are the reprofiled landform, components of the ARRT and GO facilities, such as the ARRT column and large buildings of the facilities The proposal is unlikely to be visible from the majority of the road corridor immediately adjacent to the LHRRP due to the existing topography and roadside vegetation. The proposal may be visible from some locations along the road but where it is visible, views would be fleeting. Once the proposed plantings are completed, the operations including the landfill, GO facility and ARRT facility are not likely to be visible from the adjacent New Illawarra Road and Heathcote Road. Where the reprofiled landform is visible, it would only be the upper limits of the landform profile that would be visible, and the change to the view would be incremental and difficult to discern. Figure 11.5 includes a photomontage of the proposal from a vantage point on New Illawarra Road.
Impact Significance Rating	**Moderate-Low**

VR03 – Receptors at the PCYC

Photo 11.3 Representative view from receptor group VR03

As the PCYC falls within the overall site boundary of the LHRRP, the primary outlook is to the north, and is dominated by the existing landfill operations and activities.

PCYC users are however also afforded expansive views to the south and west across the densely vegetated surroundings of the Holsworthy Military Reserve. To the east, the ridge on the eastern side of the Woronora River restricts views, and is largely characterised by the prominent industrial development of the ANSTO site.

Table 11.6 VR03 Impact assessment

Consideration	Rating and comment
Sensitivity	**Low** Given the existing outlook on to the LHRRP site, and considering the nature of activity undertaken by the users, the receptors of the PCYC facility would be likely to have a low level of vulnerability to change. The PCYC is afforded attractive views to the east and south of the area towards the Holsworthy Military Reserve and the distant silhouette of the CBD skyline to the north-east – however these views are marginalised by the imposing visual presence of the landfill surroundings.
Magnitude	**Low** The elements of the proposal which are likely to be visible are the landform reprofiling, and components of the ARRT and GO facilities, such as the ARRT column and major built structures. The proposal would create a visual impact for the PCYC users, as the landform reprofiling and associated activities will take place in closer proximity to the PCYC than the existing operations of the proposal site, but the ultimate magnitude of change to the nature or quality of the views is unlikely to be significant. It is relevant to note however, that it would be possible to improve the current and future outlook for these receptors through screen planting between the facility and the proposed development.
Impact	**Low**

Significance Rating	

VR04 – Receptors at the southern part of the SICTA Gun Club

Photo 11.4 Representative view from receptor group VR04

The southern portion of the gun club site is separated from Heathcote Road by a dense band of roadside buffer vegetation – providing the backdrop to an open, expansive and exposed east facing shooting range. The lack of mature vegetation across this area and the existing topography of the LHRRP ensure this portion of the site has an expansive outlook which is largely defined by the western extent of existing LHRRP landfill areas as well as the stockpile location.

Table 11.7 VR04 Impact assessment

Consideration	Rating and comment
Sensitivity	**Low** Given the existing outlook on to the LHRRP site, the users of the southern part of the gun club would be likely to have a low level of vulnerability to change.
Magnitude	**Moderate** The elements of the proposal which are likely to be visible are the landform re-profiling, and the majority of the ARRT and GO facilities. The magnitude of change from the construction and operation of the ARRT and GO facilities would be moderate, due to the close physical and visual proximity to the southern extent of the gun club area and a lack of existing vegetation to separate and screen the proposed facilities. The magnitude of change associated with the landform height increases would occur incrementally over time, and as such the overall impacts associated with the increased landform would be low. Overall the magnitude of change would be moderate. The

	proposal would create a visual impact for the gun club users at the southern part of the club, but the ultimate magnitude of change to the nature or quality of the views is unlikely to be significant. Certainly, no aspect of the outlook that is of any particular value or significance will be affected. It is relevant to note however, that it would be possible to improve the current and future outlook for these receptors through screen planting between the facility and the proposed development.
Impact Significance Rating	**Moderate-Low**

VR05 - Receptors at the northern part of the SICTA Gun Club

Photo 11.5 Representative view from receptor group VR05

(Photo taken from top of sandstone stockpile)

The northern portion of the gun club site is much less visually exposed to the LHRRP due to the siting further north and the extent of existing mature vegetation across the majority of the northern portion of the site – as shown in the above photo.

Where views to the LHRRP facility are achieved the landfill and sandstone stockpile are prominent. However, even when these elements are visible, the visual character of this location is still largely defined by the natural landscape, rather than the LHRRP.

Table 11.8 VR05 Impact assessment

Consideration	Rating and comment
Sensitivity	**Moderate** The sensitivity of the northern gun club receptors would be higher than the sensitivity of the users within the southern portion of the site – despite the increased distance from the site, the views from this vantage points are better quality and more susceptible to change.
Magnitude	**Low**

	The main element of the proposal which is likely to be visible is the reprofiled landform. Overall, however, the proposal would cause a limited magnitude of change to existing views, even those that take in the stockpile. This is largely due to the extensive vegetative screening around most aspects of the proposal.
Impact Significance Rating	**Moderate-Low**

VR06 - Receptors at the Ridge Sporting Complex

Photo 11.6 Representative view from receptor group VR06

Users of the various recreational facilities at the Ridge Sporting Complex are afforded expansive views into the surrounding landscape to the south, west and north from various locations throughout the complex. These views are often limited by the topographic ridges and extensive existing vegetation on the ridgelines.

As users enter the site and travel along the southern perimeter road, views are confined by internal vegetation screening and landform to the south-west of the site. Once the landform rises to the top of the crest, the site topography falls towards the western boundary and expansive views to the south-west are afforded. Although the surrounding ridges to the south-west screen views of the existing landfill areas and operations, the large sandstone stockpiling is clearly visible above the ridge line as a contrasting landscape element of the existing vegetated surroundings.

This view is present for a number of vantage points within the western half of the sporting complex, including the parts of the golf course and driving range – unless screened by internal landform, buildings or structures. Towards the southern extent of the site, the site landform falls away and internal vegetation extents screen this view.

Table 11.9 VR06 Impact assessment

Consideration	Rating and comment
Sensitivity	**Moderate** The sensitivity of the sport complex users will be low to moderate, depending on the specific recreational activity. For activities such as athletics and team sports, the overall visual environment is less of a factor in the overall experience compared with activities such as golf or clay target shooting – where the surrounding visual landscape makes a much greater contribution to the user's overall experience.
Magnitude	**Moderate** The only elements of the proposal which are likely to be visible are the re-profiled landform. The magnitude of change associated with the landform height increases would occur incrementally over time, and as such the overall impacts associated with the increased landform would be low. Certainly, no aspect of the outlook that is of any particular value or significance will be affected. Figure 11.5 includes a photomontage of the proposal from a vantage point on New Illawarra Road.
Impact Significance Rating	**Moderate**

VR07 – Receptors at the ANSTO Facility

Photo 11.7 Representative view from receptor group VR07

(Taken from boundary of ANSTO facility on New Illawarra Rd)

As the majority of the ANSTO facility is inaccessible to the general public, existing views from this location could only be analysed from nearby, publicly-accessible locations (such as from New Illawarra Road, at the entry point to the ANSTO facility). In addition, views to the ANSTO

site from the LHRRP site were also considered as a means of checking the potential visibility of the proposal (i.e. reverse visibility analysis).

The existing topography and vegetation are likely to prevent any substantial views of the LHRRP from the ANSTO facilities. The reverse visibility analysis from the highpoints of the landfill areas within the LHRRP only show the upper parts of the ANSTO facilities – such as chimney stacks and pipework etc.

The stockpile may be visible from some of the eastern-most ANSTO facilities and areas, but it is likely that any views of the stockpile would be of the upper limits only, as the majority of the stockpile extents would be screened by existing mid-ground vegetation.

Table 11.10 VR07 Impact assessment

Consideration	Rating and comment
Sensitivity	**Negligible** The sensitivity of receptors at the ANSTO facility is negligible as any existing views towards the LHRRP are not likely to be appealing or significant. As employees at an industrial facility, most receptors would be unlikely to place particular importance or value on the surrounding visual environment.
Magnitude	**Low** The elements of the proposal which are likely to be visible are the landform re-profiling. The proposal would create a negligible magnitude of change for the ANSTO receptors due to the extents of screening vegetation between the LHRRP and the ANSTO site. The increased landform profile may become visible from the ANSTO site – however the extent of the landform visible is unlikely to create a significant magnitude of change to those existing views.
Impact Significance Rating	**Negligible**

VR08 – Existing residents to the north and east of the proposal site (Engadine, Barden Ridge, and Menai)

Photo 11.8 Representative view from receptor group VR08

The analysis of potentially affected residential areas was conducted from roadsides and publically accessible areas only. Assumptions about the extent and quality of views from private residences have been made from these publically accessible locations.

Receptors in residential areas of Menai, Barden Ridge, and Engadine have been grouped together as the visual environment, outlook, and quality of views is largely the same for all.

A number of suburbs adjacent to the proposal site have residential pockets with easterly and south-easterly outlooks across the Lucas Heights Conservation Area. The vast majority of these outlooks are constrained, and screened by the ridgelines, valleys, and vegetation of the conservation area. It is relevant to note that these residential areas are a significant distance from the LHRRP site (2.5 km or more) and as such, the visibility and potential visual impacts of the proposal will be substantially diminished.

For these reasons, the majority of the residential areas are not subjected to views of any obvious landfill activities or facilities, with the exception of the excavation stockpile. The mass and height of the stockpile makes it a visible (although not prominent) landscape feature that clearly contrasts with the densely vegetated surrounding landscapes.

Table 11.11 VR08 Impact assessment

Consideration	Rating and comment
Sensitivity	**Low** The sensitivity of the surrounding residential suburbs is low-moderate depending on the physical proximity and the existing viewpoints of the relevant residential areas. Several residential areas with potential views to the proposal also enjoy expansive views over semi-rural, vegetated surroundings. The majority of the receptors with potential views to the

Consideration	Rating and comment
	proposal are more than 3 km away – which lessens the overall visual sensitivity to the proposal.
Magnitude	**Low-Moderate** The elements of the proposal which are likely to be visible are the reprofiled landform and the taller components of the ARRT and GO facilities such as the ARRT column and major built structures. Existing views of the LHRRP are mostly only identified by the large stockpile of sandstone. The re-profiled landform of the proposal will occupy a larger physical area compared with the existing stockpile, but at a lower maximum height and with a more natural profile. In addition, this increased landform profile would occur incrementally over time and once completed would be vegetated to assist in the visual integration with its natural surroundings. These factors all contribute to reducing the overall magnitude of change for the residential receptors with views of the proposal.
Impact Significance Rating	**Moderate-Low**

VR09 – Future residents to the north-west of the proposal site (Heathcote Ridge)

The proposed Heathcote Ridge master planned community will be the closest residential development to the LHRRP (with the nearest houses approximately 2 km from the LHRRP site). The proposed scheme for this area appears to contemplate residential development within a bushland setting. As such, it is likely that existing and future vegetation would significantly affect views from future housing.

As the areas proposed for residential development are currently conservation areas and publically inaccessible – it is not possible to assess the potential visibility of LHRRP activities from these areas. As such, assumptions largely based on available contour information and vegetation densities and heights have been made about the potential views of the proposal from these areas.

Due to existing topography and significant extent of vegetation separating the future development areas and the LHRRP, it is unlikely that any significant views of the LHRRP would be present from the future residential pockets.

Further, it is reasonable to expect that any potential viewpoints of the LHRRP are achieved from future residential, commercial and recreational areas of Heathcote Ridge, the ongoing concept and detailed design phases would be likely to minimise the visual exposure of urban spaces within the master plan to the existing and proposed operations of the LHRRP.

Table 11.12 VR09 Impact assessment

Consideration	Rating and comment
Sensitivity	**Low** The sensitivity of the future Heathcote residential receptors would be low-moderate – the type of development appears to promote a high level of visual amenity, but would also be likely to focus views away from the existing LHRRP facility. Further, the development is a significant distance from the LHRRP site, which would diminish the visibility of the proposal.

Consideration	Rating and comment
	Also, the proposed landform reprofiling would most likely be substantially progressed by the time the potential first Heathcote Ridge development areas are developed – reducing the potential sensitivity of the residential areas to the further changes the proposal will create.
Magnitude	**Low** The only element of the proposal which is likely to be visible is the reprofiled landform. The landform would create a low magnitude of change to views from the future Heathcote ridge development. It is unlikely that unobstructed, significant views of the landfill operations would be commonly available from residential or recreational areas of the development given the significant extent of dense screening vegetation cover and existing topography visually separating the LHRRP from the future development. The magnitude of any potential impacts or views of the proposal from the future Heathcote Ridge development are also likely to be significantly reduced through the appropriate planning, siting and additional screening of the relevant residential, recreational and commercial land uses of Heathcote Ridge through the concept and detailed design phases of the master planning project.
Impact Significance Rating	**Low**

11.3.3 Photomontages

Final landform (2037)

Three photomontages of the final landform (in 2037) for receptor locations VR01, VR02, and VR06 have been prepared to assist with illustrating potential visibility of the proposal.

The photomontages presented are intended to represent the expected change in view that would be incurred for the proposal, when viewed from the identified view location. They are based on a 3 dimensional model of the proposal site incorporating data sourced from SITA, the NSW Department of Lands, and a site visit undertaken by GHD on 7 Sept 2012.

The process for preparing the photomontages ensures a reasonable level of accuracy. However, due to degrees of accuracy typical of GIS devices and digital models, the photomontages are not absolutely accurate. They are however suitable for the purposes of illustrating visibility and appearance of the proposal.

The photomontages are provided in the following figures.

The visualisations are intended to represent the expected change in view that would be incurred for the identified proposed landfill options, when viewed from the identified view location. The visualisation presented is based on a 3 dimensional model of the site incorporating data sourced from SITA, the NSW Department of Lands, and a site visit undertaken by GHD on the 7th Sept 2012. Available reference points were used to match the existing views with the proposed modelled views. While GHD has taken care to ensure the accuracy of this product, GHD make no representations or warranties about its accuracy, completeness or suitability for any particular purpose beyond that defined in this project. GHD cannot accept liability of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.

SITA
Lucas Heights Visibility Analysis

Viewpoint Locations & Aerial Oblique View

Job Number	21-20508
Revision	A
Date	20 Sep 2012

Figure 11.2

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

Existing View

Modelled view highlighting the comparison between approved landform and proposed landform

Modelled view showing proposed landform with realistic textures illustrating final landform with representative vegetation

VIEWPOINT 1

SITA
Lucas Heights Visibility Analysis

Viewpoint 1:
Truck stop far side of Heathcote Road

Job Number	21-20508
Revision	A
Date	20 Sep 2012

Figure 11.3

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

Existing View

Modelled view highlighting the comparison between approved landform and proposed landform

Modelled view showing proposed landform with realistic textures illustrating final landform with representative vegetation

VIEWPOINT 2

SITA
Lucas Heights Visibility Analysis

Viewpoint 2:
Public recreation facility

Job Number	21-20508
Revision	A
Date	20 Sep 2012

Figure 11.4

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

Existing View

Modelled view highlighting the comparison between approved landform and proposed landform

Modelled view showing proposed landform with realistic textures illustrating final landform with representative vegetation

VIEWPOINT 3

SITA
Lucas Heights Visibility Analysis

Viewpoint 3:
New Illawarra Road far side of road

Job Number	21-20508
Revision	A
Date	20 Sep 2012

Figure 11.5

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

Intermediate landform (2020 – 2021)

While the photomontages provide a representation of the likely visual impacts upon completion of the proposal, some additional overlays were prepared to provide a representation of some likely visual impressions during completion of the proposal.

Considering the staging plans for landfilling of the proposal site (Figure 6.5 to Figure 6.10), the period between Phase 5 to Phase 6 is considered to represent a possible 'worst case' scenario as it is the time period for which the largest area of landfill batter would be exposed towards the eastern catchment (which is where majority of the receptor groups are located (refer Figure 11.1)). Therefore a series of overlays were prepared to simulate what the view from VR06 Ridge Sporting Complex might be over this period.

Figure 11.6 shows the view from VR06 taken by GHD on 7 September 2012. Figure 11.7 to Figure 11.9 show the overlays which provide an impression of the probable views from VR06, the Ridge Sporting Complex from the start of phase 5 to the end of phase 6.

- Figure 11.7 shows the entire exposed batter on the western side of the landfill. As the batter would be hydromulched, it would appear as green in colour once the grass has established itself.
- Figure 11.8 shows the end of Phase 5, where the reprofiled landfill sections move gradually towards the east in front of the green batter and therefore appear as light brown/ white, until they too are hydromulched and grassed.
- Figure 11.9 shows the end of Phase 6, where the area associated with Phase 5 reprofiling has been capped and the Phase 6 reprofiling area rises above the batter and appears light brown/ white.

Existing modelling suggests that this 'worst case' visual scenario of start of phase 5 to the end of phase 6 will occur over a period of 23 months from 2020 - 2021. SITA could also grass the intermediate covers as the reprofiling works occur to further minimise visual impacts.

Figure 11.6 View taken on 7 September 2012

Figure 11.7 Impression of start of phase 5

Figure 11.8 Impression of end of phase 5

Figure 11.9 Impression of end of phase 6

11.4 Mitigation and management measures

A comprehensive list of prevention, mitigation and rectification measures has been identified and they are detailed in the LHRRP OEMP (Appendix S). The identified mitigation and rectification measures would be implemented as required and their exact details would be based on a case by case situation depending on the issue and technical solutions available at the time.

Based on the results of this assessment, mitigation of visual impacts could be achieved through:

- implementing 'early works' rehabilitation and maintenance measures – this involves substantial woodland and understory planting to screen the LHRRP from ANSTO land and adjacent roads including along Heathcote Road and around the boundary of the existing PCYC area
- applying hydromulch on exposed batter areas
- grassing the final capping layer as the reprofiling works occur to further minimise visual impacts
- Ensuring filling does not exceed proposed final landform heights
- Maintenance of fences and other site infrastructure
- Maintenance of Little Forest Road
- Screening and screen maintenance
- Progressive rehabilitation and revegetation.

11.5 Conclusions

The assessment considered impacts on nine groups of receptors, including residential receptors, travellers on main roads, and users of nearby industrial and recreational facilities. It also considered the proposal's impact at different points in time in order to provide an assessment on the likely 'worst case'. All of the receptor groups were determined to have a sensitivity of moderate or less. This was largely due to limited outlooks, limited quality of views, limited interest in views towards the LHRRP, or distance from the LHRRP site which reduces its prominence in the view (compared to other elements).

The magnitude of impacts on each of the identified receptor groups was also determined to be moderate or less, largely due to interim topography or vegetation which limits visual accessibility of the proposal elements. Significant distance from receptors also reduces the visibility of the proposal. In addition, as the proposed changes would be incremental over a long time scale rather than occurring rapidly over a short timeframe.

To ensure no significant visual impacts to the community, SITA would also implement initial rehabilitation and maintenance measures. These include perimeter screening of the LHRRP by understory planting in targeted areas. Screening would occur progressively and be finalised prior to 2025. The LHRRP would also ultimately be rehabilitated to an attractive landscape that would be used as a public parkland.

The consequent assessment of impact significance found that all the identified receptors would be exposed to impacts of moderate, low, or negligible significance. By implementing the proposed mitigation measures, the proposal would not have any significant impacts on the community.

The visual impact assessment addresses the SEARs and concludes that the proposal would meet the objective of having no significant visual impact on the community.

12. Air quality

The information presented in this chapter is based on the findings of the air quality assessment undertaken by GHD. The air quality assessment report is included in Appendix G of this EIS.

12.1 Approach and methodology

The air quality assessment was undertaken in accordance with the 'Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW' (DEC 2005) and the technical framework and notes for the 'Assessment and Management of Odour from Stationary Sources in NSW' (DEC 2006).

The air quality assessment included:

- A site inspection to develop an understanding of the existing LHRRP processes and potential odour sources, and to review odour complaint history. The site visit was also used to gain an appreciation of the potential receivers and surrounding terrain
- A review of the odour emission rates sampling regime of other landfill expansion projects in NSW which have been approved
- Extensive odour emission testing at LHRRP to quantify a reliable dataset which takes into account variability of odour emissions from the landfilled areas of the proposal site
- Synthesis of a meteorological data file using weather data recorded from the LHRRP meteorological station to gain an understanding of the local wind climate and use as a model input for conducting atmospheric dispersion modelling
- Derivation of an odour emissions inventory using:
  - measurements of odour sources onsite
  - source emission rate measurements from the emissions inventories held by GHD
- A level two odour modelling assessment of the potential operational odour impacts using the NSW EPA approved regulatory model AUSPLUME to predict the potential for odour impacts at the nearest residences. A level two assessment is a refined dispersion modelling technique using site specific input data
- Consideration of the potential impacts of the proposal were against relevant odour criteria
- Proposal mitigation methods were considered and the odour emission predictions were updated
- A qualitative dust assessment of proposal site operations

12.1.1 Objectives

In addition to addressing the SEARs, the air quality assessment provides an assessment of how well the proposal meets SITA's objectives.

The following objectives have been identified:

- No significant impacts on the community or environment
- Achieving the 2 OU odour performance criteria cumulatively at the nearest residential receptor
- Improving site gas capture and destruction either by power generation activities or gas flaring as required

12.2 Existing environment

12.2.1 Background air quality

There are no significant odorous emitting facilities located near (within 5 km of) the proposal site. Lucas Heights 1, now the Bardon Ridge sporting complex, is a potential minor source of odour. This old site is all final capped landfill, and based on the odour sampling conducted as part of this assessment would not be considered as a source of odour. Small amounts of leachate generated at the proposal site and transferred to Lucas Heights 1, where the leachate treatment plant is located, are stored and treated prior to discharge to sewer and would not have any noticeable odour impact on nearby receptors.

It is considered that there are no other sources of background odour that would affect the LHRRP site and surrounds.

The closest air monitoring station is located at Liverpool operated by OEH, where the level of particulates (PM_{10}) is measured via a TEOM. The data shows that for year of 2012 the annual average background level which was recorded was 19.7 $\mu g/m^3$ for a 24-hour average.

Areas like Lucas Heights that are subject to wind erosion and also close to urban activities tend to have elevated levels of background dust. Pollen and vegetation derived dust would also be expected in this location.

12.2.2 Air quality sensitive receptors

A sensitive receptor is defined in the DEC (2006) odour assessment guideline as a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area. The nearest sensitive receptors to the LHRRP and their approximate distance to the LHRRP boundary are presented in Table 12.1 and their locations are shown on Figure 12.1.

The nearest sensitive receptors would be those workers on site at the LHRRP followed by the attendees to the SICTA facility and the PCYC minibike club and workers and those who 'casually' attend at ANSTO Motel and the rest of the facility (R3 and R4). The nearest residential receptors are the suburbs of Engadine, R1 (approximately 2 km to the east), Barden Ridge R2 (approximately 3 km to the northeast) and Menai R3 (approximately 3.5 km northeast).

In addition, GALC is proposing a new development in the West Menai area. The West Menai State Significant Site contains 849 ha of mostly undeveloped land, covering parts of Menai, Barden Ridge and Lucas Heights.

The western boundary of this proposed development is Heathcote Road and the proposed development extends east across Mill Creek to the edge of the existing Menai residential area close to New Illawarra Road. The proposed development consists of discrete pockets of housing which limits the population size in each area.

Table 12.1 Nearby existing and proposed air quality sensitive receptors

Receptor (closest resident to LHRRP in Suburb)	Approximate distance to the LHRRP (km)
R1 Engadine	1.8
R2 Barden Ridge	3
R3 Menai	3.3
R4 ANSTO	0.3
R5 ANTSO Motel	0.5
R6 Gandangara	1.5
R7 Gandangara North	1.6

LEGEND

Air quality sensitive receptors

LHRRP boundary

Paper Size A4

0 125 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

SITA Australia
Lucas Heights Resource Recovery Park

Air quality sensitive receptor locations

Job Number	21-23482
Revision	Draft
Date	10 Feb 2015

Figure 12.1

G:\21\23482\GIS\Maps\MXD\21-23482-Z051_AirSensitiveReceptors.mxd

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

Aerial Imagery: ESRI, 2014. Works: GHD/SITA, 2014. Roads: NSW LPMA, 2012. Created by:mweber

12.2.3 Odour criteria

The 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales' ('the Approved Methods') (DEC 2005) defines odour criteria and how it should be applied in dispersion modelling. Criteria have been refined by DEC (2005) to take account of population density in the area.

Table 12.2 lists the odour certainty[7] thresholds, to be exceeded not more than 1% of the time, for different population densities.

Table 12.2 Odour criteria for the assessment of odour (DEC 2005)

Population of affected community	Odour performance criteria (nose response odour certainty units at 99th percentile)
Single Residence (≤ ~2)	7
~ 10	6
~ 30	5
~ 125	4
~ 150	3
Urban (~2,000)	2

The criteria assumes that 7 OU at the 99th percentile would be acceptable to the average person, but as the number of exposed people increases there is a chance that sensitive individuals would be encountered. The criterion of 2 OU at the 99th percentile is considered to be acceptable for the whole population.

The nearest sensitive receptor to the LHRRP is the ANSTO facility. The nearest existing residential areas are the suburbs of Engadine, R1 (approximately 2 km to the east), Barden Ridge R2 (approximately 3 km to the northeast) and Menai R3 (approximately 3.5 km northeast).

There is also potential for future residential developments to the north of the LHRRP. The number of people potentially residing in the closest areas of the proposed West Menai State Significant Site is expected to be significantly less than 2,000 people.

Proposed odour criteria for nearby existing sensitive receptors is 2 OU for receivers R1, R2 and R3, as they are part of denser urban populations of greater than 2,000 people.

One of the overarching aims of the proposal is to result in a reduction in the potential odour levels at the ANSTO premises. The approximate number of staff at ANSTO is over 1,000 people, meaning that the criteria for receptors R4 and R5 would be approximately 2.5 OU. It is important to note however that most staff would work during the daytime period, when worst-case odour impacts would not likely occur and most staff would work in an air conditioned environment that would not necessarily be impacted by odour from the LHRRP.

The proposed West Menai State Significant Site would consist of discrete pockets of housing and it is not expected that each pocket would include more than 500 people. A target assessment criterion of 2 OU is considered in this assessment. This is more conservative than the NSW EPA's policy which proposes an impact assessment criterion of 3 OU.

12.2.4 Dust criteria

Table 12.3 and Table 12.4 summarise the current air quality assessment criteria for in-air dust and deposited dust prescribed by the Approved Methods (DEC 2005).

[7] In the process of odour measurement, the odour certainty threshold is, by definition, the minimum concentration at which the panellist is certain they can detect the odour.

Table 12.3 Criteria for particulate matter

Pollutant	Criterion	Average period
Total suspended particulate matter (TSP)	90 µg/m^3	Annual
Particulate matter < 10 µm (PM_{10})	50 µg/m^3	24 hour maximum
	30 µg/m^3	Annual

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces. Table 12.4 shows the maximum acceptable increase over existing dust levels.

Table 12.4 Assessment criterion for dust deposition

Pollutant	Average period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

12.3 Assessment of potential impacts

12.3.1 Odour modelling scenarios

A total of three scenarios were modelled to enable a prediction of the potential odour emissions from the proposal site. The modelled scenarios were:

- Scenario 1 – Current LHRRP (2014) operations based on the current landfilling operations and the current eastern GO facility.
- Scenario 2 – Future Phase 1 (2016) based on the proposed phase 1 reprofiling landfilling operations and the current eastern GO facility. In this scenario the controls being currently implemented to reduce odour emissions from three higher emitting areas of the landfill have effectively reduced the odour emissions from these areas to those typical of these sources.
- Scenario 3 – Future Phase 6 (2021) based on the proposed Phase 5 reprofiling landfilling operations and the proposed western GO facility (uncovered windrows) and ARRT facilities.
- Scenario 4 – As per Scenario 3 but with covering of the early stage composting windrows within the bunker area of the GO facility.

Current operations have the highest odour emitting potential. However the modelling shows that following the completion of the odour mitigation measures being implemented by SITA, all future stages would generate lower odour emission rates than currently, with Phase 6 being assessed as being the future worst case.

To reduce the odour potential from the landfill operations, the proposed staging of the reprofiling works has been developed to maximise the areas of the proposal site that are capped and revegetated at any point in time. The proposed reprofiling staging works are outlined in Section 6.2.8.

12.3.2 Odour emission rates

A comprehensive odour sampling program was undertaken as part of this assessment. For the landfill operations a total of 62 additional odour samples were taken in addition to the 26 previous odour samples (Holmes Air Sciences 2006) taken at the LHRRP.

The existing and proposed GO facility and ARRT facility processing areas have been modelled using representative odour emission rates from similar sites operating by SITA and other companies in NSW and VIC. Scenarios 1 and 2 assumed uncovered composting for the existing

eastern GO facility. Scenario 3 also assumes uncovered windrows. This was done to represent a pseudo worst case scenario.

Odour emission rates used for the new western GO facility are conservative. GO facility emission rates assuming uncovered windrows have been included in the model when the proposal would use covered windrows with lower odour emissions which have also been assessed.

The odour emission rates applied to the proposed ARRT facility are based on available data for similar operations and are in accordance with available regulatory guidance, and are presented in the following sections.

Current LHRRP (2014) – Scenario 1

The SOERs used in the model for the existing landfill are presented in Table 12.5. These are all based on measured odour emissions at the LHRRP. Other localised emission points were identified in the final cap and intermediate cover that are not presented below. The measured odour levels are very low (approximate OER of 100 in total) and do not contribute significantly to the total site odour footprint however were included in the model. These have also since been rectified by SITA.

Table 12.5 Odour emissions for current landfill

Source	Surface area (m^2)	SOER OUv/m^2/s	OER	SOER Reference
Active tip face morning	2,500	26	65,000	Ektimo, 2014
Active tip face afternoon	2,500	40	100,000	Ektimo, 2014
Daily cover	2,500	0.03	100	Ektimo, 2014
Daily cover area	10,000	0.03	300	Ektimo, 2014
Leachate pond (quiescent)	3,550	0.26	923	Ektimo, 2014
Leachate pond (aerated) for 2 hours of the day	3,550	1.8	6,390	Ektimo, 2014
Final cap	314,755	0	0	Ektimo, 2014
Intermediate cover	394,461	Intermediate cover without gas extraction – 0.05 Intermediate cover with gas extraction – 0.023	9,628	Ektimo, 2014
Landfill batters	Stage 4 – 44756 SITA – 64829	1.8 1.4	80,560 90,761	Ektimo, 2014
Larger emission point 1 “v section”	200	11	2,200	Ektimo, 2014
Larger emission point 2 “rectangular area south of the excavation stockpile”	11,456	5.5	63,008	Ektimo, 2014
Total AM			312,380	Ektimo, 2014
Total PM			347,380	Ektimo, 2014
Total non op			247,480	Ektimo, 2014

The SOERs used in the model for the existing garden organics composting are presented in Table 12.6. Turning of the windrows has been included in the emission rates of the 4 month old static stockpiles and the maturation windrows.

Table 12.6 Odour emissions for current garden organics composting

Source	Surface area (m^2)	SOER OUv/m^2/s	OER	SOER Reference
Receivals area	564	4	2,256	URS, 2007
Shredding			5,740	URS, 2007
Static stockpile – 1 month	2,200	4.4	9,680	URS, 2007
Static stockpile – 4 month	10,210	2	20,420	URS, 2007
Maturation windrows	4,375	1.7	7,438	URS, 2007
Matured compost	730	0.6	438	URS, 2007
Screening			4,960	URS, 2007
Leachate pond	2,500	0.26	650	Ektimo, 2014
TOTAL		-	51,582	-

Future Phase 1 (2016) – Scenario 2

This scenario includes the proposed landfill re-profiling in 2016 and the current garden organics area operating at 50,000 tonnes per year before it is relocated to the other side of the proposal site. The inventory shows that the odour from the landfill increases in the afternoon due to the tip face however when the landfill is non-operational in the night time odour emissions drop considerably. Emissions for the 2016 landfill are presented in Table 12.7 and emissions for the current garden organics facility are presented in Table 12.6. The landfill is the predominant source of odour onsite during the daytime period however at the night the garden organics facility is the main contributor to odour emissions.

The SOERs used in the model for the 2016 landfill are presented in Table 12.7. This is based on several odour sources at the current site having been mitigated by SITA and not included in this modelling scenario. This includes the key elevated emissions in the intermediate cover area known as the ‘v section’ and ‘rectangular area south of the excavation stockpile’ as well as the landfill batters.

SITA is currently optimising its gas management system in these localised emission locations to ensure that the odour emissions from these areas is typical of intermediate covered areas which have an effectively operating landfill gas extraction system.

Table 12.7 Odour emissions for 2016 landfill

Source	Surface area (m^2)	SOER OUv/m^2/s	OER	SOER Reference
Active tip face morning	2,500	26	65,000	Ektimo, 2014
Active tip face afternoon	2,500	40	100,000	Ektimo, 2014
Daily cover	2,500	0.03	100	Ektimo, 2014
Daily cover area	10,000	0.03	300	Ektimo, 2014
Leachate pond (quiescent)	3,550	0.26	923	Ektimo, 2014
Leachate pond (aerated) for 2 hours of the day	3,550	1.8	6,390	Ektimo, 2014
Final cap	314,755	0	0	Ektimo, 2014
Intermediate cover	517,685	Intermediate cover without gas extraction – 0.05 Intermediate cover with gas extraction – 0.023	14,195	Ektimo, 2014

Source	Surface area (m^2)	SOER OUv/m^2/s	OER	SOER Reference
Stripped back area	2,500	1	2,500	Ektimo, 2014
total am			82,918	
total pm			117,918	

The SOERs used in the model for the garden organics composting in 2016 are the same as the current scenario (Table 12.6).

Future Phase 6 (2021) – scenario 3 and scenario 4

This scenario includes the proposed landfill reprofiling area for 2021 and the proposed western GO facility operating at 80,000 tonnes per year. Phase 6 represents the pseudo worst-case odour generating scenario for the proposal.

The inventory shows that the odour from the landfill increases in the afternoon due to the tip face however when the landfill is non-operational in the night time odour emissions drop considerably. Emissions for the 2021 landfill are presented in Table 12.8 and emissions for the proposed GO facility are presented in Table 12.9. By 2021 the proposed ARRT facility would potentially be operational and the estimated emissions are provided in Table 12.11.

The landfill is the significant source of odour onsite during the daytime period however at the night the ARRT facility and GO facility are the main contributors to odour emissions. Odour emissions from the ARRT facility are through a biofilter air discharge portal and would therefore be dispersed into the atmosphere much better than other odour emissions. The character of the odour from the biofilter is also much different from landfill gas and garden organics with characteristics similar to that of an 'earthy soil smell', but nevertheless this odour assessment conservatively assumes the three operations contributing to the total odour emission from the proposal site.

The SOERs used in the model for the Phase 6 (2021) landfill are presented in Table 12.8.

Table 12.8 Odour emissions for landfill 2021

Source	Surface area (m^2)	SOER OUv/m^2/s	OER	SOER Reference
Active tip face morning	2,500	26	65,000	Ektimo, 2014
Active tip face afternoon	2,500	40	100,000	Ektimo, 2014
Daily cover	2500	0.03	100	Ektimo, 2014
Daily cover area	10,000	0.03	300	Ektimo, 2014
Leachate pond (quiescent)	3,550	0.26	923	Ektimo, 2014
Leachate pond (aerated) for 2 hours of the day	3,550	1.8	6,390	Ektimo, 2014
Final cap	485,490	0	0	Ektimo, 2014
Intermediate cover	434,750	Intermediate cover without gas extraction – 0.05 Intermediate cover with gas extraction – 0.023	11,038	Ektimo, 2014
Stripped back area	2,500	1	2,500	Ektimo, 2014
total am			79,761	
total pm			114,761	

The SOERs used in the model for the GO facility composting in 2017 are presented in Table 12.9. This data is conservative and assumes that the windrows are uncovered when in fact they would be covered.

Table 12.9 Odour emissions for proposed GO facility

Source	Surface area (m^2)	SOER OUv/m^2/s	OER OUv/s	SOER Reference
Receivals area	1,949	4	7,796	URS, 2007
Shredding	-	-	5,740	URS, 2008
Loading	5	8	40	URS, 2007
Active composting week 1	1,500	1.95	2,925	GHD, 2009
Active composting week 2	1,500	1.12	1,680	GHD, 2009
Active composting week 3	1,500	0.97	1,455	GHD, 2009
Active composting week 4	1,500	0.89	1,335	GHD, 2009
Maturation	5,638	0.7	3,947	GHD, 2009
Finished compost	8,145	0.34	2,769	GHD, 2009
Screening	-	-	1,600	URS, 2007
Turning	713	1.18	841	URS, 2007
Leachate pond	6,818	0.145	989	Holmes Air Sciences 2006
Leachate pond (aerated) for 2 hours of the day	6,818	1.0	6,818	Holmes Air Sciences 2006
TOTAL			31,117* (unaerated)	

*The odour modelling took into account the aerated and unaerated state of the leachate pond.

The SOERs used in the model for the green waste composting in 2017 are presented in Table 12.10. This data is conservative and assumes a 90% odour reduction on the first four weeks of active composting by using breathable membrane covers.

Table 12.10 Odour emissions for proposed GO facility with breathable membrane covers

Source	Surface area (m^2)	SOER OUv/m^2/s	OER OUv/s	SOER Reference
Receivals area	1,949	4	7,796	URS, 2007
Shredding	-	-	5,740	URS, 2008
Loading	5	8	40	URS, 2007
Active composting week 1	1,500	0.20	293	GHD, 2009
Active composting week 2	1,500	0.11	168	GHD, 2009
Active composting week 3	1,500	0.10	146	GHD, 2009
Active composting week 4	1,500	0.09	134	GHD, 2009
Maturation	5,638	0.7	3,947	GHD, 2009
Finished compost	8,145	0.34	2,769	GHD, 2009
Screening	-	-	1,600	URS, 2007
Turning	713	1.18	841	URS, 2007
Leachate pond	6,818	0.145	989	Holmes Air Sciences 2006
Leachate pond (aerated) for 2 hours of the day	6,818	1.0	6,818	Holmes Air Sciences 2006

Source	Surface area (m^2)	SOER OUv/m^2/s	OER OUv/s	SOER Reference
TOTAL			24,463* (unaerated)	

*The odour modelling took into account the aerated and unaerated state of the leachate pond.

ARRT facility

The SOERs used in the model for the ARRT facility in 2017 (and onwards) are presented in Table 12.11. The biofilter emissions are based on the air flow of the building and have been assumed to be emitted through a 20 m high vertical portal. The biofilter emission rate has been developed based on GHD's review of the odour emitted from well-managed biofilters at similar approved alternative waste treatment projects in NSW and is an odour level of 250 OU/m^3.

Table 12.11 Proposed ARRT facility

Source	Flow rate (m^3/s)	Biofilter emission rate OU/m^3	OER (OU/s)	SOER Reference
Biofilter	345	250	86,250	refer appendix C of the air quality assessment - *Appendix G of this EIS*

12.3.3 Dispersion modelling results – odour

Dispersion modelling was undertaken using AUSPLUME 6.0. The dispersion modelling was conducted to predict the pattern of maximum off-site ground level odour concentrations resulting from odour emissions from the proposal site for three scenarios discussed in Section 12.3.1.

Current LHRRP (2014) – Scenario 1

Results of scenario 1 are presented in Table 12.12 and Figure 12.2 below. Results are conservative and show that the predicted impacts have the potential to impact on receivers. The predicted maximum odour impact from the proposal site expressed as a 1-hour average at the 99th percentile at receivers R4, R5, R6 and R7 are above 5 OU, a level that may be detected above the background under some conditions. These worst-case conditions generally occur in the night time and early morning.

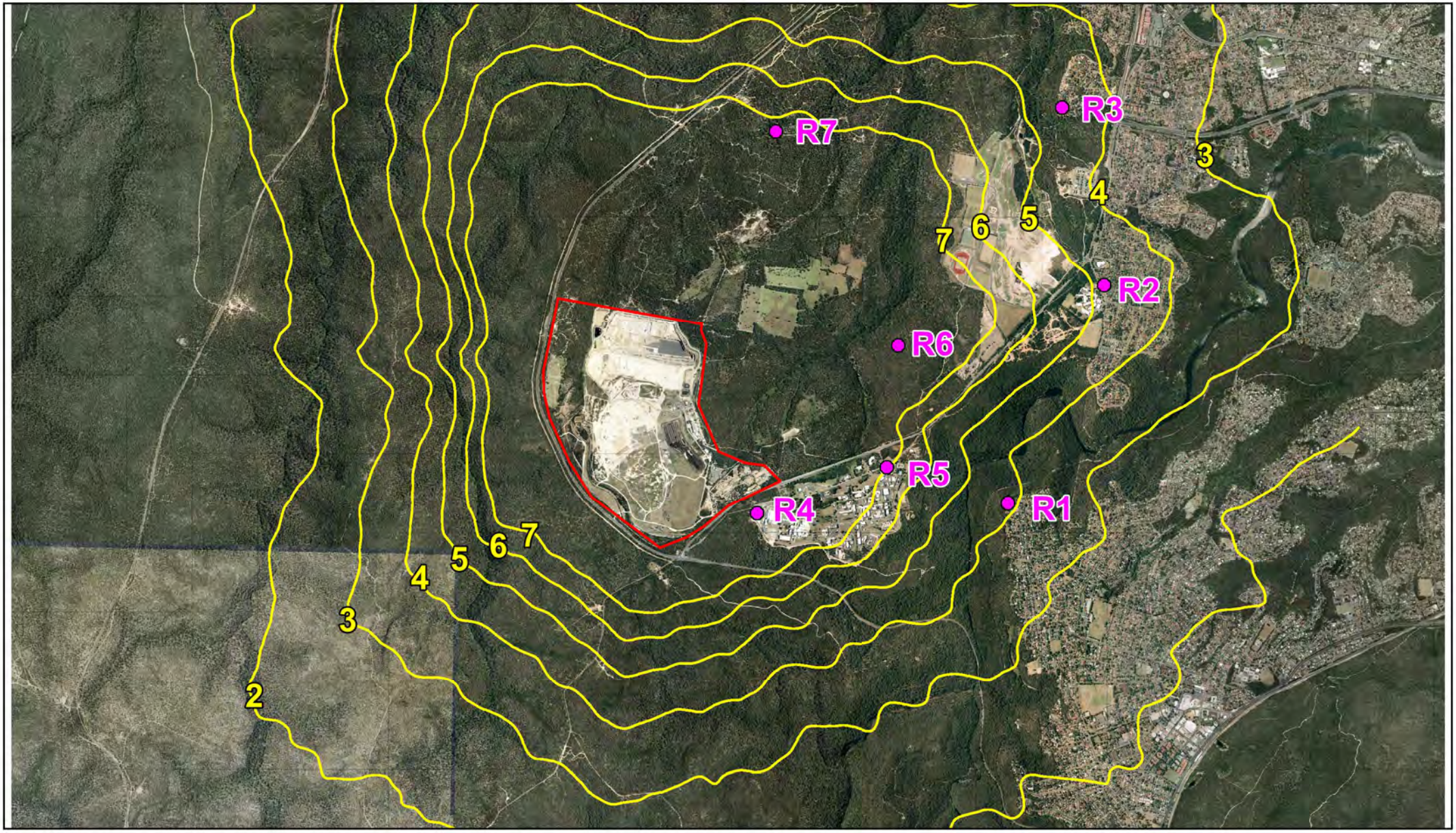
The predicted odour levels at receivers R1, R2 and R3 are all below 5 OU during the night time and early morning periods. This is consistent with the relatively few complaints received from these areas as a level of less than 5 OU is not normally able to be detected above the ambient background. The potential future receptors at R6 and R7 do not currently exist. These areas have been rezoned to allow for six new discrete communities

The maximum predicted odour impact at the ANSTO site (R4) is 10.9 OU. These worst case impacts are mostly during the night time period when impacts would be minimal, especially at ANSTO west where it is unlikely workers would be outdoors.

Table 12.12 Maximum predicted odour levels (99th percentile OU) for Scenario 1 (existing operations)

R1 – Engadine	R2 – Bardon Ridge	R3 – Menai	R4 – ANSTO West	R5 – ANSTO Motel	R6 – Gandangara	R7 – Gandangara North
4.1	4.8	4.5	10.9*	7.0	10.2	7.8

* The 99th percentile OU during the daytime is less than this value



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metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 56

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Site Boundary

Predicted maximum 99.0th percentile (P/M60)

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Predicted Odour Impact - Scenario 1 Existing

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Figure 12.2

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Future Phase 1 (2016) – Scenario 2

Results of Scenario 2 are presented in Table 12.13 and Figure 12.3 below.

The predicted maximum odour impact from the proposal site expressed as a 1-hour average at the 99th percentile at receivers R1, R2 and R3 are well below the impact assessment criteria of 2 OU and below a level recognisable above the background.

The potential future receptors at R6 and R7 are unlikely to exist in 2016. . These areas have been rezoned to allow for six new discrete communities and it would take a period of time (potentially beyond 2016) for residential dwellings to be established at these locations.

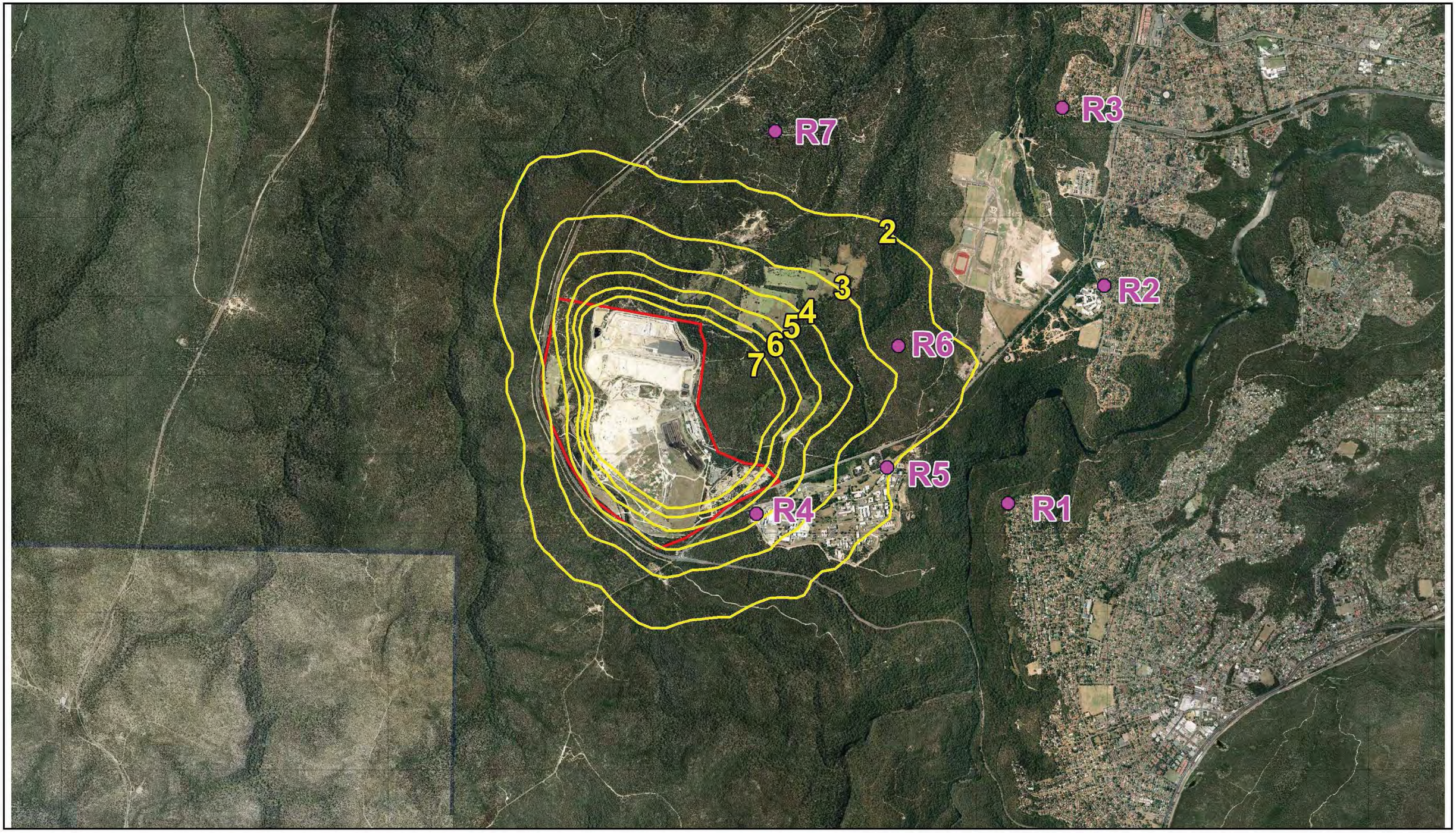
The maximum predicted odour impact at the ANSTO site (R4) is 4.2 OU. This represents over 50% reduction compared to existing levels.

It is noted significant improvement is predicted at odour receptors in this scenario compared with the existing scenario. This is largely due to the rectification of three larger odour sources identified during the site specific sampling program.

Table 12.13 Maximum predicted odour levels (99th percentile OU) for Scenario 2

R1 – Engadine	R2 – Bardon Ridge	R3 – Menai	R4 – ANSTO West	R5 – ANSTO Motel	R6 – Gandangara	R7 – Gandangara North
1.1	1.0	1.1	4.2*	2.1	2.5	1.4

* The 99th percentile OU during the daytime is less than this value



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metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 56

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Site Boundary

Predicted maximum 99.0th percentile (P/M60)

GHD
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SITA Australia
Lucas Heights Resource Recovery Park

Predicted Odour Impact - Phase 1 Future

Job Number 2123482
Revision A
Date 27/02/15

Figure 12.3

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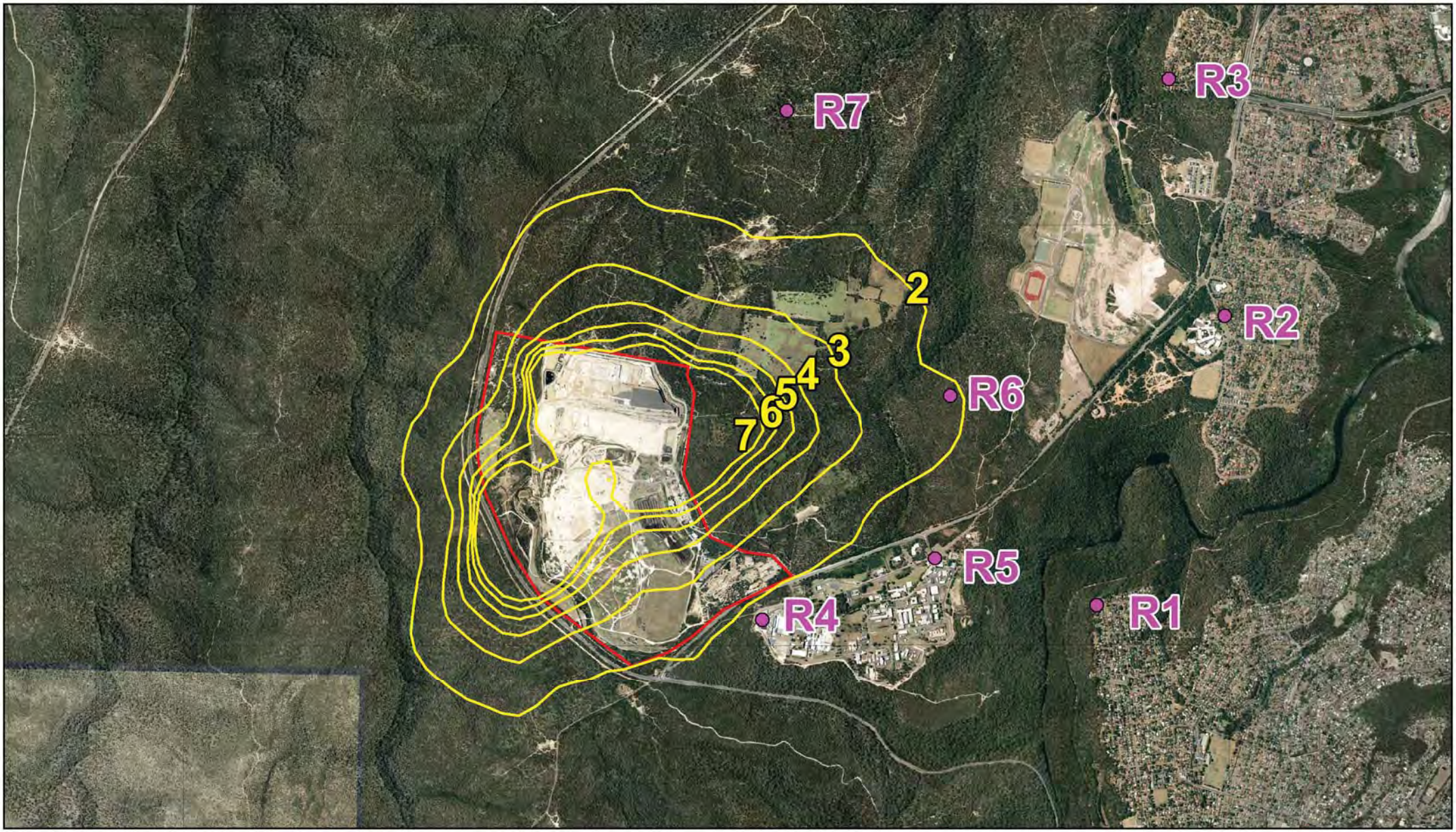
Future Phase 6 (2021) – Scenario 3

Results of the odour predictions for scenario 3 are presented in Table 12.14 and Figure 12.4 below.

The predicted maximum odour impact from the proposal site expressed as a 1-hour average at the 99th percentile at all existing receivers are below 2 OU, a level lower than that normally detected above the background. 5 OU is commonly taken as a conservative measure of the odour concentration that can be detected against background levels and which could potentially give rise to complaint.

Table 12.14 Maximum predicted odour levels (99th percentile OU) for Scenario 3

R1 – Engadine	R2 – Bardon Ridge	R3 – Menai	R4 – ANSTO West	R5 – ANSTO Motel	R6 – Gandangara	R7 – Gandangara North
0.9	1.1	1.0	1.8	1.5	2.1	1.3



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metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 56

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Site Boundary

Predicted maximum 99.0th percentile (P/M60)

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Predicted Odour Impact - Phase 6 Future

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Figure 12.4

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Future Phase 6 (2021) – Scenario 4 with breathable membrane covers

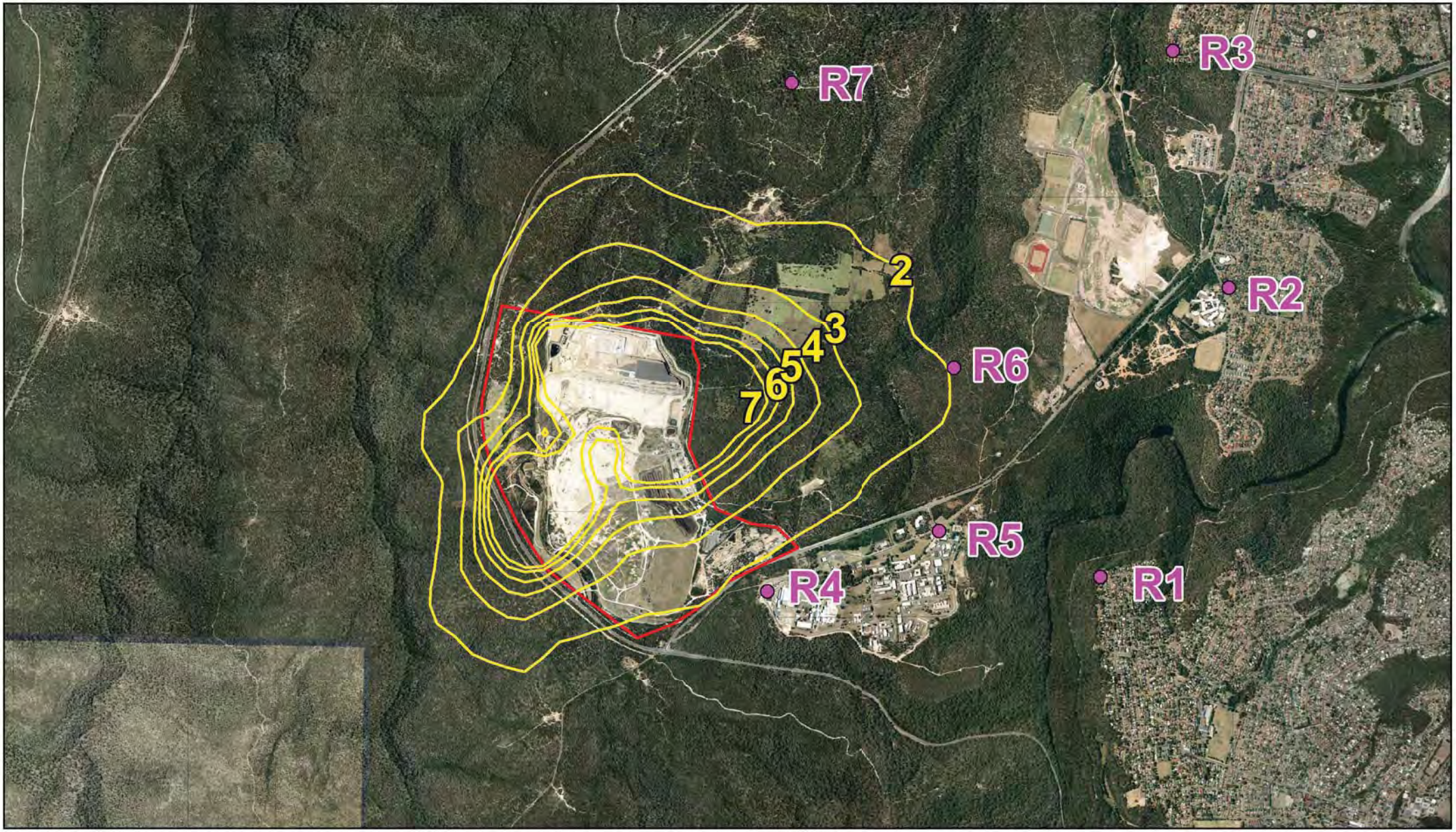
Results of the odour predictions for Scenario 4 are presented in Table 12.14 and Figure 12.4 below.

The predicted maximum odour impact from the proposal site expressed as a 1-hour average at the 99th percentile at all existing and proposed receivers are at or below 2 OU, a level lower than that normally detected above the background. 5 OU is commonly taken as a conservative measure of the odour concentration that can be detected against background levels and which could potentially give rise to complaint.

The predicted odour levels for the proposal in 2021 therefore comply with the odour criteria at all existing and proposed nearby sensitive receptors.

Table 12.15 Maximum predicted odour levels (99th percentile OU) for Scenario 4

R1 – Engadine	R2 – Bardon Ridge	R3 – Menai	R4 – ANSTO West	R5 – ANSTO Motel	R6 – Gandangara	R7 – Gandangara North
0.9	1.0	1.0	1.7	1.4	2.0	1.3



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metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 56

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Site Boundary

Predicted maximum 99.0th percentile (P/M60)

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Predicted odour impact -
Phase 6 Future - with breathable membrane covers

Job Number 2123482
Revision A
Date 15/05/2015

Figure 12.5

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12.3.4 Dispersion modelling results – dust

An indicative worst-case dust modelling scenario was identified for the proposal site. Significant sources of dust at the proposal site include:

- Wheel generated dust from trucks travelling on unpaved surfaces
- Wind erosion from unsealed surfaces such as the intermediate cover and stockpiles
- Unloading waste and
- Bulldozers moving waste around.

The potential sources of dust would move around the proposal site as construction footprint and the landfilling activities move around. As such an assessment against the worst-case 24 hour PM_{10} criteria is most relevant to determine compliance.

Dust modelling was undertaken with consideration to the Approved Methods (DEC 2005) to determine the concentration of dust (PM_{10}) over a 24 hour period.

The predicted maximum (100^{th} percentile) 24 hour dust impact of the proposal at the seven sensitive receptors are shown in the table below. This maximum dust impact is only predicted to occur one day a year. The average background dust level at the EPA monitoring station in Liverpool for the year 2012 was less than 20 ug/m^3, meaning that cumulative dust impacts exceeding the criterion (50 µg/m^3) are very unlikely. The dust predictions were also undertaken very conservatively as dust depletion from the plume was not considered, which would reduce the predicted dust impact.

Table 12.16 Predicted maximum dust impact 24 hour PM_{10} µg/m^3

R1 – Engadine	R2 – Bardon Ridge	R3 – Menai	R4 – ANSTO West	R5 – ANSTO Motel	R6 – Gandangara	R7 – Gandangara North
15.2	7.5	12.1	27.0	20.3	17.3	13.4

12.4 Mitigation and management measures

12.4.1 Voluntary Planning Agreement

Under the VPA, as discussed in section 23, SITA is committing to meet a number of environmental commitments in terms of actions it would take based on the site's environmental performance. A comprehensive list of prevention, mitigation and rectification measures have been identified and they are detailed in the OEMPs (Appendix S, Appendix T and Appendix U) and post closure EMP (Appendix V) which form part of the VPA. These would be updated following the proposal's determination to reflect any additional requirements from the conditions of consent.

As an additional level of safeguard, *Schedule 1D – Environmental Undertaking and Reporting* of the VPA prescribes the external audit process that applies to the LHRRP with one of the key issues addressed being odour. There is a significantly higher level of rigour associated with the data reporting for this proposal in comparison with standard industry practice. The complaints and auditing procedures, as noted in the LHRRP OEMP (Appendix S), would be triggered by any odour complaints.

12.4.2 Odour

The odour sampling program conducted found that the landfill batters and two odour emission points on the intermediate cover area to be the significant source of odour generated onsite.

Reducing odour from these two areas therefore is the most effective way to reduce the overall odour levels onsite.

SITA is currently actively managing and reducing the odour from site, as reflected by the decreased number of odour complaints received in the past two years. Since the studies documented in this report were commenced SITA has installed twenty nine additional landfill gas collection wells at the LHRRP. These were installed to address the issues identified by this study and this is expected to reduce fugitive landfill gas emissions significantly.

A comprehensive list of prevention, mitigation and rectification measures have been identified and they are detailed in the OEMPs (Appendix S, Appendix T and Appendix U). The identified mitigation and rectification measures would be implemented as required and their exact details would be based on a case by case situation depending on the issue and technical solutions available at the time.

Landfill reprofiling

- Reprofiling the landform to provide a minimum of 5% slope (post settlement)
- The areas of the existing landfill (south of existing active landfill area) would be stripped back in segments, with approximately 1 ha stripped in advance of the active tipping area for currently covered areas and approximately 2 ha stripped in currently capped areas. Of this area approximately 2,500 m^2 would be less than one day old to minimise the emission of odour from the stripped surface. At the commencement of each day's landfilling the stripped surface would extend to the landfilled waste over an area equivalent to the active tipping area. The stripped material would be available for reuse. Where areas of excessive soil fill over waste are identified, localised investigations are to be undertaken and additional capping or intermediate cover can be stripped back such that previously land filled waste is not exposed
- The depth of the strip back would be as follows:
  - Stripping back of the existing areas which are capped and revegetated would not expose previously landfilled waste
  - Stripping back of the existing areas of intermediate cover (south of the existing active landfilling area) would not expose previously landfilled waste
- Each morning equivalent to a day's waste disposal operations the stripped surface would be further stripped back to waste (to minimise the potential for the perching of leachate) and waste placed directly over this area. This would ensure there is no exposed waste during the night when the potential for odour issues off site is higher
- The stripping arrangement would continue to be examined to ensure that it can optimise the recovery of cover materials and not cause off-site odour complaints
- The stripping of existing cover layers (and other odour controls) would be undertaken in accordance with the LHRRP OEMP (Appendix S) which is included in the VPA, with the VPA process being the governing mechanism to determine the strip back configuration and details.
- Re-testing in 2015/16 of the rectified localised emission points, the v section, the area south of the excavation stockpile and the batters to confirm odour modelling predictions

LHRRP

- Cover odorous wastes as soon as possible after delivery in accordance with the requirements of the site's environment protection licence

- Minimise the size of the active landfill face, taking into account the practicalities, safety, access, traffic management, etc.
- Inspect and monitor the capping layer regularly
- Train staff (internal and contractors) on odour management strategy and all relevant procedures
- Install and operate a landfill gas collection system progressively to minimise odour as a result of landfill gas seepage

GO facility

- Conduct random monitoring and inspections of incoming vehicles to determine waste composition
- Order manures in accordance with production schedules and blend with compost only in favourable weather conditions at any given time
- Train staff (internal and contractors) on odour management strategy and all relevant procedures
- Only allow up to 40,000 tonnes of composting material to be stored on site (includes receival, shredding, active composting and maturation stage) at any one time at the western GO
- Measure oxygen and moisture content of compost (active phases) and control with aeration and moisture addition

ARRT facility

- Process waste daily
- Carry out composting at set periods of time, to set temperatures, oxygen levels and moisture levels to provide certainty that composted material has fermented properly and has stabilized
- Maintain the facility under negative pressure, ensuring odours do not escape the building
- Regular inspection of biofilters and maintenance of biofilter media
- Train staff (internal and contractors) on odour management strategy and all relevant procedures

12.4.3 Dust

Dust emissions during construction would be managed via a construction environmental management plan.

Examples of key dust mitigation measures that are included in the OEMPs are provided in the sections below.

LHRRP

- Do not undertake dust generating activities during adverse weather conditions
- Cessation of operations if unsafe (for example, during strong winds)
- Monitor monthly dust deposition at six boundary locations on site
- Limit vehicles to specified routes around the site and ensure speed limits are adhered to
- Use of dust suppression techniques such as watering to maintain moist conditions on exposed areas and unsealed roadways

GO facility

- Cover or enclose vehicles during transport around the site
- Spray windrows, final compost storage areas and loading areas, particularly prior to transportation and turning
- Cessation of operations if unsafe (for example, during strong winds)
- Operate water cart(s) on trafficable areas as required

ARRT facility

- Conduct all operating activities within the enclosed areas of the ARRT facility
- Cover or enclose vehicles during transport around the site
- Spray windrows, final compost storage areas and loading areas, particularly prior to transportation and turning
- Operate water cart(s) on trafficable areas as required

12.5 Conclusions

The odour assessment shows that the total odour emissions from the LHRRP would decrease compared to the existing situation and that odour receptors would be subject to lower potential odour impacts because of the proposal.

It is noted that the improvements to odour levels would be realised in 2016 or potentially sooner. For the modelled scenario 2 (2016 – phase 1 reprofiling works), over 50% reduction was predicted at ANSTO when compared against existing odour levels. This improvement is expected to continue over the life of the proposal as an increasing area of landfill is capped and rehabilitated.

Furthermore, predicted odour levels for the proposal in 2021 (worst case year for potential odour impacts) comply with the odour criteria at all existing and proposed nearby sensitive receptors.

Dust dispersion modelling shows that potential dust impacts from the proposal would not impact adversely on any surrounding dust sensitive receptors.

The air quality assessment addresses the SEARs and concludes that the proposal would meet the following objectives:

- No significant impacts on the community or environment
- Achieving the 2 OU odour performance criteria cumulatively at the nearest residential receptor
- Improving site gas capture and destruction either by power generation activities or gas flaring as required.