Lot 2 Albany Highway, North Bannister Shire of Boddington

NORTH BANNISTER RESOURCE RECOVERY PARK FOOTPRINT EXPANSION

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## SUEZ Recycling \& Recovery (Perth) Pty Ltd

## September 2017

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# executive summary 

## background \& purpose

On 31 ${ }^{\text {st }}$ May, 2016, the SUEZ Recycling \& Recovery Australia group of companies (SUEZ) acquired the shares in Perthwaste Pty Ltd including its waste management businesses and the North Bannister Resource Recovery Park (RRP) located in the western portion of Lot 2 Albany Highway, North Bannister.

The RRP covers an area of approximately 22 ha and was approved by the Shire of Boddington in September 2011 as a Class II / III landfill with 11 cells, a total waste capacity of 2.5 million tonnes and an estimated operating life of 18-20 years based on an initial annual tonnage of 13,000tpa increasing to 200,000tpa over a nine year period. In November 2016, SUEZ sought and obtained approval from the Department of Water and Environment Regulation (DWER) to increase the annual tonnage throughput from 200,000tpa to 350,000tpa to accommodate SUEZ's previous client needs as well as those of Perthwaste.

Geotechnical investigations by SUEZ since its acquisition of the RRP have identified extensive sub-surface rock in the latter stage cells of the RRP significantly reducing the viability of constructing these cells.

Accordingly and in view of the significantly reduced life of the RRP, SUEZ is now seeking the approval of the Shire of Boddington to the southern expansion of the footprint of the RRP to extend its operating life by an estimated additional 23 years.

SUEZ is concurrently making application to the DWER to amend the Licence for the current landfill to allow construction of the first two cells of the proposed Expanded Footprint.

## proponent

SUEZ is a leading multinational waste, recycling and resource recovery service provider and a leader in sustainable resource recovery providing services to more than 56,000 commercial and industrial business Australia wide as well as over 3.7 million households employing over 2100 employees and contractors, across Australia.

SUEZ has a significant presence in Western Australia and currently provides collection and disposal services for a variety of clients including local governments, service industries and commercial enterprises and operates a number of recycling and resource recovery facilities within WA recovering approximately 200,000 tonnes per annum of material that would otherwise be sent to landfill.

SUEZ also operates community consultation; education and support programs associated with its operations and facilities in Australia and is developing similar programs and relationships with the Boddington and regional community.

## need for expanded footprint

The WA Waste Strategy notes that the amount of waste being recovered in Western Australia has been increasing steadily for a number of years. However, the State's performance when benchmarked against other mainland states is still poor. A total of 3.2 million tonnes of Municipal and Commercial \& Industrial Waste was generated in 2014-15 of which $41 \%$ was recycled / recovered with the balance 1.9 million tonnes being sent to landfill.

The Strategy sets targets of 50\% diversion from landfill 30 June 2015 and 65\% diversion from landfill of material presented for collection in the metropolitan region by 30 June 2020.

The Strategy recognises that landfills will continue to play an important role in waste management and that the waste industry plays a pivotal role in providing a range of collection, sorting, processing and safe disposal of waste in Perth and Peel.

Following the closure of a number of landfills in recent years, the Perth Metropolitan region now has only four major Metropolitan landfills that can accept Class II or III wastes and specifically Cockburn, Red Hill, Rockingham and Tamala Park which is expected to close in the near future.

DWER Guidelines for the Siting, Design, Operation and Rehabilitation of Landfills effectively preclude future landfills within the Swan Coastal Plain and effectively limit the siting of future landfills to areas south of the Metropolitan Region, the foot of the Darling Scarp or areas inland thereof.

Based on the 2015-16 total of 3.2 million tonnes of Municipal and C\&I Waste generated per annum there is a current need, between the Metropolitan and near Metropolitan landfills including the RRP, for landfill airspace of 1.9 million tonnes decreasing to 1.1 million tpa over time if the $65 \%$ recovery rate is achieved. Population growth over ensuing years will see this requirement steadily increase to approach 2 million tpa at 65\% recovery. Total medium to longer term capacity including the North Bannister RRP is currently estimated at 1.3 million tpa.

There is clearly a need for additional landfill airspace to be developed on an on-going basis to ensure an adequate supply to meets the needs of a growing Metropolitan population.

Approval of the Expanded Footprint for the North Bannister RRP will enable the growing need for landfill airspace to not only continue to be met in a sustainable manner but in the process thereof reduce the pressure for the development of new "greenfield" landfill sites.

## site \& surrounding land uses

The North Bannister RRP is located on Lot 2 Albany Highway, North Bannister approximately 100km southeast of Perth. Lot 2 is situated approximately 5 km west of the Highway with the entry road approximately 1.5 km north of the Nth Bannister / Wandering Road junction.

Lot 2 has a total area of $390 h a$ and is accessed by sealed road from Albany Highway and prior to development of the RRP, substantial areas of the lot were cleared for the purposes of Blue Gum plantation operated by WA Plantation Resources (WAPRES).

The lands to the north, west and immediate south of Lot 2 are State Forest. The lands to the east, between the RRP and Albany Highway have been substantially planted to Blue Gums with the balance used for grazing of sheep.
The closest "development" to Lot 2 is the Threeways Roadhouse on Albany Highway just north of the North Bannister / Wandering Road junction and approximately 5.5km (straight line distance) east, south-east of the RRP. The roadhouse has been vacant for some time with no signs of it being occupied in the short term. Boddington is located approximately 30 km by road south, south-east of Lot 2 ( 25 km straight line distance).
The RRP site is isolated, well removed from any residents and its expansion will not impact the amenity of residents of the region. The potential also exists for future synergies with more intensive development of the lands to the immediate east of the RRP, be it for industrial or intensive agricultural purposes, including power supply through Biogas generation.

## local \& regional planning context

Lot 2 Albany Highway is zoned "Rural" under The Shire of Boddington Local Planning Scheme No 2. Table 1 - Zoning Table of the Scheme sets out a number of land uses and the "permissibility" of those uses within the various Zones of the Scheme. Table 1 does not specifically provide for the use of waste disposal / landfill.

The use closest in form to waste disposal / landfill currently provided for under Table 1 is that of "Industry Noxious" which is defined under the Scheme as:
"industry - noxious: means an industry which is subject to licensing as "Prescribed Premises" under the Environmental Protection Act, 1986 (as amended)."

Table 1 - Zoning Table identifies "Industry - Noxious"" as an "SA" use within the Rural Zone requiring the specific approval of Council and advertising for public comment under Clause 6.4 of the Scheme. A landfill is a Prescribed Premises under the Environmental Protection Act.

The Scheme does not define specific Objectives for the Rural Zone but does identify a range of Scheme wide Objectives. The proposed expansion of the RRP is consistent with the Objectives of Local Planning Scheme No 2.

The proposed Expanded Footprint is also consistent with the State Planning Strategy and the Shire's Local Planning Strategy 2007 and Draft 2016.

Given the estimated construction cost, the proposed Expanded Footprint will require the approval of the Mid-West Wheatbelt (Central) JDAP.

## existing waste management facility

## site access

Access to the RRP is via a $7 m$ wide sealed bitumen road off Albany Highway. The access road is controlled by an electronic boom gate during operating hours and closed after hours by locked, rural steel gate. No public access is permitted to the site.

The RRP operates 5.00 am to 5.00 pm Monday to Friday and 5.00 am to 1.00 pm Saturdays and most Public Holidays. Waste placement and cover operations can continue to 6.00 pm .

## waste class

The RRP is currently licensed to accept 350,000 tonnes per annum of Class II and Class III putrescible waste consisting primarily of household waste, food waste and non-recyclable waste and non-chemical wastes from commercial and light industrial premises. Special wastes such as asbestos and clinical waste not requiring incineration are buried under controlled conditions.

Toxic, flammable, poisonous, infectious and radioactive wastes are not permitted. The RRP is also licensed for the acceptance of liquid and greenwaste, used tyres and for compost manufacture and soil blending.

Waste entering the site is screened by video cameras at the weighbridge.

## cell operation \& capping

The RRP as originally approved proposed 11 cells with a total airspace of 3.38 million $\mathrm{m}^{3}$ and a waste capacity of 2.5 million tonnes. The original 11 cells have been subsequently condensed down to six cells.

Development of the landfill is undertaken on a progressive basis or Cells. Filling of Cells 1-3 is nearing completion. SUEZ has commenced construction of Cell 4 which will provide a further 530,000m3 of interim airspace which is likely to be exhausted by late 2019.

Cell preparation and lining comprises a compacted clay underlining, primary lining geomembranes to prevent movement of any leachate into the soil and groundwater below the cell, a drainage layer and covering protecting fabric cushion Geotextile above which the waste is placed.

Once the working cell has reached final profile, the cell is permanently capped. Capping is only undertaken in dry conditions and typically during summer and autumn and comprises an engineered clay cap, drainage layer and sub-soil / topsoil planting layer.

## leachate management

The cells are constructed with an internal engineered leachate collection system with a shared sump. Leachate levels within the cells are regularly monitored and periodic extraction is undertaken by submersible pumps within the sump and directed to the Leachate Evaporation Dams.

## surface water management

Surface water on site is channelled from around the southern and eastern edges of the existing landfill to Stormwater Dams. Surface water data collected from the Dams indicates that surface waters are not impacted by the landfill.

## groundwater monitoring

Groundwater monitoring bores are currently installed in 18 locations across and surrounding the existing and proposed landfill areas. Groundwater sampling and analysis has been carried out at the site since 2011 with no evidence of contamination to groundwater.

## proposed expanded footprint <br> expanded footprint

The proposed Expanded Footprint has been designed in accordance with Victorian BPEM Guidelines and configured to avoid and thereby retain the remnant vegetation towards the southern portion of Lot 2.

The footprint has been divided into nine cells and will provide an additional 9,915,000m3 of airspace equating to 8,031,000 tonnes providing an estimated life of 23 years at current disposal rates. Cells 14 \& 15 within the original footprint (former Cells 5 and 6) provide a further 2,070,000m3 extending the overall life of the RRP by an additional 6 years at current disposal rates.

SUEZ is currently constructing Cell 4 of the original footprint to provide adequate interim airspace and will proceed immediately to construction of Cell 5 within the Expanded Footprint. Construction of the Expanded Footprint will require the progressive clearing of the Blue Gum plantation and will not impact any remnant vegetation.

## cell lining \& capping

The liner and capping systems will consist of the same layer system as the current landfill.
The maximum waste elevation is approximately 396 m AHD at the landfill crest, extending up to 401.6 m $A H D$ at the central ridge.

## landfill gas extraction

Landfill gas (LFG) is composed of a variety of gases which include methane, carbon dioxide, oxygen, nitrogen, hydrogen and water vapour.

Vertical and horizontal gas extraction wells will be installed during the placement of wastes. A flaring facility will be utilised to control and dispose of the landfill gas extracted. Once the volume of landfill gas generated in the decomposing waste mass increases to a sufficient quality and quantity an energy recovery facility may be used to generate electricity.

## leachate management

The Expanded Footprint may require additional leachate ponds to be constructed as the landfill footprint increases. Additional ponds will be constructed, if required, based on the ongoing monitoring and modelling results.

## surface water management

An additional stormwater dam may be required in the future towards the southern extent of the site to assist in stormwater management as the landfill footprint increases.

- environmental impact assessment - expanded footprint


## flora \& fauna

The proposed expansion area extends into Tasmanian Blue Gum plantation. The landfill has been specifically located to avoid areas of remnant bushland on the site. Clearing will be required within plantation forest only. SUEZ will also implement a range of measures to minimise possible impacts on areas of remnant vegetation, including the adjacent State Forest.

## surface water and stormwater

A site specific Surface Water, Drainage and Sediment Control Plan will be designed and implemented which will divert undisturbed (uncontaminated) surface run-off in a manner to prevent erosion and prevent stormwater from disturbed areas from flowing offsite or entering waterways. A biannual groundwater monitoring program will also be developed and implemented and reporting to the DWER annually.
SUEZ will also implement a range of measures to minimise possible deterioration or contamination of surface water or groundwater.

## heritage

A search of the Aboriginal Heritage Inquiry System revealed that there are no registered sites or Other Heritage places.

## air quality

EPA Draft Separation Distances between Industrial and Sensitive Land Uses recommends that a putrescible landfill site (Class II and III) maintain a separation distance of $1,000 \mathrm{~m}$ to the nearest sensitive receptor. The nearest sensitive receptor is approximately 4.4 km west of the proposed facility, well beyond the separation distances for a putrescible landfill site.

Predicted residential standard odour impacts of 2.5 ou (odour units) were assessed and determined to have an average radius of approximately 2 km ; still 2 km away from the nearest sensitive receptor and therefore unlikely to impact occupants.

SUEZ will implement a range of measures to further minimise the risk of odour impacts.

## noise - construction \& operation

The nearest sensitive receptor is approximately 4.4 km west of the proposed facility.
Noise levels were predicted at the nearest sensitive receptor to the landfill for both construction and operation and assessed against night time noise criteria. The predicted worst case construction and operational noise levels at the nearest sensitive receptor are $24 d B A$ and $22 d B A$, respectively, comfortably below the most stringent, night time, criteria of 37 dBA .

SUEZ will implement a range of measures to minimise the risk of noise impacts.

## dust

Fugitive dust emissions to air potentially adversely impact air quality and therefore the health of site workers and fauna as well as resulting in dust deposition on remnant flora.
SUEZ will implement a range of measures to minimise the risk of dust impacts.

## fire

A Bushfire Hazard Level Assessment and Bushfire Management Plan has been prepared which considers vegetation type and structure, climate, the topography of the site and adjoining lands and reviews the Bushfire Management Plan originally developed for the RRP.
The site currently has $2 \times 160$ kL water tanks with a fixed standpipe for rapid filling of appliances. Two portable units are also available on-site for rapid deployment. There is also a large stormwater dam for refilling the water trucks and/or fire-fighting tanks if needed. A 15 kL water truck, normally used for dust suppression, can be used as a water cart and has couplings compatible for connection to the local brigade's appliances.

The Bushfire Management Plan concludes that the fire threat to people and property is significantly reduced.

## hazardous materials

SUEZ will store all chemicals and hazardous materials in appropriate containment areas and will implement a range of measures to minimise the risk of hazardous materials impacting the environment.

It is considered that the proposed Expanded Footprint will have minimal impact on the environment and amenity of the immediate area of the site.

## social impact assessment - expanded footprint

## consultation

SUEZ has consulted with the Shire of Boddington, Department of Water and Environmental Regulation and the Bibbulmun Track Foundation.

SUEZ is also establishing a Community Reference Group (CRG) within the local community which is expected to comprise representatives of SUEZ, Council and the Community. The primary purpose of the CRG is to function as a reference body for SUEZ, their stakeholders and the community.

## visual \& landscape

The RRP and proposed Expanded Footprint are situated approximately 5 km west of Albany Highway. The landform and vegetation between the Footprint and the Highway will fully screen the current landfill and Expanded Footprint from Albany Highway.

The Bibblumun Track runs along the northern boundary of the site then heading in a general south-westerly direction beyond the site. Boonering Hill / Natural Pavement is located approximately 800 metres to the west and is a 20 minute uphill walk from the main Track.

A Visual Impact Assessment of the proposed Expanded Footprint was undertaken by Golder Associates confirms that as with the current landfill, the Expanded Footprint will be visible from Boonering Hill / Natural Pavement.

SUEZ met with the Bibbulmun Track Foundation on the $29^{\text {th }}$ August, 2017 to discuss the proposed Expanded Footprint. The Foundation has advised that the existing landfill operation has not impacted the Track and no complaints have been received. SUEZ has committed to continue to work with the Foundation to minimise any future impacts.

## tourism

The RRP and proposed Expanded Footprint will not impact tourism associated with movement on Albany Highway. SUEZ is instituting a regular quarterly programme of road side collection of fugitive litter from waste transport vehicles and is upgrading the cover on its fleet of waste trailers to minimise the risk of fugitive litter.

It is possible that the proposed Expanded Footprint may result in further consolidation of local tourist services such as food and entertainment resulting from the on-going flow-on effects of the local employment and spending generated by the RRP.

## economic \& community

The RRP has a total current on-site complement of 18 persons of whom six are from within the local region and it is anticipated that staff replacements over time will result in a higher local workforce. SUEZ's preference is to fill its workforce requirements locally, as far as practical, as there are significant advantages in doing so.
The proposed Expanded Footprint will secure current employment well into the future as well as foster further future additional opportunities during the construction and operational stages, both directly and indirectly through the flow-on effects of sourcing of labour, plant and materials locally.
The total construction cost of the Expanded Footprint is estimated at $\$ 36$ million with the construction cost of each Cell estimated in the order of $\$ 4$ million. It is expected that a portion of the construction budget could be sourced locally including earthmoving, construction plant hire, concreting, trades and materials. Cell lining materials and processes are highly specialised and will be sourced from outside the region.

Operationally, approximately $\$ 75,000$ in services and consumables is currently sourced locally.
SUEZ is also a supporter of the local community and since assuming operations at the RRP have supported the Lions Boddington Rodeo, Boddington Arts Council, Boddington Community Resource Centre and

Boddington Skate Park with funding and sponsorship support totalling $\$ 23,500$. SUEZ has also committed to becoming a Gold Sponsor of the Bibbulmun Track.

## traffic

A Traffic Impact Assessment has been prepared and addresses both the existing RRP as well as the proposed Expanded Footprint at the current disposal rate of 350,000tpa.

The Traffic Impact Assessment concluded that the predicted traffic generation from the site will not adversely impact the operation of the existing road network and particularly Albany Highway.

SUEZ will also implement a range of measures to minimise disruptions and amenity impacts from haulage traffic to and from the RRP.

## conclusion

The need for the Expanded Footprint is driven by the growing need for landfill airspace to not only continue to be met in a sustainable manner but in the process thereof reduce the pressure for the development of new "greenfield" landfill sites.

The proposed Expanded Footprint is consistent with the State Planning Strategy and the Shire of Boddington Local Planning Strategies and Local Planning Scheme.

The proposed Expanded Footprint is located wholly within an existing Blue Gum plantation and will have minimal impact on flora and fauna within the region. The landfill is well removed from any sensitive premises and the design and range of environmental management measures to be implemented by SUEZ will ensure minimal impact on the environment.

The RRP and proposed Expanded Footprint will not impact tourism nor impact most walkers on the Bibbulmun Track except from Boonering Hill / Natural Pavement which is a 20 minute uphill walk from the main Track. The Bibbulmun Track Foundation has advised that the exiting landfill operations have not impacted the Track and SUEZ has committed to continue to work with the Foundation to minimise any future impacts.

The Traffic Impact Assessment confirms that the predicted traffic generation from the site will not adversely impact the operation of the existing road network and particularly Albany Highway.

The RRP currently employs of 18 persons and it is SUEZ's preference to fill its workforce requirements locally, as far as practical, as there are significant advantages in doing so.

The proposed Expanded Footprint will secure current employment well into the future as well as foster further future additional opportunities within the region during the construction and operational stages, both directly and in-directly through the flow-on effects of sourcing of labour, plant and materials locally.

While some of the flow-on effects of the Expanded Footprint will benefit other regions, there still remains the potential for the direct and flow-on effects of the proposed Expanded Footprint to further consolidate the local and regional economy well into the future and encourage the development and diversification of current and future businesses that will strengthen and broaden the economic base of the region.

Accordingly, SUEZ earnestly seeks the support of the Council for the approval of the Expanded Footprint to enable it to continue to meet the growing need for landfill airspace in a sustainable manner.

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Figure 3 : Surrounding Land Use Figures 4a \& 4b : Current Cell Layout Figure 5 : Monitoring Bores

Appendix 1 : Perthwaste Development Approval
September 2011

Appendix 2 : Environmental Impact Assessment
Golder Associates July 2017

Appendix 3 : Bushfire Management Plan
Ecosystem Solutions August 2017

Figure 6 : Proposed Site Plan
Figure 7 : Cell Layout - Expanded Footprint
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Figure 9 : Visual Impact Boonering Hill

## appendices :

Appendix 4 : Visual Impact Assessment
Golder Associates August 2017

Appendix 5 : Bibbulmun Track Foundation
Correspondence 2017

Appendix 6 : Traffic Impact Assessment
Shawmac Traffic Engineers July 2017
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Plan 001 : Existing Site Plan
Plan 002 : Proposed Site Plan
Plan 003 : Cell Layout Plan

Plan 004 : Final Landform Layout Plan
Plan 005 : Typical Sections and Details

## 1. background \& purpose

On the $31^{\text {st }}$ May, 2016, the SUEZ Recycling \& Recovery Australia group of companies (SUEZ) acquired the shares in Perthwaste Pty Ltd (now called SUEZ Recycling \& Recovery (North Bannister) Pty Ltd). The acquisition of Perthwaste included its waste management businesses and infrastructure including two waste transfer stations, two materials recycling facilities, three depots, the North Bannister Resource Recovery Park (RRP), a composting facility and a fleet of 68 collection vehicles. Perthwaste employs approximately 185 people. SUEZ also acquired the land on which the RRP is located.

The RRP is located in the western portion of Lot 2 Albany Highway, North Bannister and covers an area of approximately 22 ha [Figure 1 : Location Plan]. The RRP was approved by the Shire of Boddington in September 2011 [Appendix 1 : Perthwaste Development Approval] and was licensed to accept 200,000 tonnes per annum with a projected operating life of 18 to 20 years. Approval was granted for a five year period and the RRP commenced construction in July 2014 and operating in March 2015.

Prior to the purchase of the RRP, SUEZ operated a landfill at Shale Road, South Cardup within the Shire of Serpentine Jarrahdale. The Cardup Landfill is owned by West Australian Landfill Services (a joint venture between SUEZ and Hanson) (WALS). As the Cardup Landfill was nearing exhaustion, SUEZ sought and obtained planning and environmental approvals for the construction of a new landfill within the Shire of York. The acquisition by SUEZ of Perthwaste and the RRP has obviated the need to construct the York landfill and South Cardup has since been closed and WALS is complying with its landfill post-closure obligations.

The transfer of SUEZ's landfill operations from South Cardup to the RRP combined with the existing landfill operations of the acquired Perthwaste business has necessitated an increase in the annual tonnage being placed at the RRP. In November 2016, SUEZ sought and obtained approval from the Department of Water and Environment Regulation (DWER) to increase the annual tonnage throughput from 200,000tpa to 350,000tpa.

The RRP was originally designed as a Class II / III landfill with eleven cells and an estimated operating life of 18-20 years based on an initial annual tonnage of 13,000tpa increasing to 200,000tpa over a nine year period.

Geotechnical investigations by SUEZ since its acquisition of the RRP have identified extensive sub-surface rock in the latter stage cells of the RRP significantly reducing the viability of constructing these cells. Exclusion of these latter cells combined with the increase in total annual tonnage will have the effect of significantly reducing the estimated life of the RRP. The current operating Cell and new Cell 4 which is under construction have a combined capacity of $760,000 \mathrm{~m} 3$ and an estimated life of 2.2 years.

Additionally, it is likely that over the ensuing years, annual tonnages will have to increase further as landfill is diverted to the RRP as a consequence of the progressive closure of existing Metropolitan Landfills that are nearing the end of their useful life.

Accordingly and in view of the significantly reduced life of the RRP, SUEZ is now seeking the approval of the Shire of Boddington to the southern expansion of the footprint of the RRP to extend its operating life by an estimated additional 23 years.


SUEZ's application for approval of the proposed expanded footprint is driven by the need to ensure an adequate and on-going supply of sustainably designed landfill airspace to service the on-going waste disposal needs of the Perth Metropolitan Region; particularly having regard for:

- the lead time required in obtaining planning and environmental approvals for the proposed expansion;
- the lead times required for detail design and construction of the expansion; and
- the considerable time and cost and increasing difficulty in obtaining approvals for landfills on "greenfield" sites.

SUEZ is concurrently making application to the DWER to amend the Licence for the current landfill to allow construction of the first two cells of the proposed Expanded Footprint; contingent on Planning Approval.

SUEZ is also, under separate Application to the Shire of Boddington, seeking approval to expand its green waste composting facility, adjacent to the landfill at Lot 2 Albany Highway.

This report:

- Identifies and discusses the planning and environmental context of the proposed site and immediate region;
- Details the waste management facility and operations;
- Details the proposed Expanded Footprint and related management issues;

Details the current green waste composting operation and proposed expansion;

- Considers the impacts, actual or potential, of the proposed facility on the local and regional environment, adjacent property owners and the broader community;
- Identifies appropriate management measures to ameliorate any impacts identified and to ensure the facility continues to operate in a manner acceptable to the relevant Authorities; and
- Assesses the impacts and benefits to the local and regional community of the proposal.

The Report should be read in conjunction with the EPA Referral Document "Environmental Impact Assessment for North Bannister landfill Expansion" prepared by Golder Associates (August 2017) and associated Appendices.

This Report has been prepared by Larry Smith Planning - Urban and Strategic Planning \& Design and Golder Associates - Environmental Engineers in association with:

- Shawmac - Traffic Engineering Consultants; and
- Ecosystem Solutions - Fire Management Consultants.


## 2. proponent

SUEZ is a leading multinational waste, recycling and resource recovery service provider. SUEZ Recycling \& Recovery (Perth) Pty Ltd, a wholly owned subsidiary of SUEZ Recycling \& Recovery Holdings Pty Ltd and the proponent for this application, is part of the SUEZ Environnement group with its head office in Paris, France and is listed on the Euronext exchanges in Paris and Brussels.

In Australia, SUEZ is a leader in sustainable resource recovery providing services to more than 56,000 commercial and industrial business Australia wide as well as over 3.7 million households. With over 2100 employees and contractors, SUEZ operates across Australia in the provision of:

- Domestic, Commercial and Industrial Waste Collection Services;
- Medical and Clinical Waste Collection and Treatment;
- Hazardous and Liquid Waste Collection, Transport and Treatment;
- Recycling and Resource Recovery Services;
- Construction \& Demolition Recovery and Recycling;
- Advanced Resource Recovery Facilities; and
- Engineered Landfills.

Since opening the very first engineered landfill in Australia at Lyndhurst in Victoria in 1991 SUEZ has continued as a leader in landfill and waste management technology. SUEZ currently operates seven engineered landfills around Australia accepting in excess of 2.5 million tonnes of waste.

SUEZ has a significant presence in Western Australia and currently provides collection and disposal services for a variety of clients including local governments, service industries and commercial enterprises. SUEZ also provides services to a range of commercial and industrial customers.

SUEZ operates a number of recycling and resource recovery facilities within WA recovering approximately 200,000 tonnes per annum of material that would otherwise be sent to landfill and specifically:

- Neerabup BioVision Advanced Resource Recovery Facility : an advanced Municipal Solid Waste composting facility processing 100,000 tonnes per annum for seven northern Metropolitan member Councils. Of the 100,000 tonnes processed, 28,000 tonnes is recycled as organic soil conditioner with an overall waste diversion of approximately $50 \%$. All Class II residuals are disposed of at the Tamala Park Landfill in Mindarie.
- Landsdale Recycling Balcatta : a specialist paper and cardboard recycling and secure document destruction facility providing also public drop off facilities for paper and cardboard. The facility processes in excess of 40,000 tonnes of paper and cardboard annually of which $100 \%$ is recycled.
- Landsdale Waste Transfer Station : a waste transfer station licenced to accept 135,000 tonnes per annum of Class II waste.
- Bibra Lake Waste Transfer Station : a waste transfer station newly acquired through the acquisition of Perthwaste and licenced to accept 120,000 tonnes per annum of Class II waste. The recycling facility processes local council and commercial recycling waste and separates into multiple material streams of which $80 \%$ is recycled.
- Welshpool Transfer Station and RRT : a resource recovery and treatment facility owned by WALS processing 165,000 tonnes per annum. The facility also processes and recovers E-Waste. The facility includes a transfer station for transport of unrecoverable waste to landfill.

WALS Shale Road Landfill operated by SUEZ, in South Cardup has now closed. It was an engineered, lined Class II landfill which accepted up to 250,000 tonnes per annum of municipal, commercial and industrial waste.

SUEZ also operates community consultation; education and support programs associated with its operations and facilities in Australia and is developing similar programs and relationships with the Boddington and regional community.

## 3. need for expanded footprint

## 3.1 west australian waste strategy 2012

The WA State Government "Western Australian Waste Strategy - Creating the Right Environment" Waste Authority 2012) aims to "engage the Western Australian community over the next decade in moving to a low-waste society by providing the required knowledge, infrastructure and incentives to change behaviour."

The WA Waste Strategy (WAWS) replaces the "Statement of Strategic Direction for Waste Management in WA - Vision \& Priorities (2003)" which sought to achieve minimal to zero Waste to Landfill by the year 2020 through proactive prevention and recovery of waste.

The WAWS notes that the amount of waste being recovered in Western Australia has been increasing steadily for a number of years. However, the State's performance when benchmarked against other mainland states is still poor and requires a significant boost if comparable outcomes are to be achieved.

The Waste Authority Annual Report 2015-16 indicates a total of 3.2 million tonnes of Municipal and Commercial \& Industrial Waste was generated in 2014-15 of which $41 \%$ was recycled / recovered with the balance 1.9 million tonnes being sent to landfill. Western Australia has the lowest rate for recovery and diversion from landfill of any mainland State. However the rate of recovery has progressively increased from only $32 \%$ in 2008/09 to $41 \%$ in 2014/15.

The WAWS seeks to guide continuous improvement in waste services, waste avoidance and resource recovery benchmarked against best practice, and sets targets for waste reduction, resource recovery and the diversion of waste from landfill.

The Strategy acknowledges that it is critical to ensure that there are appropriate waste and recyclables processing facilities available and that planning and development of waste and recycling processing facilities in the metropolitan region and other regions is undertaken early and is considered as critical infrastructure like other important infrastructure such as water, sewerage and power.

The Strategy also notes that access to land with appropriate buffers and transport links to allow the efficient and effective processing of waste is difficult to secure on a reliable basis and, as development across the State increases, this task will only become more difficult.

The WAWS focuses on five key strategic objectives:

- Initiate and maintain long-term planning for waste and recycling processing, and ensure access to suitably located land with buffers sufficient to cater for the State's waste management needs.
- Enhance regulatory services to ensure consistent performance is achieved at landfills, transfer stations and processing facilities.
- Develop best practice guidelines, measures and reporting frame works and promote their adoption.
- Use existing economic instruments to assist the financial viability of actions that divert waste from landfill and recover it as a resource.
- Communicate messages for behaviour change and promote its adoption, and acknowledge the success of individuals and organisations that act in accord with the aims and principles in the Strategy and assist in its implementation.

In respect of the first objective, the Strategy notes that enabling access to sufficient land for waste management facilities, in the right place by the right time, including appropriate buffers and access to transport networks, to meet industry needs is critical to the success of this Strategy. The Authority will work within the State planning and environmental approval systems with the aim of enabling access to well located land for the full range of waste facilities for the next 30-40 years.

In respect of Municipal Waste the Strategy sets the following targets:

- 50\% diversion from landfill of material presented for collection in the metropolitan region by 30 June 2015 (metropolitan region recovery in 2009/10 was 36\%); and
- $65 \%$ diversion from landfill of material presented for collection in the metropolitan region by 30 June 2020.

The WA Waste Authority (WAWA) established a Strategic Waste Infrastructure Planning Working Group (SWIPWG) to provide advice, initially, to the Authority on waste infrastructure planning needs for all solid waste streams for the Perth Metropolitan and Peel regions and specifically:

- Planning and Approvals;
- Facilities and Sites;
- Technology; and
- Governance and Funding.

The WAWA and SWIPWG recognise that landfills will continue to play an important role in waste management and that the waste industry plays a pivotal role in providing a range of collection, sorting, processing and safe disposal of waste in Perth and Peel. The WAWA and SWIPWG are yet to address the issue of new landfills and seem unlikely to given the considerable technical investigations and associated cost in identifying potential landfill sites.

## 3.2 metropolitan landfill requirements

The WA State Government "Western Australian Waste Strategy" aims to significantly reduce the volume of Metropolitan waste diverted to landfill by up to $65 \%$ by 2020.

Significant reduction of waste volumes to landfill will require major investments in Alternative Waste Treatment (AWT) technologies which are capable of recovering resources from domestic and commercial waste streams.

These AWT technologies are still being developed and demonstrated at a commercial scale, are not without their problems and involve very major capital investments, in the order of hundreds of millions of dollars. As a result, implementation of AWT's is likely to occur progressively.

It is significant to note in this context that current AWT technologies still require access to landfill to dispose of treatment residues which, contingent on the technology used, can represent up to $50 \%$ of the incoming waste stream tonnage.

Landfills are also required as a backup for when AWT plants need to be shut down due to malfunction, maintenance requirements or a surge in waste generation beyond the AWT plant's operating capacity, such as after a major storm event or seasonal variations in metropolitan waste generation volumes.

Additionally, the recovery of waste requires markets for the recycling of recovered waste to new product. Western Australia's isolation from the larger Eastern seaboard markets limits the market for recovered waste as a consequence of WA's limited population base for product and transport costs to get recovered waste to major eastern states markets.
"Recycling Activity in Western Australia 2011-12" prepared for the DWER indicates that 66\% of recovered materials are reused within WA with a further $33 \%$ exported overseas.

The limited WA market has seen and will continue to see closures of recycled product manufacturers while the opening of others will provide new opportunities. The recycling market place will continue to go through rationalisation and consolidation to the point where it becomes largely self-sustaining.

Accordingly, there remains a need to ensure that sufficient landfill capacity exists within the system to provide for the safe management of those wastes that cannot be recovered and recycled economically from the waste stream.

Following the closure of a number of landfills in recent years, the Perth Metropolitan region now has only four major Metropolitan landfills that can accept Class II or III wastes and specifically Cockburn, Red Hill, Rockingham and Tamala Park which is expected to close in the near future.

DWER Guidelines for the Siting, Design, Operation and Rehabilitation of Landfills effectively preclude future landfills within the Swan Coastal Plain by virtue of considerations of:

- Avoidance of areas of potable groundwater, groundwater recharge areas and defined Groundwater Supply Areas; and
- Soil type and specifically the avoidance of areas of sandy soils.

The combined effect of these and other locational considerations is to limit the siting of future landfills to areas south of the Metropolitan Region, the foot of the Darling Scarp or areas inland thereof.

Darling Scarp or near eastern Scarp locations south of the Metropolitan Area are limited by considerations of:

- The need to protect basic raw materials (sand, clays, rock);
- The presence of major mineral deposits, notably bauxite and associated refinery installations;
- Extensive surface water catchment protection areas;
- Extensive areas of State Forest;
- The distribution and proximity of semi-urban and rural residential settlements; and
- Issues related thereto, including buffers and heavy haulage traffic.

Cumulatively, these factors conspire to force the search for suitable landfill locations to outer Metropolitan / regional locations.

In this respect, the time and cost of transporting waste to a remote landfill becomes a significant consideration. Industry discussions suggest a 100km radius from the Metropolitan Area as the practical limit from both a travel time and cost perspective.

Additionally, some Local Authority Schemes in potential locations (eg. the Shires of Gingin and Chittering) preclude the development of landfills within their Municipal Area other than by Scheme Amendment (rezoning).

There are three near Metropolitan landfills Toodyay, Gingin and SUEZ's North Bannister RRP. Toodyay and Gingin are yet to be developed and have a combined annual capacity of 300,000tpa with Toodyay estimated to have a lifespan of less than 10 years and Gingin approximately 25 years.

The WA Waste Strategy seeks to increase waste recovery over the period to 2020 with the following targets for Metropolitan Municipal Waste:

- $50 \%$ diversion from landfill of material presented for collection in the metropolitan region by 30 June 2015 (actual 41\%); and
- $65 \%$ diversion from landfill of material presented for collection in the metropolitan region by 30 June 2020.

Based on the 2015-16 total of 3.2 million tonnes of Municipal and C\&I Waste generated per annum there is a current need, between the Metropolitan and near Metropolitan landfills including the RRP, for landfill airspace of 1.9 million tonnes decreasing to 1.1 million tpa over time if the $65 \%$ recovery rate is achieved. Population growth over ensuing years will see this requirement steadily increase to approach 2 million tpa at $65 \%$ recovery. Total medium to longer term capacity including the North Bannister RRP is currently estimated at 1.3 million tpa.

There is clearly a need for additional landfill airspace to be developed on an on-going basis to ensure an adequate supply to meet the needs of a growing Metropolitan population and to maintain waste disposal costs at reasonable levels. Given DWER siting constraints, land use limitations to the near south and transport cost considerations; future landfill development needs to concentrate on outer Metropolitan locations.

Approval of the expanded footprint for the North Bannister RRP will enable the growing need for landfill airspace to not only continue to be met in a sustainable manner but in the process thereof reduce the pressure for the development of new "greenfield" landfill sites.

## 4. site \& surrounding land uses

The North Bannister RRP is located on Lot 2 Albany Highway, North Bannister [Figure 1 : Location Plan] approximately 100 km south-east of Perth. Lot 2 is situated approximately 5 km west of the Highway with the entry road approximately 1.5 km north of the Nth Bannister / Wandering Road junction and is described as:

Lot 2 on Plan 2767 in Certificate of Title Volume 2228, Folio 247.
Lot 2 has a total area of 390 ha and is accessed by sealed road from Albany Highway. Prior to development of the RRP, substantial areas of the lot were cleared for the purposes of tree farming and specifically Blue Gum plantation operated by WA Plantation Resources (WAPRES). Those portions of the site not currently developed for the purposes of the RRP continue to be used and managed for plantation purposes by WAPRES. The land comprising the proposed footprint expansion is planted to Blue Gums and WAPRES maintains a lease over the area until 2022. Limited areas of Lot 2 comprise remnant Jarrah / Marri vegetation.

The existing RRP is located in the western portion of Lot 2 with the current landfill being located within a previously cleared area of approximately 22 ha bordering onto the western boundary of the lot [Figure 2 : Existing RRP].

The lands to the north, west and immediate south of Lot 2 are State Forest. The lands to the east, between the RRP and Albany Highway have been substantially planted to Blue Gums with the balance used for grazing of sheep [Figure 3 : Surrounding Land Use].

The closest "development" to Lot 2 is the Threeways Roadhouse on Albany Highway just north of the North Bannister / Wandering Road junction and approximately 5.5 km (straight line distance) east, south-east of the RRP. The roadhouse has been vacant for some time with no signs of it being occupied in the short term. Boddington is located approximately 30 km by road south, south-east of Lot 2 ( 25 km straight line distance).

The RRP site is isolated, well removed from any residents and its expansion will not impact the amenity of residents of the region. The potential also exists for future synergies with more intensive development of the lands to the immediate east of the RRP, be it for industrial or intensive agricultural purposes, including power supply through Biogas generation.



## 5. local \& regional planning context

## 5.1 state planning strategy 2050

The State Planning Strategy 2050 is the highest order planning instrument in the WA planning system and envisages a doubling of Western Australia's current population to 5.6 million by 2056.

The Strategy identifies six principles underpinning sustained growth and prosperity within the State and specifically Community, Economy, Environment, Infrastructure, Regional Development and Governance.

The Strategy defines five Strategic Goals and specifically:

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- Global Competitiveness;
- Strong and Resilient Regions;
\square Sustainable Communities;
- Infrastructure Planning and Coordination; and
\square Conservation.
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The Strategy defines three broad sectors of the State - North West, Central and South West - with subregions within each. The Strategy further identifies five Strategic Directions of key importance to WA's sustained growth and specifically:

- Economic development
- Physical infrastructure
- Social infrastructure
- Environment; and
- Security.

The Strategic Direction of direct relevance to the application is that of Physical Infrastructure - Waste. The Strategy identifies the need for:
"A network of strategically located waste management facilities and infrastructure [that] will assist recycling and stimulate innovation in reprocessing."

The Strategy recognises that sites for waste treatment facilities require sufficient buffers in order to ensure sites are available and avoid land-use conflicts and waste management facilities must be sited, designed and operated to meet environmental criteria and prevent pollution.

The Strategy acknowledges the DWER siting restrictions and that future landfills will need to be located outside the Perth metropolitan area.

Aspirations identified by the Strategy of direct relevance are:

- Behaviour change in community and organisations, and improvements in technology and product design, resulting in a reduction in waste generation;
- Secure strategic sites, buffers and corridors for waste management facilities; and
- Ensure waste facilities have the capacity to service long term waste processing and recycling needs of a growing population and economy.

The Strategy further notes that:
"The siting, design, operation, and ongoing funding and management of waste management facilities is often complex. Planning for waste facilities will need to secure strategic sites and major corridors from the source to the waste facility.

Sites will need to be suitable in terms of buffers, transport access, relationship to existing waste facilities and producers, and the degree of risk of air, soil, groundwater, and surface water pollution.

Buffer areas surrounding some existing waste disposal facilities are also becoming inadequate as volumes of waste increase and sensitive land uses encroach on previously isolated facilities."

It is considered that the proposal is consistent with the State Planning Strategy 2050 as it supports the Aspirations arising from the Strategic Directions of broad relevance to the application. In particular, the proposed footprint expansion secures a current strategic site within a "network of strategically located waste management facilities" and ensures that the facility will continue to have the "capacity to service the long term waste processing needs of a growing population and economy".

## 5.2 shire of boddington local planning strategy 2007

The Shire of Boddington Local Planning Strategy was endorsed in August 2007 and has as its vision for the Shire to be:
"... to be widely recognised as a progressive local authority providing quality services and facilities that encourage people to live, work, visit and invest in the district."

The Strategy identifies its Aims under the key headings of :

- Mining
- Agriculture
- Rural Living
- Tourism
- Environment \& Conservation
- Urban Development; and
- Infrastructure \& Services

Aims of relevance to the proposal are:

- To ensure that conflicting land uses do not impact on current mining activities nor on areas identified as being prospective.
- To ensure the natural and cultural environments of the Shire are protected and that the principles of environmentally sustainable development are promoted.
- To identify and facilitate the provision of infrastructure and services provided by others.

The Strategy identifies five primary Precincts. The RRP is located within the Boddington North West Precinct which has as its Objectives to:

- provide for the continuing operation of gold and bauxite mining activities in recognition of its major economic contribution to the Shire and the State; and
- maximise retention of the existing extensive areas of remnant vegetation in recognition of their conservation and mining buffer land use values.

The land use guidelines of the Precinct are heavily oriented to protection and future development of the mining industry but in areas outside, recognise opportunities for tree farming on previously cleared areas. The site of the RRP is a former tree farm.

The Strategy is currently under review with the new Strategy expected to be finalised in the near future.

## 5.3 shire of boddington local planning strategy 2016 (draft)

The Shire is currently reviewing its Local Planning Scheme and has published and advertised a draft LPS. Submissions on the Draft LPS have been considered by Council and forwarded to the WAPC and Minister for final approval. The Strategy has as its Vision:
" a vibrant and connected community, providing employment and lifestyle opportunities, a beautiful environment, and easy access to the city".

The LPS identifies a range of strategies for the future development of the Shire under the key headings of:

- Settlements
- Infrastructure
- Economics and Employment
- Environment \& Conservation
- Heritage; and
- Hazards.

The Strategy has a key economic objective to:
"Support investigations aimed at identifying, securing and developing new opportunities for light and general industrial development."

The Strategy recognises the existing RRP and identifies the opportunity for broader industrial development to occur in the immediate proximity of the RRP, subject to the necessary technical investigations and structure planning.

The proposed expansion of the RRP is consistent with the Draft Local Planning Strategy 2016.

## 5.4 shire of boddington local planning scheme no 2

The Shire of Boddington Local Planning Scheme No 2 was Gazetted in February 1997 and could be expected to be reviewed following the conclusion and endorsement of the Local Planning Strategy 2016.

Lot 2 is zoned "Rural" under LPS2. Table 1 - Zoning Table of the Scheme sets out a number of land uses and the "permissibility" of those uses within the various Zones of the Scheme. Table 1 does not specifically provide for the use of waste disposal / landfill.

The use closest in form to waste disposal / landfill currently provided for under Table 1 is that of "Industry Noxious" which is defined under the Scheme as:
"industry - noxious: means an industry which is subject to licensing as "Prescribed Premises" under the Environmental Protection Act, 1986 (as amended)."

A landfill is a Prescribed Premises under the Environmental Protection Act.
Table 1 - Zoning Table of the Scheme identifies "Industry - Noxious"" as an "SA" use within the Rural Zone requiring the specific approval of Council and advertising for public comment under Clause 6.4 of the Scheme.

The Scheme does not define specific Objectives for the Rural Zone but does identify a range of Scheme wide Objectives. Those of relevance to the proposed Expansion are:

- encourage and control quality and orderly development in the Scheme area so as to promote and protect the health, safety, and general economic and social well-being of the community, and the amenity of the area
- ensure there is sufficient supply of serviced and suitable land for housing, commercial and industrial activities, community facilities, recreation and open space
- assist employment and economic growth by facilitating the timely provision of suitable land for retail, commercial, industrial and tourist development, as well as providing opportunities for homebased employment
- maintain and protect valuable areas of agricultural production and conserve its nonurban character whilst accommodating other complimentary rural activities
protect and enhance the environmental values and natural resources of the District and to promote ecologically sustainable land use and development
ensure development appropriately takes account of flooding, fire and other risks; and
- provide guidance and controls for possible future residential, special residential, commercial, industrial, rural and special rural development within the Shire of Boddington.

The proposed expanded RRP and associated infrastructure:

- Is located and designed so as to protect the health, safety and amenity of the area
- Ensures an adequate on-going airspace volume to meet the waste management needs of a growing Metropolitan population
- Will contribute further to economic growth and employment both directly and indirectly through additional employment opportunities and sourcing locally of goods and services required for the operation of the RRP
- Will not impact valuable agricultural land or agricultural activities on adjoin lands
- As an engineered fully lined landfill, protects the environmental values of the surrounding environment and will be rehabilitated progressively
- Does not impact on the flora, fauna, surface water and groundwater of the local environment; and
- Recognises and manages the risk if fire from both within and without the site.

The proposed expansion of the RRP is consistent with Local Planning Scheme No 2.
Given the estimated construction cost, the proposed Expanded Footprint will require the approval of the Mid-West Wheatbelt (Central) JDAP.

## 6. existing waste management facility

The following section provides an overview of the existing Waste Management Facility which commenced operations in March 2015 [Figure 2: Existing RRP].

## 6.1 site access

Access to the RRP is via a 7 m wide sealed bitumen road off Albany Highway. The access road is controlled by an electronic boom gate during operating hours and closed after hours by locked, rural steel gate. No public access is permitted to the site.

On entering the site all waste disposal vehicles must pass over the weighbridge control where video cameras also inspect the load to ensure compliance with Licencing conditions.

The RRP operates 5.00 am to 5.00 pm Monday to Friday and 5.00 am to 1.00 pm Saturdays and most Public Holidays. Waste placement and cover operations can continue to 6.00 pm .

The site typically receives 45 waste truck movements per weekday comprising 30 enclosed Pocket Road Trains (40 tonne) and 15 enclosed Collection Vehicles (8 tonne). Saturday and Public Holiday movements are typically half. Waste is received from SUEZ's transfer stations at Landsdale, Welshpool and Bibra Lake and from commercial waste operators at Bayswater and Jandakot. Staff vehicles comprise further 18 movements per day. The RRP currently employs 18 staff, eight of whom are employed directly by SUEZ and a further 10 by SUEZ's landfill services contractor.

## 6.2 waste class

The RRP is currently licensed to accept 350,000 tonnes per annum of Class II and Class III putrescible waste consisting primarily of household waste, food waste and non-recyclable waste and non-chemical wastes from commercial and light industrial premises. Special wastes such as asbestos and clinical waste not requiring incineration are buried under controlled conditions. The RRP is also licensed for the acceptance of liquid and greenwaste, used tyres and for compost manufacture and soil blending.

Toxic, flammable, poisonous, infectious and radioactive wastes are not permitted.
Waste entering the site is screened by video cameras at the weighbridge on entry of the waste vehicles to the site. Records of all wastes accepted are maintained and available to the DWER for audit.

## 6.3 cell operation \& capping

The RRP, as originally approved, proposed 11 cells with a total airspace of 3.38 million $\mathrm{m}^{3}$ and a waste capacity of 2.5 million tonnes. The original 11 cells have been subsequently condensed down to six cells. [Figure 4a \& 4B : Current Cell Layout].

Development of the landfill is undertaken on a progressive basis or Cells to facilitate best practice management of disposal operations and minimise the extent of time that a disposal area is "open" prior to final capping. Typically, waste is placed, levelled and compacted in 0.5 m high "lifts" to ensure maximum compaction with a tonne of waste being approximately equal to 0.8 m 3 compacted volume. A 150 mm soil cover is applied prior to close of each day's operations.



Cell preparation and lining is a highly specialised operation requiring, prior to use, formal certification of compliance to the DWER. The construction profile of each comprises a compacted clay underlining; primary lining geomembranes to prevent movement of any leachate into the soil and groundwater below the cell, a drainage layer and covering protecting fabric cushion Geotextile above which the waste is placed.

Filling of Cells 1-3 is nearing completion with approximately $230,000 \mathrm{~m}^{3}$ airspace remaining and is expected to be exhausted by the first quarter of 2018. Accordingly, SUEZ has commenced construction of Cell 4 which will provide a further $530,000 \mathrm{~m}^{3}$ of airspace which is likely to be exhausted by late 2019.

The first Cell within the Expanded Footprint will be completed prior to exhaustion of Cell 4 to enable landfill operations to transfer across into the new footprint.
While the current Cell layout provides for a further two Cells - Cell $5\left(780,000 \mathrm{~m}^{3}\right)$ and Cell $6\left(1,290,000 \mathrm{~m}^{3}\right)$ - these Cells are located further uphill of Cell 4 and are underlain by hard rock requiring extensive blasting, significantly increasing the cost of construction and impacting the viability of constructing the Cells. Additionally, the large capacity of Cells 5 and 6 results in final capping following much later, increasing leachate volumes and impacting the overall water balance of the landfill.

Once the working cell has reached final profile, the cell is permanently capped. Capping is only undertaken in dry conditions and typically during summer and autumn. In accordance with DWER Guidelines capping of each cell comprises an engineered clay cap, drainage layer and sub-soil / topsoil planting layer.

## 6.4 leachate management

The cells are constructed with an internal engineered leachate collection system with a shared sump. Leachate levels within the cells are regularly monitored and periodic extraction is undertaken by submersible pumps within the sump.

Typically, leachate is directed in the first instance to the Leachate Evaporation Dams which have a combined volume of approximately $20,000 \mathrm{~m} 3$ below the freeboard of 1.1 m . The combined surface area of the Dams is $6,900 \mathrm{~m} 2$ providing significant freeboard volume.

Leachate level within the Dams is closely monitored, particularly during winter. A freeboard is maintained at all times through re-circulation over the active landfill cell. There has not been an overflow event of the Evaporation Dams.

## 6.5 surface water management

The site is situated within the Murray River and tributaries surface water management area and Hotham sub-area and does not include nor is it in close proximity to any wetlands listed as RAMSAR sites. The landfill is positioned within the Hotham Catchment and located on the southern side of a ridge line dividing the Hotham and Upper Serpentine Catchments. The nearest creek to the landfill is Gringer Creek, approximately 6 km south-east of the landfill flowing into the Hotham River. The site gradient falls steeply from north-west to south-east.

Surface water on site is channelled from around the southern and eastern edges of the existing landfill to Stormwater Dam 1. Overflow from Stormwater Dam 1 drains along a natural drainage channel toward Stormwater Dam 2 and in turn overflows into Stormwater Dam 3. Surface water drains east across the southern part of the proposed landfill extension along existing, yet poorly defined water courses [Figure 2 : Existing RRP].

Surface water data collected from the Dams between July 2012 and September 2016 indicates that surface waters are not impacted by the landfill in view of the relatively good water quality and the absence of key landfill indicators.

## 6.6 groundwater monitoring

Groundwater monitoring bores are currently installed in 18 locations across and surrounding the existing and proposed landfill areas [Figure 5 : Monitoring Bores]. Groundwater sampling and analysis has been carried out at the site since 2011.

Groundwater quality data recorded for the existing landfill indicates total dissolved solids (TDS) concentrations range between very fresh ( $20 \mathrm{mg} / \mathrm{L}$ ) and brackish ( $4900 \mathrm{mg} / \mathrm{L}$ ). Groundwater samples collected from the newly installed wells across the proposed landfill extension were all fresh ( 239 to $518 \mathrm{mg} / \mathrm{L}$ ), the median value for all samples collected since the commencement of monitoring is $312 \mathrm{mg} / \mathrm{L}$.

Groundwater pH recorded in existing monitoring wells between 2011 and 2017 ranges between neutral and acidic ( 3.1 to 7.2 ). The pH of groundwater collected from the newly installed monitoring wells across the proposed landfill extension are consistent with these values and are acidic to marginally acidic ranging between 3.9 and 5.9. These results are considered to be a reflection of the natural groundwater pH in the area.

The existing groundwater quality database has been compared against the following criteria:

- ANZECC 2000 Freshwater Slightly-Moderately Disturbed Ecosystems
- Department of Health - Non-Potable Groundwater Use Criteria
- ANZECC \& ARMCANZ 2000 Long-term irrigation criteria.

Based on review of the groundwater quality database and field investigation, there is no evidence of contamination to groundwater at the existing landfill and proposed landfill extension site.


## 7. proposed expanded footprint

## 7.1 expanded footprint

The proposed Expanded Footprint has been designed in accordance with Victorian BPEM Guidelines and configured to avoid and thereby retain the remnant vegetation towards the southern portion of Lot 2 [Figure 6 : Proposed Site Plan].

The footprint has been developed to maximise the capacity of waste storage whilst avoiding areas of native vegetation and is based on the following assumptions:

- Disposal rate of 350,000 tpa which equates to approximately $432,000 \mathrm{~m}^{3}$ pa assuming a landfill density of $0.81 \mathrm{t} / \mathrm{m}^{3}$.
- Cell construction to take place approximately every two to three years with approximately $800,000 \mathrm{~m}^{3}$ to $1,200,000 \mathrm{~m}^{3}$ airspace constructed per cell.
- All excavations and upstream embankment slopes are $1 \mathrm{~V}: 3 \mathrm{H}$.
- Maximum excavation depth is controlled by either groundwater table or depth to refusal, whichever is shallower to optimise the volume of material excavated for use in daily cover, cell construction and capping.
- All bunds have a crest width of 3 m .
- Final waste slope is maximum of $1 \mathrm{~V}: 5 \mathrm{H}(20 \%)$ and minimum $1 \mathrm{~V}: 20 \mathrm{H}(5 \%)$.
- Daily cover required at a ratio of $1 \mathrm{~m}^{3}$ cover to $10 \mathrm{~m}^{3}$ waste.

The Expanded Footprint has been divided into nine cells [Figure 7 : Cell Layout - Expanded Footprint] with airspace varying between approximately $950,000 \mathrm{~m}^{3}$ and $1,230,000 \mathrm{~m}^{3}$ or approximately 770,000 tonnes and 977,000 tonnes [Table 7.1 : Cell Volumes - Expanded Footprint].

TABLE 7.1 : CELL VOLUMES - EXPANDED FOOTPRINT

| Cell Number | Airspace (m ${ }^{\mathbf{3}}$ ) | Waste Tonnage (tonnes) | Est. Life (years) |
| :---: | :---: | :---: | :---: |
| 5 | $1,080,000$ | 870,000 | 2.5 |
| 6 | $1,100,000$ | 900,000 | 2.6 |
| 7 | 990,000 | 800,000 | 2.3 |
| 8 | 950,000 | 770,000 | 2.2 |
| 9 | $1,230,000$ | 990,000 | 2.8 |
| 10 | 950,000 | 770,000 | 2.2 |
| 11 | $1,205,000$ | 977,000 | 2.8 |
| 12 | $1,205,000$ | 977,000 | 2.8 |
| 13 | $9,205,000$ | 977,000 | 2.8 |
| TOTAL | $9,915,000$ | 23,0 |  |


(

The Expanded Footprint will provide an additional $9,915,000 \mathrm{~m}^{3}$ of airspace equating to $8,031,000$ tonnes providing an estimated life of 23 years at current disposal rates. Cells $14 \& 15$ within the original footprint (former Cells 5 and 6) provide a further $2,070,000 \mathrm{~m}^{3}$ extending the overall life of the RRP by an additional six years at current disposal rates.

SUEZ is currently constructing Cell 4 of the original footprint to provide adequate interim airspace and will proceed immediately to construction of Cell 5 within the Expanded Footprint. Further cell development commences as the preceding cell is approaching $50 \%$ capacity with Cell 6 then partially overlaying Cell 5 . The same pattern of cell development from east to west continues for the balance of the Expanded Footprint while moving in a southerly direction.

Cell numbering in Table 7.1 does not necessarily reflect the sequence of development as it is possible that construction of Cells 14 and 15 - original footprint Cells 5 and 6 - may be required part way into the construction of the Expanded Footprint to provide overall stability to the Expanded Footprint.

Construction of the Expanded Footprint will require the progressive clearing of the Blue Gum plantation and will not impact any remnant vegetation.

## 7.2 cell lining \& capping

The liner system will consist of the following layers (from top to bottom) [Figure 8 : Cell Lining and Capping]:

- Separation geotextile above which waste is placed.
- 300 mm gravel leachate collection layer.
- Cushion geotextile.
- High Density Polyethylene (HDPE) geomembrane liner.
- Geosynthetic Clay Liner (GCL).
- 500 mm reworked in-situ or imported low permeability material to act as attenuation layer.

Final cover and capping thickness is 2.2 m with the following layers (from top to bottom) [Figure 8 : Cell Lining and Capping]:

- 0.5 m thick soil growth layer of which 300 mm is topsoil sourced from site.
- Separation Geotextile.
- 0.3 m drainage layer or Geocomposite layer.
- Geomembrane.
- $\quad 0.6 \mathrm{~m}$ compacted clay layer sourced from site or GCL.
- Gravel Gas collection layer.

The maximum waste elevation is approximately 396 m AHD at the landfill crest, extending up to 401.6 m AHD at the central ridge. The final landform profile is influenced by both practical geometric and operational constraints.


## 7.3 landfill gas extraction

Landfill gas (LFG) is composed of a variety of gases which include methane, carbon dioxide, oxygen, nitrogen, hydrogen and water vapour. LFG is produced in an anaerobic environment within the landfill and is a by-product of the waste decomposition process. Its composition varies greatly depending on factors including waste composition, age and depth of waste, moisture and temperature.

A landfill gas collection system is used to control the gas trapped in the landfill between the lining and capping layers. Collection of landfill gas minimises emissions, prevents gas migration off-site, facilitates the use of the recovered gas and greatly increases landfill site safety. The main components of the landfill gas extraction system are:

- Vertical and horizontal gas extraction wells will be installed during the placement of wastes.
- A many layered, horizontally offset network of collection pipes will be installed as the placement of waste progresses to increase the effectiveness of gas extraction.
- Condensate traps, gas well heads and associated pipe required for safe transfer of gas from the gas extraction wells will be installed after the completion of cells with landfill cap. This extracted gas will be conveyed to a flaring or an energy recovery facility.

A flaring facility will be utilised to control and dispose of the landfill gas extracted. Once the volume of landfill gas generated in the decomposing waste mass increases to a sufficient quality and quantity an energy recovery facility may be used to generate electricity.

## 7.4 leachate management

The Expanded Footprint will require modification of the leachate management system and ponds
The leachate management system currently consists of two ponds (Leachate Pond 1 (LP1) and Leachate Pond 2 (LP2)). Leachate Pond 3 (LP3) is currently under construction, with the planned commissioning date being November 2017.

An additional leachate pond (LP4) will be constructed as part of the composting area expansion. LP2 and LP4 is utilised for containment of run-off water from the composting area. A pump system allows pumping of the composting leachate to LP1 should the capacity of the ponds be exceeded. This is however only an emergency measure and is not utilised as part of normal operations.

Generally organics leachate will be evaporate from LP2 and LP4 and also sprayed on proposed irrigation areas on the property using a watercart and directional spray bars. Irrigation would be restricted to the plantation and paddock areas that have a minimum of two meters of groundwater separation to provide a buffer between the irrigate surface and groundwater.

LP1 and LP3 will be used for management and containment of leachate from the landfill cells. The leachate will be evaporated from these ponds through forced evaporation (aerators).

Additional ponds may be constructed towards the north of LP3 as the landfill footprint increases, however a monitoring system has been put in place to monitor leachate production relative to the long term water balance for the site. Additional ponds will be constructed, if required, based on the ongoing monitoring and modelling results.

## 7.5 surface water management

The Expanded Footprint will require modification of the surface management system and ponds.
Upstream surface water from the catchment area will be diverted around and past the new landfill cells as they are developed. Surface water run-off from uncapped areas will be collected and treated in the leachate ponds. Clean run-off from the capped areas will be collected and diverted via drains etc. to perimeter surface water drainage infrastructure.

An additional stormwater dam may be constructed in future towards the southern extent of the site to assist in stormwater management as the landfill footprint increases.

## 8. environmental impact assessment - expanded footprint

The following section provides an overview of the environmental impacts of the proposed Expanded Footprint [Appendix 2 : Environmental Impact Assessment - North Bannister Landfill Expansion - Golder Associates].

## 8.1 flora \& fauna

The proposed expansion area extends into Tasmanian Blue Gum plantation.
The landfill has been specifically located to avoid areas of remnant bushland on the site. Clearing will be required within plantation forest only. SUEZ will also implement a range of measures, including the following, to minimise possible impacts on areas of remnant vegetation, including the adjacent State Forest, and fauna within:

- Restrict vegetation clearing to the minimum area required for works and clearly demarcate limits of vegetation clearing and disturbance.
- Educate site personnel on practices to avoid damage to native flora, minimise soil disruption, and appropriate weed management.
- Ensure spoil piles with weeds are at least 25 m from native vegetation.
- Ensure vehicles and civil equipment are free of plant matter and soil when entering the site.
- Implement dust management measures to avoid dust settlement on adjacent vegetation.
- Relocate native fauna if discovered on site if required during site works. Fauna can only be handled by qualified and licensed personnel.
- Minimise impacts to local avian fauna by avoiding clearing during nesting seasons.
- Adequately contain/cover all waste and make landfill areas inaccessible to fauna, including feral animals.
- Implement traffic control measures for the Project e.g. speed limits to prevent fauna accidents.
- Conduct inspections of excavations each morning to locate any trapped fauna and relocate if necessary.
- Carry out progressive and approved revegetation as per the Operations Management Plan.


## 8.2 surface water and stormwater

Emissions during construction or operational activities to surface water, including sediment, caused by unmanaged stormwater may result in deterioration or contamination of surface water or groundwater quality.

A site specific Surface Water, Drainage and Sediment Control Plan will be designed and implemented which will divert undisturbed (uncontaminated) surface run-off in a manner to prevent erosion and prevent stormwater from disturbed areas from flowing offsite or entering waterways. A biannual groundwater monitoring program will also be developed and implemented and reporting to the DWER annually.

SUEZ will also implement a range of measures, including the following, to minimise possible deterioration or contamination of surface water or groundwater:

- Manage the storage of chemicals and hazardous materials in accordance with industry best practice and manufacturers recommendations.
- All waste materials (drums, chemical containers, etc.) to be stored in protected, bunded area well away from waterways.
- Ensure all spills and leaks are cleaned up immediately and waste correctly disposed of.
- Ensure all contaminated soil/water is removed by licensed contractor.
- Position stockpiles in a suitable area away from stormwater/surface water flow.
- Carry out annual review of groundwater level and quality data to identify any potential indicators of impacts to groundwater quality
- In the event contamination of groundwater is suspected, develop a groundwater model for the site to assess the risk to downgradient groundwater users (if any can be identified).


## 8.3 heritage

A search of the Aboriginal Heritage Inquiry System revealed that there have been two previous ethnographic surveys conducted within the immediate footprint area. No registered sites or Other Heritage places were identified.

Notwithstanding SUEZ will implement the following measures:

- In the event of a potential unexpected Aboriginal or other artefacts being discovered, follow an unexpected finds procedure.
- Protect identified items of heritage, cultural and archaeological significance.
- Stop works immediately if unexpected Aboriginal or other artefacts are identified.


## 8.4 air quality

Environmental Alliances Pty Ltd (Envall) completed an odour impact assessment for the now operational landfill in 2011. The assessment was conducted using the then Department of Environmental Protection (DEP) guidelines for the assessment of odour impacts in 'Odour Methodology Guideline' (DEP 2002) and 'Separation Distances between Industrial and Sensitive Land Uses' (EPA 2005). The Envall 2011 odour assessment remains relevant for the proposed Expanded Footprint.

EPA Draft Separation Distances between Industrial and Sensitive Land Uses recommends that a putrescible landfill site (Class II and III) maintain a separation distance of $1,000 \mathrm{~m}$ to the nearest sensitive receptor. The nearest sensitive receptor was determined to be approximately 4.4 km west of the proposed facility, well beyond the separation distances for a putrescible landfill site.

The Expanded Footprint is mainly to the south of the existing footprint and therefore does not bring the site boundary appreciably closer to the sensitive receptor.

The primary odour-emitting sources are considered to be the working tip-face and the leachate dam. Working tip-face odour emission rates were derived from the results of a sampling program at a landfill of similar capacity at full operation and specifically the City of Cockburn's Henderson Landfill which is licenced
for 200,000 tpa. Leachate dam odour emission rates were derived from sampling data derived from the Subiaco Waste Water Treatment facility.

The Envall odour assessment can be considered conservative in its approach with the following worst case conditions assumed:

- leachate pond at full capacity (maximum surface area) which is an unlikely scenario.
- odour emission rates are based on Henderson Landfill samples of putrescible waste in an advanced state of decomposition due to a prolonged period of hot weather. Comparison with data from other sites in Perth indicates that these emission rates were in the upper percentile of the available data.

Predicted residential standard odour impacts of 2.5 ou (odour units) were assessed and determined to have an average radius of 475 m at 200,000 tpa. Golder Associates reviewed the original Envall assessment and concluded that at 400,000 tpa the 2.5 ou distance would likely be pushed out to between two and four times this distance. If it is assumed conservatively that the average radius is five times greater, approximately 2 km , this is still 2 km away from the nearest sensitive receptor and therefore unlikely to impact occupants of the receptor.

Notwithstanding SUEZ will implement a range of measures, including the following, to minimise the risk of odour impacts:

- Daily covering of active landfill cell with 300 mm thick soil cover or alternative cover materials
- Progressive covering of waste to limit oxygen availability and aerobic decomposition.
- Bury odorous or decayed waste promptly.
- Check areas previously covered regularly and apply more cover where necessary.
- Development and implementation of a landfill gas collection system.
- Effective collection and management of leachate.
- Progressive capping of landfill cells to contain landfill gas.


## 8.5 noise - construction \& operation

ViPAC Engineers and Scientists Ltd (ViPAC) completed a noise impact assessment for the now operational landfill facility in 2011. The assessment considered the construction and operational phase impacts against Western Australia Environmental Protection (Noise) Regulations 1997 (EPNR), which set out maximum allowable noise levels based on the time of day and land use applicable at noise sensitive receptors in the vicinity of a development. Transport noise (excluding that from reversing alarms) was excluded from the assessment.

The nearest sensitive receptor was determined to be approximately 4.4 km west of the proposed facility. Sound power levels for various plant were obtained from the manufacturer.

Noise levels were predicted at the nearest sensitive receptor to the landfill for both construction and operation and assessed against night time noise criteria with all equipment considered to be operating simultaneously at the most eastern side of the site, closest to the nearest sensitive receptor. The report found that the predicted worst case construction and operational noise levels at the nearest sensitive receptor are 24 dBA and 22 dBA , respectively, comfortably below the most stringent, night time, criteria of

37 dBA. Transport noise associated with the landfill was calculated and assessed at the shortest distance between the access road and the nearest sensitive receptor ( 250 m ). Predicted transport noise impact of 45 dBA complies with the day and night time criteria of 60 dBA and 55 dBA , respectively.

Golder Associates reviewed the original ViPAC assessment and concluded that the ViPAC 2011 noise assessment remains relevant for the proposed Expanded Footprint and that the increase in tonnage from 200,000tpa to 350,000 tpa would only lead to a small increase in predicted noise levels and still well within noise criteria.

Notwithstanding SUEZ will implement a range of measures, including the following, to minimise the risk of noise impacts:

- No site works to occur outside approved work hours.
- Plant and equipment to be operated in an efficient manner to minimise noise.
- Plant and equipment to be installed with standard noise control devices.


## 8.6 dust

Fugitive dust emissions to air potentially adversely impact air quality and therefore the health of site workers and fauna as well as resulting in dust deposition on remnant flora.

SUEZ will implement a range of measures, including the following, to minimise the risk of dust impacts:

- Limit disturbed areas to minimise potential dust generation.
- Visually monitor operations to assess that no visible dust is leaving site.
- Avoid excavation and other soil disturbance works on windy days.
- Dampen ground surfaces and/or surface treat stockpiles or other exposed unsealed areas.
- Stabilise, landscape and treat rehabilitated areas as soon as practicable.


## 8.7 fire

The Western Australian Planning Commission (WAPC) and the Fire and Emergency Services Authority of Western Australia (FESA) jointly developed State Planning Policy 3.7: Planning in Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas the objectives of which are to:

- Avoid any increase in the threat of bushfire to people, property and infrastructure;
- Reduce the vulnerability to bushfire through the identification and consideration of bushfire risks in decision making at all stages of the planning and development process;
- Ensure higher order strategic planning documents, strategic planning proposals, subdivision and development applications take bushfire protection requirements into account; and
- Achieve an appropriate balance between bushfire risk management measures, biodiversity conservation values, environmental protection and landscape amenity.

These guidelines form the foundation for fire risk management planning in WA.
A Bushfire Hazard Level Assessment and Bushfire Management Plan has been prepared which considers vegetation type and structure, climate, the topography of the site and adjoining lands and reviews the

Bushfire Management Plan originally developed for the RRP in the context of the Expanded Footprint [Appendix 3 : Bushfire Management Plan - Ecosystem Solutions].

The site currently has $2 \times 160 \mathrm{~kL}$ water tanks next to the main office compound area. These tanks have a fixed standpipe for rapid filling of appliances as needed and there is a hardstand and sufficient cleared area for turnaround next to the standpipe. Two portable units are also available on-site for rapid deployment for spot fires as needed. There is also a large stormwater dam for refilling the water trucks and/or fire-fighting tanks if needed.

A 15 kL water truck, normally used for dust suppression, can be used as a water cart as required. The truck has couplings compatible for connection to the local brigade's fire appliances and can be manoeuvred readily throughout the site.

The property is serviced by the Boddington Volunteer Bushfire Brigade which is located on Chapman Road, approximately 38 km south-east of the site. This is a volunteer brigade and turn out times cannot be assured.

The footprint site itself will be cleared for land management purposes, and the proposed development of the area proposes no permanent dwellings. However a site office does exist and people will be accessing the site during the day. Outside of the site area are large areas of standing vegetation including plantations and State forest with dense Class A Forest. Separation distances from infrastructure and the site office is more than 20 m in all instances, posing a Moderate Bushfire Hazard sufficient for protection of assets.

The Bushfire Management Plan concludes that:

- the proposed expansion and the facilities to be established are such that, with the implementation of this Bushfire Management Plan, fire threat to people and property within this development is significantly reduced.
- the proposed Expansion plan provides acceptable solutions and responses to the relevant performance criteria outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).


## 8.8 hazardous materials

Chemicals and other hazardous materials required for the operation of the RRP and stored on-site could, if accidently spilt into the environment, potentially impact surface water and groundwater quality.

SUEZ will implement a range of measures, including the following, to minimise the risk of hazardous materials impacting the environment:

- Store all chemicals and hazardous materials in containment appropriate for the volume and nature of the chemicals.
- Refuelling and maintenance areas must be on a hardstand with a temporary bund.
- Contain and appropriately manage spills using absorbent materials and spill kits.
- Store spill control equipment in critical locations to allow for a quick response.
- Purchase chemicals that are the least toxic and ensuring minimum volume ordered.

It is considered that the proposed Expanded Footprint will have minimal impact on the environment and amenity of the immediate area of the site.

## 9. social impact assessment - expanded footprint

The following section provides an overview of the social impacts of the proposed Expanded Footprint.

## 9.1 consultation

SUEZ has consulted with the following in the preparation of the proposed Expanded Footprint:

- the Shire of Boddington who remains supportive of the RRP at North Bannister. The Shire is awaiting a Planning Application for the Expanded Footprint which will need to be forwarded and determined by the Mid-West/Wheatbelt (Central) Joint Development Assessment Panel.
- the Department of Water and Environmental Regulation. An application has been lodged with the DWER to amend the existing Licence to include the proposed Expanded Footprint.
- the Bibbulmun Track Foundation to brief them of the proposed Expanded Footprint and seek their continuing support to the RRP (refer Section 9.2).

SUEZ is also establishing a Community Reference Group (CRG) within the local community which is expected to comprise representatives of SUEZ, Council and the Community.

The primary purpose of each CRG is to function as a reference body for SUEZ, their stakeholders and the community. Each CRG is an advisory group only and will be asked to provide advice on a range of issues raised by SUEZ and members of the CRG.

The objectives of the CRG are to:

- facilitate community awareness of the operations, environmental performance and any short, medium and long term development of the
long term development of the facility;
provide community members with the opportunity to engage in dialogue with SUEZ regarding any issues of concern re
concern related to the facility;
- provide community members with an opportunity, wherever practicable, to provide input into SUEZ's decision making process regarding the facility; and
- foster understanding and cooperation between community members and SUEZ staff in minimising the impact of the facility on the local community.

Advertisements inviting representatives onto the CRG have been placed and it is expected that the first meeting of the CRG will be held in the near future.

## 9.2 visual \& landscape

The RRP and proposed Expanded Footprint are situated approximately 5 km west of Albany Highway. The site of the Expanded Footprint is located along the western boundary of the lot with much of the balance of the site remaining as Blue Gum plantation.

The lands to the east of the Expanded Footprint, between the RRP and Albany Highway have been substantially planted to Blue Gums with the balance used for grazing of sheep. The landform between the

Footprint and the Highway is considerably undulating with the ridge to the immediate east of the site rising to approximately 340 m AHD. Neither the current landfill nor the proposed Expanded Footprint will be visible from Albany Highway.

The lands to the north, west and immediate south of Lot 2 are heavily undulating and vegetated, being State Forest. There are no visually sensitive areas to the south of the site.

The Bibblumun Track runs along the northern boundary of the site then heading in a general south-westerly direction beyond the site.

Boonering Hill / Natural Pavement is located approximately 800 metres to the west of the RRP and Expanded Footprint. The landform between is heavily undulating and vegetated. Boonering Hill and the Natural Pavement are at an elevation of approximately 470m AHD. The peak elevation of the capped Expanded Footprint is at 400 m AHD.

In June 2011, Perthwaste commissioned a Visual Impact Assessment of the then proposed landfill on the Bibbulmun Track. The Assessment concluded that the landfill would not be visible from the Track except from Boonering Hill / Natural Pavement which is a 20 minute uphill walk from the main Track. Perthwaste met with and presented the outcomes of the Assessment to the Bibbulmun Track Foundation at which it was acknowledged and agreed by both parties that the summit of the landfill ( 386 m AHD) would be visible and ".....to take a co-operative approach to resolve any issues that arise to ensure both facilities can coexist".

The Officers Report to Council at its August, 2011 meeting noted and accepted that there would be some but limited impact on the Track:
"There are also minimum impacts on the visual amenity of the area associated with the Bibbulmun Track which is more than 450 metres from the nearest point of the landfill footprint and is screened by blue gum trees and a ridge located between the Bibbulmun Track and the landfill facility. The existing vegetation will provide a visual screen. It is acknowledged there are however visual impacts when viewed from Boonering Hill".

The Planning Application by Perthwaste for the landfill at Lot 2 was approved by Council at the August, 2011 meeting.

A further Visual Impact Assessment of the proposed Expanded Footprint was undertaken by Golder Associates [Appendix 4 : Visual Impact Assessment - Bibbulmun Track].

The Assessment confirms that the Expanded Footprint will continue to be screened from the Track for the most part by the landform and the density and height of the intervening vegetation. The Assessment also confirms that as with the current landfill, the Expanded Footprint will be visible from Boonering Hill / Natural Pavement [Figure 9 : Visual Impact Boonering Hill].

Plate 9a shows the view of the current operational landfill (Cells 1-3) from Boonering Hill. Plate 9b shows the completed Expanded Footprint superimposed onto the view from Boonering Hill. Plate 9b is a "worst view" scenario. In reality, by the time the Expanded Footprint approaches the latter stages, the preceding stages will have been capped and revegetated. The effect of the progressive capping and revegetation (from left to right) is that most of the completed footprint will appear as native vegetation - not "clay" coloured as depicted in Plate 9b.

SUEZ met with the Bibbulmun Track Foundation on the $29^{\text {th }}$ August, 2017 to discuss the proposed Expanded Footprint and Visual Impact Assessment.


9a: Existing Landfill Cells $1>3$

9b: Completed Expanded Footprint - without progressive re-vegetation of earlier cells


Figure 9 : Visual Impact Boonering Hill

The Foundation advised at the meeting that the existing landfill operation has not impacted the Track and that no complaints have been received [Appendix 5 : Bibbulmun Track Foundation Correspondence]. SUEZ and the Bibbulmun Track Foundation agreed to continue to engage to ensure any impacts on the track and its users would be minimised.

## 9.3 tourism

Albany Highway is a major transport and tourist approximately 5 km west of the RRP and Expanded Footprint. The site is well screened from Albany Highway by the intervening landform and vegetation. Signage relating to the RRP is limited to a locational pre-warning sign north of the site entry and a directional sign at the entry road.

The RRP and proposed Expanded Footprint will not impact tourism associated with movement on Albany Highway. SUEZ is instituting a regular quarterly programme of road side collection of fugitive litter from waste transport vehicles along Albany Highway north of the RRP entry. SUEZ is also upgrading the cover on its fleet of waste trailers to minimise the risk of fugitive litter during transport. It is expected that the covers on all trailers will be upgraded by the end of 2017.

The proposed Expanded Footprint will not visually impact most walkers on the Bibbulmun Track except from Boonering Hill / Natural Pavement which is a 20 minute uphill walk from the main Track.

It is possible that the proposed Expanded Footprint may result in further consolidation of local tourist services such as food and entertainment resulting from the on-going flow-on effects of the local employment and spending generated by the RRP.

## 9.4 economic \& community

The RRP when first acquired by SUEZ employed a total of 12 persons on-site. The increase in annual tonnage from 200,000tpa to 350,000tpa has required employment of a further six staff to a total current on-site complement of 18 persons.

Six of the current employees are from within the local region and it is anticipated that staff replacements over time will result in a higher local workforce.

SUEZ's preference is to fill its workforce requirements locally, as far as practical, as there are significant advantages in doing so including:

- Close employee "accessibility" to the work site.
- Reduced employee fatigue during the working day and on the homeward drive arising from short drive times.
- Improved occupational health and safety outcomes.
- Improved productivity outcomes.
- Greater appreciation and understanding of community expectations in the daily operation of the RRP.
- Stronger "local network" knowledge in respect of trades and suppliers to the RRP; and
- Faster response time to an "out of hours" event.

The proposed Expanded Footprint will secure current employment well into the future as well as foster further future additional opportunities during the construction and operational stages, both directly and indirectly through the flow-on effects of sourcing of labour, plant and materials locally.

The total construction cost of the Expanded Footprint is estimated at $\$ 36$ million with the construction cost of each Cell estimated in the order of $\$ 4$ million. It is expected that a portion of the construction budget could be sourced locally including earthmoving, construction plant hire, concreting, trades and materials. Cell lining materials and processes are highly specialised and will be sourced from outside the region.

Operationally, approximately $\$ 75,000$ in services and consumables is currently sourced locally.
Input / Output Multipliers for Western Australia indicate that, on average, for:

- Every job created in a particular sector of industry or services, an additional 1.56 jobs are created in other industries and services in the broader community; and
- Every dollar spent by a particular sector of industry or services, an additional $\$ 1.20$ is spent by other industries and services in the broader community.

Clearly, while some of the flow-on effects of the Expanded Footprint will benefit other regions, there still remains the potential for the direct and flow-on effects of the proposed Expanded Footprint to further consolidate the local and regional economy well into the future and encourage the development and diversification of current and future businesses that will strengthen and broaden the economic base of the region.

SUEZ also operates community consultation; education and support programs associated with its operations and facilities in Australia and is developing similar programs and relationships with the Boddington and regional community. SUEZ is also a supporter of the local community within which it operates and since assuming operations at the RRP have supported the Lions Boddington Rodeo, Boddington Arts Council, Boddington Community Resource Centre and Boddington Skate Park with funding and sponsorship support totalling $\$ 23,500$. SUEZ has also committed to becoming a Gold Sponsor of the Bibbulmun Track.

## 9.5 traffic

A Transport Impact Assessment has been prepared for the Expanded Footprint [Appendix 6 : Traffic Impact Assessment - Shawmac].

As a Transport Impact Assessment was not undertaken for the original RRP, this assessment addresses both the existing RRP as well as the proposed Expanded Footprint at the current disposal rate of 350,000tpa.

Albany Highway is classified as a Primary Distributor road with RAV network 7 status. Albany Highway at the site is a sealed and marked single carriageway road approximately 11.0 m sealed width with open roadside drains. In the vicinity of the site Albany Highway has a posted speed limit of $110 \mathrm{~km} / \mathrm{h}$ speed limit.

In addition to daily staff movements, the existing and proposed operation involves waste delivery comprising 15 collection trucks ( 8 t ) and $30,27.5 \mathrm{~m}$ Pocket Road Trains (40t) which are classified as as-ofright vehicles and RAV 3 vehicles respectively.

The Transport Impact Assessment concluded that:

- The predicted traffic generation from the site will not adversely impact the operation of the existing road network and particularly Albany Highway.
- The layout of the intersection of the Site Access and Albany Highway intersection is considered adequate and no modifications are required. Minimum sight distance in and out of the site is achieved.
- The geometry of the existing site access complies with requirements.
- Crash history for five years to December 2016 indicated a total of 10 recorded crashes on Albany Highway in the section between Wearne Road and North Bannister. The two nearest crashes were more than 200m away from the site access.
- Provision of car parking is considered adequate as the parking demand will predominantly be for the on-site employees.

Notwithstanding that the RRP and proposed Expanded Footprint will not impact traffic flows in the locality, SUEZ will also implement a range of measures, including the following, to minimise disruptions and amenity impacts from haulage traffic to and from the RRP:

- Develop a traffic management plan to specify traffic diversions, signage and other traffic control methods.
- Provide adequate notice to the community of road works and associated diversions.


## 10. conclusion

In May, 2016, SUEZ acquired Perthwaste Pty Ltd including its waste management businesses and the North Bannister Resource Recovery Park located in the western portion of Lot 2 Albany Highway, North Bannister.

Geotechnical investigations by SUEZ since its acquisition of the RRP have identified extensive sub-surface rock in the latter stage cells of the RRP significantly reducing the viability of constructing these cells. In view of the significantly reduced life of the RRP, SUEZ is seeking the approval of the Shire of Boddington to the southern expansion of the footprint of the RRP to extend its operating life by an estimated additional 23 years.

SUEZ is concurrently making application to the DWER to amend the Licence for the current landfill to allow construction of the first two cells of the proposed Expanded Footprint.

The need for the Expanded Footprint is driven by the growing need for landfill airspace to not only continue to be met in a sustainable manner but in the process thereof reduce the pressure for the development of new "greenfield" landfill sites.

The proposed Expanded Footprint is consistent with the State Planning Strategy and the Shire of Boddington Local Planning Strategies and Local Planning Scheme.

The Expanded Footprint has been divided into nine cells varying between approximately $950,000 \mathrm{~m}^{3}$ and $1,200,000 \mathrm{~m}^{3}$ or approximately 770,000 tonnes and 977,000 tonnes and will provide an additional $9,915,000 \mathrm{~m} 3$ of airspace equating to $8,031,000$ tonnes providing an estimated life of 23 years at current disposal rates.

The proposed Expanded Footprint is located wholly within an existing Blue Gum plantation and will have minimal impact on flora and fauna. The landfill is well removed from any sensitive premises and the design and range of environmental management measures to be implemented by SUEZ will ensure minimal impact on the environment.

A Bushfire Hazard Level Assessment and Bushfire Management Plan confirm that the proposed expansion and the facilities to be established are such that, with the implementation of the Bushfire Management Plan, the fire threat to people and property within the development is significantly reduced.

The RRP and proposed Expanded Footprint will not impact tourism associated with movement on Albany Highway. SUEZ is instituting a regular quarterly programme of road side collection of fugitive litter from waste transport vehicles along Albany Highway north of the RRP entry. SUEZ is also upgrading the cover on its fleet of waste trailers to minimise the risk of fugitive litter during transport.

The existing RRP operation has not impacted the Bibbulmun Track and no complaints have been received by the Bibbulmun Track Foundation. The proposed Expanded Footprint will not visually impact walkers on the Bibbulmun Track except from Boonering Hill / Natural Pavement which is a 20 minute uphill walk from the main Track.

The Traffic Impact Assessment for the existing landfill and proposed Expanded Footprint concluded that the predicted traffic generation from the site will not adversely impact the operation of the existing road network and particularly Albany Highway.

The RRP currently employs of 18 persons and it is SUEZ's preference to fill its workforce requirements locally, as far as practical, as there are significant advantages in doing so.

The proposed Expanded Footprint will secure current employment well into the future as well as foster further future additional local opportunities during the construction and operational stages, both directly and in-directly through the flow-on effects of sourcing of labour, plant and materials locally.

While some of the flow-on effects of the Expanded Footprint will benefit other regions, there still remains the potential for the direct and flow-on effects of the proposed Expanded Footprint to further consolidate the local and regional economy well into the future and encourage the development and diversification of current and future businesses that will strengthen and broaden the economic base of the region.

Accordingly, SUEZ earnestly seeks the support of the Council for the approval of the Expanded Footprint to enable it to continue to meet the growing need for landfill airspace in a sustainable manner.

## appendix 1 :

## Perthwaste Development Approval 2011

Your Ref:
Our Ref:
Enquiries: Steve Thompson - Consultant Planner

TPG Town Planning and Urban Design Mr Leigh Caddy

## Dear Mr Caddy

## PLANNING APPLICATION - Lot 2 ALBANY HIGHWAY NORTH BANNISTER

I refer to your submission regarding the above. The Council considered the planning application at its meeting on Tuesday $20^{\text {th }}$ September 2011 where it resolved:

$$
\begin{array}{llll}
\text { Council Resolution } & 153 / 11 & \text { Moved } & \text { Cr Veitch }
\end{array}
$$

That Council approve the Planning Application received on $5^{\text {th }}$ May 2011 for a Landfill Facility, defined as "Industry-Noxious" in Local Planning Scheme No. 2, at Lot 2 (Plan No. 2767) Albany Highway, North Bannister, subject to the following conditions:

## General

1. The land use and development hereby approved must be carried out in accordance with the plans submitted with the application, addressing all conditions, or otherwise amended by the Council and shown on the approved plan and these shall not be altered and/or modified without the prior knowledge and written consent of the Council;
2. This approval shall expire and be of no further effect if the land use hereby approved has not been substantially commenced within a period of five (5) years from the date hereof, or within any extension of that time (requested in writing prior to the approval expiring) that may be granted by the Council. Where the Planning Approval has lapsed, no further development is to be carried out;

## Landfill Operation

3. The operations are undertaken in accordance with details set out in the planning application except as modified by planning approval conditions to the satisfaction of the Council;
4. No excavation slope, with the exception of the working face, is to exceed a ratio of 1 vertical to 3 horizontal;
5. When not in use, the excavation face shall be graded to a maximum of 1 vertical to 3 horizontal;
6. The hours of operation of the landfill facility on Lot 2 (Plan No. 2767) Albany Highway, North Bannister are limited to between 5.00am to 8.00pm, unless prior approval of the Shire has been sought to vary these times;

## Vehicle Access

7. The vehicular crossover between the subject land and Albany Highway is to be designed, constructed, sealed and drained to the satisfaction of the Council and Main Roads Western Australia prior to occupation;
8. Arrangements being made with and to the satisfaction of the Council and Main Roads Westem Australia for a night tum pocket for southbound traffic and a passing bulge for southbound traffic prior to occupation;
9. Crossovers are rationalised onto Albany Highway to the satistaction of the Council and Main Roads Western Australia prior to occupation;
10. An easement is secured over properties beween Lot 2 (No. 2767) and Abany Highway o the satisfaction of the Council;

## Environmental Nanagement

11. The putrescible landfill facility operates in accordance with a Class II or III of the Prescribed Premises and does not accept waste associated with a Class V or $V$ landill;
12. All waste materials and by products of vehicle wash-down areas on the subject property must be contained on site and directed to a suitable waste treatment facility to the satisfaction of the Council;
13. Toxic and hazardous chemicals are to be stored within contained compounds on chemically resistant suraces to the satisfaction of the Councif;
14. The operator implements dust control measures for the private vehicular access road, site works and all operations to the satisfaction of Council;
15. The applicant/operator submits a Rodent Vermin Management Plan to the satisfaction of the Council prior to occupation;
16. Waste transport vehicles and trailers used to hau bukk loads are to be fuly enclosed to minimise odour to the satisfaction of the Council;

## Stormwater Management

17. Prior to the commencement of any site works, the applicantoperator shall prepare and submit to Council a Drainage Management Strategy consistent with "Landfills for disposal of putrescibles materials" (Department of Water WQN111). The Strategy shall be to the satistaction of the Council and shall, once approved, be implemented, and maintained by the operator to the satisfaction of the Council;

## Minimising Landscape Impacis

18. Prior to the commencement of any site works, the applicantoperator shall prepare and submit to the Council a Landscape Assessment and Management Plan of the development when viewed from the Bibbulmun Track. The Plan is to maximise screening and set out required revegetation. The Landscape Assessment and Management Plan shall be to the satisfaction of the Council and shall, once approved, be implemented prior to occupation and be maintained by the operator;
19. The proponent is to ensure that rubbish is contained on site to the satisfaction of the Council;

## Fire Management

20. Prior to the commencement of any site works on the land, the applicantoperator shall prepare and submit to Council a Fire Management Plan. The Plan shall be to the satisfaction of the Council and shall, once approved, be implemented by the operator at their expense to the Council's satisfaction prior to the occupation of the land and shall thereafter be maintained, as appropriate, under the approved Plan;

## Safety

21. The landfill site shall be fenced, gated and sign-posted against unathorised entry prior to occupation and such features shall thereafer be permanently maintamed to the satisfaction of the Council;
22. The safety of persons employed at or visiting the landill site is to be implemented in accordance with a Works Safety Plan to be prepared prior to occupation to the satisfaction of the Counci;
23. The operator is to submit an Emergency Response Plan to the satisfaction of the Council prior to occupation;

## Public Liabiliy Insurance

24. The operator is to retain appropriate Public Liabiliyy Insurance to cover the entre area the subject of this approval to the satistaction of the Council;

## Aboriginal Hertage

25. The appicant/operator to commission an Aboriginal heriage assessment to the satisfaction of the Council prior to site works commencing, unless advised by the South West Aboriginal Land and Sea Council or the Deparment of Indigenous Alfairs, the Council expects the Aboriginal heritage assessment to incorporate archaeological and ethnographic research, field survey and consultation;

## Rehabilitation and Funding to Address Environmental Repair

26. The applicantoperator shall prepare and submit a Rehabilitation Plan prior to occupation to the specification and satisfaction of the Counci; and
27. Prior to occupation, arrangements satisfactory to the Council are made between the proponent and the Shire of Boddington / State Government in order to protect the local community and the Shire of Boddington regarding long-term site management. and resourcing following closure of the landfill facility.

## ADVICE

A) In relation to Conditions 3, 18 and 19, the Council seeks to ensure that the development does not make the Bibbulmun Track less attractive to walkers due to odour, noise and dust pollution and visual impact.
B) In relation to Condition 8 it is acknowledged that Perthwaste agrees, if requested formally by Main Roads Western Ausiralia, that it will construct at its own cost a north bound acceleration lane. The requirement to construct only relates to impacis created by the landill operations.
C) In relation to Condition 10, the Council's granting of approval in no way implies that it will be constructing the unmade and unnamed road on the northern boundary of the application site. The Council has no intention to construct or upgrade this road.
D) In relation to Condition 12, this includes that the Council expects the operator will adopt best practice for managing the spread of dieback.
E) In relation to Condition 20, the Fire Management Plan is to prevent as far as practicable damage to the property or adjoining State Forest and properties by reason of fire. The plan shall include details and pariculars of hazard assessment, access, water supply, fire suppression response and hazard separation.
F) In relation to Condition 22, the operator will need to also ensure that other legislative requirements are met.
G) In relation to Condition 24, the issue of the approval shall not, in any way, render the Shire of Boddington liable for damage or injury of any kind to any member of the public and/or the operators such liability shall be the sole responsibility of the
operator. The operator shall ensure that they hold sufficient public liability insurance cover for any claim against them.
H) In relation to Condition 27, this may require a trust, fund or other appropriate mechanism to be established to ensure that the Shire of Boddington and the community are not liable for costs including remediation, clean-up, leachate treatment, borehole water testing, flare or gas engine maintenance, emergency response to fires and general site maintenance.
I) This approval does not cover buildings or the landfill power generation system. The Council, does in principle support the opportunity to capture landfill gas and to establish a power plant.
J) The operator is advised the land use and development are to comply with the requirements of the Environmental Protection Act, Aboriginal Heritage Act and other relevant statutory requirements.
K) Construction of the landfill facility shall not be commenced until the applicant/operator is in receipt of the appropriate licences. The Council will expect the operator to hold a valid works approval and licence for the landfill facility at all times.
L) The Council encourages the operator to:

- cover the landfill on a daily basis to reduce odour;
- seal the internal private vehicular access road to minimise dust;
- regularly review the integrity of the composite synthetic liner to contain the leachate; and
- report incidents of an environmental nature to the Department of Environment and Conservation any unusual activities such as people working outside nominated working hours, unusual traffic movements or anything out of the ordinary that may cause concern to the community.
M) Part 14 of the Planning and Development Act 2005 provides the right to apply to the State Administrative Tribunal for review of some planning decisions and you may wish to take professional advice to determine whether or not such a right exists in the present instance. The State Administrative Tribunal Rules 2004 require that any such applications for review be lodged with the Tribunal within 28 days of the date on which notice of the decision is given.
$\begin{array}{lll}\text { Seconded } & \text { Cr Hardie } & \text { Carried }\end{array}$
Please contact the Shire's Consultant Planner (Steve Thompson) on 98834999 should you wish to clarify or discuss.

Once again, thank you for taking the time to make a submission.
Yours faithfully


Gary Sherry
Chief Executive Officer
$21^{\text {st }}$ September 2011

## appendix 2 :

## SUEZ RECYCLING AND RECOVERY

## Environmental Impact Assessment for North Bannister Landfill Expansion

## Submitted to:

Mr Craig Barker
SUEZ Recycling and Recovery Australia
116 Kurnall Road
WELSHPOOL WA 6106


Report Number. 1671227-002-R-Rev1
Distribution:
1 electronic copy - SUEZ Recycling and Recovery
1 electronic copy - Golder Associates Pty Ltd

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ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

### 1.0 INTRODUCTION

This Environmental Impact Assessment (EIA) has been prepared for the proposed expansion of the SUEZ Recycling and Recovery (SUEZ) North Bannister Waste Resource Recovery Park (NBRRP) located at Lot 2 on Plan 2767 Albany Highway, North Bannister.

### 2.0 SCOPE OF WORK

The scope of work of this EIA is to summarise the following for the Project:

- Site environmental and social conditions
- Key potential environmental and social impacts
- Environmental management measures for the key potential environmental and social impacts, and

■ Residual risk level assigned to each impact after implementation of management measures.
This EIA will also assist in the review and revision (where required) process of the existing North Bannister Construction Environmental Management Plan (CEMP) and North Bannister Operational Environmental Management Plan (OEMP).

### 3.0 THE PROJECT

### 3.1 Overview

The NBRRP is located approximately 100 km south-east of Perth. Currently approved as a Class II and Class III putrescible waste landfill facility occupying an area of approximately 19 ha. The site is licensed by the Department of Water and Environmental Regulation (DWER) (license \# L8871/2014/1) under the following categories:

- 57: Used tyre storage
- 61: Liquid waste facility
- 62: Solid waste depot
- 64: Class II and Class III putrescible landfill site, and
- 67A: Compost manufacturing and soil blending.

Located off the Swan Coastal Plain, the site is bounded by bush to the north, south and west, and by a blue gum plantation to the south-east and east. The facility is not located in a drinking water catchment area.

The proposed expansion is set in hilly terrain amongst blue gum plantation and patches of disturbed and degraded remnant vegetation. It lies at the top of a small sub-catchment that drains south-westerly into an unnamed ephemeral tributary of the Hotham River. Table 1 summarises the Site.

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

Table 1: Site summary

| Aspect | Summary |
| :--- | :--- |
| Site address | Lot 2 on Plan 2767 Albany Highway, North Bannister |
| Site area | The NBRRP is located within the Shire of Boddington on Lot 2 of Plan 2767, Albany Highway, <br> North Bannister. The site is situated within privately owned land of 390 ha and is 30 km north of <br> the township of Boddington and approximately 100 km south-east of Perth. |
| Site use | Currently the site is classified by the DWER as Class II and Class III for accepting putrescible <br> waste under Prescribed Premises Category 64. This type of landfill is commonly called a <br> Putrescible Landfill. Waste is accepted in accordance with the DWER Landfill Waste <br> Classification and Waste Definition 1996 (As amended December 2009). <br> The existing site location is presented in Figure 1 and the Site Plan is presented in Figure 2 (both <br> provided in Appendix A). |

### 3.2 Landfill design

The proposed landfill expansion design is provided in Figure 8 to 10 (Appendix A). It has been developed to maximise the capacity of waste storage whilst avoiding areas of native vegetation. The design is based on the following assumptions:

■ Disposal rates of:

- $350000 \mathrm{t} / \mathrm{y}$ (baseline), which equates to approximately $432000 \mathrm{~m}^{3} / \mathrm{y}$.
- $400000 \mathrm{t} / \mathrm{y}$ (sensitivity), which equates to approximately $494000 \mathrm{~m} 3 / \mathrm{y}$.
- Assumed landfill density of $0.81 \mathrm{t} / \mathrm{m}^{3}$.
- Cell construction to take place approximately every two to three years (approximately $800000 \mathrm{~m}^{3}$ to $1200000 \mathrm{~m}^{3}$ airspace constructed per cell).
- All excavations and upstream embankment slopes are $1 \mathrm{~V}: 3 \mathrm{H}$.
- Maximum excavation depth is controlled by either groundwater table or depth to refusal, whichever is shallower. The purpose of this is to optimise the volume of material excavated for use in daily cover, cell construction and capping.
- All bunds have a crest width of 3 m .

■ Final post settlement waste slope is nominally $1 \mathrm{~V}: 5 \mathrm{H}$ (20\%) on the side slopes and $1 \mathrm{~V}: 20 \mathrm{H}$ (5\%) on top.

- Daily cover required at a ratio of $1 \mathrm{~m}^{3}$ cover to $10 \mathrm{~m}^{3}$ waste, which assumes the use of alternative cover material to supplement soil cover, as per the current licence conditions.
- The liner system will consist of the following layers (from top down):
- Separation geotextile.
- 300 mm gravel leachate collection layer.
- Cushion geotextile.
- High Density Polyethylene (HDPE) geomembrane liner.
- Geosynthetic Clay Liner (GCL).
- 500 mm reworked in situ or imported low permeability material to act as attenuation layer.

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

- Final cover ${ }^{1}$ thickness will nominally be in the order of 1.0 to 1.9 m and is likely to consist of the following layers (from top to bottom):
- 0.5 m thick soil growth layer (of which 300 mm is anticipated to be topsoil or compost or mulch or a combination thereof) - sourced from site
- Separation Geotextile
- 0.3 m drainage layer (which can be replaced with geocomposite layer), if required
- Geomembrane
- 0.6 m compacted clay layer (which can be replaced with GCL) - sourced from site
- Gas collection layer (gravel).
- Landfill is designed in using the Victorian BPEM as a general guideline.

■ The landfill will be progressively capped in stages and vegetation re-established throughout the life of the landfill.

### 3.3 Proposed cell development methodology

The expanded footprint area has been divided into 9 cells with airspace varying between approximately $950000 \mathrm{~m}^{3}$ and $1200000 \mathrm{~m}^{3}$ (approximately 770000 tonne and 977000 tonne). Future cell development will commence during completion of Cell 4 in the existing footprint with Cell 5 located towards the south-east of the existing landfill and Cell 6 located directly to the west of Cell 5 . The same pattern of cell development (west to east, while moving in a southern direction) is followed for Cells 7 to 13, followed by development of Cell 14 and 15 (located in the existing footprint). Cells 14 and 15 have a combined airspace capacity of approximately $2140000 \mathrm{~m}^{3}$ (1 730000 tonne).

Cell development data for the expanded footprint is provided in Table 2.
Table 2: Cell development information - expanded footprint

| Cell Number | Airspace | Tonnage | Years |
| :---: | :---: | :---: | :---: |
| 5 | 1080000 | 870000 | 2.5 |
| 6 | 1100000 | 900000 | 2.6 |
| 7 | 990000 | 800000 | 2.3 |
| 8 | 950000 | 770000 | 2.2 |
| 9 | 1230000 | 990000 | 2.8 |
| 10 | 950000 | 770000 | 2.2 |
| 11 | 1205000 | 977000 | 2.8 |
| 12 | 1205000 | 977000 | 2.8 |
| 13 | 1204000 | 977000 | 2.8 |
| TOTAL | $\mathbf{9 9 1 5 0 0 0}$ | $\mathbf{8 0 3 1 0 0 0}$ | 23 |

[^0]ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

### 4.0 LEGAL ENVIRONMENTAL OBLIGATIONS

Table 3 provides a list of relevant acts, regulations, codes of practice and approvals relevant, for the Project. This list is not definitive and may change as the project progresses.

Table 3: Legal environmental obligations

| Documentation/I nstrument Type | Applicable Documentation/Instruments |  |
| :---: | :---: | :---: |
| Acts and Regulations | Aboriginal Heritage Act 1972 (WA) <br> Contaminated Sites Act 2003 (WA) <br> Dangerous Goods Safety Act 2004 (WA) <br> Environmental Protection Act 1986 (WA) (EP Act) <br> Environmental Protection Regulations 1987 (WA) <br> Environmental Protection (Controlled Waste) Regulations 2004 (WA) <br> Environmental Protection (Noise) Regulations 1997 (WA) <br> Environmental Protection (Unauthorised Discharges) Regulations 2004 (WA) <br> Rights in Water and Irrigation Act 1914 (WA) (RIWI Act) <br> Wildlife Conservation Act 1950 (WA) <br> Bush Fires Act 1954 (WA) <br> Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act). |  |
| Codes of Practice | National Standards for Criteria Air Pollutants 1 in Australia - Air Quality Fact Sheet (Department of the Environment and Heritage, 2005) (Department of Environment, 2015) A Guideline for managing the impacts of dust and associated contaminants from land developments sites, contaminated sites, remediation and other related activities (DEC, 2011) Landfills for disposal of putrescible materials (Department of Water, 2009) Code of Practice for the Management and Control of Asbestos in the Workplace (NOHSC: 2018, 2005) Landfill Waste Classification and Waste Definitions 1996 (As Amended) (DWER). AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines AS/NZS 4360:1999 Risk Management HB 203:2012 "Managing environment-related risk". |  |
|  | Department of Water and Environmental <br> Regulation (Previously Department of Environment Regulation) (DER)) | Part V Works Approval and Licence amendment |
|  | DWER (previously Department of Water (DOW)) | Dewatering Licence under the RIWI Act 1914 |
|  | Department of the Environment and Energy (previously Department of the Environment (DOE)) | Referral of a Controlled Action under the Environment Protection and Biodiversity Conservation Act 1999 (if applicable). |
|  | Environmental Protection Authority (EPA) | Referral of a proposed action under the Environmental Protection Act 1986 (if applicable). |

### 5.0 ENVIRONMENTAL BACKGROUND

### 5.1 Flora and fauna

ENV Australia Pty Ltd (ENV) completed a Flora and Vegetation survey in 2011, this was supplemented by a desktop ecological survey in 2017, undertaken by Animal Plant Mineral (APM). Whilst the 2011 survey was conducted in an area outside of the proposed expansion zone ( $<100 \mathrm{~m}$ to the north), the findings are considered applicable due to the degree of likeness between the vegetation complexes with both areas being dominated by Tasmanian Blue Gum (Eucalyptus globulus) plantation with isolated patches of disturbed remnant vegetation.

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

## Flora and vegetation

The proposed expansion area extends into Tasmanian Blue Gum plantation. There are two adjoining patches of remnant vegetation that could potentially be foraging and or breeding habitat, but the final landform design footprint avoids these areas.

The 2011 field survey identified a total of 28 taxa, 24 genera and 18 families in the survey area, comprising 26 native flora taxa and two introduced. The plant families most commonly recorded were Asteraceae (four species) and Fabaceae (three species). The dominant vegetation complex of the proposed project area is Dwellingup 4 (D4) (Mattiske and Havel, 1998), which is comprised of open forest of Eucalyptus marginata, Corymbia calophylla, Banksia grandis and Allocasuarina fraseriana. The D4 vegetation complex is found to be well represented in the greater region.

No species of conservation significance were recorded within the survey area; however, nine species of conservation significance were identified as potentially occurring in a search of the Flora Database. Two species were listed as Endangered under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 and as Declared Rare Flora (DRF) under the Wildlife Conservation (WC) Act 1950, the remaining seven are listed as Priority Flora under the WC Act. All species of conservation significance that were identified as potentially occurring in the survey area are perennial and would have been identified during the survey if present.

The database search determined that no Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) are known to occur. Additionally, databases of the DWER, Department of Biodiversity, Conservation and Attractions (DBCA, previously Department of Parks and Wildlife) and the Federal Department of Environment and Energy, have been scrutinised and there are no records of groundwater dependant ecosystems within the catchment in which the landfill is located, within a 15 km search radius.

Vegetation condition within the survey area varied from 'Degraded' to ‘Completely Degraded'. Known disturbances include historical logging, fire and invasion by introduced species. Areas that have been entirely altered from their natural state were described as being 'Completely Degraded' and are represented by the Tasmanian Blue Gum (Eucalyptus globulus) plantation.

As none of the conservation significant species were identified during the survey and the vegetation was recorded as 'Degraded' it is considered unlikely that Lot 2 Albany Highway supports species of conservation significance.

## Fauna

The desktop ecological survey identified that up to 27 fauna species have the potential to occur, comprising one reptile, two mammals, 20 birds and two invertebrates.

Of potential concern are the fauna species of conservation significance, which are:

- Chuditch (Dasyurus geoffroii) is listed as Vulnerable under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the Wildlife Conservation Act 1950 (WC Act)
- Carnaby's Black Cockatoo (Calyptorhynchus latirostris) endangered under the EPBC Act and WC Act
- Baudin's Black Cockatoo (Calyptorhynchus baudinii) endangered under the EPBC Act and WC Act

■ Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) is listed as Vulnerable under the EPBC Act and WC Act, and

- Western brush wallaby (Macropus Irma) is listed as a P4 under the WC Act.

All three Black Cockatoo species found in the State's south-west are considered likely to occur in the area. These species are protected under the EPBC Act and the WC Act. Additionally, the Chuditch and the Western brush wallaby, both protected under the WC Act, are known to occur in the greater area.

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

Potentially suitable feeding, refuge and maternal denning habitats for the Chuditch and Western Brush Wallaby; and nesting habitat for the Black Cockatoos, were identified in the remnant vegetation found adjacent to and outside of the proposed expansion footprint. However, the small size and disturbed/absent understory limits the diversity of native fauna potentially occupying the area (APM, 2016).

The results of a search of the EPBC Act list of protected species and threatened ecological communities considered to be Matters of National Environmental Significance (MNES) is included as Appendix B.

### 5.2 Geological setting

### 5.2.1 Geomorphology

The proposed landfill extension site is set in hilly terrain amongst Tasmanian Blue Gum plantation and within a small sub-catchment that drains south-westerly into an unnamed ephemeral tributary of the Hotham River. The confluence is approximately 27 km south south-east of the site, about 1.5 km north north-east of the township of Boddington. The Hotham River subsequently joins the Murray River, which discharges into the Peel Inlet.

The local topography in the area can be described as follows:

- Boonerring Hill is located to the east of the site with smaller ranges to the south and north
- The site generally slopes down from west to east with a localised high point at RL 380 m at the south-western corner of site and a low lying area to the east of the proposed extension area.

There is a subtle valley through the southern portion of the area in which the proposed landfill expansion will take place, comprising two distinct drainage swales.

### 5.2.2 Regional geology

The site is located on the Darling Plateau, to the east of the Darling Fault, and over Archaean granitic and gneissic rocks that form part of the Yilgarn Block. Based on the Pinjara 1:250 000 Geological Series map (Figure 4, Attachment A), the site is located in an area of laterite that has formed in situ from the weathering of the underlying granitic rock and forms part of a classic saprolitic regolith profile.

The laterite is generally massive and cemented and may be pisolitic or vesicular. It averages 4 m in thickness and the upper portions may consist locally of uncemented pisolites. The laterite has been described to pass down through a pallid zone of variable thickness into weathered bedrock with only local redistribution occurring. A number of deposits have formed on colluvial slopes above alluvium and are chiefly laterised sands (Wilde and Low, 1978).

Overlying the laterite are deposits of yellow, grey or white sand of variable thickness associated with present or ancient drainage courses (Figure 3 and Figure 4, Appendix A). There has been some redistribution of this material into eolian dunes. Where it overlies the massive laterite of the Darling Range, the sand unit is much less extensive, is grey or white but not yellow, and is invariably associated with drainage courses (Wilde and Low, 1978).

### 5.2.3 Local geology

Within the vicinity of the proposed landfill site, the Quaternary colluvium (Figures 4 and 5, Appendix A) consists of shallow dipping sheets of sand on the valley sides, upslope from alluvial and below rock or laterite outcrops. In areas of active erosion, colluvium occurs between valley alluvium and the rock out crop (separated from both by a marked change of slope) and also occurs as gravel deposits in valleys that are actively incising the regolith surface.

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

Tholeiitic quartz dolerite dykes intrude all Archean rocks throughout the area. They are particularly prominent in the granitic terrain but often obscured by surficial deposits. The dykes are generally around 2 to 10 m thick, but range up to 200 m maximum thickness. No dykes are indicated within the vicinity of the site on the Pinjarra 1:250 000 geology sheet; however, total magnetic intensity (TMI) data acquired from the Department of Mines, Industry Regulation and Safety (DMIRS) inconclusively suggests one dyke may dissect the site on a north north-west to south south-east bearing, while another may be present approximately 1 km east of the site, on a similar bearing.

Where granitic rock which constitutes the basement rock in the area is exposed such as on Boonerring Hill, immediately west of the site, faulting is observed. These faults generally trend north-westerly to west north-westerly and are consistent with a lineament swarm indicated by TMI data. These lineaments could possibly indicate a broad fault zone in the granitic bedrock.

### 5.3 Surface water

The Project is situated within the Murray River and tributaries surface water management area and Hotham sub-area (Landgate, 2016). The Project area does not include and is not in close proximity to any wetlands listed as Ramsar sites. The closest Ramsar wetland is the Peel-Yalgorup system, which is approximately 57 km west of the Project area (Landgate, 2016). The landfill is positioned within the Hotham Catchment and located on the southern side of a ridge line dividing the Hotham and Upper Serpentine Catchments. The nearest creek to the landfill is Gringer Creek, approximately 6 km south-east of the landfill flowing into the Hotham River.

The site gradient falls steeply from north-west to south-east. Site elevation ranges from approximately 368 m AHD in the north-western corner of the existing landfill, measured at groundwater monitoring well location MW01, and falls to around 328 to 330 m AHD at MW06 and GMB8, outside the south-eastern boundary of the proposed landfill extension.

Surface water on site is channelled from around the southern and eastern edges of the existing landfill to Stormwater Dam 1. Overflow from Stormwater Dam 1 (SD1) drains along a natural drainage channel toward Stormwater Dam 2 (SD2), which in turn overflows into Stormwater Dam 3 (SD3) (Figure 5, Appendix A). Surface water also drains east across the southern part of the proposed landfill extension along existing, yet poorly defined water courses (Figure 5, Appendix A). Stormwater Dam 4 (SD4) is located in the southeastern corner of the site and overflow from this dam drains east along an existing water course until its confluence with the south-easterly flowing drainage line between SD2 and SD3.

Surface water data collected from SD1, SD2 and SD3 between July 2012 and September 2016 indicates that collected surface water run-off from the site is fresh, slightly acidic and has a low nutrient content (average total nitrogen $=2.3 \mathrm{mg} / \mathrm{L}$ ). The relatively good water quality and the absence of key landfill indicators, such as elevated potassium to chloride ratios and elevated nitrogen species, supports the view that surface waters are currently not impacted by the landfill. The historic surface water laboratory data (since 2012) indicates some variability in laboratory results, which may reflect seasonal influences due to evaporation and rainfall effects. The results of surface water monitoring carried out to date for the site is presented in Appendix C.

### 5.4 Groundwater

### 5.4.1 Groundwater monitoring

Groundwater monitoring bores are currently installed in 18 locations across and surrounding the existing and proposed landfill areas (Figure 6, Appendix A). Eight of the 18 monitoring bores (MW01 to MW08) bores have been monitored for groundwater level and quality since 2011 and eight (GMB1 to GMB8) have been monitored twice since their installation in February 2016. The remaining two monitoring bores (GMB111 and GMB112) have not yet been incorporated into routine monitoring at the site having been installed in
December 2016.

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

Groundwater levels have been recorded at close to ground surface ( $<1 \mathrm{~m} \mathrm{bgl}$ ) at the end of the winter rainfall period (September - October). Therefore, it is possible that surface discharge or expression of groundwater occurs during this time along the south, south-east trending drainage channel located to the east of the proposed landfill extension (i.e. between MW05 and MW06).

### 5.4.2 Groundwater recharge, flow and discharge

Groundwater recharge into the regolith profile occurs by infiltration of rainfall falling directly on the lateritic soils. Additionally, recharge is also expected from drainage lines where the fractured rock basement is in contact with the weathered saprolite/lateritic profile.

The groundwater table in the vicinity of the proposed landfill extension is located below the lateritic profile, within the underlying saprolitic clays. Monitoring bores located to the north (MW01) and north-east (GMB1) of the existing landfill are dry having been installed on the upslope sections of the terrain and are presumably too high in the landscape to be within the local groundwater system.

Lateral groundwater flow will be controlled locally by the composition of the parent rock, depth and extent of weathering and bedrock topography. Based on groundwater level measurements recorded on 25 May 2017, the lateral groundwater flow direction across the proposed extension is easterly, however in the broader local scale, is expected to swing south south-easterly in alignment with the drainage line at the base of the valley.

The rate of groundwater flow within the regolith profile is controlled by the hydraulic gradient (approximately 0.03 ) across the proposed landfill extension site and the hydraulic conductivity of the saprolite and saprock (overlying the granite bedrock). Based on information collected during the field investigation, the rate of groundwater flow within the regolith profile is expected to be low (i.e. $<50 \mathrm{~m} / \mathrm{year}$ ).

Following periods of rainfall, towards the end of the winter season and into spring, groundwater levels are expected to reach their seasonal high.

### 5.4.3 Groundwater quality

Groundwater sampling and analysis has been carried out at the site since 2011. This data is presented in Appendix C.

Groundwater quality data recorded for the existing landfill indicates total dissolved solids (TDS) concentrations range between very fresh ( $20 \mathrm{mg} / \mathrm{L}$ ) and brackish ( $4900 \mathrm{mg} / \mathrm{L}$ ). Groundwater samples collected from the newly installed wells across the proposed landfill extension were all fresh ( 239 to $518 \mathrm{mg} / \mathrm{L}$ ), the median value for all samples collected since the commencement of monitoring is $312 \mathrm{mg} / \mathrm{L}$.

Groundwater pH recorded in existing monitoring wells between 2011 and 2017 ranges between neutral and acidic (3.1 to 7.2). The pH of groundwater collected from the newly installed monitoring wells across the proposed landfill extension are consistent with these values and are acidic to marginally acidic ranging between 3.9 and 5.9. These results are considered to be a reflection of the natural groundwater pH in the area.

The existing groundwater quality database compares groundwater quality to the following criteria:

- ANZECC 2000 Freshwater Slightly-Moderately Disturbed Ecosystems
- Department of Health - Non-Potable Groundwater Use Criteria
- ANZECC \& ARMCANZ 2000 Long-term irrigation criteria.

Data exceeding the criteria are sporadic and do not indicate trends. Elevated levels of pH , electrical conductivity (EC), chloride, nitrate as N and total phosphorus exceedances are common over the monitoring period indicating naturally elevated background levels.

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Comparison of the groundwater quality data from the newly installed boreholes indicate few exceedances, but includes exceedances for pH , copper, iron and zinc. The majority of the exceedances are marginal and are not interpreted as indicative of any deterioration of natural groundwater chemistry. Data exceeding the criteria for chromium, copper, iron and zinc are frequently recorded across all monitoring locations and therefore are interpreted to be due to the natural composition of the groundwater being high in these elements (i.e. this represents background or baseline concentrations for the area).

Screening for contaminants has been carried out during selected (not all) monitoring rounds and no detections of pesticides, polycyclic aromatic hydrocarbons, polychlorinated biphenyls or volatile organic compounds have been recorded. Samples submitted for screening of contaminants were selected by other consultants. Total recoverable hydrocarbons (TRH) was detected in MW02, MW03, MW05 and MW06, however for each monitoring bore, the most recent sampling round reported in the database indicates groundwater collected from these bore was free from TRH. All detections of TRH were between February and May 2012 and may have been remnant from lubricants used during drilling of the monitoring bores and has since dissipated.

TRH was detected in two of the newly installed monitoring bores (GMB5 and GMB7) at levels close to the laboratory detection limits during sampling in February 2016. In each case the $\mathrm{C}_{16}-\mathrm{C}_{34}$ fraction of TRH was detected, which indicates that the source of these hydrocarbons could be from grease or lubricants; however, we do not know what the source is. It is anticipated that the amount of TRH in these monitoring bores is minimal and therefore will likely dissipate over time until undetectable. Samples from these wells were not tested for TRH in the most recent monitoring round (May 2017).

Based on review of the groundwater quality database and the results of the recent field investigation, there is currently no evidence of contamination to groundwater at the existing landfill and proposed landfill extension site.

### 5.4.4 Other groundwater users

Department of Water and Environmental Regulation groundwater databases indicate no other groundwater users are located within 15 km of the landfill catchment.

### 5.4.5 Hydrogeological setting

As depicted in the conceptual site model (Figures 7, Appendix A) the hydrogeological setting of the Project does not give cause to concern for detrimental impacts to the environment or to other groundwater users.

In the context of a source, pathway and receptor assessment, the key reasons for this are:

- Source (Landfill) - Any extension of the landfill will be designed, engineered and operated (with appropriate monitoring and contingency protocols) to appropriate standards to avoid interactions between leachate with groundwater.
- Pathway (Groundwater Flow) - Good understanding of the hydrogeological setting can be demonstrated based on the work carried out to date. The hydrogeology is fairly simple, comprising a saprolitic regolith profile overlying Archaean granitic and gneissic rocks, typical of the Yilgarn Block.

■ Pathway (Groundwater Flow) - Given the relatively low hydraulic conductivity of the regolith profile and low hydraulic gradient at the site, the rate of transport of any contaminated groundwater off site is expected to be low.

- Pathway (Groundwater Flow) - The absence of palaeovalleys or hydraulic pathways into areas of potential concern (for example drinking water catchments).
- Receptor - Resident groundwater quality is relatively good and could serve some beneficial use (i.e. irrigation for crops/livestock). The release of any potential contaminants into the groundwater underlying the landfill could result in deterioration of groundwater quality and compromise its future beneficial use. This risk could be managed through early identification of any impacts to groundwater quality by routine groundwater level and quality monitoring.

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- Receptor - There are no sensitive environmental areas or registered groundwater users in the catchment where the landfill is located, within a 15 km search radius, and the catchment is not pristine, having been significantly disturbed through agricultural activities.

A technical memorandum that includes additional for groundwater information has been included as Appendix D.

### 5.5 Heritage

Archae-aus completed a desktop Aboriginal heritage assessment for the Project in 2017.
The objectives of the desktop assessment were:

- To undertake a search of the Department of Planning Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System (AHIS) for any known registered Aboriginal sites, Other Heritage places and heritage surveys undertaken within and surrounding the project area.
- Obtain records of sites and survey reports from the DPLH and other sources where possible.
- Summarise the heritage values of the area with an assessment of potential heritage within the North Bannister Landfill Expansion area.

The AHIS search revealed that there have been two previous ethnographic surveys conducted within the immediate footprint area, although no registered sites or Other Heritage places were identified. When the search was expanded to a 5 km radius from the NBRRP expansion area, a total of four ethnographic and one archaeological heritage surveys were conducted and one site was identified (Registered Site DAA $3582 /$ Serpentine River). When the search was expanded to a $15-20 \mathrm{~km}$ radius the number of sites and registered surveys increased.

The full Aboriginal Heritage Desktop Assessment is included as Appendix E.

### 5.6 Community

The site is located on 390 ha of privately owned land (Lot 2 of Plan 2767), approximately 30 km north of the Shire of Boddington and 100 km south-east of Perth. Lot 2 is zoned as "Rural" in the Shire of Boddington Local Planning Scheme No. 2.

The nearest sensitive receptors include, two private residences ( 4.4 km and 9 km away) and a commercial residence, the North Bannister Roadhouse ( 7 km away).

As mentioned in Section 5.4, there are no sensitive environmental areas or registered groundwater users within a 15 km search radius of where the landfill is located, and the catchment is not pristine, having been significantly disturbed through agricultural activities.

The Boddington Gold Mine's Residue Disposal Area is approximately 10 km to the south and the mine itself is a further 10 km south. A small section of the 1000 km Bibbulmun Track passes the northern and western boundaries of Lot 2 and is approximately 400 m to 500 m to the northern boundary of the existing facility. This may potentially result in transient sensitive receptors (track users) on an occasional basis.

The Application for works approval details for the facility were advertised in the West Australian newspaper on 19 December 2011 as a means of advising interested stakeholders and to seek public comment. No submissions were received.

As part of engaging with the community, NBRRP is planning to initiate a community reference group.
NBRRP has advised that during operations to date there have been no complaints regarding noise or odour.

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### 5.7 Air and odour

### 5.7.1 Odour assessment

Environmental Alliances Pty Ltd (Envall) (Envall, 2011) completed an odour impact assessment for the now operational landfill. The assessment was conducted using the then Department of Environmental Protection (DEP) guidelines for the assessment of odour impacts in 'Odour Methodology Guideline' (DEP 2002) and ‘Separation Distances between Industrial and Sensitive Land Uses’ (EPA 2005) and was based on the assumption the landfill operation was as per Department of Environment and Conservation (DEC, now DWER) practices and specifications.

The nearest sensitive receptor was determined to be approximately 4.4 km east of the proposed facility, well beyond the separation distances for a putrescible landfill site. The guidance (EPA, 2005) for separation distances between landfills and sensitive land uses requires buffer distances of 150 m for a single residence and 500 m to the nearest sensitive land use, such as a subdivision. According to the guidance (EPA, 2005) if the buffer distance is met, then no further assessment of odour is required. Given the distance to the nearest sensitive land use, the additional odour modelling that was conducted by Envall could therefore be considered as a due diligence study.

The primary odour-emitting sources are considered to be the working tip-face and the leachate dam. Working tip-face odour emission rates were derived from the results of a sampling program at a landfill of similar capacity and waste type to that of the proposed landfill at full operation (City of Cockburn's Henderson Landfill; $200000 \mathrm{t} / \mathrm{yr}$ ). Leachate dam odour emission rates were derived from sampling data derived from the Subiaco Waste Water Treatment facility.

The assessment (Envall, 2011) was conducted using the U.S. Environmental Protection dispersion model CALPUFF (a multi-layer, multi-species non-steady-state puff dispersion model) with upper wind and temperature data, synthetically generated met files; and included land use, terrain and meteorological inputs.

Predicted odour impacts were assessed using the Department of Environment and Energy's (DEE) 'Interim Odour Guidance Statement' (DoE 2005) and the then-DEC's favoured Queensland Environment Protection Authority criterion of 2.5 ou (1-hour average; 99.5 percentile) (EPA, 2004). The average radius of these impacts was 475 m , comparable with the default separation distance of 500 m and almost 4 km from the nearest sensitive receptor.

### 5.7.2 Golder review

In considering whether the Envall 2011 odour assessment conducted for the proposed facility remains relevant for the proposed expansion, the following is noted:

- The guidelines for the assessment of odour impacts (DEP 2002) remain current in 2017.
- The separation distances between industrial and sensitive land uses provided in (EPA 2005) were updated in the Draft Separation Distances between Industrial and Sensitive Land Uses in September 2015 (EPA 2015). A proposed putrescible landfill site (Class II and III) now is subject to a recommended separation distance of 1000 m .

■ The nearest sensitive receptor is still that determined to be approximately 4.4 km east of the site. The expansion of the site footprint is mainly to the south of the existing footprint and therefore does not bring the site boundary appreciably closer to the sensitive receptor.

- The assessment criterion of 2.5 ou (1-hour average, 99.5 percentile) remains current in 2017. It is understood that DWER currently assigns criteria of 2.5 ou (1-hour average; 99.5 percentile) and 8 ou (1-hour average; 99.9 percentile) for fugitive odour source impacts.

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■ The odour assessment can be considered conservative in its approach with the following worst case conditions assumed:

- leachate pond at full capacity (maximum surface area), which is an unlikely scenario. It should be noted that there will be an additional leachate pond. However, there are evaporators/aerators in the pond that stop them from becoming anaerobic.
- odour emission rates based on Henderson Landfill samples of putrescible waste in an advanced state of decomposition due to a prolonged period of hot weather. Comparison with data from other sites in Perth indicates that these emission rates were in the upper percentile of the available data.
- The dispersion model, CALPUFF, used in the assessment remains one of the preferred models for this type of assessment as does the modelling methodology employed.
- The assessment concludes that given the very wide margin between the most stringent of the predicted extent of the unacceptable impacts and the location of the nearest sensitive receptor, there should be considerable confidence that the proposed landfill would not cause unacceptable odour impacts.

Doubling the area of the working tip-face and the surface area of the leachate dam used in the assessment to conservatively represent a doubling in the annual waste received by the landfill from 200000 t to 400000 t would lead to a doubling of the total odour emission rate. This suggests that the predicted 2.5 ou impact with an average radius 475 m would be doubled to a 5 ou impact at this distance from the source.
The 2.5 ou distance would likely be pushed out to between two and four times this distance. If it is assumed conservatively that the average radius is five times greater than the original radius, approximately 2 km , this is still 2 km away from the nearest sensitive receptor. It is therefore concluded that no additional odour assessment is required for the proposed expansion.

## $5.8 \quad$ Noise

### 5.8.1 Noise assessment

ViPAC Engineers and Scientists Ltd (ViPAC) (ViPAC, 2011) completed a noise impact assessment for the now operational landfill facility. The assessment considered the construction and operational phase impacts against Western Australia Environmental Protection (Noise) Regulations 1997 (EPNR), which set out maximum allowable noise levels based on the time of day and land use applicable at noise sensitive receptors in the vicinity of a development.

Transport noise (excluding that from reversing alarms) is strictly excluded from the EPNR and therefore transport noise associated with the facility was assessed against Western Australia Planning Commission (WAPC) State Planning Policy 5.4 'Road and Rail Transport Noise and Freight Considerations in Land Use Planning '(WAPC, 2005).

Background ambient noise levels were determined at the location of the facility over a seven day period using a calibrated unattended noise logger. The La90 during the day was determined to be 43 db and 42 db at night (unweighted).

The nearest sensitive receptor was determined to be approximately 4.4 km east of the proposed facility.
Sound power levels for various plant were obtained from the manufacturer and $1 / 3$ octave band levels were derived by ViPAC from measurements on similar equipment. The vehicles and plant for the construction phase included:

- Pad foot roller (1)
- $\quad$ Smooth drum roller (1)
- Grader (1)
- Excavator (2)

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－Water truck（1）
－Dump truck（1）
－Dozer（1）
－Loader（1）
－$\quad$ Scraper（1）
－Compactor（1）．
The vehicles and plant for the operational phase consist of：
－Grader（1）
－Excavator（1）
－Water truck（1）
－Dump truck（1）
－Dozer（1）
－Compactor（1）．
Noise levels predicted at the nearest sensitive receptor due to the proposed landfill construction and operation were assessed against night time noise criteria and all equipment was considered to be operating simultaneously at the most eastern side of the site，closest to the nearest sensitive receptor．The report found that the predicted worst case construction and operational noise levels at the nearest sensitive receptor are 24 abbreviated $\mathrm{dB}(\mathrm{dBA})$ and 22 dBA ，respectively，comfortably below the most stringent，night time，criteria of 37 dBA ．

Transport noise associated with the landfill was calculated based on 38 to－and－from vehicle movements （bringing waste to site and leaving empty）in a 12 －hour period and assessed at the shortest distance between the access road and the nearest sensitive receptor（ 250 m ）．The report concludes that the predicted transport noise impact of 45 dBA complies with the day and night time criteria of 60 dBA and 55 dBA ，respectively．

## 5．8．2 Golder review

In considering whether the ViPAC 2011 noise assessment undertaken for the proposed facility remains relevant for the proposed expansion，the following is noted：
－The noise regulations and the levels they set out for the proposed facility remain current in 2017.
－The EPNR criteria influencing factor consideration（to determine the assessment criteria）remains appropriate in 2017.
－Background ambient noise levels without the current facility are unlikely to have changed appreciably since the noise survey due to no change in conditions in the vicinity（e．g．there has been no introduction of additional noise sources such as neighbouring industrial activities）．

■ The nearest sensitive receptor is still that determined to be approximately 4.4 km east of the site．The expansion of the site footprint is mainly to the south of the existing footprint and therefore does not bring the site boundary appreciably closer to the sensitive receptor．
－The noise levels of the individual plant and vehicles to be used on the expanded site is unlikely to change．

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- The assessment can be considered conservative in its approach with several worst case conditions assumed, e.g. all plant and vehicles operating simultaneously at the boundary of the site closest to the nearest sensitive receptor, under worst case weather conditions (using CONCAWE method) and using the most stringent (night time) criteria.

■ The assessment found that the predicted noise levels at the nearest sensitive receptor were well below the relevant criteria.

Conservatively doubling the number of plant and vehicles in each of the assessments: construction (expansion), operation and transport noise (based on a doubling of the annual waste received from 200000 t to 400000 t ) would lead to a 3 dBA increase in the predicted noise levels at the nearest sensitive receptor, still well below the criteria (Table 4). It is unlikely that construction or operation noise would be audible above background levels ( 42 dBA ) at the nearest sensitive receptor. It is therefore concluded that no additional noise assessment is required for the proposed expansion.

Table 4: Predicted increase in noise levels at nearest sensitive receptor.

| Phase | PredictedNoise Level at Nearest <br> Receptor <br> (dBA) <br> Most Stringent Criterion <br> (dBA) <br>  $\quad 200000 \mathrm{t} / \mathrm{yr}$ |  | $\mathbf{4 0 0} \mathbf{0 0 0 \mathrm { t } / \mathrm { yr }}$ |
| :--- | :---: | :---: | :---: |
|  | 24 | 27 | 37 |
| Operation | 22 | 25 | 37 |
| Transport Noise | 45 | 48 | 55 |

### 6.0 ENVIRONMENTAL IMPACT ASSESSMENT

A qualitative risk assessment was conducted for the Project, which assessed the likely key environmental and social impacts of the proposed construction and operation of the Project based on the:

- Information available describing the pre-upgrade environmental and social conditions of the site.
- Descriptions of proposed construction works and operations.
- Environmental and social factors applicable to the site.
- Identified sensitive environmental and social receptors.

Sensitive environmental and social receptors include:

- Flora and fauna including potential Black Cockatoo habitat.

■ Surface water flow and quality in the Murray and Hotham Rivers and their unnamed ephemeral tributaries as well as Gringer Creek.

- Local groundwater quality.
- Air quality.

■ Potential undiscovered Aboriginal Heritage sites.
■ Nearby residence (4.4 km away).
Risk rankings were applied using a semi-quantitative risk assessment process based on the AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines and ranked using Golder's Risk matrix included in Appendix F. The implementation of management measures were also assessed in terms of the hierarchy of hazard controls. The results of the risk assessment, presenting the relevant environmental and social factors, the potential environmental and social impacts of the Project during construction works and management to mitigate this are summarised in Table 5.
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Table 5: Potential environmental and social impacts, management measures and risk

| Environmental or Social Factor | Potential Environmental and Social Impacts | Recommended Management Measures | Residual |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Likelihood | Consequence | Risk Level |
| Flora and Vegetation | Disturbance to and/or clearing of vegetation as a result of construction or operational activities. | The landfill has been specifically located to avoid clearing of any remnant bushland on the site. Limited clearing will be required within plantation forest only. <br> Restrict vegetation clearing to the minimum area required for works and clearly demarcate limits of vegetation clearing and disturbance (including marking on site map). <br> Carry out progressive and approved revegetation as per the Operations Management Plan. <br> Implement dust management measures. <br> Educate site personnel on practices to avoid damage to native flora, minimise soil disruption, and appropriate weed management. <br> Ensure spoil piles with weeds are at least 25 m from native vegetation. <br> Ensure civil machinery and equipment are free of plant matter and soil when entering the site. | 2 | 2 | Low Risk <br> 4 |
|  | Direct damage to flora and vegetation proposed to be retained, impacting flora and fauna habitat. |  | 2 | 2 | $\begin{gathered} \text { Low Risk } \\ 4 \end{gathered}$ |
|  | Dust emissions potentially settling on vegetation foliage. |  | 3 | 2 | $\begin{gathered} \text { Low Risk } \\ 6 \end{gathered}$ |
|  | Introduction of new weeds to the Project area as a result of increased vehicle movements. |  | 2 | 2 | $\begin{gathered} \text { Low Risk } \\ 4 \end{gathered}$ |

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| Environmental or Social Factor | Potential Environmental and Social Impacts | Recommended Management Measures | Residual |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Likelihood | Consequence | Risk Level |
| Fauna | Construction: <br> Disturbance to and/or clearing of vegetation as a result of construction works resulting in the loss of fauna habitat and/or displacement of fauna. | - Relocate native fauna if discovered on site/if required during site works. Fauna can only be handled by qualified and licensed personnel. <br> Restrict access to Project Area to prevent community and fauna access. <br> Adequately contain/cover all waste and make landfill areas inaccessible to fauna, including feral animals. Implement traffic control measures for the Project e.g. speed limits to prevent fauna accidents. <br> Implement dust and noise management measures as specified within the Operations Management Plan. Fill excavations as soon as practicable. <br> Conduct inspections of excavations each morning to locate any trapped fauna and relocate if necessary. | 3 | 2 | $\begin{gathered} \text { Low Risk } \\ 6 \end{gathered}$ |
|  | Noise emissions from the operation of vehicles, other equipment potentially disturbing fauna and impacting their health. |  | 1 | 2 | $\begin{gathered} \text { Very Low } \\ \text { Risk } \\ 2 \\ \hline \end{gathered}$ |
|  | Dust and exhaust emissions potentially impacting the health of fauna. |  | 1 | 2 | $\begin{gathered} \text { Very Low } \\ \text { Risk } \\ 2 \end{gathered}$ |
|  | Vehicle collisions with fauna potentially resulting in fauna injury or death. |  | 1 | 3 | Very Low Risk 3 |
|  | Increased presence of feral animals (i.e. fauna accessing buried waste). |  | 2 | 2 | Low Risk 4 |
|  | Operation: <br> Potentially increased traffic resulting in increased fugitive exhaust emissions, adversely impacting air quality and therefore faunal health. |  | 2 | 2 | Low Risk 4 |
|  | Potential accidental entrapment of fauna in excavations or trenches. |  | 1 | 2 | $\begin{gathered} \text { Very Low } \\ \text { Risk } \\ 2 \end{gathered}$ |
| Landforms | Landfill landform visual impact to the surrounding area. | The landfill site is located in a remote bushland area (approximately 4.4 km from the nearest sensitive receptor), which combined with the intervening landform and vegetation provides a considerable buffer minimising impacts to visual and landscape amenity. | 2 | 1 | Very Low Risk 2 |

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| Environmental or Social Factor | Potential Environmental and Social Impacts | Recommended Management Measures | Residual |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Likelihood | Consequence | Risk Level |
| Surface water and stormwater | Emissions to surface water, including sediment, caused by unmanaged stormwater during landfill construction and operation. | Design and implement a site specific Surface Water, Drainage and Sediment Control Plan. <br> Manage the storage of chemicals and hazardous materials in accordance with industry best practice and manufacturers recommendations. <br> Divert undisturbed (uncontaminated) surface run-off in a manner to prevent erosion. <br> Prevent stormwater from disturbed areas from flowing offsite or entering waterways. <br> All waste materials (drums, chemical containers, etc.) to be stored in protected, bunded area well away from waterways. <br> Ensure all spills and leaks are cleaned up immediately and waste correctly disposed of. <br> Ensure all contaminated soil/water is removed by licensed contractor. <br> Position stockpiles in a suitable area away from stormwater/surface water flow. | 3 | 2 | $\begin{gathered} \text { Low Risk } \\ 6 \end{gathered}$ |
|  | Deterioration/contamination of surface water or groundwater quality caused by on-site spills (such as hydrocarbons, saline, or other contaminated materials) during construction or operational activities. |  | 2 | 2 | Low Risk <br> 4 |
|  | Potential sediment discharge to surface water from excavation and material transport works, potentially impacting surface water quality and indirectly the local environment. |  | 2 | 2 | Low Risk <br> 4 |
| Groundwater | Deterioration/contamination of groundwater quality caused by seepage of leachate from the landfill cells during operation. | Revise existing biannual groundwater monitoring program to include new works. Implement program. Carry out annual review of groundwater level and quality data to identify any potential indicators of impacts to groundwater quality <br> In the event contamination of groundwater is suspected, develop a groundwater model for the site to assess the risk to downgradient groundwater users (if any can be identified). | 2 | 3 | $\begin{gathered} \text { Low Risk } \\ 6 \end{gathered}$ |
|  | Deterioration/contamination of groundwater quality caused by seepage of leachate from the leachate containment well during operation. |  | 2 | 3 | $\begin{gathered} \text { Low Risk } \\ 6 \end{gathered}$ |
| Heritage | Construction: <br> Uncovering of unexpected Aboriginal heritage items during site works. | Stop works immediately if unexpected Aboriginal or other artefacts are identified. <br> In the event of a potential unexpected Aboriginal or other artefacts being discovered, follow an unexpected finds procedure. | 2 | 3 | $\begin{gathered} \text { Low Risk } \\ 6 \end{gathered}$ |


| Environmental or Social Factor | Potential Environmental and Social Impacts | Recommended Management Measures | Residual |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Likelihood | Consequence | Risk Level |
| Community/traffic | Construction: <br> Noise emissions potentially impacting the community. | Develop a traffic management plan to specify traffic diversions, signage and other traffic control methods proposed for the Project. <br> Provide adequate notice to the community of road works and associated diversions. <br> Manage dust and noise in accordance with the management measures provided in the Operations Management Plan. <br> Site Manager addresses complaints as per the Operations Management Plan. | 2 | 2 | $\begin{gathered} \text { Low Risk } \\ 4 \end{gathered}$ |
|  | Dust emissions potentially impacting the community. |  | 1 | 2 | Very Low Risk 2 |
|  | Operation: <br> Potential increased traffic volume resulting in: <br> Traffic congestion. <br> Increased exhaust emissions. <br> Noise emissions. |  | 2 | 2 | $\begin{gathered} \text { Low Risk } \\ 4 \end{gathered}$ |
| Air quality | Construction: <br> Fugitive emissions to air potentially adversely impacting air quality and therefore the health of site workers and fauna, and dust deposition to flora caused by: <br> - Dust produced by vegetation and/or earth clearing works. | Covering/sealing all vehicles carrying waste <br> Only removing vehicle covers in the vicinity of the tipping face of the active cell <br> Limit disturbed areas to minimise potential dust generation. <br> Visually monitor operations to assess that no visible dust is leaving site. <br> Avoid excavation and other soil disturbance works on windy days. <br> Dampen ground surfaces and/or surface treat stockpiles or other exposed unsealed areas. <br> Position stockpiles in a suitable area away from stormwater/surface water flow and restrict heights of stockpiles to minimise impacts from wind. Stabilise, landscape and treat rehabilitated areas as soon as practicable. <br> Reduce handling and transportation of excavated materials. <br> Plant and equipment installed with emission control devices to meet industry standards. <br> Enforce speed restrictions. | 2 | 2 | Low Risk 4 |
|  | Dust and exhaust emissions from vehicle movements and/or operation. |  | 2 | 2 | $\begin{gathered} \text { Low Risk } \\ 4 \end{gathered}$ |
|  | Dust produced by excavating and working the active tip face. |  | 2 | 2 | Low Risk $4$ |
|  | Dust produced by soil loading, unloading and transportation works. |  | 2 | 2 | Low Risk $4$ |
|  | Dust produced by on-site stockpiling activities and wind erosion of stockpiles. |  | 2 | 2 | Low Risk 4 |
|  | Operations: <br> Potentially increased traffic utilising access roads and operating on site, resulting in increased fugitive exhaust emissions, potentially adversely impacting air quality and therefore the health of the community, fauna and flora. |  | 2 | 2 | Low Risk $4$ |

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| Environmental or Social Factor | Potential Environmental and Social Impacts | Recommended Management Measures | Residual |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Likelihood | Consequence | Risk Level |
| Noise | Construction: <br> Generation of noise due to landfill construction works, including activities at proposed borrow areas (such as operation of vehicles and other equipment) adversely impacting off-site receptors and native fauna. | Acoustical treatment measures incorporated during landfill construction and operation, together with the distance to the nearest sensitive receptors, will minimise the impact of noise levels to acceptable limits. <br> No site works to occur outside approved work hours. <br> Operate plant and equipment in an efficient manner to minimise noise. <br> Plant and equipment installed with standard noise control devices. <br> Prevent unnecessary idling. <br> Develop and implement an appropriate vehicle and equipment maintenance program. <br> Manage complaints in accordance with Suez incident and complaints management procedure. | 2 | 2 | Low Risk 4 |
|  | Operations: <br> Generation of noise due to landfill operational activities (such as operation of vehicles and other equipment) adversely impacting offsite receptors and native fauna. |  | 2 | 2 | Low Risk <br> 4 |
| Chemicals and hazardous materials | Chemicals and other materials accidently spilt into the environment potentially impacting surface water/groundwater quality. | Store all chemicals and hazardous materials in containment appropriate for the volume and nature of the chemicals. <br> Refuelling and maintenance areas must be on a hardstand with a temporary bund. <br> Assess the location, contents, specification/suitability and integrity of the chemical storage areas as required (i.e. not near waterways or drains). <br> Safety Data Sheets (SDS) must be available at the location where chemicals are stored and where they are used. <br> Contain and appropriately manage spills using absorbent materials and spill kits. <br> Store spill control equipment in critical locations to allow for a quick response. <br> Educate site personnel as to spill response and kit locations. <br> Manage contents of spill kits to ensure adequate supplies are available. <br> Purchase chemicals that are the least toxic and ensuring minimum volume ordered. | 3 | 2 | $\begin{gathered} \text { Low Risk } \\ 6 \end{gathered}$ |

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| Environmental or Social Factor | Potential Environmental and Social Impacts | Recommended Management Measures | Residual |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Likelihood | Consequence | Risk Level |
|  | Construction: <br> Domestic waste and other waste materials contaminate the site potentially impacting flora and fauna habitat and the health of site workers and fauna. | Integrate waste minimisation and re-use methods to on-site operations. <br> Place all domestic waste including recycling in labelled lidded bins. <br> Recycle recyclable materials, including cardboard and | 2 | 2 | Low Risk 4 |
| Waste management | Disposal of waste in an environmentally unacceptable manner or unsuitable waste facility. | scrap metal wherever possible. <br> Conduct regular inspections to ensure waste is segregated as required. <br> Do not store waste receptacles in close proximity to sensitive areas such as waterways or stormwater drains. <br> - Manage and track complaints in accordance with the site complaint register. | 1 | 2 | $\begin{aligned} & \text { Very Low } \\ & \text { Risk } \\ & 2 \end{aligned}$ |

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

### 7.0 CONCLUSION

After an assessment of the key potential environmental risks and impacts following the implementation of proposed environmental management measures, seven risks were calculated as Very Low and 27 as Low. No residual risks were calculated as Moderate or above. As such, no additional risk management measures were proposed.

### 8.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled - "Important Information Relating to this Report", which is included in Appendix G of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

### 9.0 REFERENCES

Animal Plant Mineral Pty Ltd (2017). North Bannister Landfill Fauna Survey, North Bannister WA. Animal Plant Mineral, Ellenbrook WA.

ANZECC and ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000.

Australian Standard 5667:1998 Water Quality - Sampling, Part 11: Guidance on the Sampling of Groundwaters (AS 5667.11:1998).

Australian Standard 5667:1998 Water Quality - Sampling, Part 10: Guidance on Sampling of Wastewaters (AS 5667.10:1998).

Department of Environment Regulation [DER] (2014). Assessment and management of contaminated sites Contaminated Sites Guidelines.

Department of Environment [DoE] (2005). Interim Odour Guidance Statement, Department of Environment, Perth, Western Australia, 2005.

Department of Environmental Protection [DEP] (1997). Environment Protection (Noise) Regulations (1997). Department of Environmental Protection, Government of Western Australia, 1997.

Department of Environmental Protection [DEP] (2002). Odour Methodology Guideline, March 2002
Department of Environment Regulation [DER] (2015). Environmental Risk Assessment Framework Division 3, Part V, Environmental Protection Act 1986. December 2015. Department of Environment Regulation, Perth WA.

ENV Australia (2011). North Boddington Landfill - Groundwater Monitoring Well Installation and Groundwater Baseline Testing, Letter to Perthwaste dated 1 June 2011.

Environmental Alliances Pty Ltd [Envall] (2011). Assessment of Odours from Proposed North Boddington Landfill, Job No. L1013, 18 April 2011.

Environmental Protection Authority [EPA] (2015). Draft Environmental Assessment Guideline for Separation distances between Industrial and Sensitive Land Uses, Western Australia, September 2015.

Environmental Protection Authority [EPA] (2005). Guidance for the Assessment of Environmental Factors, No.3, Separation distances between industrial and sensitive land uses, Western Australia, June 2005.

Environmental Protection Authority [EPA] (2015). Environmental Assessment Guideline for Preparation of management plans under Part IV of the Environmental Protection Act 1986 (EAG 17). August 2015. Environmental Protection Authority, Perth WA.

Geological Survey of Western Australia (1980), PINJARRA, Sheet S1 50-2 and part of Sheet S1 50-1, first edition 1980.

Golder (2016). Project Eagle, Feasibility Study for Landfill Expansion. 1650453-001-R-Rev0. March 2016. Golder Associates Pty Ltd, Perth WA.

Golder (2017a). Proposed Future Cells, North Bannister Resource Recovery Park - Geotechnical Investigation. 1664535-002-R-Rev0. February 2017. Golder Associates Pty Ltd, Perth WA

Golder (2017b). Proposed Leachate Pond North Bannister Resource Recovery Park - Geotechnical Investigation. 1664535-001-R-Rev0. March 2017. Golder Associates Pty Ltd, Perth WA.

Landgate (2016). SLIP Enabler (WA Atlas). Surface water catchments. Available at: https://www2.landgate.wa.gov.au/bmvf/app/waatlas/ Accessed 22 May 2017

ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION

Mattiske E.M; Havel, J.J., (1998). Vegetation Complexes of the South-west Forest Region of Western Australia. Maps and report prepared as part of the Regional Forest Agreement. Western Australia for the Department of Environment and Conservation and Environment Australia. Western Australia.

National Environment Protection Council [NEPC] (2013). National Environmental Protection (Assessment of Site Contamination) Amendment Measure (No.1).

Orell P, Morris K (1994). Chuditch recovery plan, 1992-2001. Western Australian Wildlife Management Program 13, 25 p.

Queensland Environmental Protection Authority (2004). Odour Impact Assessment for Developments. State of Queensland, Environmental Protection Agency and Queensland Parks and Wildlife Service, 2004.

ViPAC Engineers and Scientists Pty Ltd (2011). Acoustic Report, Perth Waste - North Boddington Landfill, document 840560-2, 7 April 2011.

Western Australian Planning Commission [WAPC] (2005). State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning, May 2005.

Wilde S A \& Low G H (1978). Explanatory Notes Perth, Western Australia. 1:250,000 Geological Map Series SH/50-14. Geological Survey of Western Australia. Perth, Western Australia

# ENVIRONMENTAL IMPACT ASSESSMENT FOR NORTH BANNISTER LANDFILL EXPANSION 

## Report Signature Page

## GOLDER ASSOCIATES PTY LTD


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## APPENDIX A

## Figures





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## APPENDIX B

## Search Results from FloraBase and EPBC Protected Matters Act Databases

## EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 07/02/17 16:59:33

## Summary

Details
Matters of NES
Other Matters Protected by the EPBC Act
Extra Information

## Caveat

Acknowledgements


## Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| World Heritage Properties: | None |
| :--- | :--- |
| National Heritage Places: | None |
| Wetlands of International Importance: | 1 |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | None |
| Listed Threatened Ecological Communities: | None |
| Listed Threatened Species: | 15 |
| Listed Migratory Species: | 4 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| Commonwealth Land: | None |
| :--- | :--- |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 9 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Commonwealth Reserves Marine: | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| State and Territory Reserves: | None |
| :--- | :--- |
| Regional Forest Agreements: | 1 |
| Invasive Species: | 18 |
| Nationally Important Wetlands: | None |
| Key Ecological Features (Marine) | None |

## Details

Matters of National Environmental Significance

| Wetlands of International Importance (Ramsar) | [Resource Information] |
| :--- | :--- |
| Name | Proximity |
| Peel-yalgorup system | $50-100 \mathrm{~km}$ upstream |


| Listed Threatened Species | [Resource Information] |  |
| :--- | :--- | :--- |
| Name | Status | Type of Presence |
| Birds | Critically Endangered | Species or species habitat <br> may occur within area |
| Calidris ferruginea |  | Species or species habitat <br> known to occur within area |
| Callyptorhynchus banksii naso | Vulnerable | Roosting known to occur <br> Forest Red-tailed Black-Cockatoo, Karrak [67034] |
| Carea |  |  |


| Name | Status | Type of Presence |
| :--- | :--- | :--- |
| Diuris purdiei | Endangered | Species or species habitat <br> may occur within area |
| Purdie's Donkey-orchid [12950] | Endangered | Species or species habitat <br> may occur within area |
| Thelymitra dedmaniarum  <br> Cinnamon Sun Orchid [65105] Endangered | Species or species habitat <br> likely to occur within area |  |


| Listed Migratory Species | [Resource Information] |
| :--- | ---: |
| * Species is listed under a different scientific name on the EPBC Act - Threatened | Species list. |
| Name | Threatened |


| Migratory Terrestrial Species |  |
| :--- | :--- |
| Motacilla cinerea | Species or species habitat <br> Grey Wagtail [642] |
|  | may occur within area |

## Migratory Wetlands Species

Calidris ferruginea
Curlew Sandpiper [856]
Critically Endangered
Species or species habitat may occur within area

## Numenius madagascariensis

Eastern Curlew, Far Eastern Curlew [847] Critically Endangered Species or species habitat may occur within area

Other Matters Protected by the EPBC Act
Listed Marine Species
[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
| :--- | :--- | :--- |
| Birds | Species or species habitat <br> likely to occur within area |  |
| Apus pacificus | Sperk-tailed Swift [678] | Species or species habitat <br> likely to occur within area |
| Ardea alba | Great Egret, White Egret [59541] |  |

Ardea ibis
Cattle Egret [59542] Species or species habitat may occur within area

Calidris ferruginea
Curlew Sandpiper [856] Critically Endangered Species or species habitat

Haliaeetus leucogaster
White-bellied Sea-Eagle [943]
Species or species habitat may occur within area

Merops ornatus
Rainbow Bee-eater [670]
Species or species habitat may occur within area

Species or species habitat may occur within area

Rostratula benghalensis (sensu lato)

Endangered*

Species or species habitat may occur within area

Species or species habitat may occur within area

## Extra Information

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

| Name | State |
| :--- | :--- |
| South West WA RFA | Western Australia |
| Invasive Species | [Resource Information] |

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status |
| :--- | :--- |
| Birds | Type of Presence |
| Columba livia | Species or species habitat <br> likely to occur within area |
| Rock Pigeon, Rock Dove, Domestic Pigeon [803] | Species or species habitat <br> likely to occur within area |
| House Sparrow [405] | Species or species habitat <br> likely to occur within area |
| Passer montanus <br> Eurasian Tree Sparrow [406] | Species or species habitat <br> likely to occur within area |
| Streptopelia chinensis |  |
| Spotted Turtle-Dove [780] | Species or species habitat <br> likely to occur within area |
| Streptopelia senegalensis | Laughing Turtle-dove, Laughing Dove [781] |


| Mammals |  |
| :--- | :--- |
| Canis lupus familiaris |  |
| Domestic Dog [82654] | Species or species habitat <br> likely to occur within area |
| Felis catus | Species or species habitat <br> likely to occur within area |
| Mus musculus | Species or species habitat <br> likely to occur within area |


| Name | Status | Type of Presence |
| :---: | :---: | :---: |
| Oryctolagus cuniculus |  |  |
| Rabbit, European Rabbit [128] |  | Species or species habitat likely to occur within area |
| Rattus rattus |  |  |
| Black Rat, Ship Rat [84] |  | Species or species habitat likely to occur within area |
| Sus scrofa |  |  |
| Pig [6] |  | Species or species habitat likely to occur within area |
| Vulpes vulpes |  |  |
| Red Fox, Fox [18] |  | Species or species habitat likely to occur within area |
| Plants |  |  |
| Asparagus asparagoides |  |  |
| Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473] |  | Species or species habitat likely to occur within area |
| Chrysanthemoides monilifera |  |  |
| Bitou Bush, Boneseed [18983] |  | Species or species habitat may occur within area |
| Chrysanthemoides monilifera subsp. monilifera |  |  |
| Boneseed [16905] |  | Species or species habitat likely to occur within area |
| Genista sp. X Genista monspessulana |  |  |
| Broom [67538] |  | Species or species habitat may occur within area |
| Pinus radiata |  |  |
| Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780] |  | Species or species habitat may occur within area |
| Rubus fruticosus aggregate |  |  |
| Blackberry, European Blackberry [68406] |  | Species or species habitat likely to occur within area |

## Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250 K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

## Coordinates

## Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales<br>-Department of Environment and Primary Industries, Victoria<br>-Department of Primary Industries, Parks, Water and Environment, Tasmania<br>-Department of Environment, Water and Natural Resources, South Australia<br>-Department of Land and Resource Management, Northern Territory<br>-Department of Environmental and Heritage Protection, Queensland<br>-Department of Parks and Wildlife, Western Australia<br>-Environment and Planning Directorate, ACT<br>-Birdlife Australia<br>-Australian Bird and Bat Banding Scheme<br>-Australian National Wildlife Collection<br>-Natural history museums of Australia<br>-Museum Victoria<br>-Australian Museum<br>-South Australian Museum<br>-Queensland Museum<br>-Online Zoological Collections of Australian Museums<br>-Queensland Herbarium<br>-National Herbarium of NSW<br>-Royal Botanic Gardens and National Herbarium of Victoria<br>-Tasmanian Herbarium<br>-State Herbarium of South Australia<br>-Northern Territory Herbarium<br>-Western Australian Herbarium<br>-Australian National Herbarium, Canberra<br>-University of New England<br>-Ocean Biogeographic Information System<br>-Australian Government, Department of Defence<br>Forestry Corporation, NSW<br>-Geoscience Australia<br>-CSIRO<br>-Australian Tropical Herbarium, Cairns<br>-eBird Australia<br>-Australian Government - Australian Antarctic Data Centre<br>-Museum and Art Gallery of the Northern Territory<br>-Australian Government National Environmental Science Program<br>-Australian Institute of Marine Science<br>-Reef Life Survey Australia<br>-American Museum of Natural History<br>-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania<br>-Tasmanian Museum and Art Gallery, Hobart, Tasmania<br>-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.
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Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61262741111

## APPENDIX C

## Surface Water and Groundwater Data

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Appendix C-Surface Water Quality Database










CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB1

COORDS: 442393.1 m E 6396457.9 m N MGA94 50 (dGPS) SURFACE RL: 347.80 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 11.80 m

SHEET: 1 OF 1
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 15/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB2

COORDS: 441830.5 m E 6396082.3 m N MGA94 50 (dGPS) SURFACE RL: 354.17 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$
HOLE DIA: 115 mm HOLE DEPTH: 46.50 m

SHEET: 1 OF 3
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 15/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT:
PROJECT: North Bannister Resource Recovery Facility
LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB2

COORDS: 441830.5 m E 6396082.3 m N MGA94 50 (dGPS) SURFACE RL: 354.17 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$

HOLE DIA: 115 mm HOLE DEPTH: 46.50 m

SHEET: 2 OF 3
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: Mike Bartlett DATE: 15/2/16
CHECKED: David ThomsdDATE: 25/2/16


CLIENT:
PROJECT: North Bannister Resource Recovery Facility
LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB2

COORDS: 441830.5 m E 6396082.3 m N MGA94 50 (dGPS) SURFACE RL: 354.17 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DIA: 115 mm HOLE DEPTH: 46.50 m

SHEET: 3 OF 3
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: Mike Bartlett DATE: 15/2/16
CHECKED: David ThomsdDATE: 25/2/16


CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB3

COORDS: 441613.0 m E 6395738.1 m N MGA94 50 (dGPS) SURFACE RL: 361.73 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 31.50 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 17/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT:
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB3

COORDS: 441613.0 m E 6395738.1 m N MGA94 50 (dGPS) SURFACE RL: 361.73 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 31.50 m

SHEET: 2 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 17/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB4

COORDS: 442207.2 m E 6395343.3 m N MGA94 50 (dGPS) SURFACE RL: 334.37 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 19.50 m

SHEET: 1 OF 1
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 17/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB5

COORDS: 441949.1 m E 6395152.5 m N MGA94 50 (dGPS) SURFACE RL: 352.95 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 25.50 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 18/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT:
PROJECT: North Bannister Resource Recovery Facility
LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB5

COORDS: 441949.1 m E 6395152.5 m N MGA94 50 (dGPS) SURFACE RL: 352.95 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 25.50 m

SHEET: 2 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 18/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility
LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB6

COORDS: 441895.0 m E 6395432.8 m N MGA94 50 (dGPS) SURFACE RL: 345.37 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 19.50 m

SHEET: 1 OF 1
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 18/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB7

COORDS: 441615.0 m E 6395412.8 m N MGA94 50 (dGPS) SURFACE RL: 356.98 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 16.30 m

SHEET: 1 OF 1
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 19/2/16 CHECKED: David ThomsdDATE: 25/2/16


CLIENT: SUEZ Recycling \& Recovery
PROJECT: North Bannister Resource Recovery Facility LOCATION: Lot 2 Albany Highway, North Bannister
JOB NO: 1650453

## PRELIMINARY REPORT OF BOREHOLE: GMB8

COORDS: 442572.1 m E 6395182.2 m N MGA94 50 (dGPS) SURFACE RL: 334.62 m DATUM: AHD (dGPS) INCLINATION: $-90^{\circ}$ DIRECTION: $000^{\circ}$ HOLE DEPTH: 15.80 m

SHEET: 1 OF 1
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: Mike Bartlett DATE: 19/2/16 CHECKED: David ThomsdDATE: 25/2/16


LEADERS IN WATER MANAGEMENT SINCE 1969

## DRILLING REPORT

| Driller | Frank | Bore No | MW04A | Commenced | $16 / 03 / 2015$ |
| :--- | :---: | :--- | :--- | :--- | :---: |
| Assistant | Alex | Rig | Mud Rotary | Completed | $16 / 03 / 2015$ |
| Drillers <br> Licence | 185 | Property Owner | Perthwaste Green Recycling |  |  |
| Location: | North Bannister Bore MW04A |  |  |  |  |


| Depth of strata <br> (metres) | Description of Strata |  | Details |  |
| :---: | :---: | :--- | :--- | :---: |
| Surface To | 1 | Brown medium sand with some gravel | Diameter of Bore (mm) | 50 |
| 1.0 | 2.0 | Red to brown medium sands with very | Static Water Level (m) | 3.9 |
|  |  | coarse gravel | Pumping Level (m) |  |
| 2.0 | 3.0 | Red fine to medium sands with gravel | Supply (L/s) |  |
| 3.0 | 3.4 | Red to pink sands with gravel |  |  |
| 3.4 | 4.0 | Grey clays (sloppy) | Water Analysis: |  |
| 4.0 | 5.0 | White clays, Some greys with clear sands | pH |  |
| 5.0 | 6.0 | Grey clays some white clays | T.D.S (mg/L) |  |
| 6.0 | 7.0 | Sloppy white clays with clear medium sand | Total Iron (mg/L) |  |
| 7.0 | 8.0 | White clays |  |  |
| 8.0 | 9.0 | Hard white clays very chunky | Screen length (m) |  |
| 9.0 | 10.0 | White clays | Screen diameter (mm) | 50.0 |
| 10.0 | 11.0 | White clays | Screen aperture (mm) | 0.5 |
|  |  | Stop Drilling | Depth of Packer (m) |  |
|  |  |  | Total Depth (m) |  |
|  |  |  | Developing (Hours) |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

LEADERS IN WATER MANAGEMENT SINCE 1969

## DRILLING REPORT

| Driller | Frank | Bore No | MW07 | Commenced | 17/03/2015 |
| :--- | :---: | :--- | :--- | :--- | :---: |
| Assistant | Alex | Rig | Mud Rotary | Completed | $17 / 03 / 2015$ |
| Drillers <br> Licence | 185 | Property Owner | Perthwaste Green Recycling |  |  |
| Location: | North Bannister Bore MW07 |  |  |  |  |


| Depth of strata <br> (metres) | Description of Strata |  | Details |  |
| :---: | :---: | :--- | :--- | :---: |
| Surface To | 1.0 | Light brown sand fine to medium | Diameter of Bore (mm) | 50 |
| 1.0 | 2.0 | Light brown sands with gravel | Static Water Level (m) | 2.0 |
| 2.0 | 3.0 | Light brown sands with gravel | Pumping Level (m) |  |
| 3.0 | 4.0 | Brown sands, medium to coarse with some gravel | Supply (L/s) |  |
| 4.0 | 5.0 | Brown sands, medium to coarse with some white clays |  |  |
| 5.0 | 6.0 | White Sloppy clay with some medium clear sands | Water Analysis: |  |
| 6.0 | 6.5 | Thick brown clays | pH |  |
| 6.5 | 7.0 | Grey thick clays | T.D.S (mg/L) |  |
| 7.0 | 8.0 | Grey Clays | Total Iron (mg/L) |  |
|  |  | Stop Drilling |  |  |
|  |  |  | Screen length (m) |  |
|  |  |  | Screen diameter (mm) | 50.0 |
|  |  |  | Screen aperture (mm) | 0.5 |
|  |  |  | Toptal Depth (m) |  |
|  |  |  | Testing (Hours) | 6.1 |
|  |  |  |  |  |
|  |  |  |  |  |

LEADERS IN WATER MANAGEMENT SINCE 1969

## DRILLING REPORT

| Driller | Frank | Bore No | MW08 | Commenced | 16/03/2015 |
| :--- | :---: | :--- | :---: | :--- | :---: |
| Assistant | Alex | Rig | Mud Rotary | Completed | $16 / 03 / 2015$ |
| Drillers <br> Licence | 185 | Property Owner | Perthwaste Green Recycling |  |  |
| Location: | North Bannister Bore MW08 |  |  |  |  |



CLIENT:
PROJECT: Landfill Expansion LOCATION: Future Cells Area
JOB NO: 1664535

COORDS: 441743 m E 6396236 m N MGA94 50 SURFACE RL: 357.7 m DATUM: AHD INCLINATION: -90
HOLE DEPTH: 15.00 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: CC DATE: $1 / 12 / 16$ CHECKED: DATE:


CLIENT:
PROJECT: Landfill Expansion LOCATION: Future Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 안 |  | $\begin{gathered} \stackrel{y}{4} \\ \stackrel{y}{4} \\ \hline \end{gathered}$ |  | $\begin{array}{\|c\|c\|c\|} \hline \text { DEPTH } \\ \text { RL } \end{array}$ | SAMPLE OR FIELD TEST | $\begin{array}{\|c} \underset{\sim}{\underset{\sim}{u}} \\ \stackrel{y}{\underset{\sim}{u}} \\ \underset{\sim}{u} \\ \underset{\sim}{u} \\ \hline \end{array}$ | $\begin{aligned} & 0 \\ & \frac{0}{T} \\ & \frac{1}{c} \\ & \text { do } \\ & \text { O } \\ & \hline 1 \end{aligned}$ | O <br> $\sum_{0}$ <br> 0 <br> 0 <br> 0 <br> 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion
LOCATION: Future Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{aligned} & \frac{\widetilde{4}}{\mathbf{4}} \\ & \stackrel{y}{3} \end{aligned}$ |  | $\begin{array}{\|c\|} \hline \text { DEPTH } \\ \text { RL } \end{array}$ | SAMPLE OR FIELD TEST |  |  | O <br> $\sum_{0}$ <br> 0 <br> 0 <br> 0 <br> 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT: SUEZ Recycling \& Recovery (Perth) Pty Ltd PROJECT: Landfill Expansion LOCATION: Future Cells Area JOB NO: 1664535

COORDS: 441741 m E 6396450 m N MGA94 50 SURFACE RL: 366.9 m DATUM: AHD INCLINATION: $-90^{\circ}$
HOLE DEPTH: 15.00 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: CC DATE: 30/11/16
CHECKED:
DATE:


CLIENT:
PROJECT: Landfill Expansion LOCATION: Future Cells Area
JOB NO: 1664535

| Drilling |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{aligned} & \stackrel{Y}{4} \\ & \stackrel{y}{4} \\ & \vdots 3 \end{aligned}$ |  | $\left\lvert\, \begin{array}{\|c\|c\|c\|} \text { DEPL } \\ \hline \end{array}\right.$ | SAMPLE OR <br> FIELD TEST | $\begin{array}{\|c} \underset{\sim}{\underset{\sim}{\underset{~}{\sim}}} \\ \underset{\sim}{u} \\ \underset{\sim}{u} \\ \underset{\sim}{u} \\ \hline \end{array}$ | $\begin{aligned} & 0 \\ & \frac{0}{\overline{1}} \\ & \frac{1}{4} \\ & \text { d } \\ & 0 \end{aligned}$ | $\stackrel{1}{0}$ $\sum_{i}^{\infty}$ 0 0 0 $J$ | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT: PROJECT: Landfill Expansion LOCATION: Future Cells Area JOB NO: 1664535

COORDS: 441648 m E 6396312 m N MGA94 50 SURFACE RL: 373.4 m DATUM: AHD INCLINATION: -90
HOLE DEPTH: 15.45 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: CC DATE: $1 / 12 / 16$
CHECKED:
DATE:


CLIENT:
PROJECT: Landfill Expansion LOCATION: Future Cells Area
JOB NO: 1664535


COORDS: 441648 m E 6396312 m N MGA94 50 SURFACE RL: 373.4 m DATUM: AHD INCLINATION: -90
HOLE DEPTH: 15.45 m

SHEET: 2 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: CC DATE: $1 / 12 / 16$
CHECKED:

CLIENT:
PROJECT: Landfill Expansion
LOCATION: Future Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{aligned} & \frac{Y}{4} \\ & \stackrel{y}{4} \\ & \vdots \end{aligned}$ |  | $\underset{\mathrm{RL}}{\substack{\text { DEPTH }}}$ | SAMPLE OR <br> FIELD TEST |  |  | O $\sum_{n}^{m}$ $\omega$ 0 0 0 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion LOCATION: Future Cells Area
JOB NO: 1664535



CLIENT: SUEZ Recycling \& Recovery (Perth) Pty Ltd
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535

COORDS: 441653 m E 6395943 m N MGA94 50 SURFACE RL: 363.0 m DATUM: AHD INCLINATION: $-90^{\circ}$ HOLE DEPTH: 10.95 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: CC DATE:
CHECKED: DATE.

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { O } \\ & \frac{\text { O}}{1} \\ & \stackrel{\text { M }}{\Sigma} \end{aligned}$ |  | $\xrightarrow[\substack{\text { ¢ } \\ \stackrel{4}{4} \\ 3}]{ }$ |  | $\underset{\mathrm{RL}}{\mathrm{DEPTH}}$ | SAMPLE OR FIELD TEST |  |  | $$ | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{array}{\|l\|l} \hline \frac{y}{4} \\ \stackrel{y}{3} \end{array}$ |  | $\underset{\mathrm{RL}}{\mathrm{DEPTH}}$ | SAMPLE OR FIELD TEST |  | $\begin{aligned} & 0 \\ & \frac{0}{T} \\ & \frac{1}{a} \\ & \frac{\alpha}{0} \\ & \frac{0}{0} \\ & \hline \end{aligned}$ | 0 $\sum_{n}^{\infty}$ $\omega$ 0 0 0 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\left\lvert\, \begin{array}{c\|} \text { DEPTH } \\ \mathrm{RL} \end{array}\right.$ | SAMPLE OR FIELD TEST | $\begin{array}{\|l} \stackrel{\rightharpoonup}{\underset{\sim}{w}} \\ \stackrel{y}{\sim} \\ \underset{\sim}{u} \\ \underset{\sim}{u} \\ \hline \end{array}$ |  | $\square$ <br> $\sum_{0}$ <br> 0 <br> 0 <br> 0 <br> 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{gathered} \stackrel{y}{4} \\ \stackrel{y}{\mid} \end{gathered}$ |  | $\begin{gathered} \text { DEPTH } \\ \hline \end{gathered}$ | SAMPLE OR FIELD TEST | $\begin{array}{\|l\|l\|l\|} \hline \underset{\sim}{u} \\ \underset{\sim}{u} \\ \underset{\sim}{u} \\ \underset{\sim}{u} \\ \hline \end{array}$ |  | ${ }^{1}$ $\sum_{i}$ 0 0 0 $J$ | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT: SUEZ Recycling \& Recovery (Perth) Pty Ltd
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535

COORDS: 441894 m E 6395950 m N MGA94 50 SURFACE RL: 350.3 m DATUM: AHD INCLINATION: $-90^{\circ}$
HOLE DEPTH: 12.00 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: CC DATE:
CHECKED: DATE:

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{gathered} \stackrel{y}{4} \\ \stackrel{y}{\mid} \end{gathered}$ |  | $\underset{R L}{\text { DEPTH }}$ | SAMPLE OR <br> FIELD TEST |  | $\begin{aligned} & \frac{0}{T} \\ & \frac{1}{n} \\ & \frac{1}{c} \\ & \frac{0}{0} \\ & 0 \end{aligned}$ | O $\sum_{n}^{\infty}$ $\vdots$ 0 0 0 $j$ | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\stackrel{\stackrel{r}{\underset{\sim}{u}}}{\stackrel{y}{3}}$ |  | $\begin{gathered} \text { DEPTH } \\ \hline \end{gathered}$ | SAMPLE OR FIELD TEST | 促号 | O 모 $\frac{1}{4}$ d 0 | O $\sum_{n}^{\infty}$ $\omega$ 0 0 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT: SUEZ Recycling \& Recovery (Perth) Pty Ltd
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535

COORDS: 442051 m E 6396018 m N MGA94 50 SURFACE RL: 342.7 m DATUM: AHD INCLINATION: $-90^{\circ}$ HOLE DEPTH: 10.50 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling
LOGGED: CC DATE:
CHECKED DATE:

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| O O T 岂 |  | $\begin{gathered} \stackrel{\text { r }}{\underset{y}{\mid}} \\ \underset{3}{\star} \end{gathered}$ |  | $\underset{\mathrm{RL}}{\mathrm{DEPTH}}$ | SAMPLE OR <br> FIELD TEST |  | $\begin{aligned} & \frac{0}{x} \\ & \frac{1}{1} \\ & \frac{1}{4} \\ & \frac{1}{0} \\ & 0 \\ & \hline \end{aligned}$ |  | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion
LOCATION: Expansion Cells Area
JOB NO: 1664535



This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for

CLIENT: SUEZ Recycling \& Recovery (Perth) Pty Ltd PROJECT: Landfill Expansion LOCATION: Southern Area

JOB NO: 1664535

COORDS: 442186 m E 6395688 m N MGA94 50 SURFACE RL: 337.3 m DATUM: AHD INCLINATION: -90
HOLE DEPTH: 20.00 m

SHEET: 1 OF 2
DRILL RIG: Comacchio Geo 305 CONTRACTOR: Proline Drilling LOGGED: CC DATE: 8/12/16 CHECKED:

DATE:


CLIENT:
PROJECT: Landfill Expansion
LOCATION: Southern Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\left\lvert\, \begin{array}{c\|} \text { DEPTH } \\ \mathrm{RL} \end{array}\right.$ | SAMPLE OR FIELD TEST | $\begin{array}{\|l} \stackrel{\rightharpoonup}{\underset{\sim}{w}} \\ \stackrel{y}{\sim} \\ \underset{\sim}{u} \\ \underset{\sim}{u} \\ \hline \end{array}$ |  | $\square$ <br> $\sum_{0}$ <br> 0 <br> 0 <br> 0 <br> 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |


|  | $\bigcirc$ |  | Sa004 SPT $10.50-10.95 \mathrm{~m}$ 3, 3, 5 <br> $\mathrm{N}=8$ <br> Sa007 <br> SPT 13.50-13.95 m <br> 2, 4, 8 <br> $\mathrm{N}=12$ <br> Sa008 <br> SPT 16.50-16.95 m <br> 6, 12, 16 <br> $\mathrm{N}=28$ <br> Sa009 <br> SPT 19.50-19.95 m <br> 7, 16, 25 <br> $\mathrm{N}=41$ |  | $40 \%$ fine to medium grained angular quartz sand <br> pale grey and red brown, 20\% iron cemented concretions <br> brown and pale grey <br> $60 \%$ coarse grained angular quartz sand <br> yellow, brown and pale red, $70 \%$ fine to coarse grained angular quartz sand, mottled | M | St |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | his report of boreh echnical purposes information on | must be read $y$, without atte and do not nec | in conjunction with accompanying notes and abbreviations. npt to assess possible contamination. Any references to p ssarily indicate the presence or absence of soil or groundw | thas <br> ential <br> ter co | been <br> nta |  |

CLIENT:
PROJECT: Landfill Expansion
LOCATION: Future Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{aligned} & \stackrel{r}{4} \\ & \stackrel{y}{3} \\ & 3 \end{aligned}$ |  | $\underset{\mathrm{RL}}{\mathrm{DEPTH}}$ | SAMPLE OR FIELD TEST |  | $\begin{aligned} & 0 \\ & \frac{0}{\overline{1}} \\ & \frac{1}{4} \\ & \frac{\alpha}{0} \\ & 0 \end{aligned}$ | D <br> 0 <br> $\sum_{0}$ <br> 0 <br> 0 <br> 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |



CLIENT:
PROJECT: Landfill Expansion LOCATION: Future Cells Area
JOB NO: 1664535

| Drilling |  |  |  |  | Sampling |  | Field Material Description |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{aligned} & \stackrel{y}{4} \\ & \stackrel{y}{4} \\ & \end{aligned}$ |  | $\begin{array}{\|c\|c\|} \hline \text { DEPTH } \\ \mathrm{RL} \end{array}$ | SAMPLE OR <br> FIELD TEST |  | $\begin{aligned} & 0 \\ & \frac{0}{\bar{x}} \\ & \frac{1}{4} \\ & \frac{1}{4} \\ & 0 \\ & 0 \end{aligned}$ | O <br> $\sum_{0}^{0}$ <br> $\omega$ <br> 0 <br> 0 <br> 0 | SOIL/ROCK MATERIAL DESCRIPTION |  | STRUCTURE AND ADDITIONAL OBSERVATIONS |

(





## APPENDIX D

## Groundwater Technical Memorandum

DATE 17 August 2017
TO Craig Barker
SUEZ Recycling and Recovery Australia
CC

REFERENCE No. 1671227-002-R-Rev0 Appendix D

EMAIL

SUPPORTING INFORMATION- GROUNDWATER CHARACTERISTICS, MONITORING AND QUALITY FOR NORTH BANNISTER LANDFILL EXPANSION

### 1.0 GROUNDWATER

### 1.1 Groundwater monitoring

Groundwater monitoring bores are currently installed in 18 locations across and surrounding the existing and proposed landfill areas. Eight of the 18 monitoring bores (MW01 to MW08) bores have been monitored for groundwater level and quality since 2011 and eight (GMB1 to GMB8) have been monitored twice since their installation in February 2016. The remaining two monitoring bores (GMB111 and GMB112) have not yet been incorporated into routine monitoring at the site having been installed in December 2016.

### 1.2 Groundwater recharge, flow and discharge

Groundwater recharge into the regolith profile occurs by infiltration of rainfall falling directly on the lateritic soils, as well as from overland flow. Additionally, recharge is also expected from drainage lines when there is surface flow and from the fractured rock basement at the contact with the weathered saprolite/lateritic profile. A cross-sectional conceptual representation of the interpreted regolith profile and groundwater flow behaviour at the proposed landfill extension site is shown in Figure 7(Appendix A of main report). The line of cross section represented is oriented on a south west to north east bearing, facing north.

The groundwater table in the vicinity of the proposed landfill extension is located below the lateritic profile, within the underlying saprolitic clays. Monitoring bores located to the north (MW01) and north-east (GMB1) of the existing landfill are dry having been installed on the upslope sections of the terrain and are presumably too high in the landscape to be within the local groundwater system.

Lateral groundwater flow will be controlled locally by the composition of the parent rock, depth and extent of weathering and bedrock topography. Based on groundwater level measurements recorded on 25 May 2017, the lateral groundwater flow direction across the proposed extension is easterly; however in the broader local scale, is expected to swing south south-easterly, mimicking surface water flow/topography. The interpreted and conceptual groundwater flow regime is shown in Figure 6 (Appendix A of main report).

The rate of groundwater flow within the regolith profile is controlled by the hydraulic gradient (approximately 0.03 ) across the proposed landfill extension site and the hydraulic conductivity of the saprolite and saprock (overlying the granite bedrock). The range in hydraulic conductivities recorded during field investigations carried out in February 2016 indicate groundwater flow in the upper, clay rich saprolite profile could be up to an order of magnitude lower than within the saprock materials overlying bedrock. Based on information collected during the field investigation, the rate of groundwater flow within the regolith profile is expected to be low (i.e. $<50 \mathrm{~m} /$ year). The hydraulic conductivity and rate of groundwater flow in the underlying bedrock is not known.

Following periods of rainfall, towards the end of the winter season and into spring, groundwater levels are expected to reach their seasonal high. Groundwater levels have been recorded on a semi-regular basis from the original eight monitoring bores located at the landfill site since 2011, this data has been presented in a hydrograph below.


Graph 1: Hydrograph
The hydrograph shows that groundwater levels have varied seasonally at individual well locations by up to 5.5 m . The relatively large amount of groundwater level fluctuation is interpreted as being due to a combination of low storage capacity of the regolith profile and also forced lowering of the groundwater table during summer by abstraction from nearby production bores. Some evidence for sustained lowering of the groundwater table is observable from the 2017 groundwater level measurements shown in Graph 1.

Groundwater levels have been recorded at close to ground surface ( $<1 \mathrm{~m} \mathrm{bgl}$ ) at the end of the winter rainfall period (September - October). Therefore it is possible that surface discharge or expression of groundwater occurs during this time along the south, south east trending drainage channel located to the east of the proposed landfill extension (i.e. between MW05 and MW06). This process is shown conceptually in Figure 6 and may manifest as either damp, boggy ground from which evaporation loses would occur or pooling or even surface flow in lower lying areas and along drainage beds (though this has not been directly observed by Golder).

### 1.3 Groundwater quality

Groundwater sampling and analysis has been carried out at the site since 2011. This data is presented in Appendix C of the main report.

Groundwater quality data recorded for the existing landfill indicate fresh to brackish groundwater with total dissolved solids (TDS) concentrations ranging between very fresh ( $20 \mathrm{mg} / \mathrm{L}$ ) up to brackish ( $4900 \mathrm{mg} / \mathrm{L}$ ). There appears to be some inconsistency with the units presented in the groundwater quality database provided for this review. The results presented in Appendix C (and described above) exclude results where the TDS values were disproportionally high when compared with the electrical conductivity values recorded in the field during sample collection. The TDS results that have been excluded ranged from 5000 to $47000 \mathrm{mg} / \mathrm{L}$. It is suspected that these values are erroneous as a result of incorrect conversion factors applied to the raw laboratory data. Groundwater samples collected from the newly installed wells across the proposed landfill extension were all fresh ( 239 to $518 \mathrm{mg} / \mathrm{L}$ ), the median value for all samples collected since the commencement of monitoring is $312 \mathrm{mg} / \mathrm{L}$.

Groundwater pH recorded in existing monitoring wells between 2011 and 2017 ranges between neutral and acidic (3.1 to 7.2). The pH of groundwater collected from the newly installed monitoring wells across the proposed landfill extension are consistent with these values and are acidic to marginally acidic ranging between 3.9 and 5.9. These results are considered to be a reflection of the natural groundwater pH in the area, in particular where groundwater has had a low residence time since infiltrating from rainfall in the upper slopes of the site topography (I.e. GMB3 and GMB7).

The groundwater collected from the newly installed wells is $\mathrm{Na}-\mathrm{Cl}$ type (refer to Piper Plot - Graph 2). Samples collected from existing wells could not be plotted as the appropriate groundwater analytes are not recorded in the existing database.

Piper Plot


Graph 2: Piper Plot - proposed landfill expansion groundwater types
The existing groundwater quality database provides comparison of groundwater quality to the following criteria:

- ANZECC 2000 Freshwater Slightly-Moderately Disturbed Ecosystems
- Department of Health - Non-Potable Groundwater Use Criteria
- ANZECC \& ARMCANZ 2000 Long-term irrigation criteria.

Exceedances of these criteria noted do not appear to show any trends and occur on a sporadic nature. For some analytes including, pH , electrical conductivity (EC), chloride, nitrate as N and total phosphorus exceedances are widespread throughout wells and over the period of monitoring to date, which indicates, in the absence of clear trends, the natural quality of groundwater in the area is above these criteria.

Comparison of the groundwater quality data from the newly installed boreholes for the same criteria indicate very few exceedances, but include pH , copper, iron and zinc. The majority of the exceedances are marginal and are not interpreted as indicative of any deterioration of natural groundwater chemistry having taken place across the proposed landfill expansion footprint. Exceedances of the criteria for chromium, copper, iron and zinc are frequently recorded across all monitoring locations and therefore these exceedances are interpreted to be due to the natural composition of the groundwater being high in these elements (i.e. this represents background or baseline concentrations for the area).

Screening for contaminants has been carried out during selected (not all) monitoring rounds and no detections of pesticides, polycyclic aromatic hydrocarbons, polychlorinated biphenyls or volatile organic compounds have been recorded. Total recoverable hydrocarbons (TRH) have been detected in MW02, MW03, MW05 and MW06, however for each monitoring bore, the most recent sampling round reported in the database indicates groundwater collected from these bore was free from TRH. All detections of TRH were between February and May 2012 and may have been remnant from lubricants used during drilling of the monitoring bores and has since dissipated.

TRH was detected in two of the newly installed monitoring bores (GMB5 and GMB7) at levels close to the laboratory detection limits during sampling in February 2016. In each case the $\mathrm{C}_{16}-\mathrm{C}_{34}$ fraction of TRH was detected which indicates the source of these hydrocarbons could be from grease or lubricants, however we do not know what the source is. It is anticipated that the amount of TRH in these monitoring bores is minimal and therefore will likely dissipate over time until undetectable. Samples from these wells were not tested for TRH in the most recent monitoring round (May 2017).

Based on review of the groundwater quality database and the results of the recent field investigation, there is currently not evidence of contamination to groundwater at the existing landfill and proposed landfill extension site.

### 1.4 Other groundwater users

Department of Water groundwater databases have been scrutinised and there are no records of other groundwater users within the catchment in which the landfill is located, within a 15 km search radius.

### 2.0 HYDROGEOLOGICAL SETTING

The hydrogeological setting of the landfill site as summarised in the conceptual site model (Figures 6 and 7, Appendix A) has no characteristics that give cause to concerns for detrimental impacts to the environment or to other groundwater users, from the operations of the landfill. In the context of a source, pathway and receptor assessment, the key reasons for this are:

- Source (Landfill) - Any extension of the landfill will be designed, engineered and operated (with appropriate monitoring and contingency protocols) to appropriate standards to avoid interactions between leachate with groundwater.
- Pathway (Groundwater Flow) - Good understanding of the hydrogeological setting can be demonstrated based on the work carried out to date. The hydrogeology is fairly simple, comprising a saprolitic regolith profile overlying Archaean granitic and gneissic rocks, typical of the Yilgarn Block.
- Pathway (Groundwater Flow) - Given the relatively low hydraulic conductivity of the regolith profile and low hydraulic gradient at the site, the rate of transport of any contaminated groundwater off site is expected to be low.
- Pathway (Groundwater Flow) - The absence of palaeovalleys or hydraulic pathways into areas of potential concern (for example drinking water catchments).
- Receptor - Resident groundwater quality is relatively good and could serve some beneficial use (i.e. irrigation for crops/livestock). The release of any potential contaminants into the groundwater underlying the landfill could result in deterioration of groundwater quality and compromise its future beneficial use. This risk could be managed through early identification of any impacts to groundwater quality by routine groundwater level and quality monitoring.
- Receptor - There are no sensitive environmental areas or registered groundwater users in the catchment where the landfill is located, within a 15 km search radius, and the catchment is not pristine, having been significantly disturbed through agricultural activities.


## GOLDER ASSOCIATES PTY LTD

Michael Bartlett<br>Senior Hydrologist

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## APPENDIX E

Aboriginal Heritage Desktop Assessment (Archae-aus, 2017)

# Desktop Research of the Aboriginal Heritage <br> Values for the North Bannister Landfill <br> Expansion Project Area 

J une 2017

For
Golder Associates on behalf of Suez Environment

By
Archae-aus Pty Ltd

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## DISCLAIMER

The authors are not accountable for omissions and inconsistencies that may result from information which may come to light in the future but was not forthcoming at the time of this research.

## ACKNOMEDGEMENT

We wish to pay our respects to Elders past and present and extend those respects to all Aboriginal people, espec ially those who read this report.

## PERSONNE

Monica Jimenez-Loza no wrote this report with editorial assistance from Fiona Hook.

## EXECUIIVE SUMMARY

Archae-aus was contracted by Golder Associates to undertake an Aboriginal heritage desktop a ssessment within and surrounding the North Bannister Land fill Expa nsion footprint area.

The objectives of the desktop are:

- To undertake a search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (AHIS) for any known registered Aboriginal sites, Other Heritage places and heritage surveys undertaken within and surrounding the project area; and
- Obta in records of sites a nd survey reports from the DAA and other sources where possible;
- Summarise the heritage values of the area with an assessment of potential heritage within the North Ba nnister Landfill Expansion area.

The AHIS search revealed that there have been two previous ethnographic surveys conducted within the immediate footprint area, although no registered sites or Other Hentage places were identified. When the search was expanded to a 5 km radius from the North Bannister expansion area, a total of four ethnographic and one archaeological hentage surveys were conducted and one site was identified (Registered Site DAA 3582 / Serpentine River). When the search was expanded to a $15-20 \mathrm{~km}$ radius the numbers of sites and surveys increased significantly, suggesting that the low number of places within and immediately surrounding the Project Area is the direct result of a low number of investigations rather than a lack of heritage sites.

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## TERMS AND ABBREVIATIONS

|  |  |
| :---: | :---: |
| Aboriginal archaeological place or assemblage | A place (or group of physical sites) in which evidence of past activity by Aboriginal people is preserved (either prehistoric or historic or contemporary), and which has been, or may be, investigated using the discipline of archaeology and represents a part of the archaeological record. |
| Aboriginal Site | This term is used only for archaeological sites to which the AHA applies by the operation of Section 5. |
| ACMC | The Aboriginal Cultural Material Committee |
| AHA | Abbreviation for Aboriginal Heritage Act 1972 |
| AHIS | Aboriginal Heritage Inquiry System - a Department of Aboriginal Affairs database of Registered sites, Other Heritage Places and heritage surveys |
| Archaeological site | Is a place (or group of physical sites) in which evidence of human past activity is preserved (either prehistoric or historic or contemporary), and which has been, or may be, investigated using the discipline of archaeology and represents a part of the archaeological record. This term is used to refer to a place regardless of whether it has been assessed under section 5 of the $A-A$. |
| Artefact | Any object (article, building, container, device, dwelling, ornament, pottery, tool, weapon, work of art etc.) made, affected, used, or modified in some way by humans. |
| Assessment | Professional opinion based on information that was forthcoming at the time of consideration |
| Cultural material I archaeological material | Any object (article, building, container, device, dwelling, ornament, pottery, tool, weapon, work of art etc.) made, affected, used, or modified in some way by humans. |
| DAA | Department of Aboriginal Affairs |
| Heritage survey | Survey and inspection undertaken in order to investigate and document the archaeological record of a particular area |
| HPA | Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (the HPA). |
| Native Title | Recognition of the traditional rights and interests to land and waters of Aboriginal and Torres Strait Islander people |
| NTA | Native Title Act 1993 |
| Object | An artefact - any object made, affected, used, or modified in some way by humans. |
| Section 16 | In the Aboriginal Heritage Act 1972, that allows for the archaeological investigation/research of an Aboriginal site. |
| Section 16 Permit | A document from the DAA detailing the conditions attached to the permission granted by the registrar of Aboriginal sites to conduct further investigations at a site. |
| Section 17 Disturbance | When an Aboriginal site has been damaged by ground disturbance works without Section 18 permission. |
| Section 18 | The section of the Aboriginal Heritage Act 1972 that details the process for permission to disturb the land on which a site is located. |
| Section 18 Approval | A letter from the Minister of Aboriginal Affairs providing approval for the disturbance of land on which a site is located. |
| Section 39(2) Assessment | Process of the ACMC assessing a reported site's significance and interest. |
| Scope | The nature of the work undertaken as requested by the client or proponent. |
| SWALSC | South West Aboriginal Land and Sea Council - a Native Tittle Service Provide to the Noongar people, who are the traditional owners of the southwest of Australia. |

## SECTION ONE - INTRODUCTION

## OBJ ECTIVES

Archae-aus was contracted by Golder Associates to undertake an Aboriginal heritage desktop a ssessment within and surrounding the North Bannister Landfill Expansion footprint area (Project Area).

The objec tives of the desktop study are:

- undertake a search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (AHIS) for any known registered Aboriginal sites, Other Heritage places and heritage surveys undertaken within and surrounding the project area; and
- Obta in records of sites a nd survey reports from the DAA and other sources where possible;
- Summarise the heritage values of the area with an assessment of potential heritage within the North Ba nnister Landfill Expansion area.


## THE PROJ ECTAREA

North Bannister is approximately 94 km south-southeast of Perth, near and within the Youraling State Forest. It is a small location within the Wheatbelt and is situated within the Darling Scarp within the Shire of Boddington. The North Bannister Landfill expansion footprint area covers approximately 66 ha (see Map 1). The project area is 6 km from the North Bannister roadhouse and the township of Boddington is 9 km away. A small section of the Bibbulmun Track is approximately 500 m away from the northem boundary of the project area.

Map 1. North Bannister Landfill Development Area - existing Landform and expanded footprint area


## LEGISLATION

## REFVANTLEGISLATION

Westem Australia's Aboriginal Heritage Act 1972 (the AHA) is the main legislative framework for Aboriginal heritage in the State. Important and significant Aboriginal sites and objects are protected under it. The AHA protects sites and objects that are significant to living Aboriginal people as well as Aboriginal sites of historical, anthropological, archaeological and ethnographic signific ance. The AHA is currently administered by the Department of Aboriginal Affairs (DAA). The primary sections of the AHA that need to be considered are section 5 which defines the term 'Aboriginal Site' [1], and section 39 (2) which details what the Aboriginal Cultural Materials Committee (ACMC) should have in regards to considering the importance of objects and places. Section 17 of the AHA statesthat it is an offence to: alter an Aboriginal site in any way, including collecting artefacts; conceal a site or artefact; or excavate, destroy or damage in any way an Aboriginal site or artefact; without the a uthorisation of the Registrar of Aboriginal Sites under section 16 or the Minister of Aboriginal Affairs under section 18 of the AHA.

Aboriginal heritage sites are also protected under the Commonwealth Aboriginal and Torres Strait Islander Henta ge Protection Act 1984 (the HPA). The HPA complements state/teritory legislation and is intended to be used only as a 'last resort' where state/tenitory laws and processes prove ineffective. Under the HPA the responsible Minister can make temporary or long-term declarations to protect areas and objects of significance under threat of injury or desecration. The HPA also encourages heritage protection through mediated negotiation and agreement between land users, developers and Aboriginal people.

Aboriginal human remains are protected under the AHA and the HPA. In addition the discovery of human remains requires that the following people are informed: the State Coroner or local Police under section 17 of the Coroners Act 1996; the State Registrar of Aboriginal Sites under section 15 of the AHA; and the Federal Ministerfor Aboriginal Affa irs under Section 20 of the HPA.
In terms of broader recognition of Aboriginal rights, the Native Title Act (NTA) recognises the traditional rights and interests to land and waters of Aboriginal and Torres Strait Islander people. Under the Native Title Act (NTA), native title claimants can make an application to the Federal Court to have their native title recognised by Australian law. The NTA was extensively a mended in 1998, with further a mendments occuring in 2007 and again in 2009. Under the future act provisions of the Native Title Act (Cth), native title holders and registered native title claimants are entitled to certain procedural rights, including a right to be notified of the proposed future act, or a right to object to the act, the opportunity to comment, the right to be consulted, the right to negotiate or the same rights as an ordinary title holder (freeholder).

## DAA Register Status

The Aboriginal Heritage Inquiry System (AHIS), managed by the DAA, is the tool through which the public can access information about heritage places and their legal status. There are two broad categories in the in which the AHIS categorises heritage places: Aboriginal sites (registered sites) or
Other Heritage Places. A registered Aboriginal site is a place that fulfils the following definitions for protection under section 5 of the AHA:
a) Any place of importance and significance where persons of Aboriginal descent have, or appearto have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present
b) Any sacred, ritual or ceremonial site which is of importance and special significance to persons of Aboriginal descent

[^1]c) Any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State
d) Any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.
The Other Heritage Place category has three status sub-categories:

- Lodged - lodges information about a potential Aboriginal site that has not yet been assessed by the ACMC.
- Stored Data / Not a Site - a place that has been assessed by the ACMC but who have decided that the place does not fulfil the above definitions for an Aboriginal Site; or
- Stored Data - the stored information on a place that has been destroyed or salvaged (a subcategory no longer ascribed).
Other Heritage Places are afforded no protection under AHA; however, a place with the Lodged subcategory may potentially be assessed as being an Aboriginal Site in the future by the ACMC and maybe protected under the AHA. As such, the Other Heritage Place category is not a reliable indicatorfor the legal status of a heritage place.

In the last few years, the register status for some places has changed from one of these categories to another. It is apparent that there has been a shift in the benchmarks used by the ACMC in the assessment of places as Aboriginal Sites under section 5 of the Aboriginal Heritage Act (AHA). These changes have been most notic eable since 2012, particularly in the outcomes of section 18 a pplications, despite no change in the AHA itself. For example, changes have been made to the register whereby some Aboriginal sites have been re-classified as Other Heritage Places, meaning that they are no longer considered to be Aboriginal Sites which are protected under the AHA. This process has been criticised for its lack of transparency and for the limited consultation with Aboriginal people and heritage professionals. Further these changes are now being challenged by Aboriginal groups in the Supreme Court. One decision by the court in April 2015 determined that the ACMC criteria used for assessing places under 5b was incorect¹. The ACMC was instructed to reassess those places assessed by the ACMC under 5b since 2012. This a ssessment has still not occurred. Other challenges under 5a a ssessments are in tra in through the Supreme Court.

## 1

https://www.dlapiper.com/-/media/Files/Insights/Publications/2015/04/Supreme_court_clarifies_meaning_of_sacred _site in WA.pdf

## SECTION 2 - DESKTOP RESEARCH

## PREVIOUS CULTURAL HERTAGE MANAG EMENTSTUDIES

A systematic search of the AHIS was undertaken in order to identify Registered Sites and Other Heritage Places, as well as obtain a list of reports associated with archaeologic al and ethnographic work camied out immediately within the North Bannister footprint, within a 5 km radius and within a $15-20 \mathrm{~km}$ radius of the project area. The site files and survey reports were reviewed and the results are detailed below and in Appendix One.

## Aboriginal Heritage Surveys

The AHIS search revealed that there have been two previous ethnographic surveys conducted within the immediate footprint area, although no registered sites or Other Heritage places were identified (Map 2). When the search was expanded to a 5 km radius from the North Bannister expansion area, a total of four ethnographic and one archaeological heritage surveys were conducted and one site was identified (Registered Site DAA 3582 / Serpentine River). This site is described as a ceremonial and mythologic al site of signific ance and importance.

When the search was expanded to a $15-20 \mathrm{~km}$ radius the numbers of sites and surveys increased signific antly, suggesting that the low number of places within the Project Area is the direct result of a low number of investigations rather than a lack of heritage sites.

## Archaeological Survey Reports

Within a $15-20 \mathrm{~km}$ radius of the project area there are a total of 75 surveys areas assessed for archaeological sites and material. The results of these surveys have been detailed within 26 reports, which have been listed within Table 1 below.

Table 1. Archaeologic al and combined archaeological / ethnographic heritage survey reports from within a $\mathbf{1 5 - 2 0} \mathbf{~ k m}$ radius of the North Bannister Landfill expansion area

| Survey <br> Report \# | Author | Title |
| :---: | :---: | :---: |
| 19354 | Bruce Veitch | The report of an Aboriginal Heritage Survey of twelve proposed drilling traverses, near Boddington, Western Australia |
| 20976 | Archae-Aus Pty Ltd | Addendum report to : Hook, F (2001) The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : (McCoy Crusher location 2 and McCoy Conveyor Lake B |
| 22070 | Archae-Aus Pty Ltd | The report of an Aboriginal archaeological assessment of the McCoy and Orion mining regions, Huntly and Willowdale MInes, near Dwellingup, South - Western Australia |
| 22128 | Department of Conservation and Land Management | Assessment report on possible Indigenous Heritage site located in Bannister Forest Block |
| 22588 | Artefaxion Pty Ltd | Aboriginal Heritage study for Shotts Terminal to Wells Terminal 330kV transmission line upgrade north of Collie |
| 23641 | Archae-Aus Pty Ltd | The Report of an Aboriginal Archaeological Assessment of the Myara Region, near McCoy Mine, Karnet, South-Western Australia : 24 Predictive Model Sample Areas 10 Proposed Creek Crossings |
| 23797 | Yates Heritage Consultants | An Archaeological and Ethnographic Survey of the Tullis Bridge Weir Cable Trench and Three Drill Site Locations on Boggy Brook Road, Boddington |
| 24138 | Yates Heritage Consultants | Preliminary Report on an Aboriginal Site Survey of the Proposed Residue Disposal Area Option 1 Saddle Back Farms North Bannister |
| 27033 | John Cecchi Heritage Management Consultancy | Report On An Archaeological Survey Of MRWA Pinjarra Williams Road (SLK 0-67) and Bannister Marradong Road (SLK 0-22) Upgrade Works |
| 27036 | John Cecchi Heritage Management Consultancy | Ethnographic Survey Of Pinjarra- Williams And Bannister-Marradong Roads |
| 28491 | Archae-aus Pty Ltd | The First Addendum To; Hammond and Doering (2010) the Report of an Aboriginal Archaeological Assessment of the O'Neil Region, Near McCoy Mine Karnet, South-Western Australia: Proposed |


| Survey <br> Report \# | Author | Title |
| :---: | :---: | :---: |
|  |  | Sugargum Creek Crossing |
| 28497 | Amanda Yates | Reassessment of DIA 21470 Birdiya Hill / Mount Wells |
| 28563 | Archae-Aus Pty Ltd | The First Addendum To: Hammond and Doering (2010) The Report of an Aboriginal Archaeological Assessment of the O'Neill Region,Near McCoy Mine, Karnet,South Western Australia |
| 103251 | Quartermaine Consultants | Report on an Archaeological Survey for Aboriginal Sites Boddington Gold mine - Survey Extension. |
| 103570 | Steve Brown | Final Report to the Australian Heritage Commission, April 1979 to September 1980. |
| 103917 | Tamora Pty Ltd | Archaeological Survey for Aboriginal Sites along the Albany Highway H1 35.4 SIk to 92.39 SIk. November 1991. |
| 104068 | R. H. Pearce | Survey for Aboriginal Sites (Water Supply Dam Impoundment Area). |
| 104069 | R. H. Pearce | Worsley Alumina Joint Venturers Bauxite/Gold Operation - Survey for Aboriginal Sites. |
| 104081 | A. H. Pearce | Survey for Aboriginal / Archaeological Sites for Alcoa of Australia Ltd. Sep 1987. |
| 104082 | C. Peck | Monitoring and Conservation Work on Sites in the South-West. |
| 104095 | R. H. Pearce | Worsley Alumina Project: Survey for Aboriginal Sites. |
| 105486 | Tamora Pty Ltd | Report on an Aboriginal Survey at Boddington Gold Mine |
| 104095 | Archae-Aus Pty Ltd | Worsley Alumina Project: Survey for Aboriginal Sites |
| 105486 | Archae-Aus Pty Ltd | Report on an Aboriginal Survey at Boddington Gold Mine |
| 106528 | Archae-Aus Pty Ltd | The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia: Crusher and workshop area spur conveyor Wuka Haul Road extension conveyor alignment |
| 106544 | Archae-Aus Pty Ltd | A first addendum report to : Hook, F and De Gand, D. 2000. The report of an Aboriginal Heritage assessment of the Scott Region Project area, Huntly Mine, Dwellingup, South Western Australia Wuka Road 1 Scott North Mining Area and Chipala Haul Road |

These surveys took place over a number of years and the consultants were primarily engaged to conduct assessments for drilling, mining and exploration, transmission line upgrades, cable trenching and water supply dam impoundment area projects within North Bannister, Boddington, Dwellingup, Waroona, Bannister Forest, Myara, Kamet and Sugargum Creek.

## Ethnographic Heritage Survey Reports

Within a $15-20 \mathrm{~km}$ radius of the project area there are a total of nine ethnographic surveys have been undertaken and are listed in the Table 2 below.

Table 2. Ethnographic heritage survey reports from within a $\mathbf{1 5 - 2 0} \mathbf{~ k m}$ radius of the North Bannister Landfill expansion area

| Survey <br> Report \# | Author | Title |
| :--- | :--- | :--- |
| 20247 | Department of Indigenous <br> Affairs | Report on Boddington field investigations :October - December 2002 |
| 20842 | A. Yates | Ethnographic survey of Mount Wells and surrounding area, near Boddington : open access |
| 20853 | A. Yates | Ethnographic survey of Mount Wells and surrounding area, near Boddington : restricted access |
| 21425 | Tamora Pty Ltd | Boddington Gold MIne Section 18 Application Aboriginal Heritage Act 1972-1980 |
| 21817 | Tamora Pty Ltd | Ballaruk (traditional owners) Aboriginal site recording project |
| 21818 | Tamora Pty Ltd | Ballaruk (traditional owners of Whadjuk territorial boundaries the lands of the Ballaruk Peoples) <br> Aboriginal site recording project : additional material |
| 27178 | Pthnosciences | Report of an Ethnographic Survey of Two Proposed Water-Monitoring Sites on the Serpentine River <br> and one on the Dandalup River near Alcoa's Huntly Mine near Dwellingup, Western Australia |
| 28489 |  | Ethnographic Survey of the Myara and O'Neil Mining Regions: Focussing on Aboriginal Site DIA 3582 |


| Survey <br> Report \# | Author | Title |
| :--- | :--- | :--- |
|  |  | (Serpentine River) |
| 28490 | Peter Randolph | Addendum : Ethnographic Survey of the Myara and O'Neil Mining Regions: Focussing on Aboriginal <br> Site DIA 3582 (Serpentine River) |
| 102073 | Edith Cowan University | Western Australia Regional Forest Agreement Aboriginal Consultation Project. Vol.2. Nov.1997. |
| 102074 | Edith Cowan University | Western Australia Regional Forest Agreement Aboriginal Consultation Project. Vol.1. Nov.1997. |
| 106534 | Daniel de Gand, Consultant <br> Anthropologist | Ethnographic report on an Aboriginal Community Consultation Project conducted in Pinjarra, Western <br> Australia |

Anthropologists were engaged to conduct these consultations and surveys for development, mining and water monitoring sites within Boddington, Mount Wells, Serpentine River, Dwellingup, Myara and Pinja rra.

## Aboriginal Heritage Sites

Within a 5 km radius of the project area, only one heritage place is listed (ethnographic site DAA 3582 / Serpentine River), which is approximately 2.4 km north of the North Bannister project area.
Expanding the search to a $15-20 \mathrm{~km}$ radius from the project area, there are 14 registered Aboriginal sites and 77 Other Heritage Places; these include both archaeological and ethnographic places. The features of these sites are summarised in the tables below and discussed in the preceding section.

Table 3. Types of Heritage Place types/features within a $\mathbf{1 5 - 2 0} \mathbf{~ k m}$ radius of the North Bannister Landfill expansion area

| Heritage Place Type / Feature | \# | Proportion of total features (\%) | Proportion of places with this feature (\%) | Heritage Place <br> Type / Feature | \# | Proportion of all features (\%) | Proportion of places with this feature (\%) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Artefact scatter | 70 | 58.3 | 76.9 | Ceremonial | 2 | 1.6 | 2.1 |
| Man-made structure | 8 | 6.6 | 8.8 | Hunting place | 2 | 1.6 | 2.1 |
| Mythological | 8 | 6.6 | 8.8 | Engraving | 1 | 0.8 | 1 |
| Water source | 5 | 4.1 | 5.4 | Plant source | 1 | 0.8 | 1 |
| Modified tree | 4 | 3.3 | 4.3 | Named place | 1 | 0.8 | 1 |
| Grinding patches/grooves | 3 | 2.5 | 3.2 | Ochre source | 1 | 0.8 | 1 |
| Skeletal/burial | 3 | 2.5 | 3.2 | Meeting place | 1 | 0.8 | 1 |
| Camp | 3 | 2.5 | 3.2 | Historical | 1 | 0.8 | 1 |
| Quarry | 2 | 1.6 | 2.1 | Food source | 1 | 0.8 | 1 |
| Lizard trap | 2 | 1.6 | 2.1 | Natural feature | 1 | 0.8 | 1 |

Table 4. Registered Aboriginal sites within a $\mathbf{1 5 - 2 0} \mathbf{~ k m}$ radius of the North Bannister Landfill expansion area

| DAA ID | Heritage Place Name | Heritage Place Type | DAA Status |
| :--- | :--- | :--- | :--- |
| 3267 | KITTY'S GRAVE, BANNISTER | Skeletal Material / Burial | Registered Site |
| 3268 | AVON DOWNS 1. | Man-Made Structure, Other: PA 09, <br> LIZARD TRAP | Registered Site |
| 3269 | BANNISTER GNAMMA HOLE. | Ceremonial, Water Source | Registered Site |
| 3270 | POLLARD'S POSSUM TREE | Modified Tree | Registered Site |


| DAA ID | Heritage Place Name | Heritage Place Type | DAA Status |
| :--- | :--- | :--- | :--- |
| 3485 | AVON DOWNS 2. | Man-Made Structure, Modified Tree, Other: <br> LIZARD TRAP | Registered Site |
| 3498 | METRO ROAD | Artefacts / Scatter, Engraving, Grinding <br> Patches / Grooves | Registered Site |
| 3536 | SWAN RIVER | Mythological | Registered Site |
| 3537 | CARRAY RIVER | Mythological | Registered Site |
| 3538 | SERPENTINE RIVER | Source | Ceremonial, Mythological |

Table 5. Other Heritage Places within a $\mathbf{1 5 - 2 0} \mathbf{~ k m}$ radius of the North Bannister Landfill expansion area

| DAA ID | Heritage Place Name | Heritage Place Type | DAA Status |
| :---: | :---: | :---: | :---: |
| 3524 | CONNELLY CREEK | Artefacts / Scatter | Lodged |
| 3563 | JARRAHDALE | Artefacts / Scatter, Quarry | Lodged |
| 3843 | 34 MILE BROOK 1 | Artefacts / Scatter | Stored Data / Not a Site |
| 3844 | 34 MILE BROOK 2 | Artefacts / Scatter | Stored Data / Not a Site |
| 3877 | HEDGES | Artefacts / Scatter | Stored Data / Not a Site |
| 4231 | BODDINGTON FOREST 37 | Artefacts / Scatter | Stored Data / Not a Site |
| 4232 | BODDINGTON FOREST 38 | Artefacts / Scatter | Stored Data / Not a Site |
| 4233 | BODDINGTON FOREST 39 | Artefacts / Scatter | Stored Data / Not a Site |
| 4234 | BODDINGTON FOREST 40 | Artefacts / Scatter | Stored Data / Not a Site |
| 4235 | BODDINGTON FOREST 41 | Artefacts / Scatter | Stored Data / Not a Site |
| 4236 | BODDINGTON FOREST 42 | Artefacts / Scatter | Stored Data / Not a Site |
| 4238 | BODDINGTON FOREST 44 | Artefacts / Scatter | Lodged |
| 4239 | BODDINGTON FOREST 45 | Grinding Patches / Grooves | Stored Data / Not a Site |
| 4240 | BODDINGTON FOREST 46 | Artefacts / Scatter | Lodged |
| 4261 | BODDINGTON FOREST 15 | Artefacts / Scatter | Stored Data / Not a Site |
| 4264 | BODDINGTON FOREST 18 | Artefacts / Scatter | Stored Data / Not a Site |
| 4265 | BODDINGTON FOREST 19 | Artefacts / Scatter | Stored Data / Not a Site |
| 4271 | BODDINGTON FOREST 25 | Artefacts / Scatter | Stored Data/ Not a Site |
| 4272 | BODDINGTON FOREST 26 | Artefacts / Scatter | Stored Data / Not a Site |
| 4273 | BODDINGTON FOREST 27 | Artefacts / Scatter | Stored Data / Not a Site |
| 4274 | BODDINGTON FOREST 28 | Artefacts / Scatter | Stored Data / Not a Site |
| 4275 | BODDINGTON FOREST 29 | Artefacts / Scatter | Stored Data / Not a Site |
| 4276 | BODDINGTON FOREST 30 | Artefacts / Scatter | Stored Data / Not a Site |
| 4277 | BODDINGTON FOREST 31 | Artefacts / Scatter | Lodged |
| 4278 | BODDINGTON FOREST 32 | Artefacts / Scatter | Lodged |
| 4279 | BODDINGTON FOREST 33 | Artefacts / Scatter | Lodged |


| DAA ID | Heritage Place Name | Heritage Place Type | DAA Status |
| :---: | :---: | :---: | :---: |
| 4280 | BODDINGTON FOREST 34 | Artefacts / Scatter | Stored Data / Not a Site |
| 4281 | BODDINGTON FOREST 35 | Artefacts / Scatter | Stored Data / Not a Site |
| 4305 | BODDINGTON FOREST 06 | Artefacts / Scatter | Stored Data / Not a Site |
| 17210 | Thirty Four Mile Brook 4 | Artefacts / Scatter | Stored Data / Not a Site |
| 17211 | Thirty Four Mile Brook 3 | Artefacts / Scatter | Stored Data / Not a Site |
| 18447 | Thirty four mile brook, north bank | Artefacts / Scatter | Stored Data / Not a Site |
| 18448 | Thirty four mile brook artefact scatter 1 | Artefacts / Scatter | Stored Data / Not a Site |
| 18449 | Thirty four mile brook artefact scatter 2 | Artefacts / Scatter | Stored Data / Not a Site |
| 19263 | Jarrahdale Camping Ground 1 | Artefacts / Scatter, Camp, Meeting Place, Water Source | Lodged |
| 19264 | Jarrahdale camping ground 2 | Artefacts / Scatter | Lodged |
| 19807 | S01/07 | Artefacts / Scatter | Lodged |
| 19825 | S01/03 Artefact Scatter | Artefacts / Scatter | Lodged |
| 19826 | S01/04 Artefact Scatter | Artefacts / Scatter | Lodged |
| 21470 | Birdiya Hill (Mt Wells) | Mythological, Camp, Hunting Place | Lodged |
| 21471 | Dukatj (34 Mile) Creek | Mythological, Camp, Water Source, Other: food source | Stored Data / Not a Site |
| 22992 | Dwellingup Artefact Scatter (S03-01) | Artefacts / Scatter | Lodged |
| 22993 | Dwellingup Artefact Scatter (S03-02) | Artefacts / Scatter | Lodged |
| 22994 | Dwellingup Scarred Tree (S03-03) | Modified Tree, Skeletal Material / Burial | Lodged |
| 22995 | Dwellingup Scarred Tree (S03-04 ) | Modified Tree, Skeletal Material / Burial | Lodged |
| 22996 | Dwellingup Artefact Scatter (S03-05) | Artefacts / Scatter | Lodged |
| 23000 | Dwellingup Artefact Scatter (S04-01) | Artefacts / Scatter | Lodged |
| 23001 | Dwellingup Artefact Scatter (S04-02) | Artefacts / Scatter | Lodged |
| 23005 | Dwellingup Artefact Scatter (S04-06) | Artefacts / Scatter | Lodged |
| 23006 | Dwellingup Artefact Scatter (S04-07) | Artefacts / Scatter | Lodged |
| 23007 | Dwellingup Artefact Scatter (S04-08) | Artefacts / Scatter | Lodged |
| 23008 | Dwellingup Artefact Scatter (S04-09) | Artefacts / Scatter | Lodged |
| 23009 | Dwellingup Artefact Scatter (S04-10) | Artefacts / Scatter | Lodged |
| 23010 | Dwellingup Artefact Scatter (S04-11) | Artefacts / Scatter | Lodged |
| 23011 | Dwellingup Artefact Scatter (S04-12) | Artefacts / Scatter | Lodged |
| 23012 | Dwellingup Artefact Scatter (S04-13) | Artefacts / Scatter | Lodged |
| 23013 | Dwellingup Artefact Scatter (S04-14) | Artefacts / Scatter | Lodged |
| 23014 | Dwellingup Artefact Scatter (S04-15) | Artefacts / Scatter | Lodged |
| 23015 | Dwellingup Artefact Scatter (S04-16) | Artefacts / Scatter | Lodged |
| 23016 | Dwellingup Artefact Scatter (S04-17) | Artefacts / Scatter | Lodged |
| 23017 | Dwellingup Artefact Scatter (S04-18) | Artefacts / Scatter | Lodged |
| 23020 | Dwellingup Artefact Scatter (S04-21) | Artefacts / Scatter | Lodged |
| 23028 | Bannister Lizard Traps 1 | Man-Made Structure | Lodged |
| 23029 | Bannister Lizard Traps 2 | Man-Made Structure | Lodged |
| 23030 | Bannister Lizard Traps 3 | Man-Made Structure | Lodged |
| 23031 | Bannister Lizard Traps 4 | Man-Made Structure | Lodged |


| DAA ID | Heritage Place Name | Heritage Place Type | DAA Status |
| :--- | :--- | :--- | :--- |
| 23032 | Bannister Lizard Traps 5 | Man-Made Structure | Lodged |
| 27937 | Dandalup River | Mythological, Hunting Place, Natural <br> Feature, Plant Resource, Water Source | Stored Data / Not a Site |
| 28355 | MY08-27 | Artefacts / Scatter | Lodged |
| 28356 | MY08-28 | Artefacts / Scatter | Lodged |
| 28357 | MY08-29 | Artefacts / Scatter, Historical | Lodged |
| 28365 | MY08-37 | Artefacts / Scatter | Lodged |
| 28366 | MY08-38 | Grooves | Lrtefacts / Scatter |
| 28367 | MY08-39 | Artefacts / Scatter, Man- Made Structure | Lodged |
| 28368 | MY08-40 | Artefacts / Scatter | Lodged |
| 28369 | MY08-41 | Artefacts / Scatter | Lodged |
| 29544 | SP10-01 |  | Lodged |

As shown in Table 3, the majority of places recorded in the study area contain artefact scatters. The remaining features, however, are relatively unusual or rare in the area. Below is a general discussion about a number of featuresfound surrounding the North Bannister project area.

## Artefact scatters

Artefact scatters are a common feature that tends to dominate the archaeologic al record of surface assemblages. The majority of organic materials that would have been present at these sites have long since decomposed, leaving behind an incomplete assemblage. What we see today are primarily the stone objects that were left behind once people moved on from an area. They can be the result of one or multiple occupations and are the surviving tangible link to a more complex knowledge system and a broadermaterial culture.

The assemblages within the study area are primarily manufactured from quartz and crystal quartz with some dolerite. Quartz was the most common material found in assemblages and by inference, is generally associated with the late Holocene if found in sites that do not have fossiliferous chert and silcrete. Quartz became the main raw material for stone tool manufacture as result of other materials being depleted over time and because the preferred fossiliferous chert deposits became submerged (Hallam 1983). The assemblage typically consist of flakes, some retouched, flake fragments, cores, grinding material and manuports; however there are also some formal tools recorded such as backed artefacts, bi-polar pieces and blades.

The stone tools would have been used for a variety of subsistence activities such as for hunting, skinning, cutting, stone tool manufacture, food preparation and woodworking. Specifically, grindstones would have been utilised for a variety of activities such as the preparation of plant and animal material or used forgrinding up ochre to create pigment.

Once they had finished their activities the groups moved on, leaving behind the objects that were no longernecessary; however the organic materials have long since decayed.

Plate 1. Artefacts from site DAA 23006 (Rapley et al. 2006)


Plate 2. View of dolenite and quartz artefacts from site DAA 23001 (Rapley etal. 2006)


## Grinding areas

Places with grinding areas and grooves are thought of as a type of persistent places-permanent areas that were known to the people travelling through the land as a food preparation area. Grinding material, especially a fixed grinding platform, is considered site fumiture and the patches are fixture in the landscape that would have been part of cultural memory and knowledge. Grinding patches are the direct result of women repeatedly using the same area to process seeds and plant material for food. Known water sources would have been located nearby, to allow for wet milling (the practise of seed and plant grinding using water). Grinding technology is typically associated with increased dietary exploitation of seeds and grains during the Holocene (Fullagaret al. 2016).

## Man Made Structures

There are numerous human made structures within the study area, such as stone arrangements, standing stones and lizard traps. Although the exact purpose of each stone arrangement or structure is not known, they may be connected to ceremonial areas, produced as symbols and artistic expression as well as being markers or centres for mythological and initiation knowledge transmission (Mitchell n.d.).

The most signific ant and elaborate of these human made structure sites is Avon Downs 1 (DAA 3268), which encompasses a complex of stone alignments a nd numerous structures including some circular, some linear, some slabs (described as "lizard traps"), slab walls, raised "shelter" structures, some individual upright slabs (embedded), and a "u" shaped circular arrangement (see Plate 3, Plate 4) (Randolph 2011). This site is a Protected Area under the AHA owing to its signific ance to the heritage of the State.

Plate 3. Avon Downs 1 - View of a stone anrangement (Randolph 2011)


Plate 4. Avon Downs 1 - Slab structure ("lizard trap") (Randolph 2011)


In Peter Randolph's' (2011) paper on Aboriginal stone arrangements in the south of Westem Australia, he discusses those structures labelled as "lizard traps". These are three sided and walled structures covered by a slab (see Plate 4). Although they have been categorised with this title, there is no evidence that they were actually used to trap lizards. Numerous "lizard traps" have been recorded in the Bannister Forest Block. For example, sites Bannister Lizard Traps 1 to 5 are all located on granite outcrops and are actually comprised of the walled "lizard traps", fireplaces and va rious stone and slab a rangements.

## Modified trees

Scarred trees are physical evidence of deliberate modification. The reasons for these scars vary from wood and bark removal to make objects such as dishes and shields, for watercraft construction or for honey orgum/sap extraction, for example. There are also cultural reasons for tree modific ation, such as is likely the case with sites S03-03 and S03-04 in the study area. Noongar representatives present at the time of recording states that at time, trees were marked during the disposal of the dead (Rapley et al. 2006). It was traditional practise to inter the deceased with:
"...their head to the west and feet to the east so that they faced the rising sun...the head of the deceased wasplacesnearthe tree and a scar was made in the base of the tree facing east".

Plate 5. S03-04, view west of scarred tree (Rapley et al. 2006)


## Ethnographic Sites

Numerous ethnographic sites have been recorded in the study area, including mythological, ceremonial, water source and named place sites. The amount of material available for these places is limited, due to the sensitive nature of the information. However we do know that these places hold a great deal of cultural significance to Traditional Owners, as these areas were gathering places where they and their ancestors practiced their c ulture.


Map 2. DAA Registered sites and

 Area


## DISCUSSON

The sites and artefacts that remain visible on the surface of the study area provide small hints, or markers, reminding us of the joumeys and lives of the Noongars ancestors who lived in and travelled through this area. They knew at what time of the year the soaks or creeks were full of water, just as they knew when certain plant and seed species grew and what resources the animals were following. While making their way from place to place, food, tool and stone resources were selected, shelters were built or used and family groups camped to prepare the items they needed for the next stretch of their joumey. What we see in the archaeological record today is only a small indication of what life was like, showing us some behaviours that took place when people camped or stopped. Theoretic al lines can be drawn from site to site. Artefact to artefact, showing us a pathway and connection between these campsites, stopping grounds and resource centres. Just as there are song lines in Aboriginal culture, we can consider the joumey between the material that remains as the story of how these people travelled and lived in the landscape.

More permanent features, such as stone arrangements and other human made structures, scarred trees, grinding areas, water sources, engraving sites, burials a nd ceremonial and mythologic al sites add to the cultural map of the area. These are persistent places - a permanent area that was known to the people travelling through the land. These places would have been revisited and the cultural knowledge of these sites and features passed down through the generations.

All of these features are of interest to a rchaeologists and anthropologists, as it allows us to investigate how people have lived in the landscape through time and the connection between places, such as the ceremonial grounds and the subsistence camps. All of the places are connected via a multitude of joumeys that the Noongars ancestors undertook.

## Predictive Model

Over the years, Archae-aus has developed a nuanced understanding of heritage assessments in the South West Forests. In 1999 Archae-aus was approached by Alcoa World Alumina Australia to produce a model to aid future cultural heritage management work for their operations in the Jarrah Forests near Dwellingup. One of the limitations of archaeologic al survey work conducted in the Darling Scarp is very low ground surface visibility. By creating a predictive model for Aboriginal archaeological site location and producing a series of interactive GIS maps indicating high, medium and low archaeological sensitivity levels (see Figure 1), the project aids in planning development and in developing Aboriginal archaeologic al survey strategies.

Figure 1. Example map showing areas of very low to very high Aboriginal archaeological site probability


To create this deductive and inductive predictive model, Hook (2001) reviewed existing literature on Aboriginal settlement pattems in the Darling Scap and GIS modelling literature. Site location and composition statistics was also compiled from previously recorded site data stretching from Mundaring Weir to Collie (from the Department of Aboriginal Affairs Register of Aboriginal Sites). Using this data, Hook (2001) determined that Darling Scap Aboriginal settlement pattems were sea sonally determined and that the location of archaeological habitation sites could be predicted. The Darling Scap predictive model has been continuously updated and used since 2004, and shapes our heritage a ssessment sa mpling strategies and results interpretation for all heritage survey work for Alcoa.

This useful and timesaving cost limiting tool could be used to develop a strategy for future hentage assessments within the North Bannister development area. This planning tool would be used to focus efforts on conducting the heritage assessments in high and medium archaeological site probability zones. The model could also be used to pre-plan infrastructure avoiding as much as possible high and very high archaeological sensitive zones.

## Potential Heritage within the North Bannister Landfill Expansion Area

It is evident from the high number of Aboriginal heritage sites within a 5 to 20 km radius of the project a rea that the lack of heritage sites immediately and surrounding the North Bannister Landfill Expansion area is due to a little to no investigations occuming in that range. The diversity and range of archaeological and ethnographic sites and features surrounding the project area speak to the varied usage of the landscape, from camping grounds, quamies and grinding places to ceremonial, mythologic al and burial sites.

The desktop study area sits within a ceremonial landscape. From the extensive and significant Avon Downs 1 stone a rrangement site, the smaller stone markers and a rangements to the multiple identified ceremonial and mythological grounds, the archaeology and ethnographic histories clearly show that this place is one of high cultural importance.

According to McDonald and Veth (2014) stone a rangements replaced engravings as a major art form in the Pilbara and Westem Desert in the last 500 years which make stone arrangements a highly signific ant form of art and places of cultural knowledge transmission.

It is therefore recommended that full Aboriginal heritage investigations, both archaeological and ethnographic, occur within the North Bannister Landfill Expansion area prior to any ground disturbing works occuring. Areas of particular focus should be any granite or stony outcrops, as the desktop research indic ates that there is a possibility forstone a rrangements to have been constructed there.

The development and use of predictive modelling in determining heritage survey strategies and targeting is an asset that Archae-aus could bring to the project. This predictive modelling can be utilised in planning future heritage assessments in the project area if it goes ahead.

## RECOMMENDATIONS

The following recommendations are based on the results of the desktop research.

1) It is recommended that Suez Environmental undertakes the following prior to a ny ground disturbing workscommencing:
a) engages qualified archaeologists to conduct pedestrian surveys, across the project area in order to identify any Aboriginal archaeological sites;
b) engages qualified anthropologists to conduct a consultation and an assessment of the project area, in order to ascerta in if there are any ethnographic sites; and
c) consults with SWALSC and engages Noongar representatives that have been nominated by SWALSC to participate in all aspects of the a rchaeologic al and ethnographic assessments.

## REFERENCES CITED

Fullagar, R., Stephenson, B. \& Hayes, E., 2016. Grinding grounds: Function and distribution of grinding stones from an open site in the Pilbara, westem Australia. Quatemary Intemational, 427, pp.175183. Available at: http://dx.doi.org/10.1016/j.qua int.2015.11.141.

Hallam, S., 1983. The Perth Airport Extension, 1983: Preliminary Report on Prehistoric Aboriginal Sites,
McDonald, J. \& Veth, P., 2014. Art Graphics in Arid Landscapes: Pilbara and Westem Desert Petroglyphs. Australian Archaeology.

Mitchell, M., Stone a mangements as symbols: a theoretical and methodological approach in Esperance Nyungar country, Westem Austra lia. Australian Archaeology.
Randolph, P., 2011. Some Indigenous stone a rrangements in the south of Westem Australia. In C. Bird \& E. Webb, eds. "Fire and Hearth", Forty Years On: essays in Honour of Sylvia J Hallam. Perth: Records of the Westem Austalian Museum, pp. 50-60.
Rapley, S., Hammond, C. \& Veitch, B., 2006. The report of an Aboriginal archaeeological assessment of the McCoy and Orion mining regions, Huntly and Willowdale mines, near Dwelingup, southwestem Australia, Fremantle: Alcoa World Alumina Australia and Archae-aus.

## APPENDIX ONE: DAA REGISTER SEARCHES

## Aboriginal Heritage Inquiry System

77 Other Heritage Places in Custom search area (4); 421165.43mE, 6374768.29 mN z50 (MGA94) : 465199.71mE, 6415213.04 mN z50 (MGA94)
Disclaimer
The Aboriginal Heritage Act 1972 preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.
(s): Gnaala Kara Booja People ILUA
On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and,
respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah \#2 and Wagyl Kaip \& Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).
The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.
Likewise, from 8 June 2015 the Department of Mines and Petroleum (DMP) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.
If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMP, you should seek https://www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx.
Further advice can also be sought from the Department of Aboriginal Affairs (DAA) at heritageenquiries@daa.wa.gov.au.

## Aboriginal Heritage Inquiry System

## Copyright

Coordinate Accuracy
Copyright in the information contained herein is and shall remain the property of the State of Western Australia. All rights reserved.
Accuracy is shown as a code in brackets following the coordinates. Map coordinates (Latitude/Longitude and Easting/Northing) are based on the GDA 94 Datum. The Easting/Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '500000mE:Z50' means Easting=500000, Zone=50.
Terminology (NB that some terminology has varied over the life of the legislation)
Place IDISite ID: This a unique ID assigned by the Department of Aboriginal Affairs to the place
o Registered Site: The place has been assessed as meeting Section 5 of the Aboriginal Heritage Act 1972
o Other Heritage Place which includes:
Stored Data / Not a Site: The place has been assessed as not meeting Section 5 of the Aboriginal Heritage Act 1972
Lodged: Information has been received in relation to the place, but an assessment has not been completed at this stag

Status Reason: e.g. Exclusion - Relates to a portion of an Aboriginal site or heritage place as assessed by the Aboriginal Cultural Material Committee (ACMC). e.g. Origin Place ID: Used in conjuction with Status Reason to indicate which Registered Site this Place originates from.
Access and Restrictions: Access and Restrictions: the exact location of the place, please contact DAA.

- Restrictions:
- Male Access Only: Only males can view restricted information. Female Access Only: Only females can view restricted information
Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.
in any way.
File Restricted = Yes: Some of the information that the Department of Aboriginal Affairs holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Aboriginal Affairs receives written approval from the informants who provided the information. Download the Request to Access Restricted Information letter and form.
- Boundary Restricted = Yes: To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least $4 \mathrm{~km}^{2}$ ) provides a general indication of where the place is located. If you are a landowner and wish to find out more about
Status: $\qquad$
List of Other Heritage Places with Map


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*Registered





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410649 mN Zone
50 [Unreliable] $\qquad$ 438439 mE
635218 mN Zon
50 [Reliable]
437739 mE
6375878 mN Zone
50 [Reliable]
438679 mE
6377318 mN Zone
50 [Reliable]
439989 mE
Artefacts /
Scatter
Artefacts /
Scatter
Artefacts /
Scatter

| ID | Place Name | File Restricted | Boundary Restricted | Restrictions | Status | Status <br> Reason | Origin Place ID | Type | Knowledge Holders | Coordinates | $\left\lvert\, \begin{aligned} & \text { Legacy } \\ & \text { ID } \end{aligned}\right.$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4235 | BODDINGTON FOREST 41 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 440339 mE 6380448 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{SO105} \\ 0 \end{gathered}$ |
| 4236 | BODDINGTON FOREST 42 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter |  | 440389mE 6382298 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0105 \\ 1 \end{gathered}$ |
| 4238 | BODDINGTON FOREST 44 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 444939 \mathrm{mE} \\ 6383248 \mathrm{mN} \text { Zone } \end{gathered}$ $50 \text { [Reliable] }$ | $\underset{3}{\mathrm{~S} 0105}$ |
| 4239 | BODDINGTON FOREST 45 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Grinding Patches / Grooves | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 443639 \mathrm{mE} \\ 6383848 \mathrm{mN} \text { Zone } \end{gathered}$ $50 \text { [Reliable] }$ | $\begin{gathered} \mathrm{S}_{4} 0105 \\ \hline \end{gathered}$ |
| 4240 | BODDINGTON FOREST 46 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 443839 \mathrm{mE} \\ 6380398 \mathrm{mN} \text { Zone } \end{gathered}$ $50 \text { [Reliable] }$ | $\begin{gathered} \mathrm{S} 0105 \\ 5 \end{gathered}$ |
| 4261 | BODDINGTON FOREST 15 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 440739 mE 6374848 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0102 \\ \hline \end{gathered}$ |
| 4264 | BODDINGTON FOREST 18 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts Scatter | *Registered Knowledge Holder names available from DAA | 50 [Reliable] $\qquad$ | $\begin{gathered} \mathrm{SO} 02 \\ 7 \end{gathered}$ |
| 4265 | BODDINGTON FOREST 19 | No | No | No Gender Restrictions | Stored Data <br> / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 439239 mE 6375048 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0102 \\ 8 \end{gathered}$ |
| 4271 | BODDINGTON FOREST 25 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 441439 mE 6375848 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0103 \\ 4 \end{gathered}$ |


| ID | Place Name | File Restricted | Boundary Restricted | Restrictions | Status | Status <br> Reason | Origin Place ID | Type | Knowledge Holders | Coordinates | $\begin{aligned} & \text { Legacy } \\ & \text { ID } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4272 | BODDINGTON FOREST 26 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 440939 mE 6375948 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0103 \\ 5 \end{gathered}$ |
| 4273 | BODDINGTON FOREST 27 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 440339mE 6375948 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0103 \\ 6 \end{gathered}$ |
| 4274 | BODDINGTON FOREST 28 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 439739 mE 6375548 mN Zone 50 [Reliable] | $\underset{7}{\mathrm{~S} 0103}$ |
| 4275 | BODDINGTON FOREST 29 | No | No | No Gender Restrictions | Stored Data <br> / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 439939 mE 6375298 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{SO103} \\ 8 \end{gathered}$ |
| 4276 | BODDINGTON FOREST 30 | No | No | No Gender Restrictions | Stored Data <br> / Not a Site |  |  | Artefacts Scatter | *Registered Knowledge Holder names available from DAA | 439239mE 6375248 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0103 \\ 9 \end{gathered}$ |
| 4277 | BODDINGTON FOREST 31 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 444539mE 6375498 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{SO104} \\ 0 \end{gathered}$ |
| 4278 | BODDINGTON FOREST 32 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 445139 mE 6378148 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0104 \\ 1 \end{gathered}$ |
| 4279 | BODDINGTON FOREST 33 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 50 [Reliable] <br> 444839 mE 6378548 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0104 \\ 2 \end{gathered}$ |


| ID | Place Name | File Restricted | Boundary Restricted | Restrictions | Status | Status Reason | Origin Place ID | Type | Knowledge Holders | Coordinates | $\begin{array}{\|l} \text { Legacy } \\ \text { ID } \end{array}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4280 | BODDINGTON FOREST 34 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts Scatter | *Registered Knowledge Holder names available from DAA | 443789 mE 6376648 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0104 \\ 3 \end{gathered}$ |
| 4281 | BODDINGTON FOREST 35 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 50 [Reliable] | $\begin{gathered} \mathrm{S} 0104 \\ 4 \end{gathered}$ |
| 4305 | BODDINGTON FOREST 06 | No | No | No Gender Restrictions | Stored Data <br> / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 444989 mE 6374848 mN Zone 50 [Reliable] | $\begin{gathered} \mathrm{S} 0101 \\ 5 \end{gathered}$ |
| 17210 | Thirty Four Mile Brook 4 | No | No | No Gender Restrictions | Stored Data <br> / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 437389mE 6378048 mN Zone 50 [Reliable] |  |
| 17211 | Thirty Four Mile Brook 3 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 437339 mE 6376698 mN Zone 50 [Reliable] |  |
| 18447 | Thirty four mile brook, north bank | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 438842 mE 6375388 mN Zone 50 [Reliable] |  |
| 18448 | Thirty four mile brook artefact scatter 1 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts Scatter | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 437333 \mathrm{mE} \\ 6376724 \mathrm{mN} \text { Zone } \\ 50 \text { [Reliable] } \end{gathered}$ |  |
| 18449 | Thirty four mile brook artefact scatter 2 | No | No | No Gender Restrictions | Stored Data / Not a Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 437339 mE 6376698 mN Zone 50 [Reliable] 50 [Reliable] |  |


| ID | Place Name | File Restricted | Boundary Restricted | Restrictions | Status | Status Reason | Origin <br> Place ID | Type | Knowledge Holders | Coordinates | Legacy ID |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 19263 | Jarrahdale Camping Ground 1 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter, Camp, Meeting Place, Water Source | *Registered Knowledge Holder names available from DAA | 436140mE 6405632 mN Zone 50 [Reliable] |  |
| 19264 | Jarrahdale camping ground 2 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 437109 mE 6406257 mN Zone 50 [Reliable] |  |
| 19807 | S01/07 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 421784 mE 6400339 mN Zone 50 [Reliable] |  |
| 19825 | S01/03 Artefact Scatter | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 421489mE 6386283 mN Zone 50 [Reliable] |  |
| 19826 | S01/04 Artefact Scatter | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 421098 mE 6384892 mN Zone 50 [Reliable] |  |
| 21470 | Birdiya Hill (Mt Wells) | Yes | Yes | No Gender Restrictions | Lodged |  |  | Mythological, Camp, Hunting Place | *Registered Knowledge Holder names available from DAA | Not available when location is restricted |  |
| 21471 | Dukatj (34 Mile) Creek | Yes | Yes | No Gender Restrictions | Stored Data / Not a Site |  |  | Mythological, Camp, Water Source, Other: food source | *Registered Knowledge Holder names available from DAA | Not available when location is restricted |  |
| 22992 | Dwellingup Artefact Scatter (S03-01) | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | 426751mE 6394894 mN Zone 50 [Reliable] |  |

Aboriginal Sites Database
Legacy
ID

| ID | Place Name | File <br> Restricted | Boundary Restricted | Restrictions | Status | Status Reason | Origin Place ID | Type | Knowledge Holders | Coordinates | Legacy ID |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 29544 | SP10-01 | No | No | No Gender Restrictions | Lodged |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | ```435013mE 6400229mN Zone 5 0 ~ [ R e l i a b l e ] ~``` |  |




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| Authority trading as Landgate (2017). |
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| Title, Mining Tenement, Petroleum |
| Application, Petroleum Titte boundary |
| data copyright © the State of Western |
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| Terms of Use statement at |
| http://www.daa.wa.gov.au/Terms-Of- |
| Use/ |

## Aboriginal Heritage Inquiry System

## Government of Western Australia

Heritage Survey Database

## Search Criteria

Disclaimer
Heritage Surveys have been mapped using information from the reports and / or other relevant data sources. Heritage Surveys consisting of small discrete areas may
not be visible except at large scales. Reports shown may not be held at DAA. Please consult report holder for more information. Refer to www.daa.wa.gov.au/heritage for information on requesting reports held by DAA.
Your heritage enquiry is on land within or adjacent to the following Indigenous Land Use Agreement(s): Gnaala Karla Booja People ILUA
The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.
Likewise, from 8 June 2015 the Department of Mines and Petroleum (DMP) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.
If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMP, you should seek https://www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx.
Further advice can also be sought from the Department of Aboriginal Affairs (DAA) at heritageenquiries@daa.wa.gov.au.
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## Aboriginal Heritage Inquiry System

The following legend strictly applies to the spatial accuracy of heritage survey boundaries as captured by DAA.
Boundaries captured from surveyed titles, GPS (2001 onwards) submitted maps georeferenced to within 20m accuracy. Boundaries captured from GPS (pre 2001) submitted maps georeferenced to within 250m accuracy.
Boundaries captured from submitted maps georeferenced to an accuracy exceeding 250m.
Surveys submitted with insufficient information to allow boundary capture.

## Access <br> Very Good <br> Unreliable <br> Indeterminate

Some reports are restricted.
Spatial Accuracy
Copyright in the information contained herein is and shall remain the property of the State of Western Australia. All rights reserved. This includes, but is not limited to,
information from the
Copyright
Register of Aboriginal Sites established under and maintained under the Aboriginal Heritage Act 1972 (AHA).
Good / Moderate

## Aboriginal Heritage Inquiry System

Heritage Survey Database

| Survey Report ID | \|Report Title | Report Authors | Lead <br> Consultants | Area No. | Survey Type | Area Description | Spatial Accuracy | Field I Desktop |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 19354 | The report of an Aboriginal Heritage Survey of twelve proposed drilling traverses, near Boddington, Western Australia | Veitch, Bruce | Bruce Veitch | 1 | Archaeological \& Ethnographic | Twelve proposed drilling traverses approximately 16 km north-west of Boddington. Access roads to traverses were also surveyed, as shown in Fig 1. and Fig. 2. The traverses and the access roads between the main track and the traverses was surveyed. Each traverse was surveyed with a different boundary, and the lengths of the access tracks surveyed are as follows: A4 - both sections are linked by access track, width of survey area is 15 metres. A3 - width of survey area is 10 metres. A2 - wi... | Very Good | Field and Desktop |
| 20247 | Report on Boddington field investigations :October - December 2002 | Reynolds, Robert | Department of Indigenous Affairs | 1 | Ethnographic | Boddington field investigations. Nine sites in the Boddington area as shown in map 1 | Good | Field and Desktop |
| 20842 | Ethnographic survey of Mount Wells and surrounding area, near Boddington : open access | Yates, <br> Amanda | A. Yates | 1 | Ethnographic | Mount Wells and surrounding area, near Boddington. Area immediately west of the Boddington Gold Mine, 3893ha generally encompassing Mt Wells and the power line corridor as shown in Figure 2. | Good | Field and Desktop |
| 20853 | Ethnographic survey of Mount Wells and surrounding area, near Boddington : restricted access | Yates, <br> Amanda | A. Yates | 1 | Ethnographic | Mount Wells and surrounding area, near Boddington. Area immediately west of the Boddington Gold Mine, 3893ha generally encompassing Mt Wells and the power line corridor as shown in Figure 2. | Good | Field and Desktop |
| 20976 | Addendum report to : Hook, F (2001) The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia: (McCoy Crusher location 2 and McCoy Conveyor Lake B | Hook, Fiona | Archae-Aus Pty Ltd | 1 | Archaeological | The survey area comprises areas of impact at the Huntly and Willowdale Mines at Dwellingup and Waroona: <br> Part of Survey Area 1 - the proposed McCoy Crusher (as per Map 2), and Survey Area 7, the Wandoo Haul Road (as shown in Map 8). | Good | Field and Desktop |
| 20976 | Addendum report to : Hook, F (2001) The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : (McCoy Crusher location 2 and McCoy Conveyor Lake B | Hook, Fiona | Archae-Aus Pty Ltd | 2 | Archaeological | The survey area comprises areas of impact at the Huntly and Willowdale Mines at Dwellingup and Waroona: <br> Part of Survey Area 1 - the Proposed Conveyor area, as per Map 2; as well as Survey Area 5 - the Jarrah Haul Road \& Mining area, as shown in Map 6. | Good | Field and Desktop |
| 20976 | Addendum report to : Hook, F (2001) The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : (McCoy Crusher Iocation 2 and McCoy Conveyor Lake B | Hook, Fiona | Archae-Aus Pty Ltd | 3 | Archaeological | The survey area comprises areas of impact at the Huntly and Willowdale Mines at Dwellingup and Waroona - Survey Area 3 - the Marri Haul Road extension and mining areas, as shown in Map 4. | Good | Field and Desktop |

## Aboriginal Heritage Inquiry System

Government of Western Australia

| Survey Report ID | Report Title | Report Authors | Lead Consultants | Area No. | Survey Type | Area Description | Spatial Accuracy | Field I Desktop |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 20976 | Addendum report to: Hook, F (2001) The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : (McCoy Crusher location 2 and McCoy Conveyor Lake B | Hook, Fiona | Archae-Aus Pty Ltd | 4 | Archaeological | The survey area comprises areas of impact at the Huntly and Willowdale Mines at Dwellingup and Waroona: <br> Survey Area 4 - Wuka Haul Road Mining Areas, as per Map 5; <br> Survey Area 2 - Lake Banksiadale Pipeline, as per Map 3; <br> Survey Area 6 - Mallee Haul Road Extension and Mining Area, as per Map 7. | Very Good | Field and Desktop |
| 21425 | Boddington Gold MIne Section 18 Application Aboriginal Heritage Act 1972-1980 | Worley Alumina Pty Ltd | Tamora Pty Ltd | 1 | Ethnographic | Boddington Gold MIne Section 18 Application as shown in Figure 2. | Good | Field and Desktop |
| 21817 | Ballaruk (traditional owners) Aboriginal site recording project | Machin, Barrie | Tamora Pty Ltd | 1 | Ethnographic | Whadjuk territorial boundaries the lands of the Ballaruk Peoples as shown in Figure 10. | Unreliable | Field and Desktop |
| 21818 | Ballaruk (traditional owners of Whadjuk territorial boundaries the lands of the Ballaruk Peoples) Aboriginal site recording project : additional material | Machin, Barrie | Tamora Pty Ltd | 1 | Ethnographic | Whadjuk territorial boundaries the lands of the Ballaruk Peoples as shown in Figure 10. | Unreliable | Field and Desktop |
| 22070 | The report of an Aboriginal archaeological assessment of the McCoy and Orion mining regions, Huntly and Willowdale MInes, near Dwellingup, South - Western Australia | Rapley, Stuart | Archae-Aus Pty <br> Ltd | 1 | Archaeological | The report of an Aboriginal archaeological assessment of the McCoy and Orion mining regions, Huntly and Willowdale MInes, near Dwellingup, South - Western Australia | Moderate | Field and Desktop |
| 22128 | Assessment report on possible Indigenous Heritage site located in Bannister Forest Block | Phillips, M | Department of Conservation and Land Management | 1 | Archaeological | Private property within the Bannister Forest Block | Moderate | Field and Desktop |
| 22588 | Aboriginal Heritage study for Shotts Terminal to Wells Terminal 330kV transmission line upgrade north of Collie | Mattner, Joe | Artefaxion Pty Ltd | 1 | Archaeological \& Ethnographic | The project area is situated between Collie and Boddington, south of Perth. The large Shotts Terminal is situated approximately 12 km northeast of Collie, roughly 2 km north of the junction of Collie and Bingham Rivers and south of the CollieWilliams Raod. The Wells Terminal will be situated approximately 18 km northwest of Boddington, roughly 2 km south of Mt Wells and a kilometre or so west of Thirty Four Mile Brook. | Unreliable | Field and Desktop |
| 23641 | The Report of an Aboriginal Archaeological Assessment of the Myara Region, near McCoy Mine, Karnet, South-Western Australia : 24 Predictive Model Sample Areas 10 Proposed Creek Crossings | Hammond, Clint | Archae-Aus Pty Ltd | 1 | Archaeological \& Ethnographic | The Myara survey area is approximately 13 km north of Huntly mine and measures 15 km (north/south) by 18 km (east/west) and covers an area of $170 \mathrm{~km}^{2}$. Additionally there were ten proposed creek crossings at various location within the McCoy mine area. | Moderate | Field and Desktop |
| 23797 | An Archaeological and Ethnographic Survey of the Tullis Bridge Weir Cable Trench and Three Drill Site Locations on Boggy Brook Road, Boddington | Yates, Amanda; Goode, Brad | Yates Heritage Consultants | 1 | Archaeological \& Ethnographic | An Archaeological and Ethnographic Survey of the Tullis Bridge Weir Cable Trench and Three Drill Site Locations on Boggy Brook Road, Boddington | Good | Field and Desktop |

## Aboriginal Heritage Inquiry System

\section*{| Survey | Report Title |
| :--- | :--- |
| Report |  |}

24138 Preliminary Report on an Aboriginal
Site Survey of the Proposed Residue Farms North Bannister Gold operations.
Heritage Survey Database

| Survey Report ID | Report Title | Report <br> Authors | Lead Consultants | Area No. | Survey Type | Area Description | Spatial Accuracy | Field I Desktop |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 24138 | Preliminary Report on an Aboriginal Site Survey of the Proposed Residue Disposal Area Option 1 Saddle Back Farms North Bannister | Yates, <br> Amanda | Yates Heritage Consultants | 1 | Archaeological \& Ethnographic | The proposed Residue Disposal Area Option 1 is within the intensively worked timber plantation known as Saddleback Tree Farm which is located on Plantation Road North Bannister, to the immediate north east of the Newmont Boddington Gold operations. | Moderate | Field and Desktop |
| 27033 | Report On An Archaeological Survey Of MRWA Pinjarra Williams Road (SLK 0-67) and Bannister Marradong Road (SLK 0-22) Upgrade Works | Cecchi, John B. | John Cecchi Heritage Management Consultancy | 1 | Archaeological \& Ethnographic | Pinjarra William Road from SLK 0 to 67 and Bannister Marradong Road from SLK 0 to 22, Shires of Murray and Boddington. | Good | Field and Desktop |
| 27036 | Ethnographic Survey Of PinjarraWilliams And Bannister-Marradong Roads | R. \& E. O'Connor | John Cecchi Heritage Management Consultancy | 1 | Archaeological \& Ethnographic | Pinjarra William Road from SLK 0 to 67 and Bannister Marradong Road from SLK 0 to 22, Shires of Murray and Boddington. | Good | Field and Desktop |
| 27178 | Report of an Ethnographic Survey of Two Proposed Water-Monitoring Sites on the Serpentine River and one on the Dandalup River near Alcoa's Huntly Mine near Dwellingup, Western Australia | Hall, Lois | Ethnosciences | 1 | Ethnographic | Two proposed water-monitoring sites on the Serpentine River and one on the Dandalup River near Alcoa's Huntly mine near Dwellingup. | Good | Field and Desktop |
| 28489 | Ethnographic Survey of the Myara and O'Neil Mining Regions: Focussing on Aboriginal Site DIA 3582 (Serpentine River) | Randolph, Peter. | Peter Randolph | 1 | Ethnographic | Myara and O'Neil Mining Regions, Near McCoy Mine, Karnet | Unreliable | Field and Desktop |
| 28490 | Addendum : Ethnographic Survey of the Myara and O'Neil Mining Regions: Focussing on Aboriginal Site DIA 3582 (Serpentine River) | Randolph, Peter. | Peter Randolph | 1 | Ethnographic | Myara and O'Neil Mining Regions, Near McCoy Mine, Karnet | Unreliable | Field and Desktop |
| 28491 | The First Addendum To; Hammond and Doering (2010) the Report of an Aboriginal Archaeological Assessment of the O'Neil Region, Near McCoy Mine Karnet, South-Western Australia <br> Proposed Sugargum Creek Crossing | Hammond, Clint |  | 1 | Archaeological | Proposed Sugargum Creek Crossing | Moderate | Field and Desktop |
| 28497 | Reassessment of DIA 21470 Birdiya Hill / Mount Wells | Yates, Amanda |  | 1 | Archaeological \& Ethnographic | DIA 21470 Birdiya Hill / Mount Wells | Good | Field and Desktop |
| 28563 | The First Addendum To: Hammond and Doering (2010) The Report of an Aboriginal Archaelogical Assesment of the O'Neill Region,Near McCoy Mine, Karnet,South Western Australia | Hammond, Clint | Archae-Aus Pty Ltd | 1 | Archaeological | The Sugargum Creek Crossing is approximately 25 km east-north-east of Huntly mine and measures 140 m (north/south) by 290 m (east/west). | Moderate | Field and Desktop |
| 102073 | Western Australia Regional Forest Agreement Aboriginal Consultation Project. Vol.2. Nov. 1997. | Centre for Social Research. | Edith Cowan University | 1 | Ethnographic | Regional Forest Agreement Aboriginal Consultation Project as shown in Figure 1. | Unreliable | Field only |

## Aboriginal Heritage Inquiry System

| Survey Report ID | Report Title | Report <br> Authors | Lead <br> Consultants | Area No. | Survey Type | Area Description | Spatial Accuracy | Field / Desktop |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 102074 | Western Australia Regional Forest Agreement Aboriginal Consultation Project. Vol.1. Nov. 1997. | Centre for Social Research. | Edith Cowan University | 1 | Ethnographic | Regional Forest Agreement Aboriginal Consultation Project as shown in Figure 1. | Unreliable | Field only |
| 103251 | Report on an Archaeological Survey for Aboriginal Sites Boddington Gold mine - Survey Extension. | Quartermaine G | Quartermaine Consultants | 1 | Archaeological \& Ethnographic | The survey area consists of the extension to Boddington Gold Mine, as shown in Figures 2 and 3. | Good | Field and Desktop |
| 103570 | Final Report to the Australian Heritage Commission, April 1979 to September 1980. | Brown, S. | Steve Brown | 1 | Archaeological | The following site ID's were surveyed: 14850, 14855, 14857,14858, 11625, 20588-20589, 5762, 5744, 3268, 3485, 9925, 9818, 11659, 11635, 5455, 5457, 2642-2646, 2655, 11995-11996, 11216-11217, 10853-10855, 14909, 12189, 1457814579, 12204, 14132, 14184, 14185, 14434, 14369, 14321, 11945, 10392, 11939, 1164911656, 11530,11479-11480,2846, 5940, 11001, 10858, 5657, 5932, 2882, 11132, 11919, 5937, 2109, 3110, 11943, 14717, 14732, 14028, 1417814182, 14209, 14895, 7837, 11011, 12053, 3056 and more... | Moderate | Field and Desktop |
| 103917 | Archaeological Survey for Aboriginal Sites along the Albany Highway H1 35.4 SIk to 92.39 SIk. November 1991. | Bavin, L. | Tamora Pty Ltd | 1 | Archaeological | Albany Highway H1 35.4 SLK to 92.39 SLK, Metropolitan and Narrogin Divisions. The length of the road interval is 56.99 km . The survey area consists of a road reserve extending 30 m either side of the centre of the existing road as shown in Fig. 1 | Very Good | Field and Desktop |
| 103917 | Archaeological Survey for Aboriginal Sites along the Albany Highway H1 35.4 SIk to 92.39 SIk. November 1991. | Bavin, L. | Tamora Pty Ltd | 2 | Archaeological | Albany Highway H1 35.4 SLK to 92.39 SLK, Metropolitan and Narrogin Divisions. Along with the road reserve, 13 gravel pits and 6 spoil sites were surveyed as shown in Figs 2-4 | Unreliable | Field and Desktop |
| 104068 | Survey for Aboriginal Sites (Water Supply Dam Impoundment Area). | Pearce, R. | R. H. Pearce | 1 | Archaeological | The survey area comprises: <br> 1) A portion of the valley extending 1.7 km northwest from the junction of 34 -Mile Brook with Old Soldiers Road, bounded by the 230.5 m contour (as shown in Figure 1). <br> 2) Tributary - part of a valley 1 km south of the above junction, extending 660 m west from the 34 -Mile Brook, and bounded by the 230.5 contour (as shown in Figure 1). | Good | Field and Desktop |
| 104069 | Worsley Alumina Joint Venturers Bauxite/Gold Operation - Survey for Aboriginal Sites. | Pearce, R. | R. H. Pearce | 1 | Archaeological | The survey area consists of <br> 1) The Quarantine Strip, a strip 160 m wide and 1.6 km along the western boundary of the Bunning Forest, as shown in Figure 1. <br> 2) The powerline corridor - a 100 m wide corridor from the northwest corner of Location 530 westwards for 3.4 km to the existing SEC Transmission Line in Hedges block, as shown in Figure 1. | Good | Field and Desktop |

## Aboriginal Heritage Inquiry System

Government of Western Australia
Department of Aboriginal Affairs

\section*{| Survey | Report Title |
| :--- | :--- |
| Report |  |}

104081 Survey for Aboriginal / Archaeologica

## 1987.

Pearce,

| Survey <br> Report <br> ID | Report Title | Report Authors | Lead Consultants | Area No. | Survey Type | Area Description | Spatial Accuracy | Field / Desktop |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 104081 | Survey for Aboriginal / Archaeological Sites for Alcoa of Australia Ltd. Sep 1987. | Pearce, R. | A. H. Pearce | 1 | Archaeological | Survey for Alcoa, part of Mineral Lease 239A, about 25 km east of Dwellingup. Land involves the eastern portion of the Hedges Block of State Forest, an area of approximately 1800 ha , as shown in Fig. 1 This survey area was then extended to incorporate an area of approximately 8 square km immediately south of the previous survey area as shown in Fig. 4 | Indeterminat <br> e | Field and Desktop |
| 104082 | Monitoring and Conservation Work on Sites in the South-West. | Peck, C. | C. Peck | 1 | Archaeological | Monitoring and conservation work on sites in the South-West. The following sites were visited: (Id) 4407, 3342, 21387, 5888, 3268. | Unreliable | Field only |
| 104095 | Worsley Alumina Project: Survey for Aboriginal Sites. | Pearce, R. | R. H. Pearce | 1 | Archaeological | Worsley Alumina Project. The mining area near Boddington, the refinery near Collie and the transport corridor, a total area of 280 square km as shown in Figure 2. | Good | Field and Desktop |
| 105486 | Report on an Aboriginal Survey at Boddington Gold Mine | Yates, Amanda | Tamora Pty Ltd | 1 | Archaeological \& Ethnographic | Boddington Gold Mine 120 km south east of Perth. The specific survey areas are in parts of ML264SA (2) and M70/1031, and an area in the north west of the mine in State Forest as shown in Fig. 2 | Good | Field and Desktop |
| 106528 | The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : Crusher and workshop area spur conveyor Wuka Haul Road extension conveyor alignment Wa | Hook, Fiona | Archae-Aus Pty Ltd | 2 | Archaeological | The project area comprises Spur Conveyor measuring approximately 4.4 km long by 30 m wide and the Wuka Haul road extension measuring approximately 8.5 km long by 30 m wide as shown in Map 1 | Good | Field only |
| 106528 | The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : Crusher and workshop area spur conveyor Wuka Haul Road extension conveyor alignment Wa | Hook, Fiona | Archae-Aus Pty Ltd | 3 | Archaeological | The project area comprises the Conveyor Alignment measuring approximately 3.6 km long by 30 m wide as shown in Map 1 | Good | Field only |
| 106528 | The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : Crusher and workshop area spur conveyor Wuka Haul Road extension conveyor alignment Wa | Hook, Fiona | Archae-Aus Pty Ltd | 4 | Archaeological | The project area comprises the Wardang Haul Road extension, as shown in Map 1 | Very Good | Field only |

## Aboriginal Heritage Inquiry System

Government of Western Australia
Department of Aboriginal Affairs
Heritage Survey Database

| Survey <br> Report <br> ID | Report Title | Report Authors | Lead Consultants | Area No. | Survey Type | Area Description | Spatial Accuracy | Field / Desktop |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 106528 | The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : Crusher and workshop area spur conveyor Wuka Haul Road extension conveyor alignment Wa | Hook, Fiona | Archae-Aus Pty Ltd | 1 | Archaeological | The project area comprises Crusher and Workshop Area measuring approximately 2.7 km east/west, by 1.1 km north/south as shown in Map 1 | Good | Field only |
| 106528 | The report of an Aboriginal Heritage assessment of the proposed work areas within the Huntly and Willowdale Mines, Dwellingup \& Waroona, South Western Australia : Crusher and workshop area spur conveyor Wuka Haul Road extension conveyor alignment Wa | Hook, Fiona | Archae-Aus Pty Ltd | 5 | Archaeological | The project area comprises the Alligator Haul Road extension. The survey area is a creek crossing zone located immediately adjacent to the existing Orion conveyor as shown in Map 6. | Good | Field only |
| 106534 | Ethnographic report on an Aboriginal Community Consultation Project conducted in Pinjarra, Western Australia | De Gand, Daniel | Daniel de Gand, <br> Consultant Anthropologist | 1 | Ethnographic | Murray Shire | Very Good | Field only |
| 106544 | A first addendum report to: Hook, F and De Gand, D. 2000. The report of an Aboriginal Heritage assessmnet of the Scott Region Project area, Huntly Mine, Dwellingup, South Western Australia Wuka Road 1 Scott North Mining Area and Chipala Haul Road Ni | Hook, Fiona | Archae-Aus Pty Ltd | 2 | Archaeological | Scott Region Project Area, Huntly Mine, Dwellingup: Scott North Mining Area, and Chipala haul road extension - which covers an area measuring approximately 6 sq. km , the haul road extension measures approximately 2.2 km long and is on average approximately 100 m wide, as shown in Map 3 | Very Good | Field only |
| 106544 | A first addendum report to : Hook, F and De Gand, D. 2000. The report of an Aboriginal Heritage assessmnet of the Scott Region Project area, Huntly Mine, Dwellingup, South Western Australia Wuka Road 1 Scott North Mining Area and Chipala Haul Road Ni | Hook, Fiona | Archae-Aus Pty Ltd | 3 | Archaeological | Scott Region Project Area, Huntly Mine, Dwellingup: Ningham mining area - covering an area measuring approximately 4sq.km, as shown in Map 4 | Very Good | Field only |
| 106544 | A first addendum report to : Hook, F and De Gand, D. 2000. The report of an Aboriginal Heritage assessmnet of the Scott Region Project area, Huntly Mine, Dwellingup, South Western Australia Wuka Road 1 Scott North Mining Area and Chipala Haul Road Ni | Hook, Fiona | Archae-Aus Pty Ltd | 4 | Archaeological | Scott Region Project Area, Huntly Mine, Dwellingup: the proposed Ninghan haul road extension is approximately 2.5 km long and on average approximately 100 m wide, as shown in Map 4. | Indeterminat <br> e | Field only |
| 106544 | A first addendum report to : Hook, F and De Gand, D. 2000. The report of an Aboriginal Heritage assessmnet of the Scott Region Project area, Huntly Mine, Dwellingup, South Western Australia Wuka Road 1 Scott North Mining Area and Chipala Haul Road Ni | Hook, Fiona | Archae-Aus Pty Ltd | 1 | Archaeological | The area comprises the Wuka Haul Road extension, Huntly Mine, near Dwellingupapproximately 4.8 km long and is on average 100 m wide, as shown in Map 2. | Very Good | Field only |


| Survey <br> Report <br> ID | Report Title | Report Authors | Lead Consultants | Area No. | Survey Type | Area Description | Spatial Accuracy | Field I Desktop |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 106544 | A first addendum report to: Hook, F and De Gand, D. 2000. The report of an Aboriginal Heritage assessmnet of the Scott Region Project area, Huntly Mine, Dwellingup, South Western Australia Wuka Road 1 Scott North Mining Area and Chipala Haul Road Ni | Hook, Fiona | Archae-Aus Pty <br> Ltd | 5 | Archaeological | Scott Region Project Area, Huntly Mine, Dwellingup: Wuka conveyor corridor (North Dandalup Crossing) - the proposed corridor measures approximately 1 km long and is on average approximately 50 m wide as shown on Map 1 | Good | Field only |


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## Aboriginal Heritage Inquiry System

Sites in Custom search area (3); $421331.96 \mathrm{mE}, 6374664.93 \mathrm{mN}$ z 50 (MGA94) : 465034.15mE, 6414981.25 mN z50 (MGA94)

## Search Criteria

## Disclaimer

 the Register of Aboriginal Sites, and some registered sites may no longer exist.(t) Gnaala Karla Booja People ILUA
South West Settlement ILUA Disclaimer
On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and,
respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah \#2 and Wagyl Kaip \& Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).
The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.
Likewise, from 8 June 2015 the Department of Mines and Petroleum (DMP) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.
If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMP, you should seek https://www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx.
Further advice can also be sought from the Department of Aboriginal Affairs (DAA) at heritageenquiries@daa.wa.gov.au.

## Aboriginal Heritage Inquiry System

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Terminology (NB that some terminology has varied over the life of the legislation)
Place ID/Site ID: This a unique ID assigned by the Department of Aboriginal Affairs to the place
Status:
o Registered Site: The place has been assessed as meeting Section 5 of the Aboriginal Heritage Act 1972
o Other Heritage Place which includes: - Stored Data I Not a Site: The place has been assessed as not meeting Section 5 of the Aboriginal Heritage Act 1972

- Lodged: Information has been received in relation to the place, but an assessment has not been completed at this stage to determine if it meets
Section 5 of the Aboriginal Heritage Act 1972
Status Reason: e.g. Exclusion - Relates to a portion of an Aboriginal site or heritage place as assessed by the Aboriginal Cultural Material Committee (ACMC). e.g.
Origin Place ID: Used in conjuction with Status Reason to indicate which Registered Site this Place originates from.
Access and Restrictions:
Access and Restrictions:
in any way.
- File Restricted = Yes: Some of the information that the Department of Aboriginal Affairs holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Aboriginal Affairs receives written approval from the informants who provided the information. Download the Request to Access Restricted lnformation letter and form. . with the Registrar allows.
- Boundary Restricted = Yes: To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least $4 \mathrm{~km}^{2}$ ) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact DAA.
- Restrictions:
- Male Access Only: Only males can view restricted information. - Female Access Only: Only females can view restricted information
Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.
List of Registered Aboriginal Sites with Map

| Site ID | Site Name | File Restricted | Boundary Restricted | Restrictions | Status | Status Reason | Origin <br> Place ID | Site Type | Knowledge Holders | Coordinates | Legacy <br> ID |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3267 | KITTY'S GRAVE, BANNISTER | Yes | Yes | No Gender Restrictions | Registered Site |  |  | Skeletal Material / Burial |  | Not available when location is restricted | S00215 |
| 3268 | AVON DOWNS 1. | No | No | No Gender Restrictions | Registered Site |  |  | Man-Made Structure, Other: PA 09, LIZARD TRAP |  | $\begin{gathered} 454940 \mathrm{mE} \\ 6397098 \mathrm{mN} \\ \text { Zone } 50 \\ \text { [Unreliable] } \end{gathered}$ | S00216 |
| 3269 | BANNISTER GNAMMA HOLE. | Yes | Yes | No Gender Restrictions | Registered Site |  |  | Ceremonial, Water Source |  | Not available when location is restricted | 500217 |
| 3270 | POLLARD'S POSSUM TREE | No | No | No Gender Restrictions | Registered Site |  |  | Modified Tree |  | $\begin{gathered} 456639 \mathrm{mE} \\ 6384648 \mathrm{mN} \\ \text { Zone } 50 \\ \text { [Unreliable] } \end{gathered}$ | S00218 |
| 3485 | AVON DOWNS 2. | No | No | No Gender Restrictions | Registered Site |  |  | Man-Made Structure, Modified Tree, Other: LIZARD TRAP? |  | $\begin{gathered} 455639 \mathrm{mE} \\ 6399649 \mathrm{mN} \\ \text { Zone } 50 \\ \text { [Unreliable] } \end{gathered}$ | S02654 |
| 3498 | METRO ROAD | No | No | No Gender Restrictions | Registered Site |  |  | Artefacts / Scatter, Engraving, Grinding Patches / Grooves |  | $\begin{gathered} 452390 \mathrm{mE} \\ 6411849 \mathrm{mN} \\ \text { Zone 50 } \\ \text { [Unreliable] } \end{gathered}$ | S02566 |
| 3536 | SWAN RIVER | No | No | No Gender Restrictions | Registered Site |  |  | Mythological | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 446787 \mathrm{mE} \\ 6461614 \mathrm{mN} \\ \text { Zone } 50 \\ \text { [Reliable] } \end{gathered}$ | S02548 |
| 3537 | MURRAY RIVER | No | No | No Gender Restrictions | Registered Site |  |  | Mythological | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 409996 \mathrm{mE} \\ 6373194 \mathrm{mN} \\ \text { Zone } 50 \\ \text { [Reliable] } \end{gathered}$ | S02549 |
| 3538 | CANNING RIVER. | No | No | No Gender Restrictions | Registered Site |  |  | Mythological, Named Place, Ochre, Water Source | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 412123 \mathrm{mE} \\ 6442557 \mathrm{mN} \\ \text { Zone 50 } \\ \text { [Reliable] } \end{gathered}$ | S02550 |

## Aboriginal Heritage Inquiry System

Dovernment of Western Australia

| Site ID | Site Name | File <br> Restricted | Boundary Restricted | Restrictions | Status | Status <br> Reason | Origin Place ID | Site Type | Knowledge Holders | Coordinates | Legacy ID |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3582 | SERPENTINE RIVER | Yes | Yes | No Gender Restrictions | Registered Site |  |  | Ceremonial, Mythological | *Registered Knowledge Holder names available from DAA | Not available when location is restricted | S02407 |
| 4230 | BODDINGTON FOREST 36 | No | No | No Gender Restrictions | Registered Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 442043 \mathrm{mE} \\ 6377648 \mathrm{mN} \\ \text { Zone 50 } \\ \text { [Reliable] } \end{gathered}$ | S01045 |
| 4237 | BODDINGTON FOREST 43 | No | No | No Gender Restrictions | Registered Site |  |  | Artefacts / Scatter, Quarry | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 444139 \mathrm{mE} \\ \text { 6380148mN } \\ \text { Zone 50 } \\ \text { [Reliable] } \end{gathered}$ | S01052 |
| 18749 | HEA01 | No | No | No Gender Restrictions | Registered Site |  |  | Artefacts / Scatter | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 434720 \mathrm{mE} \\ 6385573 \mathrm{mN} \\ \text { Zone } 50 \\ \text { [Reliable] } \end{gathered}$ |  |
| 27935 | Hotham River | No | No |  | Registered Site |  |  | Mythological | *Registered Knowledge Holder names available from DAA | $\begin{gathered} 462541 \mathrm{mE} \\ 6372372 \mathrm{mN} \\ \text { Zone 50 } \\ \text { [Reliable] } \end{gathered}$ |  |


| Legend |
| :--- |
| Selected Heritage Sites |
| Registered Sites |
| Aboriginal Community <br> Occupied |
| Aboriginal Community <br> Unoccupied |
| Town |
| $\square$ |


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## APPENDIX F

## Golder's Risk Matrix

## APPENDIX F

## Golder's Risk Matrix

| Likelihood |  | Descriptor |
| :--- | :--- | :--- |
| Almost certain | 5 | Incident will occur in every circumstance (e.g. every time). |
| Likely | 4 | Incident will probably occur (e.g. 1 in 10 times). |
| Possible | 3 | Incident may occur at some time (e.g. 1 in 100 times). |
| Unlikely | 2 | Incident not expected to occur, but conceivable (e.g. 1 in 1000 times). |
| Rare | 1 | Incident would only occur in exceptional circumstances (e.g. 1 in 10000 times). |


| Likelihood |  | Consequence |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Catastrophic | Major | Significant | Minor | Insignificant |
|  |  | 5 | 4 | 3 | 2 | 1 |
| Almost certain | 5 | 25 (VH) | 20 | 15 | 10 | 5 |
| Likely | 4 | 20 | 16 (H) | 12 | 8 | 4 |
| Possible | 3 | 15 | 12 | 9 (M) | 6 | 3 |
| Unlikely | 2 | 10 | 8 | 6 | 4 (L) | 2 |
| Rare | 1 | 5 | 4 | 3 | 2 | 1 (VL) |
| (VL) Very Low Risk | No additional controls necessary. Continue to monitor risk. |  |  |  |  |  |
| (L) Low Risk | Consider additional controls to further reduce risk. |  |  |  |  |  |
| (M) Moderate Risk | Controls must be implemented to reduce risk. |  |  |  |  |  |
| (H) High Risk | Risk unacceptable; do not proceed without controls, minimum of 'engineering controls'. |  |  |  |  |  |
| (VH) Very High Risk | Risk unacceptable; do not proceed without controls, elimination or substitution. |  |  |  |  |  |

## APPENDIX G

## Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

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## appendix 3 :

Bushfire Management Plan - Ecosystem Solutions - 2017

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## Bushfire Management Plan

North Bannister Waste Management, Albany Highway Boddington

18 August 2017

Prepared for:
Suez Recycling \& Recovery Australia
C/- Larry Smith


## Limitations Statement

This report has been solely prepared for Suez Recycling \& Recovery Australia (C/- Larry Smith). No express or implied warranties are made by Ecosystem Solutions Pty Ltd regarding the findings and data contained in this report. No new research or field studies were conducted other than those specifically outlined in this report. All of the information and details included in this report are based upon the research provided and obtained at the time Ecosystem Solutions Pty Ltd conducted its analysis.

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## Document Control

## Client - Suez Recycling \& Recovery Australia

Site - North Bannister Waste Management, Albany Highway Boddington

| Version | Revision | Purpose | Author | Reviewer | Submitted |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | Form | Date |
| Draft Report | Rev A | Draft Report | GM | GM | Electronic (network) | 18/08/2017 |

Filename: <br>192.168.1.254\data\projects\17372 north banister waste managment facility\reports\north bannister bmp v1.docx

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## Appendices

Appendix A - Shire of Boddington Firebreak and Fuel Hazard Reduction Notice 2016/2017

## 1 Introduction

Suez Recycling and Recovery manage the North Banister Resource Recovery Facility, located at Lot 2, 6364 Albany Highway, North Bannister, within the Shire of Boddington (Figure 1)

The operation is looking at extending their landfill area and as such changing the surrounding bushfire hazards around the facility.

The purpose of this Bushfire Management Plan is to detail the fire management methods and requirements that will be implemented within the site to reduce the threat to occupants within the facility and fire fighters in the event of a fire within or near the Site.

Note that this plan is designed for Bushfire Risk and does not include structural/internal fire prevention measure as required under the Building Code of Australia

This Bushfire Management Plan (BMP) has been prepared by Gary McMahon (B.Sc. M. Env Mgmt. PG Dip Bushfire Protection) of Ecosystem Solutions Pty Ltd for the resource recovery facility at Albany Highway Boddington (hereafter referred to as the 'site').


Figure 1 Site Location

## 2 Site Description

### 2.1 Location

The landfill site is located at Lot 2 of Plan 2767, 6364 Albany Highway, North Bannister, in the Shire of Boddington (Map 1). The site is in privately owned land of 390 ha and is 30 km north of the Boddington townsite. It is approximately 100 km south east of Perth. The landfill facility is located approximately 6 km by road from Albany Highway (Figure 1)and access is from Albany Highway approximately 1.65 km north of the North Bannister - Wandering Road Intersection.

### 2.2 Landscape Elements

The site sits approximately 340m above sea level (Australian Height Datum - AHD). The topography slopes down to the east, with the highest areas of the site on the western boundary at 389 m in the south-western corner, and 370 m in the north-western corner. Topography across the site varies by approximately 60 m over 1 km . Beyond the western boundary the land continues to rise steeply ( Map 1).

Most of the land is currently being used for Blue gum (Eucalyptus globulus) plantation leased to Australian Blue Gum Plantations Ltd. The remaining portion of Lot 2 consists of remnant native vegetation (Jarrah/Marri-Eucalyptus marginata/Corymbia calophylla) woodland, with a disturbed typical Jarrah/Marri woodland understory, and further areas of extensive Eucalyptus globulus plantation. The areas to the east of the site support sheep grazing. The current landfill area is shown in Figure 2 and Map 2, however the presence of rock has resulting in this area not being suitable for future expansion. The area to the south of the current area is now proposed to be used. This will be conducted in stages but will eventually take up the entire area.

The site adjoins State Forest to the west, and agricultural production and tree plantations to the north and south.


Figure 2 Current Site, showing landfill area in the north west corner.

## 3 Statutory Conditions

The Western Australian Planning Commission (WAPC) introduced State Planning Policy 3.7: Planning in Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas in December 2015 (WAPC, 2015). The Guidelines for Planning in Bushfire Prone Areas was then updated in February 2017 and some ancillary changes in August 2017.

The objectives of this policy are to:

- Avoid any increase in the threat of bushfire to people, property and infrastructure;
- Reduce the vulnerability to bushfire through the identification and consideration of bushfire risks in decision making at all stages of the planning and development process;
- Ensure higher order strategic planning documents, strategic planning proposals, subdivision and development applications take bushfire protection requirements into account; and
- Achieve an appropriate balance between bushfire risk management measures, biodiversity conservation values, environmental protection and landscape amenity.

The policy determines those areas that are most vulnerable to bushfire and where development is appropriate and not appropriate. The provisions and requirements contained in the new Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) are used in for this determination.

These guidelines form the foundation for fire risk management planning in WA at a community and land development level.

The Bushfires Act (1954) sets out provisions to reduce the dangers resulting from bushfires, prevent, control and extinguish bushfires and for other purposes. The Act addresses various matters such as prohibited burning times, and enables Local Government to require landowners/occupiers to maintain fire breaks, to control and extinguish bushfires and to establish and maintain Bushfire Brigades.

This Bushfire Management Plan (BMP) demonstrates that all fire protection requirements for issues including, development design, access, water supply, building locations and other relevant performance criteria contained in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) can be achieved to the satisfaction of the WAPC.

## 4 Fire Risk

Numerous elements affect building survival in a bushfire event. Some of these factors relate to the bushfire behaviour experienced at the Site, others relate to the design and the construction materials used in the building and the development's surrounding landscape. Infrastructure, utilities, climate and human behaviour also contribute to the overall risk.

Within this plan, the assessment of fire risk takes into account the layout of the development and the conditions that exist at the Site. These include:

- Vegetation Type and cover;
- Topography, with particular reference to ground slopes and accessibility;
- Climate; and
- Relationship to surrounding development.


### 4.1 Vegetation and Topography

An assessment of the composition of the vegetation and the slope of the land under that vegetation was conducted on site on 21 June 2017 by Gary McMahon from Ecosystem Solutions.

The main office and infrastructure facilities are located in the lower part of the landscape (Map 2). The surrounding vegetation throughout the site, is predominantly Blue gum plantations (Figure 3). There are, however, patches of native eucalyptus bushland, consisting of Eucalyptus marginata (Jarrah) and Corymbia calophylla (Marri) with associated multiple strata of vegetation (Figure 4) (Map 2) .


Figure 3
Bluegums


Figure 4
Forest Vegetation

All of this vegetation is Classified as Class A- Forest, under AS 3959-2009 due to the density of vegetation and stratification of the vegetation. The fuel levels are consistent with the surface fuel loads of 25 tonnes per hectare and the overall fuel load of 35 tonnes per hectare at maturity. This is the default fire fuels used in AS 3959-209 and used in the Fire behaviour equations derived by McArthur (1976) and Nobel et al (19880).

Relative to the infrastructure area of the site, the slope under this assessed vegetation is upslope and away from the office/administration and workshop areas.

Map 3 shows the classification of the vegetation within the site under AS 3959-2009.

### 4.2 Fire Climate

Bush fire behaviour is significantly affected by weather conditions. They will burn more aggressively when high temperatures combine with low humidity and strong winds. Generally, the greatest fire risk occurs from summer through to autumn, when the moisture levels in the soil and vegetation are low.

The Site is located within the southern area of south-west Western Australia which experiences hot dry summers and cool wet winters (commonly called a Mediterranean climate). Data from the Bureau of Meteorology at Wandering (approximately 24 km to the South-east), confirms that the Site experiences hot dry summers with an average December to February temperature of $30.3-32.2{ }^{\circ} \mathrm{C}$ and 11 mm of rain per
month over summer. Winters are cooler with a mean maximum temperature through June, July and August of $12-14^{\circ} \mathrm{C}$ and an average July rainfall of 90mm. (Figure 5 - BOM, accessed June 2017).


Figure 5 Mean maximum recorded temperature and monthly rainfall for Wandering 23 km SE of site
The 3pm December wind rose for Wandering shows that the afternoon sea breeze from the south and southeast dominates 20-30 \% of the time(Figure 6).. In this instance, any afternoon fire event would spread from the south east to the north west


Figure 6 Wind Rose for Wandering in km/h for December, January and February

The combination of hot dry summers, prevailing winds and dry vegetation poses a bushfire risk. Bushfire prevention is considered essential for the protection of life and property and to ensure that frequent and uncontrolled burning does not degrade the vegetation and conservation values of the surrounding landscape.

### 4.3 Surrounding Landscape \& History

The site adjoins State Forest, farming areas and tree plantations. The site is surrounded by infrequent single residence houses, the nearest one located approximately 4.5 km away, including the caretakers dwelling, and a roadhouse located 6.0 km away. The nearest township (Boddington) is about 30 km south of the proposed landfill site. The closest airport is located 45 km away at Serpentine. The north and west of the proposed landfill site is surrounded by State Forest.

The site and surrounding area has been used for silviculture purposes and includes extensive plantation areas of Eucalyptus globulus (Tasmanian blue gum). These trees have been densely planted in rows and have little or no understory, contributing to the overall fire risk.

The overall fire risk to people and property within the Site is considered Moderate to Extreme due to the extent of vegetation within the site, however with the establishment of the new land fill area to the west of the site, the amount of fire fuel and hazard will be reduced significantly. By complying with the requirements of this BMP, this risk can be appropriately managed.

### 4.4 Bushfire Hazard Level Assessment

Bushfire Hazard Level (BHL) Assessment is determined by rating the vegetation type against Table 3: Hazard levels and characteristics of Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

A Bushfire Hazard Level Assessment Map has been prepared which considers vegetation type and structure, and the topography of the Site (Map 4). The Class A- Forest vegetation is an Extreme bushfire hazard. Any areas within 100m of an Extreme or Moderate bushfire hazard are also considered to be a Moderate bushfire hazard to reflect the increase in risk.

Provided the requirements of this BMP are maintained, the fire risk to people and property within the proposed Site is considered Moderate as the risk will decrease as the new landfill foot print is cleared of vegetation.

## 5 Bushfire Management Plan

The aim of the Bushfire Management Plan is to reduce the impacts to residents and fire fighters in the event of bushfire within or near the Site.

The Site will need to be developed to incorporate fire management measures outlined within this plan. This includes the following bushfire protection elements as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015):

- Location;
- Siting and Design of Development:
- Vehicular Access; and
- Water sources and storage;

Maps 5 and 6 show the elements of the Bushfire Management Plan as mentioned below.

### 5.1 Element 1: Location

## Performance Principle

The intent of this element may be achieved where the development is located in an area where the bushfire hazard assessment is or will on completion, be moderate or low, or a BAL-29 or below and the risk can be managed.

## Acceptable Solutions

To achieve compliance with this element using an acceptable solution approach, acceptable solutions A 1.1 must be met:

## A1.1 - Development Location

## Background

Australian Standard (AS) 3959-2009 requires that properties exposed to a potential bushfire risk, be assessed to determine a "Bushfire Attack Level" (BAL). The standard defines BAL as:

A means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared, and the basis for
establishing the requirements for construction to improve protection of building elements from attack by bushfire. (Standards Australia, AS 3959-2009).

Once assigned, a BAL will determine the appropriate construction requirements for a structure under the BCA.

AS 3959-2009 specifies 6 Bushfire Attack Levels (BAL), ranging from Low to Extreme. There are increasing construction requirements ranging from ember protection to direct flame contact protection as the BAL level increases. A BAL assessment determines the appropriate construction requirements for the property. The determination of a property's BAL in accordance with AS 3959 for bushfire prone areas, is a site-specific assessment that considers a number of factors including the slope of the land, the types of surrounding vegetation and its proximity to other building or structures on the site. A BAL-LOW rating is considered to be a low bushfire hazard land classification. BAL-12.5, BAL-19 and BAL-29 ratings are considered to be areas with a moderate bushfire hazard and BAL-40 and BAL-FZ are rated as areas with extreme bushfire hazard levels and these are not normally approved as suitable building sites by the decision-making authorities.

## Acceptable Solutions

No formal structures are proposed within the site. However there is sufficient cleared/gravel areas surrounding the main office that provides adequate separations distance to ensure that any of the existing office/maintenance compounds to ensure radiant heat flux levels are below $29 \mathrm{~kW} / \mathrm{m} 2$ (i.e. a . BAL-29 or lower rating).

A BAL analysis of the site has been used as a surrogate for radiant heat flux measures in the areas where people are likely to take refuge or situation in a fire event.

If any formal structure is proposed in the future, a BAL assessment, conducted by an accredited Bushfire Consultant, will accompany the building application.

BAL contours for the Class A - Forest vegetation Flat or upslope are shown in Map 5.

To the east of the proposed site near the eastern road from Albany highway is a small office building. This dwelling does not require a BAL assessment unless additions to it are planned.

If any additions or new construction is required, to achieve a BAL-29 rating a separation between any structure and any Class A - Forest that is upslope or flat will need to be 21 metres.

The setback required from Class A - Forest upslope or flat, the separation distances and BALs are shown in Table 1.

Table 1 BAL Separation Distances: Class A - Forest Vegetation: Upslope or Flat Land.

| Veg Class | BAL - FZ (m <br> from veg) | BAL-40 (m from veg) | BAL-29 (m from veg) | BAL-19 (m from veg) | BAL-12.5 (m from veg) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Class A Forest | <16m | 16-<21m | 21-<31m | 31-<42m | 42-100m |

These separation distances are shown in Map 4.

By maintaining these distances for any amendments to the current structures or the construction of any new dwellings, the performance principle for this element is met.

## 5.2 Element 2: Siting \& Design of Development

## Performance Principle

The intent of this element may be achieved where the siting and design of the development, including roads, paths and landscaping, is appropriate to the level of bushfire threat that applies to the site. That it minimizes the bushfire risk to people, property and infrastructure, including compliance with AS 3959 if appropriate.

## Acceptable Solutions

To achieve compliance with this element acceptable solution A2.1 must be met to the extent that it satisfies Element 1 -Location.

## A2.1 - Asset Protection Zone

## Background

The WAPC (2015) states that the Asset Protection Zone (APZ) is a low fuel area immediately surrounding a habitable or specified building, and is designed to minimise the likelihood of flame contact with buildings. All of the requirements prescribed in A2.1 are essential and must be achieved to ensure compliance.

Non-flammable features such as driveways, lawns, landscaped gardens and vegetable patches can form part of the APZs. Isolated trees and shrubs may be retained within APZs.

All APZs should be accommodated within the boundaries of the subject lot, except in situations where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity. The presence of a wall between the bushfire hazard and the site does not alone preclude the need for an Asset Protection Zone (WAPC, 2015).

The size of the APZ from each external wall, supporting post or column of a dwelling needs to be sufficient to provide adequate protection to ensure the potential radiant heat impact of a fire does not exceed $29 \mathrm{~kW} / \mathrm{m}^{2}$. The size of the zone is dependent on the adjacent vegetation type and topography, with the distance increasing as the slope increases (WAPC, 2017).

The Shire of Boddington Firebreak Notice requires an Asset Protection Zone of 20 metres as a minimum. In areas adjacent to Class A - Forest that is upslope/flat in relation to a dwelling this will need to be increased to 21 metres.

## Acceptable Solutions

Every building will be surrounded by an APZ, depicted on submitted plans, which meets the following requirements:
a. Width: measured from any external wall or supporting post or column of the proposed building, and of sufficient size to ensure the potential radiant heat impact of a bushfire does not exceed $29 \mathrm{~kW} / \mathrm{m}^{2}$ (BAL29) in all circumstances;
b. Location: the APZ should be contained solely within the boundaries of the lot on which the building is situated, expect in situations where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, into perpetuity;
c. Fences: within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
d. Objects: within 10 metres of a building combustible object must not be located close to vulnerable parts of the building i.e. windows and doors.
e. Fine Fuel load: combustible dead vegetation matter less then 6 mm in thickness reduced to and maintained at an average of two tonnes per hectare.
f. Trees ( $>5 \mathrm{~m}$ in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and/or surface vegetation, canopy cover should be less than $15 \%$ with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.
g. Shrubs ( $0.5 m-5 m$ in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than $5 \mathrm{~m}^{2}$ in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated at trees.
h. Ground covers (<0.5 m in height): can be planted under trees but must be property maintained to remove dead plant material and any parts within 2 meters of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 100 millimetres in height are to be treated as shrubs.
i. Grass: should be managed to maintain a height of 100 millimetres or less.

Within this development, Asset Protection Zones will meet the acceptable solutions requirements of A2.1.

### 5.3 Element 3: Vehicular Access

## Performance Principle

The intent of this element may be achieved where the internal layout, design and construction of public and private vehicular access and egress in the site allow emergency and other vehicles to move through it easily and safely at all times.

## Acceptable Solutions

To achieve the intent, all applicable 'acceptable solutions' must be addressed.

## A3.1 - Two Access Routes

The main entrance to the site is via Albany Highway to the east, approximately 6 km away on a private road with a boom gate off Albany Highway. This road has an approximate width of 7-10 m along most of its length (Figures 7 \& 8).


Figure 7
Main access road, note very wide shoulders


Figure 8
main access way

There are numerous wide tracks within the site, including two emergency access routes are available to egress from the landfill footprint (see Map 6). Apart from the private access road, an existing road runs along the northern and southern boundary of the whole facility, providing access to the landfill facility from the either end.


Figure 9 Southern EAW

The Shire of Boddington in their 2016-2017 Bush Fire Notice define a fire access track as:
"Fire access tracks are spaces that can provide vehicle and pedestrian access in the case of a fire. They shall be maintained, cleared of flammable material for the purpose of fire control and in a trafficable condition. There areas shall be 2.5 m wide as a minimum and have a 4.0 m vertical clearance."

The exiting road way, tracks and access ways allows for employees to escape and fire crews to enter the site in a bushfire situation. This internal process meets both the intent and performance principle for A3.1.

## A3.2 - Public Roads

No public roads are proposed as part of this development.

## A 3.2-Cul de sac

While the main access to the site is via a private road into the site and this is the main access/egress route for employees within the site, no formal cul de sacs are proposed as part of this development.

## A 3.4- Battle Axe

No Battle Axe access legs are proposed as part of this process.

## A 3.5 - Private Driveway Longer Than 50 m

The location of the facilities and site office are proposed to be located more than 50 m from a public road, (being Albany highway 6 km east of the sit on a private gravel road). The resulting access road (Figures 7 \& 8) meets the standards as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) Table 4, Column 3:

- required where house site is more than 50 metres from a public road
- Minimum trafficable surface: 4 metres
- Horizontal clearance: 6 metres
- Vertical clearance: 4.5 metres
- Maximum grade over <50 metres: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum cross fall: 1 in 33
- Curves minimum inner radius: 8.5 metres;
- The driveway must be all weather surface (i.e. compacted gravel, limestone or sealed):
- Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes.
- Passing bays constructed every 200 m with a minimum length of 20 m and a minimum width of 2 m (resulting in a combined width of the passing bay and constructed private driveway to be a minimum of 6 metres) - Note that the main road access/egress into the site consists of a 7-10 m paved surface with ample width on the shoulders for the safe exit of employees and access for fire appliances (Figure 7 \& 8). This meets the above requirements for A 3.5 .


## A3.8-Firebreaks

Lots greater than 0.5 hectares must have an internal perimeter firebreak of a minimum width of three metres or to the level as prescribed in the local firebreak notice issued by the Shire of Boddington (Appendix A). There are fire breaks established around the landfill site and around the stockpile /green waste area.

The 2016/17 Shire of Boddington Bushfire Order time periods are:

- Prohibited Burning Period - 15th December - 14th March inclusive;
- Restricted Burning Period - 2nd November - 14th December inclusive \& 15th March - 26th April inclusive.

The compliance period for the completion of the firebreaks and other fire requirements in the Boddington region is the 15 th of November each year and the break must be maintained until the 26 th of April. These dates can change due to seasonal fire conditions. If this does occur, changes will be published in the local newspapers. It is the responsibility of the individual property owner to maintain in good order and condition, their firebreaks, gates and property fences.

An area of 20 metres wide cleared of all flammable material shall be established immediately around the perimeter of all homesteads, buildings, haystacks and fuel storage areas.

During the field visit in June 2017, firebreaks and separation distances between fire hazards had been maintained as required within the existing lots.

### 5.4 Element 4: Water Sources and Storage.

## Intent

To ensure that water is available to the development to enable people, property and infrastructure to be defended from bushfire.

The intent of this element may be achieved where the subdivision, development or land use is provided with a permanent and secure water supply that is sufficient for firefighting purposes.

## Acceptable Solutions

## A4.2 Non-reticulated areas

The site currently has $2 \times 160 \mathrm{~kL}$ water tanks within the facility, next to the main office compound area. These tanks have a fixed standpipe for rapid filling of appliances as needed and there is a hardstand and sufficient cleared area for turnaround next to the standpipe (Figure 10).

The site also contains a 15 kL water truck that is used for dust suppression and can be used as water cart as required (Figure 11). . This has couplings compatible for connection to the local brigades fire appliances and can be manoeuvred readily throughout the site.


Figure 10

Water Tanks and Standpipe - ample turning access is available


Figure 11 Water Truck Refilling

Two portable units are also with the site for rapid deployment for spot fires as needed (Figure 12).


Figure 12 Fire Fighting Trailer

The fire suppression requirements for any built asset/dwelling will be documented within the Building Licence application.

There is also a large stormwater dam, this can be deployed for refilling the water trucks and/or fire-fighting tanks if needed

### 5.5 Dwelling Construction

Any dwelling that is to be constructed or additions planned to existing dwellings shall be designed and built to conform with:

- The Shire of Boddington's specifications and requirements; ; and
- Australian Standards AS3959-2009 (Recommendations)- with a BAL-29 rating, construction sections 3 \& 7 of AS 3959-2009 apply; with a BAL-19 rating construction sections $3 \& 6$ of AS 3959-2009 apply; with a BAL 12.5 rating construction sections $3 \& 5$ apply.


### 5.6 Fire-Fighting Facilities

The property is serviced by the Boddington Volunteer Bushfire Brigade which is located on Chapman Road, approximately 38 km south-east of the site. This is a volunteer brigade and turn out times cannot be assured. The current Fire Control Officers for the area are Paul Patrick - ph: 0427470 346, Robert Sneigowski - ph: 0427556 327, Paul Carrotts - ph: 0428838053 and Dave Thompson - ph: 0428306 946. The managers $/$ site Manager should make themselves aware of any changes to this by contacting the Shire of Boddington prior to each fire season or noting changes listed in the Shire of Boddington's Annual Bushfire Notice, which is published and distributed to landowners annually. ${ }^{1}$.

The operation of the waste facility on days declared as a Total Fire Ban under Section 22C of the Bush Fires Act (1954) and Total Vehicle Movement Bans, declared by the Shire of Boddington, can be undertaken under an exemption under the proviso that:

- One able bodies person is available to undertake the role of " fire spotter";
- There is an adequate supply of clay/sand at the site for use on a fire outbreak;
- A minimum 1,000 litre quick response fire using with 20 m of 19 mm hose is available in the proximity of any work;
- One water truck with a minimum capacity of 15 kL is available;
- There is a bulk water supply of 100 kL ; and
- At least two able bodied persons remain at work for at least 30 minutes after the work is completed to ensure there is no occurrence of fire.

Note that the exemption for the Shire of Boddington's Harvesting and Total Vehicle Movement Ban requires approval by the Shire or their authorised representative such as the Chief Fire Control Officer.

[^2]
## 6 Conclusion.

This plan provides acceptable solutions and responses to the relevant performance criteria outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

The site itself will be cleared for land management purposes, and the proposed development of the area proposes no permanent dwellings, however a site office does exist and people will be accessing the site during the day once operational. Outside of the site area are large areas of standing vegetation including plantations and State forest with dense Class A Forest. Separation distances from infrastructure and the site office is more than 20 m in all instances, posing a Moderate Bushfire Hazard sufficient for protection of assets. Bushfire safety is a shared responsibility between governments, fire agencies, communities and landowners. The planning and building controls outlined in this plan will reduce the risk of bushfire to people and property. It will not remove all risk however. People interpret risk differently. The way they prepare and maintain their properties, buildings and assets and the actions they take (e.g. evacuate early or stay and defend) greatly influence their personal safety. Should any residents eventuate within the proposed Site, they need to maintain self-reliance and not wait or expect warnings or assistance from emergency services.

## 7 Summary

### 7.1 Overall Fire Threat

The design of the proposed expansion and the facilities to be established at the time of development are such that, with the implementation of this Bushfire Management Plan, fire threat to people and property within this development is significantly reduced.

### 7.2 Land Managers Responsibilities

The managers of the land will be responsible for:

- Being aware of the bushfire risk potentially affecting the property, with an understanding that bushfire threat can never be fully removed;
- Reading, understanding and complying with this Bushfire Management Plan;
- Maintaining Asset Protection Zones as specified in Section 5 (A2.1):
- Maintaining Access/Egress ways as specified in Section 5 (A 3.1)
- Maintain Fire Breaks as specified in Section 5.3;
- Preparing and implementing contingency measures in the event a bushfire should occur onsite;
- Responding to and complying with fire protection or hazard management notices issued by the local government;
- Maintaining, in good order and condition, all access gates and property fencing, ensuring that the fence does not encroach over the firebreak;


### 7.3 Shire of Boddington's Responsibilities

The responsibility for compliance with the law rests with individual property owner and occupiers and the following conditions are not intended to necessarily transfer some to the responsibilities to the Shire of Boddington.

The Shire of Boddington shall be responsible for:

- Monitoring bush fuel loads in road reserve, public reserves, POS areas and other areas of bushfire risk and maintaining fuel loads at safe levels;
- Maintain public roads to appropriate standards ensuring compliance with standards.
- Developing and maintaining District Fire-Fighting Facilities.
- Maintaining, in good order, the condition of the district water tanks and fire hydrants and the apparatus for firefighting purposes.
- Enforcement of the Annual Bush Fire Notice.
- Provision of fire prevention and preparedness advice to landowners upon request.


## 8 Compliance Checklist

The following comprises the completed checklist for performance criteria and acceptable solutions as stipulated in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

| Element |  |  |  |
| :--- | :--- | :--- | :--- |
| 1: Location | Yes | No | Comment |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A1.1? | $\checkmark$ |  |  |
| 2: Siting and design of development | Yes | No | Comment |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A2.1 | $\checkmark$ |  |  |
| 3: Vehicular access | Yes | No | Comment |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.1 | $\checkmark$ |  |  |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.2 |  |  | N/A. |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.3 |  |  | N/A. |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.4 |  |  | N/A |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.5 | $\checkmark$ |  |  |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.6 | $\checkmark$ |  | N/A |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.7 |  |  | N/A |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A3.8 | $\checkmark$ | Nemment |  |
| 4: Water sources and storage | No | Cos |  |
| Does the proposal comply with the performance criteria by <br> applying acceptable solution A4.1 | N |  | N |

## Applicant Declaration

This Bushfire Management Plan meets the requirements of SPP 3.7 and the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

I declare that the information proposed within this plan is true and correct to the best of my knowledge.

Gary McMahon (B.Sc. M. Env Mgmt. PG Dip Bushfire Protection)
for Ecosystem Solutions Pty Ltd.

BPAD Level 3. No. 35078

August 2017


## 9 References

DFES (2015). Map of Bush Fire Prone Areas. Department of Fire and Emergency Services. [available at www.dfes.wa.gov.au/bushfireproneareas].

FESA, WAPC \& Dept. of Planning (2010). Planning for Bushfire Protection. Edition 2. May, Government of Western Australia, Perth. WA.

FESA (2012). Visual Fuel Load Guide for Scrub Vegetation of the Swan Coastal Plain and Darling Scarp, including Geraldton Sandplains \& Leeuwin Ridge Regions of Western Australia. Bushfire and Environmental Protection Branch, Fire and Emergency Services Authority of Western Australia.

Tille, P.J. and Lantzke, N.C. (1990). Busselton-Margaret River-Augusta land capability study. Land Resources Series No. 5. Department of Agriculture, Western Australia.

WAPC (2015). Guidelines for Planning in Bushfire Prone Areas. Western Australian Planning Commission, Perth. WA.

WAPC (2015a). State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7). Western Australian Planning Commission, Perth. WA.

WAPC (2017) Guidelines for Planning in Bushfire Prone Areas. Version 1.1 February 2017. Western Australian Planning Commission, Perth. WA.

## 10 Glossary

AS 3959: Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas.

Asset Protection Zone (APZ): A low fuel area immediately surrounding a building.

BAL: Bushfire Attack Level (BAL) as set out in the Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS 3959), as referenced in the Building Code of Australia (as amended).

BAL Assessment: An assessment prepared in a manner and form set out in AS 3959 to determine a BAL. It is strongly recommended that BAL assessments are prepared by accredited Level 1 BAL Assessors, unless otherwise exempted in these Guidelines.

BAL Contour Map: A BAL Contour Map is a scale map of the subject lot/s illustrating the potential radiant heat impact and associated indicative BAL ratings in reference to any classified vegetation remaining within 100 metres of the assessment area after the development is complete. The intent of the BAL contour map is to identify land suitable for development based on the indicative BAL rating. It is strongly recommended that BAL Contour Maps are prepared by an accredited Bushfire Planning Practitioner.

Bushfire: An unplanned fire burning in vegetation. A generic term which includes grass fires, forest fires and scrub fires not with and without a suppression objective.

Bushfire hazard: The potential or existing flammability of vegetation that, in association with topography and slope, when ignited may cause harm to people and/or damage property and/or infrastructure.

Bushfire Hazard Level (BHL) assessment: A BHL assessment provides a measure of the likely intensity of a bushfire and the likely level of a bushfire attack on a site determined by categorising and mapping land as having a low, moderate or extreme Bushfire Hazard Level in accordance with the methodology set out in the Guidelines. It is strongly recommended that Bushfire Hazard Level assessments are prepared by an accredited Bushfire Planning Practitioner.

Bushfire Management Plan (BMP): A document that sets out short, medium and long term risk management strategies for the life of the development. It is strongly recommended that Bushfire Management Plans are prepared by accredited Bushfire Planning Practitioners in accordance with the requirements set out in the

Guidelines on behalf of the landowner/proponent with the assistance of the responsible authority for emergency services where required.

Bushfire Planning Practitioner: A person who holds Level Two or Level Three accreditation under the Western Australian Bushfire Association Framework.

Bushfire prone area: An area that has been designated by the Fire and Emergency Services Commissioner under s. 18P of the Fire and Emergency Services Act 1998 as an area that is subject, or likely to be subject, to bushfires. Such areas are identified on the Map of Bush Fire Prone Areas and can be found on the Department of Fire and Emergency Services website.

Bushfire Protection Criteria: A performance based system of assessing bushfire risk management measures contained in the Guidelines and applied to all strategic planning proposals, subdivisions and development applications.

Bushfire risk: The chance of a bushfire igniting, spreading and causing damage to people, property and infrastructure.

Bushfire risk management: Means the application of the bushfire protection criteria contained in the Guidelines.

Development application: An application for approval to carry out development or change a land use under either a local planning scheme or region planning scheme. This includes local development plans but excludes application for single houses and ancillary dwellings on a lot or lots less than $1,100 \mathrm{~m}^{2}$.

Guidelines: Refers to the Guidelines for Planning in Bushfire Prone Areas (WAPC 2015), as amended.

WAPC: Western Australian Planning Commission.

## 11 Maps




Suez Recycling \& Recovery Australia | Bushfire Management Plan





Suez Recycling \& Recovery Australia | Bushfire Management Plan

# Appendix A <br> - Shire of Boddington Firebreak and Fuel Hazard Reduction Notice 2016/2017 



TOWNSITES OF BODDINGTON AND RANFORD



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## Mr Craig Barker

SUEZ Recycling and Recovery Australia
116 Kurnall Road
WELSHPOOL WA 6106

## NORTH BANNISTER RESOURCE RECOVERY FACILITY - VISUAL IMPACT ASSESSMENT

## Dear Craig

SUEZ Recycling and Recovery Australia (SUEZ) requested Golder Associates Pty Ltd (Golder) to carry out a visual impact assessment of the North Bannister Resource Recovery Park (NBRRP) landfill from the Bibbulmun track.

The Bibbulmun track is located to the North and North West of the NBRRP as shown in Figure 1. The visual impact of the site was assessed from four vantage points (refer Table 1 and Figure 1).

Table 1: Vantage point location

| Vantage Point | Latitude $^{\mathbf{1}}$ | Longitude $^{\mathbf{1}}$ | Direction of View |
| :--- | :---: | :---: | :--- |
| 1 | -32.563568 | 116.377819 | East |
| 2 | -32.563568 | 116.377819 | South |
| 3 | -32.569074 | 116.369530 | South East |
| 4 | -32.572913 | 116.368631 | East |

${ }^{1}$ Co-ordinate system is World Geodetic System (WGS) 84
Figure 2 to Figure 5 show the views from the different vantage points.
The NBRRP landfill will be screened by vegetation from Vantage Point 1 and 2 and will only be visible from Vantage Point 3 and 4 . Figure 4 and Figure 5 show the landfill at completed height, prior to the establishment of vegetation from Vantage Point 3 and 4 respectively. Once vegetation has been established it is expected that the landfill will blend with the surrounding topography and that visual impact would be minimal.

During the operational phase SUEZ will commit to providing a visual screen as far as practical in the form of vegetation such as trees along the edge of their property. Progressive capping and planting of vegetation will take place as sections of the landfill is completed. During the operational phase SUEZ will aim to establish a 'green' wall along the western edge of the landfill cell to minimize visual impact.


Figure 1: Location plan showing Bibbulmun track and vantage points


Figure 2: Vantage Point 1, looking east. Landfill obscured by vegetation.


Figure 3: Vantage Point 2, looking south. Landfill obscured by vegetation.


Figure 4: Vantage Point 3, looking south east. Landfill shown at final height, prior to establishment of vegetation.


Figure 5: Vantage Point 4, looking east. Landfill shown at final height, prior to establishment of vegetation.
We trust this letter meets with your expectations, but should you have any questions please contact the undersigned.

Yours sincerely
GOLDER ASSOCIATES PTY LTD


Liza du Preez
Associate / Principal Landfill Engineer
LDP/GLR/hn

[^3]
# From: Linda Daniels: Bibbulmun Track Foundation [mailto:linda@bibbulmuntrack.org.au] Sent: Thursday, 31 August 2017 1:29 PM <br> To: Barker, Craig [craig.barker@suez.com](mailto:craig.barker@suez.com) <br> Subject: RE: North Bannister - Visual Impact Assessment 

Hi Craig
Thank you for the visual impact assessment and follow-up.
I will forward to the Board and look forward to continuing our discussion around sponsorship.
Kind regards
Linda

## Linda Daniels

Executive Director

Bibbulmun Track Foundation
T: (08) 94810551
F: (08) 94810546
E: linda@bibbulmuntrack.org.au
W: www.bibbulmuntrack.org.au


Enjoying the Track? Give something back... become a Member today.
From: Barker, Craig [mailto:craig.barker@suez.com]
Sent: Tuesday, 29 August 2017 3:11 PM
To: Linda Daniels: Bibbulmun Track Foundation
Subject: FW: North Bannister - Visual Impact Assessment
Hi Linda
Thanks for your time today and it was good catching up again. As discussed:
We remain happy talking more broadly to the board (in the city or on site at your preference)
SUEZ takes its role as responsible neighbour very seriously and it's great to hear none of your walkers have complained about our operations. We intend keeping it that way.
SUEZ remains receptive to supporting the local community and our immediate stakeholders where we can. We have operators and a substantial investment in equipment on site which can be utilised for track maintenance.
Kindly revert as soon as possible. We would obviously appreciate your support in our expansion plans and will work with you to ensure minimal impact to the track and its users.
Craig Barker
State Infrastructure Manager - Western Australia SUEZ Recycling \& Recovery Australia
SITA Australia is changing brand to SUEZ
Tel : +61 (0) 893507155
Mob: +61 (0) 408633684
Email: craig.barker@suez.com
suez.com.au
$22^{\text {nd }}$ July 2011
Linda Daniels
Executive Director
Bibbulmun Track Foundation
PO Box 7605
Cloister Square
PERTH WA 6850

Dear Linda,

## RE: PROPOSED NORTH BODDINGTON LANDFILL, LOT 2, ALBANY HIGHWAY, NORTH BANNISTER

Thank you for meeting with us yesterday to discuss the potential impact of our project on the Bibbulmun Track and Boonerring Hill.

Present at Meeting:

- Mike Wood - Chairman, Bibbulmun Track Foundation
- Patrick Tremiett - Board Member, Bibbulmun Track Foundation
- Linda Daniels - Executive Director, Bibbulmun Track Foundation
- Andrew Howe - TPG (The Planning Group)
- Bruce Bowman - Bowman and Associates
- Kim Gorey - Perthwaste Pty Lid

At the meeting Perthwaste presented and overview of the project and a Visual Impact Assessment (attached) from the Bibbuimun Track Foundation and Boonerring Hill.

To summarise the Visual Impact Assessment:

1. The Landfill will not be visible from the Bibbulmun Track at locations (1,2 and 3)

To minimise this Perthwaste Pty Ltd undertake at all times to maintain screening in the form of trees to ensure the Landfill is not visible from the track.


## PERTHWASTE

2. The Landfil will be visible from the Summit Boonerring Hill (Location 4).

It is acknowledged that from the summit the Landfill is visible. To reach the summit it is approximately a 20 minute walk from the Bibbulmun Track.
3. It was also agreed that Perthwaste Pty Lid and the Bibbulmun Track Foundation would have Bi-Annual meetings to discuss the Odour and Noise impact on the Bibbulmun Track.

These Meetings would commence once the facility is operational.
4. Both parties Perthwaste Pty Lid and Bibbulmun Track Foundation have agreed on a cooperative approach to resolve any issues that arise to ensure both facilities can co-exist.

Could you please confirm the receipt of this correspondence and confirmation that the Bibbulmun Track Foundation agrees to the co-operative approach to allow the faciilities to co-exist.

Please contact me should you have any queries.

Kind Regards

Kim Gorey
Managing Director


(1) Boonerngg kis. fortion of thctify visible from hill summit foot in BBblumum Tracty

(1) sibbulnun Track, Cleared atea between 2 hillis Factly screened by topography and vegetation


## appendix 6:

Traffic Impact Assessment - Shawmac 2017

Project:
Client:
Author:
Date:
Document \#

Lot 2 Albany Highway, Boddington
SUEZ Recycling \& Recovery Australia
Keli Li
$4^{\text {th }}$ July 2017
1705013-002

## Document Status

| Version | Document Status | Prepared By | Reviewed By | Approved By | Date |
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## 1. Summary

Shawmac was commissioned to assess the traffic impacts associated with the proposed expansion of North Bannister Waste Management Facility (WMF) located on Lot 2 Albany Highway, Shire of Boddington. The proposed expansion will increase the life of the WMF by approximately a further 20 years.

The assessment has been undertaken in accordance with the West Australian Planning Commission publication "Transport Impact Assessment Guidelines Volume 4-Individual Developments". The peak level of traffic generation from the site was estimated from operational characteristics provided by SUEZ, the operator of the facility.

Traffic was assigned to the adjacent existing road network and flows used as a basis for assessing traffic impacts associated with the site. Based on the assessment, it was shown that the existing and predicted flows can be accommodated within the existing network with minimal adverse impacts.

## 2. Introduction and Background

### 2.1. Proponent

Shawmac was commissioned by SUEZ Recycling \& Recovery Australia to assess the traffic impacts associated with the proposed expansion of North Bannister Waste Management Facility (WMF). The North Bannister WMF is located on Lot 2 Albany Highway, North Bannister in the Shire of Boddington.

### 2.2. Site Location and Land Use

Figure 1 shows the site location in relation to Perth.


Figure 1 - Site Location

Currently, the study site is developed as a Waste Management Facility and the current operation covers 19 hectare of 1,000 hectare of land. The existing site together with the surrounding area is shown in Figure 2.


Figure 2 - Site Aerial Photograph

### 2.3. Referenced Information

In undertaking the study, the information listed below was referenced:

- MRWA Functional Hierarchy Criteria
- MRWA Standard Restricted Access Vehicle (RAV) Route Assessment Guildelines - Version 4
- Austroads Guide to Road Design Part 4A - Unsignalised and Signalised Intersections.
- Austroads Guide to Traffic Management Part 3 - Traffic Studies and Analysis
- Australian Standard AS2890.2:2004 Parking Facilities Part 1 Off-Street Parking Facilities


## 3. Site Proposal

### 3.1. Regional Context

The site is located within the Shire of Boddington approximately 100 km to the southeast of Perth and 1.2 km to the north of North Banister Threeways Roadhouse. It has direct access to Albany Highway.

### 3.2. Land Use

The existing site is a Waste Management Facility and the proposed expansion of the landfill footprint will not change the land use of site. The existing site layout is shown in Appendix A. The proposed expanded landfill footprint is shown at Figure 4.

As shown in Shire of Boddington Local Planning Scheme No. 2 the study site is zoned as "Rural". This is shown in
Figure 3.


Figure 3 - Extract of Shire of Boddington Local Planning Scheme No. 2


AIRSPACE VOLUME $=9.500,000 \mathrm{~m}^{3}$


Figure 4 - Expanded Landfill Footprint

### 3.3. Hours of Operation

The facility will operate from 5:00 to 17:00 Monday to Friday and 5:00am to 13:00 on Saturday. The WMF currently accepts 350,000 tonnes of waste per annum. Total annual tonnage will remain unchanged with the expanded landfill footprint. Waste delivery will operate from 4:45 to 18:00. The existing and predicted average hourly truck movement into the site is provided in Table 1. The existing and predicted weekday daily and peak hour movements are summarised in Table 2. No public access is permitted to the site.

Table 1 - Existing and Predicted Daily Operating Schedule

|  | Average Number of Trucks |  |
| :---: | :---: | :---: |
| Time Period | Monday - <br> Friday | Saturday |
| $4: 45-5: 00$ | 2.7 | 0.8 |
| $5: 00-6: 00$ | 3.1 | 2.8 |
| $6: 00-7: 00$ | 2.6 | 1.4 |
| $7: 00-8: 00$ | 4.1 | 1.1 |
| $8: 00-9: 00$ | 3.7 | 1.6 |
| $9: 00-10: 00$ | 3.9 | 1.9 |
| $10: 00-11: 00$ | 3.9 | 1.6 |
| $11: 00-12: 00$ | 4.4 | 1.1 |
| $12: 00-13: 00$ | 3.5 | 1.2 |
| $13: 00-14: 00$ | 3.6 | 0.5 |
| $14: 00-15: 00$ | 3.6 | 0.1 |
| $15: 00-16: 00$ | 3.8 | 0 |
| $16: 00-17: 00$ | 1.5 | 0 |
| $17: 00-18: 00$ | 0.1 | 0 |

Table 2 - Existing and Predicted Weekday Daily and Peak Hour Traffic

|  | Number of Trucks |
| :---: | :---: |
|  | Existing and Predicted |
| Daily Traffic | 45 |
| AM Peak | 5 |
| PM Peak | 4 |

### 3.4. Major Attractors and Generators of Traffic

The development site is the traffic attractor. The generators of traffic will be the waste transfer stations located at Landsdale, Welshpool, Bibra Lake and Bayswater. Waste collection trucks and Pocket Road Trains will generally travel to the site along Tonkin Highway or Armadale Road and then Albany Highway.

## 4. Existing Situation

### 4.1. Existing Roads

## Albany Highway

Albany Highway is classified as a Primary Distributor road with RAV network 7 status according to the MRWA digital mapping website. Albany Highway at the site is described as a sealed and marked single carriageway road approximately 11.0 m sealed width with open roadside drains.

In the vicinity of the site Albany Highway has a posted speed limit and of $110 \mathrm{~km} / \mathrm{h}$ speed limit.
Figure 5 below shows the typical configuration of Albany Highway.


Figure 5 - Albany Highway Configuration

### 4.2. Road Hierarchy and Status

The existing and proposed operation involves waste delivery using collection trucks (8t) and 27.5m Pocket Road Trains (40t) which are classified as as-of-right vehicles and RAV 3 vehicles respectively.

Figure 6 and Figure 7 show the road hierarchy and Restricted Access Vehicle categories for the road network adjacent to and around the site. Table 3 shows the permitted Prime Mover and trailer combinations for Albany Highway.

Table 3 - Prime Mover and Trailer Combinations

| Road Name | Prime Mover and Trailer Combinations | Length | Max permitted <br> mass |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Albany |  |  |  |  |  |
| Highway | Category | (A) PRIME MOVER TOWING SEMI TRALER AND B DOUBLE |  | <= | 107.5 Tonnes |



Figure 6 - Road Hierarchy (Source MRWA website)


Figure 7 - RAV Network (Source MRWA website)

### 4.3. Road Hierarchy vs Actual Flows

Table 4 details the comparison of flows against the maximum desirable flows under the MRWA Road Hierarchy Criteria.

Table 4 - Desirable Maximum Flows vs Actual Flows

| Location and date of count. |  | Classification | Desirable Maximum <br> Traffic Volume (vpd) | Actual Daily Traffic <br> Flows (vpd) |
| :--- | :---: | :---: | :---: | :---: |
| Albany Highway | North of North Bannister Rd | Primary Distributor | $<35,000$ vpd. | 3,541 |

A comparison of the figures and the classification limit indicates that Albany Highway is operating well within its desirable limits.

## 5. Transport Assessment

### 5.1. Assessment Years

The development is assessed on increasing the per annum volumes in 2017 and current network conditions.

### 5.2. Time Periods for Assessment

Assessment is based on Albany Highway daily traffic and peak hour periods.

### 5.3. Other Development

No development in the vicinity of the site has been identified that would significantly alter current traffic generation or have the potential to affect this assessment.

### 5.4. Traffic Generation

The traffic generation of movements to and from the site due to the expansion was determined based on information provided by the operator of the facility. Current 17 staff are employed on-site. The expanded footprint will require up to an additional 5 staff for a total of 22 on-site staff. The expanded footprint will not result in an increase in collection vehicle or pocket road train movements to and from the WMF at current annual tonnages. Light vehicle movements generated by staff are expected to occur during morning and afternoon peak hours. Daily trip generation is summarised below in Table 5 and peak hour trip generation is summarised in Table 6 (hourly truck numbers are roundup values from Table 1). Note: the current WMF did not start operating until July 2014 so the traffic count which recorded during $26^{\text {th }}$ of April and $7^{\text {th }}$ May 2014 does not contain traffic generated from the WMF. Traffic generation is therefore fully applied onto the 2014 traffic count in order to assess the traffic impacts of the "existing" and expanded WMF.

Table 5 - Daily Traffic Generation

| Vehicle Type | Inbound Daily <br> Vehicle Movement | Outbound Daily <br> Vehicle Movement | Total Daily Vehicle <br> Movement |
| :--- | :---: | :---: | :---: |
| Employee Vehicles | 22 | 22 | 44 |
| Waste Delivery Vehicles (Collection Trucks) | 15 | 15 | 30 |
| Pocket Road Train | 30 | 30 | 60 |
| Total | 67 | 67 | 134 |

Table 6 - Peak Hour Distribution

| Vehicle Type | AM Peak 11:45-12:45 |  | PM Peak 13:30-14:30 |  |
| :--- | :---: | :---: | :---: | :---: |
|  | AM Peak in | AM Peak out | PM Peak in | PM Peak out |
| Employee Vehicles (Assuming 50\% of <br> employees arriving/leaving during AM/PM <br> peak) | 11 | 0 | 0 | 11 |
| Waste Collection Trucks and Pocket Road <br> Trains | 5 | 5 | 4 | 4 |
| Total | 16 | 5 | 4 | 15 |

### 5.5. Distribution

The distribution of traffic is expected to be to and from the north along Albany Highway. The impact on adjacent roads is summarised in Table 6.

Table 7 - Traffic Prediction Adjacent Network

| Location | Daily Traffic - Existing / <br> Predicted <br> $(\mathrm{ypd})$ | MRWA Indicative <br> Traffic Volume. <br> $($ vpd) | AM Peak Hour Traffic - <br> Existing / Predicted <br> $($ vph $)$ | PM Peak Hour Traffic - <br> Existing / Predicted <br> (vph) |
| :--- | :---: | :---: | :---: | :---: |
| Albany <br> Highway | $3,541 / 3,675$ | $<35,000$ (Primary <br> Distributer) | $263 / 284$ | $283 / 302$ |

### 5.6. Site Access

Truck and light vehicle access will be from an existing access driveway connecting Albany Highway.

### 5.6.1. Intersection Capacity

The site generated traffic is spread relatively evenly throughout the day and therefore the volume of traffic generated during the typical road network peak hours is low. As such a detailed capacity analysis of the Site Access / Albany Highway intersection is not warranted.

### 5.6.2. Intersection Geometry

The layout of the intersection of Site Access and Albany Highway intersection was assessed in accordance with Austroads "Guide to Road Design - Part 4A: Unsignalised and Signalised Intersections". Based on the predicted major road traffic flows ( 136 peak hour vehicle movements on southbound lane) and predicted right turn movements (16 movements - existing and expansion), the development falls within the BAR/BAL area of the graph as shown in Figure 8.

The layout of the intersection of Site Access and Albany Highway is shown below in Figure 9. An approximately 230 m long right-turn pocket (Auxiliary Lane) has been provided. Albany Highway in the vicinity of the site has a low traffic volume and the right-turn pocket provides excellent storage capacity for queueing of trucks. The existing intersection layout is therefore considered adequate and no modifications are required.


Figure 8 - Intersection Configuration Assessment


Figure 9-Intersection Configuration

### 5.6.3. Crossover Geometry

The geometry of the existing site access was assessed in accordance with The Australian Standard AS2890.2:2002 Parking Facilities Off-Street Commercial Vehicle Facilities. Based on the proposed site layout, the site crossover complies with the requirements.

### 5.6.4. Access Sight Distance

Albany Highway in the vicinity of the site is on a $2 \%$ to $3 \%$ down grade north to south and has a relatively straight alignment. The required Stopping Sight Distance and Entering Sight Distance from the site egress is defined in accordance with Appendix E and F of MRWA RAV Assessment Guidelines as provided in Appendix C. A desktop review concluded that minimum sight distance in and out of the site could be achieved.

## 6. Parking Assessment

Detailed parking provision and bay dimensions are not shown on site plan, however as indicated by the client, there will be ample parking provided for the site employees.

## 7. Site Specific and Safety Issues

The crash history of the roads surrounding the site for the five-year period ending December 2016 was accessed via the MRWA Crash Analysis Reporting System (CARS).

The report indicated that:

- There were 10 recorded crashes on Albany Highway in the section between Wearne Road (SLK 89.63) and North Bannister Road (SLK 92.34), including:
- 4 "Rear End" crash,
- 2"Non-Collision" crash,
- 2 "Hit Object" crash and
- 2"Other / Unknown"

The existing site access is located at approximately SLK 90.63 and the two nearest crashes occurred at SLK 90.39 and SLK 90.83 which are more than 200 m away from the site access.

The crash history does not indicate any unacceptable hazards currently existing in the road environment and it is anticipated that the development will not adversely impact the crash pattern.

It is also worth to note that there are warning signage erected in the vicinity of the site entrance to alert drivers when they are traveling along the Road Train Route and approaching site access.

- A warning sign to alert northeast-bound drivers when overtaking Road Trains is located 3 km to the northwest of the site access on Albany Highway as shown in Figure 10.
- "Road Trains Entering" warning signs are located 500 m to the southeast and northwest of the site access along Albany Highway as shown in Figure 11.

Figure 10-Road Train Route Sign


Figure 11 - Road Trains Entering Warning Sign

## 8. Conclusions

This Transport Impact Statement has been prepared to assess the traffic impacts associated with the existing and proposed expansion of North Bannister WMF at Lot 2 Albany Highway, North Bannister. Based on this review the following conclusions have been made:

- The expected increase in traffic using Albany Highway is predicted to be in the order of 134 vehicle movements per day over 2014 pre-WMF traffic flows, with peak hour vehicle movements to be 16 during morning peak hour and 15 during afternoon peak hour.
- The overall development will be serviced by an existing crossover off Albany Highway and there is clear sight distance in both directions from the access location to vehicles travelling along Albany Highway and there are no anticipated safety issues.
- The intersection of Site Access and Albany Highway has sufficient capacity to carry the site generated traffic and the existing AUR treatment is sufficient to cater for the existing and additional truck movements.
- Provision of car parking is considered adequate as the parking demand will predominantly be for the onsite employees.


## Appendix A - Existing Site Layout Plan



## Appendix B - Traffic Count

## Volume by Hour

## 26 Apr 2014 to 07 May 2014

Albany Hwy (H001)
Count:Classification Counts
North of North Bannister Rd (SLK 92.33)

| Average Vehicle Volume |  |  |  |  |  |  |  |  | Both Directions |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Hour | Mon $\boldsymbol{x}^{\text {a }}$ | Tue as | Wed es | Thu as | Fria | Sat | Sun ${ }^{\text {a }}$ | Mon - Fri | Mon - Sun |
|  | 0000 | 10 | 18 | 17 | 10 | 18 | 21 | 10 | 15 | 15 |
|  | 0100 | 10 | 10 | 12 | 15 | 6 | 12 | 6 | 11 | 10 |
|  | 0200 | 4 | 11 | 11 | 16 | 7 | 9 | 4 | 10 | 9 |
|  | 0300 | 17 | 22 | 22 | 21 | 11 | 13 | 5 | 19 | 16 |
|  | 0400 | 38 | 45 | 26 | 21 | 41 | 14 | 11 | 34 | 28 |
|  | 0500 | 119 | 99 | 90 | 84 | 81 | 35 | 22 | 95 | 76 |
|  | 0600 | 190 | 148 | 141 | 125 | 128 | 76 | 43 | 146 | 121 |
|  | 0700 | 178 | 171 | 163 | 139 | 157 | 113 | 70 | 162 | 142 |
|  | 0800 | 222 | 196 | 177 | 223 | 183 | 180 | 131 | 200 | 187 |
|  | 0900 | 221 | 232 | 166 | 207 | 260 | 222 | 193 | 217 | 214 |
|  | 1000 | 256 | 250 | 253 | 225 | 304 | 270 | 293 | 258 | 284 |
|  | 1100 | 288 | 234 | 224 | 219 | 273 | 318 | 350 | 248 | 272 |
|  | 1200 | 323 | 247 | 236 | 213 | 288 | 319 | 414 | 261 | 291 |
|  | 1300 | 299 | 252 | 280 | 262 | 326 | 348 | 443 | 280 | 313 |
|  | 1400 | 339 | 261 | 242 | 214 | 308 | 360 | 471 | 273 | 314 |
|  | 1500 | 275 | 258 | 241 | 278 | 323 | 344 | 474 | 275 | 313 |
|  | 1600 | 258 | 246 | 240 | 270 | 385 | 294 | 432 | 280 | 304 |
|  | 1700 | 228 | 205 | 194 | 236 | 318 | 213 | 322 | 236 | 245 |
|  | 1800 | 211 | 179 | 166 | 162 | 269 | 153 | 203 | 197 | 192 |
|  | 1900 | 129 | 105 | 88 | 114 | 182 | 80 | 151 | 124 | 121 |
|  | 2000 | 89 | 66 | 63 | 80 | 105 | 59 | 91 | 81 | 79 |
|  | 2100 | 52 | 47 | 42 | 55 | 77 | 49 | 53 | 55 | 54 |
|  | 2200 | 52 | 40 | 41 | 32 | 52 | 34 | 47 | 43 | 43 |
|  | 2300 | 24 | 17 | 17 | 14 | 35 | 23 | 14 | 21 | 21 |
|  | Total | 3830 | 3359 | 3132 | 3235 | 4135 | 3559 | 4253 | 3541 | 3644 |
| Peak Statistics |  |  |  |  |  |  |  |  |  |  |
|  |  | Mon | Tue ${ }^{\text {ar }}$ | Wed es | Thu as | Frias | Sat 4 | Sun ex | Mon - Fri | Mon - Sun |
| AM | 1/4 Hour | 1100 | 1045 | 1045 | 0830 | 1045 | 1100 | 1145 | 1045 | 1045 |
|  | $1 / 4 \mathrm{Hr} \mathrm{Vol}$ | 86 | 72 | 71 | 75 | 99 | 84 | 94 | 73 | 75 |
|  | 1 Hour | 1045 | 1145 | 1145 | 1015 | 1130 | 1115 | 1145 | 1145 | 1145 |
|  | 1 Hr Vol | 309 | 259 | 254 | 247 | 306 | 320 | 402 | 263 | 296 |
|  | 1 Hr Fact | . 8983 | . 9811 | . 9007 | . 8821 | . 8407 | . 9412 | . 8701 | . 9132 | . 9631 |
| PM | 1/4 Hour | 1415 | 1545 | 1330 | 1600 | 1630 | 1430 | 1515 | 1330 | 1330 |
|  | 1/4 Hr Vol | 109 | 78 | 74 | 82 | 113 | 103 | 138 | 75 | 84 |
|  | 1 Hour | 1330 | 1415 | 1315 | 1515 | 1600 | 1345 | 1430 | 1330 | 1330 |
|  | 1 Hr Vol | 345 | 268 | 281 | 306 | 385 | 364 | 498 | 283 | 323 |
|  | 1 Hr Fact | . 7913 | . 8933 | . 8818 | . 9329 | . 8518 | . 8878 | . 9022 | . 9449 | . 9594 |

## Class By Day

Albany Hwy (H001)
N of North Bannister Rd (SLK 92.33)

| Vehicle Classification Austroads 1994 |  |  |  |  |  |  |  |  |  |  |  |  |  | Both Directions |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Class |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Heavy | Total |
| Monday |  | 2862 | 153 | 187 | 39 | 7 | 8 | 26 | 15 | 91 | 102 | 328 | 3 | 806 | 3815 |
| \% | 6 | 75.0 | 4.0 | 4.9 | 1.0 | 0.2 | 0.2 | 0.7 | 0.4 | 2.4 | 2.7 | 8.6 | 0.1 | 21.1 |  |
| Tuesday |  | 2375 | 114 | 200 | 33 | 5 | 10 | 22 | 23 | 111 | 92 | 367 | 3 | 866 | 3349 |
| \% | 6 | 70.9 | 3.4 | 6.0 | 1.0 | 0.1 | 0.3 | 0.7 | 0.7 | 3.3 | 2.7 | 11.0 | 0.1 | 25.9 |  |
| Wednesday |  | 2238 | 101 | 182 | 34 | 7 | 7 | 17 | 17 | 83 | 84 | 343 | 4 | 778 | 3112 |
| \% | 6 | 71.9 | 3.2 | 5.8 | 1.1 | 0.2 | 0.2 | 0.5 | 0.5 | 2.7 | 2.7 | 11.0 | 0.1 | 25.0 |  |
| Thursday |  | 2320 | 117 | 184 | 30 | 5 | 8 | 14 | 21 | 84 | 78 | 371 | 3 | 798 | 3235 |
| \% | 6 | 71.7 | 3.6 | 5.7 | 0.9 | 0.2 | 0.2 | 0.4 | 0.6 | 2.6 | 2.4 | 11.5 | 0.1 | 24.7 |  |
| Friday |  | 3143 | 187 | 238 | 44 | 7 | 14 | 19 | 26 | 76 | 68 | 304 | 9 | 805 | 4135 |
| \% | 6 | 76.0 | 4.5 | 5.8 | 1.1 | 0.2 | 0.3 | 0.5 | 0.6 | 1.8 | 1.6 | 7.4 | 0.2 | 19.5 |  |
| Saturday |  | 2884 | 308 | 140 | 21 | 5 | 15 | 17 | 9 | 26 | 17 | 110 | 2 | 362 | 3548 |
| \% | 6 | 81.3 | 8.7 | 3.9 | 0.6 | 0.1 | 0.4 | 0.5 | 0.3 | 0.7 | 0.5 | 3.1 | 0.1 | 10.2 |  |
| Sunday |  | 3668 | 273 | 151 | 18 | 3 | 12 | 22 | 2 | 16 | 22 | 56 | 3 | 305 | 4241 |
| \% | 6 | 86.5 | 6.4 | 3.6 | 0.4 | 0.1 | 0.3 | 0.5 | 0.0 | 0.4 | 0.5 | 1.3 | 0.1 | 7.2 |  |


| Class | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Heavy | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ADT (M-S) | 2784 | 179 | 183 | 31 | 6 | 11 | 20 | 16 | 70 | 66 | 268 | 4 | 675 | 3634 |
| \% | 76.6 | 4.9 | 5.0 | 0.9 | 0.2 | 0.3 | 0.6 | 0.4 | 1.9 | 1.8 | 7.4 | 0.1 | 18.6 |  |
| AWT (M-F) | 2588 | 134 | 198 | 36 | 6 | 9 | 20 | 20 | 89 | 85 | 343 | 4 | 810 | 3529 |
| \% | 73.3 | 3.8 | 5.6 | 1.0 | 0.2 | 0.3 | 0.6 | 0.6 | 2.5 | 2.4 | 9.7 | 0.1 | 23.0 |  |
| Weekend | 3276 | 291 | 146 | 20 | 4 | 14 | 20 | 6 | 21 | 20 | 83 | 3 | 337 | 3895 |
| \% | 84.1 | 7.5 | 3.7 | 0.5 | 0.1 | 0.4 | 0.5 | 0.2 | 0.5 | 0.5 | 2.1 | 0.1 | 8.7 |  |

Heavy $=$ Classes 3-12

Appendix C - Sight Distance Requirements - MRWA RAV Assessment Guidelines

## APPENDIX E - STOPPING SIGHT DISTANCES

| Operating <br> Speed <br> $\mathrm{km} / \mathrm{h}$ | Downhill |  |  | Level | Uphill |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $-9 \%$ | $-6 \%$ | $-3 \%$ |  | $3 \%$ | $6 \%$ | $9 \%$ |

RAVs Categories 2-6

| 60 | $\cdot$ | $\cdot$ | 120 | 109 | 101 | 94 | 89 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathbf{7 0}$ | $\cdot$ | $\cdot$ | 151 | 137 | 126 | 118 | 111 |
| 80 | $\cdot$ | $\cdot$ | 184 | 167 | 154 | 143 | 135 |
| 90 | $\cdot$ | $\cdot$ | 218 | 198 | 183 | 171 | 161 |
| 100 | $\cdot$ | $\cdot$ | 255 | 232 | 214 | 200 | 188 |

## APPENDIX F - ENTERING SIGHT DISTANCES

| Operating Speed km/h | Downhill (approaching traffic) |  |  |  | Level | Uphill (approaching traffic) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | -8\% | -6\% | -4\% | -2\% |  | 2\% | 4\% | 6\% | 8\% |

RAVs Categories 2-4

| 40 | 97 | 94 | 92 | 90 | 88 | 87 | 86 | 85 | 84 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 50 | 130 | 126 | 123 | 120 | 117 | 115 | 113 | 111 | 110 |
| 60 | 167 | 162 | 157 | 152 | 149 | 146 | 143 | 140 | 138 |
| 70 | 209 | 201 | 194 | 188 | 183 | 179 | 175 | 172 | 169 |
| 80 | 253 | 243 | 234 | 227 | 220 | 215 | 210 | 205 | 201 |
| 90 | 302 | 289 | 278 | 268 | 260 | 253 | 247 | 241 | 236 |
| 100 | 364 | 346 | 331 | 318 | 307 | 298 | 290 | 282 | 276 |
| 110 | 448 | 422 | 400 | 382 | 367 | 353 | 342 | 332 | 323 |

development application plans:

Plan 001 : Existing Site Plan<br>Plan 002 : Proposed Site Plan<br>Plan 003 : Cell Layout Plan<br>Plan 004 : Final Landform Layout Plan<br>Plan 005 : Typical Sections and Details








[^0]:    ${ }^{1}$ Please note that the proposed capping system is provisional only and is likely to be different to the system that will ultimately be constructed. The final capping system will be based on a risk assessment.

[^1]:    [1] http://www.daa.wa.gov.au/en/Heritage-and-Culture/Aboriginal-heritage/Aboriginal-Site-and-other-HeritagePlaces/

[^2]:    ${ }^{1}$ As at December 2016, the Chief Bush Fire Control Officer for the location can be contacted on 0427838137 (Greg Day) and the Deputy Chief Bush Fire Control Officer can be contacted on 0427988705 (William Batt). This information should be updated by the owners annually. DFES Emergency Information Line is 1300657209.

[^3]:    j:\env\2016 - environment\1671227 suez env studies nth bannister\correspondence outl003 visual assessment\1671227-003-I-rev0.docx

