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SPECIALISTS IN LIVING AND WORKING PLACES

PROPOSED REGIONAL LANDFILL
FERNVIEW FARM, GINGIN

Prepared for:

Veolia Environmental Services Australia Pty Ltd
4-6 Rivers Street
BIBRA LAKE WA 6163

Report Date: 30 April 2008
Project Ref: 2006/058, V10
ENVIPERT00035AA-Preliminary Site Investigation

Written/Submitted by:	Reviewed/Approved by:
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SPECIALISTS IN LIVING AND WORKING PLACES

30 April 2008

The Director
EPA Service Unit
4th Floor, 168 St Georges Terrace
Perth WA 6000

Attention: I-Lyn Loo

Dear I-Lyn

RE: Proposed Regional Landfill, Fernview Farm, Gingin

Attached is a final version of the EPS documentation for the Gingin Landfill.

The revised documentation has been adjusted to reflect comments received on the original and also includes copies of the comments made and our responses as an appendix (Appendix O) to ensure that the content of our response is clear.

We are keen for this matter to be listed with the EPA at the earliest opportunity

For and on behalf of Coffey Environments Pty Ltd

pp N D Morton.

Noel Davies
Manager - Environmental Services, WA

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ABBREVIATIONS

AGO	Australian Greenhouse Office
AHD	Australian Height Datum
AWT	Alternative Waste Technology
bgl	below ground level
BOD	Biological Oxygen Demand
°C	Degrees Celsius
CALM	Department of Conservation & Land Management (now Department of Environment and Conservation
CEO	Chief Executive Officer
Cllr	Councillor
COD	Chemical Oxygen Demand
CQA	Construction Quality Assurance
DEC	Department of Environment & Conservation
DoE	Department of Environment
DRF	Declared Rare Flora
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EPBC Act	*Environmental Protection & Biodiversity Act 1999*
EPS	Environmental Protection Statement
FML	Flexible Membrane Liner
GCL	Geo-synthetic Clay Liner
GLCDC	Gingin Land Conservation District Committee
ha	hectare
HDPE	High Density Polyethylene

ABBREVIATIONS

kL	kilolitres
km	kilometres
km/hr	kilometres per hour
LDPE	Low Density Polyethylene
LFG	Landfill Gas
MLA	Member of Legislative Assembly
MLC	Member of Legislative Council
Mm^3	Million cubic metres
mm	millimetre
m	metre
MP	Member of Parliament
m/s	metres per second
MSW	Municipal Solid Waste
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
PCB	Polychlorinated Biphenyl
PM	Particulate Matter
SWL	Standing Water Level
TEC	Threatened Ecological Community
t	tonnes
tpa	tonnes per annum

ABBREVIATIONS

µm	Micro metre
VES	Veolia Environmental Services Pty Ltd
v/v	'by volume'
WA	Western Australia
WAPC	Western Australian Planning Commission
WMB	Waste Management Board

EXECUTIVE SUMMARY

Project Outline

Veolia Environmental Services Australia Pty Ltd (VES) proposes to construct and operate a landfill facility within the Shire of Gingin. The proposed site is approximately 16km northeast of the Gingin townsite, in an area zoned 'Rural' under the Shire of Gingin's Town Planning Scheme No. 8 (Shire of Gingin, 1997). This zoning permits for noxious industries at the discretion of the Shire (Shire of Gingin, 1997). A draft Town Planning Scheme No. 9 was drafted in 2003 which includes as one of it aims '*to promote the Gingin Shire as an opportune location for regional development of industry, infrastructure, and other specialised regional facilities*'

Figures 1-3 depict the site's regional location, an aerial photo and the surrounding land uses. The site has been carefully selected to achieve a buffer distance from surrounding residences and to minimise the impacts on visual amenity. The nearest residence is Fernview Farm located approximately 1.95km to the south of the proposed facility, within Lot 7778. Beyond Lot 7778, the nearest residence to the facility is approximately 2.3km to the north east (Figure 4).

The landfill will be constructed in a series of stages, each of which will have the capacity to accept approximately 12-18 months of waste at the design throughput for the facility of 100,000tpa-150,000tpa. Each of the stages will consist of a number of cells. The initial design life of the facility is approximately 25 years. However, the intention is that once the processes that act to decompose the organic content of the waste are complete, the stages will be excavated and the waste screened to recover the organic material as compost. The key characteristics of the proposed landfill facility are presented in Table A1 below.

VES originally proposed to construct a bioreactor landfill at Gingin, A bioreactor landfill requires the controlled injection of a quantity of selected organic rich liquid waste such as biosolid sludges to work efficiently but at this point in time approval for such a landfill is not possible under the current statutory framework as there is no landfill classification which would allow controlled injection of liquid wastes. Under the current descriptions of the various landfill classifications only solid spadeable waste are able to be accepted. It is understood that a review of the various landfill classification categories is already underway with a view to adding a new category of bioreactor landfill to the list licenced premises.

Once this review of landfill classification categories is complete and the subsequent bioreactor landfill classification gazetted VES plan to apply for approval for a bioreactor landfill at Gingin.

TABLE A1
KEY CHARACTERISTICS OF THE PROPOSAL

PARAMETER	DETAILS
Site Area	• Approximately 405 Acres (163.9ha)
Landfill Area	• Approximately 29ha.
Landfill Depth	• 25-60m
Landfill Airspace Capacity	• Approximately 4.75Mm^3
Post Capping Contours	• The maximum height will not exceed 225m AHD.

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PARAMETER	DETAILS
Operating Hours for Waste Acceptance	• Monday to Friday - 0700 – 1700 • Saturday - 0700 – 1600 • Open for public holidays (excluding Good Friday & Christmas Day) except for exceptional circumstances.
Operational Life (total)	• Nominal life of 25 years.
Nominal Waste Acceptance Rate	• 100,000 to 150,000 tonnes per annum
Landfill Design	• The facility will be designed in accordance with the DoE's 2005 guidelines for the Siting, Design, Operation and Rehabilitation of Landfills.

The facility design incorporates a high integrity lining and capping system, landfill leachate and gas management systems, which together with surface water controls will protect ground and surface waters from contamination. The design of the lining and leachate management systems conforms to the recommendations contained in the Draft *Siting, Design, Operation and Rehabilitation of Landfills* guidelines published by the former Department of Environment (now the Department of Environment and Conservation) in 2005.

VES will operate the facility to ensure that off-site impacts normally associated with the operation of landfills (litter and odour) are maintained to acceptable levels.

This document also presents information on the geology and hydrogeology of the site which confirms that the site characteristics are favourable for a landfill development.

VES has maintained an extended interaction with the community since this proposal was first presented to the Shire of Gingin in October 2004. This has included:

- Meetings with the shires of Gingin and Chittering;
- Briefings with key stakeholders including:
    - Neighbouring property owners;
    - Action Group Against Stable Fly;
    - Gingin Land Conservation District Committee;
    - WA Farmers Federation;
    - Moore Catchment Council;
    - Concerned Citizens Against Waste;
    - Gingin Property Rights Group; and
    - Ellen-Brockman Integrated Catchment Group

VES has developed a question and answer document to provide summary information to interested parties. This document has become an evolving document as different parties raise issues of interest or concern not previously considered by VES.

EXECUTIVE SUMMARY

Key Environmental Factors

The key environmental factors for this project that have been assessed in this referral document are:

Biophysical

- Flora
- Fauna

Pollution Management

- Air Quality- Dust
- Air Quality – Odour
- Air Quality - Landfill Gas Emissions and Greenhouse Gases
- Water Quality – Surface Water and Groundwater
- Noise

Social Surroundings

- Transport
- Amenity – Visual
- Amenity – Litter
- Amenity – Fire
- Amenity – Vermin, pest and nuisance species control

A summary of the proposal characteristics, potential environmental impacts and proposed management measures to mitigate those impacts is presented in Table 7.

VES's environmental commitments are presented in Table A2.

Based on the assessment of each environmental factor, it is concluded that the Environmental Protection Authority's objectives for each factor will be achieved given the nature of the proposal, characteristics of the existing environment, proposed environmental management measures and environmental commitments proposed by VES.

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TABLE A2

PROPONENT ENVIRONMENTAL COMMITMENTS

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
1	Environmental Management	To ensure all aspects of project construction and operation are conducted such that environmental impacts are minimised as far as practicable, and that regulatory requirements are complied with.	1. The following environmental impacts will be minimised and controlled by the design of the landfill and site operational procedures. The procedures will be updated as required to reflect any changes in the design, construction and operation of the proposed facility. The operational procedures will then be implemented through a VES Environmental Management System. • Waste Acceptance Criteria (Commitment 4); • Air Emissions and Dust (Commitment 5); • Surface Water, Storm Water and Groundwater (Commitment 6); • Noise and Vibration (Commitment 7); • Solid and Liquid Waste (Commitment 8); • Flora, Fauna and Vegetation Management Plan (Commitment 9); and • Amenity – Visual, Litter, Fire and Vermin, Pest and Nuisance species control (Commitment 11). 2. The following management plans will be prepared prior to lodging a Works Approval Application: • Fire Management Plan; • Spill Response and Management Plan; • Landfill Contingency Management Plan (see commitment 2); • Decommissioning & Aftercare Management Plan (see commitment 3); and • Landscape Rehabilitation Management Plan (see commitment 10). 3. Implementation of the approved Environmental Management Program (EMP).	Prior to lodging a Works Approval application	DEC

EXECUTIVE SUMMARY

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
2	Landfill Contingency Management		1. Prepare a Landfill Emergency Response Plan which will address, but will not be limited to the following: • Delivery of wastes that do not conform to the site waste acceptance criteria (Section 3.1.1); • Response to fire (either on-site or on adjacent land, see Commitment 1 above); • Unusual climatic conditions, such as extreme rainfall events; • Bomb threat; • Waste vehicle rollover, vehicle accident or waste fire transit; • Failures of the stormwater management, lining or leachate management systems; and • Detection of contamination by the groundwater or surface water monitoring regime (Section 5.6). 2. Implementation of the approved landfill contingency management plan including regular staff training.	Prior to operation	DEC
3	Decommissioning & Aftercare Management Plan	To provide the framework to ensure that the site is left in an environmentally acceptable condition at closure.	1. Prepare a Preliminary Decommissioning & Aftercare Management Plan prior to lodging a Works Approval Application, which will address but will not be limited to the following: • Management procedures detailed in Section 3.3.7. • Conceptual plans for the removal of site infrastructure; • Conceptual plans for the final landform and landfill profile; • A conceptual rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders; • A conceptual plan for post closure management of the leachate management and landfill gas systems; • Long-term monitoring and maintenance schemes; and	Prior to lodging a Works Approval application	DEC/Shire of Gingin

EXECUTIVE SUMMARY

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
			• Preliminary plans for management of the landfill cap and landscape vegetation. 2. Preparation of a Final Decommissioning and Aftercare Management Plan at least 6 months prior to decommissioning, or at a time to be agreed with the EPA, which will address but will not be limited to the following: • The management measures detailed in Section 3.3.7. • Final plans for the removal of infrastructure; • Final plans for the final landform, landfill profile and planting regime; • A final rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders; • A final plan for post closure management of landfill leachate and landfill gas; and • Final plans for management of the landfill cap and landscape vegetation. 3. Implementation of the approved Final Decommissioning & Aftercare Plan.	At least six months prior to the anticipated date of decommissioning or at a time to be agreed with the EPA	
4	Waste Acceptance Management	To ensure that all waste accepted for disposal complies with relevant guidelines and the conditions of the site licence.	1 Waste will be accepted at the facility in accordance with the procedures detailed in Section 3.1.1. The procedures will be updated prior to lodging a Works Approval Application and will address the following: • Procedures at the weighbridge and hours of operation; • Criteria for acceptance of waste for disposal; and • Documentation and record keeping including analytical testing requirements. 2. Implementation of the approved waste acceptance procedures.	Prior to lodging a works approval application Ongoing through the life of the project	DEC

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NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
5	Air Emissions Management	To protect surrounding land users such that gaseous and particulate emissions will not adversely affect their welfare and amenity or cause health problems.	1. Air emissions will be minimised through the design of the landfill and managed through procedures detailed in Sections 5.3, 5.4 and 5.5. The management procedures address the following, which will be updated prior to operation to reflect any design or operational changes: • Construction stage impacts; • The use of water sprays during dry and windy conditions; • The use of speed limits to minimize dust generated by vehicle movements; • The use of minimum drop heights when loading and unloading soils and other excavated materials; • Minimisation of areas of disturbed and/or exposed soils; • Management and covering of waste to limit odour emissions; • Operation of the landfill gas management system; • Incident management; • Responsibilities; • Monitoring requirements; • Response, mitigation and contingency measures; • Reporting requirements; • Employee training and awareness; and • Implementation of a complaint management procedure to receive, investigate and action dust and odour complaints. 2. Implementation of the approved air emissions management procedures.	Prior to lodging a works approval application Ongoing through the life of the project	DEC

EXECUTIVE SUMMARY

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
6	Surface Water and Groundwater Management	To manage the potential effects of the operation on surface water and to maintain existing flow paths and water quality where possible. To monitor surface and ground water quality and identify and mitigate sources of contamination during construction and operation.	1. Surface water and groundwater will be protected by the design of the facility and managed in accordance with the management procedures detailed in Section 5.6.4 and Appendix H "Preliminary Surface Water, Groundwater and Landfill Leachate Management Plan". The management procedures address the following, which will updated prior to operation to reflect any design or operational changes: • Management of contaminated surface water runoff; • Diversion of clean surface water around the landfill and removal of sedimentation prior to re-use/discharge; • Management of contaminated storm water to ensure it is not discharged to surface water or groundwater; • Storage of waste materials generated on-site; • Management of sewage and grey water; • Storage of chemicals and petroleum hydrocarbons; • Recovery mechanisms and structures for chemical and hydrocarbon spills; • Groundwater monitoring bore locations and construction; • Surface water, leachate and groundwater monitoring regimes; • Parameters and sample frequency for monitoring; • Monitoring requirements; • Response, mitigation and contingency measures; and • Reporting requirements. 2. Implementation of the approved surface water (including stormwater) and groundwater management procedures (on-going).	Prior to lodging a works approval application Ongoing through the life of the project	DEC

EXECUTIVE SUMMARY

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
7	Noise and Vibration Management	To protect the amenity of nearby residences from noise impacts resulting from construction and operational activities associated with the proposal by ensuring that noise levels meet the *Environmental Protection (Noise) Regulations 1997.*	1. Noise emission will be managed in accordance with management procedures detailed in Section 5.7. The management procedures, which will updated prior to operation to reflect any design and operational changes, address but will not be limited to the following,: • Site working hours during construction and operations; • Noise management procedures for construction; • Maintenance of equipment that contribute to overall plant noise; • The use of silencers where necessary; • Employee training and awareness; • Noise monitoring and reporting as necessary; and • a complaint management procedure to receive, investigate and action noise complaints. 2. Implementation of the approved noise management procedures.	Prior to lodging a works approval application Ongoing through the life of the project	DEC
8	Solid & Liquid Waste Management	Ensure that the generation of all wastes follows consideration of waste reduction in accordance with the waste hierarchy of reduction, reuse, recycling treatment and disposal during construction and operation.	1. Solid and liquid waste generated on site will be managed through procedures detailed in Section 5.6. The management procedures, which will be updated as required prior to operation to reflect any design or operational changes, address but are not limited to the following: • Compliance with the requirements of the DEC and Regulations in relation to the management, handling and storage of wastes including application of the waste hierarchy of reduction, reuse, recycling treatment and disposal; • Implementation of waste reduction and recycling initiatives where recyclable wastes will be removed and approved by an approved contractor; • General refuse and putrescible (domestic and industrial) solid waste and inert materials which meet the requirements of Section 3.1.1 will be disposed in the landfill; • Storage of hazardous materials such as coolants, cleaning agents, lubricants and fuels; • Solvents and hazardous liquids will be collected and removed from the site for recycling	Prior to lodging a works approval application	DEC

EXECUTIVE SUMMARY

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
			or disposal at an approved disposal site; • Education of employees and contractors in safe waste management practices; • Prohibition of burning of waste on-site at all times; and • Preparation of annual waste reports. 2. Implementation of the approved solid and liquid waste management procedures.	Ongoing through the life of the project	
9	Fauna and Vegetation Management	To maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities. To protect Specially Protected (Threatened) Fauna species and their habitats with the provisions of the *Wildlife Conservation Act 1950*.	1. Potential impacts on flora and fauna at the site will be minimised through the design of the facility and managed through procedures detailed in Sections 5.1 and 5.2. The management procedures, which will be updated as required prior to operation to reflect any design or operational changes, address but are not limited to the following,: • Feral and introduced animal management; • Management of fauna species location if required; • Dieback hygiene; • Weed management and control; • Clearing of vegetation; • Protection of remnant vegetation; • Monitoring requirements; and • Reporting requirements. 2. Implementation of the approved fauna and vegetation management procedures.	Prior to lodging a works approval application Ongoing through the life of the project	DEC
10	Landfill Design	To design and manage the site in a manner which minimise adverse environmental	1. Landfill cells will be designed and operated in accordance with the Draft *Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005). An outlined design of the facility is given in Section 3 and the management procedures required for the design, construction and operation of the facility are given in Section 5. The procedures will be updated as required to reflect any changes in the	Prior to lodging a Works Approval application	DEC

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
		impacts.	design, construction and operation of the facility. The design of the landfill will incorporate, but will not be limited to the following features: • Engineered lining system; • Leachate extraction and management system; • Leachate recirculation system; • Active landfill gas extraction and management; • Engineered capping system; and • Surface water management scheme The landfill and the leachate storage ponds will be designed and constructed so that a separation distance of at least 2m is maintained between the highest predicted groundwater level and the formation level for the containment liner.		
11	Landfill Operation	To manage the facility in a manner that minimises adverse impacts and enhances amenity, where possible.	1. The wastes will be placed within the cells according to the site staging plan (shown in Figure 9). Filling will generally proceed from south to north across the site (Stage 1 through to 6); with only one cell active at any time. As finished levels are reached in each cell, the final cap will be progressively placed. To provide continuity of operation during the filling operations (except during the construction of Stage 6), the landfill may have an active filling area and a stage under preparation. 2. During the operation of the facility, potential impacts will be managed in accordance with the procedures in the following sections of this report. As previously mentioned they will be updated prior to lodging a Works Approval Application as indicated on this table: • Flora (Section 5.1) • Fauna (Section 5.2) • Air Quality – Particulate Emissions (Section 5.3)	Prior to lodging a works approval application	DEC

EXECUTIVE SUMMARY

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
			• Air Quality – Odour (Section 5.4) • Air Quality - Landfill Gas Emissions and Greenhouse Gases (Section 5.5) • Water Quality – Surface Water and Groundwater (Section 5.6) • Noise (Section 5.7) • Transport (Section 5.8) • Amenity – Visual (Section 5.9) • Amenity - Litter (Section 5.10) • Amenity – Fire (Section 5.11) • Amenity – Vermin, pest and nuisance species control (Section 5.12) 3. Monitoring regimes for the site include but are not limited to the following: • Landfill gas monitoring (surface); • Landfill leachate monitoring (head on the liner and chemical characteristics); • Surface water monitoring (Sedimentation Pond); • Groundwater monitoring; • Visual dust monitoring; and • Litter monitoring and subsequent removal The Landfill Contingency Management Plan will detail responses to be adopted depending on the results of testing.		

1 INTRODUCTION

1.1 Proposal Overview

The purpose of this document is to provide the Environmental Protection Authority (EPA) with relevant information to allow the assessment of the environmental acceptability of the proposal by Environmental Protection Statement for Veolia Environmental Services Pty Ltd (VES). The document incorporates the response by VES to all issues raised by the EPA Service Unit and other Stakeholders in response to the submission of the draft document. The proposal consists of the construction and operation of a landfill facility in Cullalla, located within the Shire of Gingin. The location of the proposed landfill is shown in Figures 1 and 2.

VES has undertaken an extensive site selection process, where previous potential sites were discounted due to potential groundwater and/or vegetation constraints. Following the site selection process, Wannamal Road South is the proposed location for the landfill facility. This location was selected due to its topography, distance from sensitive premises and waterways, geological suitability and depth to groundwater.

During the operation of the proposed landfill, waste will be placed in a series of engineered stages made up of cells. The landfill will be designed to maximise the production and capture of biogas, optimising the conditions for the breakdown of waste. This is achieved through careful water management which will incorporate leachate recirculation and pH control, temperature and microbe levels in each cell. A site layout plan is included as Figures 4 and 6.

An extensive network of pipes within each of the engineered stages will enable the effective re-circulation of leachate and the subsequent capture of biogas. Gas created by landfill wastes is considered a significant contributor to greenhouse gas production in Australia. Greenhouse gas emissions from waste, which are dominated by methane, increased by 13% between 1990 to 1996, and were responsible for 4% of Australia's net greenhouse gas emissions in 1996 (AGO, 1998). A custom designed biogas extraction system will be incorporated in the landfill design by VES, which will potentially capture 90% of the gas generated from the degrading waste. The captured gas will then be piped to a generator after pre-treatment to remove excess moisture and the generated electricity will then be fed into the Western Australian power network.

This proposal presents an opportunity for future waste management in Western Australia, which is technologically advanced, reliable, cost effective and environmentally responsible.

VES originally proposed to construct a bioreactor landfill at Gingin, A bioreactor landfill requires the controlled injection of a quantity of selected organic rich liquid waste such as biosolid sludges to work efficiently but at this point in time approval for such a landfill is not possible under the current statutory framework as there is no landfill classification which would allow controlled injection of liquid wastes. Under the current descriptions of the various landfill classifications only solid spadeable waste are able to be accepted. It is understood that a review of the various landfill classification categories is already underway with a view to adding a new category of bioreactor landfill to the list licenced premises.

Once this review is completed and the subsequent bioreactor landfill classification gazetted VES plan to apply for approval for a bioreactor landfill at Gingin.

1.2 Proponent Details

1.2.1 Proponent

The proponent for the proposed landfill is **Veolia Environmental Services Pty Ltd,** a division of the French owned company Veolia Environment. VES has been in operation in Australia since 1991, providing a comprehensive range of waste services.

Address of Proponent

Veolia Environmental Services Pty Ltd

4-6 Rivers Street

BIBRA LAKE WA 6163

Key Contact

Chris Griffin - Project Director

Mobile: 0412 598 922

Email: chris.griffin@veolia.com.au

1.2.2 Environmental Record

VES are committed to best practice operations and sound environmental principles, recognising they are one of the strongest ways to maintain performance and growth. VES have demonstrated this commitment through gaining ISO 14001, AS/NZS 4801 and ISO 9001 accreditation and developing a company sustainable development policy. Further information regarding VES can be found at www.veoliaes.com.au.

Woodlawn and Ti Tree Bioreactor Landfills

VES successfully operates two bioreactor landfill sites, at Woodlawn, 200km southwest of Sydney, and Ti Tree Bio-energy near Ipswich in southeast Queensland. These two facilities are the culmination of years of research by VES into sustainable waste management, utilising a proven technology that is already being used successfully in several countries around the world. Woodlawn has been in operation since September 2004 and Ti Tree since May 2003.

Other Environmental and Community Contributions by VES

In addition to high operation standards, VES has also implemented or contributed to the following positive environmental and community contributions:

- Clean Up Australia – VES has been a major sponsor of Clean Up Australia Day for the past six years.
- Clean Up Antarctica – VES and Veolia Environment combined resources with the Australian Antarctic Division to restore and rehabilitate Antarctica's former waste sites. VES is involved in the clean up of partially degraded waste including batteries, waste oils, chemicals, domestic wastes, plastics, building materials etc. VES has also donated 240 purpose built containers (10m^3 capacity) worth $A2 million in support of the Australian Antarctic Division's clean up strategy.
- Keep Australia Beautiful - sponsorship of the 'Plastic Bags Reduction Initiative Awards' since 2004.

- National Stroke Foundation – sole sponsor of an annual art exhibition at NSW Parliament House and charity auction dinner since 2003.
- University Scholarship Programs – VES sponsors several university scholarships available to students undertaking research focussing on sustainability.
- VES was the first environmental services company in Australia to commit to sustainable development, an achievement which has been recognised by both the Banksia Foundation and the United Nations Association of Australia where VES was nominated as a finalist in their respective 2003 award programs.
- VES has been successfully operating a recycling facility at Jandakot since 2000. Up to 5,000m^3 of material (predominately construction and demolition waste) are processed a week. Thereby diverting in excess of 70% of the incoming waste stream from landfill. The diverted materials are sold back to the construction industry as filling sand, aggregate and rubble. Timber and metal is separated from the incoming waste stream for recycling with the residual (15%-30%) being disposed at DEC approved Class II Landfills.

VES has extensive community support programs associated with its operations in the eastern states and envisages forming the same operating relationships with the community of Gingin.

1.3 Site Location and Land Use

1.3.1 Location of Landfill

The proposed landfill site is located in Cullalla, approximately 16km north of Gingin, within the Shire of Gingin (Figure 1). The site is located on Lot 7778 Wannamal Road South, a privately owned property of 1,750ha. The area proposed for the landfill itself covers approximately 29ha (Figure 2). Figure 3 shows the surrounding land uses.

The property has been selectively cleared with farming and horticultural operations located in several areas of the property. A feedlot for Kimberly cattle is located near the Fernview Farm residence (Figure 2), with the majority of the remainder of the property utilised for grazing. Areas of regrowth and scrub have been previously used for wildflower production, with evidence of Geraldton Wax plantations previously killed by frost.

The proposed landfill footprint is located in the northern most part of Lot 7778 and is predominantly cleared grazing land (Figure 2 and 5). The heaviest foliage is native scrub regrowth in an area cleared by Mr Fernie approximately 15 years ago. This regrowth covers 25% of the south-eastern most section of the footprint (Figure 5). North of the existing track which bisects the footprint, exists low scrub and pasture used for wild flower production and cattle grazing.

The siting of this facility in the vicinity of Fernview Farm within Lot 7778, takes advantage of the large buffer zone that the site offers, minimising any impact of the activities on local residents. The nearest residence is Fernview Farm located approximately 1.95km to the south of the proposed facility, within Lot 7778. Beyond Lot 7778, the nearest residence to the facility is approximately 2.3km to the north east (see Figure 4).

1.3.2 Criteria for Site Selection

As indicated in Section 1.1, VES has investigated the suitability of several sites for the proposal. In identifying the site most suited to this proposal, VES took into account the following factors:

Logistics

The Shire of Gingin is one of the fastest growing rural shires in Western Australia, with a current population of approximately 3000 people, anticipated to grow between 7,500 and 16,000 by 2030 (WAPC, 2006). It is apparent that with the rapidly expanding population, there will be an increased requirement for appropriately managed waste facilities within the region.

Government Policy on Diverting Waste from Landfill

A number of Government policies exist which argue against the siting of landfills and other activities with the potential to impact on groundwater on the Swan Coastal Plain. This site is located on the Dandaragan Plateau, which is not part of the Swan Coastal Plain.

Facility Type

The facility will be partially excavated into the side of an existing valley on the site, as no existing voids such as former quarries exist in the area. This approach results in efficient utilisation of the site and reduces the potential visual intrusiveness.

Buffer Distances

The site takes advantage of the significant buffering offered by surrounding land features and uses. The site is located on the Dandaragan Plateau, elevated away from the Swan Coastal Plain and the Gingin townsite. The Boonanarring Nature Reserve covers a total of 9,250ha west of the proposed site (Figure 3). The nearest residence is Fernview Farm located approximately 1.95km to the south of the proposed facility, within Lot 7778. Beyond Lot 7778, the nearest residence to the facility is approximately 2.3km to the north east (see Figure 4).

Groundwater

Crisalis International Pty Ltd was commissioned to undertake a desktop assessment of the hydrogeology of the proposed landfill site which is provided in Appendix C and summarised in Section 2.1.6. The proposal is considered to present a low risk of groundwater contamination due to the large depth to groundwater across the site. Five monitoring bores have been constructed (Appendix B and Figure 4) and these indicate that groundwater is present at approximately 145m AHD. This will be approximately 15m below the formation level of the liner (160m AHD).

Surface Water

There are no known surface water bodies present on the site. The nearest major surface water features are Gingin Brook approximately 4.5km to the south-west and Boonanarring Brook located approximately 5km to the west of the site.

Flora and Fauna

A preliminary flora survey of the area was conducted by qualified botanists, on 31 May 2006, with a supplementary spring survey conducted on 11 November 2006 to target annual and ephemeral species. A further spring survey was conducted in September 2007 to assess vegetation quality in an area to the north-east of the main landfill footprint which VES wish to have the flexibility to clear to

locate services and stockpiles. DEC staff identified this vegetation is being of better condition and required it to be surveyed. The results of all of the surveys are provided in Appendix F.

No species of Declared Rare or Priority Flora were recorded from the site during the 2006 or 2007 site visits, nor were any Threatened Ecological Communities recorded.

The vegetation of the study area ranged from pasture vegetation with a condition of Completely Degraded to vegetation in Very Good to Excellent condition (Section 2.2.1), with the majority of vegetation being regrowth from previously cleared that are currently used for grazing cattle. The majority of species recorded within the study area were also recorded within the nearby Boonanarring Nature Reserve (Burbidge *et al*., 1996).

- A section of vegetation to the south of the proposed site was identified during the vegetation surveys as being in excellent condition, and the recommendation was made that consideration be given to retaining this portion of vegetation for conservation purposes. As such, VES, has shifted its original landfill footprint and has committed that this area will remain external to any site operations. Impacts to this vegetation south of the proposed footprint will be minimised by the construction of a 1.8m mesh security fence along the existing fence line which is approximately 60m inside the southern lease boundary. VES will develop a weed monitoring and management programme in this area prior to the commencement of operations.

Several fauna species of conservation significance have been identified by the DEC as potentially occurring within the region (Section 2.2.2). However, limited habitat types on site, including the lack of any surface water reduces the likelihood of several of these species occurring at the site. Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) which is listed as a Schedule 1 species ('Fauna that is rare or likely to become extinct') under the Western Australian *Wildlife Conservation Act 1950*, is likely to frequent portions of the site that contain banksias as these provide favourable foraging areas.

Coffey Environments believes that the site does not have special significance for this species of cockatoo given its cleared state and the extensive availability of similar woodland and heath habitat present within the region. This includes the Boonanarring Nature Reserve which abuts the western boundary of the property and has 9,250ha in reserve.

Geotechnical Stability

The site is located on a deep stable sand formation which will provide a stable foundation for the lining system. Although it is located in proximity to the Darling Fault system, this fault zone has not been active for many millions of years and thus is not in a seismic risk zone.

1.3.3 Land Ownership

The proposed site is located on Lot 7778 Diagram 209805, 1189 Wannamal Road South, Cullalla. Lot 7778 is owned by Mr John Fernie. A private arrangement has been reached between Mr Fernie and VES, whereby ownership of the land on which the facility will be located will be retained initially by Mr Fernie. At some future time, and prior to final decommissioning of the site, ownership will transfer to VES to provide for ongoing post-closure management of the site during the post-closure management period. Internal company policy for VES requires a post-closure management period following closure of a landfill site, where putrescibles waste remains in cells. The duration of the post-closure management period would typically be 20-30 years. However, it will be determined in conjunction with the DEC at the conclusion of the site's life and depending on the nature of the materials that may remain on site.

The boundary of Lot 7778 and the proposed footprint and associated infrastructure are shown in Figures 2 and 4.

1.3.4 Zoning

The site is zoned 'Rural' under the Shire of Gingin's Town Planning Scheme No. 8 (Shire of Gingin, 1997). This zoning permits for noxious industries at the discretion of the Shire (Shire of Gingin, 1997). A draft Town Planning Scheme No. 9 was drafted in 2003 which includes as one of it aims '*to promote the Gingin Shire as an opportune location for regional development of industry, infrastructure, and other specialised regional facilities*'.

1.4 Need for Project

The State Government has adopted a Strategy aimed at progressing towards Zero Waste to Landfill by the year 2020 (WMB, 2004). VES is supportive of this goal and is involved in a range of activities aimed at recovering valuable resources from various waste streams.

The achievement of zero waste 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 and involve very major capital investments in the order of tens of millions of dollars. As a result, implementation of AWT's will occur progressively and slowly over the next 15 years and there will be an ongoing need to ensure that sufficient landfill capacity exists to provide for the safe management of those wastes that cannot be recovered from the waste stream.

All of the AWT facilities around Australia have struggled to meet environmental and production targets and as a result, there is growing concern as to whether these facilities should form the basis of waste planning until they can be demonstrated to work reliably. As mentioned in Section 1.1 once the landfill classifications have been modified to include bioreactor landfills VES intends to refer to the EPA a proposal to operate the Gingin landfill as a bioreactor landfill. Included in this referral will be the intention to undertake landfill mining, which is the excavation of decomposed waste in order to extract carbon rich material as well as plastics that have not broken down. It is the opinion of VES that technologies will improve for the processing of dirty plastics back into diesel. These technologies exist today albeit not at commercial enough levels to justify reclaiming plastics from landfills. This coupled with the potential to reclaim carbon in the soil fraction is seen by VES as harvesting as much as possible from the waste stream. VES expects energy costs to continue to rise as the worlds demand for energy continues to climb making the commercial reality of reprocessing discarded plastics back into a fuel a real option. If both the potential reclamation of carbon and the conversion of plastic back into energy become a reality then the long term proposal by VES will help the State Government to ultimately minimise waste or meet the zero waste to landfill goal.

VES proposes that the facility will provide an environmentally responsible approach to managing a segment of the waste stream generated in the Metropolitan area while also providing the Shire of Gingin and surrounding shires with the opportunity of utilising a most technically advanced facility. These communities are generally currently served by small unlined, unstaffed landfills with limited recycling and recovery services

The Shire of Gingin is one of the fastest growing rural shires in Western Australia, with a current population of approximately 3000 people (WAPC, 2006). Over the next 25 years, population growth along what is known as the 'Gingin Coast' alone is expected to increase from between 7500 (low

growth) and 16 000 (high growth) permanent residents (WAPC, 2006). The Gingin Coast extends along a 50km stretch of the coastline west of the Brand Highway. Increases in population have likewise been projected for the surrounding shires of Chittering, Wanneroo, Victoria Plains. Additional seasonal fluctuations of non-permanent residents may increase the total serviceable population well beyond these figures, and as such an increase in infrastructure and services will be required to support this population growth.

The total Gingin Shire area currently generates approximately 3,500t of solid waste annually or just over 1t per person within the shire (WAPC, 2006). The shire provides domestic waste, public litter and inert waste, trailer and car drop-off services as well as a number of landfill facilities licensed by the DEC, the largest of which is located at Lancelin, approximately 76km (by road) from the Gingin town centre.

It is apparent that with the rapidly expanding population within the Shire of Gingin and the adjacent Shire of Chittering, there will be an increased requirement for appropriately managed waste facilities within the region. This proposal offers such a facility in a manner that is efficient, economically viable and environmentally responsible.

1.5 Alternative Approaches

1.5.1 Facility Does Not Proceed

The consequences of not proceeding with the proposed landfill facility include:

- An opportunity would be lost to create a long term, sustainable, cost effective solution for safe solid disposal in the area, thus protecting the interests of the Shire of Gingin and its ratepayers.
- The region would continue to rely on landfills and waste disposal facilities, currently operating at a much poorer standard, until such time that alternative waste technology are economically viable for the Shire to consider.
- The facility will also provide some opportunities for additional investment and employment within the Shire.
- The Perth metropolitan region will lose the opportunity to diversify its waste management arrangements.

1.5.2 Alternatives in Waste Management Approaches

Bioreactor Landfill

Although the design of a bioreactor landfill does not differ significantly from a conventional landfill, it does offer the following advantages and opportunities:

- Accelerated waste stabilisation, when compared to a conventional landfill. Therefore reducing the long-term environmental impacts of the facility which also leads to reduced post closure time and associated costs;
- The opportunity for the landfill operator to manage on-site significant outputs from the landfill such as landfill leachate. Thereby reducing treatment/off-site disposal costs and associated environmental impacts. A conventional landfill typically would require the collection of leachate for on-site treatment or tankering off-site;

- The opportunity to enhance methane recovery over a shorter timescale when compared to a conventional landfill. Thereby controlling landfill gas production to produce energy over a shorter time scale, also reducing the long-term environmental impacts; and
- The opportunity to recover emplaced materials (landfill mining) to produce a much needed compost or organic rich soil amendment in the local area, which a conventional landfill cannot typically offer. In addition, landfill mining potentially offers the opportunity to reduce the footprint of the landfill.

Alternative Waste Treatment Technologies

As described in Section 1.4, AWTs are still being developed and demonstrated at a commercial stage. It is anticipated that such technologies will be progressively implemented over the next 15 years, with a requirement for landfill space whilst such technologies are being developed. It is also worth noting that at their current stage of development AWT's have a residual of about 30% which will still need to go to at least a landfill of at least class 2. VES is of the view that AWTs are not commercially feasible in Western Australia at this time without the backing of Government partner that will underwrite the very substantial additional cost for treatment of waste in such facilities. VES considers that this proposal and the future proposal for a bioreactor landfill, once the legislative framework has been modified, provides a useful alternative to AWTs in the interim period while these technologies are developed to a commercial reality.

1.6 Approvals Process

Environmental approval for the proposal is required under the *Environmental Protection Act 1986.* This will require approvals under both Part IV of the Act from the EPA and Minister for the Environment and Part V of the Act from the Department of Environment and Conservation (DEC) in the form of a Works Approval to construct the landfill and licence to operate the facility.

No Commonwealth Government environmental approval is believed necessary.

1.6.1 Environmental Protection Statement (EPS)

The EPA has provided informal advice that the proposal may be suitable for assessment at the level of Environmental Protection Statement (EPS). This level of assessment is typically applied to proposals of local interest that raise a number of significant environmental factors which can be readily managed, where it is considered that environmental conditions under Part IV of the Act are required to ensure the proposal is implemented and managed in an environmentally acceptable manner, and where in the judgement of the Authority, a formal public review period may be unnecessary because the proponent has adequately consulted with stakeholders. A summary of the EPS assessment procedure is included in Appendix A.

1.6.2 Works Approval / Licensing

Subject to approval of this proposal by the Minister for the Environment, VES will be required to prepare a Works Approval application that incorporates the EPA's conditions for submission to and approval from, the DEC for the construction of the landfill.

The landfill will be required to operate under a DEC Licence for prescribed premises. This licence is issued under Part V of the *Environmental Protection Act 1986*.

1.6.3 Other Processes

VES will work with the Shire of Gingin to obtain the necessary municipal approvals.

2 DESCRIPTION OF EXISTING ENVIRONMENT

2.1 Physical Environment

2.1.1 Climate

The study area has a Mediterranean climate with mild wet winters and dry hot summers. These seasons extend into the autumn and spring months which are transitional periods between the main seasons. The climate of the region is strongly influenced by high pressure systems and in the warmer months by the development of easterly winds.

Long term climatic data was obtained from the Pearce RAAF airbase, approximately 35km south-southeast of Gingin. Records dating from 1937 indicate that the long term average annual rainfall is 684.8mm, of which approximately 80% usually falls between May and September. In contrast, the mean summer rainfall is just 29.2mm and it is not unusual for there to be extended dry periods during the warmer months.

Mean maximum air temperatures range from 33.4°C in February to 17.7°C in July. Summer maximum temperatures can be strongly dependent on sea breezes. The average minimum temperatures range from 8.2°C in August to 17.8°C in February.

Winds are largely easterly in direction but are varied throughout the warmer months by afternoon sea breezes, and in the cooler months by westerlies associated with rain bearing fronts. Average wind speeds are considerably lighter in winter as compared to summer, with a mean afternoon wind speed of 15.3km/hr throughout winter and 19.7km/hr throughout summer. However maximum wind gusts are often attained during the cooler months in association with severe activity.

Mean annual evaporation is approximately 2000mm, exceeding annual rainfall by more than 1000mm.

2.1.2 Soils and Landforms

The proposed site is situated on the southern part of the Dandaragan Plateau, a gently undulating, sand and laterite covered plateau 140m AHD to 260m AHD (Moncrieff, 1989). The Gingin Scarp lies to the west of the site, with the Muchea and Darling Faults to the east. There is little runoff from the Dandaragan Plateau due to the permeable surface cover (Moncrieff, 1989). The site lies above a subdued synclinal structure of the Upper Cretaceous sediments of the Coolyena Group, on the southern toe of the Swan Syncline (Kay & Diamond, 2001).

Regional geology is mapped as comprising Unit Qpo and Unit Czl (GSWA, 1978). Unit Qpo is described as soil and undifferentiated sand over laterite of the Coastal Plain. The sand is largely colluvial, with some minor alleviated areas. Unit Czl is described as laterite material which is largely massive in form, but includes overlying pisolithic gravel and laterized sands.

2.1.3 Geology

Drilling approximately 1km south of the site (boreholes RG2A and RG2B, Figure 4), as part of an investigation by Diamond (2000) describes the stratigraphic succession through to the Leederville Formation and underlying Parmelia Formation. A summary log for bore RG2A is provided in Table 1, as reproduced from Diamond (2000).

TABLE 1
SUMMARY LOG FOR BORE RG2A

DEPTH (mbgl)*	STRATIGRAPHIC UNITS		
0-6	Quaternary (Surficial Deposits)		
6-25	Poison Hill Greensand		Coolyena Group
25-34	Gingin Chalk		
34-63	Molecap Greensand		
63-148	Kardinya Shale	Osborne Formation	
148-196	Henley Sandstone		
196-254	Pinjar Shale	Leederville Formation	Warnboro Group
254-450	Wanneroo Member		
450-472	Marginiup Member		
472-490	Parmelia (Sandstone) Formation		

*mbgl = metres below ground level

Some detail of the shallow Quaternary and Upper Cretaceous sediments has been provided by recent air-core drilling at the proposed site to depths of 29m bgl. Detailed logs of the six boreholes (Appendix B) indicate mainly medium to coarse sands, mostly ferruginised with lateritised horizons at shallow depth (2m-5m bgl) within the Surficial Deposits as described in Moncrieff (1989) and Kay and Diamond (2001).

The Upper Cretaceous sediments (Poison Hill Greensand) are clearly weathered to the drilled depth in each hole, as described by Kay and Diamond (2001), and it is unclear from the bore logs where the boundary is between the Surficial Deposits and the weathered Greensand. Indeed, as the Surficial Deposits are themselves weathered and reworked Upper Cretaceous (Moncrieff, 1989), it seems likely that the boundary between the two is gradational and not easily determined. Certainly there is no obvious change in lithology or geophysical logs which define a stratigraphic boundary as such. The absence of any boundary indicates that the Surficial Deposits and upper weathered Poison Hill Greensand form a single vadose zone for the unconfined aquifer beneath the proposed landfill site.

2.1.4 Hydrology

There are no surface waters bodies present on the site, the nearest surface water body is Gingin Brook which has its headwaters located 4-5 km to the south-west of the site. Boonanarring Brook which extends into the Boonanarring Nature Reserve is located approximately 5km to the west of the site. Red Gully Creek is some 15km to the northwest, and the Moore River 25km directly to the north. Lake Beermullah and White Lake are approximately 15km to the east, with Wannamal Lake lying approximately 15km to the northeast.

2.1.5 Regional Hydrogeological Setting

The regional hydrogeological setting is detailed in Appendix C and is summarised briefly below.

The proposed landfill lies on the southern part of the Dandaragan Plateau between the Gingin Scarp to the west and the Barberton Plateau between the Muchea and Darling Faults to the east, some 16km northeast of Gingin. The site lies above a subdued synclinal structure of Upper Cretaceous sediments of the Coolyena Group, on the southern toe of the Swan Syncline. The Upper Cretaceous sediments – referred to as a minor aquifer - are not well understood, as little investigation of these has been carried out (Moncrieff, 1989; Kay and Diamond., 2001) and groundwater in these areas is not used apart from on isolated rural developments.

2.1.6 Local Hydrogeology of the Proposed Landfill

In April 2006, Crisalis International Pty Ltd was commissioned to undertake a desktop assessment of the hydrogeology of the proposed landfill site. The complete report is provided as Appendix C, and is summarised briefly below.

In order to assist with definition of local groundwater conditions within the regional context, the report (Appendix C) specifically interpreted data from:

- Diamond (2000), where deep bores (RG2A & RG2B, Figure 4) were emplaced to investigate groundwater; and
- Drilling (Appendix B) preliminary groundwater analysis (Appendix D) conducted as part of an assessment of the proposed landfill site.

The report (Appendix C) documented the following:

Site Stratigraphy

- Interpreting data from Diamond 2000 revealed that in the vicinity of the proposed landfill, the unconfined Poison Hill aquifer is not in hydraulic continuity with the main groundwater yielding unit of the Leederville aquifer – the Wanneroo Member. The main focus for assessing potential impacts from the proposed landfill was identified as the groundwater in the unconfined Poison Hill Aquifer.
- The Upper Cretaceous sediments (Poison Hill Greensand) were identified as clearly weathered to the drilled depth in each hole, as described by Kay and Diamond (2001), and it was unclear from the bore logs where the boundary is between the Surficial Deposits and the weathered Greensand. No obvious change in lithology or geophysical logs were identified which defined a stratigraphic boundary as such. The absence of any boundary indicated that the Surficial Deposits and upper weathered Poison Hill Greensand form a single vadose zone for the unconfined aquifer beneath the proposed landfill site.

Groundwater Levels

- The piezometric head of water in the Leederville aquifer was measured in bore RG2A at 110m AHD, 51m below surface and above the upper surface of the Kardinya Shale.
- Bore RG2B was drilled to provide a water supply for drilling of the deeper bore RG2A, and taps into groundwater in the Poison Hill aquifer. Groundwater levels within this bore were recorded at 18.26m below casing, or ~143m AHD within the Poison Hill Greensand in November 2000.
- There are no surface waters bodies present on the site, the nearest surface water body is Gingin Brook which has its headwaters located 4-5 km to the south-west of the site. Boonanarring Brook which extends into the Boonanarring Nature Reserve is located approximately 5km to the west of the site. Red Gully Creek is some 15km to the northwest, and the Moore River 25km directly to the

north. Lake Beermullah and White Lake are approximately 15km to the east, with Wannamal Lake lying approximately 15km to the northeast.

TABLE 2
DEPTH TO GROUNDWATER AT MONITORING BORES

Bores Drilled in February 2006					
BORE No.	**BORE ELEVATION (m AHD)**	**GROUNDWATER RWL (m AHD)**			**DRILLED DEPTH (m AHD)**
BH2	~170*	~143.5**			~146
BH3	~185*	~143.7**			~156
BH6	~185*	~143.5**			~156
BH1	~195*	-			~167
BH5	~200*	~144**			~172
BH4	~220*	-			~193
		MEASURED GROUNDWATER LEVEL (m AHD)			
BORE No.	**BORE ELEVATION (m AHD)**	**08 SEPTEMBER 2006**	**20 DECEMBER 2006**	**28 JUNE 2007**	**DRILLED DEPTH (m AHD)**
MB1/1A	180.37	Dry	Dry	147.07	138.37
MB2	183.51	144.01	144.99	145.01	137.51
MB3	168.01	143.53	144.54	144.61	139.51
MB4/4A	189.73	Dry		144.13	135.73
MB5	190.45	N/A	N/A	143.87	136.45
FLV 4	157.45	144.17			116.45

Notes:
Bore elevation measured from top of casing.
*surface elevations estimated from Figure 3 in Appendix C
**Rest water levels (RWL) estimated where possible from groundwater table contours for September 2006 Figure 3 in Appendix C

The report (Appendix C) concluded any potential subsurface contamination of leachate, if sufficient to reach groundwater, would flow generally in a west-south-west direction towards the Gingin Brook catchment. However, as the likely flow distance to Gingin Brook is several kilometres, the dilution and dispersion of any contamination over this distance would be sufficient to preclude any impact on water in Gingin Brook.

The report (Appendix C) indicates that a search for known groundwater bores within the vicinity of the site identified five bores. Three are located together to the east of the site, which will be used as

abstraction bores for the proposed landfill (see Section 3.9). A further two bores are located 1.2km to the south of the proposed landfill. In order for the bores to be impacted by low levels of contamination from the lined site, they would need to be immediately down-gradient of the site (i.e. to the west-south-west), and well within a 500m radius. Neither of these bores would be impacted by any contamination, given their positions and distance from the site.

Other identified groundwater bores are in excess of 2.3km to northeast and southeast of the proposed facility (Figure 4) and neither of these are down-hydraulic gradient of the proposed facility.

Subsequent discussions with hydrogeologists from the Department of Water and Department of Environment and Conservation (See Response 1.5 of Appendix O) confirmed the views expressed in the hydrogeological review presented at Appendix C that due to its location, the design of the lining and leachate management system and the proposed operational controls, the site does not represent a significant threat to regional water quality or the headwaters of Gingin Brook.

2.2 Biological Environment

2.2.1 Vegetation / Flora

No site specific flora surveys have been previously conducted at Lot 7778; however a comprehensive biological survey of the adjacent Boonanarring Nature Reserve was conducted in 1986, and gives a detailed description of vegetation in undisturbed areas within the region (Burbidge *et al*, 1996).

Heddle *et al.* (1980) identified the vegetation within the survey area as part of the Cullalla Complex. This vegetation complex occurs on the Dandaragan Plateau and consists predominantly of a mixture of Low Open Forest of *Banksia* species – *Eucalyptus todtiana* and Open Woodland of *Corymbia calophylla* with a second storey of *E. todtiana – Banksia attenuata – B. menziesii – B. illicifolia*.

Approximately 40% of the estimated pre-European extent of the Cullulla vegetation complex is remaining and 3% is currently protected within in secure reserves. This is below the minimum 10% target established in *Bush Forever* (Government of Western Australia, 2000).

A preliminary flora survey of the area was conducted by qualified botanists from ATA Environmental, on 31 May 2006, with a supplementary spring survey conducted on 11 November 2006 to target annual and ephemeral species. A further survey was completed on 18 September 2007 in response to a request by DEC staff to examine vegetation quality in the north east sector of the area proposed for disturbance. The results of these surveys are documented in Appendix F.

Prior to conducting the field survey, a search of the DEC's Declared Rare and Priority Flora database (Appendix G) was undertaken to identify significant flora that could potentially occur in the survey area. This investigation encompassed a review of the following databases:

- DEC's 'Threatened (Declared Rare) Flora' database; and
- DEC's 'Declared Rare and Priority Flora List' which contain species that are Declared Rare (Conservation code R or X for those presumed to be extinct) poorly known (Conservation codes 1, 2 or 3) or require monitoring (Conservation Code 4).

The results of the DEC database search are presented in Table 3 below.

TABLE 3
SIGNIFICANT FLORA RECORDED IN THE VICINITY OF THE STUDY AREA

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	FLOWERING PERIOD
Acacia drummondii subsp. *affinis*	P3	Lateritic gravely soils	Jul - Aug
Acacia pulchella var. *reflexa* acuminate bracteole variant (RJ Cumming 882)	P3	Sandy loan or sandy clay over laterite	Jul - Sep
Banksia chamaeophyton	P4	Grey white sand over laterite	Oct - Dec
Calytrix sylvana	P4	Lateritic soils, sand, sandplains and ridges	Aug - Oct
Darwinia acerosa	R	Granitic outcrops, gravely soil	Sep - Nov
Daviesia epiphyllum	P3	Lateritic soils, breakaways, stony hills	Apr - July
Dryandra kippistiana var. *paenepeccata*	P3	Lateritic gravely soils	Oct - Nov
Dryandra platycarpa	P4	Laterite boulders, dry yellow-grey sand	May - Aug
Dryandra polycephala	P4	Loam and laterite gravel	Jul - Oct
Dryandra pteridifolia subsp. vernalis	P3	White – grey sand over laterite	Sep - Oct
Grevillea saccata	P4	Yellow brown sand with lateritic gravel	Apr - Nov
Hibbertia glomerata sub sp. *ginginensis*	P1	Brown clay lateritic soil	July - Sep
Hibbertia miniata	P4	Flat, dry yellow – white – grey sand	Aug - Nov
Hypolaena robusta	P4	Flat, dry yellow – white – grey sand	Sept - Oct
Persoonia sulcata	P3	Lateritic or granitic soils	Sep - Nov
Petrophile plumosa	P3	Red/brown laterite, loam, sandplains, hills	Jul - Nov
Platysace ramosissima	P3	Sandy soils	Oct - Nov
Ptychosema pusillum	R	Sandy soils	Aug - Oct
Synaphea grandis	P4	Laterite	Oct - Nov
Thamsia sp. Gingin (F & J Hort 1511)	P3		
Verticordia paludosa	P4	White – grey sand	Jan - May

A search of DEC's Threatened Ecological Communities (TEC) database was also conducted for the survey area prior to undertaking the field assessment. No TEC's were listed as occurring in the geographical range of the survey area.

2.2.1.1 Vegetation Associations

The vegetation survey confirmed that the vegetation is part of the Cullulla Complex identified by Heddle (1980). A total of five vegetation associations were identified within the study area during the May 2006 site visit. These vegetation associations are mapped in Figure 5 and are described below.

A total of ten vegetation associations were identified and delineated within the study area during the 2006 and September 2007 surveys. These vegetation associations are mapped in Figure 5 and described below.

EtLOW

Low Open Woodland of *Eucalyptus todtiana* to 4m with scattered *Nuytsia floribunda* over a mixed Shrubland. Other common species include *Xanthorrhoea preissii, Eremaea beaufortioides*, and *Stirlingia latifolia.* This vegetation association is located in the central portion of the study area to the north of the sandy track and is natural regrowth of previously cleared vegetation. According to the vegetation condition rating scale as described in Bush Forever (Government of Western Australia, 2000) this vegetation association was classified as being in Good condition.

BaBmEtLOW1

Low Open Woodland of *Eucalyptus todtiana, Banksia menziesii* and *Banksia attenuata* to 5m over a Tall Shrubland of *Jacksonia sternbergiana* over an Open Mixed Shrubland. Other common species include *Allocasuarina humilis, Xanthorrhoea preissii, Petrophile brevifolia* and *Eremaea beaufortioides*. The most obvious difference from this vegetation association and the other two BaBmEtLOW associations is the condition of the vegetation which was classified as being in Very Good to Excellent condition with few obvious signs of human disturbance This vegetation association is located in the eastern and southern sections of the study area. To the north of the sandy track the vegetation comprises regrowth from more recent clearing while the vegetation to the south of the track is in significantly better condition.

BaBmEtLOW2

Low Open Woodland of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* to 3m in height over *Adenanthos cygnorum* Shrubland to 1.5m in height over Low Heath dominated by *Xanthorrhoea preissii, Stirlingia latifolia* and *Eremaea pauciflora*. Other associated species include *Allocasuarina humilis, Caustis diocia, Conospermum stoechadis* and *Jacksonia floribunda*. This vegetation association which was similar in general structure and dominant species to the other BaBmEtLOW associations but in a poorer condition was recorded from the northwestern portion of the study area and has been regularly cleared. There was also evidence of recent grazing activities in the area and as a consequence the vegetation condition rating scale as described in Bush Forever (Government of Western Australia, 2000) of this vegetation association was classified as being in Good.

BaBmEtLOW3

Low Open Woodland of *Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* to 4m in height over a Low Heath of *Allocasuarina humilis, Xanthorrhoea preissii, Eremaea pauciflora* and *Stirlingia latifolia.* Other associated species recorded include *Conospermum stoechadis, Conostephium*

pendulum, Hakea preissii and *Jacksonia sternbergiana*. This vegetation association is located within the north east portion of the study area and is natural regrowth of previously cleared vegetation. The area appears to have been cleared less recently than the BaBmEtLOW2 association and as a consequence the condition was considered to be in Good to Very Good condition.

BaBmLOF

Low Open Forest of *Banksia attenuata* and *Banksia menziesii* to 4m in height over a Low Open Shrubland of *Allocasuarina humilis, Xanthorrhoea preissii, Regelia ciliata, Stirlingia latifolia, Verticordia nitens, Eremaea pauciflora a*nd *Conospermum stoechadis*. Other species recorded from this association include *Leucopogon capitellatus, Philotheca spicata* and *Conostephium pendulum.* This association was recorded from the central eastern portion of the survey area and while the aerial photography indicates that it has obviously been cleared in the recent past, the condition of the regrowth vegetation was considered to be Very Good.

BmBpJsCTS

Closed Tall Scrub of *Banksia menziesii, Banksia prionotes* and *Jacksonia sternbergiana* to 3m in height with scattered *Eucalyptus todtiana* over *Melaleuca huegelii*, *Allocasuarina humilis, Adenanthos cygnorum* and *Ptilotus polystachyus* Open Shrubland over *Eremaea pauciflora, Acacia pulchella* and *Stirlingia latifolia* Low Open Heath. Other common species recorded from this association include *Eremaea beaufortioides, hakea costata, Stirlingia latifolia* and *Xanthorrhoea preissii*. This association was recorded from a small area in the central western portion of the study area and while it had obviously been cleared in the past 10 or so years and there was evidence of recent grazing by stock, the condition was considered to be Good to Very Good.

AcTS

Tall Shrubland of *Adenanthos cygnorum* with scattered *Nuytsia floribunda* and *Eucalyptus todtiana* to 3m over a Low Open shrubland of *Eremaea beaufortioides* and *Xanthorrhoea preissii*. Other common species include *Stirlingia latifolia* and *Hibbertia hypericoides.* This vegetation association is located in the south western portion of the study area and comprises regrowth from previously cleared native vegetation.

JsTOS

Tall Open Shrubland of *Jacksonia sternbergiana* to 3.5m in height over a Mixed Open Heath of *Jacksonia floribunda, Melaleuca huegelii, Adenanthos cygnorum, Hibbertia hypericoides* and *Synaphea spinulosa*. Other common species recorded from this vegetation association include *Adenanthos cygnorum, Eremaea beaufortioides, Pimelea angustifolia* and *Synaphea spinulosa*. This association was recorded from a very small area along the northwestern boundary of the survey area and while is has obviously been previously cleared (~ 10 years prior to survey) the condition was considered to range from Good to Very Good.

MhS

Shrubland of *Melaleuca huegelii* to 1.5m in height with scattered *Eucalyptus todtiana, Banksia attenuata* and *Corymbia calophylla* over Low Heath of *Xanthorrhoea preissii, Hibbertia hypericoides* and *Synaphea spinulosa*. Other species recorded from this vegetation type include *Adenanthos cygnorum, Daviesia decurrens* and *Lechenaultia biloba.* This association was recorded from the crest of the hill in the central northern portion of the survey area. The area had previously been largely cleared with only

scattered Marri and Prickly Bark trees retained as shade trees for grazing stock. As a consequence the condition of this association was considered by be Good.

MLCH

Low Closed Heath of *Xanthorrhoea preissii, Allocasuarina humilis*, *Eremaea pauciflora*, *Leucopogon capitellatus* and *Synaphea spinulosa* to 1m in height. Other species associated with this vegetation association include *Eremaea beaufortioides, Leucopogon capitellatus, Petrophile linearis, Philotheca spicata* and *Stirlingia latifolia*. This association was recorded from the central eastern portion of the survey area and was relatively species rich with 42 species recorded from a single 10m x 10m quadrat sampled. While it is evident from recent aerial photography of the area that this vegetation association has previously been cleared the regrowth was considered to be in Very Good condition.

In addition to native vegetation within the survey area, an area of pasture is located along the western boundary of the study area. This area has been subject to clearing and intense grazing and comprises of pasture grass species.

2.2.1.2 Vegetation Condition

The condition of the vegetation was assessed using the condition rating scale of Keighery published in *Bush Forever* (Government of Western Australia, 2000). Keighery's condition rating scale ranges from Pristine (which the vegetation exhibits no visible signs of disturbance) to Completely Degraded (where the vegetation structure in no longer intact and without native plant species). The vegetation of the study ranged from pasture vegetation with a condition of Completely Degraded to vegetation in Very Good to Excellent condition. Vegetation condition is mapped in Figure 5.

Descriptions of the vegetation condition ratings in *Bush Forever* (2000a) are outlined in Table 4.

TABLE 4
VEGETATION CONDITION RATING SCALE

Pristine Pristine or nearly so, no obvious signs of disturbance.
Excellent Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structures caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure cause by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia, 2000.

2.2.1.3 Conservation Significance of Vegetation

A search of DEC's TEC database was undertaken prior to conducting the initial May 2006 survey. No TECs were listed by the DEC as occurring in the geographical range of the survey area and this was confirmed from data collected from the May and November 2006 and September 2007 surveys.

Using the floristic data collected from each of the 10m x 10m quadrats and referencing the species to those mapped in Griffin (1992), the vegetation within the survey area is inferred as corresponding most closely with Vegetation Types 1a and 1b. These vegetation types are distinct from the Floristic Community Types described by Gibson *et al.* (1994).

According to Griffin (1992), Vegetation Types 1a – Low and Open Low Woodlands dominated by *Banksia attenuata* and *Banksia menziesii* and 1b –Shrubland of *Adenanthos cygnorum* are poorly reserved within the Bindoon to Moora area. Griffin (1992) does state that this vegetation type is probably conserved within Boonanarring Reserve to the west of the study area. This was confirmed in an assessment of the Reserve undertaken in 1996 which indicated that *Banksia* and *Adenanthos* vegetation types occur on Cullalla soils within the Reserve boundaries.

2.2.1.4 Flora

2.2.1.4.1 Flora Species Recorded

A total of 151 species were recorded within the study area from the May and November 2006 and September 2007 survey. This included 127 native species and 24 introduced species.

The dominant families were the Myrtaceae (Eucalypt family – 14 species), Proteaceae (*Banksia* family – 21 native species) and Papilionaceae (Pea family – 12 species, 1 introduced species).

The majority of species recorded within the study area were also recorded within the nearby Boonanarring Nature Reserve (Burbidge *et al*., 1996). No Declared Plants (i.e. weeds) were identified during the May and November 2006 or September 2007 surveys.

A list of the flora recorded within the survey area during the May and November 2006 and September 2007 surveys is presented in Appendix F. Quadrat data collected from the three surveys is also presented in Appendix F.

2.2.1.4.2 Conservation Significance of Flora

No species of Declared Rare or Priority Flora were recorded from the site during the 2006 or 2007 surveys.

2.2.2 Fauna

2.2.2.1 Site Assessment

A Level 1 Fauna assessment was completed in September October 2007. The results of this survey are reported in the updated flora and fauna assessment included as Appendix F.

A search of DEC's Threatened and Priority Species database (Appendix G) was undertaken to identify Scheduled and Threatened species and Priority species previously recorded in the region. Details of how species are classified in both lists are shown in Appendix F. A search of the Commonwealth *Environment Protection and Biodiversity Conservation* (*EPBC*) *Act 1999* online database was also undertaken.

Dr Annabelle Stewart, a qualified zoologist of Coffey Environments, conducted a Level 1 Fauna assessment including a site visit on 18 September 2007. Dr Stewart examined the site for available habitat types and searched for small reptiles and mammals. Any significant trees that contained hollows that may be suitable for breeding Black-Cockatoos were recorded using a hand-held GPS. Signs of feeding such as chewing, scarring or scratch marks were noted. Carnaby's Black-Cockatoos have a short upper mandible and leave characteristic chewing marks on discarded Marri nuts and Banksia sp. cones. Searches for Quenda scats and scratchings were made across the site. The weather was generally fine with only occasional light rainfall during the site visit.

Several conservation significant fauna species have been identified by the DEC as potentially occurring within the study area (Table 5).

TABLE 5
POTENTIAL THREATENED AND PRIORITY FAUNA OCCURRING IN THE VICINITY OF LOT 7778 WANNAMAL RD SOUTH

SPECIES	COMMON NAME	CONSERVATION STATUS		Comment
		Wildlife Conservation Act*/DEC priority list	EPBC Act	
Dasyurus geoffroii	Chuditch, Western Quoll	Schedule 1	Vulnerable	Species *unlikely* to be present as habitat is not suitable
Pseudocheirus occidentalis	Western Ringtail Possum	Schedule 1	Vulnerable	Species *highly unlikely* to be present as habitat is not suitable and it is disjunct from the known current populations
Pseudomys shortridgei	Heath Mouse (Dayang)	Schedule 1	Vulnerable	Species *unlikely* to be present as habitat is not suitable

SPECIES	COMMON NAME	CONSERVATION STATUS		Comment
		Wildlife Conservation Act*/DEC priority list	EPBC Act	
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	Schedule 1	Endangered	Species *likely* to forage on site but unlikely to rely on the area for survival
Calyptorhynchus sp	White-tailed Black Cockatoo	Schedule 1		Species *likely* to forage on site but unlikely to rely on the area for survival
Pseudemydura umbrina	Western Swamp Tortoise	Schedule 1	Critical	Species *highly unlikely* to be present as there are no wetlands on site
Cacatua leadbeateri	Major Mitchell's Cockatoo	Schedule 4		Species *potentially present* in region but unlikely to rely on the area for survival
Macropus irma	Western Brush Wallaby	Priority 4		Species *unlikely t*o be present as there are no wetlands or lakes on site
Charadrius rubricollis	Hooded Plover	Priority 4		Species *potentially* present in region
Hylacola cauta whitlocki	Shy Heathwren (western ssp)	Priority 4		Species *potentially* present in region but unlikely to rely on the area for survival
Galaxiella munda	Western Mud Minnow	Priority 4		Species *highly unlikely* to be present as there are no wetlands on site
Isoodon obesulus fusciventer	Southern Brown Bandicoot or Quenda	Priority 5		Species *unlikely* to be present in region

Notes:

i) *Wildlife Conservation Act, 1950*
Schedule 1= Fauna that is rare or is likely to become extinct
Schedule 4 = Other specially protected fauna
DEC Priority List
Priority 4 = Taxa in need of monitoring
Priority 5 = Taxa in need of monitoring (conservation dependent)

ii) EPBC Act: *Commonweatlh Environmental Protection and Biodiversity Conservation Act, 1999*

Coffey Environments has used the data collected during September 2007 site visit, vegetation association mapping, floristic data and photographs to provide an indication of the fauna habitats that are available within the site. Most of the area contains *Eucalyptus todtiana*, with a variety of shrubs providing undergrowth. The undergrowth includes *Adenanthos cygnorum*, *Nuytsia floribunda*, *Banksia*

menziesii, *B. prionotes*, and *Xanthorrhoea preissii*. No surface water, streams or wetlands are present on the site.

Several conservation significant fauna species have been identified by DEC as potentially occurring within the region. However, limited habitat types on site, including the lack of any surface water reduces the likelihood of several of these species occurring at the site.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) which are listed as Schedule 1 species ('Fauna that is rare or likely to become extinct') under the *Western Australian Wildlife Conservation Act 1950* is likely to frequent portions of the site that contain Banksias as these provide favourable foraging areas. No Black-Cockatoo's were sighted during the site visit, although potential feeding habitat are present in areas of Low Open Woodland of *Eucalyptus todtiana, Banksia menziesii* and *Banksia attenuate*, particularly to the south of the site.

However, Coffey Environments is of the opinion that the site has no particular conservation significance for this species of cockatoo given the extensive availability of similar woodland and heath habitat present within the region. This includes the Boonanarring Nature Reserve which is located 1km from site and has 9,250ha if relatively undisturbed vegetation in reserve. The study area's location is not considered strategic as there are extensive vested reserves with high quality feeding habitat both adjacent to the site and in close proximity to the site. Furthermore, the vegetation present at the site does not provide suitable breeding habitats for these species of cockatoo, and no suitable breeding hollows were recorded during the site visit.

During the site visit no scats, diggings or scratchings from mammal species listed as Schedule or Priority species were recorded. However, a number of scats and tracks from the Western Grey Kangaroo were recorded. The Western Grey Kangaroo is not protected under Commonwealth legislation but is protected under the *Wildlife Conservation Act 1950*. Rabbit scats and diggings were also present on tracks and in the vegetation.

Limited habitat types on site, including the lack of any surface water reduces the likelihood of several of these species occurring at the site. Of the six Schedule 1 listed species, four are unlikely to occur at the site. The Western Swamp Tortoise requires wetland habitats which are not present; the Heath Mouse has a very limited distribution in the south-eastern wheatbelt through to the south coast and is unlikely to occur at the site. Western Ringtail Possum's habituate peppermint (*Agonis flexuosa*) dominated woodlands and use tree hollows for nesting sites, preferring Tuarts (*E. gomphocephala*) and Marri (*Corymbia calophylla*), vegetation associations which are not present at the site.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) which is listed as a Schedule 1 species ('Fauna that is rare or likely to become extinct') under the Western Australian *Wildlife Conservation Act 1950*, is likely to frequent portions of the site that contain banksias as these provide favourable foraging areas. Coffey Environments considers that the site does not have special significance for this species of cockatoo given the extensive availability of similar woodland and heath habitat present within the region. This includes the Boonanarring Nature Reserve which abuts the western boundary of the property and has 9,250ha in reserve. The proposed landfill location is not considered strategic as there are extensive vested reserved with high quality feeding habitat both adjacent to the site and in close proximity to the site. Furthermore, the vegetation present at the site does not provide suitable breeding habitats for this species of cockatoo.

The chuditch (*Dasyurus geoffroii*) is a second species identified by the DEC as potentially occurring at the site which is listed as a Schedule 1 species. Chuditch generally prefer a site with dense understorey's which provide adequate cover and den sites (usually hollow logs). The proposed landfill site is

vegetated by low open woodlands (Section 2.2.1.1), which has regrown from previously cleared vegetation. The site does not provide the dense understorey or den sites required by the chuditch, and as such it is considered that the site is not one of significance for the chuditch.

2.2.2.2 Potential Impacts

The fauna habitats which may potentially be contained within the study area are likely to provide foraging habitat for a limited number of threatened species known or considered to potentially occur within the region. Impacts on native fauna may potentially occur as a result of the destruction of habitat through vegetation clearing. However, there were no particular features or specific habitat at Lot 7778 Wannamal Rd South that would indicate it has ecological functional significance that is different to other sites within the region including the adjacent Boonanarring Nature Reserve.

Coffey Environments believes that the site does not have special significance for threatened species identified by the DEC as potentially occurring in the region given the extensive availability of similar woodland and heath habitat present within the region. This includes the Boonanarring Nature Reserve which abuts the western boundary of the property and has 9,250ha in reserve. However, the presence of feeding habitats for the Black-Cockatoo species is an important consideration for development and any potential impacts to these species should be minimised. The clearing of vegetation from the site may result in the loss of potential feeding habitat for the Carnaby's Black Cockatoo, Major Mitchell's Cockatoo, Hooded Plover, Shy Heathwren and Western Mud Minnow.

From a fauna perspective, areas of the vegetation to the north of the site could be described as 'good' quality, while areas to the south of the site could be described as 'excellent' quality. The habitat supports the normal range of vertebrate species found in similar habitats in the region. It is Coffey Environments' view that clearing portions of the vegetation from north of the site would not impact on a significant or important functional ecosystem that should be preserved. However, areas of 'excellent' quality vegetation to the southeast of the site should be retained for conservation purposes.

Other potential impacts include increased species mortality due to the heightened volumes of traffic associated with the project, and increased predation on native fauna by feral animals which may increase as a result of inadequate landfill management. These impacts should be addressed through the application appropriate management strategies

2.2.3 Boonanarring Nature Reserves – Potential Impacts

The Boonanarring nature reserve is located approximately 1 -1.5km to the west of the proposed landfill site. The facility has a limited potential to impact on the Reserve in view of the extent of the separation distance. The potential pathways for impacts to occur are:

- Dust impacts on vegetation;
- Litter impacts on fauna and amenity; and
- Impacts on ground or surface water quality.

The management measures outlined in Section 5 are designed to ensure that there are no adverse impacts to the Boonanarring Nature Reserve.

In particular, dust is not anticipated to be an issue in view of the both the separation distance and the high standard of dust control that has been proposed. Similarly litter will be controlled by keeping

tipping faces small, using litter fences and screens and through regular programs to pick up any windblown litter at the fence line of the facility and beyond.

There is little or no potential for impacts on the Reserve due to impacts from the facility on local ground or surface water quality due the following factors:

- The very high standard of design and construction applied to the liner and leachate management system which minimises the potential for leakage;
- The absence of surface water features on the facility which means there are no surface water flows leaving the site;
- The great depth to groundwater under the Boonanarring reserve (estimated to be 60 metres) which means it is most unlikely that plants will utilise the regional aquifer as a source of water;
- As the rate of groundwater flow is estimated at around 5 metres per year, it is estimated that groundwater will take up to 80 years to travel from the vicinity of the landfill site to the edge of Boonanarring Reserve. This is ample time to allow contaminants to be dispersed, diluted or attenuated by natural physical and chemical process before reaching the Reserve; and
- Finally the direction of groundwater flow both regionally and locally is to the south-west thus water flowing under the site will not impact on Boonanarring Brook which is located to the West of the facility

2.3 Aboriginal and European Heritage

No archaeological or ethnographic study has been conducted within the vicinity of the proposed site as these areas have previously been subject to extensive clearing and disturbance associated with cattle grazing and wildflower production.

A search of the Register of Aboriginal Sites database maintained by the Department of Indigenous Affairs (search date: 18 April 2006) did not find any significant sites in the area.

3 DESCRIPTION OF PROPOSAL

3.1 Introduction

This section presents an introduction to the design and operation of the proposed landfill. The following sections describe the proposed facility in greater detail.

The proposed facility will be designed as an engineered landfill which will incorporate an engineered liner and capping systems and active landfill leachate and gas management systems. The basis for the waste inputs to the landfill will be driven by production of high quality landfill gases for energy recovery.

The basic design philosophy of the proposed landfill incorporates the following features:

- *Leachate Recirculation* (Section 3.1.2 below): The moisture content of the emplaced waste will be controlled through leachate recirculation.
- *Landfill Gas Generation and Recovery (*Section 3.1.3 below): Leachate recirculation will enhance degradation thereby increasing methane production and energy recovery.

The success of the above landfill features will depend on a range of factors including:

- Nature of the waste stream accepted;
- Landfill design;
- Operational management practices adopted at the facility; and
- Success of the stabilisation (degradation) process.

The degradation of waste within a landfill typically occurs in five stages (which can take many decades to complete):

- Stage 1: Aerobic
- Stage 2: Hydrolysis and fermentation (anaerobic)
- Stage 3: Acetogenesis (anaerobic)
- Stage 4: Methanogenic (anaerobic)
- Stage 5: Aerobic.

3.1.1 Site Details

An overview of the existing environment is provided in Section 2 of this report. This is briefly outlined below.

- The site is located on the Dandaragan Plateau, elevated away from the Swan Coastal Plain and the Gingin townsite. The Boonanarring Nature Reserve covers a total of 9,250ha west of the proposed site (Figure 3). The nearest residence is Fernview Farm located approximately 1.95km to the south of the proposed landfill, within Lot 7778. Beyond Lot 7778, the nearest residence to the landfill is approximately 2.3km to the north east (see Figure 4).
- Groundwater is located approximately 15m below the proposed formation levels for the landfill liner (160m AHD).

- There are no surface water bodies located on site. The nearest surface water features are Gingin Brook located approximately 4.5km to the south-west and Boonanarring Brook which is located approximately 5km to the west of the site.
- There are no known species of significant flora present within the study area.

The key characteristics of the proposed landfill facility are presented in Table 6 below.

TABLE 6
KEY CHARACTERISTICS OF THE PROPOSAL

PARAMETER	DETAILS
Site Area	• Approximately 405 Acres (163.9ha)
Landfill Area	• Approximately 29ha
Landfill Depth	• 25m-60m
Landfill Airspace Capacity	• Approximately 4.75Mm^3
Post Capping Contours	• The maximum height will not exceed 225m AHD.
Operating Hours for Waste Acceptance	• Monday to Friday - 0700 – 1700 • Saturday - 0700 – 1600 • Open for public holidays (excluding Good Friday & Christmas Day) except for exceptional circumstances
Operational Life (total)	• Nominal life of 25 years.
Nominal Waste Acceptance Rate	• 100,000 to 150,000 tonnes per annum
Landfill Design	• The facility will be designed in accordance with the DoE's 2005 guidelines for the Siting, Design, Operation and Rehabilitation of Landfills.

3.1.2 Waste Acceptance Criteria

The facility will be licensed in accordance with the *Environmental Protection Act 1986*. Landfill operations must comply with the EP Act 1986, its regulations and relevant environmental protection policies.

For the purpose of the site operating licence, the site waste acceptance criteria will be developed in accordance with the Class II landfill Criteria, detailed in *Landfill Waste Classifications and Waste Definitions 1996 (As Amended)* (DoE, 2005b).

Principal waste types accepted at the facility will include:

- Municipal Solid Waste (MSW);
- Solid wastes containing biodegradable organics conforming to the Class II landfill acceptance criteria*, Landfill Waste Classifications and Waste Definitions 1996 (As Amended)* (DoE, 2005b).

3.1.3 Leachate Recirculation

Landfill leachate is an aqueous liquid which is generated within landfills as the result of the physical and biological decomposition of the deposited waste. Its management is of fundamental importance from the beginning of a landfill's life to decades after closure. Leachate is formed from infiltration of water (i.e. rain) into the landfill and also from the moisture content of waste itself. Landfill leachate is highly variable in its chemical characteristics and typically exhibits elevated levels of organics and nutrients and possibly heavy metals where wastes contain significant concentrations of metals have been accepted.

Leachate composition is dependent upon a variety of factors which include but are not limited to:

- Heterogeneity and composition of the waste;
- Design of the landfill;
- Operational practices of the landfill;
- Age of the waste;
- Moisture content of the waste; and
- Stage of biodegradation achieved by the waste.

Leachate is recognised as a potential source of surface water and groundwater contamination. Landfill design concepts have improved dramatically in recent years and are principally devoted towards ensuring minimal environmental impacts. As a consequence a number of specific design and operational measures are adopted in landfills to prevent leachate entering natural waters (e.g. introduction of landfill impermeable liners and caps and applied restrictions of leachate head on the liner). However, no landfill liner system can guarantee zero leakage for its entire lifetime and it is for this reason that landfills need to be sited in areas that have low vulnerability to impacts on surface water and groundwater.

The waste inputs to the proposed landfill will be closely controlled to encourage predominately organic rich wastes. Waste materials containing hazardous chemical wastes, significant concentrations of heavy metals, pesticides, asbestos and other contaminants which pose risk to human health will be not be accepted .

The philosophy of leachate recirculation potentially offers the following benefits:

- The opportunity for the landfill operator to manage on-site the significant outputs from the landfill, e.g. landfill gas and leachate;
- A reduction or elimination of the requirement for landfill leachate treatment (through a treatment plant), thereby reducing treatment/off-site disposal costs and associated environmental impacts; and
- A relatively simple and inexpensive leachate management method.

The leachate recirculation system will be designed and operated in accordance with best practice, in order to protect the environment. Specifically the following will be considered:

- Operational practices such as the application of daily cover materials and compaction of emplaced waste materials will be undertaken in a manner which will optimise the even distribution of recirculated leachate and therefore the more rapid decomposition of waste.

- The addition of leachate to the landfill will be carefully controlled, avoiding complete saturation of the waste, which can potentially impact on the stability of cells and also inhibit decomposition of wastes.
- The final landfill design will ensure that leachate can be readily drained from each cell and the leachate head on the liner will not exceed design specifications.

3.1.4 Landfill Gas Generation and Recovery

Landfill gas (LFG) is composed of a variety of gases which include methane, carbon dioxide, oxygen, nitrogen, hydrogen and water vapour. Methane and carbon dioxide are the major constituents typically comprising in excess of 90% of the gas with water vapour being the other most significant component. In addition, trace levels of other organic compounds are present in LFG which are responsible for some of the malodours associated with landfilling operations. Typical trace compounds which are considered as potential odorants include hydrogen sulphide, organosulphur compounds, aldehydes and carbon disulphide which give LFG its characteristic and sometimes offensive odour. These compounds are odorous and detected as offensive by the human nose at very low concentrations.

LFG is produced in an anaerobic environment within the landfill. It is a by-product of the waste decomposition process and its composition varies greatly depending on factors such as:

- Waste composition;
- Age of the emplaced waste;
- The depth of waste;
- Density of waste;
- The moisture content and distribution;
- pH and nutrient availability;
- Landfill temperature;
- The presence of chemical inhibitors;
- The design of the landfill cell; and
- The hydraulic characteristics of the site.

Landfill gas may migrate from the landfill through the cap and sidewalls by diffusion, convection or by water transport. The control of landfill gas is vital in the design of the facility to:

- Minimise the risk of LFG migration, where it may be a threat if it accumulates in buildings and infrastructure. It may also affect vegetation by displacing oxygen from the root zone.
- Minimise potential impacts on air quality locally and on a global scale (methane and carbon dioxide are significant greenhouse gases);
- Avoid air ingress into the landfill thereby minimising the risk of landfill fires; and
- Permit the effective control of landfill gas emissions and allow energy recovery.

Conditions within the landfill will be optimised to encourage decomposition through:

- Control of waste inputs into the landfill, focusing on biodegradable wastes; and

- Design of the landfill stages (cells) to ensure that landfill gas is managed (via the landfill liner and cap design and gas collection and management system). The stages will be designed to encourage the early establishment of methanogenic conditions and help maintain them (promotion of anaerobic conditions);

Both methane and carbon dioxide are greenhouse gases, however methane is some twenty times more active as a greenhouse gas than carbon dioxide. It is therefore environmentally beneficial if the methane that is generated can be captured and burnt to produce energy, carbon dioxide and water.

Landfill gas will be extracted from the landfill via an active removal system comprised of a number of gas extraction wells placed within the waste (Section 3.3.6). The gas extraction wells will be either horizontal or vertical wells, or a combination of both. Construction of the landfill gas extraction system will be progressive as the waste is placed in the landfill. The system will operate by inducing a slight vacuum within the extraction wells and associated piping that will promote gas flow from the waste mass to the gas extraction wells. Condensate traps will be installed to allow for the capture and temporary storage of the condensate, which will be collected and used in the leachate recirculation system. An energy recovery facility will manage/utilise the LFG once it is extracted from the landfill. Where the recovered gas is of low quality (i.e. low methane content) it will be conveyed to a portable flare. The flare will remain in place throughout the life of the landfill to burn excess landfill gas that cannot be utilised to generate power.

3.1.5 Financial Guarantees/Assurances

In submissions from regulatory agencies, the issue of provision of Financial Guarantees has been raised. The suggestion has been made that VES should provide Financial Guarantees as either a post-closure bond or to cover the cost of remedial works in the event that there is some impact on the environment.

VES is of the view that such guarantees are not required given the size of the corporate structure that is backing the proposal (VES is a massive global conglomerate with operations in all States of Australia and on all continents.) and the commitments given to ensure the highest level of management throughout the life of the facility and during an extended post-closure management period.

Notwithstanding this position, if Government required such a guarantee and it was applied in an even handed fashion to all similar facilities, VES would be pleased provide any necessary guarantees. VES envisages that the nature and size of the guarantee would be determined by an independent assessment of the risks posed by the facility and through discussion with the relevant regulatory agencies (Primarily DEC and the Shire of Gingin).

3.2 Conceptual Design of the Facility

3.2.1 Introduction

The proposed facility consists of an engineered landfill composed of six or more landfill stages, which will be designed and operated to meet the *Draft Siting, Design, Operation and Rehabilitation of Landfills (DoE, 2005a)*. The location and footprint extent of the landfill and associated infrastructure is shown in Figures 2 and 4. The landfill will be bound on its northern and western boundaries by an existing landform (valley sides), which will be selectively excavated to accommodate the facility. The formation levels for the landfill will not exceed a depth of 160m AHD where the contours for the cap will not exceed 225m AHD.

The following paragraphs present a summary of the proposed conceptual design of the landfill, highlighting key design principles which will help to ensure the site maintains a high standard of environmental protection. It does not give a detailed account of the design parameters or constraints that will be used in the design of the facility.

The waste acceptance criteria at the site will be in accordance with the Class II landfill Criteria detailed in the document titled *Landfill Waste Classifications and Waste Definitions 1996 (As Amended)* (DoE, 2005b). However, the landfill will be designed in accordance with Class III landfill as detailed in *Draft Siting, Design, Operation and Rehabilitation of Landfills (DoE, 2005a),* which will help to ensure a high standard of environmental protection.

The design of the landfill will consider but will not be limited to the following:

- Nature of the waste (Landfill Class);
- Protection of soils, surface water and groundwater;
- Stability and settlement issues;
- Leachate management;
- Landfill gas control;
- Visual impacts, landscaping and restoration;
- Environmental nuisances;
- Operational requirements; and
- Monitoring requirements.

The main components of the facility include the following:

Engineered landfill

- Storage of excavated materials - sand spoil dump;
- Landfill stages (earthworks formation);
- Lining system;
- Leachate collection and recirculation systems;
- Landfill gas extraction and control/utilisation system;
- Capping system;
- Landfill gas power generation facility; and
- Surface water management scheme.

Infrastructure

- Site access roads;
- Weighbridge;
- Administration office;

- Leachate retention ponds including a loading pad for potential tankering of leachate off-site;
- Utilities (e.g. sewage, electricity, telephone and water);
- Equipment storage yard; and
- Site security and fencing.

3.2.2 Earthworks

Preparatory earthworks are required for construction of the landfill which will include the following:

- Topsoil striping/removal of existing vegetation (principally pasture species and limited re-growth).
- Preparatory earthworks to achieve the formation levels, which will include the selective excavation of the existing landform. Excavated *in-situ* materials will be stockpiled as shown on Figure 2. The basal formation will be engineered to fall to the south at a minimum gradient of 3%.
- Formation of intercell and perimeter bunds.
- Earthworks formations to be occupied by the engineered containment system will be cleared of uneven, soft or loose material and be prepared by re-grading and compacting as necessary to produce a stable formation.
- 500mm thick compacted subgrade over the entire earthworks footprint, which will form a firm platform for the composite liner system or approved equivalent. The surface will be smooth and firm, without irregularities including bumps, hollows or shrinkage cracks and free of unsuitable materials.

All of the above features will be constructed in accordance with a Construction Quality Assurance (CQA) Plan. Upon the completion of the construction works a validation report will be compiled to confirm that the facility has been constructed in accordance with the CQA Plans.

3.2.2.1 Stability and Settlement Assessment

The design of the landfill will involve a detailed stability and settlement assessment prior to the final design of the earthworks model. The design will assess the stability of the overall landfill which will include but will not be limited to the following (which will take into account the presence and movement of waste and leachate):

- Slippage within the foundation (subgrade) beneath the landfill base and sides;
- Slippage within the liner system;
- Slippage at the waste/liner interface;
- Rotational failure within the waste;
- Slippage failure of the cap or of its components;
- Effects of settlement on the landfill cap and restoration; and
- Effects of settlement on environmental management infrastructure e.g. the landfill gas and leachate collection and management systems.

3.2.3 Landfill Liner

The primary function of the landfill liner system is to protect the surrounding land from potential impacts of landfill leachate and gas. The liner will be installed upon the formation created by the earthworks. The main engineering components of the liner include (as shown in Figure 8):

- GCL (or equivalent) installed on the base and the sidewalls of the landfill as shown in Figure 10. The GCL will have a hydraulic permeability of less than 1×10^{-9}m/s. The GCL will extend up the side slopes and will tie into adjacent stages and the landfill perimeter by an anchor trench as shown in Figure 10.
- 2mm thick smooth (smooth/textured on the side slopes) high density polyethylene (HDPE) flexible membrane liner (FML), will be installed directly above the approved GCL (or equivalent). The FML will meet the physical and mechanical requirements of *Draft Siting, Design, Operation and Rehabilitation of Landfill* (DoE, 2005a). The FML will extend up the side slopes and tie into adjacent stages and the landfill perimeter by an anchor trench as shown in Figure 10.
- A protective geotextile will be installed directly above the approved FML, as soon as practical and itself overlain by the 300mm leachate drainage layer and leachate control measures. The details are shown in Figure 8. The geotextile will extend up the side slopes and tie into adjacent stages as shown in Figure 10. The protective geotextile will be placed to form a continuous layer across the FML to prevent the intrusion of the overlying leachate drainage media onto the FML.

The design of the liner system will be based on the ability of the lining system to contain landfill gas and control leachate migration within operating regime envisaged for the facility and the geological and hydrological setting. The engineering components of the liner, in particular the GCL will be determined during the detailed design and the source evaluation. The landfill liner will be designed in accordance with best practice (DoE, 2005a) for a Class III landfill.

All of the above features will be constructed in accordance with a Construction Quality Assurance (CQA) Plan.

3.2.4 Leachate Collection System

The leachate collection system at the landfill facility will enable the collection of landfill leachate for leachate recirculation. Subsequently also controlling the leachate head on the liner system. The design of the leachate collection system for the landfill will ensure the following as suggested by the *Draft Siting, Design, Operation and Rehabilitation of Landfill* (DoE, 2005a):

- It is appropriately sized to collect the estimated volume of leachate (predicted by water balance models).
- It is resistant to chemical attack, and physical, chemical and biological clogging.
- It is able to withstand the weight of waste and the compaction equipment without crushing.
- It can be inspected and cleaned by readily available video inspection and pipe-cleaning equipment.

The leachate collection system for the proposed landfill will consist of the following elements:

- 300mm thick leachate drainage gravel layer over the entire base of the landfill. The drainage layer is a highly porous medium which provides a preferential pathway to the leachate extraction sump. The hydraulic conductivity of the drainage layer will be greater than 1×10^{-3}m/s.

- Leachate collection pipework (perforated HDPE) will be laid in a herringbone arrangement which will convey leachate to leachate collection sumps as shown in Figure 7. The leachate collection sumps are located at low points of the landfill formation (south side of the landfill); leachate will collect here for recirculation or storage as applicable (via the side wall riser and pump). The pipes will be placed at 25m spacing.
- Sidewall risers and leachate extraction sump: Two side risers will be installed in each sump (of which there are two). One small diameter pipe will provide inspection and flushing capability of the leachate collection system. The other larger pipe will allow the extraction of leachate from the sump via a submersible pump.
- Provisions for monitoring landfill leachate quality and quantity from the facility. In addition, perimeter bores will also be installed and monitored to measure potential landfill leachate migration.

All of the above features will be constructed in accordance with a Construction Quality Assurance (CQA) Plan.

Leachate levels within the landfill will be controlled by regular monitoring of the leachate head on the landfill liner. Typically the maximum head of leachate on the liner is limited to 300mm (DoE, 2005a); however the level of leachate at the sump will be higher in order to protect the pump in the sump.

In order to maintain a leachate level of 300mm or less above liner system, the leachate will be pumped from the leachate collection wells for:

- Recirculation into the landfill mass; and/or
- Storage in the leachate ponds for potential treatment and evaporation.

3.2.5 Leachate Recirculation System

Leachate that drains into the sumps will be extracted using a submersible pump placed down the side wall risers at the low point of the sump (see Figure 7). Leachate will then be recirculated into the landfill or temporarily conveyed to the leachate ponds.

The recirculation system will be designed to ensure sufficient capacity to store and treat all leachate generated over two consecutive wet years in accordance with *Draft Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005a). A preliminary design of the leachate recirculation system is shown in Figure 12.

The leachate recirculation system for the proposed facility will consist of the following elements:

- In areas of significant waste depth, slotted dispersion pipes may be installed in vertical bore holes 1m wide, backfilled with rubble.
- In areas close to the perimeter of the landfill, over bunds, slopes and shallow waste areas, horizontal leach drains will be constructed by excavating trenches within previously completed landfill lifts.
- The leachate recirculation systems will be connected to the rising main from the leachate storage ponds via portable pipework.

3.2.6 Leachate Storage Ponds

Two leachate storage ponds will be incorporated into the leachate collection and recirculation system, see Figure 6 for the location of the ponds. Leachate will be pumped from the base of the landfill via the sump and the sidewall risers to the leachate storage pond. The ponds will be used to store the leachate prior to recirculation into the landfill, offering the opportunity to buffer the pH of the leachate and also provide some additional treatment e.g. aeration (e.g. for leachate produced during the acetogenic phase) if required. The ponds will be designed in accordance with *Draft Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005a), also maintaining a freeboard of at least 1m. In addition, the pond will also be required to store the rainfall generated within the footprint of the ponds, for a critical storm event.

Leachate volume will increase and decrease from the surface of the leachate ponds via evaporation and incident rainfall respectively. If necessary, leachate will be tankered off-site for disposal at a licensed disposal site.

The leachate ponds will have the same lining system as the landfill which will include the following:

- Earthworks formations to be occupied by the leachate ponds will be cleared of uneven, soft or loose material and be prepared by re-grading and compacting as necessary to produce a stable formation.
- 500mm thick compacted subgrade over the entire earthworks footprint for each of the ponds, which will form a firm platform for the composite liner system or equivalent. The surface will be smooth and firm, without irregularities including bumps, hollows or shrinkage cracks and free of unsuitable materials.
- GCL (or equivalent) installed on the base and the sidewalls of the leachate ponds as shown in Figure 10. The GCL will have a hydraulic permeability of less than 1×10^{-9}m/s. The GCL will extend up the sidewalls and tie into the surrounding by an anchor trench as shown in Figure 10.
- 2mm thick high density polyethylene (HDPE) flexible membrane liner (FML) will be installed directly above the approved GCL as shown in Figure 10. The FML will meet the physical and mechanical requirements of *Draft Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005a). The FML will extend up the side slopes and tie into the surrounding ground by an anchor trench as shown in Figure 10.

A loading pad (hard stand area, bunded to capture potential spillage and return back to the leachate ponds) will be constructed adjacent to the leachate storage ponds. This will provide the opportunity for off-site tankering of leachate in the rare event that the leachate storage ponds approach full capacity.

The engineering components of the liner, in particular the GCL will be determined during the detailed design and the source evaluation. The leachate storage pond liner will be designed in accordance with best practice (DoE, 2005a) for a Class III landfill.

3.2.7 Landfill Gas Extraction

The landfill lining and capping system aim to control gas migration from the landfill. In addition, an active gas extraction system will be incorporated into the design, as detailed in Section 3.3.6. The LFG collection system will be designed to:

- Prevent migration;
- Minimise emissions;

- Manage accelerated gas generation produced from leachate recirculation; and
- Optimise utilisation.

The primary components of the LFG control system will include the following in addition to the capping and lining system:

- Vertical and/or horizontal gas extraction wells will be installed in accordance with the placement of waste materials. The spacing of the wells will be determined following an operational assessment for the site. The gas wells and connecting joints will be designed to withstand anticipated settlement rates (including leachate recirculation). Figure 13 shows a preliminary layout design for the gas extraction wells.
- Condensate traps, gas well heads and associated gas pipework will be connected to the gas extraction wells once the cell has been completed and landfill cap has been installed. This will allow LFG to be captured and conveyed to the flare or the energy recovery facility according to the quality and quantity of the extracted LFG.
- An energy recovery facility will be used once a consist quality and quantity of LFG is generated from the landfill. Generated electricity will supply power to the south-west interconnected grid.
- Provisions for monitoring LFG quality and quantity produced from the facility. In addition, surface LFG monitoring will be conducted. Three of the most significant sources of LFG emissions are considered to be landfill gas flares, surface emissions from capped and temporary capped areas and landfill gas engines.

Vertical gas collection wells will not be used for leachate recirculation due to the potential for:

- Blockage of the perforations in the gas well casing by sediments and bacterial growth;
- Silting (i.e. the pores become progressively blinded (obscured) with fines) of the waste and stone fill surrounding the perforated gas well thereby reducing the effective gas conductance; and
- The potential for differential settlement around the gas well due to leachate recirculation. This may damage the gas well and/or cause a reduction in the cross-sectional area available for gas flow.

LFG Utilisation Plant

VES will conduct an assessment of the landfill in order to estimate the future rates of gas production over the lifetime of the facility. This will allow the subsequent sizing and design of the plant. The design of the LFG utilisation plant will be presented in a report to the DEC for approval prior to construction. The report will include drawings and specifications supported by calculations and method statements. The designs for the gas control systems will consider:

- Performance standards which will aim to achieve LFG control at the facility e.g. whether temporary or permanent systems;
- The design life of the elements of the gas control system;
- The purposes of the elements of the gas control system;
- Selection of materials and products;
- Compatibility of the installed elements of the control system in terms of the phased development of the site;

- Operational and maintenance requirements; and
- Health and safety issues.

3.2.8 Capping, Landscaping and Aftercare

A site rehabilitation and aftercare management plan will be developed to meet the requirements of the Shire of Gingin and the DEC. Site aftercare is essential in order to meet the primary environmental goals of land management and conservation. There are two main aspects to site closure:

- Site capping and revegetation; and
- Post-closure monitoring and maintenance.

Capping and Landscaping

VES intends that the site is rehabilitated and returned to native bushland following site closure. This will be achieved by:

- Stockpiling stripped topsoils to preserve this valuable resource and the stock of seed and other biota that it contains.
- Progressively capping the site with interim capping materials to control dust and litter, encapsulate the waste, reduce leachate formation and improve the efficiency of gas collection and control;.
- At the time of site closure, final waste contours for the cells/stages will be achieved and then a cap will be installed. The cap will tie into the site perimeter bunding and into the adjacent cell/stage (once completed) to provide a seal. The cap will meet the design requirements of Class III landfill (DoE, 2005a) and will consist of the following:
- 300mm thick regulating layer (within which no waste material is placed);
- 600mm thick compacted low permeability fill;
- 1.5mm thick HDPE or Low Density Polyethylene (LDPE) liner;
- Non-woven geotextile layer;
- 300mm thick drainage layer;
- Non-woven geotextile layer;
- 1000mm thick Topsoil/soil/mulch; and
- Surface water drainage scheme.

The topography of the landfill cap will blend into the surrounding landscape, with a gradient of no steeper than 1V:5H to reflect surrounding landforms.

The surface of the cap will be vegetated with selected local native species based on the data obtained from baseline vegetation surveys as soon as possible following the placement of topsoils to provide erosion control.

Site Closure and Aftercare

The rehabilitation and aftercare management plan for the facility will be developed in accordance with the *Draft Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005a). In particular the plan will include the following:

- Maintenance of landfill cap, in particular to: prevent/control erosion; restore depressions; and seal and monitor cracks in the cap caused by settlement; and restore/maintain vegetation;
- Maintenance and operation of leachate collection and treatment system;
- Maintenance and operation of landfill gas-extraction system; and
- Environmental monitoring of groundwater; surface water, landfill gas, leachate and settlement.

VES has a strong commitment to aftercare and envisages that the site will be managed by VES for an extended period following closure (typically 15-25 years). The site will only be transferred from VES control when monitoring confirms that the site is stable and non-polluting and with the written agreement of the DEC and Shire of Gingin.

3.2.9 Surface Water Management

During the operation of the landfill facility surface waters will be generated from:

- Hard-stand areas within the site; and
- Landfill leachate storage ponds (Section 3.3.5).

Surface waters generated within the footprint of the landfill (not including external areas to the landfill) during operation will consist of two distinct types

- *Contaminated surface waters*: Generated during the operation of the landfill (prior to the installation of the landfill cap) from rainfall falling within active cells of the landfill. Contaminated surface waters will be controlled via the leachate collection system (Sections 3.3.3 to 3.3.5 inclusive), landfill lining system and the site perimeter bunding.
- *Un-contaminated surface waters*: Generated from the landfill cap once the cell is complete. At the perimeter of the active cells, un-contaminated surface waters will be controlled via drainage channels and will be directed into stormwater retention ponds for potential discharge to groundwater.

Given the sandy, porous nature of soils on site, there is an extremely low potential for surface water flows to be generated. Drainage structures will be sized to meet the design requirements of *Draft Siting, Design, Operation and Rehabilitation of Landfill* (DoE, 2005a).

During the operation of the landfill facility, un-contaminated surface waters will be directed into a sedimentation pond (Figure 11). The pond will be located down gradient of the facility, facilitating passive collection of any surface waters. The pond will be unlined allowing sedimentation and subsequent infiltration to groundwater (collected waters are un-contaminated and contain only sediments which will be removed in the settlement pond). The pond will be maintained to prevent excess silting. Stored water within the sedimentation pond will be disposed by:

- Infiltration into groundwater;
- Evaporation from the pond surface;

- Used for dust control; and/or
- Used for irrigation of re-vegetated areas outside the landfill area.

3.3 Staging of Construction

The construction of the landfill facility will be a staged development where construction activities will occur at intervals throughout the life of the facility. This will allow the progressive use of the landfill areas so that construction, operation, capping and leachate recirculation can occur simultaneously in different areas (stages) of the site.

The area proposed for the landfill covers approximately 29ha. The total volume of available airspace has been assessed as approximately 4.75Mm^3.

The initial construction works at the facility will include; establishing site infrastructure (site access roads etc.), bulk earthworks, leachate storage ponds and the construction of the landfill cell which forms Stage 1. Subsequent stages will be constructed as required. The exact timing of future construction stages will be dependant on the volumes of waste received at the facility and the requirement to prepare the next cell in time for ongoing receival of waste. Figure 9 is an indicative staging plan for the development. This may be revised during the detailed design stage of the project and will be confirmed as part of the Works Approval process.

The landfill will be constructed in accordance with a CQA Plan with associated construction quality control procedures to ensure that materials and workmanship meet the design specifications.

The leachate ponds will be constructed as part of the site infrastructure. However, the landfill gas utilisation plant will be built within a timeframe to manage the anticipated production of landfill gas. Operations at the facility will only commence once:

- The validation report demonstrates that the facility has been constructed to the specification.
- The facility has been approved by the DEC and Shire of Gingin.

3.4 Procedures for Placement of Waste Materials

The placement of waste within the landfill will be similar to normal operating procedures adopted for landfills.

The first layer of waste will be placed within the landfill in accordance with a method statement to avoid damage to the underlying liner. This will be detailed in the CQA Plan.

The wastes will be placed within the stages according to the site phasing plan (shown in Figure 9). Filling will generally progress from south to north across the site (Stage 1 through to 6), where only one stage will be active at any time. As finished levels are reached in each cell, the final cap will be progressively placed. At all phases (except during the construction of Stage 6) during the filling operations, the landfill will have an active filling area and a stage under preparation.

During the placement of waste materials the working face will be kept as narrow as possible, operating in accordance with good management practices. In accordance with the site staging plan, intercell and site perimeter bunds, which separate active stages (cells) from non active stages, will be lifted as required to allow the placement of waste.

Waste delivery vehicles will reverse up to an open trench and gravity discharge the wastes into the trench; the emplaced waste will then be backfilled and covered.

Daily cover will be used at the end of every working day to cover the deposited waste. The cover material will typically be sand, soil or biodegradable sheeting. The choice of material used as daily cover will be an important management consideration at the landfill as it could potentially limit gas and leachate movement, thereby stratifying the waste. The daily cover may be scraped back before additional waste is placed on top and if this occurs, the daily cover will then be stored for reuse.

An intermediate cap (thickened daily cover material) will be placed over waste which will be left for extended periods of time e.g. during site shutdowns. Prior to placement of wastes over these areas the intermediate cap will be removed and the surface ripped to prevent stratification within the waste body.

Potential environmental impacts arising from operational practices will be discussed in Section 5.

3.5 Waste Inventory

The site will be fenced to prevent unauthorised entry, site access gates will be provided at the site entrance which will be secured with suitable locks outside of operating hours. All trucks/vehicles entering the site to deposit waste will be required to stop at the unstaffed weighbridge. Entry to the operational area of the landfill will only be gained using the electronic recognition and security access provided for vehicles that regularly access the site or following approval from the site supervisor.

Wastes accepted at the facility will generally be subject to a pre-booking procedure, which will allow the total volumes of waste onsite to be managed appropriately. A record will be kept for each of the trucks entering the site. Information recorded will include:

- Customer;
- Truck identification;
- Driver's name;
- Incoming truck weight;
- Date and time of arrival;
- Origin of materials;
- Type of material delivered and the origin of truck contents;
- Outgoing truck weight; and
- Date and time of trucks exiting the facility

3.5.1 Inspection of Incoming Wastes

The majority of wastes entering the site will originate from transfer stations operated by VES. This portion of the waste stream will be visually inspected at the transfer station prior to delivery at the site and also at the tipping face. Wastes originating from sources other than VES transfer stations will only access the site after pre-booking and gaining approval from VES. Upon arrival at the site the vehicle will require clearance at the weighbridge and will be visually assessed at the tipping face by supervisory staff.

The inspection at the tipping face will comprise an examination of the visible surface of the waste prior to emplacement and an inspection of the waste prior to the delivery vehicle departing the landfill. In addition, the compliance testing for the incoming material will be verified and recorded.

The wastes will only be assessed by members of staff who are aware of the waste description for each load they are inspecting and are familiar with the wastes permitted for disposal at the landfill.

Where the visual inspection of the waste identifies that the waste is not consistent with the description provided, or is otherwise not permitted at the landfill, then the waste will be referred to the site manager for appropriate action.

The following provisions will be in place at the landfill to prevent the disposal of unacceptable wastes:

- Signs indicating the types of wastes accepted;
- A booking procedure for unscheduled deliveries;
- A program of inspection for incoming waste loads will be adopted.
- All information will be entered on a computer where records can be regularly backed up and archived. Records will be kept for the life of the landfill; and
- Vehicles carrying waste which does not comply with Class II landfill Criteria detailed in the document titled *Landfill Waste Classifications and Waste Definitions 1996 (As Amended)* (DoE, 2005b) will not be accepted.

3.6 Summary of Operational Practices

The facility will be licenced in accordance with the *Environmental Protection Act 1986*. Landfill operations must comply with the EP Act, its regulations and relevant environmental protection policies.

In addition to the design features described above, a best practice landfill requires careful control over all aspects of its operation. Key operational practices aimed at maintaining environmental standards are:

- The site will be secured with perimeter fencing and a single point of access through a lockable gate.
- All deliveries will be weighed (weighbridge) and vetted to verify their origin and nature before allowing the load to be deposited at the tipping face. All trucks/vehicles entering the site to deposit waste will be stopped at the unstaffed weighbridge; entry to the operational area can only be gained through the electronic recognition and security access or following verbal communication (by radio) with the site supervisor. Trucks with unsuitable loads will be directed off-site, either by personnel at the tipping face or refused entry by the electronic intelligence. Trucks accessing the landfill via the electronic intelligence will require prior booking and will generally be from a regular source with a known waste type.
- Supervisory staff will be trained in and familiar with the guidelines issued by the DEC on waste acceptance and also the requirements of the site Environmental Protection Licence.
- Waste will be deposited under supervision in defined tipping areas, where the active tipping face will be kept to a minimum.
- Waste will be compacted continuously during the day to maximise density.

- Waste will be covered daily with approved daily cover material to minimise odour, litter and access to the waste by vermin and birds.
- Tipping will only occur within the lined active stage of the landfill. Leachate will be captured and directed to the storage ponds for evaporation or recirculation within the landfill.
- Portable litter screens will be used downwind of the tipping face to trap windblown litter.
- Completed stages (cells) will be capped and rehabilitated as soon as they reach design height.
- Landfill gas management systems will be installed progressively and landfill gas is either flared or used to produce green power.
- Leachate management systems will be monitored regularly to ensure leachate levels within the landfill liner are kept within acceptable limits.
- Leachate will be recirculated through the waste body to promote rapid decomposition of the waste and assist in achieving landfill stability in the shortest possible time.
- Water from the surface water diversion systems will be directed to the sedimentation pond (Figure 11).
- Emergency procedures will be established and maintained to identify the potential for and the response to accidents and emergency situations, which may occur during the operations of the facility.

3.7 Development and Commissioning Strategy / Timeframe / Project Life

The construction is scheduled to start in late 2007. Stage and cell construction will be completed in phases in accordance with Figure 9 and Section 3.4.

3.8 Services and Utilities

The site is supplied with electric power and telecommunications from the public networks.

High voltage power lines are located to the west of the landfill footprint. The power lines are the Moora to Muchea line number 81. This may provide the means for green energy provision to Western Australia's power grid from the landfill. Locally 240 volt single phase power is available at the proposed location of the entrance.

Water will be sourced from existing groundwater bores on site (Extraction Licence is provided as Appendix E). It is envisaged that the facility will use approximately 150,000litres/per day (54,750kL/per year), primarily for dust control. A 100,000litre fire fighting water storage tank will be maintained on site. Wherever feasible, water use on site will be restricted by adopting techniques such as mulching of stockpiles, limiting the length of accessible unsealed roads and minimising the overall areas of disturbed soil.

3.9 Site Access and Security

The main routes for accessing the site are shown on Figure 1. Access to the site will initially be gained along Wannamal Road West and then Wannamal Road South. Vehicles approaching the site from the north or south will generally use Brand Highway and then turn on to Wannamal Road West.

The site access road will be designed in accordance with the requirements of the Shire of Gingin and will be gravel sheeted from Wannamal Road South to the facility. The location of the site access road is shown on Figure 2. It is anticipated that some vegetation clearing will be required which will be kept to a minimum by following existing easements where possible. The chosen access route offers less vegetation clearing when compared to the alternative route located to the south of the site. This southern access route also presents further difficulties as it contains a power line along the edge and existing infrastructure used by the present land owner. The existing access route to the south of the site, as shown on Figure 2 will remain but will only be used by light vehicles and will not be used for waste delivery.

The extent of clearing and the potential impacts are discussed in Section 5.1.

The strategy for preventing unauthorised entry at the landfill facility comprises:

- The site will be fenced to prevent unauthorised entry, site access gates will be provided at the site entrance which will be secured with suitable locks.
- All trucks/vehicles entering the site to deposit waste will be stopped at the unstaffed weighbridge; entry to the operational area can only be gained through the electronic recognition and security access.
- 1.8m high mesh security fence around the perimeter of the site (inspected monthly); and
- The gates are locked outside of operating hours and only authorised Veolia personnel and the Fire Brigade will hold keys.

End-of-day procedures relating to securing the site will be established.

3.10 Transport

During construction, traffic movements will predominately consist of a small number of private cars and light commercial vehicles. In addition, a small number of large vehicle movements (less than fifty movements over the three month construction period) will be required to deliver large items of earth moving plant to the site and construction materials. Traffic volumes recorded at a count station 3km north of Gingin Brook Road show that in 1997/8 the average annual daily traffic was about 2000 vehicles per day and have remained at this level since 1989/90 (WAPC, 2006). Significant spare traffic capacity therefore exists along the Brand Highway through the study area (WAPC, 2006), and as such construction stage vehicle movements are not considered be significant, utilising heavy haulage routes where practical.

Access to the site is strictly controlled for safety and operational control reasons. Access is not permitted for car and trailer tipping with such waste being directed to regional transfer stations.

During site operations it is anticipated that up to 25 trucks per day will access the site to deliver waste materials. In addition, approximately 5 light vehicles per day will access the site.

3.11 Workforce

During construction, a workforce of contractors will be engaged to undertaken the construction of the landfill facility. On completion of the construction stage, staff numbers will return to the normal site staff of up to fifteen staff, which includes:

- Site Manager

- Environmental Manager
- Maintenance personnel
- Landfill engineers
- Chemist
- Leading hand
- Landfill labourers
- Landfill plant operators – Compactor, dozer, water truck, grader and excavator.

3.12 Waste Management

3.12.1 Stormwater

It is expected that low volumes of stormwater will be generated on site due to the high permeability and depth of sand present. Notwithstanding, the site will be designed such that surface water is directed around and away from the active portion of the landfill. A description of surface water management is provided in Section 3.3.8.

3.12.2 Domestic Sewerage

Sewerage and grey water will be directed to an on-site storage tank and leach drain system. The on-site storage tank will be emptied on a regular basis and transported to an appropriate licensed facility.

3.12.3 Solid Wastes

The operation of the proposed landfill (e.g. from administration offices) will result in the generation of minor quantities of solid waste and domestic waste. Once operational all generated wastes apart from liquid and hazardous wastes will be managed within the facility. During the construction and development phase all waste will be stored for off-site disposal at a licenced facility (see Section 5.6).

3.12.4 Leachate Wastes

As described previously, landfill leachate is managed via leachate collection and recirculation system (see Sections 3.1.2, 3.3.3-3.3.5 inclusive).

3.13 Sustainable Energy and Greenhouse Gas Emissions

According to the “Hope for the Future: The Western Australian State Sustainability Strategy” (Government of Western Australia, 2003) the long-term goal for sustainable energy use in Western Australia depends on encouraging and facilitating movement away from our reliance on combustion of fossil fuels to practices that conserve energy and encourage the use of more benign alternative forms of energy, including renewable energy.

The EPA’s Preliminary Position Statement No. 6 “Towards Sustainability” (2004) also discusses the issue of sustainability and energy. The EPA discusses sustainability and energy in the context of greenhouse gas emissions and concludes that meeting any realistic Australian emissions targets will involve a gradual move away from conventional coal-fired electricity to less carbon intensive forms of energy.

Landfill Gas (LFG) is produced as a by-product of the decomposition or organic materials. LFG is predominantly a mixture of methane (CH_4) and carbon dioxide (CO_2) with traces of other compounds including low levels of sulphur based compounds such as hydrogen sulphide (H_2S) and mercaptans (R-S) which tend to make the LFG odorous. The exact ratio of the constituents changes over the life of the landfill with the percentage of CO_2 being highest in the early stages of decomposition while CH_4 continues to rise steadily as oxygen levels in the waste body are consumed and anaerobic conditions predominate.

Both CO_2 and CH_4 are active greenhouse gases with CH_4 being more than 20 times as radiatively active as CO_2. Methane is the principal constituent of natural gas. The Lower Explosive Limit (LEL) and Upper Explosive Limit (UEL) of methane are approximately 5 and 15% v/v respectively.

In line with the above policies, VES proposes to equip completed stages with Landfill Gas capture systems. In the early stages of the landfill development, captured LFG will be flared to oxidise the CH_4 to the less radioactively active CO_2. As LFG volumes increase, the LFG will be directed to stationary engines which generate ‘green’ electricity that can be distributed on the Western Power distribution network.

4 IDENTIFICATION OF ENVIRONMENTAL FACTORS

The following strategic environmental factors have been identified as most relevant to this proposal:

Biophysical

- Flora (Section 5.1)
- Fauna (Section 5.2)

Pollution Management

- Air Quality – Particulate Emissions (Section 5.3)
- Air Quality – Odour (Section 5.4)
- Air Quality - Landfill Gas Emissions and Greenhouse Gases (Section 5.5)
- Water Quality – Surface Water and Groundwater (Section 5.6)
- Noise (Section 5.7)

Social Surroundings

- Transport (Section 5.8)
- Amenity – Visual (Section 5.9)
- Amenity – Litter (Section 5.10)
- Amenity – Fire (Section 5.11)
- Amenity – Vermin, pest and nuisance species control (Section 5.12)

Each of the environmental factors identified above have been discussed in detail in Section 5 of this report. A summary of the findings of Section 5 is provided in Table 7 below, which includes the following:

- Key environmental factors applicable to the current proposal;
- Environmental objectives for each factor;
- Project characteristics that contribute to potential environmental impacts;
- Proposed management and mitigation measures that will be implemented to address these impacts; and
- Predicted environmental outcome.

TABLE 7
SUMMARY OF IDENTIFICATION OF KEY ENVIRONMENTAL FACTORS & PROPOSED MITIGATION AND MANAGEMENT STRATEGIES

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
BIOPHYSICAL					
Terrestrial Vegetation and Flora	Landfill facility footprint and site access road	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	The landfill is to be constructed in an area of cleared land, previously used for cattle grazing. An area of Very Good to Excellent quality vegetation exists adjacent to the landfill footprint. There is potential for impacts on this area of Very Good to Excellent quality vegetation through dust, litter or the propagation of weeds and exotic plant species. Heddle *et al.* (1980) identified the vegetation within this area as part of the Cullulla Complex. This vegetation complex occurs on the Dandaragan Plateau and consists predominantly of a mixture of Low Open Forest of *Banksia* species – *Eucalyptus todtiana* and Open Woodland of *Corymbia calophylla* with a second storey of *E. todtiana – Banksia attenuata – B. menziesii – B. illicifolia*. Vegetation surveys confirmed that the vegetation is part of the Cullulla Complex. Approximately 40% of the estimated pre-European extent of the Cullulla vegetation complex is remaining and 3% is currently protected within secure reserves. This is below the minimum 10% target established in Bush	The landfill has been sited to minimise clearing of vegetation. VES will exclude a section of vegetation in Very Good to Excellent condition south of the site from operational areas. Impact to this vegetation will be minimised by the construction of a 1.8m mesh security fence, with litter control capping, along the existing fence line which is approximately 60m inside the southern lease boundary. VES will develop a weed monitoring and management programme in this area prior to the commencement of operations. The access road between	VES believes the EPA may consider this environmental factor relevant, and accordingly the factor is further discussed in Section 5.1 VES believes that the management procedures outlined in Section 5.1.3 will allow the EPA objectives to be met in relation to this factor.

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
			Forever (Government of Western Australia, 2000a; 2000b). The majority of species recorded within the study area were also recorded within the nearby Boonanarring Nature Reserve (Burbidge *et al*., 1996). No Declared Plants (weeds) were identified during the May or November flora survey. An area of relatively undisturbed vegetation in an as yet unsurveyed area will require clearing in order to provide an access road between the operational area and eastern boundary of Lot 7778. This area covers a total of 2.72ha.	the operational area and eastern boundary of Lot 7778 has been sited along existing easements to minimise the area of clearing required. A spring flora survey will be conducted in 2008 to ascertain the quality and condition of this vegetation. A very high standard of management will be employed to limit dust and litter impacts. VES will undertake regular inspections of boundary fences for wind blown litter and clean up as necessary. Restoration schemes and erosion control measures which incorporate planting regimes will minimise the introduction of noxious weeds to the site.	

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
Terrestrial Fauna	Landfill facility footprint and site access road	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	The location of the proposed landfill is considered to potentially have little direct or indirect impact on fauna as it will be constructed on land that has largely previously been cleared for agricultural use.	Clearing of vegetation will be minimised to the extent feasible. Impacts to the vegetation to the south of the lease area will be minimised by the construction of a 1.8m mesh security fence, with litter control capping, along the existing fence line which is approximately 60m inside the southern lease boundary. VES will develop a weed monitoring and management programme in this area prior to the commencement of operations Staff inductions will address the need to preserve native fauna and control feral animals and vermin.	VES believes impacts on fauna can be managed to meet EPA objectives.
POLLUTION MANAGEMENT					
Air Quality - Particulate	Proposal site and immediate	To ensure that best practicable measures are taken to ensure	Potential sources of particulate emissions at the site are as follows, as discussed in Section 5.3.3:	VES will design the landfill facility to minimise potential dust migration	Given the distance of the proposed site from dust sensitive premises,

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
Emissions	surrounding area	that emissions do not adversely affect the environment values or the health, welfare and amenity of people and nearby land users by meeting accepted guidelines, standards and criteria.	***Construction and Development Phase*** • Land clearing/Earthwork activities; • Construction activities; • Vehicles movements on unsealed tracks; • Truck unloading; • Wind action on cleared/graded areas and soil stockpiles; and • Spillages of soils and construction materials on to the roads. ***Commissioning and Operational Phase*** • On-going construction activities; • Wind-borne dust/litter associated with waste placement; • Daily cover, capping materials and stockpiles; and • Vehicle movements. The magnitude of dust impacts is influenced primarily by wind speed and direction. Off site impacts will be minimised due to the large separation distance and management measures including litter screens and active daily management programs.	through the capping design and the phasing design of the landfill Section 5.3.4). In addition, operational procedures will aim to minimise dust generation and migration during construction and operational activities. The procedures identified in Section 5.3.4 will be implemented to the satisfaction of the DEC.	VES believe dust impacts can be managed to meet the reasonable expectations of the community as detailed in Section 5.3. VES does not believe the EPA will consider this a significant environmental factor.
Air Quality - Odour	Proposal site and immediate surrounding	To ensure that best practicable measures are taken to ensure that emissions do not adversely affect the	Potential sources of odour at the site include the following, as discussed in Section 5.4.3 : ***Commissioning and Operational Phase*** • Un-capped or operational areas of the	VES will design the landfill facility to minimise potential odour migration through the landfill containment system	Prevailing winds on site are from the east, the nearest residence to the west is 14km from the site. In addition, the Boonanarring Nature

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
	area.	environment values or the health, welfare and amenity of people and nearby land users by meeting accepted guidelines, standards and criteria.	landfill, including the active tipping face; • Leachate including leachate collection and management infrastructure (e.g. Leachate storage ponds and recirculation); • Landfill gas collection pipework; • Landfill gas utilisation plants and enclosed gas flare; • Leakage of landfill gas through cracks, gaps and fissures in the landfill cap and liner systems; • Lateral migration through the surrounding geological strata; and • Intrusive engineering works and excavation of emplaced wastes for the installation of the landfill leachate and gas infrastructure. The magnitude of odour impacts is influenced by prevailing climatic conditions and landforms and the proximity of sensitive receptors. Offsite impacts will be minimal due to the large separation distance to sensitive land users.	(engineered cap and liner); and the active LFG collection, control and management system (Section 5.4.4). In addition, operational procedures will aim to minimise odour generation and migration during construction and operational activities. The procedures identified in Section 5.4.4 will be implemented to the satisfaction of the DEC.	Reserve is located to the west of the site. Secondary winds are from the south east, the nearest residence to the north east some 2km away, Given the distance of the proposed site from odour sensitive premises and the high standards adopted for design and management, VES believe potential odour impacts can be managed to meet the reasonable expectations of the community as detailed in Section 5.4. VES does not believe the EPA will consider this a significant environmental factor.
Landfill Gas Emissions and Greenhouse Gases	Proposal site and surrounding area within a radius of 1km	To minimise emissions of greenhouse gases to levels as low as practicable on an on-going basis and	Potential sources of greenhouse emissions at the facility during construction and operation phases include (Section 5.5.3): • Uncontrolled LFG emissions; • Emissions from the LFG flare and utilisation	VES will design the landfill facility to contain and control LFG emissions through a landfill containment system (engineered cap and liner). The design will also include the active	Given the proposed design and management measures, VES believe landfill gas emissions and greenhouse

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
	(odour).	consider offsets to further reduce Global Greenhouse emissions.	plant; and • Vehicle emissions. Landfill gas consists predominantly of methane and carbon dioxide, along with minor proportions of other gaseous hydrocarbons. The capture of methane from landfill is a recognised method for reducing greenhouse gas emissions (Australian Greenhouse Office, 1998) and is an endorsed State Government objective.	management and capture of LFG where it will be used for flaring or electricity generation depending on the quality and quantity of LFG produce. Additionally, operational procedures will aim to minimise LFG migration during construction and operational activities. The procedures identified in Section 5.5.4 will be implemented to the satisfaction of the DEC. This also includes the regular monitoring of landfill gas generated on site.	impacts can be managed to meet the reasonable expectations of the community. In particular a report will be prepared for the DEC which details the design of the landfill gas management scheme as detailed in Section 5.5. VES does not believe the EPA will consider this a significant environmental factor.
Water Quality – Surface Water and Groundwater	Proposal site and immediate down-gradient area	Ensure surface water quality from the landfill facility does not adversely affect the environment or the health, welfare and amenity of nearby land users by meeting the statutory requirements and acceptable	The facility has the potential to contaminate surface water (stormwater) and groundwater through the following (Section 5.6.3): ***Construction and Development Phase*** • Storage and use of chemicals and petroleum hydrocarbon products; • Disposal of sewage and grey water; • Management of sediments in stormwater run-off; and	VES will design the landfill facility to minimise potential impacts on surface water and groundwater through (Section 5.6.4): • Engineered containment system (liner and cap) to prevent any potential contamination of	Given the landfill design, active management measures, depth to groundwater, absence of existing surface waters and monitoring regime proposed, VES believe surface water and groundwater quality impacts can be managed to meet the

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
		standards. To maintain the quality of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.	• Storage of waste materials on-site ***Commissioning and Operational Phase*** • Transport of contaminants from the landfill to groundwater through poor surface water management within the landfill; • Leakage or discharge of landfill leachate into groundwater originating from the landfill or the leachate storage ponds; • Disturbance of soil or stream profiles, which result in increased sediment loads; • Abstraction of groundwater; • Transport, storage, handling and disposal of chemical agents and cleaners; • Increased surface runoff volumes due to the creation of hard surfaces, which prevent re-infiltration. This in turn can also contain elevated levels suspended solids (i.e. first flush); • Spillage or leakage of sewerage and grey wastewater from ablutions facilities; • Spillage or leakage of stored chemicals and petroleum products; • Storage of waste materials generated on site; • Spillage or leakage of bio-solids/sludge;	groundwater or stormwater through the release of landfill leachate or gas; • Separate management of stormwater run-off and landfill leachate. This includes the installation, maintenance and monitoring of a site drainage system that diverts clean surface water runoff away from areas receiving waste for disposal; • Active management of landfill leachate, where the leachate head will be maintained at 300mm above the liner; • The leachate storage ponds will be designed to have an equivalent lining system to the landfill; • Implementing stringent	reasonable expectations of the community. VES does not believe the EPA will consider this a significant environmental factor.

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
			and • Leakage of petroleum products from mobile plant used on site and employees cars parked in the car park. The proposal is considered to present a low threat to surface water due to the absence of any surface water bodies within several kilometres of the site. The proposal is considered to present a low risk of groundwater contamination due to the large depth to groundwater and the proposed containment design of the landfill.	waste acceptance criteria to ensure excluded wastes are not placed in the landfill; and • Implementation of surface and groundwater monitoring program to the satisfaction of DEC. In addition, operational procedures will aim to minimise the potential for stormwater and groundwater contamination during construction and operational activities. The procedures identified in Section 5.6.4 will be implemented as part of the sites environmental management plan to the satisfaction of the DEC. VES will ensure compliance with the site environmental licence at all times.	

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
Noise and Vibration	Proposal site and immediate surrounding area.	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels comply with the *Environmental Protection (Noise) Regulations 1997.*	Potential sources of noise at the site are, as discussed in Section 5.7.3: ***Construction and Development Phase*** • Mobile plant (Cranes, vehicles, earthmoving and construction equipment) ***Commissioning and Operational Phase*** • On-going construction activities; • Operational activities including the placement of waste (via compactors) and the delivery of waste materials; and • Vehicle movements The most likely source of noise impacts at the site are heavy vehicles transporting waste to and from the site and the operation of heavy equipment within the site. However, due to the surrounding topography of the site and the distance to the nearest noise sensitive receptors this is not considered to be significant.	Operational procedures will aim to minimise potential noise impacts during construction and operational activities. The procedures identified in Section 5.7.4 will be implemented to the satisfaction of the DEC and include: • Construction activities will be conducted in accordance with AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites. • Noise emissions at the nearest existing residences, will be managed by engineering design methods and installation of required noise attenuation measures to comply with the Environmental Protection (Noise)	Given the location of the proposed landfill in terms of buffering distances and the rural surrounding land uses, VES believes noise impacts can be managed to meet the reasonable expectations of the community. VES does not believe the EPA will consider this a relevant environmental factor.

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
				Regulations 1997 (as amended) at all times, including achieving not more than 35dB(A) at the nearest sensitive premises.	
Transport		Ensure that traffic movements associated with the project do not adversely affect the health, welfare and amenity of nearby residents and sensitive areas.	The construction and operation of the facility will require regular vehicle access to deliver waste materials and conduct construction activities which can potentially have the following impacts (Section 5.8.3): ***Construction and Operational Phases*** • Release of green house gases; • Hazards to the public which range from direct (collision) to indirect (road damage from heavy vehicle use); • Human health risks associated with vehicle emissions; • Traffic noise generated by trucks accessing the site, which is discussed in Section 5.7; • Dust migration from trucks utilising unsealed roads (Section 5.3); and • The increase in traffic associated with the proposed landfill operations also heightens the potential for animal deaths, due to vehicular impacts.	Operational procedures will aim to minimise the potential transport impacts. The procedures identified in Section 5.8.4 will be implemented to the satisfaction of the DEC and include: • The use of designated regional roads (Wannamal Road South and Wannamal Road West) and the avoidance of Cullalla Road, except when the waste collection vehicles are collecting waste in that area. • Development of a truck movement plan which will ensure the separation of excavation haulage	VES believes potential transport impacts can be managed to meet EPA objectives.

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
			All site traffic will access the facility via Wannamal Road South and Wannamal Road West. Cullalla Road will only be utilised by locally generated traffic accessing the site from the south and east. During operation, it is anticipated that up to 25 trucks per day will access the site to deliver waste materials	vehicles and waste vehicles.	
Amenity - Visual		To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.	During the construction and operation of the landfill facility, visual intrusion could potentially include (Section 5.9.3): • Earthworks; • Waste profiles; • Landfill gas utilisation plant; • Site infrastructure (e.g. site offices); and • Potential light overspill. Vantage points will be restricted to the east through to the south east of the site, with the natural topography of the site shielding it from other directions. The landfill site may be visible from Wannamal Road South, which is predominantly used by local traffic only, and sections of Cullalla Road. The landfill will be rehabilitated in accordance with best practice rehabilitation and aftercare (DoE, 2005a). The rehabilitation and aftercare management plan will be developed in	VES will design the facility to minimise potential visual intrusion of the landfill (Section 5.9.4) where: • The landfill cap will be installed at a gradient no steeper than 1V: 5H. • The landfill will be rehabilitated in accordance with best practice rehabilitation and aftercare (DoE, 2005a). • Elevations of the proposed buildings on site (e.g. site offices and landfill gas utilisation plant) will be carefully considered so not to adversely impact	Given the location of the proposed landfill in terms of buffering distances, VES believes impacts can be managed to meet the reasonable expectations of the community. VES does not believe the EPA will consider this a relevant environmental factor.

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
			consultation with the local community and regulatory and planning authorities. The rehabilitation plan will be regularly reviewed.	on visual amenity. • Land clearing will be kept to a minimum where possible. The site access road will follow existing easements where feasible. In addition, operational procedures will aim to minimise visual intrusion during construction and operational activities. The procedures identified in Section 5.9.4 will be implemented as part of the sites environmental management plan to the satisfaction of the DEC.	

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
Amenity - Litter	Proposal site and immediate surrounding area.	To protect the amenity of surrounding areas from activities associated with the proposal by ensuring litter is managed in accordance with the Litter Act 1979.	Litter is generally regarded as a visual pollutant and essentially impacts on the human environment, although in certain situations it may impact on flora and fauna. During the construction and operation of the landfill facility, sources of litter can potentially include (Section 5.10.3): • Vehicles transporting waste into the facility; • Active tipping face; and • Exposed surfaces of the landfill.	VES will design the landfill facility to minimise potential litter migration through the landfill containment system (engineered cap and liner) and the phasing arrangement (Section 5.10.4). In addition, operational procedures will aim to minimise litter generation and migration during construction and operational activities. The procedures identified in Section 5.10.4 will be implemented as part of the sites environmental management plan to the satisfaction of the DEC.	Given the proposed management measures, VES believe litter impacts can be managed to meet the reasonable expectations of the community. VES does not believe the EPA will consider this a relevant environmental factor.

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
Amenity - Fire	Proposal site and immediate surrounding area.	The general amenity of the area adjacent to the project should not be unduly affected by the proposal.	Most fires at landfills are intentionally lit by vandals, although under certain circumstances fires may occur due to spontaneous combustion and poor landfill gas management. Potential environmental impacts of landfill fires include (Section 5.11.2): • Release of smoke and odours into local environment; • Damage to the lining and capping system thereby reducing the integrity of the containment system; • Damage to internal infrastructure such as landfill gas and leachate collection systems; and • Spread of fire to adjacent land, with the associated potential risks to vegetation, fauna and property landowners.	VES will design the landfill facility to minimise potential for landfill fires through (Section 5.11.3): • Site security at the site will prevent unauthorised access and the potential for vandalism; • Waste acceptance procedure. • Active landfill gas extraction system; and • Landfill Containment System: The engineered lining and capping system will limit air ingress. In addition, operational procedures will aim to minimise the generation of fires and effectively control them in the instance they do occur. The procedures identified in Section 5.11.3 will be implemented as part of the sites environmental management plan to the satisfaction of the DEC.	Given the proposed management measures, VES believe the potential for landfill fire can be managed to meet the reasonable expectations of the community. VES does not believe the EPA will consider this a relevant environmental factor.

FACTOR (SITE SPECIFIC FACTOR)	RELEVANT AREA	EPA OBJECTIVE	POTENTIAL IMPACTS/PROPOSAL CHARACTERISTICS	PROPOSED MANAGEMENT	PREDICTED OUTCOME/ RELEVANCE OF FACTOR
Amenity - Vermin, Pest and Nuisance Species Control	Within landfill site boundaries.	The general amenity of the area adjacent to the project should not be unduly affected by the proposal.	Vermin, pest and nuisance species are attracted to landfills primarily due to the availability of food and suitable host conditions. Vermin, flies and birds attracted to the landfill can potentially have the following adverse impacts: • The introduction of non native species such as feral animals into the area; • Bird-strike damage to aircraft; and • Introduction of pathogens to nearby water bodies, crops and animals.	VES will design the landfill facility to minimise the potential for vermin, bird and fly ingress by controlling odours and litter generation and migration which may potentially attract vermin and birds. In addition, VES will develop feral and introduced animal management procedures as required. Operational procedures will aim to minimise the potential for vermin, bird and fly ingress as discussed in Section 5.13.3. Those procedures identified in Section 5.13.3 will be implemented to the satisfaction of the DEC.	Given the proposed management measures, VES believe vermin, pest and nuisance species can be managed to meet the reasonable expectations of the community. VES does not believe the EPA will consider this a relevant environmental factor.

5 ENVIRONMENTAL MANAGEMENT

5.1 Terrestrial Flora and Vegetation

5.1.1 EPA Objective

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

5.1.2 Potential Environmental Impacts

The landfill has been sited to minimise clearing of vegetation, particularly that which is in good condition, however the proposal will result in the loss of some vegetation to accommodate the footprint.

Figure 5 denotes the vegetation associations and condition present within the proposed site. Table 8 summarises the vegetation associations which will require clearing in order to accommodate site infrastructure.

TABLE 8
VEGETATION ASSOCIATIONS AFFECTED BY PROPOSED SITE INFRASTRUCTURE

VEGETATION ASSOCIATION	DESCRIPTION	CONDITION[1]	INFRA-STRUCTURE	PROPOSED AREA REQUIRED FOR CLEARING (ha)
JsTOS	Tall Open Shrubland of *Jacksonia sternbergiana* to 3.5m in height over a Mixed Open Heath of *Jacksonia floribunda, Melaleuca huegelii, Adenanthos cygnorum, Hibbertia hypericoides* and *Synaphea spinulosa*. Other common species recorded from this vegetation association include *Adenanthos cygnorum, Eremaea beaufortioides, Pimelea angustifolia* and *Synaphea spinulosa*.	Good to Very Good	Landfill stages	0.060
MhS	Shrubland of *Melaleuca huegelii* to 1.5m in height with scattered *Eucalyptus todtiana, Banksia attenuata* and *Corymbia calophylla* over Low Heath of *Xanthorrhoea preissii, Hibbertia hypericoides* and *Synaphea spinulosa*.	Good	Landfill stages Spoil dump	1.40 1.54

VEGETATION ASSOCIATION	DESCRIPTION	CONDITION[1]	INFRA-STRUCTURE	PROPOSED AREA REQUIRED FOR CLEARING (ha)
BmBpJsCTS	Closed Tall Scrub of *Banksia menziesii, Banksia prionotes* and *Jacksonia sternbergiana* to 3m in height with scattered *Eucalyptus todtiana* over *Melaleuca huegelii*, *Allocasuarina humilis, Adenanthos cygnorum* and *Ptilotus polystachyus* Open Shrubland over *Eremaea pauciflora, Acacia pulchella* and *Stirlingia latifolia* Low Open Heath.	Good to Very Good	Landfill stages	3.57
BaBmEtLOW2	Low Open Woodland of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* to 3m in height over *Adenanthos cygnorum* Shrubland to 1.5m in height over Low Heath dominated by *Xanthorrhoea preissii, Stirlingia latifolia* and *Eremaea pauciflora*.	Good	Landfill stages Internal access road (OA)	16.3 0.16
BaBmEtLOW3	Low Open Woodland of *Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* to 4m in height over a Low Heath of *Allocasuarina humilis, Xanthorrhoea preissii, Eremaea pauciflora* and *Stirlingia latifolia.*	Good to Very Good	Soil Dump Internal access road (OA)	0.913 0.074
EtLOW	Low Open Woodland of *Eucalyptus todtiana* to 4m with scattered *Nuytsia floribunda* over a mixed Shrubland.	Good	Landfill stages Internal access road (OA) Weighbridge Proposed Office and workshop Spoil Dump	4.34 0.43 0.125 0.084 21.78

VEGETATION ASSOCIATION	DESCRIPTION	CONDITION[1]	INFRA-STRUCTURE	PROPOSED AREA REQUIRED FOR CLEARING (ha)
BaBmLOF	Low Open Forest of *Banksia attenuata* and *Banksia menziesii* to 4m in height over a Low Open Shrubland of *Allocasuarina humilis, Xanthorrhoea preissii, Regelia ciliata, Stirlingia latifolia, Verticordia nitens, Eremaea pauciflora* and *Conospermum stoechadis*.	Very Good	Proposed Office and workshop Equipment storage yard Leachate ponds	0.190 0.917 0.391
MLCH	Low Closed Heath of *Xanthorrhoea preissii, Allocasuarina humilis*, *Eremaea pauciflora*, *Leucopogon capitellatus* and *Synaphea spinulosa* to 1m in height.	Very Good	Spoil Dump Internal access road (OA) Office and workshop	1.02 0.198 0.030
Cleared		Degraded	Landfill stages Spoil dump	3.94 0.117
			TOTAL	**57.579**

Notes:
OA: Internal access road within operational area.
NOA: Internal access road outside operational area, providing access from the operational area to Crown Reserve land on eastern boundary of Lot 7778.
[1] Vegetation Condition Rating Scale of Keighery published in Bush Forever (Government of Western Australia, 2000.

In addition to the clearing listed above it is estimated that approximately 2.72ha of additional vegetation (unsurveyed) will need to be cleared external the landfill site to construct the eastern access road. This is based on the access road running in a northerly alignment along an existing firebreak and then easterly through good quality vegetation before entering an area of cleared land that has been used for horticultural purposes.

There is also the potential for site activities such as physical disturbance and additional vehicle movements to introduce new weed species, or encourage the spread of existing weed populations.

Migration of landfill gas outside the perimeter of landfill sites is another potential impact where sites have been inadequately engineered. In such circumstances, the gas will can exclude oxygen from the soil and lead to the exposure and possible death of plants and soil fauna.

Dust generated during construction and operation has the potential to negatively affect surrounding vegetation, but this is considered likely to be minor provided the dust suppression measures outlined in Section 5.3 are implemented.

5.1.3 Environmental Management and Mitigation

The landfill has been sited to avoid the need for clearing undisturbed vegetation. Whilst the landfill and associated infrastructure will require the clearing of some vegetation classified as 'Degraded to Very Good', this area is currently used for grazing and was cleared by the farmer in approximately 1970 Subsequently, the landfill footprint has been chained at about 5 year intervals to control regrowth. The area on the eastern side of the site earmarked for spoil dumps and a possible inert cell has not been physically cleared on such a regular basis but has been the subject of regular grazing. Both areas are regularly accessed by licensed wildflower pickers.

It will be necessary to clear some undisturbed vegetation on the eastern side of the site to allow construction of the site access road.

Strategies to be employed to minimise the impacts on vegetation include:

- Clearing boundaries will be clearly marked and identified, including the use of fencing where appropriate. Personnel will be educated on the importance of adhering to clearing limits in order to minimise disturbance to existing vegetation.
- Cleared soil and/or vegetation are to be stockpiled for potential use as daily cover and/or capping material.
- Site disturbance is to be minimised, with vegetation retained where possible in between infrastructure in accordance with Health, Safety and Operational requirements.
- Roads and tracks will be developed along existing easements where possible.
- Vegetation in Very Good to Excellent condition present to the south of the proposed footprint will be protected by the construction of a 1.8m mesh security fence (with litter control capping) along the existing fence line which is approximately 60m inside the southern lease boundary. VES will develop a weed monitoring and management programme in this area prior to the commencement of operations.
- Vehicle use will be restricted to designated tracks with parking in allocated areas.
- Off-road driving will be prohibited within the landfill site.
- A Fire Management Plan will be prepared and implemented as part of the project's Environmental Management Program to minimise the risk of fire.
- The landfill will be designed in accordance with Section 3, such that the potential migration of LFG beyond the perimeter of the site will be minimised.
- Strict controls will be enforced over tipping of waste to limit windblown seed dispersal of weed species.
- Strict dust control protocols will be used to minimise the impact of dust on surrounding vegetation.
- Weed control programs will be implemented as necessary to limit the spread of weed species into area of undisturbed vegetation.
- The 2.72ha of land to be cleared for the access road on the eastern boundary will be the subject of a Survey during 2008 to verify that no DRF or TEC's are present. Available evidence suggests that the vegetation is similar to that already surveyed.

- The post-closure rehabilitation will be to return the site to a vegetated state with natural vegetation.

Section 5.3.4 details dust management procedures to minimise the impact on surrounding vegetation.

5.1.4 Predicted Outcome

It is considered the EPA's objective in relation to this factor will be met in view of:

- The degraded nature of much of the vegetation proposed for clearing;
- The commitment to manage and rehabilitate the site upon completion of the project;
- The commitment to construct a 1.8m mesh security fence, with litter control capping, along the existing fence line which is approximately 60m inside the southern lease boundary to minimise the impacts on the area of excellent quality vegetation immediately south of the proposed site;
- The availability of higher quality habitat areas in the locality, such as the Boonanarring Nature Reserve: and
- Staff inductions will raise awareness in staff about the need to protect native flora and fauna.

5.2 Terrestrial Fauna (Including Specifically Protected (Threatened) Fauna)

5.2.1 EPA Objective

Protect Specially Protected (Threatened) Fauna species and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950.*

5.2.2 Potential Environmental Impacts

Impacts on native fauna may potentially occur as a result of the destruction of habitat through vegetation clearing. The proposal requires the removal of approximately 51.16ha of vegetation ranging in condition from Completely Degraded pasture to low open woodlands in Good condition.

Despite this loss of vegetation, the proposal is not expected to significantly impact on the fauna species considered likely to occur in the project area.

The fauna habitats which may potentially be contained within the study area are likely to provide foraging habitat for a limited number of threatened species known or considered to potentially occur within the region. As discussed in Section 2.2.2, it is believed that the site does not have special significance for threatened species identified by the DEC as potentially occurring in the region given its cleared state and the extensive availability of similar woodland and heath habitat present within the region. This includes the Boonanarring Nature Reserve which abuts the western boundary of the site and has 9,250ha in reserve.

Migration of landfill gas outside the perimeter of landfill sites is another potential impact where sites have been inadequately engineered. In such circumstances, the gas will can exclude oxygen from the soil and lead to the exposure and possible death of plants and soil fauna.

Other potential impacts include increased species mortality due to the heightened volumes of traffic associated with the project, and increased predation on native fauna by feral animals which may increase as a result of inadequate landfill management.

5.2.3 Environmental Management and Mitigation

Strategies to be employed to minimise the impacts on fauna include:

- Clearing of vegetation will be restricted to the minimum necessary to implement the project, with clearing boundaries clearly marked and identified.
- Vegetation in Very Good to Excellent condition present to the south of the proposed footprint will be minimised by the construction of a 1.8m mesh security fence, with litter control capping, along the existing fence line which is approximately 60m inside the southern lease boundary. VES will develop a weed monitoring and management programme in this area prior to the commencement of operations.
- Vehicles and machinery will be parked in designated locations only to minimise habitat damage.
- Traffic will be restricted to established roads and parking areas, to again minimise habitat destruction.
- Site traffic speed limits will be maintained at levels which will minimise fauna death on roads.
- Ensuring putrescibles wastes are covered with soil at the end of each day. This will minimise the potential for night time foraging by birds and feral and native animals.
- Ensuring house keeping procedures such as litter removal at the perimeter of the site are maintained to discourage fauna from the site.
- Applying the odour control strategies outlined in Section 5.4 to minimise the attraction of fauna to the site.
- Site environmental inductions will raise employee awareness in relation to conservation of fauna (particularly rare, threatened or vulnerable fauna) and their habitats.
- Direct contact with fauna will be avoided whenever possible.
- The post-closure rehabilitation will be to return the site to a vegetated state with natural vegetation
- The landfill will be designed in accordance with Section 3, such that the potential migration of LFG beyond the perimeter of the site will be minimised.
- VES have an agreement with the Shire of Gingin to seal any sections of the road to the facility which is currently unsealed.
- Potential impacts on native fauna due to the increased movement of vehicles on public roads will be reduced by:
    - Restricting waste deliveries predominately to daylight hours to avoid times of increased fauna movements near dawn and dusk.
    - A register will be maintained on site which records fauna related transport incidents.
    - If monitoring indicates significant fauna injuries or mortalities are occurring mitigation measures will be adopted in consultation with the DEC Swan Region.
    - VES is committed to monitoring the impact of fauna-related transport incidents along the Wannamal Road West. As part of this commitment it will record all fauna deaths (e.g. kangaroos) and the approximate location of the incident. All incidents, including those not

related to staff from the landfill will be recorded. If the number of incidents is at an unacceptable level (e.g. more than 10 strikes per week) management strategies will be implemented to reduce the rate of deaths. Speed limits on access roads within the site will be kept at a maximum speed limit of 60km/hr. From the weighbridge to the landfill cells the speed limit will be restricted to 30km/hr.

5.2.4 Predicted Outcome

It is considered the EPA's objective in relation to this factor will be met in view of:

- The degraded nature of much of the vegetation proposed for clearing, which is considered to have limited habitat potential for threatened fauna species identified by the DEC as potentially occurring in the region;
- The commitment to construct a 1.8m mesh security fence, with litter control capping, along the existing fence line which is approximately 60m inside the southern lease boundary to minimise the impacts on the area of excellent quality vegetation immediately south of the proposed site;;
- The availability of higher quality habitat areas in the locality, such as the Boonanarring Nature Reserve; and
- The landfill operational procedures proposed by VES to discourage both native and feral fauna from frequenting the site.
- Staff inductions will raise awareness in staff about the need to protect native flora and fauna.

5.3 Air Quality - Particulate Emissions

5.3.1 EPA Objective

To ensure that best practicable measures are taken to ensure that emissions do not adversely affect the environment values or the health, welfare and amenity of people and nearby land users by meeting accepted guidelines, standards and criteria.

5.3.2 Existing Environment and Air Quality Standards

The landscape within the area of the proposed landfill has been previously cleared and modified for grazing. The area is generally low lying, with elevated landforms located immediately to the north, west and partially to the south. Winds are largely easterly in direction, but are varied throughout the warmer months by afternoon sea breezes and in the cooler months by westerlies, associated with rain bearing fronts.

Due to the topography of the surrounding landscape and the distance (1.95km) to the nearest sensitive premises, the potential for migration of particulate emissions off-site are not anticipated to be significant. Particulate emissions from the site will be minimised the management and mitigation measures detailed below.

Air Quality Standards

Particulates, alternatively referred to as particulate matter (PM), are tiny particles of solid or liquid suspended in a gas which includes dust, smoke, soot and droplets of liquid. For monitoring purposes PM generally falls within three main categories:

- PM_{10} particles with a diameter of 10µm.
- $PM_{2.5}$ particles with a diameter of 2.5µm.
- Total Suspended Particulate (TSP) particles with a diameter less than 50µm.

In June 1998 the National Environment Protection Council (NEPC) agreed to set uniform standards for ambient air quality. The standards contained in the NEPM for ambient air quality in relation to particulates are shown in Table 9 below.

The Environmental Protection Authority (EPA) requires that air pollutants meet the ambient air NEPM standards and goals. In Western Australia the NEPM standards are implemented under the *National Environment Protection Council (Western Australia) Act, 1996*.

TABLE 9
STANDARDS AND GOALS FOR PARTICULATES

POLLUTANT	PARTICULATE LEVEL	TIME PERIOD	GUIDANCE
Total Suspended Particulate Matter	90 µg/m^3	Annual	NHMRC, 2002
Particulate matter <10 ug/m^3 (PM_{10})	50 µg/m^3	24 hour	NEPM, 2003
Particulate matter <2.5 ug/m^3 ($PM_{2.5}$)	25 µg/m^3	24 hour	NEPM, 2003

5.3.3 Potential Environmental Impacts

Activities which have the potential to generate particle emissions are discussed below.

Development and Construction Phase

The potential for dust emissions during the construction phase will be largely dependant on local wind conditions, coupled with the frequency and duration of rainfall. During dry weather conditions, the wind may cause re-suspension of dust from areas of construction activity (e.g. where trucks are entering or departing the site). The main activities that may contribute to dust generation during the construction phase include:

- Land clearing activities;
- Earthwork activities;
- Construction activities;
- Vehicles movements on unsealed tracks;
- Truck unloading;
- Wind action on cleared/graded areas and soil stockpiles; and
- Spillages of soils and construction materials on to the roads.

Dust emissions arising from construction activities may have the potential to adversely affect human health, visual amenity, and the surrounding vegetation and fauna. The generation of dust also has a nuisance value.

Commissioning and Operation Phase

Site activities that have the potential to generate dust during the operation of the landfill include:

- On-going stage construction activities (as detailed in the development and construction phase above).
- Wind-borne dust associated with waste placement.
- Wind-borne dust associated with daily cover (placement and removal) and capping of completed phases and cells.
- Wind action on cleared/capped/graded areas and soil stockpiles.
- Vehicle movements.
- Spillages of materials from incoming trucks on to site access roads.

5.3.4 Environmental Management and Mitigation

Design Phase

The landfill will be designed in accordance with current best practice (DoE, 2005a) incorporating best available techniques to ensure optimum protection of the environment. In particular, it will be designed to incorporate the following features which will minimise the potential for particulate emissions:

- Materials excavated as part of the earthworks activities will be stockpiled within a specific location (Figure 2). The stockpiles will be immediately re-vegetated or stabilised to provide erosion control and minimise potential dust migration.
- Those areas of the site that are disturbed during the construction phase which will no longer be accessed during operation, will be rehabilitated with native vegetation in accordance with Section 5.1. Site operational procedures will prevent unauthorised access to rehabilitated areas to enhance the establishment of vegetation.
- All vehicles accessing the site beyond the site administration building will pass over a cattle grid arrangement which will serve to knock off any materials on the wheels and under body of the vehicle before entering public roads.
- The surface of the landfill will be sealed with an engineered landfill capping system (as detailed in Section 3.3.7). This will minimise potential dust emissions from the surface of the landfill. The landfill cap will be vegetated to provide erosion control.

Development and Construction Phase

During the construction phase (and subsequent stage construction phases) the following management and mitigation measures are proposed to reduce air and dust emissions:

- Unsealed roads, exposed areas and earthworks will be regularly watered down to minimise wind blown dust migration. Dust liftoff from residue stockpiles will be minimised through the use of mulch and/or hydro seeding
- All site traffic will adhere to the site speed limit to minimise dust generated by vehicle movements.

- Dust emissions will be monitored on a regular basis through visual inspections of disturbed and open areas in accordance with the sites environmental Licence conditions issued pursuant to Part V of the *Environmental Protection Act 1986* and the Minster's Conditions pursuant to Part IV of the *Environmental Protection Act 1986*.
- Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid dust complaints. A Complaints Register will be established to record any complaints received, date, nature, and resolution action undertaken.
- If visual dust inspections and complaints both indicate that dust is being generated from the site, and is crossing the site boundary, then additional dust management techniques will be adopted such as mulching, hydro seeding, chemical crusting agents or additional use of water trucks or sprays.
- All trucks entering and leaving the site will be covered to prevent wind blown emissions.
- No burning of waste materials will be permitted onsite.
- Good housekeeping practices will be adopted on site to minimise dust generation. All materials stored outside which have the capacity to generate dust must be adequately covered at all times.
- Dust management during the construction phase will be consistent with the intent of relevant EPA Policies, Guidelines and Criteria for Environmental Impact Assessment No. 18, *Air Quality Impacts from Land Development Sites* (EPA, 2000a).

Commissioning and Operation Phase

In addition to the measures detailed above for the design and construction phases, the following management and mitigation measures are proposed to manage air and dust emissions during the operation of the facility:

- All solid waste materials delivered to the facility will be contained in a covered vehicle, which will only be unloaded within the active cell and in the vicinity of the tipping face.
- All vehicles leaving the site beyond the site administration building will pass over a cattle grid arrangement which will serve to knock off any materials on the wheels and under body of the vehicle before entering public roads.
- Unsealed roads, stockpiles of soil and exposed areas and if necessary the tipping face, will be regularly watered down. Especially during dry and windy conditions in order to minimise dust lift-off. A dedicated water tank and stand pipe will be maintained for use on the site. Water for dust suppression will be obtained from an existing licensed production bore FLV4 or other licensed groundwater resource if required.
- Permanent access roads will be unsealed initially and progressively sealed (extending as far as possible to the tipping face) and cleaned (grader, mechanical road sweeper/ cleaner) on a regular basis as required to minimise potential dust migration.
- Vehicle movements, with the exception of movements within the landfill stages, will be restricted to designated roadways. Vehicle speeds will be restricted to less than 60 km/hr on access roads prior to the weighbridge and 30 km/hr between the weighbridge and the landfill tipping face in order to minimise the potential fro dust emissions.

- Existing vegetated areas which are not required during the construction and operation of the facility will be maintained. Disturbed areas not required during the operation of the facility, will be progressively stabilised with native vegetation or pasture once construction work is complete.
- Volumes of stockpiled soils and materials stored on site will be kept to a minimum where possible.
- General housekeeping practices will be undertaken to ensure there is no accumulation of waste materials within the landfill site that may generate dust.
- The facility will be completed in accordance with the staging plan (see Figure 9 and Section 3.4). Following stage/cell completion, the surface will be capped and re-vegetated as soon as possible to minimise potential dust emissions.
- Emplaced wastes will be regularly compacted.
- Dust emissions will be monitored daily through visual inspections of disturbed and open areas. The results of these inspections will be recorded in a log maintained on site for inspection by DEC or the Shire of Gingin
- Ambient dust monitoring will not be conducted unless dust is determined to be an issue at the site boundary, which will be determined by daily visual assessments. Where dust monitoring is deemed necessary, PM_{10} dust emissions beyond the boundary of the premises will be maintained below 50µg/m^3.
- Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid dust complaints. A Complaints Register will be established to record any complaints received, date, nature, and resolution action undertaken.
- The Site Manager will contact any complainants that have concerns related to dust and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the Site Manager will take steps to ensure that any identified impacts are addressed.

5.3.5 Predicted Outcome

It is considered that the measures identified above will reduce particulate emissions arising from the construction and operation of the facility to within NEPM and other adopted criteria. Given the distance to dust sensitive premises, the topography of the surrounding land and implementation of measures identified to reduce or control construction dust, it is believed that construction phase dust emissions can be managed to meet the EPA's objective.

5.4 Air Quality - Odour

5.4.1 EPA Objective

To ensure that best practicable measures are taken to ensure that emissions do not adversely affect the environment values or the health, welfare and amenity of people and nearby land users by meeting accepted guidelines, standards and criteria.

5.4.2 Existing Environment and Odour Quality Standards

Air Quality Standards

Odour impacts from the facility will be assessed using the criteria and methodologies specified in the guidance published by the EPA (2002a) *Interim Guidance Statement for the Assessment of Odour Impacts* (No.47) and DEP (2002) *Odour Methodology Guidelines*. The criterion in the EPA's Guidance Statement for acceptable odour impacts is an odour concentration equivalent to an intensity level of 'distinct' averaged over a 3 minutes expressed as the 99.5 percentile of one year's data. Intensity levels are qualitative descriptions of an odour sensation which are defined numerically in the German standard in the *VDI 1992 Olfactory – Determination of Odour Intensity* as summarised in Table 10 below. The criterion applies at 'odour-sensitive' land uses.

TABLE 10
ODOUR INTENSITY CATEGORIES

DOUR STRENGTH	INTENSITY LEVEL
Extremely Strong	6
Very Strong	5
Strong	4
Distinct	3
Weak	2
Very Weak	1
Not Perceptible	0

Odour monitoring and modelling is not proposed at the site as buffer distances will significantly exceed the requirements of the EPA Guidance Statement *Separation Distances between Industrial and Sensitive Land Uses* (No.3). In addition, the proposed facility will be designed for "best practice" emission control as detailed in the EPA Guidance Statement *Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process* (No.55). However, if deemed necessary modeling will be undertaken in accordance with the DEC guidelines that prevail at the time.

5.4.3 Potential Environmental Impacts

Odours from landfills are typically associated with:

- Trace components in landfill gas (such as hydrogen sulphide), which are detected by the human olfactory sense as offensive and are considered odorous at even very low concentrations (see Section 3.1.3).
- Handling of odorous wastes.
- Inadequate emplacement and covering of biodegradable wastes.

Given the fugitive nature of odour emissions, emphasis will be given to preventative measures relating to landfill gas management (see Sections 3.1.3, 3.3.6 and 5.5), waste acceptance and emplacement of the wastes (see Sections 3.1.1 and 3.5). The emission of odours depends on numerous factors which include:

- Generation rate of landfill gas.
- Effectiveness of the containment system including the surface cover/capping layers.

- Effectiveness of the gas abstraction and control system.

Construction and Development Phase

Earthworks and construction activities will be undertaken at the site during the initial construction and development phase and during subsequent development of the site (stage formation as required). These activities are not considered to have significant potential odour implications.

Commissioning and Operation Phase

Potential sources of odour emissions during the operation of the landfill include:

- Un-capped or exposed operational areas of the landfill including the active tipping face;
- Leachate, which also includes leachate collection systems (e.g. leachate storage ponds) and treatment infrastructure (e.g. recirculation);
- Landfill gas collection pipework;
- Landfill gas utilisation plant and gas flares;
- Landfill gas leakages through cracks, gaps and fissures in the landfill cap and liner;
- Lateral migration of LFG through surrounding strata; and
- Intrusive engineering works and excavation of wastes for the installation of landfill leachate and gas infrastructure.

Key parameters for such emissions are the velocity and temperature of the emission and the mass concentration of the odorant in the gas stream. Factors that influence the emission rate from landfill surfaces include the type and thickness of cover material and the degree of compaction. Factors that effect air dispersion include:

- Odour emission rates;
- Wind speed and direction;
- Topography; and
- Meteorological conditions.

5.4.4 Environmental Management and Mitigation

Design Phase

The landfill will be designed in accordance with current best practice to ensure potential impacts on the environment are minimised within statutory guidelines. The design of the landfill will incorporate the following features which will minimise potential odour impacts.

Collection of gas is the primary means of controlling odour. If odour can be detected then it is an indication that the gas as a whole is not being collected efficiently. The design of the LFG collection and utilisation systems and the containment system will aim to contain and control LFG and odours through the following:

- *Engineered lining system*: The sides and the base of the landfill will be lined with an engineered lining system; which will help to prevent uncontrolled movement of landfill gas into the surrounding strata (Section 3.3.2).
- *Engineered capping system*: The surface of the landfill will be sealed with an engineered cap, to minimise landfill gas emissions to the atmosphere and control the ingress of air. The cap will allow the controlled recovery and management of landfill gas and odour. It will be designed in accordance with the *Draft Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005a) for a Class III landfill.
- *LFG Management System*: An active LFG extraction and utilisation system will be incorporated into the design, which will allow the efficient collection and management of LFG. The management system, once operational, will reduce any in-situ gas pressure by abstraction. Therefore reducing the potential for odour migration (Section 3.3.6).
- Leachate and LFG collection wells and associated pipework will be adequately sealed to prevent potential odour emissions. The landfill leachate and gas management systems will be designed to compliment the liner and capping system, such that they do not adversely impact on the integrity of the landfill liner or capping system.
- *LFG Utilisation- Flaring and Energy Recovery*: Upon the effective collection of the LFG, it will be conveyed to an enclosed flare or energy recovery facility according to the quality and quantity of LFG generated. The system of combustion will be designed and operated to meet emission limits for flares and stationary gas engines.

The LFG management system will be designed and operated (through operational and monitoring procedures) to prevent the escape of landfill gas beyond the containment system.

Commissioning and Operation Phase

The following management and mitigation measures are proposed to minimise odour emissions during the operation of the facility:

- Any activities conducted on site (including the placement of waste and installation of landfill leachate and gas infrastructure) will not degrade the integrity of the installed engineered lining and capping system. This will be achieved through the adherence to operational management processes on site.
- All wastes delivered to the site will be contained in a covered vehicle to minimise potential odour emissions.
- The waste types accepted at the site will be controlled in accordance with the waste acceptance procedure (Section 3.1.1). No prohibited waste will be accepted at the site.
- Odorous waste will be covered immediately upon receipt.
- Only one tipping face for solid waste will be active at any time, where the surface area of the active tipping face will be kept as small as possible. Daily inspections of the tipping face will be undertaken by the Site Manager.
- Operational procedures adopted at the tipping face will aim to prevent surface ponding of water which can potentially emit odours.

- Incoming waste material at the facility will be covered as soon as practicable following placement within cells. Effective compaction of the waste will also act to minimise the release of odours from recently tipped waste.
- The leachate storage ponds will be routinely checked for odour emissions.
- Weather conditions will be monitored on site. Cover materials placed for adverse weather conditions will be able to reasonably withstand the anticipated conditions without significant damage and exposure of the underlying waste material.
- The active gas extraction system and utilisation plant (or enclosed flare) will be operational as soon as possible, depending on the quality and quantity of gas generated. This will minimise the release of uncontrolled landfill gas emissions through passive venting.
- Leachate infrastructure such as sumps, wells and side wall risers will be effectively sealed, only retaining any necessary access for monitoring and maintenance.
- During the operation of the facility, operational procedures will be implemented which will manage odour issues associated with:
    - Waste materials which have decomposed significantly prior to placement within the facility.
    - Old waste disturbed by digging.
    - Malodorous wastes.
    - Agricultural and sewage treatment residues.
    - Operation and maintenance of leachate collection and treatment systems.
    - Operation and maintenance of landfill gas collection and treatment systems.
- LFG monitoring will be conducted in accordance with the site's Environmental Licence conditions pursuant to Part V of the *Environmental Protection Act* and the Minster's Conditions pursuant to Part IV of the *Environmental Protection Act 1986*.
- Odour management will be consistent with the intent of relevant EPA Policies, Guidelines and Criteria and the EPA (2002a) *Interim Guidance Statement for the Assessment of Odour Impacts* (No.47).
- Surface LFG monitoring will be conducted on a monthly basis. This monitoring will focus on areas along the edge of the void and at regular intervals across the surface of the facility. The monitoring will be conducted in accordance with site operational procedures formed in compliance with the site environmental management plan. Testing for hydrogen sulphide will also be undertaken if landfill gas odours are of concern.
- All LFG monitoring results will be recorded and reported to DEC annually.
- Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid odour complaints. A Complaints Register will be established to record any complaints received, date, nature, and resolution action undertaken.
- The Site Manager will contact any complainants that have concerns related to odours and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of

repeated valid complaints, the Site Manager will take steps to ensure that any identified impacts are addressed.

- If it is found during operation that complaints are being received in relation to odour, the following contingency measures will be investigated and possibly implemented at the site:
  - Provision of improved drainage to minimise the occurrence of standing water.
  - Spreading of hydrated lime over newly filled or saturated waste.
  - Use of deodorisers.
  - Increasing cover thickness or using different more impermeable intermediate cover material.

5.4.5 Predicted Outcome

Given the distance to the nearest sensitive premises, the surrounding site topography and implementation of measures identified to reduce or control odour, it is believed that odour emissions can be managed to meet the EPA's objective.

5.5 Air Quality – Landfill Gas and Greenhouse Gas Emissions

5.5.1 EPA Objective

To minimise emissions of greenhouse gases to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.

5.5.2 Air Quality Standards

The facility will be designed and operated in accordance with the requirements of the EPA (2002b) *Guidance Statement for Minimising Greenhouse Gas Emissions* (No. 12).

5.5.3 Potential Environmental Impacts

The decomposition of waste gives rise to landfill gas (biogas) containing methane and carbon dioxide, which contributes to Australia's net greenhouse emissions. According to the 1996 National Greenhouse Gas Inventory (AGO, 1998), some 727,000 tonnes of methane escaped to the atmosphere from managed solid waste disposals within Australia. This represented 3.7% of the Australia's net greenhouse gas emissions in 1996. The methane in biogas is a potential energy source, and the technologies to recover the methane for electricity generation are well understood. Landfill gas generation facilities significantly reduce greenhouse gas emissions by converting the methane produced by decomposing material into carbon dioxide. Methane has a 'global warming potential' twenty-one times greater than carbon dioxide. Landfill gas generation reduces greenhouse gas emissions in two ways. Firstly, the emissions from landfills are reduced through the conversion of methane into carbon dioxide. Secondly, the electricity generated displaces the need to produce electricity from other emission producing fuels.

LFG can therefore have the following impacts:

- Contribute to global greenhouse gases;
- Adversely impact regional air quality and cause off-site odours; and

- Potentially impede the survival of vegetation surrounding the landfill and prevent revegetation of the landfill cap.

In addition, LFG presents potential asphyxiate and explosive hazards both on and off-site.

Potential sources of greenhouse emissions at the facility during construction and operation activities include:

- Uncontrolled LFG emissions;
- Emissions from the LFG flare and utilisation plant; and
- Vehicle emissions.

5.5.4 Environmental Management and Mitigation

Design Phase

The landfill will be designed in accordance with current best practice incorporating best available techniques to minimise adverse impacts on the environment. Design features will focus on minimising the potential for LFG release and migration.

The features of the landfill which aim to reduce LFG gas emissions and ensure its effective collection are the same as discussed for odour (Section 5.4), with the addition of the following which specially address greenhouse gas emissions:

- Landfill Gas flaring and Energy Recovery: The implementation of these methods of LFG management will reduce greenhouse emissions.
- Where enclosed landfill flares are used they will be designed to reduce volatile organic compounds emissions by 98% and the flare will be fitted with an auto ignition and flame arrestor beneath combustion zone.

The LFG management system will be designed and operated to prevent the escape of landfill gas beyond the containment system.

Construction and Development Phase

VES will assess how the quantities of LFG generated will vary over the life of the landfill in order to estimate the future rates of gas production over the lifetime of the facility. This will determine the sizing and design of the plant energy recovery facility. The designs for the gas control and utilisation systems will consider:

- Performance standards which will aim to achieve LFG control at the facility e.g. whether temporary or permanent systems;
- The design life of the elements of the gas control system;
- The purposes of the elements of the gas control system;
- Selection of materials and products;
- Compatibility of the installed elements of the control system in terms of the phased development of the site;
- Operational and maintenance requirements;

- A comparison of the greenhouse gas emissions for the landfill and the current practice of landfilling; and
- Health and safety issues.

In addition, a LFG monitoring plan will be developed for the site prior to the construction and development phase.

Commissioning and Operation Phase

In addition, to the measures detailed in Section 5.4.4 the following management and mitigation measures are proposed to minimise LFG emissions during the operation of the facility:

- Any activities conducted on site (including the placement of waste and installation of landfill leachate and gas infrastructure) will be conducted in a manner that does not compromise the integrity of the installed engineered lining and capping system. This will be achieved through the implementation of comprehensive operational management procedures.
- No prohibited waste will be accepted at the site.
- The waste acceptance procedure of the site will be adhered to at all time (see Section 3.1.1).
- Only one tipping face for solid waste will be active at any one time, where the surface area of the active tipping face will be kept as small as possible. Daily inspections of the tipping face will be undertaken by the Site Manager.
- Controlled leachate recirculation will be undertaken on site (see Sections 3.1.2 and 3.3.3-3.3.5 inclusive) which will influence LFG generation.
- Weather conditions will be monitored on site. Cover materials placed for adverse weather conditions will avoid any opening and be able to reasonably withstand the anticipated conditions without significant damage and exposure of the underlying waste material.
- The active gas extraction system and utilisation plant will be operational as soon as possible, depending on the quality and quantity of gas generated. This will minimise the release of uncontrolled landfill gas emissions.
- Leachate infrastructure such as sumps, wells and side wall risers will be effectively sealed (retaining any necessary access for monitoring and maintenance).
- Smoking will only be allowed in certain areas of the site that are considered to be of low fire risk. Areas where smoking will not be allowed will include the active cell, in the vicinity of the leachate storage ponds and leachate and LFG infrastructure.
- Vegetation around the vicinity of the landfill will be monitored on a monthly basis, where particular attention will be given to any areas that indicate decline in health.
- Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid complaints related to LFG (more likely to be received regarding odour). A Complaints Register will be established to record any complaints received, date, nature, and resolution action undertaken.

- The Site Manager will contact any complainants that have concerns related to LFG (odour) and determine the nature of the concern. The Site Manager will take steps to ensure that any identified impacts are addressed.
- A comprehensive Aftercare Management Plan (see Section 3.3.7) will be developed for the site to the satisfaction of the DEC. This will include the long-term monitoring and management regime for the site.

Landfill Gas Monitoring

- LFG monitoring will be conducted in accordance with the Licence conditions pursuant to Part V of the *Environmental Protection Act* and the Minster's Conditions pursuant to Part IV of the *Environmental Protection Act 1986*.
- Surface LFG monitoring will be conducted on a monthly basis. This monitoring will focus on areas along the edge of the void and at regular intervals across the surface of the facility. The monitoring will be conducted in accordance with a site operational procedure formed in compliance with the site environmental management plan.
- As part of the LFG management regime at the site and the implementation of LFG management, the quality and quantity of LFG produced from within the landfill will be monitored on a regular basis.

5.5.5 Predicted Outcome

Given the design and management procedures detailed above it is believed air quality and gaseous emissions at the landfill facility can be managed to meet the EPA's objective.

5.6 Water Quality – Surface Water and Groundwater

5.6.1 EPA Objective

Ensure surface water quality from the landfill facility does not adversely affect the environment or the health, welfare and amenity of nearby land users by meeting the statutory requirements and acceptable standards.

To maintain the quality of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.

5.6.2 Existing Environment and Water Quality Standards

The proposed landfill lies on the southern part of the Dandaragan Plateau between the Gingin Scarp to the west and the Barberton Plateau between the Muchea and Darling Faults to the east, some 16km northeast of Gingin (Figure 1). The site lies above a subdued synclinal structure of Upper Cretaceous sediments of the Coolyena Group, on the southern toe of the Swan Syncline. The Upper Cretaceous sediments – referred to as a minor aquifer - are not well understood, as little investigation of these has been carried out (Moncrieff, 1989; Kay and Diamond., 2001) and groundwater in these areas is not used apart from on isolated rural developments.

Crisalis International Pty Ltd was commissioned to undertake a desktop assessment of the hydrogeology of the proposed landfill site, the complete report is provided as Appendix C and summarised in Section 2.1.6. Four monitoring bores have been constructed (Figure 4) and these indicate that groundwater is present at approximately 145m AHD. This will be approximately 15m below

the proposed formation levels for the liner. The proposed lined facility is considered to present a low risk of groundwater contamination due to the large depth to groundwater across the site.

Surface water bodies are not present on the site. The nearest major surface water feature is Gingin Brook approximately 7km to the south. Boonanarring Brook is approximately 5km to the southwest of the site. Red Gully Creek is approximately 15km to the northwest, and the Moore River 25km directly to the north. Lake Beermullah and White Lake are approximately 15km to the east, with Wannamal Lake lying approximately 15km to the northeast.

Water Quality Standards

Due to the absence of surface waters on the site, a surface water monitoring regime is not deemed necessary at the site to assess existing surface water quality.

Groundwater at the site will be monitored prior, during and post operation of the landfill and will be compared with:

- Groundwater background concentrations collected prior to the construction and operation of the facility.
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines (ANZECC 2000).

5.6.3 Potential Environmental Impacts

A variety of petroleum and chemical products are stored and used in very small quantities by the facility, which include but are not limited to:

- Lubricating Oils (1,000litres) stored in a sheltered and bunded area within the workshop area located near the weighbridge; and
- Automotive Diesel Fuel (50,000litres) stored in a sheltered and bunded area (alternatively double lined storage tank) located near the weighbridge.

All chemicals and petroleum hydrocarbons stored on the site (including waste petroleum and chemicals) will be in accordance with:

- Australian Standard AS1940 2004: The Storage and Handling of Flammable and Combustible Liquids
- Australian Standard AS4452 1997: The Storage and Handling of Toxic Substances
- *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007.*
- *Dangerous Goods Safety (Explosives) Regulations 2007*
- *Dangerous Goods Safety Act 2004.*

All chemicals will be stored in accordance with the manufacturer's instructions and material safety data sheets, which will be made available to all staff.

The potential for surface water and groundwater contamination from petroleum hydrocarbons and chemicals is considered to be limited due to the low volumes stored and used on site and absence of a surface water body in the close vicinity.

Stormwater generated from hardstand areas within the site will be collected via a stormwater arrangement and directed to ground soakage via kerb turnouts, sumps and buried pipes.

Vehicles will be washed down on the active cell of the landfill. Any servicing or maintenance of mobile plant/trucks will be performed offsite at an appropriate location or onsite on a hardstand area. Petroleum spill kits will be available on service vehicles, at the hardstand area and work shop.

Construction and Development Phase

As part of the construction phase earthworks, surface contouring and landfill and infrastructure construction will be undertaken. These activities will have the potential to alter the existing surface water flows (stormwater flow) within the site and potentially have an impact on groundwater quality. This is considered unlikely due to the soil types at the site which favour rapid infiltration of stormwater. The following aspects will be addressed to manage potential impacts during the site design and construction phase:

- Control of erosion and sediment transportation;
- Disposal of sewage and grey water; and
- Accidental release of chemicals or hydrocarbons (fuel, lubricants and oil) required for standard operation and maintenance of earthmoving equipment during construction.

The generation of solid wastes will also have the potential to reduce the quality of storm water and groundwater through leaching of contaminants. In addition, the waste has the potential to generate odour and to increase the number of vermin, depending on the waste type. During construction, solid and liquid waste generated from daily activities will generally consist of:

- Stripped soils potentially containing weeds.
- Construction materials and packaging.
- Spent hydrocarbon products.
- Domestic waste.
- Spent chemicals, solvents and paints.
- Wood, plastic, metal and paper waste.

Operational and Commissioning Phase

During the operational phase the landfill has the potential to contaminate or degrade groundwater through:

- Transport of contaminants from the landfill to groundwater through poor surface water management within the landfill;
- Leakage or discharge of landfill leachate into groundwater originating from the landfill or the leachate storage ponds;
- Disturbance of soil or stream profiles, which can result in increased sediment loads;
- Abstraction of groundwater;
- Transport, storage, handling and disposal of chemical agents and cleaners;

- Increased surface runoff volumes due to the creation of hard surfaces, which prevent re-infiltration. This in turn can also create elevated levels of suspended solids (i.e. first flush);
- Spillage or leakage of sewage and grey wastewater from ablutions facilities;
- Spillage or leakage of stored chemicals and petroleum products;
- Spillage or leakage of bio-solids; and
- Leakage of petroleum products from mobile plant equipment used on site and employees cars parked in the car park.

The operation of the proposed facility (e.g. from administration offices) will result in the generation of minor quantities of solid waste and domestic waste. However, once operational, all generated wastes that meet the site waste acceptance criteria (Section 3.1.1) will be managed within the facility. Wastes generated on site that will require off-site disposal will potentially include:

- Scrap metals;
- Hazardous waste generated on site (including liquid wastes such as spent petroleum hydrocarbon products and chemicals);
- Other liquid waste: and
- Fuel, oil or contaminated materials/soils from chemical spillages.

5.6.4 Environmental Management and Mitigation

A Preliminary Surface and Ground water Management plan has been developed for the facility and is included as Appendix H. This document identifies potential risks and provides further detail on monitoring programs, action criteria and contingency measures to be implemented in the unlikely event that significant deterioration in groundwater quality is detected in monitoring bores.

The main management and mitigation measures are summarised in this section of the document.

Design Phase

The landfill will be designed in accordance with current best practice incorporating best available techniques to minimise adverse impacts on the environment. In particular, it will incorporate design features which will minimise the potential for impacts on surface water regimes and groundwater quality.

Surface Water

The detailed design of surface water management system at the landfill will take into account the meteorology, hydrology and hydrogeology of the site. There are no surface water bodies present on the site, and due to the nature of the underlying site strata the capacity to retain water at the surface is limited. However, it is recognised that a surface water management scheme is required in order to protect the groundwater. The surface water management scheme includes the following key design features of the facility:

- Rainwater coming into contact with waste and/or leachate will be managed as leachate. The surface water management system will be separate to the leachate management system for the site.

- Bunds and surface water drains will be established to redirect surface water outside of the footprint and away from the landfill.
- Surface water generated on-site from hardstanding, stockpiles, landfill cap and other areas outside of the landfill footprint will be directed to the sedimentation pond prior to reuse or discharge.
- The surface water drainage system will be designed to cope with predicted storm events in accordance with the best practice guidance (DoE, 2005a).
- Landfill capping will be undertaken as soon as possible following stage/cell completion (designed as detailed in Section 3.3.7), to reduce infiltration. The cap will be protected against erosion (e.g. planting) and able to accommodate settlement without compromising its ability to shed water. The cap will be installed no steeper than 1V:5H. The capping of the landfill cells will be progressive. On the completion of each cell the cap will be installed as soon as possible and tied into the liner at the perimeter. Where applicable, the cap edges will be left for future incorporation into the adjacent stages/cells. Where applicable, joints between sections of placed engineered clay will be constructed with a stepped connection between successive layers to assure the continuity of the seal.
- The design of the leachate storage ponds will incorporate an engineered liner as detailed in Section 3.3.5. The ponds will be designed in accordance with *Draft Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005a) to ensure the system can store the volume of leachate expected to be generated over a year duration also maintaining a freeboard of at least 1m. In addition, the pond will also be required to store the rainfall generated within the footprint of the ponds, for a critical storm event.

The surface water generated in and around the vicinity of the leachate lagoon will be fully contained as detailed in Sections 3.3.8. This water will be controlled and managed separately to other surface waters generated on site and will under no circumstances be discharged directly to the surrounding environment.

Groundwater

In April 2006, Crisalis International Pty Ltd was commissioned to undertake a desktop assessment of the hydrogeology of the proposed landfill site. The complete report is provided as Appendix C. The potential for direct groundwater contamination from the lined landfill is not considered to be significant due to; the significant depth to groundwater (approximately 15m below the formation level for the liner), the distance to the nearest major surface water body Gingin Brook (4.5km) and the location of groundwater bores in the vicinity.

For a Class III landfill, the best practice guideline (DoE, 2005a) suggests a 2m minimum separation of waste from the water table. At the proposed facility, the depth to groundwater is approximately 15m below the formation level for the liner. Therefore, groundwater ingress into the landfill has not been considered in the design. The landfill and associated infrastructure (leachate storage ponds), which could possibly present a risk to groundwater quality will be fully lined with a composite liner system. The design of the landfill will specifically address:

- Geotechnical stability of the lining system, wastes and underlying geological strata;
- Efficiency of the leachate collection system (e.g. drainage layer, pipework, pumps and abstraction sumps);

- Long term management control of leachate; and
- The ability to effectively control and collect landfill gas, therefore minimising the potential for landfill gas migration.

The design of the landfill aims to contain the waste and the potential impacts on the environment. The following key engineering features will be incorporated into the design of the landfill to control potential impacts on groundwater quality:

- *Landfill containment system: engineered lining system* (Section 3.3.2). This will contain the leachate within the stages in unison with the leachate management system. In addition, the construction of an earthen bund around the perimeter of the void, which extends 2m above the base liner, will provide a basin structure in which the level of leachate can be maintained.
- *Landfill containment system: engineered capping system* (Section 3.3.7). This design feature will limit the generation of leachate post capping.
- *The leachate recirculation system* (Sections 3.3.4 and 3.3.5), will aim to closely control the leachate head on the liner along with the leachate collection system (Section 3.3.3). The landfill design will provide a robust leachate collection system with several levels of redundancy against clogging.
- *Contained Leachate Storage Ponds*: *engineered lining system* (Section 3.3.5). The design of the lining system for the leachate storage ponds will be equivalent to that of the landfill, thereby containing the leachate within the ponds.

Appendix I presents an assessment of the worst case risk of groundwater impact from credible liner failure and supports the view that the site does not represent a significant threat to the quality of water in the underlying superficial aquifer or the waters of Gingin Brook 4.5 km to the south-west.

Construction and Development Phase

During the site development and construction phase, the following initiatives will be undertaken to minimise impacts on surface waters and groundwater:

- Supervisory staff will be trained in and familiar with the guidelines issued by the DEC on waste acceptance and the requirements of the site Environmental Protection Licence. Therefore eliminating the potential for the placement of prohibited wastes in the facility.
- Waste materials arising from construction activities will be managed and disposed of into skips located on site. The storage of waste materials on site must not be accessible to vermin or attract local fauna. Waste storage facilities will be covered (e.g. lid), located on site hardstand areas and bunded if necessary. They will be emptied on a regular basis by a licenced contractor to an approved facility. Waste will be separated where possible to allow recovery of materials.
- All waste bins will be inspected regularly to ensure they are in good condition and are not corroded.
- Clean surface runoff will be diverted around the construction site and discharged into sediment trap(s) prior to release into the environment.
- Stormwater which accumulates within the footprint of the landfill during construction, will drain to temporary sedimentation basins in the construction area prior to discharge by pumping or gravity flow into the surface water (stormwater) management system (Section 3.3.8).

- Drainage and water collection structures will be inspected on a regular basis and properly maintained.
- Appropriate erosion control methodologies such as sediment traps, drain design and energy dissipating structures will be applied to control the velocity of flows in unlined open drains to prevent scour.
- Any servicing or maintenance of mobile plant/trucks will be performed offsite at an appropriate location or onsite on a hardstand area.
- All refuelling of mobile plant will be undertaken in a designated area of the site. Any fuel tank(s) stored on site during the construction phase will be adequately contained and bunded above ground in accordance with the *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007* and AS1940 2004: *The Storage and Handling of Flammable and Combustible Liquids.*
- Appropriate procedures for the storage and handling of chemicals and hydrocarbons will be developed prior to construction to minimise the potential for spillages.
- A spill response procedure will be implemented to deal with spillages and leakages. The procedure will include details on methods of containment, collection and disposal and training of personnel. Recovery procedures will be immediately implemented in the event of a chemical and hydrocarbon spillages. A 'Spill Register' will be maintained on site which will record any spills, date, nature and resolution action.
- Sewage and grey water will be directed to temporary, sealed treatment and storage facilities ('Portaloos') or systems designed to accommodate and treat peak volumes of effluent generated during the construction phase. Treatment systems will be established and operated in accordance with the Shire of Gingin requirements under the Health Act. Wastes will be collected and removed from site by a licenced liquid waste contractor.
- A groundwater monitoring programme will be implemented prior to construction in order to attain baseline groundwater quality at the site. The groundwater samples will be collected from bores previously installed at the site (refer Figure 4). Baseline monitored parameters will include but not be limited to pH, electrical conductivity, heavy metals, nutrients (nitrogen and phosphorous) and total petroleum hydrocarbons.
- Groundwater will be monitored in accordance with the Licence conditions issued pursuant to Part V of the *Environmental Protection Act* and the Minster's Conditions pursuant to Part IV of the *Environmental Protection Act 1986*.

Commissioning and Operation Phase

Drainage and hydrological impacts will be managed in accordance with the Environmental Protection Authorities (EPA) Draft Guidance *Management of Surface Run-Off from Industrial and Commercial Sites* (No. 26) (EPA, 1999). The following initiatives are proposed to manage surface water during the operation of the facility in addition to the management practices detailed previously:

- Hazardous wastes (including spent chemicals, contaminated soils, oily rags, and petroleum hydrocarbon wastes) generated on site will be stored in fully enclosed containers. The containers will be will be located over an impervious hardstand area that is sheltered and contained to prevent

loss of product in the event of spillage. The waste will be collected and disposed of at an approved landfill/recycling facility by an appointed sub-contractor.

- Where applicable, the collection of waste will comply with the *Environmental Protection (Controlled Waste) Regulations 2004*. Where controlled waste tracking forms are required, they will be retained for three years from the date of receipt.
- Solid wastes generated on-site (i.e. site offices) will be collected and disposed of into bins with lids located on site (to prevent fauna and rain ingress). These bins will be emptied on a regular basis to the landfill.
- Effluent from on-site ablutions and kitchen facilities will be directed to an on-site storage tank and leach drain arrangement. Liquid wastes will be collected and removed from site by a licenced liquid waste contractor.
- All staff will be made aware of issues affecting waste management, associated environmental impacts and be given opportunities to improve waste management procedures. Additional opportunities for recycling or reuse will be investigated and implemented where practical and cost effective.
- Uncontaminated stormwater, not incident on the landfill footprint or leachate storage ponds, will be intercepted by surface water diversion drains. The intercepted water will be diverted to the sedimentation pond prior to discharged or use onsite. Figure 11 show the location of these key features. The sedimentation ponds will be designed to trap sediment and act as a detention basin during peak storm flows. The stormwater drains will be designed for a peak flow rate for the catchment in accordance with the *Draft Siting, Design, Operation and Rehabilitation of Landfills* (DoE, 2005a).
- The leachate management system (including the leachate ponds) will be constructed and maintained to best practice management standards, to minimise the possibility of waste or landfill leachate coming into contact with uncontaminated stormwater or groundwater.
- Waste entering the site for disposal will be managed in accordance with the approved landfill waste acceptance regime at the site to ensure that only suitable wastes are accepted (see Section 3.1.1).
- Prior to the commencement of construction, a site specific Landfill Emergency Response Plan and a spill response procedure will be developed to the satisfaction of the DEC. The approved procedure will be implemented to ensure that potential environmental incidents with the potential to impact on local ground and surface water quality will be rapidly addressed.
- A comprehensive Rehabilitation and Aftercare Management Plan (see Section 3.3.7) will be developed for the site to the satisfaction of the DEC. This will include the restoration and long-term monitoring and management regime for the site.

Surface Water and Groundwater Monitoring

- A groundwater monitoring program will be established and implemented to determine potential changes in groundwater quality as a result of site operations. The program will be a continuation of the regime adopted during the construction and development stage (prior to operation of the facility). Additional bores will be installed, the precise location of which will be determined following finalisation of the landfill as-built configuration. In principle, the additional monitoring bores will be installed around the landfill (including the leachate storage ponds), on the inferred up hydraulic

gradient side (to monitor background groundwater quality) and on the inferred down gradient side of potential contaminant sources (refer Figure 4).

- Ongoing groundwater monitoring parameters will include but not be limited to pH, electrical conductivity, heavy metals, nutrients (nitrogen and phosphorous), ammoniacal nitrogen, total dissolved solids and total petroleum hydrocarbons. Results will be compared to background concentrations and Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines (ANZECC, 2000).
- Surface waters contained within the sedimentation pond will be monitored on a quarterly basis. Parameters monitored will include but will not be limited to total dissolved solids, total suspended solids, turbidity, pH, electrical conductivity, nutrients (nitrogen and phosphorous), ammoniacal nitrogen and total petroleum hydrocarbons. This monitoring regime may be reduced after discussions with the DEC following a twelve month monitoring period.
- Landfill leachate levels within the waste will be monitored on a monthly basis. Leachate will be sampled from the leachate storage ponds on a quarterly basis where baseline monitored parameters will include but not be limited to; visual appearance (colour, turbidity, free phase hydrocarbons, foaming), pH, electrical conductivity, heavy metals, nutrients (nitrogen and phosphorous), ammoniacal nitrogen, chemical oxygen demand (COD), biological oxygen demand (BOD) and total petroleum hydrocarbons.
- Where monitoring indicates elevated nutrients or other contaminants in the groundwater and sedimentation pond a contingency plan will be implemented. The general approach to this contingency plan will be as follows:
- Identification of the type of contamination;
- Assessment of the potential environmental impact;
- Isolation of the source of the contamination and re-direction of the flow to leachate storage ponds if possible;
- Assessment and implementation of appropriate treatment for the contamination;
- Further monitoring to pin point the source of contamination; and
- Undertake measures to rectify source of contamination.

It is difficult to be precise about remedial action until the type, severity and source of the contamination has been identified. However, having a management plan with a number of options will ensure any contamination is dealt with quickly and efficiently.

- All monitoring results will be recorded and reported to DEC annually. Where an anomalous result is identified, the sample will be immediately directed for analysis in a NATA registered laboratory and investigations implemented to identify potential causes for the anomaly.

5.6.5 Predicted Outcome

It is considered that the measures proposed will minimise the potential for unacceptable impacts on surface water and groundwater resources during the project development and operations phases respectively to the extent that the EPA's objective in relation to this factor will be met.

5.7 Noise and Vibration

5.7.1 EPA Objective

To protect the amenity of nearby residents and other land users from noise impacts resulting from activities associated with the proposal by ensuring that noise levels comply with the *Environmental Protection (Noise) Regulations 1997.*

5.7.2 Noise Standards

The *Environmental Protection (Noise) Regulations 1997 (as amended)* stipulate the allowable noise levels that can be received at any noise sensitive premises as a result of activities occurring on another premise. The allowable noise level is determined by the calculation of an influencing factor, which is added to the baseline criteria set out in Table 1 of the *Regulations*.

5.7.3 Potential Environmental Impacts

Construction and Development Phase

Noise may be generated at the proposed site during construction and during operation. Construction activities will be undertaken between 7am and 7pm, Monday to Saturday. Standard construction plant and earthmoving equipment will be the main source of noise emissions during construction. No blasting will be required as part of any site preparatory works.

The noise generated during construction will include the following operation of:

- Cranes;
- Vehicles moving on site and travelling to and from the site;
- Construction equipment;
- Earthmoving and excavation equipment; and
- Compactors.

Commissioning and Operational Phase

During operation, the main sources of noise from the facility will include:

- On-going stage construction activities (as detailed in the development and construction phase above);
- Operation activities including the placement (via compactors) and delivery of waste materials; and
- Vehicle movements (including reversing).

5.7.4 Environmental Management and Mitigation

The management and mitigation measures outlined below will ensure that the proposed landfill will complies with the *Environmental Protection (Noise) Regulations 1997* and draft EPA Statement 14 – *Road and Rail Transportation Noise* (EPA, 2000b) at all times.

The remote nature of the site and large separation distances to sensitive land-uses means that there is little likelihood that noise or vibration emissions will result in off-site impacts

Construction and Development Phase

During the site development and construction phase, the following initiatives will be undertaken to minimise noise emissions:

- In accordance with *AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Site*, the equipment used for construction will be the quietest reasonably available. Silencers and noise attenuation will be used on equipment as required to meet applicable noise limits.
- Personnel will have access at all times to operational manuals for equipment being utilised and must be familiar with the procedures detailed in the operations manual.
- All workers must wear appropriate hearing protection if in close proximity to machinery for extended periods.
- A point of contact (name and phone number) will be provided for handling enquiries and complaints regarding construction activities.
- A 'Complaints Register' will be maintained on site to record any complaints received, this register will include the date, nature and resolution action of any complaints received.
- Following complaints the source of any excessive noise will be identified and work practices modified or re-scheduled to reduce or eliminate the risk of future events.
- Equipment maintenance and inspection schedules will be implemented to ensure that all equipment is operating as per the manufacturer's instructions and within regulatory requirements. This will include ensuring all noise control equipment is correctly fitted and operating at design performance.
- Where possible, significant road traffic movements will be scheduled to avoid noise sensitive periods (e.g. night-time).
- Particularly noisy activities will be scheduled for implementation in accordance with the *Environmental Protection (Noise) Regulations, 1997* criteria in order to minimise public disturbance. The majority of construction activities will be undertaken within normal working hours (0700 – 1900 hours Monday to Saturday).
- Noise emissions will be monitored in accordance with the Licence conditions issued pursuant to Part V of the *Environmental Protection Act 1986* and the Minster's Conditions pursuant to Part IV of the *Environmental Protection Act 1986*.

Commissioning and Operations Phase

During the site commissioning and operations phase, the following initiatives will be undertaken to minimise noise emissions in addition to the measures detailed above:

- Noise emissions at the nearest existing residences, will be managed by engineering design methods and installation of required noise attenuation measures to comply with the *Environmental Protection (Noise) Regulations 1997 (as amended)* at all times, including achieving not more than 35dB(A) at the nearest sensitive premises.
- The facility will not "contribute significantly" to noise at the nearest noise sensitive premises.

- All site access roads will be progressively sealed (reaching as close to the working face as reasonably practical).
- All compactor drivers operating on the landfill will receive training regarding minimising potential noise impacts.
- All mobile plant used on site will be regularly maintained including exhaust mufflers.
- Speed limits will be enforced on all site access roads.
- The use of amplified telephone systems will be avoided.
- In areas of the site where high levels of noise are unavoidable and are likely to be a hazard to persons working onsite, prominent warning notices will be displayed and, where necessary, appropriate hearing protection will be provided.
- Noise monitoring will be conducted in accordance with the Licence conditions and the Minster's Conditions.
- A Complaints Register will be established to record the details of any complaints received, date, nature, and resolution action undertaken. The Site Manager will contact any complainants that have concerns related to noise levels and determine the nature of the noise nuisance. If the nuisance is of an ongoing nature, the Site Manager will take steps to ensure that any identified noise source is addressed within 48 hours. If the source is not clear, the Site Manager may initiate additional monitoring or other site evaluation involving a noise specialist. The Site Manager or Noise Specialist will then ensure that appropriate measures are implemented to remove the nuisance if it is caused by the construction or operation of the facility.
- In such circumstances, repeated complaints will be investigated to assess the need for completion of a detailed noise assessment that will be undertaken by a qualified sub-consultant using approved methods. A report will be prepared to address potential noise exceedences and will include practical and feasible mitigation measures that may be adopted.

5.7.5 Predicted Outcome

It is considered that acoustical treatment measures incorporated during construction and operation will reduce noise levels in the surrounding environment to meet the EPA's objective in relation to this factor.

5.8 Transport

5.8.1 EPA Objective

Ensure that traffic movements associated with the project do not adversely affect the health, welfare and amenity of nearby residents and sensitive areas.

5.8.2 Existing Environment

The location of the proposed facility has been carefully selected to provide the necessary separation (buffer) distances between the active areas of the landfill and sensitive receptors such as residential areas. The DoE (now DEC) has published draft guideline on the siting and design of landfills (DoE, 2005a), which recommends a minimum separation distance of 500m (Class II or III) to the nearest residential subdivision and 150m from the nearest single residential dwelling. The nearest residence is

Fernview Farm located approximately 1.95km to the south of the proposed facility, within Lot 7778. Beyond Lot 7778, the nearest residence to the facility is approximately 2.3km to the north east (see Figure 4).

The main routes for accessing the site are shown in Figures 1 and 2. Access to the site will initially be gained along Wannamal Road West and Wannamal Road South. Vehicles approaching the site from the north or south will generally use Brand Highway and then turn on to Wannamal Road-West.

5.8.3 Potential Environmental Impacts

Construction and Development Phase

The construction phase will result in increased traffic along Wannamal Road West and Wannamal Road South and the access roads to the site. This increased traffic would result from workforce commuting and construction related deliveries of material and equipment. It is anticipated that a small number of large vehicle movements (less than fifty movements over the three month construction period). Traffic associated with the construction phase would build up as the peak construction period is reached and then decrease as the landfill nears the commissioning phase.

During the construction phase, the workforce traffic would mostly occur between 6.30am and 7.30am, and again between approximately 6.30pm and 7.30pm. Construction related deliveries will occur during normal construction hours (7am to 7pm, Monday to Saturday). The construction stage vehicle movements are not considered to be significant and will utilise heavy haulage routes where practical.

Commissioning and Operation Phase

During operation, it is anticipated that up to 25 trucks per day will access the site to deliver waste materials. Professional drivers in licensed and well-maintained trucks will be employed to undertake road transport.

As discussed previously, it is proposed that all site traffic will access the facility via Wannamal Road South and Wannamal Road West. Cullalla Road will only be utilised by locally generated traffic accessing the site from the south and east. Access to the site will be strictly controlled for safety and operational control reasons. Access will not be permitted for car and trailer tipping, who will be directed to waste transfer stations.

Potential transport impacts include:

- Release of green house gases;
- Hazards to the public which range from direct (collision) to indirect (road damage from heavy vehicle use);
- Human health risks associated with vehicle emissions;
- Traffic noise generated by trucks accessing the site, which is discussed in Section 5.7;
- Dust migration from trucks utilising unsealed roads (Section 5.3); and
- The increase in traffic associated with the proposed landfill operations also heightens the potential for animal deaths, due to vehicular impacts.

5.8.4 Environmental Management and Mitigation

Strategies to be employed to minimise transport impacts will address both the development and construction phase and the commissioning and operation phase as discussed below.

Construction and Operation Phases

- An access road will be constructed and progressively sealed from Wannamal Road South to the site boundary and weighbridge (extending as far to the facility as possible).
- Other permanent site roads will be aggregate sheeted to provide safe access and reduced dust emissions.
- Use of designated regional roads (Wannamal Road South and Wannamal Road West) and the avoidance of Cullalla Road, except when the waste collection vehicles are collecting waste in that area.
- All potential traffic delays during the development and construction phase will be coordinated with Main Roads WA and the Shire of Gingin.
- Movement of construction items that could obstruct regular traffic will be scheduled to off peak periods.
- Waste consignment deliveries will be restricted to daylight hours wherever practicable. The community and the Shire of Gingin will be notified of any planned night-time transport to or from the proposed site.
- Delivery of equipment will be designed to minimise delays and road closure.
- Appropriate signage will be installed which will be visible and appropriately maintained.
- Site speed restrictions will be imposed to reduce dust generation and the likelihood of traffic incidents. Appropriate signposting of slow speed limit will be used at the site.
- Good visibility will be maintained at all times on intersection/entry points to the facility.
- Movement of oversized vehicles to and from the site will be supervised throughout the development and construction phase.
- Road awareness will be a component of induction and toolbox briefings.
- Only fully enclosed or covered vehicles will be used to transport waste to minimise the possibility of spillage which may create traffic hazards.
- All vehicles will be appropriately maintained, where service history records will be maintained.
- Access to the site will be strictly controlled for safety and operational control reasons (see Sections 3.6 and 3.10). Access will not be permitted for car and trailer tipping with such waste being directed to transfer stations.
- Development of a truck movement plan which will ensure the separation of excavation haulage vehicles and waste vehicles.

5.8.5 Predicted Outcome

It is considered that due to the location of the proposed facility and the measures identified, potential transport impacts will be managed so that they do not adversely affect the health, welfare and amenity of nearby residents and sensitive areas, thereby meeting the EPA's objective.

5.9 Amenity – Visual

5.9.1 EPA Objective

To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.

5.9.2 Existing Environment

The proposed site is situated on the southern section of the Dandaragan Plateau between the Gingin Scarp to the west, and the Muchea and Darling Faults to the east. The site is set back from the Brand Highway and is quite well shielded by trees, particularly the Boonanarring Nature Reserve which abuts the western boundary of the property. The nearest residence is Fernview Farm located approximately 1.95km to the south of the proposed facility, within Lot 7778. Beyond Lot 7778, the nearest residence to the facility is approximately 2.3km to the north east.

The proposed landfill footprint cuts into the side of an existing valley, with a ridgeline running north to south through the middle of the property, effectively shielding the site from all directions bar the east through to south east (Figure 2).

5.9.3 Potential Environmental Impacts

During the construction and operation of the landfill facility, visual intrusion will potentially include:

- Earthworks;
- Waste profiles;
- Landfill gas utilisation plant;
- Site infrastructure (e.g. site offices); and
- Potential light overspill.

Vantage points will be restricted to the east through to the southeast of the site, with the natural topography of the site shielding it from other directions. Therefore, the landfill will be partially visible from Fernview Farm located approximately 1.95km to the south (within Lot 7778). It is not anticipated that the facility will be visible from the residence located 2.3km to the north east. The landfill site may be visible from Wannamal Road South, which is predominantly used by local traffic only, and sections of Cullalla Road.

The landfill will be rehabilitated in accordance with best practice rehabilitation and aftercare (DoE, 2005a). The aftercare management plan will be developed in consultation with the local community and regulatory and planning authorities. The rehabilitation plan will be regularly reviewed to ensure that changed circumstances are reflected in the plan.

5.9.4 Environmental Management and Mitigation

Strategies to be employed to minimise transport impacts will addressed at design phase, construction phase and operation phase, as discussed below.

- The landfill cap will be installed at a gradient no steeper than 1V: 5H.

- The landfill will be rehabilitated in accordance with best practice rehabilitation and aftercare (DoE, 2005a).
- The restoration and aftercare scheme for the site will ensure that the restoration contours blend into the surrounding landscape pre and post settlement, ensuring that local visual amenity is not adversely affected. The planting regime adopted will reflect local native flora. Where tree planting is envisaged, the depth of the cap will be amended to accommodate in accordance with best practice (DoE 2005a).
- Elevations of the proposed buildings on site (e.g. site offices and landfill gas utilisation plant) will be carefully considered so not to adversely impact on visual amenity.
- Land clearing will be kept to a minimum where possible. The site access road will follow existing easements where feasible.
- The location of the facility will provide adequate separation distances to surrounding sensitive land users. The facility will only potentially be visible from Wannamal Road South, which is predominantly used by local traffic only, and sections of Cullalla Road.
- The landfill will be rehabilitated on an on-going basis as a stage/cell reaches its projected capacity. Following cap placement the placed topsoils will be seeded to provide erosion control and improve the visual impact of the placed waste.
- Waste will only be placed within the landfill facility during daylight hours, thereby eliminating the requirement for flood lighting.
- Litter migration will be controlled at the site in accordance with Section 5.10.

5.9.5 Predicted Outcome

It is not considered that visual amenity will be unduly affected due to the topography of the surround landscape which effectively shields the site. As a result of the careful site selection and the landfill design commitments it is considered that the EPA's objective will be met.

5.10 Amenity – Litter

5.10.1 EPA Objective

To protect the amenity of surrounding areas from activities associated with the proposal by ensuring litter is managed in accordance with the *Litter Act 1979*.

5.10.2 Existing Environment and the Required Outcome

The landscape within the area of the proposed landfill has been previously cleared and modified for grazing. The proposed area is generally low lying, with elevated landforms located immediately to the north, west and to some extent also the south. The site is set back from the Brand Highway and is quite well shielded by trees, particularly the Boonanarring Nature Reserve which abuts the western boundary of the property.

The design, construction and operation of the landfill facility will aim to ensure that no litter from the proposed facility reaches beyond the boundary of the premises.

5.10.3 Potential Environmental Impacts

The term litter should be taken to mean any wind-blown material other than particulate matter. Litter is often one of the most serious causes of pollution associated with landfills and therefore must be controlled in order to:

- Prevent the formation of litter by controlling potentially wind-blown materials at the source e.g. from vehicles and the active tipping face.
- Prevent litter accumulating within the infrastructure and management systems within the landfill e.g. leachate and gas control and extraction systems.

Lightweight litter such as paper and plastic (e.g. plastic bags) are often the most difficult to control as they are easily wind blown. Litter may be generated during the construction phase (e.g. packaging materials), however good house keeping practices will keep this to a minimum. It is considered that the majority of litter will potentially be produced during the operational phase. Potential sources include:

- Vehicles transporting waste into the facility;
- Active tipping face; and
- Exposed surfaces of the landfill.

5.10.4 Environmental Management and Mitigation

Design Phase

The landfill will be designed in accordance with current best practice incorporating best available techniques to minimise adverse impacts on the environment. In particular it will be designed to incorporate features which will minimise the potential for litter migration, including the following:

- The phasing arrangement of the landfill (Sections 3.4 and 3.5) which will look to minimise the potential for airborne emissions.
- Landscaping (screen planting and bunding) on the perimeter of the facility.

Construction and Operational Phases

Management practices which will be adopted on-site to minimise the potential impact on amenity include:

- A policy of good housing keeping will be endorsed at the site throughout construction and operation phases.
- The site will be maintained in a secure manner using fences, gates and a weighbridge so that only authorised vehicles and persons can enter the site (Sections 3.6 and 3.10).
- Supervisory staff will be trained in and familiar with the guidelines issued by the DEC on waste acceptance and the requirements of the site Environmental Protection Licence.
- The general public will have no direct access to the site, therefore reducing the potential for open trailers etc.
- All waste materials delivered to the facility will be in a covered vehicle which will only be unloaded within the active cell and in the vicinity of the tipping face.
- A speed limit will be enforced at the site, to limit the potential for materials loss (litter) from vehicles.

- Only one tipping face will be active for solid waste at any one time, where the surface area of the active tipping face will be kept as small as possible. Daily inspections of the tipping face will be undertaken by the Site Manager.
- All deliveries will be vetted to verify their origin and nature before the load is allowed to be deposited at the tipping face. Delivered waste will be deposited promptly upon receipt.
- Adequate mobile plant will be available on site for the placement, compaction and covering of waste. An adequate supply of daily cover materials will be available on site.
- The waste will be compacted following placement, to reduce the potential for wind blown litter.
- Daily meteorological monitoring will be undertaken, as part of the daily and weekly operations.
- During dry and windy conditions the active tipping face will be kept damp by watering.
- Daily cover (soil) or biodegradable sheeting will deposited over the waste at the end of every working day. No waste surfaces will be left uncovered for extend periods of time (e.g. in excess of 12 hours).
- Portable litter screens will be used downwind of the tipping face to trap windblown litter. The screens will be inspected on a daily basis and the trapped litter will be removed. Staff will be trained in the appropriate placement of the screens to trap as much litter as possible.
- Temporary litter fences will be constructed around the active cell.
- Dedicated staff will be employed to collect wind blown litter from litter fences and from around the site.
- Site boundary fences will be used to control any litter which migrates outside of the working area. Regular inspections of the fences and collection of litter around the site boundary and beyond, specifically targeting ditches and access/haul roads.
- Completed stages/ cells will be capped promptly once design height has been reached.
- Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid litter complaints. A Complaints Register will be established to record any complaints received, date, nature, and resolution action undertaken.
- The Site Manager will contact any complainants that have concerns related to litter and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the Manager will take steps to ensure that any identified impacts are addressed.
- Waste vehicle operators will be required to inspect their vehicles prior to leaving the site to ensure all doors are securely closed and no waste debris is on the vehicle.

The above measures will generally control the migration of windblown litter during normal operating conditions. During very strong winds it may be necessary to suspend operations for a short period.

5.10.5 Predicted Outcome

As a result of the location of the site, the surrounding topography, design commitments and the high standard of management, it is considered that the EPA's objective will be met.

5.11 Amenity – Fire

5.11.1 EPA Objective

The general amenity of the area adjacent to the project should not be unduly affected by the proposal.

5.11.2 Existing Environment and Required Outcome

Landfill fires are not a common occurrence at landfill facilities. However, once started they are difficult to extinguish; therefore the primary method of control is prevention.

The cause of landfill fires can include:

- Vandalism;
- Poor management of landfill gas; and
- Spontaneous combustion of incompatible waste.

Fire can not only impact on amenity but also be a hazard to local properties and health.

The design, construction and operation of the proposed landfill facility will aim to prevent landfill fires. However, in the instance it does occur, management practices will be implemented to efficiently control and extinguish any fires.

5.11.3 Potential Environmental Impacts

Potential environmental impacts of landfill fires include:

- Release of smoke and odours into local environment;
- Damage to the lining and capping system thereby reducing the integrity of the containment system;
- Damage to internal infrastructure such as landfill gas and leachate collection systems; and
- Spread of fire to adjacent land, with the associated potential risks to vegetation, fauna and property landowners.

5.11.4 Environmental Management and Mitigation

Design Phase

The landfill will be designed in accordance with current best practice incorporating best available techniques to minimise adverse impacts on the environment. In particular, it will be designed to incorporate the following features which will minimise the potential for landfill fires:

- Site Security at the site will prevent unauthorised access and the potential for vandalism (see Sections 3.6 and 3.10).
- *Landfill Gas Extraction System* (see Section 3.3.6): This will control the build up of LFG in the landfill.
- *Landfill Containment System* (Sections 3.3.2 and 3.3.7): The engineered lining and capping system will limit air ingress.

Construction and Operational Phases

Management practices which will be adopted on-site to minimise the potential impact on amenity include:

- Site security will be maintained (see Sections 3.6 and 3.10) to prevent unauthorised access during and outside operational hours.
- Supervisory staff will be trained in and familiar with the guidelines issued by the DEC on waste acceptance criteria and also the requirements of the site Environmental Protection Licence. Prohibited wastes which have the capacity to potentially initiate a fire (e.g. reactive and hot waste) will be refused at the site entrance.
- Waste will be promptly emplaced, compacted and covered in well-defined cells to prevent the ingress of air.
- Daily cover (soil) or biodegradable sheeting will be deposited over the waste at the end of every working day to limit air ingress. Daily cover material will be non combustible.
- Adequate mobile plant will be available on site for the placement, compaction and covering of waste. An adequate supply of daily cover materials will be available onsite.
- Completed stages/ cells will be promptly capped to prevent the ingress of air and allow the active control of landfill gas.
- Active landfill gas management will be endorsed on site (Section 3.3.6) to prevent air ingress in to the waste and the LFG extraction and collection systems.
- Fires must be extinguished as soon as possible and be reported to the DEC.
- A fire management plan will be developed prior to the construction of the facility in conjunction with the local fire authority.
- A water supply capable of being delivered to any point on the landfill and to the satisfaction of the fire authority will be maintained on site.
- In the event of a deep seated fire within the landfill, the use of water will be minimised and alternative methods will be undertaken to eliminate the ingress of oxygen into the waste body (e.g. capping off the area). These may include chemical retardants and dedicated landfill fire suppression treatments.
- No wastes will be burnt onsite.
- No fires will be lit onsite.
- Smoking will only be allowed in certain areas of the site that are considered to be of low fire risk. Areas where smoking will not be allowed will include the active cell, in the vicinity of the leachate storage ponds and leachate and LFG infrastructure.
- All fuel or flammable solvents will be kept in an appropriately ventilated secure store.
- Landfill compactors and other machinery on site will be fitted with an appropriate fire suppression system or extinguisher for equipment fires.
- Vegetation around the boundary will not be allowed to overgrow.
- Fire breaks will be maintained around the inside of the perimeter security fence.

5.11.5 Predicted Outcome

As a result of the design commitments and the high standard of management, it is considered that the EPA's objective will be met.

5.12 Amenity – Vermin, Pest and Nuisance Species Control

5.12.1 EPA Objective

The general amenity of the area adjacent to the project should not be unduly affected by the proposal.

5.12.2 Potential Environmental Impacts

The existing flora and fauna for the proposed location of the landfill is discussed in Sections 2.2, 5.1 and 5.2 of this report. It is generally acknowledged that putrescibles wastes attract vermin such as rodents, flies and birds. For many years, Gingin has been affected by large populations of the stable fly (*Stomoxys calcitrans* L.), to the detriment of both humans and livestock.

Vermin, flies and birds attracted to the landfill can potentially have the following adverse impacts:

- The introduction of non native species such as feral animals into the area;
- Bird-strike damage to aircraft;
- Introduction of pathogens to nearby water bodies, crops and animals; and
- Nuisance factor from the introduction or population increase of vermin.

5.12.3 Environmental Management and Mitigation

Design Phase

The landfill will be designed in accordance with current best practice incorporating best available techniques to minimise adverse impacts on the environment. In particular, it will incorporate features which will minimise the potential for vermin and birds ingress at the site, including:

- Selection of the site in a manner which provides adequate separation distances to surrounding sensitive land uses.
- Design and operation of the landfill to minimise potential odours and migration of litter which may attract vermin and birds (see Sections 5.4 and 5.10).

Construction and Operational Phases

Management practices adopted to minimise potential impacts on amenity include:

- Wastes delivered to the site will be contained in a covered vehicle to minimise potential odours, which may attract vermin and birds.
- A policy of good housing keeping will be endorsed at the site throughout construction and operation phases.
- Only one tipping face will be active for solid waste at any one time, where the surface area of the active tipping face will be kept as small as possible. Daily inspections of the tipping face will be undertaken by the Site Manager.

- No prohibited waste will be accepted at the site, the waste acceptance procedure of the site will be adhered to at all times (see Section 3.1.1 and 3.6).
- Highly odorous waste will be covered immediately upon receipt.
- Waste which has been awaiting collection for some time is prone to fly infestations. Operational procedures will be adopted to limit the acceptance of such wastes. Where accepted the waste will be promptly buried.
- Daily cover (soil) or biodegradable sheeting will deposited over the waste at the end of every working day.
- Effective compaction of the waste will acts to minimise the release of odours from recently tipped waste and reduce the potential for vermin and bird ingress.
- Odour monitoring will be conducted in accordance with the Licence conditions pursuant to Part V of the *Environmental Protection Act 1986* and the Minster's Conditions pursuant to Part IV of the *Environmental Protection Act 1986*.
- The leachate ponds will be routinely checked for odour emissions.
- Bird scaring techniques will be employed on-site if deemed necessary. Where undertaken a log of techniques employed will be maintained on-site to assess the effectiveness of the methods employed.
- Adequate mobile plant will be available on site for the placement, compaction and covering of waste. An adequate supply of daily cover materials will be available onsite.
- External fences will be constructed with regular patrols to remove accumulated litter. Regular inspections and collection of litter around the site boundary and beyond will also include ditches and haul roads.
- Completed stages/ cells will be capped immediately after they reach the projected design height.
- Wastes generated on site (e.g. site offices) will be stored in vessels with lids to prevent vermin and bird ingress. Additionally they will be emptied on a regular basis.
- Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid vermin or bird complaints. A Complaints Register will be established to record any complaints received, date, nature, and resolution action undertaken.
- The Site Manager will contact any complainants that have concerns related to odours and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the Site Manager will take steps to ensure that any identified impacts are addressed.

5.12.4 Predicted Outcome

Given the distance to the nearest sensitive premises and implementation of measures identified to reduce or control pests and vermin, it is believed the EPA's objective can be met.

6 STAKEHOLDER CONSULTATION

6.1 Overview

VES is committed to open, proactive, timely and shared communication with all stakeholders to ensure landfill operations, activities and plans have been clearly communicated to stakeholders and concerns adequately addressed. VES is committed to open communication as the foundation of positive ongoing relationships and the company values stakeholder input and feedback.

Specific modes of communication used in relation to the proposal thus far include:

- Letters inviting personal briefings were sent to state and federal MPs who represent the Shire of Gingin, as well neighbouring land owners and key interest groups;
- Informal and formal meetings;
- Telephone conversations;
- Distribution of information packages within the community containing:
    - Question & answer sheet;
    - List of project participants with contact details;
    - Map of proposed Fernview site;
    - Photos of site and existing landfill facilities on the Swan Coastal Plain; and
    - VES company brochure
- E-mail correspondence;
- Hosted visits to existing VES landfill sites in the eastern states.

VES has completed its first round of community consultation, whereby it has developed a program to engage a range of different stakeholders within the community and surrounds. A series of briefings were held at the Gingin Hotel with identified stakeholders to inform them about VES's proposal. Invitations to briefings were made by telephone wherever practicable and by mail. Information provided at these briefings included details on the nature of the facility, timing of the project and the approval process.

The aim of the briefings was to both inform relevant stakeholders of the proposal and assure them that they are to be fully consulted and given some ownership of the project through an ongoing feedback process that welcomes concerns and constructive suggestions. A prime focus of the briefings was to ensure that information was delivered in a sincere, factual and matter of fact way. VES distributed information packages during these briefings as detailed above, containing question and answer pamphlets. The question and answer pamphlet has now become an active, evolving document as new questions and issues are raised by members of the community. The latest version of this document is provided as Appendix J.

VES is now moving into its second stage of community consultation involving continued liaison with engaged stakeholders and distribution of information on the project through the local media. A public meeting is planned to be held when the proposal has been formally submitted to the EPA. Following the public meeting, VES will produce a newsletter for general distribution within the community and email

briefings to key stakeholders to provide additional information and updates. In February 2007, the first issue in a series of newsletters was distributed to keep the key people of the Shire of Gingin and other interested parties informed about the proposal (Appendix N). Organised visits by interested community members to VES operated sites in Perth will also be offered to demonstrate how VES manages its existing sites.

A summary of the stakeholders engaged and briefings held to date is provided in Sections 6.2 (Table 11) and 6.3. VES views community consultation as an ongoing process that will continue throughout the life of the project. As such, VES will provide the DEC with regular updates of the community consultation programme as it progresses.

It should be noted that at the time the stakeholder and community meetings and briefings were undertaken the proposal included a bioreactor as discussed in Section 1.1. So that the integrity of the community meetings and briefings is maintained the questions and responses regarding the bioreactor have been left in the summary of stakeholder issues (Table 12).

6.2 Summary of Stakeholder Engagement for the Proposal

TABLE 11
LIST OF RELEVANT STAKEHOLDERS

GOVERNMENT AND PARLIAMENTERY STAKEHOLDERS	NON-GOVERNMENT STAKEHOLDERS
DEC	Neighbouring landowners
EPA	Local community
Shire of Gingin	Wider community
Shire of Chittering	Gingin Land Conservation District Committee
Judi Moylan Federal MP	Friends of Gingin Brook
Kim Chance MLC, Minister for Agriculture and Food, Forestry, the Midwest and Wheatbelt	Concerned Citizens Against Waste
Gary Snook MLA	Gingin Group for Property Rights
Murray Criddle MLC	Action Group Against Stable Fly
Bruce Donaldson MLC	Frogmoor Commercial Association
Anthony Fels MLC	WA Farmers Federation
Margaret Rowe MLC	Moore Catchment Council
Landskills WA (Ag Department)	Ellen-Brockman Integrated Catchment Group
	Lower Moore River Working Group Inc

6.3 Summary of Briefings Held & Issues Raised during Consultation

Table 12 summarises the issues raised during the consultation process and the response by VES to these issues. The information records:

- The issues raised by the stakeholders;
- The response provided by VES during consultation; and
- Where appropriate, a final position adopted by VES where this deviates from the information provided during the consultation process.

VES received correspondence from the Moore Catchment Council dated 26 August 2006 (Appendix K), advising that the proposal had been brought to its attention by a council member who had attended the scheduled briefings and requested that it be included in future communications.

A formal submission on the proposal was submitted on behalf of the Gingin Land Conservation District Committee. A copy of the response from VES is provided in Appendix L.

VES briefed the Shire of Chittering on 6 July 2006. A record of the issues raised and the responses provided at that time are produced as Appendix M. Note, in some cases there are minor discrepancies between the responses provided in Appendix J, K and L and the final position detailed in this report. This is a result of obtaining improved information following site investigations and the progression of a more detailed design.

TABLE 12
SUMMARY OF STAKEHOLDER ISSUES

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
Shire of Gingin Simon Fraser – CEO George Gifford – President Elizabeth Eaton – Deputy Shire President Wayne Fewster – Cllr David Roe – Cllr Mike Aspinall – Cllr Brian Manson – Cllr Anita Jarvis – Cllr William Fullerton – Cllr Reginald Beale – Cllr Alan Alderson - Cllr Lisa Edwards – Planning Officer	VES representatives gave a briefing to Shire of Gingin councillors in early March 2006, and ongoing discussions have continued since. A meeting was held on 10 March to discuss community representatives and potential stakeholders, with a full Shire presentation given on 16 May. Councillor Mike Aspinall accepted an invitation to visit VES operations in Qld and NSW, which was conducted in January 2005.	**Access** 1. The connection of Wannamal Rd South to Cheriton Rd has yet to be confirmed as there are ongoing issues with the negotiation of land exchanges for existing landowners. The DEC also has preferences in terms of the location of the road through the Boonanarring Nature Reserve. What is proposed in terms of access if this route is not available? Road upgrades will be required if heavy haulage tucks will be utilising proposed roads. **Ongoing costs to Shire** 1. Concerns were raised in relation to the long term disposal fees that may be faced by the Shire should they support the proposal.	**Access** 1. It is currently proposed to access the site via the Brand Highway, Wannamal Road West and then Wannamal Road South, vetoing Cullalla Road. Future long term options include Darwin to Perth Highway which is planned to go around Bindoon, following the rail line. Access is recognised by VES as being an issue of concern for many stakeholders, and it is proposed to regularly review the various options to ensure that the final selected access route is the optimum one. **Ongoing costs to Shire** 1. On-going discussions with the Shire of Gingin are anticipated to draw to a close shortly, where a decision satisfactory to both parties will be reached.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
Shire of Chittering Jan Stagbor – President Kenn Donohoe - CEO	VES representatives have been involved in discussions with the Shire of Chittering since March 2006. VES representatives gave a presentation to the Executive Officers Group, which included CEO's from the surrounding shires of Wongan, Dalwallinu, Gingin, Moora, Victoria Plains and Toodyay on 21 April, 2006. A full Shire council briefing was provided on July 19, with responses to questions raised during that briefing, provided to the Shire in August.	**Access** 1. How long is the road from Brand Highway to the site? Is the Gingin shire putting in the road at their cost? 2. How far is the site from the Chittering Shire boundary? **Groundwater** 1. You say there is no groundwater, then say the property has plenty of water – please explain. **Logistics** 1. Why not construct the bioreactor in Meekatharra – what are the economics? 2. Gingin is a fast growing shire, how does your proposal fit in with development plans?	**Access** 1. In total, the distance is approximately 40 kilometres. The Shire of Gingin already has a planned programme to upgrade the Wannamal Road West. Estimates are still being conducted for the upgrading of Wannamal Road South. 2. The site is approximately 4.5km west from the Chittering Shire Boundary. **Groundwater** 1. The water table below the proposed site is some 20 metres below the surface. The DoE landfill guidelines (2005a) require a buffer distance of 2.0m above the water table. The buffer above the water table at the Fernview site is sufficient to satisfy siting issues relating to water table. There are two water bores nearby that will be used to draw water from the aquifer for use on the site. **Final Position**: The formation level of the landfill will be approximately 15m above groundwater. This final formation level (160m AHD) has been agreed to minimise the potential footprint of the landfill whilst also maintaining a buffer significantly above the DoE (2005a) guidance distance of 2m. This approach therefore maximises the vertical airspace whilst not comprising the surrounding environment including visual amenity. **Logistics** 1. The extra costs associated with transport makes the siting of the Bioreactor in Meekatharra economically unfeasible. 2. The proposed landfill is in an area zoned rural, which allows for noxious industries at the discretion of the Shire. Land zoned industrial is located on the northern boundary of the site and contains high density piggeries.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		General 1. You say the site consists of poor sand – compared to what? Why is it considered poor? 2. Can you show anything relating to what you plan for Gingin? 3. Have any problems been encountered to date in planning the bioreactor landfill? **Power Generation** 1. How much power will be generated? 2. How would the turbine generate power? 3. How many turbines would there be and would they be vertical (i.e. highly visible)? **Existing Facilities Operated by VES** 1. How big is the Goulburn facility – and what is the size of the proposed Gingin facility 2. How does Gingin compare	**General** 1. The sand has a very low capability for growing commercial crops or high yielding pasture for livestock. It is low in nutrients as well as having low water retention characteristics. Other areas within the region have soils richer in nutrients with greater water holding capacity. 2. No, all of the bioreactor landfills currently in operation are very different from one another. VES offered to show any interested parties the Ti Tree facility to get an idea of what is proposed. 3. No. **Power Generation** 1. It is difficult to definitely answer this question this early in the planning process. 2. Caterpillar can supply off the shelf generators for this type of power generation. 3. They are modular style generators with more being added as needed. No, they are not very big. **Existing Facilities Operated by VES** 1. The Goulbourn facility is four times the size of the facility proposed for the Fernview site. 2. See answer above.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		with Woodlawn? **<u>Waste Input</u>** 1. The Gingin waste output is 5,000 tonnes per year, you are proposing a plant to process 100,000 tpa, so Gingin would only contribute 5% of the total waste required. Where will the additional waste come from? **<u>Bioreactor Design</u>** 1. Bentonite clay is very expensive – will you look at other liners? 2. Are there any studies on the effects of a 450mm layer of clay on HDPE liner? 3. Why do you propose a 450mm layer of clay when other sites have a 600m layer?	**<u>Waste Input</u>** 1. It is VES's intention to take all of the Shire's waste with the only exception being material that is not suitable, e.g. asbestos. This is however, a very small percentage of the total volume. The kind of facility proposed can only operate successfully if it achieves a certain economy of scale, and that depends on a high waste volume being available. There is no way it could operate with a waste input from the Shire of Gingin alone. The volume of waste the Shire produces will grow with the forecasted increase in population. The proposed facility will be able to easily absorb this, creating a sustainable solution for future waste management within the region. The remainder of the waste will generally come from the metropolitan area. **<u>Bioreactor Design</u>** 1. It is recognised that bentonite clay can be very costly; VES is currently looking at other clay sources with the correct impermeable characteristics as well as HDPE lining systems. 2. VES isn't specifically aware of any such studies, but considers it likely that such studies have been conducted. VES monitors the water that flows beneath the Ti Tree facility and there is no evidence of leakage within that system. Engineering firms could provide further information if required. 3. VES is anticipating placing a 1 meter thick layer of clay. **Final Position**: The landfill will be deigned with a composite liner which will consist of a geo-synthetic clay liner and HDPE or equivalent in accordance with best practice (DoE, 2005a).
Judi Moylan Federal MP Member for Pearce	Briefing given by VES representatives 23 August 2006.	**<u>General</u>** 1. Generally in favour of new waste technology and recycling, supporting good	**<u>General</u>** 1. Noted.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		management of waste. **Groundwater** 1. Stated that the VES team needs to demonstrate the qualifications of the people undertaking the hydrogeological studies in order to reassure stakeholders that the research is being conducted thoroughly and professionally. **Community Consultation** 1. Stressed the need for good communication and provision of full information on the proposal. 2. Feedback on the proposal she has received to date indicates that the project was proceeding on the right track in terms of communication with stakeholders.	**Groundwater** 2. The groundwater investigation will be completed by Dr Chris Barber (a recognised WA expert in hydrogeology) in conjunction with specialists from ATA Environmental. **Final Position**: The groundwater investigation has been completed by Dr Chris Barber (a recognised WA expert in hydrogeology) in conjunction with specialists from ATA Environmental. **Community Consultation** 1. Noted, VES would like to reiterate their total commitment to keeping the community informed about any issues that are identified as causing any concern. VES welcomes and encourages dialogue and feedback from the community. VES aggress that this must be a transparent process, recognizing that whilst some information is not available at this early stage in the project proceedings, required information will be provided as it becomes available. 2. Noted.
Kim Chance MLC Minister for Agriculture and Food, Forestry, the Midwest and Wheatbelt	Briefing given by VES representatives 20 July	**General** 1. Was generally in favour of improved waste management.	**General** 1. Noted.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		2. Requested to be kept informed of future developments with the proposal. 3. Raised no issues of concern other than the need for environmental protection. **<u>Compost</u>** 1. Interested in the possibility of compost production, including the nature of the final products, its value for soil improvement and potential for local landholders.	2. Noted. 3. Noted – this document outlines commitments by VES pertaining to environmental protection. **<u>Compost</u>** 1. VES envisages that there will be a very low cost, or none at all to local landholders.
Gary Snook Liberal MLA Member for Moore Shadow Minister for Agriculture; the Wheatbelt; and Property Rights	Briefing given by VES representatives 21 August	**<u>General</u>** 1. Was of the belief that advanced technology is required for future waste management and generally supported the objectives of the proposal. **<u>Waste Input</u>** 1. Discussed the possible use of waste from feed lots – indicated that a large cattle feed lot (>50,000 head) was planned for Moora.	**<u>General</u>** 1. Noted. **<u>Waste Input</u>** 1. Noted.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		Compost 1. Advised that stable fly may be an issue for stakeholders, and that any product produced from landfill mining must be affordable. 2. Was interested on the costs and financial implications of the landfill mining possibility.	**Compost** 1. VES is aware of existing problems with stable fly within the Shire, but believes the management practices outlined in Section 5.12 will adequately address any concerns. VES envisages that there will be a very low cost, or none at all to local landholders. 2. Interest noted, but no response is available at this time.
Richard Diggins Chairman Gingin Land Conservation District Committee (GLCDC); Chairman of Landskills WA (Ag Dept.)	Spoken to by Terry Murphy (of Wordsmith Communications) 13 March	**General** 1. Requested to be kept informed via email.	**General** 1. Noted.
Site neighbours/farmers Vic & Shirley Harding John Cheriton Sharon Martin Errol Howard Brendon Howard Steve Martin	Community Briefing Session 1 – Tuesday 13 June	**Site Selection** 1. Have you looked along Brand Highway or abandoned mine sites as alternative sites? **Access** 1. Who will maintain roads used by delivery tucks? 2. How many trucks will access the site, how will this	**Site Selection** 1. Yes, VES has investigated the possibility of utilising abandoned mine voids, however none suit the selection criteria. **Access** 1. This is currently being discussed with the Shire of Gingin. 2. Approximately 25 trucks per day will be accessing the site, though this may be higher during the initial construction period.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		impact other road users?	
Action Group Against Stable Fly Bernard McCarthy		3. What access roads will be used and will they be sealed?	3. It is currently proposed to access the site via the Brand Highway, Wannamal Road West and then Wannamal Road South, vetoing Cullalla Road. Future long term options include Darwin to Perth Highway which is planned to go around Bindoon, following the rail line. Access is recognised by VES as being an issue of concern for many stakeholders, and it is proposed to regularly review the various options to ensure that the final selected access route is the optimum one.
Gingin Land Conservation District Committee (GLCDC); WA Farmers Federation Lucy Beckwith **Moore Catchment Council** John Reymond **Concerned Citizens Against Waste** Cheryl Porter S. Cray L. Cuff P. Porter	Community Briefing Session 2 – Wednesday 14 June A submission was received by Lucy Beckwith on behalf of the GLCDC in August 2006 and is discussed separately below	4. Can you guarantee trucks won't be utilising Cullalla Road? **<u>Construction</u>** 1. What size cells will be used? 2. How many cells will be constructed? 3. What is the risk of an earthquake? 4. How deep are the cells – what is the distance to groundwater?	4. VES will not be using Cullalla Road, however locally generated waste from the Gingin and Bindoon areas may use the road for access to the landfill site. **<u>Construction</u>** 1. Subject to site layout, each cell will have a footprint of 50,000m^2. 2. One cell will be created every 12-18 months during the life of the facility. 3. The site is located on a deep stable sand formation which will provide a stable foundation for lining systems. Although it is located in proximity to the Darling Fault system, this fault zone has not been active for many millions of years and thus is not in a seismic risk zone. 4. The cells will extend 5m below current ground level. This will mean that the base of each cell is still more than 20m from the groundwater table. **Final Position**: The formation level of the bioreactor landfill will be approximately 15m above groundwater. This final formation level (160m AHD) has been agreed to minimise the potential footprint of the bioreactor landfill whilst also maintaining a buffer significantly above the DoE (2005a) guidance distance of 2m. This approach therefore maximises the vertical airspace whilst not comprising the surrounding environment including visual amenity.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
Farmer Lee Martin **GLCDC** Jill Love **GLCDC, Ellen-Brockman Integrated Catchment Group, Chittering Landcare Group** Rosanna Hindmarsh **Gingin Property Rights Group** Murray Nixon		**Lining** 1. Where will the clay be sourced from? 2. What happens if the lining system is breached? 3. What are manufactured liners made of? 4. What is the thickness of the liners? 5. Why are only 2 layers proposed at Gingin, yet 3 are used at TiTree?	**Lining** 1. VES is currently investigating clay sources with the correct impermeable characteristics as well as GCL and HDPE lining systems. 2. The site will incorporate a sophisticated lining and leachate management system which is designed to minimise potential impacts on groundwater. A groundwater monitoring regime will be implemented at the sit, if landfill leachate leakage is detected, cell remedial work will be immediately undertaken to locate and correct the leakage. 3. Geosynthetic Clay Liner (GCL) is a relatively thin layer (5mm thick) of powdered bentonite clay bonded between two sheets of geotextile, needle punched together to provide frictional resistance. GCL is placed on the compacted smooth subgrade and when restrained by surcharge, provides a waterproof barrier. HDPE liners are composed of generally 2mm thick sheets of High Density Polyethylene. When placed on side slopes the underside of the sheet is textured to provide frictional resistance. HDPE is placed directly over the GCL liner. A geotextile, which is a woven or non-woven synthetic fabric resistant to penetration damage, is placed over the HDPE liner. Depending on the design criteria, the geotextile can have a thickness of 4-10mm. 4. The thickness of the composite liner will depend on the final configuration; however this will be in accordance with best practice (DoE, 2005a). 5. Ti Tree was the first bioreactor constructed in Australia, and as such VES was quite conservative in the design specifications. The proposed bioreactor will be designed in accordance with best practice (DoE, 2005a).

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		Gas Production	**Gas Production**
		1. How will gas be managed and used at the site?	1. Gas will be contained within the waste mass via the capping of each cell. Initially, the extracted gas will be flared until such time that consistent and sufficient volumes of gas are generated. When such flow is reached, gas turbines will be installed to generate power.
		2. When will power generation begin and how long will it be generated for?	2. It is anticipated that power generation will begin three years after operations have commences, continuing for up to seven years after the last consignment of waste has been received.
		Compost	**Compost**
		1. What would be the quality of the final product – would it be safe to use on food produce etc?	1. The compost will be a low quality soil enhancer with carbon and nutritional benefit for local soils. VES commissioned a feasibility study of the potential compost recovery..
		2. What would be the charges for users of the compost product?	2. VES envisages that there will be a very low cost, or none at all to local landholders.
		Water	**Water**
		1. How much water is required for the bioreactor and where will this be sourced from?	1. Liquid for the bioreactor will be obtained from septage and grease trap waste. Water will be required on a seasonal basis for dust suppression purposes, and can be obtained from a bore located onsite.
		2. What water will be utilised from the Fernview property and what is the quality of this water?	2. See above. The water available at the Fernview site is of suitable quality and fit for purpose.
		3. Will wastewater from nearby piggeries potentially	3. Yes, such wastewater could be used in the bioreactor.

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		supply enough water?	
		Groundwater	**Groundwater**
		1. There is a potential for groundwater contamination.	1. The large depth to groundwater from the base of the liner means that the groundwater has a low vulnerability to contamination. The sophisticated lining and leachate management system act to further reduce the likelihood of any significant impacts.
		2. What is the risk of leachate entering the Gingin Brook?	2. The lining system acts to contain any leachate generated on site along with the active leachate management system. In the unlikely event that leachate is able to break through the lining system; it would need to migrate at least 20m vertically in order to enter the water table. Furthermore, it would need to migrate approximately 7km to Gingin Brook before any impact would occur. Dilution and dispersion of any leachate over this distance would be sufficient to limit the impact on the water in Gingin Brook. Thus there is no credible threat of any impact on Gingin Brook. A groundwater monitoring regime will also be implemented at the site.
		3. How will leachate be managed?	3. The leachate management system at the facility will enable the collection of leachate from within the landfill for leachate recirculation. The management system will ensure that the leachate head on the liner system is controlled in accordance with best practice.
		4. What is the local hydrology of the site?	4. There are no surface water bodies on the site. The local hydrogeology of the site consists of an unconfined aquifer with a surface level of approximately 145m AHD (25-75m below current ground levels).
		5. What studies/work has been done on the hydrology of the site?	5. A desktop review has been completed by Dr Chris Barber and four monitoring wells have been installed to allow water levels and quality to be assessed on a regular basis.
		6. What leachate monitoring will be done?	6. Landfill leachate levels within the waste will be monitored on a regular basis. Leachate will be sampled on a quarterly basis where baseline monitored parameters will include but not be limited to; visual appearance (colour,

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
			turbidity, free phase hydrocarbons, foaming), pH, electrical conductivity, heavy metals, nutrients (nitrogen and phosphorous), ammonia, chemical oxygen demand (COD), biological oxygen demand (BOD) and total petroleum hydrocarbons.
		7. What is the worst case scenario regarding environmental problems?	7. A serious failure of the liner system would be considered a worst case scenario, where leachate is released into to the surrounding ground, potentially contaminating groundwater in the vicinity of the facility. It is anticipated that potential contamination would not extend more than 1-2km from the site and would contain elevated total dissolved solids, ammonia, COD, BOD and nutrients. **Final Position**: The formation level of the landfill will be approximately 15m above groundwater. This final formation level (160m AHD) has been agreed to minimise the potential footprint of the landfill whilst also maintaining a buffer significantly above the DoE (2005a) guidance distance of 2m. This approach therefore maximises the vertical airspace whilst not comprising the surrounding environment including visual amenity.
		Recycling 1. What potential recycling opportunities are available within the proposal?	**Recycling** 1. The main recycling focus at this stage will be on the reuse of organic waste as a soil enhancement.
		Waste Input 1. What sorts of waste will be utilised within the bioreactor? Does this include septage wastes or industrial wastes?	**Waste Input** 1. VES will actively control the nature of wastes accepted at the site. Wastes that are considered likely to contain pesticides, heavy metals and other hazardous compounds that are potentially harmful to human health or the environment will not be accepted at the facility. Principal waste types accepted at the facility will include: • Municipal Solid Waste (MSW); • Solid wastes containing biodegradable organics conforming to the Class II

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
			landfill acceptance criteria*, Landfill Waste Classifications and Waste Definitions 1996 (As Amended)* (DoE, 2005b); • Selected soils or sludge contaminated with biodegradable hydrocarbons will be accepted after a thorough assessment to ensure the biodegradability of the contaminants and the absence of metals and pesticides; • Sewage sludge, septage and grease trap wastes; and • Liquid wastes and sludge's derived as a by-product or animal husbandry and food processing The site waste acceptance criteria will be developed in accordance with the Class II landfill Criteria, detailed in *Landfill Waste Classifications and Waste Definitions 1996 (As Amended)* (DoE, 2005b).
		2. Will items which potentially include contaminants such as heavy metals be allowed in the facility – how will you screen for these?	2. No. These will be screened for at transfer stations.
		3. Will you take green waste? If so, will it be handled separately?	3. Green waste may me added to the stabilised organic matter as a means of nutrient enrichment, particularly carbon, which would produce higher quality compost.
		4. Will the facility be able to use chicken manure?	4. VES is keen to explore the option of blending chicken waste with the greenwaste and the re-mined soil fraction as a means of nutrient enrichment, in this case nitrogen, which would produce higher quality compost.
		5. What are the anticipated required waste volumes and	5. Up to 100,000 tonnes of waste per annum will be accepted at the facility. Gingin currently generates approximately 5,000 tonnes per annum of waste,

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		where will the waste be sourced from?	which would contribute 5% of the bioreactors required waste stream, with the remainder generally coming from within the metropolitan area.
		6. What are the costs to the shire of dumping waste?	6. This is still being negotiated; however, VES will be offering a sizeable discount to the Shire of Gingin.
		7. Will VES take all of the Shire's waste?	7. It is VES's intention to take all of the Shire of Gingin's waste, with the only exception being material that is not suitable, such as asbestos. This is however, a very small percentage of the total volume. The kind of facility proposed can only operate successfully if it achieves a certain economy of scale, and that depends on a high waste volume being available. There is no way it could operate with a waste input from the Shire of Gingin alone. The volume of waste the Shire produces will grow with the forecasted increase in population. The proposed facility will be able to easily absorb this, creating a sustainable solution for future waste management within the region.
		8. What percentage of the waste will be coming from Perth?	8. See response to question 5 above.
		Misc	**Misc**
		1. How would you control flies, in particular stable flies?	1. Flies will be controlled by minimising exposed areas of waste through operational practices and the use of sprays as necessary.
		2. How will odour be managed at the site?	2. Odour will be carefully managed through the control and management of deposited wastes, regular covering of wastes and the control, extraction and burning of landfill gas.
Neighbouring Landowner	Given a personal briefing in his home by Chris Griffin (VES) August, 2006.	**Water**	**Water**
		1. Raised concerns about the potential contamination	1. As previously mentioned, due to the design of the landfill, the depth to groundwater and the distance to Gingin Brook from the site, potential impacts

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
Geoff Overheu	Was given a copy of the Hydrogeology Report by Dr Chris Barber	of the Gingin Brook which runs through his property.	on Gingin Brook are not considered significant.
GLCDC Lucy Beckwith	VES received a formal submission from Lucy Beckwith on behalf of the GLCDC in August 2006. This correspondence and the response written by VES are provided in Appendix L	**General** 1. Had concerns that the project would not adequately address the Shire of Gingin's existing waste management issues, and that VES was looking at the Shire of Gingin primarily to establish their business, not to assist the Shire. **Waste Input** 1. Had concerns that VES would not accept all of the waste from within the Shire of Gingin, noting that VES is anticipating that the Shire of Gingin will contribute approximately 5% of the waste input required. **Liability** 1. Sought assurance that if there were any environmental impacts resulting from the project, such as spills from leachate	**General** 1. As with all business ventures, there must be a mix of commercial realities and provision of excellent customer service. VES is committed to both of these in its Gingin proposal and aims to manage the Shire's waste in a thorough and satisfactory way for the community. The scale of the proposed project provides an opportunity for the Shire to utilise the facility at a lower cost than would be achieved if the Shire was to develop its own facility to the same standard. It must be pointed out that the Shire of Gingin recognises that their regional landfills need to be upgraded and are currently performing their own due diligence on their own site for a centralised facility. **Waste Input** 1. It is VES's intention to take all of the Shire of Gingin's waste, with the only exception being material that is not suitable, such as asbestos. This is however, a very small percentage (~5%) of the total volume. The kind of facility proposed can only operate successfully if it achieves a certain economy of scale, and that depends on a high waste volume being available. There is no way it could operate with a waste input from the Shire of Gingin alone. The volume of waste the Shire produces will grow with the forecasted increase in population. The proposed facility will be able to easily absorb this, creating a sustainable solution for future waste management within the region. **Liability** 1. VES agrees completely that it should cover 100% of any remediation work that may potentially be required as a result of the project. VES has offered to take interested parties to tour other bioreactor facilities in the Eastern States to check the operational capabilities and level of expertise. VES has also offered interested parties to meet with the host Shires where these facilities operate,

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		ponds, VES would be 100% culpable for remediation costs. Also sought assurance that all environmental checks and balances would be in place.	being the City Of Ipswich near Brisbane and the Shire of Mulwaree near Goulbourn to assist with due diligence. A Councillor from the Shire of Gingin has already taken up the opportunity of visiting the sites and was duly impressed. VES will also be offering a tour of the construction and demolition waste recycling facility at Jandakot Airport to further help with an understanding of the capability and commitment VES exhibits within its operations. As is in other parts of the world and other Australian states, there will be stringent licensing conditions to meet should this proposal be approved. VES works very hard at protecting its reputation as being a trusted operator of this type of facility, and will ensure that VES attains all necessary environmental approvals through a transparent and open process.
		Benefits to Shire 1. Questioned the overall benefits to the Shire of the proposal in particular: • What were perceived to be unsubstantiated benefit claims; • Lack of real employment opportunities; • How the project will inject money into the community; • Use of the proposed finished product (compost).	**Benefits to Shire** 1. All other issues aside, the facility would be well out of the community's way, and its existence would be barely noticeable. All claims made in respect to this project will be explained/substantiated as all facts become available (see earlier response). The fact is that this project can bring significant benefits to the Shire, through highly efficient waste management well into the future, the potential for an excellent soil improving product, and involvement by VES, now part of an international operation, in community development, as has been undertaken in the eastern states. Employment is in no way a primary issue for this project. Rather, it is a spin-off benefit. The number of people employed on site will double when the landfill mining process is started. There will be significant civil works required in the early stages (2 million dollars) and then on an annual basis (1 million dollars) which will be sourced from local firms. Fuel and maintenance needs will also be sourced locally which will generate a further $200,000 annually. There are other services that will be required as well. VES have commissioned a report as to the reality of being able to re-mine the

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
		Cost to Shire 1. Suggested that a truck or tonnage fee should be paid by VES to the Shire of Gingin as compensation for siting of the bioreactor within its boundaries.	material for soil enhancement. The report will be provided to any interested party upon them contacting VES. *It was noted within the response that VES would send a copy to Lucy Beckwith and the Shire of Gingin upon its completion*. **Cost to Shire** 1. VES agrees and this has been discussed with the Shire CEO verbally. VES can give numerous examples of working closely with the local Shires/Councils and communities in which it operates and will do the same in this instance.
State MPs Murray Criddle MLC Agriculture Region National Party of Australia Bruce Donaldson MLC Agriculture Region Liberal Anthony Fels MLC Agriculture Region Liberal Margaret Rowe MLC Agriculture Region Liberal	Invited to briefings, no response		

STAKEHOLDER GROUP	EXTENT OF COMMUNICATION	FEEDBACK & KEY ISSUES / QUESTIONS RAISED	VES'S RESPONSE
Others			
Ross Collard & Marilyn Chambers – members of GLCDC	Invited to briefings but failed/unable to attend		
Colin Price – neighbouring farmer	Invited to briefings but failed/unable to attend		
Bruce Cameron – neighbouring farmer	Happy with proposal, did not require briefing		
Maxine Greville	Strongly opposes proposal, did not want briefing		
David Steadman	Invited to briefing but failed/unable to attend		
Norm Wallace	Invited to briefing but failed/unable to attend		
Cyril Sauzier – neighbour	Invited to briefing but failed/unable to attend		
George Grubinic – neighbour	Invited to briefing but failed/unable to attend		
Gavin Drew – former Mayor of Gingin	Invited to briefing but failed/unable to attend		

6.4 Formal Response to Issues and Submissions Raised During Consultation

A copy of relevant correspondence between Veolia Environmental Services and the EPA Service Unit in responding to submissions is included as Appendix O. This document has been update where appropriate to reflect changes made as a result of issues raised in the submissions and now represents a final version of the documentation for consideration by the EPA.

In a number of cases there has been no direct change to the document as a result of matters raised in the submission as VES has treated the issue as comment or considered that the report already addressed the issue in an appropriate manner in its original form. The major areas of change are those dealing with:

- The assessment and management of vegetation including a commitment to rehabilitate the site to natural bushland following closure.
- The assessment and management of risk to the ground water system; and
- The regulatory framework under Part V of the *Environmental Protection Act 1986*.

7 ENVIRONMENTAL COMMITMENTS

VES, as proponent for the Landfill Project is committed to ensuring that all aspects of the development of the proposal are undertaken in a manner that minimises impacts on the environment. Accordingly, VES has proposed a series of commitments which will be met to ensure environmental objectives are met at all times. The commitments are presented in Table 13

TABLE 13
PROPONENT ENVIRONMENTAL COMMITMENTS

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
1	Environmental Management	To ensure all aspects of project construction and operation are conducted such that environmental impacts are minimised as far as practicable, and that regulatory requirements are complied with.	1. The following environmental impacts will be minimised and controlled by the design of the landfill and site operational procedures. The procedures will be updated as required to reflect any changes in the design, construction and operation of the proposed facility. The operational procedures will then be implemented through a VES Environmental Management System. • Waste Acceptance Criteria (Commitment 4); • Air Emissions and Dust (Commitment 5); • Surface Water, Storm Water and Groundwater (Commitment 6); • Noise and Vibration (Commitment 7); • Solid and Liquid Waste (Commitment 8); • Flora, Fauna and Vegetation Management Plan (Commitment 9); and • Amenity – Visual, Litter, Fire and Vermin, Pest and Nuisance species control (Commitment 11). 2. The following management plans will be prepared prior to lodging a Works Approval Application: • Fire Management Plan; • Spill Response and Management Plan; • Landfill Contingency Management Plan (see commitment 2); • Decommissioning & Aftercare Management Plan (see commitment 3); and • Landscape Rehabilitation Management Plan (see commitment 10).	Prior to lodging a Works Approval application	DEC

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
			3. Implementation of the approved Environmental Management Program (EMP).		
2	Landfill Contingency Management		2. Prepare a Landfill Emergency Response Plan which will address, but will not be limited to the following: • Delivery of wastes that do not conform to the site waste acceptance criteria (Section 3.1.1); • Response to fire (either on-site or on adjacent land, see Commitment 1 above); • Unusual climatic conditions, such as extreme rainfall events; • Bomb threat; • Waste vehicle rollover, vehicle accident or waste fire transit; • Failures of the stormwater management, lining or leachate management systems; and • Detection of contamination by the groundwater or surface water monitoring regime (Section 5.6). 2. Implementation of the approved landfill contingency management plan including regular staff training.	Prior to operation	DEC
3	Decommissioning & Aftercare Management Plan	To provide the framework to ensure that the site is left in an environmentally acceptable condition at closure.	1. Prepare a Preliminary Decommissioning & Aftercare Management Plan prior to lodging a Works Approval Application, which will address but will not be limited to the following: • Management procedures detailed in Section 3.3.7. • Conceptual plans for the removal of site infrastructure; • Conceptual plans for the final landform and landfill profile; • A conceptual rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders; • A conceptual plan for post closure management of the leachate management and landfill gas systems;	Prior to lodging a Works Approval application	DEC/Shire of Gingin

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
			• Long-term monitoring and maintenance schemes; and • Preliminary plans for management of the landfill cap and landscape vegetation. 2. Preparation of a Final Decommissioning and Aftercare Management Plan at least 6 months prior to decommissioning, or at a time to be agreed with the EPA, which will address but will not be limited to the following: • The management measures detailed in Section 3.3.7. • Final plans for the removal of infrastructure; • Final plans for the final landform, landfill profile and planting regime; • A final rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders; • A final plan for post closure management of landfill leachate and landfill gas; and • Final plans for management of the landfill cap and landscape vegetation. 3. Implementation of the approved Final Decommissioning & Aftercare Plan.	At least six months prior to the anticipated date of decommissioning or at a time to be agreed with the EPA	
4	Waste Acceptance Management	To ensure that all waste accepted for disposal complies with relevant guidelines and the conditions of the site licence.	1 Waste will be accepted at the facility in accordance with the procedures detailed in Section 3.1.1. The procedures will be updated prior to lodging a Works Approval Application and will address the following: • Procedures at the weighbridge and hours of operation; • Criteria for acceptance of waste for disposal; and • Documentation and record keeping including analytical testing requirements. 2. Implementation of the approved waste acceptance procedures.	Prior to lodging a works approval application Ongoing through the life of the project	DEC

NO	TOPIC	OBJECTIVE/S	ACTION	TIMING	ADVICE
5	Air Emissions Management	To protect surrounding land users such that gaseous and particulate emissions will not adversely affect their welfare and amenity or cause health problems.	1. Air emissions will be minimised through the design of the landfill and managed through procedures detailed in Sections 5.3, 5.4 and 5.5. The management procedures address the following, which will be updated prior to operation to reflect any design or operational changes: • Construction stage impacts; • The use of water sprays during dry and windy conditions; • The use of speed limits to minimize dust generated by vehicle movements; • The use of minimum drop heights when loading and unloading soils and other excavated materials; • Minimisation of areas of disturbed and/or exposed soils; • Management and covering of waste to limit odour emissions; • Operation of the landfill gas management system; • Incident management; • Responsibilities; • Monitoring requirements; • Response, mitigation and contingency measures; • Reporting requirements; • Employee training and awareness; and • Implementation of a complaint management procedure to receive, investigate and action dust and odour complaints. 2. Implementation of the approved air emissions management procedures.	Prior to lodging a works approval application Ongoing through the life of the project	DEC