Draft

Guidelines for Composting Works in South Australia

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EPA South Australia

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This draft EPA Guidelines for Composting Works has been released for public comment.

You are invited to comment on the draft guideline. Responses are preferred via the EPA's consultation website <http://www.epacomments.sa.gov.au/>.

Alternatively you can email comments to the project manager at <sharon.jamieson@epa.sa.gov.au> or provide written submissions to:

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1 Introduction

These guidelines apply to all Composting Works and Organic Waste Treatment Depots, hereafter called Composting Works. Development and operation of a Composting Works is an activity of environmental significance in accordance with Schedule 1[1] of the *Environment Protection Act 1993* (the Act). These guidelines provide guidance to composting operators, developers, planning authorities and regulatory bodies on site selection, development, operation, decommissioning and post-decommissioning management of Composting Works for responsible environmental management and requirements under the Act.

The guidelines are designed to provide authorities and industry with guidance on environmental issues to minimise the negative impacts of Composting Works on the environment and local communities. They are also intended to help government and industry manage waste streams and to help authorities include environmental management in planning decisions.

The Environment Protection Authority (EPA) will use these guidelines as the basis for preparing direction on development applications for proposed Composting Works referred under the *Development Act 1993* and, where applicable, for the development of conditions of licence under the Act. The EPA will also use these guidelines as the basis for continuous assessment of conformance with the Objects and General Environmental Duty of the Act.

Scope

These guidelines are written with the focus on the open windrow technology for composting depots. It is acknowledged that new sites that are fully enclosed or using in-vessel systems are unlikely to be developed in SA in the near future.

The guidelines are not a "how to compost" document—there are many excellent resources available including the Recycled Organics Unit (ROU) at the University of NSW website <www.rolibrary.com> that explain all the facets of composting.

Objectives

The principal objectives of these guidelines are to:

- explain the approval process for new composting sites
- identify potential environmental issues associated with Composting Works.

[1] If producing in excess of 200 tonnes per annum of finished compost

- recommend practices that composting and organic recycling facilities should undertake to minimise the risk of impact on the environment, in particular on water and air, and on surrounding communities, as required under the following sections of the Act:
  - **Section 10 Objects**: including the principles of ecologically sustainable development, and to ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment
  - to prevent, reduce, minimise and, where practicable, eliminate harm to the environment
  - to require persons engaged in polluting activities to progressively make environmental improvements (including reduction of pollution and waste at source) as such improvements become practicable through technological and economic developments
  - **Section 25 General Environmental Duty**: a person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.
- provide information on statutory requirements relating to environment protection and operational practices.

The key operational objectives are to:

- manage leachate, odour and gas that may impact on the environment or lead to loss of amenity value
- develop and improve procedures to be implemented for monitoring, review and continuous improvement of site operations
- minimise the duration and requirement for post-decommission monitoring and remediation.

Structure and content of these Guidelines

Table 1 below shows the structure and provides a brief outline of the main issues dealt with in these guidelines. The guidelines comprise seven sections, each relating to different components of the development, planning and operation of a Composting Works, in order to minimise the environmental impact of a facility.

All sections must be addressed in a Development Application and will form part of the assessment for the Licence Application or an application for an amendment to an existing authorisation.

Table 1 Structure of the Guidelines

OUTLINE	MAIN ISSUES ADDRESSED
1 INTRODUCTION	
Definition of the scope and purpose of the guidelines	Principal and operational objectives of the guidelines Process for project development and regulatory approval, in particular CEMP requirements, licensing requirements and conditions Environmental risk-based classification for Composting Works Structure and content of the guidelines
2 SITING OF DEPOTS	
Criteria for choosing a suitable site for a proposed facility to minimise negative impact on environment and host community	Community issues Required separation distances Preliminary site environmental assessment regarding potential impact on water quality, protected ecosystems and amenity
3 INCOMING FEEDSTOCK MANAGEMENT	
Importance of nature, origin and appropriate handling of incoming feedstock in minimising environmental impact of the composting process and the end-product	Characteristics of incoming feedstock and main types of contaminants Screening and contaminant removal options Specific issues and requirements of alternative activities: vermiculture, composting of mushroom substrate, in-vessel composting
4 ENGINEERING DESIGN AND IMPLEMENTATION	
Guidance for achieving and successfully implementing an engineering design that fits the planned purpose of the facility and minimises negative impact on environment and host community	Key design factors Technologies and specifications for minimising surface and groundwater contamination by leachate and management of stormwater Technologies for minimisation of biogas and odour emissions Construction Quality Assurance (CQA)

5 SITE LAYOUT AND OPERATION	
OUTLINE	**MAIN ISSUES ADDRESSED**
Required outcomes and suggested planning and operational solutions to coordinate and facilitate site activities while ensuring a high level of environmental performance	Planning and operation to minimise: • impact on local amenity • polluting emissions to the environment • feedstock contamination
6 ENVIRONMENTAL MANAGEMENT AND MONITORING	
OUTLINE	**MAIN ISSUES ADDRESSED**
Objectives and specific operational strategies for environmental management regarding potential hazards to the environment and host community	Water quality protection and monitoring, including groundwater, stormwater and leachate management strategies Management and monitoring of odours and biogas emissions Management of noise and other environmental issues Monitoring of meteorological conditions
7 DECOMMISSIONING AND REHABILITATION	
OUTLINE	**MAIN ISSUES ADDRESSED**
Guidance to ensure long-term protection of the environment and to minimise the duration of post-closure maintenance	Removal of equipment, products, contamination and waste from the site Suitability for the future land use Environmental monitoring if shown to have impacted previously, eg groundwater

Establishing a Composting Works

Development of a Composting Works or expansion of an existing facility must have regard to:

- South Australia's State Waste Strategy (refer Zero Waste SA)
- relevant Regional Waste Management Plans
- relevant Environment Protection Policies
- Guidelines for Composting Works (this document).

Establishing a Composting Works is a lengthy process that may take many months of research, planning, communication and construction before composting can commence.

If producing (or capable of producing) over 200 tonnes per annum (tpa) of mushroom or other compost, a developer needs to gain development approval (defined as a Schedule 22 activity under the Development Act 1993) and also an environmental authorisation (a licence) from the EPA. A Composting Works is defined as an activity of environmental significance in Schedule 1, Part A, 6(3) of the Act*:*

> Composting Works: the conduct of works at which mushroom or other compost is produced or is capable of being produced at a rate exceeding 200 tonnes per year.

The Development Assessment Commission (DAC) will be the planning authority dealing with the development approval (Schedule 10 Part 2(b) of the *Development Regulations 1993)*. A comprehensive *Guide to Development Assessment: An integrated Planning and Development Assessment System for SA* (2003) is available from Planning SA that provides relevant information on the development approval process.

The EPA licence will be developed on the basis of these guidelines and will include performance requirements and measurement for the environmental objectives stated herein and any other site-specific environmental objectives.

Stages of the development approval process are outlined below with items requiring regulatory approval shown in **bold**:

- Highly recommended: the developer instigates early discussions with the local council, Planning SA and the EPA regarding the proposal.
- The developer lodges a **Development Application** through the local council and the application will be referred to the DAC, the planning authority.
- DAC will refer the application to the EPA (may also be referred to other referral agencies, eg Primary Industries and Resources SA (PIRSA), Department for Transport, Energy and Infrastructure (DTEI), and Department of Health.
- It is advisable that a **Compost Environment Management Plan** (CEMP) is submitted as part of the development application. The CEMP should include the following information:
  - siting assessment (appropriateness of site, including risk assessment)
  - identification and quantification of potential environmental impacts
  - detailed design specifications and drawings of site facilities
  - Construction Quality Assurance (CQA)
  - operation, on-going monitoring, corrective actions
  - management review and reporting to the EPA
  - decommissioning (including post-decommissioning maintenance, monitoring, rehabilitation and reporting to the EPA).

  (Refer to Appendix 1 for topics for inclusion in a CEMP.)
- If development approval is granted, the developer must construct the site in accordance with the DAC's conditions of approval (called a Decision Notification Form or DNF). The developer lodges an application to the EPA for a **Licence**.

- If no CEMP was lodged at the development application stage, then a CEMP will be required at the licence stage (or an Environment Improvement Programme (EIP) for upgrades to existing facilities).

If any variations to the approved development are proposed, these must only be undertaken if prior consent from the planning authority is received.

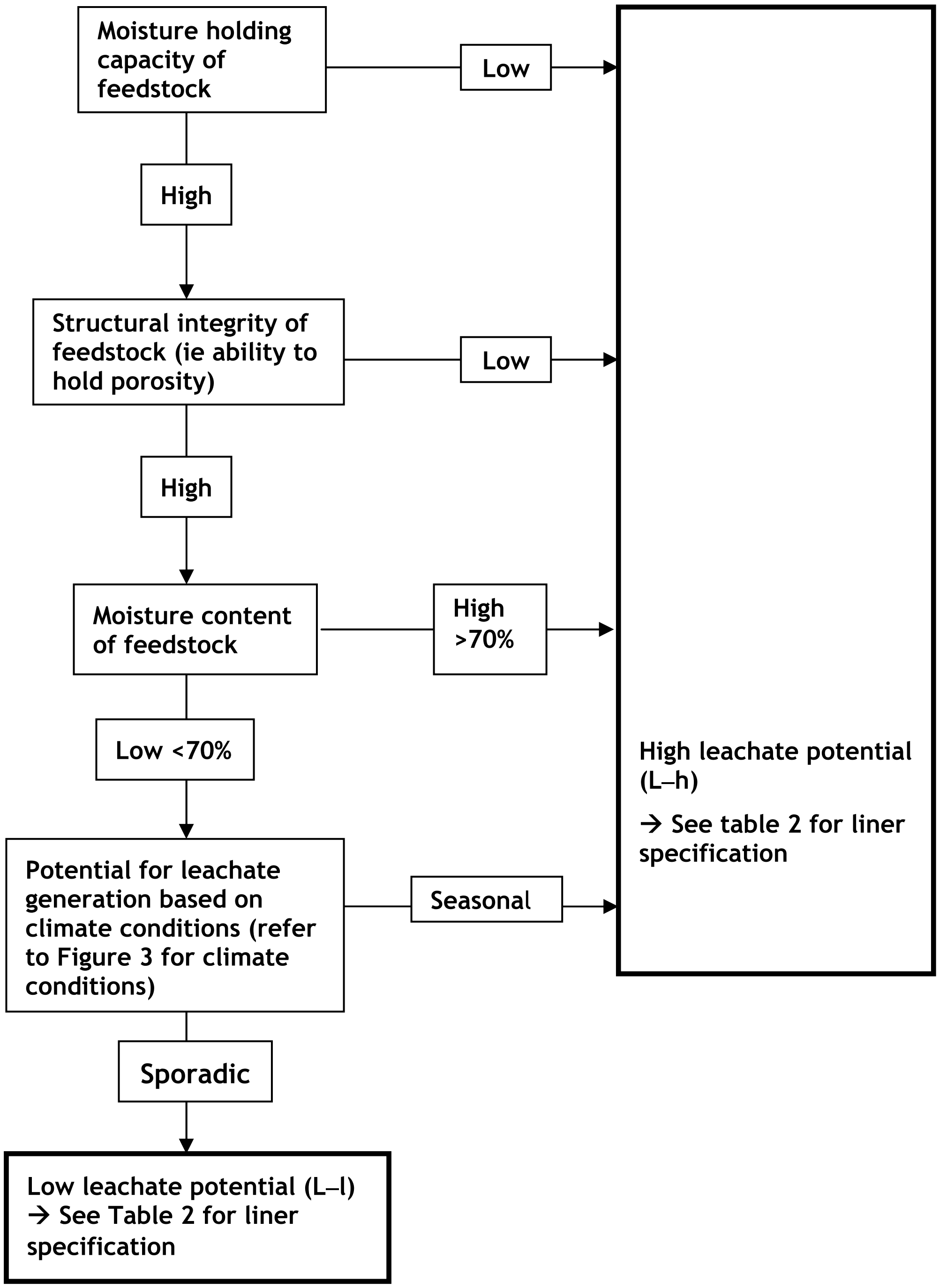
Composting Works classification

The EPA classification for Composting Works is based on the environmental risk posed by the proposed facility, regarding potential impact on the environment and local amenity value. The main emission criteria are leachate and odour. For each criterion, potential for generation is rated according to risk. Flowcharts (Figures 1 and 2) rate the risk as either high (h) or low (l). The proposed facility is consequently rated as posing an L (leachate) L–h or L–l and an O (odour) O–h or O–l environmental risk.

The rating of a proposed facility should be used as a basis for the choice and design of the Composting Works, and processes and techniques used to complement the natural setting of the proposed location and minimise negative impacts on the environment and local amenity.

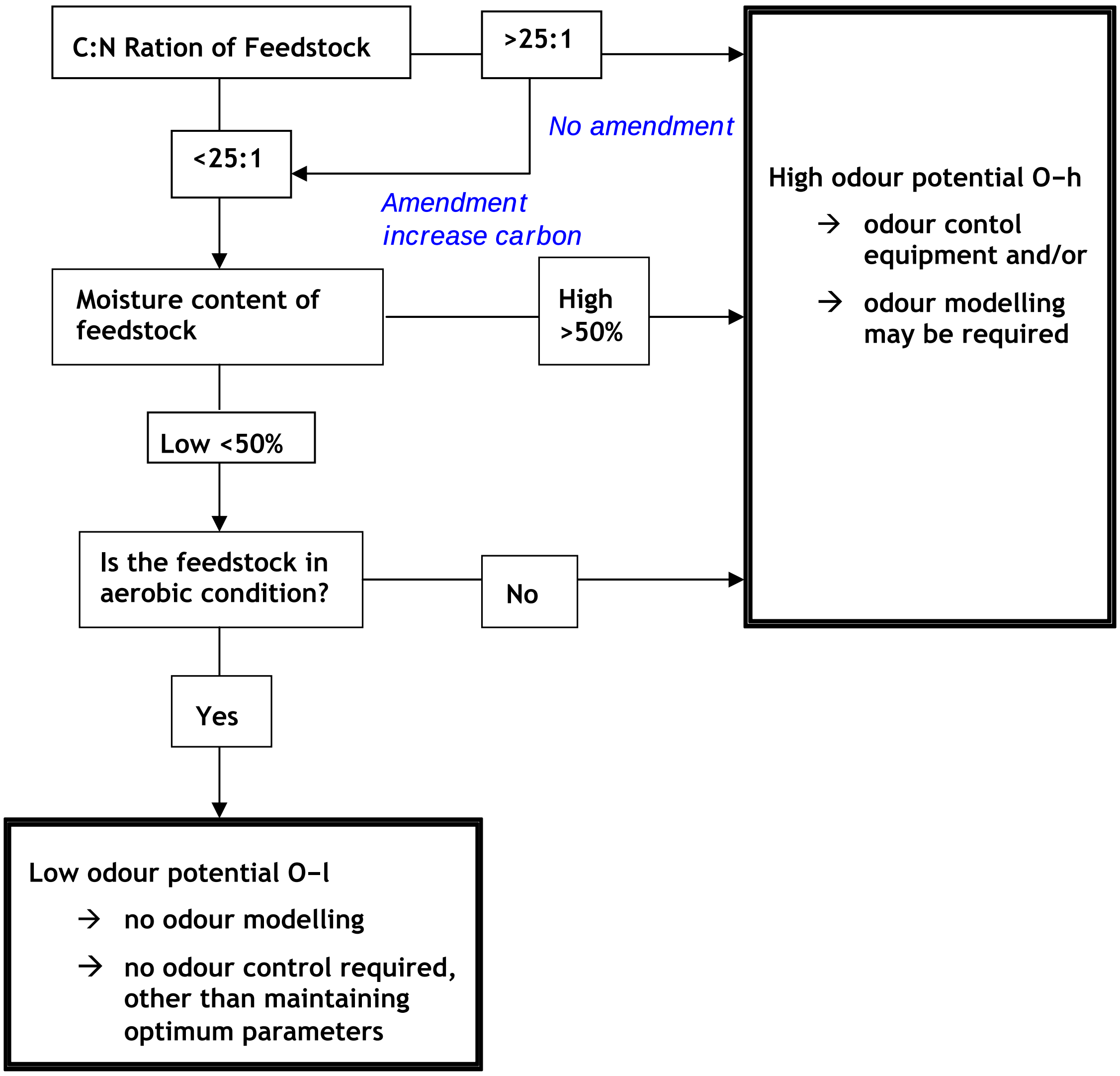
In Figure 1 there is a reference to seasonal or sporadic climate conditions for the risk of leachate generation which is intended to be a screening tool—these regions are shown in Figure 3 and are based on an assessment of the risk of leachate generation using the approach of a net water balance. This means sites that have a seasonal risk of leachate generation are those with a net positive water balance at a frequency of greater than one in five years in the wet six months of the year. That is, there has been a positive water balance in the wet six months for more than 20% of the years on record at the Bureau of Meteorology.

Preliminary net water balance = rainfall – (0.7 x Apan evaporation)—the factor of 0.7 for the Apan evaporation is based on published information for soil evaporation.



A guide to ascertaining the liner specification for construction (excludes enclosed and in-vessel)

Figure 1 Classification of Compost Works—assessment of leachate generation risk



NOTE: also refer to the *EPA Guidelines: Air pollution modelling—presentation of results* (2005a) and *Odour assessment using odour source modelling* (2006a).

Figure 2 Classification of Compost Works—assessment of odour generation risk

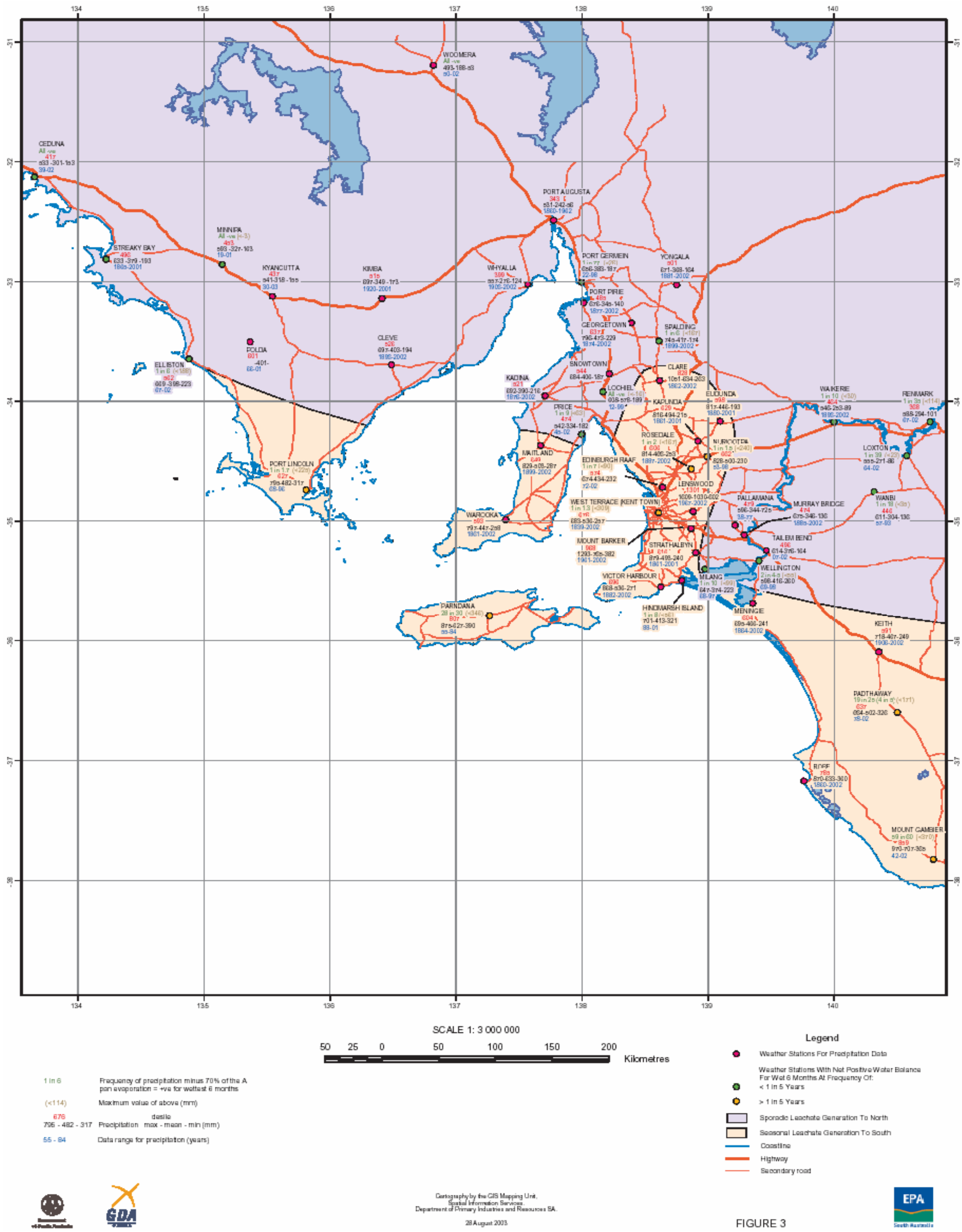


Figure 3 Potential for leachate generation based on climate conditions

2 Siting of Composting Works

The location of a Composting Works is a major factor in determining the extent to which the facility will pose an environmental risk. The aim of choosing a suitable location is to reduce the potential risks for adverse environmental impacts. Engineering and management measures will often be considered as supplementary measures to reduce adverse impacts on the environment and local amenity value.

These guidelines address the siting issues and criteria for the preliminary site investigation. It is highly advisable that communication and consultation with the EPA (and the planning authority) is commenced in the initial stage of planning.

Objectives

The objectives of a site environmental assessment in the preliminary design of a Composting Works are to:

- take into consideration existing environmental conditions
- determine the suitability of the site for composting, considering potential impacts to the surrounding environment
- recognise the constraints and opportunities of the site to minimise environmental impacts and protect the local amenity value
- identify and avoid potential conflicts with surrounding land uses
- enable identification of appropriate design, controls and processes suitable for the locality.

Waste Management Plan

Siting of Composting Works should consider aspects of any relevant Regional Waste Management Plan and (if applicable) industry management plans. This includes the waste hierarchy, waste generation rates, waste minimisation initiatives, capacity of the Composting Works, and collection and pre-treatment strategies.

Community consultation

Assessment of potential composting sites will need to consider the concerns of the host community. This will allow information sharing and early identification of issues of interest that can be considered in the siting process. The program of community participation can be continued for subsequent phases of the project.

Guidance for considering the concerns of the host community is presented in the *EPA Guidelines: community consultation for waste management and recycling facilities* (2003a).

Separation distances

Good design, good construction and good management are essential to minimise off-site impacts. Separation distances provide a buffer between the Composting Works and sensitive receptors and land uses, and act as a secondary control of potential adverse impacts. Appropriate site management practices during the development, operational stages and decommissioning of Composting Works will also be required to protect sensitive receptors and land uses.

It is advisable that the separation distance between the composting operations area and sensitive receptors and land uses should be owned or leased by the Composting Works operator to prevent future encroachment of incompatible activities and land uses. The separation distance needs to be maintained for the entire duration of the site's operation and rehabilitation. The operator may not necessarily need to own the land comprising the buffer zone, but may negotiate an agreement to avoid encroachment by incompatible land uses. The local planning authority has a role to play by also ensuring compatible surrounding land uses and avoiding encroachment.

The buffer zone may be suitable for planting vegetation as a visual screen and to assist in reducing the impacts of dust and odour on sensitive receptors.

The following minimum separation distances shall be maintained at Composting Works as measured from the closest associated compost activity to the sensitive receptor:

- 500 m to a residential development zone, rural townships and highways or arterial road networks dependent upon type and quantity of feedstocks and composting technology. For large-scale sites (ie in excess of 12,000 tpa) a one-kilometre buffer is highly desirable.
- three kilometres to an airport utilised by turbojet aircraft and 1500 m to an airport utilised by piston aircraft. Facilities that abut this buffer zone will need to demonstrate compliance with the requirements of the Civil Aviation Safety Authority.
- 500 m to areas reserved as national parks (areas of national significance in terms of their national landscape values or wildlife), conservation parks (areas with valuable wildlife or interesting natural features), recreation parks (areas managed primarily for public recreation in pleasant surroundings with some native vegetation), game reserves (areas of land and water for the conservation of native game species), forest reserves, sites of flora and fauna significance, and wilderness areas.
- 100 m to the nearest surface water, whether permanent or intermittent, including any dam, river, creek, natural watercourse (modified or not) or channel.
- 100 m to an area designated as a '100-year floodplain'.

Greater separation distances may be required based on specific conditions, such as the environmental risk of the proposed operation or the technologies and processes employed.

Further guidelines regarding separation distances can be found in the *Draft Guidelines for Separation Distances* (EPA 2000) which is currently under review.

Water resources

The principal object of the *Environment Protection (Water Quality) Policy 2003* is to achieve the sustainable management of waters by protecting or enhancing water quality while allowing economic and social development.

An assessment of the surface and groundwater conditions and management of impacts at potential Composting Works must be made by a qualified and experienced person so that the protected environmental values of the waters are, in fact, protected.

Assessment of surface water and drainage conditions

The assessment of surface water and drainage conditions should include:

- topography
- drainage paths and boundaries
- floodplains
- natural watercourses
- stream flows
- habitat conditions
- water quality
- protected environmental values
- sources of water supply and users.

Greater separation distances than those above or increased management controls may be required based on assessment of surface water conditions at the site and the potential consequences of uncontrolled discharges to surface waters.

Assessment of the hydrogeological setting

A conceptual hydrogeological model should be prepared and the assessment of the hydrogeological setting should include the following aspects:

- local and regional geology
- distribution and physical properties of aquifers
- groundwater conditions in each aquifer including: confinement, groundwater depth, groundwater flow direction and rate, aquifer thickness, saturated thickness, hydraulic conductivity, porosity and hydraulic gradient
- groundwater interaction with surface water
- groundwater quality and protected environmental values
- groundwater users in the surrounding area and other sensitive receptors
- contaminant attenuation properties of the natural subsurface conditions.

The site investigation should typically include a program of site inspection, borehole drilling, sampling and logging of sub-surface materials, groundwater well installation, testing of aquifer characteristics and groundwater sampling and testing.

The number and construction details of wells should consider the size of the Composting Works, the risk of contamination and the hydrogeological setting. As a minimum, one well should be located 'up-hydraulic' gradient of the facility and two wells located 'down-hydraulic' gradient. The location of groundwater wells should consider establishing the baseline groundwater conditions in the local area and their ongoing utilisation as monitoring wells during operation of the facility and for post-decommissioning monitoring. This would be required for sites processing more than of 12,000 tpa of feedstock or where environmental assessment deems there is a risk of potential impact.

The Department of Water, Land and Biodiversity Conservation (DWBLC) has guidelines, regulations and a permit system for installation of groundwater monitoring wells and should be contacted in this regard. DWBLC also has groundwater information from bores that may be in the vicinity of a proposed site.

Composting Works should not be located in an area where there is less than two metres of suitable sub-grade between the base of the engineered liner and any maximum-observed seasonal or permanent groundwater table. Greater vertical separation distances may be required by the EPA based on site-specific conditions and the risk of impact on the protected environmental values of groundwater.

Composting Works are not encouraged in areas of karstic terrain, in areas with groundwater springs or seeps, areas of sensitive groundwater values or groundwater protection zones. Sites proposed in these areas will require significant engineering and management controls to protect the environmental values of waters.

Preferred sites for Composting Works are those that reduce the risk of impact on the environmental values of groundwater by providing a natural, unsaturated attenuation zone beneath the base liner for contaminants that may infiltrate through the liner.

Natural unsaturated zones that retard flow of water from infiltration through the liner are preferred. For example, sites with clay soils that have low permeability and natural attenuation properties are preferred to those with sandy soils.

Conservation and recreation zones

Aboriginal and heritage issues

Composting Works siting must consider the effect on any Aboriginal sites of archaeological, anthropological or other significance, including any sites listed in the Register of the National Estate and the SA Register of Aboriginal Sites and Objects, or identified after consultation with Aboriginal councils or groups.

Reserves for environment protection

Composting Works are not permitted in areas with:

- national parks, ie areas judged to be of national significance in terms of their national landscape values or wildlife
- conservation parks, ie areas with valuable wildlife or interesting natural features
- recreation parks, ie areas managed primarily for public recreation in pleasant surroundings with some native vegetation
- game reserves, ie areas of land and water for the conservation of native game species

- forest reserves
- critical habitats of organisms and communities of flora and fauna of environmental significance
- a potential significant impact on threatened species and ecological communities as identified in the federal *Environmental Protection and Biodiversity Conservation Act 1999*, except with the approval of the Commonwealth Environment Minister. Items falling in this category will require a separate assessment in addition to that required by the South Australian EPA
- other protected areas for flora and fauna listed in state and federal regulations.

Screening and siting of facilities, and management strategies, should consider potential impacts on flora and fauna from the clearing of vegetation, modification of surface water conditions or other aspects of the Composting Works development. Potential impacts include loss of habitat, displacement of fauna, loss of biodiversity, spread of plant diseases and weeds, litter, creation of new habitats for scavenger or predatory species, and erosion.

Where clearance of native vegetation is proposed, relevant legislation will need to be complied with and consultation with the Department for Environment and Heritage‘s Native Vegetation Branch is recommended.

Unstable areas

Composting Works should not be located in areas susceptible to ground movements that may adversely impact on the integrity of the facility and engineering systems such as the liners, leachate collection system, odour management system, and composting gas collection system.

Consideration must be given to existing conditions or potential changes to site conditions from progressive development of the facility that may impact on stability, including topography, surcharge loads, drainage and surface water.

Potential unstable areas include those susceptible to ground movements due to the following:

- landslides or other ground movements associated with slopes
- seismic (earthquake) events that cause displacement at fault lines or in zones of liquefaction
- excessive differential or total settlement from uncontrolled fill, collapse of low density soils or consolidation of compressible soils, and/or
- collapse of voids or settlement of low strength zones associated with karstic terrain or former mining operations.

Amenity

Odour and biogas generation and impact assessment

A preliminary assessment of potential odours and greenhouse gas generation should be conducted as part of the site selection criteria with a view to reducing the impact on the environment and local amenity. This will need to consider the quantity, stockpile geometry, composition, moisture condition and nature and age of the feedstock as well as the composting processes.

Potential generation rates can be estimated using odour source models such as AUSPLUME. Further guidance on odour assessment is available in the *EPA Guideline: Odour Assessment using odour source modelling* (2006a).

These assessments will need to consider, in particular, the climate and wind conditions at the site (especially prevailing wind directions) with respect to the location and proximity of the facility to residences, buildings and other potential receptors.

Dust and litter

Potential for off-site migration of dust and litter should also be addressed, taking into consideration prevailing wind conditions, topography and proposed operations.

Vehicle traffic

Consideration should be given to potential impacts on the amenity value surrounding the site from vehicle traffic on the access road to the site and movement within the site.

Infrastructure

Infrastructure will be needed to operate any Composting Works, and screening (including fencing and vegetated mounds) and siting of infrastructure will need to consider the following:

- capacity and safety of access roads for anticipated vehicle traffic
- water supply for composting processes, fire fighting, potable use and other site purposes
- power and sewage disposal facilities.

3 Incoming feedstock management

From generation to reuse as a compost or mulch product, various types of feedstocks pose a potential threat to the environment if handled improperly. They can generate polluting leachate, odours, biogases, pathogens, litter and dust. This section outlines some key physical and chemical characteristics of incoming feedstocks and how these characteristics may affect the choice and environmental performance of composting processes and products. Additionally, it provides guidance concerning pre-composting treatments and specific processes.

Note: Composting Works' operators wishing to incorporate industrial wastes into their composting process or to blend in post-composting must first seek approval and provide sufficient detailed documentation to demonstrate that these wastes are 'fit for purpose'. Application for each specific waste and reuse proposal must be made to the EPA for consideration and approval prior to receiving that waste.

Objectives

The objectives of the guideline for incoming feedstock management are to:

- select incoming feedstocks to achieve minimal negative impact on the environment
- minimise negative impacts of composting processes on the environment
- ensure the nature and volumes of the feedstocks proposed for the facility are appropriate to the proposed composting technique, site selection, facility design, operations, type of equipment, and pollution control technology
- instigate quality assurance procedures during and after processing to ensure quality final product is sold.

Incoming feedstock quality and selection

The nature, quality and quantity of incoming feedstock are major factors in determining the extent to which a given composting system at a site may adversely impact on the environment.

Optimum parameters of the feedstocks should be maintained relative to the composting system being used and these are well documented in numerous books published on the topic and such good websites as ROU Library (University of NSW) <www.rolibrary.com>.

The physical and chemical characteristics of feedstocks influence the suitability and performance of the selected composting process. These characteristics include carbon to nitrogen ratio (C:N), pH, moisture content, structural stability, porosity and level of contamination. In particular, characteristics of the feedstock affect the following:

- method, frequency and volume of collection (eg longer storage periods of feedstock at the source may result in malodours and leachate from feedstocks in an advanced stage of decomposition)

- level of impurities in final product, depending on process controls
- duration and method of storage and blending prior to processing
- process control and operational measures during composting.

Carbon to nitrogen ratio (C:N)

One parameter that is very often overlooked is the carbon to nitrogen (C:N) ratio. All feedstocks must have their C:N ratio determined and this will form the basis of calculating the 'recipe' needed for mixing all the feedstocks to reach an optimum C:N averaging about 30:1 at the start of the composting process. Odour control equipment may need to be considered to reduce generation of odorous gases from feedstocks of low C:N ratio (<25:1). Sites should maintain a C:N ratio between 25:1 and 40:1 at the start of the decomposition and final product should be between 10:1 and 20:1.

Acceptability of feedstocks and contamination

All incoming feedstocks must be assessed, weighed and documented at the point of arrival on site to assist in making decisions about how and when to process the material based on environmental considerations such as odours and leachate. This will ensure traceability of the end-product and that the capacity of the site is not exceeded by enabling mass balance and materials flow calculations to be made. These records will also constitute a reference document for operators to apply source screening and develop clear procedures describing the level of on-site contaminant control and removal required prior to size reduction and further processing. These contaminant control procedures need to address the following:

- type of feedstock and risk of contaminants
- potential for removal of contaminant after composting
- environmental requirements such as odour, dust, litter and leachate control
- quality assurance and quality control requirements for incoming feedstock and outgoing product standards
- unacceptable and rejected loads (to prevent receiving such loads again).

Contaminant removal methods depend on the type of contaminants present:

- source screening is the best option for high risk feedstock containing high levels of heavy metals and chemical residues, which do not break down during the composting process. Facilities must not receive the following categories of incoming waste:
  - materials seized by the Australian Quarantine Inspection Service or PIRSA, or agricultural agencies from other states or territories
  - any organic wastes containing contaminants classified as hazardous wastes or industrial and listed wastes in any statutory instruments. See the Act, Schedule 1, and *Draft Hazardous Waste Strategy* (EPA 2005b)
  - organic waste contaminated by industrial chemicals and/or pathogens that will not be rendered harmless by the process or that may constitute a health or environmental risk in their ultimate use, including clinical waste and other related wastes of clinical origin, and diseased carcasses

  - painted timber or wood waste treated with copper chromium arsenate or creosote.

- manual or mechanical sorting is required for the removal of physical contaminants such as litter, plastic, glass and stones
- control of thermal conditions throughout the composting process is required to eliminate pathogens, weeds and seeds from feedstock and to reduce risk of combustion
- feedstock, oversized materials, screened contaminants and finished products must be stored in separate designated areas to avoid cross-contamination

Types of waste

Liquids

Incoming feedstocks that are defined as liquid should be received in concrete pits, with continuous seams, to assist in blending of these feedstocks to correct the moisture content, C:N ratio and porosity. Equipment must to be able to manoeuvre, blend and process the feedstocks to contain the liquid. An adequate amount of other feedstocks should be added to the liquid so that no leachate is created.

All incoming liquids must have a sampling regime which includes frequency of sampling and a list of analytes to be tested to ascertain that the liquid is fit for the purpose of composting. This regime must be submitted to the EPA for approval prior to liquid waste being accepted at the site.

Carcasses

Carcasses must be placed in bunkers that contain a bedding of highly absorbent material, eg sawdust, to absorb any leachate that is created. The carcasses should be well covered to prevent scavenging and odours. Carcass composting must be kept separate from the windrowing compost area until the carcasses are composted. Carcass composting timeframes will differ from most other materials and must therefore be kept separate to prevent turning too early.

Product quality assurance

The objective of implementing a product quality control is to ensure that the product does not present an environmental hazard by its proposed use. This means the compost or mulch product must not contain contaminants or pathogens that have the potential to:

- contaminate land, or food products that grow on the land
- cause surface waters or groundwater to become contaminated because of run-off that comes in contact with the compost or mulch
- cause adverse impacts on human health.

Critical quality parameters that need to be addressed by Composting Works operators include:

- destruction of human, animal and plant pathogens
- destruction of weeds and weed seeds
- prevention of chemical (including pesticides) and metal contamination

- control of nutrient content
- control of C:N ratio
- incorporation of quality control procedures that will ensure the product is 'fit for purpose'.

Table 2 Limits of contaminants in compost for unrestricted use

Contaminant	Dry solids (mg/kg)
Arsenic	20
Cadmium	3
Chromium	50
Copper	60
Lead	150
Mercury	1
Nickel	60
Selenium	5
Zinc	200
DDT/DDD/DDE	1.0
Aldrin	0.2
Dieldrin	0.2
Chlordane	0.2
Heptachlor	0.2
HCB	0.2
Lindane	0.2
PCBs	1.0

For guidance on the treatment and application rates of biosolids, see the *South Australian Biosolids Guidelines for the Safe Handling, Reuse or Disposal of Biosolids* (EPA 1997a).

The following Australian Standards must be adopted in setting environmental goals and quality parameters for compost and mulch products:

- *AS4454—2003 Compost, Soil Conditioners and Mulches*
- *AS4419—2003 Soils for Landscaping and Garden Use*
- *AS3743—2003 Potting Mixes.*

The EPA encourages Composting Works' operators to consider gaining organic certification (eg through NASAA or BFA).

Alternative methods of composting

Vermiculture

The EPA licenses vermiculture operations in accordance with their scale in the same manner as traditional composting sites (ie if capable of producing >200 tpa of finished compost then an EPA licence is required). Vermiculture operations must comply with the guidelines specified in this document with respect to minimising potential for water, air and land pollution, and impact on local communities. Each operation will be individually assessed because these operations are usually enclosed.

Vermiculture operators must, in particular, adopt specific measures to ensure:

- screening of raw materials for high levels of physical and chemical contaminants
- separation of raw feedstock destined for vermiculture from organic material destined for other treatment processes
- minimised generation and containment of odour through containment of food organics with a low C:N ratio.

Vermiculture operations should follow the *Best Practice Guidelines for Vermiculture Systems, amendment to AS4454—2003*, to ensure the environmental quality of the final product by minimising potential for pathogen and weed propagation.

Composting of mushroom substrate

The most significant issue in producing mushroom compost is the generation of odour. This can be minimised by preventing anaerobic conditions through regular turning, forced aeration and/or fully enclosing the process.

Separation distances for any proposed mushroom farm composting operation will be based on the technologies employed, but it is recommended that a two-kilometre buffer is adequate because these Composting Works are not producing mature, stable compost but a medium for growing mushrooms. Any proposal needs to be justified by sufficient supporting information and data, which will be assessed by the EPA.

In-vessel composting

In-vessel composting systems constitute the ideal composting technology in terms of environmental controls, particularly for sites that have limited buffers or problematic feedstocks (eg high odour and moisture content). They are defined as enclosed, automated systems that provide uniform temperature and oxygen profiles throughout the contents of the vessel. They may be housed either in a building or outdoors and include control of odours and leachate through in-built collection and treatment technologies.

Management of the feedstocks and the curing product when removed from the in-vessel equipment must be considered at any facility proposing the use of this technology. These two stages of production have the greatest potential to cause environmental impact. EPA advice must be sought very early in the project if development of an in-vessel composting facility is being considered.

4 Engineering design and implementation

While the natural features of a Composting Works may afford a certain level of attenuation of some environmental impacts, large[2] Composting Works may pose a risk to the environment that requires a high level of environmental performance as a precautionary approach.

To achieve a high level of environmental performance, the engineering design of Composting Works should complement the natural features of the chosen site to minimise negative impact on the environment. This section provides guidance for the choice and design of such infrastructure. It also provides, through a Construction Quality Assurance Plan, a means of managing quality control during construction and demonstrating to the project stakeholders (owner, contractors, consultants, regulator, the general public) that the construction complies with the approved design.

Objectives

The objectives of the guideline for engineering design and implementation are to:

- ensure the infrastructure of the facility is suitable for its intended purpose, scale of operation, locality and site specific requirements
- ensure site infrastructure is designed and constructed to minimise generation and emissions of leachate, gases and odours to the environment
- plan and design site activities and infrastructures to allow for an effective groundwater, surface water and odour monitoring program
- ensure that the construction has effective quality assurance and quality controls in place
- ensure sufficient records, documentation and certification (if required) are maintained to submit a report to the EPA to demonstrate that the site complies with the requirements of the development approval
- plan and design site activities and infrastructures to facilitate decommissioning.

Required outcomes

The required outcomes of the guideline for engineering design and implementation are:

- design and construction of surface water management systems to minimise the generation of leachate

[2] Large compost facilities are those processing over 12,000 tpa of feedstocks—based on 250 tonnes per week approximately.

- design and construction of a leachate barrier and leachate drainage network. This must drain to a wastewater management system in accordance with the Environment Protection (Water Quality) Policy 2003 to prevent groundwater and surface water contamination

- design and construction of systems for effective odour control and collection of biogas if warranted

- implementation of designs that will be maintained and will continue to meet the objectives and required outcomes

- demonstration to the EPA and other project stakeholders that the materials used, construction methods and completed works comply with the approved facility design.

Key design factors

The choice of composting process, technology and design of the infrastructure for the proposed site will be determined by these key factors:

- types of materials to be processed

- method of composting

- desired processing capacity

- conclusions of the preliminary environmental assessment of the potential threat to the surrounding environment (surface water, groundwater, conservation areas, etc). Refer to *Section 2—Siting of Composting Works*

- location of proposed operation with regard to neighbouring community and potential resulting loss of amenity. Refer to Section 2

- potential leachate and odour pollution issues, as per risk classification. Refer to *Section 1 Introduction*

- other potential pollution issues (eg dust, litter).

Alternative composting activities such as vermiculture and composting of mushroom substrate are characterised by specific types of feedstock and have differing goals regarding products (ie partially composted material for mushroom substrate) and are accordingly classified as L–h/O–h activities by default. Operators proposing these types of Composting Works should consult the EPA in the early stages of the development because these may require an enclosed facility.

Suggested Measures

Liner systems for Composting Works

Table 3 Liner designs

Liner designs for working areas(1) in Composting Works to minimise groundwater contamination

NOTE: The EPA may consider equivalent performance by alternative designs if sufficient justification, site-specific detail and evidence to demonstrate equivalence are provided. Conversely, the EPA may require more stringent liner design and construction depending on site-specific circumstances.

Feedstock Capacity	Less than 12,000 tpa			Greater than 12,000 tpa		
Leachate Potential	L–l (low)			L–h (high)		
Liner(2)	**Crushed rubble**	**Clay (4)**	**Asphalt or Concrete**	**Crushed rubble**	**Clay (4)**	**Asphalt or Concrete**
Protection layer	NA	500 mm mulch or wood chips	NA	NA	500 mm mulch or wood chips	NA
Liner details (3)	300 mm compacted crushed rubble or limestone; max. particle size of 40 mm and more than 40% passing 0.075 mm sieve	300 mm compacted clay with a permeability value of 1 x 10^{-9} ms^{-1} 2 layers of 150 mm	Minimum 100 mm asphalt or concrete to withstand heavy traffic	600 mm compacted crushed rubble or limestone; max. particle size of 40 mm and more than 40% passing 0.075 mm sieve	600 mm compacted clay with a permeability value of 1 x 10^{-9} ms^{-1} 3 layers of 200 mm	Minimum 100 mm asphalt or concrete to withstand heavy traffic
Sub-base	300 mm of well compacted stabilised in situ soils or select fill	300 mm of well compacted stabilised in situ soils or select fill	300 mm of well compacted stabilised in situ soils or select fill	300 mm of well compacted stabilised in situ soils or select fill	300 mm of well compacted stabilised in situ soils or select fill	300 mm of well compacted stabilised in situ soils or select fill

(1) The working area includes the composting pad, access roads and areas where maintenance and maintenance equipment is manoeuvred. Roads should be sealed to withstand heavy traffic.

(2) Working areas should have a nominal gradient of 2–6% directed to a leachate pond.

(3) All working areas and underlying liners should be regularly maintained to ensure long-term performance and thickness of the constructed surface is not compromised.

(4) Construction work at all facilities will require Level 1 supervision if using clay liners. As Constructed Reports (ACRs) will be submitted to the EPA at the conclusion of the construction.

An alternative liner system may be evaluated by the EPA providing the developer is able to demonstrate an equivalent or better performance than the above system. Any proposed alternative system must include effective management of leachate and protection of surface and underground waters.

A site-specific assessment of environmental risks (based on the types of feedstock, and quantities accepted) to determine the level of environmental protection required and to support the proposed design, needs to be provided to the EPA by the developer. Such proposals should be discussed with the EPA prior to submission of a proposal or application.

For technical assistance for assessment of materials and methodology for construction of clay liners, refer to *Appendix 1: Technical guidance for assessment of materials and methodology for construction of clay liners*.

Minimisation of surface water and groundwater contamination

Developers of new facilities are required to calculate the potential volumes of leachate to be generated at their site and design a wastewater management system to cope with the predicted volume. The design of this system must incorporate the slope of the liner, the process water added and be designed to cater for a minimum of a 1-in-25-year 24-hour rainfall event (in areas prone to flooding, the specification may be 1-in-100-year), and justify a specific proposal that demonstrates effective management of leachate and stormwater.

It is imperative that the system is designed, constructed and regularly maintained to ensure drainage of leachate from the liner to edge drains. These edge drains must be designed so that water flows freely, does not pond and be of a sufficient capacity to carry this water without overflowing. These drains will terminate at a suitably-sized wastewater pond.

Leachate and wastewater sump

Uninterrupted drainage must lead to a leachate and wastewater sump, which must be located at the lowest point of the pad to facilitate monitoring and removal of leachate. The sump can also act as a sediment trap, which will be required to be maintained regularly to ensure continued effective operation.

Design considerations must include access for:

- monitoring
- inspection and cleaning
- leachate generation volumes
- operation of pumping equipment (including the depth and storage volume for leachate)
- connection to the leachate storage and treatment facilities
- maintenance of integrity during composting operation.

Leachate storage and treatment

Assessment of options for leachate storage and treatment will need to consider the quantity and composition of leachate. Possible treatment options include aeration and evaporation, degradation by aerobic bacteria, or chemical or physical treatment. Reuse of the leachate to increase the moisture content of the windrows is the preferred option.

Design of the leachate storage capacity will need to consider the maximum potential leachate generation, rainfall, climate conditions including storm events, process water, the risk of overtopping and treatment options. Other design considerations include maintenance procedures, stagnation, odour management and control of access. Management of leachate needs to ensure that wastewater ponds do not generate offensive odours such as those caused under anaerobic conditions. The use of aerators or other measures may need to be incorporated at the facility.

Leachate storage and treatment may be in a dedicated retention or evaporation pond separate from the composting pads. Refer to Tables 4, 5 and 6 for pond design specifications.

Operators are required to demonstrate that the junction between pad liner and sump, and/or pond liner does not allow for any leachate to be lost through infiltration or spill. Above-ground storage tanks may be used in place of ponds. If tanks are to be used, similar sizing and monitoring considerations need to be included and the tanks must be stored in a bunded area that complies with *EPA Guideline: Bunding and Spill Management* (2004a), such that the capacity of the bund is at least 120% of the largest tank.

The EPA recommends that leachate, a precious water resource, is not evaporated at the facilities but instead used on-site.

Table 4 Geotechnical parameters for ponds lined with clay or geomembrane materials

	***Ponds lined with clay materials**		**Ponds lined with geomembrane materials**	
	Category 1	**Category 2**	**Category 3**	**Category 4**
Criteria	• Hydraulic head above liner ≤1 m • Lagoon capacity ≤ 2.5 mL	• Hydraulic head above liner ≤1 m • Lagoon capacity > 2.5 mL	• Hydraulic head above liner >1 m • Lagoon capacity ≤ 2.5 mL	• Hydraulic head above liner >1 m • Lagoon capacity >2.5 mL
Summary of suggested measures for the lining system	• 300 mm thick compacted clay liner with k≤1×10^{-9} m/s (minimum of 150 mm compacted thickness each layer) or 7 mm thick GCL. • If clay material is used, then the Liquid Limit (LL) of the clay ≥30% • If clay material is used, then the Plasticity Index of the clay (PI) ≥10 • Level 1 supervision • Submit an As Constructed Report to the EPA	• 600 mm thick compacted clay liner with k≤1×10^{-9} m/s (minimum of 150 mm compacted thickness each) or 7 mm thick GCL. • If clay material is used, then the Liquid Limit (LL) of the clay ≥30% • If clay material is used, then the Plasticity Index of the clay (PI) ≥10 • Level 1 supervision • Submit an As Constructed Report to the EPA	• 1 mm HDPE • Install as per manufacturer specifications • Submit an As Constructed Report to the EPA	• 1 mm HDPE • Install as per manufacturer specifications • Level 1 supervision • Submit an As Constructed Report to the EPA
Sub-grade	150 mm sub-grade preparation to provide a sound and stable base for liner construction or installation.			

* Geotechnical parameters should be determined on clay materials used during construction and results submitted to the Authority.

Synthetic materials include HDPE geomembranes and geosynthetic clay liners (GCL). Minimum properties for various geosynthetic lining materials for base liner systems provided below are reproduced from the *EPA Guidelines: Environmental management of landfill facilities (municipal solid waste and commercial and industrial general waste)* (2007).

Table 5 High Density Polyethylene (HDPE) geomembrane (smooth or textured)

Property	Value	Test method ASTM
Density	≥0.94 g/cm^3	D1505
Thickness	≥1 mm	D5994
Elongation at break (smooth liner)	≥700%	D6693
Elongation at break (textured liner)	≥100%	D6693
Elongation at yield	≥12%	D6693
Puncture resistance	≥400N	D4833
Notched content tensile test resistance	≥300 hours	D5397
Carbon black content	2-3%	D1603
Standard oxidative induction time (OIT)	>100 minutes	D3895
Oven aging at 85°C	>55%	D3895

Table 6 Geosynthetic clay liner (GCL)

Property	Value	Test method ASTM
Mass of top and bottom geotextile	>100 g/m^2	D5261
Mass of sodium bentonite, or	>3000 g/m^2	D5993
Mass of calcium bentonite	>6000 g/m^2	—
Bentonite swell index	>16 mL/2g	D5890
Peel Strength	>300 N/m	D6496

Minimisation of biogas and odour emissions

Most odour and biogas emissions can be controlled by adequate design and operation of composting processes. Measures to reduce and control hazardous and offensive emissions are:

- avoiding leachate pooling and over-saturation of the base or actual stockpiles
- ensuring windrows are aerated, either by forced aeration of static piles or timely regular turning of windrows

- monitoring of internal temperatures: elevated temperatures may indicate anaerobic conditions are occurring and present a risk of combustion
- ensuring windrows are of a manageable size so that surface-to-volume ratios are maximised for passive aeration
- adoption of enclosed composting technologies where:
  - anaerobic conditions may regularly exist due to the nature of the feedstock
  - where feedstock is highly odorous, or
  - where the operation is close to or in the prevailing wind direction of residential areas.
- designing and implementing systems for total fume capture and odour control equipment. Examples of such technologies are enclosures, bio-filters, wet scrubbers, chemical scrubbers, carbon absorption beds, afterburners, etc
- designing and implementing odour control equipment for leachate ponds (eg covers, aeration) and residual waste containers
- designing and implementing gas extraction, collection and treatment systems if warranted. Options include methane oxidation to carbon dioxide and water; by bacteria or by combustion; removal of particulates and odorous volatile gases; recirculation of air; or direct recycling by the industry for heat or electricity production. Design of these systems will need to consider:
  - optimisation of the quality and quantity of gas collected
  - the collection system between the extraction and combustion system, including pipework, vacuum source, flow control facilities, monitoring and condensate management
  - protection and maintenance of the integrity, operation and durability of system components. Considerations include corrosive gas, leachate, condensate, vandalism, stresses from surcharge loads and settlement of the feedstock
  - the risk of air intrusion and potential explosion and fire hazards
  - control of air emissions from the combustion system to comply with the *Environment Protection (Air Quality) Policy, 1994,* and reduction of volatile organic compound emissions by 98%. Design of the flare systems will need to consider retention time, temperature, ignition control and flame arresters
  - maintenance of safe working conditions with regard to air quality if negative pressure and recirculation is proposed.

Design specification, Drawings and construction quality assurance (CQA)

The objective of a CQA plan is to ensure that the construction materials used, construction methods and completed works comply with the approved Composting Works design. The CQA plan should form part of an overall Design Specification and Drawings document that must be submitted and approved by the EPA prior to commencement of any construction of works.

The successive stages of the Design Specification and CQA plan include:

- Development of a Design Specification and CQA plan prior to the start of construction that includes a program of survey, inspection, monitoring, testing, corrective action, documentation and reporting to assess compliance with the design. It should also include the design and specification requirements, CQA scope, timing, hold points, responsibility, documentation and reporting for each element of the plan. The Licensee must receive approval from the EPA for the Design Specification and CQA plan prior to commencement of construction.

- Implementation of the CQA plan to demonstrate to the EPA and other project stakeholders that the construction complies with the requirements of the approved Composting Works Design Specification and Drawings and CQA.

- Submission of the ACR for each composting pad/pond construction stage. This may include certification from an independent environmental consultant or Level 1 supervision report for clay usage (in accordance with Appendix B of *AS3798–1996 Guidelines on Earthworks for Commercial and Residential Developments*) with sufficient details and records to demonstrate that the sub-grade preparation, lining and leachate collection systems and sumps comply with the project documentation (specification and drawings and CQA). The Licensee must receive notice in writing from the EPA to indicate that the ACR has been reviewed and it is deemed acceptable to commence operation.

Roles, responsibilities and communication lines

The CQA plan should define clear roles, responsibilities and lines of communication for implementation of the plan and for contact with the EPA. A specific person or organisation must be responsible for the overall implementation of the plan.

EPA contact

The CQA plan must include notification of the EPA to provide the opportunity to monitor and inspect elements of the construction at particular 'hold points'. EPA approval of the CQA plan is required and no construction may commence prior to issue of such approval, including for sub-grade preparation and construction of the base liner, leachate collection systems and odour management systems. In addition, notice should be given at least two weeks prior to the commencement of work.

The EPA must be notified if there are changes to site conditions from those considered in the design and EPA approval in advance is required for any such proposed changes to the approved Design specification, Drawings and CQA plan.

Set-out and survey control

Set-out and survey control of the works should include the elevation reference benchmark and system, plan layout, base elevation, grades (minimum 2% towards and 1% along drainage lines), layer thicknesses, total thickness of elements and the as-built details, with all levels measured in metres according to the Australian Height Datum (mAHD).

Details of the interface between pads and where the leachate protection layer enters the leachate sump also need to be included. Survey grids should be along boundaries and changes in grades and be set at a grid spacing suitable for the project, but should be at a frequency of at least every 10 m. Surveys need to be submitted as part of the ACR to demonstrate elements of design including thickness, extent, sump area and grades. Increased survey density needs to be included for elements such as the sump. A licensed and authorised surveyor should be engaged for this aspect of the works.

Clay liner and protection layer construction

To determine suitability of soils for use in construction of the clay liner, if proposed, a site investigation is required and typically includes a program of soil sampling, inspection, logging and laboratory testing by a geotechnical professional in accordance with *AS1726–1993 Geotechnical Site Investigations*. The program typically includes sampling in surface exposures, test pits and/or boreholes. Suitability of the materials proposed for the construction needs to be established prior to their use. An inspection program must also then be employed during construction to ensure that all required parameters for construction are met.

CQA of the clay liner shall include inspection and testing by an independent Geotechnical Testing Authority (GTA) to Level 1 engagement, as outlined in Appendix B of *AS3798–1996 Guidelines on Earthworks for Commercial and Residential Developments*.

This includes inspection and testing of materials and the moisture conditioning and compaction process to assess the acceptability and uniformity of materials and workmanship, and maintenance of the integrity of completed portions of the works.

Testing includes testing of materials. The test locations and frequency should consider the size and geometry of the facility and if certain aspects require specific attention (for example protrusions, connections, sumps, etc). Typically, field density and reference compaction testing should be carried out at a frequency of one test per 1000 m^2/layer with additional tests being carried out in areas requiring specific attention.

Laboratory testing needs to be conducted by a National Association of Testing Authorities (NATA) accredited laboratory and needs to include particle size distribution and Atterberg Limits, field density testing (AS1289 5.8.1) and reference compaction testing (AS1289 5.1.1 or AS1289 5.7.1). Table 8.1 AS3798–1996 provides guidance on the frequency of field density and compaction testing (dry density ratio of greater than 95% relative to AS compactive effort (AS1289 5.1.1).

Inspection should be conducted of the method of bonding between layers of the clay liner. This should consider surface and moisture conditions at the interface between layers.

The GTA should progressively provide feedback to the project stakeholders, including the EPA, on the results of the inspection and testing program, and the compliance of the clay liner construction with the project documentation and corrective action.

Testing of the hydraulic conductivity of the completed liner can be done by laboratory testing of undisturbed samples of the liner in accordance with AS1289 6.7.1–1999 or by field testing in accordance with Table 8.1 AS 3798–1996. The minimum testing requirements are dependent on the scale of the construction works. Typically, a minimum of three tests per hectare is required. The sample size and test method should consider the particle size distribution of the materials tested.

Refer to *Appendix 3: Technical guidance for assessment of materials and methodology for construction of clay liners*.

Leachate collection system, sump and storage/evaporation pond

CQA design and construction of the protection layer and sump as part of the leachate collection system will need to consider:

- grades to and along drainage lines
- junction between pad liner and sump, and evaporation pond liner

- manufacture, type, delivery, storage, handling, layout, bedding, connection and integrity of leachate collection pipes
- the sump geometry and connection to the leachate protection layer
- the integrity of the underlying liner system.

Odour management system

CQA of the odour control device (if any) will need to include documentation demonstrating compliance with the approved design, as well as with the manufacturer's design and installation specifications. Post-installation control inspection or a commissioning trial may be undertaken to verify compliance.

ACR/CQA report

An As Constructed Report must be prepared that demonstrates to the EPA and other project stakeholders that the construction complies with the requirements of the composting operation Design Specification, Drawing and CQA Plan. It should include:

- the results of the program of survey
- inspection
- as constructed drawings
- monitoring, testing and corrective actions.

Composting activities cannot commence until the EPA has reviewed and advised the proponent in writing that operation of the relevant part of the facility may commence and a licence is issued.

5 Site layout and operation

Careful planning of the site development and layout of a Composting Works is important to facilitate and coordinate site activities, manage health and safety and minimise potential impacts on the environment and local amenity. This guideline presents the objectives and required outcomes for the layout and staged development of these facilities. It also includes suggested practical measures aimed at achieving a consistently high level of environmental performance.

Objectives

The objectives of planning the site layout, progressive development and operations are to:

- minimise impacts on the environment
- minimise health and safety risks for the site personnel and the general public
- minimise potential impacts on local amenity
- coordinate site activities and make efficient use of on-site resources to create a quality product.

Required outcomes

The required outcomes from planning the site layout, progressive development and operation are:

- protection of the environment
- promotion of efficient and effective site management
- promotion of operational procedures to minimise the potential impact of odours, noise, dust and litter on local amenity, including visual amenity
- minimisation of public and unauthorised access to the site for health and safety reasons and to avoid contamination of feedstock
- to ensure that site operation and materials flow are within the capacity of the site infrastructure
- promotion of operational procedures to facilitate feedstock screening and minimise contamination of feedstock and product
- facilitatation of monitoring of potential risks to the environment
- facilitation of decommissioning and rehabilitation of facilities. The requirements for this monitoring will be determined on a site-specific basis
- to ensure prompt and efficient emergency response to fire outbreaks or any other health and safety issues.

Suggested measures

The following measures are suggested for achieving the objectives and required outcomes for the site layout and operation:

Features

Incorporate screening, mounding and landscaping to protect local amenity and manage drainage of surface water, including diversion of clean stormwater and containment of potentially contaminated stormwater and leachate.

Layout

- Comply with the following recommended internal separation distances: 15 m between any active compost pile, curing, processing and storage areas and the property boundary, of which the 10 m closest to the boundary must be reserved for natural or landscape screening (berms or vegetative screens).
- Plan the layout of the stockpiles or windrows to ensure free drainage of leachate run-off to the sump and drainage system.
- Provide a feedstock drop-off and sorting area to control access to the facility and prevent cross contamination of feedstocks and finished products.
- Provide designated areas and containers for the temporary storage and timely removal of any rejected material or residual waste from the composting process to an EPA-licensed depot for disposal to avoid feedstock contamination.
- Consider local wind conditions, especially prevailing winds, when planning layout, screening mounds and litter management.
- Signpost the traffic flow, drop-off areas and sorting areas, etc within the site, as well as potential hazards. Comprehensive information regarding site operations, and emergency procedures should also be displayed on a sign at each entrance. Licensing information must be displayed at the entrance.

Infrastructure

- The primary access road must be of a hard surface. All access and internal roads must be constructed and maintained to allow all-weather access and be kept clean at all times.
- Install wheel-washing and rumble-bar infrastructure to prevent dust and mud drag out on to public roads, for sites processing more than 12,000 tpa.
- Provide an equipment and vehicle cleaning area to avoid dispersal of litter, mud and weeds. Refer to *EPA Guidelines: Bunding and spill management* (2004a) and *EPA Stormwater management for washbays* (2004b). Wastewater from cleaning and wheel-washing operations must be treated and managed as leachate.
- Control site access with perimeter fencing and lockable gates.
- Install and operate a gatehouse at the site entrance to control site access, to record and screen the incoming feedstock and to facilitate payment of fees. The gatehouse may incorporate a weighbridge.

- Locate site facilities in consideration of site access roads and the availability of water, power and other services.

- Plan the site infrastructures so that site access, noisy and dusty operations and equipment are as far away as possible from residential developments and other sensitive receptors.

- Consider potential adverse impacts on amenity and consider fully-enclosed buildings, particularly for noisy and/or odorous operations (and to minimise leachate generation), and consider other measures such as screenings and mounds.

- Provide an adequate fire-fighting capacity, including a fire management plan that addresses procedures, contingency plans, maintenance of equipment, EPA and Emergency Services notification, and staff training. A fire report must be submitted at the time of seeking development approval—contact the Senior Fire Safety Officer MFS on 8204 3611.

Feedstock management

- Plan and operate the depot as a series of activity areas to avoid cross-contamination of feedstock and finished products and to simplify operations.

- Plan the materials flow into, around and from the site, so that the volumes of material on site at any one time do not exceed the capacity of the site or increase the risk of adverse impacts from large stockpile sizes.

- Plan the dimensions of the stockpiles or windrows to:

  - minimise the potential for anaerobic conditions and elevated internal temperatures to develop (creating increased fire risk)

  - reduce risk of dust and odour emissions.

  (It is acknowledged that dimensions are calculated based on different factors—whatever is proposed will need justification, for example based on the method of turning windrows.)

- Incorporate regular (daily) internal temperature and moisture monitoring of stockpiles to provide opportunity for early warning and action to prevent internal combustion and malodours from anaerobic conditions.

- Minimise production and emission of waste through reuse and recycling of wastewater, heat, biogas and off-specification products.

- Ensure adequate product control such as relevant Australian Standards, in accordance with current standards and with regard to the intended use of the product, to ensure the environment protected.

Staff and training

- Hours of operation must conform to requirements defined in Development Approval and EPA licence and CEMP for the facility. Planning of operational hours must give consideration to potential adverse impacts on local residents and other sensitive receptors from aspects of the operation, including external night lighting, noise emissions, dust and odour.

- Ensure staff are adequately trained and qualified to manage the site and compost operation in an environmentally responsible and safe manner and in compliance with all provisions of the facility’s EPA licence and CEMP.

- Promote clear roles, responsibilities and lines of communication to achieve a high level of environmental performance.

Composting Works must be designed and operated with regard for the safety and health of patrons and employees and in particular the hazard identification and risk assessment requirements of the *Occupational Health, Safety and Welfare Regulations, 1995*. It is recommended operators consult SafeWork SA.

Monitoring

- Implement effective and continual documentation and reporting at all stages of the composting process including environmental monitoring. Consideration should be given to establishing an Environmental Management System (EMS) ISO14000 series.

- Implement environmental monitoring on- and off-site—as described in *Section 6 Environmental Management and Monitoring*.

6 Environmental management and monitoring

This section deals with the main environmental management issues encountered when planning and operating a Composting Works. It presents specific objectives and management strategies regarding potential hazards to the environment, site safety, human health and local amenity. The issues of monitoring and safeguarding surface and groundwater quality from wastewater contamination, management of odorous emissions, dust, litter and vectors are particularly crucial.

Objectives

The objectives of environmental management and monitoring are to:

- minimise generation of leachate
- manage leachate to avoid contamination of surface water, groundwater and soil
- minimise release of odours and biogases
- monitor to ensure any impacts from the activity on the environment may be detected and promptly managed
- prevent off-site migration of unpleasant odours, dust and litter
- avoid excessive noise levels and manage the timing of noise incidents
- minimise and manage the presence of vermin and vectors
- minimise and manage potential airborne pathogens and contaminants
- provide quality products that are 'fit for purpose' and to an Australian Standard.

Water quality protection

Water management strategies aim to safeguard the protected environmental values of surface water and groundwater in accordance with the Environment Protection (Water Quality) Policy 2003, and in particular section 4.2.24 of the Policy that states that Composting Works must incorporate a wastewater management system that effectively manages wastewater generated at the site.

The management strategy will depend on the adopted composting technology as well as on-site hydrological and hydrogeological assessment. The level of risk that the Composting Works poses to the environment and local amenity should be used to determine appropriate water management strategies. In this context, development of water management strategies will need to consider:

- site conditions
- local hydrology and hydrogeology

- safeguarding the protected water quality values of surface water and groundwater from potential impacts associated with off-site migration of contaminated stormwater, sediment and leachate
- controlling the separation of stormwater and leachate in accordance with the Environment Protection (Water Quality) Policy 2003
- water requirements for site operations, including fire fighting, dust management, irrigation and construction and operation of the facility.

Stormwater management

Surface and stormwater can be polluted by sediment or contaminants in uncontrolled stormwater flows. Appropriate stormwater controls must be employed around the site to minimise adverse off-site impacts.

Stormwater management strategies must include:

- management of surface water on-site and control of off-site stormwater discharge
- diversion of clean stormwater away from areas used for storing feedstock or active and cured compost stockpiles using drainage features and boundaries
- erosion and sediment control along drainage lines, disturbed areas and soil stockpiles. This includes stormwater flow control, vegetation, retention ponds, minimisation of land disturbance and other temporary and permanent erosion protection measures
- containment and management of potentially contaminated stormwater and leachate.

Management strategies and design criteria for storm events should consider potential receptors and the consequences of uncontrolled stormwater discharge. Design criteria for the stormwater management system must consider the 1-in-25-year Average Recurrence Interval (ARI), 24-hour duration storm event for design of drainage features and the 1-in-100-year ARI storm event to assess the risk of catastrophic events such as failure of retention ponds or flooding of the compost area or sensitive facilities or receptors.

If required, stormwater retention ponds (for stormwater not contaminated by contact with leachate) should incorporate erosion and flow control measures including erosion resistant banks, baffles and spillways. Roof run-off should be collected and may be stored in tanks for later reuse.

Further information on stormwater is available in *Stormwater pollution prevention code of practice for local, state and federal government* (EPA 1997b) and *Stormwater pollution prevention code of practice for the building and construction industry* (EPA 1999).

Leachate management

Strategies to manage leachate must include:

- potential for generation and composition of leachate during operation and the required capacity for containment of maximum likely volumes of leachate, including sufficient freeboard and contingency
- suitable drainage conditions across the liner to avoid ponding of leachate

- design and implementation of an appropriate leachate containment and collection system for the composting pads
- safeguarding the protected environmental values of surface water and groundwater
- potential emission of offensive odours from leachate sumps and storage ponds
- health and safety and minimising human contact with the leachate.

Assessment of the potential to generate leachate may be carried out by water balance modelling, followed by monitoring of leachate composition. Detailed daily time-step water balance modelling considers precipitation, surface evaporation, surface run-off, process water, water in feedstock and leachate collection pond capacity.

The modelling considers climate conditions, 1-in-25-year 24-hour storm events, operation size and geographical location, feedstock composition and leachate collection system. Water balance modelling will need to consider uncertainties and limitations involved with the input data and the model, and the worst case scenario that all water falling on to compost pads is leachate that will run off and require containment. Modelling results should be validated with site records from leachate monitoring.

Assessment of the potential impact of leachate on groundwater needs to consider the potential infiltration of leachate through the liner of the compost pad and any leachate ponds (based on the assessment of the hydrogeological setting). This assessment will also need to consider the potential concentration and mobility of contaminants in the leachate and the safeguarding of the protected environmental values of groundwater and surface water. At operating depots, the assessment should also consider the results of the leachate monitoring and groundwater monitoring programs.

Guidance for the design of leachate containment, collection and treatment systems as part of a water management strategy are presented in *Section 4 Engineering Design and Implementation*.

Surface and groundwater monitoring

For sites processing more than 12,000 tpa of feedstocks, a monitoring program regarding groundwater and surface water quality must be submitted for approval by the EPA as part of the CEMP. The program should include monitoring locations, sampling protocols and frequency.

The monitoring program should be developed at the early stages of the preliminary site hydrological and hydrogeological assessment, based on the site-specific conditions, and be integrated in such decisions as the number and location of groundwater monitoring wells (refer to *Section 2 Siting of Composting Works*). As a minimum, one well must be located 'up-hydraulic' gradient of the facility and two wells located 'down-hydraulic' gradient.

Water quality analyses conducted on collected samples need to take into account the composition of incoming feedstocks and the contaminants commonly associated with Composting Works.

The pollution contingency plan should identify all reasonably foreseeable emergencies with potential to result in groundwater or surface water pollution, such as leachate leakage or spills, and should describe appropriate responses to minimise adverse effects on the surrounding environment and future recurrences.

The EPA offers guidance on groundwater and wastewater monitoring in the *Draft EPA Guidelines Regulatory monitoring and testing—water and wastewater sampling* (2006b), and *Regulatory monitoring and testing—groundwater sampling* (2006c).

Air quality protection

Air quality management strategies for identifying and managing potential hazards including odours, biogas, pathogens and dust, and minimising their adverse environmental impacts and the potential loss of amenity that they induce, need to be developed in accordance with the *Environment Protection (Air Quality) Policy 1994.*

Strategies need to consider both the operational and post-decommissioning stages of the facility. The EPA offers guidance on air quality management strategies in the *EPA Guideline: Air quality impact assessment using design ground level pollutant concentrations (DGLCs)* (2003b).

Odour management

Odorous emissions are regulated by the Act, Section 25 *'the General Environment Duty'* and Section 82 *'Offence of Causing Environmental Nuisance'*. The EPA odour assessment is based on the *EPA Guideline: Odour Assessment using odour source modelling* (2006a).

Suggested measures to minimise odorous emissions and loss of amenity include:

- ensuring control of the composting process, particularly feedstock moisture content, C:N ratio, pH, internal stockpile temperature, adequacy of aeration, and windrow dimensions and porosity. Measures include:
    - feedstock moisture and temperature control
    - analysis, sorting, screening and calculating 'recipe' mixes for all incoming feedstock
    - minimisation of uncontrolled anaerobic decomposition by appropriately timed turning and dimensions of stockpiles
    - incorporation of feedstock into active composting processes to minimise storage times.
- planning the facility to contain odorous areas and processes in accordance with the facility's rating for odour risk. This must be done through choice and design of composting process technology and odour control equipment with a high environmental performance (refer to *Section 4 Engineering design and implementation)*
- monitoring emissions to assess odour impact on local amenity, the performance of the management strategy and measures and items for improvement. This includes continuing community consultation, surveys and complaint history. The monitoring program should be included in the Composting Works' CEMP and should include frequency, scope, quality assurance procedures, documentation and recommendations for corrective actions, improvement and management review; and
- odour modelling that may assist in estimating the odour impact on amenity in the operational stage of the facility and should be used as part of site selection (refer to *Section 2 Siting of Composting Works)*. The EPA offers some guidance on this topic in the *EPA Guideline: Odour assessment using odour source modelling* (2006a). For an operational depot that is receiving a log of complaints, odour sampling and modelling may be required to demonstrate suitability of process and controls.

Biogas management

Anaerobic biodegradation of organic waste generates large quantities of greenhouse gases including methane and carbon dioxide, as well as odorous trace volatile organic compounds (VOCs).

Considerations and control factors for limiting biogas emissions from composting operations include:

- composting process control, particularly adequacy of feedstock aeration and minimisation of uncontrolled anaerobic decomposition
- containment of anaerobic processes through technologies for biogas collection and methane oxidation or recycling (refer to *Section 4 Engineering Design and Implementation*)
- monitoring to assess potential hazards, fugitive emissions, the performance of the management strategy and measures for improvement. The monitoring program should feature in the CEMP and should include the frequency, scope, quality assurance procedures, documentation and recommendations for corrective actions, improvement and management review.

Dust and other air quality issues management

Dust created within the Composting Works property must be managed on-site to prevent off-site and on-site impacts, including environmental nuisance. Other air quality issues include the management of wind-blown litter, airborne impurities, pathogens and toxins that might pose health risks to the environment or neighbouring community.

Areas susceptible to generation of dust and airborne impurities include areas of land disturbance, vehicle traffic, feedstocks with low moisture content, processing areas and soil stockpiles.

Suggested measures to manage them include:

- wind abatement systems, including vegetation or embankments
- enclosing or otherwise covering feedstock or windrows with high odour, litter and dust potential
- enclosure of activities including receival, sorting, screening and processing areas
- covering of all vehicles—a person who transports waste and products on or in a vehicle must take all reasonable and practicable steps to cover, contain or secure the waste or products to ensure that it/they remain/s on or in the vehicle throughout the course of transportation
- control of traffic movements on designated roadways
- restricting vehicle speeds on unsealed roads within the site to a maximum 25 km/h
- placement of compacted quarry granular materials and sealing regularly used roads. Refer to *Section 4 Engineering design and implementation*
- limiting the extent of disturbed areas and soil stockpiles, providing suitable orientation and shelter (with respect to prevailing wind directions) such as with enclosures, mounds or vegetation screens
- use of water or other dust suppressants on roads and use of leachate on windrows
- minimising litter migration through fences and vegetation screens

- monitoring to assess dust impact on local amenity, performance of the management strategy and measures and items for improvement. This includes continuing community consultation and surveys, complaint history, etc The monitoring program should be included in the CEMP and should include the frequency, scope, quality assurance procedures, documentation and recommendations for corrective actions, improvement and management review

- limit operations when climatic conditions result in or are likely to result in adverse off-site dust impacts.

Noise

Noise emission levels are regulated by the *Environment Protection (Industrial Noise) Policy 1994.* Site selection, operation and layout of the Composting Works must incorporate assessment of and controls for potential noise sources and minimise emissions.

Factors that influence the emission and perception of noise include:

- site meteorological and topographical characteristics

- surrounding land uses

- loudness, tone, pitch, duration and frequency of noise emission.

Measures to minimise negative impact on local amenity and health and safety of personnel include:

- providing suitable buffer distances around the facility and engineering or management controls for specific noise sources

- operating hours to be suited to the surrounding land use

- identifying noise specifications on equipment and selecting low noise plant and equipment where possible

- monitoring to assess noise impact on local amenity, performance of the management strategy and measures and items for improvement.

Meteorological monitoring

Site meteorological conditions influence the environmental performance of Composting Works (and the quality of the compost products), regarding potential hazards such as leachate generation, odour and biogas generation and dispersion, noise, dust and off-site migration of vectors etc Meteorological monitoring helps to facilitate appropriate management of the Composting Works and minimise the impact on the environment by undertaking only activities suitable for the given climatic conditions.

Major meteorological factors for monitoring include:

- rainfall and evaporation that will impact on feedstock moisture content controlling both leachate and odour generation rates. Also relevant for stormwater generation and required infrastructure

- temperature: odour generation can be greater in high temperature conditions, particularly with certain types of feedstock such as manures

- winds: wind speed and direction determines the transport and dispersion of odours, biogas, litter and dust and may influence evaporation from stockpiles. Stockpiles should be oriented with the predominant wind direction where possible.

On-site weather stations should be considered for larger sites or where there is no weather station nearby to provide local conditions. A weather station would also assist in reporting the conditions on-site at any time a complaint is lodged.

Other environmental issues

Vectors

Vectors are animals, insects, or other organisms or carriers that carry weeds, organic materials and pathogens and need to be controlled for public health or aesthetic reasons. Control programs are based on prevention and eradication through the following measures:

- good housekeeping practices such as frequent removal of waste contaminants, regular cleaning and maintenance of tipping areas, conveyor transfer points, stormwater and leachate ponds and sumps
- prevention of water pooling and stagnating
- control and minimisation of dust, to reduce the migration of certain pathogens
- preventing access of vectors to rapidly biodegradable materials, through enclosure and appropriate storage conditions
- ensuring appropriate feedstock management, including frequent turning and mixing and minimised storage times
- covering or enclosing feedstock, active and final product compost.

Weeds

The final product (whether compost or mulch) must be pasteurised and free of viable weed sources because this may affect the credibility of the business and the industry as a whole. Product should undergo a stabilisation procedure to destroy weed seeds and any propagable shoots to meet AS4454-2003. Feedstocks in the composting process should reach and maintain internal temperatures of 55^{o} C for three consecutive days and be subjected to a minimum of three turns or an alternative, as described in AS4454–2003.

Litter

Litter generation and off-site migration must be minimised through selection of quality feedstocks, rejection of highly contaminated feedstocks, and litter control and collection programs in and around the facility, including all fences and approach roads. Suggested measures to prevent unsightly conditions on-site and migration of litter beyond the premises boundaries include:

- appropriate feedstock quality assurance prior to receival on-site
- good housekeeping practices such as regular inspection of incoming feedstocks, litter pick-up and cleaning of tipping floors, conveyor transfer points and of wheels of all vehicles leaving the site
- enclosing processing, screening and storage areas and conveyors
- covering all loads during transport of materials to and from the facility.

7 Decommissioning and rehabilitation

Composting Works' operators must decommission sites in accordance with an approved closure plan to ensure long-term protection of the environment and local amenity, and to minimise the need for long-term post-decommissioning maintenance. These plans need to be approved in writing by the EPA as part of the CEMP for the facility and must include a monitoring program.

Objectives

The objectives of decommissioning and rehabilitation are to:

- ensure that, once decommissioned, the site does not constitute a hazard to the environment, local amenity, or the health and safety of people entering the site;
- take action if the site does constitute a hazard to the environment and local amenity; and
- render the site suitable for its intended future use.

Suggested measures

Decommissioning and post-decommission monitoring

Once the facility is closed, no further feedstock must be received or deposited at the site without prior approval from the EPA.

On vacating the site, the operator is responsible for removal of any contamination or waste and for rehabilitation of the site. This can be accomplished by ensuring:

- there are no remaining products, feedstocks, leachate, wastewater, amendments, contaminated products, process residues or chemicals at the facility
- all equipment, bins and process areas are emptied, cleaned and removed
- the facility has been revegetated or otherwise made suitable for the future land use
- the final land surface controls erosion and protects local amenity regarding dust, odours, vectors and litter
- groundwater and surface water monitoring may be required to be continued by the Licensee until monitoring confirms the absence of any pollution or threat to groundwater quality. If contamination is detected above ambient water quality or the EPA benchmark concentrations, more intensive monitoring and corrective action will be required. The extent of surface water or groundwater contamination will need to be determined, and plans made for corrective action for approval by the EPA. After implementation of the corrective action, less frequent monitoring could be resumed if water quality improves to within specified limits.

Reporting on groundwater and surface water monitoring will need to be in accordance with the post-decommission monitoring plan included in the CEMP of the facility.

Records of complaints should be kept and reported to the EPA in accordance with the requirements for the active site.

Monitoring shall continue until the facility operator has proven that there is and will not be any threat of pollution. An environmental auditor's report may be required to assess this. If appropriate, the EPA will then remove the requirements from the facility to continue monitoring and will advise the Licensee in writing when the requirements for decommissioning and post-closure of the facility have been fully complied with and no further action is required.

Considerations for post-closure use

The proposed post-closure use of the site must be outlined in the decommissioning and post-decommissioning monitoring plan included in the CEMP of the facility, and must consider:

- the facility location
- surrounding land uses
- consultation with the local community
- relevant regulatory and planning authority strategic plans for acceptable land use
- post-closure management measures and infrastructure, eg for management of water issues
- issues related to land use and land contamination
- occupational health and safety for workers and visitors to the site.

Financial planning

Appropriate financial planning before and during the composting activity should be in place to ensure that sufficient funds are available to address the closure needs of the site.

References

Australian Standard AS1726–1993 *Geotechnical Site Investigations*

Australian Standard AS3743–2003 *Potting Mixes*

Australian Standard AS3798–1996 *Guidelines on Earthworks for Commercial and Residential Developments*

Australian Standard AS4419–2003 *Soils for Landscaping and Garden Use*

Australian Standard AS4454–2003 *Compost, Soil Conditioners and Mulches*

Environment Protection (Air Quality) Policy 1994

Environment Protection (Water Quality) Policy 2003

Planning SA 2003, *Guide to Development Assessment: An integrated Planning and Development Assessment System for SA*, 3rd edition, Planning SA, Adelaide.

South Australian Environment Protection Authority 1997a, *South Australian Biosolids Guidelines for the safe handling, reuse and disposal of biosolids*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/biosolids.pdf>.

——1997b, *Stormwater pollution prevention code of practice for local, state and federal government*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/govcop1.pdf>.

——1999, *Stormwater pollution prevention code of practice for the building and construction industry*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/bccop1.pdf>.

——2003a, *EPA Guidelines for community consultation for waste management and recycling facilities,* EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_consultation.pdf>.

——2003b, *EPA Guidelines: Air quality impact assessment using design ground level pollutant concentration*s (DGLCs), EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_airquality.pdf>.

——2003c, *EPA Guidelines: Liquid waste classification test,* EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_liquidwaste.pdf>.

—— 2004a, *EPA Guidelines: Bunding and spill management*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_bunding.pdf>.

——2004b, EPA Stormwater management for washbays, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/water_wash.pdf>.

——2004c, *EPA Guidelines: Wastewater and evaporation lagoon construction,* EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_lagoon.pdf>.

——2005a, *EPA Guidelines: Air pollution modelling—presentation of results*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_apm.pdf>>.

——2005b, *Draft Hazardous Waste Strategy*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/draft_hw.pdf>.

——2006a, *EPA Guidelines: Odour assessment using odour source modelling*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_odour.pdf>.

——2006b, *Draft EPA Guidelines: Regulatory monitoring and testing—water and wastewater sampling*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_rmt_wws.pdf>.

——2006c, *Draft EPA Guidelines: Regulatory monitoring and testing—groundwater sampling*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_rmt_gws.pdf>.

——2007 *EPA Guidelines: Environmental management of landfill facilities (municipal solid waste and commercial and industrial general waste*, EPA, viewed 5 May 2007, <www.epa.sa.gov.au/pdfs/guide_landfill.pdf>.

Appendix 1 Topics for inclusion in a Compost Environment Management Plan (CEMP)

Topic	Detail
Siting	**Locality map**—the siting of the facility and location of environmentally sensitive areas including dwellings, adjoining land uses, schools, hospitals, national parks, airports and zones for a two-kilometre radius for facilities processing in excess of 12,000 tpa and one kilometre for less than 12,000 tpa. **Site layout map**—showing complete layout of the site including areas of specific activities, location of stockpiles, all infrastructure, monitoring points, equipment, amenities, water points, fuel/chemical storage areas and roads. **Natural characteristics of site**—local meteorology (wind, rainfall, evaporation), topography, soil morphology, geology, hydrogeology, surface waters and vegetation.
Greenhouse gas commitment	Statement from the company regarding its greenhouse gas commitment considering: • energy consumption and efficiency including source, equipment • Standard Operating Procedures, eg turning off equipment when not in use • audit of energy consumption once established.
Surface and groundwater management	Management and protection of both surface and groundwater including: • surface water diversion away from composting areas • stormwater and leachate collection and management, including construction specifications • surface water monitoring and assessment • leachate monitoring and assessment • groundwater monitoring and assessment.
Air quality	Composting processes explained including controls and monitoring, eg C:N ratios, temperature, moisture, pH, and oxygen levels if aerobic process Odour and weather monitoring (and, if necessary, odour modelling) Strategies for rapidly biodegradable or problematic feedstocks Biogas containment, extraction and treatment (if necessary) Complaint register and management strategies

Topic	Detail
Incoming feedstocks	Selection and evaluation of feedstocks assuring 'fit for purpose' of composting Tracking of all feedstocks including type, quantity, source, and reporting to the EPA Sizing of all stockpiles (dimensions, spacing) Mass balance to demonstrate site is suitable to manage maximum volumes of feedstocks, compost and final product on-site at any one time Feedstock handling and storage including disposal procedures for unsuitable feedstock/contaminants Trials—list of details to be provided to the EPA to gain approval to accept new feedstocks under a trial project
Product Quality Assurance	Process controls and monitoring (moisture, temperature and oxygen levels of the windrows) Product testing and monitoring—physical, chemical and biological—to AS4454–2003 Organic certification, NASAA or BFA are recommended
Noise	Plant and equipment and their noise specifications Assessment of noise potential and impacts Minimising and scheduling of operation of noisy equipment and heavy transport vehicles to minimise offsite impacts Noise monitoring and controls
Other operations practices	Dust and mud control Litter control, including management and storage of litter/waste on-site prior to disposal off-site Pest, weed and vermin control Site security Maintenance of facility and servicing of equipment Year planner of all scheduled monitoring and reporting times Staffing—number of employees, responsibility structure, skills, training, equipment to be operated, and working hours Facility environment policy

Topic	Detail
Emergency and contingency procedures	Fire prevention strategy, including fire report from Senior Fire Safety Officer MFS (ph: 8204 3611) Fire fighting and emergency provisions Contingency plan, eg in the event of fire, contamination of groundwater, explosions, spills, equipment breakdowns

All information regarding the development should be included in a single document that can be used as the basis for the development application and licensing, thereby minimising costs and avoiding delays in the development approval process. If all the above issues are addressed, it is probable the EPA will not require any additional information to assess the development application. This document may aid in training staff in the management procedures approved by the EPA.

Appendix 2 Glossary including acronyms

See also list of definitions on:
<www.recycledorganics.com/hot/forms/dictionary/dictionthankyou.htm>

100-year floodplain	Land where the chance of a flood occurring in any given year is at least one in 100
ACR	As Constructed Report
aerobic	In the presence of air (oxygen)
AHD	Australian Height Datum in metres—mean sea level for 1966–1968 was assigned the value of zero on the Australian Height Datum at 30 tide gauges around the coast of the Australian continent
amenity value	Of an area includes any quality or condition of the area that conduces to its enjoyment
anaerobic	In the absence of air (oxygen)
approved	Approved by the EPA
aquifer	Saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients
AS	Australian Standard
AUSPLUME	Atmospheric dispersion model developed and available from the Victorian Environment Protection Authority
BFA	Biological Farmers of Australia
biogas	Gaseous emissions from the anaerobic decomposition of organic material
biosolids	Any product consisting totally or in part of organic matter that results from a wastewater treatment process (previously referred to as sewage sludge) or septic tank.
Carbon:nitrogen ratio	The ratio of the weight of organic carbon (C) to that of total nitrogen (N) in an organic material
CEMP	Compost Environment Management Plan—a document describing management systems, operational control procedures and processes, and environmental monitoring and reporting provisions relating to a Composting Works. Some of the issues to be addressed in an environment management plan are siting, water management, gas and odour management, incoming waste management, product quality assurance, noise management, housekeeping practices, fire fighting and prevention.
compost	Material resulting from the controlled microbiological transformation of organic materials under aerobic and thermophilic conditions
compostable organics	Organic materials that are a by-product or residual from one process and can be processed through compost depots to formulate valuable recycled organic products
composting	Process of aerobic conversion of organic wastes by micro-organisms into soil conditioners, compost or humus. By definition, it is a process that must be carried out under controlled conditions yielding cured products.

Composting Works	Facility designed, constructed, operated and licensed for the controlled composting of organic materials (processing >200 tpa)
contingency plan	Document describing an organised, planned, technically coordinated and financially feasible course of action to be followed in the event of emergency or other special conditions, including, but not limited to, equipment breakdowns, fires, odours, vectors, explosions, spills, accidents, receipt or release of hazardous or toxic materials or substances, contamination of groundwater, surface water or the air attributable to a solid waste compost depot and other incidents that could threaten human health or safety or impair the usefulness of the environment
CQA	Construction Quality Assurance
cured	Biodegraded organic material that is stabilised because the rate of decomposition has slowed to a point where turning is no longer required
decomposition	Breakdown of organic waste materials by micro-organisms
Environment Improvement Programme (EIP)	A program documented and agreed with the EPA that sets out action to be taken within specified periods and describes an organised, planned, technically coordinated course of action to be followed to improve practices at a site that is already operating and having environmental impacts
environmental nuisance	(a) any adverse effect on an amenity value of an area that: (i) is caused by pollution; and (ii) unreasonably interferes with or is likely to interfere unreasonably with the enjoyment of the area by persons occupying a place within, or lawfully resorting to, the area, or (b) any unsightly or offensive condition caused by pollution.
EPA	South Australia Environment Protection Authority
feedstock amendment	Wastes or materials added to organic waste prior to reprocessing to improve the final product. Examples include water absorbent biodegradable organic materials such as sawdust, wood shavings and paper pulp; and/or inorganic chemicals/minerals (such as lime, gypsum, ammonium, phosphate, ammonium nitrate, etc) added to modify the pH and/or nutritional content of the composting mixture.
Feedstock(s)	Organic waste(s) subject to composting, fermentation, mulching, and related processes
GCL	Geosynthetic clay liner
green waste (garden waste)	Organic portion of the waste stream originating from parks, yards and gardens (also termed green organics)
groundwater	Water below the ground surface in a zone of saturation.
industrial waste	Waste material generated by industrial or manufacturing processes, but excluding 'Listed Waste'
karstic terrain	Limestone rocks that are highly eroded with channelled outcroppings

leachate	Any liquid that has come into contact with waste and is potentially contaminated by nutrients, metals, salts and other constituents. Leachate is considered wastewater and has the potential to cause water pollution if not managed properly.
liquid waste	Any waste that is liquid at 20°C, as determined in accordance with *EPA Guidelines: Liquid waste classification test* (2003c); and any liquid waste irrespective of whether or not it is packaged or otherwise contained and irrespective of whether or not the packaging or container is to be disposed of together with the liquid that it contains
Listed waste	As defined in Schedule 1 Part B of the *Environment Protection Act 1993*
methane (CH_4)	Explosive, odourless and colourless gas produced by organic waste material undergoing anaerobic decomposition.
mulch or wood chips—protection layer	Organic woody shredded layer, which comprises solid particles of a size greater than 15 mm and at least 70% by mass. The material comprising the woody layer must have a carbon: nitrogen ratio of greater than 200:1.
mulching	Size reduction of organic wastes using one or more of the following processes: cutting, shredding, grinding, or other means
NASAA	National Association for Sustainable Agriculture Australia
non-liquid waste	Any waste that: a) has an angle of repose of more than five degrees; b) does not contain or is not comprised of any free liquids when tested in accordance with liquid classification GL292/03; c) does not contain or is not comprised of any liquids that are capable of being released when waste is transported; d) does not become free flowing at or below 60°C or when it is transported; and e) is generally capable of being picked up by a spade or shovel.
organic waste	Component of the waste stream derived from living organisms (includes wood, garden, food, animal, vegetative and natural fibrous material wastes and biosolids)
pasteurisation	As defined in Section 2.3.1 of Australian Standard 4454–2003
pathogen	Living organism that can be harmful to humans, animals, plants, or other living organisms.
premises	a) building or structure b) land or a place (whether enclosed or not), or c) mobile plant, vehicle, or vessels.
recycle/ recycling	Set of processes (including biological) for converting recovered materials that would otherwise be disposed of as wastes into useful materials and or products. The following definitions apply: • *closed loop recycling*—recycling process in which the reclaimed output is used as an input to the same product system • *open loop recycling*—recycling process in which the reclaimed output is used as an input to another product system.

recycled organic product	Products derived from compostable organics that have been reprocessed through compost depots—whether by mulching, composting, vermiculture etc
reuse	Repeated use of a material or product in the same form but not necessarily for the same purpose
sensitive land use	Land uses that warrant protection from amenity-reducing off-site effects of industry such as, but not limited to: caravan parks, community centres, consulting rooms, educational establishments, childcare centres, hospitals, hotels, motels, nursing homes, offices, residential (including detached dwellings, multiple dwellings, apartment buildings, row dwellings, semi-detached dwellings), parklands, recreation areas or reserves, tourism accommodation.
separation distance	Distance between the reception, storage and processing areas of an organic waste reprocessing site and the nearest sensitive receptor
sludge	Material that has settled to the bottom of a waste treatment device
solid	See non-liquid waste
stable	Not prone to further biodegradation
Sub-grade	The natural sub-stratum underneath the base liner of the facility
surface water	Marine waters and all other waters of the state other than underground waters
tpa	tonnes per annum
vector	Carrier capable of transmitting plant materials (weeds and seeds) and pathogens from one organism to another including, but not limited to, flies and other insects, rodents and birds
vermiculture	Composting process that uses worms and micro-organisms to convert organic waste into nutrient rich humus.
waste	a) any discarded, rejected, abandoned, unwanted or surplus matter, whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter, or b) anything declared by regulation (after consultation under Section 5A of the *Environment Protection Act 1993*) or by an environment protection policy to be waste whether of value or not.
wastewater management system	System designed and operated for the purpose of collecting and managing wastewater to prevent any adverse impacts of the wastewater on the environment

watercourse Any of the following (whether temporarily dry or not): a river, creek or other natural watercourse (whether modified or not); a dam or reservoir that collects water flowing in a watercourse; a lake, wetland or other body of water through which water flows; the Coorong; an artificial channel; a public stormwater disposal system; part of a watercourse

watertable Level of the upper surface of an aquifer

windrow Long, relatively narrow pile of feedstock. Windrows have a large exposed surface that encourages passive aeration and drying of organic materials.

Appendix 3 Technical guidance for assessment of materials and methodology for construction of clay liners

The hydraulic conductivity of a clay liner depends on the material properties and method of construction.

Material properties

Assessment of material properties should include a program of site investigation and testing by a NATA-accredited laboratory. Site investigation typically includes a program of soil sampling, inspection, logging and laboratory testing by a geotechnical professional in accordance with *AS1726–1993 Geotechnical Site Investigations*. The program typically includes sampling in surface exposures, test pits and/or boreholes. Considerations include:

- Particle size distribution (AS1289 3.6.1). The maximum particle size should be about one third of the thickness of each layer prior to compaction (for example, a maximum particle size of 66 mm for a 200 mm thick layer). There should be more than 90% passing the 19 mm sieve, 70% passing the 2.36 mm sieve and more than 30% passing the 0.075 mm sieve (fine grained material).

Atterberg Limits (AS1289 3.1.1, 3.2.1, 3.3.1, 3.4.1). These tests measure soil plasticity and provide an indication of the plasticity, sensitivity to moisture conditioning and susceptibility to undergo desiccation cracking with reductions in moisture content. Clays with a low plasticity index (liquid limit less than 50%) are generally more sensitive to moisture conditioning and less susceptible to desiccation cracking compared to clays with a high plasticity index (liquid limit greater than 50%). Generally, clay soils for low permeability liner construction would have a plasticity index greater than 10%.

- Dispersion (AS1289 3.8.1). Clay soils should have a low susceptibility to undergoing dispersion.

- Calcium carbonate content. Clay soils should have a calcium carbonate content of less than 15%.

- Permeability (hydraulic conductivity). Samples for laboratory permeability testing in accordance with AS1289 6.7.1–1999 must be remoulded in layers to a uniform density and moisture condition. Testing should consider the dry density and moisture condition during sample preparation (refer below); the composition of water available on-site for moisture conditioning during earthworks; and the composition of leachate and vertical surcharge loads. Standard compaction testing (AS1289 5.1.1) must be performed on the sample prior to permeability testing to assess the relationship between dry density and moisture content. This includes the maximum dry density and Optimum Moisture Content (OMC) for Standard compactive effort. A separate compaction test must be carried out for each permeability test sample. The permeability test method should consider the particle size distribution of the proposed materials. In some cases, it may not be practical to obtain or prepare representative samples for laboratory testing, and testing on a field trial pad may be preferred.

Construction methodology

The permeability of clay is typically minimised if the clay is moisture conditioned and compacted at a moisture content that is greater than the OMC in Standard compactive effort

(AS1289 5.1.1). The OMC is the moisture condition where the dry density of the soil is maximised for a given compaction effort.

Specification of acceptable envelopes of density ratio and moisture condition during compaction (AS1289 5.1.1 or AS1289 5.7.1) has been effectively used as performance criteria for quality control during liner construction. Acceptable envelopes shall be assessed by testing as part of the design process (see above). Construction of low permeability clay liners includes:

- uniform moisture conditioning to between 0 and +3% of the OMC in Standard compactive effort (AS1289 5.1.1)
- uniform compaction in layers of less than 200 mm (or 150 mm if 300-mm liner) compacted thickness using a sheepsfoot roller to achieve a dry density ratio of greater than 95% relative to Standard compactive effort (AS1289 5.1.1)
- effective bonding between layers.