ENVIRONMENTAL GUIDELINES

COMPOSTING AND RELATED ORGANICS PROCESSING FACILITIES

Department of
Environment and Conservation (NSW)

This document was prepared by the Waste Management Section of the Department of Environment and Conservation (NSW).

From 24 September 2003 the Department of Environment and Conservation (DEC) incorporates the Environment Protection Authority (EPA), which is established in the *Protection of the Environment Administration Act 1991* as the Authority responsible for administering the *Protection of the Environment Operations Act 1997* (POEO Act). Statutory functions and powers in the POEO Act continue to be exercised in the name of the EPA.

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ACRONYMS AND ABBREVIATIONS

ANZECC	Australia and New Zealand Environment Conservation Council (now replaced by the Environment Protection and Heritage Council (EPHC).
APHA	American Public Health Association
AS	Australian Standard
AS/NZS	Combined Australian Standard and New Zealand Standard
BOD	Biological oxygen demand
C:N	Carbon to nitrogen ratio
DA	Development application
DC	Development consent
DEC	Department of Environment and Conservation (NSW)
EIS	Environmental impact statement
EMP	Environmental management plan
EMS	Environmental management system
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPA	New South Wales Environment Protection Authority (now part of Department of Environment and Conservation (NSW)).
ESD	Ecologically sustainable development
FML	Flexible membrane liner
HDPE	High density polyethylene
IDA	Integrated development assessment
ISO	International Organisation for Standardization
LEP	Local environmental plan
m/m	Mass per mass
MSW	Municipal solid waste
NMOC	Non-methane organic compounds
PET	Polyethylene terephthalate
REP	Regional environmental plan
RPD	Relative per cent difference
SEPP	State environmental planning policy
USEPA	United States Environment Protection Agency
v/v	Volume per volume

1 INTRODUCTION

Need for the guidelines

The processing of organics can deliver important environmental benefits, including the recovery and conservation of resources and a reduction in the quantity of organics going to landfills (Lechner *et al.* 2002). These benefits come from turning organics into useful and safe products, without causing harm to the environment. However, if commercial composting facilities are not well managed they can have serious environmental impacts.

Modern composting operations tend to process considerable quantities of organics. Consequently, the generation of unwanted by-products, particularly odours and water-soluble chemical compounds, can become greater than the capacity of natural processes to cope with them adequately. Even relatively simple tasks in composting and related organics processing – such as mulching, grinding and chopping – can have negative environmental impacts.

The occupiers of the facility are responsible for selecting and applying the best mix of techniques for site development and management for their particular location to meet the required environmental objectives.

The focus of these guidelines is on the appropriate environmental management of organics processing **facilities**. The document discusses the need to minimise contamination of the organic materials themselves, but only briefly mentions the use of organics and contamination issues associated with use (see Section 2).

Australia has a voluntary standard for composts, soil conditioners and mulches, Australian Standard *AS4454-2003 Composts, soil conditioners and mulches*. This standard adopts contamination thresholds from products derived from organic wastes, compostable organic materials and biosolids that are current federally or in individual states. The standard was developed for assessing the quality of compost produced from segregated green waste and for unrestricted use, such as domestic and residential uses.

Additionally, any material mixed with or produced with biosolids is regulated under the *Environmental Guidelines: Use and Disposal of Biosolids Products* (Biosolids Guidelines – EPA 1997). Whereas the Biosolids Guidelines permit the cleanest biosolids products (suitable for 'Unrestricted Use') to be used without any conditions, products containing higher concentrations of chemical contaminants (suitable for 'Restricted Use 1, 2 or 3') have stringent conditions placed on the location, method and rate of their application to land and are permitted only in non-domestic uses, such as agriculture, forestry and environmental rehabilitation.

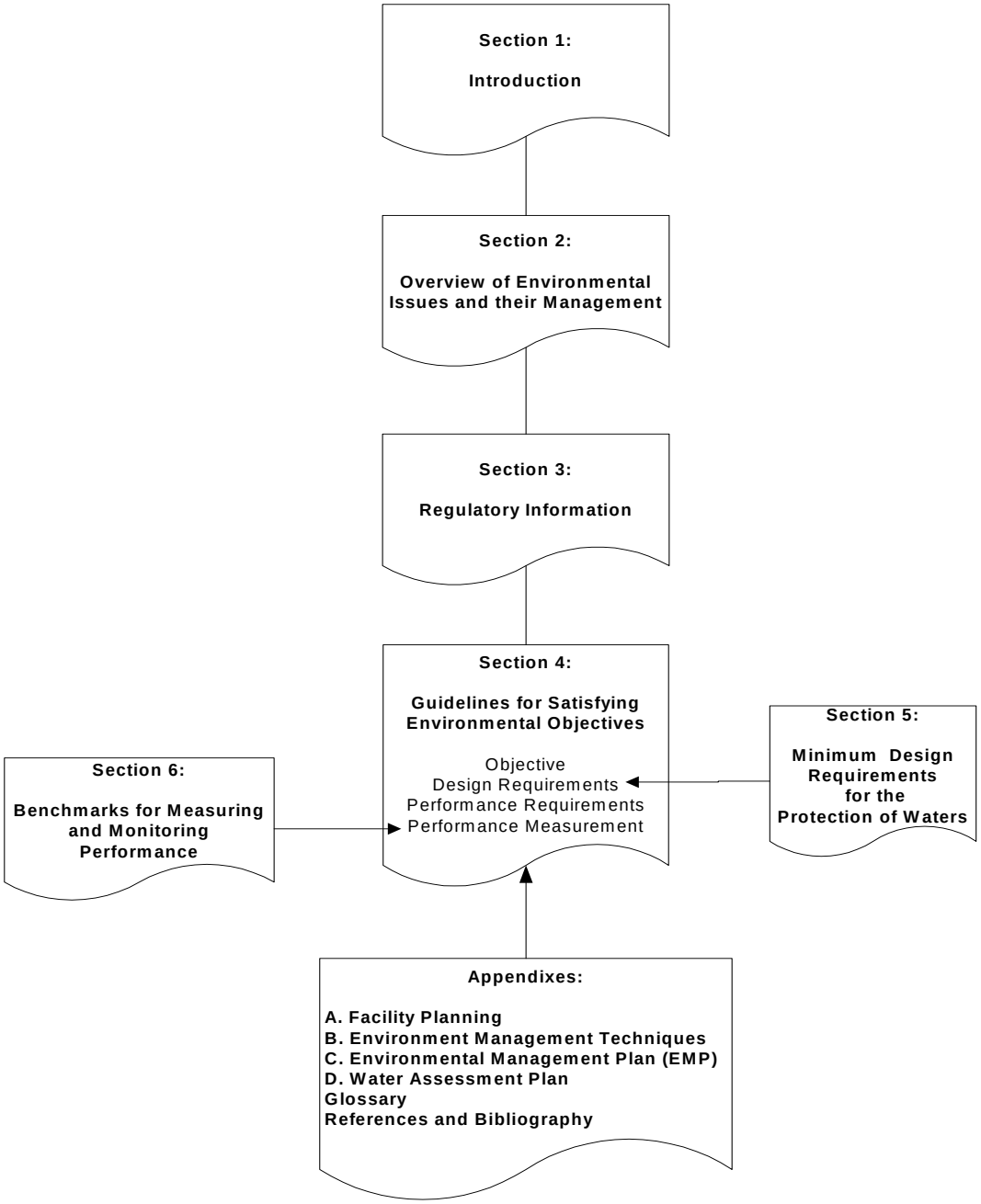
Scope of the guidelines

These guidelines (Figure 1):

- define clearly the environmental issues that affect the management of composting and related organics processing facilities (see Section 2)
- outline the regulatory framework (see Section 3)
- identify objectives, design requirements, performance requirements and performance measurements for dealing with each issue (see Sections 4, 5 & 6).
- identify the benchmarks used for measuring and monitoring performance (see Section 6)
- outline the types of issues that should be considered when planning composting and related organics processing facilities (see Appendix A)
- identify possible environmental management techniques (see Appendix B)

- list the items to be included in an environmental management plan for composting and related organics processing facilities (see Appendix C)
- list the items to be included in a water assessment plan for composting and related organics processing facilities (see Appendix D).

Figure 1: Structure of the guidelines



These guidelines cover the processing (see Table 1) of putrescible and non-putrescible organics such as:

- garden and landscaping organics
- untreated timber
- natural organic fibrous material
- processed fibrous material
- biosolids
- manures
- food organics (for example, meat, fish and fatty and oily sludges of vegetable and animal origin, including grease trap sludges)
- mixed residual waste containing organics (such as household waste).

Table 1: Types of facilities addressed by these guidelines

These guidelines **address** the following types of facilities:

- Facilities required to hold environment protection licences in **Schedule 1 to the *Protection of the Environment Operations Act 1997***, thus including but not limited to the following types of facilities:
  - aerobic processes (including windrow composting, static piles)
  - anaerobic processes (including facilities that employ digestion and fermentation technologies)
  - vermiculture
  - shredding and / or mulching processes
  - facilities involved in the preparation of mushroom growing substrate
  - organics processing facilities that incorporate a biological processing stage (e.g. mechanical–biological treatment (MBT) of municipal solid waste).
- Facilities that utilise a biological processing stage on a larger than domestic scale but that are **not required to be licensed** may find useful information such as the potential environmental issues (Section 2), items to consider during planning (Appendix A) and possible environmental management techniques (Appendix B).

Note: These guidelines **do not** provide information relating to facilities that produce fuels from organics by non-biological processes such as pyrolysis, hydrogenation or gasification.

The Department of Environment and Conservation (DEC) has taken a performance-based approach by setting objectives rather than prescribing particular environmental techniques that must be used. This approach intends to encourage facility operators to develop cost-effective solutions that not only achieve the right environmental outcomes but also are the most sensible and appropriate to particular operations.

Many of the environmental management techniques described in the guidelines are specific to open-air composting of organics by windrowing or static pile methodologies, because once these facilities are operating they generally require more attention to maintenance and good ongoing operating practices to mitigate environmental issues. Specific Minimum Design Requirements are provided only for mitigating the pollution of waters, because the guidelines reference other relevant publications that are available from the DEC such as the *Draft Policy: Assessment and Management of Odour From Stationary Sources in NSW* (EPA, 2001b) for issues other than water pollution.

These guidelines also provide information on how facilities can avoid contamination in the production of compost and related organics. They do not specify standards or other requirements relating to products from composting and related organics processing facilities. For further information see the discussion in Section 2 regarding contamination of organics.

Who should read these guidelines?

The guidelines are relevant to composting and related organics processing facilities that are required to hold environment protection licences (see Table 1). People who do composting or process organics on a larger than domestic scale but who are not required to be licensed may also find useful information in this document relating to the management of such processes.

The information provided in the guidelines aims to help:

- occupiers of existing composting and related organics processing facilities (see Table 1)
- individuals, companies, local government bodies and communities planning such facilities
- individuals or groups wishing to find out what management measures they can use to avoid or minimise the negative impacts of composting and related organics processing on local amenity, health and the environment
- suppliers or developers of individual items of equipment or entire turnkey processes for such facilities
- environmental consultants
- existing or intending users of the products of these facilities, which include composts, soil conditioners and mulches.

These guidelines can be used as a guide for the development of licence conditions for licensed facilities, but conditions may be attached to licences that vary from the guidelines owing to site-specific issues. In the event of any inconsistency between the licence conditions and the guidelines, the licence prevails as the legal requirement for the facility.

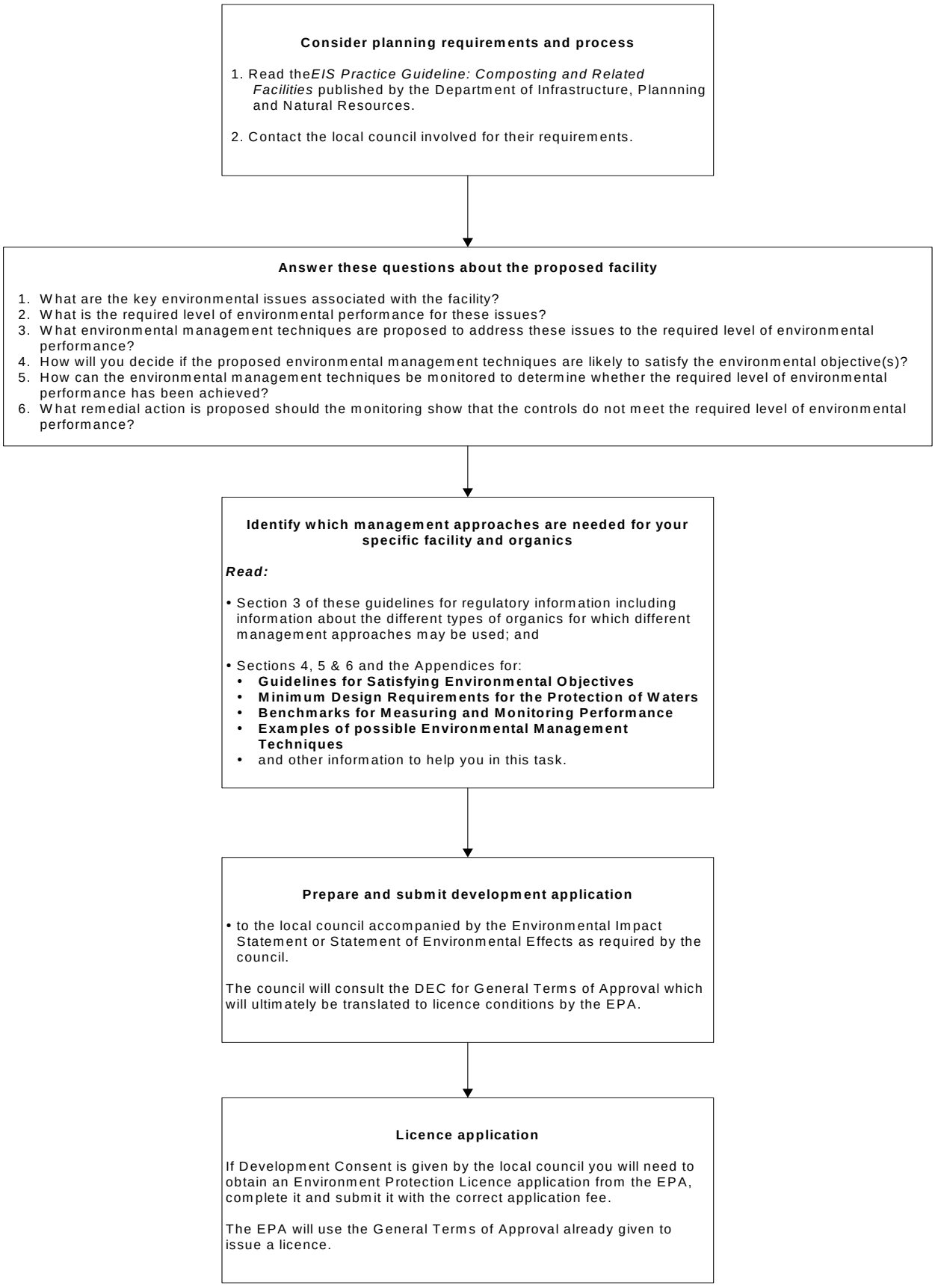
Planning a new composting facility

Figure 2 summarises the processes involved in taking a composting facility from the planning stage to the Development Application and eventually, if Development Consent is granted, to obtaining an Environment Protection Licence from the Environment Protection Authority (EPA)[1]. Further details can be obtained by reading the sections of these guidelines and another document (DUAP 1996) that are referred to in the figure.

Further information regarding licensing a composting facility may be obtained from your local DEC office.

[1] The EPA is a statutory body with specific powers under environment protection legislation. In September 2003, the EPA became part of the Department of Environment and Conservation (DEC).

Figure 2: Considerations when planning a new composting facility



The types and quantities of organics received and the design and siting of the processing facility determine the nature of potential pollutants that can be generated and the severity of the potential environmental risks, as well as the quality of the end-products.

Poor environmental management of composting and related organics processing facilities can result in one or more of the following environmental problems:

- air quality impacts, namely odours and particulate matter
- potential hazards, such as fire and explosions
- water and soil pollution
- loss of amenity, particularly odours, the presence of vermin in excessive numbers, excessive levels of noise from equipment (such as shredders and traffic), wind-blown litter and particulate matter from delivery trucks and earthmoving equipment
- production of contaminated organic products.

2 OVERVIEW OF ENVIRONMENTAL ISSUES AND THEIR MANAGEMENT

Air quality

Odour

Odour problems associated with composting and related organics processing facilities can be traced to problems with one or more of the following four processes: process control; containment of odorous areas; odour control technology; and siting (Giggey *et al.* 1995). Some of the odour compounds associated with such facilities are listed in Table 2. Although various feedstocks contain a variety of compounds, in many cases they will not be released as odour during processing **provided the process conditions are optimised** (Goldstein 2002; Gage, 2003) (see examples, Appendix B).

Most analyses of composting odours have focused on sulfur compounds, nitrogen compounds and volatile organic compounds (Table 2). Ammonia is commonly associated with unpleasant odour from composting and related organic processing facilities, mainly because it can be easily distinguished from other composting odours (Miller 1993).

Under aerobic conditions the main gaseous product of composting and mulching is carbon dioxide, and the organics are characterised by an earthy or woody odour. The most common gas compounds contributing to odours from aerated static pile composting of organics containing biosolids include dimethyl sulfide, dimethyl disulfide, dimethyl trisulfide, carbon disulfide, and benzothiazole (Fisher *et al*. 1986; Goldstein 2002). These chemicals can be toxic, although in open-air (aerobic) composting situations they are not present in high enough concentrations to be considered a health risk (Clark *et al*. 1983). However, presence of these chemicals in the atmosphere can lead to local amenity impacts (Miller 1993).

Under anaerobic conditions – when the biodegrading materials do not receive sufficient air – methane is generated, and this is accompanied invariably by the production of strong and foul odours. These odours are caused by the generation of ammonia, volatile amines (when the degrading organics have a high nitrogen content), hydrogen sulfide and volatile organic compounds (Goldstein 2002).

Table 2: Odour compounds

Compound	Description of smell	Detection limit for a particular odour panel
Sulfur compounds		
Dimethyl disulfide	Rotten cabbage	0.1 µg / m^3
Dimethyl sulfide	Rotten cabbage	2.5 µg / m^3
Carbon disulfide	Rotten pumpkin	24 µg / m^3
Hydrogen sulfide	Rotten egg	0.7 µg / m^3
Methane thiol	Pungent sulfur	0.04 µg / m^3
Nitrogen compounds		
Ammonia gas	Medicinal	27 µg / m^3
Trimethyl amine	Fishy	0.11 µg / m^3
Volatile fatty acids		
Acetic acid	Sour (vinegar)	1019 µg / m^3
Propionic acid	Rancid	28 µg / m^3
Butyric acid	Putrid	0.3 µg / m^3

(Goldstein 2002)

The absence of odours does not necessarily indicate that the process has not turned anaerobic: odours may be diminished or removed during diffusion of the biogas mixture through fresh compost, odour scrubbers or soil containing biological organisms (Farell 2001; Wilson 2002). However, the presence of unpleasant odours is a good indicator that the process has turned anaerobic.

If calm conditions are likely to occur frequently, the topography and consequent **drainage flows of air** can have a profound effect on the dispersion of odours, the extent and intensity of odours and, consequently, the impact on local amenity. Calm conditions are most likely to occur in the morning and evening. Locations likely to cause least dispersion are those that have a predictable air drainage flow and no sea breezes or other winds to disturb the stable wind conditions (Walker 1993). In this regard, the worst times of the year for odour dispersion are likely to be late autumn and winter.

High peak odour emissions at composting and related organics processing facilities generally occur during mixing and aeration procedures, such as preparation of the feedstock, and during turning of biodegrading organics (Bidlingmaier 1993). Rapidly biodegrading organics (i.e. Category 3 organics in Table 3, Section 3), such as food and animal organics, may already be giving off odours when they are received at the facility or soon after receipt. Other less biodegradable organics, such as Category 1 organics, are less likely to generate odour when received at the facility.

Odour impacts on local amenity from composting and related organics facilities can arise from poorly managed stockpiles of raw organics and / or organic products (Haug 1993). For example, large stockpiles require more ongoing management and maintenance to ensure that the potential for odour emissions and water pollution from anaerobic conditions is mitigated. Poorly managed stockpiles can turn anaerobic because of lack of aeration through the piles. If excessive moisture comes into contact with the stockpiles it can cause leachate to be generated and drain from stockpiles, potentially causing water pollution (see text later in this section titled ‘Water pollution’).

The two important pieces of legislation for minimising and controlling odour are the *Protection of the Environment Operations Act 1997* (POEO Act) and the *Environmental Planning and Assessment Act 1979* (as amended). An overview of the legislative context in relation to odour is available in the *Draft Policy: Assessment and Management of Odour From Stationary Sources in NSW* (EPA 2001b).

Particulate matter

Composting and related organics processing facilities may be sources of particles (or particulate matter) in the atmosphere. Particulate matter may be classified by the particle shape or phase (such as fibres and aerosols), their physical behaviour in air (such as suspended in air or deposited from air);, their chemical species, biological activity (such as bioaerosols) and size (including PM_{10}, $PM_{2.5}$, total, and inhalable dust) (Environment Agency 2003). The highest concentrations of particulate matter from composting and related organics-processing facilities occur during pre-treatment (shredding and mixing) of fresh organics and the turning of biodegrading organics, and can be higher in summer and when organics are dry (Tolvanen *et al.* 1998). Unsealed access roads and earthmoving equipment can also be sources of particulate matter at composting and related organics-processing facilities.

Composting and most organics-processing activities rely upon the inter-related activities of a diverse range of microorganisms to convert organics into stabilised organic products. Thus high concentrations of bacteria and fungi are likely to be present in the process feedstock, during processing, and in the final products (Swan *et al.*, 2002). It is possible in the absence of control measures that pathogens such as *Legionella longbeachae, Aspergillus fumigatus, Mycobacterium tuberculosis* and *Hantavirus* infections may be aerosol transmitted from composting and related organics and processing facilities (NSW Health Department 2001; The Staff of *Biocycle* 1991; Pillai 2002; Swan *et al.* 2002). Release of such pathogens into the air needs to be mitigated, because these pathogens are capable of causing severe infections in humans (Pillai 2002).

The principal types of particulate matter of concern to the community and the DEC are biological particulate matter, PM_{10} (size range < 10 µm), $PM_{2.5}$ (size range < 2.5 µm) deposited matter and total suspended particulate matter (TSP) that are present at composting and related organics-processing facilities. The human health effects of different-sized airborne particulate matter differ. Larger particles PM_{10} are trapped in the nose and throat, whereas smaller particles ($PM_{2.5}$) penetrate the lungs and are associated with a range of respiratory symptoms (Gilbert 1998; Swan *et al.* 2002). For example, workers at composting and related organics-processing facilities may be exposed to high levels of particulate matter (for short periods) if certain design features are not employed and key operational measures are not undertaken (Epstein *et al.* 2001). Appendix B provides some additional advice on controlling particulate emissions.

Biogas management

Decomposition of most organics in the absence of oxygen yields biogas – a mixture of approximately 65% methane and 35% carbon dioxide (Mata-Alverez 2003). Uncontrolled emission of biogas can pose a fire risk and other potential hazards to humans (see text later in this section).

Biogas generated from the decomposition of 'mixed residual waste containing putrescible organics' is likened to the biogas generated in landfills. Thus the principal key pollutants of concern arising from the decomposition of 'mixed residual waste containing putrescible organics' are methane, nitrogen oxides (NO_2 and NO), sulfuric acid mist (H_2SO_4), sulfur oxides (SO_3 and SO_2), and non-methane volatile organic compounds (NMVOC) (Tchobanoglous *et al.* 1993). These pollutants are of concern because they can be toxic or highly odorous at quite low concentrations (a few parts per million by volume for odours).

Flaring of biogas from anaerobic processing minimises the release of odours generated from biogas and reduces the risk of explosions. Alternatively, energy recovery systems can be installed to recover energy from biogas.

Liquids condensed from biogas have the potential to cause pollution of waters and cause amenity impacts (such as odour), so they must be effectively managed. Where possible, the generation of condensed liquids from biogas should be avoided.

Greenhouse impact

The emission of methane to the atmosphere is reported as the principal greenhouse impact of concern for composting and related organics-processing facilities, because methane has more than 20 times the greenhouse warming potential of carbon dioxide. In open windrow systems when an aerobic environment is maintained with proper moisture content to encourage aerobic decomposition of the organics, the composting process does not generate significant quantities of methane (USEPA 2002). Most experts agree that if isolated anaerobic pockets deep within a compost pile release methane then it is likely to be oxidised in the aerobic areas of the compost pile before any significant quantity is released to the atmosphere (e.g. Zeman & Rich 2001). Well designed and managed anaerobic systems are characterised by close monitoring and control of the generation and collection of methane (Mata-Alvarez 2003).

Zeman and Rich (2001) comment that only the carbon dioxide released by the use of fossil fuels (e.g. diesel and petrol) during transporting and processing contributes to global warming, because the carbon dioxide produced during the composting process would have been released in the longer term by the natural decay of the organic materials that are being turned into compost.

The well managed composting of organics will not produce methane, so this activity can contribute to a **reduction of global warming** by keeping organics out of landfill (Lechner *et al.* 2002). Landfills are usually oxygen poor, so methane is generally produced from the decomposition of organics in landfills. The capture of methane from landfills, even if it is included during the design phase, is never 100% efficient, so the landfilling of organics will always release methane, a powerful greenhouse gas, into the environment.

Water pollution

Leachate

Putrescible organics have a tendency to generate leachates that need careful management (Haug 1993). For example, Category 3 organics such as food, meat, fish and fatty or oily sludges usually contain sufficient quantities of moisture to generate leachate without extra water being added. Category 1 organics such as garden materials, wood and fibrous materials generally form leachates only when additional water (including rainfall) is introduced.

Leachates can be acidic, especially when they are generated under anaerobic conditions. They can cause the dissolution of metals and metallic compounds that may be present in organics. Under aerobic conditions alkaline leachates can be formed from organics with low carbon / high nitrogen ratios, such as food and animal organics.

Leachates from composting and related organics-processing facilities have the potential to pollute groundwater and surface water bodies (such as rivers, creeks and dams). They can be high in nutrients; this makes them favourable host media for bacteria and other micro-organisms and gives them a high biological oxygen demand (BOD) (Tchobanoglous *et al.* 1993).

Stockpiles of raw organics and processed organics have the potential to pollute waters, because leachate may be generated when the stockpiled organics contain excessive moisture (for example, when too much rain falls on to the organics or if stockpiled organics are not sufficiently aerated or turned) (see Appendix B). Such stockpiles may also generate offensive odours because excessive moisture will tend to cause the stockpiled organics to become anaerobic if not managed competently (see discussion relating to odour earlier in this Section).

Surface water

Surface water run-off from composting and related organics-processing facilities can cause unacceptable loads of sediment and suspended solids in receiving waters (Department of Housing 1998), while surface water run-on can lead to excessive generation of leachate (Tchobanoglous *et al.* 1993). Unvegetated exposed areas are a likely source of suspended sediment in surface water.

Note: A person who pollutes waters is guilty of an offence under the POEO Act.

Fire and other potential hazards

Methane emissions from poorly managed composting processes or uncontrolled biogas emissions represent a lost opportunity to recover energy or fuel from such facilities. Uncontrolled biogas emissions may create an explosion or fire risk and impose risks to humans (such as explosions and suffocation in confined spaces) (Rynk 2000; ASFCME 2001). So it is better to design facilities to avoid the release of these emissions, or at least to collect them.

Fire at composting and related organics processing facilities can attract public and industry concern about the perceived risks of composting activities, threaten damage and loss of equipment, and present potential dangers to workers and firefighters (Rynk, 2000).

Possible causes of fires at composting and related organics processing facilities, include:

- spontaneous combustion (see below for further information)
- sparks from works activities such as welding
- lightning strikes
- cigarettes
- build-up of particulate matter near engine manifolds and exhaust pipes of processing equipment
- bushfires and arson.

Cigarettes, sparks from welding activities and spontaneous combustion are reported as being the most common causes of fire at composting and related organics-processing facilities (Rynk 2000; Wilson 2002). Spontaneous combustion happens when decomposing organics *self heat* to a temperature high enough to ignite. The conditions for spontaneous combustion (such as large piles, limited air flow and time for temperature to build up) are usually more prevalent within large, undisturbed piles containing raw feedstock, curing compost or finished compost rather than in active composting systems (Rynk 2000).

If unauthorised access to the premises is not prevented, the risk of potential injury and damage to persons and equipment may be increased.

The Protection of the Environment Operations (Control of Burning) Regulation 2000:

- controls burning in the open or in incinerators in local government areas
- allows the EPA or local councils to grant approvals for burning in the open or in an incinerator in certain circumstances

- prohibits the burning of certain articles (including tyres, paint and solvent containers, and certain treated timbers)
- imposes a general duty on persons to prevent or minimise air pollution when burning in the open or in an incinerator.

Open burning in many council areas is prohibited unless approved by the EPA or conducted in an approved incinerator. For further information refer to the Protection of the Environment Operations (Control of Burning) Regulation 2000 or call the DEC Pollution Line on 131 555.

Amenity issues

The potential negative impacts on local amenity from inappropriately managed composting and related organics-processing facilities include:

- odour pollution
- particulate matter (including deposited matter and biological matter) pollution
- pests
- vermin
- birds
- litter
- fire
- noise from equipment or traffic.

These impacts may occur on and off the premises. The most common amenity issue is caused by the release of odour (Miller 1993). Text earlier in this section discussed air quality issues (such as odour and particulate matter).

Particulate matter leaving a poorly managed site as airborne dust may have a visual impact on the local amenity and may cause public health impacts.

Composting and related organics-processing facilities with exposed, rapidly biodegradable organics (see Glossary) may attract a large number of birds, particularly gulls and ibises; this can lead to noise problems and the spread of food scraps away from the site. Local amenity will also be reduced by the presence of large numbers of pests or vermin at composting and related organics-processing facilities and may pose environmental or health hazards.

Weed spread can have serious environmental and negative economic consequences. For example, noxious weeds can pose environmental harm and cause human health problems and loss of amenity in neighbouring areas. It is therefore important to prevent weeds from proliferating at the premises. It is also important that weeds, weed seeds and plant propagules are prevented from being transmitted to other locations via the products. The impact of pests on product quality is discussed later in this section.

Wind-blown litter emanating from composting and related organics-processing facilities can degrade the local amenity. The tracking of litter and mud on the wheels of vehicles leaving the premises may also have an impact on local amenity and on the quality of surface water run-off. Vehicles can also be a source of wind-blown litter (i.e. from uncovered loads).

Contamination of organics

Good design and management of organics-processing facilities are necessary to minimise the contamination of organics intended for beneficial use and thereby to avoid subsequent negative environmental and health impacts. It is important that facilities are designed and managed to keep contamination of final products to the lowest practicable levels.

The quality of the processed organics delivered to the market is an environmental issue that affects the viability and sustainability of a facility dedicated to producing organics for beneficial use. Contaminated organics used in the environment as composts, soil conditioners or mulches can potentially lead to the pollution of surface waters, soil and groundwater and the spreading of pathogens, pests and diseases; these in turn may pose health risks via the food chain.

The following paragraphs briefly describe the main classes of contaminants that need to be managed to prevent negative impacts on product acceptance and sustainability in the market.

Chemical contaminants

Toxic organic chemicals and metal compounds present in composted organics can have the following properties and negative effects:

- organic chemicals may not degrade during processing and are, therefore, concentrated in the final products (e.g. persistent organochlorine pesticides such as DDT)
- metal compounds (such as those of cadmium, chromium, copper, mercury, lead, nickel and zinc) that tend to accumulate can have short-term and long-term toxic effects on organisms in the environment
- soil contamination by heavy metal compounds can necessitate costly remediation or even require storage of intractably contaminated soil
- significant health hazards can arise if contaminated composts are applied to agricultural and residential land and if these chemicals enter the food chain
- the presence of contaminants can endanger domestic animals, wildlife, plants and other living organisms and may have serious ecological consequences.

Excessive levels of contaminants, pathogens, pests or toxins in organic products **will degrade the quality and value** of organics. For example, contaminants may limit or prevent the usefulness of organic products and limit the acceptance of composted organics in the market (Ren 2003).

Physical contaminants

Historically, physical contaminants, such as shredded plastic and broken glass, have posed problems with the quality of final products processed from mixed residual waste (e.g. Rynk 2001; Lantz & Venters 2002). Although many techniques are available for removal of contaminants (either at the start or end of the composting process) complete elimination cannot be assured (e.g. Rynk 2001; Satkofsky 2001).

Pathogens, plant propagules and other pests

Pathogens, plant propagules and other pests in organic products are well documented as contaminants that have the potential to degrade the quality and value of organic products. For example, the NSW viticulture industry has been concerned that processed organics have the potential to carry and spread phylloxera (*Daktulosphaira vitifoliae*) (NSW Agriculture 2002) (see also Appendix B). However, Bishop *et al.* (2002) reported that the presence of phylloxera in the feedstock for composts is unlikely and that the temperatures reached during processing in well

managed facilities readily destroy the insect. If composted organics are intended for transport to, and are used in, viticulture areas, it is essential to be aware of:

- the protocols for composting facilities to minimise the risk of phylloxera survival during processing and transport. This involves composting to *Australian Standard AS4454 Composts, Soil Conditioners and Mulches* and in particular maintaining the required temperature regime for the process (which is known to destroy the phylloxera) and managing the facility in a manner that avoids cross contamination
- NSW Agriculture compliance and licensing requirements for transport of compost into designated Phylloxera Free Zones within NSW. This involves organising a Compliance Agreement with NSW Agriculture.

Information on these phylloxera-related issues is available from NSW Agriculture.

There are also potential human health issues associated with organic products, including colonisation with spores of the fungus *Aspergillus fumigatus* (The Staff of *Biocycle* 1991) or with the bacterium *Legionella longbeachae* (NSW Health Department 2001).

3 REGULATORY INFORMATION

The EPA is a statutory body with specific powers under environment protection legislation. In September 2003, the EPA became part of the Department of Environment and Conservation (DEC).

Categorisation of incoming organics

The categorisation system identified at Table 3 corresponds to the Department of Infrastructure, Planning and Natural Resources' *EIS Practice Guideline: Composting and Related Facilities* (DUAP 1996*)*. Consent and concurrence authorities use these guidelines when they are evaluating development applications. Development consents issued nowadays generally indicate the categories of organics that are allowed to be processed at particular facilities.

The main factors that determine the categories are:

- potential to generate offensive odours
- potential to attract vermin and vectors
- potential to generate harmful leachate, which could contaminate surface water, groundwater and soil.

Category 1 organics have the lowest potential environmental impact. Category 2 organics have a greater impact. Category 3 organics (these include meat, fish, fatty foods and fatty or oily sludges; see Table 3) have the greatest potential to seriously affect the environment and amenity. Thus facility occupiers need to take special care when selecting and using equipment and management techniques suitable for the particular incoming organics, in order to avoid the abovementioned negative impacts during handling and processing.

Although the potential environmental impact of each category of organics is different, the environmental performance requirements are the same for facilities processing any category of organics (for the categorisation of organics see Table 3). As outlined in Section 4, occupiers of facilities are thus responsible for selecting and applying the best mix of techniques suitable to the category of incoming organics in order to meet environmental performance requirements (see later in this section).

When developing conditions for environment protection licences under the POEO Act (see below) the EPA uses a categorisation system (Table 3). The EPA recommends that facility planners consider using this categorisation system when selecting suitable environment management techniques (see later in this section and Appendix B). Appendix A also provides information regarding design and selection of suitable environmental management techniques to control potential impacts from categorised incoming organics.

Licensing requirements

POEO Act

The conditions under which composting facilities are required to hold environment protection licences are listed in Schedule 1 to the POEO Act. Licences may be required because the facilities are over a certain size or are located near sensitive sites such as schools or hospitals.

Environment protection licences aim to specify environmental outcomes and the minimum performance requirements that need to be achieved. For information about licensing and associated costs see *Guide to Licensing under the Protection of the Environment Operations Act 1997,* (EPA, 1999b). This publication can be obtained from the DEC website site at www.environment.nsw.gov.au or by calling the DEC Pollution Line on 131 555.

The appropriate regulatory authority (ARA) for facilities not required to hold environment protection licences by Schedule 1 to the POEO Act is usually the local council, unless the council is carrying out the activity itself, in which case the EPA is the ARA. Although these guidelines are relevant to composting and related organics-processing facilities that are required to hold environment protection licences (see Table 1), people who do composting or process organics on a larger than a domestic scale but who are not required to be licensed may find useful information in this document relating to the management of such processes.

Licence application

The EPA requires proponents to provide information with their environment protection licence applications on their proposed facilities in order for the EPA to:

- understand the likely impacts the facilities could have on the environment
- assess the measures proposed to mitigate those impacts and protect the environment.

Information on the details that must be provided on the environment protection licence application form can be obtained from the DEC website at www.environment.nsw.gov.au or by calling the DEC Pollution Line on 131 555. Appendix A is provided as a guide to help individuals, companies, local government bodies and communities planning composting and related organics processing facilities. It outlines the types of issues that should be considered when planning such facilities. The issues outlined in Section 4 of these guidelines and those described in the *EIS Practice Guideline: Composting and Related Facilities* (DUAP 1996) should also be addressed in the environmental impact statement that must be prepared under the development assessment process.

Licence conditions

Environment protection licences issued by the EPA under the POEO Act use the three-category system to specify the organics that facilities can receive (see Table 3).

Environment protection licences allow facilities to receive organics categorised as having a lesser environmental impact but not organics categorised as having a greater potential impact. For example, facilities licensed to receive Category 2 organics may receive organics from Category 1 but not from Category 3.

Licence conditions will include:

- performance requirements and performance measurements for each environmental objective listed in section 4 of these guidelines, or
- the performance requirements shown in these guidelines and any alternative performance measurements proposed by the applicant and approved by the EPA for a particular environmental objective (see below).

If receipt of a certain type of organics at a licensed facility proves to be problematic, the EPA will not permit those organics to be received at the facility any longer.

Table 3: Categorisation of organics

Potential to have environmental impact	Organics category	Types of organics permitted in categories[1] (Categories with larger numbers may contain types from classes with smaller numbers.)	
		Type	**Examples of organics**
Lowest potential environmental impact	**Category 1**	**Garden and landscaping organics**	Grass[2]; leaves; plants; loppings; branches; tree trunks and stumps.
		Untreated timber	Sawdust; shavings; timber offcuts; crates; pallets; wood packaging.
		Natural organic fibrous organics	Peat; seed hulls / husks; straw; bagasse and other natural organic fibrous organics.
		Processed fibrous organics	Paper; cardboard; paper-processing sludge; non-synthetic textiles.
Greater potential environmental impact than Category 1, less potential impact than Category 3.	**Category 2**	**Other natural or processed vegetable organics**	Vegetables; fruit and seeds and processing sludges and wastes; winery, brewery and distillery wastes; food organics excluding organics in Category 3.
		Biosolids[3] and manures	Sewage biosolids, animal manure and mixtures of manure and biodegradable animal bedding organics.
Greatest potential environmental impact	**Category 3**	**Meat, fish and fatty foods**	Carcasses and parts of carcasses; blood; bone; fish; fatty processing or food.
		Fatty and oily sludges and organics of animal and vegetable origin	Dewatered grease trap; fatty and oily sludges of animal and vegetable origin.
		Mixed residual waste containing putrescible organics	Wastes containing putrescible organics, including household domestic waste that is set aside for kerbside collection or delivered by the householder directly to a processing facility, and waste from commerce and industry.

Notes:

1. These categories are used only to facilitate reference to these groupings of waste and organics (with different potential environmental impacts) in these guidelines and in environment protection licences: they are **not** used in waste legislation.
2. Particular care should be taken when grass clippings are present in the feedstock. It is well known that careful process management is required to mitigate odour and leachate problems when processing grass clippings (e.g. Buckner 2002). High moisture content, high nitrogen levels, abundance of readily available organic matter and poor structure and tendency to mat mean that grass can easily become anaerobic and odorous.
3. Conditions applying to processing and use can be found in *Environmental Guidelines: Use and Disposal of Biosolids Products* (EPA 1997).

Development assessment

The siting of composting and related organics-processing facilities is often a contentious planning issue, particularly when the facility is proposed to be located close to residential or other areas whose occupants or users are sensitive to odours.

The *Environmental Planning and Assessment Act 1979* and the Environmental Planning and Assessment Regulation 2000 require proponents of new composting and related organics-processing facilities to lodge development applications to the appropriate consent authority (usually the local council).

This first part of the process is likely to require the preparation of an environmental impact statement (EIS). The requirements are set out in the publication *EIS Practice Guideline: Composting and Related Facilities* (DUAP 1996). For applications that involve an EIS, the EPA can require specific information to be included in the EIS at an early stage of the process.

If the facility requires an environment protection licence from the EPA (see Licence conditions, above), under integrated development assessment (IDA) the DEC will be involved in the approval process. It is important that the proponent demonstrate in the EIS that the relevant environmental outcomes specified in Section 4 of these guidelines can be achieved. If adequate information is not supplied, the EPA will request further information to support the development application, and delays in the assessment and approval process will result. Once the EPA has suitable information to support the development application, the EPA provides general terms of approval (GTA) to the consent authority. The GTAs from the EPA would be consistent with the requirements outlined in Section 4. The development consent must incorporate the EPA's general terms of approval. The EPA must ensure that the licence issued is consistent with the development consent.

Further information regarding the issues to consider during the planning of composting and related organics-processing facilities is provided in Appendix A.

Environmental management techniques

Occupiers of the facility are responsible for selecting and applying the best mix of techniques for site development and management for their particular location to meet the required environmental objectives (see Section 4). To help environment protection licence applicants discharge their responsibility, Appendix B of these guidelines provides examples of environmental management techniques covering possible approaches to the design and management of their facilities. These sample techniques will often need modifying to meet the specific environmental issues of the site, and it is likely that techniques alternative to the samples provided in the Appendix have been developed since publication of these guidelines. Thus the sample techniques should be assessed and considered by licence applicants as a starting point for selecting appropriate controls.

Appropriate environmental management techniques to meet the environmental objectives specified in Section 4 for any given site should be chosen in the light of four points:

- Management, design and construction techniques will all depend on early decisions on facility location, the selection of the proposed processing technology, and the types of organics received (see Appendix A).
- Not all techniques will be appropriate to a given facility.
- A combination of design and construction, operations management, monitoring, and remediation measures is generally required to deal with the range of potential environmental impacts for a given site and facility.
- The environmental management techniques, where relevant, meet the minimum requirements specified by the Minimum Design Requirements in Section 5 of these guidelines.

The EPA encourages occupiers to use operational, monitoring or design techniques appropriate to their proposed facility. However, these must satisfy the environmental objectives identified in Section 4 and the Minimum Design Requirements listed in Section 5, which in turn may require additional measures to prevent unacceptable impacts from occurring. The benchmark methods for measuring and monitoring the performance of facilities are described in Section 6.

Alternative methods of measuring performance

Section 6 of these guidelines describes benchmark methods to measure and monitor performance. However, in the spirit of its performance-based approach, the EPA encourages environment protection licence applicants to develop their own site-specific monitoring methods and ways of measuring the performance of facilities against the performance requirements. Applicants must demonstrate that their methods are suitable for assessing compliance with the performance requirements. If alternative methods are approved, the EPA will include them as conditions of a facility's environment protection licence.

If facility occupiers want to use alternative or modified methods to measure and monitor performance, they must provide information to support their environment protection licence applications or specific requests in negotiations on amendments to their existing environment protection licences. Applicants will need to provide documentation that either:

- identifies the extent to which the system is used successfully elsewhere and certifies that:
  - —the conditions are comparable
  - —the system has been operating long enough for its possible consequences to be known
  - —the prospective occupier can duplicate the system that is used
  - —the system works to achieve the desired outcome
  - —there is no opposing evidence
  - —the proposal is compatible with other aspects of the composting and related organics processing facility operation, and
  - —the technique is benign to the environment with respect to all other environmental objectives.

or

- demonstrates:
  - —the soundness of the proposal in field or laboratory tests
  - —that the conditions simulate the proper operating conditions
  - —that the system works to achieve the desired outcome
  - —that there is no opposing evidence
  - —how the EPA can replicate the test results produced by the applicant, if desired
  - —that the proposal is compatible with other operational aspects of the proposed composting and related organics processing facility, and
  - —that the technique is benign to the environment with respect to all other environmental objectives.

If, in the opinion of the EPA, the proposed alternative methods to measure performance will not be adequate for detecting serious or irreversible harm to the environment, the EPA may request an independent expert assessment.

Documenting environmental management

Environmental management plans and systems

The DEC encourages the development and use of environmental management plans (EMPs) and environmental management systems (EMSs), because these can be very useful framework documents that help give details of the processes, procedures and management practices for their facilities (Allen 1999). For example, a water management strategy (see Glossary) that describes the measures to be taken to protect groundwater and surface water would be an item to be included in an EMP. Environmental management plans usually cover items outside EPA

licensing requirements, such as energy and resource conservation; therefore, the EPA does not require EMPs or EMSs to be developed as a condition of licences. However, detailed information that relates to potential environmental impacts, for example the measures described in a water management strategy or a biogas management strategy (see Glossary), must be supplied to the EPA to support the development application even if an EMP is not compiled.

An outline EMP is often required under the integrated development approval process, if the development application process for the facility requires that an EIS be prepared. If you need to prepare an outline EMP, it should address all of the performance requirements and performance measurements (including monitoring strategies) in these guidelines. Appendix C contains a complete list of items that could be included in an EMP for composting and related organics processing facilities.

Water assessment plans

A water assessment plan is an important tool to help the occupier in detecting any pollution at, and emanating from, the premises. A water assessment plan should document background water characteristics before site establishment and should describe (where relevant) the discharge points and monitoring points. It should also identify indicator parameters and limits for each indicator parameter that can be used to detect possible pollution at an early stage. A water assessment plan is usually required under the integrated development approval process, unless the facility poses no pollution threat to waters at, or surrounding, the premises.

Appendix D contains a list of items that could be included in a water assessment plan for composting and related organics processing facilities. See also Section 6 ('Water pollution') for information regarding how the water assessment plan can be used to measure and monitor performance of the facility.

Financial provisions and closure plans for the facility

Financial assurance

The licensee will need to demonstrate that they have the ability to cover the cost of site remediation that may be needed when the composting and related organics processing eventually ceases.

Under the POEO Act, the EPA can require a financial assurance to secure or guarantee funding for remediation or pollution reduction programs from the occupier of a scheduled (licensed) premises. The EPA cannot require a financial assurance unless it is satisfied that it is justified with regards to:

- the degree of risk of environmental harm associated with the activities to be carried out
- any site remediation work that may be required because of activities to be carried out under the environment protection licence
- the environmental record of the holder of the environment protection licence, and
- any other matter referred to in regulations under the Act.

If the EPA requires a financial assurance, it will liaise with the applicant to establish the amount and form of the financial guarantee.

Facility closure

Under the POEO Act, the environment protection licence conditions may require the person who holds the environment protection licence to submit a closure plan to the EPA immediately before the facility is to cease operation.

If the closure plan does not adequately describe how the performance requirements listed in Section 4, Issue 13, will be achieved, the EPA would request further information.

The EPA may approve the submitted closure plan or vary it before approval. If the closure plan cannot be approved, the EPA would not accept surrender of the environment protection licence. Ongoing maintenance of the licence would impose additional administrative costs.

4 GUIDELINES FOR SATISFYING ENVIRONMENTAL OBJECTIVES

Facility environmental management revolves around the facility occupier finding answers to six fundamental questions:

1. What are the key environmental issues associated with the facility?
2. What is the required level of environmental performance for these issues?
3. What environmental management techniques are proposed to address these issues to the required level of environmental performance?
4. How will the environmental management techniques be assessed to determine whether compliance with the objective has been achieved?
5. How can the environmental management techniques be monitored to determine whether the required level of environmental performance has been achieved?
6. What remedial action is proposed should the monitoring show the controls not to be meeting the required level of environmental performance?

In relation to question 1, 13 key environmental issues have been identified for composting and related organics processing facilities and are described in this section. Composting and related organics processing facilities (for definitions see Table 1) should work to satisfy the objectives for each issue. Environment protection licences issued under the POEO Act will require these issues to be managed effectively.

Each environmental issue addressed in this section has up to 4 parts:

- an **objective,** which describes the desired environmental outcome
- **design requirements**, which describe minimum requirements and/or refer to the more detailed Minimum Design Requirements for the protection of waters specified in Section 5, which must be addressed by facility designers. Design requirements may also list and/or refer to acceptable environmental management techniques to be considered by facility planners.

  For facilities that are required to be licensed under the POEO Act, design requirements may be placed into 'general terms of approval' during the development assessment process.

  For facilities that are already licensed under the POEO Act, the design requirements would need to be addressed by facility operators and designers where changes are needed to prevent emissions and discharges from the premises.
- **performance requirements**, which describe what is necessary to satisfy the objective. These requirements generally refer to thresholds of performance that must be achieved during operation of the facility (i.e. after the commissioning of the facility).
- **performance measurements,** which state how performance will be assessed to determine whether the objective is being achieved. Methods to measure and monitor performance are described in Section 6.

Please note that these requirements would need to complement the development assessment process outlined in Section 3, which would take account of the most contentious issues, such as odour generation, odour controls and proximity to boundaries.

The **choice of environmental management techniques (question 3) is not mandated** in the guidelines, but is left up to the occupier to determine on the basis of the specific circumstances of the facility. Appendix B contains examples of techniques that have been shown to be effective

in dealing with the environmental issues. The Minimum Design Requirements for protection of waters in Section 5 identify goals for the design of environmental management techniques and specify the minimum requirements relating to question 3. The performance requirements address question 2 above, and the performance measurements address question 4 and in some circumstances question 5. Section 6 addresses questions 5 and 6.

Occupiers could refer to Appendixes A and B as a starting point to help them in selecting environmental controls. Other sources (such as the References and Bibliography in these guidelines, scientific journals, environmental consultants and industry representatives) may also be consulted when selecting environmental controls.

You may also consult the Waste Management Section of DEC for further information.

Issue 1: Odour

Objective

No emissions of offensive odours outside the boundaries of the premises.

Design requirements

Details of the likely incremental increase in odour impacts must be given in an impact assessment report for odour. This report must be prepared in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2001a).

The *Draft Policy: Assessment and Management of Odour from Stationary Sources* (EPA 2001b) contains a three-level system of odour impact assessment for point and diffuse odour sources:

- Level 1 is a simple screening exercise to identify the potentially affected zone and site suitability for a proposed facility or expansion of an existing facility.
- Level 2 is a simple dispersion modelling procedure that would be undertaken by the proponent or operator.
- Level 3 is a refined dispersion modelling procedure that would be undertaken by the proponent or operator.

Note: The *Draft Policy: Assessment and Management of Odour from Stationary Sources* is accompanied by a separate booklet, *Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW* (EPA 2001c). The Draft Policy may be modified in the final document that is due for release in late 2004, and proponents are advised to check the DEC website (www.environment.nsw.gov.au) for the current Odour Policy.

The odour impact assessment report must at least consider the likely incremental increases relating to the following:

- all phases of processing (e.g. pre-treatment, decomposition, aeration and maturation)
- raw organics and organic products managed at the premises, including impacts during receipt and storage (i.e. including stockpiling of organics)
- movement of raw organics and organic products at and to/from the premises
- management of biogas at the premises (e.g. biogas flaring).

The design of the facility, coupled with the proposed operating procedures, must ensure that the facility does not cause offensive odours outside the premises. Facilities must be designed to meet the odour performance criteria specified in the *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in New South Wales* (EPA 2001a).

Performance requirements

All plant used for processing (e.g. pre-treatment, decomposition, aeration and maturation) and the storage and or movement of raw organics and products must always be maintained and operated in an efficient manner to prevent air pollution from the premises.

Performance measurements

The absence of confirmed complaints about odour emissions shown to be caused by the facility, and demonstrated compliance with any limit conditions imposed on the licence.

Section 6 (see odour) describes methods to measure and monitor performance.

Issue 2: Particulate matter

Objective

Minimise particulate matter emissions from the facility.

Design requirements

Details of the likely incremental increase in PM_{10}, deposited matter and total suspended particulate matter (TSP) due to processing as well as raw organics and product handling at the premises must be given in an impact assessment report for air quality. This report must be prepared in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2001a) (see note below regarding $PM_{2.5}$).

The design of the facility, coupled with the proposed operating procedures, must ensure that the predicted incremental increase in particulate matter from the above modelling will satisfy the impact assessment criteria specified in the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* and will comply with the requirements specified in the Clean Air (Plant and Equipment) Regulation 1997.

Performance requirements

The processing facility must be operated in such a manner and raw organics and products must be always managed in such a manner that the assumptions made in the impact assessment modelling are continuously maintained and emissions comply with requirements specified in the Clean Air (Plant and Equipment) Regulation 1997.

Performance measurements

The absence of complaints about particulate matter emissions shown to be caused by the facility.

Emissions comply with the requirements specified in the Clean Air (Plant and Equipment) Regulation 1997.

Section 6 (see particulate matter) describes methods to measure and monitor performance.

Biological particulate matter:

These guidelines specify neither performance requirements nor performance measurements for biological particulate matter, because standardised sampling methodology was lacking at the time of publication of the guidelines. In addition, there is also a lack of consensus on the many types of sampling methods, equipment and assay methods available for biological particulate matter (Swan *et al.* 2002; Environment Agency 2003). Measures that mitigate emissions of non-biological particulate matter (such as PM_{10}, deposited matter and TSP matter) are also likely to mitigate emissions of biological particulate matter (Pillai & Ricke 2002).

Particulate matter in the size range up to 2.5 µm ($PM_{2.5}$)

$PM_{2.5}$ is primarily a human health issue, because $PM_{2.5}$ are small enough to penetrate into the lungs and are associated with a range of respiratory symptoms (Gilbert 1998; Swan *et al.* 2002). Information regarding the impact of emissions of $PM_{2.5}$ is available from the NSW Health Department and / or WorkCover NSW.

The EPA recommends that $PM_{2.5}$ be controlled by environmental management techniques that address PM_{10} (see Appendix B), because methods that measure and monitor PM_{10} include particles smaller than 10 µm (i.e. particles of the size range up to 2.5µm) (see Section 6).

Issue 3: Methane gas management

Objective

Minimise emissions of methane to air and diffusion through soil strata such that the risk to humans in confined spaces (such as explosions and suffocation) is minimal.

Design requirement

The design of **aerobic** composting and related organics processing facilities coupled with proposed operating procedures must ensure that the generation of methane is minimised.

The design of **anaerobic** composting and related organics processing facilities must ensure that environmental controls are in place for the containment, extraction and treatment of any biogas generated and must comply with *Australian Standard AS 2865-1986 Safe Working in a Confined Space*, the NSW Occupational Health and Safety (Confined Spaces) Regulation 1990 and the NSW *Occupational Health and Safety Act 2000.*

Biogas extraction and treatment equipment must be designed to ensure that as much biogas as is commercially practicable will be collected and treated or beneficially reused.

For further information regarding the design requirements and performance requirements relating to occupational health and safety at composting and related organics processing facilities, consult WorkCover NSW.

Note: Facilities that incorporate both anaerobic and aerobic processing stages must demonstrate compliance with both of the above design requirements.

Performance requirements

Aerobic composting and related organics processes must be operated, managed and maintained in such a manner that (where relevant) anaerobic conditions are mitigated.

Anaerobic composting and related organics processes must be operated, managed and maintained to contain, extract and treat all biogas generated. Occupiers of such facilities must implement and maintain procedures in accordance with the requirements of the occupational health and safety standards specified in the design requirement above.

Performance measurement

Absence of complaints about odours that are shown to be caused by anaerobic processes at the premises.

Where biogas is produced, it is extracted and utilised to the highest commercially practicable level.

Establishment of procedures and training of staff to meet the requirements of the occupational health and safety standards specified in the design requirement above.

Section 6 describes methods of measuring and monitoring performance.

Issue 4: Emissions of nitrogen oxides, sulfur oxides and non-methane organic compounds

Objective

Minimise emissions of nitrogen oxides (NO_2 and NO), sulfuric acid mist (H_2SO_4), sulfur oxides (SO_3 and SO_2) and non-methane volatile organic compounds (NMVOC) whenever using gas flare or electricity-generating equipment.

Design requirements

An impact assessment report for air quality must be prepared in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales*. The report must demonstrate that the facility is designed to comply with the following requirements:

- impact assessment criteria for any air pollutant likely to be emitted (e.g. NO_2 and SO_2), as specified in the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales*
- provisions specified in the Clean Air (Plant and Equipment) Regulation 1997.

Emissions from the biogas engine exhaust must not exceed the concentration limits specified for the following pollutants:

- nitrogen oxides (NO_2 and NO) concentration of 450 mg/m^3 (dry) at 273 K, 101.3 kPa and 7% O_2
- sulfuric acid mist (H_2SO_4) and / or sulfur trioxide concentration (as SO_3) of 100 mg/m^3 (dry) at 273K and 101.3 kPa.

The electricity-generating equipment must be designed to ensure a volatile organic compound (VOC) destruction efficiency of at least 98%.

The biogas flare must be located at ground level, shrouded, provided with automatic combustion air control, an automatic shut-off gas valve and an automatic restart system. It must also be designed so that as much biogas as is practicable will be collected and treated or beneficially reused.

The biogas flare must be designed to meet or exceed the following combustion parameters:

- instantaneous residence time of 0.6 seconds
- instantaneous temperature of 760°C.

Any liquid condensed from the biogas must not pollute groundwater or surface water and must not have an impact on amenity (such as odour problems).

Performance requirements

Any biogas flare or electricity-generating equipment must be operated and maintained in a proper and efficient manner and must comply with any licence conditions for air pollutants.

Emissions must comply with requirements specified in the Clean Air (Plant and Equipment) Regulation 1997 and the emission concentration limits specified above.

Performance measurements

Any biogas flare or electricity-generating equipment at the premises must conform to the design requirements, including the provisions of the Clean Air (Plant and Equipment) Regulation 1997 and the emission concentration limits specified above.

Section 6 describes methods of measuring and monitoring performance.

Issue 5: Water pollution

Objective

Prevent water pollution. Surface or underground discharges of leachate and water from the facility must not pollute groundwater or surface waters.

Design requirements

(**Note**: Specific Minimum Design Requirements for the protection of waters are provided in Section 5.)

The **working surfaces**, including the incoming organics and product storage areas, the active composting pad (for windrow composting) and access roads must meet the minimum requirements specified in Section 5, '1: Working surfaces'.

The design requirements for a **leachate barrier system** depend on the head of liquid (leachate) acting upon it and must at least conform to the leachate barrier systems listed in Section 5, '2: Leachate barrier system'.

It is possible that the working surfaces of the site or building, together with the leachate drainage and collection system, will act as a leachate barrier to prevent pollution of the subsoil, groundwater and surface water bodies, so a separate leachate barrier may not be required. In such situations, the **reasons for not fitting a separate leachate barrier system must be clearly documented.**

Unless the reasons for not fitting a separate leachate barrier are justified and approved by the EPA, a specially designed leachate barrier system to prevent pollution of the subsoil, groundwater and surface water bodies must be installed for all composting and related organics processing facilities that:

- process Category 2 or 3 organics
- are operated in trough, trenches or pits that are below ground level
- are set up on a terrain of highly permeable soil, or
- are set up over, or near, vulnerable groundwater or surface resources(s) requiring protection. Where the Department of Infrastructure, Planning and Natural Resources (formerly the Department of Land and Water Conservation) has prepared groundwater vulnerability maps, the areas of concern are those mapped as 'high' or 'very high' vulnerability.

If the preliminary water assessment of the site (see Appendix A) finds that the groundwater underneath and adjacent to the facility is vulnerable and that systems to prevent groundwater pollution are required, then a **groundwater and subsoil monitoring network** must be

established. The design of the groundwater and subsoil monitoring network must at least meet the minimum requirements specified in Section 5, '6: Groundwater and subsoil monitoring network'.

The **leachate collection system** must be designed to prevent water pollution and odour problems. Section 5, '3: Leachate collection system', lists acceptable techniques.

The design of the **leachate storage system** must a least comply with the minimum requirements and the acceptable characteristics specified in Section 5, '4: Leachate storage system'.

The design of **surface water controls** must at least meet the minimum requirements specified in Section 5, '5: Surface water controls'.

Performance requirements

Any leachate and surface water management systems (such as storage and barrier systems) must be maintained in such a way that they always conform to the design requirements.

Performance measurement

Any leachate and surface water management systems (such as storage and barrier systems) on the premises must conform to the design requirements.

Section 6 (see Water pollution) describes methods of measuring and monitoring performance.

Issue 6: Suitability of incoming organics

Objective

Ensure that incoming organics do not have negative environmental impacts (such as air quality impacts) or amenity impacts (such as odour).

Design requirements

Occupiers must design and put in place an incoming material-screening system that ensures that they receive only those categories of organics (see Section 3 Table 3: Categorisation of organics) that are suitable for both the processing techniques and the environmental controls installed at the facility.

Specifically, occupiers **must not receive** the following categories of organics at composting and related organics processing facilities:

- organics other than those permitted in their licences (see Section 3 Table 3)
- organics seized or subject to controls issued by the Australian Quarantine Inspection Service (AQIS) or NSW Agriculture or another agricultural agency, **unless** the facility receives and complies with any additional requirements that AQIS or the agricultural agency may impose to ensure destruction or inactivation of the contaminants or pathogens of concern
- organics that are contaminated by chemicals and/or pathogens that **will not be** rendered harmless by the process or that may constitute a health or environmental risk, including clinical waste and other related wastes of clinical origin, and diseased carcasses
- organics containing contaminants classified as **hazardous wastes** or **industrial wastes** in any statutory instruments (see: *Protection of the Environment Operations Act 1997* and *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (EPA 1999a)).

The occupier must design and implement methods and operating practices to screen incoming organics to ensure that only those organics permitted to be received at the facility are received (for examples, see Appendix B).

The quantity of organics received for processing and the finished products transported from the premises must be measured or estimated as precisely as possible (see Section 6).

Performance requirements

The processing facility must not receive any of the organics listed above and must not receive any category or type of organics other than those permitted to be received at the premises, as specified in the environment protection licence or any other terms of consent.

The quantity of organics permitted to be received at the premises as specified in the environment protection licence (e.g. as specified by the fee threshold) or any other terms of consent must not be exceeded.

Operating practices to screen incoming organics must be employed for all organics received at the facility.

Performance measurement

Compliance with the objective will be determined by assessment of the following:

- implementation of procedures to screen incoming organics
- documented evidence of the category or type and quantity of organics received at the facility
- the presence in the storage, preparation and processing areas, within the bounds of due diligence, of only those categories of organics that belong to the categories of organics (see Table 3) specified on the facility's environment protection licence.

Section 6 describes methods for measuring and recording the category or type and quantity of organics received at the facility.

Issue 7: Safe storage and disposal of process residuals and contaminated organics

Objective

Prevent water pollution and amenity impacts (such as odour and dust).

Design requirements

The design of the facility must include infrastructure to securely store all organics, contaminated products, wastes, and process residues that cannot be beneficially processed at the facility, until they can be lawfully disposed of at the facility or transferred to another facility.

The working surfaces used to store all incoming organics, contaminated products, wastes and process residues must meet the minimum requirements specified in Section 5, '1: Working surfaces' and '5: Surface water controls'.

Performance requirements

Any organics, contaminated products, wastes, and process residues are stored according to the design requirements.

Any wastes generated at the premises must be disposed of lawfully: for example, in accordance with the POEO Act and the Protection of the Environment (Waste) Regulation 1996, the occupier must comply with the following:

- Before dispatching any waste from the premises the occupier must classify or assess waste in accordance with the Waste Guidelines.

- The occupier must ensure that any waste dispatched from the premises is sent to a waste facility that is licensed to receive it or to premises that may otherwise lawfully receive it.
- For wastes classified or assessed as hazardous waste, industrial waste or Group A waste, the facility occupier must comply with the waste-tracking requirements specified in the environment protection licence and / or Protection of the Environment Operations (Waste) Regulation 1996.

Performance measurements

Compliance with the objective is measured using the following:

- There are no contaminated organics, materials, wastes or residues outside the secure storage areas provided for them at the facility.
- There is documented evidence (e.g. waste tracking data) that demonstrates that the occupier has lawfully disposed of contaminated products, wastes or residues that it has generated at the facility.

Issue 8: Stockpiling of incoming and processed organics

Objective

To minimise stockpiling of unprocessed and processed organic materials above that required for processing or to meet market requirements.

Design requirements

The occupier must demonstrate during the planning stage that potential markets for processed organics have been identified, including the projected quantities of processed organics that each type of market will absorb.

The projected maximum quantities of incoming and processed organics stored at the premises at any one time, and the management procedures to control odour, leachate and heat generation must be identified in the planning stage. (Appendix B contains suggested stockpile targets and management procedures.)

Performance requirement

Any incoming and processed organics must be stored and managed in quantities not exceeding the design requirements.

Performance measurement

The quantities of incoming and processed organics (identified during the planning stage) stored at the premises are not exceeded.

Issue 9: Noise

Objective

Minimise noise emissions.

Design requirements

The assessment of noise impacts must be conducted in accordance with the *NSW Industrial Noise Policy* (EPA 2000b), which includes the following basic steps:

- determining existing background and ambient noise levels, using the method commensurate with the expected level of impact and as specified in the *NSW Industrial Noise Policy* (EPA 2000b)

- using the procedure specified in the *NSW Industrial Noise Policy* as the basis for deriving project specified noise levels
- predicting the noise levels produced by the proposed facility, having regard to meteorological effects (such as wind and temperature inversions)
- comparing the predicted noise levels with the project-specific noise levels produced by the proposed facility, to establish any impact.

The design of the facility coupled with the proposed operating procedures must satisfy the requirements of the *NSW Industrial Noise Policy* (EPA 2000b); consideration must be given to the mitigation strategies for noise control identified in Section 7 of the Policy.

Performance requirement

The site-specific noise level determined for a particular facility will be determined / negotiated in accordance with the objectives of the *NSW Industrial Noise Policy* and thus will include consideration of the receiver's land-use type, the existing background and ambient noise levels, and the nature, level and characteristics of the source noise.

In some instances the site-specific performance requirement for noise emissions, under typical meteorological conditions relevant to the site, may be specified in environment protection licences.

Performance measurements

The absence of complaints about noise emissions shown to be caused by the facility that exceed the relevant criteria when sampled and analysed in accordance with the methods prescribed in the *NSW Industrial Noise Policy*

Issue 10: Litter

Objective

The local amenity must not be degraded by litter emanating from the composting and related organics processing facility.

Design requirements

The design of the facility coupled with proposed operating procedures must control litter and site materials to ensure that the local amenity is not degraded by litter or site materials emanating from the premises. For example, design and operating procedures must prevent vehicles leaving the facility from distributing mud, sediment, litter, or site materials beyond the boundary of the premises, and must ensure that regular inspections are carried out and any litter found is cleaned up immediately.

Performance requirements

The processing facility must be operated and maintained in such a manner that litter and site material do not emanate beyond the boundary of the premises.

Performance measurements

Compliance is measured by:

- absence of mud and other types of dirt, organics, wastes and litter being carried by vehicles from the facility that could be deposited on roads outside the facility and on nearby streets
- inspection of the facility and nearby areas to confirm that effective steps are being taken to keep the facility free of litter, as shown by the absence of wind-blown litter and site materials within one working day after windy weather (see Appendix B).

Issue 11: Security of the premises

Objective

Ensure that the premises are secure.

Design requirement

The occupier must put into place provisions for denying unauthorised access to the following areas:

- areas used for receiving, storing and processing of organics, process residuals and contaminated materials
- all areas used to store flammable materials.

Performance requirements

The occupier must prevent unauthorised entry to the areas of the facility used for receiving, storing and processing of organics, process residuals and contaminated materials and all areas used to store flammable materials.

Performance measurements

Compliance with the performance requirement is determined by assessing whether the occupier has established and implemented procedures for preventing vehicles or persons from being on the premises without their presence being recorded in a permanent way.

Issue 12: Fire management

Objective

To ensure that the facility is not a fire risk and that the facility is adequately prepared in the event of fire.

Design requirements

The occupier must prepare a fire management strategy that must identify at least the following:

- the potential causes of fire at the composting facility
- the procedure to follow, persons responsible, and equipment to be used in the event of a fire. This will include on-site resources and external resources (such as the Bush Fire Brigade), and details of how the procedure will operate on a 24-hour-a-day basis.
- the maintenance schedules for all fire-fighting equipment and facilities. At a minimum, all equipment and facilities should be visually checked for damage on a weekly basis, and test-operated on a quarterly basis.
- details of all the fire-fighting equipment that will be installed at the flammable store and at site buildings.
- how all fire-fighting equipment will be clearly signposted and how access to it will be ensured at all times
- details of the firebreaks to be constructed and maintained around all filled areas, stockpiles of combustibles, gas extraction equipment and site buildings
- training of facility staff in fire-fighting techniques.

Performance requirement

The fire management strategy must be maintained and available to relevant staff trained in the procedures and techniques outlined in the fire management strategy.

Performance measurements

Compliance with the performance requirement is determined by assessing whether the occupier has:

- equipment and associated signage installed and maintained as specified in the fire management strategy
- trained staff in the maintenance procedures and fire-fighting techniques outlined in the fire management strategy.

Issue 13: Closure of the facility

Objective

To ensure that, after closure, the composting and related organics processing facility does not cause environmental harm.

Design requirement

Before closure of the facility the occupier must prepare a closure plan for approval by the EPA.

Performance requirements

The minimum requirements for site remediation when the facility closes are as follows:

- products, feedstock, amendments, contaminated products, process residues or chemicals must not remain on the premises
- all equipment (including appliances, bins and process areas) must be emptied, cleaned and disinfected
- all equipment must be removed from the premises, unless it can be demonstrated that the equipment that remains will not have the potential to cause environmental impacts and is needed for subsequent uses of the site
- the facility must be revegetated or otherwise made stable and suitable for the proposed future land use of the site. The revegetation of any exposed working areas must be started within 30 days of cessation of composting and related organics processing (weather permitting), and the final revegetation layer must be of a depth and type sufficient to support the revegetation scheme proposed.
- the final surfaces prepared on the site must control surface erosion and protect local amenity
- groundwater monitoring and monitoring of surface water bodies must be continued until it demonstrates the absence of any pollution that would pose a threat to the quality of groundwater, surface waters or surface water bodies.

Performance measurement

Compliance with the performance requirement will be assessed against the following:

- the minimum requirements specified above
- compliance with the POEO Act, particularly those provisions relating to facility closure (see Section 3), water and air pollution, and the emission of odour.

5 MINIMUM DESIGN REQUIREMENTS FOR THE PROTECTION OF WATERS

Section 4 Issue 5 of these guidelines contains design requirements for protection of waters. The design requirements described in this section are the **minimum requirements** that must be met when occupiers are developing and selecting cost-effective techniques suitable and appropriate to satisfy the environmental objective for the protection of waters. They are not 'one size fits all' requirements. Because of the nature of the facility or its location, the proponent may identify the need for a more rigorous design, or the EPA or the local planning authority may determine that more stringent requirements need to be imposed.

1. Working surfaces

Goal

To ensure storage areas, active composting surfaces, and associated access roads are constructed to prevent the pollution by leachate of subsoil, groundwater and surface water bodies and to allow all-weather vehicular access to any part of the processing site that needs to be reached by vehicles.

Minimum Design Requirement

The working surfaces, including the incoming organics, final product, process residuals and contaminated material storage areas, the active composting pad (for windrow composting) and access roads, must:

- be bunded and graded sufficiently to prevent both run-on and run-off of surface water
- be designed and constructed from an inert low-permeability material such as compacted clay, modified soil, asphalt or concrete over a compacted base able to support, without sustained damage, the load of material on it and the load of any machinery used in the composting facility
- be able to support all structures, machinery and vehicles as applicable and allow access to any utilised part of the processing site, irrespective of the weather conditions; vehicles may include:

  —transport vehicles used for the delivery of organics and the transport of finished products

  —mobile equipment used in all phases of all the processes operated on the site

  —fire-fighting vehicles and equipment.

2. Leachate barrier system

Goal

To prevent the pollution by leachate of subsoil, groundwater and surface water bodies over the period of time that raw organics or products remain on the premises, beyond the closure of the facility, and until the premises has ceased to pose potential environmental threats.

Minimum Design Requirement

The material processing or storage areas of the facility must have a leachate barrier system that forms a secure barrier between the groundwater, soil and substrata and the composting or stored organics. Acceptable leachate barriers include:

- a clay or modified soil liner consisting of at least 600 mm of recompacted clay with an in-situ permeability (K) of less than 10^{-7} ms^{-1}. Such liners should be placed in successive layers up to 300 mm uncompacted thickness. Each underlying layer should be scoured to prevent excessive permeability due to the lamination.
- a natural geological barrier that is proven by competent geotechnical investigations to provide a secure barrier between the groundwater, soil and substrata and the composting organics, equivalent to the 600-mm recompacted clay above
- a concrete or asphalt cement pad of a thickness of at least 100 mm, designed to withstand the loads from all machines, vehicles and equipment that are required to operate the facility.

The basis of the design adopted for the leachate barrier system **must** be documented in the water management plan.

3. Leachate collection system

Goal

To ensure that leachate is collected efficiently at the composting and related processing facility for further management, thereby avoiding water pollution and/or odour problems.

Minimum Design Requirement

The leachate collection system must include:

- conduction of all feedstock storage, active composting and mature compost storage on a specially prepared low-permeability pad (see 'Working surfaces' and 'Leachate barrier system' in this section)
- installation of a drainage layer underneath the processing area to provide adequate leachate drainage from composting organics. This may consist of a bed of coarse material such as wood chips, or alternatively the processing platform may permanently incorporate a drainage layer designed to withstand the loading, working and removal of compost.
- for small-scale facilities or facilities in drier areas, incorporation of an absorbent material in compost and at the base of the pile
- design and maintenance of the slope and orientation of windrows and/or leachate drains such that free drainage of leachate to a collection drain is permitted and ponding of leachate is avoided
- shaping of the piles and windrows to maximise run-off and hence reduce infiltration
- enclosing of leachate drains to reduce the emission of odours.

4. Leachate storage system

Goal

To ensure that leachate is stored efficiently at the composting and related processing facility for further management, thereby avoiding water pollution and/or odour problems.

Minimum Design Requirement

The design of the leachate storage system must at least comply with the following requirements:

- Leachate must be collected and stored in either a dam that is lined (see below for acceptable characteristics) or in above-ground storage tanks.

- Above-ground storage tanks must be surrounded by a bund with a capacity of 110% or greater than that of the tanks within the bund.

  (**Note:** Above-ground tanks are the preferred option for leachate storage.)

- Leachate dams or tanks must have monitoring equipment installed (such as **high-level alarms** that are interlocked to the discharge pump or line), or the occupier must implement management practices to ensure that they cannot be overfilled
- If the leachate dam or tanks are open at the top, they must be capable of at least accepting the run-off or leachate generated by any 1-in-10-year, 24-hour-period storm event without overflowing.

Acceptable characteristics of a suitable leachate-dam liner include:

- There should be a clay or modified soil liner consisting of at least 900 mm of recompacted clay with an in-situ permeability (K) of less than 10^{-9} ms^{-1}. Successive layers should be of compatible material, and each underlying layer should be scoured to prevent excessive permeability due to the lamination. The sides should generally have a slope not exceeding a gradient of one vertical to three horizontal, in order to allow suitable compaction of the barrier and to facilitate subsequent testing.
- If the leachate dam is located in an area of poor hydrological conditions or otherwise poses a significant potential threat to surface or groundwaters, the clay or modified soil liner should be overlaid with a flexible membrane liner (FML) of permeability (K) for water of less than 10^{-14} ms^{-1}. The FML should have material properties that ensure it can maintain this permeability for a period at least equivalent to the desired working life of the leachate dam. The FML should have a minimum thickness of 1.5 mm and should be laid according to the procedures outlined in an approved construction quality assurance program. All joins and repairs should be fully tested to ensure that the liner's integrity is not breached at these locations, and the FML should be protected against load-induced damage.

5. Surface water controls

Goal

To avoid the generation of excessive leachate and to prevent any sediment or pollutants from being carried off the premises.

Minimum Design Requirement

The surface water controls must at least meet the following requirements:

- The facility must be designed to prevent surface water from mixing with the organics received and processed at the premises and the final products, process residuals and contaminated materials stored at the premises.
- All water that has entered processing and storage areas and water that has been contaminated by leachate must be handled and treated in the same manner as leachate.
- All surface water that has been collected from areas such as cleared or non-vegetated surfaces must be treated in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). For large, exposed facilities the facility planner / site occupier should contact the DEC regarding the application of the Landcom guideline to their particular facility.
- Exposed areas at the composting and related organics processing facility site must be minimised. The occupier must not clear more than the minimum area needed.

- The facility should be designed to contain one or more catch basins capable of collecting all surface water generated from the design of a 1-in-10 year, 24-hour-period storm event without overflowing.
- It should be designed such that any surface water that has come in contact with the processing and/or storage area and/or that has been contaminated by leachate must be handled in the same manner as leachate.

Note: For sites where discharges of surface water to surface water bodies such as rivers, creeks and dams cannot be avoided, stringent quality and discharge conditions will be attached to the environment protection licence. Where such licensed discharges occur, discharge limits on the environment protection licence will be negotiated on a site-by-site basis. These negotiations will take into account the nature of the waste water, the available treatment options, and the available ambient water quality and flow objectives, such as the *Water Quality and River Flow Interim Environmental Objectives* for that catchment. (Copies of the *Water Quality and River Flow Interim Environmental Objectives* for each catchment can be obtained from the DEC website at www.environment.nsw.gov.au/ieo/ or by calling the DEC Pollution Line on 131 555.)

6. Groundwater and subsoil monitoring network

Goal

To provide an effective system for monitoring the characteristics of groundwater and/or subsoil at various parts of the premises and to rapidly detect any pollution of groundwater and/or subsoil.

Minimum Design Requirement

The minimum requirements for establishing an effective groundwater and subsoil monitoring network are as follows:

- There should be one monitoring bore per aquifer, located down the hydraulic gradient from the processing area. **Note:** It is advisable, however, to also locate one monitoring bore per aquifer up the hydraulic gradient from the processing area so that you can establish whether any change in water quality detected down-gradient has been caused during the passage of the water under the processing area.
- When it is not possible to locate hydraulically up-gradient bores, a sufficient number of samples must be taken at compliance-point bores before composting and related organics processing activities start, in order to characterise the background characteristics of the groundwater.
- If only one thin (less than 5-m thick) aquifer is identified on site, then single, fully slotted bores are sufficiently reliable indicator bores for pollutants.
- If multiple aquifers are identified on site, or an aquifer of a thickness greater than 5 m is identified, the monitoring bores should be:

  —a nest of bores, slotted over different intervals, or

  —a multi-port bore, or

  —an appropriate combination of both.
- When there is no evidence of groundwater, the groundwater monitoring and subsoil monitoring network must include the installation of suction lysimeters to extract pore water and monitor the vadose zone beneath the composting and related organics processing facility and at suitable locations surrounding the facility. This procedure will indicate the presence of leachate in the subsoil and allow its analysis.

- Monitoring wells should have a minimum internal diameter of 50 mm; have sampling ports of suitable strength, with slotted sections; and be gravel packed and have cement/bentonite seals between the sections. The occupier must ensure that the porous media surrounding the monitoring bores and the lysimeter cup are composed of material that does not affect the accuracy of the sample.
- The standpipe of the monitoring bores must be adequately sealed near ground level with cement-based grout and a security cover must cover the top of the standpipe; additionally, the standpipe must be constructed in such a way to prevent the ingress of surface water and to prevent extraneous material (such as insects) from getting into the well.
- For installation and bore maintenance, the following standard texts may be referenced:

  —*Handbook: Groundwater. Volume II: Methodology* (USEPA 1991)

  —*Guidelines for Groundwater Monitoring at Municipal Landfill Sites* (Hirschberg K-J 1993)

  —*Minimum Construction Requirements for Water Bores in Australia* (ARMCANZ 1997).

6 BENCHMARKS FOR MEASURING AND MONITORING PERFORMANCE

Section 4 of these guidelines contains performance measurements that state how the EPA will determine whether the objective for each environmental issue relating to composting and related organics processing facilities is being achieved. This section describes the minimum requirements that must be met when occupiers are developing and selecting cost-effective techniques suitable and appropriate for measuring and monitoring performance of their facilities.

If facility occupiers want to use alternative or modified methods to measure and monitor performance (see Section 3), they must provide written information to support their environment protection licence applications or to support specific requests in negotiations on amendments to their existing environment protection licences. If the benchmarks identified by this Section for measuring and monitoring performance are not suited to the proposed facility, then documentation submitted to the EPA must clearly establish that the proposed alternative methods to measure performance will detect serious or irreversible harm to the environment (see Section 3). Similarly, if the facility occupier identifies that the proposed facility or amendments to an existing environmental protection licence will not pose potential environmental harm, then they must provide the EPA with written information to justify why the methods for measuring and monitoring performance (as identified in this Section) will not be used.

For further information regarding the documentation that will need to be provided for proposing alternative techniques methods to measure performance, refer to Section 3.

Odour

Odour emissions must be sampled and measured by the methods prescribed in *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (EPA 1998).

All complaints reported to the occupier regarding odour must be considered in the light of meteorological data and / or delivery of unusual organics to identify any correlations. Site-specific meteorological data (see below) must therefore be collected and recorded in accordance with *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2001a).

In general, the EPA encourages the establishment of meteorological stations at all composting and related organics processing facilities to help verify odour complaints. In some instances the EPA **may require** monitoring of meteorological conditions.

Meteorological stations installed at composting and related organics processing facilities should, where practicable, continuously measure and electronically log the following parameters:

- wind speed at 10 metres (m / s)
- wind direction at 10 metres (°)
- ambient temperature at two levels (2 metres and 10 metres) (°C)
- parameters needed to determine the Pasquill-Gifford stability class—that is, either sigma theta (°) or solar radiation (W / m^2).

These parameters must be sampled and analysed in accordance with the general methods for ambient air monitoring prescribed in *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (EPA 1998).

The methods specified in the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (EPA 1998) must be used for establishing, siting, operating and maintaining meteorological equipment.

Particulate matter

If the EPA requires ambient monitoring in conditions of environment protection licences, sampling and analysis of these air pollutants, including the requirements for sampling of PM_{10}, deposited matter and total suspended particulate (TSP) matter, must be conducted in accordance with the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (EPA 1998) (see also note in Section 4 relating to $PM_{2.5}$).

Notes

To date, the literature indicates that best practice to minimise emissions of biological particulate matter is to implement environmental controls that minimise measurable emissions of all particulate matter such as PM_{10}, deposited matter and total suspended particulate (TSP) matter (see also note in Section 4 relating to biological particulate matter).

At the time of publication of these guidelines the UK Environment Agency had published a draft technical guidance document for *Monitoring of Particulate Matter in Ambient Air around Waste Facilities* (Environment Agency 2003). The document provides a methodology for measuring biological particulate matter (or bioaerosols).

Emissions of nitrogen oxides, sulfur oxides, non-methane organic compounds and volatile organic compounds

Sampling positions must be selected in accordance with test method TM-1 specified in *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (EPA 1998).

The EPA may require periodic stack emission testing for air pollutants and odours (such as nitrogen oxides, sulfur oxides, non-methane organic compounds and volatile organic compounds (VOC) destruction efficiency). These requirements for emission testing and VOC destruction efficiency will be specified by environment protection licence conditions and may include requirements to monitor:

- at the biogas engine exhaust:
  - sulfuric acid mist (mg/m^3), sulfur trioxide (mg/m^3), sulfur dioxide (mg/m^3), oxides of nitrogen (NO_2 and NO) (mg/m^3), carbon monoxide (ppm), volatile organic emissions (ppm), velocity (m/s), volumetric flow rate (m^3/s), temperature (°C), moisture content in stack gases (%), dry gas density (kg/m^3), molecular weight of stack gases (g/gmol), carbon dioxide in stack gases (%), oxygen in stack gases (%)
- at the line supplying biogas to the biogas engine:
  - volatile organic compounds (ppm), velocity (m/s), volumetric flow rate (m^3/s), temperature (°C), moisture content in stack gases (%), dry gas density (kg/m^3), molecular weight of stack gases (g/gmol), carbon dioxide in stack gases (%), oxygen in stack gases (%)
- the combustion parameters of the biogas thermal oxidation equipment or the biogas flare, including volumetric flowrate (m^3/s) and temperature (°C).

To determine compliance with the performance requirements specified in Section 4, occupiers must undertake sampling and analysis of air pollutants strictly in accordance with the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (EPA 1998).

Water pollution

Water assessment plan

Before site establishment, a comprehensive hydrological investigation of both the site and the surrounding groundwater and surface water bodies would have been conducted (see Appendix A). This preliminary water assessment of the site establishes the background characteristics of the groundwater and surface water bodies that may be at risk from the composting and related organics processing facility. This information therefore forms the basis for ongoing management and assessment of water at the site.

A water assessment plan (Appendix D) needs to be developed to enable the occupier to detect any water pollution at the premises (see over the page). A water assessment plan should document the background characteristics of water (established during the preliminary water assessment of site) and describe (where relevant) the discharge points and monitoring points. It should also identify indicator parameters and limits for each indicator parameter that can be used to detect early indications of possible water pollution.

Appendix D contains a list of items that should be included in a water assessment plan for composting and related organics processing facilities.

Sampling of water pollutants

The appropriate methods contained in *Approved Methods for Sampling and Analysis of Water Pollutants in NSW* (EPA 1998) must be used for sampling or analysing surface water bodies, groundwater or leachate, unless the EPA has expressly approved other methods.

The water assessment plan (Appendix D) must consider the monitoring of the performance of the composting and related organics processing facility at the following locations and using the frequency of monitoring specified below:

- **Surface water bodies (such as rivers, creeks and dams):** Representative samples must be collected **quarterly** and tested for total suspended solids and the indicator parameters selected in the water management plan (see Appendix D).
- **Groundwater:** All groundwater monitoring bores and lysimeters must be sampled **quarterly** by a suitably qualified person. This frequency can be relaxed if it can be demonstrated that there are no seasonal effects after data have been collected for five consecutive years. Tests should be taken with a representative sample for all the indicator parameters selected in the water management plan (see Appendix D).
- **Leachate:** Representative samples must be taken **quarterly** or for each **batch of processed organics** and tested for all indicator parameters identified in the water management plan (see Appendix D).

  Initial characterisation testing of leachate should be taken for aromatics, volatiles, halocarbons and the base, neutral and acid-extractable organic contaminants that could be detected by Methods 8260 and 8270 (USEPA 1992).
- **Discharge to surface water bodies:** Where such licensed discharges occur, sampling requirements, such as frequency of sampling, will be negotiated on a site-by-site basis. These negotiations will take into account the nature of the discharge. Sampling must be taken with a representative sample for all the indicator parameters selected in the water management plan (see Appendix D).

Assessment of water monitoring results

Use statistical procedures for all analytical results to determine whether there has been a significant (90% confidence level) change in the value of one or more of the indicator parameters specified in the water assessment plan (see Appendix D). Analysis of variance or other suitable statistical techniques can be used to perform this assessment. For a discussion of the statistical analysis of groundwater data see *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (USEPA 1989). The occupier may need expert help to obtain reliable water monitoring data and / or to interpret it correctly. Helpful information concerning water quality investigation can also be found in *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (EPA 1998).

If sampling of groundwater monitoring bores, lysimeters, surface water bodies or licensed discharges indicates levels for any indicator parameter exceeding the limits specified in the water assessment plan (Appendix D), then the affected groundwater monitoring bores, lysimeters, surface water bodies or licensed discharges must be **resampled** as soon as possible.

Note that if the anomaly is verified in resampling the EPA must be notified as required in the environment protection licence.

Under the POEO Act, if pollution incidents causing or threatening material harm to the environment are detected, then the facility occupier must take immediate action to contain the pollution. They must report the incident to the appropriate regulatory authority in accordance with the POEO Act, giving details such as the nature and source of the pollution, any actions taken, and any future action that will be carried out to prevent recurrence. If the EPA directs the future actions, these must be commenced as soon as practicable.

Water assessment report

The water assessment report is prepared to report the extent of failure of water and / or leachate management when assessment of water monitoring results indicates a possible water pollution incident.

The water assessment report must document:

- the specific indicator parameters exceeding the limits specified in the water management plan or discharge limits specified in the environment protection licence
- the extent of the pollution
- possible causes of exceedences of the indicator parameter limits listed in the water management plan or discharge limits specified in the environment protection licence
- any other relevant information.

Water pollution remediation plan

If the water assessment report indicates that action is required to mitigate the pollution and remediate the water, then a water pollution remediation plan must be prepared. The information obtained during preparation of the water assessment report must be considered during preparation of the water pollution remediation plan.

The water pollution remediation plan is a structured plan for the remediation of groundwater, subsoil or surface water bodies when a preliminary water assessment of the site (Appendix A) or an assessment of water monitoring results indicates pollution that requires remediation. The information obtained during preparation of the water assessment report must be considered for preparing the water remediation plan.

The water pollution remediation plan must:

- document why the pollution occurred
- document the process to be used to protect water from further pollution
- document assessment of practicable ways of returning the water to the original quality
- where relevant, document identification and remediation of contaminated sediments.

Appendix B contains further information relating to environmental management techniques for identifying and assessing the clean-up of pollution incidents.

Example: If assessment of groundwater monitoring indicates significant increases in values of indicator parameters, then resampling should be undertaken to validate the increase. If the increase is validated by the resampling, this may be evidence that leachate has been in contact with groundwater, in which case a water assessment report must be prepared to determine whether action to avoid further pollution and remediate the water is required. The findings of the water assessment report may determine that preparation of a water pollution remediation plan is required.

Measuring and recording quantities of organics received

The minimum requirements for measuring and recording quantities of organics received are as follows:

- The quantity of each **category of organics** (see Section 3 Table 3: Categorisation of organics) received at the premises must be recorded, together with its source, according to the National Waste Classification System (Moore *et al.*1993); and
- The quantities of organic products dispatched from the site must be measured or estimated as precisely as possible, then recorded and reported to the EPA in accordance with the conditions specified in the environment protection licence.

Composting and related organics processing facilities that accept more than 25,000 tonnes a year of organics should install a weighbridge. If a weighbridge is installed, it must be certified in accordance with the *Trade Measurement Act 1989* and must, where practicable, be operational at all times.

If a weighbridge is not installed or if it becomes inoperable, the estimated tonnage of organics received by all vehicles at the premises must be recorded.

APPENDIX A: FACILITY PLANNING

The information in this Appendix is provided as a guide to help individuals, companies, local government bodies and communities to plan composting and related organics processing facilities. It outlines the types of issues that should be considered when planning such facilities.

The issues outlined below and those described in the *EIS Practice Guideline: Composting and Related Facilities* (DUAP 1996) should be addressed in the environmental impact statement that is required to be prepared under the development assessment process (see Section 3).

Location of the facility

The EPA recommends that composting works be located away from residences or other sensitive receptors. Unless they are designed, maintained and operated correctly, they can cause dust and odour nuisance. The impacts and necessary odour management approaches will depend upon:

- the size of the composting area
- the category of the organics to be composted (See Table 3)
- the composting technology employed
- whether the composting process is enclosed or open-air
- whether odour removal technology is employed
- the estimated odour emission rate
- the topography of the site
- the direction and frequency of winds
- the distance of the facility from the property boundaries.

Select an appropriate site

Judicious location of the processing site is, perhaps, the most effective way of dealing with the potential negative impacts on local amenity. Careful design and selection of process components and equipment, as well as good operating techniques, procedures and staff training, are other important ways of avoiding amenity problems.

An appropriate separation distance from any work or storage area of the site to the nearest residence, public building or business is crucial. The most suitable buffer distance will, however, depend on:

- the category of the organics being processed (see Table 3)
- the nature of the processes being operated on the site
- the location of the facility with respect to population and sensitive areas
- the type of equipment, buildings and protective structures on the site
- the level of expertise and training of staff operating the processes
- the intensity of the around-the-clock supervision of the processes
- the prevailing meteorological conditions at the site.

Table A1 identifies the areas that are considered inappropriate by the Department of Infrastructure, Planning and Natural Resources for composting and related organics processing facilities because of their environmental sensitivity. This list is not exhaustive, as an EIS-based assessment may indicate other inappropriate areas.

Table A1: List of environmentally inappropriate areas for composting and related organics processing facilities (from *EIS Practice Guideline: Composting and Related Facilities*, DUAP 1996, Table 2)

Area	Objective
A site located within an area of significant environmental or conservation value identified under relevant legislation or a planning instrument, including: • National Parks • historic and heritage areas, buildings or sites • any reserves for environmental protection, for example, aquatic, marine, nature, karsts • areas covered by a Conservation Agreement • Wilderness Areas identified or declared under the *Wilderness Act 1987* • other areas protected under the *National Parks and Wildlife Act 1974* • World Heritage Areas • areas on the Register of the National Estate • SEPP 14 wetlands, REP 20 wetlands, SEPP 26 Littoral Rainforests • areas zoned under an LEP or REP for environmental protection purposes, for example, high scenic, scientific, cultural or natural heritage.	To avoid the risk of damaging areas of high environmental value
Sites within an identified drinking water catchment (surface water or groundwater), for example, any lands nominated as 'Special or Protected Areas' by local water supply authorities (such as Sydney Water, Hunter Water, Council) or in the vicinity of a groundwater bore used as drinking water.	To avoid the risk of polluting drinking water
Sites located in an area overlying an aquifer that contains drinking-water-quality groundwater that is vulnerable to pollution. (Consult the Department of Infrastructure, Planning and Natural Resources for criteria to determine the vulnerability of groundwater.)	To protect groundwater and surface water resources
Sites where the substrata are prone to landslip or subsidence.	To avoid sites that may have unsuitable substrata
Sites on floodplains that may be subject to washout during major flood events. (Consult councils for information about local flooding characteristics.)	To avoid washout risk if a significant flood event occurs

To ensure the environmental protection of these areas, and to provide certainty to developers seeking sites for composting and related organics processing facilities, the Department of Infrastructure, Planning and Natural Resources recommends in their *EIS Practice Guideline: Composting and Related Facilities* (DUAP 1996) that:

> proponents ensure that areas included in the Table [Table A1 here] are excluded from consideration for a composting and related organics processing facility early in the site selection process.

The Department of Infrastructure, Planning and Natural Resources guidelines also set out the steps to be taken in selecting an appropriate site, with heavy emphasis on conducting appropriate geological, hydrogeological, topographic and meteorological evaluations to establish the appropriateness of a site.

Schedule 3 of the Environmental Planning and Assessment Regulation 2000 requires an EIS for a number of designated developments. Clause 49, in particular, is relevant to composting and related organics processing.

The community has the opportunity to make inputs into the site assessment process irrespective of whether the plans are for a designated development or not:

- For designated developments the community is able to make comments after the DA (Development Application) and supporting EIS have been lodged, as specified within Part 4 of the *Environmental Planning and Assessment Act 1979*.
- For facilities not requiring an EIS but still requiring planning consent, the consent authority should consider Section 90 of the *Environmental Planning and Assessment Act 1979* when determining the application. Although there is no formal requirement for the exhibition of such proposals, the consent authority may treat them as advertised development. This will provide opportunity for public notification and input into such proposals.

Consult the Department of Infrastructure, Planning and Natural Resources publication *EIS Practice Guideline: Composting and Related Facilities* (DUAP 1996) for further details.

Preliminary water assessment of the site

A comprehensive hydrological investigation of both the site and the surrounding groundwater regime needs to be conducted before site establishment. The technique used should take into consideration the *EIS Practice Guideline: Composting and Related Facilities* (DUAP 1996). For example, the investigation should identify the groundwater flow pathways for all aquifers on site, assess the vulnerability of the groundwater underneath and adjacent to the facility, and establish whether systems to prevent groundwater pollution need to be set up (see Issue 5, Section 4 for environmental outcomes).

A water pollution remediation plan (see Section 6) should be developed if pollution of groundwater, surface water or the subsoil is confirmed in the preliminary water assessment of the site or is identified by external monitoring.

Note that, under the POEO Act, if pollution incidents causing or threatening material harm to the environment are detected, then the facility occupier must take immediate action to contain the pollution. They must report the incident to the appropriate regulatory authority in accordance with the POEO Act, giving details such as the nature and source of the pollution, any actions taken, and any future action that will be carried out to prevent recurrence. If the EPA directs the future actions, these must be started as soon as practicable.

Odour impact assessment

An odour impact assessment will be prepared as outlined in Issue 1, Section 4.

Select appropriate processing equipment

Processing equipment should be appropriate for the types and quantities of organics that are to be processed. Carefully select equipment for the complete system (including receiving organics, pre-processing, the high-rate active phase, the curing phase and post-processing) (Haug 1993). Occupiers of composting and related organics processing facilities should be able to demonstrate that they are minimising the levels of contaminants, such as heavy metal compounds, other chemicals and inert contaminants, in the final products (see discussion, Section 2).

It is much easier to prevent atmospheric emissions in the early stages of the biodegradation processes if automated in-vessel bioreactors or enclosed areas fitted with exhaust air bio-filters or purifiers are used, rather than if traditional open-air methods, such as the turned pile, aerated static pile and windrow (with or without aeration) are used.

Nevertheless, it has been demonstrated using open-air methods of aerobic biodegradation (composting) that it is possible to avoid odorous emissions when processing the more difficult types of organics. The process controls are, however, more demanding and labour intensive than for in-vessel processes.

In selecting a suitable processing system or methodology for the early stages of biological processing, consider:

- the category (see Section 3 Table 3) and quantities of organics to be processed
- the anticipated levels of contaminants, pathogens, weeds, weed seeds and propagable shoots in the feedstock
- the location of the facility with respect to population and sensitive areas
- the ability of the occupier to monitor and maintain appropriate process conditions seven days a week all year round (mainly for rapidly biodegradable organics processing)
- the choice between:

  —higher up-front investment costs together with lower labour costs, or

  —lower up-front investment costs coupled with higher labour costs
- the desired time lapse between receipt of organics and the products reaching the curing stage
- the desired levels of quality and consistency in the products
- the projected revenue from the sale of the products and from fees charged for acceptance of organics.

In-vessel facilities have the advantage of being faster and more likely to produce a consistent and well-pasteurised product (while keeping odour impacts to a minimum) than the other available processes. There are a significant number of manufacturers and suppliers of in-vessel composting systems. For helpful guidance on selection criteria as well as a comparison with other methods of composting, see the following three publications:

- *Guidelines for Composting in Australia—Return it to the Earth* (Denlay 1993)
- *The Biocycle Guide to the Art and Science of Composting*, The JG Press Inc, Emmaus, Pennsylvania 1991 (The Staff of Biocycle, 1991).
- *The Practical Handbook of Compost Engineering* (Haug 1993)

Other equipment can have significant, indirect effects in helping to reduce atmospheric emissions, for example:

- equipment that can cut, shred, chop and grind vegetation small enough to enable it to mix with other organics so that the less rapidly biodegradable organics can biodegrade faster (Note: Wood from Australian native trees is generally much harder than the wood found in Europe or the USA, and this fact should be borne in mind when specifying/evaluating such equipment)
- equipment for the effective mixing of organics and other materials from the different streams of feedstock in order to reach the desirable carbon to nitrogen ratio and moisture content before composting starts
- equipment for the effective turning, mixing and aeration of organics that are in the active stage of degradation. (This is not needed with some types of in-vessel equipment that can achieve sufficient internal mixing.) This equipment can vary from simple front-end loaders or bulldozers to purpose-built windrow-turning machines.

The sound power (noise) levels of the mobile and stationary processing equipment chosen need to be considered at the site-selection stage. Their suitability should be assessed with respect to:

- their proposed location on the site
- the natural characteristics of the site
- attenuation measures planned for the site
- the proximity of sensitive receiving locations.

Noise prediction, by modelling, should be done at the site selection and planning stage, in order to predict whether adverse noise impacts are likely to occur (see Section 4).

Using the categorisation of incoming organics to select appropriate equipment

For processing Category 1 organics (see Section 3 Table 3) the simpler open-air methods for composting have generally been found to be satisfactory, provided that the materials being processed (especially grass clippings, weeds and leaves) are not allowed to become anaerobic.

For processing Category 2 organics (see Section 3 Table 3), open-air methods for composting have been found to be satisfactory with strict feedstock preparation and operating controls. However, Category 2 organics have a much greater likelihood of odorous emissions than do Category 1 organics and also a greater need for maintenance and careful ongoing operating practices to mitigate potential environmental impacts. Category 2 organics are best processed in **enclosed facilities**. For this reason, if the applicant intends to use an open-air facility to compost Category 2 organics, they will need to demonstrate clearly at the planning and community consultation stage that the location, design, operating methodology and resources of the facility will prevent odorous emissions and degradation of the local amenity.

For processing Category 3 organics the likelihood of odorous emissions is much greater than for Category 2 organics (see Section Table 3), and open-air methods for composting have generally, but not invariably, been found to be unsatisfactory. It is most **unlikely that the** EPA **would grant an environment protection licence for the open-air composting of Category 3 organics**. As with Category 2 organics, the applicant would need to demonstrate clearly at the planning and community consultation stage that the location, design, operating methodology and resources of the facility would prevent odorous emissions and degradation of the local amenity.

The processing of Category 3 organics by vermiculture is an exception to the above, because there is no need to turn the biomass and, therefore, the degradation of organics can take place in containers covered with layers of material such as curing compost, generally without significant odour-emission problems.

In the treatment of municipal solid waste (MSW), a very important consideration is the ability of the system to minimise contamination of the compost by heavy metal compounds, other chemicals, and inert contaminants. Processes that exert large forces on the waste mass, such as those experienced during shredding or vigorous tumbling, may result in the breaking-up of containers, bottles, batteries, and electronic components. This fragmentation can make it difficult and expensive to recover the 'inert contaminants' in a form that can be processed. It will also release any heavy metal compounds and other toxic chemicals that were previously contained.

The role of alternative technologies

Alternative technologies have the potential to recover significant value from mixed residual waste (McMillen 2001). Such technologies should be regarded as a complement to, rather than a substitute for, the segregated collection of waste. A variety of management practices, including source segregation, must be considered as part of any system to produce quality processed organics (e.g. Rynk 2001).

Key considerations when selecting the suitability of alternative technologies include:

- the impact of the system on total recovery of organics
- whether the system can produce marketable products
- full cost implications.

Councils will be better able to assess the options relating to the growing number and types of alternative waste technologies by using the AWT (alternative waste technologies) Assessment Tool (DEC 2003). The assessment tool consists of a CD containing the assessment spreadsheet and handbook that can be obtained from the DEC. The AWT Assessment Tool and accompanying handbook will provide decision-makers with a robust and well documented means of evaluating alternative technology proposals for the treatment of wastes. For information contact John Harley, Manager, Local Government, on 02 8837 6018.

Producing quality compost suitable for market

Generators and collectors that supply organics to composting facilities should seek appropriate advice from composting facilities and end-users. This includes having agreed product specifications and being aware of on-site management practices (see also Section 2 and Appendix B).

APPENDIX B: ENVIRONMENTAL MANAGEMENT TECHNIQUES

This Appendix is the starting point for occupiers who need help in selecting environmental controls to meet the requirements of Section 4. If you need further information relating to environmental management techniques you may also consider consulting other sources (such as the References and Bibliography sections of these guidelines, scientific journals, environmental consultants and industry representatives). You may also consult the Waste Management Section of DEC for further information.

The techniques set out here have been shown to be effective in dealing with the environmental issues identified in Section 2. Facility planners should consider them as a basis for developing operational controls to suit their own facilities. Most of the techniques are specific to open-air composting of organics by windrowing or static pile methodologies, because once these types of facilities have been established they generally require more attention to maintenance and good ongoing operating practices to mitigate environmental issues. By contrast, many different types of proprietary enclosed or in-vessel processing methodologies are available with environmental controls supplied as part of the package. Such technologies are not well documented in publicly available technical literature, as they form part of the intellectual property purchased from the suppliers.

Using the categorisation system to select appropriate techniques

Section 3 (see Table 3) outlines a categorisation system for incoming organics. This categorisation system should be used to identify the potential environmental impact of organics received at a facility and therefore used to select appropriate techniques to control the potential environmental impacts.

For example, in accordance with Section 4 Issue 6, facilities holding or proposing to hold environment protection licences to receive and process Category 2 organics need to demonstrate that they have in place appropriate handling and storage arrangements for any unprocessed Category 1 and Category 2 organics, in order to reduce the impacts of odour and leachate. Similarly, facilities wanting to receive and process Category 3 organics will need to demonstrate that they have in place appropriate handling and storage arrangements for any unprocessed organics.

This Appendix and Appendix A provide further guidance on using the categorisation system to guide the selection of appropriate environmental management techniques.

Minimising odour emissions

Process control

Open-air compost facilities have the potential to generate significant odour impacts if they are not operated correctly. The main causes of odour generation from these facilities are (according to the Washington State Department of Ecology 1998) a porosity of less than 35% in the compost pile, inhibiting air circulation

- moisture levels greater than 60% in the compost pile, eliminating adequate free airspace
- initial carbon to nitrogen ratio (C:N) below 25:1, promoting ammonia volatilisation
- compost pile pH greater than 7.5, promoting hydrogen sulfide and mercaptan generation compost pile oxygen concentration below 16%, promoting volatile organic formation.

Gage (2003) also discusses the management of potential odour sources at composting facilities.

Management practices for mitigating odour during processing

Odour problems can arise when organics that are highly biodegradable, such as Category 3 organics, are not treated or managed appropriately and when improper gas management techniques are employed.

The following best practice measures can be applied in addition to those related to biogas emissions and process control:

- Enclosed storage and processing facilities should be used, particularly for the processing of Category 2 and Category 3 organics (see Appendix A for further information).
- There should be immediate attention to potential odorous organic loads, such as rapidly biodegradable organics (see Glossary).
- Rapidly biodegradable organics (see Glossary) should be covered, and the quantity of such material exposed to the atmosphere should be kept to a minimum; rapidly biodegradable organics include grass clippings, food and animal organics and organic sludges.
- Rapidly biodegradable organics (see Glossary) of food and animal origin should be stored in moisture- and vermin-proof bins that are designed and constructed to resist the action of organic acids and facilitate washing; these bins should be located on a concrete- or bitumen-sealed and bunded washdown apron that is:
  - —connected to the leachate collection system
  - —protected to prevent the infiltration of rain into the leachate collection system.
- Records of complaints about odours should be kept, and they should be correlated with weather conditions and deliveries of categories of organics.

See also later in this Appendix for information relating to mitigating odour from stockpiles of raw organics and products and managing biogas.

Minimising particulate matter emissions

Minimising emissions of particulate matter

Management practices must minimise the quantity of pollutants leaving the site as airborne particulate matter, reduce the stormwater sediment load, and protect the local amenity.

The following best practice measures can be used to minimise generation of PM_{10} and total suspended particulate (TSP) matter:

- Construct sealed or gravel roads from the public roadway to the gatehouse or organics reception section of the composting and related organics processing facility.
- Spray water to suppress matter that has been deposited on unsealed roads; additional suppression methods may be required in areas with fine soils and in dry or windy condition.
- Regularly turn composting windrows and ensure that they have a suitable moisture content.

Minimising emission of airborne pathogens

Four important methods useful for minimising the emission of airborne pathogens are:

- Do not allow organics that are being processed, or products such as composts, soil conditioners and mulches, to lose too much moisture; for example, keep the moisture content at 25% (m / m) or more.
- Have adequate environmental management techniques at the facility to manage particulate matter (such as PM_{10}, deposited matter and suspended particulates).

- Avoid uncontrolled emissions of biogas in aerobic processes by keeping the organics being processed adequately aerated.
- Ensure that every part of a batch of product has been subjected to stabilisation conditions during processing (e.g. Standards Australia 2003).

Note: The Australian Standards Committee recommends that a warning label for use be displayed on composts, potting mixes and other organic gardening products (Standards Australia 2003; NSW Health Department 2002).

Minimising amenity impacts (including odour and particulate matter)

Keep stockpiles of raw organics and products low

Keep stockpiles of raw organics and finished products as small as practicable to avoid potential negative environmental impacts. The following targets should be aimed for:

- The quantity of cured organics stored at the facility should not be greater than 18 months' worth of production.
- The quantity of Category 1 organics awaiting processing should not exceed 10% of the currently utilised facility processing capacity (tonnes / year).
- The quantity of Category 2 and Category 3 organics awaiting processing should not exceed one day's production, unless it is stored in a manner that prevents the release of odours.
- The quantity of organics received for processing each year should be based on either current trends, where available, or on production plans for the forthcoming year.

Managing storage times for feedstock

The storage times of organic feedstock should be controlled to avoid emissions of offensive odours.

If possible, rapidly biodegradable organics (see Glossary), including Category 2 and Category 3 organics, should be prepared into processing feedstock as soon as they are received, or no later than by the end of the day of receipt. Biosolids should, however, be handled as specified in the *Environmental Guidelines: Use and Disposal of Biosolids Products* (EPA 1997).

If rapidly biodegradable organics (see Glossary) such as biosolids cannot be put into the process as soon as they are received at the site, they should be placed into either enclosed storage containers or sheds fitted with exhaust air purifiers, or covered with a 15-centimetre-thick layer of compost that is in the curing stage.

Some Category 1 organics such as vegetation, natural fibrous organics and wood organics may be stored for longer periods than the rapidly biodegradable organics (see Glossary). However, they should not be stored for more than 2 months unless adequate procedures are in place to control the threat of fire.

Managing stockpiles of curing and finished product

Stockpiles of curing organics and finished product have the potential to cause amenity impacts (such as offensive odour and particulate matter emissions) and also to pollute waters (Haug 1993). In addition to minimising the quantity of curing organics and finished product at the premises (see above), you must ensure that stockpiles are managed appropriately to prevent environmental impacts. For example, regular turning of stockpiles would help to ensure that piles of curing organics and finished product maintain aerobic conditions. It also ensures distribution of any leachate generated within the piles and helps to maintain an appropriate moisture content. A watering system for the stockpiles may also be required to maintain moisture content.

Stockpiles of curing or finished product should be adequately labelled to help maintain appropriate quality control of the product. Labels should include the date the stockpile was established, the dates of subsequent turning, and any other notes regarding the practices used to manage the stockpile.

Covering of organics

When rapidly biodegradable organics (see Glossary) are in an 'active state' during open-air handling and/or processing, they should be covered in order to reduce odour emissions.

If open-air processing techniques are used, it has been found to be very useful to cover the piles or windrows with a 15-centimetre-thick layer of freshly made compost that is in the curing stage. The micro-organisms that are present in the fresh compost are able to reduce odour emissions by converting the odorous substances to less volatile substances.

The covering affords other benefits by protecting the composting organics from:

- losing too much valuable heat and moisture
- getting too wet in the event of rainfall.

Covering also makes it more difficult for vermin and vectors to get to the raw organics. The use of fresh compost in the curing stage or mulch as a cover material also has the following benefits:

- limits run-on and infiltration of water
- controls and minimises the risk of fire
- minimises emission of biogas
- reduces fly propagation and rodent attraction
- decreases litter generation.

The best source of this covering material is the previous batch of compost or mulch prepared in the same area (Haug 1993).

Management of leachate drains and storage ponds

Leachate drains and storage ponds have the potential to generate odours. Odours from these structures are generally associated with the leachate becoming anaerobic, for example, as a result of leachate ponding in the drainage system or inadequate aeration in the storage system (see '3. Leachate collection system: minimum design requirements' and '4. Leachate storage system' in Section 5).

Safe storage and disposal of residual wastes and contaminated organics

Contaminated products or organics and process residues should not be stockpiled because they can:

- have negative impacts on the environment at or near the facility and disturb local amenity
- contaminate organics in the process and/or the finished product.

Any plan for the handling of such contaminated organics should indicate the maximum quantities intended to be stored and how they are going to be stored securely before disposal.

Contaminated products and residues that meet the acceptance criteria for waste as defined in *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (EPA 1999a) and *Environmental Guidelines: Solid Waste Landfills* (EPA 1996) can be disposed of in landfills that are licensed to accept them.

Consult the DEC or the relevant DEC guidelines for information on the treatment and/or disposal of waste that does not meet the above criteria for landfilling.

Whenever feasible, recyclable materials should be transported to appropriate collection centres or to recycling facilities.

Keep the weed population low

Facility occupiers should consider:

- setting up a plan to manage any declared noxious weeds. This could be addressed as part of the EMP if that is required for licensing
- implementing measures to keep the weed population low throughout the site
- using measures that ensure that every part of a batch of product has been subjected to stabilisation and pasteurisation conditions, because such conditions should ensure the destruction of weed seeds and propagable shoots (e.g. Standards Australia 2003).

Keep pest and vermin populations low

Use the following measures:

- Cover rapidly biodegradable organics (see Glossary), keeping the quantity exposed to a minimum. Rapidly biodegradable organics include grass clippings, food and animal wastes and organic sludges.
- Store rapidly biodegradable organics (see Glossary) of food and animal origin in moisture- and vermin-proof bins that are designed and constructed to resist the action of organic acids and to facilitate washing.
- Locate the bins on a concrete- or bitumen-sealed and bunded washdown apron that is:
  —connected to the leachate collection system
  —protected to stop rain getting into the leachate collection system.
- Take steps to ensure that surfaces are adequately drained to prevent ponds of water forming on the site.
- Episodic outbreaks of pests or vermin at composting and related organics processing facility sites should be controlled by established deterrence and eradication measures.

Wind-blown litter

Wind-blown litter is a nuisance to the community, and can be controlled by the following techniques:

- The occupier should introduce procedures that prevent the unnecessary proliferation of litter; they should also consider the use of litter fences, and be responsible for ensuring that all wind-blown litter that leaves the site is retrieved. For example, following a period of windy weather, the EPA recommends that the facility occupier implement procedures to clean up wind-blown litter on and near the facility as soon as practicable (preferably within one working day).
- Clear all fences and gates of litter, preferably on a daily basis or as required.
- Exit signs need to advise transport operators and private vehicle drivers that they can be fined for any litter on public roads resulting from improper transport of wastes or organics.
- All litter that leaves the site should be retrieved on a daily basis.

Cleaning of vehicles

The occupier should ensure that vehicles leaving the processing site do not track loose mud and litter outside the facility. It is also the responsibility of the facility occupier to keep access roads to the facility free of dirt and litter from customers and other facility users.

Vehicles that use composting and related organics processing facilities may inadvertently collect mud and litter on their wheels while on the site. It is essential that this be removed before the vehicle leaves the site, in order to minimise effects on both the local amenity and the quality of stormwater run-off. The site occupier should therefore provide **a wheel washing** or **wheel cleaning facility** for use by all vehicles. The site occupier is responsible for deciding what cleaning method is appropriate, considering the site traffic and local road conditions. Hand-held pressure-washing hoses, drive-through immersion bunds and vibration grids are all options that may suit different operations.

The site occupier should also provide a truck body and tray cleaning and disinfecting facility for use by open-bodied vehicles delivering rapidly degradable (Categories 2 and 3) organics. The site occupier is responsible for deciding what cleaning method is appropriate.

Signs at the processing facility should advise all vehicle operators that it is the vehicle operator's responsibility to ensure that the remnants of their load or the organic material stuck to the underside of the vehicle or the wheels does not litter public roads. For example, trucks should be covered to prevent loaded trucks being a source of wind-blown litter.

Management of biogas

For **composting (aerobic) processes**, subsurface diffusion of biogas generated as an unwanted by-product during composting and related organics processing can be reduced by the good barrier properties of an effective compost pad and leachate barrier system. Such containment is especially important for processes that are operated in troughs, trenches or pits that are below ground level.

Another technique for preventing subsurface diffusion is to construct slightly raised processing platforms or surfaces. No additional containment is required if an adequate aeration program is maintained whilst the organics is in an active state of decomposition.

The requirements for containment of biogas from **anaerobic processes** will depend greatly on the design of the overall process. When gas is extracted from within an anaerobic process, care should be taken so that these gases are appropriately treated and not allowed to escape to the atmosphere.

The most common way of **treating biogas** is by oxidation, preferably with energy recovery. This energy recovery may be through the direct recovery of the calorific value of the biogas, the transmission of the cleaned gas through a gas distribution network, or the generation and sale of electricity. The EPA does not have any preferred energy recovery option, but leaves this decision to the site occupier.

The best practice for **handling any liquid** that is condensed from the biogas is to treat it in the same manner as leachate (see earlier in this Appendix), with the exception that it should not be spray irrigated because of its odour potential and low pH.

Preventing water pollution

Surface water and leachate management

Section 5 outlines minimum design requirements for protection of waters.

The generation of leachate from raw organics can be minimised by operational practices implemented at the facility. For example, leachate can be minimised by mixing Category 2 organics into windrows containing a large proportion of actively composting Category 1 organics (typically at a ratio of 25:1 Category 1: Category 2 (w / w) or greater. Regular turning of windrows can also help minimise the quantity of leachate draining from the windrows.

Options for wastewater and leachate management include on-site reuse, evaporation and discharge to sewer.

Assessment of potential impacts from leachate

Because the collected leachate from organics is usually rich in nutrients, the recommended practice is to recover these nutrients by using the leachate for the wetting of new organics or actively composting organics that require additional moisture. In-vessel facilities should incorporate features to allow for the drainage and removal of leachate.

Leachate should be tested before decisions regarding its management are finalised, because if leachate is recirculated into composting organics or released for disposal it may cause water pollution if the potential impacts are not fully investigated. Decisions regarding the management of leachate should be based on the concentration of pollutants, the site's soil chemistry, and the specific operating conditions of the facility.

Leachate testing could be conducted for aromatics; volatiles; halocarbons; and the base, neutral and acid extractable organic contaminants that can be detected by Methods 8260 and 8270 (USEPA 1992). The analysis should, however, be conducted in accordance with the conditions specified in the environment protection licence and / or in the water assessment plan.

Screening of organics received

The receipt and use of unsuitable organics may lead to product quality problems in the case of contaminated organics or to processing problems in the case of the wrong types of organics.

Best practice to avoid problems consists of:

- advising generators and transporters of the types of organics that the facility is prepared or licensed to accept and those that it will not
- being sure that facility staff can identify the different categories and types of organics and also the potential outward signs of unacceptable contamination
- operating a comprehensive incoming organics inspection procedure before, during and after organics unloading
- implementing a random incoming organics sampling and testing protocol.

Remember that it is possible for a relatively small quantity of contaminated organics to ruin the quality of a much larger quantity of product, owing to the mixing that occurs during processing and subsequent handling.

Conducting trials for processing 'new' organics

If a new type of organic is to be accepted at a facility and the potential of the organics to produce odours or leachate during processing or the quality of the final product is unknown, a trial processing of the organic type is recommended. Areas that should be addressed in this trial include:

- collecting a representative sample of the organics to be processed
- determining the environmental impacts (such as leachate and odour) arising from the unprocessed organics and the processing of the organics
- putting into place operating procedures to control these environmental impacts
- assessing the quality of the compost generated from the organics.

Note: Any facility that holds an environment protection licence issued by the EPA must contact the EPA if a new type of organics is to be processed at the facility.

Environmental quality and management of organics

Selection and mixing of ingredients for processing feedstock

Organics and mixtures of organics subjected to processing in **non-enclosed** facilities should have a minimum angle of repose of 5 degrees and no free liquids.

Any liquid or semi-liquid amendments should be mixed with sufficient quantities of absorbent organics, such as sawdust or wood shavings or paper pulp, so that the resulting mixture meets the criteria for non-liquid wastes in the Waste Guidelines – that is, it should have a minimum angle of repose of 5 degrees and no free liquids. The resulting mixture should also have the appropriate carbon to nitrogen (C:N) ratio for the intended biodegradation process. Note that the thorough mixing of components will enable biodegradation to take place more efficiently and, therefore, with a lower likelihood of odour problems.

The combinations of ingredients chosen for the feedstock used in composting processes should give efficient biodegradation of the organics present, while minimising the emission of odours and greenhouse gases during the process.

The values most commonly recommended for **C:N ratio** for effective biodegradation are in the range of 25:1 to 30:1. Very few organics have C:N ratios that are in this range and, therefore, the common advice is to make mixtures for which the overall C:N ratios fall into this range. Organics with C:N ratios significantly outside the recommended range that are allowed to degrade are prone to give rise to significantly worse atmospheric emissions than those attained during normal controlled composting.

Note, however, that large pieces of ligneous organics, such as wood pieces or chips, do not degrade much during the active period of composting. Therefore, when such organics are present in significant quantities, overall C:N ratios of 40 or higher have been found to be advisable in order to have the carbon to nitrogen ratio of the actively degrading biomass in the desired range.

Food and animal organics, as well as fresh grass, have low C:N ratios. If they are not mixed with high C:N organics for biodegradation, ammonia gas and odorous amines will be produced until the C:N ratio finally rises to a level at which the more beneficial types of processes take over. Also, such organics usually contain too much water, which limits the availability of oxygen; anaerobic processes tend to occur, leading to the release of methane and bad odours.

Wood and natural fibre organics (for example, paper) have very high C:N ratios. This leads not only to much slower degradation, but also to the loss of carbon as carbon dioxide and heat until the C:N ratio is right for the beneficial composting processes to take over. It may require several microbial cycles before the beneficial processes begin to take place at a substantial rate.

Nitrogen-rich organics, such as food organics, are good sources of additional **nitrogen** in the composting of high C:N organics such as garden organics, and it is better to use them than inorganic fertilisers such as ammonium nitrate or phosphate.

Organics can vary greatly in **pH** without affecting the rate of decomposition. The optimum range for composting is somewhere between 5.5 and 8.5. Lower pHs encourage the growth of fungi, so that higher rates of cellulose and lignin breakdown may occur (EcoRecycle Victoria 1998). Odours due to ammonia production have been associated with a pH exceeding 9 (Goldstein 2002).

The presence of **adequate quantities of water** is crucial for beneficial degradation processes, but the presence of too much water leads to undesirable anaerobic reactions, as mentioned above (e.g. EcoRecycle Victoria 1998). Water-absorbent and biodegradable additives (feedstock amendments or bulking agents) such as wood shavings, sawdust and paper pulp are used to get

the moisture content of wet organics into the range of 50% to 65% (by weight). Such amendments or bulking agents can degrade without problems, even when their moisture content is as high as 75% to 85% (by weight).

Oxygen is a critical ingredient that can quickly get exhausted in rapidly degrading organics (in the 'active state') (see below.)

Mixing and aeration

Steps should be taken to make sure composting organics in the active state have an adequate supply of oxygen. Biodegradation of organics in the active state is characterised by high levels of oxygen demand, which means that the internal oxygen levels can rapidly fall below what is optimum for the wellbeing of the aerobic organisms present. When the oxygen level drops too far, anaerobic organisms begin to predominate, resulting in undesirable odour and methane production.

It is important, therefore, to take steps to ensure that adequate oxygen levels are maintained, either by a program of forced ventilation, or by turning or mixing the composting organics at regular intervals. Portable equipment with long probes that can measure oxygen levels and temperature deep within composting organics are recommended for monitoring oxygen levels in order to establish when turning is required. Turning or mixing also has the benefit of helping to cool the composting mix; cooling may be needed if the temperature starts to climb above 60°C to 65°C (e.g. EcoRecycle Victoria 1998).

Management of phylloxera

Research demonstrates that the presence of phylloxera in the feedstock for composting is unlikely, and the temperatures reached during processing in well-managed facilities readily destroy the insect (Bishop *et al.* 2002). If composted organics are intended for transport to and used in viticulture areas, it is essential to be aware of:

- management protocols at composting facilities to minimise the risk of phylloxera survival during processing and transport. This involves composting to the standards of *Australian Standard AS 4454–2003: Composts, Soil Conditioners and Mulches* (Standards Australia 2003) and managing the facility to avoid cross contamination.
- NSW Agriculture compliance and licensing requirements for transport of compost into designated Phylloxera Free Zones within NSW. This involves organising a Compliance Agreement with NSW Agriculture.

Information on phylloxera-related issues is available from NSW Agriculture and CORE (Centre for Organic and Resource Enterprises).

Destruction or inactivation of other harmful organisms

The processing conditions should be able to ensure a satisfactory reduction in the levels of human, animal and plant pathogens and the inactivation of noxious weeds, weed seeds and propagable shoots. The product should not contain harmful biodegradable contaminants. Products should meet the requirements of *Australian Standard AS 4454–2003: Composts, Soil Conditioners and Mulches* (Standards Australia 2003).

The times required to pasteurise the products depend on the mixing regime used and the prevailing temperatures attained in the biodegrading matter. The *Best Practice Guidelines for Composting Systems* in Appendixes N and O of AS4454–2003 (Standards Australia 2003) recommend pasteurisation regimes for the various types of processes that are currently being used. These regimes can be used as guides to achieving a successful outcome.

For organic products that are derived from biosolids or organic mixtures with biosolids, the requirements laid down in *Environmental Guidelines: Use and Disposal of Biosolids Products* (EPA 1997) including the amendment (EPA 2000a) apply.

Marketing of stabilised processed organics

A plan for the marketing and sales, or the giving away, of the different types of processed organics should be prepared annually and should be based on the anticipated quantities of organics to be received at the site. The seasonal fluctuations that may affect the availability of different types of feedstock organics will need to be considered.

Quality assurance of the product and the consistency of products sold to users is important for maintaining and increasing sales of organic products (e.g. Allen 1999). *Australian Standard AS4454-2003: Composts, Soil Conditioners and Mulches* (Standards Australia 2003) contains guidance regarding product quality assurance. Assessment of quality and consistency could include sampling and testing of the following (Woods End Research Laboratory 2000):

- heavy metal levels
- physical composition and inert contamination
- pathogenic bacteriology and phytopathogens
- potentially toxic elements (PTEs)
- maturity and plant growth performance.

Preventing unauthorised entry to the facility

Ensure that the premises is secure.

The best practice for preventing unauthorised entry to the facility is to:

- install and maintain lockable security gates at the facility
- unless natural barriers prevent entry to the site, install and maintain a 1.8-metre-high wire-mesh fence topped with three strands of barbed wire, either around the perimeter of the site or around those parts of the site that are used for reception, storage, processing and flammable storage.

Fire management

Fire-fighting capacity

Occupiers should be able to show that their facilities have sufficient fire-fighting capacity by developing a site-specific fire management strategy to minimise the incidence and impact of fires.

Prevent fires from occurring at the facility

It is important that adequate fire prevention measures are in place, fire-fighting equipment is accessible, and staff are trained and able to manage fire outbreaks at any part of the facility.

The following points should generally be covered:

- Clear signs should tell the public that flammable liquids are not permitted on the site. This should be reinforced by advice to customers at the gatehouse and inspection of loads at the organic reception area.
- Approved quantities of combustible contaminants that have been separated from the organics received for processing and are destined for recycling (such as tyres and plastic bottles) should be stockpiled in small piles or in windrows.

- All fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store. This store should be located away from reception, storage and processing areas. All flammable liquids should be stored within a bund that can hold 110% of the volume of the flammable liquids stored there, so that any release of raw or burning fuel cannot cause a fire in the combustible organics present on the site or affect the stormwater.

Minimising noise emissions

Noise attenuation measures

Acceptable noise attenuation measures include siting noise-sensitive land uses away from the development, erecting acoustical barriers, treating equipment acoustically and limiting hours of operation. Particular attention should be paid to the design of items such as speed humps and vibration grids to prevent noise generation. Guidance on noise control techniques can be found in the *NSW Industrial Noise Policy* (EPA 2000b), and in engineering noise control texts.

Adequate staffing and training

The level and nature of staffing and training should be adequate for environmentally responsible and safe management of the composting and related organics processing facility.

Staffing levels should be high enough to ensure that the facility can comply at all times with all provisions of its environment protection licence.

Staff training should be effective enough to ensure that:

- all operators of mobile plant and other equipment are skilled at undertaking all the tasks required of them
- all personnel who operate gas-testing, water-sampling or water-testing apparatus are familiar with the required testing and sample retention protocols
- all personnel who inspect incoming organics are skilled at identifying organics that are unacceptable and can record data accurately.

Staffing requirements will vary as a function of the size of the facility, the type of organics, and the diversity and complexity of site operations.

Clean-up of pollution incidents

The following indicator parameters may be used in identifying and assessing the clean-up of pollution incidents:

- alkalinity, ammonia, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate, organochlorine pesticides, organophosphate pesticides, pH, total phenolics, polycyclic aromatic hydrocarbons, potassium, sodium, sulfate and total organic carbon (TOC).

When you are sampling and analysing you should use the appropriate methods in *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (EPA 1998), unless the EPA specifies other methods in the environment protection licence.

Note: Under section 148 of the POEO Act there is a duty to report pollution incidents to the appropriate regulatory authority.

APPENDIX C: ITEMS TO BE INCLUDED IN AN ENVIRONMENTAL MANAGEMENT PLAN FOR A COMPOSTING OR RELATED FACILITY

Principal component	Subparts
Siting (from Environmental Impact Statement, Statement of Environmental Effects or Statement of Environmental Factors)	• **locality map** showing the siting of the facility and location of environmentally sensitive areas, including residential zones, dwellings, schools and hospitals • **ground plan** of facility, including location of monitoring points / equipment • **natural characteristics of site** (local meteorology (wind and rain patterns), soil morphology, geology, hydrogeology and surface waters) • **facility environmental policy** (including protection of environmentally sensitive areas) • **business plans** (type and quantity of organics to be processed now and in future, and type and quality of products) • **staffing** (organisation, headcount, skills, responsibilities, training and proposed working hours)
Water management	• surface water controls • leachate controls and handling • water monitoring and assessment • leachate monitoring and assessment • contaminated water remediation
Gas and odour management	• process controls and monitoring • odour and weather monitoring • management of rapidly biodegradable organics (see Glossary) • gas containment and extraction (for fermentation processes) • gas monitoring • remediation of uncontrolled gas emissions • gas oxidation controls and monitoring
Incoming organics management	• screening and recording of organics received • organics handling and storage
Product quality assurance	• feedstock selection • process controls and monitoring • product testing and monitoring – physical, chemical and biological • management of contaminated organics and products
Noise management	• scheduling of the operation of noisy equipment and heavy transport vehicles • noise monitoring
Housekeeping practices	• dust and litter control • pest, weed and vermin control • site security • disposal of wastes and contaminated products • maintenance of facility and equipment • stock controls
Fire-fighting and prevention	• fire prevention • fire-fighting provisions

APPENDIX D: ITEMS TO BE INCLUDED IN A WATER ASSESSMENT PLAN FOR A COMPOSTING OR RELATED COMPOSTING FACILITY

Principal component	Subparts
Groundwater and subsoil monitoring network	• documentation describing the **background characteristics of the groundwater** • unless the preliminary water assessment of the site (Appendix A) has established that the facility poses minimal risk to groundwater, the water assessment plan should include: — a scale drawing showing the **location and depth of groundwater monitoring bores** — documentation outlining the groundwater hydraulics and the procedures used for bore development and bore security (refer to Section 5)
Discharges to surface water bodies (where relevant)	• a scale drawing of **discharges to surface water bodies** (including creeks, rivers and dams) • documentation outlining the predicted discharge conditions (e.g. frequency and volume)
Surface water bodies monitoring network	• documentation that describes the **background characteristics of the surface water bodies** before composting and related organics processing activities start • a scale drawing of **monitoring points for all surface water bodies** (such as creeks, rivers and dams), which includes: — surveyed monitoring points established upstream and downstream of the facilities — discharges from the premises to surface water bodies — a minimum of one monitoring point per surface water body located downstream from (for flowing or perennial waters) or near (for still waters) the processing area. It is advisable, however, to locate one reference monitoring point per surface water body – upstream (for flowing waters) or distant (for still waters) from the processing area – in order to establish whether any detectable change in water quality has been caused by the processing activities.
Indicator parameters and limits for routine monitoring and assessment of waters	• a **list of indicator parameters and limits** for routine monitoring and assessment of waters (including groundwater, surface water bodies such as rivers, creeks and dams) and leachate • documentation that gives details of how the parameters were selected and limits for the specific indicators adopted will provide an indication of all the possible types of pollution that may occur. The indicator parameters chosen should be based on the preliminary water assessment of the site (Appendix A) and the types of organics processed as the facility. The following parameters could be used in identifying and assessing waters: — alkalinity, ammonia, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate, organochlorine pesticides, organophosphate pesticides, pH, total phenolics, polycyclic aromatic hydrocarbons, potassium, sodium, sulfate and total organic carbon (TOC). The regular monitoring of electrical conductivity (sometimes written as EC) may be used for preliminary indication of changes in water quality. This is because EC is a measure of the ability of water to conduct an electric current and is sensitive to variations in dissolved solids, mostly mineral salts. Increases in the measured values of EC for waterbodies are often good warnings of changes in the abovementioned indicator parameters.

GLOSSARY

Act: the *Protection of the Environment Operations Act 1997*

Activator (or **Inoculum** or **Starter**)**:** a culture of micro-organisms and / or a mixture of enzymes used for speeding up the start of biodegradation / composting processes. The activator may be in a specially concentrated form or simply be matured organics recycled in the process

Active state: refers to organics that are undergoing, or are capable of undergoing, rapid biological decomposition. This usually means that they are emitting, or are capable of emitting, heat in the presence of moisture

Aerobic: in the presence of air (oxygen)

Alkalinity of water: its acid-neutralising capacity, being the sum of all titratable bases measured as its quantitative capacity to react with a strong acid to a designated pH

Anaerobic: in the absence of air (oxygen)

Amendments: see **Feedstock amendments**

Amenity: the existence of healthy, pleasant and agreeable (community) surroundings

Aquifer: a saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients

AUSPLUME: an atmospheric dispersion model developed by, and available from the Victorian EPA (EPA Centre for Air Quality Studies, Environment Protection Authority Victoria, Latrobe Research & Development Park, Ernest Jones Drive, MACLEOD VIC 3085)

Batch: samples taken from one site in one day

Bioaerosol: organisms or biological agents that can be dispersed through the air and that have the potential to affect human health (see also **Biological particulate matter**)

Biodegradable: able to be transformed to a lower state by environmentally significant biological processes

Biogas: gaseous emission from the anaerobic decomposition of organics

Biogas management strategy: a strategy that is specifically tailored to be appropriate for an individual site and that establishes procedures for the monitoring and control of biogas

The aim of making this strategy is to ensure that:

- biogas does not pose an explosion hazard
- the community amenity is not degraded by odour emissions
- community health is not degraded by emissions of hazardous air pollutants
- the impact of greenhouse gas emissions is minimised.

Biological particulate matter: a type of particulate matter that is characterised by its biological activity

Bioremediation: the remediation or decontamination of any contaminated matter by the use of processes involving biological organisms

Biosolids: the organic product that results from sewage treatment processes (otherwise referred to as sewage sludge)

Biosolids Guidelines: the document published by the NSW EPA titled *Environmental Guidelines: Use and Disposal of Biosolids Products* (EPA 1997) and *Addendum to Environmental Guidelines: Use and Disposal of Biosolids* (EPA 2000a)

Biosolids products: organics containing any component of biosolids, including pure biosolids in the form of liquid or cake, or derived organics such as compost, lime sludges or pellets

Buffer distance: the distance between the reception, storage and processing areas of a composting and related organics processing site and a segment of the environment to be protected

Categorisation of organics: see table below.

Organics category	Types of organics permitted in categories[1] (Categories with larger numbers may contain types from classes with smaller numbers.)	
	Type	**Examples of organics**
Category 1	**Garden and landscaping organics**	Grass[2]; leaves; plants; loppings; branches; tree trunks and stumps.
	Untreated timber	Sawdust; shavings; timber offcuts; crates; pallets; wood packaging.
	Natural organic fibrous organics	Peat; seed hulls / husks; straw; bagasse and other natural organic fibrous organics.
	Processed fibrous organics	Paper; cardboard; paper processing sludge; non-synthetic textiles.
Category 2	**Other natural or processed vegetable organics**	Vegetables; fruit and seeds and processing sludges and wastes; winery, brewery and distillery wastes; food organics excluding organics in Category 3.
	Biosolids[3] and manures	Sewage biosolids, animal manure and mixtures of manure and biodegradable animal bedding organics.
Category 3	**Meat, fish and fatty foods**	Carcasses and parts of carcasses; blood; bone; fish; fatty processing or food.
	Fatty and oily sludges and organics of animal and vegetable origin	Dewatered grease trap; fatty and oily sludges of animal and vegetable origin.
	Mixed residual waste containing putrescible organics	Wastes containing putrescible organics, including household domestic waste that is set aside for kerbside collection or delivered by the householder directly to a processing facility, and waste from commerce and industry.

Notes:

1. These categories are used only to facilitate reference to these groupings of waste and organics (with different potential environmental impacts) in these guidelines and in environment protection licences: they are **not** used in waste legislation.
2. Particular care should be taken when grass clippings are present in the feedstock. It is well known that careful process management is required to mitigate odour and leachate problems when processing grass clippings (e.g. Buckner 2002). High moisture content, high nitrogen levels, an abundance of readily available organic matter and poor structure and tendency to mat mean that grass can easily become anaerobic and odorous.
3. Conditions applying to processing and use can be found in *Environmental Guidelines: Use and Disposal of Biosolids Products* (EPA 1997).

C:N (carbon to nitrogen) ratio: the ratio, by mass, of carbon atoms to nitrogen atoms present in the organics

Closure plan: a plan required by conditions of an EPA environment protection licence issued by the EPA in accordance with Section 76 of the *Protection of the Environment Operations Act 1997* for a specific facility to establish procedures for the closure of the site. Information to be included in this plan includes:

- timetable for staged remediation
- revegetation or stabilisation program
- proposed post-closure monitoring, maintenance and use

Compost: stable, pasteurised organics resulting from the controlled microbiological transformation of organics

Compost pad: the prepared area upon which composting takes place

Composting: the process of aerobic conversion (under controlled conditions) of organics by micro-organisms, yielding cured soil conditioners, compost or humus

Composting and related organics processing: for the purpose of these guidelines means the production of composts, soil conditioners, mulches and other products by processes including composting, mulching, digestion and fermentation

Cover material: material used to cover organics at processing facilities

Cured: refers to biodegraded organics that are stable in their current form with respect to normal composting processes

Curing: the process during which organics that have already gone through the active / rapid stage of biodegradation become cured

DEC: the Department of Environment and Conservation (NSW). DEC incorporates the staff of the Environment Protection Authority (EPA), National Parks and Wildlife Service, Botanic Gardens Trust and Resource NSW, and creates strong linkages with the Sydney Catchment Authority

Decomposition: the breakdown of organics by micro-organisms

Design requirement: describes the minimum requirements and / or refers to Minimum Design Requirements specified in Section 5 that must be addressed by facility planners. Design requirements may also list and / or refer to acceptable environmental management techniques to be considered by facility planners

DUAP: Department of Infrastructure, Planning and Natural Resources, formerly known as the New South Wales Department of Urban Affairs and Planning

Electrical conductivity: sometimes written as **EC**—a measure of the ability of water to conduct an electric current. EC varies with temperature. It is sensitive to variations in dissolved solids, mostly mineral salts

eH: sometimes written as **Eh,** this is the redox potential that characterises the oxidation–reduction state of natural waters (commonly varying between –500 mV and + 700 mV). It is usually determined potentiometrically in situ in the field

Environmental issue: consists of four parts:

- *objective*, which sets out the expected environmental results, and guides the formulation of strategies to achieve the objective
- *design requirement*, which describes the minimum requirements and / or refers to Minimum Design Requirements in Section 5 that must be addressed by facility planners. Design requirements may be placed into 'general terms of approval' during the development assessment process.

- *performance requirements*, which define what must be done to achieve the desired outcome
- *performance measurements*, which set out ways of measuring the performance requirements to determine whether the desired outcome is being achieved

Environment protection licence: see the *Protection of the Environment Operations Act 1997*

EPA: the New South Wales Environment Protection Authority. The EPA is a statutory body with specific powers under environment protection legislation. In September 2003, the EPA became part of the Department of Environment and Conservation (DEC)

Facility: a premises at which a scheduled activity under schedule 1 to the Act takes place

Feedstock: organics suitable for composting, fermentation, mulching and related processes

Feedstock amendments: wastes or organics added to organics before processing to improve the final product. Examples include water absorbent biodegradable organics (such as sawdust, wood shavings and paper pulp), and / or inorganic chemicals / minerals (such as lime, gypsum, ammonium phosphate or ammonium nitrate) added to modify the pH and / or the nutritional content of the composting mixture

Fermentation: the anaerobic process of turning organics into high-energy compounds such as methane, organic acids and alcohols and a solid residue that can be composted and / or cured and pasteurised, yielding compost or soil amendments

Greenhouse gases: gases, such as methane and carbon dioxide, that are implicated in the greenhouse effect, which in turn is thought to cause global warming

Groundwater: any water contained in or occurring below the surface of the ground

Hazardous waste: any liquid or non-liquid waste that is:

(a) specified in Part 3 of the Appendix below, or

(b) otherwise assessed and classified as hazardous waste in accordance with the procedures set out in the Waste Guidelines.

APPENDIX—Types of Waste

Part 3 Types of hazardous waste

(1) Any waste that meets the criteria for assessment as dangerous goods under the *Australian Code for the Transport of Dangerous Goods by Road and Rail*, and categorised as one of the following: (a) explosives, (b) gases (compressed, liquefied or dissolved under pressure), (c) flammable solids (excluding garden organics, natural organic fibrous material and wood organics, and all physical forms of carbon such as activated carbon and graphite), (d) flammable liquids, (e) substances liable to spontaneous combustion (excluding garden organics, natural organic fibrous material and wood organics, and all physical forms of carbon such as activated carbon and graphite), (f) substances which in contact with water emit flammable gases, (g) oxidising agents and organic peroxides, (h) toxic substances, (i) corrosive substances.

(2) Pharmaceuticals and poisons (being waste generated by activities carried out for business or other commercial purposes and that consists of pharmaceutical or other chemical substances specified in the Poisons List under the *Poisons and Therapeutic Goods Act 1966*).

(3) Clinical waste.

(4) Cytotoxic waste.

(5) Sharps waste.

(6) Any radioactive waste, being waste that: (a) contains a substance that emits ionising radiation spontaneously, and (b) has a specific activity greater than 100 becquerels per gram, and (c) consists of, or contains more than, the prescribed activity of any radioactive element listed in Schedule 1 to the Radiation Control Regulation 1993.

(7) Any liquid radioactive waste, being waste that: (a) contains a substance that emits ionising radiation spontaneously, and (b) has a specific activity ratio or a total activity ratio (as determined in accordance with the procedures set out in the Waste Guidelines) that is greater than one.

(8) Any declared chemical waste that: (a) is the subject of a chemical control order under the *Environmentally Hazardous Chemicals Act 1985*, and (b) is not permitted to be disposed of to a landfill site because of such an order.

(9) Quarantine waste.

[*Protection of the Environment Operations Act 1997*]

Inactivation: when referring to weed seeds and propagable shoots, means that they are no longer capable of propagating plant forms. When referring to pathogens and other organisms, means a reduction in their numbers and their activity so that they do not pose a threat to the life and health of other organisms

ISCST3: an atmospheric dispersion model developed by and available from the USEPA

Leachate: liquid released by, or water that has percolated through, organics, and which contains dissolved and / or suspended liquids and / or solids and / or gases

Litter: solid waste or organics that has been carelessly discarded and is not part of the collection system

Lysimeter: an instrument to collect water flowing through the vadose zone or unsaturated zone in the soil

Material recovery: a form of resource recovery in which the emphasis is on separating and processing organics

Methane (CH_4): an explosive, odourless and colourless gas produced by organics undergoing anaerobic biological decomposition

Minimum Design Requirements: describe and / or list the minimum requirements for the design of environmental management equipment and practices (e.g. working surfaces) for the protection of waters (see Section 5)

Mulching: the size reduction of organics using one or more of the processes such as the following: cutting, milling, shredding and grinding. Usually the mulch is then pasteurised.

Non-liquid waste: any waste that:

(a) has an angle of repose of more than 5 degrees, and

(b) does not contain, or is not comprised of, any free liquids (as determined in accordance with the Waste Guidelines), and

(c) does not contain, or is not comprised of, any liquids that are capable of being released when the waste is transported, and

(d) does not become free flowing at or below 60 degrees Celsius or when it is transported, and

(e) is generally capable of being picked up by a spade or shovel.

[*Protection of the Environment Operations Act 1997*]

Offensive odour means an odour:

(a) that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances:

  (i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

  (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations

Organics: means natural organic materials of waste and non waste origin including:

(a) putrescible organics (such as: meat, fish, poultry, fruit, vegetables and their cooked or processed products; biosolids and manures; and animal materials), and

(b) non putrescible organics (such as: timber; garden trimmings; agricultural, forestry and crop materials; and natural fibrous organic and vegetative materials),

but excludes:

(c) human made organic chemicals (such as: solvents; industrial, agricultural, mining, commercial, household chemicals; cleansing agents; and personal care products), and

(d) naturally occurring organic chemicals which have been refined and/or concentrated by human activity (such as: oil; petrol; diesel; and coal tar)

(see Section 3 Table 3 for their further categorisation for composting processes)

Pasteurisation: the process involving heat and resulting in reduction in the levels of human, animal and plant pathogens and in the inactivation of weed seeds and propagable shoots

Pathogen: a living organism that can be harmful to humans, animals, plants or other living organisms

Performance measurement: specifies the process to be followed in measuring environmental characteristics to determine whether a particular performance requirement or desired outcome is being met or achieved, or the extent of the difference between the measured characteristic of the environment and a particular performance requirement or a particular desired outcome

Performance requirement: defines the quantifiable or qualifiable characteristics of the environment against which environmental quality can be assessed

pH: the negative logarithm of the hydrogen ion concentration of an aqueous solution. This provides a measure of whether a solution is acid or alkaline.

POEO Act: the *Protection of the Environment Operations Act 1997*

Premises: includes:

- a building or structure, or
- land or a place (whether enclosed or not), or
- a mobile plant, vehicle, vessel or aircraft

Processing of organics: For the purposes of these guidelines, 'processing' includes composting, digestion, mulching, fermentation and similar processes that involve biological organisms

Propagule: a part of a plant that can lead to the growth (propagation) of a full plant in the environment, such as a seed, rootstock, stem or leaf

Rapidly biodegradable organics: biodegradable organics, including putrescible organics, that are able to be decomposed under favourable conditions by microbial action, in both the presence and the absence of oxygen, to a noticeable extent within 14 days; rapidly biodegradable organics include grass clippings, food and animal organics and organic sludges

Recycling of organics: the processing of organics into a similar non-waste product

Related organic processing processes for the conversion of organics into soil conditioners, compost, humus or other products (for example, mulching, fermentation and digestion). They should be processes that are carried out under controlled conditions.

Relative per cent difference: the difference between duplicate samples divided by the average and expressed as a percentage

Resource recovery: the extraction and use of resources from waste and/or organic sources. Resources recovered can be used in the manufacture of new products. Recovery of value includes the production of energy by using components of waste as a fuel, production of compost using organics as a medium, and reclamation of land.

Run-off: the portion of precipitation that drains as a surface flow

Run-on: where surface water runs off one site and flows on to the site in question (that is, the composting and related organics processing site)

Sludge: material that has settled to the bottom of a waste-treatment device

Solid: see **Non-liquid waste**

Solid waste landfill: a site for the disposal of solid waste by landfilling, as defined in *Environmental Guidelines: Solid Waste Landfills* (EPA 1996).

Spadeable: a physical state of material in which the material behaves sufficiently like a solid to be able to be moved by a spade at normal outdoor temperatures

Stabilised or stable: not prone to further biodegradation (see **Cured**)

Surface water: includes all natural and constructed waterways or channels whether flow is intermittent or not; all lakes and impoundments (except lined dams associated with landfilling activities; and other marshes, lagoons and swamps)

The Act: the *Protection of the Environment Operations Act 1997*

Toxins: substances that are harmful to humans, animals or plants

Transfer station: a waste facility used to transfer waste from collection vehicles to a bulk haul vehicle in order to achieve long-distance transportation efficiency

Treatment of waste: the processing of waste into a different type of waste

Uppermost aquifer: the nearest geological medium to the base of the processing surface that acts, or could potentially act, as an aquifer

Vadose zone: the zone beneath the topsoil and overlying the watertable, in which water in pore spaces coexists with air or in which the geological materials are unsaturated

Vector: a carrier that is capable of transmitting a pathogen from one organism to another

Vermiculture (or vermicomposting): a composting process that uses worms and micro-organisms to convert organics into nutrient-rich humus

Waste: as defined in the *Protection of the Environment Operations Act 1997*:

waste (unless specifically defined) includes:

(a) any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment, or

(b) any discarded, rejected, unwanted, surplus or abandoned substance, or

(c) any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, processing, recovery or purification by a separate operation from that which produced the substance, or

(d) any substance prescribed by the regulation to be waste for the purposes of this Act.

A substance is not precluded from being waste for the purposes of the Act merely because it can be processed, re-used or recycled.

Waste Guidelines: the document called *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes*, issued by the EPA and in force as at 1 July 1999 (EPA 1999a)

Water assessment plan: a plan that is developed to enable the occupier to detect any water pollution at the premises (see Appendix D)

Water assessment report: a report that describes the extent of failure of water and / or leachate management when assessment of water monitoring results detects a possible incidence of water pollution

Water management strategy: a strategy that describes the measures to be taken to protect groundwater and surface water, including:

- measures to prevent uncontrolled discharges from the facility
- measures to avoid discharges of water of lower environmental quality than those of the receiving waters
- measures to monitor the quality of waters that are present at or near the facility and the environmental quality of which may be affected by activities on the facility
- measures to be taken to remediate waters in the event of confirmed pollution by discharges.

Water pollution remediation plan: a structured plan for the remediation of groundwater, subsoil or surface water bodies when a preliminary water assessment of the site (Appendix A) or assessment of water monitoring results detects pollution that requires remediation

Watertable: the level of the upper surface of an aquifer

Windrow: system of composting involving the aeration of horizontally extended piles formed by a front-end loader or windrow turner. Extended piles are generally 1.5 to 3 m in height, and length is limited by the size of the composting pad. Aeration can be achieved by mechanical turning and / or the delivery of air from the base of the windrow

REFERENCES AND BIBLIOGRAPHY

Legislation

The following legislation is available at www.legislation.nsw.gov.au:

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