Operating organic waste processing facilities

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1. Purpose

Processed organic waste material can improve soil's physical and chemical properties. It can also divert significant amounts of material from landfill, improve water retention in soils and reduce reliance on chemical fertiliser. The facilities that process organic waste can harm human health and the environment if not properly managed.

This guideline helps the organic waste processing industry comply with the:

- Environment Protection Act 2017 (the Act) and
- Environment Protection Regulations 2021 (the Regulations).

It applies to all facilities that process organic waste sourced on or offsite. These processes include, but are not limited to:

- composting
- anaerobic digestion
- vermicomposting
- black soldier fly processing
- food waste dehydration
- thermal treatment
- mulching.

1.1. Scope

This guideline:

- contextualises common hazards in the organic waste processing industry
- compiles information on managing those hazards
- supports compliance with the general environmental duty (GED) and other legislation as relevant
- suggests practical control measures appropriate for your operations.

Sections 1 to 5 of this guideline apply generally to facilities that process organic waste. Section 6 of this guideline gives additional detail specific to some common processing technologies. Appendix A provides an example checklist summarising the considerations outlined in this guideline Appendix B provides technical information specific to performing a risk assessment and risk management for chemical and microbial contaminants.

Organic waste processing sometimes occurs along with other processes. This can include processes such as converting waste to energy through anaerobic digestion. Many of the principles in this guideline may apply to these other processes. This document only covers processing organic waste material.

2. Legislative context

This guideline does not set or prescribe mandatory requirements that an organic waste processing facility must follow. Similarly, it does not deem compliance with any existing legal obligation. Before implementing any recommendation or information in this guideline, you should assess it to determine whether it is reasonably practicable in your specific circumstances. Following this guideline will help show that you have taken reasonable measures to comply with the Act. Other legislation is likely also relevant to your operations. This guideline does not provide guidance to meet those other obligations. This guideline does not replace legal requirements or your permission conditions. It is not a complete guide on running an organic waste processing facility. Nor is it suitable for risk assessments of output material use. It does not cover all considerations relevant to this industry. Not all aspects described in it will necessarily apply to your operation.

2.1. *Environment Protection Act 2017*

The Act takes a preventative approach to managing risks to human health and the environment from pollution and waste in Victoria. This approach focuses on preventing impacts from waste and pollution. It also focuses on managing impacts after they have occurred. For more information, see **What the *Environment Protection Act 2017* means for Victorian businesses.**

The GED is the cornerstone of the Act. It requires a person engaging in an activity to understand and minimise its risks of harm to human health or the environment from pollution or waste so far as reasonably practicable. See Industry guidance supporting you to comply with the general environmental duty (EPA publication 1741).

Risks of harm can be minimised by implementing and maintaining appropriate risk controls. The effectiveness of those operational controls should be monitored and continually improved. The Act also gives EPA powers to monitor and enforce compliance with the GED.

Part 6.4 of the Act sets out the waste duties that apply to industrial waste. The feedstock you use and your output material may be classified as industrial waste as defined in section 3 of the Act. Waste duties are summarised in Managing industrial waste (EPA publication 1990).

For waste generators

If you generate waste you must take reasonable steps to ensure it goes to a lawful place. This includes:

- classifying your waste
- informing your waste transporter about your waste
- verifying that your waste is transported to premises authorised to receive industrial waste – commonly referred to as a lawful place.

You must also meet your GED.

For waste transporters

If you transport waste you must take it to a lawful place. Always ensure the location you are taking waste to is authorised to receive that type of waste. Never deposit waste without consent from the person receiving it. You must also meet your GED.

Waste producers and transporters are responsible for ensuring the site accepting their waste is a lawful place. There are several ways for a site to be a lawful place. These include:

- Specific circumstances under regulations (reg) 63 of the Regulations
- A determination under reg 5 of the Regulations, or section 48 of the Act

- A declaration of use under reg 64 of the Regulations
- An EPA permission or a permission exemption
- Authorised emergency storage or use of waste under section 157 of the Act

Ask the waste receiver which one applies to their site if you need to verify it's a lawful place. For more information, see EPA Publication 1946.1: How to establish lawful place.

For waste receivers

Waste receivers must only accept types of waste they are lawfully authorised to receive. Once you accept waste you must meet your GED. This means you need to minimise risks of harm to human health and the environment from the waste.

Organic waste processing facilities have duties to:

- only receive waste they are authorised to receive
- take all reasonable steps to ensure their waste outputs are or will be transported to and received at a premises authorised to receive that industrial waste – this includes:
  - identifying and classifying the organic waste output
  - providing sufficient information about the industrial waste to a person who is collecting, consigning, transferring or transporting the organic waste output to enable transportation to a place or premises that is authorised to receive it
  - verifying that a place or premises that is proposed to receive the organic waste output is authorised to receive that organic waste output – this may mean ensuring the organic waste output complies with the processed organics determination, through using a declaration of use, or through an EPA permission.

Priority Waste and Reportable Priority Waste

Waste from organic waste processing facilities may also be priority waste or reportable priority waste (RPW). All of the industrial waste duties plus additional duties apply to management of priority waste. These include taking all reasonable steps to ensure that:

- the priority waste is contained in a manner that prevents its escape
- the priority waste is isolated in a manner that ensures resource recovery remains practicable
- a person who collects, consigns, transfers or transports the priority waste is provided the following information, where reasonably available:
  - the nature and type of the priority waste
  - any risks of harm to human health or the environment that exist in relation to the priority waste
  - any other information that can reasonably be expected to be necessary for the person to comply with a duty in relation to the priority waste under the Act.

You must inform EPA every time RPW is exchanged. You must use **EPA's electronic waste tracker tool** to comply with this duty.

2.2. Environment Protection Regulations 2021

The Act sets out the definition of industrial waste and establishes waste duties. The Regulations set up the process for classifying industrial waste and adds to the definition of industrial waste. Part 4.2 of the Regulations sets out the requirements for managing industrial waste in line with the Act. This includes:

- the definition of industrial waste
- classifying industrial waste
- the authorisation to receive industrial waste.

The Regulations also prescribe activities requiring an EPA permission under the Act (see Section 2.3 of this guideline).

Waste determinations are made under reg 5. They authorise a person, place or premises to receive industrial waste (that is, they provide a lawful place).

The processed organics determination sets contaminant thresholds and administrative requirements. If met, the determination will authorise a site to receive and use organic waste. This determination does not include:

- liquid organic waste
- digestate from anaerobic digestion
- raw mulches
- vermicast.

The processed organics determination does not apply to all types of organic waste, such as manure, biochar and fibrous organic waste. If the determination does not apply to your output material, you will need to consider other lawful place pathways. This may be, for example, a declaration of use or an EPA permission (see Section 2.3 of this guideline).

The determination does not address risks from all types of contamination. You may need extra monitoring and controls depending on your feedstocks and outputs. For feedstocks, end-uses and technologies other than those covered by the determination, refer to Appendix B of this guideline.

The GED applies to all organic waste processing operations. This includes operations that meet the determination and those that don't. That means risks to human health and the environment from the use and storage of processed organic waste must be minimised so far as reasonably practicable.

2.3. EPA permissions

The requirements for Permissions are in Chapter 4 of the Act. Schedule 1 of the Regulations sets out that certain activities need certain kinds of permissions. EPA also has the power to issue exemptions for development licences, operating licences (EP Act 2017 s 80) and permits (EP Act 2017 s 82). Permissions work together with the GED to ensure high performance standards. You may need more than one permission for your operations, depending on the type of activity.

Permissions are categorised by level of risk to human health and the environment:

- registrations are required for activities with low to moderate risk
- permits are required for activities with moderate risk or high risk with low complexity
- licences are required for high-risk or complex activities – the type of licence also depends on the stage of operation (pilot project, development and operating licences) and the type of activity.

Some activities relevant to the organic waste processing industry requiring permissions include:

- Organic waste processing requires an A07a (licence) or A07b (registration). This permission is not required for operations processing only waste that is generated onsite. It is also not required if less than $5m^3$ of organic waste is stored on site at any time. See Schedule 1 item 11 of the Regulations .
- Waste and resource recovery requires an A13 (licence, permit or registration).
- RPW management requires an A01 (licence).
- Supply or use of RPW requires an A16 (permit).
- Waste to energy facilities need an A08 (licence).
- Immobilising, thermally degrading or incinerating waste requires an A02a (anticipated for thermal treatment).
- Temporary storage of designated waste requires an A23 (registration). Designated waste is defined in the Regulations (regulation 3).

Please note this this list is not all-encompassing. There may be other permissions not listed here that may apply to your activity. See check if you need a permission for more information.

EPA may issue a permission with conditions, and you must comply with those conditions. Some conditions relate to technology selection and reflect best available techniques and technologies. These will develop and improve over time. EPA may conduct periodic licence reviews, which introduce higher standards. This will help you meet your obligations of continual improvement as part of the GED (see Section 2.1 of this guideline).

For general information on permissions and applications, refer to EPA's Permissions scheme policy (EPA publication 1799-2). You can check if you need a permission here. If you think you need a permission, EPA recommends you contact us for a pre-application discussion. This will ensure you undertake appropriate research and apply for the correct permission. Please contact EPA on permissions@epa.vic.gov.au to discuss your application.

For help applying for a licence refer to how to apply for a licence and this Development licence application guideline (EPA publication 2011).

EPA encourages innovation and research. A pilot project licence may be suitable for this activity. It supports the research, development or demonstration of an innovative technology or technique. This licence belongs in the high-risk permissions tier along with our other licences.

2.4. Environment reference standard

When deciding whether to issue an operating licence or development licence, EPA must consider factors. These are described in sections 69(3) and 74(3) of the Act for development licences and operating licences. One of these factors is the environment reference standard (ERS).

The ERS identifies environmental values. These are values that the Victorian community want to achieve and maintain. It provides a way to assess those environmental values in locations across Victoria. The ERS identifies standards for ambient air, ambient sound, land and water environments. Any or all 4 of these may be relevant to your business practices. Industry may use the ERS to understand potential impacts on human health and the environment that may arise from their activity or site.

The ERS acts as a benchmark for assessing potential impacts on human health or the environment.

3. Risk management

Under the GED, you must have a detailed understanding of the risks your business poses to human health and the environment. Then you can minimise them so far as reasonably practicable.

This section introduces a 4-step process for assessing and controlling risk (Figure 1) in the context of the organic waste processing industry.

A good way to record how you have gone about this is by developing and maintaining a Risk Management and Monitoring Program (RMMP). This is a requirement for all licence holders. Your RMMP's risk assessment section should follow this guideline on assessing and controlling risk (EPA publication 1695). EPA has also produced a series of short videos to help explain the 4-step risk management process. EPA may require a RMMP through permission conditions or as a part of your permission application under section 51A of the Act. Your RMMP may also help you identify and demonstrate best practice (EPA publication 1517).

The level of detail in your RMMP should be proportionate to the complexity of your operations and feedstock risk profile. The more complex and higher the risk, the more comprehensive, detailed and quantitative your RMMP should be. Less complex and lower risk facilities may perform elements of their risk assessment in a qualitative manner.

Your RMMP's incident response section should follow EPA's guidance on responding to harm caused by pollution (EPA publication 1991). EPA recommends a separate emergency response plan for all operations. EPA may require one as part of your permission conditions.

3.1. Steps in controlling hazards and risks

Figure 1 The four steps to risk management

3.1.1. Identify hazards

The first step is to identify the hazards your operations generate. This includes:

- who or what could be exposed to those hazards
- how they are likely to be exposed
- the harm that could result from that exposure.

One way to organise this information is in a conceptual site model (CSM). A CSM shows:

- where the hazards come from (the source)
- how exposure to them can occur (the pathway)
- the people, fauna, flora or environmental aspects they impact (the receptors).

An example conceptual site model for an open-windrow composting site is shown in Figure 2. This example does not address the risks associated with the use of your output material. You should consider those risks in line with Appendix B of this guideline.

Key hazards relevant to the organic waste processing industry are highlighted in Section 3.2 of this guideline.

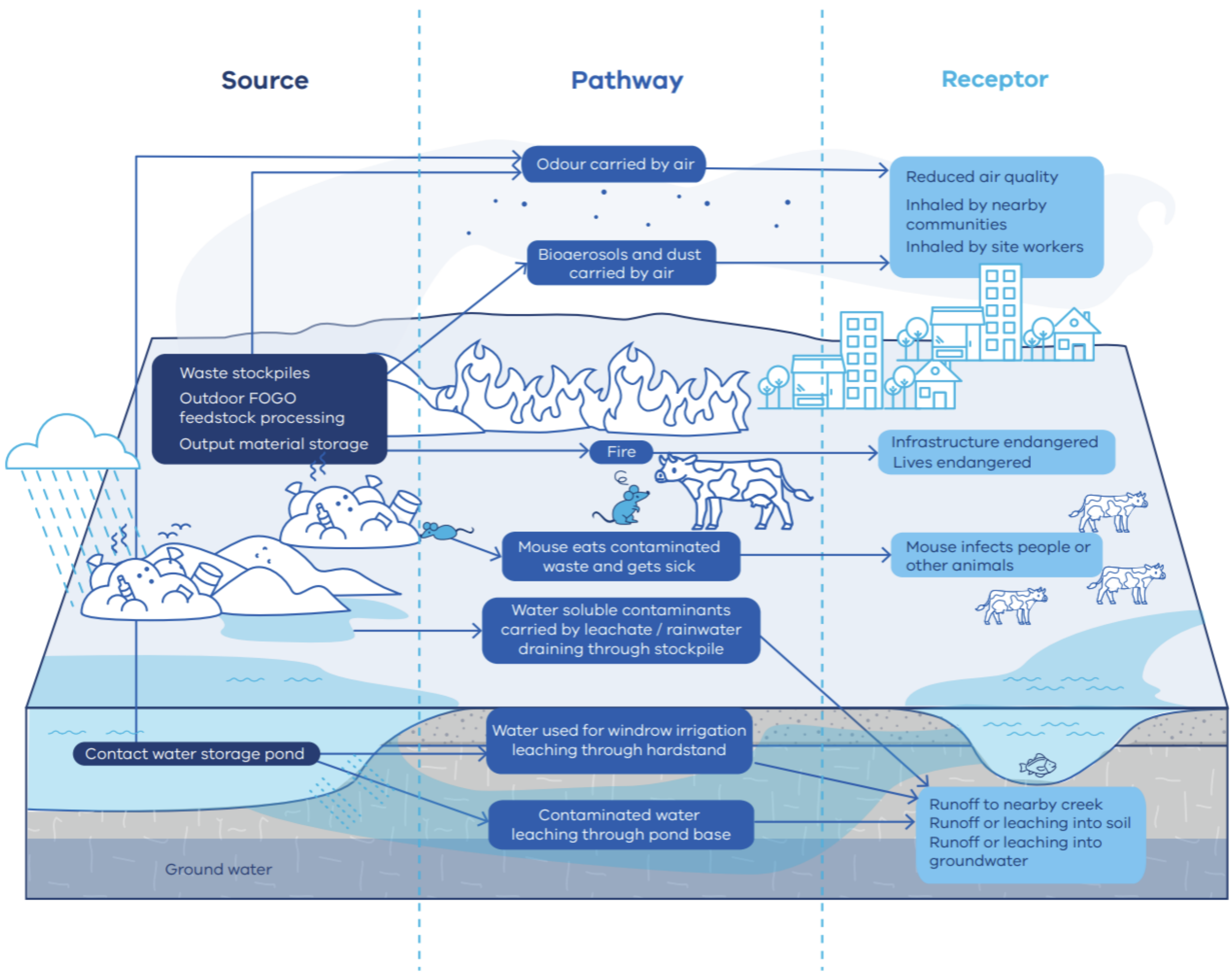


Figure 2: Example conceptual site model for a composting site

In addition to the CSM in Figure 2, contamination should also be considered. For instance, if not properly managed, chemical contamination can enter the environment from the organic waste processing facility itself, or the site of application of processed organic waste to land. Chemical contamination from unprocessed feedstock or contaminated output can contaminate land, groundwater or surface water.

3.1.2. Assess risks

This step involves assessing the likelihood and consequence of the hazards identified in Step 1. This identifies the harm to human health and the environment they could cause. It also informs your RMMP and conceptual site model by identifying hazards requiring the most attention.

Exposure and dose response are important considerations when assessing risk. This is how organisms are impacted by exposure at different levels. Operators should identify all risks of harm to human health and the environment from their activities. More detail on risk assessments for microbial and chemical contamination can be found in Appendix B: Risk assessment and management for chemical and microbial contaminants. EPA has published guidelines to assist you in performing a risk assessment for other risks such as:

- Separation distances guideline
- Liquid storage and handling guidelines (EPA publication 1698)
- Commerce, industry and trade noise guidelines
- How to control noise from your business
- Guidance for assessing odour (EPA publication 1883).

3.1.3. Implement controls

Eliminating risks is preferable to minimising or controlling them (Figure 3). Some risks can be eliminated by choosing the appropriate site location (Section 4.1 of this guideline) and site layout (Section 4.2 of this guideline). Some others can be eliminated by choosing feedstocks and waste acceptance criteria (Section 4.3 of this guideline).

Enclosed operations can provide more efficient controls than unenclosed operations, and may be an appropriate method for managing risk. This should be considered when determining how to minimise risks of harm to human health and the environment from your operations.

Other risks are inherent and cannot be eliminated. In such cases, controls may be appropriate to minimise those risks so far as reasonably practicable. The controls selected should break the source–pathway–receptor linkage identified in your CSM. These controls are described in the context of key hazards in Section 3.2 of this guideline . Your RMMP should include a review of best-practice risk control equipment. It should also include your rationale for selecting your particular equipment.

Administrative controls are the least favourable and generally can only be implemented by people at your site. That means they may be ineffective for offsite people and environmental receptors.

Figure 3 Hierarchy of controls

3.1.4. Check controls

Ongoing monitoring of your controls will ensure they are working as planned. This maintains minimised risk to human health and the environment from your activities. It also ensures your output material is of the highest quality you can achieve.

Your control monitoring should include conducting site inspections and consultation with employees. This ensures anything noticed or likely to cause harm to human health and the environment is known and managed.

One option for ensuring the safety of your operations is using the Hazard Analysis and Critical Control Point (HACCP) system. This can also apply to your output material. It aims to prevent issues by identifying critical points of a problem and implementing controls before they occur. For more information on this process and its implementation see Australian Institute of Food Safety. Examples of HACCP specific to organic processing facilities are provided in Appendix B. Risk assessment and management for chemical and microbial contaminants.

3.2. Common hazards

You should consider all the hazards described in this section. This is not an exhaustive list. Hazards at your site should be identified by the process described in Section 3.1.1 of this guideline.

Hazards can change, appear or disappear with changing circumstances. It is important to understand how this occurs at your site. This will inform your management practices and may impact the quality of your output material. For example, odour at your site may not be a concern during summer but rainfall during winter may cause pooling and anaerobic conditions.

3.2.1. Contamination

Contamination in feedstocks and output material can pose risks of harm to human health and the environment. For example, pieces of plastics in your feedstock can contribute to microplastics in your output material. Food waste may attract vermin to your site (see 3.2.7 Biosecurity). Feedstocks of animal or human origin can introduce pathogens into your process. Broadly:

- chemical contaminants include natural, anthropomorphic, organic, and inorganic chemicals
- microbial contaminants are microorganisms that can cause disease in humans, animals, and plants
- physical contaminants are visible items such as plastic, metal and glass.

The processed organics determination prescribes specific contaminant limits. You must comply with these if you plan to use it to secure the authority to receive processed organic waste.

You should have acceptance criteria (the criteria for wastes and contaminants able to be received at your premises). These criteria should be able to produce output material of good quality. This avoids unacceptable levels of physical, chemical and microbial contamination in your feedstocks. Acceptance criteria may be included in your commercial contracts with suppliers of the waste you process.

Use Appendix B in the first instance to determine your feedstock's risk level. Higher risk wastes may need more regular and in-depth contamination assessments. They may also require comprehensive controls for all hazards. You should prioritise contaminants that:

- are likely to occur in your feedstock
- pose the greatest risks to human health
- are least likely to be broken down through your selected processing technology.

Table 1 provides some example feedstock categories in increasing order of risk. This is based on the likelihood of pathogen survival, ease of processing and contaminants likely to occur in that feedstock. It also indicates waste codes that may apply to those feedstocks.

Table 1: Example feedstock categories and their likely contaminant categories

Feedstock	Examples	Likely contaminant categories	Feedstock indicative waste code	Risk profile
Natural fibrous organics, untreated timber	Grass, leaves, straw, branches, seed husks	Fungal spores Physical contaminants	K310 – NH, K300	Low
Dry herbivore manure	Horse, cattle, sheep	Chemical and microbial contaminants	K220	Medium[1]
Food organics	Kerbside FOGO, winery/brewery/ distillery waste	Fungal spores Chemical, microbial and physical contaminants	K210, K200	High
Liquid waste, wastes of animal or human origin	Abattoir waste, mortalities, grease trap, meat, dairy, fresh manure, sewage, biosolids[2]	Chemical, microbial and physical contaminants	K100, K110, K220, K400 – H, K400 – NH, K410	High

The earlier you manage physical contamination in the waste management chain, the more efficient the process will be. Options to remove remaining physical contamination include:

- manual picking
- air separators
- sieving
- star screens and disc screens
- trommel sorting.

Each has different strengths and efficiencies. The option(s) you choose will depend on your feedstock and the physical contamination in it.

Acceptance criteria for microbial contamination may include restrictions. For example, specific limits on the number of dead chickens or broken eggs in poultry manure. Any remaining microbial contamination should be managed through risk assessment and pathogen inactivation. See Appendix B for risk assessments and (Section 5.1 of this guideline) for pathogen inactivation. Manure from diseased animals may need special consideration.

Managing chemical contamination depends on the type of contamination and your processing technology. Some contaminants may be degraded through processing, some may not, and some can even become concentrated. You should closely monitor degraded contaminants, to ensure they are consistently removed. You should also monitor undegraded contaminants in your output material. This

[1] Note that this is referring to dry herbivore manure only. The processed organics determination lists 'Animal manure and mixtures of animal manure and animal bedding' as high risk.
[2] That are treatment grade T4 per EPA Publication 943 'Guidelines for environmental management: Biosolids land application.

ensures they are below any relevant standards. It can also identify the source to allow you to avoid the feedstock. Appendix B details risk assessments for chemical contamination.

One control for risks associated with chemical contamination is the amount of higher-risk feedstock in a batch. Operators should determine how much of a feedstock can be included in a batch while still controlling that process and producing good quality compost (for example, the amount of FOGO in open windrow composting).

Per- and polyfluoroalkyl substances (PFAS) are one type of chemical contamination. PFAS are a group of manufactured chemicals. They convey non-stick, water-repellent, surfactant and flame-retardant properties. They have a wide range of uses such as firefighting, agricultural, industrial and medical applications. Due to their widespread use and chemical stability, PFAS are found in many waste streams. There is a risk that organic waste processing facilities' output materials contain PFAS, which can enter the environment once the material has been applied to land.[3]

There is ongoing research into the effects of PFAS on people and the environment. The Department of Climate Change, Energy, the Environment and Water has published the PFAS National Environmental Management Plan (NEMP). The NEMP is a how-to guide for managing and preventing the spread of PFAS contamination. It provides the most up-to-date guidance for managing PFAS in organic waste. If you suspect risk of PFAS in your feedstock or output material, you should use the PFAS NEMP.

For more information on managing feedstocks, see Sustainability Victoria's (SV) Guide to biological recovery of organics.

- Section 2.2 provides information on separating mixed feedstocks
- Section 3 provides information on controlling quality of feedstocks
- Section 6.1 provides information on matching feedstock and technology.

If you wish to change your operations and include new feedstocks, you may need to amend your permission. You should liaise with EPA's permissions pathway assessor in the first instance. EPA will consider the changed level of risk to human health and the environment, and the proposed risk management controls. EPA recommends monitoring feedstock and output material contamination more often when feedstock changes. This helps you to understand and control any changing risks. Refer to Appendix B for more information.

3.2.2. Odour

Odour from organic waste processing is one of the most common community pollution reports that EPA receives. The goal for Victoria is to have air that is free from offensive odours (ERS Part 2). It is your duty under the GED, so far as reasonably practicable, to reduce the risk of harm from offensive odour. EPA recommends including odour monitoring (EPA publication 1881) and management in your RMMP. You should consider proactive measures to reduce the likelihood of odour generation. You should also consider reactive measures to address issues when they arise. Sections 4 to 7 of the Guidance for assessing odour (EPA publication 1883) describe how to perform an odour assessment.

Odour issues will be site-specific and your choice of odour controls will depend on your operations. Odorous conditions are sometimes intrinsic to some operations. Here, enclosing operations and implementing odour controls may be an appropriate solution to consider. Enclosed techniques are generally better than open techniques at managing some risks. Well-designed enclosed technologies help prevent odour issues and may provide better heterogeneity for pasteurising conditions. This makes it more suitable for managing odour from higher risk feedstocks and may be an appropriate method for

[3] Heads of EPA Australia and New Zealand, *PFAS National Environmental Management Plan Version 3.0*, March 2025, 1.2.

managing risk. This should be considered when determining how to minimise risks of harm to human health and the environment from your operations.

Management options for indoor operations include biofiltration (EPA publication 1880) or air scrubbers. For outdoor operations, options include forced aeration and monitoring. Treatment options could include a backup in case of system failure – a backup could include activated carbon or an afterburner.

A balanced feedstock recipe appropriate to your technology can reduce risk of odour. Recipe factors may include carbon-to-nitrogen ratios (C:N ratio), aeration, moisture levels, pH levels, and temperature. Ongoing monitoring of parameters contributing to odour can prevent the issue from occurring (for example, where raw materials are received and where processing occurs).

Some common odour-causing situations and potential solutions include:

- formation of anaerobic conditions may be managed by Liquids management and efficient aeration
- stockpiled feedstocks at your receival area may be resolved with prompt feedstock use
- inefficiently functioning or dirty machinery may be resolved with regular maintenance and cleaning
- odour from movement/screening/shredding/aeration of feedstocks can be resolved by performing these processes in enclosed areas with odour-control equipment.

For information on how to control odour, refer to Odour advice for businesses.

3.2.3. Fire

Fires can have catastrophic impacts on human health and the environment. Fire can also impact personal and business finances. They can start at organics waste processing facilities spontaneously from overheating stockpiles. They can also start from accidental ignition. This can be contributed to by meteorological conditions or from faulty electrical equipment. Fires offsite, such as bushfires or a fire at a nearby site, can also ignite a fire at your site.

Organics decompose through microbial and chemical action, which can generate considerable heat. They will spontaneously combust when the heat generated is higher than that lost to the surrounding environment.

Allowing a pile to get to an internal temperature of over 90°C can trigger rapid self-heating and eventual combustion. For example, FOGO undergoing composting typically ignite between 150°C and 200°C.

Moisture content will also influence spontaneous combustion - low moisture levels will stop biological activity (stopping self-heating), and high moisture levels will allow for evaporative cooling of the pile. To reduce the risk of spontaneous combustion, organics storage (that is, any organic waste not being otherwise actively managed) should be kept **below 70°C** and moisture content should be maintained at either **less than 20 per cent OR more than 45 per cent**[4]**.**

Your RMMP should describe ongoing monitoring and management practices to prevent fire and minimise harm at your site. This will guide the practices you include in your emergency management plan (EMP). EPA strongly recommends that you contact the Country Fire Authority (CFA) or Fire Rescue Victoria (FRV) when developing your EMP. This should be completed before applying for a permission. CFA, FRV, and Emergency Recovery Victoria help in natural emergencies and publish guidance. You can use their guidance to help design your site for managing fire risks. FRV and CFA can advise on your proposed site layout, operational controls and firefighting equipment. If your site is already operational, EPA strongly recommends consulting FRV and CFA to improve your operations. Consider FRV's Fire safety guidelines and the Waste Industry Safety and Health Forum's Reducing fire risk at waste

[4] Rynk, Robert. *Fires at Composting Facilities: Causes and Conditions. Compost Operators Forum,* (2000)..

management sites. This is not specific to organic waste processing but is good information on performing a fire risk assessment.

EPA recommends following the Management and storage of combustible recyclable and waste materials guideline (EPA Publication 1667). This provides information on:

- hazard identification
- safe storage
- fire mitigation
- developing an EMP
- site planning.

One way to manage the risk is to comply with the separation distances in EPA Publication 1667.3: Management and storage of combustible recyclable and waste materials - guideline. However, if you wish to use different stockpile measurements than those described in the guideline alternative methods of risk management can be used by doing a Fire Risk Assessment (FRA). If you choose to follow this alternative method, the measurements should be no greater than what your machinery can effectively access. You should show that radiant heat from a fire source feature will not cause ignition to nearby stockpiles, buildings or fixed equipment. This includes radiant heat from other stockpiles. EPA recommends engaging a suitably qualified consultant to calculate stockpile distances and dimensions.

Other practices suitable for your operations may include:

- thermal imaging cameras and temperature and moisture probes to monitor stockpiles for conditions that contribute to fire risk. Temperature and moisture levels impact most processing technologies. It may be efficient to combine fire temperature and process control temperature monitoring.
- active fire prevention systems, such as automatic suppression, that are appropriate to your fire risk
- a change in your operations on days of elevated fire danger or total fire bans.

3.2.4. Liquids

Some liquids pose a higher risk to human health and the environment than others. These liquids may require higher level controls to minimise risk so far as reasonably practicable. Liquids from organic wastes or rain may contaminate nearby soils and surface or groundwaters. It can recontaminate processed waste or turn anaerobic and cause issues. These liquids can include:

- run-off
- leachate
- floodwater
- firewater
- wash water from cleaning equipment or machinery
- contact water – which is water that has contacted organic wastes.

If you process liquid wastes or produce liquid output your site has a higher risk of liquid management issues. You will need to undertake a more detailed risk assessment for liquids and include a higher standard of controls. These controls should confine the liquid organic waste. This will also prevent odour and contamination of surrounding soil, surface water and groundwater.

Ways to manage risks from liquids include:

- Fully enclosed operations.
- Performing a hydrogeological assessment (HA) following Hydrogeological assessment guidelines for groundwater quality (EPA publication 668). This helps understand an activity's potential to contaminate groundwater and estimate seepage. A hydrogeological assessment may recommend groundwater contamination management. It can also identify naturally occurring background levels of chemical substances (EPA publication 2033).
- Investigating contamination in contact water.

- Keeping non-contact water separate from contact water. This can be achieved by using separate drainage, collection and storage systems. This reduces the volume of contact water to be managed. It reduces contamination from the site and enables reuse of non-contact water. Reuse may include wetting organic wastes, firefighting or cleaning, among other uses.
- Installing groundwater monitoring wells and implementing an ongoing groundwater monitoring program.
- Liquid storage ponds have a base that prevents leaking into the environment. This should be made from a composite lining system. This means either geosynthetic clay liners or compacted clay liners overlaid by a geomembrane.
- Operation and storage should occur on impermeable hardstand surfaces. This should also include effective bunding, drainage, collection and storage of liquids. Operation and storage includes pre-processing and processing, feedstock receipt and output material storage.
- Choosing construction material by its estimated seepage and what is reasonably practicable. Options include:

  concrete: generally recommended
  high-density polyethylene liner overlaying concrete: recommended for liquid mixing pits
  clay: may be appropriate for output material storage if HA results show there is very low risk of surface or groundwater contamination – this likely requires a protected surface to mitigate damage from cracking and machinery scraping
  composite geomembrane overlaying compacted clay.

- Hardstand surfaces comprising of compacted clay should have hydraulic conductivity less than 1 x 10-9 m/s using fresh water and 50,000 ppm sodium chloride solution. See Australian Standard 1289.6.7.1: 2001 for detail on hydraulic conductivity testing. Conductivity may need to be less for your operations, depending on the risk of harm and what is reasonably practicable. Things to consider as part of the design of the compacted clay include number and thickness of constructed layers, construction quality assurance processes, permeability of material and degree of compaction.
- Hardstands can be comprised of more than one material layer, such as a geomembrane over a compacted lay liner. The design should provide adequate protection of the geomembrane to decrease the potential for damage
- A 2 to 4% slope in hardstand drainage surfaces gives sufficient flow without erosion from excessive flow rate. Swale drains should be a minimum of 1% slope.
- Hardstand surfaces should include design measures to minimise deformation from traffic loads and be maintained to avoid cracking or scraping back to become permeable.

Please note that this is not a mandatory list of methods for managing liquid risks at an organic waste processing facility. They are methods of minimising risks of harm to human health and the environment and ways of meeting your obligations under the GED.

You may wish to propose hardstand construction different to the recommendations in this guideline. If you do, you should demonstrate that the proposed design will minimise risks of harm to human health and the environment so far as reasonably practicable The choice of hardstand design should be supported with an assessment of the seepage through the hardstand layer.

A flood could introduce contamination, waste or disease to your site or transport them from your site in runoff. Either way, it is your duty to manage risks associated with flood waters so far as reasonably practicable. Your liquid management infrastructure should be able to accommodate a one-in-20-year storm event. Your RMMP should cover risk controls during floods and clean-up of floodwaters. As a general note, EPA encourages onsite management of flood-impacted green waste.

The Liquid storage and handling guidelines (EPA publication 1698) provide information on:

- engineering controls
- proper storage and handling

- preventing spills
- responding to an incident.

3.2.5. Output material

You can primarily manage contamination in output material through feedstock selection and processing. Refer to Sections 5.1, 5.2, and 5.3 of this guideline for more information on managing contamination in output material.

3.2.6. Air

The goal for Victoria is to have air quality that sustains wellbeing and enjoyment (ERS part 5). Air pollutants generated at your site can impact air quality for nearby communities. Air pollutants can include dust, greenhouse gases and bioaerosols. For example, long-term exposure to dust increases the risk of lung and heart disease. Greenhouse gases contribute to climate change. You should understand air pollutants produced from your operations and reduce them so far as reasonably practicable. Refer to the Guideline for assessing and minimising air pollution (EPA publication 1961).

Dust controls may be required for your business. They may include covering certain operations, wetting dusty areas and using suction-sweeping machinery. See Section 13.7 of EPA publication 1961 for details on performing a dust risk assessment. Guidance can be found in Dust advice for businesses and examples of how to manage dust in the workplace.

Your facility may emit greenhouse gases depending on the energy source for machinery and power. They can also be generated incidentally from processing organic wastes. Under the GED, you must minimise risks of harm from these emissions. For details on doing this, refer to EPA publication 1961. EPA recommends you use the Australian Government's National Greenhouse Accounts Factors as a starting point to determine your emission factors. It is published annually and provides emission factors to help companies and individuals to estimate their GHG emissions. It ensures consistency between inventories at the company and facility level. If your operations produce methane, an option may be to capture it for use in energy generation. Another option to reduce emissions may be using feedstocks from nearby sources. This minimises distances travelled.

Bioaerosols are a form of airborne particulate of microbial, plant or animal origin. They can cause infections and allergies. They may be an entire microscopic structure such as bacteria, viruses, fungi or spores. They can also be a component of an organism (such as skin cells, hair or cell fragments). They are most likely generated along with dust. They can impact people onsite and can migrate offsite and impact nearby communities.

All feedstocks pose bioaerosol risks. Indoor facilities should consider biofilters to manage risks from bioaerosols. Some facilities do not have enclosed operations and sensitive land use within 250 m of the site boundary. These facilities should ensure that generated bioaerosols are below:

- 1,000 colony forming units per cubic metre (CFU m^3) for total bacteria
- 500 CFU m^3 for *Aspergillus fumigatus*.

Separation distances are required for odour and controls for dust. These would usually also reduce risk to nearby communities from bioaerosol inhalation. For more information, see EPA publication 1961. Information on performing a risk assessment for airborne microbes and bioaerosols can be found in Section 13 of that guideline.

3.2.7. Biosecurity

Organic waste processing facilities host a variety of biosecurity risks. These can significantly impact human health and the environment. Each risk will need different mitigation measures.

Any animal interacting with organic material can transport pathogens on or offsite. For example, vermin or birds nesting in it or animals eating it. If this is a risk for your site, your controls will depend on your technology type and may include enclosing or fencing your operations.

3.2.8. Litter

Litter (as defined in section 3 of the Act) may be generated at your site. Offences for litter and unlawful disposal of waste are included in the Regulations. EPA and other litter authorities enforce litter and unlawful disposal of waste. EPA, local councils, Victoria Police and Parks Victoria may:

- issue fines
- undertake investigations
- enable public reporting of incidents
- take legal action for more serious cases.

For information on regulation of litter under the Act, refer to the summary of litter regulations.

Portable litter screens and enclosing operations can prevent wind carrying litter from your site. You should clean up litter immediately. This prevents it from recontaminating processed material or entering nearby properties or environments.

3.2.9. Noise

Noise pollution can harm the health and wellbeing of onsite workers, neighbours and nearby communities. It is your responsibility to ensure your business does not emit unreasonable noise. Use the noise guidance for businesses and unreasonable noise guidelines to assess the noise coming from your site. How to reduce noise from your business (EPA publication 1481) provides guidance on how to minimise it.

Machinery, such as exhaust fans and truck movement (EPA publication 1891), will likely cause noise issues. Considerations to minimise noise and mitigate your risk include:

- proper initial selection of machinery, considering the noise each machine makes
- regular maintenance of machinery
- only allowing the use of trucks or operation equipment during particular hours of the day.

4. Risk management in facility planning

Site location and layout are important in eliminating or minimising risks to human health and the environment. This section provides an overview of some considerations when planning your facility.

4.1. Location

An appropriate site location can minimise a range of risks of harm to human health and the environment including those posed by liquids, odour, noise and fire. Appropriate buffer distances also minimise many of these risks. Facilities with buffer distances greater than the minimum recommendations set out in EPA guidelines on separation distances (EPA publication 1949) are still required to comply with the GED. They must minimise risks of harm to human health and the environment so far as reasonably practicable.

You may need a planning permit from your local council. If you are operating a composting facility, refer to Assessing an application for a composting facility (EPA publication 3002). Council will refer the planning permit application to EPA to assess whether your separation distances are appropriate.

EPA guidelines on separation distances (EPA publication 1949) sets recommended separation distances for different facility types. This includes composting facilities (Appendix C). You should follow the process set in that guideline if:

- you wish to vary this recommended separation distance
- you need to establish a separation distance because your facility type is not listed in Appendix C of the EPA publication 1949.

EPA guidelines should also be used in this assessment, including:

- the guideline for assessing and minimising air pollution (EPA publication 1961)
- guidance for assessing odour (EPA publication 1883)
- guidance for field odour surveillance (EPA publication 1881).

Your site-specific assessment should include your selected technology type and efficiency of your controls. See Section 6 of this guideline. The more enclosed your operations and higher the standard of controls, the lower the risk generated by your site. Other considerations may include meteorological conditions, topography and proximity to sensitive land uses.

Avoiding operating in an area with a flood risk will minimise your site's risks of harm from both contact water and non-contact water. Contact water is water that has been in contact with organic wastes. Non-contact water is water that has not been in contact with organic wastes. You should assess your site's flood risk to the degree appropriate for your location. For example, proximity to surface water bodies and meteorology of the area and operations (for example, degree of enclosure). In some cases, you should also consult with your relevant catchment management authority. For example, if your site is within a floodplain or subject to a flood overlay zone. You should do this before submitting a permission application. This may show the risk of contamination or pollution is too great and stop you from operating in that area. It is also generally advised that operations are not located within 100 m of a surface water body.

Once you've secured planning approval, you may need an EPA permission. For information on EPA permissions, see Section 2.3 of this guideline.

4.2. Layout

Good site layout can mitigate risks from fire, contact water and non-contact water and risk to air. See Section 3.2.3 for fire, Section 3.2.4 for water and Section 3.2.6 of this guideline for air.

4.3. Receiving industrial waste to be processed

You should have quality control procedures at your waste receival point. This should include strict acceptance criteria and screening. This avoids unintentionally accepting:

- industrial waste contaminated with material you are not authorised to receive – this may include priority waste or reportable priority waste (see Section 2.1 of this guideline)
- wastes with high risk of contamination
- wastes with contamination risks that you cannot control.

Removing contamination or contaminated material is better done earlier in the feedstock supply chain. It may not be possible for a waste processor to effectively remove contamination in feedstock they receive.

You should have a quarantine area for temporarily storing material you are not authorised to receive. This should also be used for waste you cannot process. These wastes should then be transported to a premises authorised to receive them. Visible levels of physical contaminants can be determined with the method described in The Australian Standard AS 4454-2012 Composts, soil conditioners, and mulches (AS 4454-2012) Appendix I.

You should manage non-visible contaminants in your feedstock according to their hazard profile. For example, chemical and microbial contamination. Information on this can be found in Section 3.2.1 of this guideline . Contaminated material should be decontaminated. It should then be managed in line with your waste duties (Section 2.1 of this guideline). Otherwise, you should reject it.

You should only accept waste volumes that you can realistically process. This mitigates issues relating to stockpiling unprocessed material. For example, litter production, pathogen proliferation and odour.

4.4. Storing organic material

Correctly storing and handling input and output material can prevent risk to human health and the environment in many ways. This includes:

- mitigating fire risk (Section 3.2.3 of this guideline)
- protecting soil and groundwater from contamination (Section 3.5.4 of this guideline)
- avoiding litter (Section 3.2.8 of this guideline)
- avoiding cross or re-contamination of processed wastes (Section 5.2 of this guideline).

It can also save valuable material, produce less waste and save money. If you process liquid waste, liquid storage and handling guidelines (EPA publication 1698) will be relevant to your operations. If you process solid organic waste, the storing and handling solids guideline will be relevant to your operations.

Depending on the type and amount of waste you receive and how you manage it onsite, you may need permissions for storage. For example, if you receive and store RPW, you may need an A01 licence.

5. Managing output material

Complying with the GED includes minimising risks of harm to human health and the environment from your output material. Waste generators also have a duty to take all reasonable steps to ensure their waste is or will be transported to and received at a lawful place. This section details risks your output material may generate that you will need to record in your RMMP.

You should periodically test measurable parameters and maintain them at appropriate levels. This will show that risks from your output material have been appropriately mitigated. Failure to monitor and manage risks may constitute a breach of the GED. It may also mean output materials may not meet the specifications set out in the processed organics determination. Following the recommendations in this guideline will help demonstrate that risks from the use of the processed organic output have been minimised so far as reasonably practicable and complies with the GED.

The frequency of monitoring and type of analytes will depend on the risks identified during your risk assessment phase.

5.1. Pathogen contamination

Pathogens can cause severe disease in people, animals or plants. Pathogens include bacteria, viruses, helminths, protozoa and fungi, among others. Pathogen inactivation means your output is less likely to cause disease. Composting and some types of anaerobic digestion should produce a pasteurised output. Vermicomposting, food dehydration, mesophilic anaerobic digestion and mulching may not.

Unpasteurised output may need more processing to minimise risks of harm from pathogens. Options for more processing include:

- composting
- pasteurising forms of digestion
- physiochemical sanitation – this should not adversely impact any microbes required for the primary technology.

You should manage pathogen contamination in accordance with Appendix B. You may demonstrate pathogen inactivation if your output material meets relevant standards:

- the processed organics determination for compost
- anaerobic digestion determination for digestate (See Section 2.2 of this guideline).

You should also consider spore-forming bacteria and other resilient pathogens. This is particularly relevant for facilities processing medium to high risk and high-risk feedstocks (see Table 1). This can be done by measuring the surrogates below that are inactivated under similar conditions:

- *Bacillus cereus* and *Clostridium perfringens* are appropriate surrogates. These should be below the detection limit in 1 g, dry weight.
- Sites processing human sewage or biosolids should test for enteric viruses. There should be < 1 plaque-forming unit per 10 g, dry weight.

These are just examples of pathogens you should investigate. All organic waste processing facilities should routinely perform microbial risk assessments. You should adapt these to events that may change the microbial risks of organic materials. For example, disease outbreaks and changes in feedstock.

All components of your processing material should experience pathogen inactivating conditions (outlined below). This is very important. Knowing the levels and types of pathogens throughout your operations is important. It means you can choose the most appropriate measures to minimise or eliminate risks from those pathogens. You should use several conditions that inactivate pathogens, known as a multibarrier approach. This is particularly important if you are processing higher-risk wastes.

Temperature is an important pathogen inactivating factor. It should not be so high that it kills organisms required for your processing technology or creates a fire risk. Other pathogen inactivating conditions include:

- pH
- ammonia
- volatilisation of acids
- predation and competition for nutrients with beneficial microorganisms.

If the processed organics determination applies, refer to Section 6 of this guideline for achieving pasteurisation. Higher risk wastes are likely to need:

- longer times at pasteurising conditions
- other inactivating conditions
- both longer times at pasteurising conditions and other inactivating conditions.

A detailed understanding of your process is important. It helps organise sequential or concurrent formation of appropriate pathogen inactivating conditions. One option is the HACCP system, introduced in Section 3.1.4 of this guideline. Refer to Appendix B for more information about how to perform risk assessments for contamination.

5.2. Pathogen recontamination

Even with effective pathogen inactivation, pathogen recontamination can occur from:

- incoming feedstock
- incomplete treatment
- using contact water on or near processed (or processing) materials
- a poorly designed site – for example, one with insufficient distance or barriers between operation and storage areas.

Pathogen recontamination can be prevented by:

- ensuring homogeneity in pathogen inactivating conditions to avoid recontamination
- separating work areas and equipment for feedstocks and output material
- maintaining effective washing procedures, particularly if the same equipment must be used on materials at different stages of the process
- positioning stockpiles that are at different stages of processing – for example, pre-processing, active processing and output material – this prevents materials at different stages contaminating one another, which can occur through liquid runoff or wind dispersal.

5.3. Physical and chemical contamination

You should regularly assess the state of contamination in your output material. Physical and chemical contamination and physiochemical properties of your output material are critical. This is specifically relevant when applying it to land. This is true for all technology types and should be considered.

5.4. Plant propagules

Plant propagules can cause harm to the environment by proliferating weeds. When you inactivate propagules your material is less likely to lead to a weed infestation. Inactivating propagules means treating to prevent them from germinating and growing new plants. For example, physical removal, temperature control and chemical treatment. To ensure inactivation, test to confirm that no germination occurs after a 21-day incubation period. For guidance on this process, consult Section 2.2 and Appendix M of AS 4454-2012.

5.5. Maturity

Maturity testing is not required by the processed organics determination. It is good practice to ensure your output material will not cause harm to the receiving environment. Composting and some types of digestion can produce a mature output. Vermicomposting, food dehydration and mulching may require more processing. For example, composting or digestion. AS 4454-2012 holds information on measuring and meeting maturity (particularly Appendix N and O).

For further detail on maturation, see Sections 4 and 5 of SV's Guide to biological recovery of organics.

5.6. Failed batches

A batch may fail if it does not meet the processed organics determination. It may also fail if the output material is not fit for its intended end-use. Management of this material will depend on the reason for failure, with options including:

- reprocessing with the same technology – this is preferred when the parameter that fails would be achieved through repeat application of the same process
- reprocessing by another technology
- identifying an alternative suitable end-use if the failed batch is no longer suitable for its intended end-use
- removal from your site by implementing your duty to investigate alternatives to waste disposal
- disposal (see lawful place and Section 4.3).

6. Technology summaries and specific considerations

This section introduces some common technologies for processing organic waste.

Composting is the most established technology with the largest state of knowledge. Other processing technologies do not have as much state of knowledge. If you are considering establishing a site with one of these other technologies, EPA encourages you to discuss your plans with us first. More information on state of knowledge can be found in Appendix C.

6.1. Composting

Composting is the degradation of organic waste by microorganisms in the presence of oxygen. It converts it into a stabilised and nutrient-rich output material. Composting can provide many environmental benefits such as diverting organic waste from landfill which would otherwise cause landfill gas emissions or creating a useable output which supports plant growth.

Pasteurisation occurs during the thermophilic phase. During this phase, the waste heats to a certain temperature for a specific period. Other factors contribute to the inactivation of pathogens, such as:

- volatile acids and alkalis
- predation
- antimicrobial compounds produced by other microorganisms.

The most common composting technologies include in-vessel composting and windrow composting. Windrow composting should include a specified number of turns of the waste material. This ensures the whole mass has reached thermophilic conditions for the right duration.

To show a composting site is minimising risks to human health and the environment, EPA suggests:

- Turning composting piles. Compost windrow-turning machinery is significantly more effective than front-end loaders for homogenisation and aeration. This contributes significantly to pasteurisation and maturation.
- Turning piles after spending the appropriate period of time at pathogen-inactivating temperature (see Table 2 below).
- Performing several cycles where a windrow is held at pathogen inactivating temperatures for 3 days. Followed by turning between each cycle to ensure homogenous pathogen inactivation. The number of cycles required to reach proper pasteurisation will vary depending on your feedstocks, local climate and management practices. Lower risk feedstocks may need as few as 3 cycles, whereas higher risk feedstocks will likely need at least 5.
- Performing moisture-level monitoring alongside temperature monitoring. This allows you to add water to a composting pile while it is being turned.
- Performing efficient pathogen inactivation to mitigate risk from most pathogens. This also promotes beneficial microbial growth. There are many interrelating factors that contribute to pathogen inactivation. These are summarised in Table 2.
- Your facility may emit greenhouse gases depending on the energy source for machinery and power. They can also be generated incidentally from processing organic wastes. See Section 3.2.6 of this guideline for more detail on managing this risk.
- Performing a risk assessment and incorporating appropriate controls. The following documents may help you choose composting technology and feedstock:
  - SV's Resource recovery technology guide Sections 3.3.1.1-3.3.1.3
  - New South Wales EPA's fact sheet on emissions impacts of composting food waste.
- If you are composting mortalities on farms, refer to EPA publication 2050.
- EPA Determination – Specifications acceptable to the Authority for receiving processed organics provides specifications for producing compost that is safe for use.

- Agriculture Victoria provides guidance on compost management and use.
- The appropriate guide to operational and most testing requirements for composting is Australian Standard AS 4454-2012.

You may need to change your management practices based on weather conditions. For example, drier conditions can result in plants translocating nitrogen from leaves into stems and roots. This may alter the C:N ratio. It may also alter the effectiveness of bulking agents added to promote decomposition.

Many factors can impact conditions required for pathogen inactivation. For example, temperature and rain. These risks can differ with different technology types. For example, open windrow composting is impacted by temperature and rainfall. In-vessel composting is less affected. This will affect pathogen inactivation conditions.

Table 2: Pathogen inactivating conditions for open windrow compost

Parameter	Ideal value	Detail	Method of achievement
Homogeneity	–	Ensures all material experiences pathogen inactivating conditions	Regular use of compost windrow turners
Temperature	55–65°C	Inactivates many pathogens Supports growth of beneficial microbes	Appropriate C:N ratio, moisture content, aeration and porosity
Time at temperature	>3 days	All material experiences pasteurising conditions	Mitigating meteorological impacts (such as wind cooling) Turning after time at temperature
Moisture content	45–60%	Low moisture means beneficial bacteria cannot undertake the composting process High moisture can create anaerobic conditions	Wet feedstocks mixed with dry Liquids are effectively drained and managed Wetting mechanisms Aeration
Oxygen content	Approx. 10%	Aerobic conditions are required for beneficial composting microbes	Aeration with windrow turner Liquids are effectively drained and managed
pH	6.5–9.5	Reflects predictable fluctuations in healthy compost Supports beneficial microbial growth, their competition with pathogenic bacteria and producing antimicrobial compounds Volatilises acids and generates ammonia	Balanced feedstock If too acidic, ensure anaerobic conditions have not formed. Conduct thorough aeration and appropriate moisture content If too basic, increase aeration to flush ammonia or add agricultural lime
Porosity	45–65% pore space	Cools pile and provides oxygen	Balanced feedstock with sufficient bulking agent volume (such as organic garden waste) Effective turning and liquid management

Parameter	Ideal value	Detail	Method of achievement
Carbon to nitrogen ratio	25:1–35:1	Supports growth of beneficial microbes	Balanced feedstock. High nitrogen feedstocks include poultry manure, sewage/biosolids, food waste Urea High-carbon feedstocks include woodchips, straw, paper, garden organics

6.2. Anaerobic digestion

Anaerobic digestion is a biological process by which microorganisms degrade organic material, leading to the generation of biogas (containing methane and carbon dioxide) and leaving a digestate behind. Biogas produced by this process can be used to generate electricity or supplied to natural gas lines, while the digestate is generally applied to land as fertiliser.

The biogas output from anaerobic digestion is mostly methane and carbon dioxide. These gasses have greenhouse effect potential. See section 3.2.6 of this guideline for more detail on managing this risk. The liquid digestate output is an effluent or supernatant. This can contain pathogens and emerging contaminants which should be managed before being discharged. The solid output is usually a stabilised sludge. 'Dry anaerobic digestate' can also process raw inputs with higher total solids than 'wet anaerobic digestate'. Further treatment may be required to ensure all contaminants are destroyed or removed. For example through thermal treatment or composting. EPA has published information about the legislative instruments (designation and determination) for managing digestate. It clarifies how they function to reduce burden for production and use of digestate that is low risk. See the Safe production and use of digestate guidelines.

EPA has published two instruments related to anaerobic digestate:

- Designation for Classification of Digestate for Composting or Other Secondary Processing or Use. This sets specifications which, if met, reclassify digestate as not RPW. Where the designation applies, RPW duties such as permissions for transport or use no longer apply.
- The Determination for Specifications Acceptable to the Authority for Receiving Digestate. This sets specifications which, if met, provides authority to receive applicable anaerobic digestate.

EPA recommends anaerobic digestion facilities conduct an odour assessment to determine what odour management controls are suitable and proportionate for a specific facility. See Guidance for assessing odour (EPA publication 1883). These should be at odour-producing sources.

6.3. Vermicomposting

Vermicomposting is the degradation of organic waste by worms. Worms eat it and produce nutrient-rich output from their waste. Vermicomposting does not produce a pasteurised or mature output material. Pathogen contamination will need significant attention and further processing may be necessary.

6.4. Black soldier fly processing

Black soldier fly processing is the degradation of organic waste by larvae. Larvae eat it and produce nutrient-rich output from their waste. It is a fast way to process large amounts of organic waste. The flies produce ammonia, which poses significant odour issues and is an air emission (see Section 3.2.6 of this guideline). It should be performed indoors to control the flies' living conditions and support more efficient controls. There is a lack of understanding on the effectiveness of black soldier fly processing.

Particularly whether black soldier fly larvae can effectively suppress potential pathogenic microorganisms.

6.5. Pyrolysis and gasification

Pyrolysis and gasification involve heating feedstocks in limited oxygen environments. This produces pyrolysis gas or syngas for energy, solid outputs called biochar, char, and tar, and liquid outputs (depending on the recovery processes). Pyrolysis, gasification, and combustion/incineration processes operate at different temperatures and under different oxygen environments. Pyrolysis generally operates at 400–700°C and under oxygen free environment and gasification operates around 600–900°C and under partial oxygen environment. However, combustion/incineration operate at >900°C under excess oxygen environment. Syngas produced during pyrolysis can be used onsite to sustain the heat required for the pyrolysis process itself. It can also be exported from site as heat or electricity. The minimum necessary treatment temperature is based on contaminant depolymerisation or devolatilisation temperature. Generally, temperatures above 350°C can effectively remove some contaminants. Some microplastics only depolymerise above 450°C.

Specific conditions can effectively destroy devolatilised or depolymerised dioxins, furans, PFASs and microplastics. For example, combusting the flue gas from the thermal unit in a thermal oxidiser above 850°C for 2 seconds residence time.

Key considerations for a thermal treatment facility include:

- emissions to air which includes greenhouse gases, particles, noise and odour
- contamination and output use, including the output biochar's physiochemical properties. This is significantly influenced by combustion temperature and level of oxygen, and feedstock.

Refer to the energy from waste guideline (EPA publication 1559) for further information.

6.6. Organic waste dehydration

Organic waste dehydration involves heating organic waste (usually food). Waste is typically heated in a range between 40°C and 80°C for hours or days so that most of the water evaporates. Depending on the operational temperature, the dehydrator output may not be appropriately pasteurised. The output is generally insufficiently decomposed or matured and can begin decomposing once moistened. This can:

- generate acidic leachate
- cause pathogens to proliferate
- be phytotoxic to plants
- turn anaerobic
- produce methane gas and odorous sulphurous compounds
- attract vermin.

Depending on the operational temperature, dehydrators can be used as pre-treatment to reduce weight of waste and/or produce pasteurised but unstabilised and unmatured output. (Please note that it is recommended that dehydrated waste undergo further processing such as composting or anaerobic digestion to pasteurise the waste and break down decomposable organics to produce stabilised outputs). Considering the high-risk profile of food waste, you should understand and manage contamination risks. See Section 3.2 of this guideline Common hazards.

Appendix A: Checklist

This appendix provides an example checklist summarising the considerations outlined in this guideline. Its primary audience is organic waste processors. EPA may also use it to confirm considerations raised in this guideline have been addressed. It is not an exhaustive list of everything that needs to be covered. There may be risks identifiable through a risk assessment that this guideline does not cover.

Stage	Step		Requires controls or performance	Controls implemented or performance completed
Site setup	Proposed technology selected		¨	¨
	Appropriate buffer distances		¨	¨
	Planning permit from local council obtained, if required		¨	¨
	Appropriate EPA permissions obtained, including authorisation to receive planned feedstock		¨	¨
Site operation	Appendix B used to determine feedstock risk level		¨	¨
	Performed comprehensive risk management of:	Odour	¨	¨
		Fire	¨	¨
		Liquids	¨	¨
		Contamination	¨	¨
		Output material	¨	¨
		Air	¨	¨
		Biosecurity	¨	¨
		Litter	¨	¨
		Noise	¨	¨
		Any others identified	¨	¨
Output material management	Procedure in Appendix B is followed, if applicable		¨	¨

Stage	Step	Requires controls or performance	Controls implemented or performance completed
	Output is pasteurised and residual risks are appropriately managed. Or risks from microbial contamination are appropriately managed	..	..
	Output is mature, otherwise risks are appropriately managed	..	..
	Output is below physical, chemical and microbial contaminant thresholds. Otherwise, material is re-processed, removed or disposed	..	..

Appendix B: Risk assessment and management for chemical and microbial contaminants

Purpose and intended audience

This appendix builds on EPA's existing guidelines for risk identification and assessment. It addresses issues specific to organics processing facilities and organic waste management. It was developed for:

- facility operators
- environmental consultants
- other environmental practitioners.

This appendix supports compliance with the:

- Environment Protection Act 2017 (the Act)
- Environment Protection Regulations 2021 (the Regulations)
- other relevant obligations such as permission conditions.

Please note that risk assessments of high-risk waste are likely to require the competence of a risk assessor. Please see Engaging consultants (EPA publication 1702) for further guidance. The risk assessor should have experience in microbial or chemical risk assessment, or both.

B1. Risk assessment

If you are an operator of an organic waste processing facility, you should conduct a risk assessment. This ensures risks are managed, and human health and the environment are protected both onsite and offsite. The process or framework used is known as an environmental health risk assessment (EHRA). An EHRA is used to characterise the nature and magnitude of health risks from environmental stressors. Specifically, health to humans and ecological receptors (including livestock). Environmental stressors include microbial, chemical and physical contaminants. In this document, microbial contaminants have a specific meaning. It means pathogenic microorganisms that may have an adverse impact on human health and the environment.

Performing a risk assessment (as far as it is reasonably practicable to do so) will help minimise risk of harm to human health and the environment under the GED.

Assessing risk is typically a tiered process. The assessment complexity increases until the level of information is appropriate for decision making. For example, complexity would be expected to increase as the risk attached to feedstock increases. A screening level (or tier 1) risk assessment may be sufficient for low-risk feedstocks. For example, where a simple comparison of monitoring data can be made to AS 4454-2012 values. This document focuses on higher tiers of risk assessment where:

- screening values are not available (and may need to be developed)
- a more detailed risk assessment is necessary.

The fundamental EHRA steps are the same for all contaminants and typically include the following:

1. problem formulation (sometimes also referred to as hazard identification)
2. exposure assessment
3. health effects or dose-response assessment
4. risk characterisation.

Figure B1 provides an overview of the EHRA process for microbial and chemical contaminants.

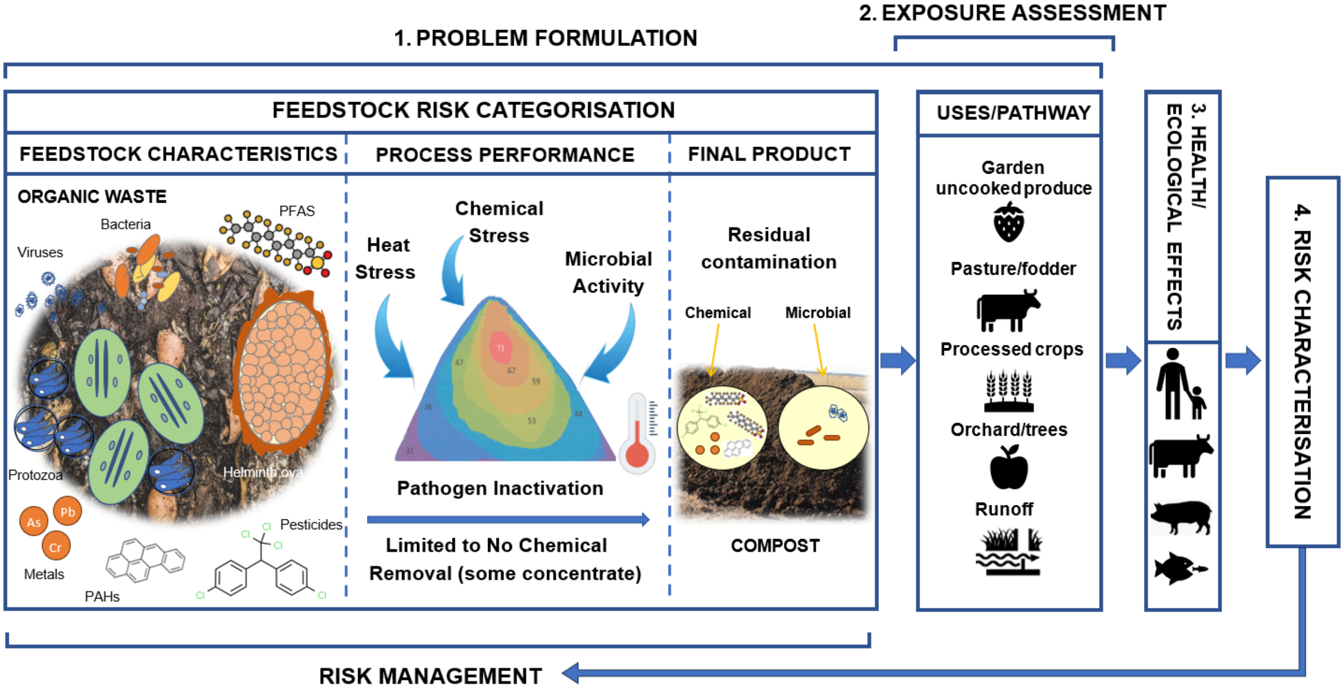


Figure B1. General EHRA steps for composting (risk assessment is site/feedstock/technology/end-use specific and the source, pathway and receptor-related information will differ and should be considered for each application). Please note risks can also be managed at the end-user level (restrictions of use, withholding periods, methods of application, among others). However, it is preferable for the risk to be managed upstream.

The fundamental EHRA steps are explained in more detail in the following sections. For more guidance on general risk assessment processes refer to:

- Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012)
- Quantitative microbial risk assessment: Application for water safety management (WHO 2016).

1.1. Problem formulation

Problem formulation identifies the hazards associated with an activity or feedstock (source), along with exposure pathways (how the hazards migrate) and the populations exposed. These are commonly referred to as source-pathway-receptor linkages. You can only estimate risks for scenarios where all these elements are present. This is known as a complete source-pathway-receptor linkage. Complete linkages also determine the scope of risk assessment.

Conceptual exposure models can help identify source-pathway-receptor relationships onsite and offsite for a given site as well as providing an effective communication tool. Figure B2 provides an example of a conceptual exposure model.

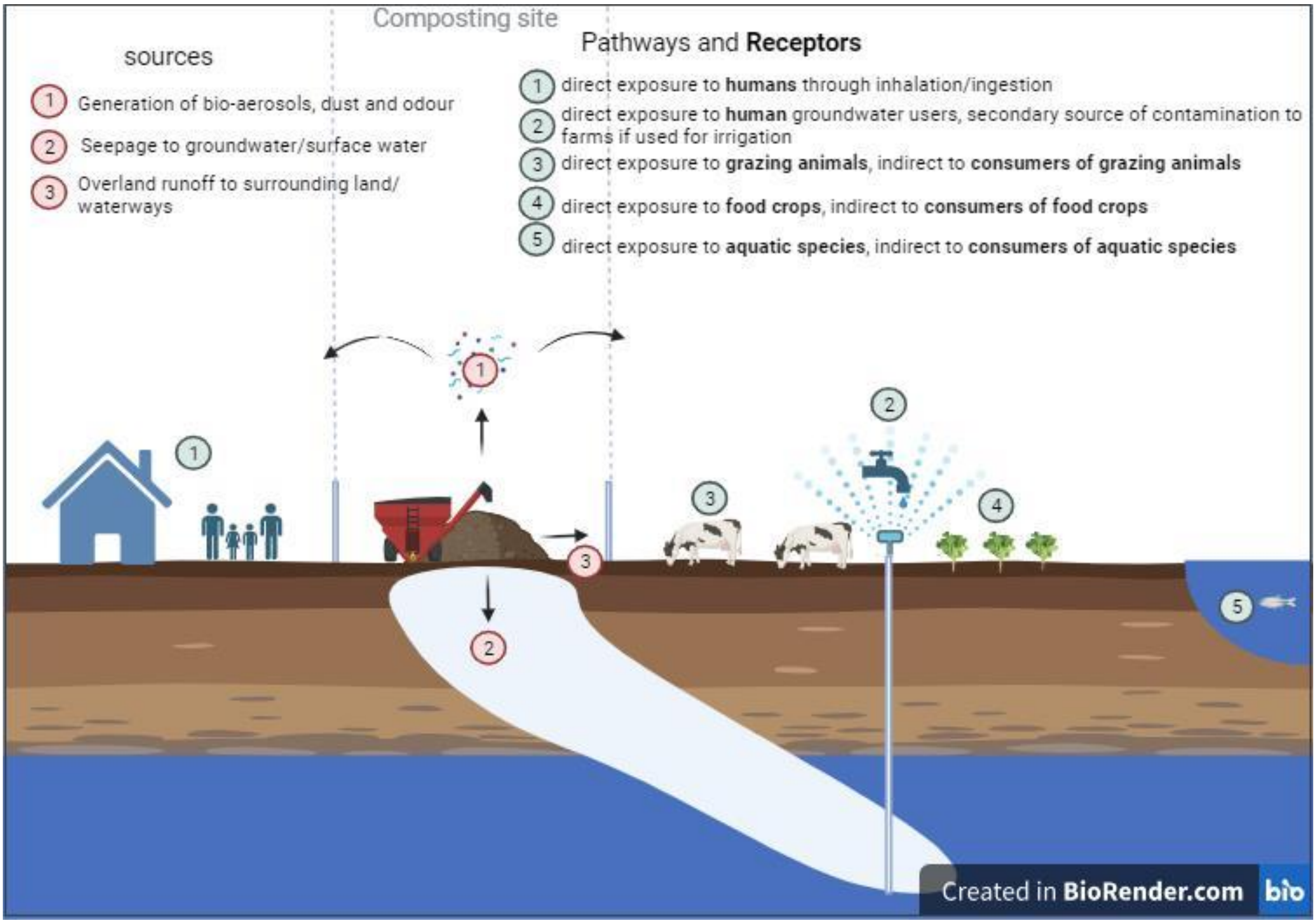


Figure B2. An example of a conceptual exposure model

Feedstocks are the primary source of hazards. You should consider feedstock characterisation to identify relevant hazards. This should occur at the problem formulation stage and include the following:

- pathogen and contaminant loading in feedstock (based on prevalence and levels in waste)
- operating parameters impacting inactivation (log reduction value) or removal of contaminants
- operating parameters, practice or events – these can impact generation of bioaerosols or promoting bacterial pathogen regrowth
- residual pathogen and contaminant loading in compost.

Pathways and receptors are typically determined by operational practices, controls and end uses. You should consider the following when identifying pathways and receptors:

- operating parameters, practice or events impacting generation of dust, bioaerosols and runoff
- sensitive receptors on and offsite that may be exposed to pathogens or chemicals from recycled material
- end-use, for example:
  broadacre applications for pasture or cropping
  planting compost for gardens
  ornamental planting (among other uses).

Based on available information you should identify the hazards likely to be present in a specific feedstock. Information can include monitoring data and literature. Hazards can include pathogens and contaminants. Once you have identified the hazards, you should determine technologies or mechanisms for their inactivation or removal during the treatment process. When considering the extent of treatment, keep end-uses in mind to ensure output materials are fit for purpose. These considerations form part of the risk management process in Section 3 Figure 1.

Figure B3 illustrates the main pathogens of relevance in Victoria, their primary reservoirs and how likely they are to be inactivated by the composting process. It is an example only.

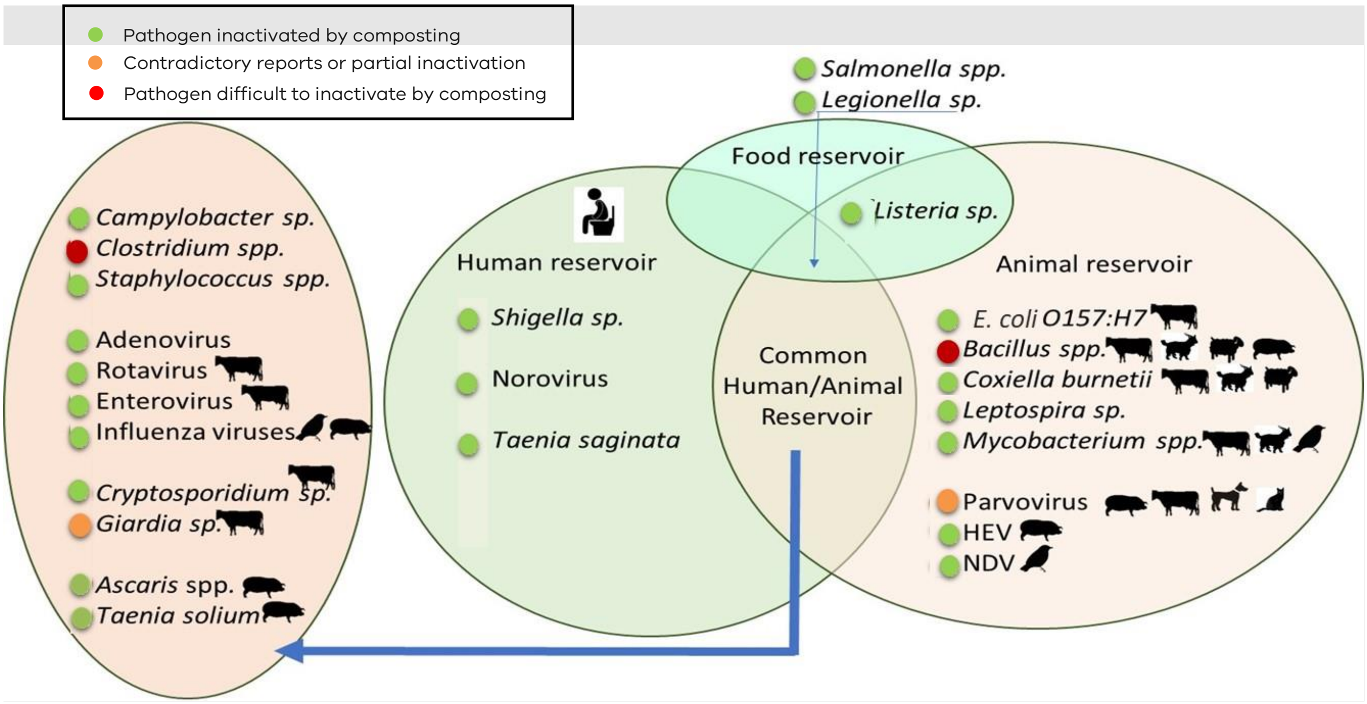


Figure B3. Summary of the main pathogens relevant in Victoria, their main primary reservoirs (humans, food, animals) and the effectiveness of thermophilic processes in inactivating them.

The coloured dots reflect the performance of composting for their inactivation. Legionella is not relevant to organic waste as such but can become a health issue in compost because of its ubiquity in the environment.

By identifying the pathogens and contaminants present in feedstock and the performance of the treatment process in inactivating these pathogens or removing contaminants, operators of organic waste processing facilities will be able to characterise residual risk associated with their output (that is, the pathogens likely to survive the process or to regrow, or both, and the contaminant levels likely to remain).

You should optimise treatment processes to minimise residual risk and identify and mitigate operating practices that may promote the volatilisation of bioaerosols or the regrowth of bacterial pathogens. This is particularly important when managing high-risk feedstocks. For high-risk feedstocks, you should make additional consideration of risks to ecology and food production for chemicals that bioaccumulate or biomagnify. For example, some per- and polyfluoroalkyl substances (PFAS) have been shown to bioaccumulate in livestock. Therefore, you should consider bioaccumulation risk for output materials used in pasture improvement or fodder crops. At this step, you should also consider the strategy to be implemented in the event of process failure or any other unforeseen event. The following subsections provide further information on feedstock characterisation.

1.1.1. Contaminants in feedstocks – risk-based sampling

Several factors that influence feedstock risk may not change through the treatment process (for example, chemical load). It is highly recommended that you have a strong understanding of the composition of feedstock and its associated risks so the output material is fit for purpose for end users.

Similarly, organic waste processing facilities should request compositional and chemical analysis from waste producers and feedstock suppliers to inform their risk assessments. Processers can determine the frequency for this in line with the risk profile of the waste type and its sources. You should consult with your waste producers to identify potential contaminants of concern and develop an understanding of contaminant characteristics.

EPA recommends organic waste processing facilities undertake best practice to verify all contaminants of concern and assess risk of incoming wastes prior to acceptance. The initial assessment may investigate all potential contaminants of concern based on types and characteristics of waste, including chemicals and pathogens, and activities from which the waste is generated.

EPA recommends a risk-based sampling approach for identifying pathogen and chemical risk in feedstock. This uses the probability of detection and feedstock risk to determine the number of samples that should be taken. It is expected that you undergo more thorough characterisation and monitoring for high-risk feedstock compared with a low-risk feedstock.

It is preferable that you gather information (analyses provided by waste producers or information from literature, or both) before implementing a monitoring program. For example, you should seek information about prevalence and levels of specific pathogens. As it is not always possible technically or economically to monitor for a specific pathogen and determine a process' performance, you should identify an appropriate surrogate for that pathogen. This surrogate could be an indicator or another pathogen likely to have the same fate during waste processing.

You should conduct the following sampling stages:

1. Feedstock characterisation: aims to understand contaminant (microbial and chemical) composition and expected variability in the feedstock. You may determine sampling intensity based on consideration of feedstock risk rating, how well the feedstock is mixed (degree of homogeneity), and spatial and temporal distribution of contaminants. You may adopt a sampling design such as composite sampling for well-mixed feedstock and include sufficient replication and quality control to provide data confidence.

5\. Feedstock monitoring: you can reduce sampling intensity and frequency once you have characterised feedstock composition and variability. The aim of feedstock monitoring is to assess whether incoming feedstocks fall within expected composition and are suitable for risk management controls in place.

If you add a new feedstock to the treatment process, or monitoring of a characterised feedstock identifies chemical or microbial composition beyond anticipated variability, you should restart the characterisation process to target identified contaminant/s of concern. Where you identify new contaminants or contaminant concentrations beyond anticipated variability, you should undertake an internal quality management procedure to investigate and identify the source. To ensure traceability, you should sample and store incoming waste until you have tested relevant batches and confirmed satisfactory output standards.

Operators of organic waste processing facilities should know the risks associated with the feedstock they receive and implement a process that mitigates them. This guideline aims to help operators assess those risks. This guideline does not require operators to test for all pathogens at the receival stage. Rather, it helps operators understand what pathogens the feedstock a facility receives may contain (based mostly on available literature) and apply a process that mitigates identified microbial risks. Testing for specific pathogens at the commissioning phase may demonstrate that a pathogen is not present, or that the process is removing them to an acceptable level.

1.1.2. Feedstock categories

The categorisation approach adopted by EPA ranks feedstocks from lowest to highest potential risk of harm to human health and the environment.

Feedstocks are categorised based on answers to the following questions:

1. Pathogen and contaminant loads:
    1.1. Is the feedstock likely to contain pathogens that may survive the treatment process at levels that pose unacceptable public health or biosecurity risks, or both? (low, medium or high)
    1.2. Is the feedstock likely to contain contaminants that may remain at high levels after the treatment process or potentially accumulate in soils, or both, posing unacceptable risk to human health and the environment?
    1.3. Is the feedstock likely to contain physical contaminants?
    1.4. Is the feedstock likely to generate odours?

6. Performance of the waste treatment process:
    1.5. Is the feedstock easy to treat (easy, moderately difficult)? That is, is it heterogenous or too wet or has a very low or very high pH, for example?

Risk levels presented in Table B1 are weighted for the presence of pathogens as they typically present more severe exposure risks but also includes consideration of chemical and physical contaminants as well as odour. In the spirit of good processing practice and better outcomes for human health and the environment, you should carefully assess the use of feedstocks with undesirable chemicals. You should only accept such feedstock if treatment capability for the contaminants is satisfactorily proven to EPA as part of a permissions assessment. From a microbial risk assessment perspective, it is also important that you consider the difficulty of processing certain feedstocks.

Table B1. Risk matrix for feedstock categorisation

The risk categorisations below are indicative. Further risk assessment of actual feedstock streams should be carried out.

Feedstock type	Processing difficulty**	Pathogen load	Chemical contamination	Physical contamination	Odour
Garden and landscaping organics	Low	Low	Low*	Low	Low
Untreated timber	Medium	Low	Low	Low	Low
Natural fibrous organics	Low	Low	Low	Low	Low
Municipal source separated kerbside garden waste (GO)	Medium	Low*	Medium*	Medium	Low
Biosolids*	Low	High	Medium	Medium	Medium
Aged manure	Medium	Medium	Low	Low	Low
Dewatered sewerage sludge and fresh manures	Medium	High	Medium	Medium	High

Feedstock type	Processing difficulty**	Pathogen load	Chemical contamination	Physical contamination	Odour
Other natural or processed vegetable organics	High	Low	Low/Medium	Medium	High
Mixed source separated kerbside (garden or food waste – FOGO)*	High	Medium	Medium	High	Medium
Kerbside – FO	High	Medium	Medium	High	High
Grease interceptor trap wastes	High	High	High	Medium	High
Liquid organic wastes	High	Medium*	Medium	Low	High
Liquid wastes, industrial source	High	Medium*	High	Low	High
Meat, fish and fatty foods	High	High	Medium	Medium	High

*These feedstocks may require assessment to understand actual risk.

** The inclusion of 'processing difficulty' is intended to capture risks posed by the nature of the feedstock that can present challenges for processing. Processing difficulty is an important consideration. For example, scientific literature shows that reducing microbial risks from food waste and similar high-risk waste is much more difficult and less likely than in other waste. This is due to the physico-chemical characteristics of the waste (pH, water content, nutrient availability, heterogeneity, etc.). In some cases, processing difficulty could result from the presence of specific contaminants (physical, chemical or microbial).

1.1.3. High-risk wastes: identifying pathogen and contaminants of relevance

Animal and human sludges, and solid wastes are likely to contain many pathogens transmissible to humans or other animal species. Animals raised in an intensive farming facility are likely to shed more pathogens than animals raised on pasture or free-range animals.

Figure B3 shows pathogens likely to be present in Victoria and their primary reservoirs. The term reservoir refers to a natural host or environment in which a pathogen lives, grows and multiplies. Reservoirs can include humans, animals and the environment (for example, soil or water). Most pathogens are common to animal and human reservoirs. Icons representing various animals are placed next to pathogen names when a primary reservoir is clearly identified but this does not mean pathogens could not be found in other hosts. Most importantly, Figure B3 emphasises the importance of animal waste as a reservoir for numerous pathogens posing a significant risk to biosecurity and public health. *Salmonella* spp. is found in all reservoirs, which makes it a good candidate for monitoring waste treatment process performance.

Figure B3 indicates that spore-formers – *Clostridium* spp. and *Bacillus* spp., parvovirus and *Ascaris* spp. are the pathogens most likely to survive most waste treatment processes. For example, *Bacillus anthracis* (the agent of anthrax) may, like other *Bacillus* bacteria, survive thermophilic processes. *Giardia* survival may be overestimated as cyst viability was not ascertained during studies that reported their survival.

Physical and chemical contaminants in feedstock could pose increased risks not only to output quality but also to the treatment process and surrounding environment of the operating site. The degree of consequence from increased risks depends on chemical characteristics and concentrations. High-risk wastes are more likely to contain contaminants, such as pollutants and chemicals, at higher concentrations. During treatment these chemicals may not break down sufficiently and compromise output quality.

Pollutants include plastics, glass, metals and treated timber. Their presence can lead to chemicals being released during the treatment process. For example, conventional plastics as well as bioplastics can break down into microplastics and release chemical additives, such as plasticisers, flame retardants, light and heat stabilisers and pigment (such as phthalates, adipates and polychlorinated hydrocarbons).

High-risk wastes can also contain chemicals including heavy metals, PFAS, surfactants, pharmaceutical and veterinary chemicals, pesticides and preservatives. Some chemicals may cause operational issues due to the adverse effects of chemicals on microbial activity. Further, some high-risk wastes may have high loading of substances such as oil and grease content, which can cause treatment process issues and may require additional operational controls.

Human waste

Figure B3 shows the main pathogens of interest for public health (human, food and common human or animal reservoir). Most of the pathogens listed in the animal reservoir can be transmitted to humans. These pathogens can potentially be present in human waste in small quantities due to pre-treatment in wastewater treatment plants. Human waste is typically accompanied by a mixture of chemical contaminants, depending on the waste streams received or treated by the wastewater plant.

Animal manures, litters and processing wastes

In addition to the pathogens of primary concern for public health listed in Figure B3, Table provides 4 lists of pathogens of concern for biosecurity specific to various animal wastes. Some of these may be transmitted to humans. The nature of the pathogens that may be present influence what inactivation mechanism you should use and when you should use it during the waste treatment process.

Table B2. Diseases and agents of disease of relevance for animal manures, litters and processing wastes

A. Cattle manure, dairy sludge and beef processing wastes

Disease	Agent
Bacterial agents	
Anthrax	*Bacillus anthracis*
Bovine Johne's disease (BJD)	*Mycobacterium avium paratuberculosis*
Bovine genital campylobacteriosis	*Campylobacter fetus venerealis*
Campylobacteriosis	*Campylobacter jejuni, Campylobacter coli*
Clostridium infection	*Clostridium* spp.
Leptospirosis	*Leptospira* sp.
Listeriosis	*Listeria monocytogenes*
Q fever	*Coxiella burnetii*

Disease	Agent
Bacterial agents	
E. coli infection	*E. coli* O157:H7
Foot rot	*Fusobacterium necrophorum, Dichelobacter nodosus*
Salmonellosis	*Salmonella* spp.
Staphylococcus infection	*Staphylococcus* spp.
Viral agents	
Infectious bovine rhinotracheitis (IBR)	Bovine alphaherpes virus 1 (BoHV-1)
Bovine viral diarrhoea virus (BVDV)	Pestivirus A
Enterovirus infection	Enterovirus
Parvovirus infection	Bovine parvovirus
Rotavirus infection	Rotavirus
Parasites	
Cryptosporidiosis	*Cryptosporidium parvum*
Giardiasis	*Giardia lamblia*
Sarcocystis	*Taenia saginata* in humans
Coccidiosis (black scours)	*Coccidia* spp/*Eimeria* spp
Neosporosis	*Neospora caninum*

B. Sheep and goat manure and processing wastes

Disease	Agent
Bacterial agents	
Ovine Johne's disease (OJD)*	*Mycobacterium avium paratuberculosis*
Brucellosis	*Brucella ovis*
Foot rot	*Dichelobacter nodosus*
Big head in sheep	*Clostridium novyi* type A
Black leg	*Clostridium chauvoei*
Q fever	*Coxiella burnetii*
Campylobacteriosis	*Campylobacter jejuni, Campylobacter coli*
Leptospirosis	*Leptospira* sp.
Listeriosis	*Listeria monocytogenes*
Salmonellosis	*Salmonella* spp.

Viral agents	
Caprine arthritis encephalitis (CAE) or Big knee disease#	Caprine arthritis encephalitis virus (CAEV)
Parasites	
Sarcocystis	*Sarcocystis* spp. in dogs and cats
Coccidiosis (black scours)	*Coccidia* spp/*Eimeria*

[#] Transmission to goat and sheep through goat milk.

*Goats may be infected by both OJD and BJD agents.

C. Poultry manure, litter and processing wastes

Disease	Agent
Bacterial agents	
Avian chlamydiosis#	*Chlamydia psittaci*
Avian botulism	*Clostridium tetanii*
Campylobacteriosis	*Campylobacter jejuni*
Clostridium infection	*Clostridium* spp.
Leptospirosis	*Leptospira* sp. [&]
Avian mycoplasmosis	*Mycoplasma* spp.
Salmonellosis	*Salmonella* spp.
Listeriosis	*Listeria monocytogenes*
Mycobacteriosis	*Mycobacterium* sp.
Viral agents	
Avian infectious laryngotracheitis	Gallid herpesvirus I
IBDV	Infectious bursal disease virus
Avian flu	Avian influenza virus
Newcastle disease virus	Newcastle disease virus

[#] Can infect humans, cattle, sheep, goats, horses and pigs.
[&] Likely to be present in litter due to rodent droppings and urine.

D. Pig manure and processing wastes

Disease	Agent
Bacterial agents	
Brucellosis	*Brucella suis*
Bacillus infection	*Bacillus* spp.
Campylobacterioris	*Campylobacter coli*

Disease	Agent
Clostridium infection	*Clostridium* spp.
Leptospirosis	*Leptospira* sp.
Listeriosis	*Listeria monocytogenes*
Salmonellosis	*Salmonella* spp.
Viral agents	
Hepatitis E	Hepatitis E virus
Parvovirus infection	Porcine parvovirus
Swine flu	Influenza A virus
Parasites	
Ascaris infection	*Ascaris* spp.
Taeniasis	*Taenia solium*

Food waste

Pathogens present in food waste will vary depending on the food type (that is, what kind of animal the food waste meat originated from) and the process involved in preparing the food. Albeit in smaller quantity, any pathogen could be present in mixed-source separated kerbside (food organics/garden organics – FOGO) waste.

Compared with other organic waste streams, food waste is often characterised by a low C:N ratio, high readily available nutrients and high moisture content, loose physical structure and high density. While food waste is suitable for most waste treatment processes, these characteristics make it a feedstock that can be difficult to treat. This means that you may not always be able to achieve recommended pathogen reduction. So, despite lower pathogen load than animal manures, food waste is categorised as a high-risk waste.

In addition, FOGO collected through municipal separated waste may also contain low to moderate levels of chemical contaminants, such as pesticides and PFAS, as well as high levels of physical contamination, such as plastics and glass, which you may not be able to remove during processing. Stringent acceptance criteria complemented by other removal steps during processing can mitigate this issue.

Pre-processed wastes

Pre-processed wastes are wastes that underwent some preliminary processing, often at the site where they were generated. Pre-processed wastes are likely to require further treatment processing before use. The presence of chemical contaminants will be specific to its waste stream.

Anaerobic digester outputs

The main factors impacting inactivation during anaerobic digestion are temperature, volatile fatty acids (VFAs), ammonia and solid retention time. Thermophilic anaerobic digestion is more effective in inactivating pathogens than mesophilic anaerobic digestion. Batch sequencing also achieves better inactivation than semi-continuous and fully continuous operations.

While some pathogens are inactivated by anaerobic digestion, others remain active in the digestate. As *E. coli* and *Salmonella* will be inactivated long before some other pathogens, there is risk in the application of digestates on agricultural land and assessment of digestate safety based only on the analysis of *E. coli* and *Salmonella*.

To improve the safety of the digestate and its applications to land, pre- or post-treatment are recommended. Physiochemical-based sanitation is possible if it is separated from the biological process of anaerobic digestion so the harsh conditions in the sanitation stage do not affect the anaerobes and other functional organisms in anaerobic digestion. Alternatively, the digestate can be used as feedstock for further waste treatment processing.

Dehydrated organic waste

Dehydrated organic waste is the partially degraded output produced by machines that process organic waste (mostly food waste) in a short period (usually less than 24 hours) by actively heating and mixing the waste in the presence of air. This is done with or without the addition of microorganisms. General descriptions of the processes used are:

- Rapid dehydrator unit applies heat (for example, ≥ 80°C) to its contents to rapidly reduce volume and weight by up to 80–90% in one to 3 days. This occurs by removing water through dehydration. Oxygen is not precluded and the food waste is agitated, ground and heated. Occasionally, enzymes are added.
- Rapid decomposition unit is a type of aerobic in-vessel composting unit that uses a thermophilic bacterium and has temperature and mixing controls. It is carried out at 50–70°C with a processing time of as little as 24 hours.

The main function of dehydrator and decomposition units is to separate liquids from the solid component of food waste. The end-outputs are dehydrated food waste or partially degraded food waste and water, which is collected as a liquid output or evaporated in chamber. Both processes reduce the weight of the initial waste by up to 90%.

The high temperatures that cause food waste dehydration largely inactivate indigenous (including pathogenic) microorganisms. Spore formers remain potential exceptions. Application of dehydrated food waste directly to soil may be phytotoxic to plants. When dehydrated food waste becomes remoistened after land application, it may produce odour and spore-forming microorganisms will regrow.

While dehydrators may play an important role in pre-treatment and reducing waste volume, best practice options for dehydrated food waste and partially degraded food waste is to further treat the waste prior to land application.

Liquid feedstocks

At most organic waste processing facilities liquid waste can pose increased risks to the environment and the final output. These risks are due to the physical nature of liquid waste and the potential for less thorough characterisation.

Managing any liquid waste requires additional controls to contain the liquid organic waste to prevent odour and contamination of surrounding soil, surface water and groundwater. Some examples of containment measures include mixing pits at composting facilities, above-ground tanks and concrete bunding.

Liquid mixing pits should:

- be as impervious as possible (for example, made of concrete with a high-density polyethylene (HDPE) liner
- have associated drainage infrastructure
- be fully bunded to prevent spillage from the mixing pits polluting nearby land or surface water.

Liquid containment can be constructed using the information in the Liquid storage and handing guidelines (EPA Publication 1698).

1.1.4. Antimicrobial resistance

Feedstocks can contain antibiotics, antimicrobial resistant bacteria (ARB) and antimicrobial resistant genes (ARG). Incorrect handling of these feedstocks may result in spreading antimicrobial resistance (AMR) to the environment, livestock, wildlife, produce and people. Examples of feedstocks that may contain antibiotics, ARB and ARG include – but are not limited to – abattoir waste, waste from meat processing plants, poultry mortalities, manure and biosolids.

There are still many unknowns regarding waste treatment processes and removing AMR. Removal efficacy varies depending on the class of antibiotic, species of bacteria and type of gene. Other factors, including temperature, process duration, C:N ratio, aeration and moisture content, may also affect the removal of AMR. Studies have largely focused on AMR in manure, therefore reducing AMR using waste treatment processes in other feedstocks is not well known.

The majority of antibiotic removal occurs during the mesophilic and thermophilic stages of any waste treatment process. For example, composting is most effective at removing or reducing ARB and ARG of human or animal origin susceptible to heat degradation. Bacteria capable of sporulation, or of environmental origin, or both, are more likely to survive and maintain AMR. If exposed to antibiotics during the treatment process, previously susceptible bacteria may develop AMR.

While most treatment processes are not 100% effective at removing antibiotics, ARB and ARG, they are beneficial for reducing overall concentrations of antibiotics present and removing many pathogens that may be carrying AMR. To reduce the spread of AMR from the output of the waste treatment process, the following actions are recommended:

- optimisation of the waste treatment process and implementation of a process management system
- performance testing to ensure pathogen removal
- prevention of runoff and wind dispersal both at the waste processing site and on applied land
- implementation of withholding periods prior to allowing livestock grazing or harvesting of crops to prevent AMR bacteria from entering the food chain.

1.2. Exposure assessment

The exposure assessment step is intended to quantify exposure for all relevant pathways identified in the problem formulation step, including operation and output material use-related pathways. You should consider both primary and secondary exposure pathways. They may include:

- **primary exposure** – direct exposure to contaminants (microbial or chemical, or both) in feedstocks or output materials (inhalation of bioaerosols and dust, dermal contact or ingestion)
- **secondary exposure** – indirect exposure to contaminants during transport or transfer of contaminants (crops, livestock, groundwater).

Exposure assessment requires consideration of the levels of contaminants (microbial and chemical) as well as the duration and frequency of each exposure pathway. You can estimate exposures (for example, volumes ingested or inhaled, or both) from literature or through modelling approaches for relevant receptor groups (humans or animal populations). You should pay attention to populations at greater risk (children, the elderly and adults with immunodeficiency, among others).

You should also characterise the exposure of animals and their role in contamination transmission and vectors of disease, or the bioaccumulation of chemicals and contribution to food pathways for humans. Assessments should also consider conditions in which contaminant concentrations or exposure may be at their highest. Examples include when the output is being sprayed onto a field, when compost windrows are being turned or screened or when seasonal weather changes cause strong prevailing winds (impacting down-wind receptors). Identifying activities that result in higher exposures may also help mitigate them by altering practices to reduce their occurrence. At the waste treatment site, this may vary from installing barriers or biofilters to trap dust and bioaerosols, to ceasing outdoor work on windy days.

End uses and site operations will determine the level of exposure. It is important that waste treatment output is fit for its intended purpose to protect human health and the environment. You may reduce exposure by various controls or preventative measures as described in Section 3 of this document.

1.3. Health effects assessment

Health effects or dose-response assessments examine the capacity of a contaminant (microbial and or chemical) to cause adverse health effects in humans and animals. This step is intended to identify critical health effects for each hazard and select or establish dose-response relationships that describe the association between exposure and the probability of disease or infection. For chemicals, dose-response relationships are often used to determine a point of departure (POD), which is the starting point for estimating a safe exposure level or dose. Additional considerations for derivation of a safe dose are whether the data is based on human studies or animals (if animals, then a human equivalent dose (HED) is estimated) as well as uncertainties in the HED, database uncertainty and inter- and intra-species variability. Default extrapolation factors are used to account for uncertainty in these parameters.

Dose-response relationships for microbial agents and infection (or illness when infected) are slightly different to chemicals as each pathogen particle may act independently. Dose-response models are only described in published literature for specific enteric (relating to or occurring in the intestines) pathogens (for example, *Salmonella, E. coli* O157:H7, *Campylobacter* and rotavirus) causing gastrointestinal illnesses and adenovirus and *Legionella,* which can cause gastrointestinal or respiratory infections, or both. The use of surrogates and models to estimate the risk of bioaerosol exposure remains a developing field so you should use it conservatively and in conjunction with epidemiological data.

You should use a different approach when dose-response are not available. A common conservative approach is to use the minimal infectious dose reported in published literature as the level of pathogens achieving 100% of infection.

1.4. Risk characterisation

The final step of an environmental health risk assessment is to collate the information collected in the previous steps and quantify risks associated with each hazard.

Risk can be described qualitatively (for example, categorising subjectively as high, medium or low), quantitatively (numerical estimate) or semi-quantitatively (a combination of numerical and qualitative assessment). This step may require a risk assessor skilled in the field being assessed (chemical or microbial, or both). Any limitations, uncertainties and assumptions should be clearly stated in the assessment.

For chemicals, you can characterise risks by screening against acceptance criteria or through more complex comparisons of exposure and dose-response information. For common contaminants, you should develop acceptance criteria that consider:

- the specific treatment processes for the site
- appropriate applications for the output
- exposure pathways
- dose-response assumptions.

You should then compare analytical test results against your acceptance criteria and determine if the wastes should be accepted.

Chemical risks are commonly expressed as a ratio of the exposure and the safe dose (also referred to as a hazard quotient).

If you have carried out a quantitative microbial risk assessment (QMRA), you should express the endpoint in µDALY ($1x10^{-6}$ DALY) so you can directly compare it to the accepted health-based target. Disability-adjusted life years (DALY) provides a mechanism for assessing health outcomes and allocating resources based on the severity of impact by converting probability of illness into burdens of disease. DALY weighs the severity for each health impact within the range of zero (good health) to one (death). You then multiply the weighting by the duration of the effect and the number of people affected. In the case of death, duration is regarded as the years lost compared to normal life expectancy (estimated at 81 years). You can use the accepted health-based target of one µDALY per person a year. When no quantitative data is available, you can use epidemiological studies along with site-specific data to estimate the level of risk (very low, low, medium or high).

As the consequences of exposure to opportunistic pathogens transported as bioaerosols remains potentially high for a large subset of the population (young, elderly and immunocompromised), EPA recommends a precautionary approach that conservatively assesses the potential consequences as severe in environments impacted by these types of pathogens. This means the likelihood of exposure will be the only parameter assessed in the absence of available dose-response models when assessing risk from bioaerosols.

Generally, a standard risk assessment includes a risk matrix where the overall probability of harm is assessed by considering the likelihood of exposure, along with the consequences of the harm being realised. Due to gaps in knowledge, the probability of harm to neighbouring communities may be the only parameter assessed, based on their distance from your facility.

When assessing microbial risks for bioaerosols, distances described in the Guideline for assessing and minimising air pollution (EPA Publication 1961) and this guideline apply as long as concentrations are less than 1,000 colony forming units per cubic metre (CFU per m^3) for total bacteria or less than 500 (CFU per m^3) for *Aspergillus fumigatus* (as relevant to the facility), or both. Further information on separation distances, pathogen presence and probability of harm is provided in EPA Publication 1961 and National Guidelines for Water Recycling: Managing Health and Environmental Risks (NRMMC 2006). Please note that this type of risk assessment only considers the direct risk to neighbouring communities through inhalation. A more extensive risk assessment process should be followed if an indirect risk through the ingestion of contaminated produce is identified.

Box 1. Disability adjusted life years (DALYs) calculation

This explanation of the calculation of DALYs is extracted from the NRMMC 2006. The calculation of DALYs per case is based on Havelaar and Melse (2003), with a modification using Australian data for rotavirus, as described in WSAA (2004) (Health risk assessment of firefighting from recycled water mains. Occasional paper no. 11, WSAA, Melbourne).

Pathogens found in sources of contamination can have very different health outcomes. Some outcomes are mild (for example, diarrhoea) while others can be severe (for example, haemolytic uraemic syndrome associated with *Escherichia coli* O157:H7). DALY provides a mechanism for assessing these outcomes and allocating resources based on the severity of impact. Standard risk assessments determine the likelihood of infection or illness. DALY converts these likelihoods into burdens of disease.

The basic principle of DALY is to provide a weight of severity for each health impact, within the range of zero (good health) to one (death). The weighting is then multiplied by the duration of the effect and the number of people affected. In the case of death, duration is regarded as the years lost compared to normal life expectancy (estimated at 81 years).

Therefore, **DALYs = YLL (years of life lost) + YLD (years lived with a disability or illness).**

In this context, disability refers to conditions that detract from good health. In this guideline, disability generally relates to illness.

Using this approach, mild diarrhoea with a severity weighting of 0.1, lasting 7 days results in a DALY of 0.002 (0.1 x 7/365), whereas the death of a one-year-old (resulting in a loss of 80 years of life) equates to a DALY of 80 (1x 80).

Using an Australian example of rotavirus infection:

- mild diarrhoea (severity rating of 0.1), lasting 3 days in 97.5% of cases
- severe diarrhoea (severity rating of 0.23), lasting 7 days in 2.5% of cases
- rare deaths of very young children in 0.015% of cases.

The DALY per case = (0.1 x 3/365 x 0.975) + (0.23 x 7/365 x 0.025) + (1 x 80 x 0.00015) = 0.0008 + 0.0001 + 0.012 = 0.013

Infection with *Cryptosporidium* can cause watery diarrhoea (severity weighting of 0.067) lasting for 7 days, with death in 0.0001% of cases. This equates to a DALY per case of 0.0015.

Campylobacter can cause diarrhoea of varying severity, including Guillain–Barré syndrome of varying severity, reactive arthritis and occasional deaths. The calculated DALY per case is 0.0046.

Based on DALYs per case, the impacts of the 3 pathogens, by decreasing order of importance, is rotavirus > *Campylobacter* > *Cryptosporidium*.

B2. Risk management

Risk assessment informs risk management. Risk management typically follows the risk characterisation phase of a risk assessment and is intended to provide context to risk reduction or mitigation processes and technologies. Following the implementation of risk reduction or mitigation, you can re-run risk assessment to assess the effectiveness of your risk management.

For chemical hazards, risk management options typically involve ways to reduce chemical concentration (either at the feedstock, treatment or output material phase) or elimination and control of exposure pathways. Management options are highly specific to the chemical and you should consider its physical and fate characteristics (that is, how a chemical may behave in an environment, such as if it degrades, bioaccumulates etc.).

It is important that you understand the capability and capacity of your selected treatment process to break down targeted chemicals. These factors will be influenced by operating conditions, which can affect consistency in meeting risk-reduction targets.

For pathogens, there are different means of reducing the risk to the populations exposed (human or animal, or both). You can mitigate the hazard by:

- reducing the pathogen loading by pre-treatment or acceptance criteria
- optimising operating parameters and practices to improve pathogen inactivation and minimising the volatilisation of bioaerosols and regrowth of bacterial pathogens.

If residual pathogen loading is likely to be too high for some uses, you can reduce exposure by:

- restricting the use of the treatment output
- using methods of land application likely to reduce exposure
- imposing a withholding period after land application
- all of the above.

Managing risks as early as possible in the treatment process (for example, well before land application) is preferred as it is easier to control. For that reason, it is important to determine the risk profile of feedstocks, optimise the treatment process to reduce that risk profile and assess acceptable end-uses, if still required.

This document provides a categorisation of feedstock risks. The list of hazards described is not exhaustive and you should ensure you assess the risk of your feedstock considering any events that might increase its risk profile (disease outbreak, climate change or other weather impact, among other factors).

2.1. Managing feedstock

Appropriate management of feedstock is an important part of protecting the environment, human health and amenity. The main factors influencing risk associated with a particular feedstock are its potential to:

- contain harmful pathogens or chemicals
- generate offensive odours
- contain physical contaminants that may be offensive
- attract vermin and vectors
- generate harmful leachate, which could contaminate surface water, land and groundwater
- contain plant pests and propagules.

These risks can lead to exceedances of environmental values in the environment reference standard (ERS). For example, harmful leachate could impact specific environmental values protected in the ERS.

2.2. Contaminants in outputs – risk-based sampling

Managing output quality is an ongoing process. You should carry out ongoing monitoring for high-risk incoming wastes that may have ongoing streams. You may observe unexpected contaminants in the output quality validation stage (for example, compost validation test) or processing issues (for example, processing temperature does not elevate to a standard operating parameter to meet the pasteurisation requirement).

Chemical criteria for output quality validation such as AS 4454-2012 may be limited and may not cover all contaminants identified in incoming wastes. During the output phase, you should monitor for any contaminants of concern that you identified in your feedstock. For pathogen monitoring, you should identify pathogen surrogates or indicators likely to have the same fate as pathogens of concern.

EPA recommends a risk-based sampling approach to ensure microbial and chemical contaminant risks are managed appropriately and cost effectively. This uses the probability of detection and risk of the feedstock to determine sample size. High-risk feedstock is expected to undergo more thorough characterisation and monitoring than low-risk feedstock. You should conduct the following sampling stages:

1. **Output monitoring commissioning stage**: you should monitor the quality of the composted waste following methods outlined in AS 4454-2012. Additional analyses may be required, based on identified risks. Monitoring pathogen surrogates or indicators in the feedstock and output will demonstrate the performance of the process removing specific pathogens (Log Reduction Values). Please note that you should repeat this stage if conditions change. For example, if you accept new feedstocks or implement changes in the process. This commissioning stage is important as it enables you to optimise your process and identify required controls.
7. **Output monitoring at the compliance stage:** Once you have optimised the process and implemented the necessary controls, you can reduce monitoring of the output. The analyses and frequency required will vary depending on contaminants and pathogens identified in the feedstocks, the heterogeneity of the feedstock, the process and the risks to end-users.

2.3. Managing the process

2.3.1. Multibarrier approach to protect human and animal health

Any treatment process relying on one step only may not ensure output material safety. For example, the pasteurisation process assumes that all particles within the waste reach the necessary temperature for an appropriate period of time. Because of the heterogenous nature of most waste, this is often impossible to achieve and can pose unacceptable risks to human and animal health when processing high-risk feedstocks.

Because several factors contribute to pathogen inactivation, a multibarrier approach is recommended. For example, some resilient pathogens may survive pasteurisation. You should optimise the waste treatment process to facilitate the sequential or concurrent effect of various factors to achieve appropriate pathogen inactivation. This is particularly important for high-risk wastes likely to contain pathogens that may survive thermophilic conditions.

In this approach, you should pay attention to controlling parameters during treatment. The nature of the feedstock is also important as it dictates what pathogens and indigenous microflora are likely to be present. Indigenous microflora are important as they are responsible for degrading organic matter and generating heat, producing antimicrobial compounds or preying on pathogens, or both.

This approach dictates what the C:N ratio and pH are, impacting the type of volatile acids and amount of ammonia volatilised.

2.3.2. Hazard analysis – critical control point approach

As more wastes are being diverted from landfill, the waste receivers should implement robust process management systems to cope with increasingly diversified feedstocks. To optimise waste treatment performance, if you are treating high-risk feedstock, you should develop a hazard analysis – critical control point (HACCP) system, similar to the one recommended in the *Australian drinking water guidelines*.

HACCP is a holistic approach based on identifying risks and control points for each step of the waste treatment process. Figure B4 illustrates a basic HACCP management system developed for compliance with AS 4454-2012 and how it could be adapted to high-risk feedstocks. Similar HACCP management systems should be developed for any technology used for processing waste. Developing and implementing such a process management system requires suitably trained and competent personnel.

This approach includes:

- knowledge of feedstocks and potential end-users to identify pathogens and chemicals that present risks for end-users
- identification of parameters or indicators, or both, that will best monitor process effectiveness in inactivating those pathogens or removing chemicals, or both
- extensive knowledge of the waste treatment process as it may need to be designed and optimised to inactivate specific pathogens or remove chemicals, or both
- identification and control of factors in the process likely to inactivate resistant pathogens of relevance or remove chemicals – factors responsible for inactivation of pathogens during the mesophilic or maturation phases, or both, should be considered, in addition to heat, once time-temperature compliance is achieved
- design and implementation of operational monitoring and quality controls
- continuous re-assessment of new and emerging risks (such as transient populations and climate change).

All facilities should develop a process and quality management system based on the HACCP approach for each type of material or waste category received (the feedstock). The process requires validation and reporting on a regular basis.

For composting low- and medium-risk wastes (for example) a basic HACCP system, based on compliance with AS 4454-2012 is usually sufficient. Figure B4 identifies at least 4 hazards and 4 corresponding critical control points.

You can design a process management system for low and medium risk wastes using this simplified HACCP approach. That management process will provide strategies for when critical control point requirements are not met. Note that blending is not an appropriate strategy when microbial levels are higher than recommended.

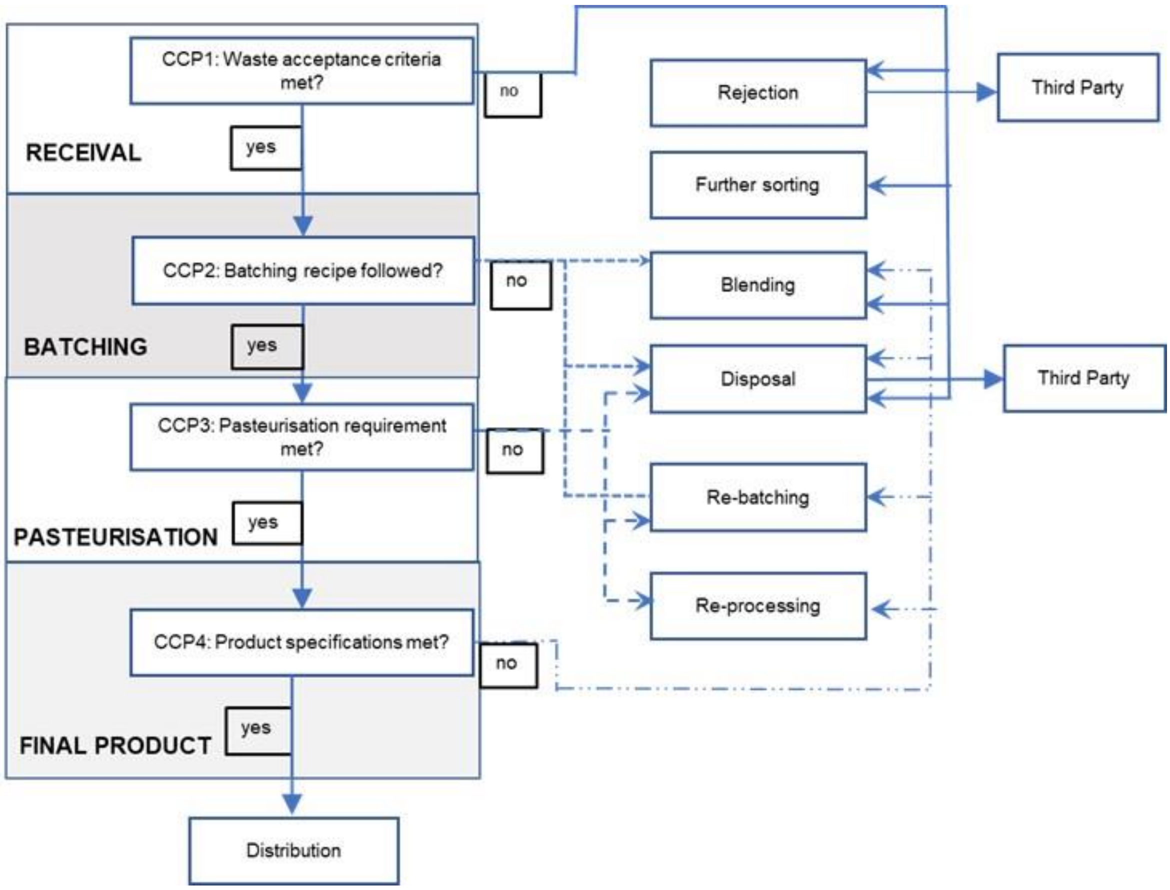
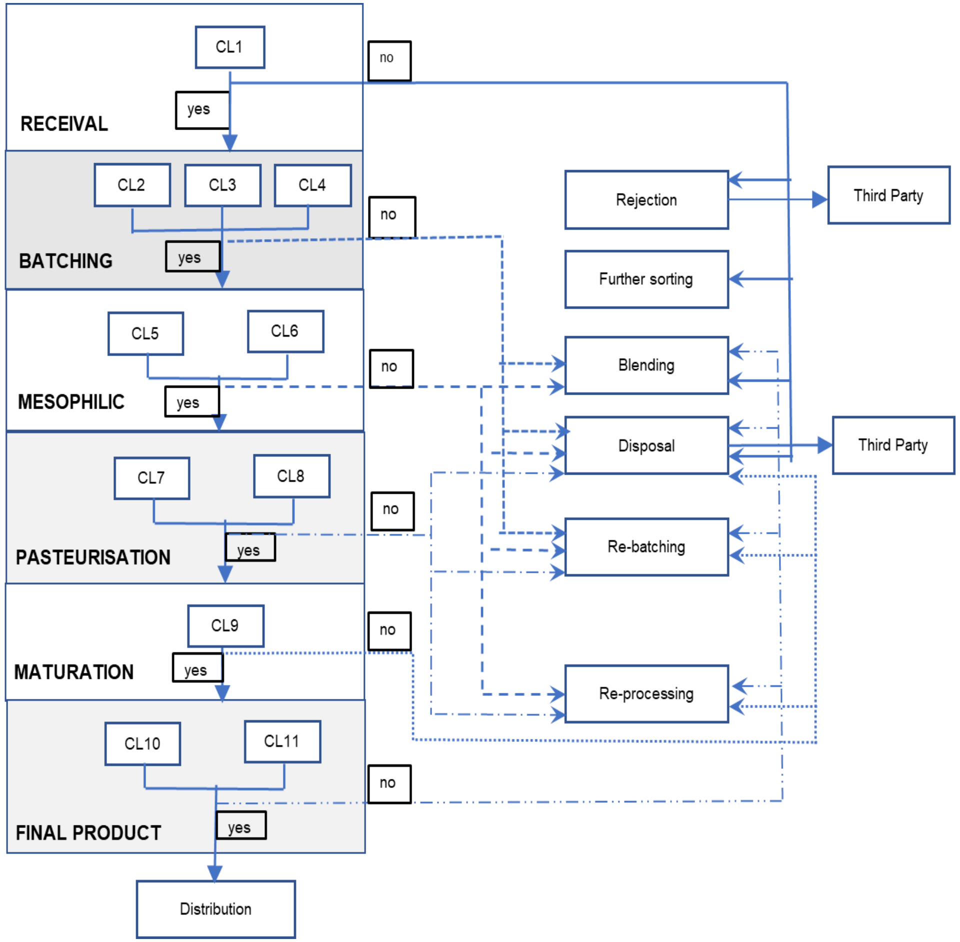


Figure B4 Basic HACCP approach for low and medium risk wastes

#	Hazard analysis (HA)	Critical control point (CCP)	Examples of critical limits (CL)
1	Contaminants in the incoming waste	Receival	Waste acceptance criteria: • plastics – light and flexible or film ≤0.05 dry matter w/w • glass, metal, rubber and rigid plastics: ≤0.5 dry matter w/w • chemical contaminants limits
2	Structure and composition of the compost pile not adequate for an aerobic degradation process	Batching	A specific recipe is formulated, with appropriate initial moisture content and C:N for the feedstocks: 25:1-35:1 3 volumes of Green Waste (GW) for every volume of pre-treated biosolids
3	Pasteurisation is incomplete, resulting in failure to inactivate most pathogens	Pasteurisation	Time-temperature requirements: • 5 cycles of turn after 3 consecutive days at temperature ≥55°C (open windrow) • temperature ≥60°C for 72 consecutive hours. (aerated enclosed vessel)
4	Pathogens survived composting or regrew, or both (compost not fit for intended use)	Final output material	Testing as per local standards or guidelines: • <100 *E. coli* per gram (dry weight), and no detection of *Salmonella* per 50 g (dry weight).

For high-risk wastes, you should identify additional hazards and implement critical control points . You may use additional reference organisms. Figure B5 provides an example for high-risk wastes. Please note this list is not exhaustive and examples are indicative only. The hazards in your process and corresponding critical control points may be different.



Legend			
	Hazard Analysis	Critical Control Point	Examples of Critical Limits (CL)
1	Contamination in the incoming waste	Waste receival	Waste acceptance criteria: Light/flexible or film plastic ≤0.05 % dry matter w/w Glass, metal, rubber and rigid plastics ≤0.5 % dry matter w/w Maximum of 2 dead chicken per ton of chicken litter
2	Structure and composition of the pile not adequate for aerobic degradation	Batching	Specific recipe formulated, with appropriate initial moisture content: 3 volumes of green waste for every 1 volume of food waste Moisture 55-60%
3	Material difficult to degrade is present in the feedstock		Specific bulking agent added to promote the activity of specific microorganisms.
4	Pathogens in the feedstock are resistant to heat may be inactivated by ammonia		Specific C:N ratio to favour ammonia volatilisation e.g. C:N ratio between 25:1 and 30:1
5	Temperature rising too quickly resulting in fire risk and/or inhibition of beneficial organisms,	Mesophilic phase	Appropriate air flow and/or turning and water addition to control temperature ≤ 40°C and moisture over 50%.
6	Difficulty transitioning from mesophilic to thermophilic phase when sporulation occurs		pH and temperature controlled using air flow and moisture content e.g. temperature maintained < 40°C for 12 h while a pH 6-7 is recorded before a rise to 55°C over a 24 h. period.
7	Pasteurisation is incomplete, resulting in failure to inactivate most pathogens.	Pasteurisation	Time-temperature requirements: 5 cycles of turn after 3 consecutive days at T ≥ 55°C (open windrow). T ≥ 60°C for 72 consecutive hours. (aerated enclosed vessel)
8	Pathogens may be inactivated by other factors than heat		Secondary barrier for inactivation e.g. appropriate airflow or water addition to maintain moisture >50% and pH ≥ 8.5 for at least a week
9	Pathogens may survive pasteurisation	Maturation	Maturation period sufficient as demonstrated by maturity test
10	Pathogens survived composting and/or regrew (compost not fit for intended use)	Final product quality assurance	Testing as per local standards or guidelines. Less then 100 *E. coli* per gram (dry weight), and no detection of *Salmonella* per 50 g (dry weight).
11	Spore forming bacteria can survive and regrow in compost		No detection of *Bacillus cereus* per 50 g (dry weight), or *Clostridium perfringens* ≤ 100 MPN/gram (dry weight)

Figure B5. Extended HACCP approach for high-risk wastes.

2.3.3. Recommended technology types

You should manage risks associated with specific categories of waste throughout the waste processing operation, from its receival through to the output material, including the wastewater produced. You should prepare, validate and follow a process management plan for each type of feedstock used. This process management plan should follow a hazard analysis critical control point approach.

Table B3 specifies the recommended technology for each feedstock category. The recommendations in Table 3 may be best practice, however you should consider what is reasonably practicable for your operation. Risks from higher-risk feedstocks can be controlled by following the other recommendations in the guideline without using a technology recommended in Table 3, however you should assess this on a case-by-case basis. You should ensure your chosen technology is appropriate for the feedstock you intend to use it for. Some feedstocks should be processed as soon as practicable and the most odorous wastes should not be stored for more than 48 hours.

You could use alternative technologies but should demonstrate risk is minimised and controls are in place. Please note that Table B3 provides information on managing risks of harm from organic waste processing. However, different parts of an overall process have different risk profiles. For example, in-vessel compositing of higher-risk feedstocks may be appropriate for pasteurisation, however open windrow may be suitable for the maturation phase.

Table B3. Recommended feedstock for technology types

Feedstock category	Recommended technology requirements		
	Open environment	Enclosed or covered environment	Enclosed with secondary odour control
1: Lowest potential risk of harm to human health and the environment	Yes	Yes	Yes
2: Medium potential risk of harm to human health and the environment	Yes	Yes	Yes
3: Medium to high potential risk of harm to human health and environment	No	Yes	Yes*
4: Highest potential risk of harm to human health and the environment	No	No	Yes*

*Consider full enclosure of all operations including raw material receival and unloading for highest risk wastes.

Note:

1. **Open environment:** you can process low-risk wastes using open air methods where the process can be kept aerated. This may not be appropriate in locations where there are insufficient separation distances for adverse environmental conditions (for example, in high winds).

8. **Enclosed or covered environment:** medium-risk wastes can be processed in enclosed or covered systems that provide a level of engineered control through the enclosure, as well as limited control over odour emissions.
9. **In different locations**, the requirements for enclosed and covered systems may vary. In some situations, covered environment can include material covers.
10. **Enclosed with secondary odour controls**: higher-risk wastes may require a higher level of engineered odour controls as process management alone is not sufficient to effectively minimise risks of odour impact. The most common type of secondary odour control is biofilters.
11. **Highest-risk wastes:** all aspects of operation including unloading and sorting is enclosed, negative pressure, air-lock system, etc.

2.3.4. Managing end uses

While you should eliminate or minimise all risks so far as reasonably practicable as early as possible during the process, the output of the treatment process may still pose some risks for human health and the environment.

Control or preventative measures to mitigate these risks will mostly aim to reduce exposure by:

- restricting uses
- applying waste to land using soil injection rather than surface application
- implementing withholding periods
- establishing application rates and frequencies that reduce the risk of contaminant accumulation.

More information on managing end uses for specific wastes can be found in Guidelines for environmental management: Biosolids land application (EPA publication 943).

Appendix C: Further reading on state of knowledge

State of knowledge is all the information you should reasonably know about managing your business' risks. This includes information from:

- EPA
- your business
- industry
- government.

It is used to comply with the GED and any other requirements. State of knowledge evolves over time. Updates to guidelines and technical documents continue to build industry state of knowledge.

EPA expects the organic waste processing industry to be aware of this guideline. The information contained and referenced within it as it all contributes to state of knowledge. Non-EPA guidelines may also contribute to state of knowledge. This includes those developed by industry, the federal government and international bodies.

AS 4454-2012 sets requirements for organic products. These products are used to amend the physical and chemical properties of soils and growing media. It specifies physical, chemical, biological and labelling requirements for composts, mulches and soil conditioners. It also applies to related products derived largely from compostable organic materials. AS 4454-2012 is referenced in Sections 5 and 6 of this guideline but that information is not a substitute for AS 4454-2012 itself.

Best Available Techniques (BAT) for Waste Treatment reference and conclusion documents. Published by the European Integrated Pollution Prevention and Control Bureau Joint Research Centre . These documents may be helpful for you in selecting techniques for your operations. These are referred to during EPA's permission application assessments.

Further information on managing fire risk from organic wastes includes:
Rynk, Robert. (2000). Fires at Composting Facilities: Causes and Conditions. Compost Operators Forum.
Gray, Brian. F. (2016). Spontaneous Combustion. In M. J. Hurley, SFPE Handbook of Fire Protection Engineering - Fifth Edition

- https://doi.org/10.1007/978-1-4939-2565-0_20

Rein, Guillermo. (2016). Smoldering Combustion. In M. J. Hurley, SFPE Handbook of Fire Protection Engineering - Fifth Edition.

- http://dx.doi.org/10.1007/978-1-4939-2565-0

Davenport, John A. (2008). Storage and Handling of Chemicals. In Arthur E. Cote, NFPA Fire Protection Handbook – Twentieth Edition

Other EPAs in Australia have published guidelines on operating organic waste processing facilities. Such as:

- New South Wales EPA environmental guideline 'Composting and related organics processing facilities
- South Australia's EPA Compost guideline
- Western Australia's EPA guideline 'Better practice organics recycling'.

These documents hold good general information on environmental management, issue resolution and monitoring.

The following documents provide additional technical information and support the development of this guideline:

Briancesco R et al. 2008, 'Assessment of microbiological and parasitological quality of composted wastes: health implications and hygienic measures', Waste Management Research, vol. 26, issue 2, pp. 196-202.

Brinton W F et al. 2009, 'Occurrence and levels of fecal indicators and pathogenic bacteria in market-ready recycled organic matter composts', Journal of Food Protection, vol. 72, issue 2, pp. 332-339.

Adhikari B K et al. 2008, 'Characterization of food waste and bulking agent for composting', Waste Management, vol. 28, pp. 795-804

Beck-Friis B et al. 2003, 'Composting of Source-Separated Household Organics At Different Oxygen Levels: Gaining an Understanding of the Emission Dynamics', Compost Science & Utilization, vol. 11, issue 1, pp. 41-50.

Chang J I & Chen Y J 2010, 'Effect of bulking agents on food waste composting', Bioresource Technology, vol. 101, pp. 5917-5924.

Chang J I & Hsu T E 2008, 'Effect of compositions on food waste composting', Bioresource Technology, vol. 99, pp. 8068-8074.

Kumar M et al. 2010, 'Co-composting of green waste and food waste at low C:N ratio', Waste Management, vol. 30, pp. 602-609.

Lepesteur M 2021, 'Human and livestock pathogens and their control during composting', Critical Reviews in Environmental Science and Technology, DOI: 10.1080/10643389.2020.1862550.

Li Z et al. 2013, 'Experimental and modelling approaches for food waste composting: A review', Chemosphere, vol. 93, issue 7, pp. 1247-1257.

Manga M et al. 2016, 'The Fate of Helminth eggs during the Co-composting of Faecal Sludge with Chicken Feathers and Market waste', Presented at the 13*th* IWA Specialized Conference on Small Water and Wastewater Systems (SWWS) and the 5*th* IWA Specialized Conference on Resources-Oriented Sanitation (ROS), Athens, Greece. 2016.

Sundberg C 2005, 'Improving Compost Process Efficiency by Controlling Aeration, Temperature and Ph', Doctoral thesis Swedish University of Agricultural Sciences Uppsala.

Sundberg C et al. 2013, 'Effects of Ph and microbial composition on odour in food waste composting', Waste Management, vol. 33, pp. 204-211.

Roser D et al. 2011, 'Managing the contaminants in feedlot wastes: Development of realistic guidelines – Final Report', Meat & Livestock Australia, North Sydney.

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