Environment Protection Authority

Guidelines for the safe handling and reuse of biosolids in South Australia

EPA South Australia

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For further information please contact:

Information Officer
Environment Protection Authority
GPO Box 2607
Adelaide SA 5001

Telephone: (08) 8204 2004
Facsimile: (08) 8124 4670
Free call (country): 1800 623 445

Website: https://www.epa.sa.gov.au/
Email: epainfo@sa.gov.au

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Disclaimer

This publication is a guide only and does not necessarily provide adequate information in relation to every situation. This publication seeks to explain your possible obligations in a helpful and accessible way. In doing so, however, some detail may not be captured. It is important, therefore, that you seek information from the EPA itself regarding your possible obligations and, where appropriate, that you seek your own legal advice.

Contents

List of figures

List of tables

Abbreviations

BCC	biosolids contaminant concentration
CLAR	contaminant limiting application rate
CWMS	community wastewater management system
DHW	Department for Health and Wellbeing
DEW	Department for Environment and Water
EP Act	*Environment Protection Act 1993*
EPA	South Australian Environment Protection Authority
EPC	endrocrine disrupting chemical
EPP	environment protection policy
HCB	hexachloro-benzene
LOR	limit of reporting
ML	maximum levels
MPACL	maximum permissible annual contaminant loading
MPC	maximum permissible concentrations (of contaminants in soils)
MRL	maximum residue limits (of contaminants in food)
NATA	National Association of Testing Authorities, Australia
NLAR	nutrient limiting application rate
NEPM	National Environment Protection Measure
NRA	National Registration Authority
NWQMS	National Water Quality Management Strategy
PFAS	per- and poly-fluoroalkyl substances
PCB	polychlorinated biphenyl
PIRSA	Primary Industries and Regions South Australia
PPCP	pharmaceuticals and personal care product
SCC	soil contaminant concentration
STEDS	septic tank effluent disposal scheme
WIE	water industry entities
WWTP	wastewater treatment plant
WQEPP	*Environment Protection (Water Quality) Policy 2015*

Summary

This guideline will assist the producers and end users of biosolids meet their general environmental duty under the Environment Protection Act 1993, and where developed using current and historical understanding of the safe and reliable production, handling and management of biosolids. As this knowledge changes and develops with new innovations, science and understanding, these guidelines will require periodical updating to reflect best current practice, and as such the EPA welcomes comment and suggestions for improving these guidelines. Please refer to the contact information for the EPA to provide a submission.

1 Introduction

1.1 Scope

This guideline is for the safe handling and use of biosolids generated from:

- municipal wastewater treatment plants (WWTP) treating domestic wastes and industrial wastes accepted via trade waste agreements
- community wastewater management systems or CWMS (previously commonly referred to as septic tank effluent disposal schemes or STEDs).
- water industry entities.

The guideline is prepared by experts in public health, engineering, soil and water science, the environment, treatment facility operation, contracting, catchment management and local government.

This guideline does not address the handling and disposal or reuse of:

- biosolids or sludges from WWTPs which accept solely industrial wastes,
- grease trap wastes
- screenings, grit and scum
- sewer silt and stormwater waste
- drinking water treatment sludges
- septic tank waste.

For guidance on the management of septic tank waste please see the *EPA Guideline: Septage management 2020*.

The guidelines applies to the following groups of stakeholders:

- **Producers** – owners, operators or contractors of WWTPs or CWMS and associated on-site and off-site biosolids storage facilities such as South Australian Water Corporation, local councils or other water industry entities.
- **Reprocessors** – owners, operators, or contractors of biosolids processing facilities who process biosolids by mixing with a substrate or composting prior to resale of a final product containing biosolids.
- **Transporters** – operators, contractors, councils or farmers who transport biosolids.
- **End users** – farmers, councils, landscapers or householders who use biosolids or products containing biosolids.

1.2 Objectives

The guideline ensures sustainable, beneficial reuse of biosolids can be safely practised in South Australia. Its primary objective is to protect human and animal health, the environment and agricultural products.

The specific objectives are to:

- set minimum biosolids treatment and quality standards
- provide a classification scheme to determine appropriate uses of biosolids based on their contaminant concentrations and the treatment processes used to reduce pathogens, odour and the potential for vector attraction
- communicate the obligations of producers, reprocessors, transporters and end users of biosolids under legislation
- ensure that the statutory requirements of regulatory authorities such as South Australian Environment Protection Authority (EPA), Department for Health and Wellbeing (DHW) and Primary Industries and Regions South Australia (PIRSA) are adequately specified
- suggest best practice for selection and management of application sites

- ensure that there are adequate controls to protect the environment and public health with regard for occupational health and safety
- suggest monitoring, reporting and record keeping systems to demonstrate compliance with the general environmental duty under the section 25 of the *Environment Protection Act 1993* (EP Act).

1.3 How to use this guideline

There are three main steps:

Step 1: Determine the classification of the biosolids product by establishing its Contamination Grade and Stabilisation Grade. Classification procedures are detailed in section 4 and sampling procedures are detailed in Appendix 1 Sampling and analysis.

Step 2: From the classification, determine the end uses for the product (refer to section 5.1).

Step 3: Determine where the beneficial application of biosolids products to land is permitted and the maximum allowable application rate to be used. Section 6 provides best management practices and activity constraints. The maximum allowable application rate can be determined once background information from the site has been collected (refer to section 6.2.2).

In those instances where the wastewater treatment sludge cannot meet the requirements of either the Contamination Grade or the Stabilisation Grade, and cannot be used as a biosolid, further treatment, application on different land or mixing are options.

The guideline also outlines:

- the roles and responsibilities of producers, reprocessors, transporters and end users (section 3)
- requirements for record keeping and information transfer (section 3).

The appendices contain further technical detail relating to the calculation of Contamination Grades, application rates and monitoring requirements. References and relevant departmental and industry contact lists are also included in this document (refer to Appendix 6).

1.4 Definition of biosolids

1.4.1 Definition

The municipal and septic wastewater treatment process produces both a solid and a liquid waste stream. The solid residues are referred to as sludge. Biosolids are sludges that have been treated to a standard suitable for beneficial reuse. That is, stabilised organic solids derived totally or in part from wastewater treatment processes which can be managed safely to utilise beneficially their nutrient, soil conditioning, energy or other value.

The term biosolids does not include untreated wastewater sludges, industrial sludges or the product produced from the high temperature incineration of sewage sludge. It should also be noted that many other solid waste materials are not classified as biosolids, eg animal manures, food processing or abattoir wastes, solid inorganic wastes, and untreated sewage or untreated wastes from septic systems/sullage wastes.

Biosolids can contain significant quantities of organic matter and plant nutrients, and as such are viewed as a valuable resource for the agricultural, horticultural and municipal sectors.

1.5 Benefits of biosolids

Biosolids contain useful amounts of nitrogen, phosphorus and organic matter, and limited quantities of potassium and trace elements. Biosolids are generally lower in nutrient content than fertilisers but the use of biosolids can reduce the need for fertilisers.

Benefit	Description
Soil conditioner	Many South Australian soils are known for their inherent infertility and fragility. Biosolids can improve soil conditions so that nutrients and moisture are better retained within it, reducing soil erosion and suppressing soil borne plant diseases.
Organic matter	Australian soils are generally low in organic matter and can benefit from biosolids. As a source of organic matter, regular application of biosolids may increase the soil organic matter over a period to deal with impoverished soils.
Nitrogen	Nitrogen content and availability can vary greatly depending on the source of the biosolids and the treatment process. The nitrogen is generally present in the ammonium and organic forms, and in smaller concentrations in the nitrate form.
Phosphorus	Phosphorus availability is often unaffected by the treatment process and approximately 50% to 80% of the total phosphorus applied is available to plants in the first year[1]. When applied at the nutrient limiting application rate (NLAR—refer to Appendix 3), phosphorus will generally be available at more than adequate levels for plant growth for two or more years following application.
Potassium	Biosolids generally contain low levels of potassium so for some crops, eg forage for hay cutting, additional potassium may be required.
Sulfur	Addition of biosolids to soils can increase the level of plant available sulfur, an essential plant nutrient.
Other nutrients	Micronutrients such as boron, copper, iron, manganese, molybdenum and zinc may be present in biosolids. The concentration of these will vary depending on the source of the biosolids.

1.5.1 Potentially undesirable constituents

Pathogens

Biosolids can contain a range of pathogenic organisms, including viruses, helminths, protozoa, bacteria and fungi, which are potentially harmful to human, plant and animal health. The wastewater treatment process combined with a stabilisation process (refer to section 4.3) ensure that all biosolids are treated to a suitable standard for reuse.

There are two treatment standards: Stabilisation Grade A and Stabilisation Grade B (refer to section 4.3). Biosolids classified as Stabilisation Grade A contain fewer pathogens and the use of these biosolids is less restricted.

[1] European Environment Agency 1997, *Sludge treatment and disposal – management approaches and experiences*, EEA, Denmark, https://www.eea.europa.eu/publications/GH-10-97-106-EN-C

Septic tank sludge (or septage) is unclassified as it is not given a stabilisation grade or contamination grade and therefore have very restricted use (for guidance on the management of septic tank waste please see the *EPA Guideline: Septage management*.

Chemical Contaminants of Concern (CoC)

Biosolids can contain a range of contaminants (inorganic and organic chemicals), which may, if applied in sufficiently high concentrations, have a deleterious effect on soils, plants, animals and human health. The source of these contaminants are from:

- the widespread use of household cleaning chemicals, personal care products, medicines and pesticides
- the disposal of industrial and household wastes to sewerage systems
- existing contamination within the environment
- the impact of metal pipes and fittings in the water supply system.

Hazard assessments have been conducted for a range of metals in biosolids and in terms of potential environmental effects. The metals of principal concern are cadmium, copper and zinc[2]. While most of the metal contaminants that occur in biosolids are also trace elements important for plant health growth, it is necessary to monitor they do not exceed recommended levels (refer to section 4.2).

The organic compounds of concern are those that persist for a significant amount of time. These include DDT/DDD/DDE, aldrin, dieldrin and chlordane. The use of the majority of these compounds is now banned under the *Agricultural Chemicals Act 1955*, and evaluation of biosolid quality over time indicates negligible concentrations of these chemicals in biosolids.

This revision of the guideline has removed the need to constantly monitor biosolids for these contaminants. However, there is a possibility that previous usage may result in these chemicals being detected in biosolids and/or at the application site.

A broad range of chemicals has been identified as having the potential to alter the normal functioning of the endocrine system in both wildlife and humans. Known as endocrine disrupting chemicals (EDCs), this range of chemicals includes dioxins, PCBs, pesticides such as DDT, nonylphenol and pharmaceuticals such as the contraceptive pill. There are limited studies investigating the presence of EDCs in sludge. On the basis of a study in 2008[3], the US EPA has concluded that dioxins in biosolids applied to land do not pose a significant risk to human health or the environment.

The detection of EDCs, including nonylphenols, in biosolids destined for land application has been reported in other studies[4],[5] but no direct health effects have been documented.

Pharmaceuticals and personal care products (PPCPs) refer to any product used for personal health, cosmetic reasons or used by agribusiness to enhance growth or health of livestock. PPCPs include prescription and over-the-counter

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2 Warne M, McLaughlin MJ, Heemsbergen D, Bell M, Broos K, Whatmuff M, Barry G, Nash D, Pritchard D, Stevens D, Pu G & C Butler 2008, *Draft Position Paper: Recommendations of the Australian National Biosolids Research Program on Biosolids Guidelines.*

3 Hundal LS, Cox A, Granato TC and Z Abedin 2008, 'Levels of Dioxins in Soil and Corn Tissues after 30 Years of Biosolids Application', *J. Environ. Qual* 37: 1497−1500,

4 Harrison EZ, Oakes *SR,* Hysell M*, A* Hay 2006, *'*Organic Chemicals in Sewage Sludges*'*, *Science of the Total Environment* 367: 481−497.

5 Kinney CA, Furlong ET, Zaugg SD, Burkhardt, MR, Werner SL, Cahill JD and GR Jorgensen 2006, 'Survey of Organic Wastewater Contaminants in Biosolids Destined for Land Application', *Environ. Sci. Technol* 40: 7207−15.

therapeutic drugs, veterinary drugs, cosmetics, fragrances and sunscreens. To date there is no evidence of adverse human health effects due to the presence of PPCPs in the environment[6].

PPCPs are introduced to the environment via excretion by humans, through washing off externally applied products and the disposal of unwanted medication to sewers and landfill[7]. Pharmaceutical, cytotoxic and medical wastes within South Australia must not be disposed of directly to sewers without the relevant approvals. Please contact the EPA for advice relating to the appropriate management and disposal of pharmaceutical cytotoxic and medical wastes, including requirements for sterilisation by autoclave and disposal by incineration.

As with EDCs, there is some evidence that wastewater treatment processes can reduce concentrations of these products[8]. Although some studies have indicated concerns about the bioavailability of PPCPs following land application of sludge[9], previous reviews of the available data for PPCPs in biosolids concluded that no scientific evidence exists that land application of biosolids is harmful to either human health or the environment[10].

Per- and poly-fluoroalkyl substances (PFAS) are known contaminants within wastewater treatment networks, with sources ranging from food packaging and preparation items; environmental contamination entering sewer networks; and from trade waste producing facilities. The persistence of these compounds and associated bioavailability and bioaccumulation, with uncertain environmental and health outcomes, means that these compounds should be monitored in biosolids. No criteria have been developed for these compounds, but ongoing monitoring of these compounds by water utilities producing biosolids should be undertaken. The sale and use of fluorinated firefighting foams has been banned in SA under the Environment Protection (Water Quality) Policy 2015.

Further research into treatment removal, presence in biosolids, environmental fate and transport and potential adverse impacts on human health and the environment is required for CoCs. No criteria have been developed for all CoCs listed, but ongoing monitoring of these compounds by water utilities producing biosolids should be undertaken where known or potential contamination of the wastewater source exists, and further evaluation of results undertaken in consultation with the EPA.

To prevent the accumulation of chemical contaminants, biosolids producers, reprocessors and end users are required to comply with:

- maximum contaminant concentrations in biosolids (refer to Tables 15, 16 and 17)

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6 US Environmental Protection Agency 2007, *Pharmaceuticals and Personal Care Products*, US EPA, Washington DC.

7 Kanda R, Griffin P, James HA and J Fothergill 2003, 'Pharmaceutical and personal care products in sewage treatment works', *J. Environ. Monit.* 5: 823−830.

8 Brun GL, Bernier M, Losier R, Doe K, Jackman P and HB Lee 2006, 'Pharmaceutically active compounds in the Atlantic Canadian sewage treatment plant effluents and receiving waters and potential for environmental effects measured by acute and chronic aquatic toxicity', *Environ. Toxicol. Chem.* 25: 2163−76.

Miao X, Yang J and CD Metcalfe 2005, 'Carbamazepine and Its Metabolites in Wastewater and in Biosolids in a Municipal Wastewater Treatment Plant', *Environ. Sci. Technol* 39: 7469−75.

Giger W, Alder AC, Golet EM, Kohler H, McArdell CS, Molnar E, Siegrist H and MJ Suter 2003, 'Occurrence and Fate of Antibiotics as Trace Contaminants in Wastewaters, Sewage Sludges and Surface Waters', *Chimia* 57(9): 485−491.

Ying G and RS Kookana 2007, 'Triclosan in wastewaters and biosolids from Australian wastewater plants', *Environ. Internat.* 33: 199−205.

9 Kim S, Eichhorn P, Jensen JN, Weber AS and DS Aga 2005, 'Removal of Antibiotics in Wastewater: Effect of Hydraulic and Solid Retention Times on the fate of Tetracycline in the Activated Sludge Process', *Environ. Sci. Technol.* 39(15): 5816−23.

10 Jones-Lepp TL and R Stevens 2007, 'Pharmaceuticals and personal care products in biosolids/sewage sludge: the interface between analytical chemistry and regulation', *Anal. Bioanal. Chem.* 387: 1173−83.

- annual contaminant loading limit (refer to Table 13)
- maximum permissible concentrations for heavy metals and organic chemicals in soils (refer to Table 14).

The annual contaminant loadings to soil are controlled through the first two conditions. The cumulative contaminant loadings that may occur as a result of biosolids applications are limited through all three conditions.

Non-biodegradable material

The presence of any foreign non-biodegradable material that may cause human or animal injury or damage to equipment should be prevented in biosolids. This material is generally removed by screens prior to sewage entering WWTPs.

1.6 Review of the guidelines

These guidelines will be reviewed when research data, new technologies or updated national guidance indicate that it is appropriate to do so.

2 Statutory framework

2.1 Legislation

The procedures described in this guideline provides a means of minimising public health risks and environmental harm. Producers, reprocessors and end users of biosolids need to be aware of the requirements of relevant statutes and satisfy themselves that they have complied with all necessary safeguards and procedures.

2.1.1 Environment Protection Act 1993

Under the *Environment Protection Act 1993* (EP Act), discharges to the environment must be managed so they do not cause detriment to the receiving environment. The EP Act includes a general environmental cuty which end users need to be aware. It states:

> A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

The EP Act provides for the development of environment protection policies (EPPs) which can set out detailed requirements for protecting particular aspects of the environment, or protecting the environment from particular activities. The EPPs contain penalties for the breach of mandatory provisions, relating to required behaviours or causing certain types of environmental harm.

Environment Protection (Water Quality) Policy 2015

The *Environment Protection (Water Quality) Policy 2015* (WQEPP) is especially relevant to this guideline and should be considered in the assessment of suitability of the use of biosolids and sludge as it relates to protection of waters.

Relevant sections of the WQEPP include the general obligation to avoid the deposit of waste into waters or onto land from which it is reasonably likely to enter any waters and the obligation not to deposit any listed pollutants into waters or onto land from which it is reasonably likely to enter any waters.

In addition, there are environmental values for any given type of water body that may require protections and related water quality trigger values that all reasonable and practicable measures must be made to avoid activating. For the purposes of the WQEPP, sludge includes biosolids.

In cases where the guideline is not complied with, the EPA or another administering agency, may issue an environment protection order and the person who has been issued with an order must comply with it or risk enforcement action (including fines or being prosecuted).

2.1.2 Other legislation

Legislation relating to food standards

The Australia New Zealand Food Standards Code developed under the *Food Standards Australia New Zealand Act 1991* (Commonwealth) specifies ’maximum levels‘ (ML) and ’maximum residue limits’ (MRL) permitted to be present in food. MRLs normally apply to agricultural and veterinary chemicals, and MLs apply to metal and non-metal contaminants and natural toxicants.

The *Food Act 2001* (South Australia) ensures food for sale is both safe and suitable for human consumption and provides for the application of the Food Standards Code (from the Commonwealth Act listed above).

The *Food Regulations 2017* enables the adoption of the Food Standards Code.

Land and Business (Sale and Conveyancing) Act 1994

The *Land and Business (Sale and Conveyancing) Act 1994* (LBSC Act) and the *Land and Business (Sale and Conveyancing) Regulations 2010* (LBSC Regulations) are set in place to provide consumer protection for property buyers in South Australia. Section 7 of the LBSC Act specifies the requirement for a land owner and other organisations to complete a series of questions as part of the Form 1 or Form 2 Statement when land or businesses are sold. The 'Particulars relating to environmental protection' under the LBSC Regulations constitute part of these forms and include a series of questions relating to specific environmental interests.

A vendor has the responsibility to respond to some of these questions and to specify, where applicable, the existence of an environmental assessment of the land or part of the land. This includes any site testing conducted in relation to the use of biosolids.

Livestock Act 1997

The *Livestock Act 1997* and the *Livestock Regulations 2013* specify the requirements for the management of livestock to prevent contamination of livestock and their products. These have been taken into consideration in the preparation of this document.

This guideline includes information on the use of biosolids on pastures (refer to section 5.4.2).

Health and safety legislation

The *South Australian Public Health Act 2011* contains provisions for the prevention and abatement of conditions and activities which are or may be unsanitary, and offensive or dangerous to public health and for the protection of water supplies. The *South Australian Public Health (Wastewater) Regulations 2013* detail the legislative requirements for wastewater systems, including on-site wastewater systems for the manufacture, installation, operation and maintenance of wastewater systems.

Biosolids producers, reprocessors and end users must meet the requirements of the *Work Health and Safety Act 2013.* These requirements include the responsibilities of both employer and employee to provide the necessary information and equipment to ensure a safe working environment. Further information on the health and safety aspects of working with biosolids is included in section 6.3.

Producers and processors of meat, seafood, eggs, sprouts, plant and dairy products must comply with the *Primary Produce (Food Safety Schemes) Act 2004* and associated regulations to manage risks to consumers and primary industry markets associated with unsafe or unsuitable primary produce.

Planning, Development and Infrastructure Act 2016

An Act to provide for matters that are relevant to the use, development and management of land and buildings, including by providing a planning system to regulate development within the state, rules with respect to the design, construction and use of buildings, and other initiatives to facilitate the development of infrastructure, facilities and environments that will benefit the community. The disposal (ie burial) of biosolids may constitute an activity of environmental significance (ie a waste depot) and development approval may be required.

River Murray Act 2003

The *River Murray Act 2003* ensures that all reasonable and practicable measures are taken to protect, restore and enhance the River Murray in recognition of its critical importance. The water quality objectives of the Act are to manage the levels of nutrients and potential pollutants (including sediments) and prevent or minimise impacts on the River Murray. All persons have a duty of care under this act to take reasonable and practical measures to prevent or minimise harm to the River Murray. The Act should be considered if applying biosolids in the River Murray Protection Area.

Agricultural and Veterinary Products (Control of Use) Act 2002

The *Agricultural and Veterinary Products (Control of Use) Act 2002* and *Agricultural and Veterinary Products (Control of Use) Regulations 2004* are the primary legislation governing use of rural chemicals including fertilisers. They prescribe labelling requirements and standards limiting the levels of unacceptable impurities such as heavy metals in fertilisers, and include a general duty that requires reasonable steps to be taken when using fertilisers and chemicals to minimise contamination or harm to land, animals, plants, humans and the environment.

Natural Resources Management Act 2004

The *Natural Resources Management Act 2004* contains general provisions for the protection of water bodies.

National Water Quality Management Strategy

The *National Water Quality Management Strategy* (NWQMS) has produced a *Guideline for Sewerage System Sludge Biosolids Management*. The specific requirements of the NWQMS document are included in the current guidelines. If biosolids are to be transported interstate, the requirements of this guideline and the relevant documentation of the receiving state should be met. The volume of biosolids transported interstate should be reported to the EPA on an annual basis.

2.2 EPA licensing

WWTPs and CWMS that discharge to the environment are licensed under Schedule 1 'Prescribed Activities of Environmental Significance' in the EP Act. Conditions relating to the operation of these plants, including the production, treatment and disposal or reuse of biosolids, will be addressed through licence conditions. Biosolids depots operating independently of a WWTP, CWMS or an EPA licensed waste depot will also be required to be licensed under Schedule 1[11].

Facilities which produce compost or are capable of producing compost at a rate exceeding 200 tonnes per year must also be licensed under the EP Act.[12] The requirements of the operators in relation to biosolids will be addressed through licence conditions.

End users of biosolids are not required to be licensed under the EP Act. Approval for biosolids to be applied to a site is not required by the EPA. The end user however must ensure they are compliant with the general environmental duty under the EP Act. This guideline includes recommendations of management practices and record keeping to assist in meeting this requirement.

11 Under 'activity 3(2)(e) Waste Processing – other' of Schedule 1 of the EP Act.

12 Under 'activity 3(2)(a) Waste Processing – composting' of Schedule 1 of the EP Act.

3 Roles, responsibilities and record keeping

3.1 Producer

Records to be maintained by the producer are listed in Table 1. The producer must also supply the EPA with an annual report on the treatment and use of biosolids. Specific reporting requirements are:

- total biosolids volume held/stockpiled
- summary of quality of biosolids removed
- summary of:
  - volume of biosolids removed
  - end use of treated biosolids
  - application site.

The *Biosolids Analysis Sheet for Producers*, which must be completed for each batch of biosolids, can be found in Appendix 4 Reporting and application forms. These records must be made available to the EPA or its agents during inspections. The producer is responsible for the sampling and analysis of all biosolids products.

Where the biosolids depot is managed by a depot manager on behalf of a council, the manager is responsible to the local council environmental health officer for providing a monthly summary of:

- volume of biosolids received
- origin of biosolids
- disposal site (drying lagoon)
- volume of biosolids taken from depot and destination
- names of pump-out contractors.

When supplying the biosolids to an end user, the producer is responsible for calculating the application rate for the first year of application (refer to Appendix 4). The producer should also inform users of limitations for its use as defined in the guideline.

Table 1 Records to be maintained by the producer

Record keeping requirements	
Sludge input (also relevant for depot managers of CWMS)	• Name of licensed contractor and driver • Date • Volume of load • Origin of biosolids (domestic or industrial)
Biosolids information	• WWTP/CWMS name • Batch code • Source of biosolids (which lagoon/drying bed, dewatered, etc) • Date stockpiled • Contamination Grade and contaminant analysis results • Stabilisation Grade, method of stabilisation (including any blending) and any pathogen analysis results • Solids content • pH

Record keeping requirements	
Destination of biosolids (not required for residential use)	• Name of end user and contact details • End use • Address of destination • Quantity removed • Date removed • Site analysis results • Calculation of CLAR and NLAR

3.2 Reprocessor

Records to be maintained by the reprocessor are listed in Table 2. The *Biosolids Analysis Sheet for Reprocessors*, which must be completed for each batch of biosolids, can be found in Appendix 4. These records must be made available to the EPA or its agents during inspections. The reprocessor is responsible for the sampling and analysis of all reprocessed biosolids products.

When supplying the reprocessed biosolids to an end user, the reprocessor is responsible for calculating the application rate for the first year of application (refer to Appendix 4). The reprocessor should also inform users of limitations for its use as defined in the guideline.

Table 2 Records to be maintained by the reprocessor

Record keeping requirements	
Biosolids input	• WWTP batch code (provided by WWTP) • Batch size (before reprocessing) • WWTP/CWMS name
Reprocessed biosolids	• Reprocessors batch code • Batch size (after reprocessing) • Contamination Grade and results of contaminant analysis • Stabilisation Grade, method of stabilisation (including any blending) and any pathogen analysis results • Solids content • pH • Date stockpiled • Materials reprocessed with biosolids
Destination of biosolids (not required for residential use)	• Name of end user and contact details • End use • Address of destination • Quantity removed • Date removed • Site analysis results • Calculation of CLAR and NLAR

3.3 End user

Records that are suggested to be maintained by the end user are outlined in Table 3. End users are also responsible for declaring any environmental assessments conducted in relation to the use of biosolids in accordance with Form 1 or Form 2 questions under section 7 of the LBSC Act when selling the land (refer to section 2.1.2). End users who are utilising biosolids for urban landscaping (see section 5.4.3) are not required to maintain records.

Table 3 Records to be maintained by the end user

Record keeping requirements	
Biosolids source	• Source of biosolids or reprocessed biosolids and batch number
Application of biosolids	• Location of the application site • Area of the application site • Date of application • Volume of biosolids applied • Method of application and incorporation

3.4 Transporters of sludge

Transporting of sludges and septage are not addressed by these guidelines, For guidance on the management of septic tank waste please see the EPA Guideline: Septage management.

3.5 Transporters of biosolids

Transporters of biosolids should take the precautions outlined in section 6.4. As biosolids are considered a product, information on the transport or receival of biosolids is not required to be submitted to the EPA.

Contractors and persons responsible for the transport of biosolids should ensure that all employees are trained and provided with health and safety information on the handling of biosolids (refer to section section 6.4).

4 Biosolids grading

4.1 Outline

Biosolids are to be classified according to the analysis of representative samples of the product and/or approved stabilisation processes. Sampling requirements are outlined in Appendix 1 Sampling and analysis.

The classification system is used to determine permissible end uses for biosolids products. There are two steps involved in the classification process:

- Determining the **Stabilisation Grade** – assigned according to the treatment that the batch of biosolids has undergone to reduce pathogens and vector attraction, and to control odours.
- Determining the **Contamination Grade** – assigned according to the concentration of a range of chemical contaminants present in the biosolids.

If assessments of the Contamination Grade and/or the Stabilisation Grade are not undertaken, the product is automatically rated as Unclassified.

The Biosolids Analysis Sheet for Producers, which must be completed for each batch of biosolids, can be found in Appendix 4 Reporting and application forms. These records must be made available to the EPA or its agents during inspections.

Once a batch of biosolids has been assigned a Stabilisation Grade and/or a Contamination Grade, the possible end uses, and any restrictions relating to its usage, can be determined.

4.2 Contamination grading

Producers and reprocessors of biosolids must undertake the sampling and analysis required to provide sufficient information about the concentration of contaminants in biosolids prior to their removal from the treatment plant, CWMS or reprocessing site.

All biosolids are contaminated to some extent by elements potentially toxic to humans, animals or plants such as metals or organic chemicals (eg pesticides). Much of this contamination is the results of industrial wastes discharged to sewers but some can be attributed to products used in the domestic environment (eg cleaning products, personal care products and medicines) or to the corrosion of components in the water supply reticulation and household systems. These elements can be concentrated by the sewage treatment process in sludge.

The objective of contamination grading is to avoid using biosolids in a manner that would risk excessive uptake of contaminants by crops, ingestion by humans or animals or deleterious effects on the environment. These outcomes could result from either using biosolids of an inappropriate quality as a large single application to a site or through repeat applications to a site. Maximum permissible concentrations (MPCs) have been set for the contaminants in soils used for the production of food crops for human and animal consumption (refer to Appendix 3 Procedures for determining biosolids application rate).

Biosolids products should not be applied to sites where existing contaminant concentrations are in excess of the maximum allowable soil contaminant concentration contained in Appendix 3, unless approved by the EPA.

Contamination Grading of biosolids involves the following steps:

- Sampling (refer to Appendix 1 Sampling and analysis).
- Accredited laboratory testing of contaminant levels (eg NATA).
- Statistical examination of the results and presentation of summary data.
- Calculation of the biosolids contaminant concentration (BCC) for comparison with the chemical contaminant thresholds (refer to Table 4).

4.3 Biosolids contaminant concentration

For the purpose of determining biosolids contamination grading and application rates, the batch concentration is taken to be approximately 68% of the values lying within one standard deviation of the mean of all the analyses of the element for that batch. This applies to biosolids removed from drying pans, and composted or blended biosolids.

The Biosolids Contaminant Concentration (BCC) is defined as:

BCC = m + s

where:

m = mean concentration of a given contaminant calculated from all samples

s = standard deviation of the mean concentration of a given contaminant calculated from all samples

When biosolids are frequently sampled and analysed (eg daily), the BCC is taken to be approximately 95% of the values lying within two standard deviation of the mean of all analysis of that element.

The Biosolids Contaminant Concentration (BCC) is defined as:

BCC = m + 2s

Biosolids achieving Contamination Grade A are the highest quality (lowest level of contaminants) while Contamination Grade B is the lowest quality (highest level of contaminants).

The grade of a biosolids batch will be equivalent to the lowest grade determined for any of the contaminants in that batch. For example, if all the contaminants except copper have Contamination Grade A, but copper has Contamination Grade B, then the Contamination Grade for the biosolids must be assigned as B.

If a biosolids product is untested or the contaminant levels are higher than the Contamination Grade B thresholds, then the biosolids are considered unclassified[13].

An example of calculating the Contamination Grade is provided in Appendix 2 Example of calculating Contamination Grade.

[13] Unclassified sludges for disposal to landfill are considered as Commercial and Industrial Wastes (Listed) and require classification for disposal. Refer to Current Waste Criteria on the EPA website.

Table 4 Contaminant acceptance concentration thresholds for biosolids (upper limit of metal concentrations for contaminant classification of biosolids)

Contaminant	Grade A[14] (mg/kg dry weight)	Grade B[15] (mg/kg dry weight)
Cadmium	1	20
Chromium (VI)*	1	1
Copper	100	2,500
Zinc	200	2,500

* Further advice should be sought from the EPA for exceedences of Chromium (VI) affected by limit of reporting (LOR) results

4.3.1 Contaminants not included in the grading

Certain compounds were excluded from the contamination grading:

Arsenic, Barium, Beryllium, Cobalt, Chromium (III), Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium and Vanadium.

Based on the average concentrations of the following compounds in biosolids used in the National Biosolids Research Program and the minimum recorded ambient background of these compounds in Australian agricultural soil, and given the typical agronomic application rate of 10 tonnes/ha, the concentration of these compounds is unlikely to have a significant impact on the background concentration.

4.4 Stabilisation grading

All biosolids need to be treated in a manner that will reduce the possibility of nuisance through attraction of pests such as insects and rodents. This treatment is generally referred to as ‘vector attraction reduction’ (refer to Table 5). The processes listed reduce available nutrients for microbial growth and associated odour production, provide conditions that minimise microbial growth or erect a physical barrier between the biosolids and vectors.

14 Equivalent to Grade A Biosolids. Source: NWQMS *Guidelines for Sewerage Systems Biosolids Management* except where previous version of South Australian Biosolids value was retained as it was lower.

15 Equivalent to Grade C Biosolids. Source: NWQMS *Guidelines for Sewerage Systems Biosolids Management*.

Table 5 Vector attraction reduction

Vector attraction reduction	Biosolids most suited
Treatment process reduces volatile solids by ≥38%	All biological anaerobic or aerobic processes
Biosolids containing no unstabilised solids dried to ≥75% solids content	Fully stabilised by anaerobic or aerobic processes
Biosolids containing unstabilised solids dried to ≥90% solids content	Heat dried biosolids
Aerobic treatment for ≥14 days at temperatures: minimum 40^0C and average >45^0C	Composted
Alkaline treatment pH raised to ≥12, and without addition of further alkali pH maintained at ≥12 for 2 hrs and then at pH ≥11.5 for an additional 22 hours	pH (alkali/lime addition) and temperature
Injection or incorporation of biosolids soon after application	

Biosolids also require treatment to achieve a microbiological quality consistent with prescribed uses. Microbiological quality is assessed on the content of potential pathogens including enteric bacteria, viruses and helminths. There are two grades based on those prescribed in the NWQMS *Guidelines for Sewerage Systems Biosolids Management*:

Grade A < 100 *E coli* per gm total solids (dry weight)
< 1 salmonella per 50 gm total solids (dry weight)
< 1 virus per 50 gm total solids (dry weight)
< 1 viable heminth ova per 50 gm total solids (dry weight)

Grade B < 1,000 *E coli* per gm total solids (dry weight)

These gradings are generally achieved by recognised processes described in Tables 6 and 7. Alternative processes will be approved by EPA and SA Health providing it can be demonstrated that they reliably achieve the microbiological requirements of the designated class.

Table 6 Approved process to achieve Stabilisation Grade A[9]

Approved process	Conditions
Long-term storage	Sludge is anaerobically digested, dried to achieve a minimum solids content >10% by weight and then stored for at least 3 years.
Composting by windrow	Temperature must be maintained at 55˚C or higher for 15 days or longer. The windrow is to be turned at least 5 times.
Composting by static aerated pile or in-vessel	Temperature must be maintained at 55˚C or higher for at least 3 continuous days.
Heating and drying	Biosolids are dried by heating to >80˚C to achieve a solids content of at least 90% by weight.
Lime stabilisation with heating	pH raised an then maintained above 12 for at least 72 hours. During this time the temperature should be maintained at 52˚C or higher.
Pasteurisation	Dried biosolids heated at 70˚C for at least 30 minutes.
Medium-term storage	Anaerobically digested sludge dried in sludge lagoon for 12 months and stored for 1 year
Other processes will be approved providing it is demonstrated that they can reliably achieve Stabilisation Grade A microbiological quality requirements. Once approved the EPA will confirm in writing to the individual applicant.	

Table 7 Approved processes to achieve Stabilisation Grade B[9, 16]

Approved process	Conditions
Aerobic digestion	Aerobic conditions are maintained for a period of between 40 days at 20^0C and 60 days at 15^0C.
Short-term storage	Anaerobically digested sludge dried in sludge lagoon for 12 months and stored for 6 months
Medium-term storage	Sludge is anaerobically digested, dried by lagoon evaporation and then stored for at least one year to achieve a minimum solids content >75% by weight.
Long-term storage	Undigested sludge dried by lagoon evaporation and then stored for at least 3 years to achieve a minimum solids content >75% by weight.
Controlled anaerobic conditions	Anaerobic conditions are maintained for a period of between 15 days (at around 35 to 55^0C) and 60 days (down to 20^0C).
Composting by windrow, static aerated pile or in vessel methods	Temperature must be maintained at 40^0C or higher for 5 days or longer. In this period the temperature must be maintained at 55^0C or higher for 4 hours.
Lime stabilisation	pH raised and then maintained above 12 for at least 2 hours.

16 *Re-use of stored sludge from Bolivar Sewage Treatment Works* (1995) and *Alternative standard for assignment of Stabilisation Grade B to undigested sludge* (2000, SA Health Commission.

Approved process	Conditions
Agitated air drying	Centrifuged cake mixed with an equal volume of previously dried biosolids and turned to mix and dry aged not less than 60 days and not less than 50% solids.
Other processes will be approved providing it is demonstrated that they reliable achieve Stabilisation Grade B microbiological quality requirements. Once approved the EPA will confirm in writing to the individual applicant.	

4.4.1 Moisture control

There is a potential for regrowth of pathogens such as *Salmonella* if processed biosolids become wet. If a batch of Stabilisation Grade A or B biosolids becomes wet (for example from rainfall exceeding 10 mm in any 24-hour period), then it must be remixed to ensure consistent solids content throughout the batch. Biosolids should not be taken exclusively from the surface but if this occurs, the biosolids must be downgraded by one Grade until redried for a period of one month.

4.5 Reclassification of biosolids

Biosolids can be blended with other materials into a product that has more desirable characteristics or properties for reuse than the 100% biosolids product. Biosolids are usually blended with other materials to dilute the concentration of contaminants such as metals in the biosolids. In either case, any product which contains biosolids cannot be used for any purpose without being assigned both a Stabilisation Grade and/or a Contamination Grade in accordance with this guideline. If blending occurs after grading, the blended product may require regrading.

5 Land application of biosolids

5.1 Permitted end uses

This section covers land application of biosolids for beneficial use. It addresses which biosolids are suitable for each end use based on Contamination Grade and Stabilisation Grade (refer to Table 8) and some general requirements of the producer, reprocessor and end user. This section should be read in conjunction with section 6.

Table 8 Stabilisation and contamination grade requirements for particular end uses of biosolids

Minimum grade		Acceptable applications	Contamination/stabilisation limited applications
Stabilisation	**Contamination**		
A	A	• Home garden and retail sale • Urban landscaping • Forestry • Site rehabilitation*	• Agriculture (refer to section 5.4.2)
Either or both B, but neither failing B			• Agriculture (refer to section 5.4.2) • Urban landscaping • Forestry • Site rehabilitation
Fails B	Fails B	EPA approved licensed facility (ie landfill)**	

* There may still be some site specific regulatoruy requirements under the site contamination provisions in the EP Act.

**if biosolids are sent to a landfill, the landfill must be approved to receive it and the biosolids are required to meet the approved landfill's physical and chemical criteria for disposal.

5.2 Other uses

Uses outside the scope of this guideline will be considered separately on an individual basis by the EPA.

5.3 Restrictions

All biosolids and products containing biosolids must be developed by a producer or reprocessor approved by the EPA. Biosolids classification records must be retained, listing the volume and quality of biosolids (through batch number and batch analysis) applied to each site (refer to sections 3.1 and 3.2). This should be made available upon request during inspections by the EPA or its agents.

The consent of the site's owner or controlling authority is required prior to any reuse of biosolids. The end user must also maintain records of volumes of biosolids received, date received, area of land applied to and date of incorporation, unless otherwise specified in the end use (refer to section 6).

All biosolids and products containing biosolids, except those only suitable for landfills, may be sold in bulk providing the buyer is given information stating that the product contains biosolids. With the exception of Home garden and retail sale, biosolids may not be bagged for sale and sold through retail outlets.

Usage of biosolids should not lead to a limitation in the land use and the contaminant levels should not exceed the MPCs (refer to section 4.2).

Repeated application of biosolids to land may breach the EP Act. Sites where multiple applications occur in breach of this guideline or where biosolids are continually deposited and stored to facilitate drying, constitute the conduct of a waste depot, an activity that requires a licence under the EP Act. Information on site selection, specific restrictions and environmental management is provided in section 6.

5.4 End use definitions

5.4.1 Home garden and retail sales

Home garden and retail sales include biosolids that are suitable for distribution, marketing and use (including public sale and distribution) in the community throughout Australia. These biosolids can also be used in residential areas and are suitable for use in homes and gardens.

Biosolids with Stabilisation Grade A and Contamination Grade A are suitable for this use.

The end user can use biosolids without maintaining records. This is also the only end use where biosolids may be bagged and sold through retail outlets, provided that each bag is specifically labelled stating that the product contains biosolids. The labelling for each bag should include:

- directions for safe use and handling by user and worker
- maximum application rates based on levels of organic matter, nutrients and trace elements in the biosolids
- restricted uses such as on acidic soils (pH<5.5), for additions to soil intended for growing leafy vegetables, root and tuber plants.

5.4.2 Agriculture

For the purpose of defining the environmental and public health impacts associated with the use of biosolids, the following categories of agricultural production systems are specified in Table 9.

Application areas should be managed to maintain optimum plant growth and soil conditions (eg pH>5.5), minimise contaminant uptake and ensure compliance with the MRLs and MLs for food, feed, livestock or other farm produce[17], as well as ensuring MPCs are not exceeded.

Irrigation with water of moderate salinity increases the risk of mobilisation of certain metals (in particular cadmium). Biosolids should not be applied to irrigated, non-permanent plantings (eg field crops and vegetables). This issue is not a concern for permanent plantings, which have a woody composition, such as vines or orchards. In general, metals do not accumulate to high concentrations in the fruit of vines, citrus and stone fruit species (ie oranges, lemons, apricots, peaches, pomefruit, olives). Less information is available for nut crops, so growers wishing to use biosolids in these crops should monitor and assess metal accumulation.

No biosolids are suitable as a soil replacement.

5.4.3 Urban landscaping

Urban landscaping excludes household application (domestic gardens) and is divided into two subclasses:

- **Recreational** – areas of high public access such as parks, sports grounds and racecourses.
- **Non recreational** – areas of limited public access such as freeway, road and flower beds.

The end user is not required to maintain records for use of biosolids for urban landscaping.

[17] Refer to Australia New Zealand Food Standards Code and MRL Standard (NRA)

Table 9 Agricultural categories

Category	Definition	Restrictions
Perennial pastures for grazing	Comprises land sown to grass and other herbage species that can be repeatedly used for grazing or at times cut for fodder conservation to feed animals for human food products.	• Refer to sections 6.1 and 6.2 • Time of application (section 6.2.4)
Field crops	Comprises cultivation or preparation of land for sowing of annual crops, eg cereals and legumes grown under natural rainfall, and supplementary irrigation for the purpose of human food products.	• Refer to sections 6.1 and 6.2 • Time constraints (section 6.2.4)
Perennial horticulture	Comprises growing permanent horticultural bushes and trees for periodic harvesting of fruits and other parts for human consumption.	• Refer to sections 6.1 and 6.2
Vegetable production	Comprises planting and growing annual horticultural plants which are harvested as a whole or parts thereof for human consumption in a raw and/or processed form.	• Refer to sections 6.1 and 6.2 • Only classification Stabilisation A/Contamination A biosolids can be used. Biosolids reuse on vegetables is a potential high-risk practice and the EPA does not recommend bulk biosolids application for this purpose. • Leafy vegetables, root crops (onions, carrots, etc) and other tuber crops
Non-food crop production	Comprises growing crops for fibre production, eg flax and includes oils for non-food use (eg eucalyptus oil, canola oil), turf, tree woodlots, flowers and ornamental plants which are not consumed by humans or used for rearing animals for food production.	• Refer sections 6.1 and 6.2

Note: if there is a rotation of crops, the restriction for the most limiting crop applies.

5.4.4 Forestry

Applications of biosolids to a forestry plantation site can be made provided that the following conditions are complied with:

1 The water table in spring[18] (September, October and November) is to no closer than 5 m to the natural surface of the application site.

2 The plantation canopy has closed or will close over within 12 months, which is typically:

   a following the second and third thinnings

   b not likely to occur in the second half of rotation in a 35–40 year crop.

3 Minimal surface runoff is expected from the application site, which is typically when the canopy has closed.

4 The maximum nitrogen loading rate from the repeated application of biosolids should be no greater than that which will provide 1,000kg N/ha[19].

5 Grazing stock are not permitted access at any time to the application site[20].

6 Records maintained by the owner of the plantation should include:

   a the location receiving the biosolids

   b the actual application rate

   c the date of application

   d the source of the biosolids and an identifying batch code supplied by the biosolids producer.

7 Analysis are undertaken by the biosolids producer, in addition to those specified in Appendix 1, that state the concentrations of total and readily available nitrogen in the biosolids and this information is provided to the forestry owner.

Repeat applications of biosolids can be made to the same area under the same conditions after seven years, if the original application rate was 60% or less than the maximum application rate.

5.4.5 Site rehabilitation

Site rehabilitation includes the rehabilitation of mines and landfill final surface rehabilitation. Use of biosolids as part of the final surface rehabilitation at a landfill site must form part of an EPA approved closure plan and support the post rehabilitation use of the site[21].

Site assessments conducted for this end use must provide sufficient evidence to show that the proposed practice will not be detrimental to the environment.

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18 The depth of the water table in spring (ie at its highest) will need to be determined and a datum value set. Forestry SA has indicated that a GIS reference record can be prepared for forest estates, or in absence of this data, the water table measurements should be taken at the time of application to determine the height at that locality.

19 Forestry SA.

20 If grazing is to be permitted one year after application of the biosolids, then existing guideline requirements for agricultural use should prevail.

21 Refer to EPA Guideline: *Environmental management of landfill facilities – soild waste disposal* (2019).

5.4.6 Landfills

Sludge not suitable for beneficial use can only be disposed of in landfills licensed to receive that material. It is preferred that only unclassified sludge are disposed of through this option, because classified biosolids have alternative uses available.

Unclassified sludge proposed for landfill disposal must be:

- 'spadable' solid waste such that it does not constitute a liquid waste (ie is any waste that is liquid at 20°C, as determined in the EPA Guideline, *Liquid waste classification test (2003)*, regardless of whether or not the liquid is packaged or otherwise contained, and irrespective of whether or not the packaging or container is to be disposed of together with the liquid that it contains).
- tested to determine the concentrations of chemical substances (total and leachable) to assess whether it meets the requisite disposal criteria in accordance with EPA waste classification and disposal requirements and guidelines.
- authorised to be received at the landfill.

Unclassified sludges for disposal to landfill are considered as Commercial and Industrial Wastes (Listed) and require classification for disposal. Refer to the *Current criteria for the classification of waste—including Industrial and Commercial Waste (Listed) and Waste Soil, March 2010*.

6 Site selection and environmental management

Once the biosolids grading and feasible end uses have been determined (refer to sections 4 and 5), the suitability and land capability of potential end use sites needs to be evaluated. Appropriate management practices need to be adopted to ensure the sustainable and safe use of biosolids.

6.1 Beneficial land application

An initial site selection step should occur early in the development of a scheme to determine the suitability of land for sustainable biosolids use. Site selection factors include:

- environmental and public health constraints (ie buffer distances to waterways/houses)
- land capability factors (ie rainfall, evaporation, soil types, slopes, watertable depth).

Refer to Table 10 for the restrictions that apply to all end uses of biosolids.

Table 10 Site characteristics restricting the use of biosolids

Site characteristic	Restriction	
Acidic soil	Biosolids not be applied to soil that has a pH <5.5 (ratio 1:5 soil/0.01M $CaCl_2$) and pH <6.0 (ratio 1:5 soil/0.01M $CaCl_2$) for additional applications.	
Buffer zones (agricultural use only)	The following buffer widths are recommended minima; the EPA should be consulted for lesser distances.	
	Watercourse	100 m
	Property access roads	5 m
	Property boundaries and public roads	50 m (N/A for Grade A)
	Dwellings on adjoining properties	100 m
	Due consideration needs to be given in each case to the potential for nuisance resulting from odour or dust originating from the use of biosolids.	
High nutrient levels	Application of biosolids to sites where there is a risk of the applied nutrients being leached from the root zone must be avoided.	
Poor drainage	Biosolids not applied to waterlogged soil or soil subject to waterlogging.	
Rocky ground	Biosolids not applied to rocky ground (untillable), except for site rehabilitation and urban landscaping purposes.	
Sloping land	Preventative measures must be taken to ensure that runoff and erosion is avoided.	

<table>
<tr><th>Site characteristic</th><th>Restriction</th></tr>
<tr><td>Surface waters and shallow groundwaters</td><td>Biosolids must not be applied to land in such a way that they could have an adverse impact on groundwater or surface waters.

Biosolids should not be applied to land that is close to dams which have banks that are lower than the surrounding land even if they do not collect water flowing in a watercourse.

The following criteria have been developed as a guide to protect water quality and are based on the soil type, permeability and porosity. The most useful soil attribute for assessing contamination potential is an estimate of the percentage of clay in the upper 100 cm of the profile. This is based on the premise that the clay fraction slows water movement and provides water storage capacity (allowing time for plant uptake). Therefore the soil profile must be examined to a depth of 100 cm in order to assess its characteristics.
<table>
<tr><th>Average clay % (0−100 cm)</th><th>Minimum depth to groundwater</th></tr>
<tr><td>>35%</td><td>1.5 m</td></tr>
<tr><td>25−35%</td><td>2 m</td></tr>
<tr><td>15−25%</td><td>3 m</td></tr>
<tr><td>10−15%</td><td>4 m</td></tr>
<tr><td>5−10%</td><td>5 m</td></tr>
<tr><td><5%</td><td>8 m</td></tr>
</table>
</td></tr>
</table>

6.2 Environmental management

Following the selection of potentially suitable end use sites, proponents will need to adopt effective site management controls to protect public health and the environment.

Other than the site management controls with restricted relevance (see Table 11), site management controls apply to all end users of biosolids. The exception to this section is where sludges are going to landfill (refer to section 5.4.6).

Table 11 General end use requirements

End use	Site management control		
	Calculation of application rate required	Access constraints	Time restrictions
Home garden & retail sale	See section 5.4.1	×	×
Agriculture	✓	✓	✓
Urban landscaping	×	✓	×
Forestry	✓	×	×
Site rehabilitation	×	×	×
Landfills	N/A – see section 5.4.6	✓	v

✓ = required × = not required

6.2.1 Stockpiling

If possible, biosolids should be stored at the biosolids production or reprocessing site rather than at the application site. Biosolids should be stockpiled and stored in a manner so as not to impact on the environmental values of groundwater and surface waters, and not cause offensive odours beyond the boundaries of the premises. Only short-term storage should occur at the end use/application site. Where biosolids are stockpiled on application sites, the following performance objectives should be met:

- All biosolids retained within the storage area.
- Biosolids stored on the property for no longer than six months. At the end of this period, all biosolids products should have been applied.
- Stockpiles located at a distance of at least 100 metres from the nearest adjoining property.
- Stockpiles located on level ground away from areas subject to flooding.
- Stockpiles not subjected to erosion by wind or rain.
- Stockpiles not accessible to stock.
- Stockpiles not turned or broken up on dry, windy days so minimising off-site odour and dust generation.

6.2.2 Application rates

Agriculture

To ensure additions of nutrients in biosolids do not exceed agronomic rates and contaminants do not accumulate in soils above the MPCs (refer to Appendix 3 Procedures for determining biosolids application rate), site-specific application rates need to be calculated for biosolids usage in agriculture.

The amount of biosolids that can be applied to a site in any year and the number of years that it can be applied, will be advised by the biosolids supplier (the producer or reprocessor), calculated in accordance with this guideline. The overall biosolids application rate is determined by the most limiting factor of the Nutrient Limiting Application Rate (NLAR) or Contaminant Limiting Application Rate (CLAR). The calculation for determining these levels is shown in Appendix 3.

In practice, the concentration of potentially toxic elements in all the metropolitan biosolids limits application of unblended material approximately 10 to 20 tonnes/ha (depending upon the source of the biosolids). The loading rate could also be

limited further by existing concentrations of contaminants in the soil. More precise information will be provided by the biosolids supplier.

It should be noted that in the case of intentional, uneven applications such as down the planting row of trees, the loading rate is determined from the area that biosolids are applied to, not from the total area of the orchard.

It should also be noted that the maximum permissible annual contaminant load for cadmium has been set across a period of five years instead of the one-year period. It is possible to apply biosolids at an application rate of 0.15 kg/ha cadmium in the first application. However, no subsequent biosolids applications containing cadmium may be made until five years has passed since last application. Alternatively, an annual loading rate of 0.03 kg/ha/yr averaged over five years (ie 0.15 kg/ha/5 year cadmium) could be adopted.

A local agronomist should be consulted in relation to cropping requirements for the calculation of NLAR.

PIRSA can assist with permissible levels, management of contaminated produce and declarations of treated product, along with advice on applicable legislation. (refer to Appendix 6 Contacts).

Forestry

The application rate for biosolids usage in Forestry is limited by nutrient uptake of the trees which in turn will be influenced by the species and maturity. Advice should be sought from Forestry SA in these cases (refer to Appendix 6).

Home garden and retail sales

Biosolids to be used should have the approximate application rate specified on the label (refer to section 5.4.1). The application rate should be determined by the supplier in accordance with this guideline.

6.2.3 Application frequency

Where a site has received a previous biosolids application or application of any other soil ameliorants, the potential residual soil nutrients and contaminants will need to be considered prior to any subsequent biosolids application. The optimal application frequency will vary from site to site depending on the site history and proponent needs. Previous biosolids applications are considered when determining the suitable application rate (refer to Appendix 3). The biosolids may be applied in one or more applications yearly, providing that the annual metal and nutrient loading limits, and soil maximum permitted concentrations are observed.

6.2.4 Time of application

Winter application of biosolids should be avoided and application should not occur during rainfall events or when heavy rains are forecast. To avoid nutrient losses, biosolids should be applied to fallow land as close to the time of sowing as possible. Biosolids should not be applied when strong wind will carry dust and/or odours beyond the buffer area or property boundary.

Applications to permanent pasture can only occur during renovation or establishment.

6.2.5 Intractable waste

Intractable wastes such as plastic, rubber and other similar materials in biosolids are undesirable foreign materials and can have negative effects on the use of biosolids.

These materials can be detrimental to stock or wildlife by ingestion and sharp objects can give rise to health and safety concerns for end users or reprocessors. Most plastics are non-biodegradable and will persist in the environment, building up with repeatedly applied biosolids containing intractable waste which should be removed prior to biosolids application. Intractable wastes may have been removed during the biosolids treatment process or WWTP operations through the use of coarse and fine screens within the process train.

Intractable wastes must be transported and disposed of to a waste depot authorised to receive them, which may need to include a medical waste incinerator, depending on the nature of the contaminants.

6.2.6 Incorporation into the soil

Incorporation into the soil is recommended where possible for all end uses of biosolids other than landfill.

For use in agriculture, biosolids should be incorporated into the soil within one month of spreading. Biosolids should also not be applied to 'top dress' agricultural pasture. Biosolids used for Urban landscaping (recreational) should be incorporated within one month of spreading if its classification type is Stabilisation B−Contamination B. This is to minimise the risk of stormwater causing biosolids to be washed off site. However, if the classification type is Stabilisation A−Contamination B, it can be used for topdressing. In all cases, reasonable judgement should be exercised with respect to the appropriate application and incorporation requirements for the biosolids and site in question.

The application method should ensure biosolids are evenly spread so that maximum agronomic benefit is obtained. Following incorporation, very little, if any, of the biosolids should be visible on the surface.

6.2.7 Soil pH management

Following application, it is good practice to manage the receiving soils to maintain soil pH levels above 5.5 to minimise metal uptake in plants, as well as the migration of nutrients and contaminants into groundwater. Low soil pH levels can be adjusted through liming.

To ensure that biosolids are not repeatedly applied to soils with a pH below 5.5, the end user should complete a pH ($CaCl_2$) soil analysis within two months prior to biosolids reapplication. The results of this analysis should be provided to the supplier for all repeat applications for biosolids usage in Agriculture or Urban landscaping (recreational).

6.2.8 Signs and fencing

Signs and fencing are not required around sites that have received biosolids, fencing may be necessary to restrict stock access (refer to section 6.2.9).

6.2.9 Access constraints

There are no access constraints for biosolids usage in Home gardens and retail sales, Urban landscaping (non-recreational), Forestry and Site rehabilitation. Landfills have general access constraints that need to be observed.

Agriculture

For biosolids usage in agriculture, animals should be withheld until the biosolids have been incorporated into the soil and a crop/pasture has been re-established. This is to prevent the animals from eating the biosolids directly.

Urban landscaping (recreational)

If biosolids other than Stabilisation Grading A and Contamination Grading A are used in Urban landscaping (recreational), public access should be restricted until vegetation is re-established.

Forestry

Grazing stock are not permitted access to the application site at any time.

6.2.10 Time constraints

Agriculture

Biosolids used in Agriculture for field crop uses should be incorporated into the soil before planting can occur.

6.2.11 Post-application monitoring

No post application monitoring is required unless the end user wishes to reapply biosolids. If it is within 10 years of the initial application, a simple soil pH measurement must be taken and provided to the supplier. The pH provides a good indication as to whether there has been any change in the chemistry of the receiving soil.

6.3 Work health and safety

As biosolids may contain low levels of contaminants, endotoxins, biological material (gram negative bacteria and some fungi) and infectious micro-organisms that could be harmful to people who come into contact with the material, sensible care should be exercised when handling biosolids products. The following precautions are suggested:

- hands should be well washed and nails scrubbed with soap and water before eating, drinking or smoking, and at the end of the working day
- food or drink should not be consumed and people should not smoke while working with biosolids
- a suitable change of clothing should be worn during work and footwear (boots) and gloves (rubber) should be worn
- showering facilities should be made available to employees
- eye protection should be worn, consistent with good work practice to avoid problems with dust
- suitable masks or respirators conforming with the Australian Standard (AS/NZS 1715:1994: *Selection, use and maintenance of respiratory protective devices*) should be worn to prevent inhalation if dust or aerosols are considered to be a problem
- contractors, site operators and management in the industry should abide by the requirements of the *Work Health and Safety Act 2011* and have policies in place to protect the health and safety of employees
- on-site workers should be educated as to the risks associated with exposure to biosolids (ingestion or inhalation of biosolids dusts)
- extra care should be exercised when handling lime for lime stabilisation purposes. Lime can be corrosive and cause significant skin, eye, oral and respiratory irritation. Appropriate work health and safety procedures need to be implemented for workers dealing with lime
- techniques that minimise the generation of mists and airborne dust should be adopted where possible (ie using wet sweeping – but not flushing – techniques rather than dry sweeping, avoiding the use of high pressure equipment such as water jet sprays or air pressure devices)
- cuts and abrasions should be covered with waterproof dressings
- on-site workers should have relevant immunisations such as tetanus and hepatitis C.

6.4 Transport of biosolids

Transport of sludge and septic tank effluent are listed in Schedule 1, clauses 3(5)(b), 3(6)(b) and 3(6)(c) of the EP Act as activities for which a licence is required. Transport of liquid wastes is not permitted except by a person licensed by the EPA. Enquiries concerning waste transport licences should be directed to the EPA senior licensing officer (refer to Appendix 6).

Transport of biosolids does not require a licence from the EPA; however precautions must be taken to prevent spillage, odours, or contamination of the product being transported.

Transport routes and site access should be chosen to minimise public nuisance in both rural and urban areas. When transporting biosolids on a public road, the load must be covered using industry standard dust control procedures to prevent the loss of fine material. If the biosolids are not air dried, then precautions must be taken to ensure no drainage from the load escapes from the vehicle whilst in transit.

Vehicles used to transport biosolids must be cleaned in a location such that washdown water cannot enter the stormwater system and preferably, only at wastewater treatment plants, or at sites approved by the EPA for the reprocessing of biosolids. Vehicles should not be cleaned while parking on farm drives or on other compacted areas where there is a risk that the wash down water will remain ponded on the surface for any significant time.

Any transport spills should be cleaned up rapidly. Dry clean-up methods are always preferred. Flushing of spilt biosolids into waters is prohibited and will result in enforcement action being taken by the EPA.

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8 Glossary

Aerobic digestion	The biochemical decomposition of organic matter into carbon dioxide and water by micro-organisms in the presence of air (oxygen).
Agricultural land	The current or future use of land for agriculture which includes horticulture, turf and any purpose of husbandry. This includes keeping or breeding livestock, poultry or bees, and growing fruit, vegetables, field crops or pastures. Home vegetable gardens and home gardens are also considered agricultural land.
Agriculture	Modern agriculture is the cultivation of land for the commercial growing of crops and pastures, and raising of animals for sustainable food and fibre production. It is also a permitted end use (refer to section 5). For use in agriculture the biosolids must have a minimum of Stabilisation Grade B and Contamination Grade C.
Anaerobic digestion	Mesophilic biochemical decomposition of organic matter into carbon dioxide, methane and water by micro-organisms in the absence of dissolved oxygen, typically at 30−35ºC for 15−30 days.
Application site	The area over which the biosolids are applied.
Arable/broadacre for cropping	Comprises cultivation or preparation of land for sowing of annual crops, eg cereals and legumes grown under natural rainfall and supplementary irrigation for the purpose of human food products.
Batch	A quantity of biosolids assumed to be homogeneous, clearly identifiable and traceable, that has been or is to be sampled for analysis and assigned a Contamination Grade and Stabilisation Grade.
Beneficial land application	The application in volumes of biosolids to an area where the use of nutrients in the products does not exceed the nutrient requirements of the crops, pastures or vegetation and/or the use of the beneficial characteristics of the organic matter in the biosolids.
Beneficial use	The use of biosolids to improve soil properties and nutrient levels.
Bioavailability	The availability of a substance for uptake by biological systems.
Biosolids	Stabilised organic solids derived totally or in part from wastewater treatment processes which can be managed safely to utilise beneficially their nutrient, soil conditioning, energy, or other value. The term biosolids does not include untreated wastewater sludges, industrial sludges or the product produced from the high temperature incineration of sewage sludge. It should also be noted that many other solid waste materials are not classified as biosolids, eg animal manures, food processing or abattoir wastes, solid inorganic wastes, and untreated sewage or untreated wastes from septic systems/sullage wastes.
Biosolids depot	A depot for the receiving, drying and stockpiling of biosolids (refer to Figures 3−5).
Biosolids products	Material containing any component of biosolids, including pure sewage biosolids in the form of liquid or cake or materials such as compost, lime sludges or pellets.

Blending	The mixing of biosolids with other materials which alters the concentration of potentially toxic elements in the biosolids but has little impact on the reduction of pathogens.
Buffer zone	A designated strip of land between a biosolids depot or biosolids application site and sensitive areas (ie property boundaries and watercourses) to minimise potentially adverse impacts such as noise, dust and odours.
Bund	A wall structure designed to retain or exclude runoff.
Classification	The process of assigning biosolids into classes based on their quality.
Community wastewater management system (CWMS)	A system for the collection and management of wastewater generated in a town, regional area or other community, but does not include SA Water sewerage infrastructure.
Contaminants	Potentially toxic elements (ie metals and organochlorine pesticides) occurring in biosolids which may affect plant or animal growth, or human health.
Contamination Grade	A grading method used to describe the quality of a biosolids batch according to the concentration of potentially toxic elements contained therein.
Contamination limiting application aate (CLAR)	The limiting rate at which biosolids can be applied without exceeding the maximum allowable concentration of any one component.
Controlled access	Where restrictions on public or livestock are imposed so that biosolids application areas cannot be used or access is appropriately controlled during periods stipulated by this guideline.
Dilution	The combining of materials for the purpose of reducing contamination levels or as an alternative to disposal.
Endorsement	A formal and explicit approval; to write something in order to give permission for something.
Endotoxin	A toxin produced by certain bacteria and released upon destruction of the bacterial cell.
Grading	Process of describing biosolids products on the basis of their contaminants (Contamination Grade) and degree of stabilisation (Stabilisation Grade).
Groundwater	The part of the subsurface water that is in the zone of saturation. The water can be held in saturated soil, rock-medium, fractures or other cavities within the ground, including underground streams.
Home garden and retail sale	This is a permitted end use of biosolids (refer to section 5). It includes biosolids that are suitable for distribution, marketing and use (including public sale and distribution) in the community throughout Australia. These biosolids can also be used in residential areas and are suitable for use in homes and gardens. If intended for use in home garden and retail sale, the biosolids must have a minimum of Stabilisation Grade A and Contamination Grade A.
Horticulture	The commercial cultivation of fruit, vegetables and flowers, including berries, grapes, vines and nuts.

Incorporation	Cultivation to a depth of at least 75 mm of land, to which biosolids have been applied so that the biosolids are thoroughly mixed with the topsoil.
Lagoon	A storage facility for sludge.
Land application	Spraying or spreading of biosolids on to the land surface or their injection below the land surface at rates which do not preclude beneficial reuse.
Landfill	Waste disposal site used for the controlled deposit of solid waste onto or into land.
Large landfill	A landfill with a total waste capacity greater than 130,000 tonnes (approximately 200,000 m^3).
Medium landfill	A landfill with a total waste capacity between 26,000 tonnes (approximately 52,000 m^3) and 130,000 tonnes (approximately 200,000 m^3).
Small landfill	A landfill with a total waste capacity less than 26,000 tonnes (approximately 52,000 m^3).
Landfill depot	Solid waste disposal area licensed by the EPA.
Liquid waste	Any waste that is liquid at 20°C, as determined in accordance with EPA Guideline, *Liquid waste classification test (2003)*, regardless of whether or not the liquid is packaged or otherwise contained, and irrespective of whether or not the packaging or container is to be disposed of together with the liquid that it contains.
Maximum residue limits (MRL)	The maximum level of a chemical which is permitted to be present in food, expressed in milligrams of the chemical per kilogram of food (mg/kg) unless otherwise stated.
Micronutrient	A vitamin, mineral or other substance essential (eg selenium, copper, zinc, etc) for good health, but required in minute amounts only.
Mixing	The combining of two or more monostreams that have each met the requisite criteria for the purpose of creating a product.
Non-recreational	This is a subclass of Urban landscaping and includes the use of biosolids in areas of limited public access such as freeways, roads and flower beds.
Nutrient limiting application rate (NLAR)	The rate at which biosolids can be applied to a land area without exceeding the recommended annual nutrient requirements of the crop or vegetation grown.
Pathogens	Micro-organisms such as bacteria and viruses, helminths (worms) and protozoan parasites such as Giardis, Entamoeba and Cryptosporidium, which can cause disease in humans and animals.
Perennial pastures for grazing	Comprises land sown to grass and other herbage species that can be repeatedly used for grazing or at times cut for fodder conservation to feed animals for human food products.
Permanent horticulture	Comprises the growing of (permanent) horticultural bushes and trees for periodic harvesting of fruits and other parts for human consumption.
Permeability	Specific permeability (k); a measure of the ease of fluid (water) flow through a porous medium (such as a soil profile).

Producer	Person responsible for the operation of the sewage treatment plant which produces biosolids, and for associated on-site and off-site facilities.
Recreational	This is a subclass of Urban landscaping and includes the use of biosolids in areas of high public access such as parks, sports grounds and racecourses.
Reprocessing facility	Establishment which receives biosolids from a sewage treatment plant operator (or producer) or other reprocessor and modifies the physical, chemical or microbiological form of the biosolids to produce a product for beneficial reuse.
Reprocessor	Person responsible for the operation of a reprocessing facility.
Residential use	Use in home gardens.
Salinity	A measure of the electrical conductivity (dS/m) of a mixture of soil and water, and is an indication of the amount of readily soluble salts in the soil. These salts, when dissolved in water, form electrical ions. While ions are a normal and essential part of a healthy soil, too many can make it difficult for plants to extract water from the soil.
Section 7 searches	A search conducted under section 7 of *the Land and Business (Sales and Conveyancing) Act 1995* to determine information relating to a property title that would be of interest to prospective purchasers. Commonly used by property conveyancers.
Sensitive areas	Land areas which are considered to be of ecological, natural, cultural or heritage value and worthy of preservation.
Septage	The product of periodic desludging of a septic tank. It is primarily septic tank sludge, but may include septic tank effluent which may inadvertently be mixed in when desludging a septic tank.
Septic tank effluent disposal (STED) scheme	A common drainage system for the collection of effluent from septic tanks in townships, now known as community wastewater management systems.
Sludge	Any product consisting totally or in part of organic matter that results from a wastewater treatment process (previously referred to as sewage sludge) or septic tank sludge that has not been treated to a standard appropriate for beneficial reuse. Note: Only dried sludge can be co-disposed of to a landfill (refer to section 5.4.6)
Soil conditioner	A substance used to improve the physical or chemical properties of soil.
Stabilisation	The processing of biosolids to reduce or eliminate the potential for putrefaction and which as a result reduces pathogens, vector attraction and potential to generate offensive odours.
Stabilisation grade	A grading method used to describe the quality of a batch of biosolids according to the microbiological activity contained therein, and potential for vector attraction and potential to give off offensive odours.
Stockpile	A secure pile of biosolids that can be identified in terms of source and date of origin. The stockpiling can be part of the stabilisation process.
Supplier	A producer or reprocessor.

Surface waters	Any river, stream, lake, lagoon, swamp, wetlands, unconfined surface water, dam, tidal waters. A river or stream may be perennial or intermittent, flowing in a natural channel with an established bed or in an artificially modified channel which has changed the course of the stream.
Sustainable use	The use of nutrients in biosolids at or below the agronomic loading rate and/or use of the soil conditioning properties of biosolids. Sustainable use considers protection of human health, the environment and the multifunctionality of soils.
Topdress	The application of a surface dressing of manure or fertiliser over land.
Unclassified	A classification for biosolids that are untested or fail either Stabilisation Grade B or Contamination Grade B (refer to section 4).
Urban landscaping	This is a permitted end use of biosolids (refer to section 5) and includes use of biosolids for landscaping purposes. For use in urban landscaping the biosolids must have a minimum of Stabilisation Grade B and Contamination Grade B.
Vectors	Insects and animals, such as flies, mosquitoes and rodents, which are attracted to the putrescible organic material in biosolids and which may spread pathogens.
Vegetable production	Comprises the planting and growing of horticultural plants which are harvested as a whole or parts for human consumption in a raw and/or processed form.
Wastewater treatment plant (WWTP)	The processing facility that treats wastewater to render it acceptable for discharge to the environment and which as a result produces biosolids, effluent and minor residuals.
Watercourse	Means any of the following (whether or not temporarily dry): • a river, creek or other natural watercourse (whether modified or not) • a dam or reservoir that collects water flowing in a watercourse • a lake or other body of water through which water flows • the Coorong • an artificial channel • a public stormwater disposal system • part of a watercourse.
Waters	All surface waters and underground waters including the water within a public stormwater disposal system or irrigation drainage channel, but excluding water within: • the pipes and closed tanks of a water reticulation system • a sewage system or wastewater management system • a closed tank constructed of or line with material impervious to water • a private or public swimming pool.
Water table	The surface of an underground water body at which the pressure is atmospheric.
Windrow	A long, relatively narrow pile of organic material. Windrows have a large exposed surface which encourages passive aeration and drying of organic materials. Windrows may be naturally ventilated or actively aerated by forced-pressure or vacuum-induced aeration. The equipment used for turning determines the size, shape and spacing of the windrows or piles.

Appendix 1 Sampling and analysis

Where and how to sample

Biosolids

Samples are best obtained by combining a number of individual grab samples.

Lagoon sludges

For lagoons at wastewater treatment plants, one sample is collected for every 500 m^3 (approximately) of spadeable sludge. However, up to five samples may be bulked prior to analysis. For each lagoon a minimum of three samples should be analysed. This is provided that the operator has no reason to believe that the quality of the sludge from any drying pan will be markedly difference from any other being cleaned out at the same time. If the operator feels that there may be a difference in sludge quality, the frequency of analysis should be increased.

Sampling should be representative and samples taken from evenly distributed locations around the lagoon. Collection points should be located where the sludge is well mixed.

If an environmental health officer suspects a load of lagoon sludge (including septage removed from septic tanks) to be contaminated (by industrial wastes or from a previous contaminated load), and may result in environmental harm, a sample may be taken and forwarded for analysis. The cost should be recouped from the contractor if the analysis confirms contamination of the load. The EPA should be contacted for advice on further action (refer to Appendix 6 Contacts).

Stockpiles (batch production)

It is important that all biosolids samples collected for analysis are as representative as possible of the batch as a whole. If the biosolids are allowed to weather in a stockpile for a considerable period of time there may be a wide variation in the analysis of the material collected because weathered fines of the biosolids have different characteristics to larger material. Similarly it is possible that surface material will have different properties to material buried within the stockpile. Biosolids must be sampled for analysis prior to being removed from the production site. If this occurs more than one month after removal from the drying pan, then the sample(s) must be collected from within the stockpile (approximately 1 metre from the surface) and not from the weathered surface. The sampler must make every effort to ensure that the samples are as representative as possible of the batch.

Each stockpile of blended or composted biosolids should be individually assessed. Individual grab samples should be taken every 500 dry product tonnes and five subsamples combined to form one composite sample representing 2,500 dry product tonnes (refer to Figure 1). A minimum of three samples should be analysed from each batch. The number of samples required can be determined from the total volume of material in the batch. Biosolids should be sampled as close as practicable to the time of use. If the biosolids have not been used within three years of analysis, reanalysis should be undertaken.

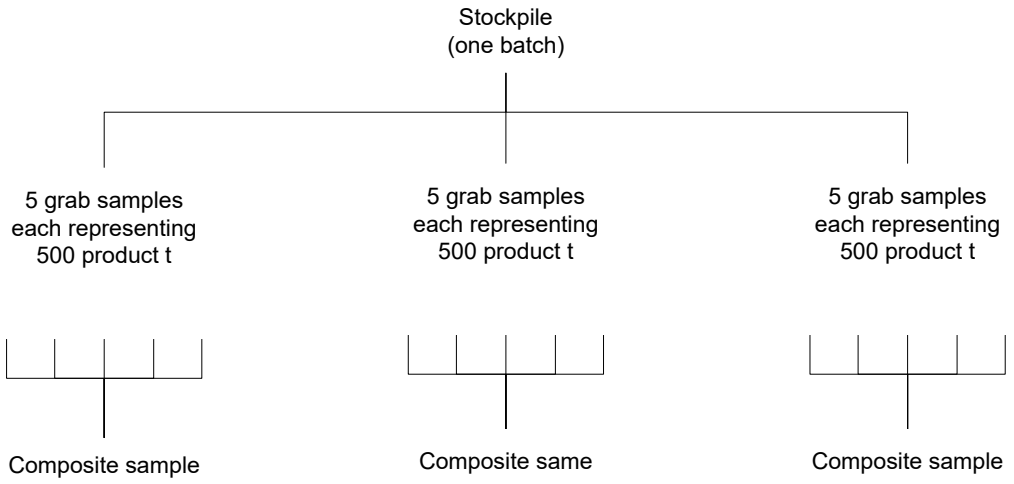

Figure 1 Stockpiling or batch sampling

For continuous processes, individual grab samples should be taken periodically from the end of the process line. Similarly to batch sampling, one subsample should be taken every 500 dry product tonnes and five subsamples combined to form one composite sample representing 2,500 dry product tonnes (refer to Figure 2).

Alternatively, if the product does not vary greatly in contaminant levels over a period of time, the product can be stockpiled in batches and tested using that method. Once again, if the biosolids have not been used within three years of analysis, reanalysis should be undertaken.

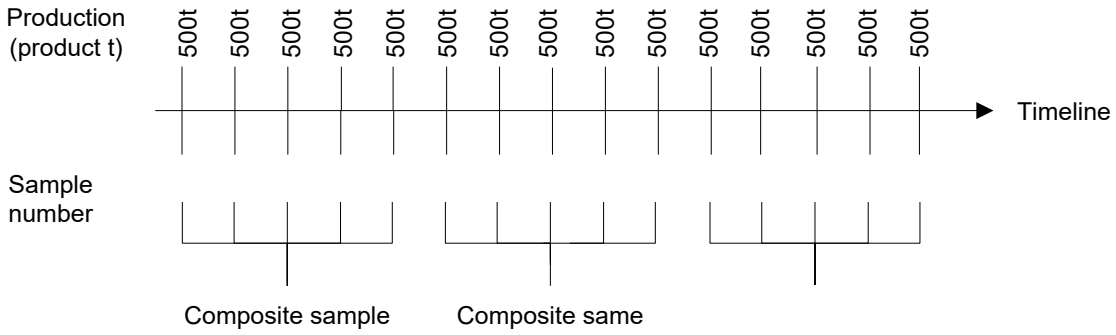

Figure 2 Continuous production sampling

Soil (application site)

For soil analysis, samples can be collected at any time throughout the year.

Sampling of the application site should be as representative as possible. Composite samples should be collected from the top 100 mm of soil (as a minimum) and 20−40 cores taken[22] for each site. The sampling site should be 40 hectares or less, otherwise more composite samples should be taken. Sampling should be conducted in a 'W' pattern across the paddock for best representation of that paddock.

[22] Brown AJ 1999, 'Soil sampling and sample handling for chemical analysis', *Soil Analysis: An Interpretation Manual*, KI Peverell, LA Sparrow and DJ Reuter (eds), CSIRO Publishing, Melbourne, pp 35−53.

Sample collection and storage

Information should be sought from the laboratory conducting the analysis as to the sample collection, preparation, storage and preservation. The laboratory will also provide information as to the amount of material required for analysis.

Sampling should be undertaken by a suitably qualified person.

Generally, samples should be placed in appropriate decontaminated sample containers with gas-tight, non-absorptive seals, allowing no headspace and kept on ice until arrival at the laboratory. Arrangements should be made to ensure delivery of chilled samples to the laboratory within the holding time of the specified analysis. Samples must remain preserved and be analysed within the time limitations which apply for the analyte and laboratory method. Additional information on sample integrity and appropriate procedures are available from AS 4482.1− 2005[23].

Person(s) conducting sampling must complete chain of custody documentation for each sample which details the following information:

- sample location (source)
- nature of sample
- sample number (if more than one sample taken from the same location)
- identity of sampler
- analyses to be performed
- sample preservation method
- date and time sample taken
- departure time from site
- dispatch courier(s).

Important sample handling, storage and transport references include section 7.4 of AS 4482.1− 2005 and section 5 of Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils of the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (Site Contamination NEPM). AS 4482.1− 2005 Appendix 1 provides a Chain of Custody form.

Analysis of samples

A laboratory accredited by the National Association of Testing Authorities (NATA) or with an acceptable quality management and assurance program, such as certification from the Australiasian Soil and Plant Analysis Council (ASPAC), must perform all analysis. All analyses should be based upon relevant US EPA methods or alternative methods that have been shown to give equivalent or better results and are acceptable to the EPA.

Samples should be analysed for the parameters listed in Table 12. Units are mg/kg dry weight unless otherwise specified.

[23] Schedule B(2) Guideline on Data Collection, Sample Design and Reporting of the *National Environment Protection (Assessment of Site Contamination) Measure 2013* (Site Contamination NEPM).

Table 12 Sampling requirements

Soil	Biosolids process (Contamination Grade)	Biosolids process (Stabilisation Grade A)	Biosolids process (Stabilisation Grade B)
pH (CaCl) (pH units) Cation exchange capacity Clay content Organic carbon content Iron Total Arsenic Total Cadmium Chromium (VI) Total Copper Total Lead Total Mercury Total Nickel Total Zinc	pH (CaCl) (pH units) Moisture content (%) Total Cadmium Chromium (VI) Total Copper Total Zinc Dieldrin* Chlordane* PFAS** Total Nitrogen Ammonia Nitrate/Nitrite (Oxidised N) Total Kjeldahl Nitrogen Total Phosphorus	Salmonella (# per 50 grams total solids–dry weight) Helminth ovum (# per 50 grams total solids–dry weight) PFU Total virus (# per 50 grams total solids–dry weight) *E. coli* (# per grams total solids–dry weight)	*E coli* (# per grams total solids–dry weight)

*Analysis for contaminant tracking only.

**Biosolids criteria for PFAS have been identified as a priority for the next version of the PFAS National Environment Management Plan produced by the Heads of EPAs Australia and New Zealand. Once produced these criteria will be incorporated within this guideline. Until then the standard suite of 28 PFASs should be analysed for in addition to TOPA to characterise the PFAS and PFAS precursors present.

Analysis results

The results for each batch of biosolids analysed must be used to calculate the Biosolids Contaminant Concentration (BCC). Refer to Appendix 2 Example of calculating contamination grade. The results of a soil analysis for the site intended to receive the biosolids allows for the assessment of background soil contaminant levels (measured soil contaminant concentration or MSCC).

Generally, the MSCC is only required before the initial application of biosolids and 10 years following after the first analysis of the soils on the site. The exception to this requirement is that sites where repeat applications of biosolids have taken place will require a pH analysis in the 12 months prior to application.

Appendix 2 Example of calculating contamination grade

In order to calculate the contamination grade of a biosolids batch the following procedure should be followed:

- **Step 1** – Sample the biosolids (refer to Appendix 1)
- **Step 2** – Analysis of biosolids sample by an accredited laboratory of contaminant levels (eg NATA)
- **Step 3** – Statistical examination of the results and presentation of summary data
- **Step 4** – Calculation of the biosolids contaminant concentration (BCC) for comparison with the chemical contaminant thresholds (refer to Table 4).

Examples of Steps 3 and 4 of the Contamination Grading procedure are provided below:

Step 3 Statistical examination of the results and presentation of summary data.
For each contaminant, calculate the mean and standard deviation of the results.

Sample	Cadmium (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)
1	0.87	432.3	185.1
2	1.83	529.9	208.4
3	0.58	430.0	139.2
4	0.49	582.1	120.0
5	1.43	454.7	286.2
6	2.01	396.3	66.8
7	0.56	510.4	197.0
Mean	**1.11**	**476.5**	**171.8**
Standard deviation	**0.64**	**66.0**	**70.7**

Note: elements shown are example only and calculations must apply to all elements of concern.

Step 4 Calculation of the biosolids contaminant concentration (BCC).
Calculate the BCC using the equations provided in section 4.2.1.

	Arsenic (mg/kg)	Copper (mg/kg)	Lead (mg/kg)
Mean	1.11	476.5	171.8
Standard deviation	0.64	66.0	70.7
Batch BCC (m+s)	1.75	542.5	242.5
Frequent (eg daily) BCC (m+2s)	2.39	608.5	313.3

Step 4 (cont) Determining the contamination grade

Compare each BCC with the chemical contaminant thresholds to determine the Contamination Grade. The Batch BCC has been used for the purposes of this example.

Compound	BCC (mg/kg)	Grade A (mg/kg)	Grade B (mg/kg)	Biosolids classification
Cadmium	1.75	1	20	B
Chromium (VI)	0.8	1	1	A
Copper	542.5	150	2,500	B
Zinc	242.5	250	2,500	A
Dieldrin	0.013	0.02	0.5	A
Chlordane	0.007	0.02	0.5	A
Lowest Contamination Grade of contaminant equates to Contamination Grade				B

Appendix 3 Procedures for determining biosolids application rate

A maximum annual biosolids application rate is set so that:

- the amount of contaminant supplied to the site does not exceed the maximum contaminant load and the maximum annual cadmium load (refer to Table 13) – Contaminant Limiting Application Rate or CLAR
- the addition of nutrients from biosolids do not exceed agronomic rates – Nutrient Limiting Application Rate or NLAR.

The application rate is set to minimise the risk of high concentrations of available metals being present in the soil at any time and taken up by crops. The maximum biosolids application rate will be determined by the lower of the CLAR and the NLAR.

Calculation of maximum permissible concentration (MPC)

The objective of Contamination Grading is to avoid using biosolids in a manner that would risk excessive uptake of metals by crops, ingestion by humans or animals or deleterious effects on the environment. These outcomes could result from using biosolids of an inappropriate quality as a large single application to a site or through repeat applications to a site.

Maximum permissible concentrations (MPCs) have been set for the contaminants in soils used for the production of food crops for human and animal consumption (refer to Tables 14, 15, 16 and 17). Critical soil concentrations of metal contaminants can adversely affect microbial processes and plant productivity (ie Cu, Zn) or exceed levels permitted by food standards for human consumption (ie Cd). These critical values are affected by soil properties such as pH, clay content, organic carbon content and cation exchange capacity.

A set of soil-specific maximum limits for copper, zinc and cadmium are shown Tables 15, 16 and 17, respectively and are dependent on the soil properties at a site. In addition, a maximum permissible annual contaminant load (MPACL) has been set for cadmium (Table 13).

Table 13 Limiting amounts of contaminants that can be annually applied to soils (MPACL) [24]

Contaminant	Limiting value (kg/ha per year)
Cadmium	0.03 (or 0.15 kg/ha per 5 years)

The total permissible concentration for copper and zinc equates to the sum of the appropriate maximum permitted added biosolids copper and zinc concentrations from Table 4, and the appropriate ambient background soil concentration taken from Table 18. For example, if a selected site intended for biosolids application has a pH 7.5, an organic carbon content of 1%, an iron content of 0.5% and a cation exchange capacity of 10 cmolc/kg, the total permissible concentration for copper and zinc would be:

Copper = 102.8 mg/kg Cu (Table 15) + 10 mg/kg Cu (Table 18)

= 112.8 mg/kg Cu

Zinc = 305.8 mg/kg Zn (Table 16) + 25 mg/kg Zn (Table 18)

= 330.8 mg/kg Zn

Biosolids products should not be applied to sites where existing contaminant concentrations are in excess of the maximum allowable soil contaminant concentration contained in Tables 14, 15, 16 and 17.

[24] NWQMS Guidelines for Sewerage Systems: Biosolids Management

Table 14 Maximum permissible concentrations (MPCs) [25, 26]

Contaminant	Soils used for food production (mg/kg dry weight)
Arsenic	20
Lead	200
Mercury	1
Nickel	60

Table 15 Maximum permitted added biosolids copper (Cu) concentrations in soils receiving biosolids to prevent toxic effects to plants and micro-organisms

	Organic carbon content%							
pH	**OC**	**0.5**	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**
		mg added biosolids Cu/kg soil						
4.0		4.1	8.5	17.7	27.1	36.7	46.4	56.2
4.5		5.9	12.2	25.2	38.7	52.3	66.2	80.2
5.0		8.4	17.4	36.0	55.2	74.7	94.5	114.5
5.5		11.9	24.8	51.4	78.7	106.6	134.8	163.4
6.0		17.0	35.3	73.3	112.4	152.2	192.5	233.2
6.5		24.3	50.4	104.7	160.4	217.2	274.7	332.8
7.0		34.7	72.0	149.4	228.9	309.9	392.0	475.0
7.5		49.5	102.8	213.2	326.8	442.4	559.5	678.0
8.0		70.7	146.7	304.3	466.4	631.4	798.6	967.6

[25] Beryllium, chromium, cobalt, molybdenum, selenium, vanadium, heptachlor, HCB and PCBs have no set MPCs as the typical levels found within soils in South Australia are either low or below detection limits levels, and the concentrations found in SA biosolids present low risk and/or have poor bio-availability.

[26] NWQMS Guidelines for Sewerage Systems: Biosolids Management.

Table 16 Maximum permitted added biosolids zinc (Zn) concentrations in soils receiving biosolids to prevent toxic effects to plants and micro-organisms

	Cation exchange capacity (cmolc/kg)							
	All species, including sugarcane							
	CEC correction factor	0.3	0.5	1.0	2.0	3.0	4.0	6.0
pH	CEC	3.0	5.0	10.0	20.0	30.0	40.0	60.0
		mg added biosolids Zn/kg soil						
4.0		14.8	21.2	34.4	56.0	74.5	91.1	121.1
4.5		20.2	28.9	47.0	76.5	101.7	124.5	165.5
5.0		27.6	39.5	64.3	104.5	139.0	170.1	226.0
5.5		37.7	54.0	87.8	142.8	189.8	232.3	308.8
6.0		51.5	73.7	119.9	195.1	259.3	317.4	421.9
6.5		70.4	100.7	163.8	226.5	354.3	433.6	576.4
7.0		96.1	137.6	223.8	364.1	484.0	592.4	787.4
7.5		131.3	188.0	305.8	497.5	661.3	809.3	1075.7
8.0		179.4	256.8	417.8	679.6	903.4	1105.6	1469.6

Table 17 Maximum permitted total cadmium (Cd) concentrations in soils receiving biosolids to ensure food products for human consumption do not exceed Australian Cadmium Food Standards

	Clay content (%)		
pH	5	25	50
	Mg Cd/kg soil		
4.5	0.54	1.17	1.96
5.5	0.68	1.31	2.10
6.5	0.82	1.45	2.24
7.5	0.96	1.59	2.38
8.5	1.10	1.73	2.52

Table 18 Expected concentrations of copper and zinc in ambient background (uncontaminated) soils at different levels of soil iron[27]

Soil Fe%	Cu (mg/kg)	Zn (mg/kg)
0.1	<4	<4
0.5	<10	<25
1	<15	<35
5	<45	<85
10	<70	<130
15	<90	<165
20	<105	<195
25	<120	<225

Calculation of CLAR

To calculate the CLAR the following information is required:

- results of analysis of receiving soil (refer to Appendix 1) – Measured Soil Contaminant Concentration or MSCC (mg/kg)
- results of analysis of biosolids (refer to Appendix 1) – Biosolids Contaminant Concentration or BCC (mg/kg)
- maximum permissible annual cadmium load (refer to Table 13) – MPACL (kg/ha/yr)
- maximum permissible soil concentration (refer to Tables 14–17) – MPC (mg/kg).

The CLAR needs to be calculated for each contaminant using the following equations:

For all parameters (except Cd): OR For Cadmium:

$$CLAR = \frac{(MPC - MSCC)}{BCC} \text{ x } 1.333 \text{ x } 1000 \text{ x } 0.1 \qquad CLAR = \frac{MPACL}{BCC} \text{ x } 1000$$

Assumptions:		
	Soil bulk density (dry tonnes/m^3)	1.333
	Incorporated soil mass (dry tonnes/ha)	1,000
	Incorporation depth (m)	0.1

The producer or reprocessor will calculate the maximum application rate for the first application. The end user must also recalculate the loading rate prior to each subsequent application to allow for differences in BCC between batches of biosolids and to ensure that the annual loading of contaminants is not exceeded.

When the area of application is not the whole area, such as when trees are planted in rows, then the biosolids shall be applied at the calculated rate to only that part of the soil that is being cultivated. This area is known as the 'true area of application'.

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27 Hamon RE, McLaughlin MJ, Gilkes RJ, Rate AW, Zarcinas B, Robertson A, Cozens G, Radford N, and L Bettenay 2004, 'Geochemical indices allow estimation of heavy metal background concentrations in soils', *Global Biogeochem. Cycl* 18(1) Art. No. GB1014.

Calculation of NLAR

To calculate the NLAR the following information is required:

- crop nutrient requirement or CNR (kg/ha) – seek advice on these
- results of analysis of biosolids (refer to Appendix 1) – BCC
- available biosolids nutrient or ABN (kg/t) – example provided below
- biosolids type – provided by producer or reprocessor.

The NLAR needs to be calculated for each nutrient (N and P) with the assessment consistent with the following approach for nitrogen[28].

The NLAR is calculated using the following equation:

$$NLAR(t/ha) = \frac{CNR(kg/ha)}{ABN(kg/t)}$$

Available N

For nitrogen, the ABN is calculated using the following equations:

$$ABN\ \ (year\ \ 1) = ammonium\ \ N + oxidised\ \ N + (organic\ \ N\ \ x\ \ MR/1000)$$

where:

$$Organic\ \ N = TKN - (ammonium\ \ N + oxidised\ N)$$

$$Oxidised\ \ N = N\ \ as\ \ Nitrite\ \ and\ \ Nitrate$$

$$TKN = Total\ \ Kjeldahl\ \ Nitrogen$$

$$MR = Mineralisation\ \ Rate$$

The mineralisation rate for organic nitrogen included as organic nitrogen is not immediately available and may be released over a number of years. The rate of release is assumed to be dependent on the biosolids treatment process as shown in Table 19.

When frequent applications of biosolids are intended, the residual organic nitrogen in the soil from previous applications will need to be considered for its future contribution to available soil nitrogen.

28 Nitrogen loading is unlikely to be a key factor for most municipal biosolids.

Table 19 Estimated nitrogen mineralisation rate (MR) [First Year][29]

Biosolids type	Nitrogen mineralisation rate (first year of application)
Anaerobically digested	15%
Aerobically digested	25%
Composted	10%

[29] NSW EPA Environmental Guidelines: *Use and Disposal of Biosolids Products* 2000.

Appendix 4 Reporting and application forms

Form 1 Biosolids analysis sheet for producers

Form 2 Biosolids analysis sheet for reproducers

Form 3 Biosolids application record for end users

Form 1 Biosolids analysis sheet for producers

This sheet is to be completed for all batches of biosolids before the biosolids can be reprocessed or used in accordance with the *Guideline for the safe handling and reuse of biosolids in South Australia*. A copy must be forwarded by the producer to the EPA as part of the annual reporting procedure. A copy should also be provided to persons receiving biosolids from that batch.

WASTEWATER TREATMENT PLANT THAT PRODUCED THE BIOSOLIDS

BATCH IDENTIFIER (Use a unique code for each batch) _____ INITIAL BATCH SIZE _____ DATE STOCKPILED (tonnes) _____

STABILISATION GRADE (at date of completion of this form) _____

This batch of biosolids has been stabilised by (tick as appropriate):

Ageing ☐ Composting ☐ Other method (describe) ☐ _____

CONTAMINATION GRADE _____

This batch of biosolids has been combined with other materials before grading: YES / NO (circle one)

Results of contaminant analysis (mg/kg dry weight)

Contaminant	No of samples	Mean (m)	Standard deviation(s)	Batch BCC (m+s)	Frequent BCC (m+2s)
Cadmium					
Chromium (VI)					
Copper					
Zinc					
Dieldrin					
Chlordane					
PFOS					
PFOA					

Solids content _____ pH _____

BIOSOLIDS CLASSIFICATION

This batch of biosolids is suitable for use in the following classifications:

Home garden and retail sale ☐ Urban landscaping ☐ Land rehabilitation ☐ Forestry ☐

Agriculture ☐ [Perennial pasture ☐ Field crop ☐ Non-food crops ☐ Vegetable ☐ Perennial Horticulture ☐]

Person supplying information _____ Date _____

Position _____ Company _____

Form 2 Biosolids analysis sheet for reprocessors

This sheet is to be completed for all batches of biosolids after reprocessing. This information should be retained by the reprocessor and made available for inspection to officers of the EPA upon request. A copy should also be provided to purchases of material from this batch on request.

WWTP BATCH CODE (from biosolids analysis sheet provided by WWTP) _____

REPROCESSORS BATCH CODE (unique code to identify the batch) _____

BATCH SIZE (after reprocessing in tonnes) _____

STABILISATION GRADE (at date of completion of this form) A / B (circle one)

This batch of biosolids has been stabilised by (tick as appropriate):

Ageing ☐ Composting ☐ Other method (describe) ☐ _____

If the product has been blended the results of the microbiological testing must be attached.

CONTAMINATION GRADE _____

This batch of biosolids has been combined with other materials before grading: YES / NO (circle one)

Results of contaminant analysis (mg/kg dry weight)

Contaminant	No. of samples	Mean (m)	Standard deviation(s)	Batch BCC (m+s)	Frequent BCC (m+2s)
Cadmium					
Chromium (VI)					
Copper					
Zinc					
Dieldrin					
Chlordane					
PFOS					
PFOA					

Solids content _____ pH _____

BIOSOLIDS CLASSIFICATION

This batch of biosolids is suitable for use in the following classifications:

Home garden and retail sale ☐ Urban landscaping ☐ Land rehabilitation ☐ Forestry ☐

Agriculture ☐ [Perennial pasture ☐ Field crop ☐ Non-food crops ☐ Vegetable ☐
Perennial Horticulture ☐]

Person supplying information _____ Date _____

Position _____ Company _____

Form 3 Biosolids application record for end users

End users of biosolids should keep a record of biosolids applications. This form can be used as a minimum in assisting in applications record-keeping.

CLIENT DETAILS

Customer ID number (if known) _____

Applicants name _____

Postal address _____

Phone number _____

SITE DETAILS

Paddock name(s) _____

Section number _____

APPLICATION DETAILS

Total application area in hectares _____

NLAR = _____ t/ha CLAR = _____ t/ha

Limiting contaminant _____

Application rate _____

Period of application _____

Incorporation into the soil YES / NO Incorporation method _____

No. of previous applications _____ Years of previous application(s) _____

Total biosolids applied to date _____ t/ha

A map should be attached indicating the application area if only part of a paddock received biosolids.

BIOSOLIDS CLASSIFICATION

Source _____

Contaminant Grading _____ Stabilisation Grading _____

Signed _____ Date _____

Appendix 5 Biosolids depots

Biosolids depots

A biosolids depot may be established to provide a safe, effective and relatively inexpensive method of receiving, drying, composting, storing, ageing, mixing or processing biosolids from sources covered in these guidelines. Such a depot would need to be approved in accordance with the *Development Act 1993* and licensed by the EPA.

The use of existing licensed landfill depots for sludge processing may be permitted subject to approval from the EPA. The biosolids depot may also be established at an existing CWMS or WWTP site, provided sufficient land is available and buffer distance requirements can be met. Location of a biosolids depot on land which is already being used for landfill or wastewater treatment may comply with existing use and not require a development approval.

The design and operation of the biosolids depot should consider the aspects below setting out the components of a well-designed biosolids depot.

Depot design

Drying beds/lagoons should be adequately sized for the population they serve. The base of the drying beds should be level, well compacted, trafficable for removal of biosolids and must be able to cope with loading from the catchment. The base must be lined with a low permeability layer (such as a 300-mm thick layer of clay with a permeability not greater than 10^{-9} m/s, high density polyethylene plastic sheeting, bitumen or concrete or some other layer that has been approved by the EPA) to prevent seepage into groundwater. Advice should be sought from a geotechnical consultant in the construction of drying beds. Table 20 shows the geotechnical parameters expected.

Table 20 Geotechnical parameters for biosolids drying beds lined with clay or geomembrane materials

	Biosolids drying beds lined with clay materials	**Biosolids drying beds lined with geomembrane materials**
Summary of suggested measures for the lining system	• 300-mm thick compacted clay liner with k≤1x10^{-9} m/s (minimum of 150-mm compacted thickness each layer) or 7-mm thick geosynthetic clay liner. • If clay material is used, the liquid limit (LL) of clay ≥30%.= • If the clay material is used, then the plasticity index (PI) of the clay ≥10.=	• 1.5-mm HDPE[30] • Install as per manufacturer specifications
Sub-grade	150-mm sub-grade preparation to provide a sound and stable base for liner construction or installation	

Design factors need to consider a maximum depth of sludge to facilitate drying within a 12-month period.

Permeable geotextile containments can be utilised for dewatering and aid with drying of sludge materials. Geotextile containments should be placed upon a well compacted, trafficable base, which is lined with a low permeability layer (such as a 300-mm thick layer of clay with a permeability not greater than 10^{-9} m/s, high density polyethylene plastic sheeting, bitumen or concrete or some other layer that has been approved by the EPA. Liquid draining from geotextile contaminants must be collected and disposed/treated accordingly, such as redirection to an appropriate part of the wastewater treatment plant.

[30] Minimum properties for various geosynthetic lining materials for base liner systems can be found in the EPA *Compost Guidelines 2019*.

Drying beds and stockpiles should be located away from low lying or flood prone areas. Depth to groundwater should be not less than 3 m. The biosolids drying beds and stockpiles should be fenced to prevent unauthorised entry and health-warning signs should be erected so they are clearly visible. Access roads should be constructed and maintained to minimise dust emission. Trees and shrubs should be used to screen the biosolids depot to preserve the amenity of the area as much as possible. Figure 3 shows the requirements for a drying lagoon.

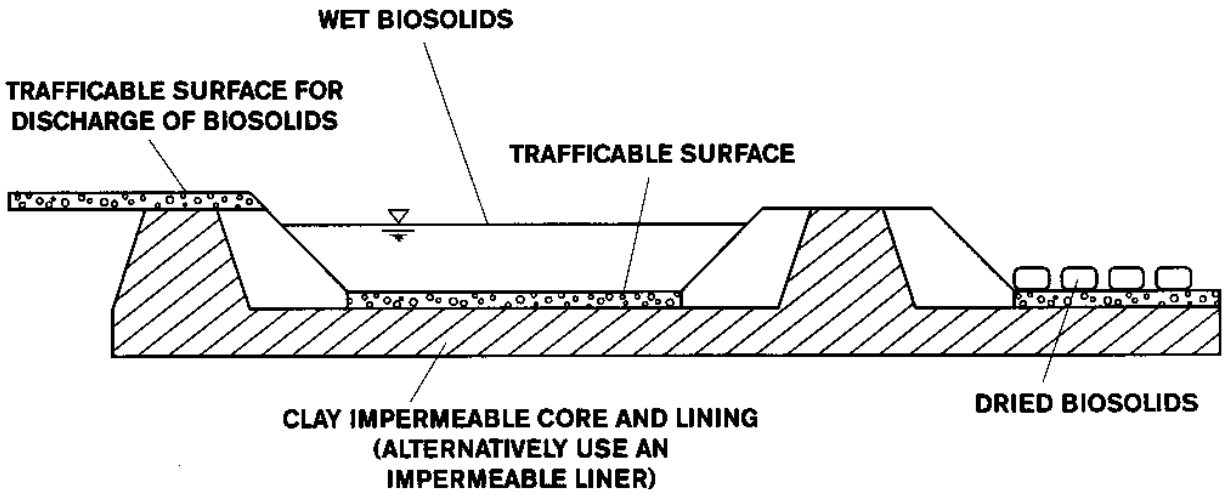

Figure 3 Section through drying lagoons

Monitoring

A monitoring program must be established (and incorporated into the depot management plan) to assess any impact of the facility on the environment. Specific requirements will be in the EPA licence.

Buffer zones

Depots containing drying beds and biosolids stockpiles must not be located within 100 metres of any watercourse. A buffer zone of at least 400 m is required between a biosolids depot and residential areas. The direction of prevailing winds and subsequent impact of odour and emissions on residents should be considered when siting the depot.

Storage of biosolids (stockpiling)

Biosolids are to be stockpiled and managed on site within a biosolids depot for a minimum period in accordance with section 4.3 to ensure adequate pathogen reduction. Design and management of the depot must meet the following requirements:

- The dried sludge storage area(s) must have a suitably compacted and impervious trafficable base (refer to Table 21) with provision for the collection of surface runoff and leachate so that no harm is caused to the environment. Stormwater from outside the storage area(s) must be prevented from entering storage area(s).
- The storage area(s) must have a slope of at least 2% to a drainage sump. The storage area and sump should be designed to hold at least the runoff from a 1-in-25-year storm event.
- The sump should be appropriately constructed to prevent the escape of leachate and stormwater by soakage. It should also be equipped with pumps or pipework to direct run-off water to an evaporation pan, CWMS (formally STEDS) lagoon or wastewater treatment plant (WWTP) for disposal, so that no harm is caused to the environment and there is no danger to public health.
- The depot manager is responsible for ensuring control of fly and mosquito breeding, odours and dust.
- The council is responsible for retaining the records of contaminants of each stockpile if the depot is run on behalf of a council.

- The age of stockpiles of stored biosolids should be clearly marked to prevent removal of fresh material.
- stockpiles of biosolids that have been composted or mixed with other material should also be clearly marked.

Table 21 Linear designs for biosolids storage areas

Liner	Crushed limestone	Clay	Asphalt or concrete
Liner details	300 mm compacted crushed limestone; max. particle size of 40 mm and more than 40% passing 0.075 mm sieve	300 mm thick compacted clay liner with $k \leq 1 \times 10^{-9}$ m/s 2 layers of 150-mm thick compacted clay	Minimum 100 mm asphalt or concrete to withstand heavy traffic
Sub-base	300 mm of well compacted stabilised in situ soils or select fill		

Figure 4 shows the requirements of a biosolids stockpile.

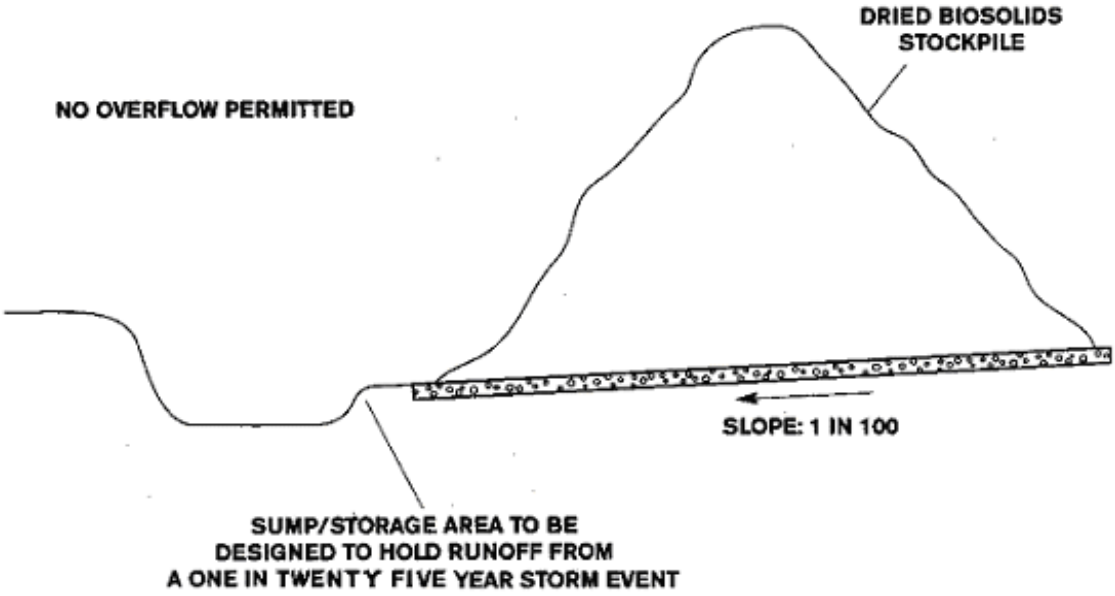

Figure 4 Section through dried biosolids stockpile

Stormwater management

The area used for drying beds and stockpiles should be designed to prevent the entry of surface stormwater. Stormwater from all areas contaminated with biosolids should be directed to a suitable area for disposal so that no harm is caused to the environment and there is no danger to public health. Uncontaminated stormwater should be managed in accordance with the *Stormwater Pollution Prevention Code of Practice for Local, State and Federal Government (1998)*.

Dust must be controlled at each biosolids depot. Possible methods are by:

- wetting the stockpile and access roads
- minimising drop heights to vehicles when loading
- developing and using wind breaks
- ceasing activities in adverse wind conditions (strong wind or wind in direction of sensitive receptors)
- using organic caking agents on stockpiles.

Additional information is available in section 6.3 Work Health and Safety.

Vector control

The depot manager is responsible for minimising the impact of vectors such as birds, wildlife, rodents, dogs, cats and insects.

Liquid biosolids should be distributed evenly in drying beds to prevent pooling and mosquito breeding sites. The depot manager should set up a program of monitoring and vector control management measures. See also Table 5.

Removal of biosolids

The depot manager should ensure the security of the depot and loading machinery at all times to prevent unauthorised removal of biosolids. The depot manager should be responsible for control of removal of biosolids and ensure only properly aged biosolids are removed for use.

The depot manager should ensure that persons who take the biosolids are provided with information about the material and guidelines for safe handling.

Composting of biosolids

Composting, or the mixing of biosolids with suitable materials (eg paper, green wastes) is an acceptable way of preparing biosolids for beneficial use within a biosolids depot. Composting temperatures must be maintained in accordance with section 4.3 to ensure adequate pathogen reduction before removal from the area for disposal or beneficial use.

Like biosolids, composted material should be stored on a suitably compacted and impervious trafficable base with provision for the collection of surface runoff and leachate so that no harm is caused to the environment. The depot manager should regularly check the compost for fly breeding and odours.

Refer to the EPA Compost Guideline for all composting operation requirements.

Figure 5 shows the requirements of a biosolids depot outlined as:

- buffer zone of 100 metres to a watercourse and 400 m to residential areas (refer to section 6.1)
- trees and shrubs used to screen depot and preserve as much as possible the amenity of the area and a fence to prevent unauthorised entry (refer to section section 6.2.8)
- all biosolids from different sources must be dried in separate lagoons and must be stockpiled separately and labelled to identify date of stockpiling and source of material (eg domestic, commercial)
- dried stockpile and runoff storage area (refer to Figure 4).

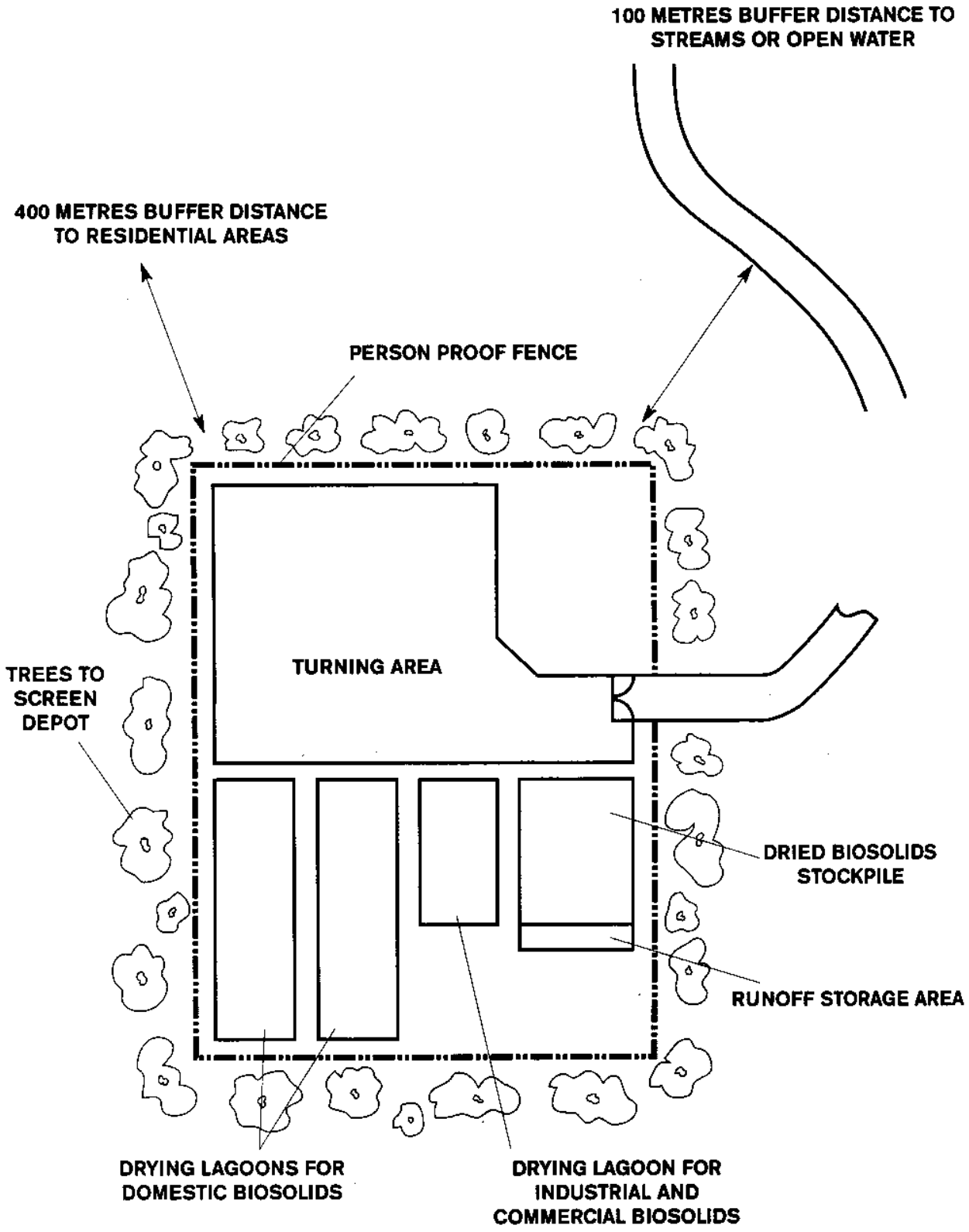

Figure 5 **Site plan of biosolids depot showing essential features and buffer distances**

Appendix 6 Contacts

All general enquires in relation to this guideline should be directed to the EPA. More specific issues will then be deferred to the relevant department.

Environment Protection Authority (EPA)

Possible issues:

- licensing of transport operators and waste depots
- surface and groundwater contamination
- biosolids depot and wastewater treatment plant licensing

GPO Box 2607
Adelaide SA 5001
Telephone: (08) 8204 2004
Facsimile: (08) 8124 4670
Freecall: 1800 623 445 (country)
Website: https://www.epa.sa.gov.au/
Email: epainfo@sa.gov.au

Department for Health and Wellbeing (DHW)

- Public health issues

PO Box 287
Rundle Mall SA 5001
Telephone: (08) 8226 6000
Facsimile: (08) 8226 6899
Website: https://www.sahealth.sa.gov.au

Primary Industries and Regions South Australia (PIRSA)

Possible issues:

- agricultural use of biosolids
- soil and irrigation water contamination

GPO Box 1671
Adelaide SA 5001
Telephone (metro): (08) 8226 0995
Facsimile: (08) 8204 1388
Website: https://www.pir.sa.gov.au/

South Australian Water Corporation (SA Water)

- Trade waste discharges and pre-treatment

GPO Box 1751
Adelaide SA 5001
Telephone: 1300 SA WATER
Website: https://www.sawater.com.au

Forestry SA

- Forestry

PO Box 162
Mount Gambier SA 5290
Telephone: (08) 8724 2888
Email: forestrysa@forestrysa.sa.gov.au
Website: https://www.forestrysa.com.au/